



Bridge Construction Inspector Training Manual

2024-2025

INSERT TAB

Table of Contents

ODOT Bridge Construction Inspector 2025

TABLE OF CONTENTS

Section 1	Introduction	Page
	Contacts	2
	Inspector's Role	3
	Inspector's Authority	4
	Bridge Types	10
	Bridge Terminology	21
Section 2	Pre-Construction Activities	
	Review Plans	1
	Review Contract Documents	3
	Order of Precedence	4
	Manual of Field Test Procedures	5
	Non Field Test Materials Acceptance Guide	9
	Record Keeping	13
	Staking	15
	Reference Points	21
	Common Staking Errors	25
Section 3	Falsework & Formwork	
	Falsework Construction	1
	Formwork Construction	16
	Access For Inspection	32
	Check Form Placement	37
	Curve Data	43
	Chord Distance Check	45
	Middle Ordinate Check	47
	Form & Falsework Removal	49
Section 4	Quality Concrete	
	Basics of Concrete	1
	Concrete Strength	14
	Vibrating Concrete	19
	Placement Methods	26
	Weather & Temperature Limits	29
	Sampling & Testing	41
	Joints	46
	Curing Concrete	56

Section 5	Reinforced Concrete	
	Basics of Reinforced Concrete	2
	Structural Engineering Concepts	4
	Reinforcement Inspection	11
	Bar Supports	25
	Bar Ties	29
	Clearances	31
	Splices	39
Section 6	Bridge Foundations	
	Common Foundation Types	2
	Spread Footings	3
	Footing Concrete Volume	5
	Structure Excavation	12
	Foundation Reports	16
	Cofferdams	17
Section 7	Driven Piles	
	Pile Driving Equipment	4
	Hammer Approval Letter	21
	Construction Documents	22
	Pile Record Book	23
Section 8	Drilled Shafts	
	Drilled Shaft Equipment	1
	Construction Process	8
	Slurry Construction	10
	Temporary Casing	15
	Construction Documents	18
	Inspection Forms	19
	Concrete Volumes	40
	Post Construction Testing	49
Section 9	Substructure	
	Periodic Checks	1
	Construction Tolerances	2
	Beam Seats	7
	MSE Walls	21
Section 10	Prefabricated Girders	
	Common Beam Types	1
	Beam Camber & Deflection	6
	Bearing Points	8
	Slabs & Boxes	15
	Girder Construction	26
	Temporary Bracing Details	32
	Diaphragms	39
	Steel Plate Girder Construction	42

Section 11	Bolting	
	High Strength Structural Bolting	1
	Field Tests	7
	Rotational Capacity Test for Long Bolts	8
	Rotational Capacity Test for Short Bolts	22
	Verification Tests	23
	Inspection Torque	26
	Field Inspection	27
	Other Types of Bolt Situations	32
Section 12	Welding	
	Field Welding	1
	Welding Processes	5
	Stud Welding	8
	Welding Positions	17
Section 13	Post-tensioned Box Girders	
	PT Box Girder Construction	1
	Preparations for Tensioning	28
	Tensioning Operations	30
	After Post-Tensioning	35
	Grouting PT Ducts	37
Section 14	Deck Construction	
	Pour Sequence	1
	Cracking of Bridge Decks	9
	Deck Grades	15
	Deck Pre-placement Conference	18
	Pouring Deck	24
	Joints	41
	MC Overlay Preparation	88
	MC Overlay	94
	MPCO Overlay	104
	PPC Overlay	107
	Polymer Membrane	112
	Rolled Waterproofing Membrane	114
Section 15	Miscellaneous	
	Concrete Repairs	1
	Crack Injection	9
	Cathodic Protection	13
	Bridge Rail	16
	Slip Form Bridge Rail	21
	Guardrail	25
	Slope Paving	29

Appendix A Glossary & Abbreviations

Appendix B Checklists

Appendix C Forms

INSERT TAB

Unit 1
Introduction

Section 1

Introduction

Contacts	2
Inspector's Role	3
Inspector's Authority	4
Basic Bridge Types	10
Bridge Terminology	21

Bridge Construction Inspector

2024-2025





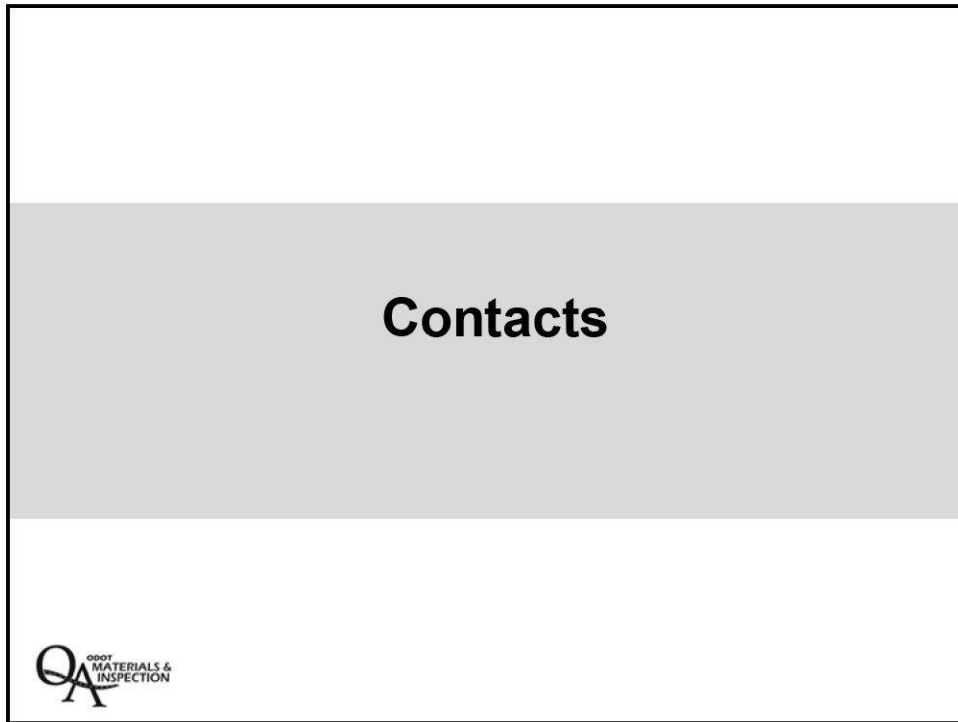
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Instructors

- **Terry Thames, PE**
Statewide Structure Quality Engineer (**Retired**)
Cell: (503) 510-3758
- **Kevin Shearmire, PE**
Sustainability Engineer
Cell: (503) 314-7823
- **Krag Kanoff**
Structure Services Coordinator
Cell: (503) 510-4286



2



3

Materials Lab Phone List

Main: 503-986-3000

Construction Training Main: 503-986-4336

Business Services Fax Line: 503-986-3096

800 Airport Road SE -- Salem, OR 97301

Revised November 2022

Last Name	Primary Phone	Cell Phone	Working Title	Crew
Archive Room	503-986-6627			
Aker, Scott		541-784-7721	Contract Compliance Specialist	7810
Baiei, Coral	503-986-3042		Office Specialist 2	7052
Baker, Vanessa		503-983-4000	Senior eConstruction Program Analyst	7810
Blower, Andrew		503-510-6213	Statewide Structure Coating Engineer	7870
Brophy, Kevin	503-986-3030		Laboratory Services Manager	7890
Brown, Wayne	503-986-3074		Temp - Bituminous/Petroleum/Chem	7890
Bulski, Nicholas	503-986-3519		Laboratory Technician	7890
Burch, Paul T		503-341-3817	State Pavement Design Engineer	7894
Burns, Eric	503-986-3080		Laboratory Assistant Crew Lead - Aggregates	7890
Business Services Fax	503-986-3096			
Butler, Lori		971-372-0786	Temp - Construction Program Analyst	7805
Chaney, Jordan	503-986-3087	503-551-5633	Laboratory Certification Inspection Coord-	7890
Chess, Dean	503-986-3059		Product Evaluation Coordinator	7870
Cieslak, Jason	503-986-3081		Laboratory Crew Lead - Aggregates	7890
Construction Hotline	503-986-4334			
Copplantz, John		971-240-1878	State Pavement Management Engineer	7894
Cordle, Tyler		503-931-2905	Pavement Management Technician	7894
Croff, Joel		971-283-6744	Assistant Pavement Quality Engineer	7894
Darnell, James		503-428-0064	Asst. Pavement Management Engineer	7894
Dennee, Mike		503-580-2013	Contract Services Group Coordinator	7810
Dobson, David	503-986-6628	971-900-7118	Statewide Structure Materials Engineer	7870
Duman, Chris		503-559-4994	State Pavement Quality & Materials Eng.	7894
Earnest, Timothy		503-979-7205	Asst. Pavement Materials Engineer	7894
Espinoza Goodman, Eli	503-986-3182		Laboratory Technician	7890
Flores, Manuel	503-986-3124		Pavement Field Technician - Construction	7894
Foster, Diana		503-779-9307	Labor Compliance Officer	7810
Free, Kim		971-375-8481	Contracts Payments Specialist	7810
Ganahl, Jerry	503-986-3194		Laboratory Assistant Crew Leader - Soils	7890
Gray, Joshua		503-986-3124	Pavement Field Technician - Construction	7894
Gunter, James		503-910-7836	Pavement Quality Specialist	7894
Guthrie, Greg	503-986-3089		Laboratory Crew Lead - Physical Testing	7890
Guthrie, Summer	503-986-3029	503-910-8770	Construction Contracts Specialist	7810
Haas, Dustin J		503-339-6982	Assistant Pavement Design Engineer	7894
Hansen, Bill		971-283-6906	Pavement Field Technician - Construction	7894
Harriman, Barbara		503-437-4523	Program Analyst - eConstruction	7805
Herring, Susan		503-881-1074	Program Analyst - eConstruction	7805

Last Name	Primary Phone	Cell Phone	Working Title	Crew
Ilg, Larry		503-930-4880	Interim SCME/Quality Assurance Engineer	7840
Jones, Brian	503-986-3042		Administrative Specialist - Construction	7052
June, Mark	503-986-3081		Laboratory Assistan Crew Lead - Petroleum	7890
Kanoff, Krag	503-986-2783	503-510-4286	Structure Services Coordinator	7870
Keys, Doug		503-385-3487	Pavement Specialist - Construction	7894
Large Conf Room	503-986-3044			
Lovingier, Corry	503-986-3052	503-339-5520	Pavement Specialist - Construction	7894
Lunch Room	503-986-3088			
McClary, Erik	503-986-3090		Laboratory Crew Leader	7890
McGrath, Paul	503-986-3073		Laboratory Assistant Crew Lead - Bit.	7890
Moderie, Justin	503-986-3115	503-510-0581	Pavement Services Engineer	7894
Murphy, Sean	503-986-3124	503-580-3921	Pavements Field Crew Lead	7894
Nelmes, Lynda		541-774-6338	Program Analyst - eConstruction	7805
Nelson, Scott	503-986-3056		Structure Services Engineer	7870
Nunez, Arthur	503-986-6630	503-983-6471	Senior Quality Assurance Engineer	7840
Olson, Brice		971-401-2849	Laboratory Crew Leader - Bit/Petro/Chem	7890
Parker, Sean		503-710-2562	Pavements Field Crew Leader	7840
Receiving Area Fax	503-986-4363			
Rodriguez, Rebecca	503-986-3076		Laboratory Crew Leader - Soils	7890
Schiller, Dan		503-339-5840	Pavement Design Specialist	7894
Sealy, James	503-986-3028	971-375-8479	Contract Payments Specialist	7810
Shuey, Hailey	503-986-3417		Laboratory Chemistry Specialist	7890
Small Conf Room	503-986-3045			
Stellmach, Greg	503-986-7181	503-979-3407	Construction Contract Engineer	7810
Stennett, Mike		503-318-9881	Senior Quality Assurance Engineer	7840
Stutzman, Adam	503-986-3782	503-586-8196	Laboratory Crew Lead	7890
Sullivan, Brian		503-400-0058	Pavement Project Delivery Coordinator	7894
Tipton, Steven		503-746-3651	Quality Assurance Coordinator	7840
Tuttle, Andrew		503-780-2353	Quality Assurance Technician	7840
VACANT		971-707-0265	eConstruction Program Analyst	7810
VACANT	503-986-6626		Laboratory Lead Technician - Construction	7890
VACANT	503-986-3012	503-856-2908	Contract Administration Engineer	7810
VACANT			AASHTOWare Lead System Administrator	7810
VACANT	503-986-3123	541-497-4628	State Construction & Materials Engineer	7800
Villarreal, Rick		503-385-3557	Pavement Specialist - Construction	7894
Wilborn, Gene	503-986-3135	541-905-7054	Interim Construction Contracts Engineer	7810
Yutzie Sell, Beth		503-508-4444	Program Support Specialist - Construction	7805

Contact Sheet
Contract Administration
Crew #7810

Last Name	Primary Phone	Cell Phone	Working Title
Headquarters 800 Airport Road Salem, OR 97301 Fax: 503-986-3096			
Aker, Scott		541-784-7721	Construction Cpmpliance Specialist
Baker, Vanessa		503-983-4000	eConstruction Program Analyst
Vacant	503-986-3012	503-302-3637	Contract Administration Engineer
Dennee, Mike		503-580-2013	Contract Services Lead Worker
Foster, Diana		503-779-9307	Labor Compliance Officer
Kim Free		971-375-8481	Contract Services Specialist
Ferry, Donna		971-707-0265	eConstruction Program Analyst
Guthrie, Summer	503-986-3029	971-283-6744	Constructions Contract Specialist
Sealy, James		971-375-8479	Contract Services Group Coordinator - Construc.
Stellmach, Greg	503-986-7181	503-979-3407	Construction Contracts Engineer
Wilborn, Gene	503-986-3135	541-905-7054	Construction Contracts Engineer
Vacant			AASHTOWare Lead System Administrator
Region 1 3700 SE 92nd Ave- Portland, OR 97266 Fax: 503-731-3252			
Nguyen, Tony		971-375-8480	Region Assurance Specialist
Rodriguez, Tony		503-781-7615	Region Assurance Specialist
Sylvia, Merry		503-781-9317	Region Assurance Specialist
Mary Saba		503-621-2047	Region Assurance Specialist
Region 2 885 Airport Road, Bdg Y, Salem, OR 97301 Fax: 503-986-2881 Mail to: 885 Airport Road, Bldg P, Salem, OR 97301			
VACANT			Region Assurance Specialist
VACANT	503-986-2641	541-430-2386	Region Assurance Specialist
Springfield Office: 2080 Laura Street, Springfield, OR 97477, 541-744-8080 , Fax 541-726-2509			
Neal, Nathan		541-953-8211	Region Assurance Specialist
Region 3 100 Antelope Road, White City, OR 97503 Fax: 541-774-6349			
Peters, Robert		541-890-6199	Region Assurance Specialist - Temp
Vacant			Region Assurance Specialist
Region 3 3500 NW Stewart Pkwy, Roseburg, OR 97470 Fax: 541-957-3547			
Vacant	541-957-3514	541-784-7721	Region Assurance Specialist
Region 5 1390 SE 1st Avenue, Ontario, OR 97914			
Smith, DJ		503-931-3399	Region Assurance Specialist

Contact Sheet
Quality Assurance Team
Crew #7840

Last Name	Primary Phone	Cell Phone	Working Title
Headquarters		800 Airport Road Salem, OR 97301	Fax: 503.986.3096
Nunez, Art		503-983-6471	Senior Quality Assurance Specialist
Parker, Sean	503-986-6631	503-710-2562	Senior Quality Assurance Specialist
Stennett, Mike	503-986-3971	503-551-2165	Senior Quality Assurance Engineer – Con.
Region 1		3700 SE 92nd Ave. Portland, OR 97266	Fax: 503.731.3252
Ty Toller		503-703-3959	R1 Senior Quality Assurance Coordinator
Eixenberger, Mitchel		971-701-5743	R1 Quality Assurance Technician
Deo, Atma		503-702-2859	R1 Quality Assurance Coordinator
Hamilton, Dan		971-678-4671	R1 Quality Assurance Technician
Region 2		455 Airport Road Bldg X, Salem, OR 97301	Fax: 503.986.2838
Tipton, Steve	503-986-2642	503.351.6949	R2 Senior Quality Assurance Coordinator
Humphries, Brent	503-986-7144	971-718-2951	R2 Quality Assurance Technician
Tuttle, Andrew		503-780-2353	R2 Quality Assurance Coordinator
McKay, Bill		503-580-3182	R2 Quality Assurance Coordinator
VACANT		503-746-3651	R2 Quality Assurance Technician
Region 3		Mail: 3500 NW Stewart Pky, Roseburg, OR 97470	Fax: 541.440.3434
Physical Location: 443 Rifle Range Street, Roseburg			
Clark, Andrew	541-957-3682	541-580-6550	R3 Senior Quality Assurance Coordinator
VACANT	541-440-3479	541-731-3650	R3 Quality Assurance Coordinator
Savage, Rod		541-784-6750	R3 Quality Assurance Technician
Region 4		63055 N. Hwy 97, Building K, Bend, OR 97701	Fax: 541.388.6104
Cunningham, Ray		541-480-9805	R4 Quality Assurance Technician
Groth, John		541-419-2275	R4 Quality Assurance Coordinator
Kirkland, Dave		541-419-1636	R4 Quality Assurance Technician
Region 5		3012 Island Avenue, La Grande, OR 97850	Fax: 541.963.1903
Brown, James	541-963-1596	541-786-0948	R5 Senior Quality Assurance Technician
Oestman, Logan		541-640-1482	R5 Quality Assurance Coordinator
Stephenson, Daniel			R5 Quality Assurance Technician

**Structure Services Group
Materials Lab Inspectors
Milwaukie, Springfield and Bend
Crew 7870**

Last Name	Primary Phone	Cell Phone	Working Title
Headquarters Materials Lab: 800 Airport Rd, SE, Salem, OR 97301			
Nelson, Scott	503-986-3056		Structure Services Engineer
Dobson, David	503-986-6628	971-900-7118	Statewide Structure Materials Engineer
Chess, Dean	503-986-3059		Product Evaluation Coordinator
Blower, Andrew		503-510-6213	Statewide Structure Coating Engineer
Kanoff, Krag		503-510-4286	Structure Services Coordinator
Eugene Office: 1920 Henderson Ave-, Eugene, OR 97403			
Thames, Terry	541-686-7598	503-510-3758	Statewide Structure Quality Engineer
Milwaukie Material Lab: 5516 SE International Way Milwaukie, OR 97222, 971-673-7002, Fax 971-673-7010			
Baggarley, Chris	971-673-7022	503-741-1632	Welding/NDE Inspector
Vacant	971-673-7006	503-708-9806	Senior Inspector - Welding & NDE
McHugh, Matt	971-673-7005	503-305-1159	Inspector Welding/NDE
Shearmire, Kevin		503-314-7823	Assistant Structure Services Engineer
Vacant			Inspector Welding/NDE
Springfield Materials Lab: 2080 Laura Street, Springfield, OR 97477 541-736-2849, Fax 541-726-2509			
McDonald, Chris	541-736-2848	541-709-8732	Inspector Prestress and General
Thomason, Chris	541-736-2849	541-255-5297	Senior Inspector - Pre-Stress & General
Bend Office: 63055 N Highway 97 - Bldg J, Bend, OR, 97703			
Johnson, Austin	503-986-5461	503-510-1384	Concrete Quality Coordinator

ODOT BRIDGE SECTION SPECIALTY LIST

<i>Link to BDM Technical Resources List</i>						
ODOT BRIDGE SPECIALTY LIST	Lead Contact	Phone No.	Primary Backup	Phone No.	Alt Backup	Phone No.
Bridge Engineer	Ray Bottenberg	(503) 551-7934	Bert Hartman	(503) 580-6876		
Bridge Program	Ray Bottenberg	(503) 551-7934	Bert Hartman	(503) 580-6876	Bruce Novakovich	(971) 283-5161
Bridge Budget	Ray Bottenberg	(503) 551-7934	Rachelle Nelson	(971) 283-5153	Caitlin Archibald	(503) 983-3773
Bridge Log	Michael McDonald	(971) 283-5611	Bert Hartman	(503) 580-6876		
Bridge Internet Website	Kourtney Masters	(503) 509-3641	Adriane McKinney	(971) 304-5526	James Schaefer	(971) 283-5456
Bridge Intranet Website	Adriane McKinney	(971) 304-5526	Charlotte Davidson	(503) 986-3209	James Schaefer	(971) 283-5456
Bridge Program Unit	Bert Hartman	(503) 580-6876	Bruce Novakovich	(971) 283-5161		
Bridge Management System	Bruce Novakovich	(971) 283-5161	Bert Hartman	(503) 580-6876		
STIP, State	Rachelle Nelson	(971) 283-5153	Bruce Novakovich	(971) 283-5161	Bert Hartman	(503) 580-6876
STIP, Local Agency	Holly Winston	(503) 798-3364	Rachelle Nelson	(971) 283-5153	Bert Hartman	(503) 580-6876
Major Bridge Maintenance Program (MBM)	Orren Jennings	(503) 509-6366	Bert Hartman	(503) 580-6876		
Bridge Condition Report	Bruce Novakovich	(971) 283-5161	Bert Hartman	(503) 580-6876		
Program Evaluation Report	Bruce Novakovich	(971) 283-5161	Bert Hartman	(503) 580-6876		
Bridge Needs Report	Bruce Novakovich	(971) 283-5161	Bert Hartman	(503) 580-6876		
Performance Measures	Bruce Novakovich	(971) 283-5161	Bert Hartman	(503) 580-6876		
BRM Data Entry	Joe Bond	(971) 283-5208	Bruce Novakovich	(971) 283-5161	Bert Hartman	(503) 580-6876
Bridge Inventory Information and Data Access	Joe Bond	(971) 283-5208	Bruce Novakovich	(971) 283-5161	Bert Hartman	(503) 580-6876
Bridge Maintenance / Repair	Orren Jennings	(503) 509-6366				
Bridge Maintenance Training	Orren Jennings	(503) 509-6366				
ODOT Maintenance Workshop	Holly Winston	(503) 798-3364	Orren Jennings	(503) 509-6366		
Bridge Maintenance Conference	Orren Jennings	(503) 509-6366	Holly Winston	(503) 798-3364	Michael Goff	(503) 930-7808
Bridge Preservation & Design Unit	Rebecca Burrow	(503) 951-9333	Steve Lovejoy	(503) 931-4764		
Bridge Drawing System (BDS)	Joe Tilman	(503) 930-8955	Paul Tichenor	(503) 986-4200		
Corrosion and Cathodic Protection	Corey Withroe	(503) 986-3339	James Garrard Jr.	(503) 986-3315		
Covered Bridges/Historic Bridges	Bjorn Miller	(503) 986-7192	Rebecca Burrow	(503) 951-9333		
Fracture Control	Steve Lovejoy	(503) 931-4764	Scott Nelson	(503) 986-3056		
Installing Utilities on Bridges	James Garrard Jr.	(503) 986-3315	Ray Bottenberg	(503) 551-7934		
Movable Bridges - Electrical	David Johnson	(503) 986-3329	Vacant			
Movable Bridges - Mechanical	Steve Lovejoy	(503) 931-4764	Vacant			
Paint Program	Andrew Blower	(503) 510-6213	Kevin Shearmire	(503) 314-7823	Alex Lim	(971) 283-5518
Permanent Fall Arrest Systems	Orren Jennings	(503) 509-6366	Ray Bottenberg	(503) 551-7934		
Structural Health Instrumentation/Monitoring	Steve Lovejoy	(503) 931-4764	Vacant			
Welding	Steve Lovejoy	(503) 931-4764	Alex Lim	(971) 283-5518	Mats Halvardson	(503) 986-3325
Bridge Standards Unit	Bert Hartman	(503) 580-6876	Albert Nako	(971) 283-5558		
Bridge Design Manual (BDM)	Rebecca Burrow	(503) 951-9333	Alex Lim	(971) 283-5518		
Bridge Design Software	Rebecca Burrow	(503) 951-9333	Jon Rooper	(503) 302-6188	Zach Beget	(541) 280-5827
Bridge CAD Manual (BCM)	Sandra Gish	(503) 798-3472	James Schaefer	(971) 283-5456		
CAD Standards & Practices	Sandra Gish	(503) 798-3472	James Schaefer	(971) 283-5456		
Concrete Bridge Design	Tanarat Potisuk	(971) 283-5600	Rebecca Burrow	(503) 951-9333		
Foundations	Susan Ortiz	(503) 302-7998	Brad Hayes	(541) 786-0905	Pete Castro	(541) 438-4552
Hydraulics/Hydrology/Scour	Vacant		Paul Wirfs	(503) 510-9636		
MicroStation Support	Sandra Gish	(503) 798-3472	James Schaefer	(971) 283-5456		
New Products/QPL	Tanarat Potisuk	(971) 283-5600	Dean Chess	(503) 986-3059		
Seismic Design / Retrofit Programs	Albert Nako	(971) 283-5558	Tanarat Potisuk	(971) 283-5600	Susan Ortiz	(503) 302-7998
Standard Drawings & Details	James Schaefer	(971) 283-5456	Sandra Gish	(503) 798-3472		
Steel Bridge Design	Alex Lim	(971) 283-5518				
Tunnels - Design	Albert Nako	(971) 283-5558	Susan Ortiz	(503) 302-7998		
Training - Bridge Design Conference	Rebecca Burrow	(503) 951-9333	Caitlin Archibald	(503) 983-3773	Charlotte Davidson	(503) 986-3209
Bridge Operations Unit	Joel Boothe	(503) 302-7998	Michael Goff	(503) 930-7808	Richard King	(503) 986-6575
Bridge Inspection Reports	Michael Goff	(503) 930-7808	Joel Boothe	(503) 302-7998	Richard King	(503) 986-6575
Element Coding Guide	Michael Goff	(503) 930-7808	Joel Boothe	(503) 302-7998	Robert Iwai	(971) 673-7004
Bridge Inspection Manual	Michael Goff	(503) 930-7808	Joel Boothe	(503) 302-7998	Robert Iwai	(971) 673-7004
Bridge Inspection Team Leader Certification	Michael Goff	(503) 930-7808	Richard King	(503) 986-6575	Joel Boothe	(503) 302-7998
Underwater Bridge Inspection	Rick Shorb	(503) 986-2979	Jason Ottosen	(503) 986-2978	Joel Boothe	(503) 302-7998
Tunnels - Inspection / Condition Assessment	Joel Boothe	(503) 302-7998	Michael Goff	(503) 930-7808	Albert Nako	(971) 283-5558
Bridge Inspection Program - Region 1	Michael Dyra	(503) 969-1091	Nathan Jaques	(971) 328-2774	Ben Lalonde	(503) 260-6355
Bridge Inspection Program - Region 2	Geoff Paul	(503) 580-5858	Michael Dyra	(503) 969-1091	Luke Teubel	(503) 476-6120
Bridge Inspection Program - Region 3	Noah Brennan	(541) 957-3587	Austin Grimes	(541) 957-3652	Michael Goff	(503) 930-7808
Bridge Inspection Program - Region 4	John Adkins	(541) 419-1688	Michael Coleman	(503) 979-7558	Michael Goff	(503) 930-7808
Bridge Inspection Program - Region 5	John Ostendorff	(541) 429-1349	Michael Coleman	(503) 979-7558	Michael Jacobson	(541) 801-4202
Local Agency Bridge Inspection Program	Richard King	(503) 986-6575	Joel Boothe	(503) 302-7998		
Other Public Agency Bridge Inspection Program	Michael Goff	(503) 930-7808	Joel Boothe	(503) 302-7998		
Bridge Inspection Training Classes	Michael Goff	(503) 930-7808	Richard King	(503) 986-6575	Joel Boothe	(503) 302-7998
Bridge Inspection Conference	Joel Boothe	(503) 302-7998	Michael Goff	(503) 930-7808	Richard King	(503) 986-6575
BRASS Load Rating Application	Jon Rooper	(503) 302-6188	John Milcarek	(503) 986-3537		
Bridge Load Ratings	Jon Rooper	(503) 302-6188	John Milcarek	(503) 986-3538		
Overload Permit Reviews	Vacant		Tim Shaw	(503) 986-4088	John Milcarek	(503) 986-3537
Bridge Design Unit	Zach Beget	(541) 280-5827	Ray Bottenberg	(503) 551-7934		
Bridge Design Coordinator	Charlotte Davidson	(503) 986-3209				
Leadworker - Region 1	Vacant		Zach Beget	(541) 280-5827		

ODOT BRIDGE SPECIALTY LIST	Lead Contact	Phone No.	Primary Backup	Phone No.	Alt Backup	Phone No.
Leadworker - Region 2	Matthew Stucker	(503) 779-3839	Ray Bottenberg	(503) 551-7934		
Leadworker - Region 3	Bob Grubbs	(541) 580-2631	Zach Beget	(541) 280-5827		
Leadworker - Region 4	Paul Strauser	(541) 410-1428	Zach Beget	(541) 280-5827		
Leadworker - Region 5	George Bornstedt	(541) 786-1072	Zach Beget	(541) 280-5827		
Other Structural Specialties						
Engineering & Asset Management						
Concrete Box Culverts	Sophie Brown	(503) 986-3778	Rob Trevis	(503) 986-3860	Wade Holaday	(971) 345-1919
Culverts & Closed Bottom Arch Pipes Under 20'	Rob Trevis	(503) 986-3860	Wade Holaday	(971) 345-1919		
Retaining Walls	Sophie Brown	(503) 986-3778				
Sound Walls						
Acoustics Program, Rules, FHWA Reporting	Daniel Burgin	(503) 509-7415				
Plans, Specs, and Technical Resources	Sophie Brown	(503) 986-3778				
Roadway Engineering Section						
Median/Shoulder Barrier	Christopher Henson	(503) 986-3561	Heidi Shoblom	(503) 689-2957		
Pipes less than 72" diameter	Will Woods	(503) 986-3667				
Standard Manholes	Will Woods	(503) 986-3667				
Traffic Structures - Traffic Section						
Butterfly Sign Supports	Scott Jollo	(503) 510-2204				
Monotube Cantilever Sign Supports	Scott Jollo	(503) 510-2204				
Roadside Sign Supports	Scott Jollo	(503) 510-2204				
Signal/Luminaire Supports	Scott Jollo	(503) 510-2204				
Truss Bridges	Scott Jollo	(503) 510-2204				

[Link to BDM Technical Resources List](#)

TECHNICAL RESOURCE LIST										Review of Industry Concerns			
UPDATED 07-31-23		TECHNICAL RESOURCES			STAKEHOLDER (Include in correspondence with Technical Resource)			Questions? E-mail: ODOT SPECIFICATIONS		Concern Resolution if both agree		Concern Resolution	
Section	Section Title	Primary Responsible Unit	Resource Position	Resource Name	Phone Number	Measurement and Payment Resource	Stakeholder Position	Stakeholder Name	Remarks	Construction and Materials Engineer	Discipline Section Manager	Chief Engineer	
For specification sections not listed, contact ODOT Specifications													
00110	Organization, Conventions, Abbreviations, and Definitions	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00120	Bidding Requirements and Procedures	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00130	Award and Execution of Contract	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00140	Scope of Work	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00150	Control of Work	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00160	Source of Materials	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00165	Quality of Materials	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A	Quality Assurance Engineer	Larry Ilg	* Specifications Engineer before Award. Construction QA Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00170	Legal Relations and Responsibilities	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00180	Prosecution and Progress	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00190	Measurement of Pay Quantities	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A	Contract Administration Engineer	Measurement Payment	* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00195	Payment	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A	Contract Administration Engineer	Measurement Payment	* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00196	Payment for Extra Work	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00197	Payment for Force Account Work	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00199	Disagreements, Protests and Claims	Project Controls Office	Specifications Engineer *	Dan Anderson	(503) 986-3777	N/A			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00205	Field Laboratory, Weighhouse, Etc.	Quality Assurance	Quality Assurance Engineer	Larry Ilg	(503) 986-3072	Measurement Payment			* Specifications Engineer before Award. Contract Administration Engineer after Award.	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00210	Mobilization	Contract Administration	Contract Administration Engineer	Measurement Payment	(503) 986-3012	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00220	Accommodations for Public Traffic	Traffic Standards	State Traffic Work Zone Engineer	Justin King	(503) 986-3584	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00221	Common Provisions for Work Zone Traffic Control	Traffic Standards	State Traffic Work Zone Engineer	Justin King	(503) 986-3584	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00222	Temporary Traffic Control Signs	Traffic Standards	State Traffic Work Zone Engineer	Justin King	(503) 986-3584	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00223	Work Zone Traffic Control Labor and Vehicles	Traffic Standards	State Traffic Work Zone Engineer	Justin King	(503) 986-3584	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00224	Temporary Traffic Channelizing Devices	Traffic Standards	State Traffic Work Zone Engineer	Justin King	(503) 986-3584	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00225	Temporary Pavement Marking	Traffic Standards	State Traffic Work Zone Engineer	Justin King	(503) 986-3584	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00226	Temporary Roadside Barriers and Impact Attenuators	Traffic Standards	State Traffic Work Zone Engineer	Justin King	(503) 986-3584	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00227	Temporary Traffic Signals and Illumination	Traffic Standards	State Traffic Work Zone Engineer	Justin King	(503) 986-3584	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00228	Temporary Pedestrian and Bicyclist Routing	Traffic Standards	State Traffic Work Zone Engineer	Justin King	(503) 986-3584	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00229	Smart Work Zone Systems	Traffic Standards	State Traffic Work Zone Engineer	Justin King	(503) 986-3584	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00230	Temporary Roadbed and Surfacing	Geotechnical Engineering	State Foundations Engineer	Tom Grummon	(541) 213-1980	Measurement Payment	State Traffic Work Zone Engineer	Justin King	Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinder	
						Measurement Payment	Pavement Design Engineer	Paul Burch				Mike Kimlinder	
						Measurement Payment	Engineering Geology Program Lead	Curran Mohnney				Mike Kimlinder	
00231	Temporary Access Road	Geotechnical Engineering	State Foundations Engineer	Tom Grummon	(541) 213-1980	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinder	
00235	Agency Provided Material Sources	Geotechnical Engineering and Engineering Geology	Material Source Program Lead	Michelle Wright	(541) 786-3137	Measurement Payment	Engineering Geology Program Lead	Curran Mohnney	Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinder	
00236	Agency Provided Disposal Sites	Geotechnical Engineering and Engineering Geology	Material Source Program Lead	Michelle Wright	(541) 786-3137	Measurement Payment	Engineering Geology Program Lead	Curran Mohnney	Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinder	

TECHNICAL RESOURCE LIST										Review of Industry Concerns			
UPDATED 07-31-23		TECHNICAL RESOURCES					STAKEHOLDER (Include in correspondence with Technical Resource)			Questions? E-mail: ODOT SPECIFICATIONS	Concern Resolution if both agree		
Section	Section Title	Primary Responsible Unit	Resource Position	Resource Name	Phone Number	Measurement and Payment Resource	Stakeholder Position	Stakeholder Name	Remarks	Construction and Materials Engineer	Discipline Section Manager	Chief Engineer	Concern Resolution
00237	Agency Provided Staging Areas	Geotechnical Engineering and Engineering Geology	Material Source Program Lead	Michelle Wright	(541) 786-3137	Measurement Payment	Engineering Geology Program Lead	Curran Mohnney	Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinger	
00240	Temporary Drainage Facilities	Hydraulic Engineering	Senior Stormwater Hydraulic Engineer	Lu Saechao	(503) 986-3365	Measurement Payment				Justin Moderie	Paul Wirfs	Mike Kimlinger	
00245	Temporary Water Management	Hydraulic Engineering	Senior Culvert Maintenance Hydraulic Engineer	Wade Holaday	(503) 986-4046	Measurement Payment	Aquatics Biology Program Leader	Tom Loynes	Stand-Alone Special Provision	Justin Moderie	Paul Wirfs	Mike Kimlinger	
00250	Diversion Bridges (Contractor Provided)	Bridge Engineering	Steel Bridge Standards Engineer	Alex Lim	(971) 283-5518	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00251	Agency Provided Temporary Bridges	Bridge Engineering	Steel Bridge Standards Engineer	Alex Lim	(971) 283-5518	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00252	Temporary Work Bridges	Bridge Engineering	Steel Bridge Standards Engineer	Alex Lim	(971) 283-5518	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00253	Temporary Work Access and Containment	Bridge Engineering	Steel Bridge Standards Engineer	Alex Lim	(971) 283-5518	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00255	Temporary Bridge Jacking	Bridge Engineering	Steel Bridge Standards Engineer	Alex Lim	(971) 283-5518	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00256	Temporary Retaining Walls	Geotechnical Engineering	Retaining Wall Engineer	Sophie Brown	(503) 986-3778	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinger	
00270	Temporary Fences	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00280	Erosion and Sediment Control	Environmental	Roadside Development and Erosion Control Program Coord.	Bob Marshall	(503) 986-3512	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.00	Scope	Environmental	Environmental and Cultural Resources Unit Manager	John Raasch	(503) 986-3370	Measurement Payment	State Environmental Eng. & Policy Manager	Rod Thompson	For Areas Not Listed	Justin Moderie	John Raasch	Mike Kimlinger	
00290.10	Staging and Disposal Sites	Geotechnical Engineering and Engineering Geology	Material Source Program Lead	Michelle Wright	(541) 786-3137	Measurement Payment	Engineering Geology Program Lead	Curran Mohnney		Justin Moderie	John Raasch	Mike Kimlinger	
00290.11	Water Conservation	Geotechnical Engineering	ODOT NOAA Liaison	Tom Loynes	(503) 986-3742	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.20	Waste, Hazardous Waste, & Hazardous Substances	Geotechnical Engineering	Hazardous Material Program Lead	Shawn Rapp	(503) 551-7976	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.29	Health and Safety	Geotechnical Engineering	Hazardous Material Program Lead	Shawn Rapp	(503) 551-7976	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.30	Pollution Control	Hydraulic Engineering	Water Resources Program Coordinator	Cory Engel	(503) 508-0764	Measurement Payment				Justin Moderie	Paul Wirfs	Mike Kimlinger	
00290.32	Noise Control	Environmental	Noise Program Coordinator	Daniel Burgin	(503) 509-7415	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.34	Protection of Fish and Fish Habitat	Environmental	ODOT/NOAA Liaison	Tom Loynes	(503) 986-3742	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.34(c)(2)	Work Area Isolation	Hydraulic Engineering	Senior Stormwater Hydraulic Engineer	Lu Saechao	(503) 986-3365	Measurement Payment				Justin Moderie	Paul Wirfs	Mike Kimlinger	
00290.36(a) and (b)	Protection of Wildlife and Wildlife Habitat	Environmental	Terrestrial Biology Program Coordinator	Paul Benton	(541) 315-5801	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.36(c)	Protection of Wildlife and Wildlife Habitat	Environmental	ESA Program Coordinator	Cash Chesselet	(503) 986-3707	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.38	Protection of Plants	Environmental	Roadside Development and Erosion Control Program Coord.	Bob Marshall	(503) 986-3512	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.40	Protection of Forests	Environmental	Roadside Development and Erosion Control Program Coord.	Bob Marshall	(503) 986-3512	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.41	Protection of Wetlands	Environmental	Wetland Program Coordinator	Brad Livingston	(503) 986-3062	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.42	Work Containment Plan and System	Environmental	ODOT/NOAA Liaison	Tom Loynes	(503) 986-3742	Measurement Payment	Steel Bridge Standards Engineer	Alex Lim		Justin Moderie	John Raasch	Mike Kimlinger	
00290.50	Protection of Cultural Resources	Environmental	Cultural Resources Program Coordinator	Tobin Boltman	(503) 877-8491	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00290.51	Protection of Sensitive Cultural Sites	Environmental	Cultural Resources Program Coordinator	Tobin Boltman	(503) 877-8491	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00293	Decommission Underground Storage Tanks	Geotechnical Engineering	Hazardous Material Program Lead	Shawn Rapp	(503) 551-7976	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinger	
00294	Contaminated Media	Geotechnical Engineering	Hazardous Material Program Lead	Shawn Rapp	(503) 551-7976	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinger	
00295	Asbestos Materials	Geotechnical Engineering	Hazardous Material Program Lead	Shawn Rapp	(503) 551-7976	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinger	
00296	Paint and Painted Materials	Geotechnical Engineering	Hazardous Material Program Lead	Shawn Rapp	(503) 551-7976	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinger	

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UPDATED 07-31-23		TECHNICAL RESOURCES					STAKEHOLDER (Include in correspondence with Technical Resource)			Questions? E-mail: ODOT SPECIFICATIONS	Concern Resolution if both agree		
Section	Section Title	Primary Responsible Unit	Resource Position	Resource Name	Phone Number	Measurement and Payment Resource	Stakeholder Position	Stakeholder Name	Remarks	Construction and Materials Engineer	Discipline Section Manager	Chief Engineer	Concern Resolution
00297	PCB and Mercury Containing Equipment	Geotechnical Engineering	Hazardous Material Program Lead	Shawn Rapp	(503) 551-7976	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinger	
00298	Well Preservation and Abandonment	Geotechnical Engineering	Engineering Geology Program Lead	Curran Mohney	(503) 508-3628	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinger	
00299	Decommission Underground Injection Control Systems	Geotechnical Engineering	Hazardous Material Program Lead	Shawn Rapp	(503) 551-7976	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinger	
0A299	Decommission Septic Tanks	Geotechnical Engineering	Hazardous Material Program Lead	Shawn Rapp	(503) 551-7976	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinger	
00305	Construction Survey Work	Geometronic	Geometronic Manager	Michael Nicols	(971) 304-4164	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Joseph Thomas	Mike Kimlinger	
00310	Removal of Structures and Obstructions	Roadway Engineering	Specifications Engineer	Dan Anderson	(503) 986-3777	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00320	Clearing and Grubbing	Roadway Engineering	Specifications Engineer	Dan Anderson	(503) 986-3777	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00330	Earthwork	Geotechnical Engineering	State Foundation Engineer	Tom Grummon	(541) 213-1980	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	John Raasch	Mike Kimlinger	
							Pavement Design Engineer	Paul Burch					
00331	Subgrade Stabilization	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00333	Aggregate Ditch Lining	Hydraulic Engineering	Senior Stormwater Hydraulic Engineer	Lu Saechao	(503) 986-3365	Measurement Payment	Quality Assurance Engineer	Larry Ilg	Stand-Alone Special Provision	Justin Moderie	Paul Wirfs	Mike Kimlinger	
00334	Preparation of Shoulders	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00335	Blasting Methods & Protection of Excavation Backslopes	Geotechnical Engineering and Engineering Geology	Engineering Geology Program Lead	Michelle Wright	(541) 786-3137	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00340	Watering	Geotechnical Engineering	State Foundation Engineer	Tom Grummon	(541) 213-1980	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00344	Treated Subgrade	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment	Pavement Design Engineer	Paul Burch		Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00350	Geosynthetic Installation	Geotechnical Engineering	Retaining Wall Engineer	Sophie Brown	(503) 986-3778	Measurement Payment	Pavement Design Engineer	Paul Burch		Justin Moderie	John Raasch	Mike Kimlinger	
00360	Drainage Blankets	Geotechnical Engineering	State Foundation Engineer	Tom Grummon	(541) 213-1980	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	John Raasch	Mike Kimlinger	
00370	Finishing Roadbeds	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00380	Rock Slope Scaling	Geotechnical Engineering	Engineering Geology Program Lead	Curran Mohney	(503) 508-3628	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	John Raasch	Mike Kimlinger	
00390	Riprap Protection	Hydraulic Engineering	Senior Bridge Hydraulic Engineer	Wesley Nickerman	(541) 239-7068	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Paul Wirfs	Mike Kimlinger	
00396	Shotcrete Slope Stabilization	Geotechnical Engineering	Engineering Geology Program Lead	Curran Mohney	(503) 508-3628	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	John Raasch	Mike Kimlinger	
00398	Rock Slope Stabilization and Reinforcement	Geotechnical Engineering	Engineering Geology Program Lead	Curran Mohney	(503) 508-3628	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00405	Trench Excavation, Bedding, and Backfill	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00406	Tunneling, Boring, and Jacking	Geotechnical Engineering	State Foundation Engineer	Tom Grummon	(541) 213-1980	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00410	Rehabilitate Existing Pipe	Hydraulic Engineering	Senior Culvert Hydraulic Engineer	Robert Trevis	(503) 986-3860	Measurement Payment				Justin Moderie	Paul Wirfs	Mike Kimlinger	
00411	Pipe Bursting	Geotechnical Engineering	State Foundation Engineer	Tom Grummon	(541) 213-1980	Measurement Payment	Senior Culvert Hydraulic Engineer	Robert Trevis		Justin Moderie	John Raasch	Mike Kimlinger	
00412	Cured-In-Place Pipe Lining	Hydraulic Engineering	Senior Culvert Hydraulic Engineer	Robert Trevis	(503) 986-3860	Measurement Payment				Justin Moderie	Paul Wirfs	Mike Kimlinger	
00413	Cured-In-Place Pipe Lining & UV Cure	Hydraulic Engineering	Senior Culvert Hydraulic Engineer	Robert Trevis	(503) 986-3860	Measurement Payment				Justin Moderie	Paul Wirfs	Mike Kimlinger	
00414	Pipe Renewel - Spray Applied Pipe Structural Liner	Hydraulic Engineering	Senior Culvert Hydraulic Engineer	Robert Trevis	(503) 986-3860	Measurement Payment				Justin Moderie	Paul Wirfs	Mike Kimlinger	
00415	Video Pipe Inspection	Hydraulic Engineering	Senior Culvert Hydraulic Engineer	Robert Trevis	(503) 986-3860	Measurement Payment				Justin Moderie	Paul Wirfs	Mike Kimlinger	
00420	Salvaging Pipe	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Paul Wirfs	Mike Kimlinger	
00430	Subsurface Drains	Geotechnical Engineering	State Foundation Engineer	Tom Grummon	(541) 213-1980	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00435	Prefabricated Vertical Drains	Geotechnical Engineering	State Foundation Engineer	Tom Grummon	(541) 213-1980	Measurement Payment	Senior Standards Engineer	Will Woods		Justin Moderie	John Raasch	Mike Kimlinger	
00440	Commercial Grade Concrete	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Ray Bottenberg	Mike Kimlinger	

TECHNICAL RESOURCE LIST										Review of Industry Concerns			
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Section	Section Title	Primary Responsible Unit	Resource Position	Resource Name	Phone Number	Measurement and Payment Resource	Stakeholder Position	Stakeholder Name	Remarks	Construction and Materials Engineer	Discipline Section Manager	Chief Engineer	Concern Resolution
00442	Controlled Low Strength Materials	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00443	Rapid Setting Controlled Low Strength Materials	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00444	Low Density Cellular Concrete	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00445	Sanitary, Storm, Culvert, Siphon, and Irrigation Pipe	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00446	Trench Drains	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00450	Structural Plate Shaped Structures	Hydraulic Engineering	Senior Culvert Hydraulic Engineer	Robert Trevis	(503) 986-3860	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Paul Wirfs	Mike Kimlinger	
00460	Paved Culvert End Slopes	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00470	Manholes, Catch Basins, and Inlets	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00475	Drain Wells	Geotechnical Engineering	Engineering Geology Program Lead	Curran Mohney	(503) 508-3628 986-3499	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
00480	Drainage Curbs	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00490	Work on Existing Sewers and Structures	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00495	Trench Resurfacing	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00501	Bridge Removal	Bridge Engineering	BDM Standards Engineer	Emily Clyburn	(971) 374-3933	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00503	Bridge Deck Cold Plane Pavement Removal	Bridge Engineering	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00504	Concrete Deck Surface Preparation	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00510	Structure Excavation and Backfill	Geotechnical Engineering	State Foundation Engineer	Tom Grummon	(541) 213-1980	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00512	Drilled Shafts	Geotechnical Engineering	State Foundation Engineer	Tom Grummon	(541) 213-1980	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00515	Micropiles	Geotechnical Engineering	State Foundation Engineer	Tom Grummon	(541) 213-1980	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00520	Driven Piles	Geotechnical Engineering	State Foundation Engineer	Tom Grummon	(541) 213-1980	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00530	Steel Reinforcement for Concrete	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Politsuk	(503) 986-3342	Measurement Payment	Structure Services Engineer	David Dobson		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00532	Rebar Continuity	Bridge Engineering	Senior Bridge Preservation Engineer	Fred Gomez	(503) 856-6449	Measurement Payment	Prestressed Concrete Standards Engineer	Tanarat Politsuk	Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00535	Post-Installed Anchor System	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Politsuk	(503) 986-3342	Measurement Payment	Structure Services Engineer	David Dobson		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00536	Internal Shear Anchors	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Politsuk	(503) 986-3342	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00538	Crack Injecting Existing Bridges	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Politsuk	(503) 986-3342	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00539	Concrete and Crack Sealing	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00540	Structural Concrete	Bridge Engineering	BDM Standards Engineer	Emily Clyburn	(971) 374-3933	Measurement Payment	Structure Services Engineer	David Dobson		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
						Measurement Payment	Quality Assurance Engineer	Larry Ilg					
00541	Ultra High Performance Concrete	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Politsuk	(503) 986-3342	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00542	Concrete Repair	Bridge Engineering	Structural Design Engineer	Mats Halvardson	(503) 986-3325	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00543	Architectural Treatment	Bridge Engineering	BDM Standards Engineer	Emily Clyburn	(971) 374-3933	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00545	Reinforced Concrete Bridge End Panels	Bridge Engineering	BDM Standards Engineer	Emily Clyburn	(971) 374-3933	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00550	Precast Prestressed Concrete Members	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Politsuk	(503) 986-3342	Measurement Payment	Structure Services Engineer	David Dobson		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00555	Post-Tensioning	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment	Prestressed Concrete Standards Engineer	Tanarat Politsuk		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00556	Multi-Layer Polymer Concrete Overlays	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Ray Bottenberg	Mike Kimlinger	

TECHNICAL RESOURCE LIST													Review of Industry Concerns			
UPDATED 07-31-23			TECHNICAL RESOURCES					STAKEHOLDER (Include in correspondence with Technical Resource)			Questions? E-mail: ODOT SPECIFICATIONS		Concern Resolution if both agree		Concern Resolution	
Section	Section Title	Primary Responsible Unit	Resource Position	Resource Name	Phone Number	Measurement and Payment Resource	Stakeholder Position	Stakeholder Name	Remarks	Construction and Materials Engineer	Discipline Section Manager	Chief Engineer				
00557	Pre Mixed Polymer Concrete Overlays	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment	BDM Standards Engineer	Emily Clyburn	Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00559	Structural Concrete Overlays	Structure Services	Structure Quality Engineer	David Dobson	(503) 986-6628	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Ray Bottenberg	Mike Kimlinger				
						Measurement Payment	BDM Standards Engineer	Emily Clyburn		Ray Bottenberg	Mike Kimlinger					
00560	Structural Steel Bridges	Bridge Engineering	Steel Bridge Standards Engineer	Alex Lim	(971) 283-5518	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00564	Fall Arrest System	Bridge Engineering	Bridge Engineer	John Adkins	(541) 388-6188	Measurement Payment	Major Bridge Maintenance Engineer	Orren Jennings		Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00565	Carbon Fiber Reinforced Polymer Strengthening - Wet Layup System	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Potisuk	(503) 986-3342	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00566	Carbon Fiber Reinforced Polymer Strengthening - Near Surface Mounted	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Potisuk	(503) 986-3342	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00567	Titanium Alloy Reinforcement System	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Potisuk	(503) 986-3342	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00570	Timber Structures	Bridge Engineering	BDM Standards Engineer	Emily Clyburn	(971) 374-3933	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00581	Bridge Drainage Systems	Bridge Engineering	Steel Bridge Standards Engineer	Alex Lim	(971) 283-5518	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00582	Bridge Bearings	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Potisuk	(503) 986-3342	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00583	Electrical Conduit in Structures	Bridge Engineering	Senior Bridge Preservation Engineer	Fred Gomez	(503) 856-6449	Measurement Payment	BDM Standards Engineer	Emily Clyburn		Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00584	Elastomeric Concrete Nosing	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Potisuk	(503) 986-3342	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00585	Expansion Joints	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Potisuk	(503) 986-3342	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00586	Expansion Joints, Modular	Bridge Engineering	Prestressed Concrete Standards Engineer	Tanarat Potisuk	(503) 986-3342	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00587	Bridge Rails	Bridge Engineering	BDM Standards Engineer	Emily Clyburn	(971) 374-3933	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00588	Precast Historic Ornamental Bridge Rails	Bridge Engineering	Structural Design Engineer	Mats Halvardson	(503) 986-3325	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00589	Utility Attachments on Structures	Bridge Engineering	Senior Structural Design Engineer (Operations)	Clayton Davey	(503) 302-7592	Measurement Payment	Structural Design Engineer	Fred Gomez	Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00590	Polymer Membranes	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00591	Spray Waterproofing Membrane	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment	Prestressed Concrete Standards Engineer	Tanarat Potisuk		Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00592	Rolled Waterproofing Membrane	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00593	Powder Coating Metal Structures	Structure Services	Senior Coatings Engineer	Andrew Blower	(503) 510-6213	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00594	Preparing and Coating Metal Structures	Structure Services	Senior Coatings Engineer	Andrew Blower	(503) 510-6213	Measurement Payment	Corrosion Engineer	David Dobson		Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00595	Reinforced Concrete Box Culverts	Geotechnical Engineering	Retaining Wall Engineer	Sophie Brown	(503) 986-3778	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger				
00596A	Mechanically Stabilized Earth Retaining Walls	Geotechnical Engineering	Retaining Wall Engineer	Sophie Brown	(503) 986-3778	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	John Raasch	Mike Kimlinger				
00596B	Prefabricated Modular Retaining Walls	Geotechnical Engineering	Retaining Wall Engineer	Sophie Brown	(503) 986-3778	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	John Raasch	Mike Kimlinger				
00596C	Cast-in-Place Retaining Walls	Geotechnical Engineering	Retaining Wall Engineer	Sophie Brown	(503) 986-3778	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	John Raasch	Mike Kimlinger				
00597	Sound Walls	Geotechnical Engineering	Retaining Wall Engineer	Sophie Brown	(503) 986-3778	Measurement Payment	AQ Program Coordinator and Noise Engineer	Natalie Lijjenwall		Justin Moderie	John Raasch	Mike Kimlinger				
00599	Concrete Slope Paving	Bridge Engineering	BDM Standards Engineer	Emily Clyburn	(971) 374-3933	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger				
00610	Reconditioning Existing Roadway	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger				
00620	Cold Plane Pavement Removal	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger				
00622	Grinding Concrete Pavement	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger				
00630	Rubblizing Concrete Pavement	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger				

TECHNICAL RESOURCE LIST										Review of Industry Concerns			
UPDATED 07-31-23		TECHNICAL RESOURCES				STAKEHOLDER (Include in correspondence with Technical Resource)				Questions? E-mail: ODOT SPECIFICATIONS	Concern Resolution if both agree		
Section	Section Title	Primary Responsible Unit	Resource Position	Resource Name	Phone Number	Measurement and Payment Resource	Stakeholder Position	Stakeholder Name	Remarks	Construction and Materials Engineer	Discipline Section Manager	Chief Engineer	Concern Resolution
00635	Grid-Rolled Aggregate Subbase	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00640	Aggregate Base and Shoulders	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00641	Aggregate Subbase, Base and Shoulders	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00645	Recycled Asphalt Products in Base	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg	Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00660	Lean Concrete Base	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00670	Concrete Pavement Undersealing	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00680	Stockpiled Aggregates	Geotechnical Engineering and Engineering Geology	Material Source Program Lead	Michelle Wright	(541) 786-3137	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	John Raasch	Mike Kimlinder	
00705	Emulsified Asphalt Prime Coat and Emulsified Asphalt Fog Coat	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00706	Emulsified Asphalt Slurry Seal Surfacing	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00710	Single Application Emulsified Asphalt Surface Treatment	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00711	Pre-Coated Aggregate Asphalt Surface Treatment	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00712	Dry Key Emulsified Asphalt Surface Treatment	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg	Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00715	Multiple Application Emulsified Asphalt Surface Treatment	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00718	Hydrated Lime Slurry in Cold In-Place Recycling	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00719	Pre-Recycle Lime Treatment	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00720	Cold In-Place Recycled Asphalt Concrete Pavement	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg	Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00721	Cold Recycled Emulsified Asphalt Concrete Pavement	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg	Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00725	Hot In-Place Recycled Asphalt Concrete Pavement	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg	Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00730	Emulsified Asphalt Tack Coat	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00735	Emulsified Asphalt Concrete Pavement	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00738	Safety Edge	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00740	Commercial Asphalt Concrete Pavement (CACP)	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00743	Porous Asphalt Concrete (PAC)	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00744	Asphalt Concrete Pavement	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00745	Asphalt Concrete Pavement - Statistical Analysis	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00746	Crack Sealing Flexible Pavements	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00748	Asphalt Concrete Pavement Repair	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00749	Miscellaneous Asphalt Concrete Structures	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00754	Plain Concrete Pavement Repair	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00755	Continuously Reinforced Concrete Pavement	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00756	Plain Concrete Pavement	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00758	Reinforced Concrete Pavement Repair	Pavement Services	Pavement Design Engineer	Paul Burch	(503) 986-3122	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
00759	Miscellaneous Portland Cement Concrete Structures	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	

TECHNICAL RESOURCE LIST										Review of Industry Concerns			
UPDATED 07-31-23		TECHNICAL RESOURCES					STAKEHOLDER (Include in correspondence with Technical Resource)			Questions? E-mail: ODOT SPECIFICATIONS	Concern Resolution if both agree		
Section	Section Title	Primary Responsible Unit	Resource Position	Resource Name	Phone Number	Measurement and Payment Resource	Stakeholder Position	Stakeholder Name	Remarks	Construction and Materials Engineer	Discipline Section Manager	Chief Engineer	Concern Resolution
00760	Unit Pavers	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00810	Metal Guardrail	Roadway Engineering	Sr. Roadway Engineer	Christopher Henson	(503) 986-3561	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00811	Cable Barrier	Roadway Engineering	Sr. Roadway Engineer	Christopher Henson	(503) 986-3561	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00812	Adjusting and Repairing Guardrail	Roadway Engineering	Sr. Roadway Engineer	Christopher Henson	(503) 986-3561	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00813	Steel Backed Timber Guardrail	Roadway Engineering	Sr. Roadway Engineer	Christopher Henson	(503) 986-3561	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00815	Bollards	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00820	Concrete Barrier	Roadway Engineering	Sr. Roadway Engineer	Christopher Henson	(503) 986-3561	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00822	Glare Shields	Roadway Engineering	Sr. Roadway Engineer	Christopher Henson	(503) 986-3561	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00830	Impact Attenuators	Roadway Engineering	Sr. Roadway Engineer	Christopher Henson	(503) 986-3561	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00840	Delineators and Millepost Marker Posts	Traffic Standards	Traffic Plans Engineer	Marty Klug	(503) 986-3586	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
		Hydraulic Engineering	Senior Culvert Hydraulic Engineer	Robert Trevis	(503) 986-3860	Measurement Payment			Culvert Drainage Markers	Justin Moderie	Paul Wirfs	Mike Kimlinder	Mike Kimlinder
00842	Facility Identification Markers	Bridge Engineering	BDM Standards Engineer	Emily Clivburn	(971) 374-3933	Measurement Payment			Bridge Markers	Justin Moderie	Rav Bottenberg		
		Hydraulic Engineering	Senior Stormwater Hydraulic Engineer	Lu Saechao	(503) 986-3365	Measurement Payment			Stormwater Control Markers	Justin Moderie	Paul Wirfs		
00850	Common Provisions for Pavement Markings	Traffic Standards	Traffic Markings & Sign Engineer	Frank Belleque	(503) 428-6874	N/A	Field Operations Specialist	Joel Fry		Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00855	Pavement Markers	Traffic Standards	Traffic Markings & Sign Engineer	Frank Belleque	(503) 428-6874	Measurement Payment	Product Evaluation Coordinator	Dean Chess		Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00856	Surface Mounted Tubular Markers	Traffic Standards	Traffic Markings & Sign Engineer	Frank Belleque	(503) 428-6874	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00857	Rumble Strips	Traffic Standards	Traffic Markings & Sign Engineer	Frank Belleque	(503) 428-6874	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00860	Longitudinal Pavement Markings - Paint	Traffic Standards	Traffic Markings & Sign Engineer	Frank Belleque	(503) 428-6874	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00865	Longitudinal Pavement Markings - Durable	Traffic Standards	Traffic Markings & Sign Engineer	Frank Belleque	(503) 428-6874	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00866	Longitudinal Pavement Markings - High Performance	Traffic Standards	Traffic Markings & Sign Engineer	Frank Belleque	(503) 428-6874	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00867	Transverse Pavement Markings - Legends and Bars	Traffic Standards	Traffic Markings & Sign Engineer	Frank Belleque	(503) 428-6874	Measurement Payment	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00868	Colored Lane Markings	Traffic Standards	Traffic Markings & Sign Engineer	Frank Belleque	(503) 428-6874	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00869	Curb and Non Traversable Median Markings	Traffic Standards	Traffic Markings & Sign Engineer	Frank Belleque	(503) 428-6874	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00902	Crosswalk Closure Support	Traffic Standards	State Traffic Sign Engineer	Marie Kennedy	(503) 986-4013	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00905	Removal and Reinstallation of Existing Signs	Traffic Standards	State Traffic Sign Engineer	Marie Kennedy	(503) 986-4013	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00910	Wood Sign Posts	Traffic Standards	State Traffic Structures Engineer	Scott Jollo	(503) 510-2204	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00920	Sign Support Footings	Traffic Standards	State Traffic Structures Engineer	Scott Jollo	(503) 510-2204	Measurement Payment				Justin Moderie	Rav Bottenberg	Mike Kimlinder	Mike Kimlinder
00921	Major Sign Support Drilled Shafts	Traffic Standards	State Traffic Structures Engineer	Scott Jollo	(503) 510-2204	Measurement Payment				Justin Moderie	Rav Bottenberg	Mike Kimlinder	Mike Kimlinder
00930	Metal Sign Supports	Traffic Standards	State Traffic Structures Engineer	Scott Jollo	(503) 510-2204	Measurement Payment				Justin Moderie	Rav Bottenberg	Mike Kimlinder	Mike Kimlinder
00940	Signs	Traffic Standards	State Traffic Sign Engineer	Marie Kennedy	(503) 986-4013	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00941	Sign Covers	Traffic Standards	State Traffic Sign Engineer	Marie Kennedy	(503) 986-4013	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00942	Permanent Barricades	Roadway Engineering	Sr. Roadway Engineer	Christopher Henson	(503) 986-3561	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00950	Removal of Electrical Systems	Traffic Standards	State Traffic Signal Engineer	Scott Cramer	(503) 986-3596	Measurement Payment				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder
00960	Common Provisions for Electrical Systems	Traffic Standards	State Traffic Signal Engineer	Scott Cramer	(503) 986-3596	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	Mike Kimlinder

TECHNICAL RESOURCE LIST										Review of Industry Concerns			
UPDATED 07-31-23		TECHNICAL RESOURCES					STAKEHOLDER (Include in correspondence with Technical Resource)			Questions? E-mail: ODOT SPECIFICATIONS	Concern Resolution if both agree		
Section	Section Title	Primary Responsible Unit	Resource Position	Resource Name	Phone Number	Measurement and Payment Resource	Stakeholder Position	Stakeholder Name	Remarks	Construction and Materials Engineer	Discipline Section Manager	Chief Engineer	Concern Resolution
00962	Metal Illumination and Traffic Signal Supports	Traffic Standards	State Traffic Structures Engineer	Scott Jollo	(503) 510-2204	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00963	Signal Support Drilled Shafts	Traffic Standards	State Traffic Structures Engineer	Scott Jollo	(503) 510-2204	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00965	Metal Camera Poles and Foundations	Traffic Standards	State Traffic Structures Engineer	Scott Jollo	(503) 510-2204	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00970	Highway Illumination	Traffic Standards	State Traffic Illumination Engineer	Ernest Kim	(503) 986-3587	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00984	Fiberglass Poles*	ITS	Sr. ITS Engineer	Ron Blacketer	(503) 986-3588	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
00985	ITS Electrical System Installation	ITS	ITS Standards Engineer	Doug Spencer	(541) 747-1276	Measurement Payment				Justin Moderie	Galen McGill	Mike Kimlinger	
00987	Telecommunications	ITS	ITS Standards Engineer	Doug Spencer	(541) 747-1276	Measurement Payment				Justin Moderie	Galen McGill	Mike Kimlinger	
00989	Photovoltaic Equipment Installation	ITS	ITS Standards Engineer	Doug Spencer	(541) 747-1276	Measurement Payment				Justin Moderie	Galen McGill	Mike Kimlinger	
00990	Traffic Signals	Traffic Standards	State Traffic Signal Engineer	Scott Cramer	(503) 986-3596	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
00991	Unintegrated Speed Feedback Assembly	Traffic Standards	State Traffic Signal Engineer	Scott Cramer	(503) 986-3596	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
01010	Stormwater Control, Water Quality Structures	Hydraulic Engineering	Senior Stormwater Hydraulic Engineer	Lu Saechao	(503) 986-3365	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Paul Wirfs	Mike Kimlinger	
01011	Stormwater Control, Ponds	Hydraulic Engineering	Senior Stormwater Hydraulic Engineer	Lu Saechao	(503) 986-3365	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Paul Wirfs	Mike Kimlinger	
01012	Stormwater Control, Water Quality Biofiltration Swales	Hydraulic Engineering	Senior Stormwater Hydraulic Engineer	Lu Saechao	(503) 986-3365	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Paul Wirfs	Mike Kimlinger	
01013	Stormwater Control, Water Quality Bioslope	Hydraulic Engineering	Senior Stormwater Hydraulic Engineer	Lu Saechao	(503) 986-3365	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Paul Wirfs	Mike Kimlinger	
01014	Stormwater Control, Water Quality Filter Strip	Hydraulic Engineering	Senior Stormwater Hydraulic Engineer	Lu Saechao	(503) 986-3365	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Paul Wirfs	Mike Kimlinger	
01030	Seeding	Environmental	Roadside Development and Erosion Control Program Coord.	Bob Marshall	(503) 986-3512	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
01040	Planting	Environmental	Roadside Development and Erosion Control Program Coord.	Bob Marshall	(503) 986-3512	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
01050	Fences	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment	BDM Standards Engineer	Emily Clyburn		Justin Moderie	Mike Kimlinger	Mike Kimlinger	
01060	Metal Cattle Guards	Bridge Engineering	Steel Standards Engineer	Alex Lim	(971) 283-5518	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Ray Bottenberg	Mike Kimlinger	
01069	Metal Handrail and Pedestrian Fence	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
01070	Mailbox Supports	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
01090	Gravel Beds and Blankets	Environmental	Roadside Development and Erosion Control Program Coord.	Bob Marshall	(503) 986-3512	Measurement Payment				Justin Moderie	John Raasch	Mike Kimlinger	
01091	Waterway Enhancements	Hydraulic Engineering	Senior Culvert Maintenance Hydraulic Engineer	Wade Holaday	(503) 986-4046	Measurement Payment	Aquatics Biology Program Leader	Tom Loynes	Stand-Alone Special Provision	Justin Moderie	Paul Wirfs	Mike Kimlinger	
01095	Site Furnishings	Roadway Engineering	Specifications Engineer	Dan Anderson	(503) 986-3777	Measurement Payment			Stand-Alone Special Provision	Justin Moderie	Mike Kimlinger	Mike Kimlinger	
01120	Irrigation Systems	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
01140	Potable Water Pipe and Fittings	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
01150	Potable Water Valves	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
01160	Hydrants and Appurtenances	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
01170	Potable Water Service Connections, 2 Inch and Smaller	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	Measurement Payment				Justin Moderie	Mike Kimlinger	Mike Kimlinger	
01201	Common Provisioni for Cathodic Protection Systems	Bridge Engineering	Corrosion Engineer	Corey Withroe	(971) 374-3931	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
01210	Quality Control	Bridge Engineering	Corrosion Engineer	Corey Withroe	(971) 374-3931	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
01215	Locate and Remove Near Surface Metal	Bridge Engineering	Corrosion Engineer	Corey Withroe	(971) 374-3931	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	

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Section	Section Title	Primary Responsible Unit	Resource Position	Resource Name	Phone Number	Measurement and Payment Resource	Stakeholder Position	Stakeholder Name	Remarks	Construction and Materials Engineer	Discipline Section Manager	Chief Engineer	Concern Resolution
01220	Repair Damaged Reinforcing Bars	Bridge Engineering	Corrosion Engineer	Corey Withroe	(971) 374-3931	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
01235	Repair Damaged Concrete	Bridge Engineering	Corrosion Engineer	Corey Withroe	(971) 374-3931	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
01240	Install Reference Cells	Bridge Engineering	Corrosion Engineer	Corey Withroe	(971) 374-3931	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
01245	Eliminate Electrical Discontinuities in Reinforcing	Bridge Engineering	Corrosion Engineer	Corey Withroe	(971) 374-3931	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
01260	Prepare Surfaces and Apply Zinc Anodes	Bridge Engineering	Corrosion Engineer	Corey Withroe	(971) 374-3931	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
01270	Install Cathodic Protection System Wiring	Bridge Engineering	Corrosion Engineer	Corey Withroe	(971) 374-3931	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
01280	Install Power and Communications	Bridge Engineering	Corrosion Engineer	Corey Withroe	(971) 374-3931	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
01285	CP Cabinets, Risers, and Weather Equipment	Bridge Engineering	Corrosion Engineer	Corey Withroe	(971) 374-3931	Measurement Payment				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02001	Concrete	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02011	Rapid Hardening Hydraulic Cement	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02010	Portland Cement	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02015	Portland Cement Concrete Repair Material	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02020	Water	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02030	Supplementary Cementitious Materials	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02035	Concrete Modifiers	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02040	Chemical Admixtures	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02045	Synthetic Fiber Reinforcing for Concrete	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02050	Curing Materials	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02055	Concrete Surface Retarders	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02060	Concrete and Crack Sealers	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02070	Bonding Agents	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02080	Grout	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02090	Lime	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02110	Posts, Blocks, and Braces	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02120	Poles	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	Senior Bridge Geotechnical Engineer	Susan Ortiz		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02130	Timber and Lumber	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	Structural Design Engineer	Mats Halvardson		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02140	Glued Laminated Timber Members	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	Structural Design Engineer	Mats Halvardson		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02150	Lumber and Timber Connectors	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	Structural Design Engineer	Mats Halvardson		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02190	Preservative Treatment of Timber	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02210	Coating Materials for Timber and Concrete	Structure Services	Senior Coatings Engineer	Andrew Blower	(503) 510-6213	N/A	Corrosion Engineer	David Dobson		Justin Moderie	Ray Bottenberg	Mike Kimlinger	
02320	Geosynthetics	Geotechnical Engineering	Retaining Wall Engineer	Sophie Brown	(503) 986-3778	N/A	Pavement Design Engineer	Paul Burch		Justin Moderie	John Raasch	Mike Kimlinger	
02340	Rock Gabion Baskets	Geotechnical Engineering	Retaining Wall Engineer	Sophie Brown	(503) 986-3778	N/A				Justin Moderie	John Raasch	Mike Kimlinger	
02350	Metal Bin Retaining Walls	Geotechnical Engineering	Retaining Wall Engineer	Sophie Brown	(503) 986-3778	N/A				Justin Moderie	John Raasch	Mike Kimlinger	
02410	Concrete Pipe	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A	Senior Culvert Hydraulic Engineer	Robert Trevis		Justin Moderie	Mike Kimlinger	Mike Kimlinger	

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Section	Section Title	Primary Responsible Unit	Resource Position	Resource Name	Phone Number	Measurement and Payment Resource	Stakeholder Position	Stakeholder Name	Remarks	Construction and Materials Engineer	Discipline Section Manager	Chief Engineer	Concern Resolution
02415	Plastic Pipe	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A	Senior Culvert Hydraulic Engineer	Robert Trevis		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02420	Metal Pipe	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A	Senior Culvert Hydraulic Engineer	Robert Trevis		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02430	Structural Plate Pipe	Hydraulic Engineering	Senior Culvert Hydraulic Engineer	Robert Trevis	(503) 986-3860	N/A				Justin Moderie	Paul Wirfs	Mike Kimlinder	
02440	Joint Materials	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02450	Manhole and Inlet Materials	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A	Senior Stormwater Hydraulic Engineer	Lu Saechao		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02470	Potable Water Pipe Materials	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02475	Potable Water Fitting Materials	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02480	Potable Water Valve Materials	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02485	Hydrant and Appurtenance Materials	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02490	Potable Water Service Connection Materials, 2 Inch and Smaller	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02510	Reinforcement	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02513	Stainless Steel Reinforcement	Bridge Engineering	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	Prestressed Concrete Standards Engineer	Tanarat Potisuk		Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02515	Prestressing Reinforcement	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02520	Steel Piles	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	Senior Bridge Geotechnical Engineer	Susan Ortiz		Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02530	Structural Steel	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02540	Forgings, Shafting, Castings and Nonferrous Materials	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02560	Fasteners	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02570	Composite Bearings	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	Prestressed Concrete Standards Engineer	Tanarat Potisuk		Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02571	Elastomeric Bearing Pads	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	Prestressed Concrete Standards Engineer	Tanarat Potisuk		Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02610	Special Filter Material	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02630	Base Aggregate	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	N/A	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02640	Shoulder Aggregate	Pavement Services	Pavement Quality and Materials Engineer	Chris Duman	(503) 986-3072	N/A	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02690	PCC Aggregates	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	Quality Assurance Engineer	Larry Ilg		Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02695	Reclaimed Glass (Mixed Waste Cullet)	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02810	Bridge Rail	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	BDM Standards Engineer	Emily Clyburn		Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02820	Metal Guardrail	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A				Justin Moderie	Ray Bottenberg	Mike Kimlinder	
02830	Metal Handrail	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02831	Pedestrian Fence	Roadway Engineering	Senior Standards Engineer	Will Woods	(503) 986-3667	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02910	Sign Materials	Traffic Standards	State Traffic Sign Engineer	Marie Kennedy	(503) 986-4013	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02920	Common Electrical Materials	Traffic Standards	State Traffic Signal Engineer	Scott Cramer	(503) 986-3596	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02925	Traffic Signal Materials	Traffic Standards	State Traffic Signal Engineer	Scott Cramer	(503) 986-3596	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
02926	Highway Illumination Materials	Traffic Standards	State Traffic Illumination Engineer	Ernest Kim	(503) 986-3587	N/A				Justin Moderie	Mike Kimlinder	Mike Kimlinder	
03010	Fencing Materials	Structure Services	Structural Materials Engineer	David Dobson	(503) 986-6628	N/A	BDM Standards Engineer	Emily Clyburn		Justin Moderie	Ray Bottenberg	Mike Kimlinder	

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03020	Erosion Materials	Environmental	Roadside Development and Erosion Control Program Coord.	Bob Marshall	(503) 986-3512	N/A				Justin Maderie	John Raasch	Mike Kimlinger

Inspector's Role



5

Definitions (00110.20)

- **Engineer** - The Chief Engineer of the Agency acting either directly or through authorized representative. If the Agency has not designated a Chief Engineer, this term denotes the person responsible for administering its public works program.
- **Project Manager** - The Engineer's representative who directly supervises the engineering and administration of a Contract.
- **Inspector** - The representative of the Engineer authorized to inspect and report on Contract performance.



6

The Role of the Inspector

The inspector's role is to see that the construction project produces the results called for in the contract.



7

Inspector's Authority



8

**Authority of the Engineer
(00150.00)**

- The Engineer has full authority over the work.
- The Contractor shall perform all work to the complete satisfaction of the Engineer.
- The Engineer's determination shall be final on all matters.



9

**Project Manager's Authority
(00150.01)**

- The Engineer may designate a Project Manager as its representative on the Project with authority to enforce the provisions of the Contract.
- The Project Manager shall have the authority to appoint Inspectors to assist in the administration of the Contract.



10

Inspector's Authority (00150.02)

- Inspect Work performed and Materials furnished
- Orally reject defective Materials and to confirm such rejection in writing;
- By oral order, temporarily suspend the Work for improper prosecution pending the Engineer's decision; and
- Exercise additional delegated authority.



11

Know When to Reject

- Warping 3/8" plywood
- Spec had said should be sufficiently rigid without distortion or warping (540.45)



12

Warping 3/8" Plywood



13

Bottom of Deck in Box Girder



14

Bottom of Deck in Box Girder



15

**Inspectors are NOT authorized to:
(00150.02)**

- Accept Work or Materials
- Alter or waive provisions of the Contract
- Give instructions or advice inconsistent with the contract documents



16

Acceptability of Materials and Work (00150.25)

If the Engineer determines that the materials furnished or the work performed are not in close conformance with the plans and specifications, the Engineer may:

- Reject the materials or work and order the Contractor, at the Contractor's expense, to remove it, or
- Accept the Materials or Work as suitable for the intended purpose, and adjust the amount paid to account for diminished value to the Agency.



17

Acceptability of Materials and Work (00150.25)

The Engineer's decisions concerning acceptability of materials or work will be final.



18

Introduction to Structures



19

Basic Bridge Types

There are generally 4 types of bridges:

- Beam bridge
- Arch bridge
- Suspension bridge
- Cable Stayed bridge



20



21

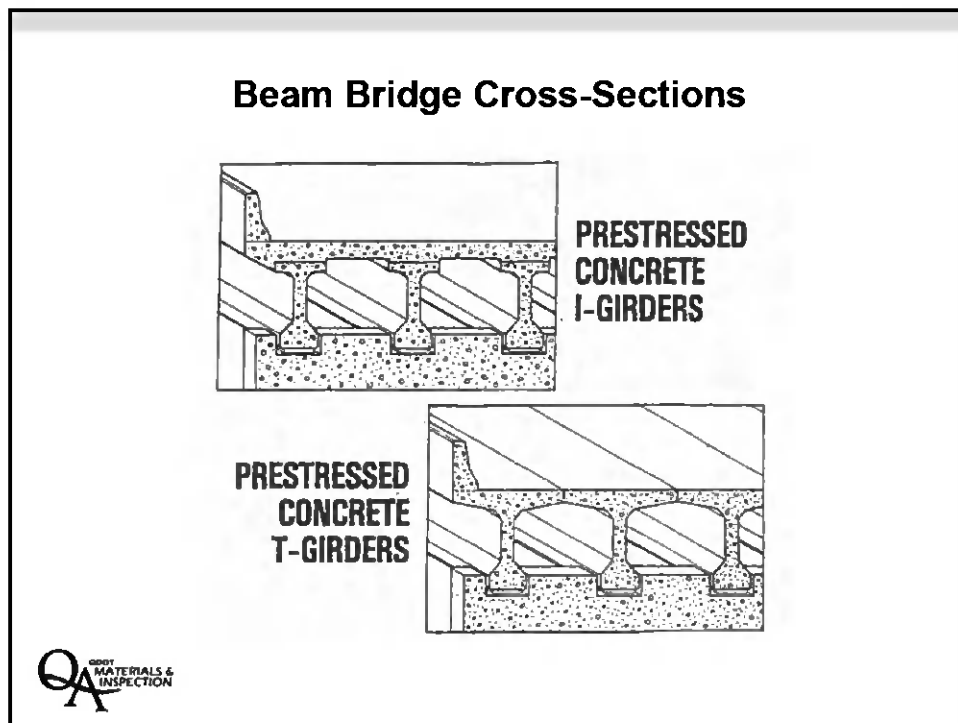
Beam Bridge

Common beam bridge types:

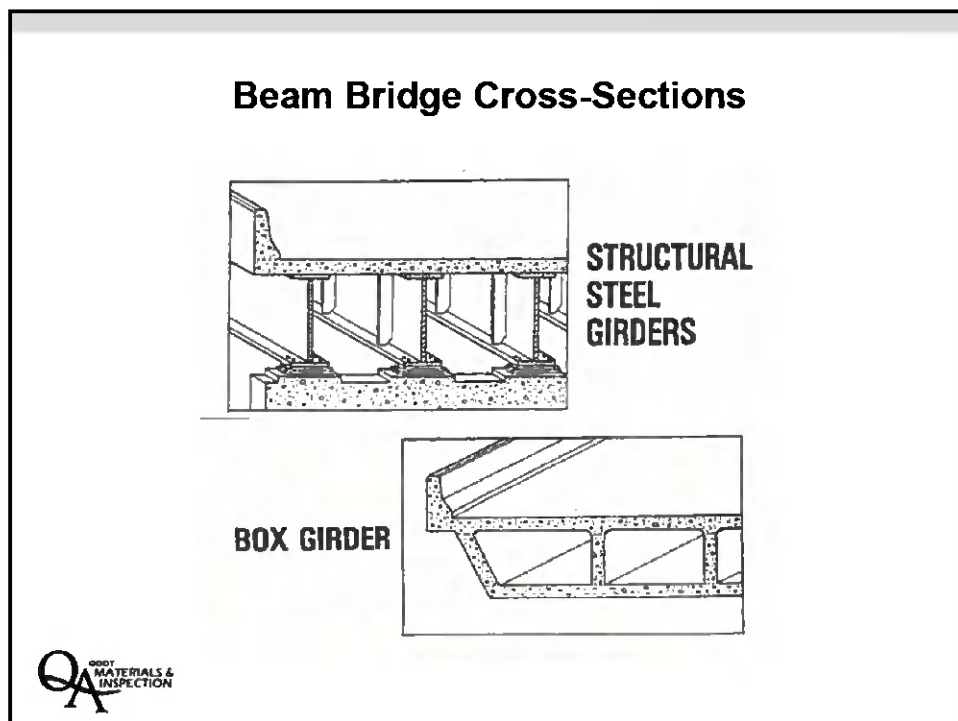
- PCPS concrete slab/box bridge
- PCPS concrete girder bridge (Bulb-I or Bulb-T)
- CIP concrete slab bridge
- CIP post-tensioned box girder bridge
- Steel plate girder bridge
- Truss bridge



22

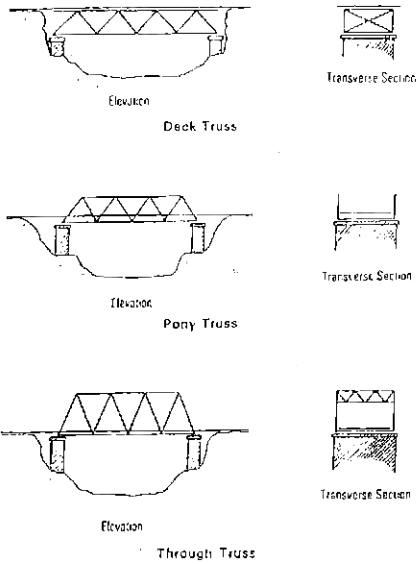


23



24

Truss Bridge Types



25

Precast, Prestressed, Concrete Slab



26

Precast, Prestressed, Concrete Box Beam



27

Precast, Prestressed, Concrete Girders



28

Steel Plate Girder



29

Post-tensioned Box Girder



30

Through Truss



31

Deck Truss



32

Arch



33

Suspension



34

Cable Stayed



35

Span Lengths

Structure Type	Span Range
PCPS slabs	70 feet
PCPS box beams	120 feet
CIP concrete slabs	50-66-50 feet (3 Span)
Precast deck girder	130 feet
PCPS bulb-I & T girders	180 feet +



36

Span Lengths

Structure Type	Span Range
CIP PT box girder	300 feet
Steel plate girder	250 feet
Steel truss	*

*Normally used for longer, multi-span continuous bridges.



37

Part of Structures

Bridges can be divided into two parts.

- Substructure
- Superstructure



38

Substructure

A bridge substructure includes:

- Foundations
(Spread footing, pile footing, drilled shafts)
- Abutments, pile caps
- Piers, columns
- Crossbeams
- Beam seats



39

Superstructure

A bridge superstructure includes:

- Bearing devices on the beam seats
- Girders
- Diaphragms
- Deck
- Other above-deck items such as curbs & rails



40

Bridge Terminology



41

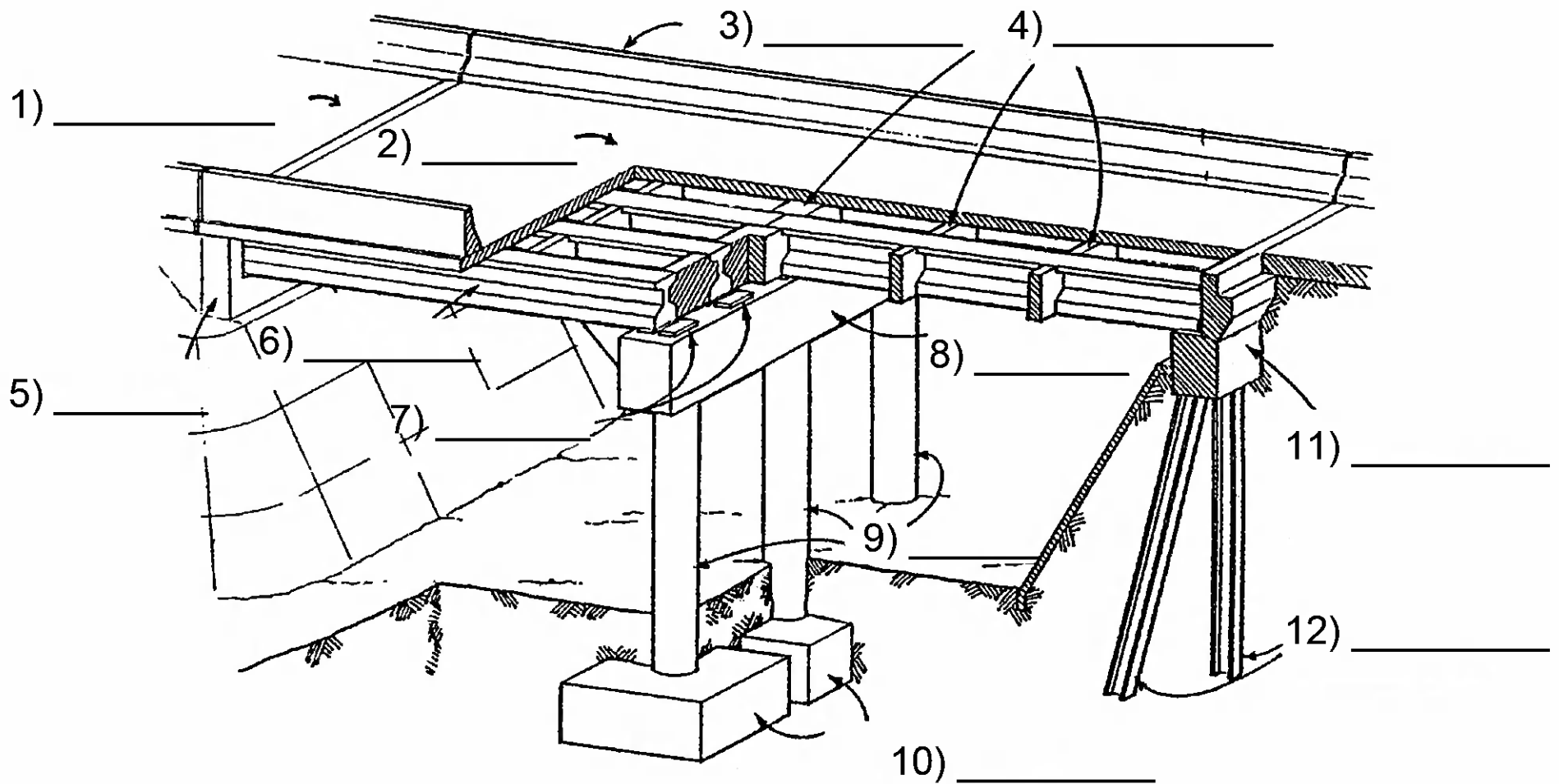
Bridge Terminology

Refer to the Glossary in Appendix A for additional bridge terminology.

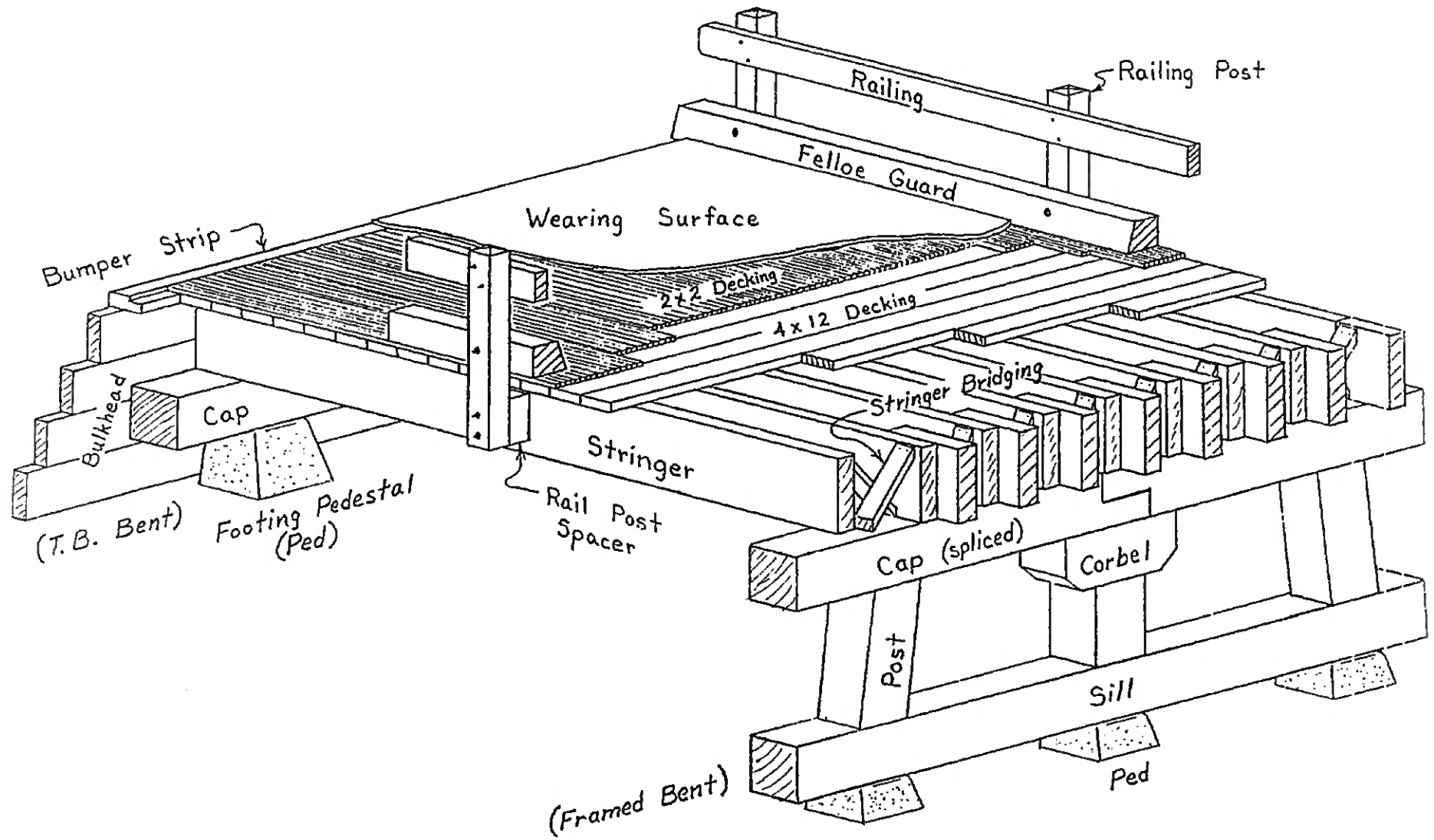


42

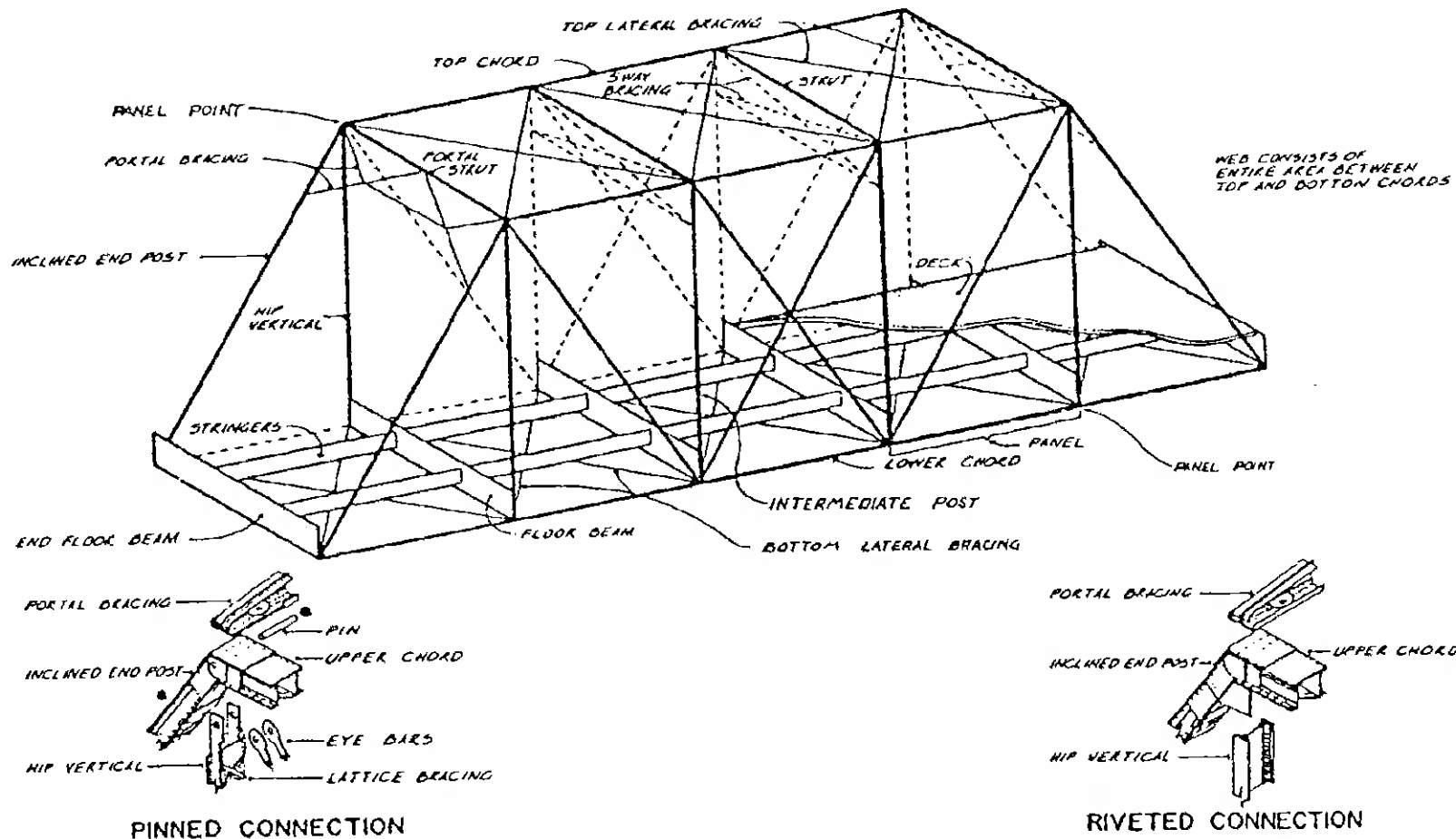
BRIDGE TERMINOLOGY EXERCISE



TIMBER STRUCTURE TERMINOLOGY



TRUSS BRIDGE TERMINOLOGY



Representative truss nomenclature. (Source: Historic American Engineering Record, National Park Service, United States Department of the Interior, Washington, D.C.)

INSERT TAB

**Unit 2
Pre-Construction
Activities**

Section 2

Pre-Construction Activities

Review Plans	1
Review Contract Documents	3
Order of Precedence	4
Manual of Field Test Procedures	5
Non-Field Test Materials Acceptance Guide	9
Record Keeping	13
Staking	15
Reference Points	21
Common Staking Errors	25

Pre-Construction Activities

Section 2



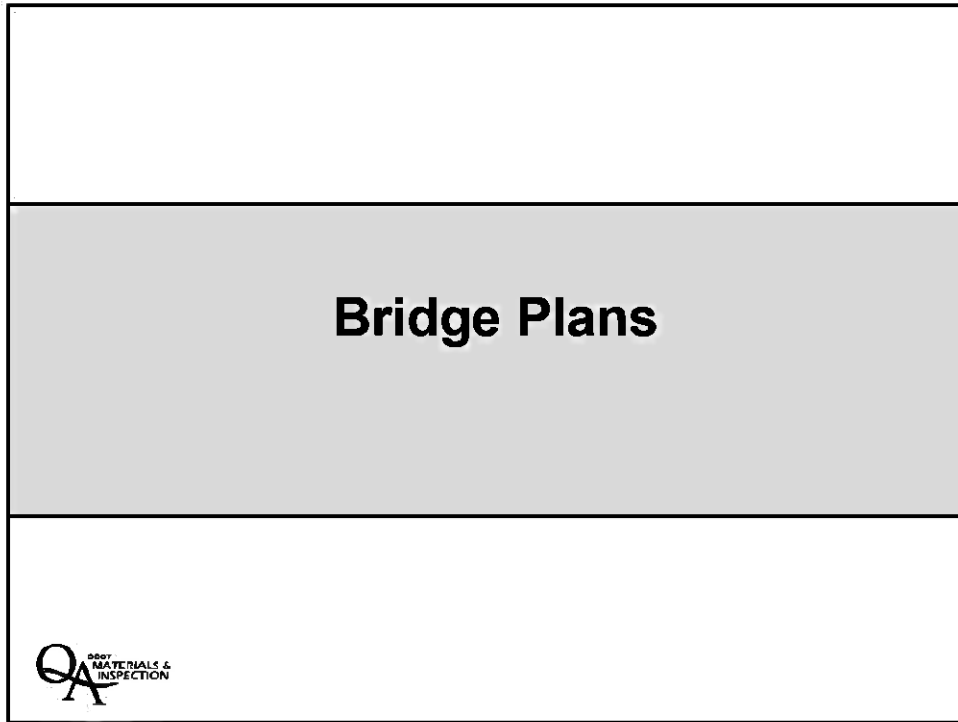
1

Review Plans

Preparations Begin in the Office



2



3

GENERAL NOTES:

Provide all materials and perform all work according to the Oregon Standard Specifications for Construction 2018.

Bridge is designed in accordance with the 2017 edition of the AASHTO LRFD Bridge Design Specifications with an allowance of 25% for future wearing surface and all of the following live loads.

Service and Strength Limit States

HL-93 Design truck for trucks per LRFD 3.6.1.3) or 16 design tandem and the design lane load.

Strength II Limit State

ODOT Type STP-5BW Permit truck

ODOT Type STP-4E Permit truck

Seismic design is performed in accordance with the "AASHTO Guide Specifications for LRFD Seismic Bridge Design" ("AASHTO LRFD Bridge Design Specifications") as modified by the "ODOT Bridge Design & Drafting Manual". The Horizontal Peak Ground Acceleration Coefficients (PGA) for 1000-year return (life safety) and Cascadia Subduction Zone Earthquake (OpenSpan) are .9 and .9 respectively, based on 2014 USGS Seismic Hazard Maps. The bridge site is defined as a Site Class ... with Site factor (Fpga) of ...

Provide all reinforcing steel according to ASTM Specification A706, or AASHTO M31 (ASTM A615) Grade 60. Use the following splice lengths (unless shown otherwise)

Reinforcing Splice Lengths (Class B) Grade 60 $F_y = 3.3$ ksi, $f_{rc} = 0.4$, 2in min. concrete clear cover									
Bar Size	#3	#4	#5	#6	#7	#8	#9	#10	#11 & #18
Uncoated	1'-3"	1'-9"	2'-2"	2'-2"	2'-2"	3'-0"	3'-5"	4'-4"	4'-10"
									Not permitted

Reinforcing Splice Lengths (Class B) Grade 60 $F_y = 4.5$ ksi, $f_{rc} = 0.4$, 2in min. concrete clear cover									
Bar Size	#3	#4	#5	#6	#7	#8	#9	#10	#11 & #18
Uncoated	1'-4"	1'-6"	1'-11"	2'-3"	2'-3"	3'-0"	3'-4"	3'-9"	4'-2"
Coated (1)	1'-4"	1'-10"	2'-8"	2'-8"	3'-2"	3'-2"	4'-0"	5'-0"	Not permitted
Coated (2)	1'-8"	2'-3"	2'-10"	3'-4"	3'-11"	4'-5"	5'-0"	5'-8"	6'-3"
									Not permitted

Use Coated (1) for epoxy coated bars with cover at least 3/4" and clear spacing between bars at least 6".

Use Coated (2) for epoxy coated bars with cover less than 3/4" or clear spacing between bars less than 6".

Increase all splice lengths 30% for horizontal or nearly horizontal bars so placed that more than 1/2" of fresh concrete is cast below the bar.

Splice reinforcing steel at alternate bars, staggered at least one splice length or as far as possible, unless shown otherwise.

Use (stainless steel) (epoxy coated) (uncoated) reinforcing steel in the deck (and bridge end panels). This includes top and bottom longitudinal bars (and top and bottom transverse bars, and all bars extending into the sidewalk) (curb) (parapet).

Place bars 2" clear of the nearest face of concrete unless shown otherwise.

Provide Deck Concrete, Class HPC-5500 - 11s concrete in deck.

Provide Foundation Concrete, Class 3300 - 11s, 1 or 1/4 concrete for pilecap.

Provide General Structural Concrete, Class HPC-4000 - 11s or 1 concrete in reinforced concrete and piers.

Provide General Structural Concrete, Class 4000 - 11s, 1 or 1/4 concrete for wingwalls and bar walls.

Provide General Structural Concrete, Class 3300 - 11s, 1 or 1/4 concrete for all other concrete

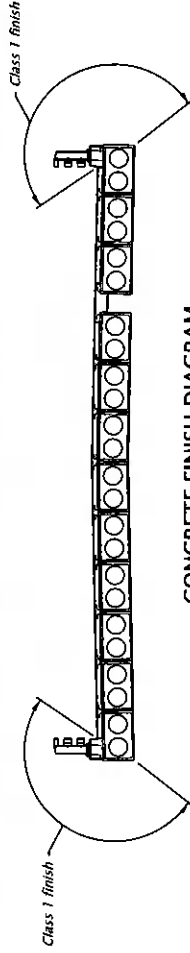
GENERAL NOTES CONT:

Provide concrete and prestressing steel in precast prestressed units according to detail plans

All utility hangers, clevises, rods, hardware, and inserts shall be hot-dip galvanized.

See Foundation Plan for foundation design notes.

Oregon law requires the rules set forth in OAR 952-001-0010 through 952-001-0090, adopted by the Oregon Utility Notification Center, in the observed. Copies of these rules may be obtained from the Center by calling 1-800-332-2344 or 811.

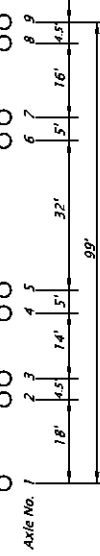


CONCRETE FINISH DIAGRAM

No Scale

TYPE OR-STP-5BW

9 Axle Vehicle
Gross Weight = 204 k



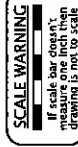
TYPE OR-STP-4E

13 Axle Vehicle
Gross Weight = 238 k



PERMIT TRUCK DIAGRAMS

No Scale



STRUCTURE NO.
22654

BUSINESS NO.
00000

CALC. BOOK
6994

HWY: 009
MAP: 82.82

COUNTY
Tillamook

DATE
8/2018

REGISTERED PROFESSIONAL ENGINEER
MICHAEL D. JACOBSON
8715
EXPIRATION DATE 12/31/2018

RENEWALS: 06-30-2019
FINAL ELECTRONIC DOCUMENT
ANNUAL FEE REQUEST

OREGON DEPARTMENT
OF TRANSPORTATION

FARMER CREEK HWY 9

US101: FARMER CREEK BRIDGE SEC.
OREGON COAST HIGHWAY
TILLAMOOK COUNTY

Designed: Michael Jacobson
Checked: Sergio Chavarrin
Reviewed: Nathan Stucker
Checked: Scott Hayes

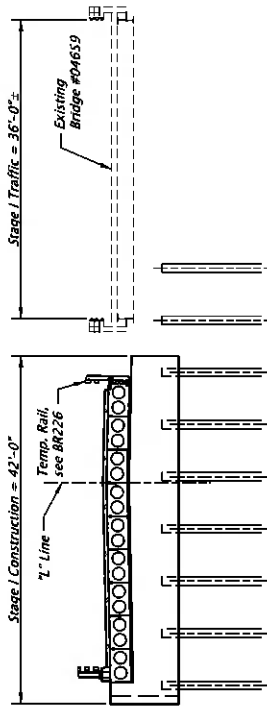
GENERAL NOTES

REVISIONS: 06-30-2019

SHEET NO.

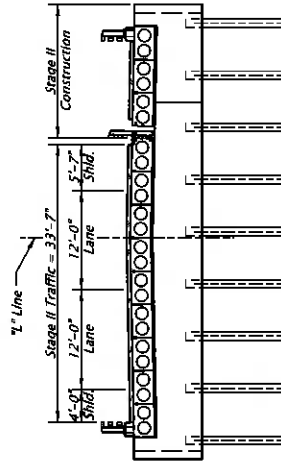
J02

Rotation: 0° Scale: Full Size 1"=1'



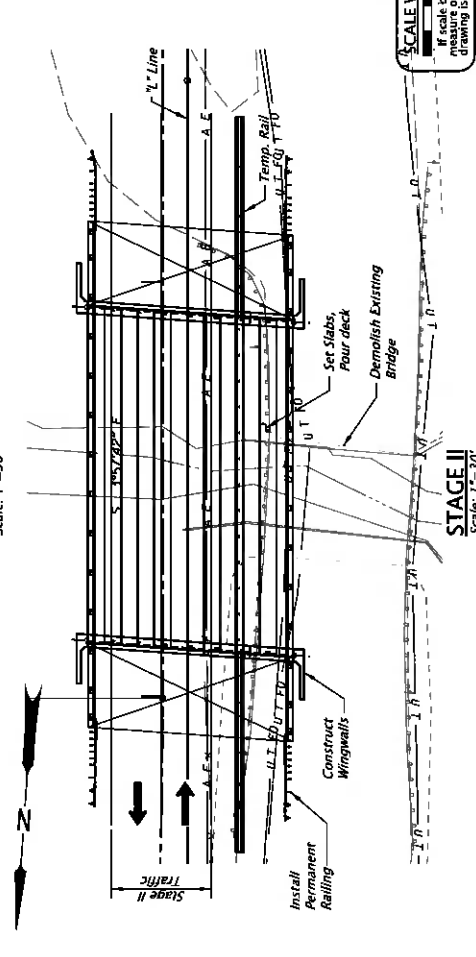
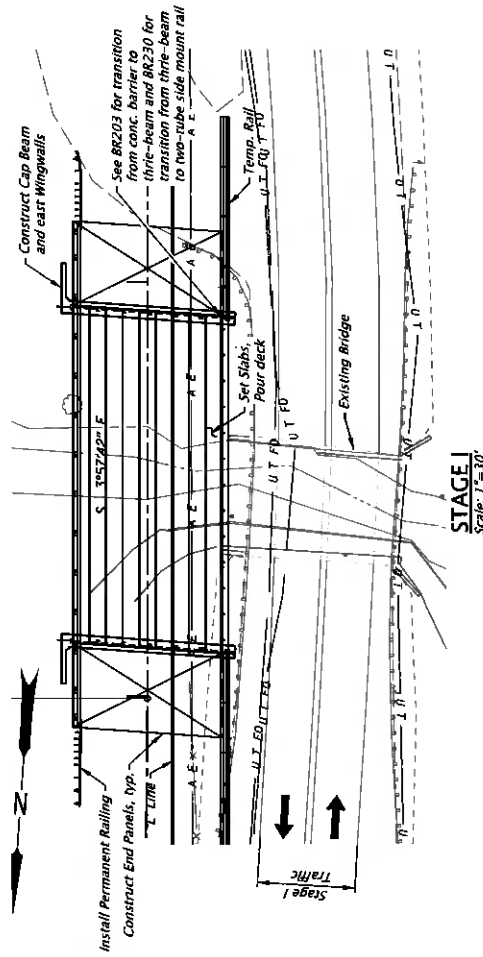
STAGE I
Scale: 1"=15'

1. Regrade channel and install riprap downstream of existing bridge.
2. Drive all piles both bents.
3. Pour partial pile cap both bents.
4. Pour east wingwalls, both bents.
5. Set 19" slabs.
6. Pour curb, deck, and partial end panels.
7. Install east perm. rail and temp. rail.
8. Open bridge to Stage II traffic.



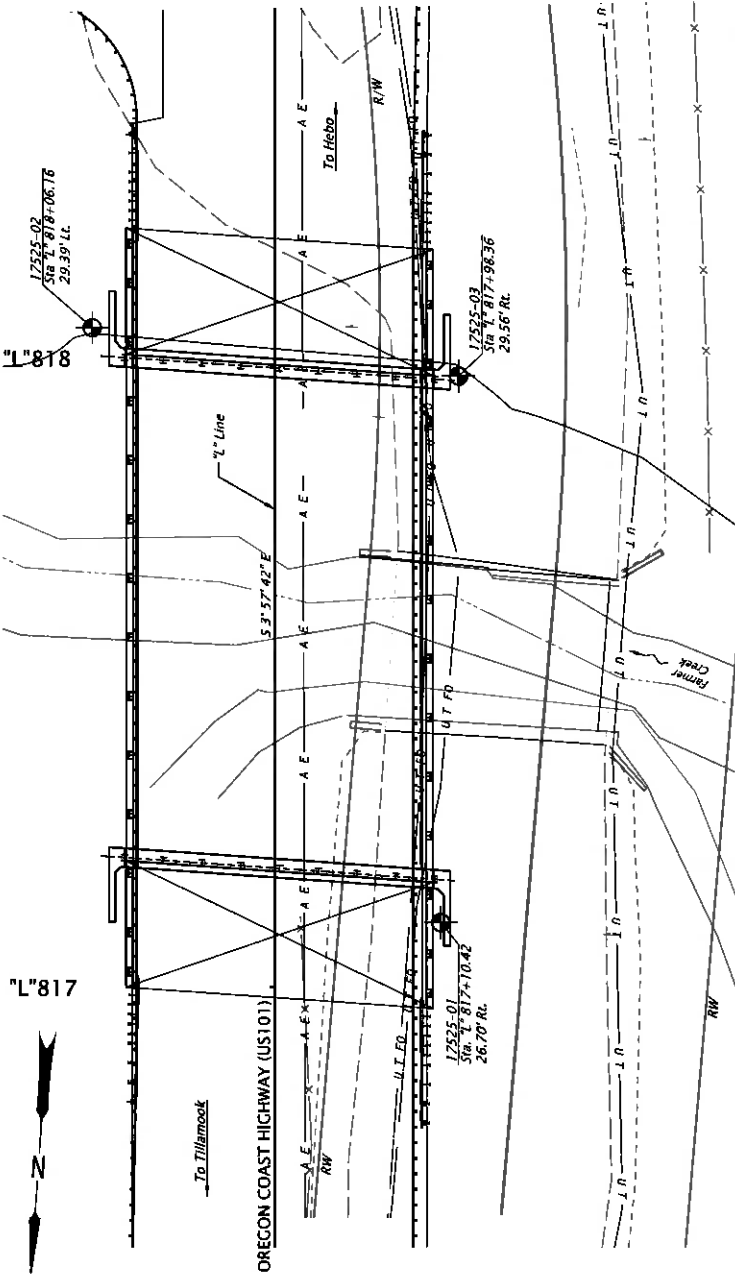
STAGE II
Scale: 1"=15'

1. Demolish existing bridge.
2. Regrade channel and install remaining riprap.
3. Pour remaining portion of pile cap, both bents.
4. Pour west wingwall, both bents.
5. Set remaining 19" slabs.
6. Pour curb, deck, and remaining portion of end panels.
7. Install west perm. rail and remove temp. rail.
8. Pour closure pour.
9. Open bridge to traffic.

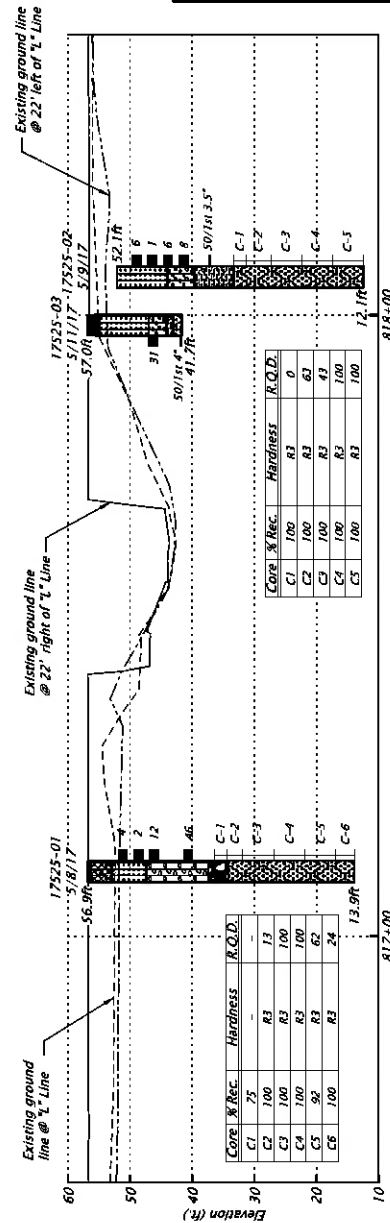


		OREGON DEPARTMENT OF TRANSPORTATION	
FARMER CREEK HWY 9 US101: FARMER CREEK BRIDGE SEC. OREGON COAST HIGHWAY TILLAMOOK COUNTY		Designer: Matthew Jordan Checker: Scott Payne Reviewer: Matthew Jordan Check: Scott Payne	
STRUCTURE NO. 22654		BAY AND NO. 00000	
CALC. BOOK 6994		HWY: 009 M.P.: 82.82	
COUNTY Tillamook		SHEET NO. J03	
DATE 8/2018		RENEWS: 06-30-2019	
PROJECT NO. 22654		PROJECT NAME FARMER CREEK BRIDGE SEC.	
PROJECT LOCATION OREGON COAST HIGHWAY TILLAMOOK COUNTY		PROJECT STAGING CONSTRUCTION STAGING	
PROJECT DATE 8/2018		PROJECT SCALE 1"=30'	

"L"817



PLAN
Scale: 1" = 20'-0"



ELEVATION
Scale: 1" = 20'-0"

Elevations shown are based on
North American Vertical Datum (1988)

UNIT DESCRIPTIONS

Asphalt

Gravel and Cobbles (Fill)

SILT SAND to **SILT** with some sand and gravel, and trace cobbles, clay, and organics; SM to MH; brown and gray; low plasticity to medium plasticity; damp to wet; very loose to loose and medium stiff; sands and gravels are angular to rounded, fine to coarse grained up to 1-inch diameter; wood observed up to 1-inch thick (Alluvium)

Gravelly SAND to **Silty Sandy GRAVEL** with some silt and sand, and trace clay and organics; SM to GP-GM; brown; medium plasticity to nonplastic; moist to wet; loose and medium dense to dense, gravels are angular to subrounded, fine to coarse grained up to 1.75-inch diameter (Alluvium)

Basaltic Sandstone GRAVEL and **COBBLES**; dark gray; very hard (R4 to R5); moderately to slightly weathered; subangular to subrounded; calcite veining (Alluvium)

Interbedded SANDSTONE and SILTSTONE (BOULDER ?); gray; moderately weathered; R1; fractured (Marine Sedimentary Rocks)

Interbedded BASALT BRECCIA and SLATE; gray; slightly weathered to fresh; R1 to R3; very close to wide joint spacing; pyrite mineralization in joints; calcite veining (Submarine Volcanics)

LEGEND

Drill hole

24 = Standard penetration test - N value

C-1 = Core sample

RQD = Rock quality designation

Geotechnical data shown on this drawing are a consolidation of information and/or revision in terminology from the drill logs. The drill logs used in compiling this drawing are available upon request. Contractor shall refer to geotechnical reports and drill logs and information contained therein.

SCALE WARNING
If scale bar doesn't measure one foot, then drawing is not to scale



OREGON DEPARTMENT OF TRANSPORTATION

FARMER CREEK HWY 9

US101: FARMER CREEK BRIDGE SEC.
OREGON COAST HIGHWAY
TILLAMOOK COUNTY

Designed: Sarah Hunt
Checked: Sange Chatterjee
Reviewed: Michael Hargrett

GEOTECHNICAL DATA

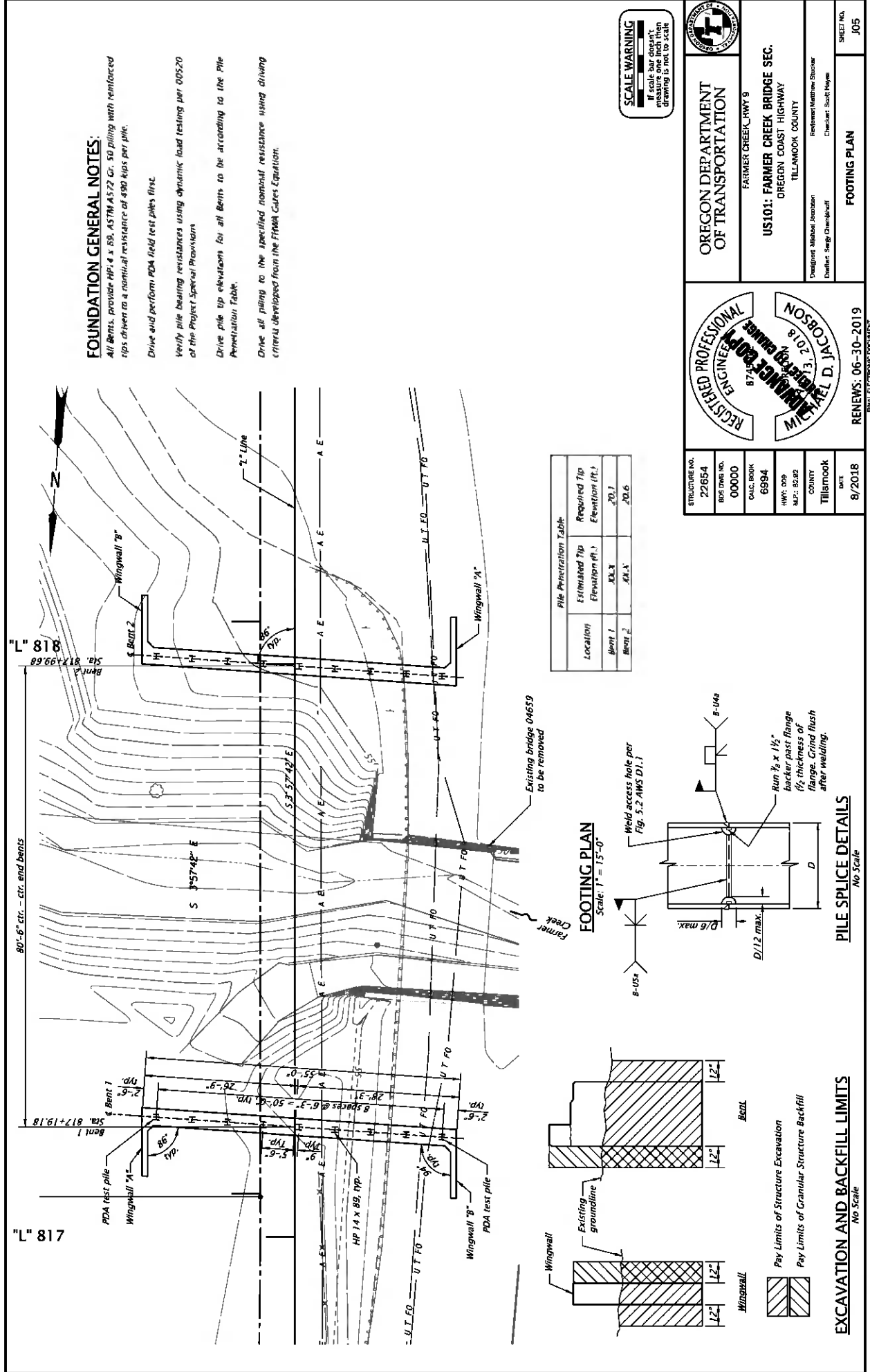
EXPIRES: 11-30-2018

FINAL ELECTRONIC DOCUMENT
AND SHEET FOR REQUEST

Rotation: 273.9617° Scale: 1"=20'

1-c0081

GE:K17525-q\pl-01 :: DefCoulit 8/27/2018 12:59:15 PM



FOUNDATION GENERAL NOTES:

- All Bents, provide HP 14 x 89, ASTM A572 Gr. 50 piling with reinforced tips driven to a nominal resistance of 490 kips per pile.
- Drive and perform PDA field test piles first.
- Verify pile bearing resistances using dynamic load testing per Q0520 of the Project Special Provision.
- Drive pile tip elevations for all bents to be according to the Pile Penetration Table.
- Drive all piling to the specified nominal resistance using driving criteria developed from the FHWA Cules Equation.



REGISTERED PROFESSIONAL ENGINEER
MICHAEL D. JACOBSON
 No. 871525
 Exp. 12/31/2018

RENEWALS: 06-30-2019
 FINAL ELECTRONIC DOCUMENT
 MANUAL FOR REQUEST

STRUCTURE NO. 22654
BUS DWS NO. 00000
CALC. BOOK 6994
HWY. 009
M.P. 82.82
COUNTY Tillamook
DIST. 8/2018

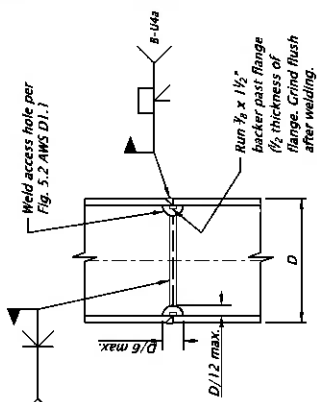
REQUIREMENTS
 FARMER CREEK HWY 9
 US101: FARMER CREEK BRIDGE SEC.
 OREGON COAST HIGHWAY
 TILLAMOOK COUNTY
 Designer: Michael Jacobson
 Checker: Scott Hayes

FOOTING PLAN
 SHEET NO. J05
 Rotation: 273.9617° Scale: 1"=15'

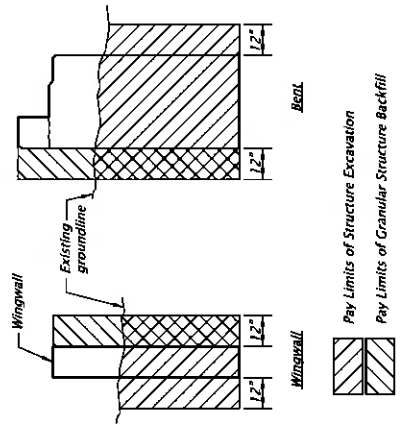
Pile Penetration Table

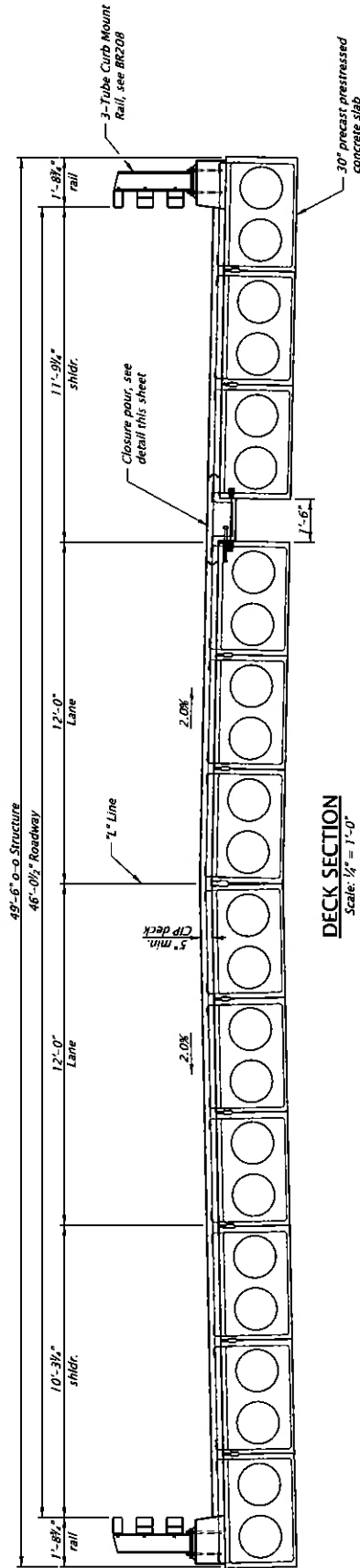
Location	Estimated Tip Elevation (ft.)	Required Tip Elevation (ft.)
Bent 1	20.1	20.1
Bent 2	20.6	20.6

FOOTING PLAN
 Scale: 1" = 15'-0"



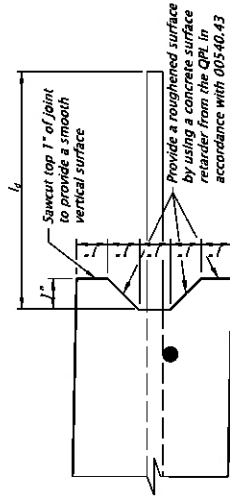
PILE SPICE DETAILS
 No Scale



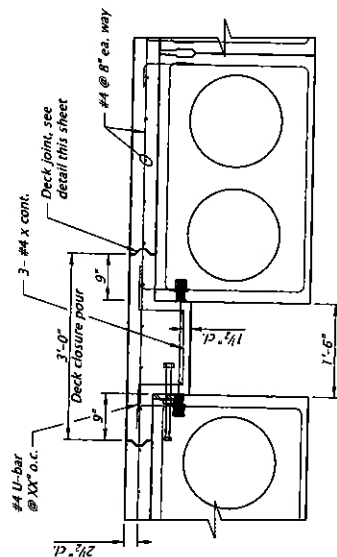


DECK SECTION
Scale: 1/4" = 1'-0"

NOTE:
Epoxy coat all deck reinforcement.



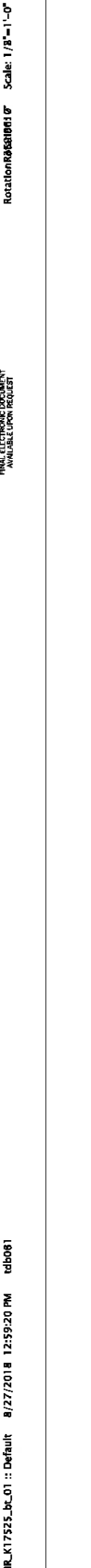
DECK JOINT DETAIL
Scale: 3/4" = 1'-0"



CLOSURE POUR DETAIL
Scale: 1/4" = 1'-0"

SCALE WARNING
If scale bar doesn't
measure one inch then
drawing is not to scale

		OREGON DEPARTMENT OF TRANSPORTATION FARMER CREEK HWY 9 US101: FARMER CREEK BRIDGE SEC. OREGON COAST HIGHWAY TILLAMOOK COUNTY		SHEET NO. J07
STRUCTURE NO. 22654		BIDS DRAW NO. 00000		CALC. BOOK 6994
HWY: 009 M.P.: 82.82		COUNTY Tillamook		DATE 8/2018
DESIGNER: Michael Jordan CHECKER: Serg Chernikoff		REVIEWER: Nathan Shuler CHECKER: Scott Hayes		DECK SECTION
RENEWS: 06-30-2019 FINAL ELECTRONIC DOCUMENT MANUAL FOR REQUEST				



30" STANDARD PRECAST PRESTRESSED SLABS

Slab Number	Number Required	Horizontal Length 0-0 at slab & R (after Shortening)	Sewer Angle	Number of Strands	Distance "Yc" to c.g. strand at midspan, in.	Distance "Yv" to c.g. top strand, in.	Concrete Strength @ 28 Days, ksi	Concrete Strength @ Release, ksi	Initial Tension per Strand, kips	Estimated Midspan Deflection, in.					Estimated Shortening 2 weeks after Release, in.
										Upward at Release	Upward 3 months after Release	Upward 5 years after Release	Downward Due to SIDL	Downward Due to SIDL	
A1-L1	12	81.33	86°	50	5.25	3.35	6.5	4.8	31.0	19 ¹ / ₈ "	28 ¹ / ₈ "	TBD	7 ¹ / ₈ "	TBD	2 ¹ / ₈ "

For General Notes and details not shown, see BR422 and BR445

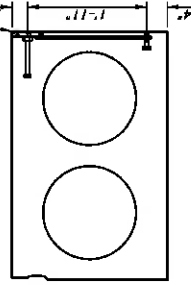
The superimposed dead load (SIDL) is ---- lbs./ft. which includes the present wearing surface, bridge rails, utilities and allowance for ---- depth of future wearing surface.

See BR208 for rail
rebar details, epoxy
coated

NOTE:
Epoxy coat all reinforcement
extending from end panel or deck
into rail. Use uncoated steel for all
other rail reinforcement.

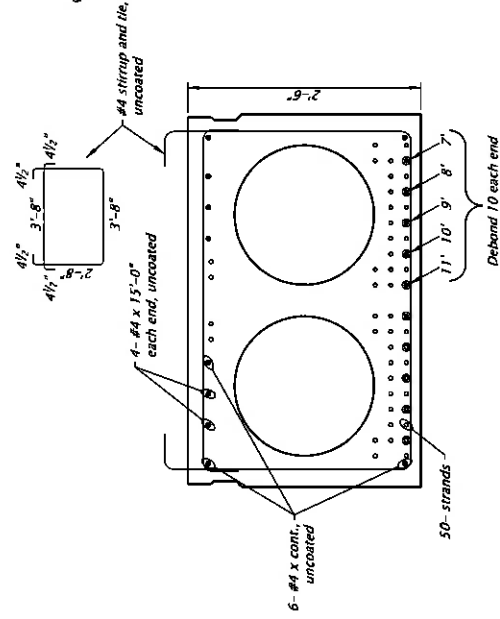
SLAB RAIL REBAR

Scale: 1/2" = 1'-0"
Slab A1 and L1 only



SLAB TEMPORARY RAIL INSERTS

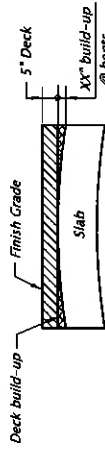
Scale: 1/2" = 1'-0"
Slab I1 only



30" SLAB DETAIL

Scale: 3/4" = 1'-0"

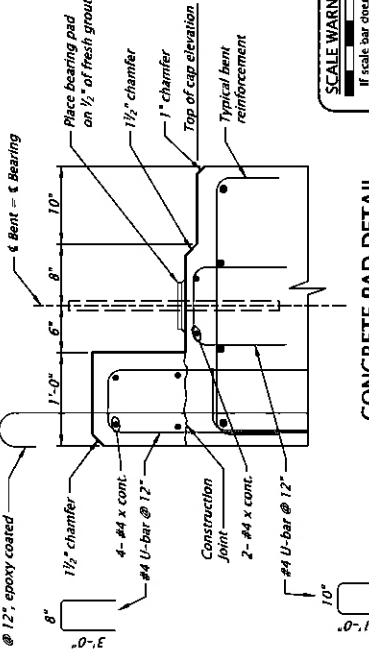
Omit keyway on exterior of Slab A1, I1, J1, and L1



DECK BUILD-UP DETAIL

No Scale

#5 x 3'-6" dowels with
Std. 180° hook one end
@ 12", epoxy coated

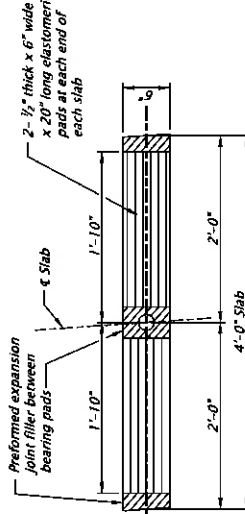


CONCRETE PAD DETAIL

Scale: 3/4" = 1'-0"

BEARING PAD DETAIL

Scale: 3/4" = 1'-0"



REGISTERED PROFESSIONAL ENGINEER
MICHAEL D. JACOBSON
No. 87152
Exp. 12/31/2018

STRUCTURE NO.
22654

BUSINESS NO.
00000

CALC. BOOK
6994

HWY: 009
M.P.: 82.82

COUNTY
Tillamook

DATE
8/2018

OREGON DEPARTMENT OF TRANSPORTATION

FARMER CREEK HWY 9

US101: FARMER CREEK BRIDGE SEC.
OREGON COAST HIGHWAY
TILLAMOOK COUNTY

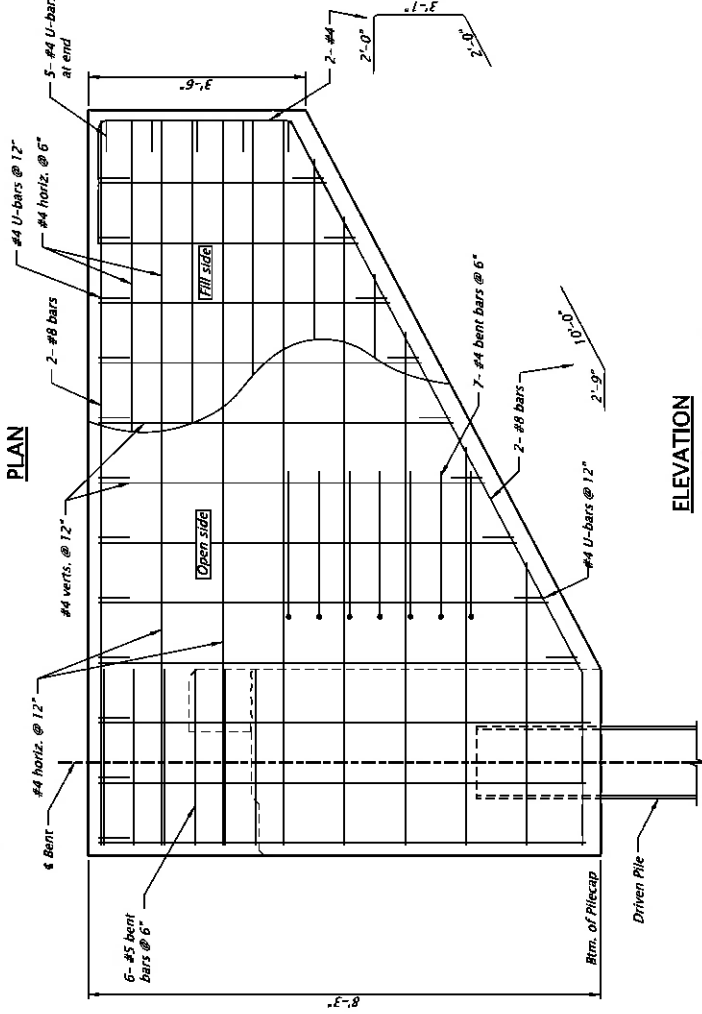
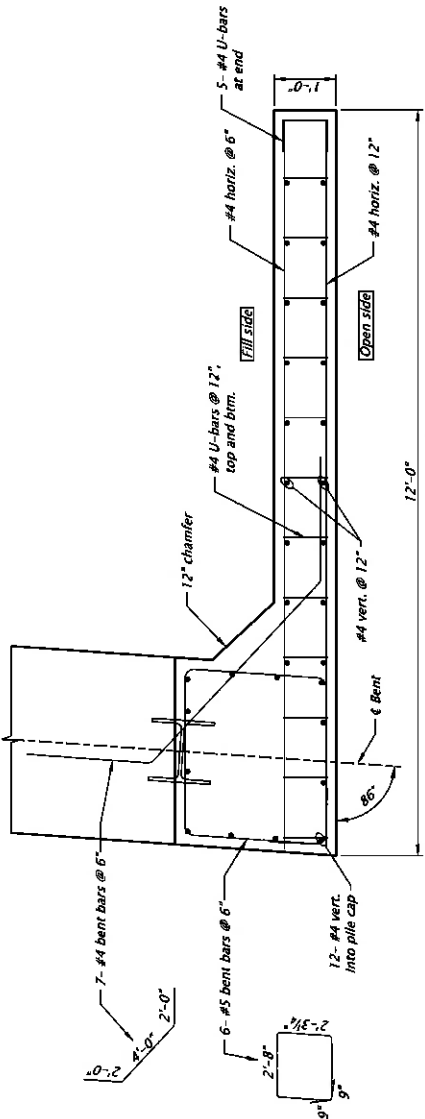
Designer: Michael Jacobson
Checker: Scott Hayes

RENEWALS: 06-30-2019
FINAL ELECTRONIC DOCUMENT
ANNUAL POST REQUEST

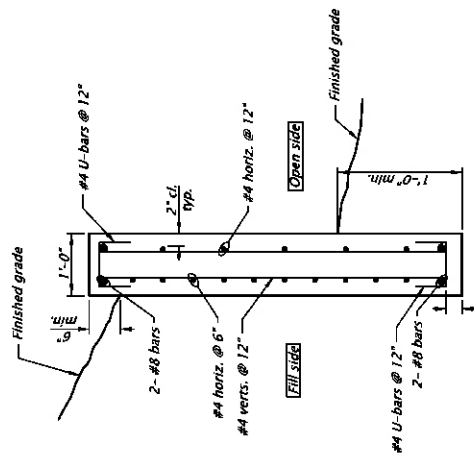
PRESTRESSED SLAB DETAILS

SHEET NO.
J09

Scale: 3/4" = 1'-0"



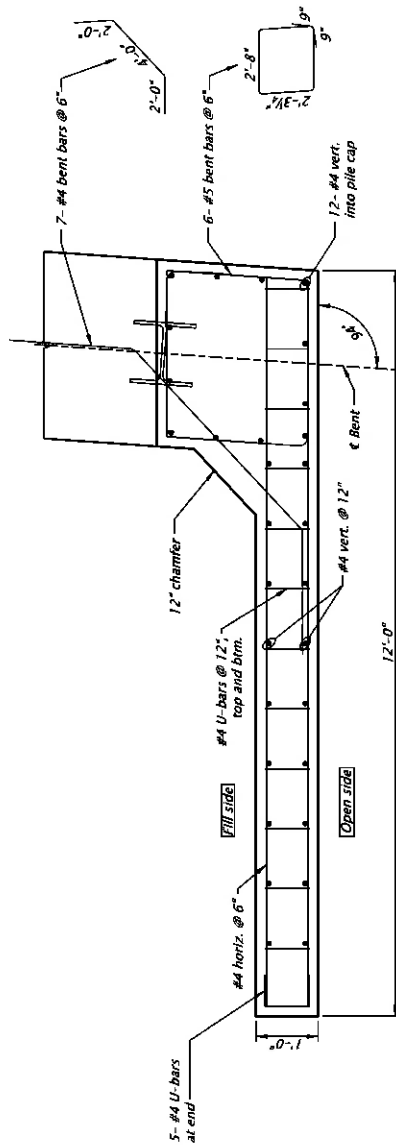
ELEVATION
WINGWALL "A" DETAILS
 Scale: 1/2" = 1'-0"
 Wingwall "A" shown, Wingwall "C" similar



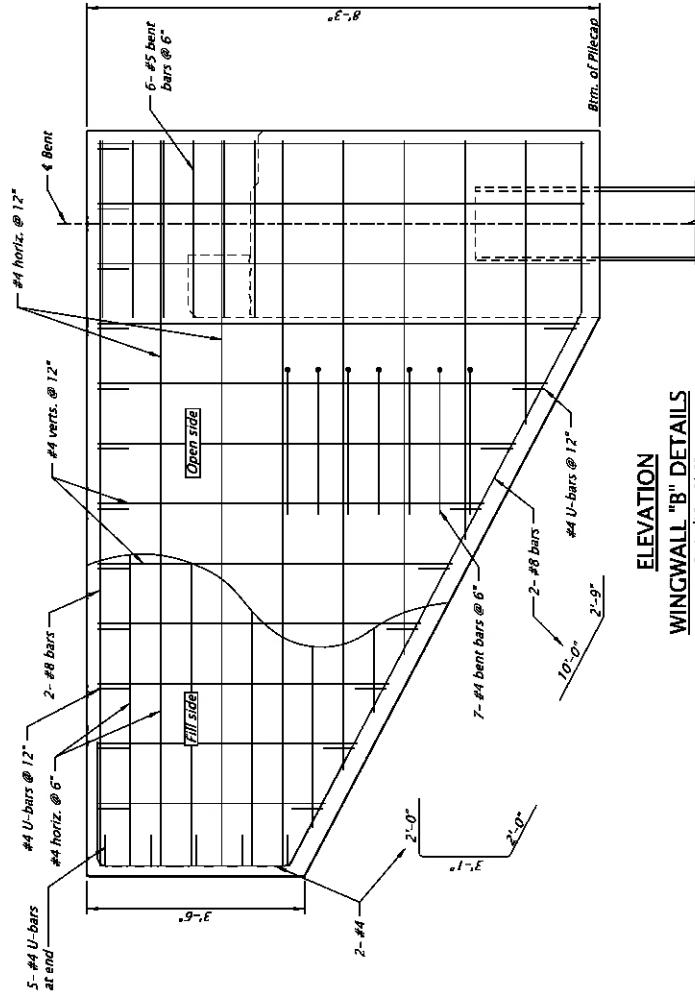
TYPICAL WINGWALL SECTION
 Scale: 1/2" = 1'-0"

SCALE WARNING
 If scale bar doesn't
 appear, please refer to
 drawing to find the scale

		OREGON DEPARTMENT OF TRANSPORTATION FARMER CREEK HWY 9 US101: FARMER CREEK BRIDGE SEC. OREGON COAST HIGHWAY TILLAMOOK COUNTY		Designer: Michael J. Alcorson Checker: Scott Hayes Date: 8/2018
STRUCTURE NO. 22654		BASIS DATE NO. 00000		SHEET NO. J10
CALC. BOOK 6994		COUNTY Tillamook		WINGWALL "A" DETAILS
HWY: 009 MAP: 82.82		DATE 8/2018		Rotation: 273.9617 Scale: 1/2"=1'-0"



PLAN



ELEVATION
WINGWALL "B" DETAILS
Scale: 1/2" = 1'-0"

Wingwall "B" shown. Wingwall "D" similar

NOTE:
For typical section, see sheet J10.



OREGON DEPARTMENT
OF TRANSPORTATION

FARMER CREEK HWY 9

US101: FARMER CREEK BRIDGE SEC.
OREGON COAST HIGHWAY
TILLAMOOK COUNTY

Designed: Michael J. Alcorn
Checked: Scott Meyer

WINGWALL "B" DETAILS

RENEWALS: 06-30-2019
FINAL ELECTRONIC DOCUMENT
MANUSCRIPT REQUEST

Rotation: 273.9617 Scale: 1/2"=1'-0"

STRUCTURE NO.	22654
BIDS DRAW NO.	00000
CALC. BOOK	6994
HWY: D09	
M.P.: 82.82	
COUNTY	Tillamook
DATE	8/2018

Early Plan Review

- Review preliminary and advance plans and specifications to minimize discrepancies on final plans.
- Check dimensions, angles, elevations, etc.
- Look for inconsistencies
- Inform RE & EOR about needed changes.



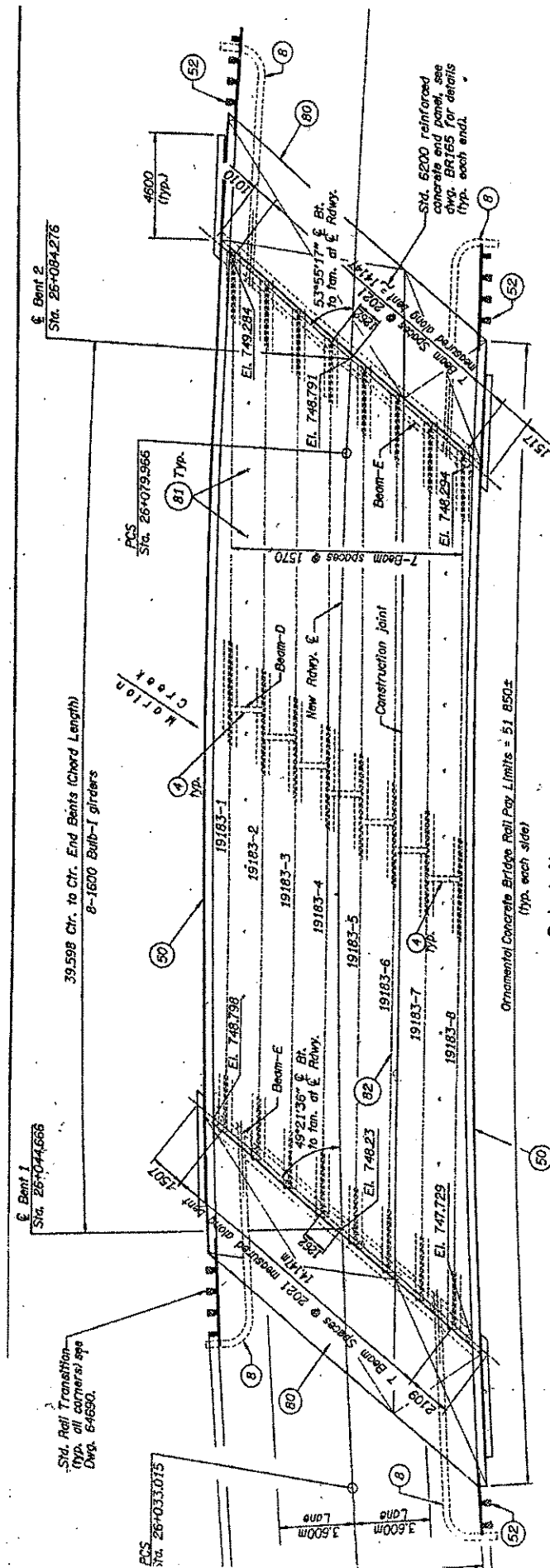
5

Case Study Plan Review Exercise

- Inspector was reviewing plans in preparation for driving piling and found problems.
- Review the following bridge plan, footing plan and girder schedule.
- What items would you be concerned about when laying out the piling?



6

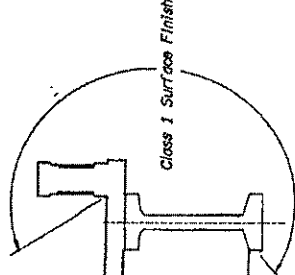
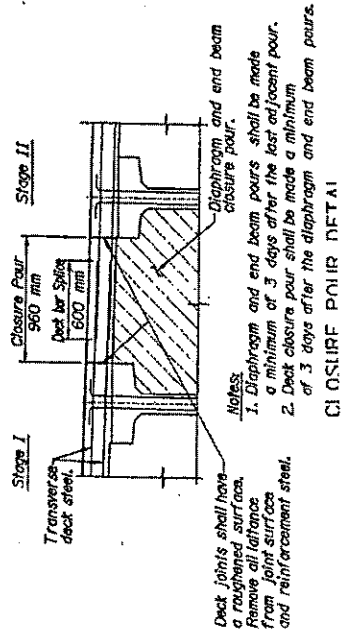


DETAIL REFERENCE NUMBERS :

- (1) Provide 325 mm diameter hole through end walls, end beams, and crossbeam. See dwg. 64695 for details.
- (2) Place culvert pipe under reinforced concrete approach panel at each utility hole both ends of bridge for future utilities. See Special Provisions (00.545.10) for pipe types. Inside pipe diameter to be 305 mm. Extend through hole in end beam to a point 2500 mm min. beyond the end of the end panel. Elbow pipes (1 m inside radius) to shoulder area to avoid guardrail as shown on plans. An oversized hole 125 mm larger diameter than the pipe shall be formed into the backwall at end beam. When the pipe is installed, the void around the pipe shall be filled with a compressible material. Cap pipe end.
- (3) Ornamental concrete bridge rail, see dwg. 64690 for details.
- (4) Std. Rail Transition (typ. all corners) see std. dwg. BR203.
- (5) 6200 mm Bridge End Panel to be constructed in two stages. See Std. dwg. BR165 and dwg. 64681 for details (typ. each end).
- (6) Place Richmond Structure concrete inserts EC-2FW, Dayton Superior F-57, or an approved equal for #19 bolts in bottom of deck at 3 m max. spacing over each utility hole (inserts to be hot dipped galv.).
- (7) Longitudinal construction joint in deck. End abutments and end panels, constructed in two stages. See detail "A"-Std. dwg. BR165 and dwg. 64681 for details.

Notes:
Elevations shown are finish grade, top of concrete at gutterline and centerline of roadway.

PLAN Scale : 1:100



TE FINISH DETAIL No Scale

CLOSURE POUR DETAIL



GIRDER TYPE	GIRDER NO.	NO. REQUIRED	LT. = LT. EXT. RT. = RT. EXT.	SPAN NUMBER	SPAN CTR.-CTR. BENTS ALONG GIRDER &	"A", 0-0 GIRDER (HORIZ. LENGTH AFTER SHORTENING)	GIRDER MASS, KG	CONCRETE STRENGTH AT 28 DAYS, MPa	CONCRETE STRENGTH AT RELEASE, MPa	INITIAL TENSION PER STRAND, IN	NO. OF STRANDS PER GIRDER "N"	DEFLECTED STRANDS PER GIRDER "DS"	FIGURE NO. FOR STRAND PATTERN	REINFORCING BARS		DIAPHRAGM NEGATIVE VALUE INDICATES BACK FROM WIDSPAN	BACK END (ON STATIONING)		AHEAD END (ON STATIONING)		EST. MIDSPAN DEFLECTION				EST. SHORTENING 2 WEEKS AFTER RELEASE							
														"S" SPACES	"L" (STRIP LEG)		"D", "D"	"L"	"E", POINT BEYOND GIRDER END	"R", POINT BEYOND GIRDER END	"L"	"E", POINT BEYOND GIRDER END	"R", POINT BEYOND GIRDER END	UPWARD AT RELEASE		UPWARD 3 MOS. AFTER RELEASE	DOWN DUE TO DEAD LOAD	DOWN DUE TO CURBS AND ACMS				
11600	19183-1	1	LT. = LT. EXT. RT. = RT. EXT.	1	SPAN CTR.-CTR. BENTS ALONG GIRDER &	"A", 0-0 GIRDER (HORIZ. LENGTH AFTER SHORTENING)	40472	50	45	139	50	24	2	20	10	1690	635	635	NO	1037	431	-51	554	NO	554	NO	554	NO	141	141	35	16
11600	19183-2 to 7	6	LT. = LT. EXT. RT. = RT. EXT.	1	SPAN CTR.-CTR. BENTS ALONG GIRDER &	"A", 0-0 GIRDER (HORIZ. LENGTH AFTER SHORTENING)	40472	50	45	139	48	24	1	20	10	1690	635	635	NO	1037	431	-51	554	NO	554	NO	554	NO	141	141	35	16
11600	19183-8	1	LT. = LT. EXT. RT. = RT. EXT.	1	SPAN CTR.-CTR. BENTS ALONG GIRDER &	"A", 0-0 GIRDER (HORIZ. LENGTH AFTER SHORTENING)	40472	50	45	139	48	24	1	20	10	1690	635	635	NO	1037	431	-51	554	NO	554	NO	554	NO	141	141	35	16

Review Contract Documents



7

Contract Documents

Include:

- Plans
- Standard Specifications
- Supplemental Specifications
- Special Provisions
- Change Orders



8

Order of Precedence Exercise

- Standard Specifications _____
- Stamped Agency Prepared Drawings _____
- Standard Drawings _____
- Contract Change Orders _____
- Other Contract Documents Not Listed _____
- Special Provisions _____
- 3D Engineered Models _____
- Approved, Unstamped Working Drawings _____
- Reviewed, Stamped Working Drawings _____



9

Contract Document Review Includes:

- Plan dimensions and angles
- Horizontal and vertical control information
- Elevations (deck, beam seat, footings, etc.)
- Soil logs, soil reports and other foundation information
- Reinforcement details



10

Contract Document Review Includes:

- Material quantities
- Review and note any special features or unusual requirements
- Field testing requirements
- Review ODOT Nonfield-Tested Material Acceptance Guide



11

AASHTOWare Project



odoteconstruction@odot.oregon.gov

AWPAdmin@odot.oregon.gov



12

What type of data will Inspectors input?

Civil Rights & Labor

- Field Interviews
 - Employee Interviews

Construction & Materials

- Daily Work Report (DWR)
 - Formerly General Daily Progress Reports
 - Weigh memos attachments
- Pay notes generated from DWR
- Sample Tests



13

13

What type of data will Externals input?

Civil Rights & Labor

- Certified Payrolls

Primes have ability to review data submitted by subs and technicians in AWP prior to ODOT's review.

Construction & Materials

- Subcontracts
- Daily Source Reports (DSR)
 - Updating production quantity
 - Identify how much material has been produced
- Submit mix designs
- Managing testing labs testers
- Sample Records - access to create records and enter test data
- View Sources and source material



14

14

AASHTOWare Project

Visit the APOST Website:

<https://www.oregon.gov/odot/Construction/Pages/AW-Construction.aspx>

Subscribe to The APOST Times:

https://public.govdelivery.com/accounts/ORDOT/subscriber/new?topic_id=ORDOT_863



AASHTOWare Project for ODOT

infocentre@dot.oregon.gov



15

15

Build America, Buy America

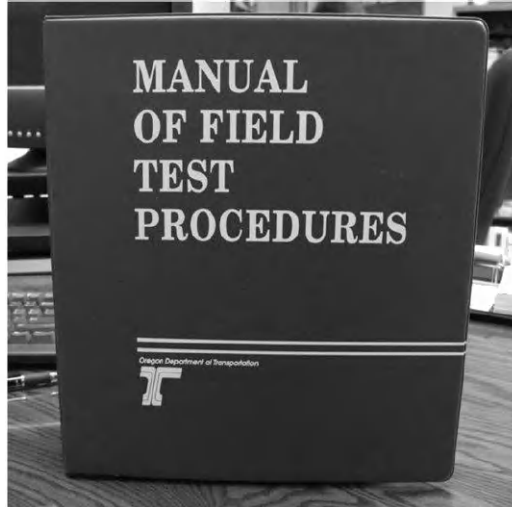


16

16

Field Testing

(00540.17 &
00165.10(a))
Sample & Test
Per MFTP



17

QC Testing Frequency

TABLE 00540-1 Frequency of Quality Control Testing

Minimum frequencies per Class of concrete based on daily production records.

<u>Production</u>	<u>Frequencies</u>
0 to 100 yd ³ on a single day	1 Set each day
<u>Quantity Over 100 yd³</u>	
100 to 600 yd ³ on a single day	1 Set per each 100 yd ³ or portion thereof
over 600 yd ³ on a single day	1 Set per each 200 yd ³ or portion thereof after reaching 600 yd ³



18

FIELD TESTED MATERIALS ACCEPTANCE GUIDE					(Revised November 2017)		Same Frequency for all Tests (Minimums)				
MATERIAL AND OPERATION	DESCRIPTION OF TEST	TEST METHOD			FORM 734-	QUALITY ASSURANCE					
		ODOT	WAQTC	AASHTO		Contractor Quality Control	Independent Assurance/Verification Project Manager	Region Quality Assurance	Materials Laboratory		
SECTION 00540 - STRUCTURAL CONCRETE (CONTINUED)											
Portland Cement Concrete	Sampling Air Content Slump Concrete Temperature Density (Unit Weight) Yield Water/Cement Ratio Strength	TM 2					(M) (S) Test at minimum frequencies according to table 00540-1. Review specs.	QA Testing <u>Projects under 100 yd³ all classes</u> 1/Project representing all classes of PCC <u>Projects over 100 yd³ all classes</u> 1/500 yd³ per class minimum 1/class			
TABLE 00540-1 Frequency of Quality Control Testing											
								<u>Minimum frequencies per Class of concrete based on daily production records.</u>			
								<u>Production</u> 0 to 100 yd³ on a single day 1 Set each day			
(S) 1 Set Represents a minimum of 3 Cylinders								<u>Quantity Over 100 yd³</u> 100 to 600 yd³ on a single day over 600 yd³ on a single day			
								1 Set per each 100 yd³ or portion thereof 1 Set per each 200 yd³ or portion thereof after reaching 600 yd³			
(M) Per Mix Design & Source											

QC Testing Frequency Example

Bridge Deck Pour: 350 cy of HPC4500.

How many sets of cylinders are required?

$$350 \text{ cy} / (100 \text{ cy/set}) = 3.5 = 4 \text{ sets}$$



19

QC Testing Frequency Exercise

Bridge Deck Pour: 850 cy of HPC4500.

How many sets of cylinders are required?



20

QA Testing Frequency

QA Testing

Projects under 100 yd³ all classes

1/Project representing all classes of PCC

Projects over 100 yd³ all classes

1/500 yd³ per class minimum 1/class



21

QA Testing Frequency Example

Total of 400 cy of HPC4500 for project.

How many QA tests are required?

$$400 \text{ cy} / (500 \text{ cy/test}) = 0.8 = 1 \text{ QA test}$$



22

QA Testing Frequency Exercise

Total of 750 cy of HPC4500 for project.

How many QA tests are required?



Small Quantity Table

Section	Type of Material	Approximate Quantity
00330	Earthwork (Embankment)	500 yd ³
00330	Earthwork (Excavation)	500 yd ²
00345 & 00346	Lime & Cement Treated Subgrade	2000 yd ²
00390 & 00395	RipRap & Rock Gabions	100 yd ³
00405	Ditch & Trench Excavation, Bedding and Backfill	50 yd ³
00440	Commercial Grade Concrete (Non-Structural Items)	50 yd ³
00495	Trench Resurfacing	500 Ton
00510	Structure Excavation and Backfill	500 Ton
0A596, 0B596 & 0C596	Retaining Walls	500 Ton
00641 & 00642	Aggregate Sub-base, Base & Shoulders	2000 Ton
00680	Stockpiled Aggregate	2000 yd ³
00730	Asphalt Tack Coat	50 Ton
00735	Emulsified Asphalt Concrete Pavement (includes asphalt cement)	2500 Ton
00745	Asphalt Concrete Pavement (Statistical Acceptance) (ACP-each Level) (includes asphalt cement).	2500 Ton

OREGON DEPARTMENT OF TRANSPORTATION
CONSTRUCTION SECTION

NONFIELD-TESTED MATERIALS ACCEPTANCE GUIDE

2021 STANDARD SPECIFICATIONS

July 2023 UPDATE



Updated versions of this guide are available by printing from the web address listed below. This document is to be used as a guide for documentation required for acceptance of Materials on ODOT Construction projects and does not relieve the user of requirements specified in the Construction Project Documents. Please notify the Contract Administration Unit, in the Construction Section at the ODOT Materials Laboratory, of any changes in Standard Drawings, Special Provisions, or Standard Specifications, etc., which would require additions to, deletions from, or changes to this listing.

Internet Address: <https://www.oregon.gov/ODOT/Construction/Pages/Structure-Services.aspx>

Contact 541-784-7721 to have correction made to this guide. A summary of changes since last publication is found at the end of this document.

*Special Provisions, Contract Plans, and Standard Specifications take precedence over this guide per 00150.10(a). Refer to the Contract for documentation requirements.

This guide provides a summary of acceptance documents for frequently used items. New Materials or Materials which are infrequently used may not be listed in this guide. Consult the Contract Documents for acceptance documentation for these items.

This guide does not have precedence over the Special Provisions, Contract Plans, or Standard Specifications. Refer to 00150.10(a)*

E – Equipment Lists and Drawings / Procedures
 L – ODOT Central Materials Laboratory Report
 I – ODOT Structure Services Inspection Report
 W – Warranty (Manufacture or Workmanship)
 P – Proof of License/Certification or Apprentice Application
 M – Manufacturer's Field Representative Report

F – Field Inspection Report (FIR)
 > *More information in form 734-2605 processing instructions.*
 O – Certificate of Materials Origin (CMO for Iron or Steel - refer to 00160.20(a))
 BG – Blue and Green Sheets (see Sec. 00960, 00970 or 00990)
 R – Field Report
 P/R – DEQ Permit or Compost Producer Registration

C – Construction Materials Certificate of Materials Origin (C-CMO) Form 734-5378 - Build America Buy America (BABA) – Refer to 00160.20(d). Specification Sections that have been identified as containing Construction Materials that may require a C-CMO have been added throughout this guide. They can also be referenced on the Qualified Products List (QPL) at the following website: <https://www.oregon.gov/odot/Construction/Pages/Qualified-Products.aspx>

Q - Quality Compliance Certificate – The certificate or equivalent document meeting specification shall be from the manufacturer and shall:

- Verify the Material meets the Specifications, and identify by number any applicable specified test methods used, (ODOT, AASHTO, ASTM, UL, others)
- Permit positive determination that Material delivered to the Project is the same Material covered by the certificate:
 - Be delivered to the Engineer with the shipment of the Material,
 - Or be an identification plate or mark, decal, sticker, label, or tag attached to the container or Material.

T – Test Results Certificate – The certificate shall:

- Be from the manufacturer, verifying the Material furnished has been sampled and tested and the test results meet the Specifications
- Include, or be accompanied by, a copy of the specified test results (ODOT, AASHTO, ASTM, UL or other)
- Identify the testing agency and the representative responsible for the test results
- Permit positive determination that Material delivered to the Project is the same Material covered by the test results
- Be delivered to the Engineer with the shipment of the Material.

Small Quantity - A method for accepting relatively small quantities of Materials as noted in this guide without normal sampling and testing. Normal acceptance of Materials may be waived by the Engineer when requested in writing by the Contractor. **Small quantity acceptance requirements are listed in this guide along with the maximum amount of Material that can be accepted as small quantity.**

QPL – For some Materials, this guide will refer to the Qualified Products List (QPL). For QPL Materials, the QPL number must be entered into the Contractor Payment System regardless of the method of documentation.

- When using an "A" listed product, document with an FIR/Pay Note citing the QPL product number.
- When using a "Q" listed product, document with an FIR/Pay Note citing the QPL product number, and attach additional documentation required by this guide.
- When using a product approved after the QPL in effect for the Project, document with an FIR/Pay Note and attach a copy of the product approval letter or page from the later edition of the QPL.

For products submitted by the Contractor that are not listed on the QPL, follow section 00160.05 of the Standard Specifications or Special Provisions.

Oregon Department of Transportation
Nonfield-Tested Materials Acceptance Guide
2021 Standard Specifications

SECTION	TYPE OF CONSTRUCTION	MATERIALS	SUBSECTION	ACCEPTANCE DOCUMENTS					REMARKS	
				FURNISHED BY CONTRACTOR TO		FURNISHED BY AGENCY				
						LAB	ENGR.	MATERIALS		
								LAB		PERSONNEL
00520 (<i>cont</i>)	Driven Piles (<i>continued</i>)	Steel Piles	02520.10		T, O	I	F	"I" is from steel manufacturer. "F" must document pile markings, heat and lot numbers, AASHTO or ASTM designation, grade, brand and quantity. Engineer to submit documents to Structure Services which will perform inspection and review of documents for all Materials and fabrication. Contact ODOT Milwaukie Materials Lab (971-673-7002) to coordinate inspection.		
00530	Steel Reinforcement for Concrete	Steel Pile Protective Coating	Refer to 00594 in this guide.							
		Steel Reinforcement for Concrete	Refer to 00530 in this guide.							
		Timber Pile Straps	02120.30		Q, O		F			
		Order Lists and Bending Diagrams Submittals	00530.11		E			"E" is submittal(s) according to 00530.11, 00150.35, and 00150.37 before ordering material.		
		Deformed Bar Reinforcement ASTM A706 & A615 & A1035 alloy CM & CS (from QPL approved manufacturer)	02510.10		O		F, QPL	"F" must document steel manufacturer's identification markings rolled into the bar. "QPL" is for rebar manufacturer.		
		Deformed Bar Reinforcement ASTM A706 & A615 & A1035 alloy CM & CS (not from QPL approved manufacturer)	02510.10	T	T, O	L	F	"I" is from steel manufacturer. "L" is test results from ODOT Salem Central Materials Lab. Obtain from each manufacturer, three 4 ft. field sample of the size representing the greatest quantity needed for the Project. Submit samples to ODOT Salem Central Materials Lab. Include manufacturer's name and heat number.		
								"F" must document steel manufacturer's identification markings rolled into the bar.		
		Dowels	02510.50		Q, O		F	"Q" is from steel manufacturer.		
	Epoxy Coated Reinforcement	02510.11(a)		Q, O		F	"Q" is for CRSI epoxy coating plant certification.			
(continued on next page)										

(continued on next page)

NFTMAG Exercise

What acceptance documents are required for the following?

- Rebar on QPL. _____
- Rebar not on QPL. _____
- Epoxy Rebar on QPL. _____



25

After Document Review

- Report any discrepancies to your Project Manager.
- Contact Engineer of Record for clarification.



26

Pre-construction Conference

- Hold pre-construction conference prior to any work beginning.
- Should be held within 30 days of the notice to proceed.



27

Contractor Submittals

- Work schedules
- Traffic control plans
- Subcontractor approvals



28

Contractor Submittals Cont'd:

- Material approvals
 - Identification of concrete plants and prefabrication plant
 - Concrete mix designs
- Working drawings



29

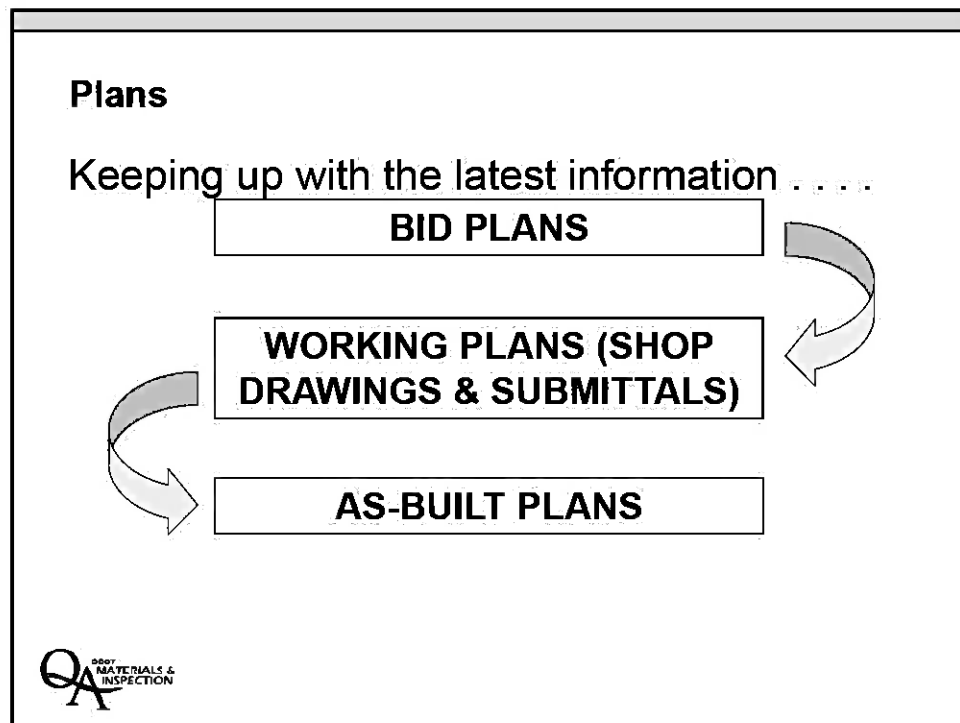
Working Drawings

Approved submittals required for the following:

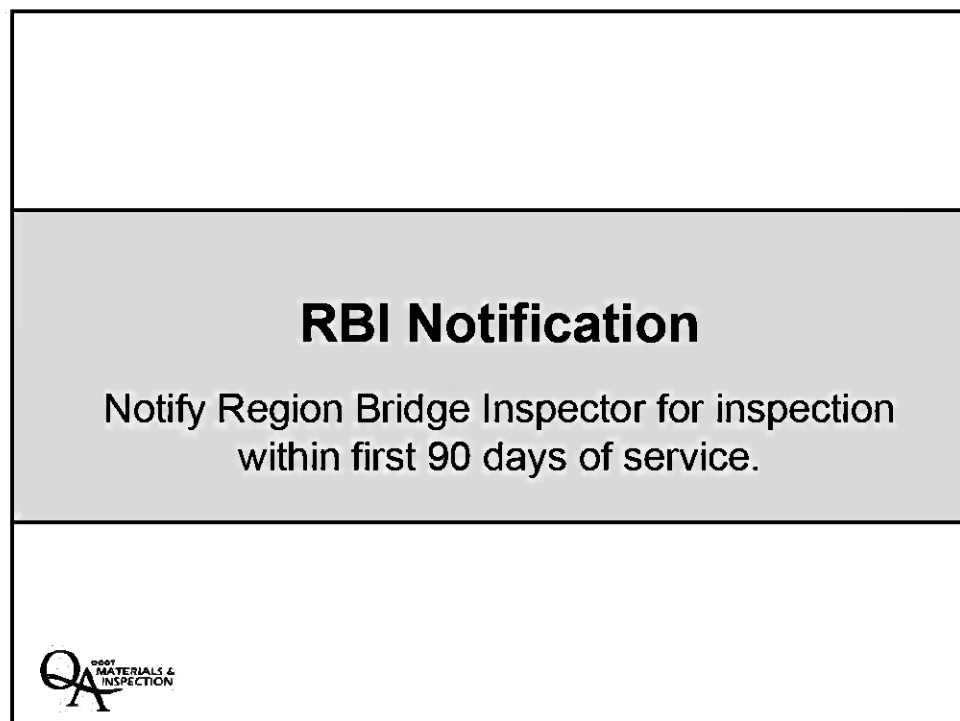
- Shoring, cribbing, or cofferdams
- Falsework and load bearing forms
- Prefabricated items
- Post-tensioning
- Fabricated steel items, and
- Reinforcing steel



30



31



32

Record Keeping

See Appendix C For Forms



33

General Daily Progress Report

[illegible]

34

Daily Force Account Record

DAILY FORCE ACCOUNT RECORD

PROJECT: **MOOSE RIVER** BRIDGE PD - 117TH AVE
 COUNTY: **MOOSE** TOWN: **TUNNATON VALLEY** DISTRICT: **MACADONNICH**
 SHEET NO: **12791** DATE: **6-17-03**

PCS WORK 12+334.58 LT TO 12+279.41 LT

TRUCKS CHECKED OUT @ 4:00 AM NO PCS WERE FOUND TO TRUCK OUT

TIME	TRUCK	QUANTITY	UNIT
8:00 AM	TRUCK #100	1.00	YD
2:00 PM	TRUCK #100	1.00	YD
TOTAL			2.00 YD

LABOR: **YAPIN 2003/2003**
1.00 YD YAPIN 2003/2003

NAME	TIME	QUANTITY	UNIT
1.00 YAPIN 2003/2003	1.00 YD	1.00	YD
1.00 YAPIN 2003/2003	1.00 YD	1.00	YD

EQUIPMENT: **1.00 YAPIN 2003/2003**

INSPECTOR: **1.00 YAPIN 2003/2003**



35

In the Field



36

On-Site Familiarization

- Determine the locations of existing utilities.
- Note any features or circumstances that may require special attention such as wetlands or endangered species habitat.
- Ensure the proper implementation of the traffic control plan.



37

Staking



38

Staking Responsibilities

Determined by Contract

- Agency provided construction stakes, lines and grades
- Contractor provided construction stakes, lines and grades



39

Accompany Survey Crew

- Find out where the stake locations are and what notations are used
- Promotes discussion of plan location interpretations between Inspector, Surveyor, and Contractor
- Check accuracy of staking by measurements and cross measurements



40

Preserving Stakes & Monuments

The contractor is responsible for preserving stakes and monuments; accurately using these controls; and setting own stringlines, batterboards, etc.



41

Staking

- Horizontal alignment
 - Centerline stakes
 - Reference points
- Vertical alignment
 - Benchmarks
 - TBM's
 - Grade stakes



42

Staking Tolerances (00305.00)

Provide according to
Construction Surveying
Manual for Contractors
(Sec 4.1)



ODOT Construction Surveying Manual for Contractors

CHAPTER 4 - CONSTRUCTION STAKING

4.1 Construction Staking Tolerances - Set stakes at other devices at an adequate frequency and within the following tolerances. The Engineer may check the stakes as stipulated with Chapter 1.4

Item	Horizontal	Vertical
Box Culverts	± 0.10 ft	± 0.05 ft
Bridge Substructures	± 0.03 ft	± 0.03 ft
Bridge Superstructures	± 0.02 ft	± 0.02 ft
Cleaning and Grading Stakes	± 1.00 ft	n/a
Construction Construction Control Points	± 0.05 ft	n/a
Construction Construction Station Points	± 0.10 ft	n/a
Curbs, Walks, and Bike Paths	± 0.03 ft	± 0.02 ft
Engineering Stationing	± 1.00 ft	n/a
Grade Stakes - Roadway Subgrade	± 0.20 ft	± 0.05 ft
Grade Stakes - Top of Road	± 0.20 ft	± 0.05 ft
ALL/PCP Corners	± 0.10 ft	± 0.02 ft
Manholes, Inlets, and Culverts	± 0.10 ft	± 0.03 ft
PCC Pavement	± 0.10 ft	± 0.02 ft
Slope Stakes and References	± 0.20 ft	± 0.10 ft
Traffic Markings	± 0.20 ft	n/a
Walls - Retaining, MSE, Sound, etc.	± 0.10 ft	± 0.05 ft
Wellhead Manholes Control Stakes	± 0.20 ft	± 0.20 ft
Lessons and Signal Poles (incl. Brackets)	± 0.20 ft	± 0.03 ft

Stakes for miscellaneous items not listed above will have a horizontal and vertical tolerance of 0.20 feet, unless otherwise directed. Features that are to be constructed from a surface should take on the same tolerance as that surface.

Staking tolerances for special circumstances will be discussed at the pre-survey meeting.

4.2 Slope Stakes and References - When slope staking is performed by the Contractor, set slope stakes and references on both sides of cut/slope at 50 foot stations and at human breaks and changes in the typical section. Establish slope stakes in the field at the actual point of intersection of the design roadway slope with the existing ground line. Slope staking of the theoretical (computer generated) slope stake catch point requires prior approval of the Engineer.

Set slope stake references further out from cut/slope than the actual catch point. Include all reference point and slope stake information on the reference stakes.

Engineering Automation
February 1, 2019

Page 11 of 30

43

Staking Tolerances Construction Survey Manual for Contractors Chapter 4.1

Substructures: ± 0.03 ft (3/8") for
horizontal & vertical position.



Superstructures: ± 0.02 ft (1/4") for
horizontal & vertical position.



44

CHAPTER 4 - CONSTRUCTION STAKING

4.1 Construction Staking Tolerances - Set stakes or other devices at an adequate frequency and within the following tolerances. The Engineer may check the stakes in accordance with Chapter 1.4.

Item	Horizontal	Vertical
Box Culverts	+/- 0.10 ft.	+/- 0.05 ft.
Bridge Substructures	+/- 0.03 ft.	+/- 0.03 ft.
Bridge Superstructures	+/- 0.02 ft.	+/- 0.02 ft.
Clearing and Grubbing Stakes	+/- 1.00 ft.	n/a
Construction Centerline Control Points	+/- 0.05 ft.	n/a
Construction Centerline Station Points	+/- 0.10 ft.	n/a
Curbs, Walks, and Bike Paths	+/- 0.03 ft.	+/- 0.02 ft.
Engineering Stationing	+/- 1.00 ft.	n/a
Grade Stakes - Roadway Subgrade	+/- 0.20 ft.	+/- 0.05 ft.
Grade Stakes - Top of Rock	+/- 0.20 ft.	+/- 0.03 ft.
All ACP Courses	+/- 0.10 ft.	+/- 0.02 ft.
Manholes, Inlets, and Culverts	+/- 0.10 ft.	+/- 0.03 ft.
PCC Pavement	+/- 0.10 ft.	+/- 0.02 ft.
Slope Stakes and References	+/- 0.30 ft.	+/- 0.10 ft.
Traffic Markings	+/- 0.20 ft.	n/a
Walls - Retaining, MSE, Sound, etc.	+/- 0.10 ft.	+/- 0.05 ft.
Wetland Mitigation Control Stakes	+/- 0.20 ft.	+/- 0.20 ft.
Luminaire and Signal Poles (incl. footings)	+/- 0.20 ft.	+/- 0.03 ft.

Stakes for miscellaneous items not listed above will have a horizontal and vertical tolerance of 0.20 foot, unless otherwise directed. Features that are to be constructed flush to another surface should take on the same tolerance as that surface.

Staking tolerances for special circumstances will be discussed at the pre-survey meeting.

4.2 Slope Stakes and References - When slope staking is performed by the Contractor, set slope stakes and references on both sides of centerline at 50 foot stations and at terrain breaks and changes in the typical section. Establish slope stakes in the field at the actual point of intersection of the design roadway slope with the existing ground line. Direct staking of the theoretical (computer generated) slope stake catch point requires prior approval of the Engineer.

Set slope stake references farther out from centerline than the actual catch point. Include all reference point and slope stake information on the reference stakes.

Horizontal Alignment

- Start with running in centerline
 - Set control points
(Curve points, POT's, etc.)
 - Set abutment and bent centerlines where possible
- Set reference points
 - For abutment and bents where possible



45

Distances

- Lengths are divided into 100-foot sections called **stations**.
- Interval stakes along an established line are ordinarily laid down at 100-foot intervals called **full stations**.
- If a marker stake is placed elsewhere along the line, it is called a **plus station**.
 - Example: A point halfway between station 10 & 11 is labeled “10+50”



46

Station Equation Example

Const Line has equation $10+50Bk=10+80Ah$

Bent 1 has station of 10+00

Bent 2 has station of 11+30 —

What is the distance between bents?

$$(11+30)-(10+00)-((10+80)-(10+50))=$$

$$130 \text{ ft} - 30 \text{ ft} = 100 \text{ ft}$$



47

Station Equation Exercise

Const Line has equation $12+10Bk=12+90Ah$

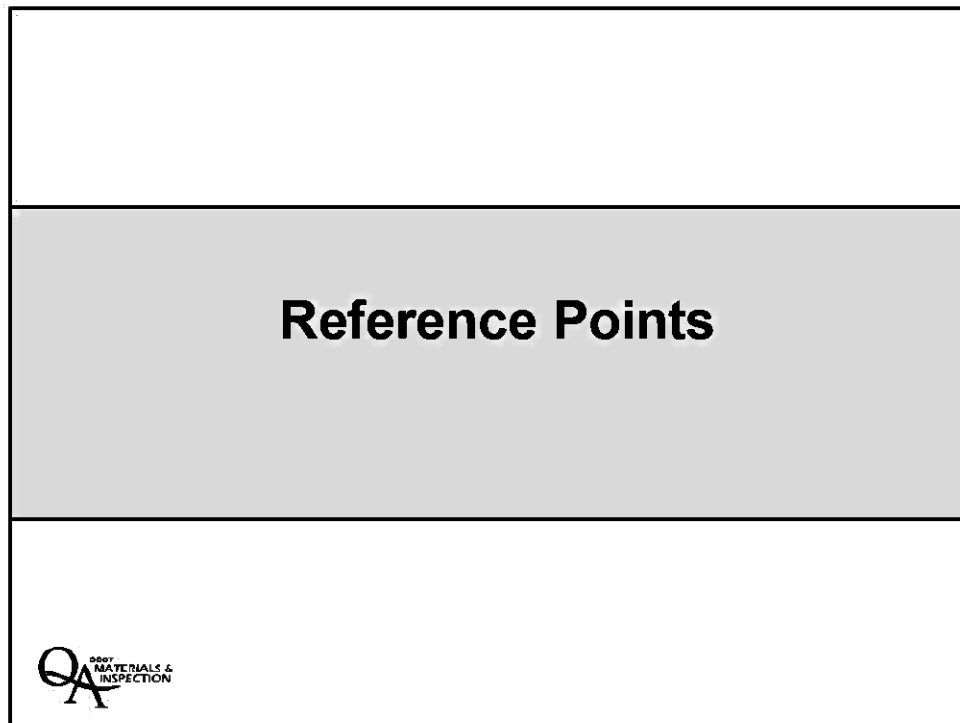
Bent 1 has station of 11+50

Bent 2 has station of 14+00 —

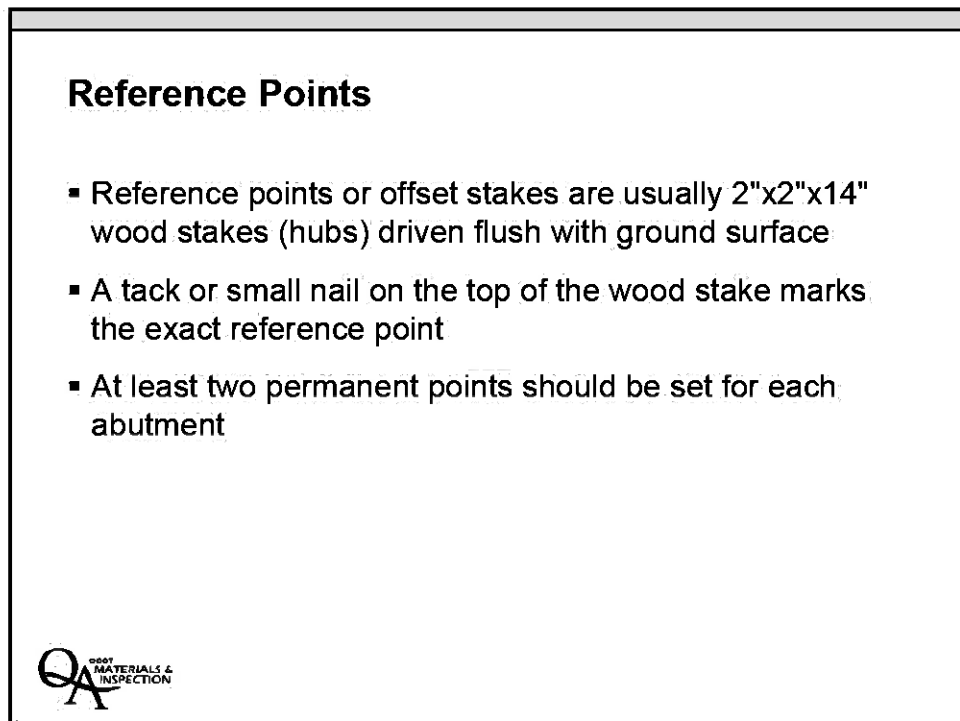
What is the distance between bents?



48



49



50

If Contractor Is Providing The Staking

Set reference stakes and elevations for the Engineer to check the layout. (Sec. 1.6 of the Construction Surveying Manual for Contractors)



51



52



53



54



55



56

Common Staking Errors

- Using incorrect working line
- Staking and elevation controls have been disturbed
 - Always check control points against previous work
- Not checking benchmarks prior to start of construction



57

Common Staking Errors Cont'd:

- Not tying into a second benchmark when setting or checking elevations
- TBM's are set in a level circuit, not a side shot
- Turning the wrong skew angle



58

Staking for Structures

The layout of the structure and the references should be double checked by using a different survey approach. All survey notes should also be independently checked.



59

Benchmarks

Place on New Bridges



60

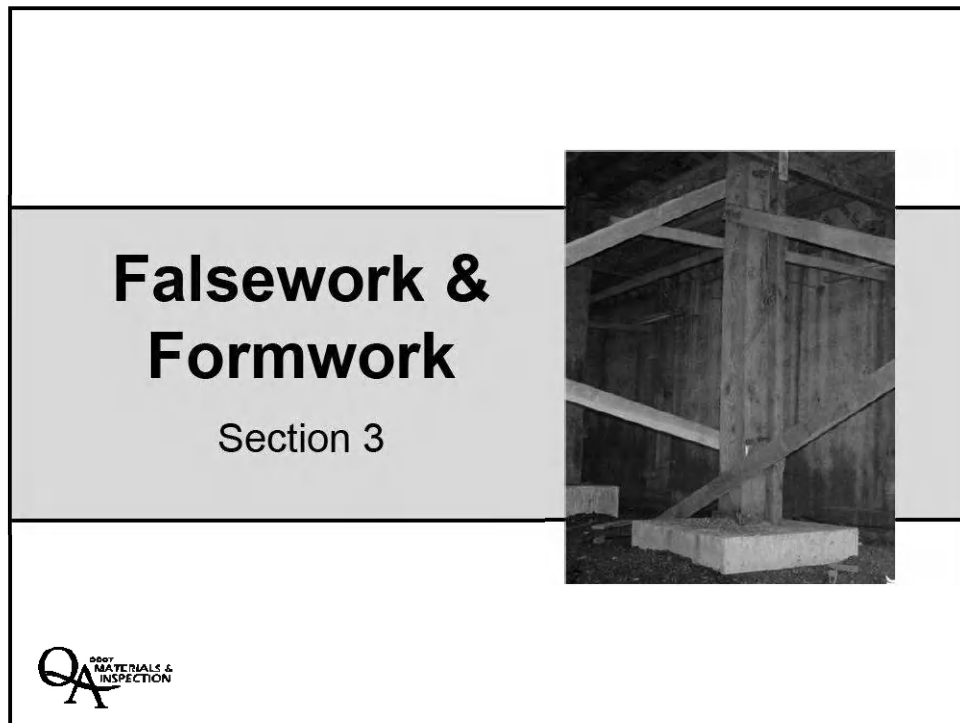
INSERT TAB

**Unit 3
Falsework &
Foamwork**

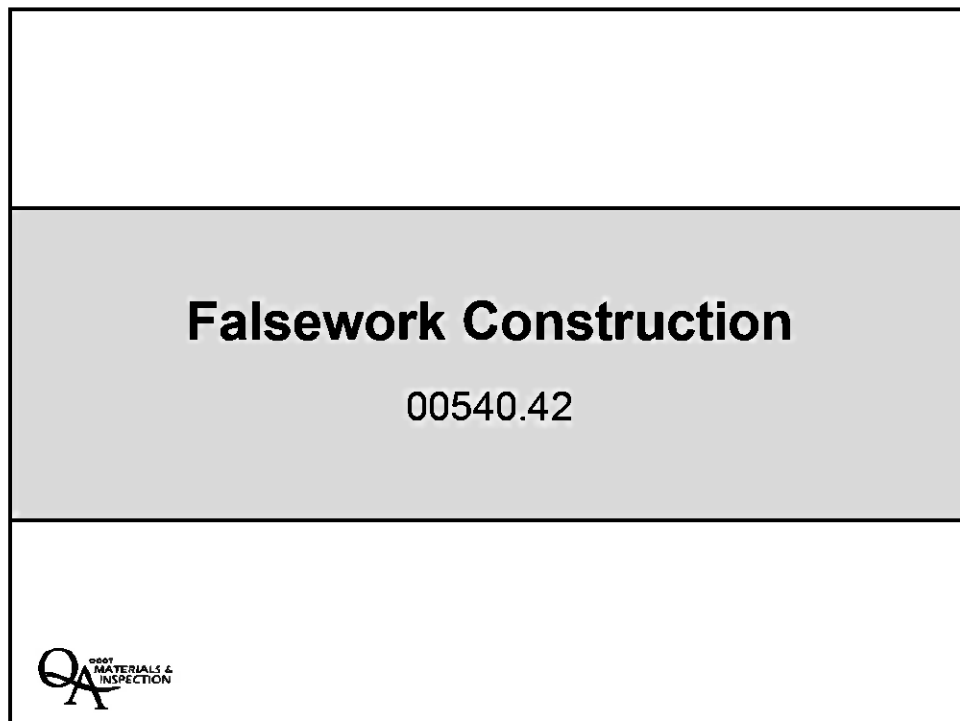
Section 3

Falsework & Formwork

Falsework Construction	1
Formwork Construction	16
Access for Inspection	32
Check Form Placement	37
Curve Data	43
Chord Distance Check	45
Middle Ordinate Check	47
Form & Falsework Removal	49



1



2

Falsework

- Temporary construction used to support the permanent structure until it becomes self supporting.
- Falsework must support the weight of the forms, fresh concrete, and Construction equipment.
- All falsework to be in accordance with the contractor's reviewed falsework plans.



3

Falsework Construction

00540.42

- Construct per AASHTO Construction Handbook for Bridge Temporary Works
- Do not place concrete until the falsework design engineer inspects work.



4

Falsework



5

Falsework Foundations

- Piling is often used.
- The inspector should verify that bearing has been reached.



6

Falsework Foundations

- Mudsills may be used with the approval of the engineer.
- Watch for excessive settlement.



7

Falsework Foundations



8

Falsework

Support System:

- Rigid vertical posts and diagonal braces
- Secure fasteners



9

Falsework

- Look for items not matching the approved falsework plans.
- Vertical 4x4's?



10

Falsework

- Vertical 4x4 supports?
- Falsework EOR site visit before placing concrete



11

Wedges Under Beam

- Hardwood wedges
- Used in pairs with only one additional block allowed
- Toenail after adjustment



12

Pier Falsework



QA
0007
MATERIALS &
INSPECTION

13

Falsework Bent



QA
0007
MATERIALS &
INSPECTION

14

Falsework Footings



15

Set Telltales from Deck Forms to Ground

Near interior falsework
bents to measure
settlement



16

Telltale from Deck Forms to Ground

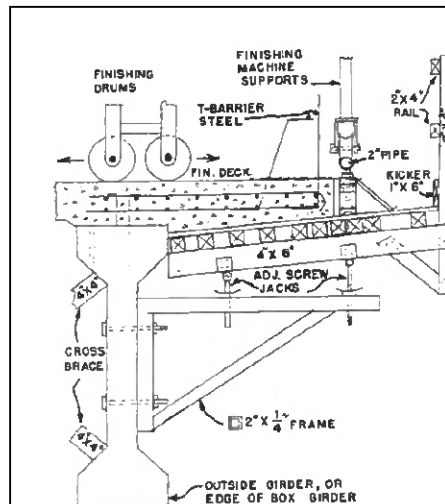
- Mark before and after pour to determine the total settlement and crush
- Compare to EOR's estimate



17

Deck Falsework

Deck overhang brackets – they are designed to support the cantilevered deck overhangs.



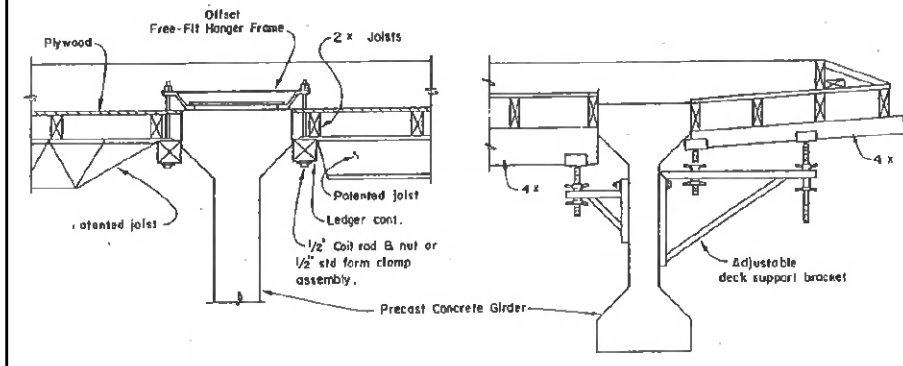
Falsework for Overhang



18

Deck Falsework

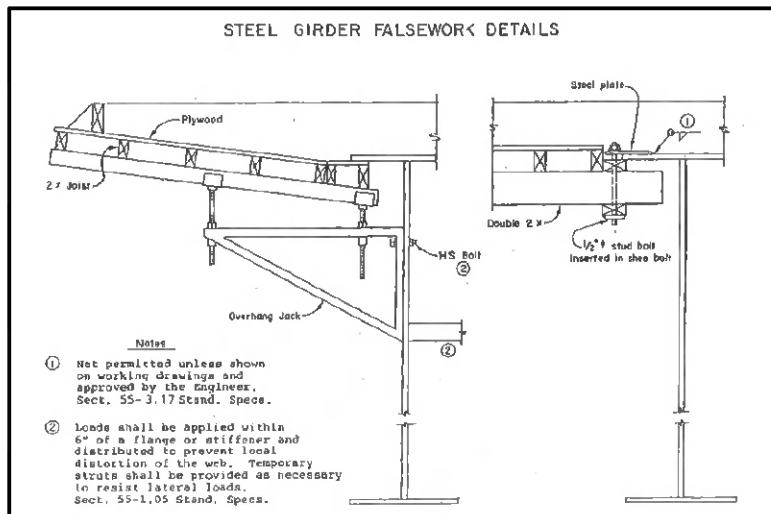
PRECAST CONCRETE GIRDER DECK AND OVERHANG FALSEWORK DETAILS



19

Deck Falsework

STEEL GIRDER FALSEWORK DETAILS



20

Deck Falsework



QA
0007
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INSPECTION

21

Falsework



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22

Screwjacks
Adjusted to Grade with Uniform Bearing



23

Case Study

Hwy 149 @ Hwy 70, Oroville, CA



24

Falsework

Cable removed.

Thoughts?



25

Falsework Collapse



26

Falsework Collapse

Hwy 149 @ Hwy 70, Oroville, CA

July 30, 2007

Fatalities: 0

Injuries: 2



27

Hwy 149 @ Hwy 70



28

Hwy 149 @ Hwy 70



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29

Hwy 149 @ Hwy 70



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30

Causes

- Falsework erection plan not followed by Contractor.
- Contractor told Inspector they would be working several spans away from this area.
- Cable bracing for falsework removed without permission from engineer.



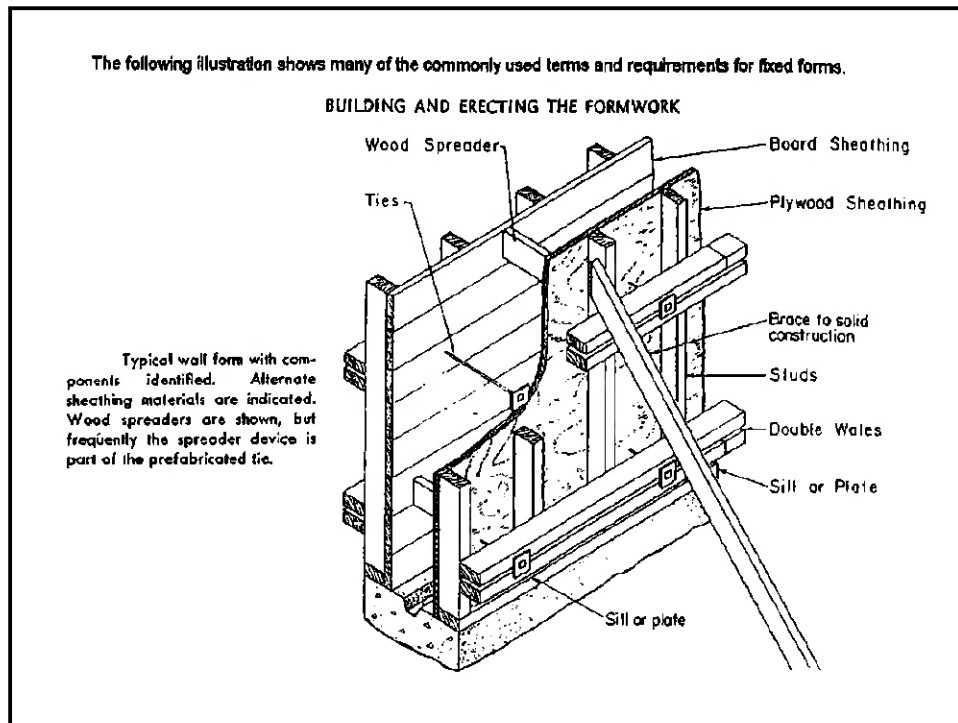
31

Formwork Construction

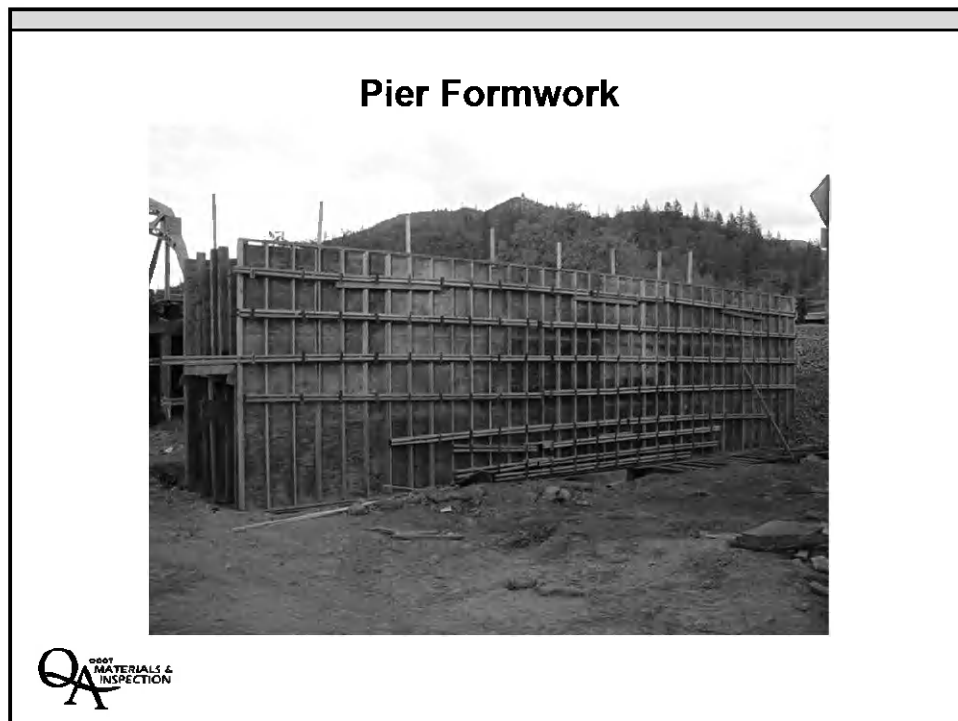
00540.45



32



33



34

Formwork Construction

- Check forms for correct dimensions and shapes.
- Forms to be mortar tight.
- Internal tie rods or snap-ties have 1" recess (2" within 25 miles of ocean).



35

2x4 Imprint on Outside of Exterior Stemwall?

Any shape inside the forms will not be poured concrete.



36

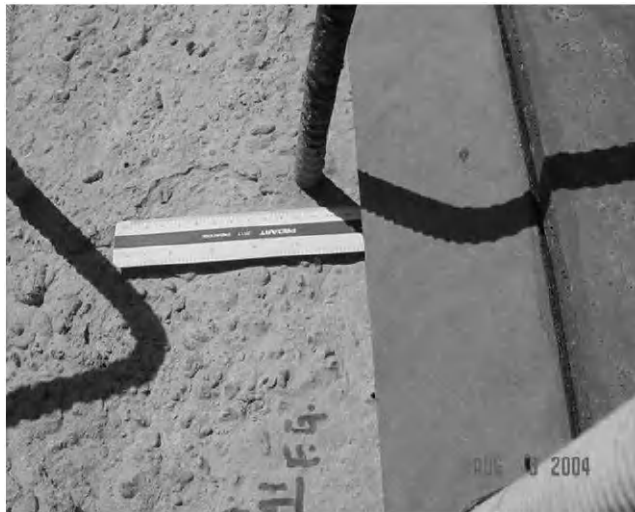
Deck Forms Against Stemwall



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37

Overhang of Deck Forms?



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38

Nylon Mesh to Make Forms Mortar Tight?



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39

Nylon Mesh?



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40

Gap Under Plywood?



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41

Excess Foam?



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42

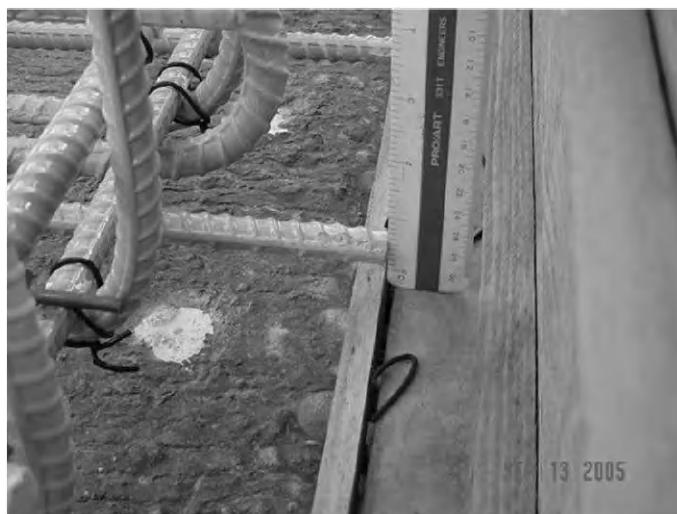
Support at Hole?



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43

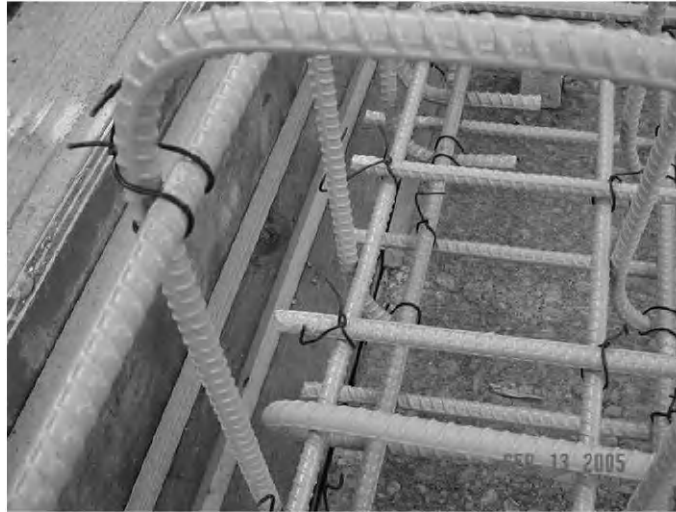
**Drip Strip Nailed Sideways on Form?
Note Clearance, Too.**



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44

Chamfer Strip on Beam?



45

Form Construction

00540.45

- Provide a $\frac{3}{4}$ " chamfer on all exposed concrete edges.
- Apply form release oil.



46

Chamfer Strips on Exposed Edges



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47

Chamfer Strips on Exposed Edges



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48

Abutment & Retaining Wall with Chamfers



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49

Wingwall with vs. Deck without Chamfers



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50

“E” Beam without Chamfers @ Shear Block



51

Top of Wingwall Spalling

- Is there preformed joint material?
- No chamfers



52

Chamfer @ Wingwall



53

Abutment with Chamfers at Cold Joint?



54

Form Construction (continued)

- Remove sawdust, dirt, excess water and other foreign materials prior to placement.
- Saturate with water immediately before placement and keep damp during placement.



55

Debris at Abutment Cold Joint



56

Debris Between Beam & Deck



57

Look for Good Lines and Shapes



58

Shape of Collar?



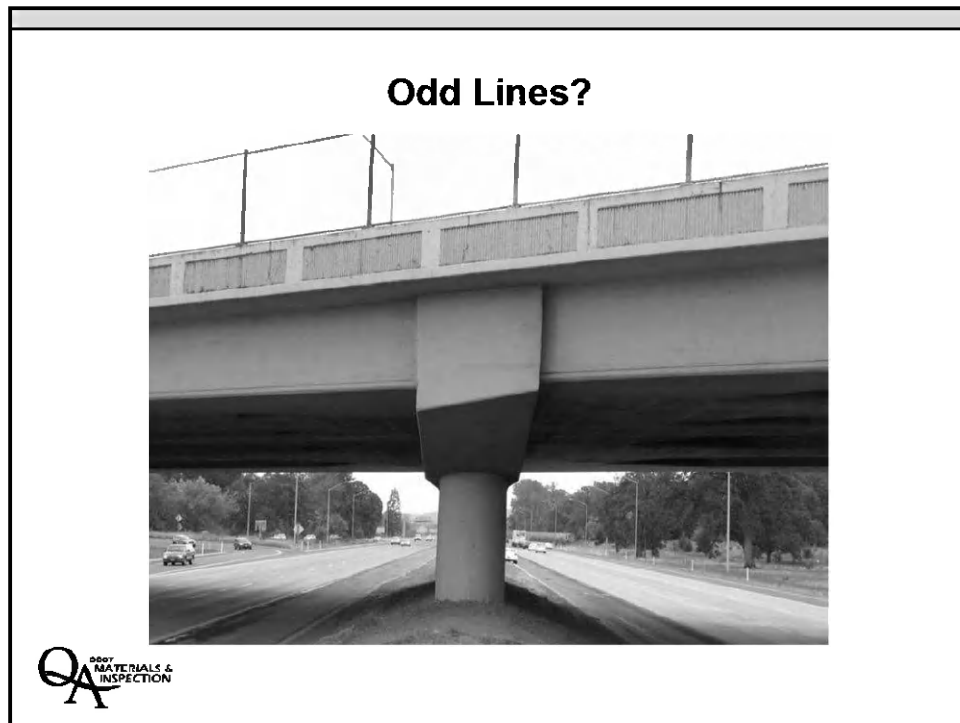
59

Collar Shape



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60



61



62

**Inspection Facilities
(00150.20 (b))**

The Contractor shall furnish walkways, railings, ladders, tunnels, platforms and other facilities necessary to permit the Engineer to have safe access to the Work to be inspected.



63

Safe Access?

64

Safe Access?



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65

Safe Access?



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66

Protected Access to Deck



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67

Stairway Access



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68

Ladder Access



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69

Ladder Supported



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70

Abutment Access



71

Work Platform for Abutment



72

Check Form Placement

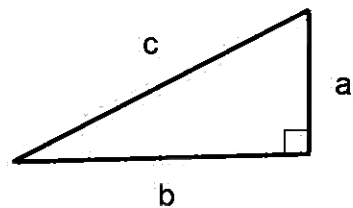
(Are Forms Squared Up?)



73

Pythagorean Theorem

$$a^2 + b^2 = c^2$$



$$c = \sqrt{a^2 + b^2}$$



74

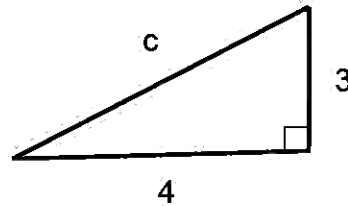
Footing Example

$$3^2 + 4^2 = c^2$$

$$c = \sqrt{3^2 + 4^2}$$

$$c = \sqrt{9 + 16}$$

$$c = 5$$

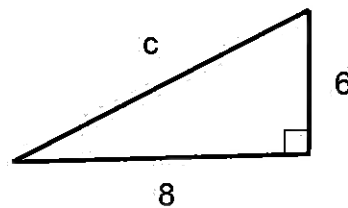


75

Footing Exercise

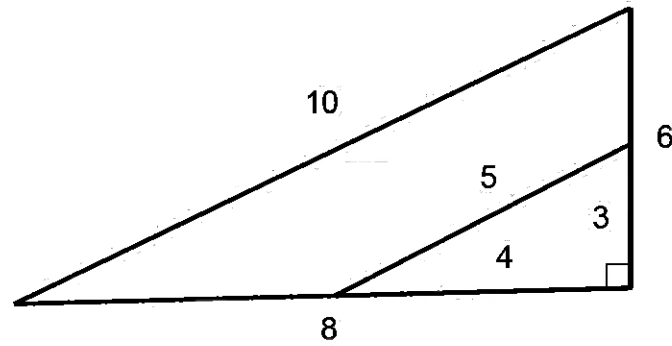
A footing is 6' wide by 8' long.

What is the diagonal distance "c"?



76

Similar Triangles



77

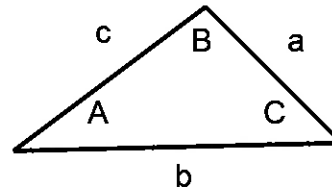
Right Triangle Exercise



78

Law of Sines

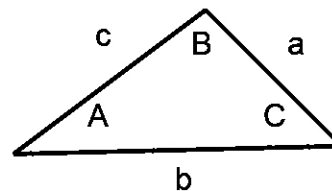
$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$



79

Law of Cosines

$$c^2 = a^2 + b^2 - 2ab\cos C$$



80

Other Types of Checks

- Measure Chord Distances
(Bent Checks)
- Measure Middle Ordinates
(Edge of Deck Checks)

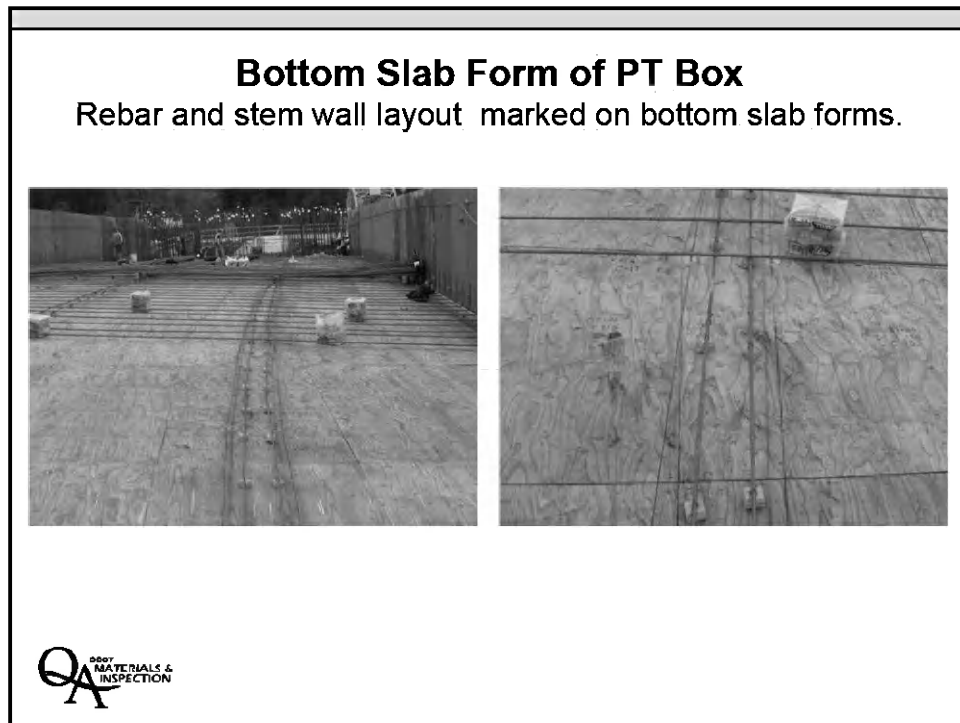


81

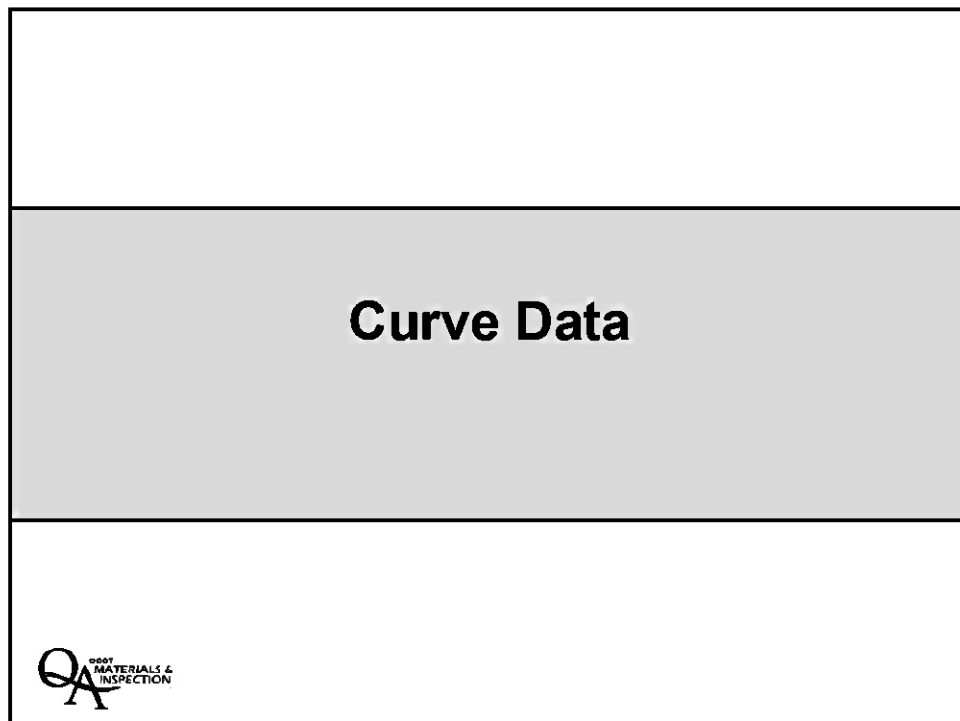
Bridge in 10° Curve (How to Check Forms Are Positioned Correctly)



82



83



84

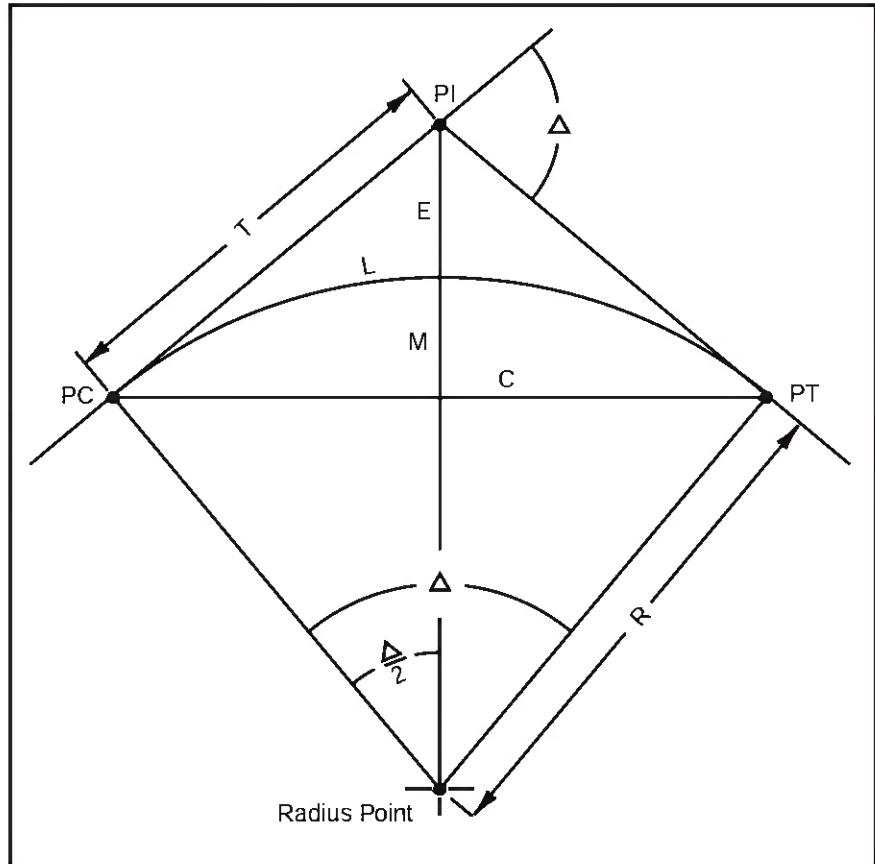


Figure 48

$$R = \frac{5729.578}{D} \quad D = \frac{5729.578}{R}$$

$$T = R \cdot \tan \frac{\Delta}{2} \quad C = 2R \cdot \sin \frac{\Delta}{2}$$

$$M = R(1 - \cos \frac{\Delta}{2}) \quad L = \frac{100\Delta}{D} = \frac{\pi R \Delta}{180^\circ}$$

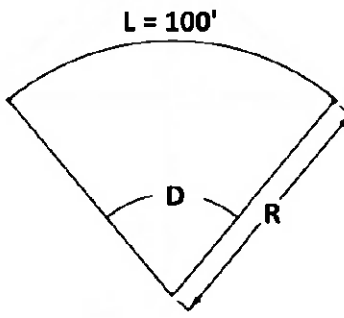
$$E = \left(\frac{R}{\cos \frac{\Delta}{2}} \right) - R$$

Curve Data

$$\frac{\Delta}{L} = \frac{100'}{L}$$

Curve defined as $D = 1^\circ$

$$\frac{1^\circ}{360^\circ} = \frac{100'}{2\pi R}$$



$R = 5,729.578'$



85

Curve Data

$\Delta / L = D / 100 \text{ ft}$

Δ = The Subtended Angle of the Curve
 D = Degree of Curve
 (Subtended Angle of 100' of Arc)
 L = Length of Curve
 R = Radius of Curve

$\Delta = D(L) / 100 \text{ ft}$

$R = 5,729.578 / D$



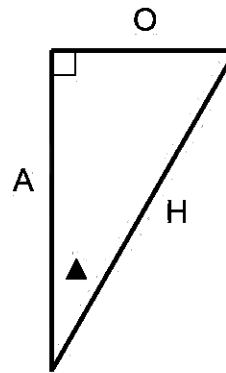
86

Trig Functions

$$\sin \angle = O / H$$

$$\cos \angle = A / H$$

$$\tan \angle = O / A$$



87

Check Chord Distance



88

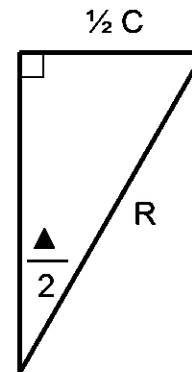
Chord Distance

$$\sin(\frac{1}{2} \Delta) = \frac{1}{2} C / R$$

$$R \sin(\frac{1}{2} \Delta) = \frac{1}{2} C$$

$$2R \sin(\frac{1}{2} \Delta) = C$$

$$\text{Chord Distance} = 2R \sin(\frac{1}{2} \Delta)$$



89

Chord Distance Example

D = 10° Bent 1 @ 10+00

Bent 2 @ 12+00

What is the chord distance between Bents 1&2?

$$L = (12+00) - (10+00) = 200\text{ft}$$

$$\Delta = D(L)/100\text{ft} = 10^\circ(200\text{ft})/100\text{ft} = 20^\circ$$

$$R = 5,729.578 / D = 5,729.578 / 10^\circ = 572.958\text{ft}$$

$$C = 2R \sin(\frac{1}{2} \Delta)$$

$$C = 2(572.958\text{ft})\sin(\frac{1}{2}(20^\circ)) = 198.99\text{ft}$$



90

Chord Distance Exercise

D = 5° Bent 1 @ 10+00
 Bent 2 @ 11+50

What is C?

$$L = (\quad + \quad) - (\quad + \quad) = \quad$$

$$\Delta = D(L)/100\text{ft} = (\quad)(\quad)/100\text{ft} =$$

$$R = 5,729.578 / D = 5,729.578 / (\quad) =$$

$$C = 2R\sin(1/2\Delta)$$

$$C = 2(\quad)\sin(1/2(\quad)) =$$



91

Middle Ordinate Check



92

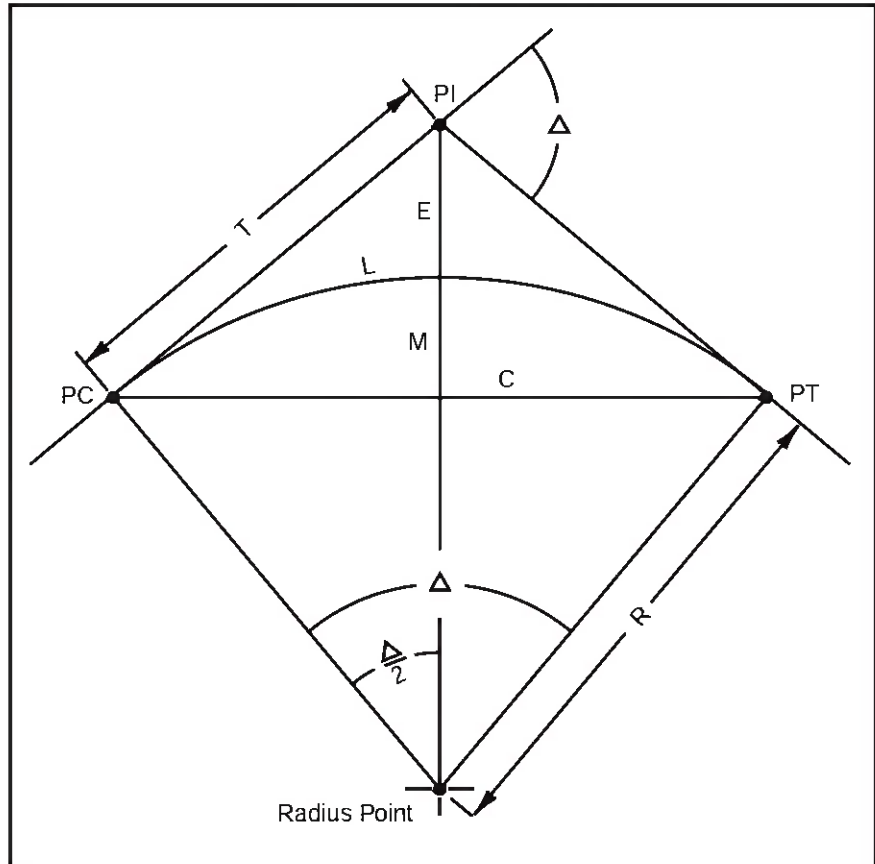


Figure 48

$$R = \frac{5729.578}{D} \quad D = \frac{5729.578}{R}$$

$$T = R \cdot \tan \frac{\Delta}{2} \quad C = 2R \cdot \sin \frac{\Delta}{2}$$

$$M = R(1 - \cos \frac{\Delta}{2}) \quad L = \frac{100\Delta}{D} = \frac{\pi R \Delta}{180^\circ}$$

$$E = \left(\frac{R}{\cos \frac{\Delta}{2}} \right) - R$$

Middle Ordinate Distance

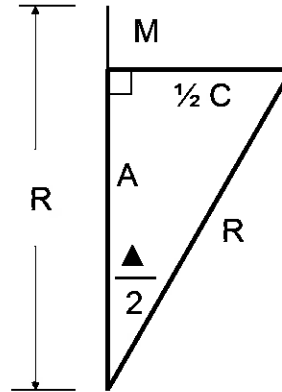
$$\cos(\frac{1}{2} \Delta) = A / R$$

$$A = R(\cos(\frac{1}{2} \Delta))$$

$$M = R - A$$

$$M = R - R(\cos(\frac{1}{2} \Delta))$$

$$\text{Middle Ordinate} = R(1 - \cos(\frac{1}{2} \Delta))$$



93

Middle Ordinate Example

$$M = R(1 - \cos(1/2 \Delta))$$

Example: $D = 10^\circ$ Bent 1 @ 10+00
Bent 2 @ 12+00

$$L = (12+00) - (10+00) = 200\text{ft}$$

$$\Delta = D(L)/100\text{ft} = 10^\circ (200\text{ft})/100\text{ft} = 20^\circ$$

$$R = 5,729.578 / D = 5,729.578 / 10^\circ = 572.958\text{ft}$$

$$M = 572.958\text{ft}(1 - \cos(1/2(20^\circ))) = 8.70\text{ft}$$



94

Middle Ordinate Exercise

D = 5° Bent 1 @ 10+00
 Bent 2 @ 11+50

What is M?

$$L = (\quad + \quad) - (\quad + \quad) = \quad - \quad$$

$$\Delta = D(L)/100\text{ft} = (\quad)(\quad)/100\text{ft} =$$

$$R = 5,729.578 / D = 5,729.578 / (\quad) =$$

$$M = R(1 - \text{Cos}(1/2 \Delta))$$

$$M = (\quad)(1 - \text{Cos}(1/2(\quad))) =$$



95

Form & Falsework Removal



96

Form & Falsework Removal

- No forms or falsework may be removed until approved by the Engineer.
- All forms and falsework must eventually be removed unless there is no permanent access, e.g., box girder bridge.



97

Field Cured Cylinders (00540.52)

- Need to verify strength
- In like conditions or worse
- Coolers are for Lab cured cylinders



98

to the Agency. Cast and cure cylinders according to AASHTO T 23 (field cured) which is equivalent to the most unfavorable field conditions for the portions of the concrete which the cylinders represent.

Forms and Falsework may be removed and subsequent loads may be placed when both conditions of Table 00540-1 are met.

Table 00540-1

Part 1:

Form and Falsework Removal for:	Percent of Specified Strength	Counting Days ¹
Side form for footings, walls, stems, abutments, caps, traffic and pedestrian barriers, and any other side Forms not supporting the concrete weight	–	1
Columns	–	3
Cantilevered bridge deck sidewalks	–	7
Bridge decks supported on steel beams or precast, prestressed concrete members; top slabs of concrete box culverts	80	7
Crossbeams, caps, box girders, T-beam girders, and flat slab Superstructures ²	80	7
Arches ²	80	7

Part 2:

Subsequent Loading ³ of:	Percent of Specified Strength	Counting Days ¹
Footings for signal, luminaire and sign supports	100	7
Footings ⁴	–	3
Walls, wall-type abutments, columns, vertical girder stems, and box culvert stems over 4 feet in height ⁴	–	3
Bottom slabs of box girders	66	5
Members and Falsework designed integrally to carry the additional loads	100	7
Pile caps, bents, and other members designed as moment-carrying members	100	7
All other members	100	7

¹ From the time of the last placement in the Forms or Falsework supports and excluding Days when the Surrounding Temperature is below 40 °F for a total of 4 hours or more.

² Where continuous spans are involved, the time for all spans will be determined by the last concrete placed affecting any span.

Form Removal & Loading Exercise

Situation: Crossbeam poured @ 4 p.m. the day before with 4,000 psi concrete.

Can side forms be removed at 6 a.m. the next day? _____

What is the minimum concrete strength to remove the bottom forms? _____

7 days later concrete strength is 3,000 psi and the contractor wants to set girders on top of the crossbeam. Is this acceptable? _____



INSERT TAB

**Unit 4
Quality
Concrete**

Section 4

Quality Concrete

Basics Of Concrete	1
Modifiers	4
Concrete Strength	14
W/C Ratio Example	16
PCA Video, VC108 '83: Consolidation Of Concrete By Vibration	19
Vibration Insertion Points	24
Placement Methods	26
Weather & Temperature Limits	29
Sampling & Testing	41
Joints	46
Curing Concrete	56
Surface Finishing	71

Quality Concrete

Section 4



1

Basics of Concrete



2

What is Concrete?

- Concrete in its basic form is a mixture of three components: Portland Cement, water and aggregate.
- The aggregates are generally divided into two groups: sand and coarse aggregate
- Modifiers and chemical admixtures are added to change the characteristics of the concrete.



3

Hydration

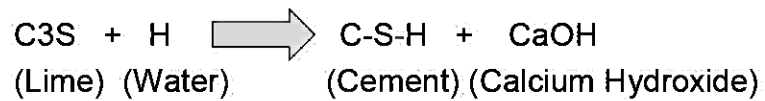
The chemical reaction between cementitious particles and water that transforms the mix of materials into a strong solid mass.



4

Hydration Process

Cement Reaction



C3S = Tricalcium Silicate (3CaO)(SiO₂)

H = H₂O

C-S-H = Calcium Silicate Hydrate gel
(indefinite composition)



5

What is Portland Cement?

Portland Cement is a binding material that is manufactured from limestone, iron ore, silica sand and alumina.



6

Portland Cement is produced in a plant where raw materials are heated in a rotary kiln. The heat from the kiln causes a chemical reaction that converts the raw materials to clinker. Then the clinker is pulverized to form the cement.



7

Modifiers

02030



8

Modifiers that have cementitious properties and may be substituted for cement include:

- Fly Ash
- Silica Fume (Microsilica)
- Slag



9

Hydration Process

Cement Reaction



Pozzolanic Reaction



S = Silicate (SiO_2)



10

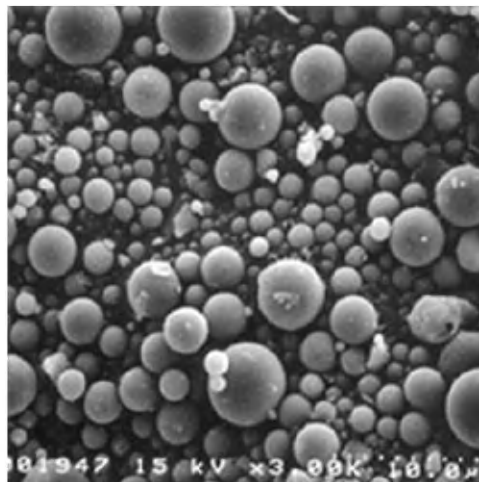
What is Fly Ash?

- It is a byproduct of the combustion of pulverized coal in electric generation plants.
- During combustion, the coal's mineral impurities fuse in suspension and are carried away by the exhaust gases. As the material cools and solidifies into spherical glassy particles, it is collected by electrostatic precipitators or bag filters.
- It is a pozzolan. When mixed with lime and water, the Calcium Hydroxide byproduct combines with it to form a cementitious material.



11

Fly Ash



12

Fly Ash Properties

- Requires less water
- Improves workability
- Less bleeding
- Less segregation
- Lower heat of hydration
- Retards the setting of concrete



13

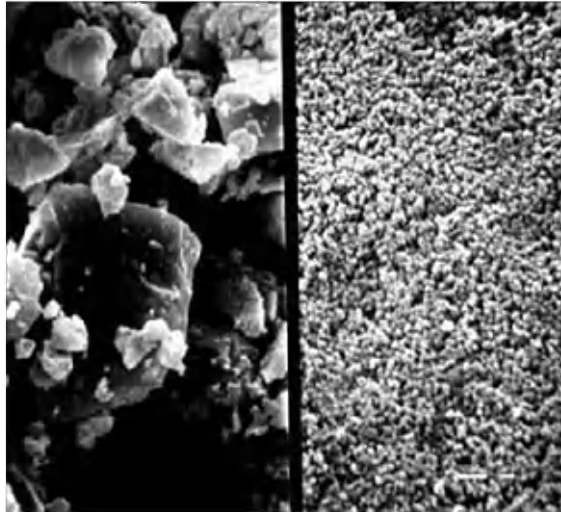
What is Silica Fume (Microsilica)?

- It is a very fine noncrystalline silica produced in electric arc furnaces as a byproduct of the production of elemental silicon or alloys containing silicon.
- It is a pozzolan. When mixed with lime and water, the Calcium Hydroxide byproduct combines with it to form a cementitious material.



14

Cement / Microsilica



15

Properties of Silica Fume (Microsilica)

- Reduces bleed water
- Reduces segregation
- Stickier mix and more difficult to finish
- Aids “pumpability”



16

Properties of Silica Fume (Microsilica)

- Increases plastic shrinkage cracking
- Reduces permeability
- Increases density
- Conductivity of 1,000 coulombs vs. 2,500 coulombs for regular concrete



17

What is Slag?

- It is a byproduct of the manufacture of iron during the use of a blast furnace.
- Slag is the molten material that floats to the surface on top of the molten iron. It is quenched with water in a process known as granulation and then ground to become ground granulated blast-furnace slag (GGBFS).



18

Slag cement (GGBFS) is a hydraulic cement with the following properties:

- Better workability
- Higher compressive & flexural strengths
- Lower permeability
- Improved resistance to aggressive chemicals



19

High Performance Concrete

Used on bridge decks



20

High Performance Concrete (HPC)

02001.30

- 66% Portland Cement, 30% Fly Ash, 4% Silica Fume or
- Defined as concrete with conductivity of less than 1,000 coulombs.



21

HPC Properties

02001.20(e)

- Shrinkage Test: ASTM C157
-0.045% max. @ 28 days
- Permeability: AASHTO T 277
1,000 Coulombs @ 90 days



22

Slump for Deck Concrete

- 4"-8" (table 02001-3)
- Use HARWRA in all HPC (02001.30(d))



23

Structural Concrete Overlays (SCO) 00559.11 & 00559.43(a)

- HPC 4500 – $\frac{3}{4}$ "
- Per 02001
- 2" thick



24

Chemical Admixtures 02040


25

Chemical Admixtures ▪ Hydration stabilizer ▪ Retarders ▪ Water reducers ▪ Air entrainment ▪ Accelerators ▪ Slump stabilizers 

26

Hydration Stabilizer

02001.30(d)

- Use in all bridge deck concrete
- Extend initial set time by 90 minutes



27

Air Entrainment

02001.20(b)

- Table 02001-2
- Severe Exposure: Elevation 1,000 ft & above (02001.02)
- Moderate Exposure: Elevation below 1,000 ft (02001.02)



28

Concrete Strength



29

Compressive Strength



Manual of Concrete Practice 308R-4

Compressive strength, percent
of 28-day moist-cured concrete

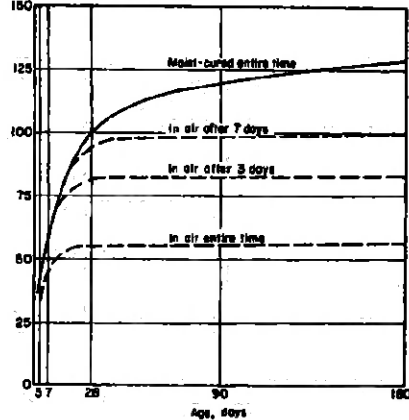
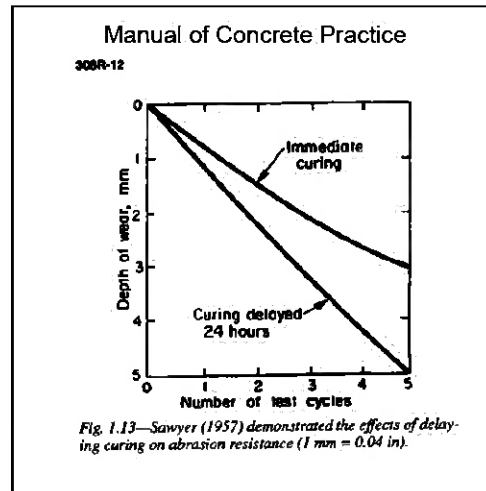


Fig. 1.4—Compressive strength of 150 x 300 mm (6 x 12 in.) cylinders as a function of age for a variety of curing conditions (Kosmatka and Panarese 1988).

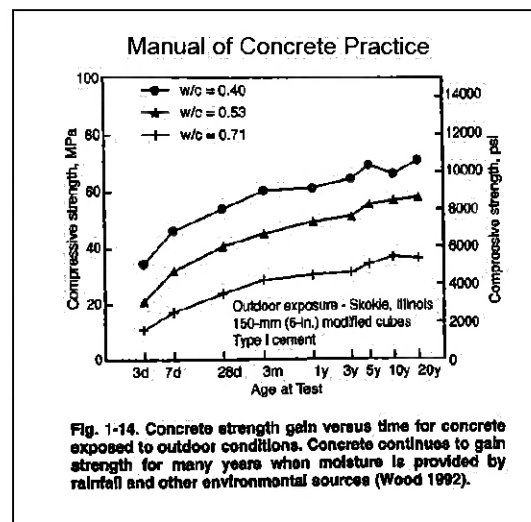
30

Abrasion Resistance



31

Strength vs. Age



32

W/C Ratio Example

One 10-yard truck of concrete mix has:

1800 lbs water

6000 lbs cementitious material

$$\text{W/C Ratio} = 1800 \text{ lbs} / 6000 \text{ lbs} = 0.30$$



33

W/C Ratio Example

What happens if the truck driver adds 10 gallons of water on the jobsite to his truck?

1800 lbs water + 10 gal (8.34 lbs/gal)

6000 lbs cementitious material

$$\text{W/C Ratio} = 1883 \text{ lbs} / 6000 \text{ lbs} = 0.314 = 0.31$$



34

W/C Ratio Exercise 1

One 8-yard truck of concrete mix has:

1872 lbs water

4800 lbs cementitious material

W/C Ratio =



35

W/C Ratio Exercise 2

One 8-yard truck of concrete mix has:

1872 lbs water

4800 lbs cementitious material

What is W/C Ratio if 10 gal of water are added onsite?



36

CONCRETE YIELD AND W/C RATIO WORKSHEET

E

English (E) or Metric (M)

PROJECT NAME (SECTION)					CONTRACT NUMBER	
CONTRACTOR			PROJECT MANAGER		BID ITEM NUMBER	
CONCRETE SUPPLIER			SUBMITTED BY		QUANTITY REPRESENTED yd ³	
CONCRETE FOR USE IN (LOCATION OR PLACEMENT)			BRIDGE NUMBER		SPECIFIED STRENGTH PSI DAYS	
DATA SHEET NUMBER	SET NUMBER	DATE	INVOICE NUMBER	BATCH SIZE	TRUCK NO & DRIVER	

CONCRETE BATCH TICKET AND FIELD TEST DATA

CEMENTITIOUS MATERIAL		AGGREGATES		AGG % FREE MOISTURE	
CEMENT	lb	#1	lb		%
SLAG	lb	#2	lb		%
FLYASH	lb	#3	lb		%
SILICA FUME	lb	FINE AGG (SAND) #4	lb		%
TOTAL CEMENT	lb	TOTAL AGG	lb		
ADMIXTURES		1	OZ		
		2	OZ		
		3	OZ		
		4	OZ		
BATCHED	lb	TOTAL ADMIXTURES	OZ		
JOBSITE	lb	TOTAL ADMIXTURES	lb		
TOTAL WATER	lb				

CONVERSIONS
WATER
 Gal x 8.34 = lb
 L = kg

Admixtures
 oz / 16 = lb
 ml / 1000 = kg

TOTAL BATCH MASS		AMBIENT	°F	SLUMP	in
lb		CONCRETE	°F	AIR	%

DENSITY

CONCRETE + POT	lb	
- POT MASS	lb	
CONCRETE MASS=	lb	+ POT CALIBRATION = lb/ft ³

YIELD

TOTAL BATCH MASS	=		=	
lb/ft ³ x 27	=		=	yd ³

CEMENT

CEMENT, FLYASH & SILICA	=		=	
CONTENT YIELD	=		=	lb/yd ³

WATER CEMENT RATIO

A. AGGREGATE FREE WATER

(FREE MOISTURE FACTOR = % FREE MOISTURE DIVIDED BY 100. EG. : 5.5% = 0.055)

BATCH MASS -	$\left(\frac{\text{BATCH MASS}}{(1 + \text{FREE MOISTURE FACTOR})} \right)$	= AGG. FREE WATER	W/C RATIO=	$\frac{\text{TOTAL FREE WATER (A+B+C)}}{\text{TOTAL CEMENT \& FLYASH}}$
#1	- (/ 1+)	=		lb
#2	- (/ 1+)	=		lb
#3	- (/ 1+)	=		lb
FINE AGG (SAND) #4	- (/ 1+)	=		lb
A. AGGREGATE FREE WATER TOTAL		=		lb
lb	=	W/C RATIO	B. WATER ADDED AT PLANT&JOBSITE	= lb
lb			C. ADMIXTURES ADDED	= lb

☐ QUALITY CONTROL	☐ VERIFICATION
CERTIFIED TECHNICIAN (PLEASE PRINT) AND CARD NUMBER	COMPANY NAME SIGNATURE DATE

Adding Water @ Jobsite

ASTM C94 (sec. 12.7) 02001.40

Adjusting the concrete mix with water or water-reducing admixture shall be done before discharge of concrete.

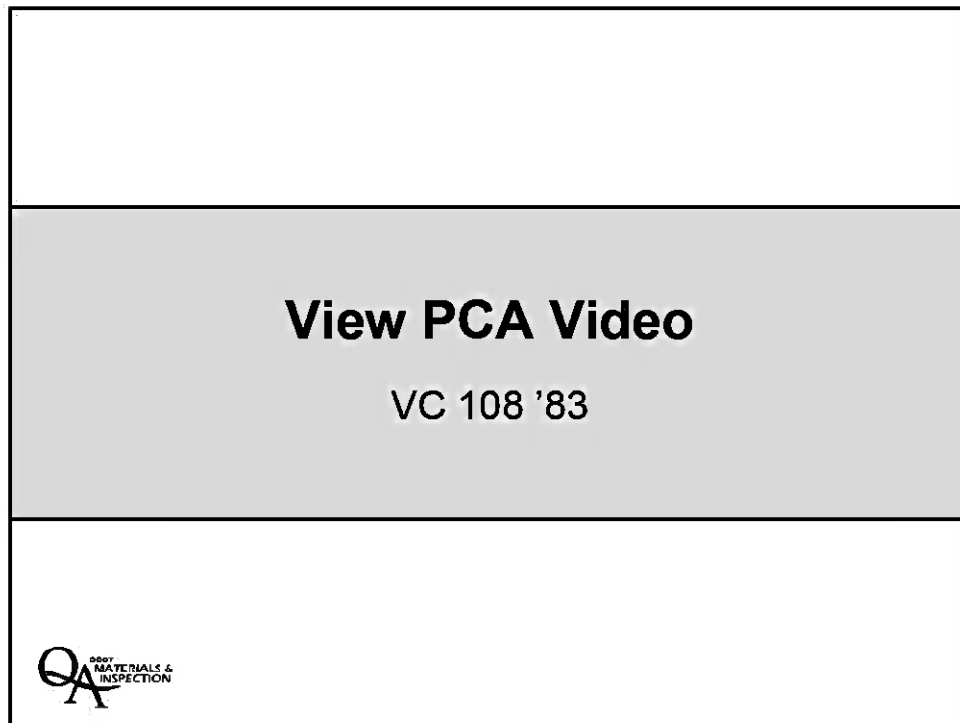


37

Vibrating Concrete



38



39



40

Vibrators

00540.23 & 00540.48(c)

- Minimum of 4,500 impulses per minute.
- Vibrate internally
- Provide extra vibrator for emergency use.
- Use proper vibrating techniques.

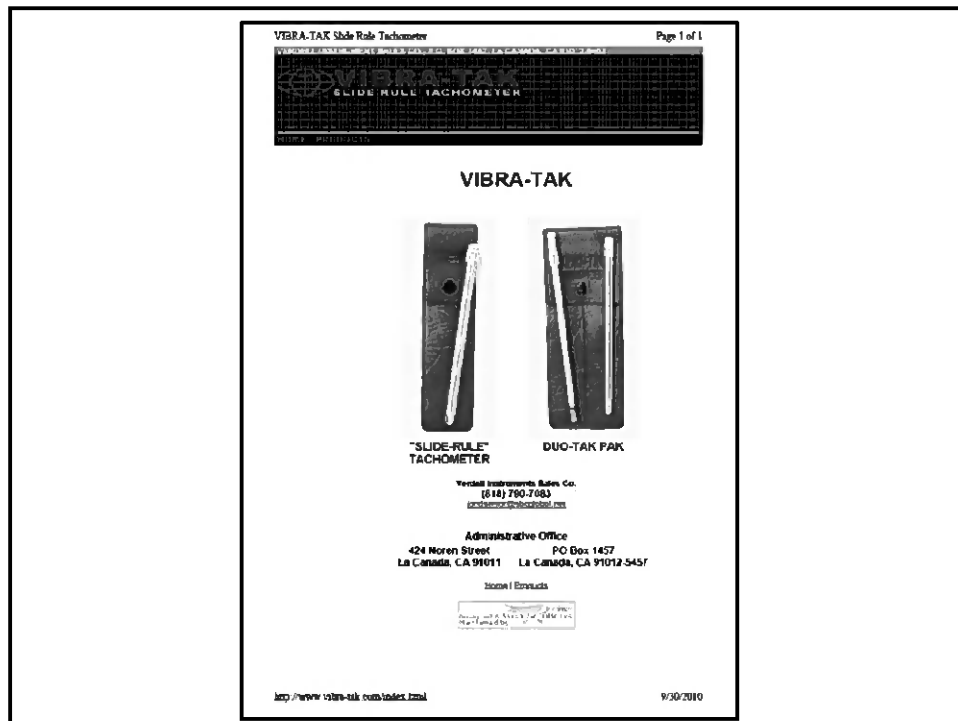


41

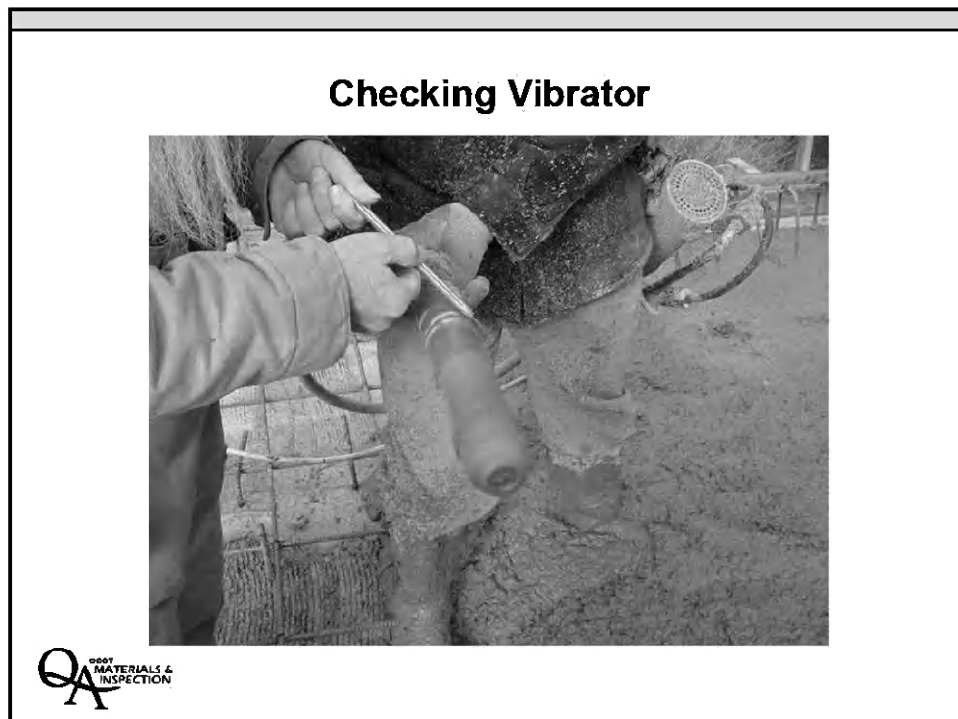
Vibra-Tak



42



43



44

Proper Vibrating Techniques

00540.48(c)

- Apply vertically at points uniformly spaced not more than $1\frac{1}{2}$ times the radius of action.
- Do not use vibrators to move concrete.
- Lower it into the concrete through the full depth of each layer.
- Penetrate into the previous layer on multilayer pours.
- Avoid direct contact with form faces and reinforcement.



45



46

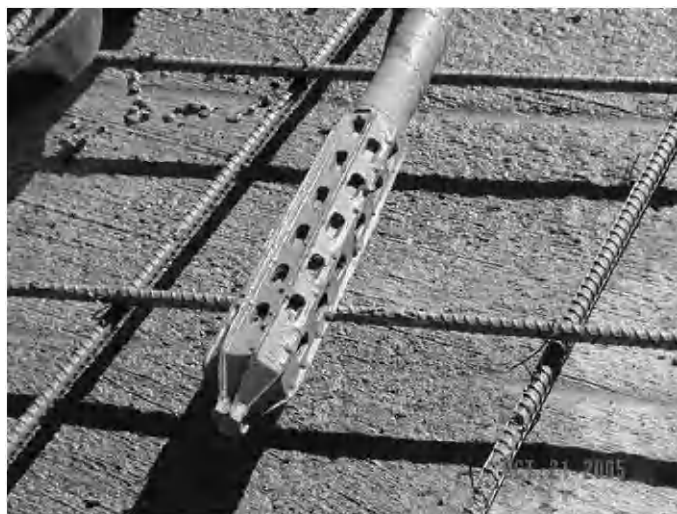
Backpack Vibrator



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47

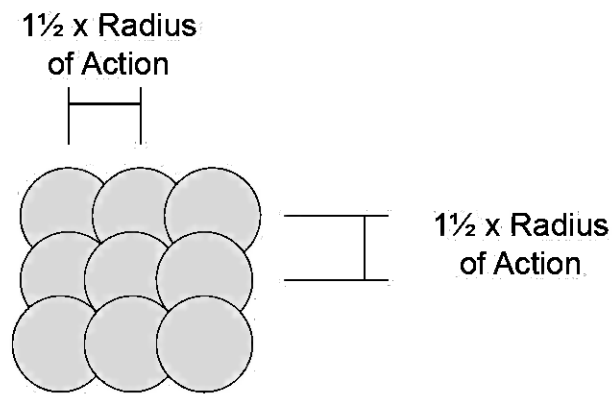
Rubber Sleeved for Epoxy Coated Bar 00540.23



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48

Vibration Insertion Points



49

Vibration Spacing Exercise

- Draw the radius of action for 9 insertion points if the insertion spacing is $2 \times$ the radius of action.

- What results would you expect from this type of spacing?



50

Poor Vibration on Column



51

Concrete Vibrators and Grinders

**JOB PROVEN
RUGGED**



OZTEC

MADE WITH PRIDE
IN THE

USA

*It must say "OZTEC" to be the
industry's best concrete vibrator*

Oztec's patented uniform, high efficiency action delivers vibration along entire length of vibrator head.



RubberHead®

Why the Oztec's patented "RubberHead"™ outperforms any other type of Vibrator.

- (a.) When a smooth vibrator head (round, square or any other shape) is lowered into a relatively stiff concrete batch, the front or nose of the vibrator drills a hole. It pushes away concrete faster than it can return. Result, shock waves produced mostly from the vibrator's front end.
- (b.) Oztec's patented "RubberHead"™ has a large number of openings which allow wet concrete to cool the inner shell. These openings act like "suction cups", which keeps concrete in contact with the entire length of the vibrator head, sending strong shock waves into the mass.



Damage caused by a standard steel vibrator head.



Inner steel construction

Urethane protective coating

Oztec's patented high efficiency vibration vector design

Oztec's High efficiency "RubberHead"™ providing maximum protection for epoxy coated rebar

Protective rubber tip



Available Sizes: (dia. x length)

1 7/8"x14"
2 1/2"x14"
2 3/4"x14"
2 3/4"x6" (short, for slabs)

Prove it to yourself!

Before you purchase a high cycle system with expensive generators or controllers, call 800-533-9055 or visit our web site to arrange a demonstration on your job site.

Selection Chart

All Heads, Shafts and Power Units Are Interchangeable*

1. Select Head Size
2. Select Shaft Length
3. Select Power Unit (Do Not Exceed Maximum Head Size)

HEADS	
Steel	High Efficiency RubberHead*
	
Part No.	Part No.
*3/4" HP 075 OZ	1 7/8" HR 188 OZ
1" H 100 OZ	2 1/2" HR 250 OZ
1 1/4" H 125 OZ	2 3/4" HR 275 OZ
1 1/2" H 150 OZ	2 3/4x6" HSR 275 OZ
1 3/4" H 175 OZ	
2" H 200 OZ	
2 1/2" H 250 OZ	
Short Heads	
Part No.	Rubber noses
*3/4 x 6" HSP 075 OZ	Available for all steel heads. Add "RT" to Steel Head Part No.
1 1/4 x 6" HS 125 OZ	
1 3/4 x 6" HS 175 OZ	
* Pencil Head requires Pencil Shafts	

SHAFTS	
	Part No.
2' FS 02 OZ	
5' FS 05 OZ	
7' FS 07 OZ	
10' FS 10 OZ	
12' FS 12 OZ	
14' FS 14 OZ	
16' FS 16 OZ	
18' FS 18 OZ	
21' FS 21 OZ	
Pencil Shafts	
3' FSP 03 OZ	
6' FSP 06 OZ	
9' FSP 09 OZ	
11' FSP 11 OZ	
15' FSP 15 OZ	
20' FSP 20 OZ	

POWER UNITS

Electric Motors

Model	Amps	HP	Maximum Head Size	
			Steel	Rubber
1.2 OZ	9	1 1/4	1 1/2"	None
1.8 OZ	15	1 3/4	1 3/4"	None
2.4 OZ	17	2 1/4	2"	1 7/8" [2 3/4" short
3.2 OZ	19	3 1/4	2 1/2"	2 3/4"

Gas Engines

Back Packs

BP - 35	-	1 3/4	1 1/2"	None
BP - 50a	-	2 1/2	2 1/2"	2 1/2"
				2 3/4" short

Carry Handle Models (Briggs & Stratton/Honda)

GV-5	-	5/5.5	2 1/2"	2 3/4"
------	---	-------	--------	--------

Wheelbarrow (Briggs & Stratton/Honda)

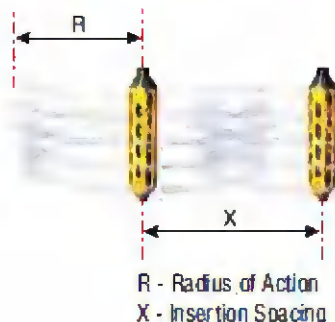
GV-5W	-	5/5.5	2 1/2"	2 3/4"
-------	---	-------	--------	--------

All Oztec vibrators meet or exceed ACI specification #309

Radius of Action - The most important bit of information needed for complete consolidation.

Radius of Action is the distance from the center of the vibrator to the outer edge, where complete consolidation takes place (see diagram). For quality concrete Oztec lists conservative values for "Radius of Action". Complete consolidation is necessary for low slump concrete with close meshed reinforcement bars, high strength concrete and architectural concrete. Radius of Action can be twice the listed values when slump is high or super plasticizers are used. It is important these values are used only as a general guide. Specifications are subject to change.

Head Diameter	Radius of Action (R - inches)	X = 1.12 Times Radius of Action	Amplitude Centerline to Side (inches)	Centrifugal Force (pounds)	Compaction Rate (cu. yds. / hour)
Steel Heads					
3/4"	3	5	0.03	155	1-3
1"	4	6	0.04	220	2-4
1 1/4"	5	8	0.04	510	2-5
1 1/2"	6	9	0.05	920	5-8
1 3/4"	8	14	0.08	1200	8-18
2"	11	17	0.075	1500	12-20
2 1/2"	13	20	0.08	1950	23-30
Rubber Heads					
1 1/2"	9	13.5	0.075	1050	9-13
1 7/8"	11	16	0.09	1400	10-18
2 1/2"	14	20	0.12	1900	14-22
2 3/4"	18	27	0.12	2100	25-35
2 3/4" short	15	22	0.12	1100	9-15



Tips & Suggestions

"The benefits of even the finest concrete vibrator are lost if the proper operating technique is not followed".

Proper consolidation techniques **will** improve

- Produce concrete with the maximum strength and qualities designed in the mix
- Bond rebar to maximize strength.
- Slow penetration of rust-causing liquids by increasing density.
- Eliminate rock pockets and lift lines.
- Minimize patchwork improving surface appearance by removing trapped air.

For Quality Concrete, Oziec Suggests:

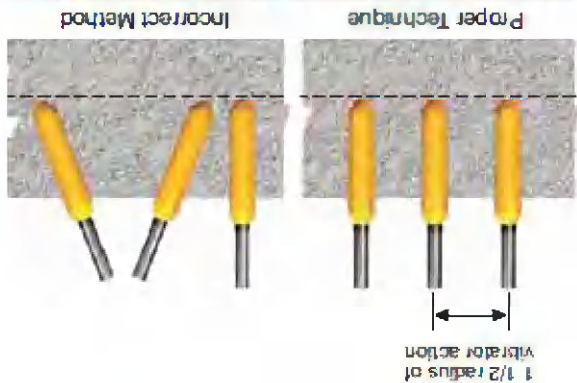
1. Select the largest vibrator suitable for the job.
2. Insert the vibrator vertically, allowing it to sink to the desired depth by its own weight. Forcing it may lock it between rebar.
3. Hold the vibrator 5 to 15 seconds then slowly lift vibrator up, staying behind the trapped air's upward movement. Allow about 15 seconds for each 2 foot distance to avoid re-trapping air.
4. A slight up and down movement will close the hole formed by the vibrator.
5. Withdraw the vibrator quickly when near the top to prevent churning air into the top layer.
6. Move vibrator and re-insert at a distance $1\frac{1}{2}$ times the Radius of Action. As shown in the diagrams.
7. Allow vibrator to pass 3 to 6 inches into the preceding layer to ensure knitting the two layers together, ensuring a good bond and preventing "lift lines" when forms are removed.
8. Try to limit pours to 2 to 3 feet high, so air has less resistance to escape.
9. Do Not use vibrator to move concrete laterally... it causes segregation (use a shovel). Place vibrator in the center of mounds to knock them down.

Consolidation eliminates pockets of aggregate and air bubbles maximizing strength, eliminating surface voids, bringing sufficient fine material to the surface and against the forms to produce the desired finish. Vibrators consolidate concrete by sending out shock waves which allows aggregate to "float" freely while pushing lighter mixtures which are stronger, more economical and result in less segregation, less bleeding and less shrinkage cracks.

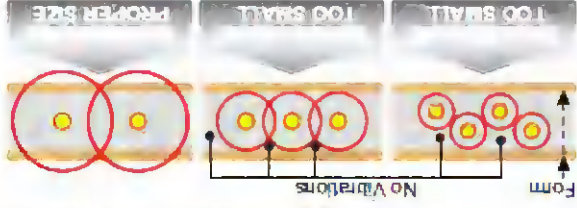
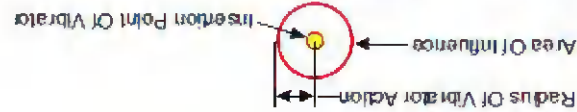
You know that you have consolidated concrete properly when a thin line of mortar appears along the form near the vibrator or the coarse aggregate disappears into the concrete.

Extension Cord Wire Size Per UL Specifications Too light an extension cord can cause poor performance and motor burn out.

Motor model#	Amps @120V	19	17	15	14	14	14	12	12	8	8	6
300H	300H	10	10	10	10	10	10	10	10	8	8	8
200H	200H	10	10	10	10	10	10	10	10	8	8	8
150H	150H	10	10	10	10	10	10	10	10	8	8	8
100H	100H	10	10	10	10	10	10	10	10	8	8	8
50H	50H	10	10	10	10	10	10	10	10	8	8	8
30H	30H	10	10	10	10	10	10	10	10	8	8	8



(MPO RTAHT: Trapped air moves upward in the max from 1 to 3 inches per second. (1 inch in near 0 slump; 3 inches in 4 to 5 inch slump).



A free source for more complete information are publications from ACL.



Vibrator Insertion Exercise 2

- What is the insertion spacing with a 1" diameter vibrator?
- What is the insertion spacing with a 1½" diameter vibrator?
- What is the insertion spacing with a 2" diameter vibrator?



53

Placement Methods

- Concrete pump
- Crane & bucket method
- Conveyor belt
- Mix truck & chute



54

Concrete Pump Hopper



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55

Concrete Pump



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INSPECTION

56

Concrete Pump Hose

- 00540.22 (a)
- 1" Aggregate Use 4" Hose
- 1 1/2" Aggregate Use 5" Hose



57

Crane & Bucket



58

Mix Truck & Chute

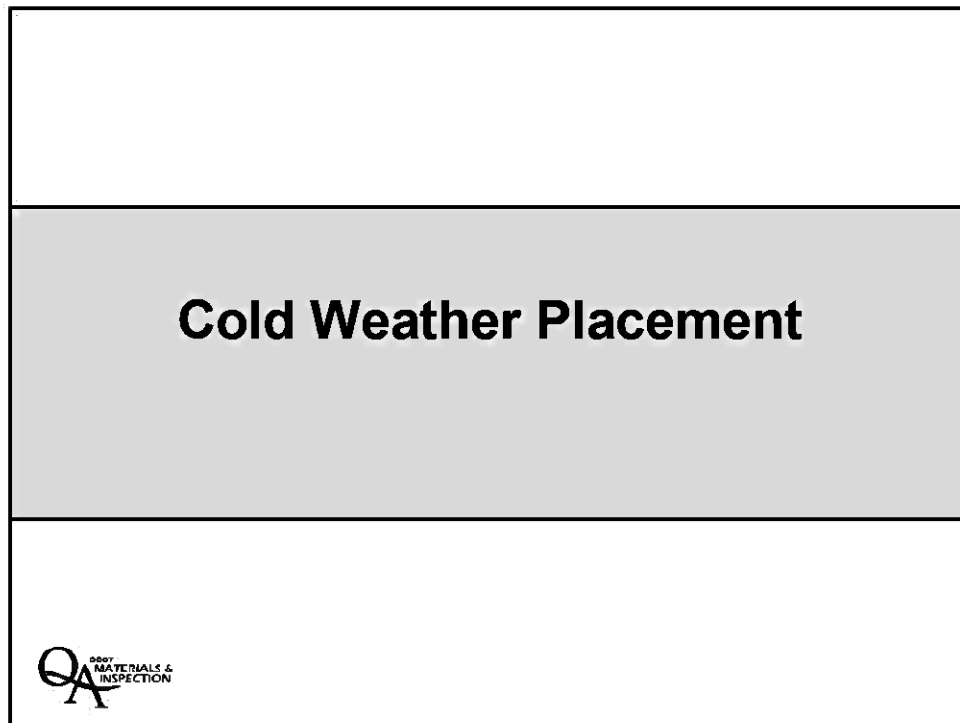


59

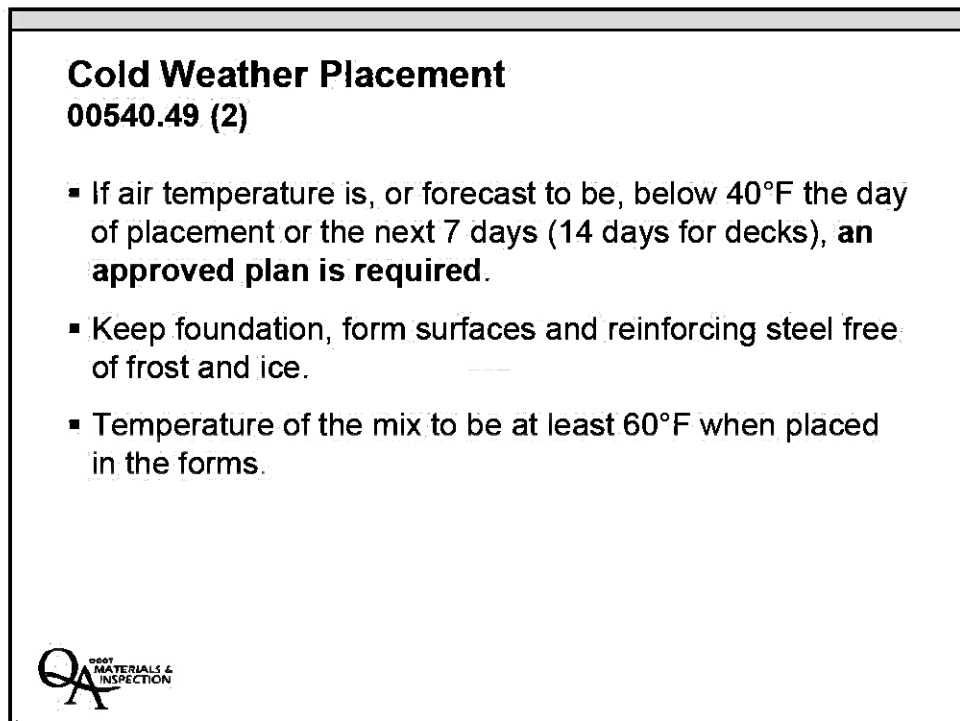
Weather & Temperature Limits



60



61.



62.

Cold Weather Placement (continued)

If air temperature is below 40°F either:

- Heat mixing water to a temperature of at least 70°F but not more than 150°F, or
- Heat the aggregates with either steam or dry heat.

The temperature of concrete with heated aggregate, heated water or both shall not exceed 80°F before placing.



63

Enclosures

If enclosures are used, do the following:

- Record air temperature with a 24-hour recording thermometer.
- Supply heat with a means of maintaining curing moisture.
- Maintain the air temperature in the enclosure between 60°F and 80°F for a period of 7 days (14 days for decks) after placing concrete.



64

Concrete Temperature During Cure 00540.51(a)

Use methods approved by the Engineer to maintain the concrete temperature at least 50°F during the cure period.

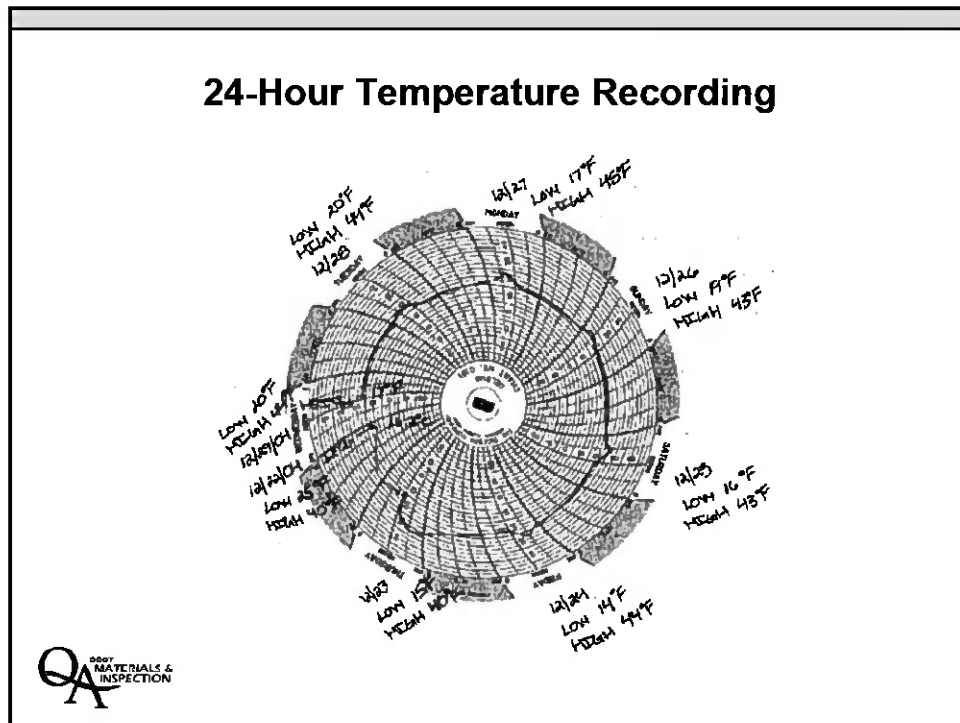


65

24-Hour Recording Thermometer



66



67



68



69



70

Heating Under Bridge

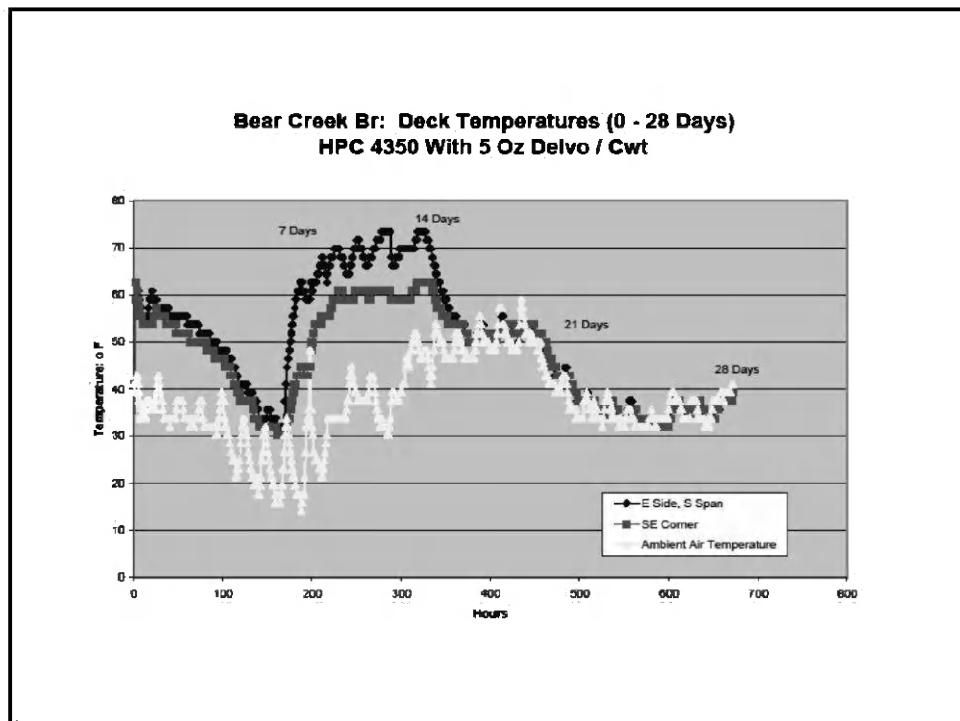
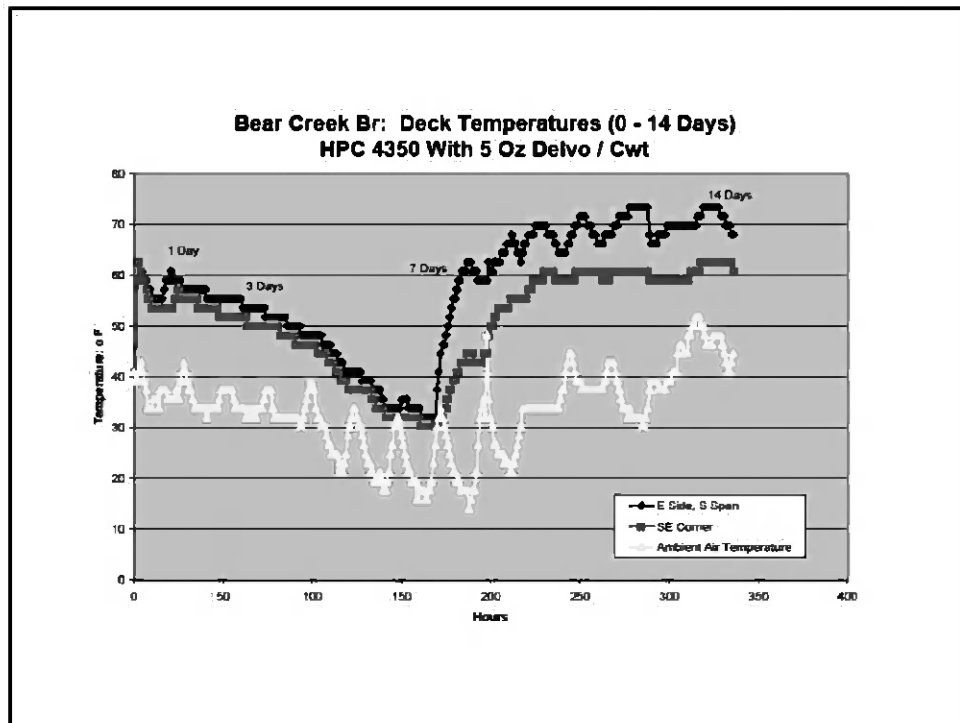


71

Bear Creek Deck Temperatures



72



Heating in Overhang Area



75

Hot Weather Placement



76

Hot Weather Placement (2001.30(d) & 540.49(a))

- Concrete temperature: 50°F - 90°F (Decks: 50°F – 80°F)
- When concrete temperature approaches 90°F take appropriate action to lower the concrete temperature.
 - Add ice in place of water
 - Night placements
- Do not place concrete on or in forms if surface temperature of the forms or reinforcing steel is 90°F or above.



77

Deck Placement 00540.49(b)

- Only if precipitation is not forecast between 2 hours before and 2 hours after the scheduled placement duration.
- An acceptable forecast will have less than 30% chance of precipitation for the entire placement window.



78

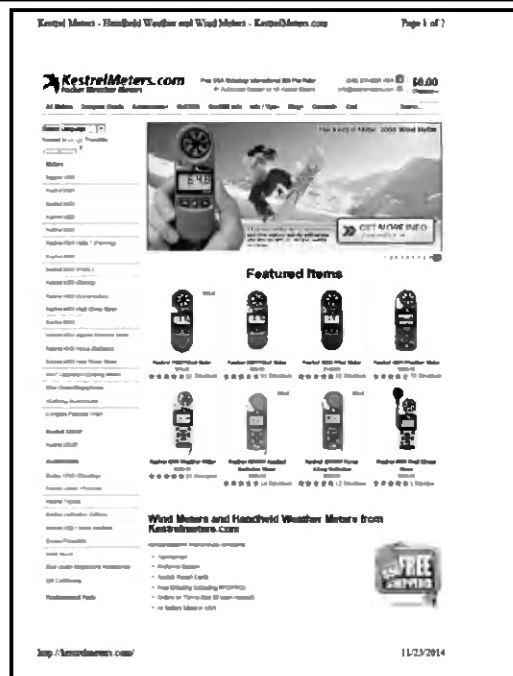
Deck Placement (continued) 00540.49(b)

- Provide a forecast to the Engineer 1 hour before placement.
- Evaporation rate less than 0.10 pounds per square foot of surface area per hour.

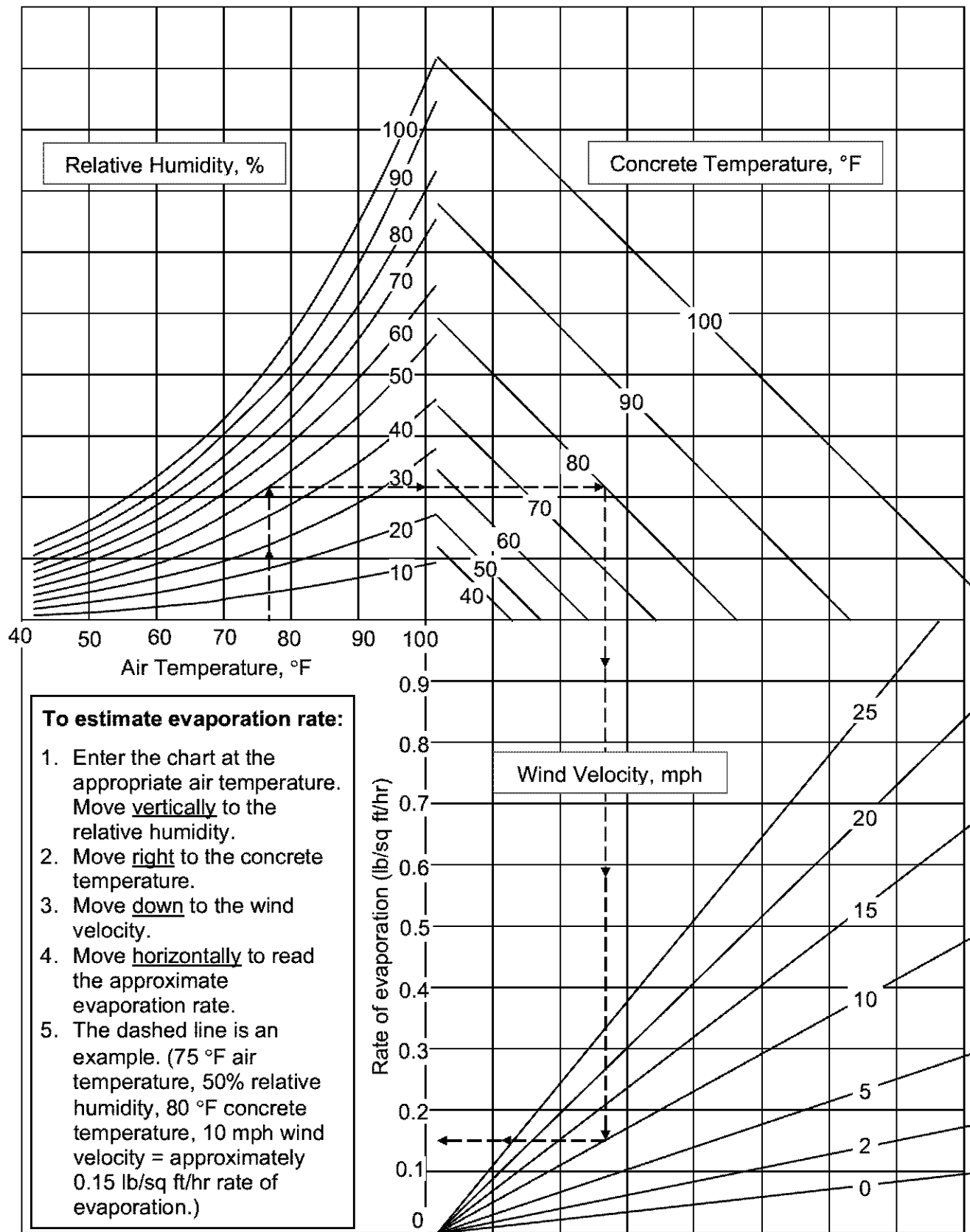


79

Kestrel Meters



80

FIGURE 00540-1 SURFACE EVAPORATION FROM CONCRETE ¹¹ Based on ACI 305 R, "Hot Weathering Concreting"

Surface Evaporation Rate Exercise

- Air Temperature is 55°F
- Humidity is 20%
- Mix Temperature is 75°F
- Wind Speed is 5mph

The surface evaporation rate is _____.

Do you allow a deck pour to start with these conditions?
_____.



81

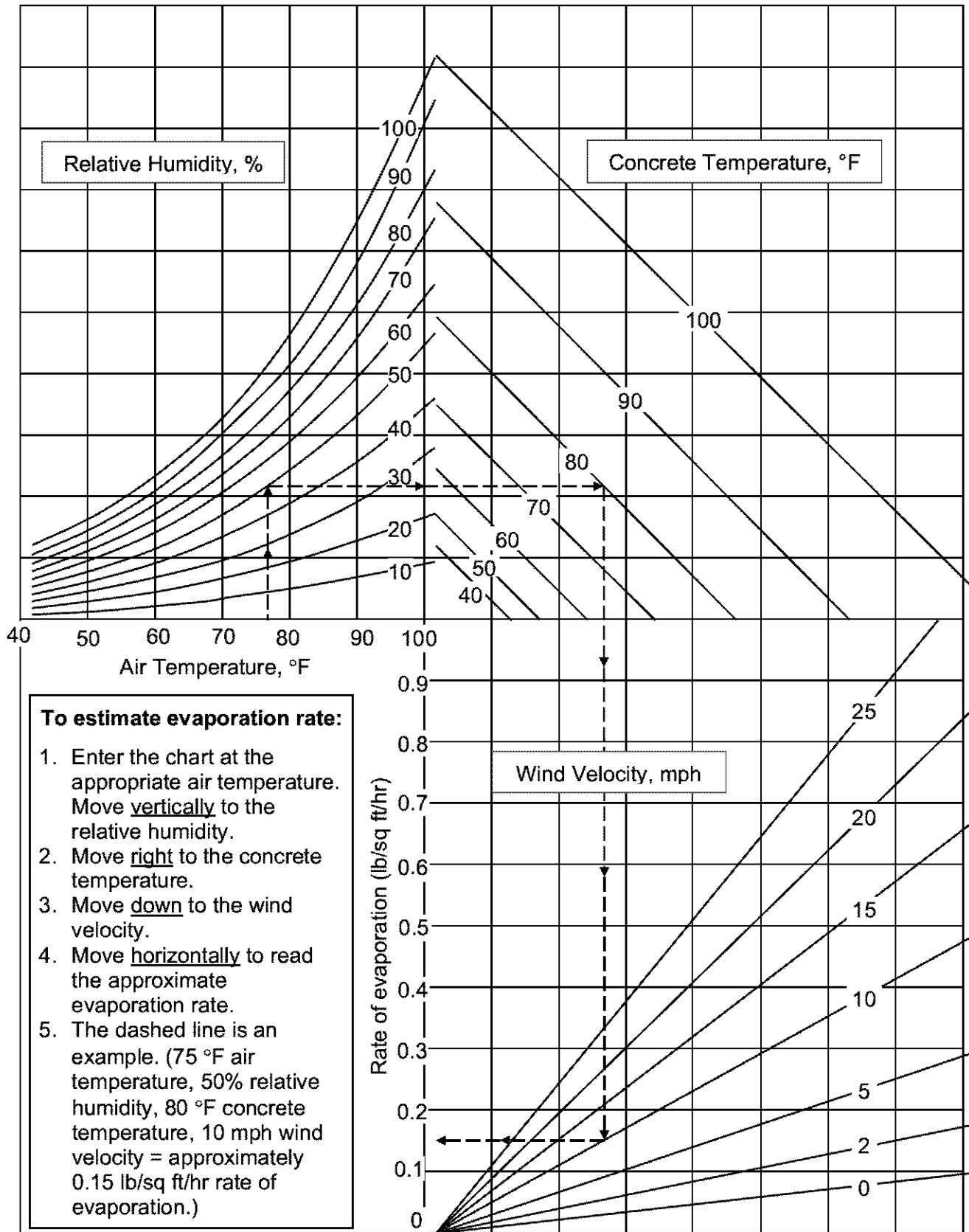
Preparations for Concrete

Before concrete is ordered:

- Verify that an approved mix design is on file with the Material Section.
- Verify that the contractor has adequate resources for the pour:
 - **A steady supply of concrete**
 - **Adequate labor and equipment**
 - **Back-up equipment at the jobsite**



82

FIGURE 00540-1 SURFACE EVAPORATION FROM CONCRETE ¹¹ Based on ACI 305 R, "Hot Weathering Concreting"

Delivery of the Concrete

Check delivery tickets for:

- Proper Project
- Concrete class per plans and mix design
- Batch time
Concrete must be in **FINAL POSITION** within 90 minutes of initial batch time. (00540.48(a))



83

Delivery of the Concrete (continued)

- Sample, test, and check temperature as required.
- If out of spec, test each truck until 2 consecutive loads meet specs. (00540.16)
- Wet down forms and existing concrete just before placement but no standing water. (00540.45)



84

Sampling & Testing



85

Slump



86

Air



87

Concrete Temperature



88

Cylinders



89

Placing Concrete (00540.48(a))

- Place concrete as close as possible to final position.
- Use appropriate chutes, drop buckets, pumps, conduits, etc.

**Do not drop concrete more than 5 feet.
(exception is drilled shafts with dry hole)**

- Place concrete in layers not to exceed 18 inches in depth.



90

4' lifts during pour in abutment wall?



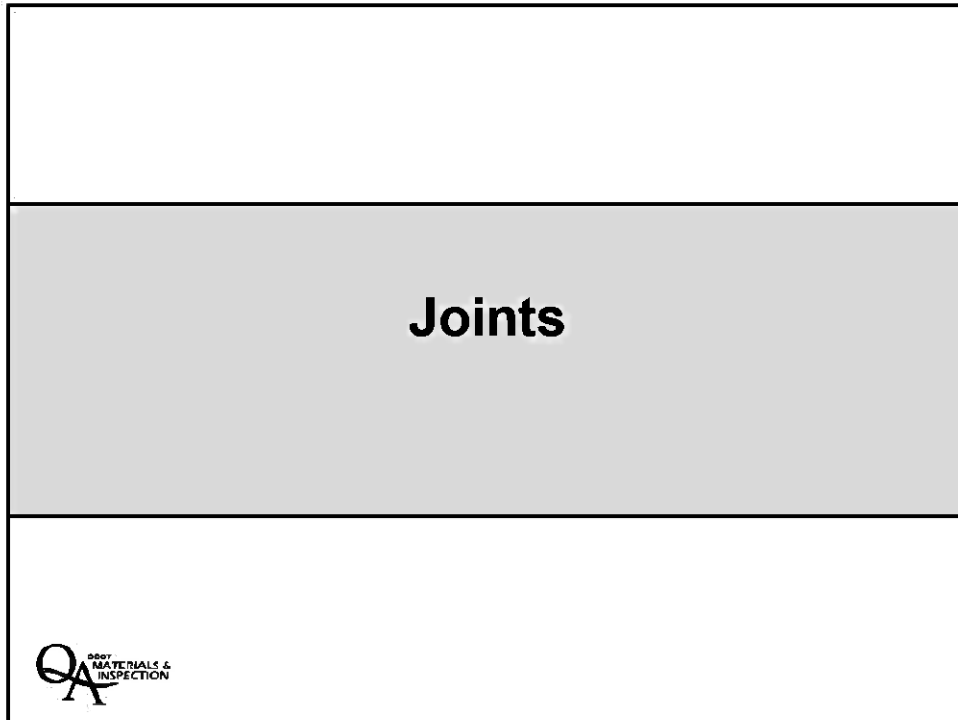
91

Placing Concrete (continued)

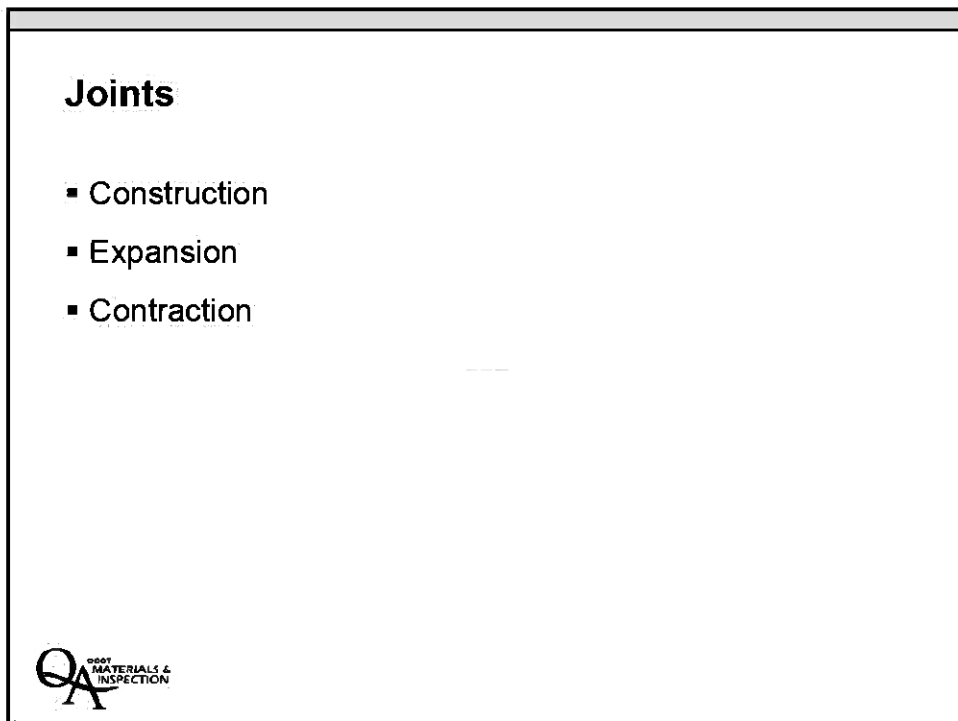
- Rate of delivery should be continuous without interruptions of more than 20 minutes. (00540.47)
- Deck placement to proceed at 20 ft/hr minimum. (00540.48(g))
- Proceed up grade from the lowest deck elevation. (00540.48(g))



92



93



94

Construction Joint

Used as a break between
concrete pours



95

Construction Joint in Abutment with Chamfers?



96

Construction Joints

00540.43

- Only at planned/approved locations
- “Roughened-surface” only or “shear-key” with roughened surface per plans
- Use concrete surface retarder
- At least 50% laitance removal
- Pre-wet for next pour



97

Deck Cold Joint with Keyway and Using Concrete Surface Retarder (00540.43)



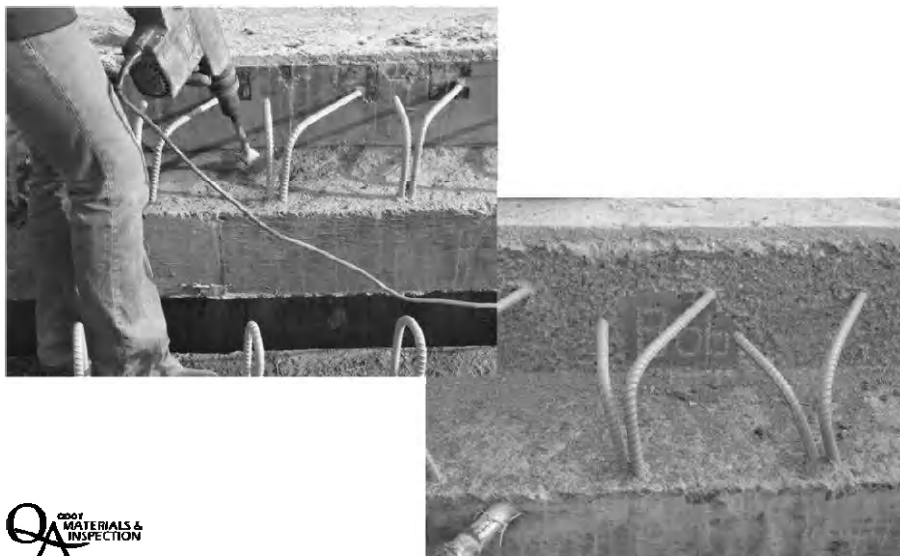
98

**Roughened Surface on Stemwall
Using Surface Retarder (00540.43)**



99

**Roughened Surface on Deck Joint
with Bush Hammer**



100

Roughened Surface on Deck Joint with Scabbler



101

Expansion Joints



102

Expansion Joints

- Allows movement between adjoining parts of a structure where **expansion** and **contraction** will occur.
- Expansion joints use compressible material or open space to allow the structure to **expand** or **contract** without breaking the concrete.



103

Expansion Joint



104

Expansion Joint



105

Expansion Joints?



106

Expansion Joints See Section 14, Deck Construction, for Deck Expansion Joints


107

Contraction Joints


108

Contraction Joint

A formed or tooled groove in the concrete surface that creates a weakened plane to control where cracking will occur.



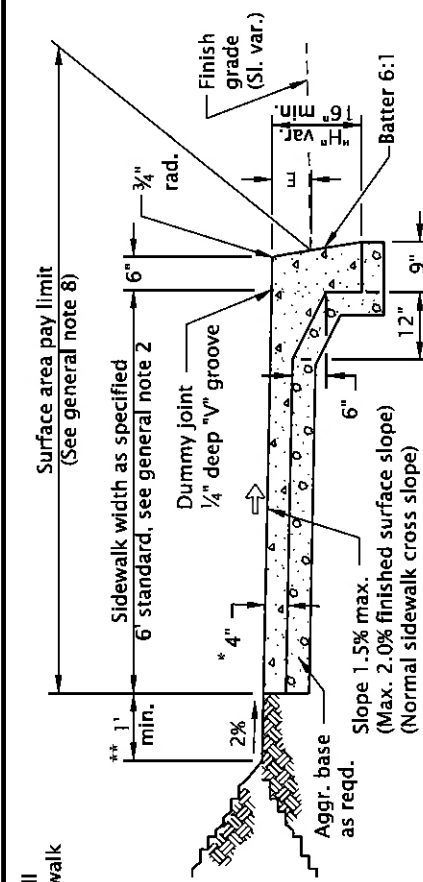
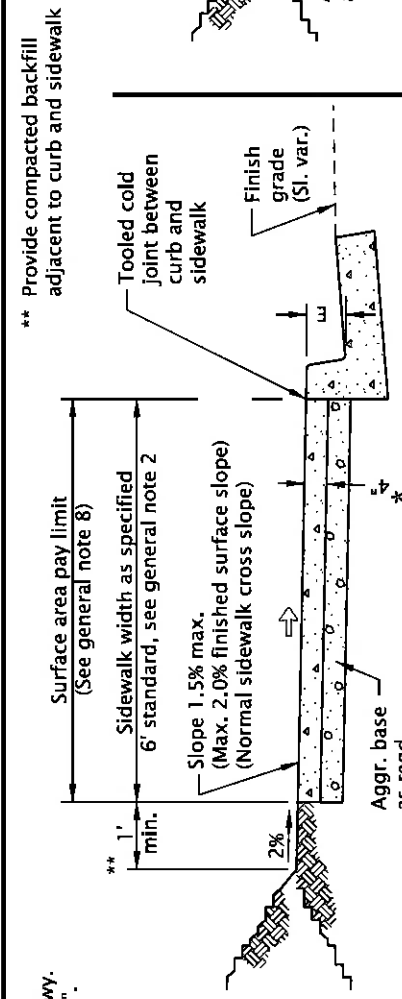
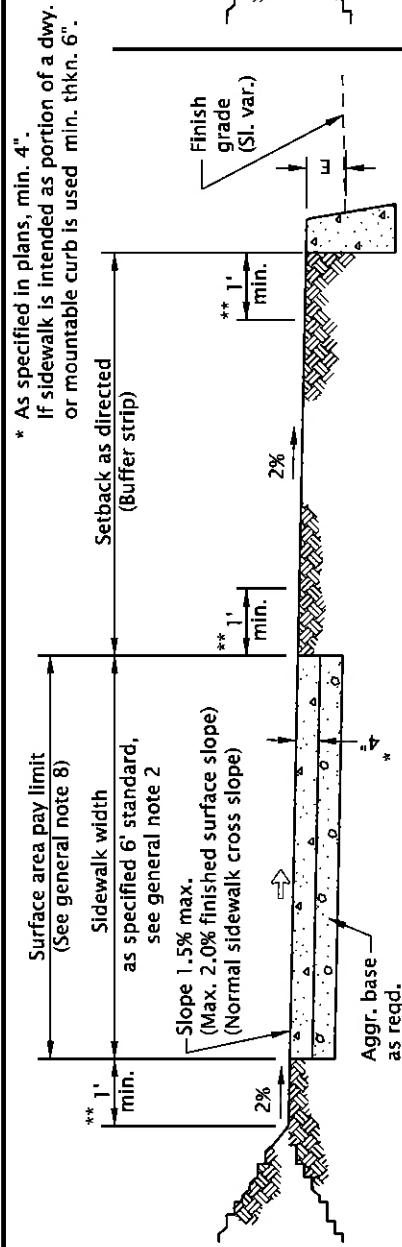
109

Contraction Joints

- 15' maximum spacing
- 1/3 thickness of concrete
00759.49(c)
- Dummy joints
@ 5' maximum
RD720



110



15' max spacing (00759.49)





111

15' max spacing (00759.49)





111

15' max Spacing (BR200)





112

15' max Spacing (BR200)





112



Curing Concrete Concrete must be properly cured to obtain the design strength and to minimize shrinkage cracks.


113

Curing Concrete 00540.51 ▪ With water, burlap and polyethylene film (polypropylene fabric can be used on horizontal surfaces instead of burlap) 00540.51(a) ▪ 7 days or as specified (14 days for decks) ▪ As soon after placement as possible without causing damage ▪ On decks cover with initial covering immediately after finishing and within 20 ft and 20 minutes of deck machine 
--

114



Post Pour Checklist

Project Information

Project Name (Section)		Contract No.	
Highway		Federal Aid No.	
Contractor or Subcontractor			
Placement Description:			

Cure Materials 540.51	Placed			Date/Time Placed	Remarks
	Yes	No	N/A		
Burlap	☐	☐	☐		
Polypropylene	☐	☐	☐		
Polyethylene (plastic)	☐	☐	☐		
Continuous water for decks	☐	☐	☐		
Soaker hoses at 10 feet on decks	☐	☐	☐		

Water Source:

Joint Preparation 540.43(a)

When

How

Cold Weather Protection 540.29(a)

Plan Approved: ☐ Yes ☐ No

Date Approved:

Description	
Temp. Monitoring	

CURE DURATION	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
Wet Cure	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Protection	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forms Removed	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

WEATHER	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
High Temp														
Low Temp														
Sky Conditions														

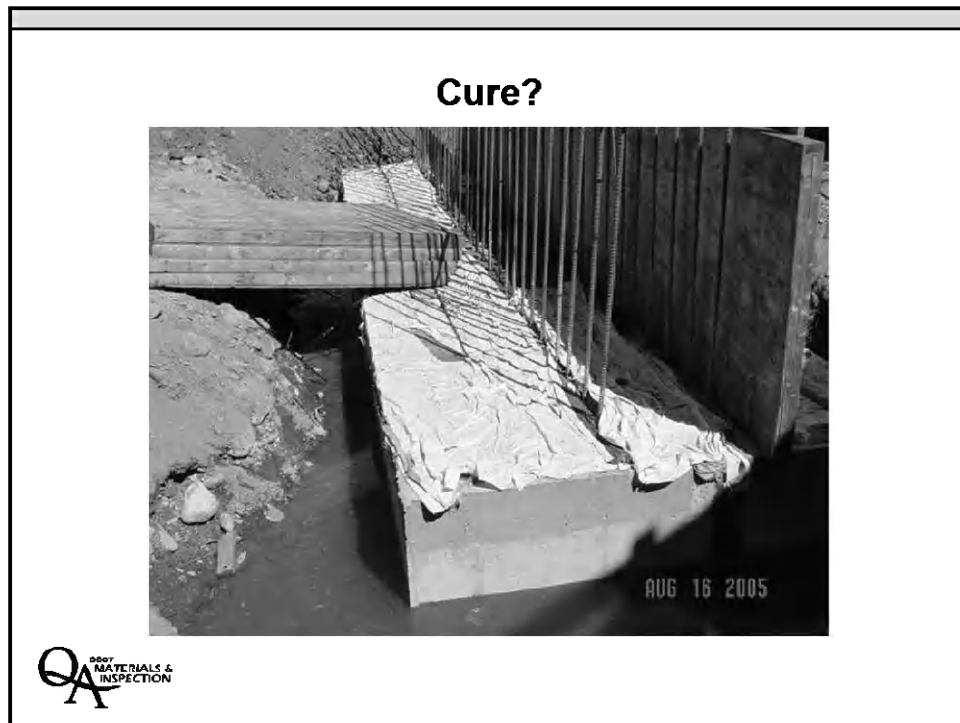
Curing Compound on Non-Structural Items (only if approved)

Area (yd²) Amount Applied (gallons) Rate gallon/yd²

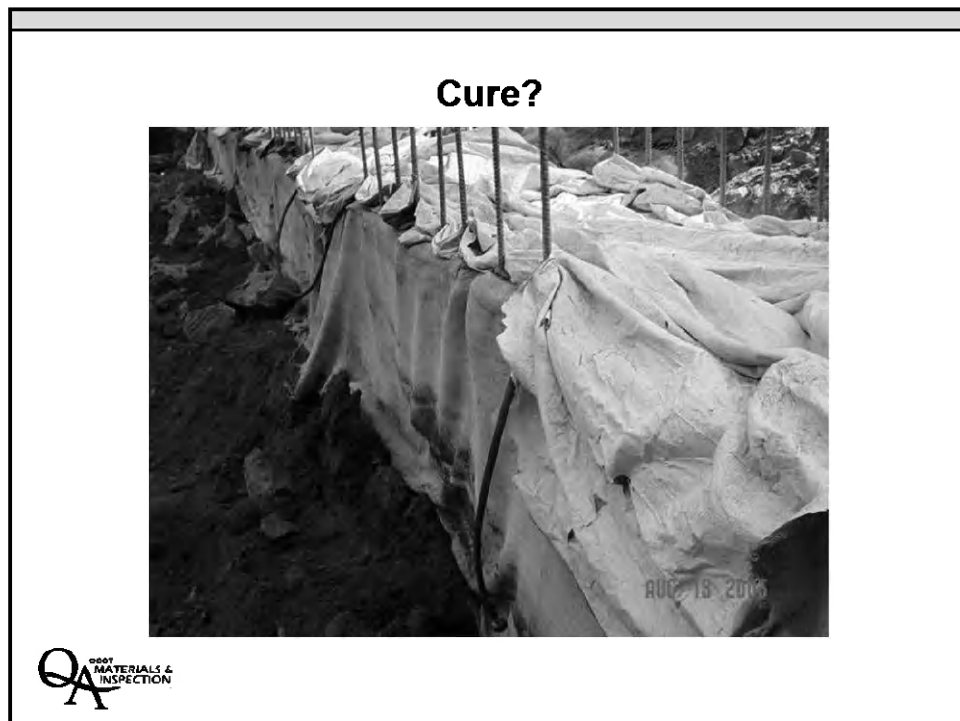
Remarks

Prepared by

Work Date



115



116

Concrete Is Dry?



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117

Abutment Not Well Covered



QA
QUALITY MATERIALS &
INSPECTION

118

Dry Concrete?



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INSPECTION

119

**Abutment Has Plastic,
But No Burlap and Dry Concrete**



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INSPECTION

120

Curing Concrete (continued)

00540.51

- Do not interrupt the cure for more than 1 hour during the 7-day cure (14-day for decks).
- Add additional cure time if temperature drops below 45°F 00540.51(c).



121

Deck Curing

00540.49 (b)

- Provide wind breaks, fog nozzles or any other approved method to prevent premature drying.
 - Premature drying is defined as evaporation of 0.10 pounds or more per square foot per hour, as determined from Figure 00540-1.
- Cover with single layer of clean initial covering immediately after finishing concrete.



122

Deck Curing (continued)

- Cover with:
 - Material of sufficient length to reach from side to side unless approved lengthwise.
 - Wet burlap having dry mass of 10 oz. per yard for 40" wide (presoak with wetting agent before using).
 - Dry polypropylene material. Fog material immediately after placing to dampen without causing running water.



123

Deck Curing (continued)

- Cover within one hour with polyethylene film
 - 4 mil thickness
 - Clear or white when the air temperature is expected to go above 65°F, black at other times. Once a type of film has been selected do not change it during the cure period. 00540.51(b)



124

Deck Curing (continued)

- Soak the deck to keep it saturated at all times during the curing period.
- Inspectors need to stay until the cure is appropriately placed.



125



126



127



128



129



130



131



132



133



134



135



136



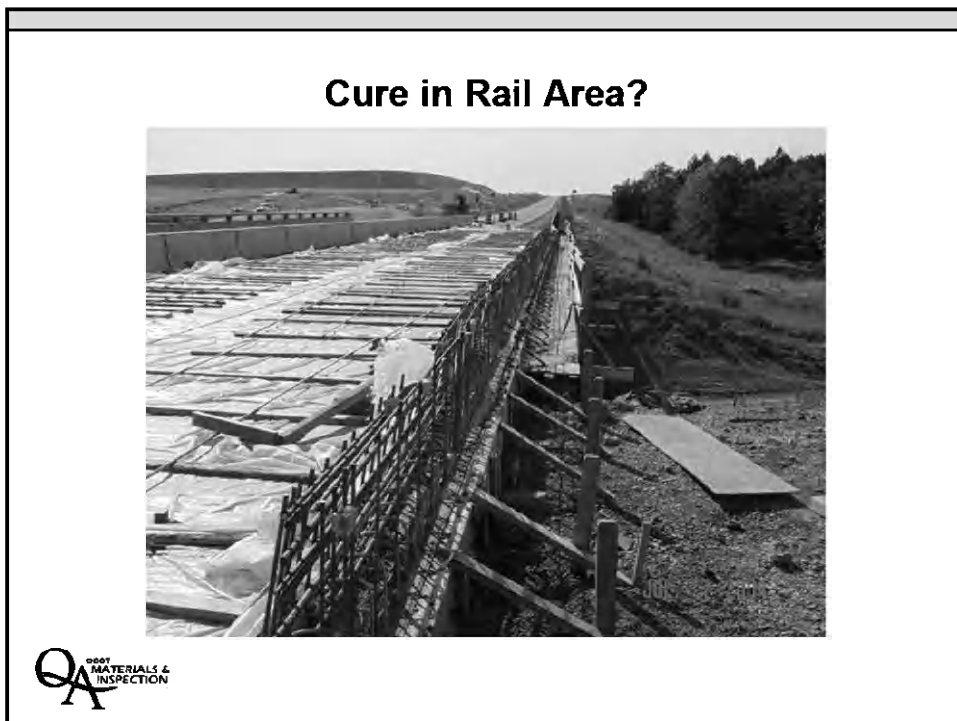
137



138



139



140

80°, color of plastic? Cure at rails?



QA
QUALITY MATERIALS & INSPECTION

141

Marks from Cure Boards



QA
QUALITY MATERIALS & INSPECTION

142

Shrinkage Cracks, Cure Was Blown Off



143

Surface Finishing



144

Surface Finishing

Concrete surfaces are finished to:

- Seal the surface from water and other elements that can rust or corrode metal ties and reinforcement within the concrete.
- Provide a uniform, pleasing appearance for surfaces that will remain visible to the public.



145

Classes of Surface Finishes

00540.53

- General Surface Finish
- Class 1 Surface Finish
(Ground, Sacked & Coated) SP00540.53
- Class 2 Surface Finish
(Ground, Floated & Coated)



146

General Surface Finish

- Remove exposed metal to a depth of 1", 2" on structures within 25 miles of Pacific Ocean.
- Remove rock pockets and unsound concrete.
- Repair all air pockets over ¼-inch in depth and all form tie removals, rock pockets, and unsound concrete and fill with an approved patching material.



147

General Surface Finish (continued)

- Repair all bulges, fins, depressions, stains, or discoloration, on exposed surfaces, to produce a smooth, uniform surface with smooth uniform lines and appearance.
- The Engineer will determine the extent of the required repairs.



148

General Surface Finish on Wingwalls



149

Class 1 Surface Finish (Ground, Sacked and Coated) 00540.53(b)

- Complete the general surface finish.
- Grind the surface to remove all laitance and surface film.
- Sack entire surface with mixture of sand, cement, water and bonding agent: 1 part bonding agent to 2 parts water or as recommended by manufacturer. (00540.53)



150

Class 1 Surface Finish (continued) (Ground, Sacked and Coated)

- Saturate the surface with water and paint, while damp with a latex emulsion paint. A minimum of two coats of latex emulsion paint shall be applied.
- The second coat may be applied any time after the previous coat, when touched lightly, does not adhere to the finger.
- Sand may be added to the latex emulsion paint to help achieve a uniform surface.



151

Class 1 Finish on Pier



152

Class 2 Surface Finish (Ground, Floated & Painted)

- Complete the general surface finish.
- Grind the surface to remove all laitance and surface film.
- Float the surface with a rubber or sponge float, using a paste of fine sand, cement, water and bonding agent to fill all air holes or voids, and to bring the surface to a uniform texture.



153

Class 2 Surface Finish (continued) (Ground, Floated & Painted)

- Keep the retextured surface damp a min. of 12 hours or until the paste has set, whichever is longer.
- If dusting occurs after the retextured surface sets and is rubbed, then it should be refinished.
- After the paste has set for a minimum of 24 hours, the surface shall be saturated with water and painted the same as the Class 1 Surface Finish.



154

Class 2 Finish



QA
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INSPECTION

155

INSERT TAB

**Unit 5
Reinforced
Concrete**

Section 5

Reinforced Concrete

Basics of Reinforced Concrete	2
PCA Video, VC114 '88 Mod '07: Fundamentals of Reinforcing and Prestressed Concrete	4
Structural Engineering Concepts	4
Reinforcement Inspection	11
CRSI Video, Mod '08: Field Inspection of Reinforcing Bars	11
WCI Video: Jobsite Handling of Epoxy Coated Rebar	22
CRSI: MSP Chp. 8, Placing Reinforcing Bars	23
Bar Supports	25
Bar Ties	29
Clearances	31
Splices	39

Reinforced Concrete

Section 5



1

**So, what's wrong with using
un-reinforced concrete?**



2

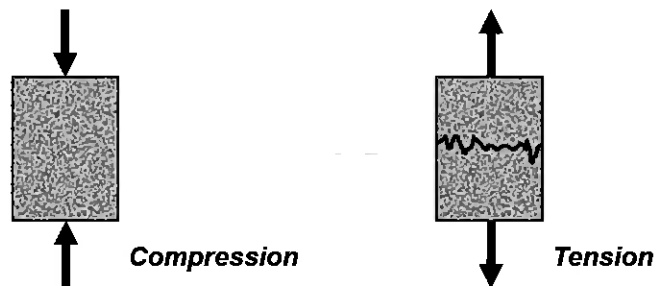
Concrete Cracks



3

Basics of Reinforced Concrete

Concrete is strong in compression and weak in tension.



Tensile capacity is approximately 10% of the compressive strength of concrete.



4

Beam Exercise



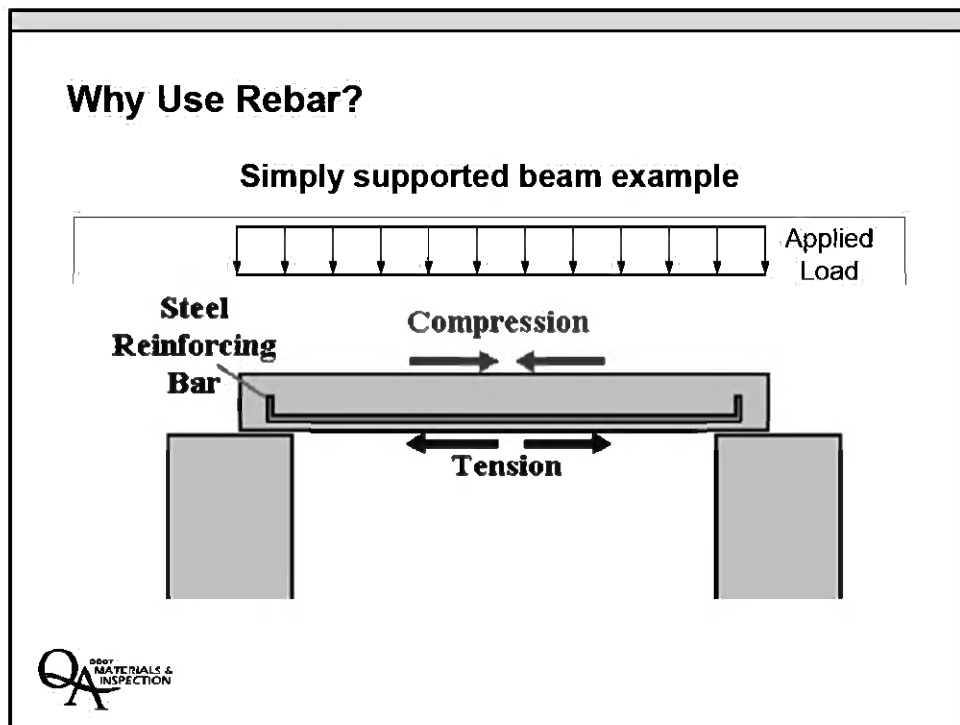
5

Basics of Reinforced Concrete (continued)

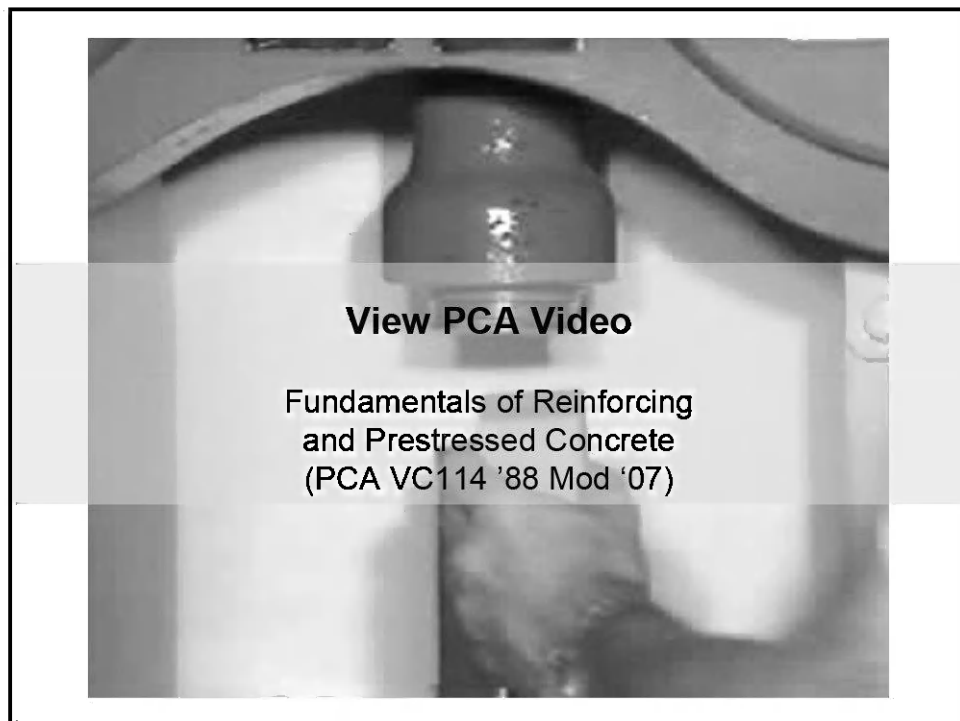
- Steel reinforcement is **strong in tension**.
- Reinforcement is added to carry tensile loads in concrete members.
- Temperature reinforcement is added to carry tensile loads due to thermal expansion of concrete members.



6



7



8

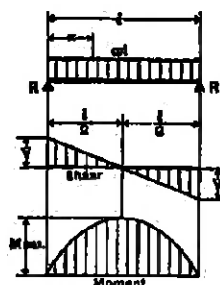
Structural Engineering Concepts



9

Shear & Moment Diagram Uniformly Loaded Simple Beam

1. SIMPLE BEAM—UNIFORMLY DISTRIBUTED LOAD



Total Equiv. Uniform Load . . .	$= wl$
$R = V$	$= \frac{wl}{2}$
V_x	$= \left(\frac{l}{2} - x \right)$
$M_{max.} \text{ (at center) }$	$= \frac{wl^2}{8}$
M_x	$= \frac{wx}{2} (l - x)$
$\Delta_{max.} \text{ (at center) }$	$= \frac{5 w l^4}{384 EI}$
Δ_x	$= \frac{wx}{24 EI} (l^3 - 2lx^2 + x^3)$



10

Maximum Shear Load at Bridge Ends and Piers



Tighter stirrup spacing
near abutments

Larger stirrup spacing
@ midspan



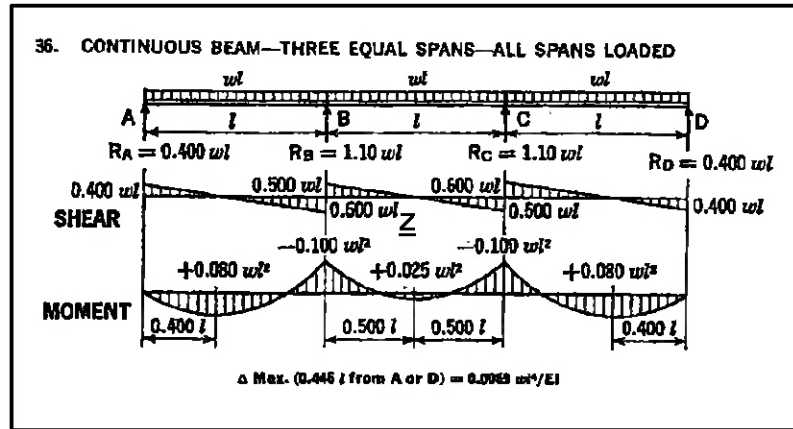
11

Tighter Stirrup Spacing at Beam Ends



12

Shear & Moment Diagram Uniformly Loaded Continuous 3 Span



13

Uniformly Loaded Continuous Beam 3 Spans

- Maximum negative moment in deck over piers.
- Additional longitudinal reinforcement added in top mat.



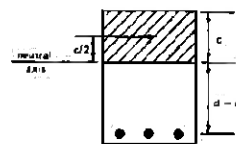
14

Beam Capacity

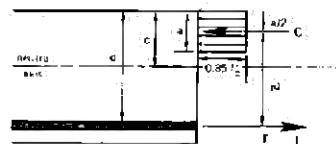


15

Strength of the Beam



Beam Cross-section



Beam Side View

$$M = A_{st}f_y(d - 1/2a) = 0.85f'_c'ab(d - 1/2a)$$



16

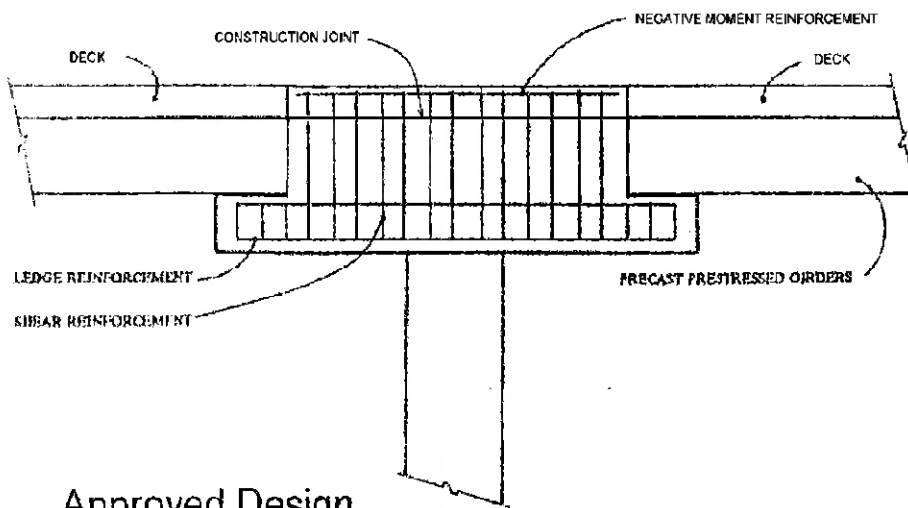
Case Study I-25: Walnut Street

Denver, CO

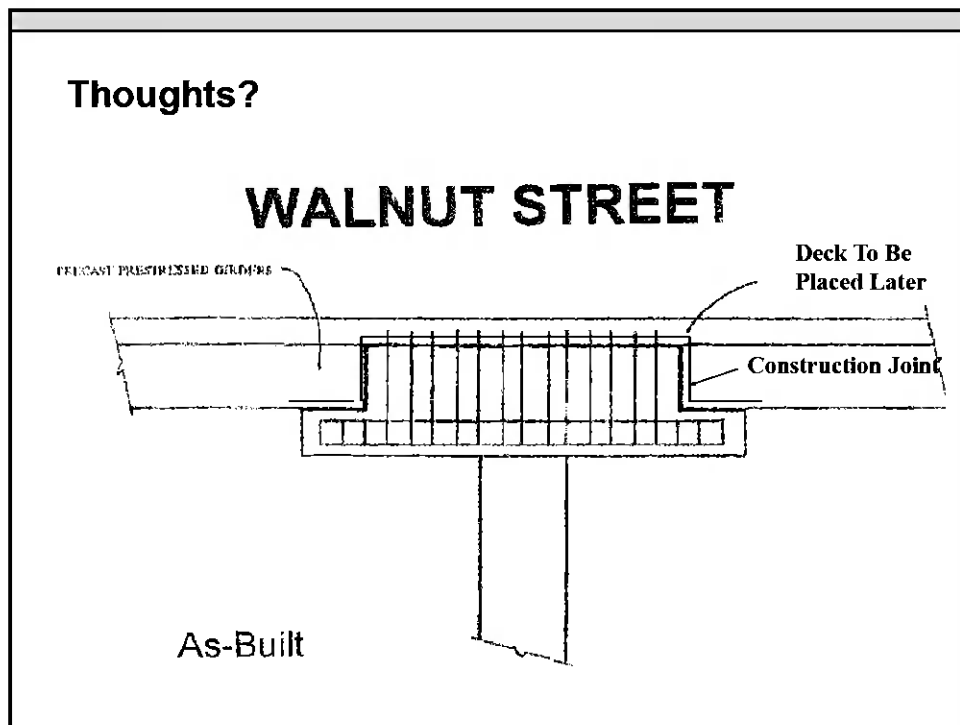


17

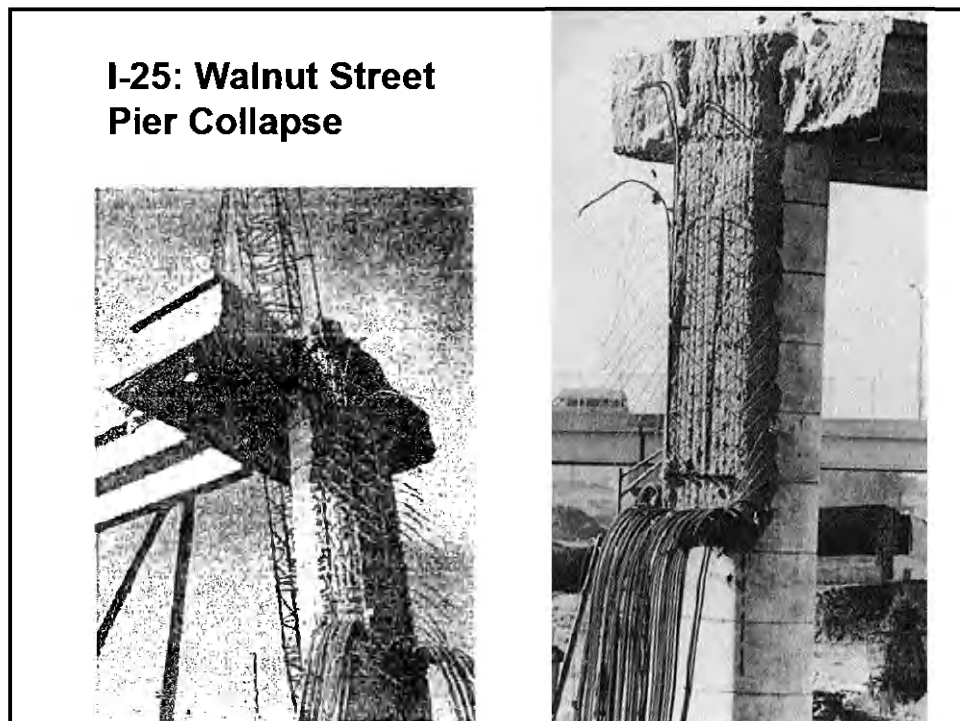
WALNUT STREET



18



19



20

Pier Collapse

I-25: Walnut Street, Denver, CO

Oct. 4, 1985

Fatalities: 1

Injuries: 4



21.

Reinforcement Inspection



22.



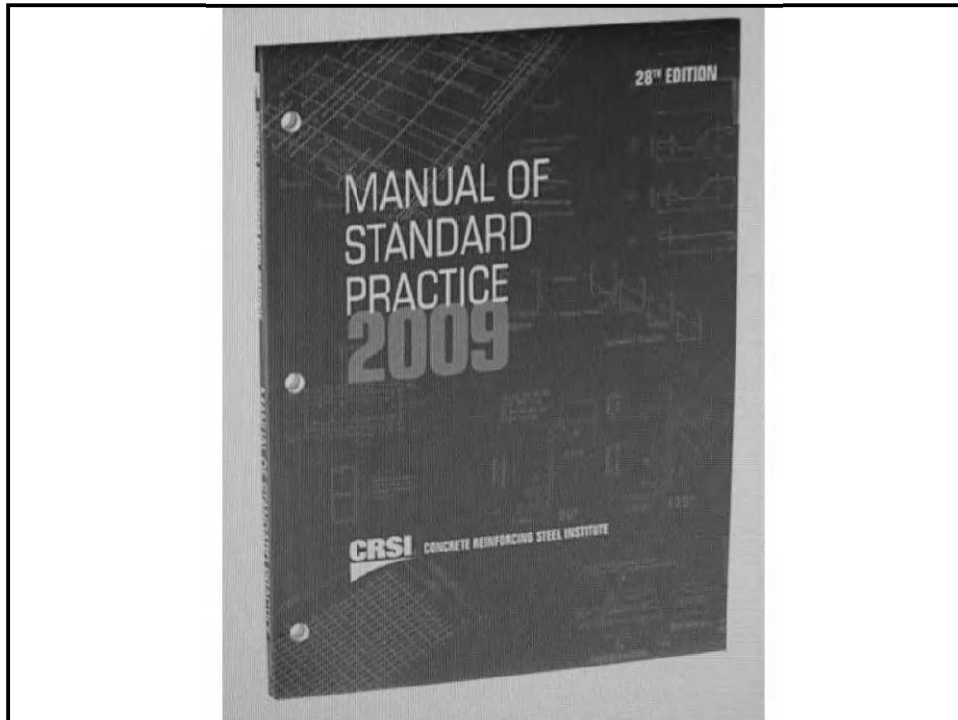
23

Type of Reinforcement

- Source
- Certifications
- Grade
- Epoxy coated or uncoated or stainless



24



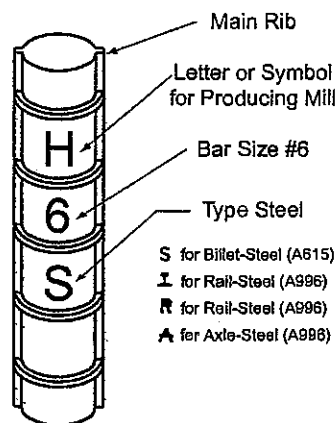
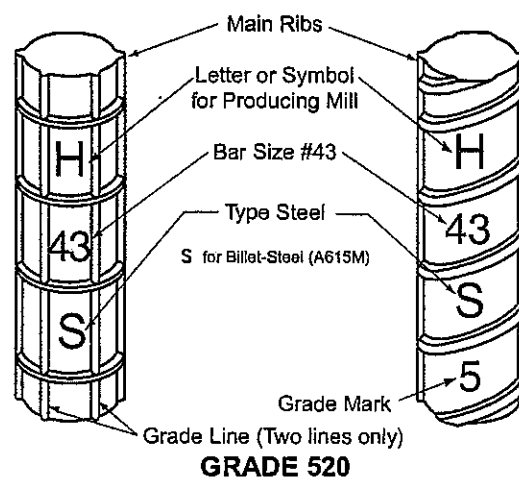
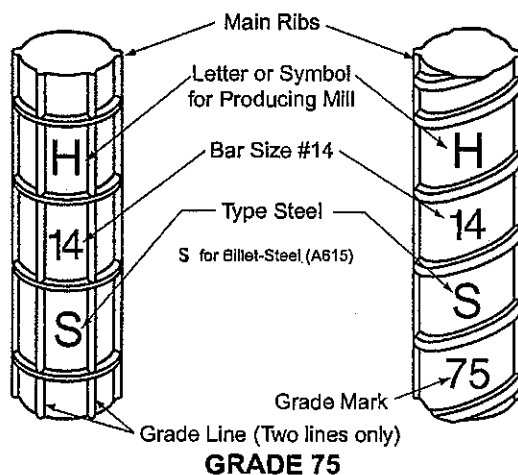
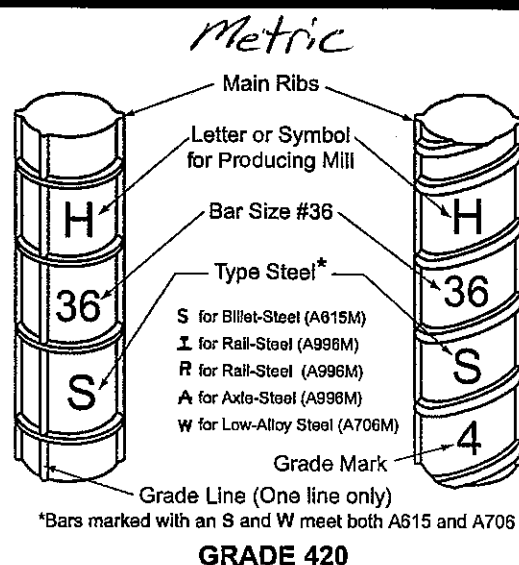
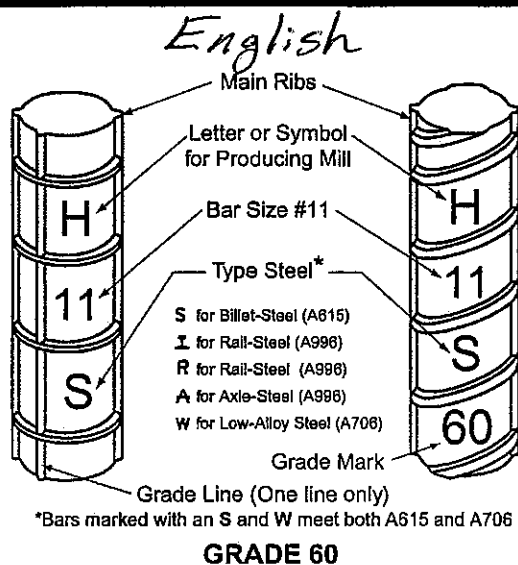
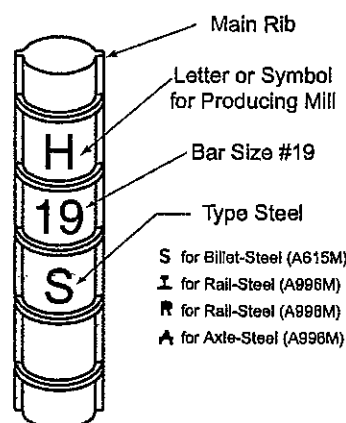
27

ASTM STANDARD INCH-POUND REINFORCING BARS			
BAR SIZE DESIGNATION	NOMINAL DIMENSIONS		
	AREA (in. ²)	WEIGHT (lb./ft.)	DIAMETER (in.)
#3	0.11	0.376	0.375
#4	0.20	0.668	0.500
#5	0.31	1.043	0.625
#6	0.44	1.502	0.750
#7	0.60	2.044	0.875
#8	0.79	2.670	1.000
#9	1.00	3.400	1.128
#10	1.27	4.303	1.270
#11	1.56	5.313	1.410
#14	2.25	7.65	1.693
#18	4.00	13.60	2.257

The current A615 specification covers bar sizes #14 and #18 in Grade 60, and bar sizes #11, #14 and #18 in Grade 75. The current A706 specification also covers bar sizes #14 and #18. Bar sizes #3 through #11 are not included in the A615 specification.

28

MATERIAL SPECIFICATIONS FOR REINFORCING BARS

**GRADES 40 AND 50****GRADES 300 AND 350**

English Rebar Numbers

- #3 - #8; Diameter in 1/8" units
#8/8 = 1" dia.
- #9 - #18; Based on area of square bars formerly used with sides of 1", 1-1/8", 1-1/4", 1-1/2" & 2" and then rounded to closest 1/8" unit diameter.



29

Metric to English Bar Conversion

- (Bar # - 1) divided by 3 then round to nearest english bar #
- #25 metric = $(25-1)/3 = \#8$ english



30

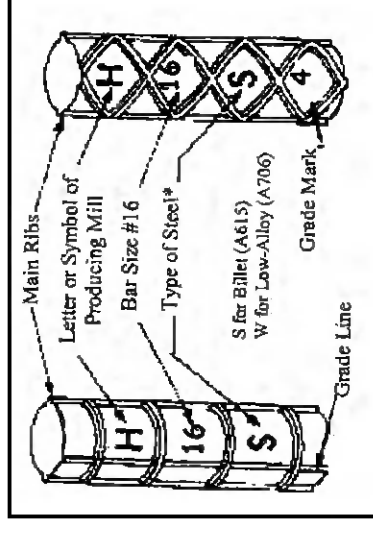
QPL Appendix A https://www.oregon.gov/ODOT/HWY/CONSTRUCTION/QPL/Docs/QPL.pdf


31

Appendix A—Approved Reinforcing Steel Producers

The ASTM specifications for billet-steel and low-alloy reinforcing bars (A615 and A706, respectively) require identification marks to be rolled into the surface of one side of the bar to denote the producer’s mill designation, bar size, type of steel and minimum yield designation. Grade 420 bars show these marks in the following order:

- 1st ---Producing Mill (usually a letter)
- 2nd --- Bar Size Number (# 4 through # 18)
- 3rd --- Type of Steel: **S** Billet (A 615)
 W for Low Alloy (A 706)
- 4th ---Minimum Yield Designation

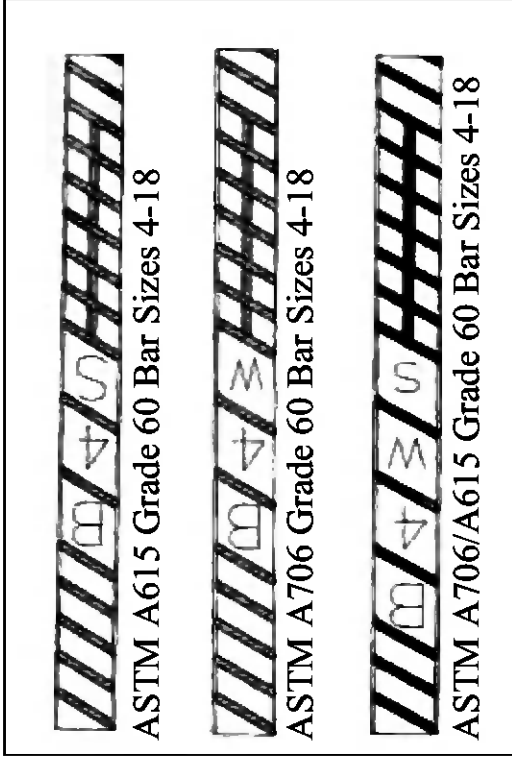


The minimum yield designation for Grade 420 bars is either one (1) single, longitudinal line (grade line) or the number 4 (grade mark).

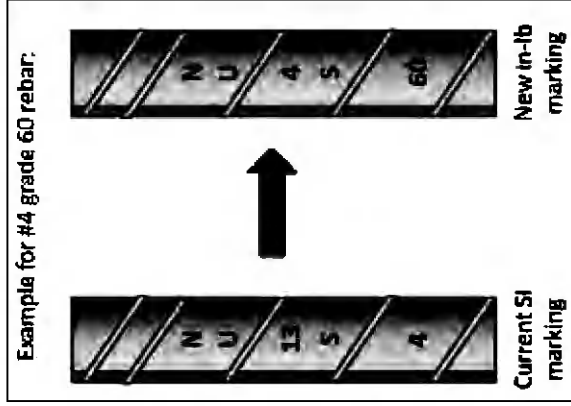
A grade line is smaller and is located between the two main ribs, which are on opposite sides of all bars made in the United States. A grade line must be continued through at least 5 deformation spaces, and it may be placed on the side of the bar opposite the bar marks. A grade mark is the fourth mark on the bar.

VARIATIONS: Bar identification marks may also be oriented to read horizontally (90° to those illustrated). Grade numbers may be placed within consecutive deformation spaces to read vertically or horizontally.

The Identification marks for the Approved Producers are shown in the following figures. Rebar grades shown on these pages are for reference only. Check the specs for the appropriate requirements.



Vinton Steel-Vinton Texas ODOT # 1841



Nucor Steel Utah ODOT # 1112

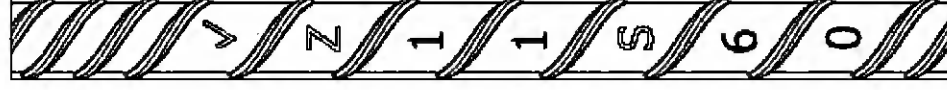
#11 REBAR



Side

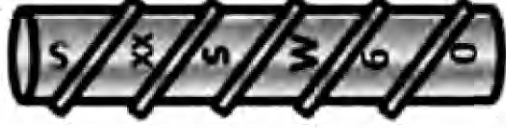


Back



Front

CMC Steel Mesa Arizona ODOT #4118

A615				A706	
Gr 60	Gr 75	Gr 80	Gr 60	Gr 80	A706/A615 Dual
					

Size: 4, 5, 6, 7, 8, 9, 10, 11, 14, 18

Nucor Steel Seattle Washington ODOT # 2935

745-G-100

	A615 Gr. 40		A615 Gr. 60		A615/A706 Gr. 60		A615/A706 Gr. 80
	A615 Gr. 40		A615 Gr. 60		A615/A706 Gr. 60		A615/A706 Gr. 80
	A615 Gr. 40		A615 Gr. 60		A615/A706 Gr. 60		A615/A706 Gr. 80
	CSA-G30.18 Gr. 400W		CSA-G30.18 Gr. 400W		CSA-G30.18 Gr. 400W		

VENDOR		TITLE	
OPTIMUS BEAUMONT, TEXAS MILL P.O. BOX 3889 LAUDERDALE, FL 33311 407.777.947		Rebar Logo Finished Bar with "B"	
PROJECT NO.		REV.	
Rebar		0	
DRAWING NO.		745-G-100	
SHEET NO.		1 of 1	

Optimus Beaumont Texas ODOT #4838

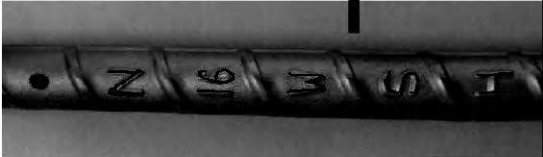
Oregon DOT – QPL (Rev. December 2022)

Cascade Steel Rolling Mills, Inc.
(McMinnville, OR)

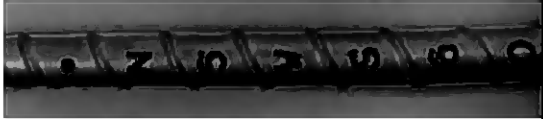


Cascade Steel Mc-Minnville Oregon
ODOT # 1111

S 		Bars #3 through #6 only	S 		Bars #14 and #18 only
W 		Bars #3 through #6 only	S 		Bars #3 through #11 only
W 		Bars #14 and #18 only	S 		Bars #14 and #18 only
SW 		Bars #3 through #11 only (#3 through #6 coiled)	W 		Bars #3 through #11 only
SW 		Bars #14 and #18 only	W 		Bars #14 and #18 only
S 		Bars #3 through #11 only (#3 through #6 coiled)	SW 		Bars #3 through #6 coiled



Current SI Marking



New IN-LBS

NUCOR STEEL – KINGMAN, AZ
ODOT #4356

A706/A615 GRADE 60 REBARS MARKINGS
Rebar sizes: #3 thru #6

**EVRAZ INC, NA PUEBLO, COLORADO
ODOT #1621 (COILED REBAR #3-#6)**

EVRAZ ROD/BAR MILL REBAR MARKINGS

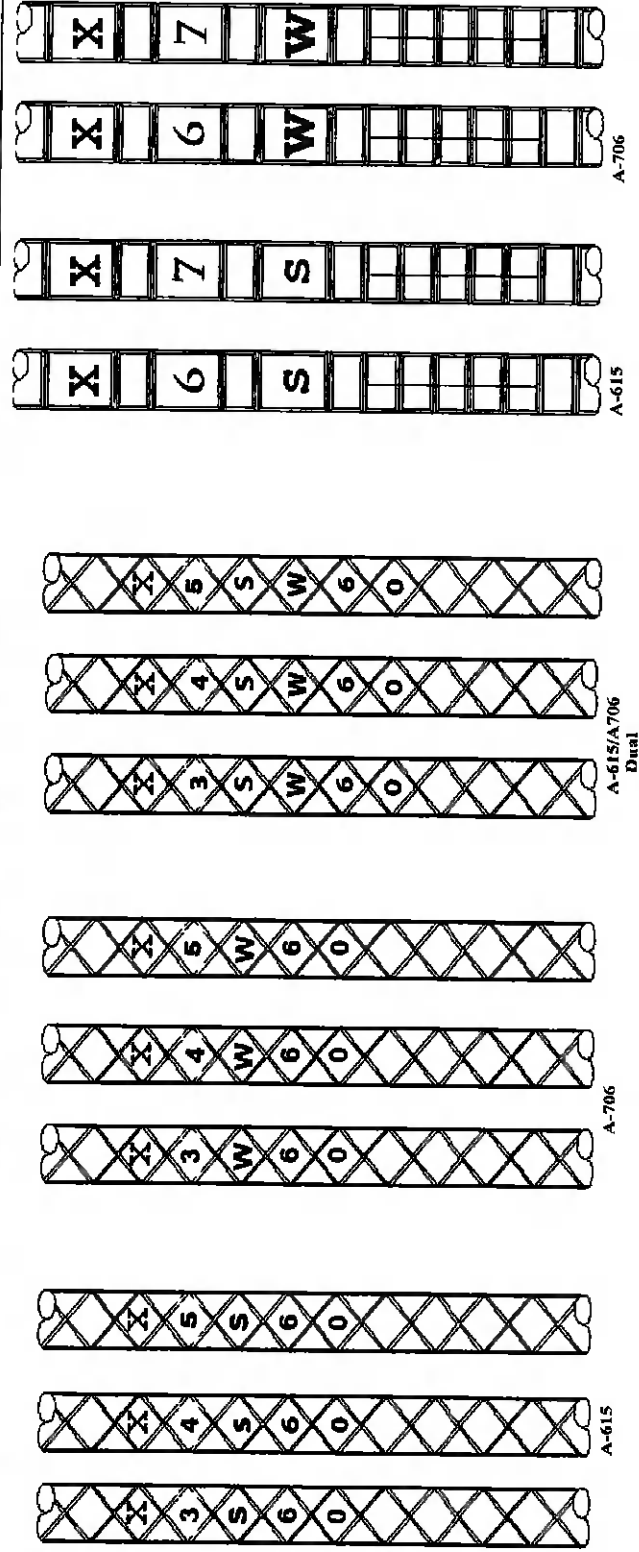


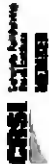
Table RB-700-S Rev 2

**NUCOR-BAURBONNAIS (KANKAKEE)
BAR SIZE #3-#11
ODOT #4943**



NUCOR STEEL - KANKAKEE
BARS #3-#11 BAR A706 ONLY

CMC Steel Oklahoma
Durant, OK



S



Bars #3 through #18 only

W



Bars #3 through #18 only

S



Bars #3 through #18 only

S



Bars #3 through #18 only

W



Bars #3 through #18 only

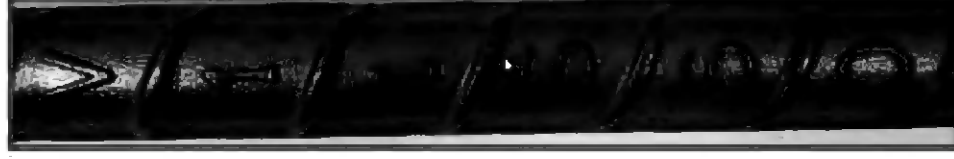
S



Bars #3 through #18 only

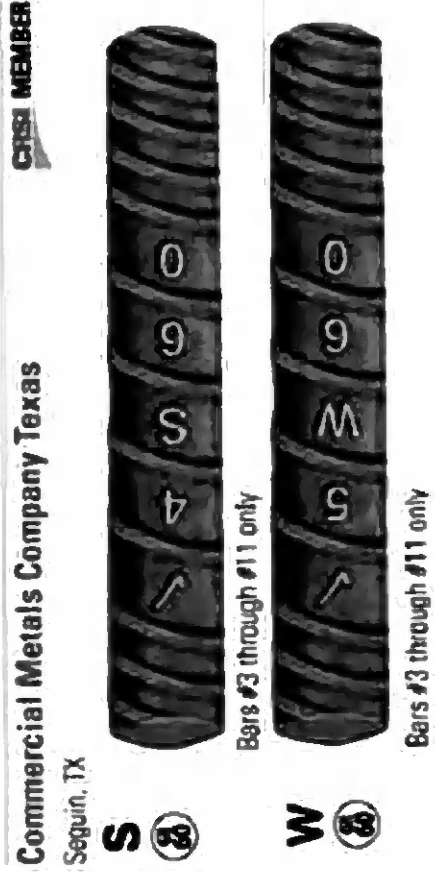
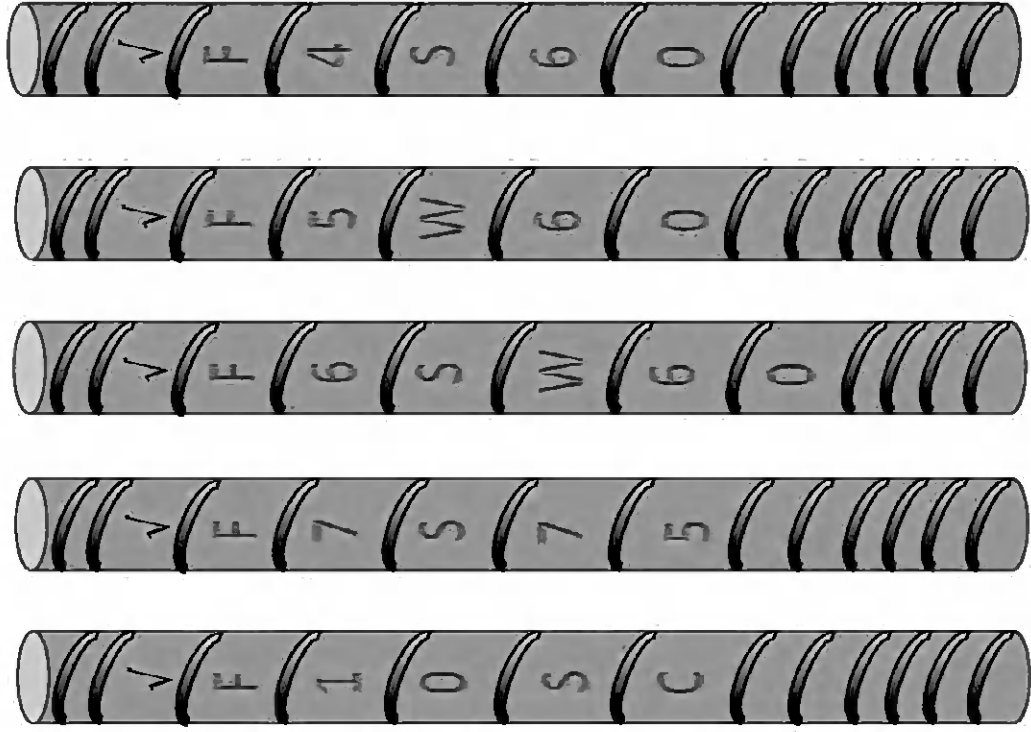
CMC STEEL-DURANT OKLAHOMA
#4-#11 STRAIGHT #3-#6 COILED
ODOT #5138

**STEEL DYNAMICS ROANOKE BAR
DIVISION
#4-#11 STRAIGHT
ODOT #5261**



CMC STEEL FLORIDA
#3-#5 COILED
ODOT #5262

CMC STEEL TEXAS
A615 GRADE 60, #3-#11 STRAIGHT
A706 GRADE 60, #3-#11 STRAIGHT
ODOT #5313



CMC STEEL SOUTH CAROLINA
A615 GRADE 60, 80, 100 #3-#18 STRAIGHT
A706 GRADE 60, 80 #3-#18 STRAIGHT
ODOT #5263

UNITED STATES DEPARTMENT OF TRANSPORTATION

CMC Steel South Carolina
Cayce, SC



Commercial Metals Company South Carolina



Bars #3 through #11 only



Bars #3 through #11 only



Bars #3 through #11 only



Bars #3 through #11 only



ASTM A1035 CS & CM (AAHSTO M334)

ChrōmX 9100 CS
SIZE #3-#11
PRODUCED BY:
CASCADE STEEL ROLLING MILLS, INC.
ODOT #3517

ChrōmX 4100 CM
SIZE #4-#11
PRODUCED BY:
CASCADE STEEL ROLLING MILLS, INC.
ODOT #5249



Bars #3 through #9 (#3 through #6 coiled)



Bars #10 and #11 only



Bars #14 and #18 only

C	R	X	4	C	4	CM	1	0	0
---	---	---	---	---	---	----	---	---	---

Product Mark

Point of Origin

Size Designation

Type of Steel

Minimum Yield Designation

ASTM A1035 Type CM

Grade 100 (100 ksi)

#4 REBAR



Grade 60
Yellow



Grade 80
Purple



Grade 100
Gold



A706 W
Orange



Dual
Blue

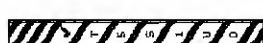
#5 REBAR



Grade 60
Yellow



Grade 80
Purple



Grade 100
Gold



A706 W
Orange



Dual
Blue

#6 REBAR



Grade 60
Yellow



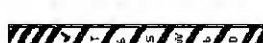
Grade 80
Purple



Grade 100
Gold



A706 W
Orange

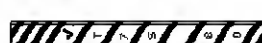


Dual
Blue

#7 REBAR



Grade 60
Yellow



Grade 80
Purple



Grade 100
Gold



A706 W
Orange



Dual
Blue

#8 REBAR



Grade 60
Yellow



Grade 80
Purple



Grade 100
Gold



A706 W
Orange



Dual
Blue

#9 REBAR



Grade 60
Yellow



Grade 80
Purple



Grade 100
Gold



A706 W
Orange



Dual
Blue

#10 REBAR



Grade 60
Yellow



Grade 80
Purple



Grade 100
Gold

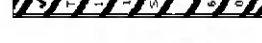


A706 W
Orange

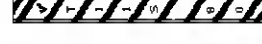


Dual
Blue

#11 REBAR



Grade 60
Yellow



Grade 80
Purple



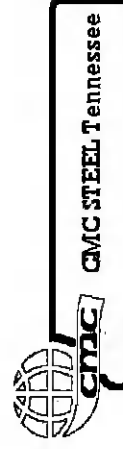
Grade 100
Gold



A706 W
Orange



Dual
Blue



CMC STEEL TENNESSEE KNOXVILLE
A615 GRADE 60, (#3-#11) A615 GRADE 80, 100 (#4-#11)
A706 GRADE 60, 80 (#3-#11) A615/A706 GRADE 60 (#4-#11)
ODOT #5333

Rebar Exercise



Mill:
Size:
Dia:
Type:
Grade:

33

Rebar Exercise



Mill:
Size:
Dia:
Type:
Grade:

34

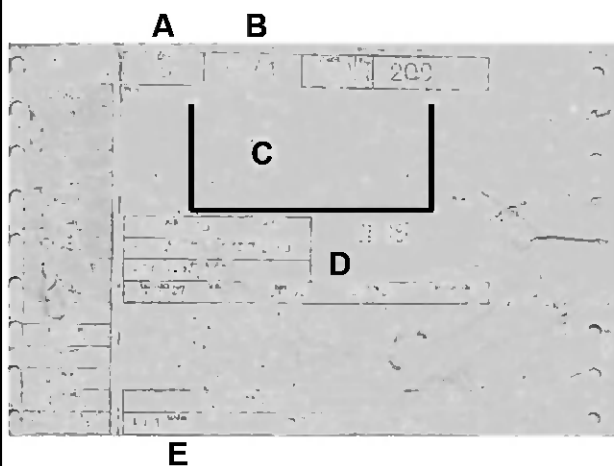
Size & Shape

- Bar size
- Bar length
- Bar shape (correct radius)
- Agrees with shop drawings



35

Rebar Material Tag



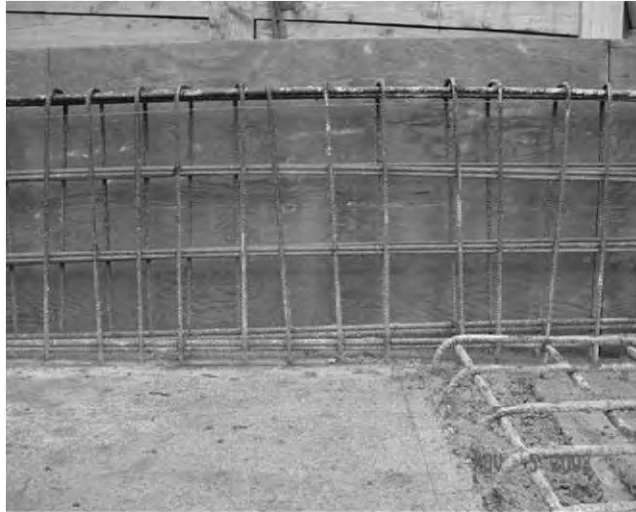
- A. Quantity
- B. Size
- C. Bend diagram
- D. Project
- E. Bar ID or mark

→ Verify



36

Doubled Up Horizontal Bars in Abutment?



QA
0007 MATERIALS &
INSPECTION

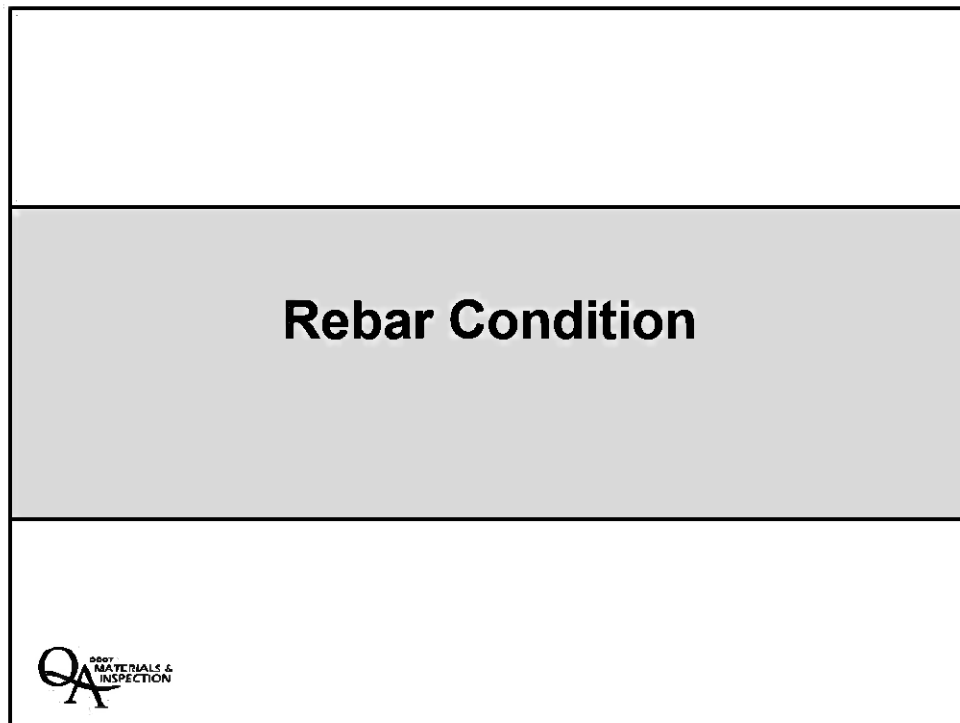
37

Hooked Bar in Middle of Deck by Itself?

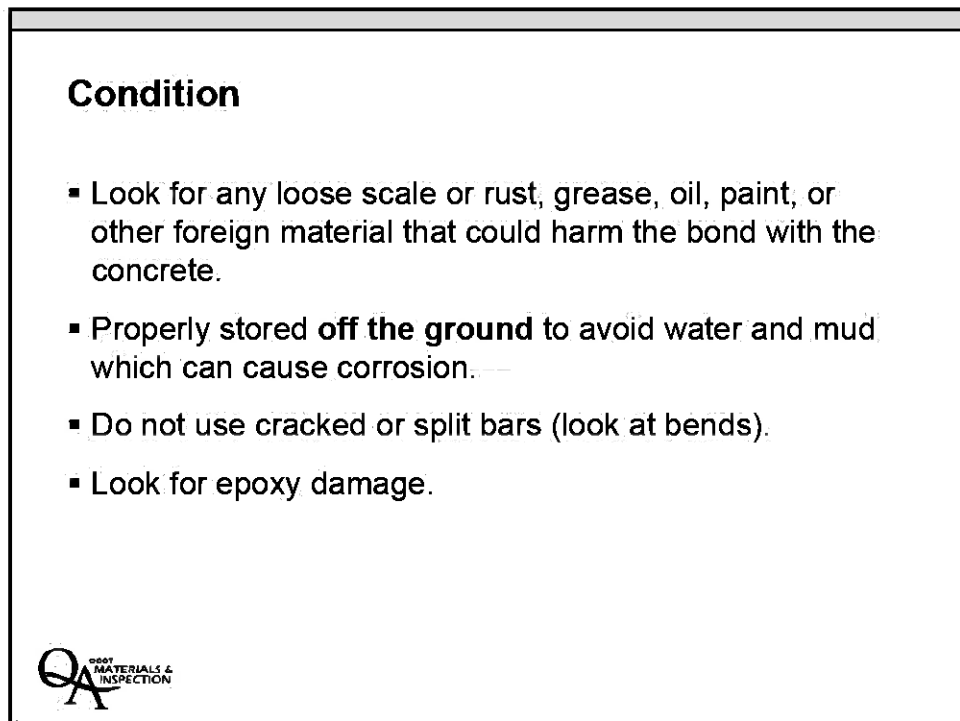


QA
0007 MATERIALS &
INSPECTION

38



39



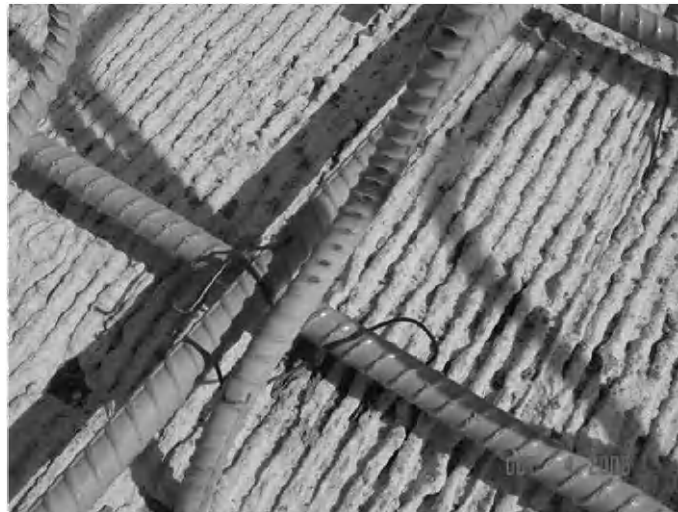
40

Field Bent Bars?



41

Epoxy Damage



42

Rebar Jobsite Storage

Total exposure time of epoxy-coated bar in storage or in place is not to exceed 2 months without covering.
(00530.40)



*Epoxy breaks
down under
prolonged UV
exposure – it
gets **chalky***

43

Faded Epoxy & Bare Ties?



QA
0001 MATERIALS &
INSPECTION

44

View WCI Video

Jobsite Handling Epoxy Coated Rebar

QA
QUALITY MATERIALS & INSPECTION

45

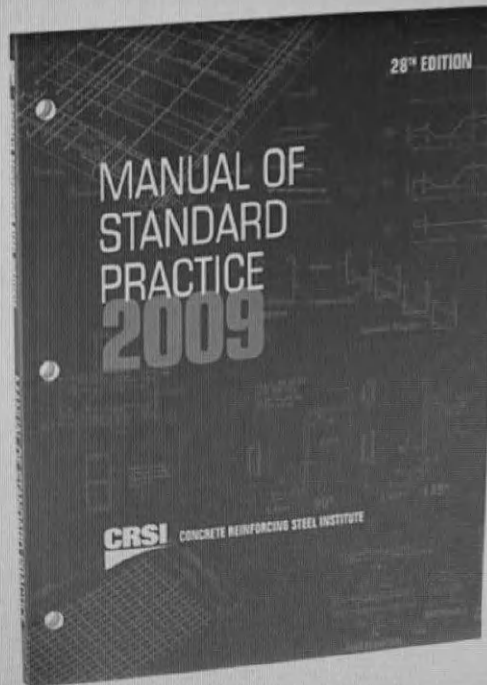
Layout

- Number
- Spacing
- Alignment

QA
QUALITY MATERIALS & INSPECTION

46

**Placement
tolerances according
to the “Manual of
Standard Practice”
00530.41**



47

Effective Depth “d”

Distance from the compression face of the beam to the centroid of the reinforcement



48

CHAPTER 8

RECOMMENDED INDUSTRY PRACTICE FOR PLACING REINFORCING BARS*

8.1 Introduction

This Chapter presents recommendations for placing reinforcing bars and is based upon industry practices that are in accordance with the ACI Building Code.

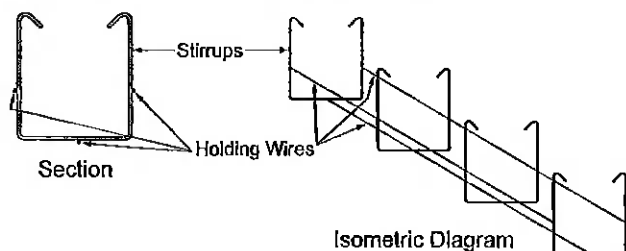
Reinforcing bars should be accurately placed in the positions shown on the placing drawings, adequately tied and supported before concrete is placed, and secured against displacement within the tolerances recommended in Section 8.8.

8.2 Welding of Reinforcing Bars

Welding of crossing bars (tack welding) should not be permitted for assembly of reinforcement unless authorized by the Architect/Engineer.

Electric resistance welds performed by computer-controlled, electronically operated welding machines in fabricating shops should be wholly differentiated from field tack welding. These electric resistance welds use a fusion process that does not introduce foreign matter to the bars or change their composition. This welding process is the same that is used for structural welded wire reinforcement (ASTM A185/A185M or A497/A497M) which is widely accepted in beams, slabs and columns. Reinforcing bar assemblies built with high-tech resistance welding machines in fabricating shops should be acceptable so long as the reinforcing bars conform to ASTM A706, holding wires conform to ASTM A82/A82M or A496/A496M, machines are operated under a continuous controlled process and test results for shop-welded specimens can be made available to the Architect/Engineer.

The holding wires serve no structural purpose but are there only to hold the reinforcement in place and, therefore, need not be subject to the same tensile, yield and elongation requirements as for the reinforcing bars.



8.3 Surface Condition of Reinforcing Bars

At the time of concrete placement, all reinforcing bars should be free of mud, oil, or other deleterious materials. Reinforcing bars with rust, mill scale, or a combination of both should be considered as satisfactory, provided the minimum dimensions, weight, and height of deformations of a hand-wire-brushed test specimen are not less than the applicable ASTM specification requirements.

8.4 Field Bending of Reinforcing Bars

Reinforcing bars should not be field bent or straightened in a manner that will reduce their strength or ductility. Bars with kinks or improper bends should not be used. No reinforcing bars partially embedded in hardened concrete should be field bent, except for:

1. Realignment of #3 through #6 [#10 through #19] bars up to about a 45° bend.
2. Realignment of #7 through #18 [#22 through #57] bars up to about 30° bend.
3. Those reinforcing bars as shown on the project drawings or permitted by the Architect/Engineer.

8.5 Spacing of Reinforcing Bars

The clear distance between parallel reinforcing bars in a layer should not be less than the nominal diameter of the bars, nor 1 inch [25 mm]. Clear distance should also not be less than one and one-third times the nominal maximum size of the coarse aggregate, except if in the judgment of the Architect/Engineer, workability and methods of consolidation are such that concrete can be placed without honeycomb or voids.

Where parallel reinforcement is placed in two or more layers, the bars in the upper layers should be placed directly above those in the bottom layer with the clear distance between layers not less than 1 inch [25 mm].

Groups of parallel reinforcing bars bundled in contact, assumed to act as a unit, not more than four in any one bundle may be used only when stirrups or ties enclose the bundle. Reinforcing bars larger than #11 [#36] should not be bundled in beams or girders. Individual bars in a bundle cut off within the span of flexural members should terminate at different points with at least 40 bar diameters of stagger. Where spacing limitations and minimum concrete cover are based on bar size, a unit of bundled bars should be treated as a single bar of a diameter derived from the equivalent total area.

In walls and slabs other than concrete joist construction, the principal reinforcement should not be spaced farther apart than three times the wall or slab thickness, nor more than 18 inches [450 mm].

In spirally reinforced and tied columns, the clear distance between longitudinal reinforcing bars should not be less than one and one-half times the nominal bar diameter, nor 1-1/2 inches [40 mm].

The clear distance limitation between bars should also apply to the clear distance between a contact lap splice and adjacent splices or bars.

*For further recommendations on bar placement, see *Placing Reinforcing Bars* available from the Concrete Reinforcing Steel Institute.

CHAPTER 8

RECOMMENDED INDUSTRY PRACTICE FOR PLACING REINFORCING BARS

8.6 Splices in Reinforcing Bars**

8.6.1 General

Splicing of reinforcing bars should be either lap splices, mechanical splices or welded splices.

Splices of reinforcing bars should be made only as required or permitted on the project drawings or in the project specifications, or as authorized by the Architect/Engineer.

8.6.2 Lap Splices

Lap splices of #14 and #18 [#43 and #57] bars should not be used, except in compression only to #11 [#36] and smaller bars.

Lap splices of bundled bars should be based on the lap splice length recommended for individual bars of the same size as the bars spliced, and such individual splices within the bundle should not overlap each other. The length of lap should be increased 20 percent for a 3-bar bundle and 33 percent for a 4-bar bundle.

Bar laps placed in contact should be securely wired together in such a manner as to maintain the alignment of the bars and to provide minimum clearances.

Bars spliced by noncontact lap splices in flexural members should not be spaced transversely farther apart than one-fifth the required length of lap nor 6 inches [150 mm].

8.6.3 Mechanical Splices

Mechanical splices should be installed in accordance with the Manufacturers' recommendations.

8.6.4 Welded Splices

All welding should conform to the current edition of "Structural Welding Code—Reinforcing Steel" (AWS D1.4/D1.4M).

8.7 Embedment and Extensions

Bottom reinforcing bars in beams should extend at least 6 inches [150 mm] into the support. Bottom bars in slabs or joists should extend into the support to the limits of the specified concrete cover or 6 inches [150 mm], whichever is less.

Generally, in one-way continuous construction, unless otherwise called for on the project drawings or in the project specifications, the top reinforcing bars should extend into adjacent spans to 0.30 of the greater clear span length beyond the far face of the support. Generally at discontinuous ends, top bars should extend into the span at least 0.25 of the clear span length beyond the face of the support and extend into the support to the specified concrete cover at the outer faces of the members into which they frame.

For structural integrity, a prescribed portion of the bottom and top reinforcement must be made continuous with the reinforcement in the adjacent spans and terminate with a standard hook or headed bar at the exterior supports. See Section 4.14 in Chapter 4.

8.8 Tolerances in Placement

Unless otherwise specified, reinforcing bars should be placed within the following tolerances as per ACI 117:

1. Tolerance for depth, d , and specified concrete cover in flexural members, walls and columns should be as follows:

Effective depth	Tolerance on d	Tolerance on specified concrete cover
$d \leq 8$ in. [200 mm]	$\pm 3/8$ in. [10 mm]	$- 3/8$ in. [10 mm]
$d > 8$ in. [200 mm]	$\pm 1/2$ in. [12 mm]	$- 1/2$ in. [12 mm]

Note: d is the specified effective depth.

Except that the tolerance for the clear distance to formed soffits should be $-1/4$ inch [6 mm], and the tolerance for concrete cover should not exceed minus one-third of the specified cover required on the project drawings or in the project specifications.

2. Tolerance for the longitudinal location of bends and ends of bars should be ± 2 inches [50 mm] except at discontinuous ends of members where the tolerance should be ± 1 inch [25 mm].
3. As long as the total number of bars specified is maintained, a reasonable tolerance in spacing individual bars is ± 3 inches [75 mm], except where openings, inserts and embedded items might require some additional shifting of bars.
4. Tolerance for length of laps in lap splices should be -1 inch [25 mm].
5. Tolerance for embedded length should be -1 inch [25 mm] for #3 through #11 [#10 through #36] bars, and -2 inches [50 mm] for #14 and #18 [#43 and #57] bars.

8.9 Bar Supports

The use of bar supports should follow the industry practices presented in Chapter 3 of this *Manual*.

Placing reinforcement on layers of fresh concrete as the work progresses and adjusting the bars during the placing of concrete should not be permitted.

The required positioning of supports in post-tensioned construction to provide the proper profile of the tendons should be in accordance with the placing drawings provided by the post-tensioning Contractor and approved by the Architect/Engineer. The sequence of placing reinforcing bars in conjunction with tendons and/or ducts should be considered by the Architect/Engineer during the design phase.

**See *Reinforcing Bars: Anchorages and Splices* by the Concrete Reinforcing Steel Institute.

CHAPTER 8

RECOMMENDED INDUSTRY PRACTICE FOR PLACING REINFORCING BARS

8.10 Concrete Protection for Reinforcing Bars

The following specified concrete cover, as per ACI 318, should be provided for reinforcing bars. For bundled bars, the specified cover should be equal to the equivalent diameter of the bundle but need not be greater than 2 inches [50 mm]; except for concrete cast against and permanently exposed to earth, the specified cover should be 3 inches [75 mm].

8.10.1 Cast-In-Place Concrete (nonprestressed)

	Concrete Cover in.	[mm]
Concrete cast against and permanently exposed to earth	3	[75]
Concrete exposed to earth or weather:		
#6 through #18 [#19 through #57]	2	[50]
#5 [#16] and smaller	1½	[40]
Concrete not exposed to weather or in contact with ground:		
Slabs, walls, joists:		
#14 and #18 [#43 and #57]	1½	[40]
#11 [#36] and smaller	¾	[20]
Beams, columns		
Primary reinforcement, ties, stirrups or spirals	1½	[40]
Shells, folded plate members:		
#6 [#19] and larger	¾	[20]
#5 [#16] and smaller	½	[15]

8.10.2 Precast Concrete (manufactured under plant control conditions)

	Concrete Cover in.	[mm]
Concrete exposed to earth or weather:		
Wall panels:		
#14 and #18 [#43 and #57]	1½	[40]
#11 [#36] and smaller	¾	[20]
Other members:		
#14 and #18 [#43 and #57]	2	[50]
#6 through #11 [#19 through #36]	1½	[40]
#5 [#16] and smaller	1¼	[30]
Concrete not exposed to weather or in contact with ground:		
Slabs, walls, joists:		
#14 and #18 [#43 and #57]	1¼	[30]
#11 [#36] and smaller	⅝	[15]
Beams, columns:		
Primary reinforcement	d_b^*	
Ties, stirrups or spirals	¾	[10]
Shells, folded plate members:		
#6 [#19] and larger	⅝	[15]
#5 [#16] and smaller	¾	[10]

* But not less than 5/8 inches [15 mm] and need not exceed 1-1/2 inches [40 mm].

CHAPTER 8

RECOMMENDED INDUSTRY PRACTICE FOR PLACING REINFORCING BARS

8.10.3 Post-Tensioned Concrete

	Concrete Cover	
	in.	[mm]
Concrete cast against and permanently exposed to earth	.3	[75]
Concrete exposed to earth or weather:		
Wall panels, slabs, joists	.1	[25]
Other members	1½	[40]
Concrete not exposed to weather or in contact with ground:		
Slabs, walls, joists	¾	[20]
Beams, columns:		
Primary reinforcement	1½	[40]
Ties, stirrups or spirals	.1	[25]
Shells, folded plate members:		
#6 [#19] and larger	d_b^*	
#5 [#16] and smaller	¾	[10]

* But not less than ¼ inches [20].

8.10.4 Corrosive Atmosphere or Severe Exposure

In corrosive atmospheres or severe exposure conditions, the amount of concrete protection should be suitably increased, and the denseness and nonporosity of the protecting concrete should be considered, or other protection should be provided.

8.11 Field Cutting of Reinforcing Bars

Various means are used to cut reinforcing bars at the job-site. The smaller size bars, #3 to #5 [#10 to #16], can usually be cut with bolt-cutters. All bar sizes can be cut with an abrasive saw or by flame-cutting such as using an oxy-acetylene torch.

Regarding flame-cutting, tests have shown that any effect of flame-cutting is localized to the end-cut surfaces. Only a very short distance, approximately ⅜ inch [5 mm], from the flame-cut ends is affected. Hardness testing was used to evaluate the effects of flame-cutting on the tensile properties of the bars. From the tests it was concluded that flame-cutting had no adverse effects.

Flame-cutting of epoxy-coated reinforcing bars is not recommended.

Bar Layout

- Longitudinal bars inside rectangle bars
- Keeps longitudinal bars confined



49

Transverse Bar Alignment Shift?



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50

Longitudinal Bar Alignment Shift?



51

Bar Supports



52

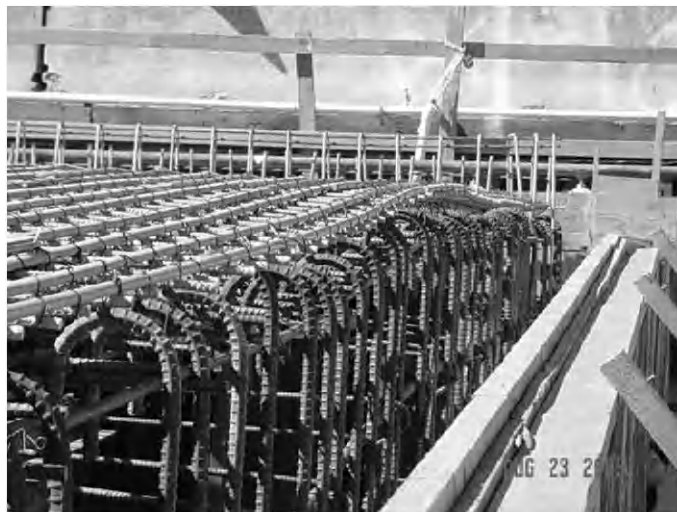
Rail Stirrup Height Uneven?



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MATERIALS &
INSPECTION

53

Transverse Deck Bars Drop at Corner?



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0007
MATERIALS &
INSPECTION

54

Bar Supports 00530.41(b) & (c)

- 2' Centers (plans)
- Concrete blocks (Dobies) or other approved devices
- No rocks, broken brick, or wood



55

Bar Supports Plans, General Notes

Support the bottom mat reinforcing steel from the forms with precast mortar blocks at 24" max. centers each way. Support the top mat reinforcing steel from the bottom mat reinforcing steel with wire bar supports as shown in Chapter 3 of the CRSI Manual of Standard Practice (SBU, BBU or CHCU). Place wire bar supports at 24" max. centers.



56

Large Support Spacing Caused Epoxy Ties to Unzip



57

Buried Bar

- Transverse top mat to aid placing bars
- Placed every 15 ft to keep bars from rolling
- Changes strength
- EOR required adding another bar on top to retain design strength



58

Buried Bar

Do not allow longitudinal buried bar along outside battered form.



59

Ties



60

Ties 00530.41(b)

Top mat of footings & decks:

- Tie 100%
- If spacing < 6" tie 50%

Other locations:

- Tie 100%
- If spacing < 1' tie 50%

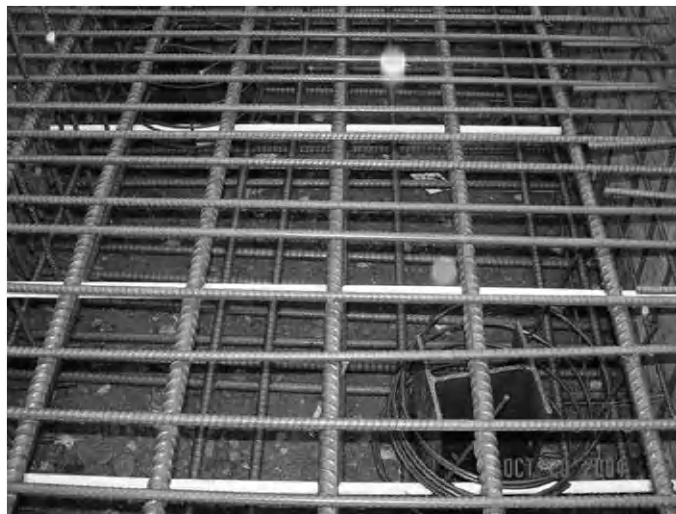


Epoxy coated ties
for epoxy rebar



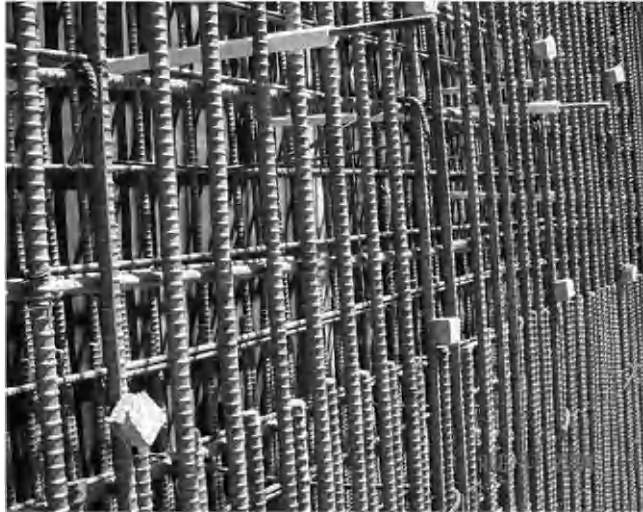
61

No Ties for Up to 10 Feet?



62

Missing Ties

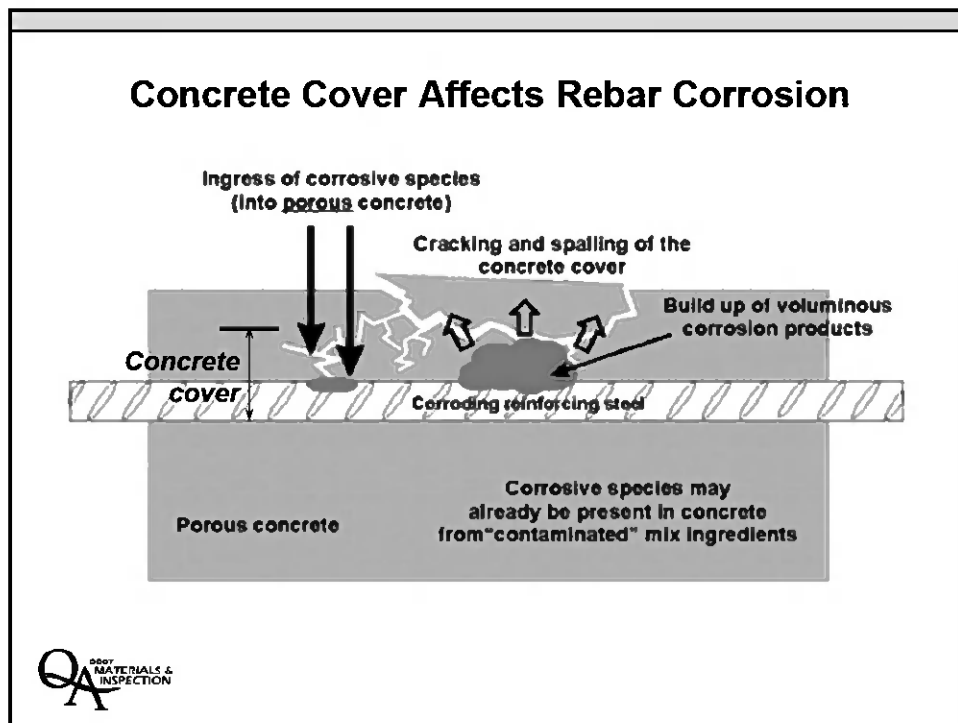


63

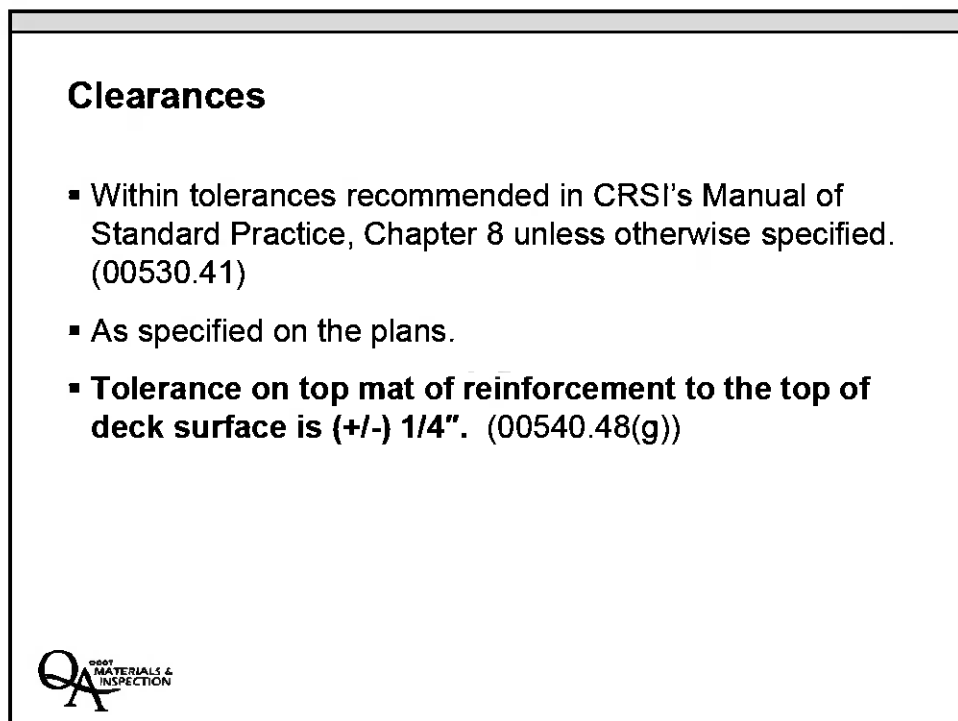
Clearances



64



65



66

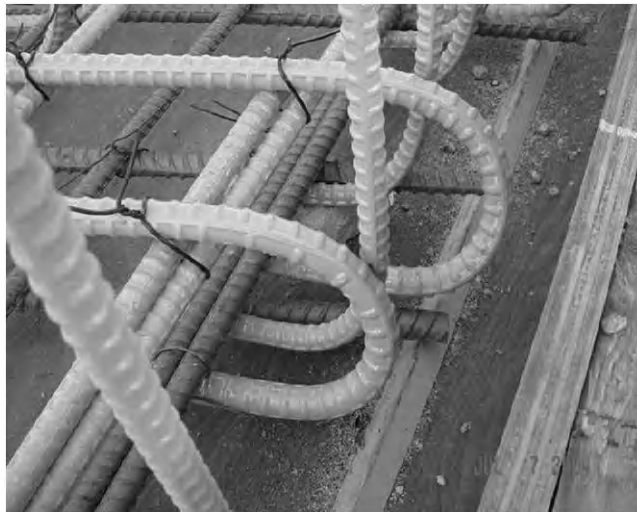
Hooked Bar Laying on Form?



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67

Transverse Bar on Chamfer Strip?



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68

Transverse Deck Bar Under Drip Strip?



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69

Transverse Bar Touching Fillet Form?



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70

$\frac{3}{4}$ " Clearance Under Deck Rebar Over Slabs?



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71

**Bottom Transverse Bars in Pilecap
Touching Forms?**



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72

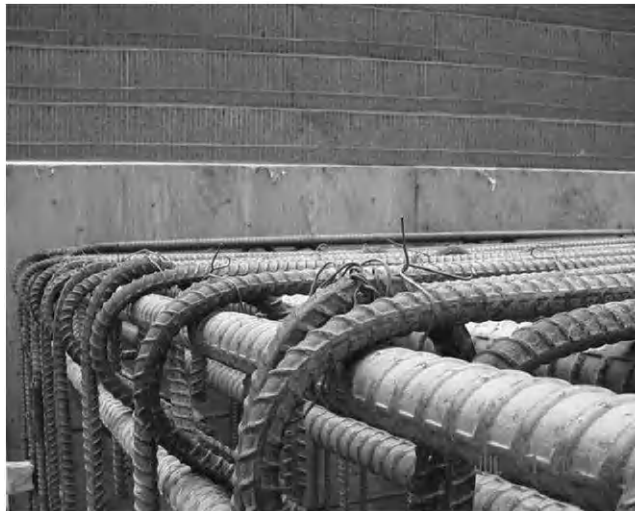
Bar Touching Form in Crossbeam?



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73

High Stirrup in Crossbeam?



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74

Watch Clearances on Rail Windows



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75

$\frac{1}{2}$ " Clearance on Vertical Rail Bars to Window Form



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INSPECTION

76

**How far are rail stirrups
from the deck side form?**



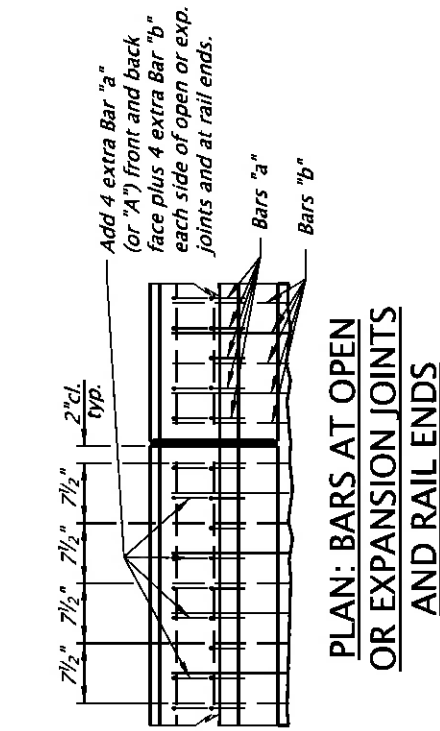
77

Clearance Exercise

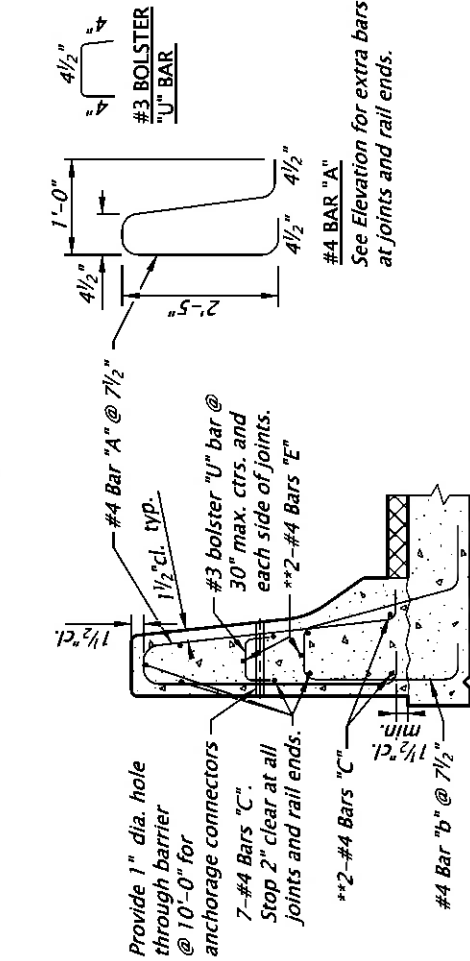
Calculate the distance from the rail stirrups to the deck side form for standard F Rail.



78



ELEVATION: CONCRETE BRIDGE RAIL (Fixed Forms)



TYPICAL SECTION (Slip Formed)

GENERAL NOTES

TYPICAL SECTION (Fixed Forms)

① 1/2 ***

1 1/2" cl.

3"

3/4" V-Groove

Roughen construction joint

Rail designed and crashed tested to meet NCHRP 350 TL-4 requirements. Provide all reinforcing steel conforming to ASTM A706 or AASHTO M31 (ASTM A615) Grade 60.

Place all bars 2" clear of the nearest face of concrete unless shown otherwise.

Provide Class 3300 – 1½ or ¾ concrete.

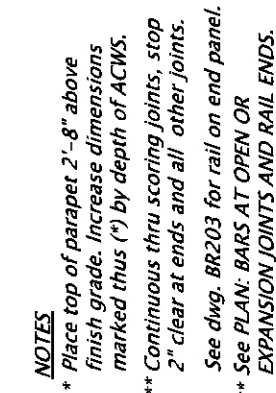
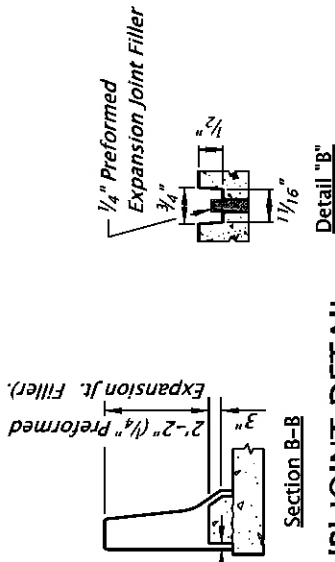
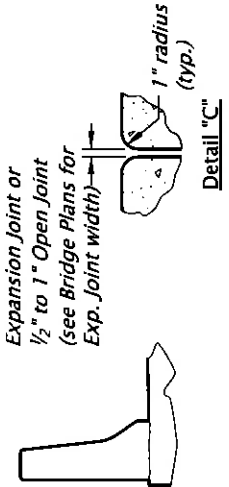
Provide steel cover plates conforming to AASHTO M183 (ASTM A36).

Hot dip galvanize after fabrication.

At skewed bents up to 20° make joints parallel to the bent center line.

For skews greater than 20° make joints normal to rail.

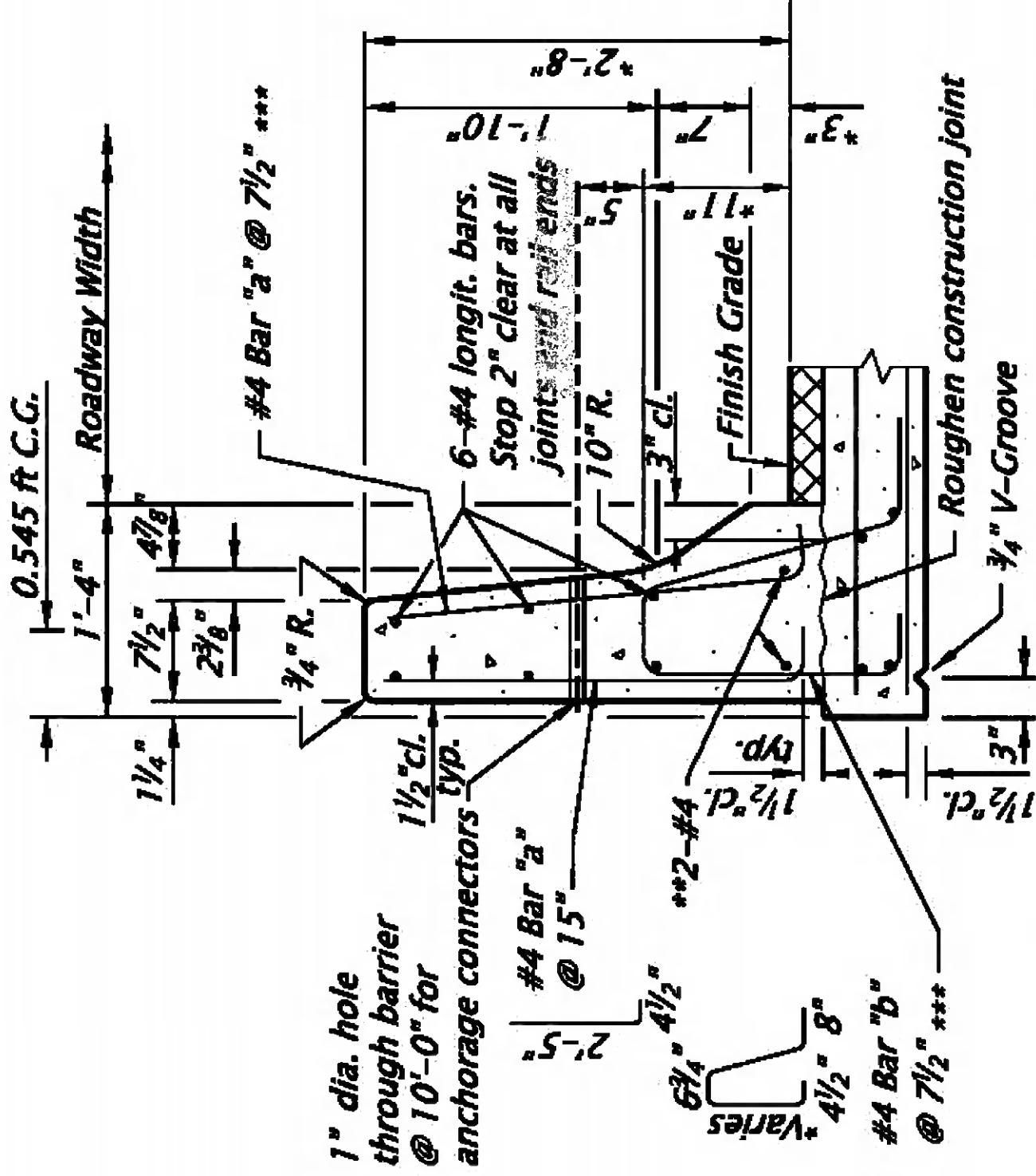
OPEN OR EXPANSION JOINT DETAIL



(Fixed Forms)

gineer.

OREGON STANDARD DRAWINGS	
CONCRETE BRIDGE RAIL TYPE "F"	
2018	
DATE	REVISION DESCRIPTION

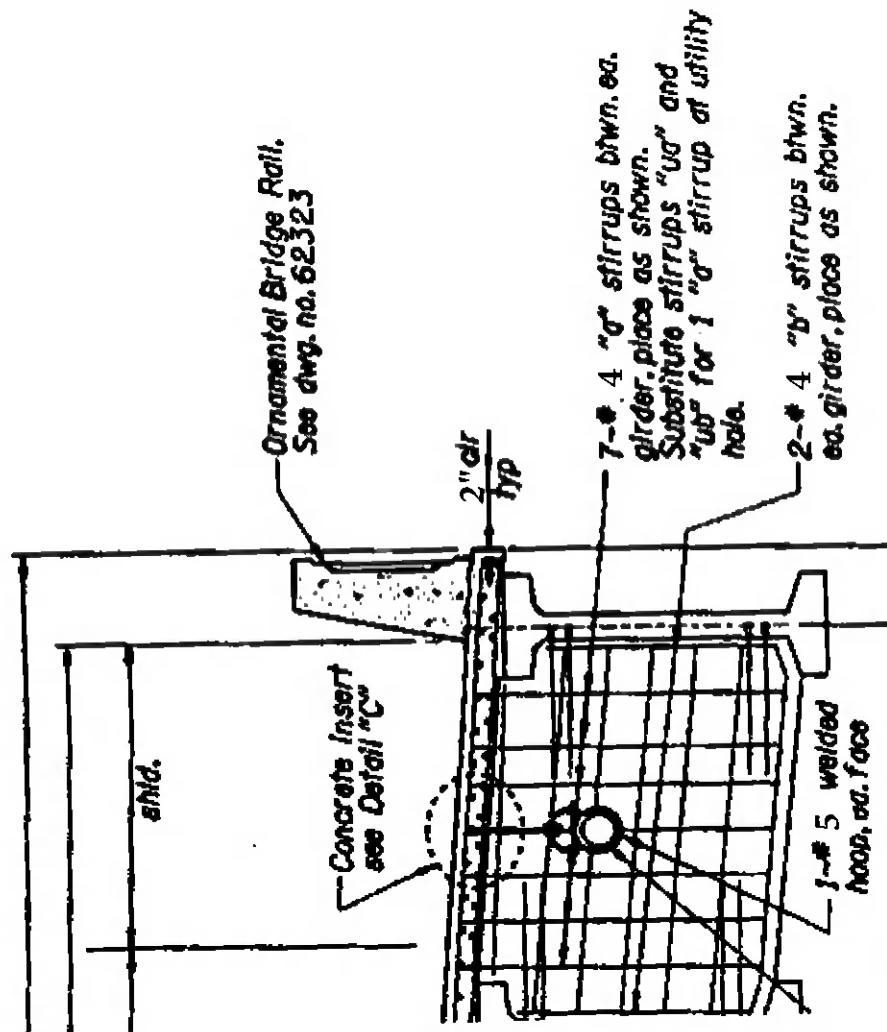


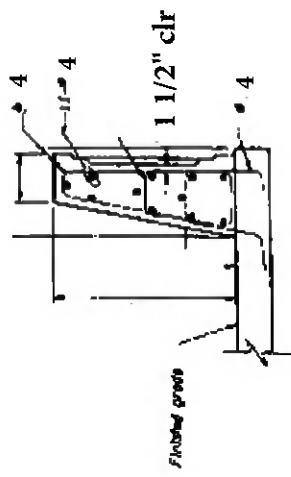
TYPICAL SECTION (Fixed Forms)

Clearance Exercise

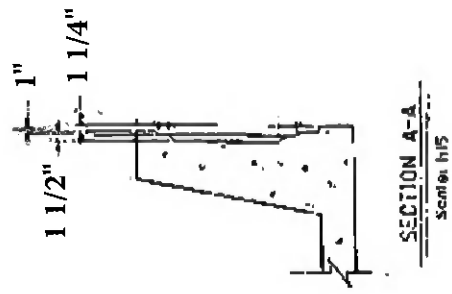
Calculate the distance from the rail stirrups to the deck side form for the ornamental rail.







TYPICAL ORNAMENTAL RAIL SECTION
 Scale: 1/4"

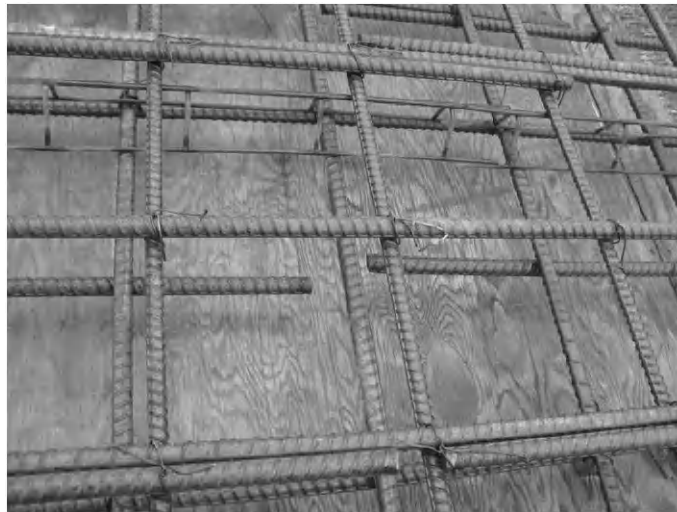


Splices



81

No Splice?



82

Splices

- As permitted per plans (stagger as required)
- Splice bars No. 11 & smaller by **lapping** or **approved mechanical splice**.
- Splice bars No. 14 and larger with an **approved mechanical splice only**.
- Welded only with prior approval and with a certified welder.



83

Lap Splice **00530.42(b)**

- Place bars in contact.
- Fasten with 3 ties/splice minimum.
- Length as shown (General Notes).
- Epoxy coated reinforcement requires longer splice length.



84

Reinforcing Splice Lengths (Class B) Grade 60 $f'_c = 4.5 \text{ ksi}$, $\lambda_{ci} = 0.4$, 2 in min. concrete clear cover										
Bar Size	#3	#4	#5	#6	#7	#8	#9	#10	#11	#14 & #18
Uncoated	1'-4"	1'-6"	1'-11"	2'-3"	2'-7"	3'-0"	3'-4"	3'-9"	4'-2"	Not permitted
Coated (1)	1'-4"	1'-10"	2'-3"	2'-8"	3'-2"	3'-7"	4'-0"	4'-6"	5'-0"	Not permitted
Coated (2)	1'-8"	2'-3"	2'-10"	3'-4"	3'-11"	4'-5"	5'-0"	5'-8"	6'-3"	Not permitted

Use Coated (1) for epoxy coated bars with cover at least $3*d_b$ and clear spacing between bars at least $6*d_b$.

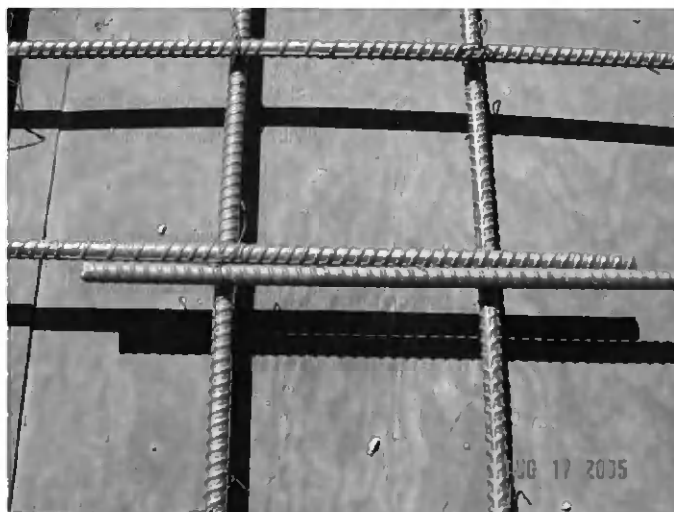
Use Coated (2) for epoxy coated bars with cover less than $3*d_b$ or clear spacing between bars less than $6*d_b$.

Increase all splice lengths 30% for horizontal or nearly horizontal bars so placed that more than 12" of fresh concrete is cast below the bar.

Splice reinforcing steel at alternate bars, staggered at least one splice length or as far as possible, unless shown otherwise.

85

1 Tie on Splice?



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86

1 Tie on Splice?



87

Mechanical Splice

00530.42(c)

- Construct per Specifications and manufacturer's recommendations.
- Construct test splices in the presence of the Engineer.
- Install splices in the presence of the Engineer. Splices made without the Engineer present will be rejected.



88

Mechanical Splice Installers

00530.30

- Provide qualified mechanical splice installers.
- Construct test splices in the presence of the Engineer.
- Construct 3 splice samples per type and size for each installer.
- Do not begin splice installation until installers have been approved.



89

Spliced Bars Project Up?



90

Spliced Vertical Column Bars



91

Reinforcement Inspection

- Inspection of the forms and reinforcement takes time.
- Check early and often to help assure they are doing things correctly and to avoid minimal rework. Do not wait until just before the concrete placement.
- Do a final check just prior to the concrete placement to assure everything still looks good.



92



Deck Rebar Checklist

Project Information

Project Name (Section)		Contract No.	
Highway		Federal Aid No.	
Contractor or Subcontractor			

Deck Placement Date:

Item	Inspected				Remarks
	Yes	No	N/A	Date (mm/dd/yyyy)	
1 Bottom Mat Bar Size & Spacing	☐	☐	☐		
2 Bottom Mat Ties @ 50%	☐	☐	☐		
3 Bottom Mat Clearance	☐	☐	☐		
4 Epoxy Ties (if epoxy bars)	☐	☐	☐		
5 Supports @ 2' Centers	☐	☐	☐		
6 Clearance @ Drip Strip	☐	☐	☐		
7 Lap Splices have three (3) ties	☐	☐	☐		
8 Top Mat Bar Size & Spacing	☐	☐	☐		
9a Top Mat Ties @ 100% if spacing is greater than or equal to 6"	☐	☐	☐		
9b Top Mat Ties @ 50% if spacing is less than 6"	☐	☐	☐		
10 Top Mat Bars directly over Bottom Mat Bars	☐	☐	☐		
11 Top & Bottom Mat Bars installed parallel to skewed joint at both ends of deck	☐	☐	☐		
12 Side & End Form Clearances	☐	☐	☐		
13 Rail Stirrup Size & Spacing	☐	☐	☐		
14 Additional Rail Stirrups @ Joints	☐	☐	☐		
15 Rail longitudinal bars cut at joint except bottom two	☐	☐	☐		
16 Rail 1-1/4" inside Edge of Deck	☐	☐	☐		
17 Rebar Support @ Corners	☐	☐	☐		
18 Dry Run Clearance Check	☐	☐	☐		

Remarks

Inspected by Date



PREPOUR CHECKLIST

PROJECT NAME (SECTION)		CONTRACT NO.	
HIGHWAY		FEDERAL AID NO.	
CONTRACTOR OR SUBCONTRACTOR			
PLACEMENT:			
	<u>DATE</u>	<u>INITIALS</u>	<u>REMARKS</u>
REINFORCEMENT			
FABRICATION			
INSTALLATION			
CLEARANCE			
FORMS			
DIMENSIONS			
CONST JOINTS			
IMBEDDED ITEMS			
BLOCKOUTS			
SURVEY/GRADE			
CONCRETE PLACEMENT			
PLACING METHOD			
QUANTITY			
POUR CREW			
VIBRATION			
LIFT SIZE			
WEATHER			
DURATION			START _____ FINISH _____
TESTING			
MIX DESIGN #			
QCT			
TEST RESULTS			
REJECTED LOADS			
REMARKS			
REMARKS			
PREPARED BY:			WORK DATE:



PREPOUR CHECKLIST

PROJECT NAME (SECTION) <u>FORM SAMPLE</u>			CONTRACT NO. <u>12345</u>
HIGHWAY <u>THE DALLES - CALIFORNIA</u>			FEDERAL AID NO. <u>BRF-RSTP-S004 (32)</u>
CONTRACTOR OR SUBCONTRACTOR <u>JD CONTRACTORS, INC.</u>			
PLACEMENT: <u>BOTTOM SLAB POUR 3; SPANS 2/3 & 8/9</u>			
	DATE	INITIALS	REMARKS
REINFORCEMENT			
FABRICATION	<u>2-29-00</u>	<u>BAP</u>	<u>MOSTLY STRAIGHT BARS, ALL CORRECT LENGTH</u>
INSTALLATION	<u>2-29-00</u>	<u>BAP</u>	<u>PLACED AS PER PLANS</u>
CLEARANCE	<u>2-29-00</u>	<u>BAP</u>	<u>40' CLEAR OF FORMS, TOP BETWEEN MATS</u>
FORMS			
DIMENSIONS	<u>3-13-00</u>	<u>BAP</u>	
CONST JOINTS	<u>3-13-00</u>	<u>BAP</u>	<u>SPAN 1/10 BUSH HAMMER & PRESS WASH, SPAN 3 & 8 SURFACE RETARDER</u>
IMBEDDED ITEMS	<u>3-13-00</u>	<u>BAP</u>	<u>VENT TUBES IN WING SECT & HIGH PT EACH SPAN</u>
BLOCKOUTS	<u>3-13-00</u>	<u>BAP</u>	<u>FALSWORK LOWERING & DRAIN HOLES</u>
SURVEY/GRADE			
CONCRETE PLACEMENT			
PLACING METHOD	<u>3-14-00</u>	<u>BAP</u>	<u>PUMP, 32m SCHWING - PCP</u>
QUANTITY	<u>3-14-00</u>	<u>BAP</u>	<u>250 m³</u>
POUR CREW	<u>3-14-00</u>	<u>BAP</u>	<u>3 FINISHERS (LARGO), 2 VIB (KPC)</u>
VIBRATION	<u>3-14-00</u>	<u>BAP</u>	<u>ONE HIGH CYCLE</u>
LIFT SIZE	<u>3-14-00</u>	<u>BAP</u>	<u>FULL DEPTH 250mm</u>
WEATHER	<u>3-14-00</u>	<u>BAP</u>	<u>FAIR, 50 1/6 (°F) & WINDY (10-15 MPH CONSISTANT)</u>
DURATION			<u>START _____ FINISH _____</u>
TESTING			
MIX DESIGN #	<u>3-14-00</u>	<u>BAP</u>	<u>2 M1 ROUND ROCK</u>
QCT	<u>3-14-00</u>	<u>BAP</u>	<u>DON BRANDON & MIKE LESNEQUE 2 M1</u>
TEST RESULTS	<u>3-14-00</u>	<u>BAP</u>	<u>AIR 6-7%, SLUMP 150 TO 175 mm</u>
REJECTED LOADS	<u>3-14-00</u>	<u>BAP</u>	<u>NONE</u>
REMARKS	<u>3-14-00</u>	<u>BAP</u>	<u>VERY SMOOTH</u>
REMARKS			
FIRST USE OF ROUND ROCK CLASS 35 MIX, VERY CONSISTANT TESTING, SLUMPS SAME THRU LOADS. PUMPING VERY EASY. SCREEDING & FINISHING WENT VERY WELL. PLACED ABOUT 35 m³/HR, 9 HRS TOTAL TIME.			
PREPARED BY: <u>IM INSPECTOR</u>			WORK DATE: <u>6-26-06</u>

INSERT TAB

**Unit 6
Bridge
Foundations**

Section 6

Bridge Foundations

ODOT Video, Part 6/12: Introduction To Bridge Foundations	1
Common Foundation Types	2
Spread Footings	3
Footing Concrete Volume	5
Structure Excavation	12
Foundation Reports	16
Cofferdams	17
ODOT Video, Part 8/12: Wet Structures Excavation	18

Bridge Foundations

Section 6



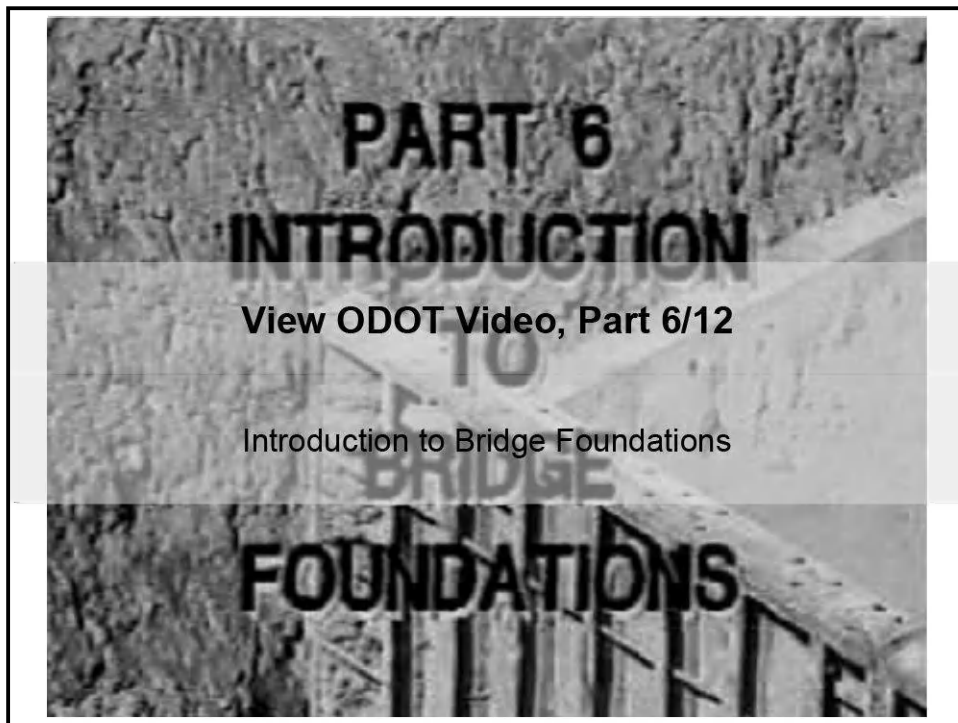
1

Bridge Foundations

The foundations of a bridge are particularly critical because they must support the entire weight of the bridge and the traffic loads that it will carry.



2



3

Common Foundation Types

- Spread Footing
- Piling
- Drilled Shafts



4

Type Of Excavation

“Dry” Excavation:

Generally stable with no waterway or de-stabilizing groundwater

“Wet” Excavation:

In or near water or significant groundwater



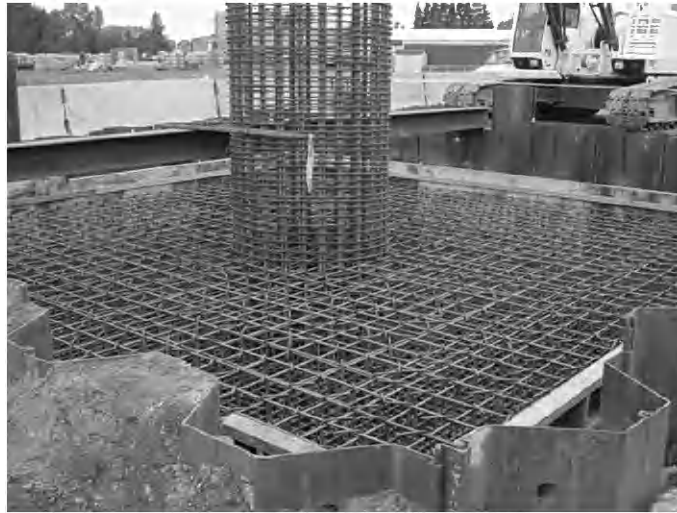
5

Spread Footings



6

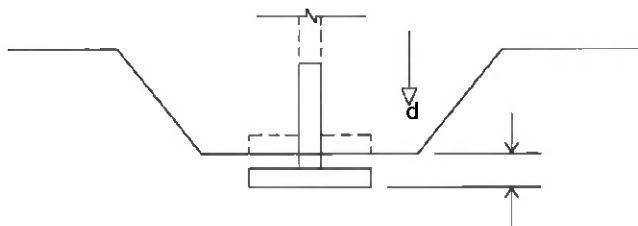
Spread Footings



7

Spread Footings

Settlement "d" < allowable settlement in project specifications.



8

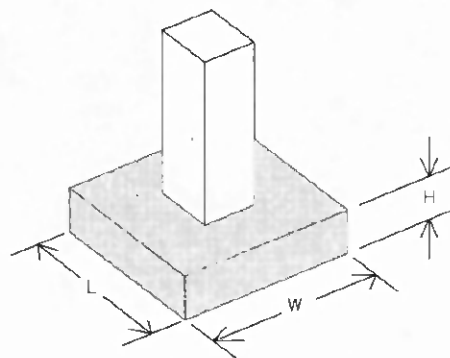
Spread Footings

- Check the Foundation Report and Drill Logs to verify that the actual foundation material exposed below the footings matches what was anticipated.
- If there are **any questions** related to foundation material suitability **contact the Geotechnical Engineer**.



9

Spread Footings



$$V = L \times W \times H$$



10

Footing Concrete Volume Example

- Footing Size: 14 ft long x 10 ft wide x 5 ft high
- Volume = (14 ft)(10 ft)(5 ft) / (27 cf/cy)
- V = 26 cy



11

Footing Concrete Volume Exercise

Footing Size: 12 ft long x 9 ft wide x 6 ft high

Volume =



12

Spread Footings

Open-Pit Excavations

- Walls of excavation are sloped for safety.
- No shoring required.
- Wide enough for workers outside of footing.



13

Spread Footings

Open-pit excavations are permitted when:

- Not in or near water.
- The soil material is adequately stable to ensure worker safety.
- The soil can be maintained in a dry condition.
- There is no threat of compromising the stability of any nearby structure or the structure being built.

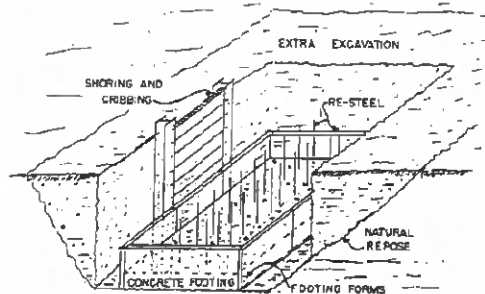


14

Spread Footings

Shored excavations

Shoring and cribbing:
A series of horizontal and vertical members that resist the surrounding soil pressure.



15

Spread Footings

Shored Excavations must be used when:

- The excavation is greater than 4 feet deep.
- The soil is not stable enough to ensure worker safety.
- The presence of adjacent structures limits the allowable size of the excavation.

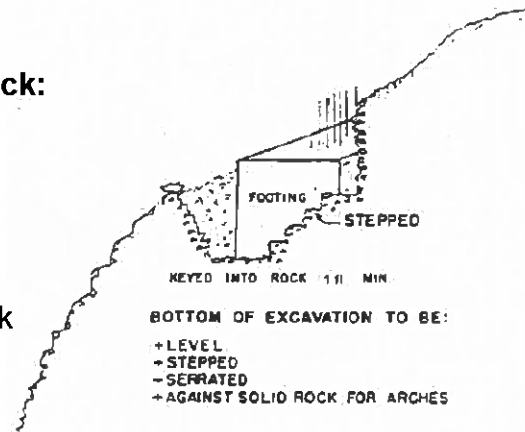


16

Spread Footings

Foundations on rock:

- Level
- Stepped
- Serrated
- Against solid rock
- For arches



17

Spread Footings

Unsuitable soils for spread footings:

If **any evidence** of problematic soils is discovered during footing construction, work should be stopped, and the Engineer should be contacted immediately.



18

Spread Footings

Items to inspect for with spread footings:

- Elevation
- Dimensions
- Reinforcement
- Soil stability



19

Spread Footings

Items to inspect for spread footings:

- Concrete cover. Dobies settle into base rock and may require larger size to maintain proper clearance.
- 3" clearance if pouring against natural ground



20

Unstable or Disturbed Materials

- Must be removed and replaced as directed.
- Structure fill must be placed in layers of not more than 6 inches. (00510.46(a))
- Each layer must be compacted to 95% of maximum density, or as specified. (00510.46(a))
- Any foundation must be approved by the Engineer before any concrete placement.



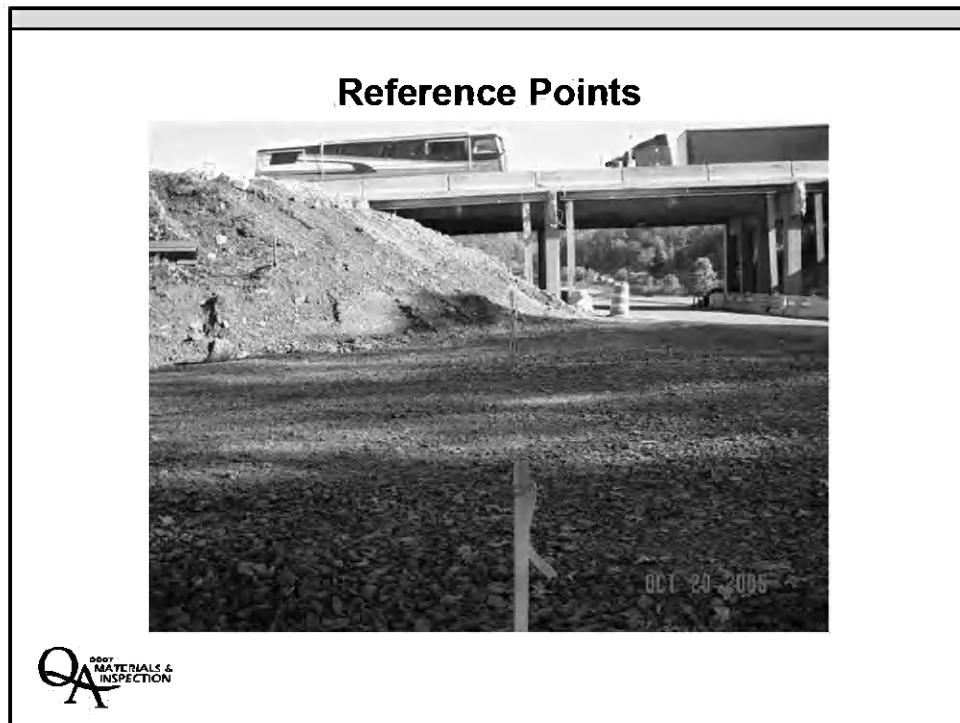
21

Foundation Location

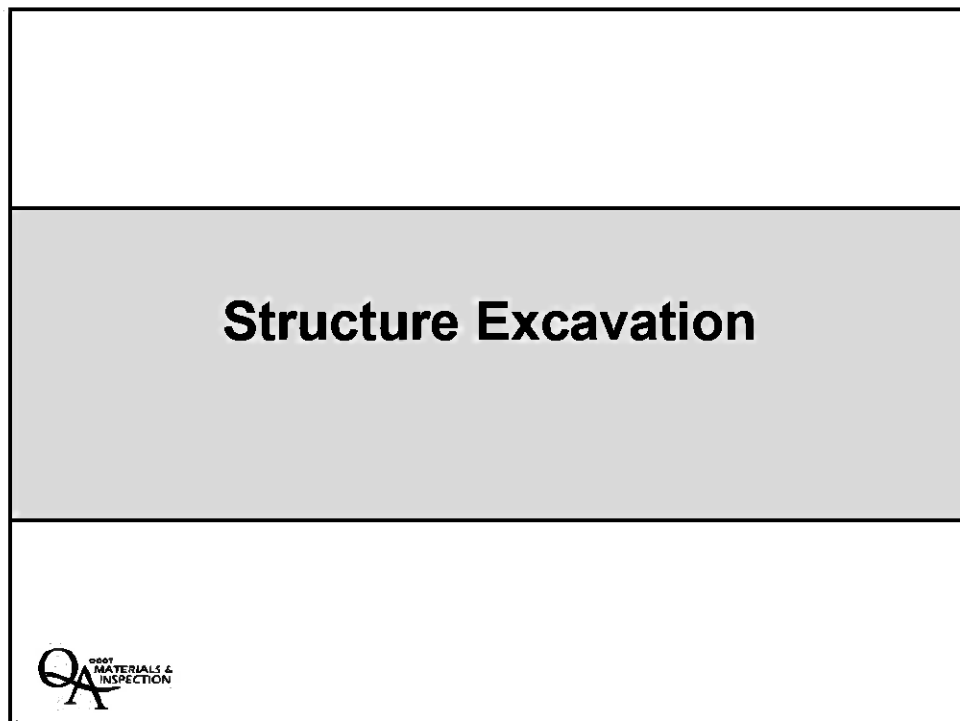
Check correct position and preserve offset reference points.



22



23

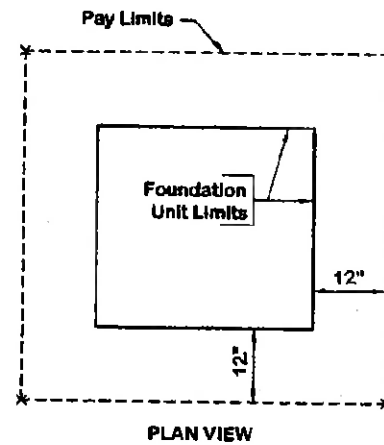


24

Structure Excavation

Measuring Excavation / Backfill

- Cross-Section original ground before excavation begins.
 - Normal volume bounded by vertical planes 1 foot outside the footing.
- (00510.80(b)(2)(c))

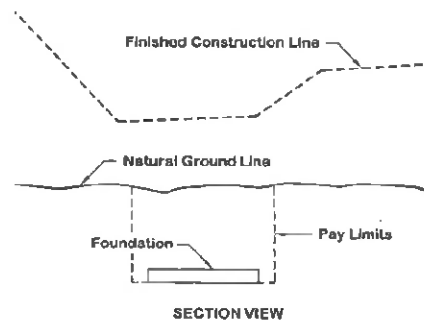


25

Structure Excavation

Measuring Excavation

- Volume of excavation is from bottom of footing to natural ground line.
 - Volume to nearest 0.1 cy
- (00190.10 (e))

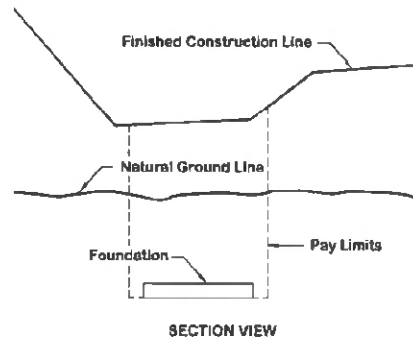


26

Structure Excavation

Measuring Backfill

Volume of backfill is from bottom of footing to finished construction line.



27

Structure Excavation Volume Example

Pier footing size is 20 ft x 10 ft

Average Depth of excavation is 5 ft

What is the volume of excavation that will be paid for?

$$\text{Volume} = L \times W \times H$$

$$\text{Volume} = (22 \text{ ft}) (12 \text{ ft}) (5 \text{ ft}) / 27 \text{ cf/cy}$$

$$\text{Volume} = 48.9 \text{ cy}$$



28

Structure Excavation Exercise

Pier footing size is 18 ft x 15 ft

Average Depth of excavation is 7 ft

What is the volume of excavation that will be paid for?

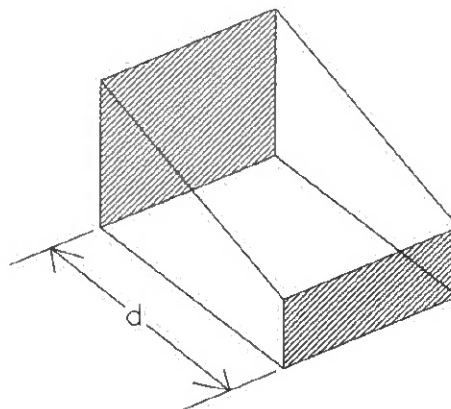
Volume =



29

Calculate Volume by Average End Area

- Measure end areas
- Average end areas
- Measure horizontal distance "d" between areas
- Multiply average end area by horizontal distance "d"



30

Average End Area Example

Left End of Excavation is 10 ft wide x 6 ft high

Right End of Excavation is 10 ft wide X 10 ft high

What is volume of excavation if it is 30 ft long:

Left End Area = $(10 \text{ ft})(6 \text{ ft}) = 60 \text{ sf}$

Right End Area = $(10 \text{ ft})(10 \text{ ft}) = 100 \text{ sf}$

Volume = $((60 \text{ sf} + 100 \text{ sf}) / 2)(30 \text{ ft}) / 27 \text{ cf/cy}$

Volume = 88.9 cy



31

Average End Area Exercise

Left End of Excavation is 12 ft wide x 4 ft high

Right End of Excavation is 12 ft wide X 10 ft high

What is volume of excavation if it is 20 ft long:

Left End Area =

Right End Area =

Volume =



32

Foundation Reports


33

Foundation Exercise From the Foundation Report (page 14), determine the type of bridge foundation to be used for Bridge #21162. From the Drill Log determine the anticipated type of material to be encountered. Bridge foundation: _____ _____ _____ Anticipated material: _____ _____


34

Geotechnical and Foundation Report

Dodge Canyon Creek Bridge, Bridge 21162, M.P. 20.95

Dodge Canyon Creek Bridge, Bridge 21163, M.P. 21.15

Calapooya Creek Bridge, Bridge 20861, M.P. 22.10

**OR138W: Dodge Cr/Calapooya Cr Bridge Replacements
Elkton – Sutherlin Hwy (Hwy. 231, M.P. 20.74 – 22.22)
Douglas County**

Published: August 2010

Bid Date: November 2010

EA PE001472-000

Key 16796 (old Keys 14813 and 15970)

**Oregon Department of Transportation
Region 3 Tech Center
Geo\Environmental Unit**



event) of the soil samples appeared to have liquefaction potential. Given the disjointed nature of the alluvial stringers which have been deposited and re-cut by the creek, it is believed the samples indicating liquefaction potential are not continuous enough to suggest a layer of soil is subject to appreciable liquefaction risk.

6.0 FOUNDATION DESIGN RECOMMENDATIONS

In accordance with ODOT's design practice, the foundation design was performed using AASHTO LRFD Bridge Design Specifications, 2007, 4th edition (with 2008 interims). Foundation design recommendations for the bridge are discussed below under the subsection following headings.

6.1 Dodge Creek Bridge 21162

It is recommended that the end bents (Bent 1 & 2) of the proposed single-span bridge be founded on HP14x89 driven H-pile with tip protection. Piles are considered the best option for the subsurface conditions encountered. The piling will derive their axial capacity, primarily through end bearing on and within the Tenmile Bedrock Formation.

The resistance factor for Bents 1 and 2 is 0.40 as determined from LRFD Table 10.5.5.2.3-1 for nominal resistance of a single pile in compression using static pile analysis with a combination of the Nordlund and Tomlinson methods and pile driving criteria determined by Wave Equation. Due to driving stress limitations induced during the driving process, the piles are recommended to be ASTM A572, Grade 50 (50 ksi yield strength). Due to driving stress limitations induced during the driving process, the recommended factored resistances are based on ASTM A36 (36 ksi yield strength) and are therefore less than the actual structural capacity of the pile. Table 1 provides detailed information for the piling recommended for Bents 1 and 2.

Bent	Pile Type, Size, Material Specification & Tip Treatment	Ultimate (Nominal) Capacity (kips)	Resistance Factor	Factored Resistance (kips)	Pile Driving Criteria	Estimated Average Cutoff Elevation (ft)	Estimated Length (ft)	Minimum Required Tip Elevation (ft)
1	HP14x89 ASTM A572 Grade 50 Reinforced Tip	940	0.40	375	Wave Equation	434	30	415
2						434	35	412

Table 1 – Dodge Creek Bridge 21162, Axial Pile Capacity Information

The pile sizes provided in Table 1 are based on axial loading of the pile. If controlling loads other than the axial loads contemplated, are anticipated, then the pile should be evaluated for those loads and sized accordingly. The cutoff elevation was estimated by assuming 2 ft. embedment into the pile cap. If the cutoff elevation listed in Table 1 is revised by 2 ft. or more, the Geotechnical Engineer should be given the opportunity to revise the estimated pile lengths to be included in the Special Provisions for the project. The estimated pile length is based on the difference between the estimated cutoff elevation and the estimation that the pile will have a penetration of approximately 7 ft. into the moderately to slightly weathered Tenmile Bedrock Formation. The minimum required tip elevation for this bridge is based on the rock contact of the adjacent test holes.

For pile foundations designed in accordance with the above recommendations, settlement is estimated to be less than approximately 1 inch and to be elastic in nature, occurring as the load is applied.

6.1.1 Lateral Pile Load Capacity

The pile foundations will be subject to lateral loads resulting from live loads, wind and earthquake loading. The laterally loaded pile analysis may be performed with the aid of the "L-Pile" computer program, geotechnical input parameters for the L-Pile program are provided in Table 2. Ground water should be assumed at an elevation of 420 ft..

DRILL LOG OREGON DEPARTMENT OF TRANSPORTATION

Page 1 of 2

Hole No.	15970-01
E.A. No.	PE001462
Key No.	15970
Start Card No.	
Bridge No.	21162
Ground Elev.	437.3 ft
Tube Height	

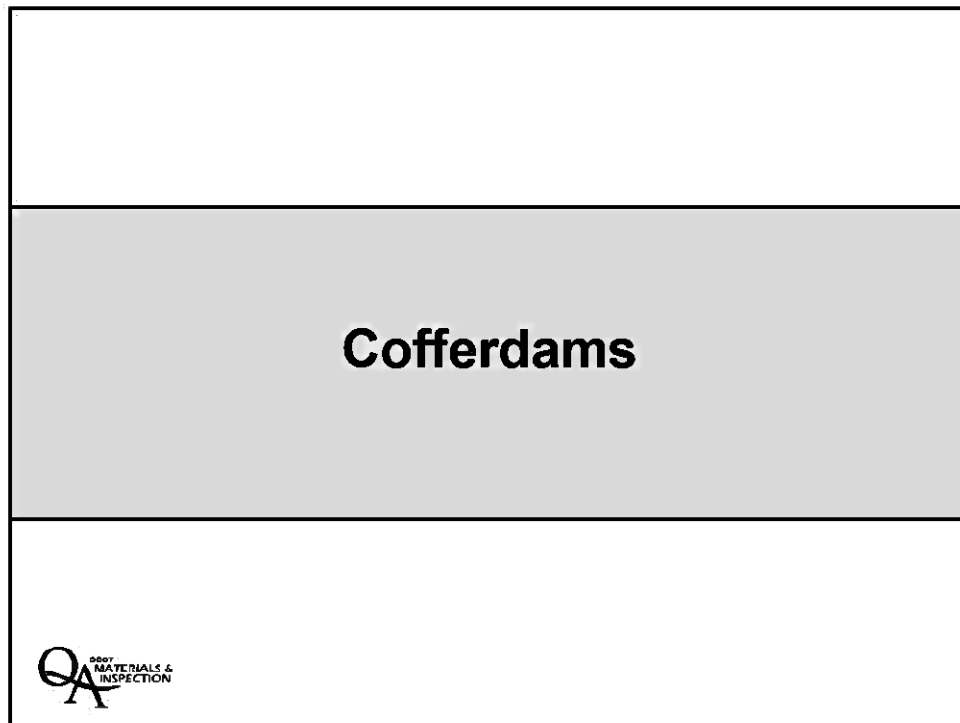
Project	Dodge Creek Bridges	Purpose	Bridge Foundation
Highway	Hwy 138 W	County	Douglas
Hole Location	Northing: 650,185.61	Easting:	4,155,421.75
Equipment	CME 75	Driller	Cascade
Project Geologist	Dan Raker	Recorder	Kim Wyttenberg
Start Date	March 11, 2009	End Date	March 11, 2009
		Total Depth	41.4 ft

Test Type	Rock Abbreviations	Typical Drilling Abbreviations
"A" - Advancer	<u>Discontinuity</u>	<u>Drilling Methods</u>
"X" - Auger	J - Joint	WL - Wire Line
"C" - Core	F - Fault	HS - Hollow Stem Auger
"N" - Standard Penetration Test	B - Bedding	DF - Drill Fluid
"U" - Undisturbed Sample	Fo - Foliation	SA - Solid Auger
"D" - Oversize Split Spoon Sample	S - Shear	CA - Casing Advancer
		HA - Hand Auger
	<u>Shape</u>	<u>Drilling Remarks</u>
	Pl - Planar	LW - Lost Water
	C - Curved	WR - Water Return
	U - Undulating	WC - Water Color
	St - Stepped	DP - Down Pressure
	R - Rough	DR - Drill Rate
	VR - Very Rough	DA - Drill Action

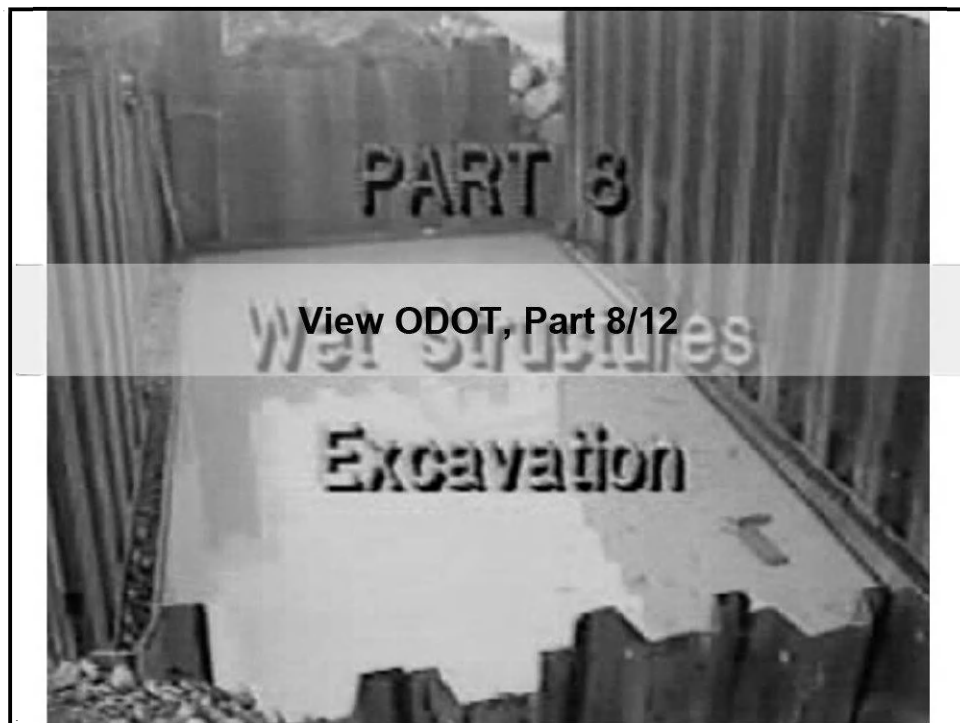
Depth (ft)	Test Type, No.	Percent Recovery	Soil Driving Resistance	Rock Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks	Water Level/ Date	Backfill/ Instrumentation
0						(0.0) Final Log 10/22/09	0.0 - 8.0 Dodge Unit-1 Sandy CLAY with some silt trace gravel, CL; orange-brown, low plasticity, damp, medium stiff, has subrounded to angular gravel; (Fill)		Sta. "C" 1094+64.9, 28.0 Drilling method 4" ID HSA (0'-25')		
5	N1	40	2-2-3			N- 1 (5.0-6.5) Sandy CLAY with some silt trace gravel, CL; orange-brown, low plasticity, damp, medium stiff, has subrounded to angular gravel. (Fill)					
10	N2	60	1-1-5		23	N- 2 (10.0-11.5) Sandy CLAY with some silt trace gravel, CL; orange-brown, low plasticity, damp, medium stiff, has subrounded gravel. (Alluvium) Lab No. 09-001632 LL=27 PI=8	8.0 - 18.0 Dodge Unit-2 Sandy CLAY with some silt trace gravel to Clayey SAND with some silt, CL, SC; orange-brown to brown, low plasticity, damp to moist, medium stiff and very loose, has subrounded gravel; (Alluvium)				
15	N3	87	2-1-3		26	N- 3 (15.0-16.5) Clayey SAND with some silt, SC; brown, low plasticity, moist, very loose. Has trace roots. (Alluvium) Lab No. 09-001633 LL=26 PI=5					
20	N4	73	7-9-5		20	N- 4 (20.0-21.5) Silty Sandy GRAVEL, GM; brown, nonplastic, wet, medium dense, fine rounded gravel. (Alluvium) Lab No. 09-001634 LL=ND PI=NP	18.0 - 22.0 Dodge Unit-3 Silty Sandy GRAVEL, GM; brown, nonplastic, wet, medium dense, rounded, fine gravel; (Alluvium)		Wet spoon		
25							22.0 - 41.4 Dodge Unit-4 MUDSTONE, gray, fresh, soft, very close to moderately close jointing, laminated to		Bedrock contact 22'	5/11/09 18'	

ODOT DRILL LOG DODGE CREEK BRIDGES.GPJ ODOT_MAN.GDT 10/27/09

Depth (ft)	Test Type, No.	Percent Recovery	Soil	Rock	Percent Natural Moisture	Material Description SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	Unit Description	Graphic Log	Drilling Methods, Size and Remarks	Water Level/Date	Backfill/Instrumentation					
			Driving Resistance	Discontinuity Data Or RQD%												
25	N5	100	50/2"			N- 6 (25.0-25.2) MUDSTONE, gray, moderately to slightly weathered, very soft to soft. (Tennmile Formation) C- 1 (25.2-26.4) MUDSTONE, gray, fresh, soft, close to moderately close jointing. (Tennmile Formation) C- 2 (26.4-31.4) MUDSTONE, gray, fresh, soft, close to moderately close jointing. (Tennmile Formation)	thin bedded dipping 20 deg, fissile along bedding; (Tennmile Formation)		Drilling method changed to HQ3-WL (25'-41.4') WC brown, then light gray to white WC Gray							
	C1	92	RQD = 0 R2													
	C2	100	RQD = 88 R2 RQD = 78													
30																
	C3	100	R2 RQD = 26			C- 3 (31.4-36.4) From (31.4'-33.0') MUDSTONE, gray, fresh, soft, close to moderately close jointing. (Tennmile Formation) From (33.0'-36.4') MUDSTONE, gray, fresh, soft, very close to close jointing, laminated to thin bedded dipping 20 deg, fissile along some laminations. Has clay seam 33.2'-33.4'. (Tennmile Formation)			Backfilled with bentonite chips (41.4'-0')							
35						C- 4 (36.4-41.4) MUDSTONE, gray, fresh, soft, very close to close jointing, laminated to thin bedded dipping 20 deg, fissile along some laminations. Has clay seam 37.0'-37.2'. (Tennmile Formation)										
	C4	100	R2 RQD = 28													
40						(41.4) Bottom of hole.										
45																
50						(41.4) Bottom of hole.										
55																
60						(41.4) Bottom of hole.										
63						(41.4) Bottom of hole.			Bottom of hole 41.4'							



35



36

Cofferdams

A water-tight enclosure that allows the construction of a bridge foundation in the dry.



37

Cofferdams

Used in or near water.



38

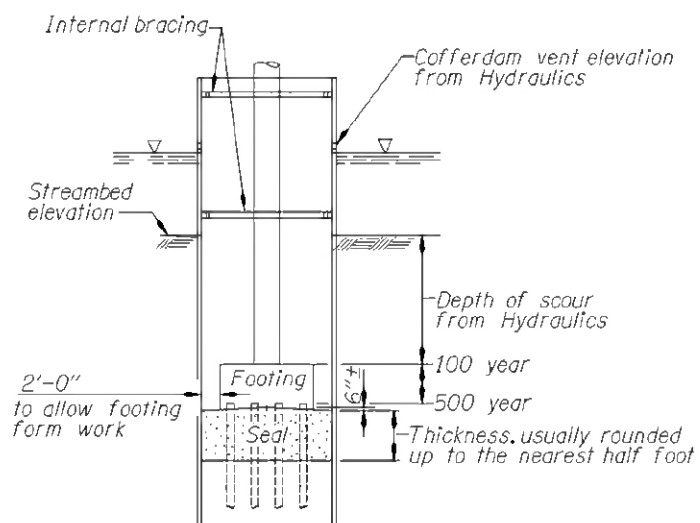
Cofferdams

A seal is used when sheet piling cannot be driven to sufficient depth to cut off water flow.



39

Cofferdam with Seal



40

Construction Steps with Seal

- Drive sheet piles
- Cut vent holes
- Install bracing
- Excavate
- Drive foundation piles
- Placing concrete seal



41

Construction Steps with Seal (continued)

- De-water
- Construct footing and column in the dry
- Flood cofferdam
- Remove cofferdam
- Place riprap



42

Sheet Piles

- Check sheet piling size and grade.
- Deep-arch interlocking sheet piles are used.



43

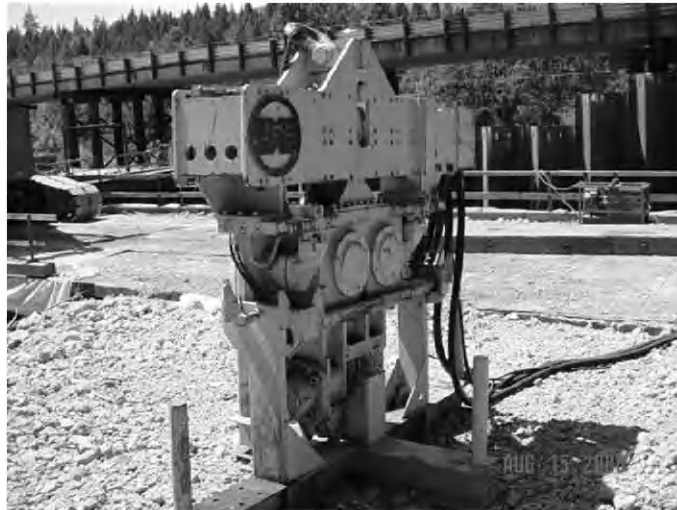
Sheet Piling Is Often Driven Using a Temporary Guide Structure

All sheet piles must be plumb.



44

Vibratory Hammer



45

Sheet Piles

Drive sheet piling at a cofferdam corner first and then work your way around.



46

Sheet Piles

- Each sheet piling section is driven about 3 feet at a time.
- Sheet Piling sections are driven progressively around the cofferdam until the required depth is reached.



47

Vent Holes

- Cut vent holes at high water elevation
- Allows water to enter the cofferdam to prevent cofferdam failure



48

Bracing

Cofferdams require adequate bracing.



49

Wet Excavation



50

Underwater Exploration

- The inspector should take and record soundings to determine underwater elevations.
- Under water inspection may be required by divers to determine proper excavation to the edges of the cofferdam, so that seals will hold.



51

Driving Foundation Pile

Template is often used

- As a guide for pile location.
- To establish elevation references.



52

Driving Foundation Pile

The inspector must:

- Monitor penetration and bearing.
- Take soundings after pile driving to check for soil displacement.



53

Placing Concrete Seal

- Keep water levels the same on both sides of the cofferdam to prevent flow through the seal.
- Place concrete under water by means of a tremie pipe.
- Use a suitable plug in the tremie pipe during the initial discharge of concrete to keep water out.



54

Placing Concrete Seal

00540.48(e)

- The concrete shall be placed continuously until seal is completed. Minimum of 50 cy/hr.
- Do not vibrate.
- Tops of seals should be kept nearly horizontal at all times.
- Take soundings of the surface of the seal.



55

Placing Concrete Seal

02001.20(c)

- Slump of 6"-10"
- Entrained Air not required
- 3,300 psi (Table 2001-1)



56

De-water Cofferdam

00540.48(e)

- After seal concrete reaches 2,200 psi
- Sump pump usually required to keep work area dry



57

Completing Construction

- Footing and pier constructed in the dry as in other situations.
- Cofferdam flooded.
- Natural streams bed lines and grades restored to avoid scour.
- Riprap placed as required.



58

INSERT TAB

Unit 7
Driven Piles

Section 7

Driven Piles

ODOT Video, Part 7/12: Pile Foundations	1
Pile Driving Equipment	4
Pile Types	16
Hammer Approval Letter	21
Construction Documents	22
Pile Record Book	23
Pile Acceptance Decision Chart	24
Pile Exercise	38

Driven Piling Section 7	
	

1



PART 7

View ODOT Video, Part 7/12

Pile Foundations

2

What is a Driven Pile?

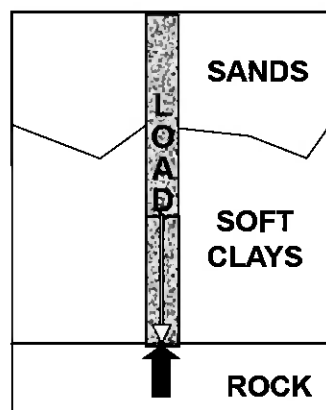
A driven pile is a deep foundation that is constructed by driving a concrete, steel or timber pile to support the anticipated loads in competent subsurface material.



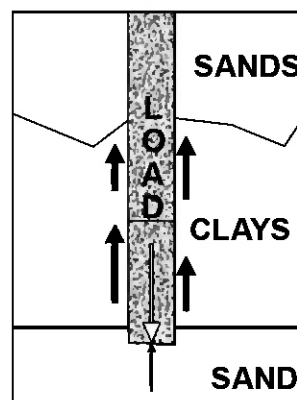
3

End Bearing and Friction Piles

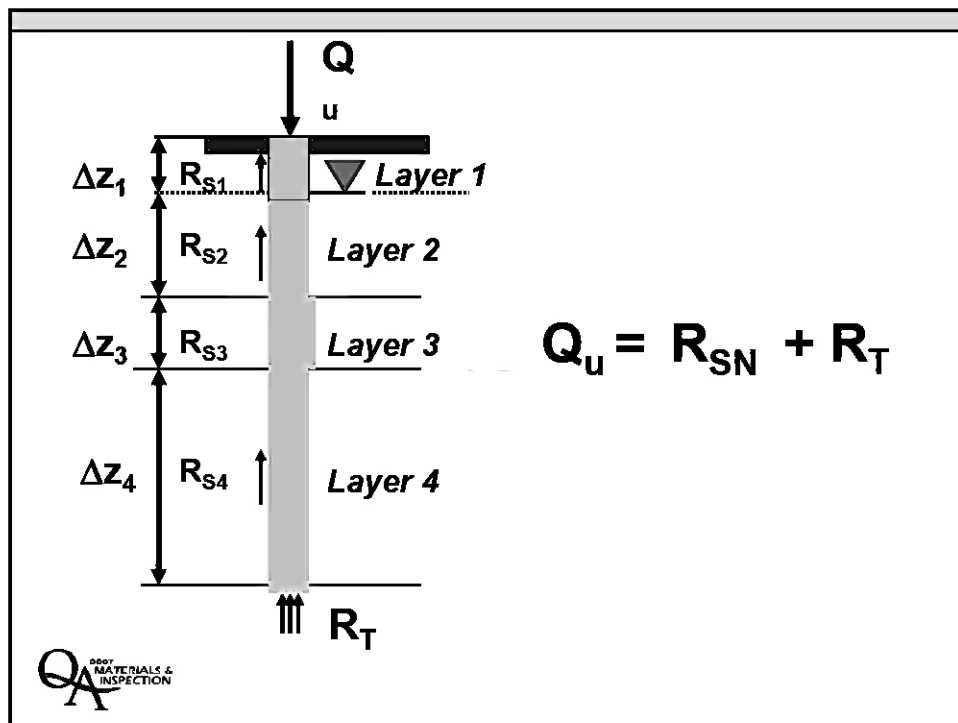
END BEARING LOAD



FRICITION LOAD

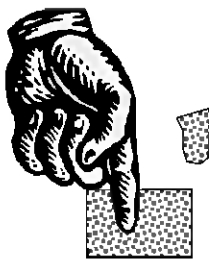


4

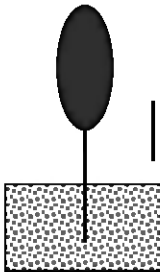


5

Displacement or Low-Displacement?



Displacement piles are piles that actually displace the material they are driven into.



Low (Non) displacement piles are piles that displace very little of the material they are driven into.

QA QUALITY MATERIALS & INSPECTION

6

“Rebound”

- The upward movement of a pile during driving
- High displacement piles increase potential for rebound
- Highly plastic and expansive clayey soils present increased potential for rebound



7

Pile Strength Vs. Time

Strength Gain (pile setup or “freeze”)

Piles can gain strength over time after they are driven in certain cohesive soils like stiff clays and clayey silts. This is due to the slow dissipation of excess pore water pressure that is created during pile driving.

Strength Lose

Piles can lose strength after driving in certain soils like very dense sands and gravels due to “relaxation” of the soil. Relaxation has to do with a change in soil structure after driving. The Geotechnical Engineer will determine if this effect applies at a given site.



8

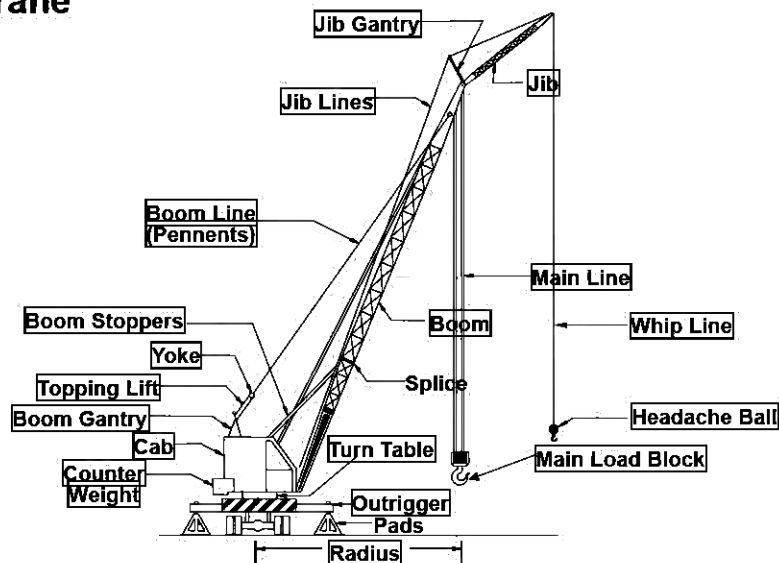
Pile Driving Equipment

- Crane
- Hammer
- Cushions
- Leads
- Template
- Special tools

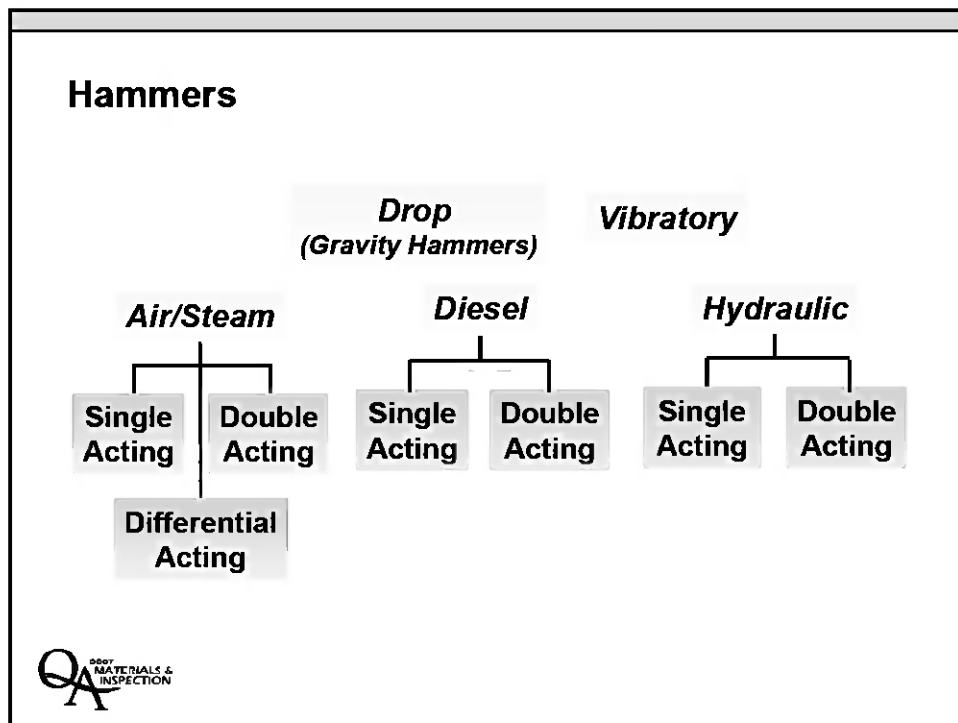


9

Crane



10



11

Open End Diesel Hammers Single-Acting



- Advantages
 - Very simple
 - No additional support equipment required
 - Lightest net weight per ft.-lb. of energy
 - Readily available (common)
- Disadvantages
 - Delivered energy variable
 - Less efficient energy transfer
 - Produces higher pile stresses
 - Dirty exhaust spray and smoke
 - Difficult to spot operation problems

12

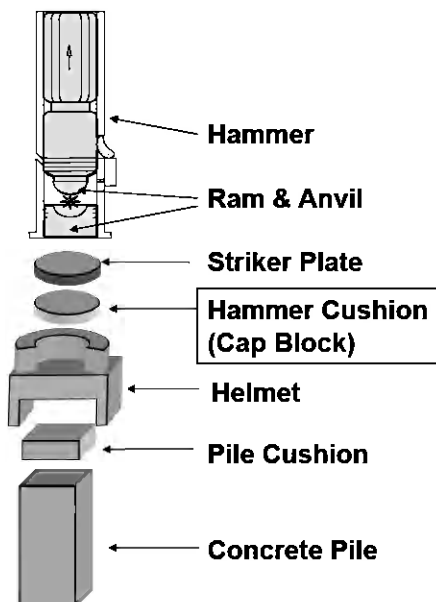
Vibratory Hammer

- Generally used for driving and extracting sheet piles, low-displacement H-piles, and pipe piles.
- Not impact hammers.



13

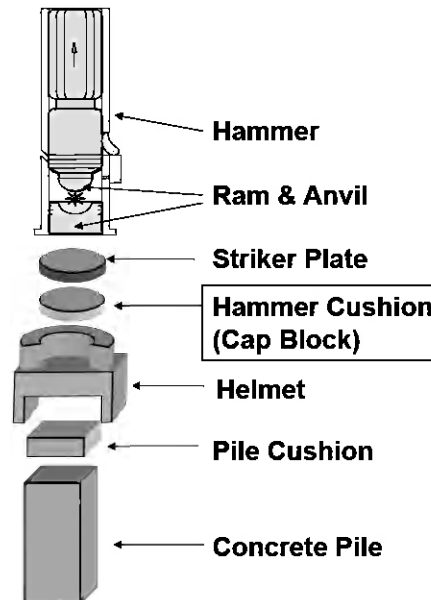
Hammer Cushions



- Used on all impact hammers except gravity (drop) hammers
- Must be made of durable manufactured (man-made) materials
- Wood, wire rope and asbestos not allowed
- Striker plate must be used

14

Hammer Cushions (continued)



- Inspected when beginning driving
- Inspected every 100 hours of driving
- Replaced when there is a reduction of thickness exceeding 25% of original thickness

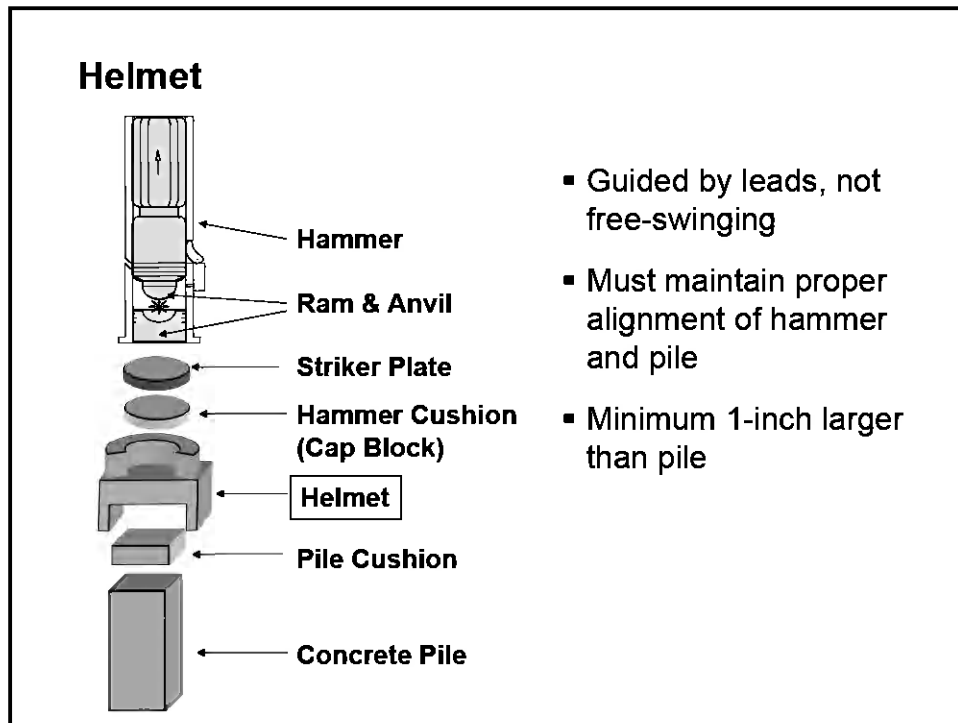
15

Hammer Cushions (continued)

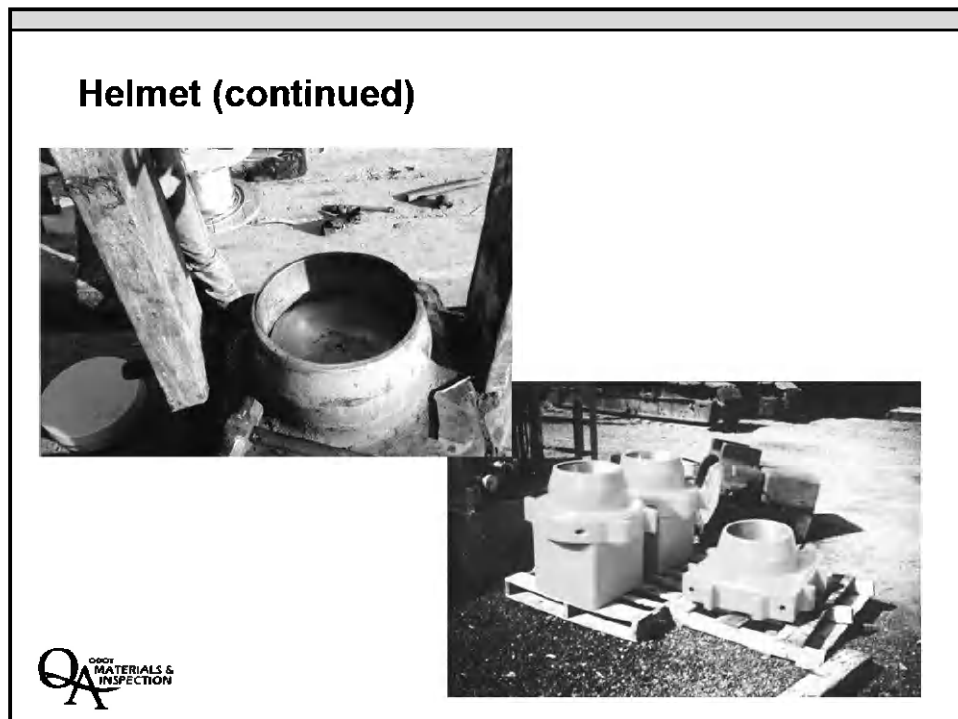


QA
0001 MATERIALS &
INSPECTION

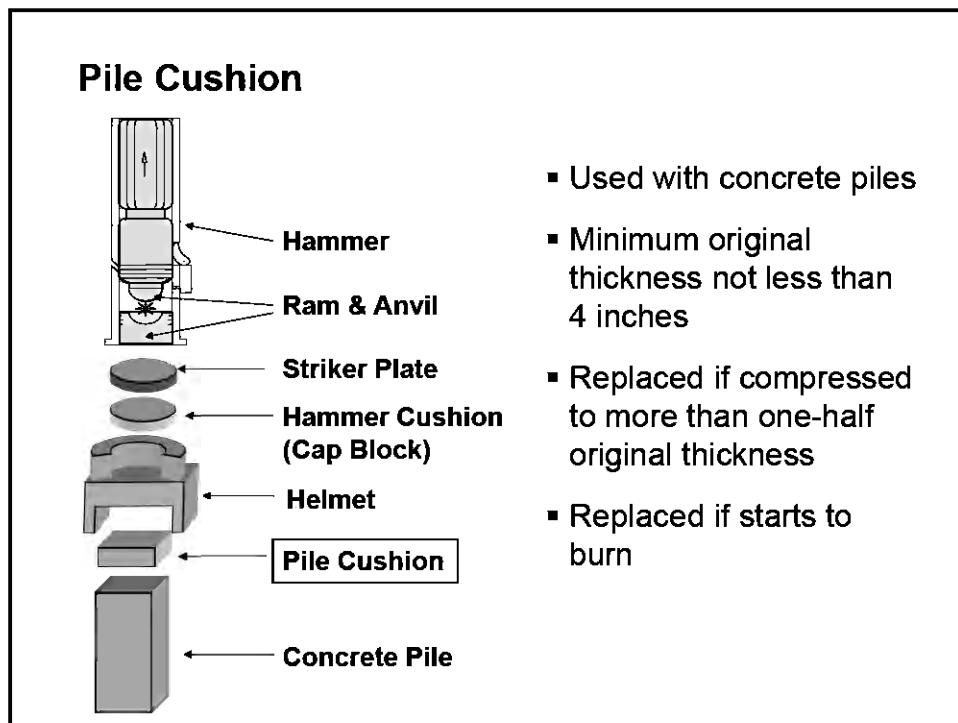
16



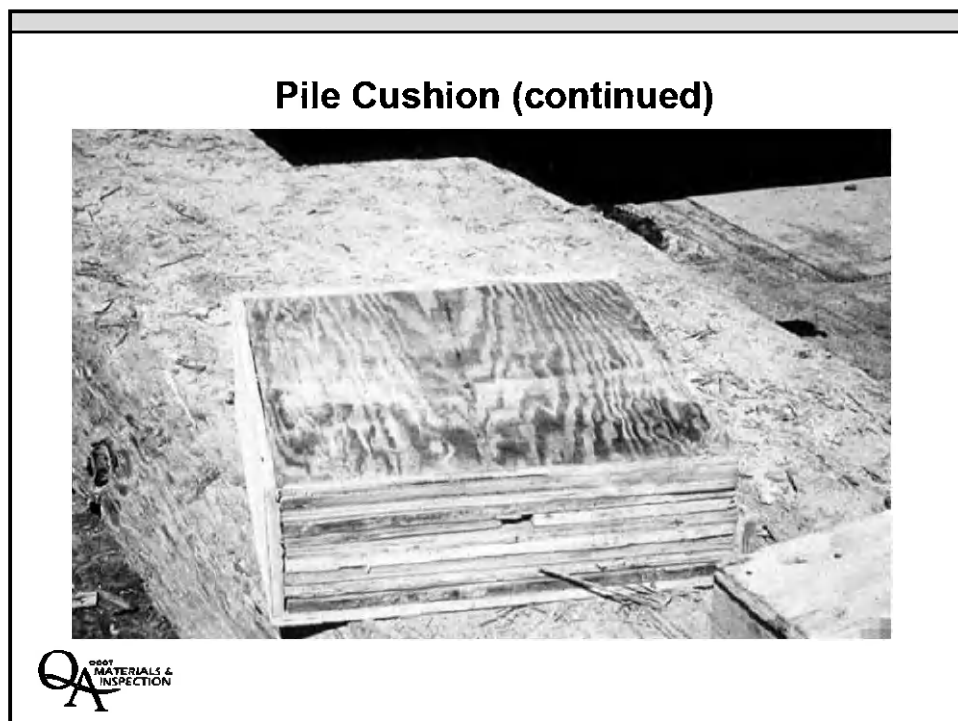
17



18



19



20

Pile Driving System Components – Leads

Crane

Hammer

Cushions

Leads ←

Template

Special Tools



21

Fixed Lead System

- Fixed at both top and bottom
- Maximum control of pile alignment
- Higher cost

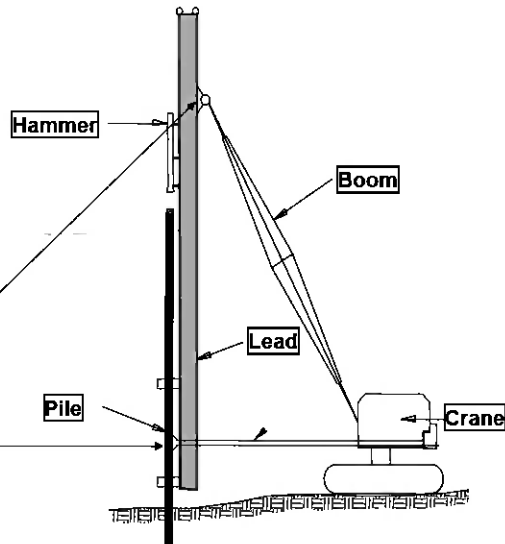


22

Semi-fixed Lead System

- **Low Cost**
- **Simple, mobile**
- **Some control of pile alignment**

Fixed either at top or bottom but allowing vertical movement

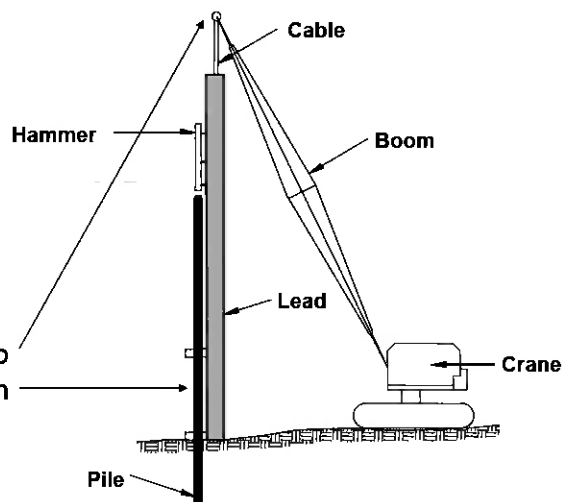


23

Swinging Lead System

- **Low Cost**
- **Simple, mobile**
- **Less control of pile alignment**
- **Must be approved by the Engineer**

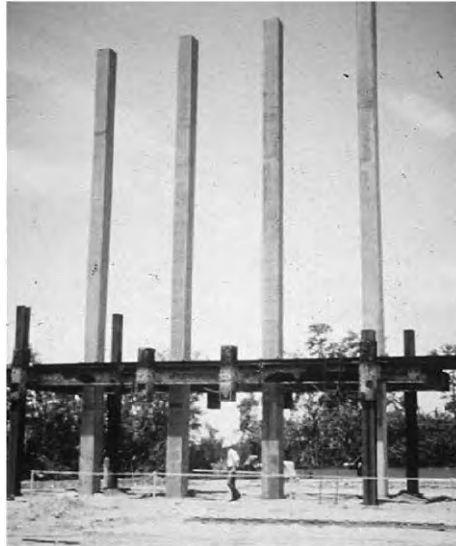
Not fixed at top or bottom



24

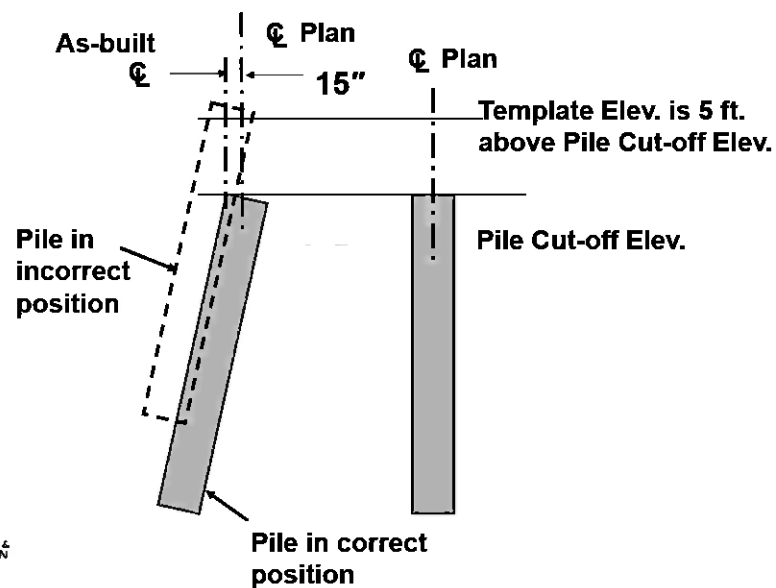
Templates

- Required for offshore leads.
- Maintains the pile and hammer in the correct location and position.



25

Templates (continued)



26

Special Tools

- Jets
- Drills (Preboring)
- Punches
- Followers



27

Jets

- Permitted when in the plans or approved by the Engineer in writing.
- Jetting plant must provide pressure equal to 100 psi at two $\frac{3}{4}$ inch jet nozzles.
- Jets must be removed for the final 5 feet of pile penetration.

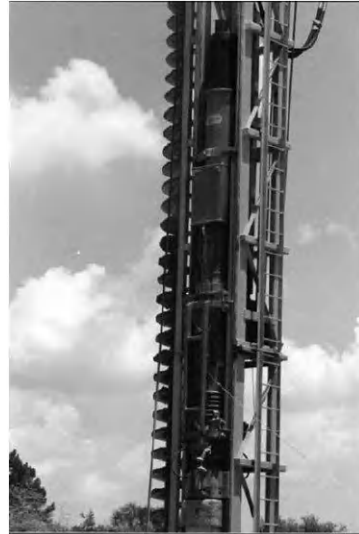


28

Preboring

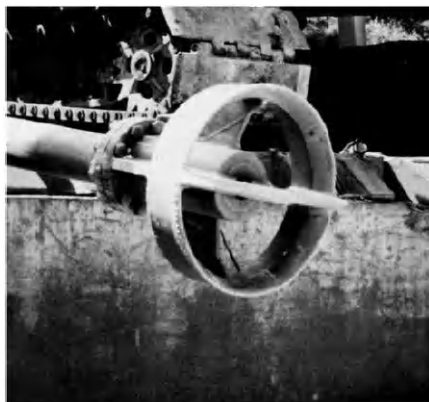


Used only when specified or
with approval of the Engineer



29

Punches



Combination Jet/Punch



Aids for advancing pre-drilled
holes through hard materials

Punch



30

Followers



- Generally used for water projects.
- Only when authorized in writing by Engineer or in contract documents.
- The first pile in each bent and every tenth pile thereafter must be driven without a follower.

31

Pile Types

- Steel pipe piles
- Steel H-piles
- Concrete piles
- Timber piles
- Cylinder concrete piles
- Composite piles
- Steel sheet piles



32

Steel Pipe Piles

- Most commonly used in ODOT
- Driven either open or closed end
- Can be filled with concrete



33

Steel H-Piles

- End bearing piles
- Low-displacement
- High bearing



34

Timber Piles

- Low bearing piles
- High-displacement
- Used typically for temporary structures



35

Sheet Piles

- Utilized mostly for temporary retaining systems, such as shoring, cofferdams and bulkheads
- Driven using either impact or vibratory hammers



36

Pile Tip Attachments – Steel H-Pile



See Section 02520.10(e)
Reinforced Pile Tips



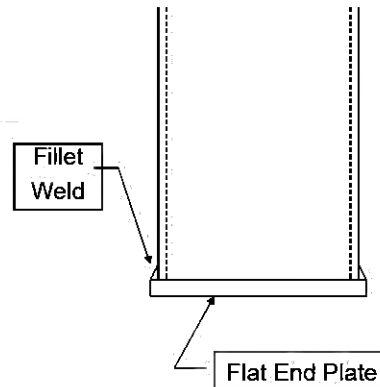
37

Pile Tip Attachments – Steel Pipe Pile See Section 02520.10 (e) Reinforced Pile Tips



38

Typical Pipe Pile End Plate



39

Subsurface Information

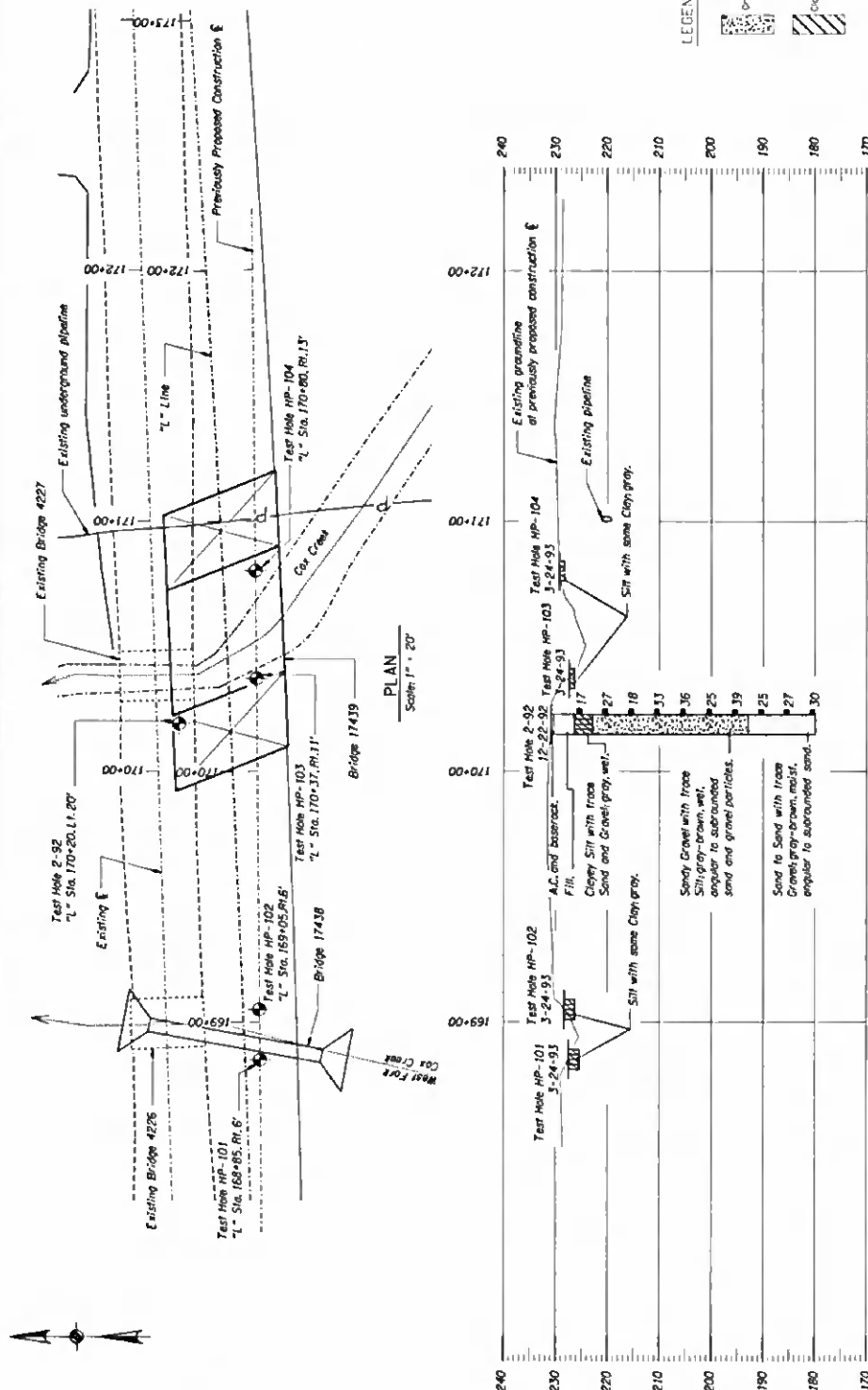
Subsurface information available to the Contractor:

- Foundation reports
- Foundation data sheets
- Drill logs
- Groundwater conditions
- Soil and rock unit descriptions
- Material engineering properties



40

Foundation Data Sheet



Foundation data shown on this drawing is a compilation of information and/or revision in geology from the Soil and Geologic Exploration Logs of the Soil and Geologic Exploration Logs used in compiling this drawing are reliable when required.

SHEET 2 OF 30	COX CREEK & WEST FORK COX CREEK BRIDGES SANITARIUM HIGHWAY M.P. 1.92 TO 1.95 LINN COUNTY	DRAWING NO. 506556
BRIDGE NO. 17419 & 17418	FOUNDATION DATA	
DATE Nov. 1993		
OREGON DEPARTMENT OF TRANSPORTATION BRIDGE ENGINEERING SECTION		
		
DESIGNER  David A. Smith	APPROVED  Ann Duxley	
CHECKED  John W. Smith	APPROVED  Gerald R. Bostel	
SCALE: 1" = 5'-0"		

1. **Sampling Population Tests.**
 a. **Y value.**
 b. **X value.**
 c. **Core Sample.**
 d. **Unadjusted Sample.**
 e. **Price Quality Designation.**
 f. **Price Quality Designation.**
 g. **Price Quality Designation.**
 h. **Price Quality Designation.**
 i. **Price Quality Designation.**
 j. **Price Quality Designation.**
 k. **Price Quality Designation.**
 l. **Price Quality Designation.**
 m. **Price Quality Designation.**
 n. **Price Quality Designation.**
 o. **Price Quality Designation.**
 p. **Price Quality Designation.**
 q. **Price Quality Designation.**
 r. **Price Quality Designation.**
 s. **Price Quality Designation.**
 t. **Price Quality Designation.**
 u. **Price Quality Designation.**
 v. **Price Quality Designation.**
 w. **Price Quality Designation.**
 x. **Price Quality Designation.**
 y. **Price Quality Designation.**
 z. **Price Quality Designation.**

OREGON DEPARTMENT OF TRANSPORTATION

DRILL LOG

Project 15: Willamette River Bridge (MP182.75)		Purpose: Willamette River Bridge Fnd. Inv.		Hole No. DH-2-03
Highway Pacific Hwy 001		County Lane	Key No. 13110	
Hole Location Northing: 267,481.07 Easting: 1,295,707.11		Start Card No.	Bridge No. 18620	
Equipment: CME 75		Driller: Ernie Phillips	Recorder: John Rehm	Ground Elev. 131.67m
Project Geologist: Bernie Kneutech		End Date: March 28, 2003		Total Depth: 10.95m
Test Type "A" - Auger Core "X" - Auger "C" - Core, Barrel Type "N" - Standard Penetration "U" - Undisturbed Sample "T" - Test Pit		Rock Abbreviations S - Shear Fo - Foliation B - Bedding F - Fault J - Joint Pl - Planar C - Curved U - Undulating Si - Stepped Ir - Irregular VR - Very Rough R - Rough Sm - Smooth SI - Stippled P - Polished Surface Roughness		
Test Type "A" - Auger Core "X" - Auger "C" - Core, Barrel Type "N" - Standard Penetration "U" - Undisturbed Sample "T" - Test Pit		Typical Drilling Abbreviations DA - Drill Action DR - Drill Rate D - Down Pressure WC - Water Color WR - Water Return LW - Lost Water Drill Remarks HS - Hollow Stem Auger DP - Drill Fluid SA - Solid Flight Auger CA - Casing Advancer HA - Hand Auger		
Depth (meters)	Test Type, No.	Percent Recovery	Driving Resistance	Discontinuity Data Or RQD%
0	C1	48.0		
1				
2	C2	39.0		
3				
4	C3	100.0		
5	C4	100.0	ROD = 74%	
6				
7	C5	100.0	ROD = 70%	
8	C6	88.0	ROD = 93%	
9	C7	100.0	ROD = 100%	
10				
11				
12				
Material Description		Unit Description		
SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin, Rock: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, RQD, Formation Name		0 - 0.91 AC then GRAVEL; GW; nonplastic (FILL); 0.91 - 3.35 GRAVEL and COBBLES up to 3.5 inch size; GW; gray; nonplastic; subrounded to subangular (Aliluvium); 3.35 - 6.39 BASALT; gray to brown; fresh to 6.39m then moderately weathered; (R2) to (R3); wide jointed; spacing up to 4 feet; calcite in joints; silt in joints in last 0.3m (intrusive Basalt); 6.39 - 7.3 Interbedded tuffaceous SANDSTONE; brown grading to gray; predominantly decomposed to fresh; (R0) to (R3); very close to moderately close jointed (Eugene Fm); 7.3 - 10.95 LAPILLI TUFF; green gray; fresh; (R2) to (R3); wide jointed; calcite cemented; clasts (Eugene Fm); 10.95 End of Hole		
Percent Natural Moisture		HQB coring		
Backfill/Instrumentation		Water Level/Date		

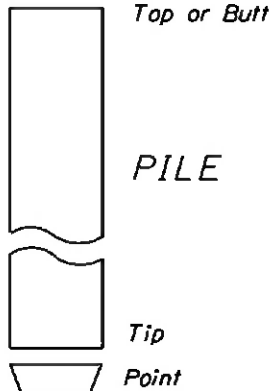
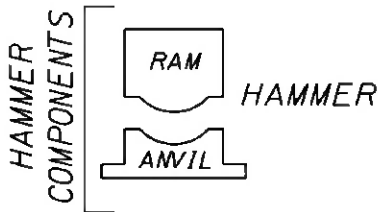
PILE AND DRIVING EQUIPMENT DATA

HIGHWAY		MILEPOST	
CONTRACT NO.		STRUCTURE NAME AND NO.	
PROJECT NAME (SECTION)			
PROJECT MANAGER		CONTRACTOR	
COUNTY	PILE DRIVING SUBCONTRACTOR (Piles Driven By):		

TYPE OF LEADS: ☐ Fixed ☐ Semi-Fixed ☐ Swinging

OTHER (Provide Description):

LEAD DIMENSIONS Depth _____ Width _____



MANUFACTURER	MODEL	TYPE
SERIAL NO.	OWNER:	
RATED ENERGY (KN-m)	@ LENGTH OF STROKE (m)	RAM WT. (KN)
MODIFICATIONS		

MATERIAL	THICKNESS (mm.)	AREA (mm ²)
----------	-----------------	-------------------------

MATERIALS	
TOTAL THICKNESS (mm.)	AREA (mm ²)
MODULUS OF ELASTICITY (E): (MPa)	
COEFFICIENT OF RESTITUTION (e)	

ALL COMPONENTS	WEIGHT (KN)	MODIFICATIONS
----------------	-------------	---------------

CUSHION MATERIALS		AREA (mm ²)
NO OF LAYERS	THICKNESS (EACH) (mm.)	TOTAL THICKNESS (mm.)
MODULUS OF ELASTICITY (E): (MPa)		COEFFICIENT OF RESTITUTION (e)

PILE TYPE & SIZE	Weight (KN/m)
LENGTH IN LEADS (m)	
WALL THICKNESS (mm)	TAPER

NOMINAL PILE RESISTANCE (KN)	ACCEPTANCE BY WAVE EQUATION ☐ Yes ☐ No
------------------------------	--

DESCRIPTION OF SPLICE

TIP TREATMENT DESCRIPTION (TYPE, MANUFACTURER, MODEL NO., ETC.)

NOTE: If mandrel is used to drive the pile, attach separate manufacturer's detail sheet(s) including weight and dimensions.

SUBMITTED BY:	DATE
---------------	------

General Materials Classification

“Coarse Grained” Materials

Granular soils
(sand, gravel, cobbles and boulders)

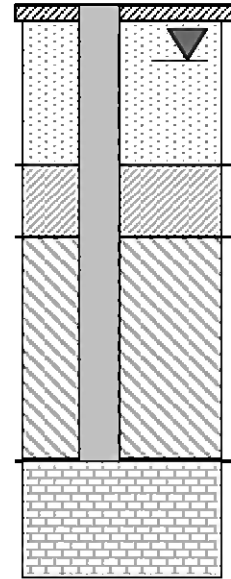
“Fine Grained” Materials

Clay (plastic or nonplastic)
Silt; may be plastic (clayey silt) or non-plastic
(sandy silt)

Intermediate Geomaterials

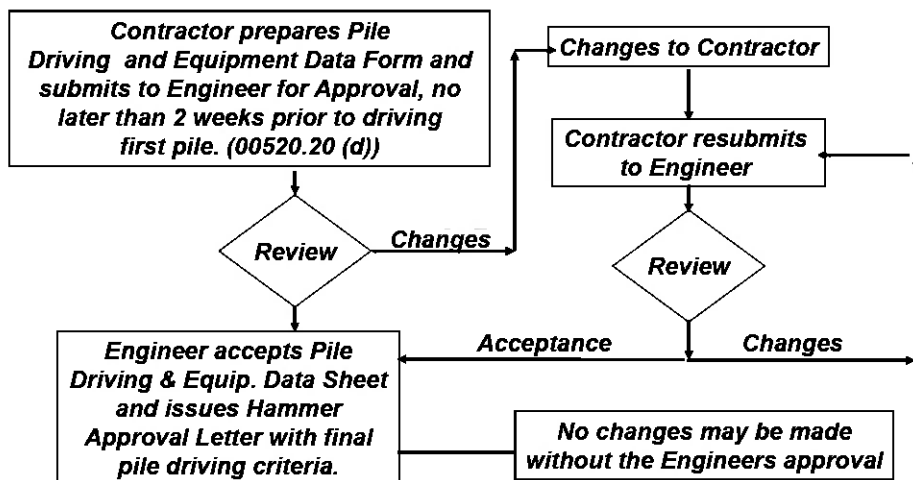
Weathered rock
Glacial till
Cemented soils

Rock



41

Pile Hammer Acceptance Process



42



INTEROFFICE MEMO

TECHNICAL SERVICES BRANCH

Bridge Section

Office Phone: (503) 986-4200

Fax Phone: (503) 986-3407

November 18, 2004

File Code:

TO: Bill Edmundson
Project Manager

FROM: Jan Six, P.E.
Geotechnical Engineer

SUBJECT: Sylvan O'Xing Sunset Hwy, Bridge No. 18674
Camelot Intchg. – Sylvan Intchg. (Phase 2) Section
Contract 12465 CON 01747
Multnomah & Washington Counties

The Pile and Driving Equipment Data Sheet submitted for use on this bridge has been reviewed and is conditionally approved for use in driving the permanent piles. The hammer is fully suitable and approved for use in driving the PP24x0.500 piles for the bridge. However, the hammer is somewhat oversized for use in driving the smaller PP12.75x0.375 piles for the wingwalls and is conditionally approved pending field hammer performance. For the wingwall piles the hammer stroke must be strictly controlled in the low range to provide the minimum acceptable blow count of 3.0, allowed in the Special Provisions and to minimize overstressing the piles.

The data sheet submitted is for a Berminghammer B5505 diesel hammer. The serial number was "to-be-determined". Please obtain the serial number off the hammer for our records. All piles should be Grade 3 steel, (45ksi).

The end-of-driving (EOD) pile criteria are listed in the tables below. This criterion is based on a wave equation analysis for the PP610x12.7 piles and on the ODOT Gates Equation for the PP12.75x0.375 piles. Inspector's graphs are also attached showing the required driving resistance (blows/inch) verses hammer stroke.

For the PP12.75x0.375 wingwall piles, the maximum allowable hammer is only 7.0 feet for the minimum allowable blow count of 3.0. Stroke higher than 7 feet will result in blow counts below this minimum acceptable value. The fuel setting for the Berminghammer must be reduced such that the stroke does not exceed 7 feet.

For Bents 1 & 2 the hammer should be operating near its maximum fuel setting and stroke at the end of driving in order to satisfy the required criteria. Pile stresses should not be a problem during driving the PP24x0.500 piles.

Sylvan O'Xing Sunset Hwy.**Bents 1 & 2****PP 24 x 0.500, driven open end****Ultimate Capacity, R_{ult} , = 1075 kips**

STROKE (ft)	BLOWS/INCH
10	15
10.5	13
11	11
11.5	10

Note: Strokes are rounded to the nearest 0.50ft. for convenience in field recording. If more precise strokes can be determined in the field then use linear interpolation between the corresponding blow counts required.

Wingwall Locations**PP 12.75 x 0.375, driven open end****Ultimate Capacity, R_{ult} , = 490 kips**

STROKE (ft)	BLOWS/INCH
7.0 (max)	3
6	4
5.2	5

All the piles at both bents may come up to bearing very quickly in the basalt bedrock or rubble. This could quickly lead to a high driving stress condition for the wingwall piles. The inspector should be aware of this condition and immediately stop driving at any signs of pile damage.

A saximeter is available for measuring the field hammer stroke and will be sent to your office on request. Please contact me at 986-3377 if you have any questions.

Attachments:**Inspector's Graphs (PP24x0.500 & PP12.75x0.375)**

Hammer Approval Letter

After reviewing the Contractor's hammer submittal, the Geotechnical Engineer will provide a letter to the Project Manager summarizing the following:

- Hammer approval (or reasons why the hammer is not approved)
- Driving criteria (stroke vs. required blow count and Inspector's graph)
- Any pile driving issues such as:
 - Pile freeze (set-up criteria)
 - Hard driving conditions (high pile stress conditions)
 - Details on pre-boring requirements



43

Construction Documents



44

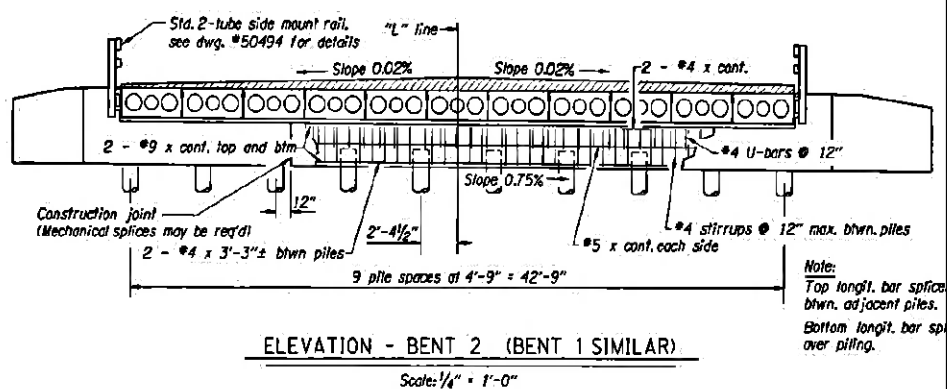
General Notes

Steel piling conforming to ASTM 252, grade 3.
All piling shall be PP12 $\frac{3}{4}$ x 0.25 driven closed ended to an ultimate capacity of 270 kips per pile.
Pile tip elevation for minimum pile penetration for each bent shall be elevation 210.
All piling shall be driven to the ultimate capacity using driving criteria developed from a wave equation analysis.



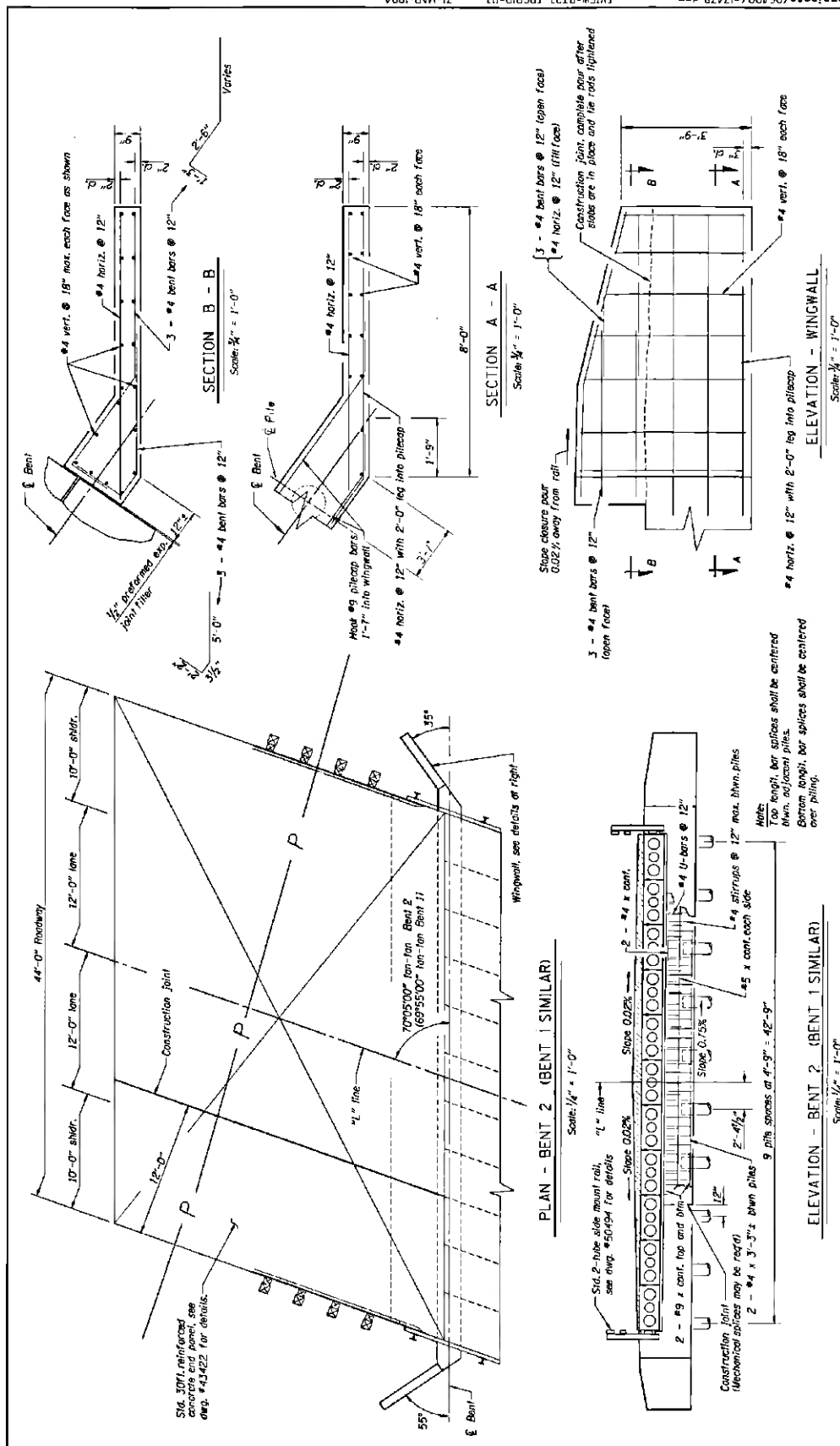
45

Bent 2 – Elevation

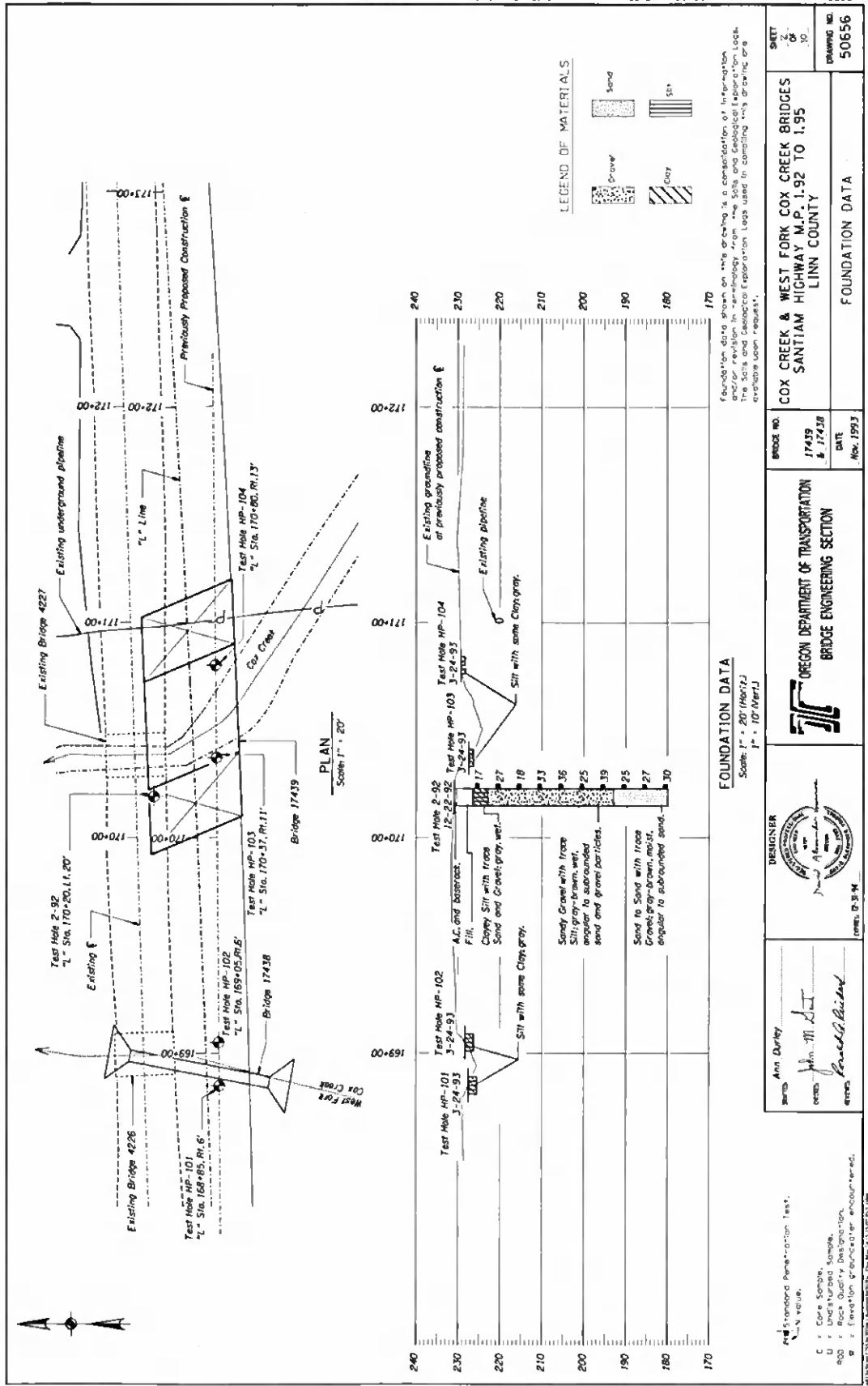


46

 OREGON DEPARTMENT OF TRANSPORTATION BRIDGE ENGINEERING SECTION		REVIEWED EXPIRES 8-30-95	BRIDGE NO. 17439	COX CREEK BRIDGE	SHEET 10 10
			DATE JUN 1994		DRAWING NO. 50658
			CALC. BOOK 4253	PLAN & ELEVATION - BENT 2 (BENT 1 SIMILAR)	



Foundation Data Sheet



Standard Penetration Test:
N = blow count
C = Core Sample
U = Undisturbed Sample
R = Rock Quality Designation
E = Elevation groundwater encountered.

DESIGNER
Ann Dwyer
Checked: John M. Dwyer
Reviewed: Fred B. Bland



OREGON DEPARTMENT OF TRANSPORTATION
BRIDGE ENGINEERING SECTION

BRIDGE NO. 17439
DATE Nov. 1993
COX CREEK & WEST FORK COX CREEK BRIDGES
SANTIAM HIGHWAY M.P. 1.92 TO 1.95
LINN COUNTY
FOUNDATION DATA
SHEET NO. 50656

Record Keeping

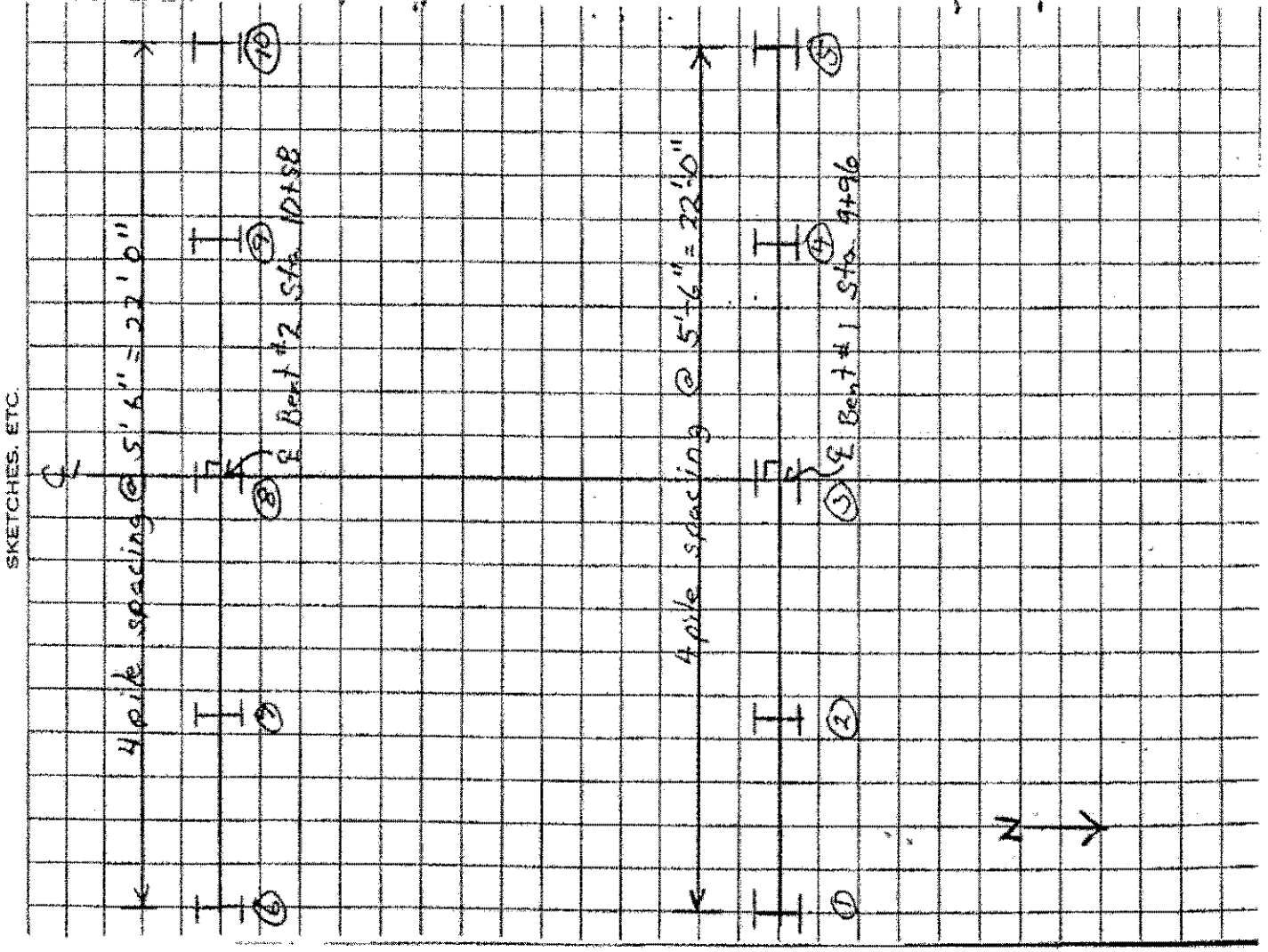
- Pile Record Book
- General Daily Progress Report
- Personal Field Diary



[illegible]

Pile Record Book

Shows pile layout and numbering system used.



Pile Record Book (Record Pile)

- A continuous record for every foot of penetration
- One Record Pile should be recorded for each bent and at least one in every 10 piles.

Test Pile Bent #123456 Data

Foot-Test	Blowcount	SKETCHES, ETC.
0-1	6	
1-2	3	
2-3	2	
3-4	2	
4-5	2	
5-6	2	
6-7	2	
7-8	4	
8-9	3	
9-10	3	
10-11	11	
11-12	10	
12-13	9	
13-14	10	
14-15	11	
15-16	21	
16-17	51	stopped driving
17-18		
18-19		
19-20		
20-21		
21-22		
22-23		
23-24		
24-25		
25-26		
26-27		
27-28		
28-29		
29-30		
30-31		

Pile # 4
Date: 1/22/83
Inspector: RHE
Recorder: B. Ho

Pile Driving Checklist

Confirm all checklist items have been addressed.

This list does not replace contract documents and is only an inspection tool.

Pre-Construction

- | | | | |
|------------------------------|-----------------------------|-----------------------------|---|
| ☐ Yes | ☐ No | ☐ NA | 1. Has the Contractor submitted the pile and driving equipment data form? 00520.20(d) |
| ☐ Yes | ☐ No | ☐ NA | 2. Do you have a copy of the Hammer Approval Letter / End of Driving Criteria, issued by the Geotechnical Engineer? |
| ☐ Yes | ☐ No | ☐ NA | 3. If followers are to be used, were they approved by the Engineer or specified in the contract documents? 00520.20(c)(4) |
| ☐ Yes | ☐ No | ☐ NA | 4. Has the embankment and excavation work been completed according to Section 00520.40(a) and (b)? |
| ☐ Yes | ☐ No | ☐ NA | 5. If a cofferdam is required, has the Contractor submitted a design in accordance with Section 00510? |
| ☐ Yes | ☐ No | ☐ NA | 6. If preboring is required, have the equipment and methods been approved? 00520.41(d) |
| ☐ Yes | ☐ No | ☐ NA | 7. If jetting is required, are the jets and supporting equipment approved? 00520.42(e) |
| ☐ Yes | ☐ No | ☐ NA | 8. Do you have a reference elevation to determine the pile cut-off and a minimum penetration depth? |

Piles and Equipment Arrive On Site

- | | | | |
|------------------------------|-----------------------------|-----------------------------|--|
| ☐ Yes | ☐ No | ☐ NA | 9. Are the leads fixed? If not, did the Professional of Record approve the lead system? 00520.20(c)(5) |
| ☐ Yes | ☐ No | ☐ NA | 10. Are there any visual defects on the pile? (If yes, please explain in the Notes / Comments section below.) |
| ☐ Yes | ☐ No | ☐ NA | 11. Does the pile diameter, length, type and grade match the contract documents? |
| ☐ Yes | ☐ No | ☐ NA | 12. Are the pile tips the right type and size and welded on properly (reinforced tips or closed end plates)? 00520.43 |
| ☐ Yes | ☐ No | ☐ NA | 13. Did the Contractor supply the mill certification reports? |
| ☐ Yes | ☐ No | ☐ NA | 14. Do piles on site match the mill certification reports? |
| ☐ Yes | ☐ No | ☐ NA | 15. Has the minimum penetration depth (minimum tip) mark been placed on the pile? |
| ☐ Yes | ☐ No | ☐ NA | 16. Are the piles marked at intervals to determine depth while diving? |
| ☐ Yes | ☐ No | ☐ NA | 17. Is all shop pile splicing performed per Section 00520.43(f)? Do you have inspection reports from Structure Services? |

Prestressed Concrete Piles (00520.44)

- | | | | |
|------------------------------|-----------------------------|-----------------------------|--|
| ☐ Yes | ☐ No | ☐ NA | 18. During delivery, are the piles being lifted by the correct number of pick points and at the correct locations? |
| ☐ Yes | ☐ No | ☐ NA | 19. Do the piles have the required information on the pile (stamp, casting date, pile #, length, prestressed yard #)? |
| ☐ Yes | ☐ No | ☐ NA | 20. Is the casting date older than 21 days for normal installation and 30 days for exposure to seawater and sulfate soils? |
| ☐ Yes | ☐ No | ☐ NA | 21. Does the length/cross-section/size/prestress configuration match the contract documents? |
| ☐ Yes | ☐ No | ☐ NA | 22. Did you physically measure the piles? |
| ☐ Yes | ☐ No | ☐ NA | 23. Are the lifting eyes removed and coated with epoxy? |
| ☐ Yes | ☐ No | ☐ NA | 24. Are there spalling/cracks or other damage visually apparent? Any damage should be reported to your supervisor for evaluation. (If so, please explain in the Notes / Comments section below.) |
| ☐ Yes | ☐ No | ☐ NA | 25. Are prestress strands cut off below the surface of concrete? |
| ☐ Yes | ☐ No | ☐ NA | 26. For storage on job site, is dunnage placed at correct lifting positions and is it placed so that it won't settle? |
| ☐ Yes | ☐ No | ☐ NA | 27. Other special details that are in the specifications, such as vents, centerhole jet pipes, voids, etc., should be explained in the Notes / Comments section below. |

Begin Pile Driving

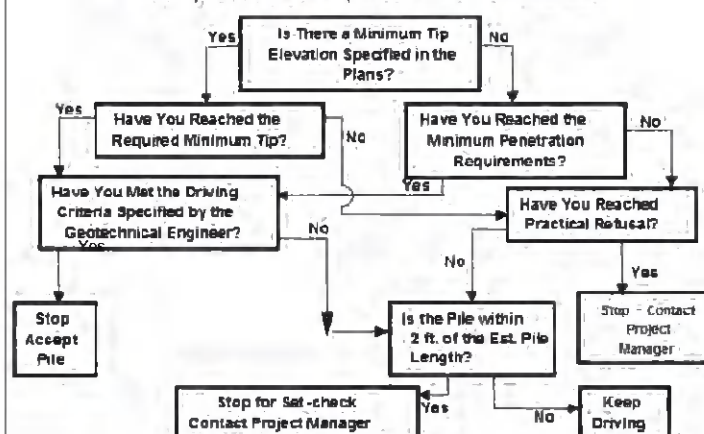
- ☐ Yes ☐ No ☐ NA 28. Is the Contractor using the approved hammer system provided in the Pile & Driving Equipment Data Sheet?
- ☐ Yes ☐ No ☐ NA 29. Has the set period elevation been determined and marked on pile, if required by the contract documents? 00520.42(d)
- ☐ Yes ☐ No ☐ NA 30. Have the horizontal and vertical pile positions been verified at the start of driving?
- ☐ Yes ☐ No ☐ NA 31. If a set period is specified, has the hammer been warmed up prior to re-driving? 00520.42(d)
- ☐ Yes ☐ No ☐ NA 32. If PDA Testing is included, has the end of driving criteria been issued by the Geotechnical Engineer?
- ☐ Yes ☐ No ☐ NA 33. Has all available pre-driving data been entered into the Pile Record Book?
- ☐ Yes ☐ No ☐ NA 34. Is the saximeter being used to record stroke?
- ☐ Yes ☐ No ☐ NA 35. If using jetting to advance pile, has the Contractor removed the jets a minimum of 5 ft. above the specified tip elevation and used an impact hammer to drive to the required bearing capacity? 00520.41(e)
- ☐ Yes ☐ No ☐ NA 36. If concrete piles require field splicing, is it in accordance with 00520.44?
- ☐ Yes ☐ No ☐ NA 37. If steel piles require splicing, is it in accordance with 00520.43(f) and (g)?
- ☐ Yes ☐ No ☐ NA 38. If included in the contract documents, is the proper number of test piles being recorded?
- ☐ Yes ☐ No ☐ NA 39. If using a pile cushion for concrete pile, does it need to be replaced? 00520.20(c)(1)

When to Stop

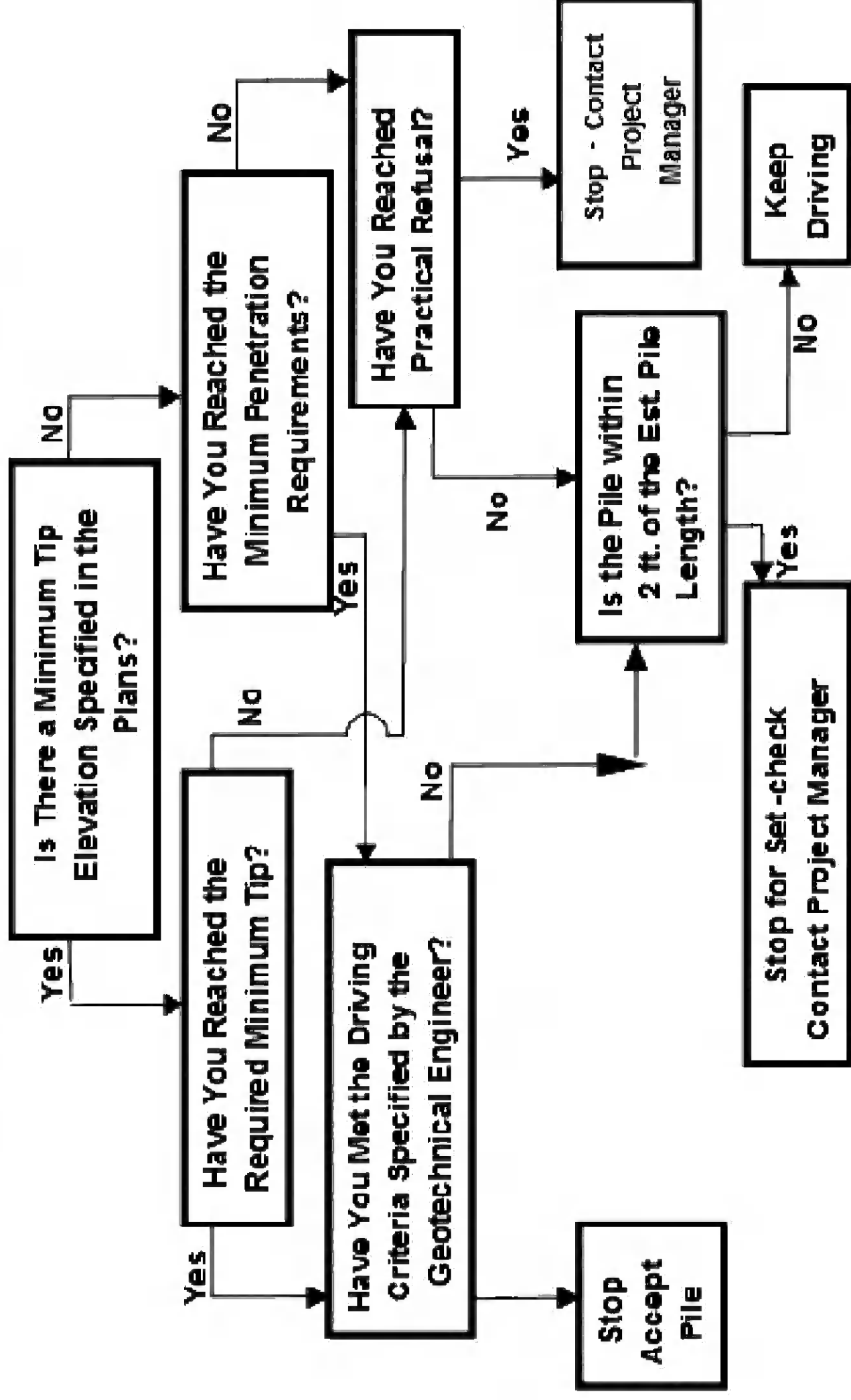
- ☐ Yes ☐ No ☐ NA 40. Is there a minimum penetration depth (minimum tip) specified?
- ☐ Yes ☐ No ☐ NA 41. If "Yes" to #40, has the pile reached the minimum penetration depth?
- ☐ Yes ☐ No ☐ NA 42. Has the pile met the end of Driving Criteria specified by the Geotechnical Engineer (i.e., PDA testing or min. blows per inch)?
- ☐ Yes ☐ No ☐ NA 43. Has the pile achieved the specified bearing resistance (i.e., PDA testing or min. blows per inch)? 00520.42
- ☐ Yes ☐ No ☐ NA 44. Is the top of pile within 2 feet of cut-off elevation.
- ☐ Yes ☐ No ☐ NA 45. Has the pile reached "refusal" driving (Practical Refusal)? 00520.42
- ☐ Yes ☐ No ☐ NA 46. Are the piles within allowable horizontal and vertical tolerances? 00520.41(f)
- ☐ Yes ☐ No ☐ NA 47. Have any of the piles heaved? 00520.41(g)
- ☐ Yes ☐ No ☐ NA 48. Have the piles been capped per the contract documents? 00520.43(i)
- ☐ Yes ☐ No ☐ NA 49. Is each row/column of the ODOT Pile Record Book filled out?

NOTES / COMMENTS

Sample Pile Acceptance Decision Chart



Sample Pile Acceptance Decision Chart



Piling Set Check

- Within 2 feet of estimated pile length.
- Wait for 24 hours to see if freeze will occur and bearing can be reached.
- Conserves piling and maximizes the friction ability of the soil.



49

Is there a potential for damage to adjacent structures?

$$D = 0.5 \times \sqrt{\text{HammerEnergy}(\text{Ft} - \text{lbs.})}$$

*This distance
monitor structures*

Pile

*This distance
survey and
monitor structures*

$$D = .25 \times \sqrt{\text{HammerEnergy}(\text{Ft} - \text{lbs.})}$$

50

Pre-Production Program (test piles)

- Determine pile lengths required for production
 - concrete and timber pile order lengths
- Check drivability of proposed hammer system
- Check performance of contractor's proposed driving system
- Determine required driving resistance



51

Check the Driving System

- Manufacturer
- Model
- Type
- Serial number
- Energy rating
- Ram weight
- Ram stroke



52

Check the Driving System

Are the leads the proper type and configuration for the job?



53

Does the helmet and hammer cushion meet the requirements of the Driving Criteria Letter?

Pile Drive Head (Helmet):

- Axially aligned with the hammer and pile
- Guided by the leads
- Not free-swinging
- Cut squarely for steel and timber
- Plane and perpendicular to longitudinal axis for concrete piles

Hammer Cushion:

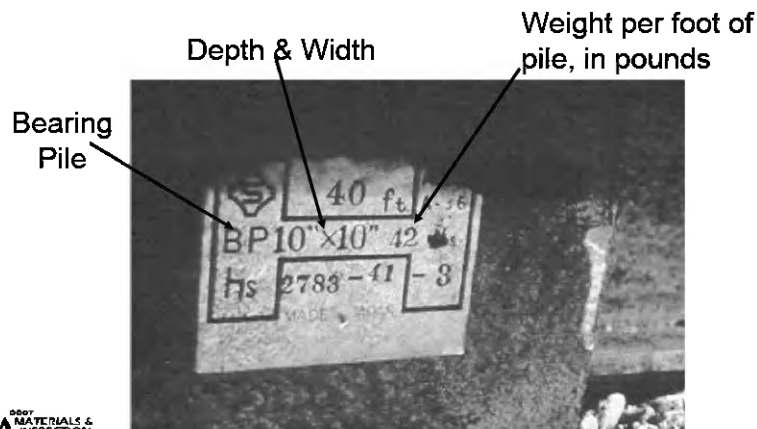
- Required for all impact hammers except gravity (drop)
- Made of manufactured materials
- Wood, wire rope and asbestos not allowed



54

Steel Piles

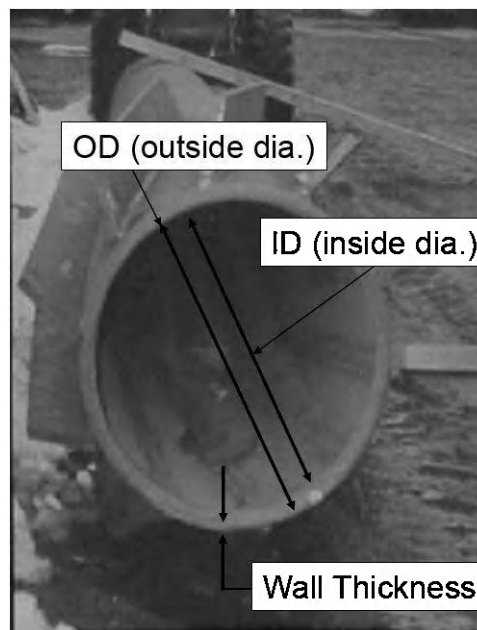
Check the Pile Certifications. Do the heat numbers on the piles match the Certificate of Analysis for the piles?



55

Steel Pipe Piles

Compare diameter, length and wall thickness to plan details.



56

Steel Pipe Piles

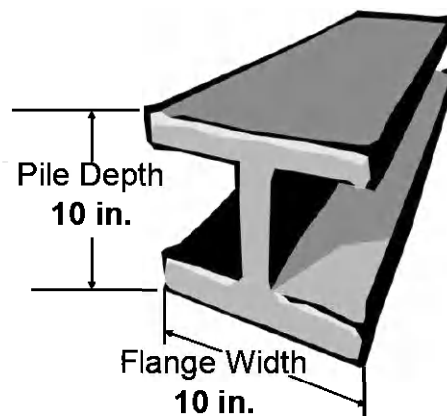
- Verify open end or closed end.
- **Closed End**
Verify the bottom plate is the correct diameter and thickness and welded per the plans.



57

Steel H Piles

Measure the pile depth and flange width for comparison to plan details.



58

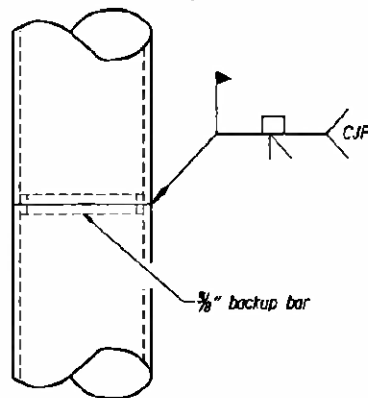
Steel H Piles



59

Pile Splices

The Project plans and specifications detail the splicing requirements for piles. For steel pipe pile a full penetration butt weld is required with a backing ring.



PIPE PILE SPLICE

Backing Bar (rings)



60

Pile Splice Measurement

00520.80(f)(1)

- None if within length listed in Special Provision
- One splice if splice is 5 ft or more when estimated pile length is 60 ft or less
- One splice if splice is 10 ft or more when estimated pile length is over 60 ft
- Only one splice per pile



61

Marking Piles



62

Monitoring Driven Pile Lengths

Cutoff
elevation = +5.00'

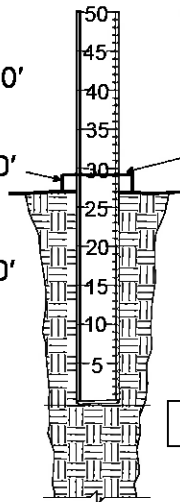
Reference
elevation = +2.00'

Ground surface
elevation = +0.00'

Length driven is the length of
pile below the cutoff elevation!

Pile marker @ 29' penetration

Tip elevation = - 27.00'



63

Saximeter

Method to determine
hammer stroke in the
field



64

Calculating Stroke Heights

Air-Steam Hammer Blows per minute

$$\text{height} = [14,400/[\text{bpm}^2]] - 0.3$$

Example:

bpm=36

$$14,400/1296 = 11.11$$

$$11.11 - 0.3 = 10.81 \text{ ft}$$

Open-End Diesel Hammers Seconds per blow

$$h = 0.0402 (T^2) - 0.3$$

h = stroke height in feet

T = time in seconds for 10 blows

Example:

Took 16 seconds for 10 blows,
therefore:

$$h = 0.0402 \times 256 - 0.3$$

$$h = 9.99 \text{ or } 10 \text{ ft.}$$



65

Marking Pile to Check for Bearing



66

Pile Bearing

00520.42 (a)

- Maintain required blows/inch (bpi) for 3 consecutive inches unless refusal is first obtained.
- Refusal is defined as 20 bpi



67

PDA Testing

Tends to result in shorter pile lengths.

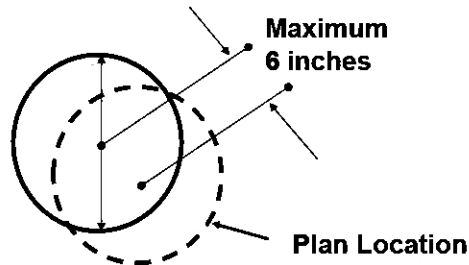


68

Horizontal Tolerance for Driving

00520.41(f)

- Within 6" of plan location
- At least 4" from edge of cap



69

Common Problems – Open End Diesel

Common Problems	Indicators
Water in fuel	Hollow sound, white smoke
Fuel lines clogged	No smoke or little gray smoke
Fuel pump malfunctioning	Inconsistent ram strokes, little gray smoke or black smoke
Fuel injectors malfunctioning	Inconsistent ram strokes, little gray smoke or black smoke
Oil low	Blows per minute rate is lower than specified
Oil pump malfunctioning	Blows per minute rate is lower than specified
Water in combustion chamber	Hollow sound, white smoke
Piston rings worn	Low strokes
Tripping device broken	Pawl does not engage piston Pawl engages but doesn't lift piston
Over heating	Paint and oil on cooling fins start to burn/sound changes



70

Steel Piles



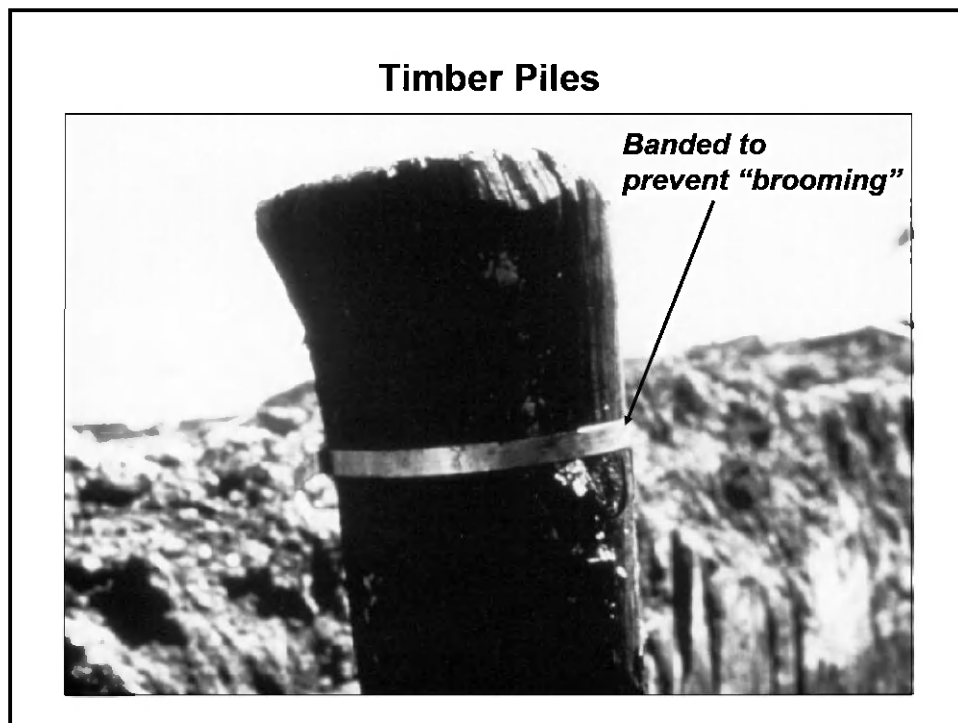
71

Steel Piles

Typical causes of damage	Possible indicators during driving	Types of damage
▪ Transporting and lifting ▪ Low steel strength ▪ Hard driving (compression) ▪ Welding ▪ Splices	▪ Pile moving out of position during driving ▪ Abrupt blow count change ▪ Observed pile damage near the pile head	▪ Bending ▪ Buckling ▪ Accordion ▪ Splitting



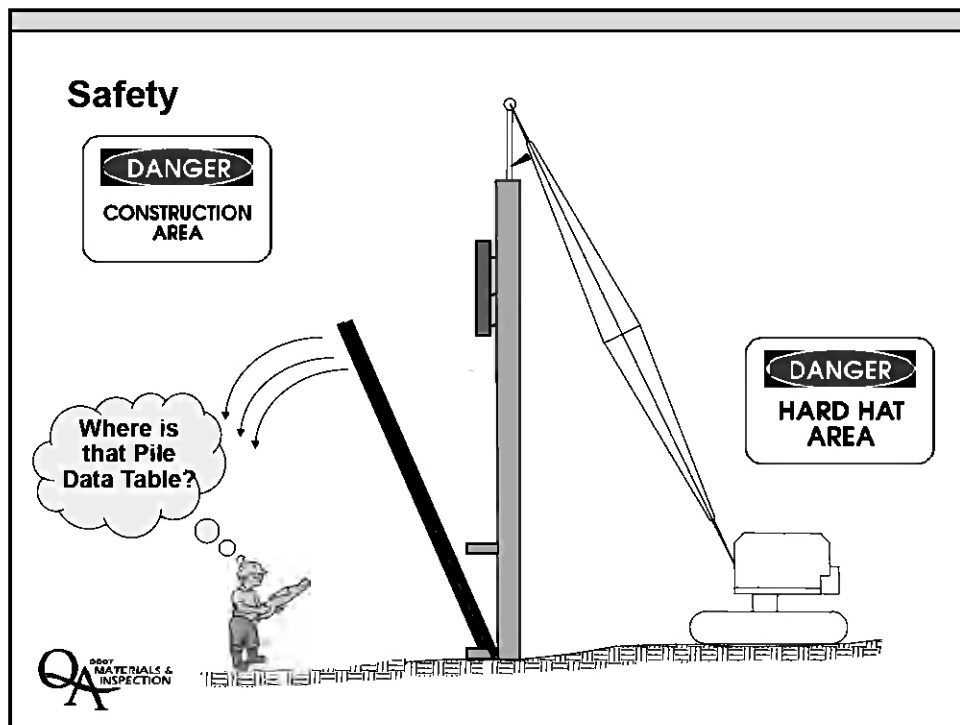
72



73

Timber Piles		
Typical causes of damage	Possible indicators during driving	Types of damage
▪ Transporting ▪ Knots and natural defects ▪ Handling ▪ Driving	▪ Pile moving out of position during driving ▪ Abrupt blow count change ▪ Appearance	▪ Splintering ▪ Cracking ▪ Shearing ▪ Brooming (head & tip)

74



75

Pile Exercise

- Are obstructions anticipated? _____
See SP00520.41(d)
- If so, what is the course of action? _____
- Why is stroke limited to 8.5 ft? _____
See Approval Letter
- What is the required blows/inch for a stroke of 7.5 ft?

QA MATERIALS & INSPECTION

76

**US20: Lake Creek Bridge Section
Grading, Drainage, Structures, Paving & Signing**

SECTION 00520 - DRIVEN PILES

Comply with Section 00520 of the Standard Specifications supplemented and/or modified as follows:

00520.00 Scope - Add the following:

Furnish and install PP 324x9.5 steel pipe piles.

00520.10 General - For steel pipe piling, provide inside, fit, open ended cutting shoes meeting the requirements of 02520.10(b).

00520.11 Engineer's Estimated Length List - The Engineer's estimated lengths of steel piling are:

Location	No.	Length (m)	Kind
#19184 Lake Creek Bridge	16	6.61	PP 324 x 9.5 (Grade 3)

00520.41(d) Preboring - Use auguring, wet-rotary drilling or other approved methods of preboring as directed.

If a pile cannot be driven to the specified pile tip elevation for minimum penetration, the pile shall be removed and preboring for that pile shall be performed to the pile tip elevation for minimum penetration. Have preboring equipment available on site during pile driving. This equipment shall be capable of preboring to a depth of 4.5 meters below the pile cap.

If preboring is necessary, permanent casing will be installed in the preborings to the tip elevation required for minimum pile penetration. The casing will have a minimum diameter of 24 inches. After the preboring has been completed and a pile has been driven in the preboring to the required end-of-driving criteria, the annulus between the casing and the pile shall be filled with Controlled Low Strength Material (CLSM) as described in Section 00442 with the following exception: the CLSM shall attain a minimum compressive strength of 1.7 MPa, not a compressive strength of 1.0 – 1.7 MPa as stated in 00442.13.

00520.42(d) Set Period and Redriving - Piles may be redriven after being allowed to set.

00520.43(c) End Treatment - Add the following:

Drive steel pipe piles open -ended with tip treatment as shown.

00520.80 Furnish Equipment for Driving Piles - Add the following:

There will be no measurement for furnishing preboring equipment.



Oregon

Theodore R. Kulongoski, Governor

Department of Transportation

Highway Division

Technical Services

Geo/Hydro Section

355 Capitol St. NE, Room 318

Salem, OR 97301-3871

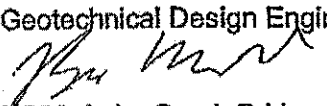
Telephone (503) 986-3378

FAX (503) 986-3407

March 10, 2005

File Code:

TO: Shane Ottosen
Project Manager

FROM: Bruce Novakovich
Geotechnical Design Engineer


SUBJECT: US20: Lake Creek Bridge Section
Lake Creek Bridge (Br. #19184)
ICE 42-S Pile Driving Hammer
Contract 13068
Santiam Highway
Jefferson County

The Pile and Driving Equipment Data Sheet submitted for Lake Creek Bridge has been reviewed. The data sheet submitted shows an ICE model 42-S is proposed for driving the permanent piles at the bridge. The serial number and owner of this pile driver was not included on the Pile and Driving Equipment Data Sheet. We request the contractor supply us with this information to complete the sheet.

The ICE 42-S pile driving hammer would need to be able to operate in a fairly restricted range to adequately install the permanent piles at the Lake Creek Bridge (Bridge No. 19184). The ODOT Gates equation indicates this hammer will need to operate at a stroke of at least 2.1 meters (6.9 feet) to install the piles to the design ultimate capacity in the blow count range required in the ODOT Standard Provisions (3-15 blows per 25mm). A WAVE equation analysis indicates high driving pile stresses may occur if the stroke exceeds 2.6 m (8.5 feet). The ICE 42-S hammer will have to be capable of operating in this limited range at the end of pile driving to successfully drive the piles to the design ultimate capacity without overstressing them. Therefore, the ICE 42-S pile driving hammer is conditionally approved, the condition being it must be able to operate at a stroke between 2.1 and 2.6 meters at the corresponding blow count necessary to achieve the design ultimate capacity. However, if the mill certification for the Lake Creek Bridge piles shows yield strengths of 389 MPa (56.4 ksi) or greater, the upper limit on the stroke can be ignored.

The end of driving pile criteria are listed in the table 1 on page 2 below. The criteria are based on the ODOT Gates Equation, as called for in the plans, with the piles driven to the ultimate capacity indicated.



Lake Creek Bridge, Bridge 19184

PP 324 x 9.5, driven open ended with interior plug 3 meters above tip

ICE 42-S

Ultimate Capacity, R_{ult} , =2135 kN

Stroke (m)	Stroke (ft)	BLOWS/IN OR 25 mm
2.59	8.5	9
2.44	8.0	11
2.29	7.5	13
2.13	7.0	15

Table 1

An inspector's graph is presented on page 3. The stroke is plotted in both English and Metric units on the graph.

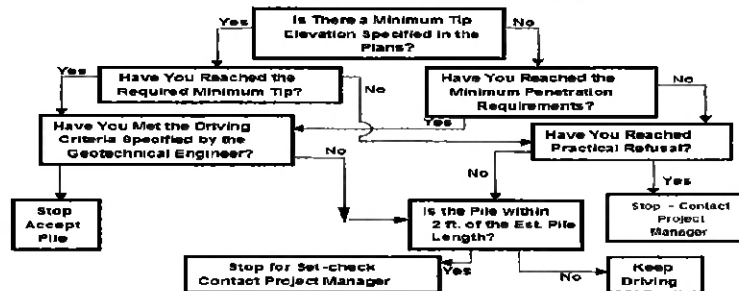
If any problems are encountered during pile driving I can be contacted at 503-986-3378.

c: Matts Halverson

Pile Driving Example

BPI measured at 15 for 3" with required BPI of 13. Pile tip is at minimum tip elevation. What do you do? _____

Sample Pile Acceptance Decision Chart



77

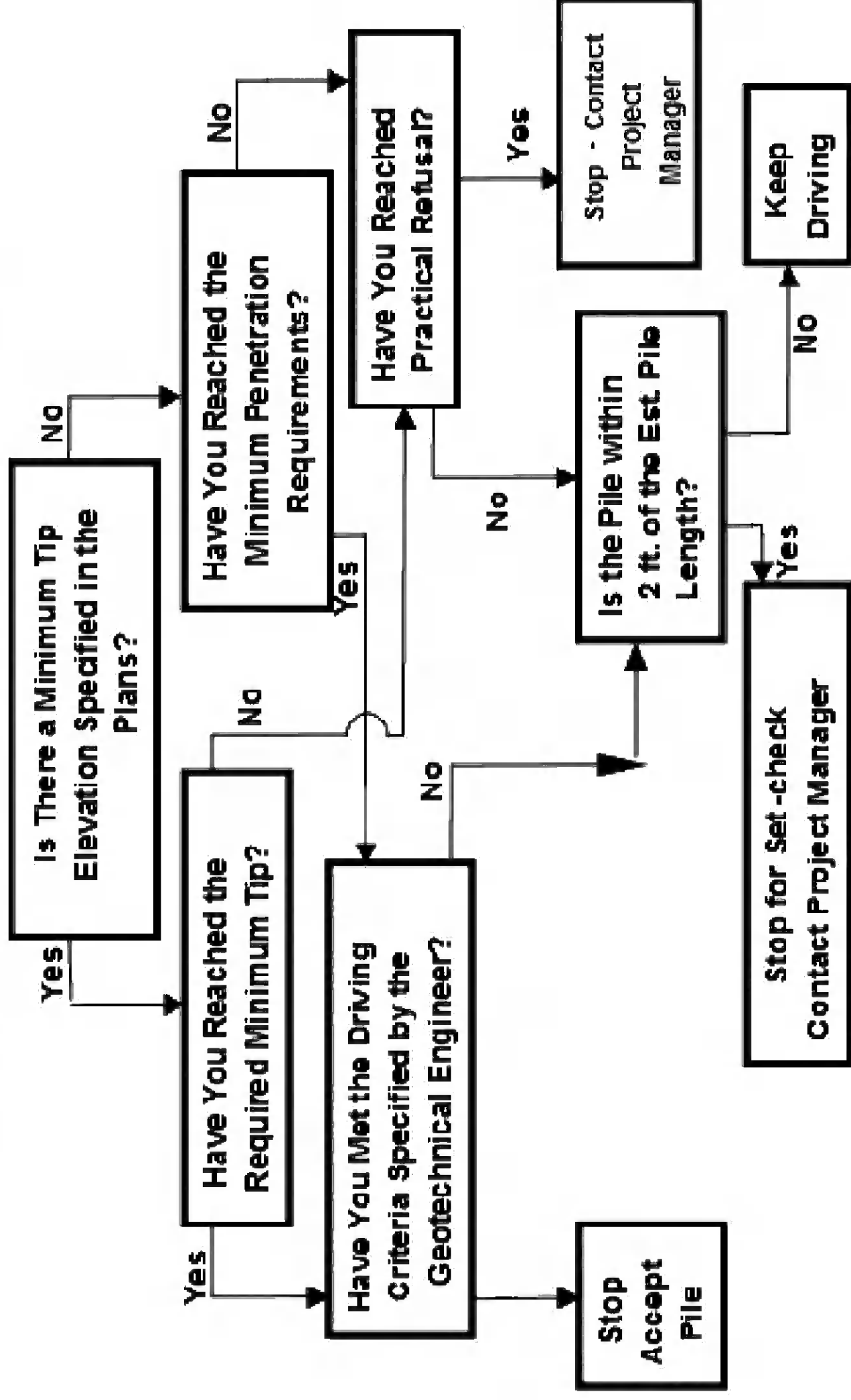
Pile Driving Example

BPI measured at 15 for 3" with required BPI of 13. Pile tip is at minimum tip elevation. What do you do? **Stop & Accept Pile**



78

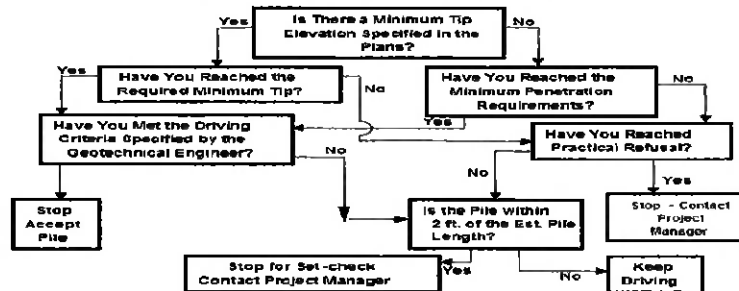
Sample Pile Acceptance Decision Chart



Pile Driving Exercise 1

BPI measured at 10 with required BPI of 13. Pile tip is at minimum tip elevation and is within 2' of estimated pile length. What do you do? _____

Sample Pile Acceptance Decision Chart

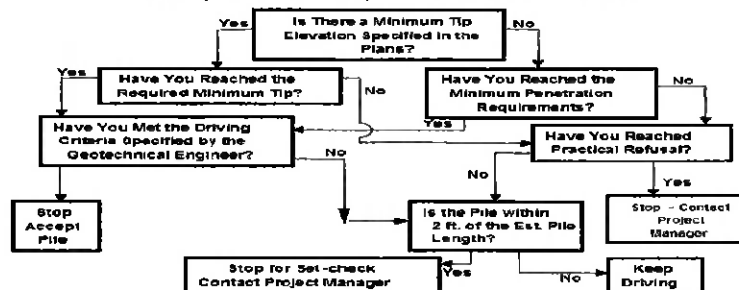


79

Pile Driving Exercise 2

BPI measured at 20 with required BPI of 13. Pile tip is 2 ft above minimum tip elevation. What do you do?

Sample Pile Acceptance Decision Chart



80

Oregon Department of Transportation



PILE RECORD BOOK

19184

BRIDGE NAME US20: LAKE CREEK	BRIDGE NO. 19184
---------------------------------	---------------------

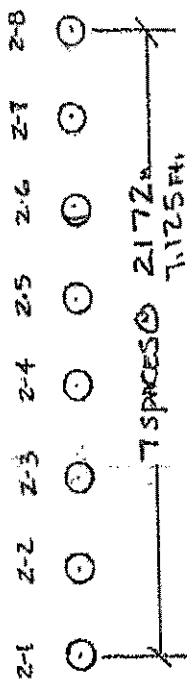
PROJECT NAME (SECTION) US20: LAKE CR BRIDGE SECTION		CONTRACT NO. C13068
HIGHWAY SANTIAM	COUNTY JEFFERSON	
PROJECT MANAGER SHANE OTTOSEN	YEAR 2005-2006	F.A. PROJECT NO. BRF-STP-S016(023)

PP 324 X 9.5 ICE 42-5

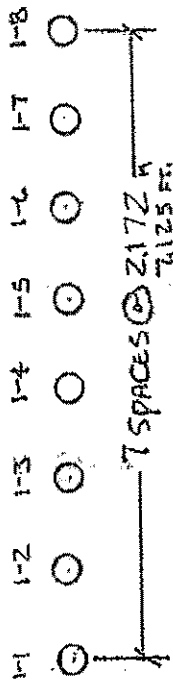
STROKE (N)	STROKE (FT)	BLOWS/IN OR 25 MM
2.59	8.5	9
2.44	8.0	11
2.29	7.5	13
2.13	7.0	15

DRIVEN OPEN ENDED WITH INTERIOR
PLUG 3 METERS ABOVE TIP

US20: LAKE CREEK BRIDGE



BENT 2



BENT 1

PP 324 X 9.5 ASTM A572, GRADE 3

BENT 1 MIN. TIP = ELEV. 1042.5

BENT 2 MIN. TIP = ELEV. 1044.5

$Q_{ult} = 2135 \text{ KN PER PILE}$
ULTIMATE CAPACITY

BRIDGE OR PROJECT NAME									
U520: LAKE CR BRIDGE									
HAMMER DESCRIPTION (MAKE, TYPE, SIZE)									
ICE MODEL 425 DIESEL SERIAL # 257									
LOCATION	ORIG. ORDER LEN.	REV. ORDER LEN.	DEL. LEN.	FRESH HEAD	LEN. LEADS	SPICES		GUT OFF	DRIVEN LEN.
						PAY	NO PAY	SALV. SCRAP	
1-1	6.61M		7.62M	25'	25'			1.3M	7.16
1-2				25'	25'			2.13	5.3M
1-3				25'	25'			1.67	5.94M
1-4				25'	25'			2.32	5.3M
1-5				25'	25'			2.17	4.85M
1-6				25'	25'	2.0M		2.28	7.62M
1-7				25'	25'			1.61	7.01M
1-8				25'	25'			2.46	5.16M

BRIDGE NO.		CONTRACT NO.		INSPECTOR(S)	
19184		C13068		JOHN CEPEDA	
KIND OF PILING		DATE		REMARKS AND SKETCHES	
PP 324 X 9.5 GRADE 3		7/11/05		HEAT # 45225	
CUT-OFF ELEV.	TIP ELEV.	SET	BEARING	INSPECTOR	
1047.51	1040.35	15 BPI	7 ⁰ STROKE	Kepeal	
1047.46	1041.36	25 BPI	7 ⁰ STROKE	Kepeal	HEAT # 45225
1047.41	1041.47	17 BPI	7 ⁰ STROKE	Kepeal	HEAT # 45225
1047.31	1042.06	18 BPI	7 ⁰ STROKE	Kepeal	HEAT # 45225
1047.28	1042.43	15 BPI	7 ⁰ STROKE	Kepeal	HEAT # 45225
1047.18	1037.52	15 BPI	7 ⁰ STROKE	Kepeal	HEAT # 45225 spliced 2.23M to 7.62 OR 25 ft
1047.07	1040.00	17 BPI	7 ⁰ STROKE	Kepeal	HEAT # 44652
1046.97	1041.81	20 BPI	7 ⁰ STROKE	Kepeal	HEAT # 44652

[illegible]

SKETCHES, ETC

Foot	Blind	Stroke
------	-------	--------

NO RECORD DONE ON PILES
EACH PILE WERE COPIED TO
MIN MINA TIP BLVD. A 24"
STEEL CASING WAS THEN SET
INTO HOLE AND THEN THE
PILE WAS SET INSIDE CASING
AND BEGINS DRIVING UNTIL
WAS ACHIEVED MIN. TD.
CONTRACTOR LATER PLACED
CLSH BETWEEN PILES AND
CASING.

RECORD FILE 1-6

SKETCHES, ETC

Foot	Blow	Stroke
------	------	--------

INSERT TAB

**Unit 8
Drilled
Shafts**

Section 8

Drilled Shafts

Drilled Shaft Equipment	1
Construction Process	8
Slurry Construction	10
Temporary Casing	15
Construction Documents	18
Inspection Forms	19
Shaft Excavation	20
Reinforcing Cage	23
Concrete Placement	31
Concrete Volumes	40
Post Construction Activities	46
Post Construction Testing	49

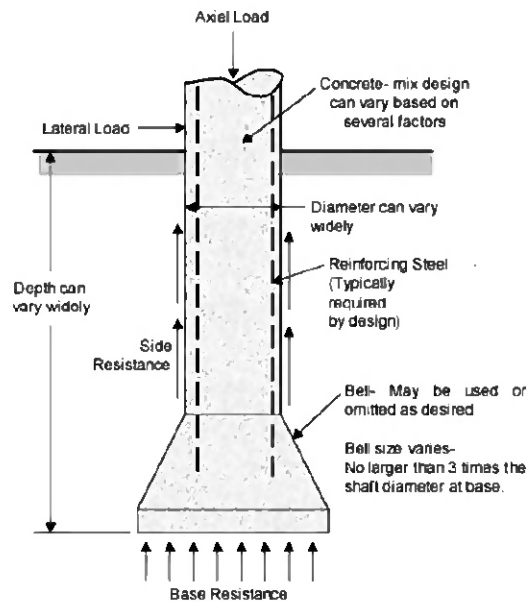
Drilled Shafts

Section 8



1

Typical Drilled Shaft



2

Drilled Shaft Equipment



3

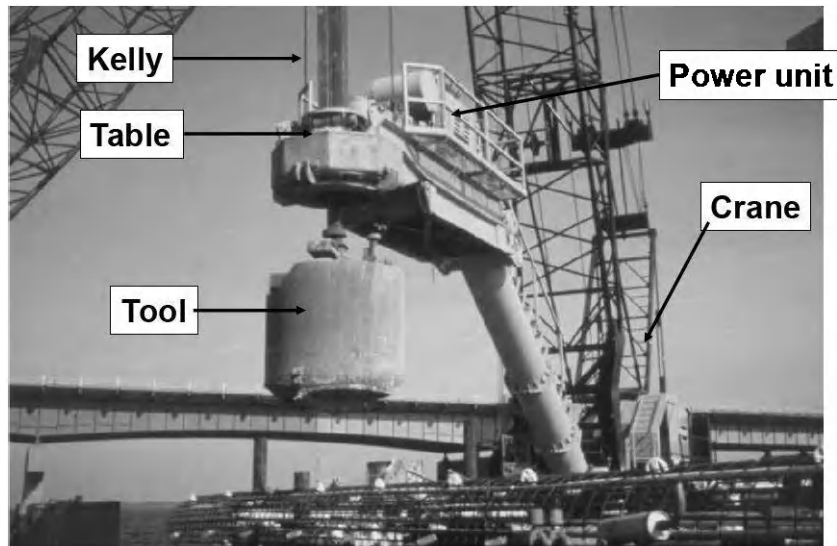


Crane Mounted Rigs

- Large power units attached to crane
- Elevated rotary table to accommodate drill tools

4

Drilling Equipment Terminology



5



Crawler Mounted Rigs

- Larger rigs capable of 12' diameter holes and 250' depth
- Smaller rigs are more maneuverable
- Good in low-headroom locations

6



Light Truck Mounted Rigs

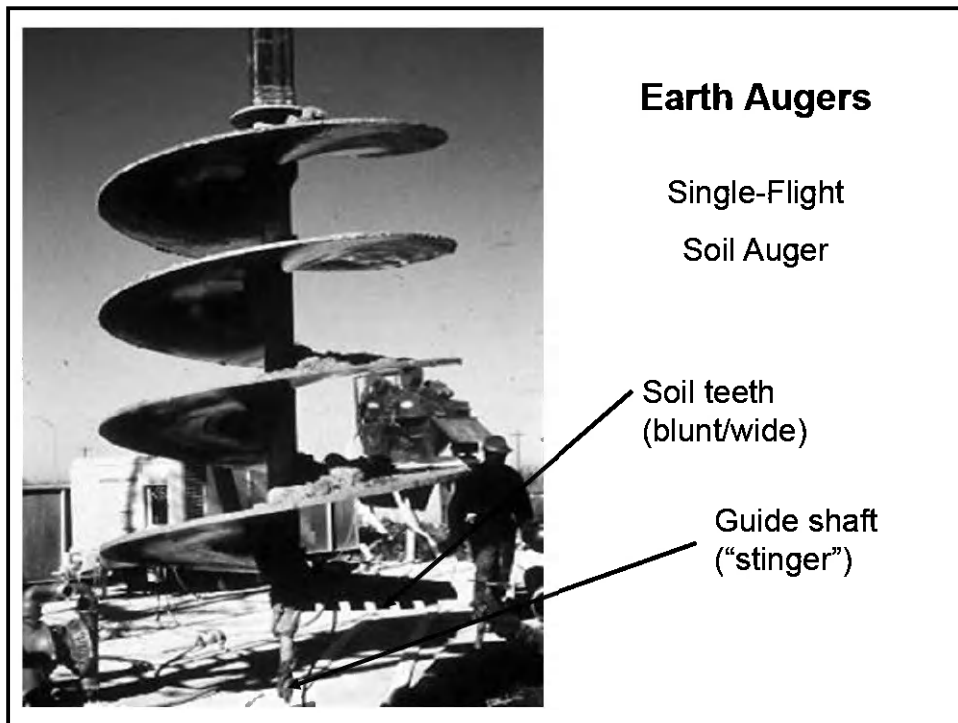
- Smaller jobs such as light and signal poles
- Access road required

7

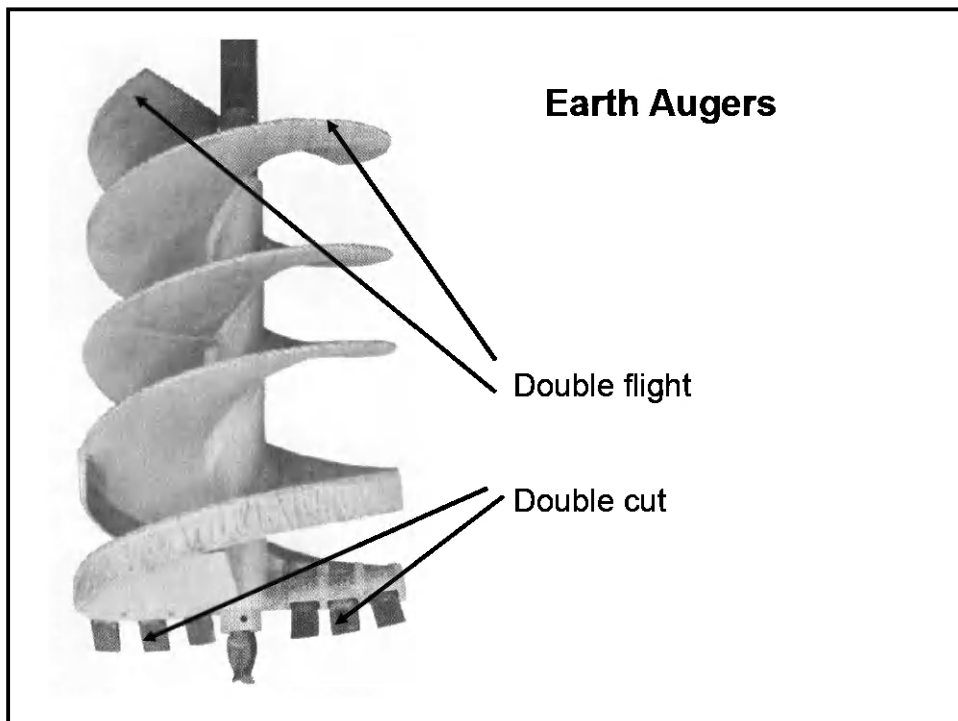


Auger Bits and Tools

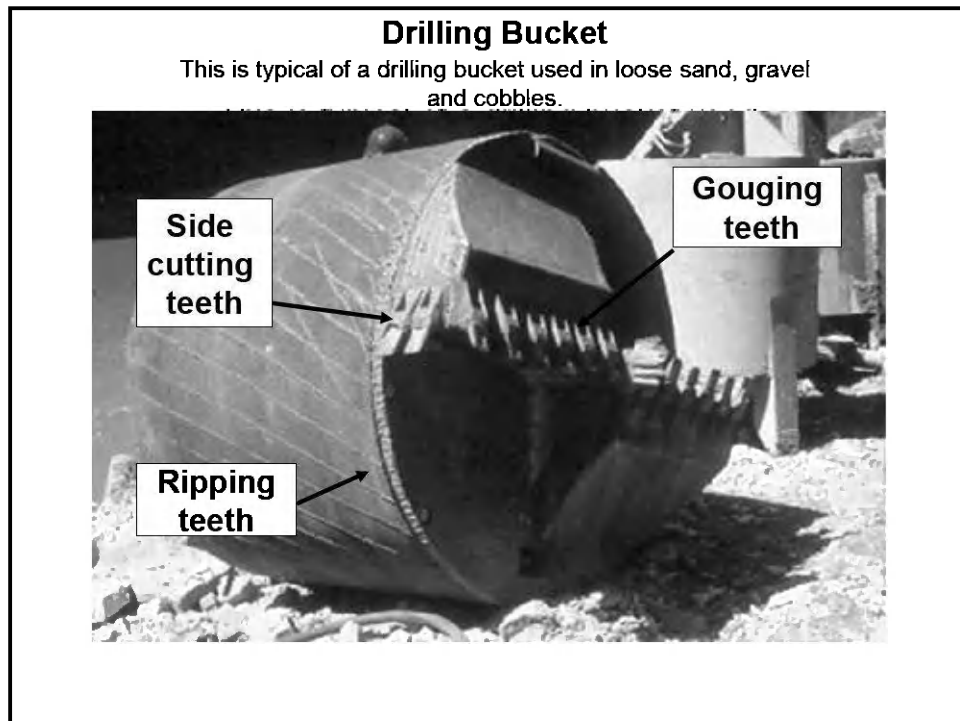
8



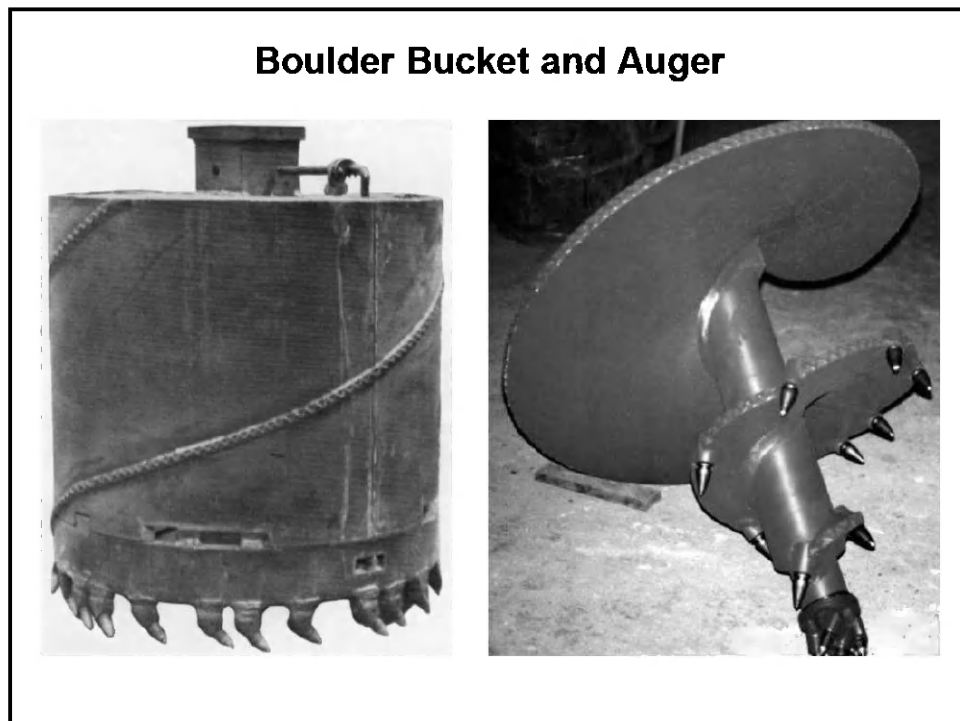
9



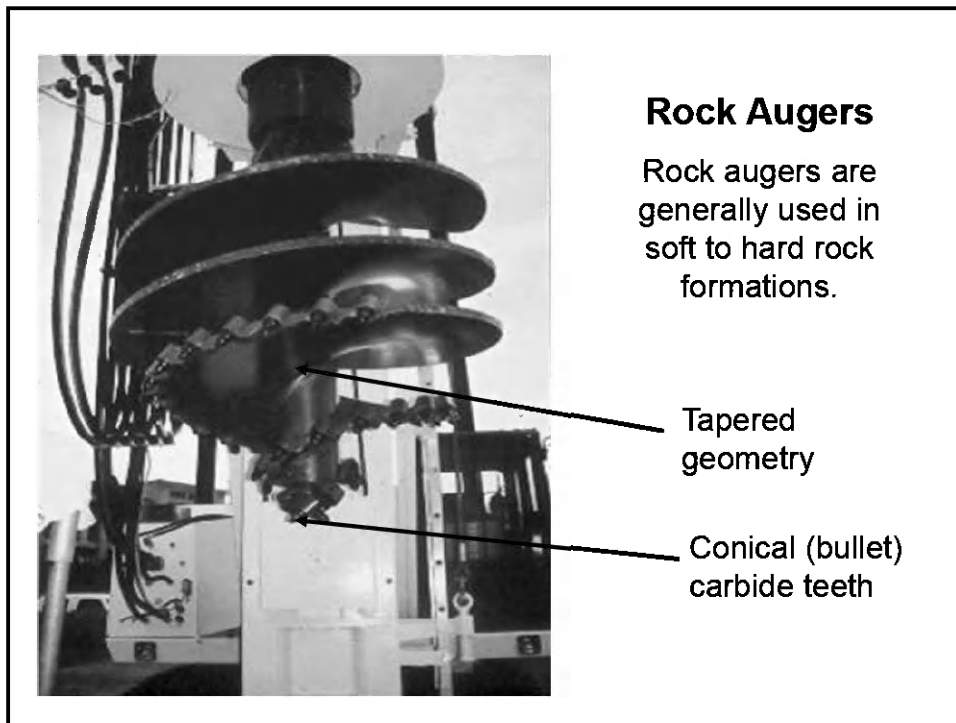
10



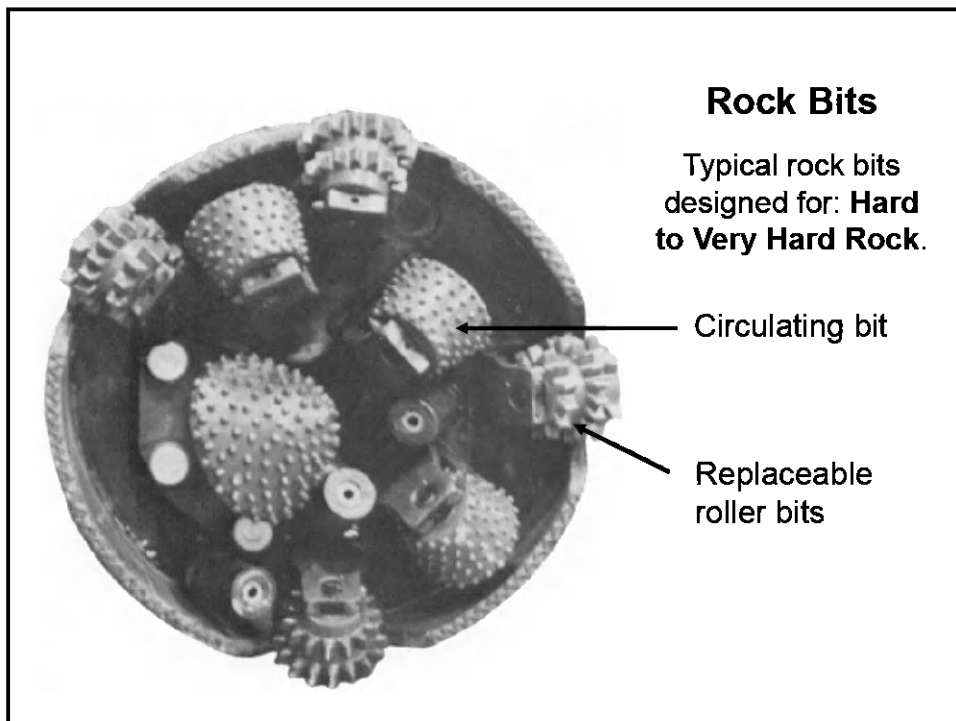
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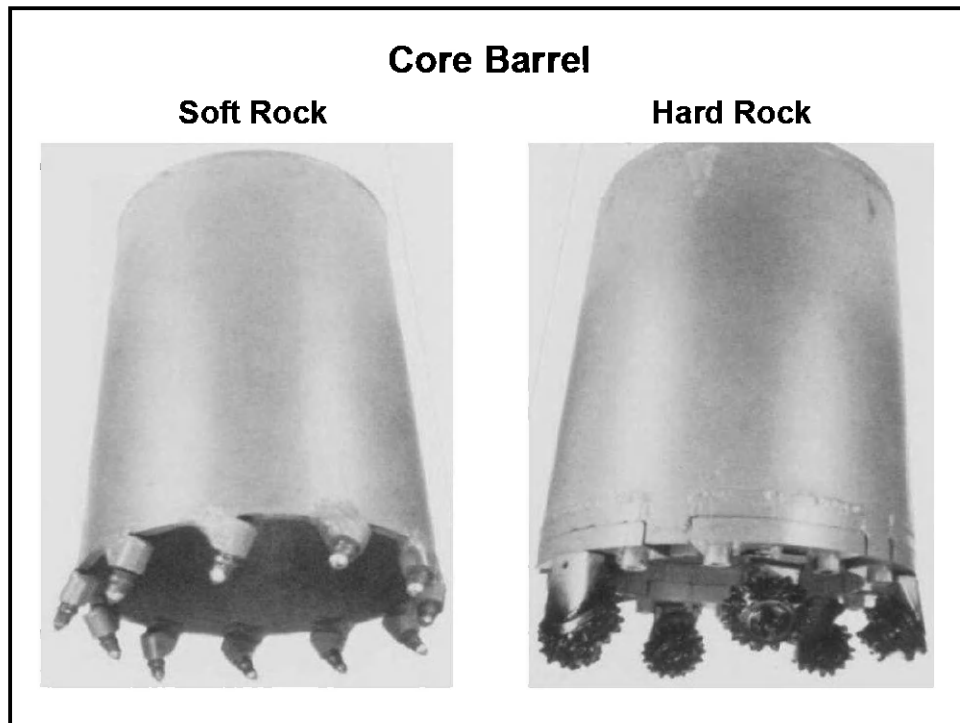
12



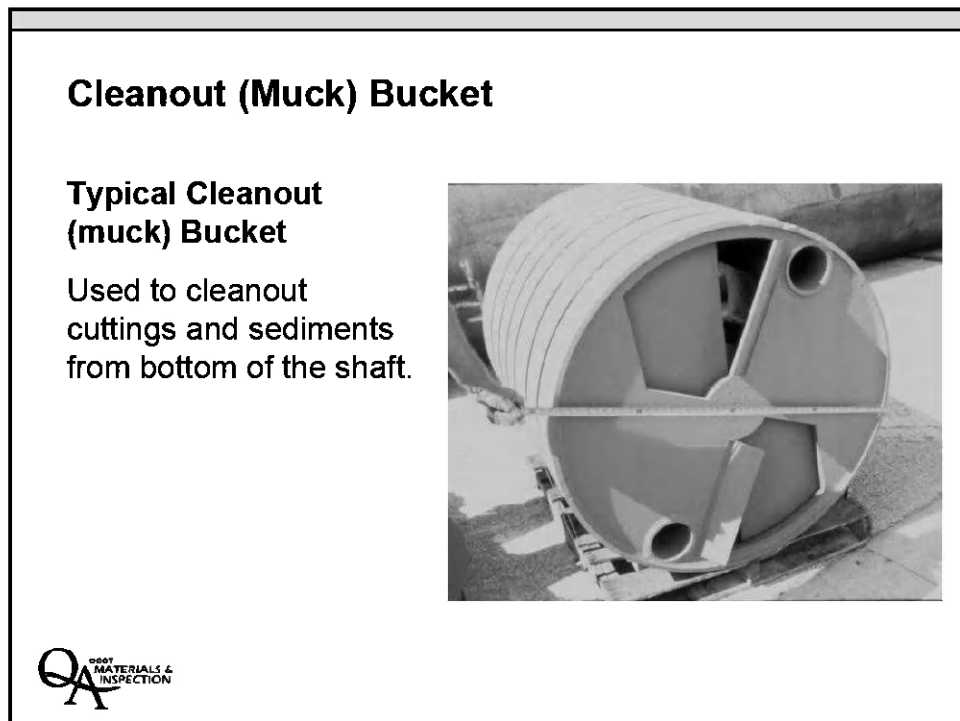
13



14



15



16

Construction Process



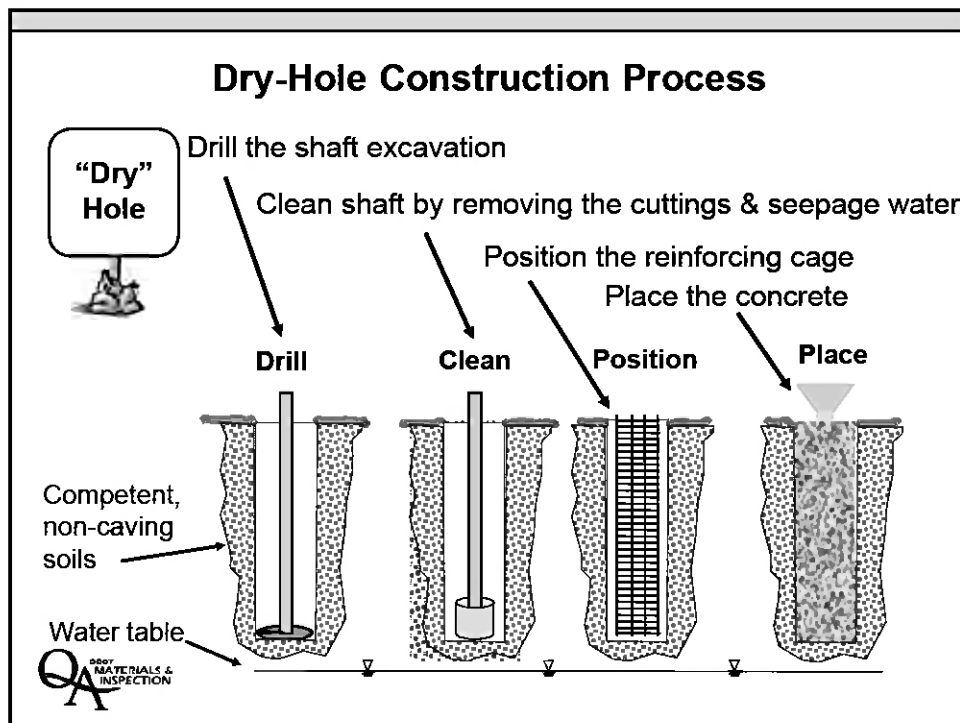
17



Dry Hole 00512.47(b)

- No more than 3" of water on bottom of shaft at time of pour.
- Seepage rate of no more than 12" per hour.
- Shaft diameter is greater than or equal to 3 feet.

18



19

Wet Hole Construction

- Wet hole construction is slurry construction.
- A slurry may be needed in a dry hole to maintain hole stability



20

Slurry Types

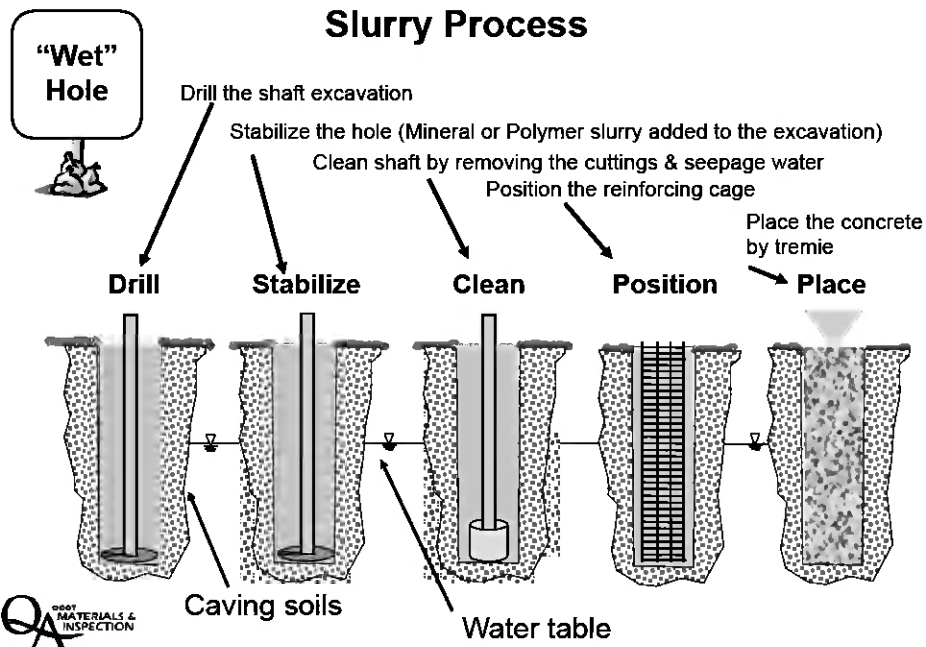
00512.14

- Mineral
- Synthetic
- Water



21

Slurry Process



22



Clean

Proper cleaning and maintaining slurry level is imperative.



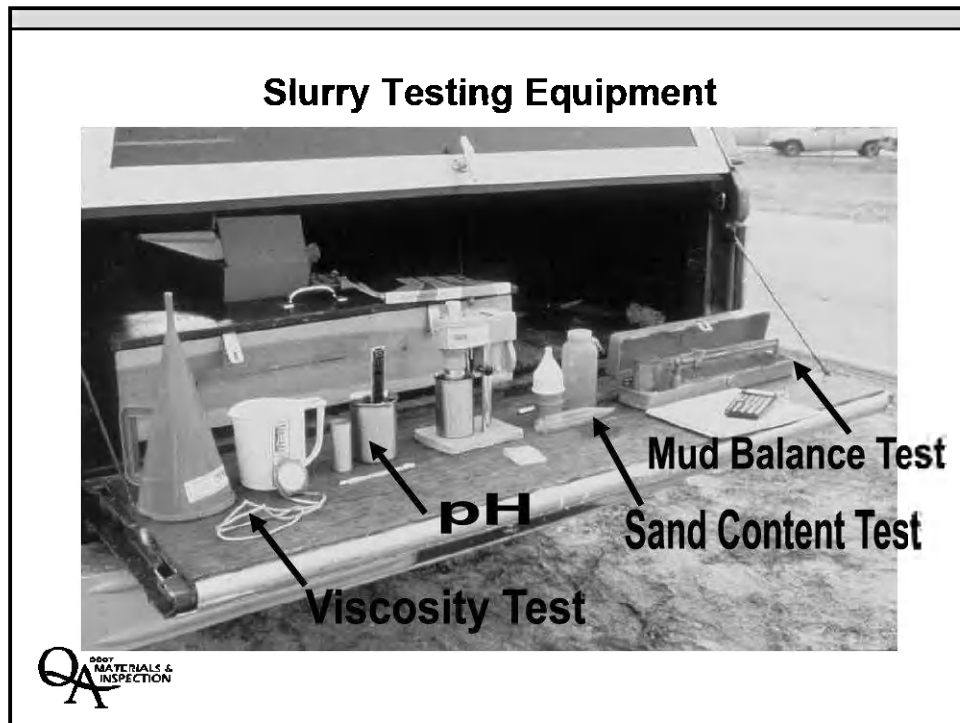
23

Testing Slurry **00512.43 (f) & (g)**

- Clean, recirculate, de-sand or replace to maintain required slurry properties.
- Test at mid-depth of the excavation and within 24" of the bottom.
- Final placement of concrete not allowed until test results show slurry properties are as specified.



24



25

Mineral Slurry	
00512.14(a)	
▪ Density	64 - 75 lb/cf max
▪ Viscosity	26 -50 sec/qt
▪ pH	8 – 11
▪ Sand Content	4.0 % max

QA MATERIALS & INSPECTION

26

Synthetic Slurry

00512.14(b)

- From QPL
- According to manufacturer's recommendations
- Sand content less than 2.0 %



27

Water Slurry

00512.14(c)

- | | |
|----------------|--------------|
| ▪ Density | 70 lb/cf max |
| ▪ Sand content | 2.0% max |



28

Placing Concrete in “Wet” Holes (Tremie Pipe or Pump Hose)



QA
0007
MATERIALS &
INSPECTION

29

Placing Concrete



QA
0007
MATERIALS &
INSPECTION

30

Temporary Casing



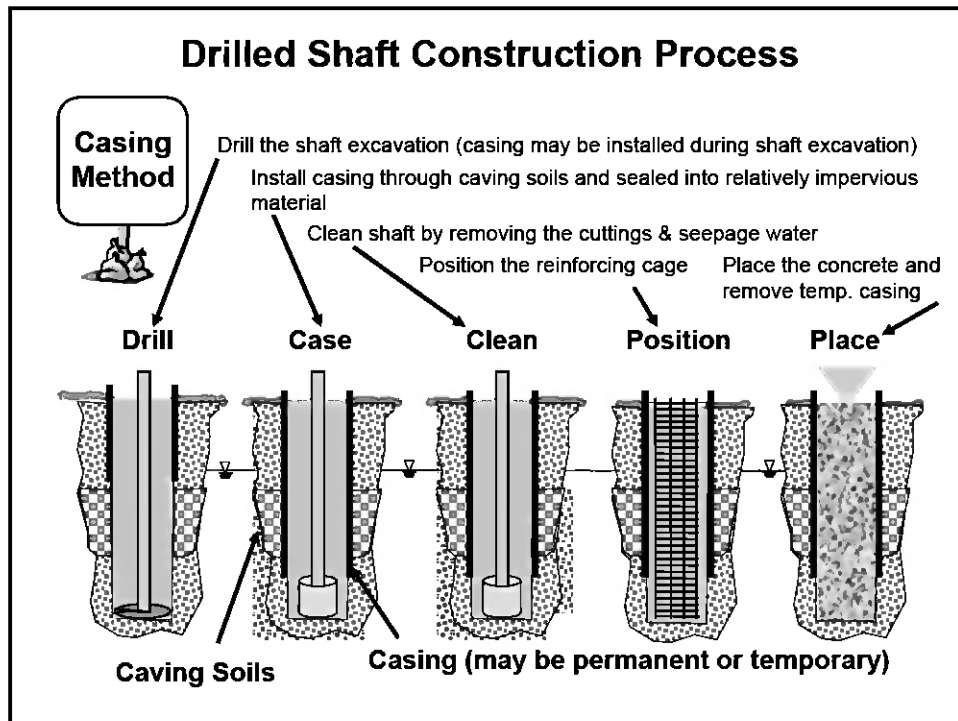
31



Temporary Casing Stabilization

- Used where an open-hole cannot be maintained.
- Used to seal off caving soils below the water table.
- Used where excessive hole deformation occurs (swelling/expansive soils).
- Used where slurry will not work.

32



33



Casing Installation Process (Casing Advancers)

- Hydraulic oscillators/rotators drive and extract casing
- Fitted with special quick coupling joints



34

Casing Removal



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0001
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INSPECTION

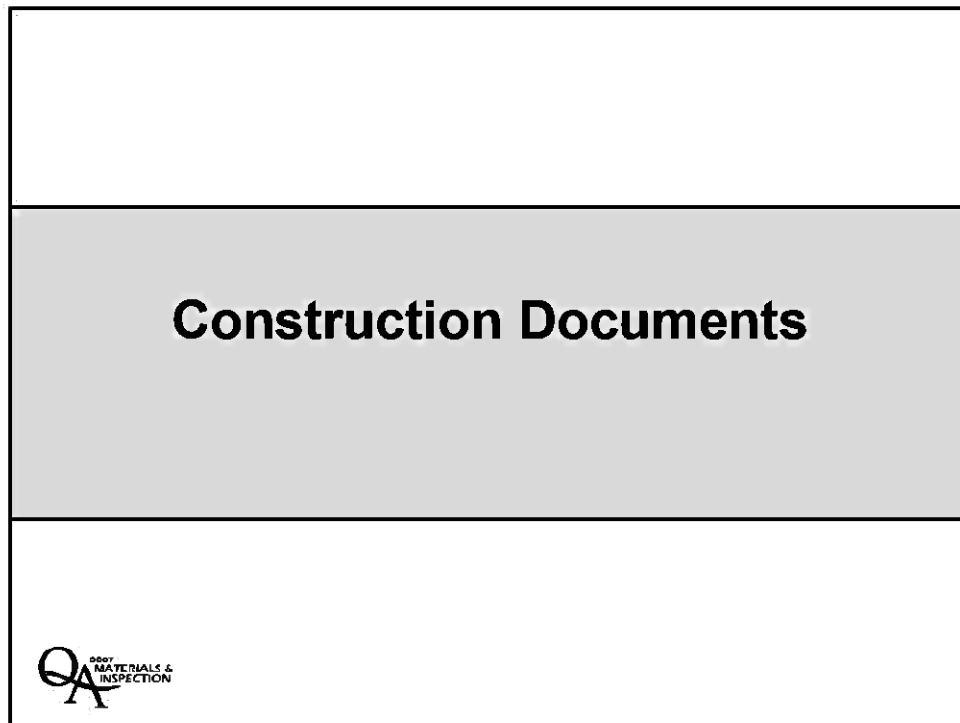
35

Permanent Casing

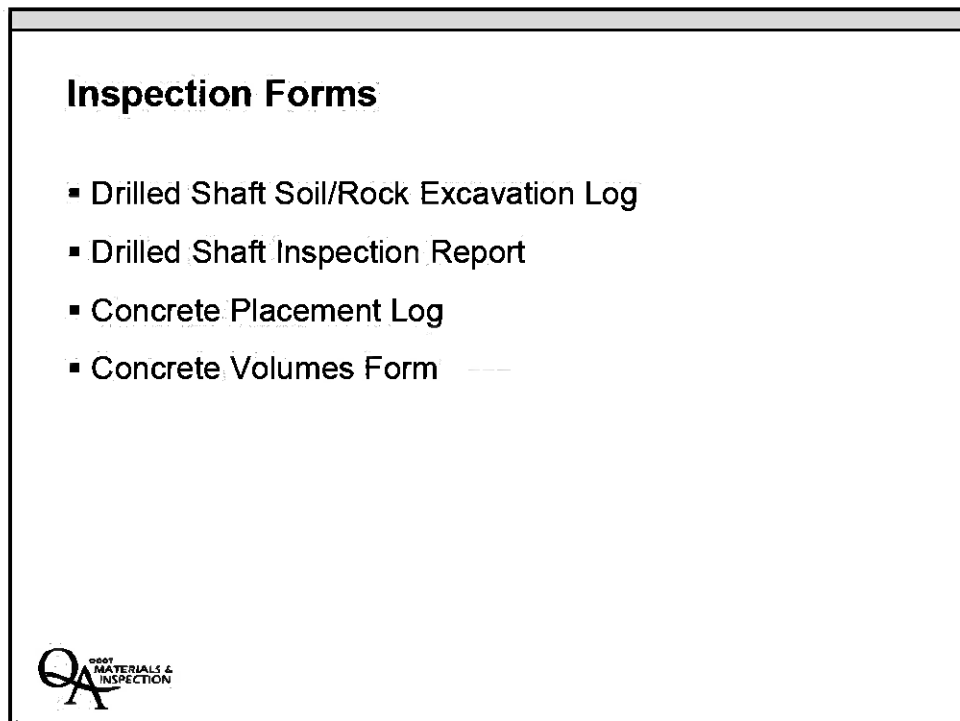


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MATERIALS &
INSPECTION

36



37



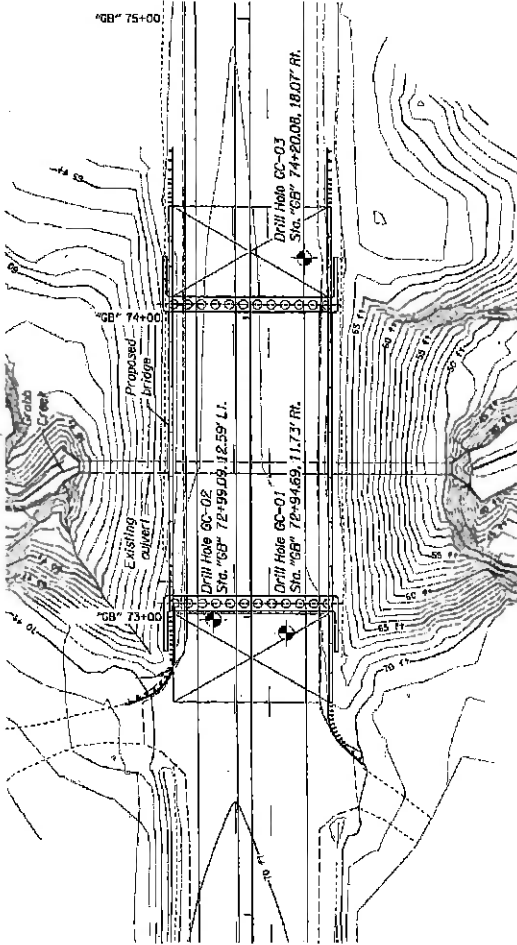
38

LEGEND OF SYMBOLS

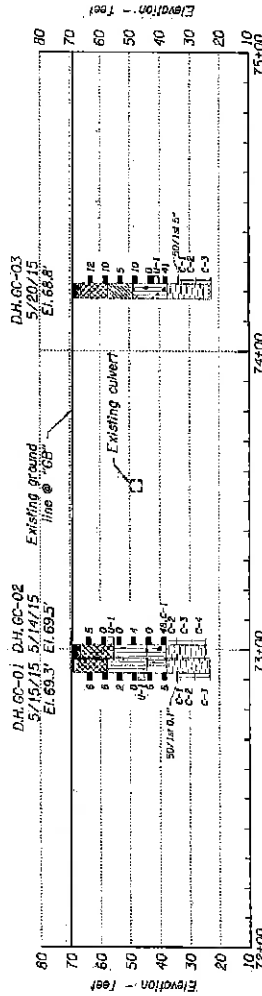
C-# = Core sample (ASTM D2113)
 R.O.D. = Rock Quality Designation (ASTM D6032)
 q_u = Unconfined compressive strength (ASTM D7012)

= Drill Hole Location
 N-value Uncorrected (raw) standard penetration resistance in accordance with ASTM D1586
 U-# = Undisturbed sample (ASTM D1587)

Asphalt Concrete (Asphalt)
 SILT, M, to Clayey SAND, SC, brown to dark brown, low to medium plasticity, damp, very loose and very soft to stiff, fine to coarse sand, (Fill)
 SILT with trace to some sand, M, green-gray to brown, low plasticity, damp to moist, very soft to soft, fine to coarse sand, with wood fragments.
 Sandy SILT, M, to SAND, SP, blue-gray, non-plastic, wet, loose, fine to coarse sand.
 SILTSTONE, gray to dark gray, slightly weathered to fresh, extremely soft to hard, close to moderately close jointing.
 Roadway Base (Fill)
 CLAY, CH, to Sandy SILT, M, brown to gray, low to medium plasticity, damp to moist, very soft to medium stiff, fine to coarse sand, with carbonized wood.
 CLAY with trace sand, CL, light brown, medium plasticity, stiff to medium stiff, and M, to Gravelly SILT, SAND, SM, SILT, with trace sand, CL, to Gravelly SILT, SAND, SM, to Sandy GRAVEL, GP, blue to blue-gray to green-gray, to gray to brown, non-plastic to low plasticity, moist to wet, very soft and very loose to dense, fine to coarse sand and gravel.
 SANDSTONE, gray, fresh, hard, moderately close jointing.



PLAN
Scale: 1"=20'-0"



FOUNDATION DATA
Scale: 1"=20'-0"

Notes:
 1. Elevations shown are based on North American Vertical Datum, 1988.
 2. Geotechnical data shown on this drawing are a consolidation of information and/or revision in terminology from the drill logs. The drill logs used in compiling this drawing are available upon request. Contractor shall refer to geotechnical reports and drill logs and information contained therein.
 3. Refer to the ODOT Soil and Rock Classification Manual (1987) for a description of the terms used on this sheet.

SCALE WARNING
 If scale bar doesn't appear, this drawing is not to scale

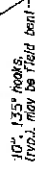
STRUCTURE NO. 22431		DATE MAR 2017		CALC. BOOK 6626	
OREGON DEPARTMENT OF TRANSPORTATION		SHANNON & WILSON, INC. Geotechnical and Environmental Consultants		SHEET 3 OF 14 DRAWING NO. 98710	
GRAB CR-HWY 45 OR38/US101: SMALL AND LARGE CULVERT UPGRADES UMPOUA HIGHWAY MP 25.1 DOUGLAS COUNTY		FOUNDATION DATA			



CONCRETE BEARING PAD DETAILS

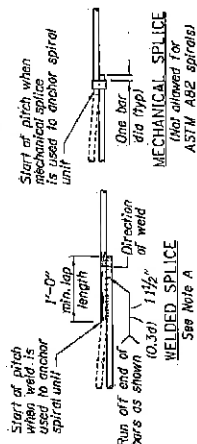
No Scale

NOTE—An
 Allow ASTM A706 for all welded splices except
 ASTM A515 Grade 60, ASTM A62 or ASTM A956
 may be used if copies of the chemical composition analysis
 are submitted and approved as conforming with the One.
 Anchor splices at each end and discontinue with one
 after turn and a splice to itself as shown. Where permitted on
 plans, provide closed loops conforming to the requirements of this
 detail. Lapped splices is not allowed within 1/6 the column height
 or less. Column cross sectional dimension at 1/6 from top
 of footing or bottom of cap beam, or in columns with spirals
 less than 3'-0" in diameter.



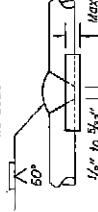
LAPPED SPLICE
See Note A

See Note A



SPIRAL SPLICE / TERMINATION DETAIL

No Scale



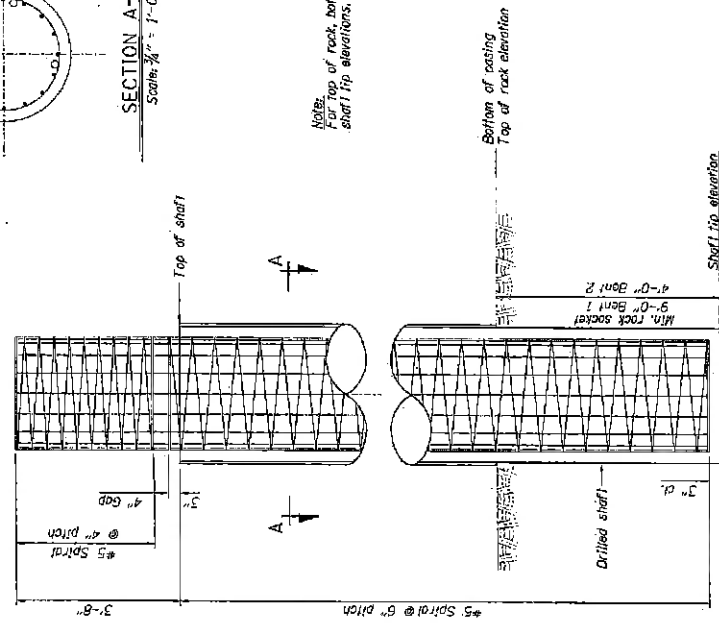
ALTERNATE WELDED SPLICE

Weld reinforcing steel splices in accordance with the latest edition of AWS D1.4.
"Structural Welding Code Reinforcing Steel"



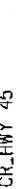
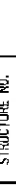
2005-08-10

Note:
For top of rock, bottom of casing, and estimated shaft lip elevations, see footing plan dwg. no. 98713



DRILLED SHAFT ELEVATION

0-1 = 4% below

DATE		REVISION	BY	CHECKED	REVIEWED			STRUCTURE NO. 22431	OR38/US101: GRABB CR HWY 45 SMALL AND LARGE CULVERT UPGRADES UMPUA HIGHWAY MP 25.1 DOUGLAS COUNTY	SHEET 13 OF 14
DATE			Michael L. Jarvis	Paul J. Strauser	Josh Goodall			MAR - 2017		DRAWING NO. 98120
DATE					Robert Grubbs			CALC BOOK 5826	BENT DETAILS - 2	
ACCOMPANIED BY DWGS. See sheet 1 of this plan set										

Drilled Shaft Inspector's Checklist

The following is a general checklist to follow when constructing a drilled shaft. The answer to each of these questions should be "Yes" or "NA" unless plans, specifications or specific approval has been given otherwise. Any answer of "No" should be explained in the Notes/Comments.

CONSULT WITH PROJECT MANAGER FOR YOUR SPECIFIC PROJECT RESPONSIBILITIES.

Pre-Construction

- | | | | |
|------------------------------|-----------------------------|-----------------------------|--|
| ☐ Yes | ☐ No | ☐ NA | 1. Has the Drilled Shaft Installation Plan been submitted and approved (00512.40)? |
| ☐ Yes | ☐ No | ☐ NA | 2. Has a list of project personnel been submitted and approved (00512.30)? |
| ☐ Yes | ☐ No | ☐ NA | 3. Have the Contractor's quality control technicians been submitted and verified? |
| ☐ Yes | ☐ No | ☐ NA | 4. Does the Contractor have an approved concrete mix design according to 02001.35? The Inspector should have a copy on the project site. |
| ☐ Yes | ☐ No | ☐ NA | 5. Has the Contractor run the required plastic concrete tests (slump loss tests) for their concrete mix design (02001.35(h))? |
| ☐ Yes | ☐ No | ☐ NA | 6. If the Contractor proposed a polymer slurry, do you have a copy of the quality control plan for the slurry (00512.40 and 00512.43(f)) and the name and phone number of the slurry manufacturer's representative who will be providing technical assistance? |
| ☐ Yes | ☐ No | ☐ NA | 7. If the Contractor plans to use a manufactured slurry, do they have the proper equipment to mix it? |
| ☐ Yes | ☐ No | ☐ NA | 8. Have you reviewed the Foundation Data sheet and drill logs and understand the subsurface conditions? |
| ☐ Yes | ☐ No | ☐ NA | 9. Has the Contractor addressed the Protection of Existing Structures (00512.40)? |
| ☐ Yes | ☐ No | ☐ NA | 10. Does the Contractor have all the equipment and tools shown in the Drilled Shaft Installation Plan (00512.40)? |
| ☐ Yes | ☐ No | ☐ NA | 11. If permanent casing is required, is it the right size and material in accordance with the plans and Section 00512.13? |
| ☐ Yes | ☐ No | ☐ NA | 12. If temporary casing is to be used, is it in accordance with the Drilled Shaft Installation Plan (00512.40)? |
| ☐ Yes | ☐ No | ☐ NA | 13. If there are contaminated media (materials), hazardous materials, or contaminated groundwater present, are they being treated in accordance with 00290 and 00294? |
| ☐ Yes | ☐ No | ☐ NA | 14. Do you have all the required drilled shaft forms that need to be filled out during shaft construction?
a. Drilled Shaft Excavation Log (form 734-2604) c. Drilled Shaft Concrete Placement Log (form 734-2597)
b. Drilled Shaft Concrete Volume Log (form 734-2603) d. Drilled Shaft Inspection Report (form 734-2598) |
| ☐ Yes | ☐ No | ☐ NA | 15. Has the drilled shaft coordination meeting been held (Section 00512.41)? |

Shaft Excavation & Cleaning

- | | | | |
|------------------------------|-----------------------------|-----------------------------|---|
| ☐ Yes | ☐ No | ☐ NA | 16. Have the locations for the drilled shafts been accurately located and marked, and both the Contractor and Inspector understand the survey markings? |
| ☐ Yes | ☐ No | ☐ NA | 17. Is the shaft being constructed in the correct location and vertical alignment according to tolerances in Section (00512.42)? |
| ☐ Yes | ☐ No | ☐ NA | 18. Is the slurry level being properly maintained in accordance with 00512.43(f)? |
| ☐ Yes | ☐ No | ☐ NA | 19. Are the proper number and types of tests being performed on the slurry and reported in accordance with 00512.43(g)? |
| ☐ Yes | ☐ No | ☐ NA | 20. Are all excavated materials (spoils) properly contained and disposed of in accordance with 00512.43(a)? |
| ☐ Yes | ☐ No | ☐ NA | 21. If temporary casing is being used, does it meet the requirements of Section 00512.43(c)? |
| ☐ Yes | ☐ No | ☐ NA | 22. Is the shaft of proper depth? |
| ☐ Yes | ☐ No | ☐ NA | 23. Does the shaft bottom meet the clean-out requirements of Section 00512.43(h)? |
| ☐ Yes | ☐ No | ☐ NA | 24. Have the drilled shaft excavation forms been completed? |

Reinforcing Cage (Construction & Placement)

- ☐ Yes ☐ No ☐ NA 25. Is the rebar the proper grade steel, correct sizes and correct configurations as shown in the project plans and shop drawings?
- ☐ Yes ☐ No ☐ NA 26. Is the rebar properly tied in accordance with Section 00530.41(b)?
- ☐ Yes ☐ No ☐ NA 27. Are the proper number of Crosshole Sonic Log (CSL) tubes furnished and installed according to the project plans?
- ☐ Yes ☐ No ☐ NA 28. Does the Contractor have the proper number and type of spacers for the steel cage in accordance with the approved Drilled Shaft Installation Plan and Section 00512.45(d)?
- ☐ Yes ☐ No ☐ NA 29. If the steel cage was spliced, was it done in accordance with the details shown on the contract plans?
- ☐ Yes ☐ No ☐ NA 30. Is the steel cage adequately secured to maintain vertical tolerance during concrete placement operations (00512.45(a) and 00512.47(e))?

Concrete Operations

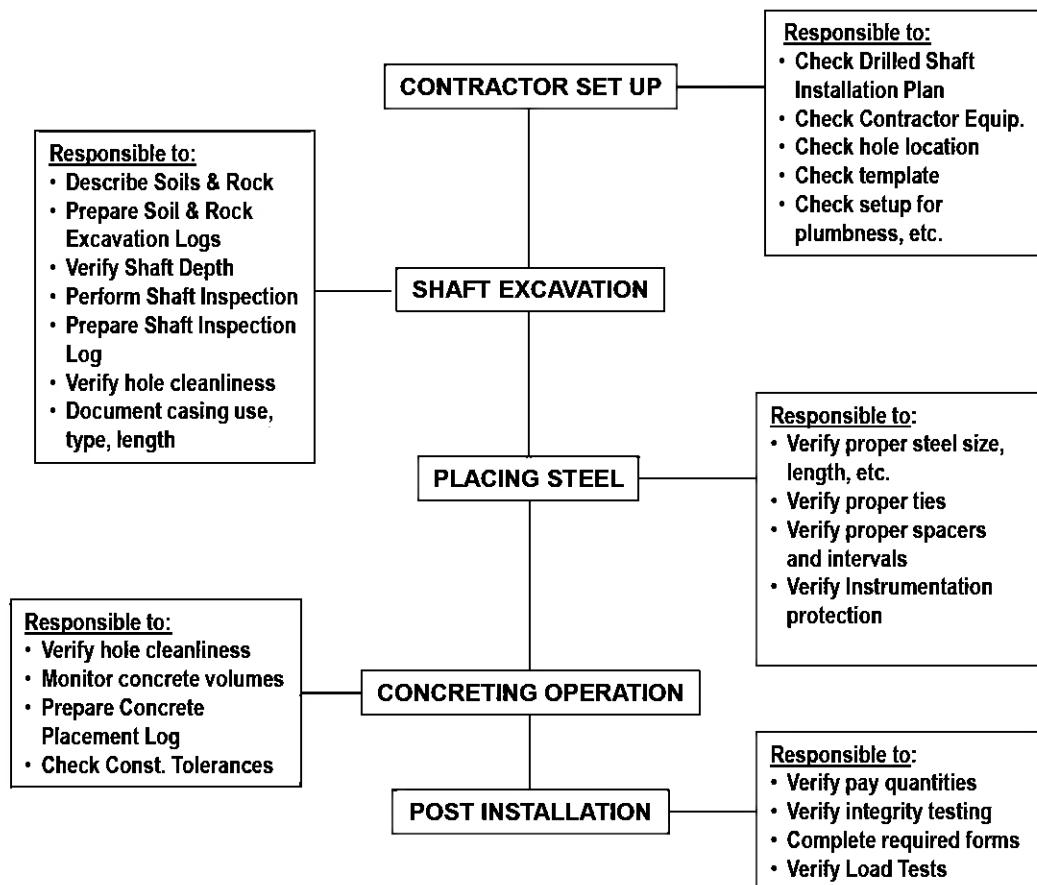
- ☐ Yes ☐ No ☐ NA 31. Prior to concrete placement, has the slurry (both manufactured and natural) been tested in accordance with Section 00512.43(g)?
- ☐ Yes ☐ No ☐ NA 32. If required, was the casing removed in accordance with Section 00512.47(e)?
- ☐ Yes ☐ No ☐ NA 33. Does the Contractor's tremie meet the requirements of Section 00512.47(a)?
- ☐ Yes ☐ No ☐ NA 34. Was the discharge end of the tremie maintained in the concrete mass with proper concrete head above it at all times (00512.47(c))?
- ☐ Yes ☐ No ☐ NA 35. For shafts with non-contact splices, have the cold joints been properly cleaned and roughened in accordance with Section 00512.47(a)?
- ☐ Yes ☐ No ☐ NA 36. For shafts without non-contact splices, did the Contractor overflow the shaft until good concrete flowed out of the top of the excavation (00512.47(a))?
- ☐ Yes ☐ No ☐ NA 37. Have the Concrete Placement and Concrete Volume logs been completed?
- ☐ Yes ☐ No ☐ NA 38. Were the concrete acceptance tests performed as required?
- ☐ Yes ☐ No ☐ NA 39. Were the Crosshole Sonic Log (CSL) tubes filled with water and capped in accordance to Section 00512.46?

Post Installation

- ☐ Yes ☐ No ☐ NA 40. Is all casing removed to the proper elevations in accordance with 00512.47(e)?
- ☐ Yes ☐ No ☐ NA 41. Is the concrete being cured in accordance with Section 00540.51?
- ☐ Yes ☐ No ☐ NA 42. Has all Crosshole Sonic Log (CSL) Testing been completed in accordance with Section 00512.48?
- ☐ Yes ☐ No ☐ NA 43. Is the shaft within the allowable construction tolerances (00512.42)?
- ☐ Yes ☐ No ☐ NA 44. Has the Contractor completed the Drilled Shaft Inspection Report (00512.40(c))?
- ☐ Yes ☐ No ☐ NA 45. Has the Inspector completed the Drilled Shaft Inspection Report (00512.40(c))?

NOTES / COMMENTS

Inspector's Responsibilities on a Drilled Shaft Project



Contractor & Equipment Arrive On-site

Inspector Responsibilities:

- Verify contractor equipment vs. drilled shaft installation plan
- Verify concrete mix design and slurry data



39

Shaft Excavation



40

Shaft Excavation, Cleaning & Inspection

Verify Drilled Shaft:

- Location, alignment, vertical tolerance, horizontal tolerance, diameter, depth
- Complete soil and rock excavation logs
- Monitor slurry testing
- Document casing usage; type, length, etc.
- Perform shaft inspection and verify cleanliness



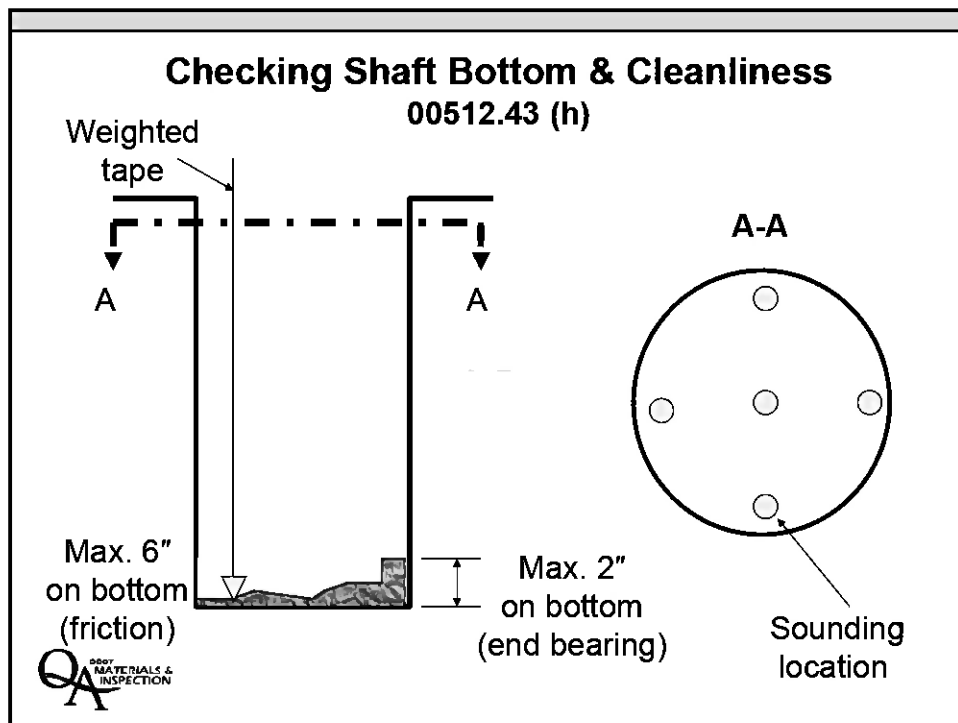
41

Shaft Depth & Cleanout Requirement

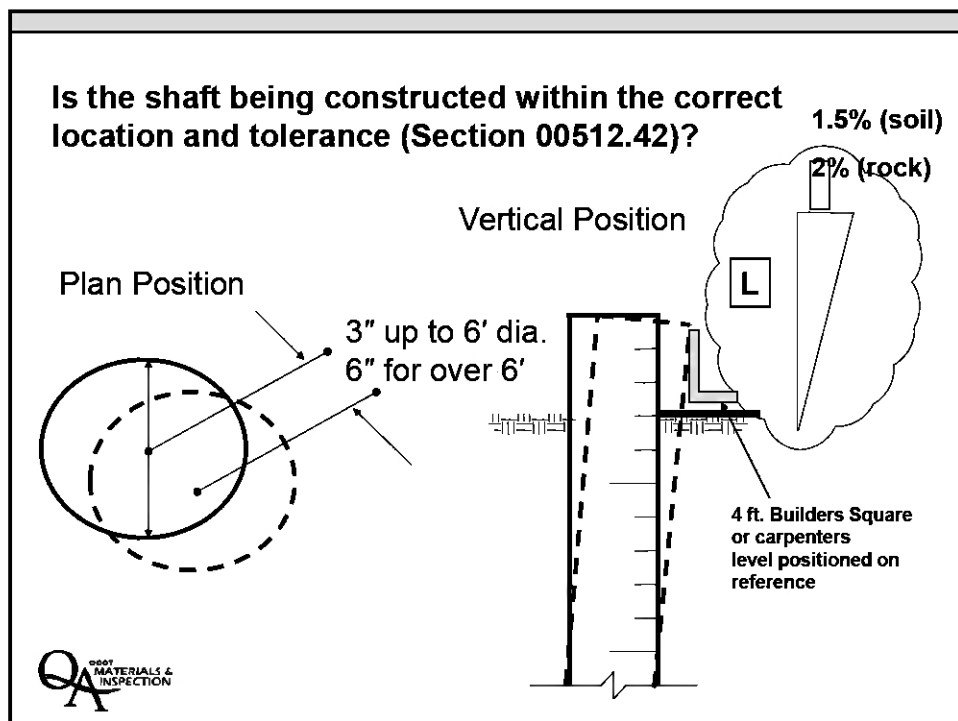
- Depth typically determined and verified by lowering a weighted tape down to the bottom of the shaft after cleaning.
- Depth typically measured and recorded to the nearest 0.1 of a foot.
- Improved cleanout can be achieved with air lifts and submersible pumps vs. cleanout buckets.



42



43



44



DRILLED SHAFT INSPECTION REPORT

BRIDGE NAME				PROJECT:			CONTRACT NO.:
BRIDGE NO.	BENT	STATION	SHAFT NO.	SHAFT DIAMETER	INSPECTED BY	CERTIFICATION NO.	DATE
DRILLED SHAFT CONTRACTOR				PRIME CONTRACTOR			

Time Excavation Started: _____ STOPPED _____

Date/Time Bottom Inspected: _____

Date Concreting Started: _____ STOPPED _____

	Plan Measurements	"As-Built" Measurements
--	----------------------	----------------------------

Top Elevation _____

Bottom Elevation _____

Shaft Diameter _____

Rock Socket Diameter
(if appl.) _____

Shaft Length* _____

*Was longer shaft approved for payment? ☐ Yes ☐ No

Concrete Volume (cy) _____

Concrete Mix Design _____

Concrete Placement Method ☐ Tremie ☐ Free Fall

Concrete Slump @ time or pour _____

Water Inflow Rate _____ gal/min (est.)

Bottom of Shaft Cleanliness Meets Specification? ☐ Yes ☐ No

Proper reinforcement and CSL tubes installed: _____

Description of bottom of shaft: _____

COMMENTS (Obstructions Encountered, etc.):

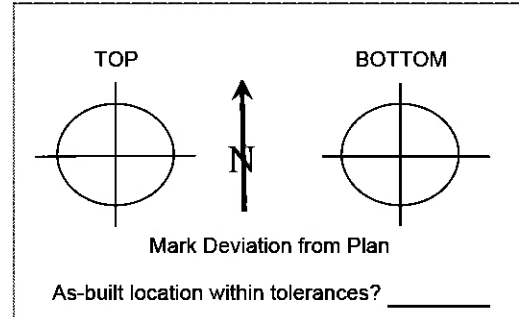
CSL Test Performed: ☐ Yes ☐ No

CSL Test Results Approved: ☐ Yes ☐ No* *If not approved, describe results and resolution

Shaft Approved by:

INSPECTOR SIGNATURE

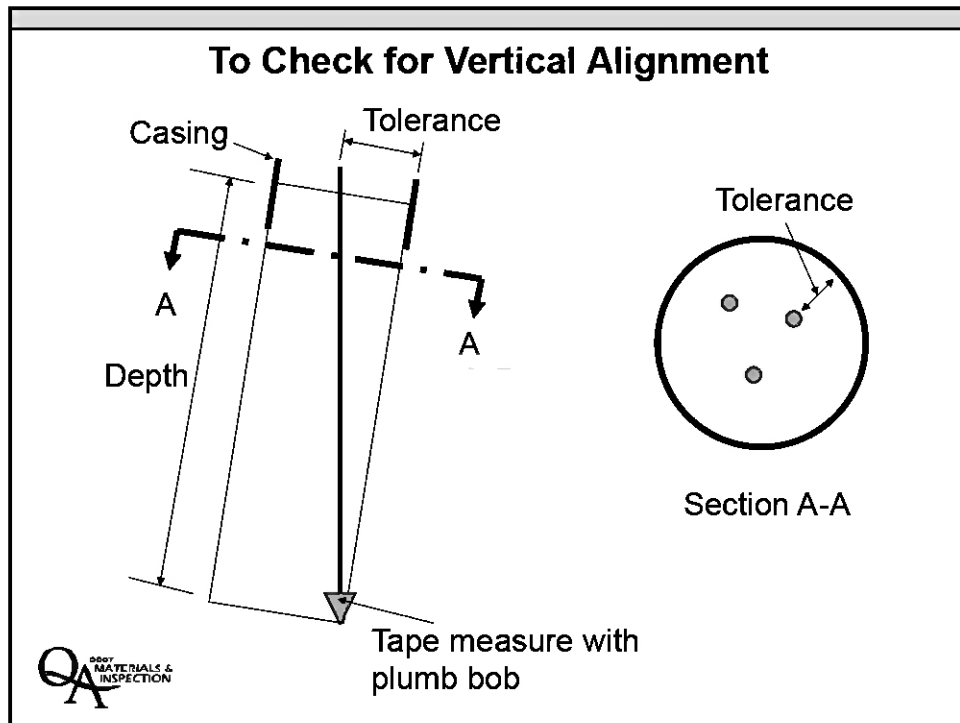
DATE



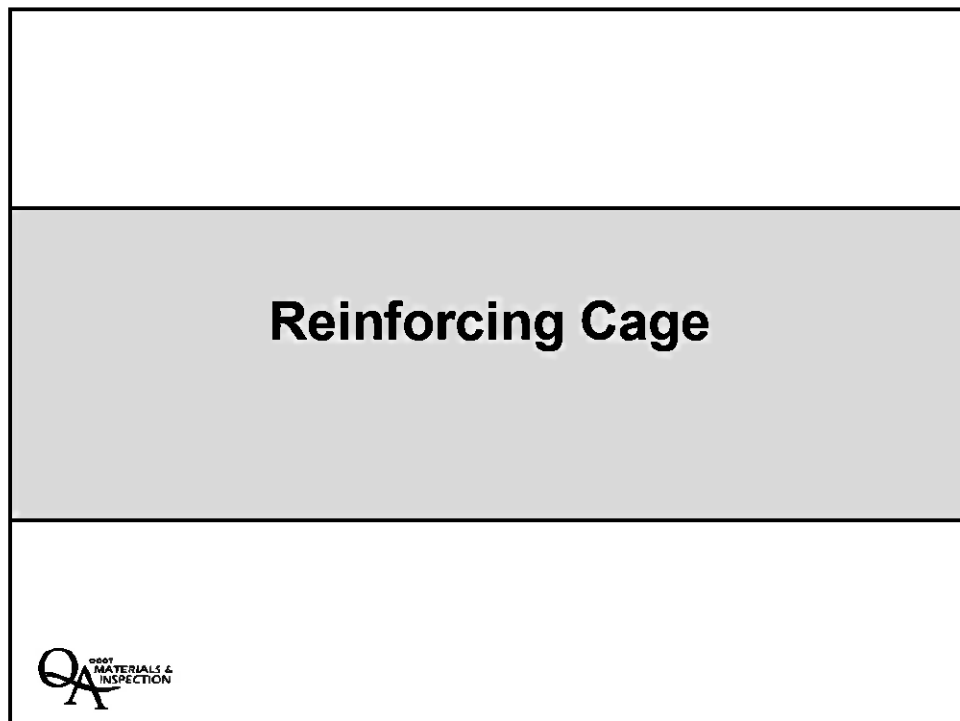
Ref. Elev.	_____	Reinforcement Elev. Before Conc. _____ Elev. After Conc. _____
Ground Surface or Mudline Elev.	_____	
Groundwater Elev.:	_____	
Top of Rock Elevation	_____	
Bottom of Shaft Elevation	_____	
		Casing OUTER (Perm/Temp) Diameter _____ Top Elev. _____ Length _____ MIDDLE Diameter _____ Top Elev. _____ Length _____ INNER Diameter _____ Top Elev. _____ Length _____

Note: Forward completed reports to ODOT Bridge Section.

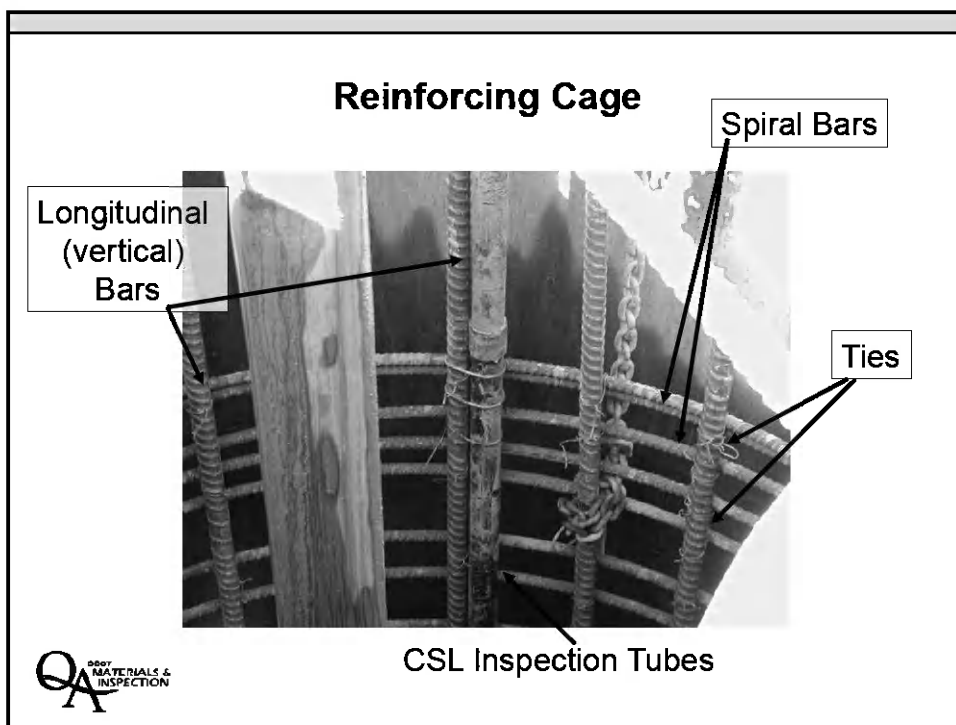
<http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/HwyConstForms1.shtml>



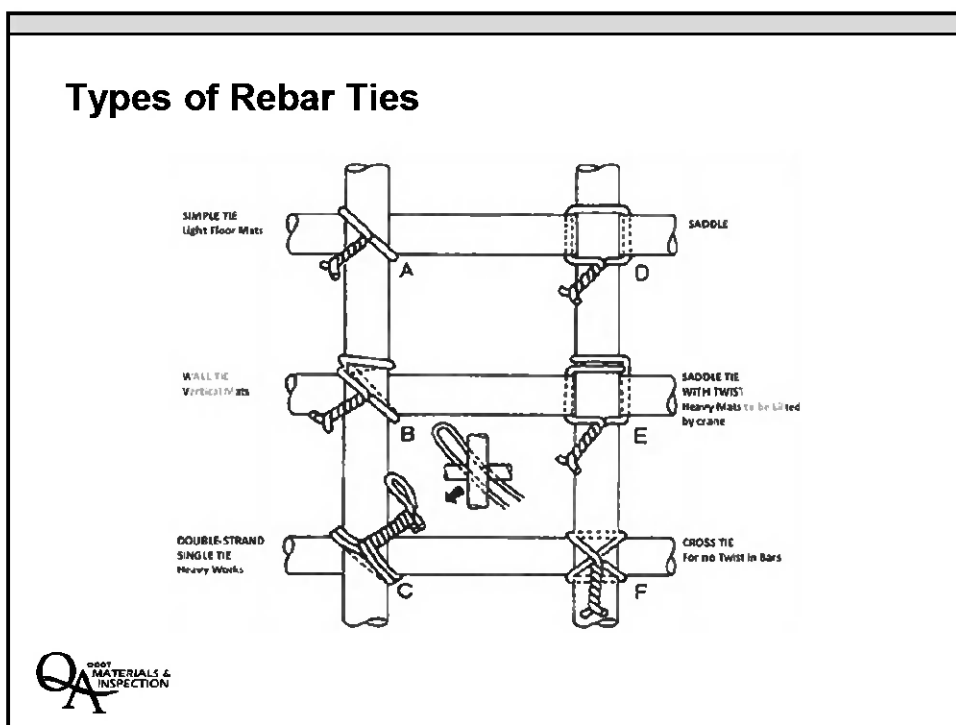
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46

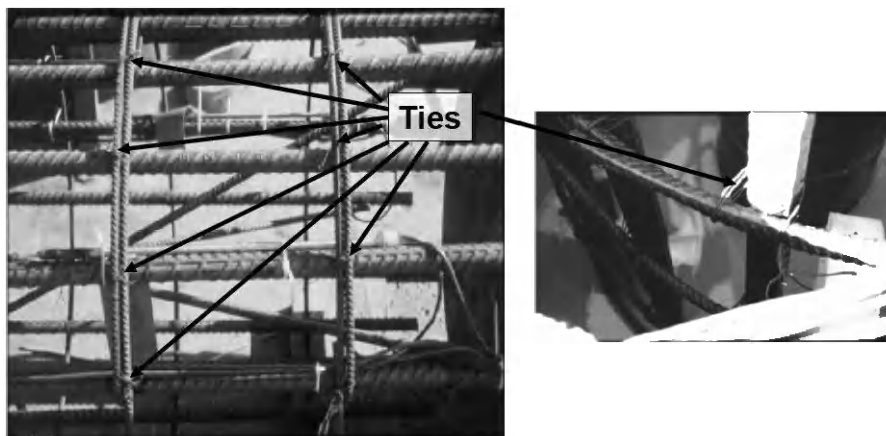


47



48

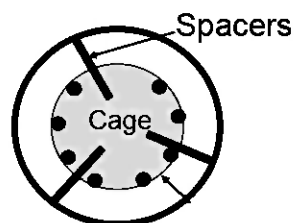
Is the rebar properly tied in accordance with Section 00530.41, Placing and Fastening?



49

Does the contractor have the proper spacers for the steel cage? 00512.45 (d)

- Maintain the required concrete cover shown in the plans, between outside of cage and shaft walls.
- Start spacers near the bottom of cage with vertical spacing intervals not exceeding 10 ft.
- Use a minimum of 1 spacer per 30 inches of rebar cage circumference with a minimum of 3 spacers at each interval.
- Standoffs are usually allowed to support the bottom of the cage.



50

Plastic Roller Spacer



QA
0001 MATERIALS &
INSPECTION

51

Epoxy Coated Rebar Spacer



QA
0001 MATERIALS &
INSPECTION

52

Plastic Spacer



53

Spacer Example

4 ft Drilled Shaft

6" clearance

How many spacers are required on each level?

$$C = \pi \times D$$

$$C = 3.14 \times 3' = 9.42'$$

$$\# \text{ of Spacers} = 9.42' / 2.5' / \text{Spacer} = 3.8$$

$$\# \text{ of Spacers} = 4$$



54

Spacer Exercise

8 ft Drilled Shaft

6" clearance

How many spacers are required on each level?



55

Reinforcing Cage Construction

- Shall be completely assembled prior to placement.
- Placed immediately after inspection and acceptance of shaft.
- Internal stiffeners removed as cage is placed in the borehole.



56

Reinforcing Cage Storage & Handling

- Do not store in contact with soil.
- Keep away from oil or other deleterious materials.
- Provide adequate supports during lifting.



57

Crosshole Sonic Log (CSL) Access Tubes

Section 00512.15 – Crosshole Sonic Log (CSL) Test Access Tubes:

- Placed per plan.
- CSL tubes to be Schedule 40 steel pipe with minimum I.D. of 1.5 inches.
- Tied securely to the reinforcement cage.
- Water-tight joints and filled with water before or no more than 1 hour after concrete placement
- Capped top and bottom.



58

Crosshole Sonic Log (CSL) Access Tubes



59

Splicing of Cage

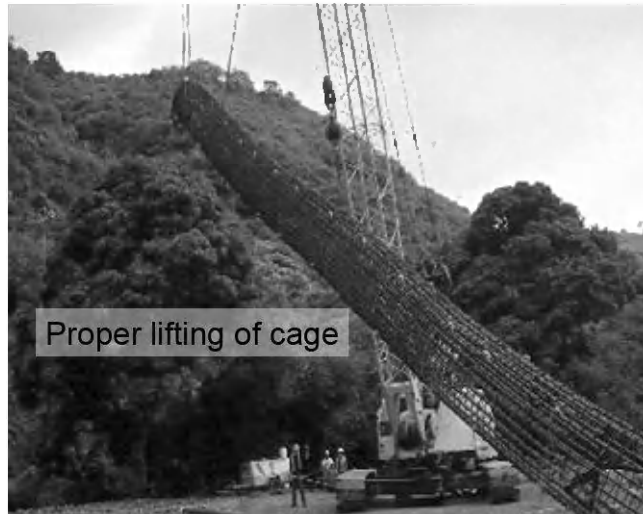
Occasionally, the plans will require the rebar cage to be spliced.

Any splicing of the reinforcement cage requires the **approval of the Structural Design Engineer, if not shown in the plans.**



60

Placement of Reinforcement Cage



61

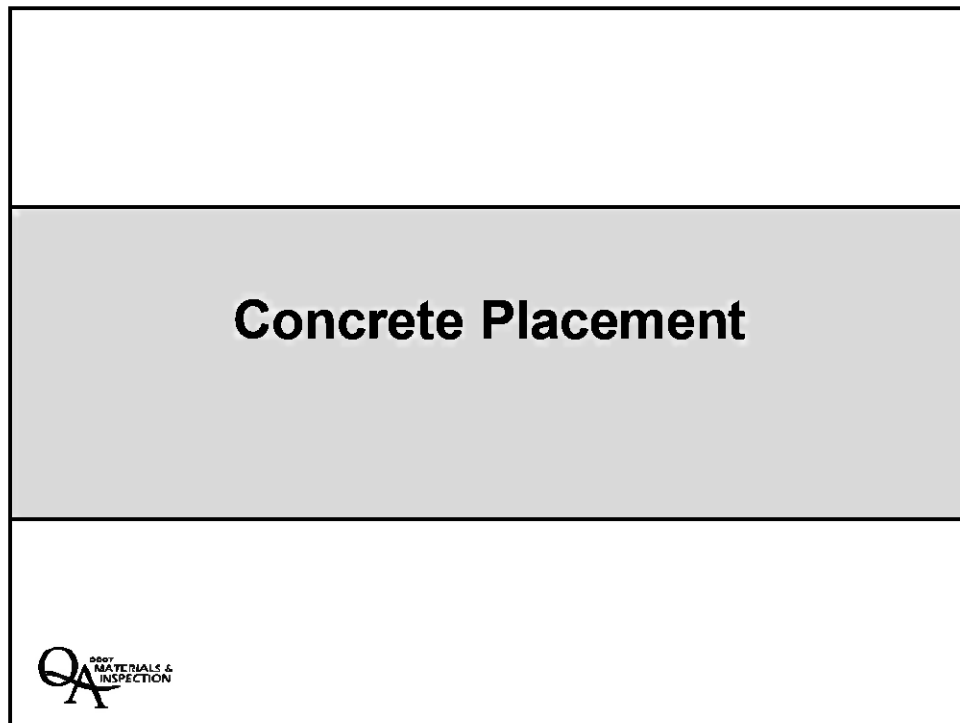
Is the steel cage secured from settling and floating during concrete placement?

- Contractor methods for maintaining cage position during construction must be described in the Drilled Shaft Installation Plan.
- Check top of cage elevation before and after concrete placement.
- After concrete placement the top of reinforcement cage should not exceed:
 - 6" above plan elevation
 - 6" below plan elevation

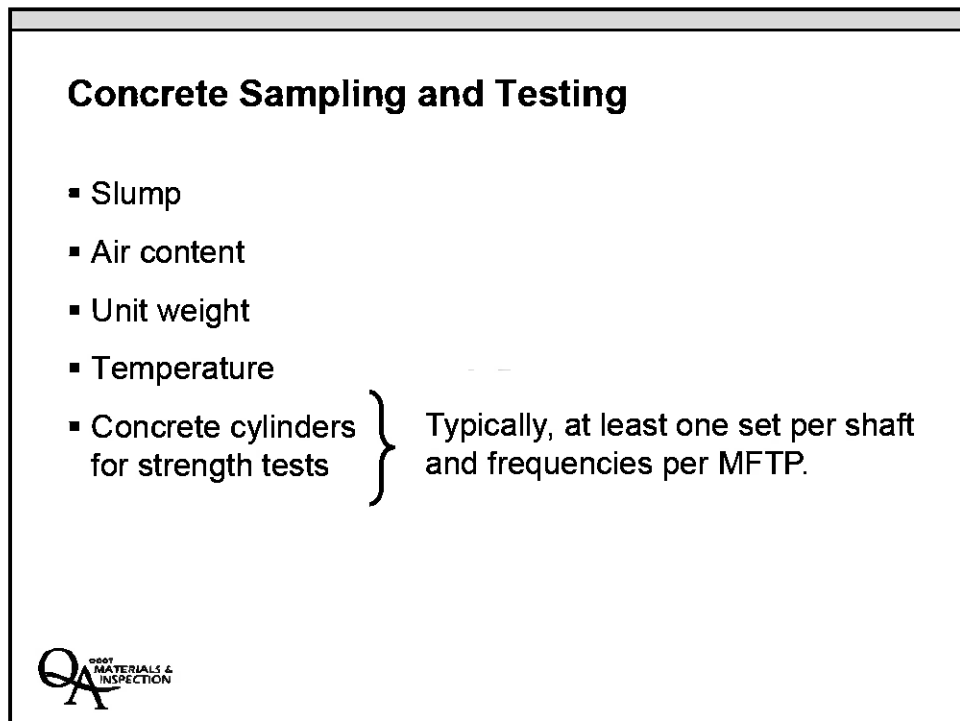
00512.42



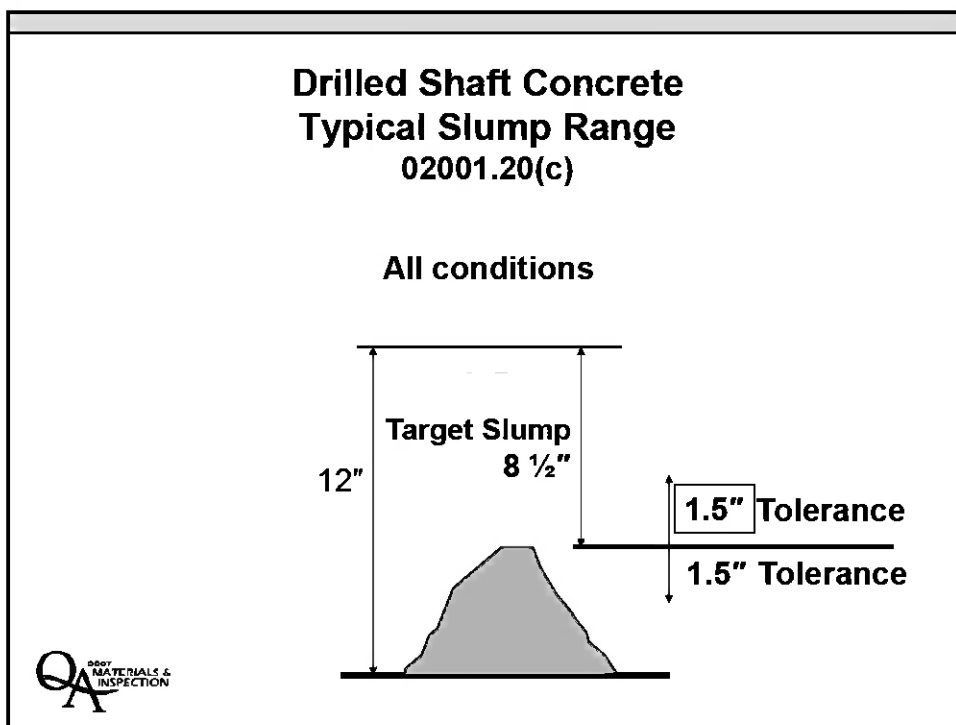
62



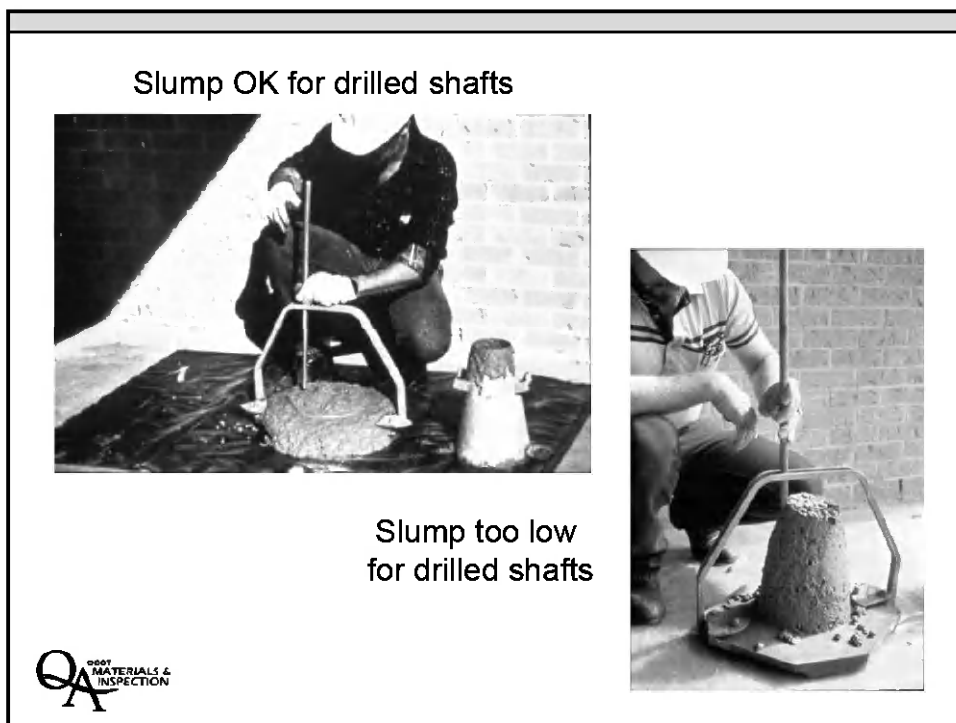
63



64



65



66

Concrete Placement

- Place concrete **continuously**.
- Place concrete **without** interruption.
- Place concrete from the **bottom** of the hole **to the top**.
- Place concrete until fresh concrete is coming out of the top of shaft, **free of water, soil debris** or other **deleterious materials**.



67

Concrete Placement

- No mechanical vibration required.
- Dispose of all displaced water, laitance and waste concrete according to regulations.
- Wet cure the top of shaft for a minimum of seven days.
00512.47(d)



68

Concrete Placement

Tremie Method

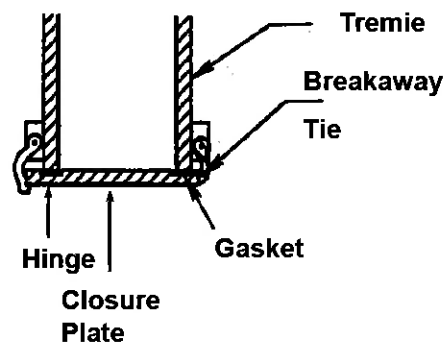
- Begins at the bottom of the hole.
- Place immediately after cleanout.



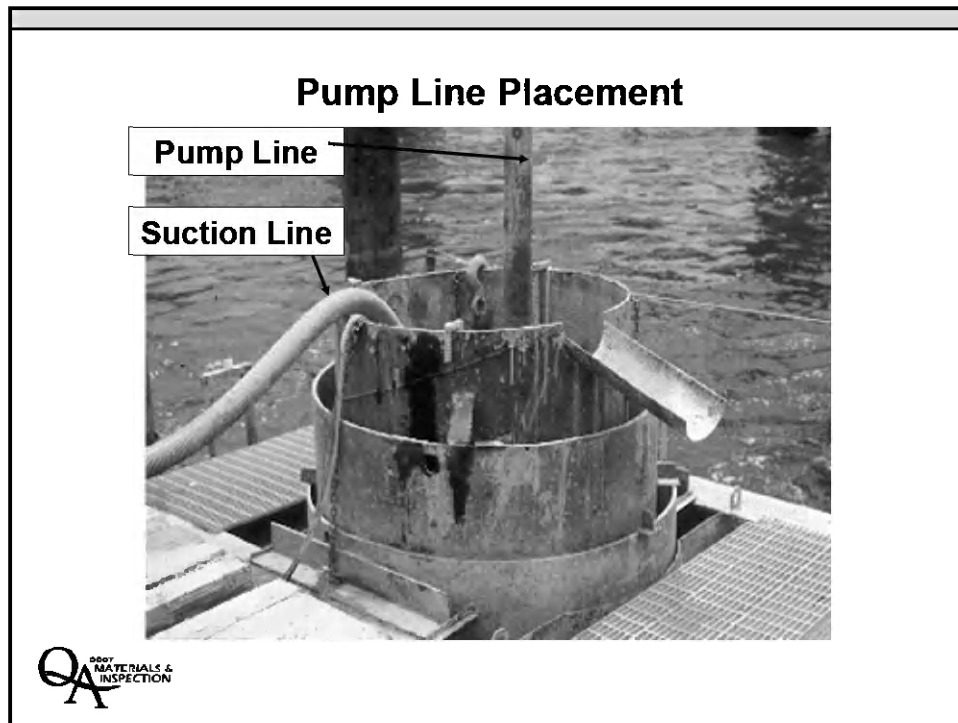
69

Gravity Tremie Placement

8" min inside dia.



70



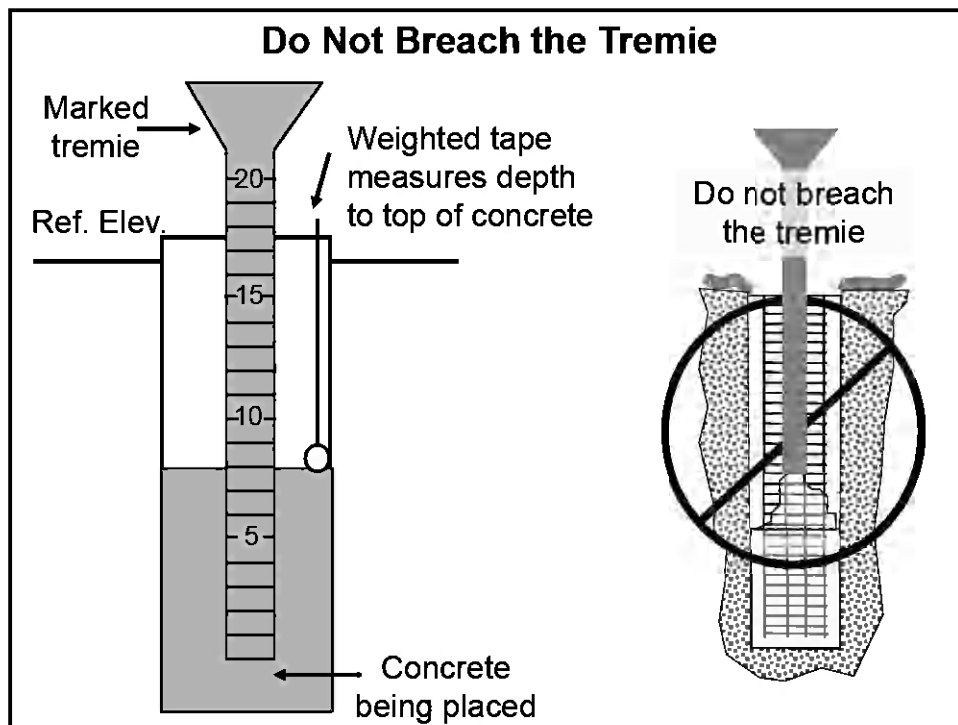
71

Tremie Concrete Placement

- Discharge end of tremie must be immersed a **minimum of 5 ft.** in the concrete at all times. 00512.47(c)
- Flow of concrete must be **continuous**.
- Concrete level in tremie must be above slurry or water level in hole.
- If tremie breaches the shaft is considered defective.

QA
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72



73

Free Fall Concrete Placement 00512.47(b)

- Free fall placement only permitted in dry holes.
- Must fall to base of shaft without contacting rebar cage or shaft walls.
- Make sure all cage bracing is removed prior to concrete placement .
- Drop chutes may be use.



74

Free Fall Method



75

Concrete Placement (Time Limits) 00512.47(a)

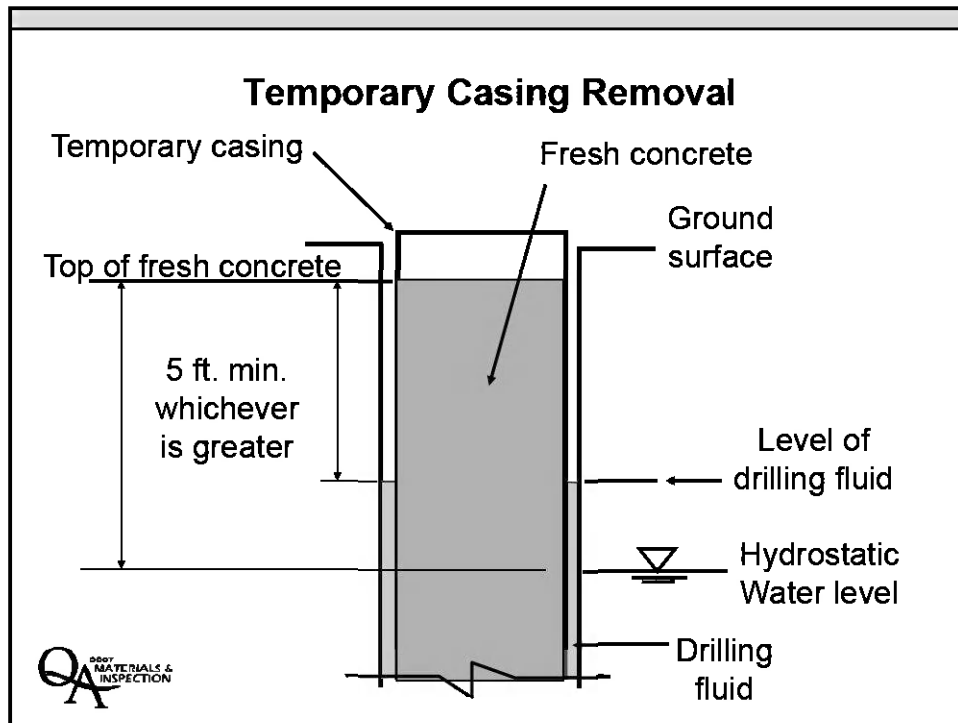
- Allow a **maximum of 60 minutes** between placements.
- No concrete older than 90 minutes from batch time.

Should a delay in concrete placement occur:

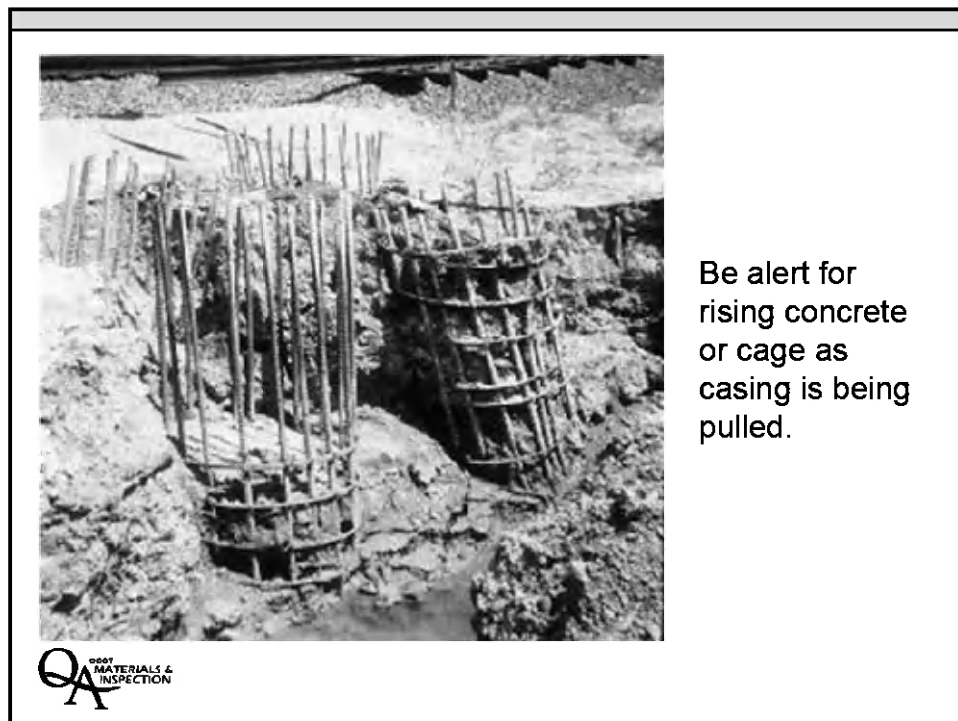
Reduce the placement rate to maintain fresh concrete flow in the shaft.



76



77



78

Permanent Casing Removal

Section 00512.47(e) Casing Removal –

- Remove the tops of permanent casing to the top of the drilled shaft or the finished groundline, whichever is lower, unless otherwise shown or directed.
- Remove the tops of permanent casing for shafts constructed in a permanent body of water to the low water elevation, unless otherwise shown or directed.



79

Concrete Volumes



80

Concrete Placement

00512.40(d)

Contractor to provide Concrete Placement Log and Concrete Volume Curve within 24 hours to the Engineer.



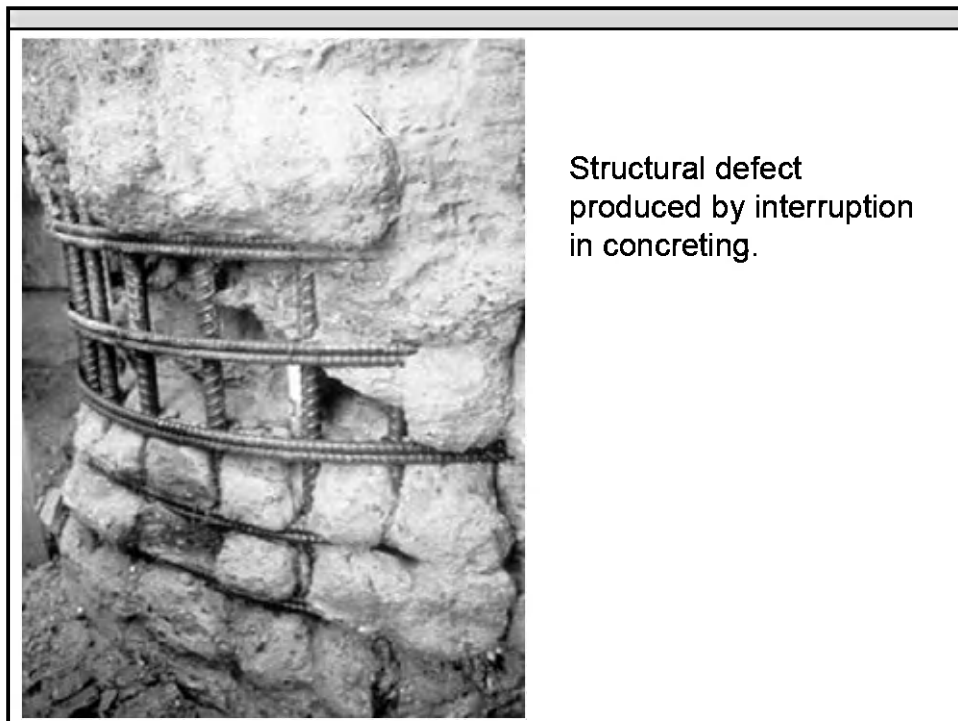
81

Typical Inspector Duties During Placement

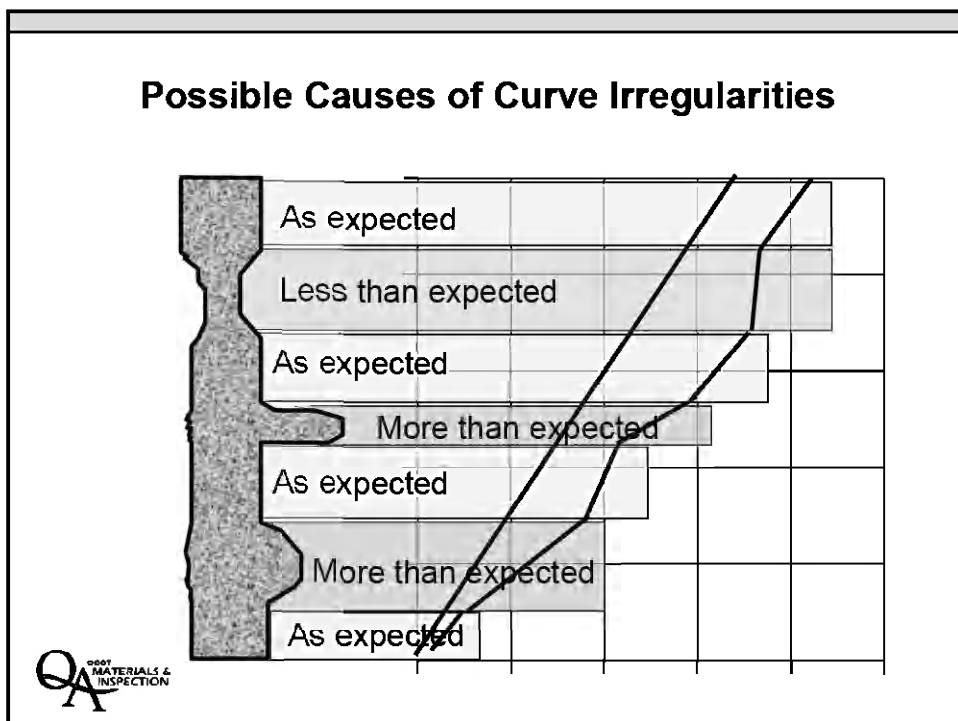
- Record start and finish times for placement.
- Record concrete quantity per load/truck.
- Measure and record depth/elevation of top of concrete after each load.
- Plot concrete volume curve.
- Verify placement is continuous.
- Monitor for tremie breaching.



82



83



84

DRILLED SHAFT CONCRETE PLACEMENT LOG

PROJECT		BRIDGE NO.	CONTRACT NO.	
BENT	STATION	SHAFT NO.	SHAFT DIAMETER	
DRILLED SHAFT CONTRACTOR		INSPECTED BY	CERT. NO.	DATE

REFERENCE ELEVATION	SHAFT TOP ELEVATION	REBAR CAGE TOP ELEVATION:		AT START	AT FINISH
DEPTH TO WATER OR SLURRY	SHAFT BOTTOM ELEVATION	REBAR DESIGN ELEV.	WITHIN SPEC? ☐ YES ☐ NO		
TOP OF ROCK ELEVATION	SHAFT LENGTH	REBAR CAGE CENTERED WITHIN SPEC? ☐ YES ☐ NO			

SHAFT CONCRETE INFORMATION					
Placement Method	Volume in Lines				Begin Pour: Date: _____ Time: _____
_____ Free Fall	#	ID	Length	Volume	End Pour: Date: _____ Time: _____
_____ Tremie	_____	_____	_____	_____ cy	Shaft Completion Time: _____ (including casing removal)
De-Airing Method	_____	_____	_____	_____ cy	
_____ Tremie Plug	_____	_____	_____	_____ cy	Total Concrete Volume Delivered (TVD) Total Concrete Volume In Shaft; cy (=TVD-VL-VW)
_____ Tremie Cap	Total Volume in Lines (VL)			_____ cy	
_____ Relief Valve	Estimated Waste Concrete (VW)			_____ cy	

Truck No.	Concrete Volume	Slump	Arrival Time	Start Time	Finish Time	Tremie Depth	Depth To Concrete	NOTES (delays, additives, breaching, casing removal)

_____ Total Concrete Volume Delivered (TVD)

INSPECTOR SIGNATURE _____ DATE _____

NOTES: _____

CASING REMOVAL					
	OD	Top Elev.	Bot. Elev.	Start	Finish
Permanent Casing	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____



DRILLED SHAFT CONCRETE VOLUMES

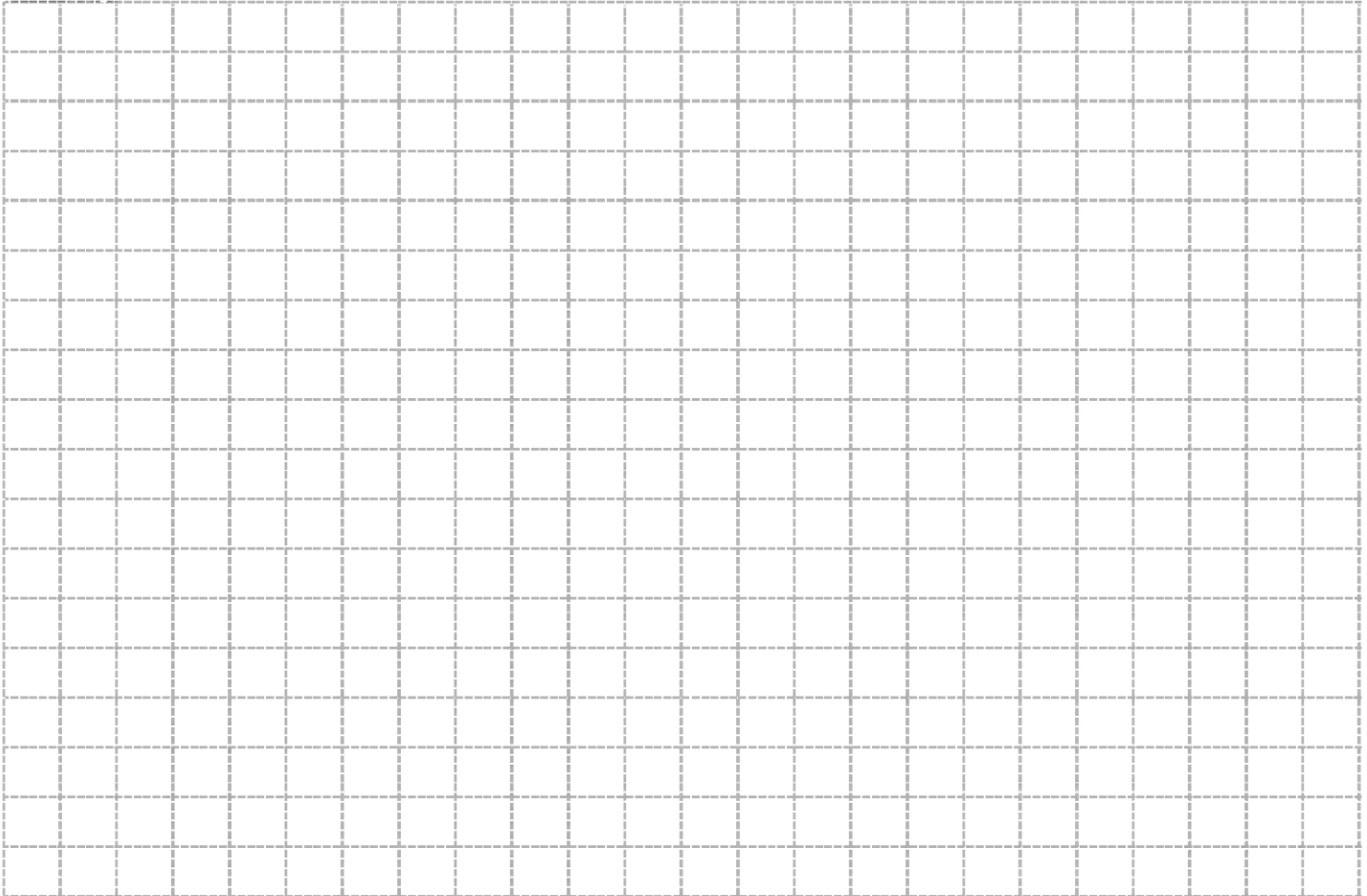
PROJECT		BRIDGE NO.	CONTRACT NO.	
BENT	STATION	SHAFT NO.	SHAFT DIAMETER	
DRILLED SHAFT CONTRACTOR		INSPECTED BY	CERT. NO.	DATE

CONCRETING CURVE

Prior to pouring concrete, a plot should be made showing the theoretical concrete surface (by depth or elev.) vs. concrete volume placed. During concrete placement the actual concrete surface vs. the actual concrete volume placed is then plotted.

Shaft Top

DEPTH/ELEVATION (Feet)



Shaft Bottom

CONCRETE VOLUME PLACED (cubic yards)

VOLUME CALCULATIONS

Volume Delivered	TVD ____ cy	Notes/Comments: _____
Volume in Lines	VL ____ cy	_____
Wastage	VW ____ cy	_____
Volume Placed (= TVD-VL-VW)	VP ____ cy	_____
Theoretical Volume $(\pi(D^2/4)(\text{Shaft Length,ft})/27)$	VT ____ cy	_____
Overpour (VP-VT)	OP ____ cy	_____

Concrete Volume Curve Example



85

Calculate Theoretical Volume of Shaft

5' Dia. Drilled Shaft

50' Long

Volume = $\pi r^2 h / 27 \text{ cf/cy}$

$V = \pi (2.5')^2 (50') / 27 \text{ cf/cy} = 36.4 \text{ cy}$

Theoretical Volume = 36 cy



86

Convert Field Measurements

6 truck loads of 8 cy each:

Tr	CY	Depth Ft	Accum CY	Elev
0	0	50	0	0
1	8	45	—	—
2	8	36	—	—
3	8	27	—	—
4	8	25	—	—
5	8	7	—	—
6	5	0	—	—

Waste = 3 cy



87

Convert Field Measurements

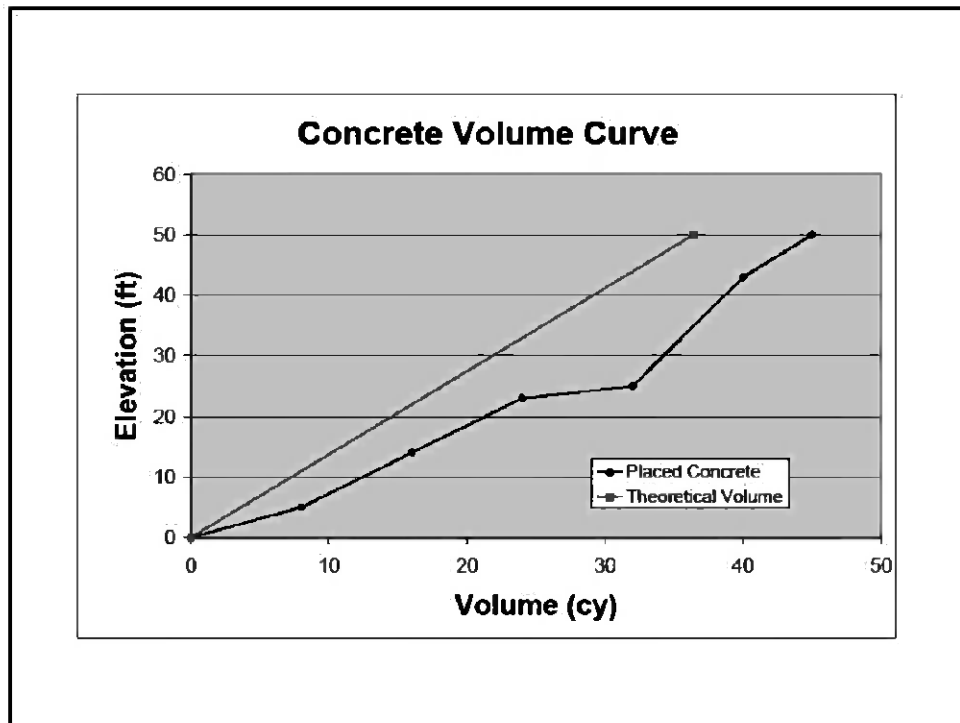
6 truck loads of 8 cy each:

Tr	CY	Depth Ft	Accum CY	Elev
0	0	50	0	0
1	8	45	8	5
2	8	36	16	14
3	8	27	24	23
4	8	25	32	25
5	8	7	40	43
6	5	0	45	50

Waste = 3 cy



88



89

Concrete Volume Curve Exercise



90

Calculate Theoretical Volume of Shaft

6' Dia. Drilled Shaft

60' Long



91

Convert Field Measurements

Each truck holds 7cy and the depth of the concrete after each truck are shown (no waste):

Tr	CY	Depth Ft	Accum. Volume	Elev.
0.	0	60	0	0
1.	7	56	_____	_____
2.	7	49	_____	_____
3.	7	42	_____	_____
4.	7	40	_____	_____
5.	7	33	_____	_____
6.	7	20	_____	_____
7.	7	13	_____	_____
8.	7	02	_____	_____
9.	7	0	_____	_____

Plot the concrete curve on the next sheet. What issues may there be?

92



DRILLED SHAFT CONCRETE VOLUMES

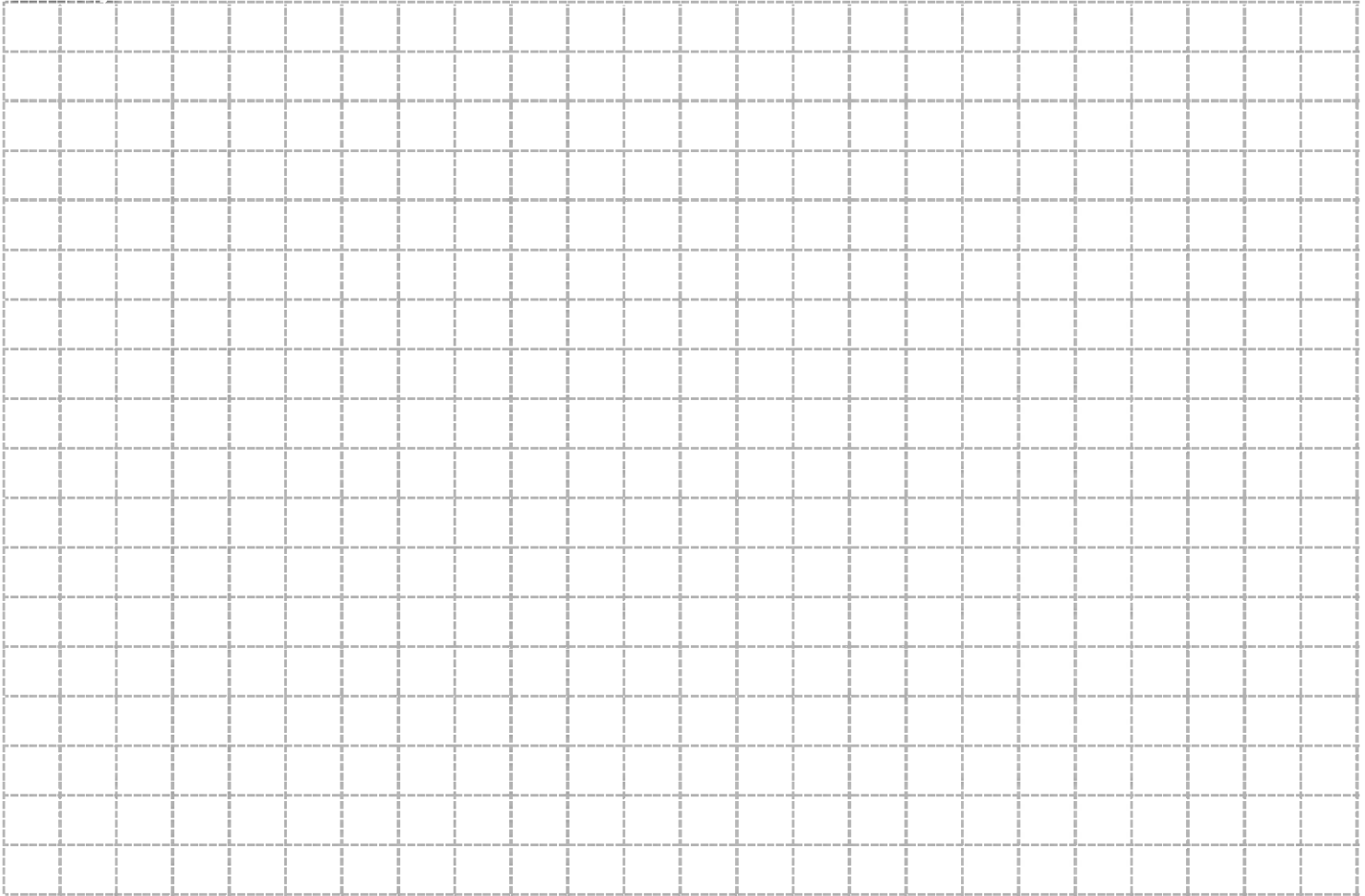
PROJECT		BRIDGE NO.	CONTRACT NO.	
BENT	STATION	SHAFT NO.	SHAFT DIAMETER	
DRILLED SHAFT CONTRACTOR		INSPECTED BY	CERT. NO.	DATE

CONCRETING CURVE

Prior to pouring concrete, a plot should be made showing the theoretical concrete surface (by depth or elev.) vs. concrete volume placed. During concrete placement the actual concrete surface vs. the actual concrete volume placed is then plotted.

Shaft Top

DEPTH/ELEVATION (Feet)

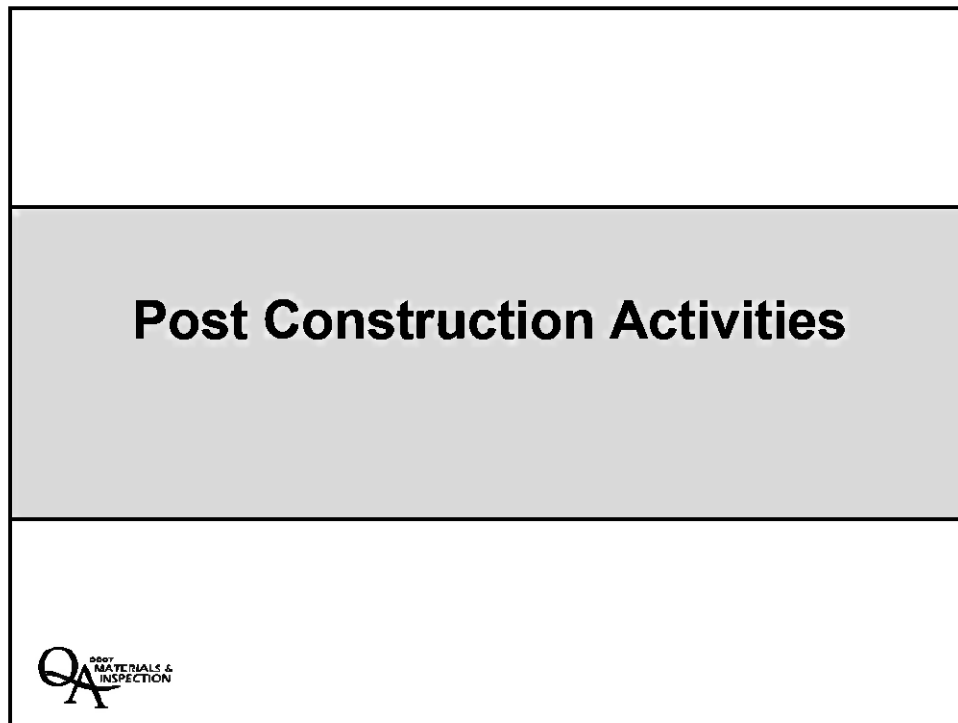


Shaft Bottom

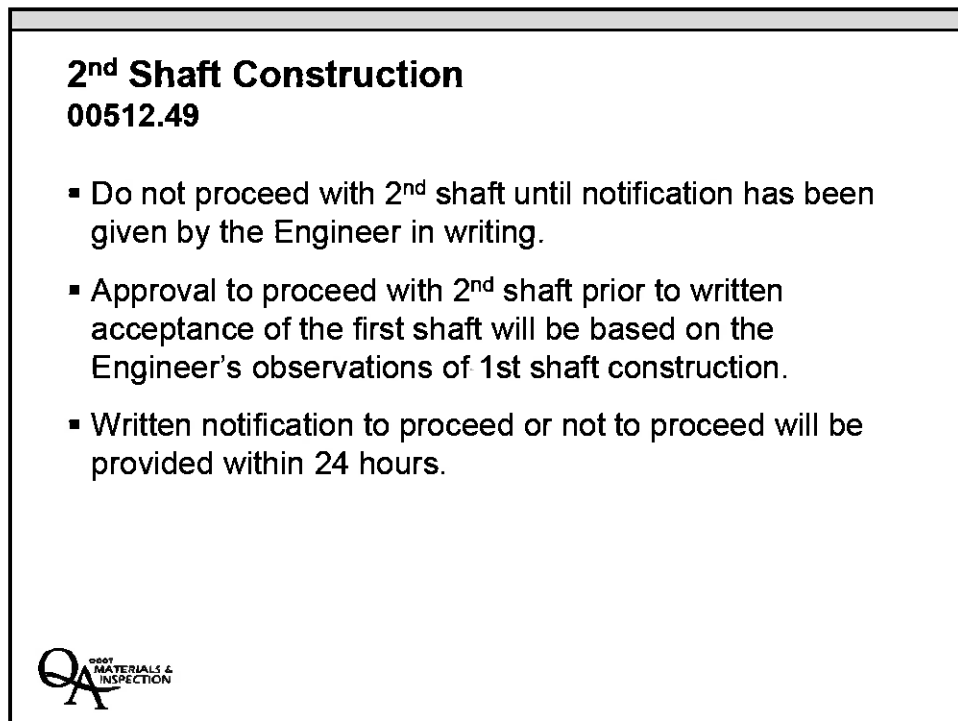
CONCRETE VOLUME PLACED (cubic yards)

VOLUME CALCULATIONS

Volume Delivered	TVD	___ cy	Notes/Comments:	_____
Volume in Lines	VL	___ cy		_____
Wastage	VW	___ cy		_____
Volume Placed (= TVD-VL-VW)	VP	___ cy		_____
Theoretical Volume $(\pi(D^2/4)(\text{Shaft Length,ft})/27)$	VT	___ cy		_____
Overpour (VP-VT)	OP	___ cy		_____



93



94

Additional Shaft Construction**00512.49**

- Do not proceed with 3rd shaft until CSL results have been reviewed and the first shaft approved by the Engineer in writing.
- After the first shaft has been accepted, make no significant change in the process unless approved by the Engineer.



95

Top of shaft concrete contaminated

96

Cage Alignment



97

Post Construction Testing



98

Crosshole Sonic Log (CSL) Testing

00512.48

Perform on the first shaft completed at each structure and others as designated by the Engineer.

Additional shafts should be tested if:

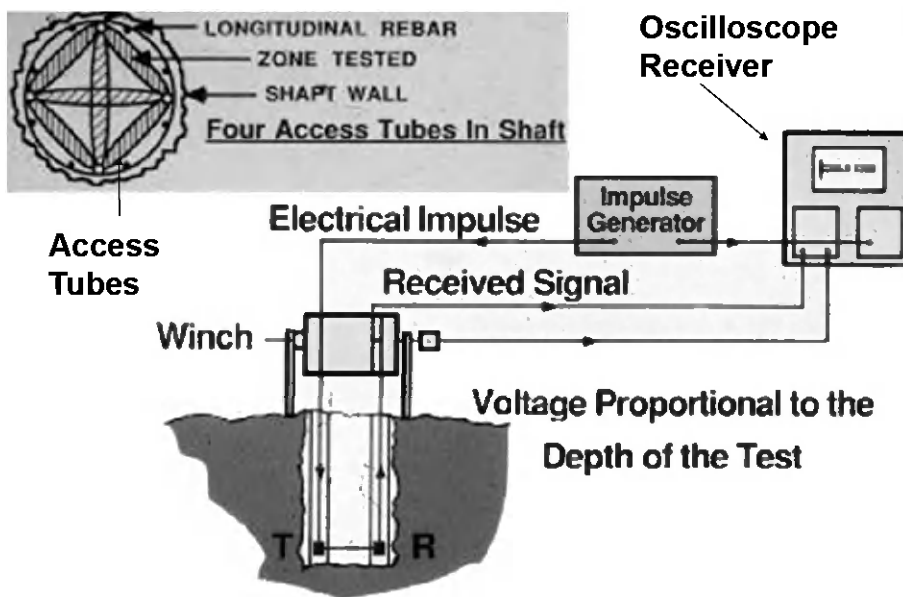
- Construction methods change or
- Shaft construction results in questionable quality shafts.

This is especially true for uncased shafts, excavated below the water level in soils.



99

Crosshole Sonic Log Testing



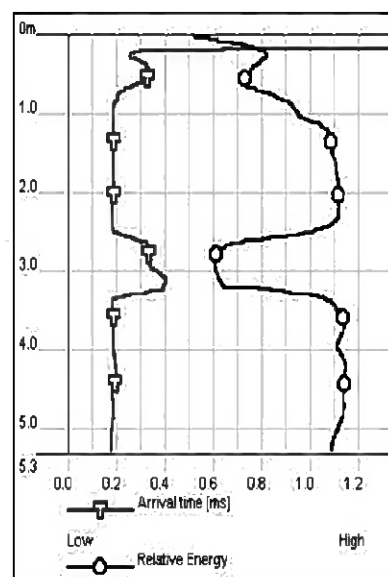
100

Source and Receiver Tools for CSL Test



101

Crosshole Sonic Log Test Results



102

Crosshole Sonic Log Test Results

If an anomaly is detected:

The Engineer will determine course of action.

May include:

- Additional CSL testing
- Excavation around shaft to expose defect
- Core drilling
- Down-hole cameras



Whatever the course of action is, the Engineer will review all the shaft construction records to determine what caused the problem.



103



Typical Problem

Very large defect found by sonic echo test. Probably due to dirty hole.

No concrete

104



Concrete Coring

- Number of holes, locations and depths determined by the Engineer.
- Log the boring like a regular borehole.
- Take photos.
- Record any driller comments on concrete quality.

105

Core Sample



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106



107

INSERT TAB

Unit 9
Substructures

Section 9

Substructure

Periodic Checks	1
Construction Tolerances	2
Beam Seats	7
MSE Walls	21
Other Walls	30
ODOT Video, Part 9/12: Substructures	37
Backfilling	38

Substructures

Section 9



1

Substructure

A bridge substructure includes the:

- Foundation
- Abutments, columns or piers
- Crossbeams, pile caps and beam seats



2

Periodic Checks

It is necessary to periodically check and recheck forms as work progresses.



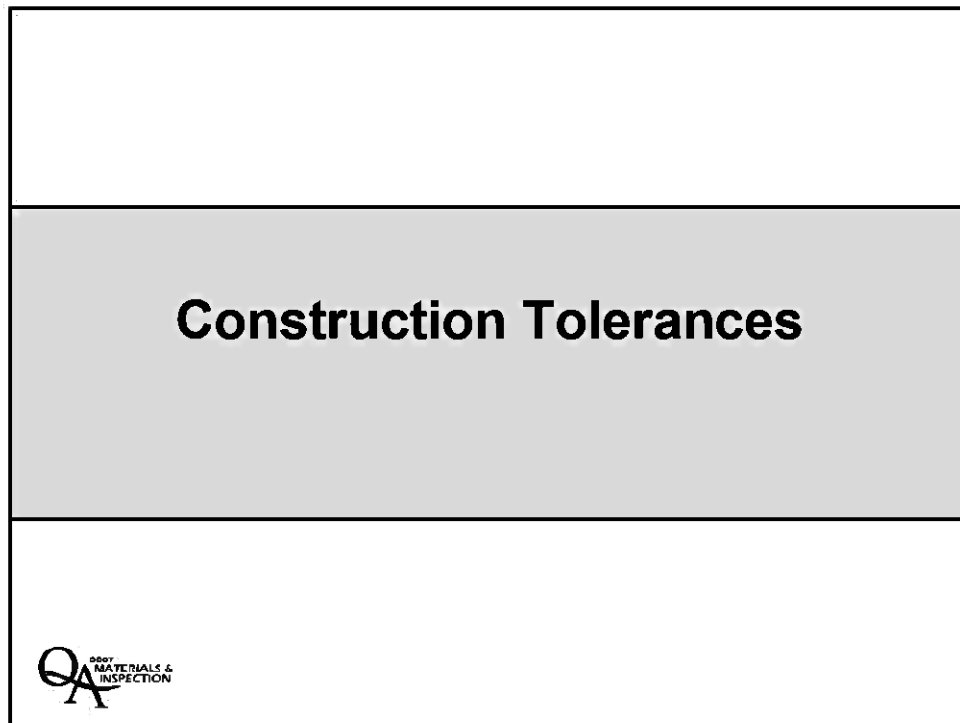
3

Locations to Check

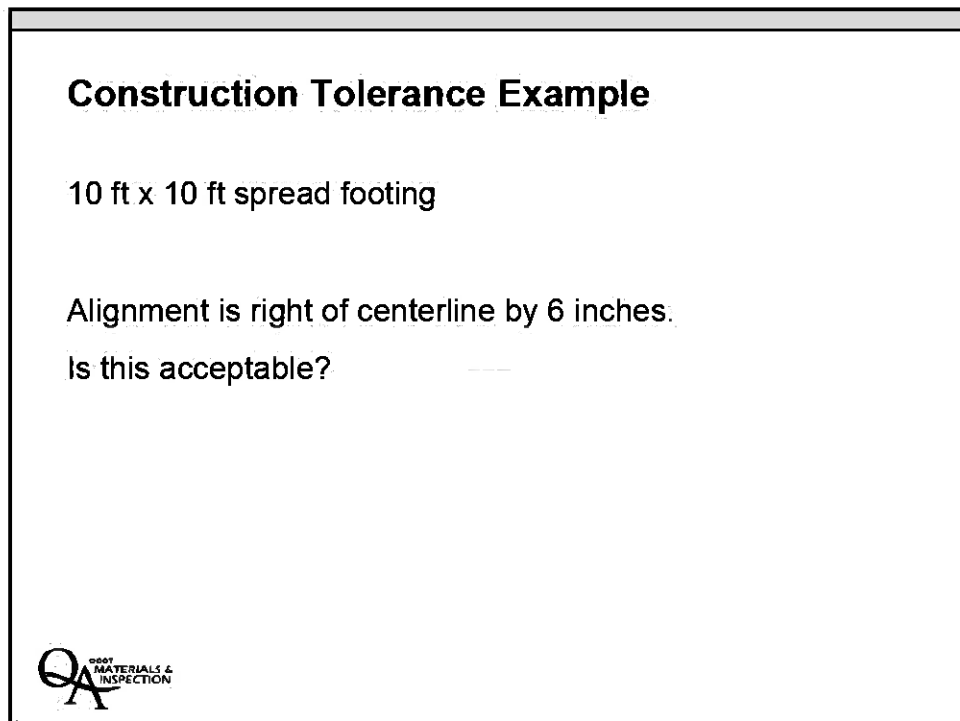
- The bottom and top of footings
- The tops of columns
- The beam seats
- Any construction joints for which a specified elevation is shown on the plans



4



5



6

Provide onsite supervisory personnel that are ODOT ADA Certified during construction of the curb ramps.

Construction

00540.40 Tolerances - The following Tolerances apply to cast-in-place Structures:

(a) Foundation Footings:

(1) Lateral Alignment:

- Actual (as cast) location of the center of gravity: 0.02 times width of footing in the direction of misplacement, but not more than 2 inches
- Supporting masonry: 1/2 inch

(2) Level or Vertical Alignment:

- Top of footing supporting masonry: 1/2 inch
- Top of other footings: minus 2 inches to plus 1/2 inch

(3) Cross-Sectional Dimensions:

- a. Horizontal dimension of formed members: minus 1/2 inch to plus 2 inches
- b. Horizontal dimension of unformed members cast against Soil:
 - Less than and equal to 2 feet: minus 1/2 inch to plus 3 inches
 - Over 2 feet and less than and equal to 6 feet: minus 1 1/2 inch to plus 6 inches
 - Over 6 feet: minus 1/2 inch to plus 12 inches
- c. Vertical dimension (thickness): 0 to plus 6 inches

(4) Relative Alignment - Footing side and top surfaces may slope with respect to the specified plane at a rate not to exceed 1 inch in 10 feet.

(b) All Other Structural Members:

(1) Vertical Alignment:

- Exposed surfaces: $\pm 3/4$ inch
- Concealed surfaces: $\pm 1\ 1/2$ inches
- Construction joints: 0 to minus 3 inches

(2) Lateral Alignment - Centerline alignment: 1 inch

(3) Level Alignment:

- a. Profile grade: ± 1 inch
- b. Top of other concrete surfaces and horizontal grooves:
 - Exposed: $\pm 3/4$ inch

- Concealed: $\pm 1 \frac{1}{2}$ inches

c. On ramps, sidewalks and intersections, in any direction, the gap below a 12 foot unleveled straightedge resting on high spots shall not exceed $\frac{1}{4}$ inch.

d. On bridge decks, in any direction the gap below a 12 foot unleveled straightedge does not vary from the testing edge by more than $\frac{1}{8}$ inch.

(4) Cross-Sectional Dimensions:

- Bridge slabs and decks vertical dimension (thickness): minus $\frac{1}{8}$ inch to plus $\frac{1}{4}$ inch
- Members such as columns, beams, piers, walls and others (slab thickness only): minus $\frac{1}{4}$ inch to plus $\frac{1}{2}$ inch
- Openings through members: $\frac{1}{2}$ inch

(5) Relative Alignment:

a. Location of openings through members: $\frac{1}{2}$ inch

b. Formed surfaces may slope with respect to the specified plane at a rate not to exceed the following amounts in 10 feet:

- Watertight joints: $\frac{1}{8}$ inch
- Other exposed surfaces: $\frac{1}{2}$ inch
- Concealed surfaces: 1 inch

c. Unformed exposed surfaces, other than Pavements and sidewalks, may slope with respect to the specified plane at a rate not to exceed the following amounts:

- In 10 feet: $\frac{1}{4}$ inch
- In 20 feet: $\frac{3}{8}$ inch

00540.41 Design of Falsework:

(a) Submittal of Working Drawings and Calculations - Submit stamped Falsework Plans and design calculations according to 00150.35, except as modified below.

Ensure the Falsework designer prepares a Falsework Design Summary and completes a Falsework Design Checklist to accompany the Plans and calculations. Include in the summary a list of each Falsework member with its:

- Assumed dead and live loads
- Allowable and design stresses
- Allowable and calculated deflections
- Design references and derivations for design formulas
- Documentation for computer-generated calculations

The Falsework Design Checklist is included in the Special Provisions.

Submit five sets (nine sets if Railroad approval is required) of the Plans and three copies (five copies if Railroad approval is required) of the calculations, summary, and checklist.

Construction Tolerance Example Key

10 ft x 10 ft spread footing

Alignment is right of centerline by 6 inches.

Is this acceptable?

Tolerance = 0.02 (width of footing) but not > 2"

Tolerance = 0.02 (10 ft) = 0.2 ft = 2 3/8" > 2"

So, Tolerance = 2"

The footing alignment does not meet specifications.

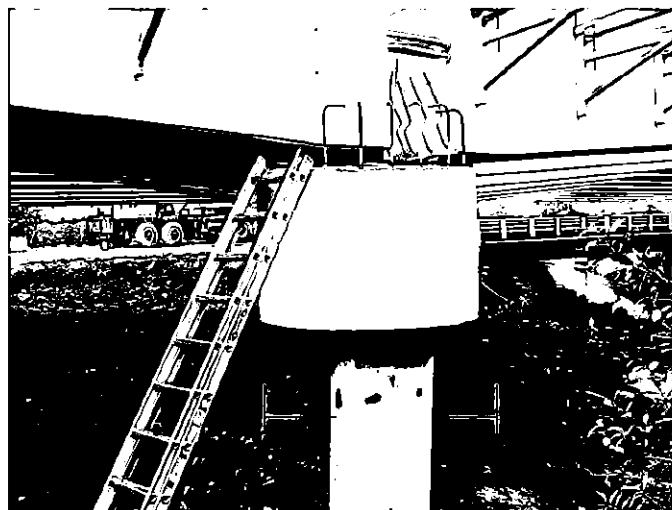


7

Pier Cap Alignment Exercise

4" off center

Is this
acceptable?



8

**Ensure proper support
under the structure.**

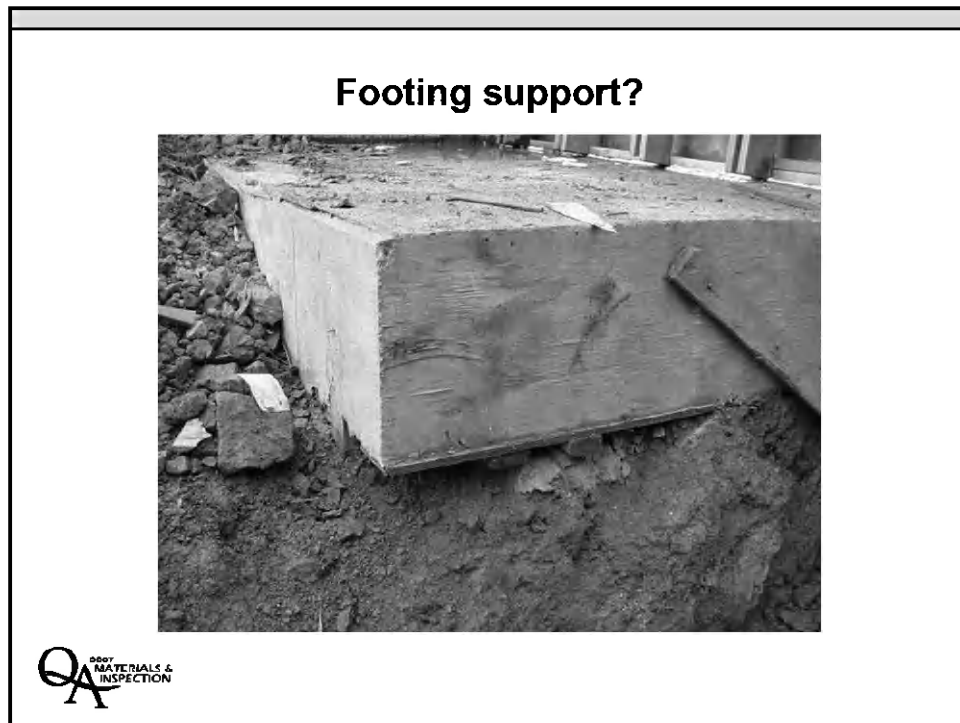


9

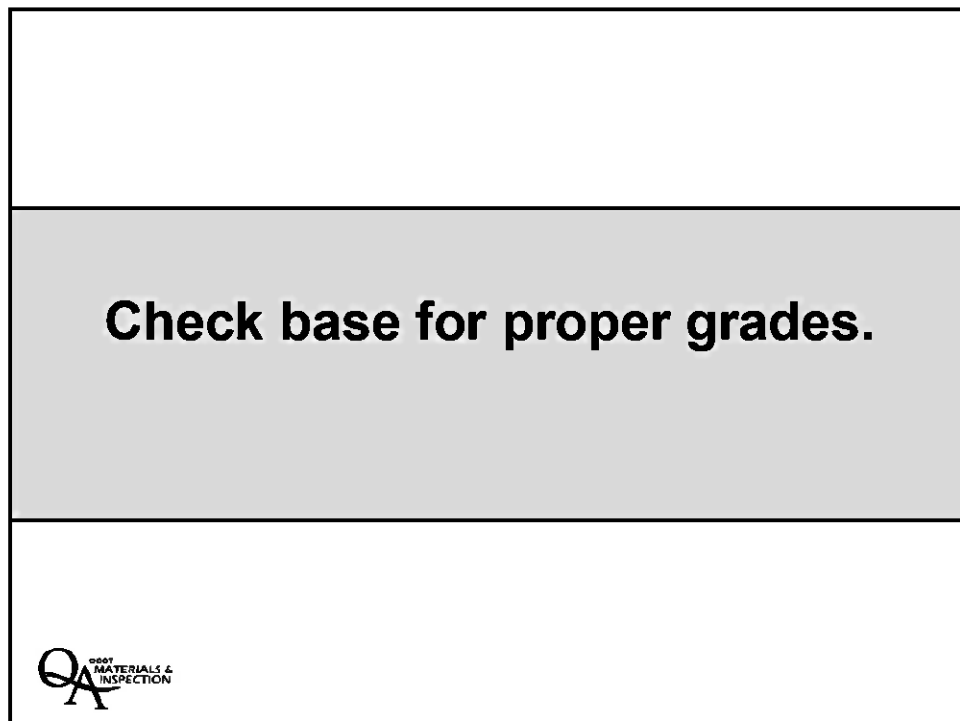
Footing support?



10



11



12

Sides Uneven

Compaction
critical
at sides
where thrust
occurs



13

Beam Seats



14

Beam Seats

Things to consider:

- Elevation
- Level
- Good consolidation
- Alignment



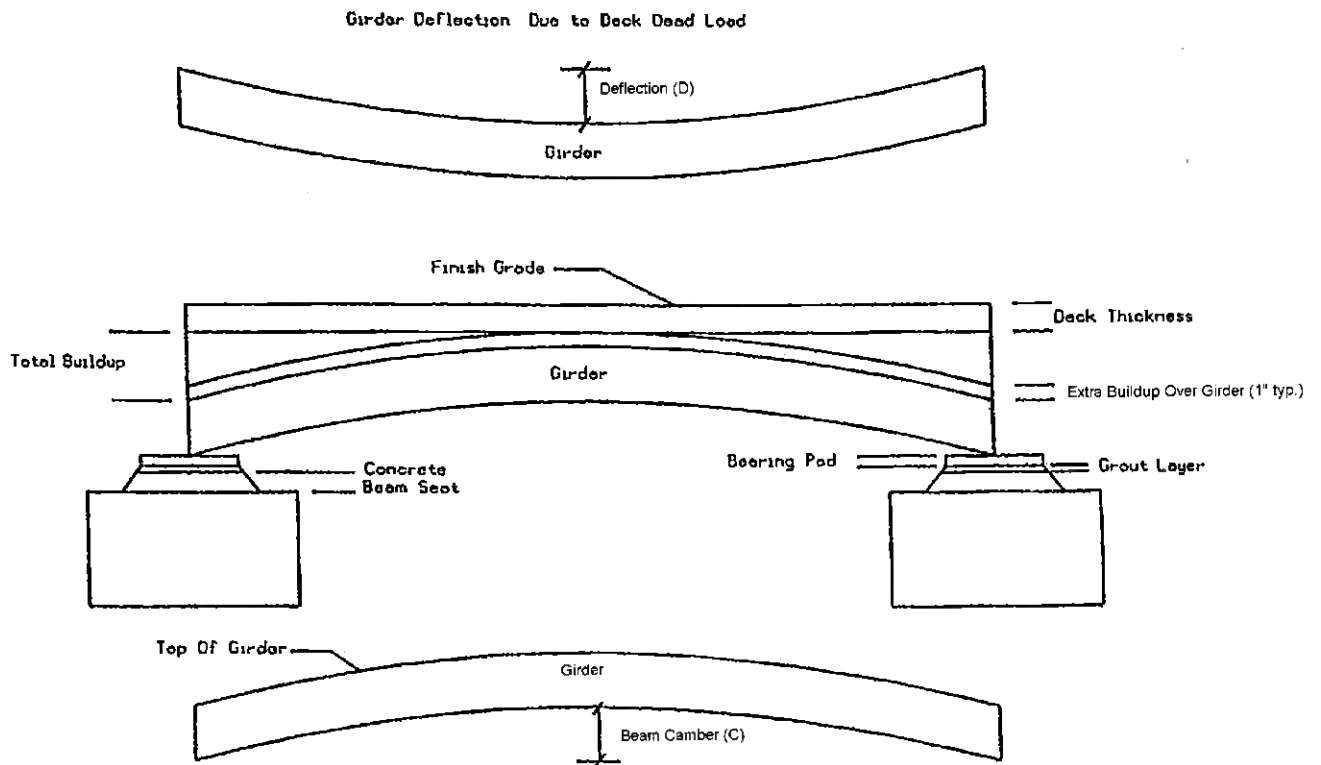
15

Calculating Beam Seat Elevation



16

PRECAST PRESTRESSED GIRDERS WITH CIP DECK BEAM SEAT ELEVATION CALCULATION



$\text{Beam Seat Elevation} = \text{Finish Grade} - \text{Deck Thickness} - \text{Total Buildup} - \text{Girder Depth} - \text{Beering Pad} - \text{Grout Layer}$ $\text{Total Buildup} = \text{Beam Camber (C)} - \text{Deck Dead Load Deflection (D)} + \text{Extra Buildup}$

Girder Centerline

2 1/2 Slope

Typical Deck

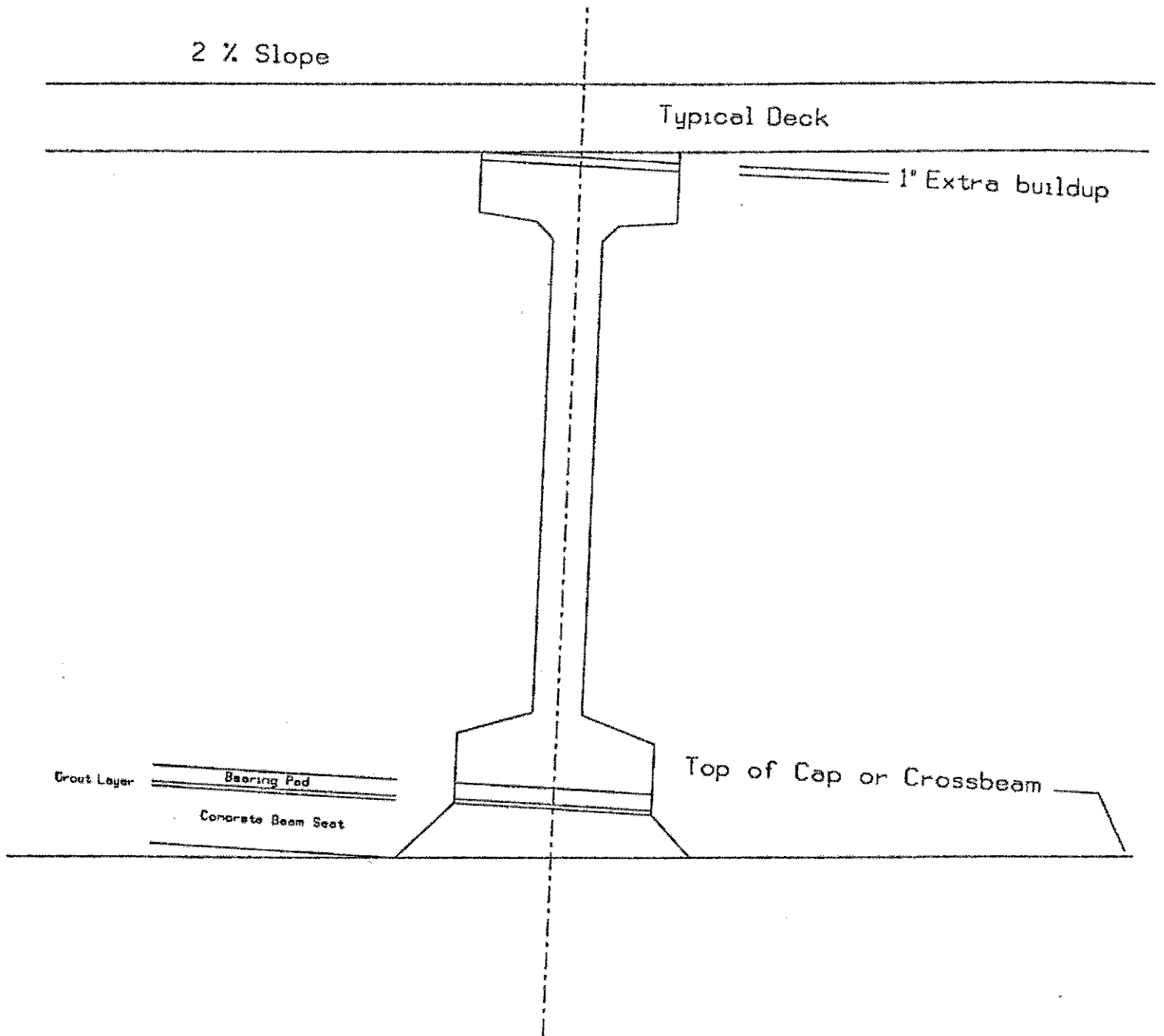
1" Extra buildup

Grout Layer

Bearing Pad

Concrete Beam Seat

Top of Cap or Crossbeam



Beam Seat Elevation Calculation

1 Girder Cambers
Beam

Measured Max Camber @ Midspan

_____ in

_____ in

_____ in

_____ in

_____ in

_____ in

2 Controlling Maximum Camber

_____ in = _____ ft

3 Deflection Due To Deck, Rail + AC

_____ in = _____ ft

4 (a) Min. Beam Buildup

_____ in = _____ ft

(b) Cross-slope Buildup @ Girder Centerline

$$\frac{(\text{Flange Width})/2}{\text{ft}} \times \frac{\text{Cross-slope}}{\text{ft/ft}} = \text{_____ ft}$$

(c) Extra Buildup @ Girder Centerline (4a+4b) _____ ft

(Horiz & vert curvature require additional adjustment)

5 Total Buildup = #2 - #3 + 4c _____ ft

6 Finish Grade Elevation Finish Grade Elevation _____ ft

7 Deck Thickness _____ in = _____ ft

8 Total Buildup (#5) _____ ft

9 Girder Height _____ in = _____ ft

10 Bearing Pad + Grout Thickness _____ in = _____ ft

11 Top of Beam Seat Elevation = _____ ft
(#6 - #7 - #8 - #9 - #10)

Sagging Span?



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17

10° Curve, 8% Cross-slope



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18

**Cross-Slope Buildup Example
(at Girder Centerline)**

Super-elevation = 8%

Girder flange width = 4 ft

Cross-slope buildup = $0.08\text{ft/ft} \times 2\text{ ft} = 0.16\text{ ft}$



19

**Cross-Slope Buildup Exercise
(at Girder Centerline)**

Super-elevation = 6%

Girder flange width = 2 ft

Cross-slope buildup = - -



20

Crest Vertical Curve

- Buildup on beams is less at the ends of the beam than on a level grade
- Common on Overpasses
- Top of hills



21

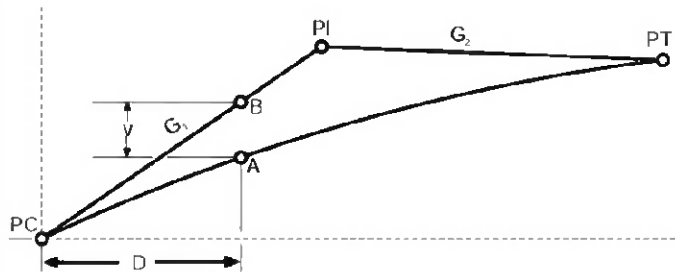
Sag Vertical Curve

- At bottom of hills (creeks tend to be at low spots)
- Buildup on beams is more at the ends of the beam than on a level grade



22

Vertical Curve Correction



$$V = \frac{(G_2 - G_1)}{2L} D^2$$

G_1 = Initial Grade

G_2 = Final Grade

L = Length of Curve

D = Distance to Point On Curve



23

Vertical Curve Correction Example

$$G_1 = + 0.04 \text{ ft/ft}$$

$$G_2 = - 0.02 \text{ ft/ft}$$

$$L = 200 \text{ ft}$$

$$D = 100 \text{ ft}$$

$$V = \frac{(G_2 - G_1)}{2L} D^2$$

$$V = (-0.02 \text{ ft/ft} - 0.04 \text{ ft/ft})(100')^2 / (2(200'))$$

$$V = -1.50 \text{ ft}$$



24

Vertical Curve Correction Exercise

$$G_1 = + 0.02 \text{ ft/ft}$$

$$G_2 = - 0.02 \text{ ft/ft}$$

$$L = 200 \text{ ft}$$

$$D = 100 \text{ ft}$$

$$V = \frac{(G_2 - G_1)}{2L} D^2$$

$$V =$$



25

Excessive Beam Buildup?

26

Beam Seat Elevation Calculation Example

Situation: You are the inspector on a bridge project which will be placing a cast in place concrete deck on precast girders. The precast girders have not been placed yet and the contractor is constructing a concrete footing. The contractor has given you their calculated Beam Seat Elevations at each Girder centerline/Bent centerline intersection and has asked for a verification.

Given: Measured maximum camber (C_b) of each precast beam. This information can be obtained from the precast manufacture's office or field verified independently.

G1 = 3.50"

G2 = 3.75"

G3 = 3.25"

G4 = 3.75"

G5 = 4.00"

Given: Maximum deflection ($D_{D,R\&AC}$) due to Deck, Rail and AC. This information should be given on the bridge detail plan sheets. Check with the Bridge Designer as required.

Maximum Deflection ($D_{D,R\&AC}$) = 1.50"

Given:

- . Girder Height = 8'
- . Girder Flange Width = 4'
- . Deck Thickness = 9"
- . Cross Slope = .03ft/ft
- . Min. Beam Buildup= 1"
- . Bearing Pad thickness = 1.50"
- . Grout Layer thickness = 0.50"
- . Finish Grade Elevation @ Controlling Girder Centerline/Bent Centerline = 2000.00'

Beam Seat Elevation Calculation Example

1 Girder Cambers

Measured Max Camber @ Midspan

Beam

G1	3.5 in
G2	3.75 in
G3	3.25 in
G4	3.75 in
G5	4 in
	in

2 Controlling Maximum Camber 4 in = 0.333 ft

3 Deflection Due To Deck, Rail + AC 1.5 in = 0.125 ft

4 (a) Min. Beam Buildup 1 in = 0.083 ft

(b) Cross-slope Buildup @ Girder Centerline

$$\frac{(\text{Flange Width})/2}{2 \text{ ft}} \times \frac{\text{Cross-slope}}{0.03 \text{ ft/ft}} = 0.060 \text{ ft}$$

(c) Extra Buildup @ Girder Centerline (4a+4b) 0.143 ft

(Horiz & vert curvature require additional adjustment)

5 Total Buildup = #2 - #3 + 4c 0.352 ft

6 Finish Grade Elevation 2000.00 ft

7 Deck Thickness 9 in = 0.750 ft

8 Total Buildup (#5) 0.352 ft

9 Girder Height 96 in = 8.000 ft

10 Bearing Pad + Grout Thickness 2 in = 0.167 ft

11 Top of Beam Seat Elevation = 1990.73 ft
(#6 - #7 - #8 - #9 - #10)

Beam Seat Elevation Calculation Exercise

Situation: You are the inspector on a bridge project which will be placing a cast in place concrete deck on precast girders. The precast girders have not been placed yet and the contractor is constructing a concrete footing. The contractor has given you their calculated Beam Seat Elevations at each Girder centerline/Bent centerline intersection and has asked for a verification.

Given: Measured maximum camber (C_b) of each precast beam. This information can be obtained from the precast manufacture's office or field verified independently.

G1 = 2.75"

G2 = 2.50"

G3 = 3.00"

G4 = 2.75"

G5 = 2.75"

Given: Maximum deflection ($D_{D,R\&AC}$) due to Deck, Rail and AC. This information should be given on the bridge detail plan sheets. Check with the Bridge Designer as required.

Maximum Deflection ($D_{D,R\&AC}$) = 1.00"

Given:

- . Girder Height = 6'
- . Girder Flange Width = 2'
- . Deck Thickness = 9"
- . Cross Slope = .08ft/ft
- . Min. Beam Buildup= 1"
- . Bearing Pad thickness = 1.50"
- . Grout Layer thickness = 0.50"
- . Finish Grade Elevation @ Controlling Girder Centerline/Bent Centerline = 3000.00'

Beam Seat Elevation Calculation Exercise

1 Girder Cambers

Measured Max Camber @ Midspan

Beam

G1
G2
G3
G4
G5

2.75 in
2.5 in
3 in
2.75 in
2.75 in

2 Controlling Maximum Camber

_____ in = _____ ft

3 Deflection Due To Deck, Rail + AC

_____ in = _____ ft

4 (a) Min. Beam Buildup

_____ 1 in = **0.083** ft

(b) Cross-slope Buildup @ Girder Centerline

$$\frac{\text{(Flange Width)}/2}{\text{ft}} \times \frac{\text{Cross-slope}}{\text{ft/ft}} = \text{_____ ft}$$

(c) Extra Buildup @ Girder Centerline **(4a+4b)** _____ ft

(Horiz & vert curvature require additional adjustment)

5 Total Buildup = #2 - #3 + 4c _____ ft

6 Finish Grade Elevation Finish Grade Elevation _____ ft

7 Deck Thickness _____ in = _____ ft

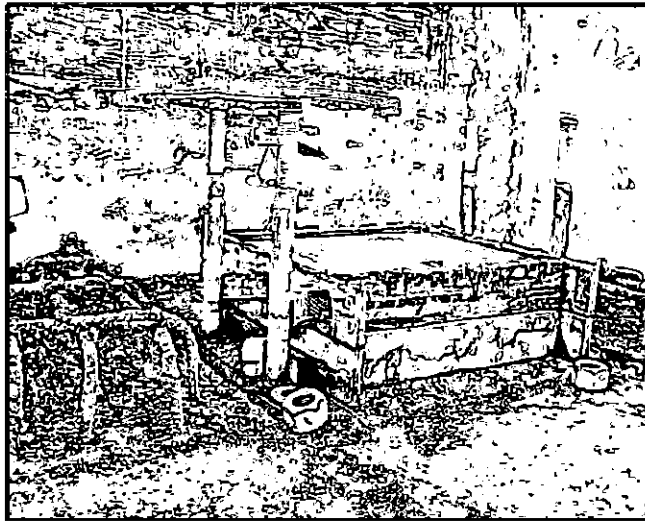
8 Total Buildup (#5) _____ ft

9 Girder Height _____ in = _____ ft

10 Bearing Pad + Grout Thickness _____ in = _____ ft

11 Top of Beam Seat Elevation = _____ ft
(#6 - #7 - #8 - #9 - #10)

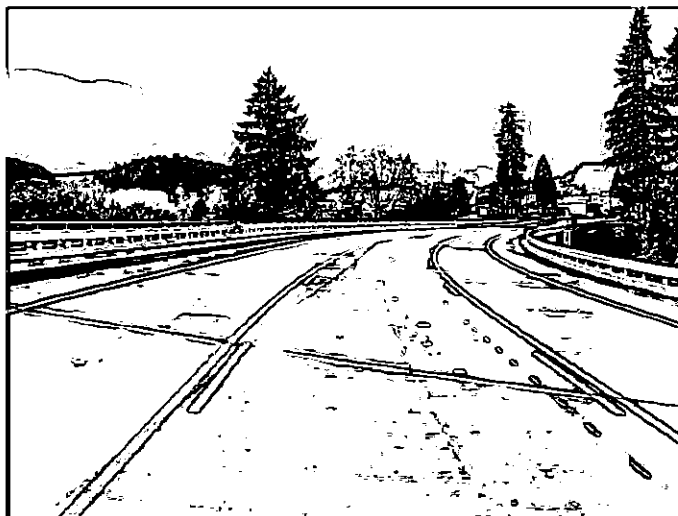
Raised Beam Seat & Extended Bolts



QA
0001 MATERIALS & INSPECTION

27

Deck Grades Between Stages Miss By 5"



QA
0001 MATERIALS & INSPECTION

28

Bents Had Straight Cross Slope

Beam seats should have been in a straight line.



29

Consolidation?



QA
0001 MATERIALS &
INSPECTION

30

Beam Seats for Steel Plate Girders



31

Beam Seats for Steel Plate Girders



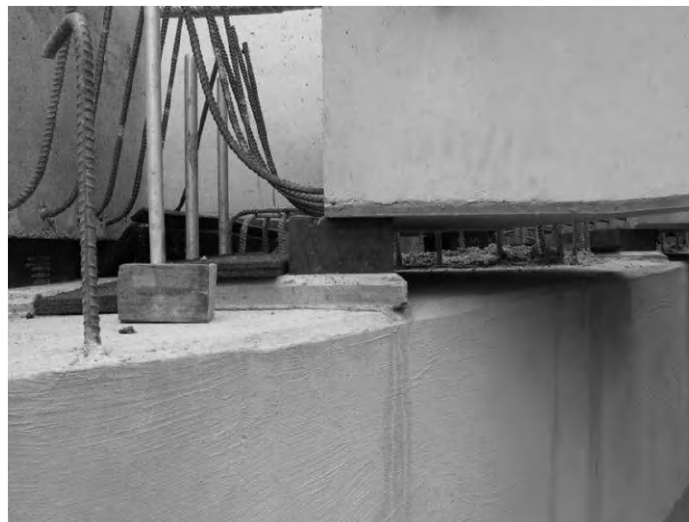
32

Beam Pedestal Alignment?



33

Box Beam on Pad?



QA
MATERIALS &
INSPECTION

34

Consolidation?



QA
0007 MATERIALS &
INSPECTION

35

Beam Seat Cure?



QA
0007 MATERIALS &
INSPECTION

36

Low Slump Concrete in "E" Beam?

- Slump spec was 3" - 8"
- Measured 1 1/2"



37

Low Slump Concrete?



38

Concrete Surface Treatments



QA
0007 MATERIALS &
INSPECTION

39

Concrete Surface Treatments



QA
0007 MATERIALS &
INSPECTION

40

Concrete Surface Treatments



41

MSE Walls

(Mechanically Stabilized Earth Walls)



42

Hilficker Wall



QA
0007
MATERIALS &
INSPECTION

43

Wire Placed on Compacted Level Surface



QA
0007
MATERIALS &
INSPECTION

44

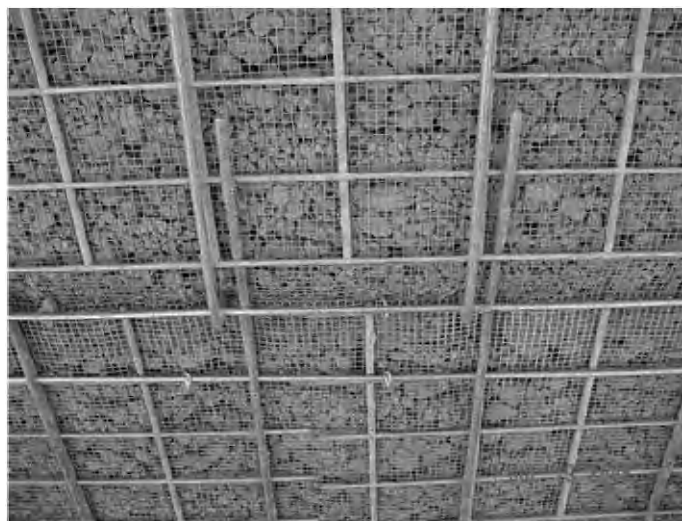
Fine Wire Mesh Against Wire Cage Wall



QA
0001 MATERIALS &
INSPECTION

45

Bottom Panel Interlaces with Top Panel



QA
0001 MATERIALS &
INSPECTION

46

MSE Wall

- Reinforced Earth Company
- Cruciform Panel



47

Straps Placed on Level Compacted Surface



48

Straps Cross at Corners



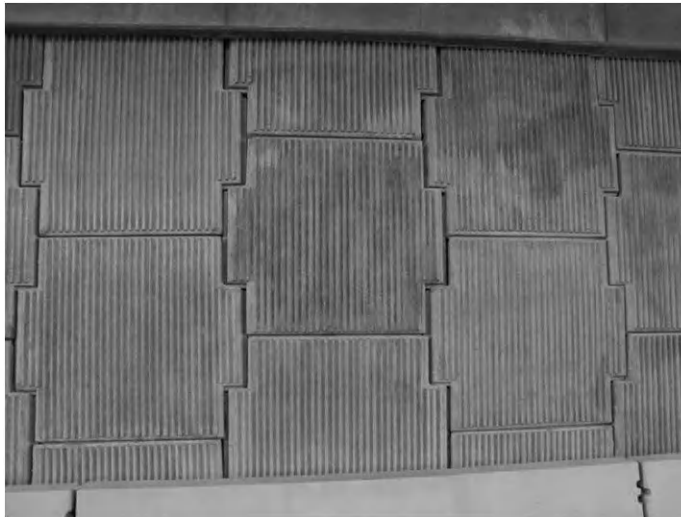
49

Support Wall During Construction



50

Check Gap Distance



51

Wall Panel Spacers



52

Fabric at Block Wall Joints



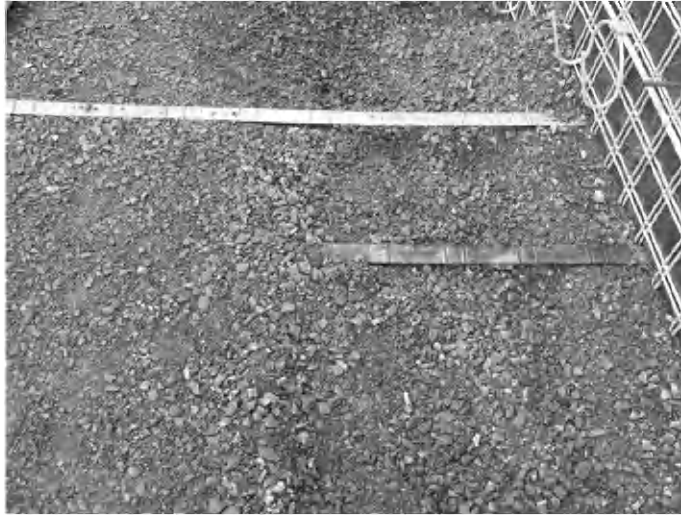
53

Compact Material in Thin Lifts



54

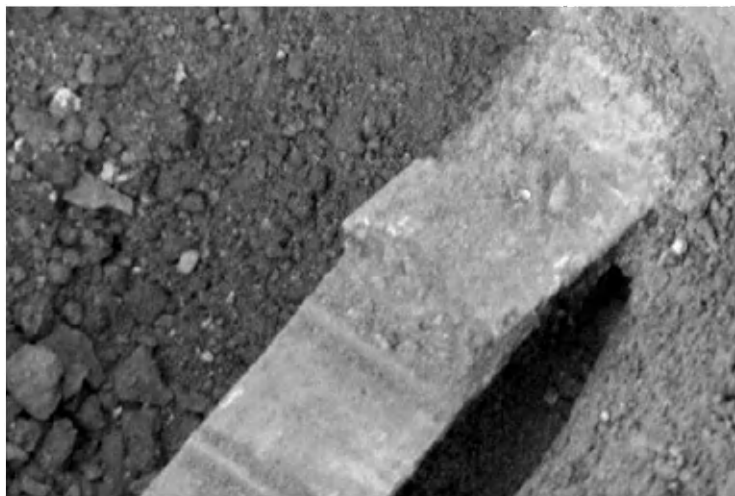
Coating on Strap?



QA
0007 MATERIALS &
INSPECTION

55

Welded Strap with No Coating?



QA
0007 MATERIALS &
INSPECTION

56

Hilficker MSE Wall with Concrete Facade Poured in Place



QA
0001 MATERIALS &
INSPECTION

57

MSE Wall Setting on Concrete Footing



QA
0001 MATERIALS &
INSPECTION

58

Concrete Face Poured on Span Side of Wall

Spread footing
on top of
MSE wall



59

Other Walls



60

Gabion Wall



61

Block Wall



62

Secant Pile Wall



63

Soldier Pile & Tieback Wall



64

Soldier Pile & Tieback Wall



65

Soldier Pile & Tieback Wall



66

Forming Up to Pour Facade



QA
0001 MATERIALS &
INSPECTION

67

Shear Studs & Rebar Placement



QA
0001 MATERIALS &
INSPECTION

68

Soldier Pile & Tieback Wall



69

Soil Nail Wall



70

Soil Nail Wall



QA
0001 MATERIALS &
INSPECTION

71

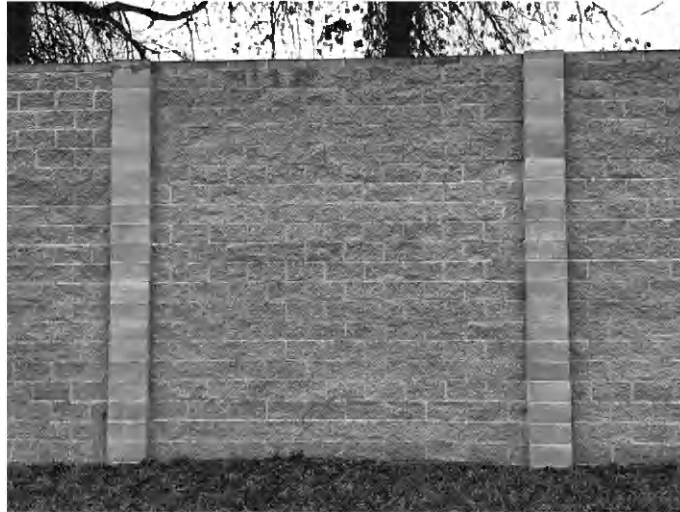
Soil Nail Wall



QA
0001 MATERIALS &
INSPECTION

72

Masonry Block Wall



73

Masonry Block Wall

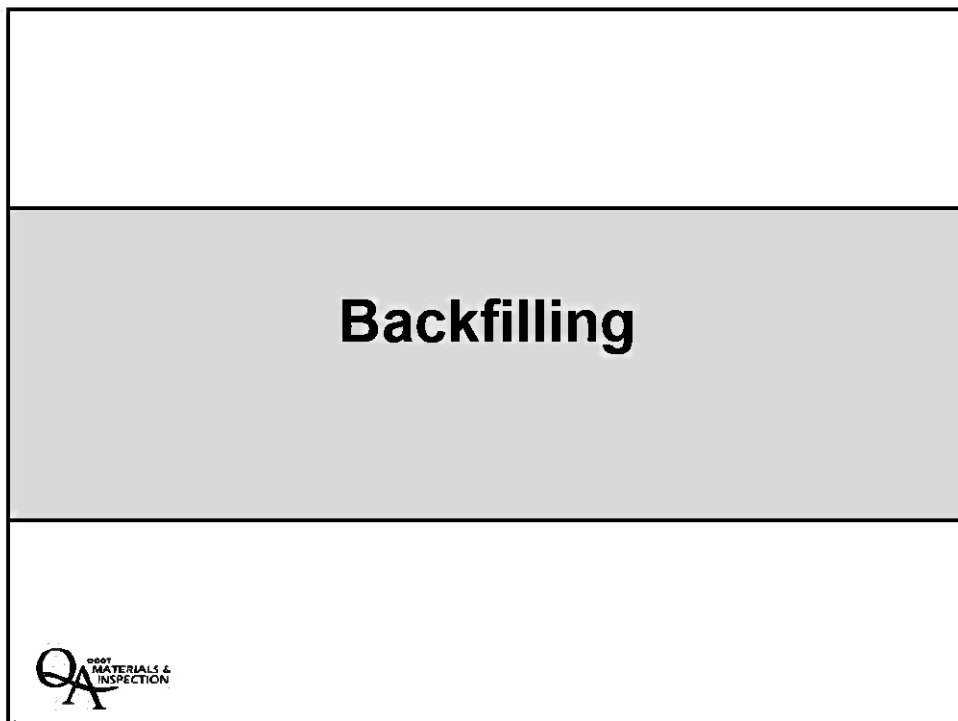
- Water repelling admixture for the caps, blocks and mortar needed
- See if included in SP00597.11



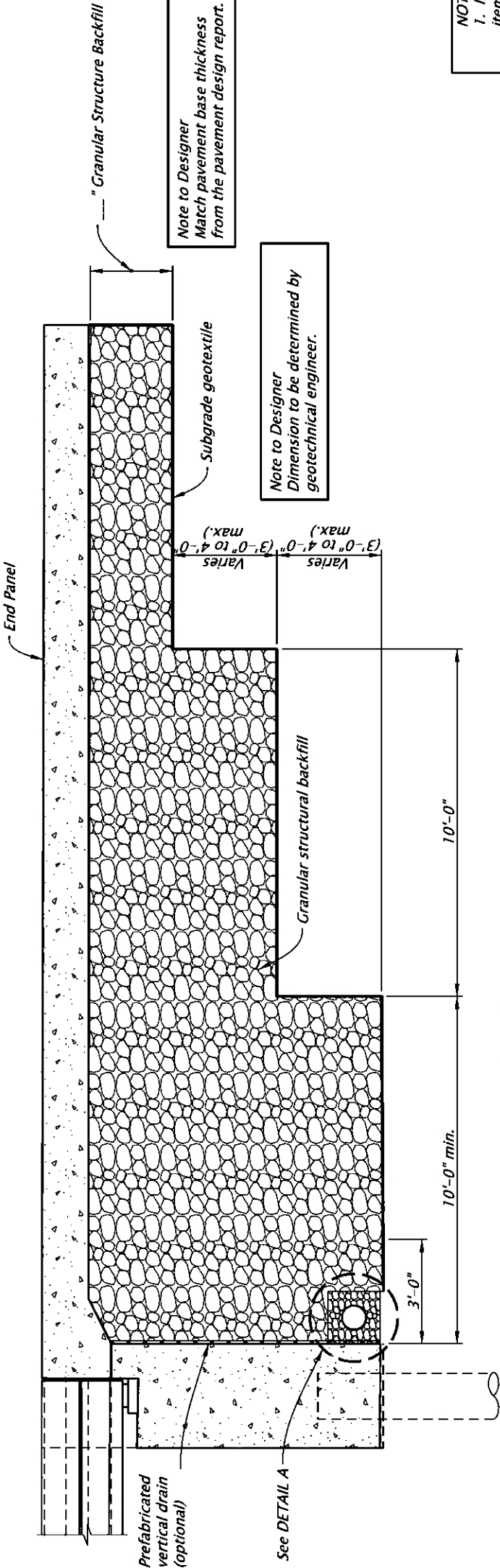
74



75



76



GENERAL NOTES

1. Engineering soil parameters

Material	γ	ϕ	pcf

- *Insert appropriate Ka, Ko, or Kp value.
2. Compact abutment backfill according to 0596C.42(a-1).

NOTES TO DESIGNERS

1. Individual measurement and payment items to include in individual specifications:

- Geotextile (00350.41(d))
- Aggregate Base (00640.90(a))
- Drain Pipe (00445)
- Granular Drain Blanket (00360(b))

2. Subgrade geotextile according to Section 2320.

3. Drain Pipe

- Size no less than 6" dia.
- Length
- Material according to 2415 Install (00445)

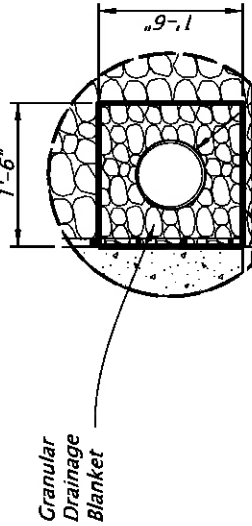
4. Granular Drain Blanket

X (cy/lf)	Pipe (in)
	6
	8
	10

Assume γ = ____ pcf

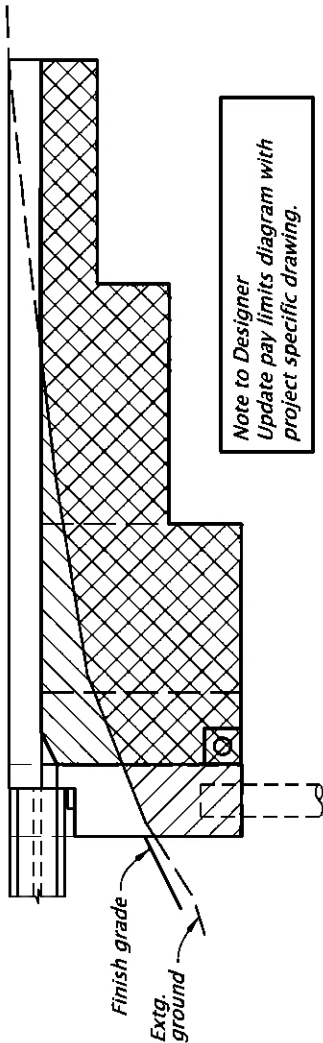
END PANEL SECTION

Scale: None

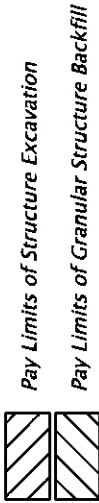


8" perf. corrugated polyethylene drain pipe, class 2, perforation at bottom 2% min. slope

DETAIL A

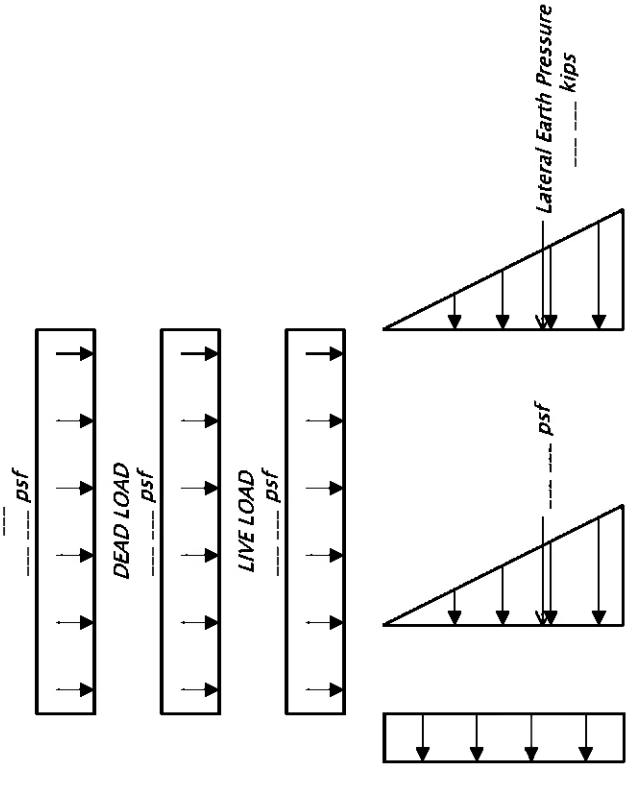


Note to Designer
Update pay limits diagram with project specific drawing.



STRUCTURE EXCAVATION AND BACKFILL PAY LIMITS

Scale: None



Note to Designer
Insert type of load and load quantity in the " ____ " blocks.

LOAD DIAGRAMS

Scale: None

OREGON DEPARTMENT OF TRANSPORTATION
TECHNICAL SERVICES
DETAILS

The selection and use of this detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without consulting a Registered Professional Engineer.

END PANEL AND WINGWALL
BACKFILL

DETAIL NO.
DET3160

Backfilling End Panels**00510.48(b)(5)****Place as shown and per 00510.46(a).**

- Place in 6-inch layers
- To 95 % of maximum density per 00330.43



77

Granular Structure Backfill**00510.13****Per 02630.10 and the following:**

- Material passing No. 200 sieve shall not exceed 15% by weight.
- The plasticity index of material passing the No. 40 sieve shall not exceed 6.



78

Hard to Compact Spots



QA
0007
MATERIALS &
INSPECTION

79

Use the Right Size Equipment



QA
0007
MATERIALS &
INSPECTION

80

Embankment Construction @ Bridge Ends 00510.47

According to 00330.42 (c-7)

- For 100 ft, place & compact before bridge construction
- Unless an engineered fill, place selected stone backfill material per 00330.15
- 6" maximum size



81

Is This Good Material Under an End Panel?



82

Backfilling**00510.48(a)**

- Do not place unbalanced loading until 7 days and 100% design strength.
- Do not place against other concrete until 3 days and 40% design strength



83

Bridge Abutment & Retaining Wall Backfill**00510.48 (b)**

- Do not place until superstructure elements are set, pinned and tensioned.
- Place at front of retaining wall before back of wall.
- For single span bridge with abutments, keep backfill heights within 2 ft of each other.



84

INSERT TAB

Unit 10
Prefabricated
Girders

Section 10

Prefabricated Girders

Common Beam Types	1
Beam Camber & Deflection	6
Bearing Points	8
Slabs & Boxes	15
Girder Construction	26
Temporary Bracing Details	32
Diaphragms	39
Steel Plate Girder Construction	42

Prefabricated Girders

Section 10



1

Common Beam Types



Slab



Bulb-l



Box

2

Common Beam Types



Steel Plate Girder

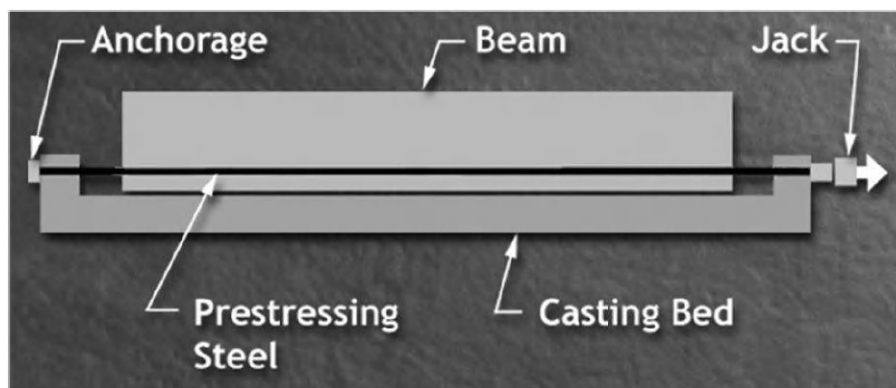


Bulb-T



3

Precast Concrete



4

Precast Slab Bed



QA
0001 MATERIALS &
INSPECTION

5

Precast Slab Bed



QA
0001 MATERIALS &
INSPECTION

6

Inserts for Tierods



QA
0007 MATERIALS &
INSPECTION

7

Precast Girder Bed



QA
0007 MATERIALS &
INSPECTION

8

MOAB



QA
0007 MATERIALS &
INSPECTION

9

Girder Reinforcement in MOAB



QA
0007 MATERIALS &
INSPECTION

10

Steel Plate at End of Girder



11

Bridge Girders

Common characteristics include:

- Camber & deflection
- Bearing points
- Diaphragms



12

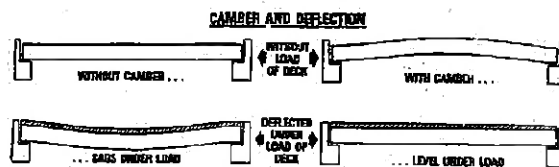
Beam Camber & Deflection



13

Beam Camber & Deflection

- **Camber** is curvature of beam without load
- **Deflection** is sagging of beam under loading



14

Sagging Span



15

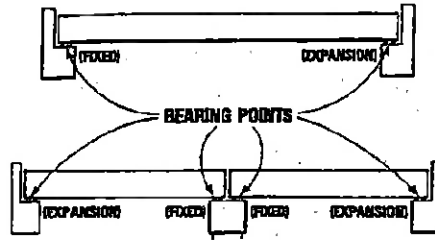
Bearing Points



16

Bearing Points

- Bearing pad or plate assembly between top of bent & bottom of beam
- One end usually fixed and the other allows movement



17

Expansion End of Beam



18

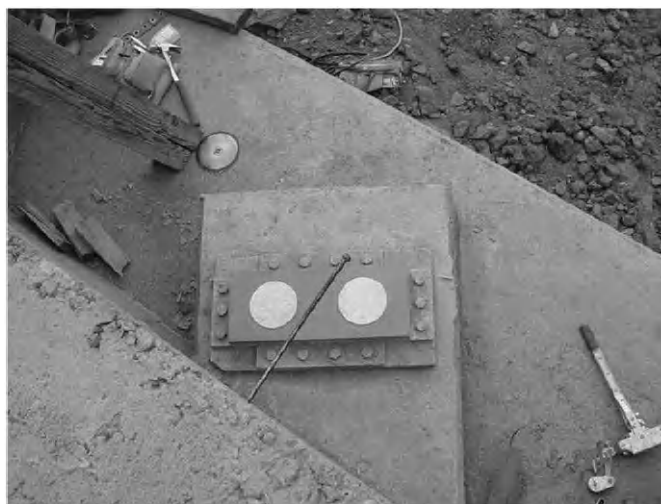
Stainless Steel Plate



QA
0007 MATERIALS &
INSPECTION

19

Teflon Bearing Pads



QA
0007 MATERIALS &
INSPECTION

20

Expansion Bearing Assembly



QA
0007 MATERIALS &
INSPECTION

21

Guided Bearing Assembly



QA
0007 MATERIALS &
INSPECTION

22

Non-Guided Bearing Assembly



23

Grout Layer



24

No Grout Layer Under Elastomeric Pad

Depends on
design of
endwall



QA
0001 MATERIALS &
INSPECTION

25

Setting Beam After Placing Grout Layer



QA
0001 MATERIALS &
INSPECTION

26

Cleaning Up Grout After Setting Beam



QA
0007 MATERIALS &
INSPECTION

27

Poor Consolidation in Crossbeam Above Bearing Assembly



QA
0007 MATERIALS &
INSPECTION

28

Large Void Under Gusset Plate Above Bearing Assembly



QA
DOT
MATERIALS &
INSPECTION

29

Good Bearing Support



QA
DOT
MATERIALS &
INSPECTION

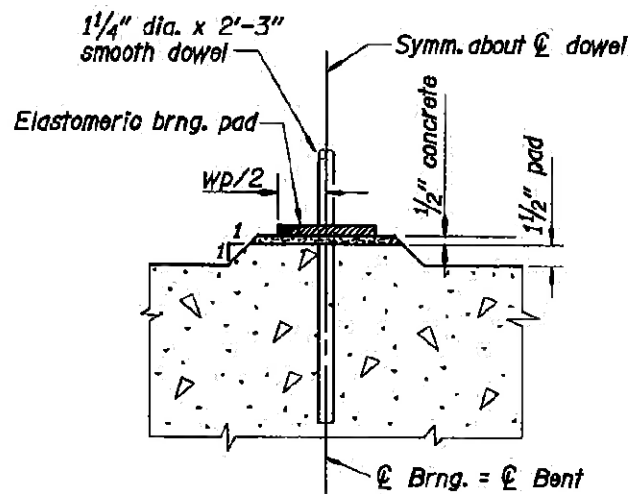
30

Slabs & Boxes



31

Bearing Details



32

Gap Under Slab?

- Need uniform bearing
- Reset slab until no gap shows



33

$\frac{3}{4}$ " Gap Under Slab Above Pad?

- 5% grade
- Slope beam seat to match grade and cross-slope
- $\frac{1}{2}$ " grout layer missing?



34

1" Gap Above Elastomeric Pad



QA
0007 MATERIALS &
INSPECTION

35

Slabs on Steel Pilecap



QA
0007 MATERIALS &
INSPECTION

36

Gap Over Elastomeric Pad

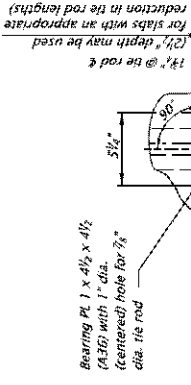


37

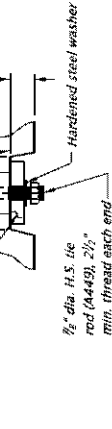
Details for Slabs & Boxes



38



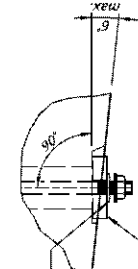
Bearing PL 1 x 4 1/2 x 4 1/2 (A36) with 1" dia. hole for 1/2" dia. tie rod



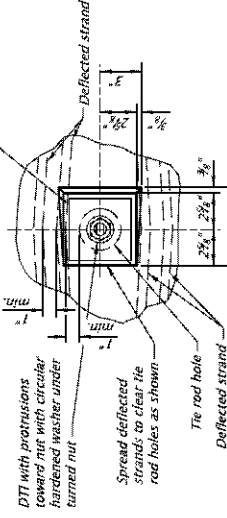
Hardened steel washer
Bearing PL 1 x 4 1/2 x 4 1/2 (A36) with 1" dia. hole for 1/2" dia. tie rod
min. thread each end

DETAIL "A"
Non-Tensioning End

DTI with protrusions toward nut with circular hardened steel washer on turned nut



Form recess bearing area perpendicular to tie rod as shown. Use Detail "B" at tensioning end of tie rod.

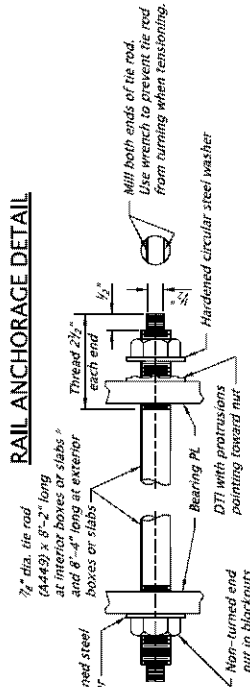


DETAIL "B"
Tensioning End



Traffic rail anchor assembly as detailed on rail drawings or approved equal

RAIL ANCHORAGE DETAIL



TIE ROD DETAIL

1 1/2" (12" slab)
1 1/2" (15" slab)
1 1/2" (18" slab)
1 1/2" (21" slab)
1 1/2" (26" slab)
2" (30" slab)
2 1/4" (33" Box)
2 1/2" (39" Box)
2 3/4" (42" Box)
2 3/4" (48" Box & 21" Slab)
2 3/4" (48" Box & 26" Slab)
1 1/2" (30" slab)

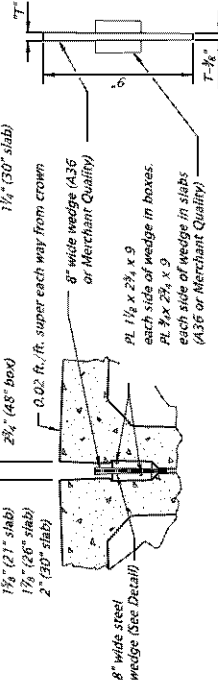
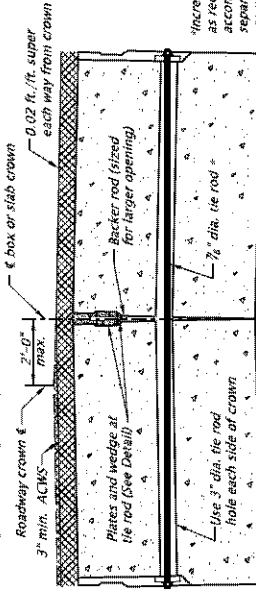


PLATE AND WEDGE DETAIL

Note: Add steel plates and wedge at each tie rod crossing before tensioning tie rods. Hot-dip galvanize wedges and plates. See Note below.

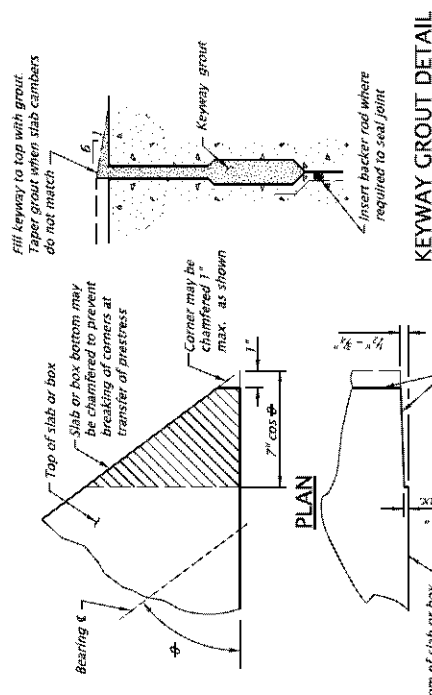


TYPICAL DETAIL FOR
INSTALLING BOXES OR SLABS ON CROWN

Note: Tighten tie rods until the bottom corners of the boxes or slabs are in contact. Loosen the tie rod and install the plates and wedges per detail. Shift wedge location as required to avoid conflict with the tie rod. Tension the tie rods. Install boxes or slabs level and build up roadway crown with AC wearing surface when roadway width is 28' or less (for bridges with ACWS).

GENERAL NOTES FOR PRESTRESSED BOXES AND SLABS

Boxes and slabs are designed for live and superimposed dead loading as shown in the General Notes. Provide the class of concrete shown in the Slab or Box Schedule with nominal maximum size aggregate of 1 or 3/4". Transfer prestress after the concrete reaches the minimum concrete strength at transfer shown in the Slab or Box Schedule. Select a keyway gROUT from the QPL for filling keyways, lifting blockouts and tie rod blockouts. Allow traffic on the bridge only after keyway gROUT has reached design strength. Provide reinforcing steel as specified in the General Notes for the Project. Provide smooth dowels conforming to AASHTO M31, Grade 60 (ASTM A615, Grade 60). Provide 1/2" diameter 7 wire low relaxation prestressing steel strand conforming to AASHTO Specification M203 (ASTM A416), Grade 270 Supplement 1. Tension strand initially to 31.9 kips per strand (after harping deflected strand). Deband strands where specified using either split or solid plastic sheathing with a minimum wall thickness of 0.025". Provide high strength tie rods conforming to ASTM A449. Provide heavy hexagon nuts conforming to ASTM A563. Hot-dip galvanize tie rods, plates, nuts and washers (except DTIs) after fabrication. Tighten tie rods to 39 kips (minimum) using mechanically galvanized direct tension indicators (DTIs) conforming to ASTM F959. Tighten all tie rods (per box or slab) to about one half the specified tension before proceeding with final tensioning. Keep boxes and slabs upright at all times. Support them within 2'-0" of the ends during storage (to prevent excessive camber, overstress or failure). Locate transport supports and lifting devices within 2'-0" of the ends of boxes and slabs. Transport boxes and slabs after the concrete has reached the 28 day design strength and a minimum of 7 days after casting.



PARTIAL ELEVATION
CHAMFER DETAIL

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without consulting a Registered Professional Engineer.

OREGON STANDARD DRAWINGS PRECAST PRESTRESSED BOX AND SLAB DETAILS

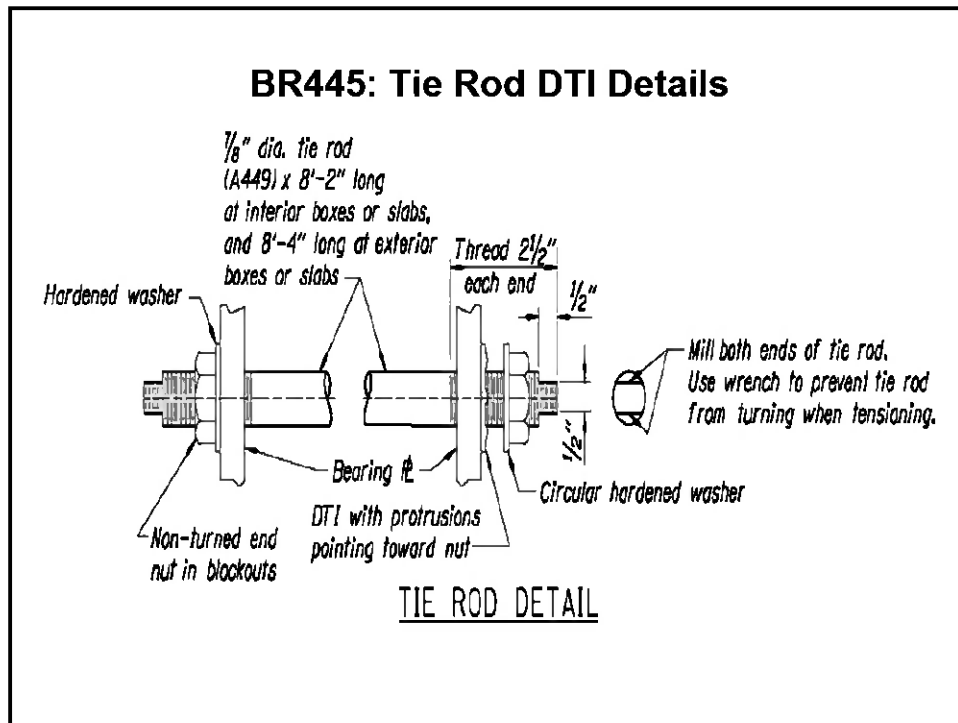
2018

REVISION DESCRIPTION

DATE

Effective Date: December 1, 2019 - May 31, 2020

BR445



39

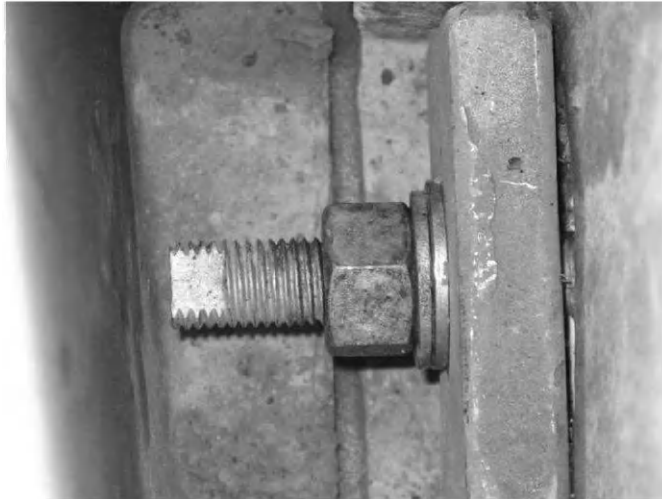
BR445: Tie Rod DTI Tightening Details

- Clean and lube tie rods and nuts before installation.
- Install DTI's as shown and tighten until nil gap is achieved.
- Nil gap is defined as refusal of a 0.005" feeler gauge at 2,3,3,4 or 4 locations with a 4,5,6,7 or 8 space washer, respectively, with at least 1 visible gap.
- 00550.50



40

DTI with Hardened Washer



41

DTI Only, No Hardened Washer?



42

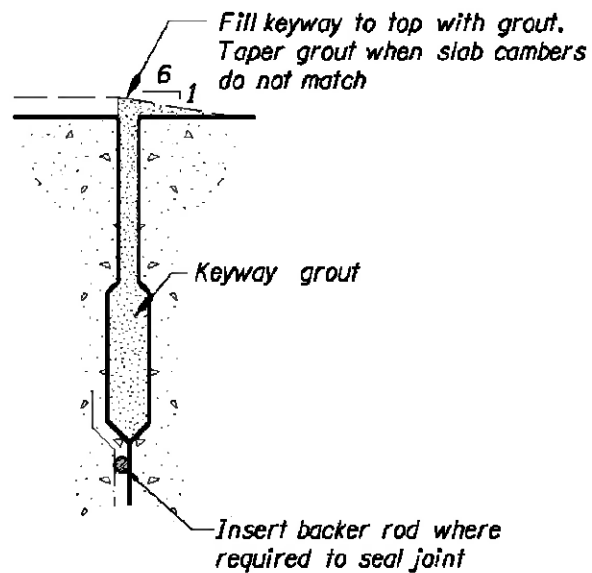
Plate Not Flush in Pocket?



43

BR445: Keyway Grout Detail

Top mismatch:
6 to 1 Taper



KEYWAY GROUT DETAIL

44

Keyway Grout Under Rolled Waterproof Membrane

No vertical
edges under
rolled
waterproof
membrane



45

Keyway Grouting 00550.51

- Keep keyways moist for 24 hours prior to grouting
- 45 degrees minimum for grouting
- Water cure grout per manufacturer's recommendations



46



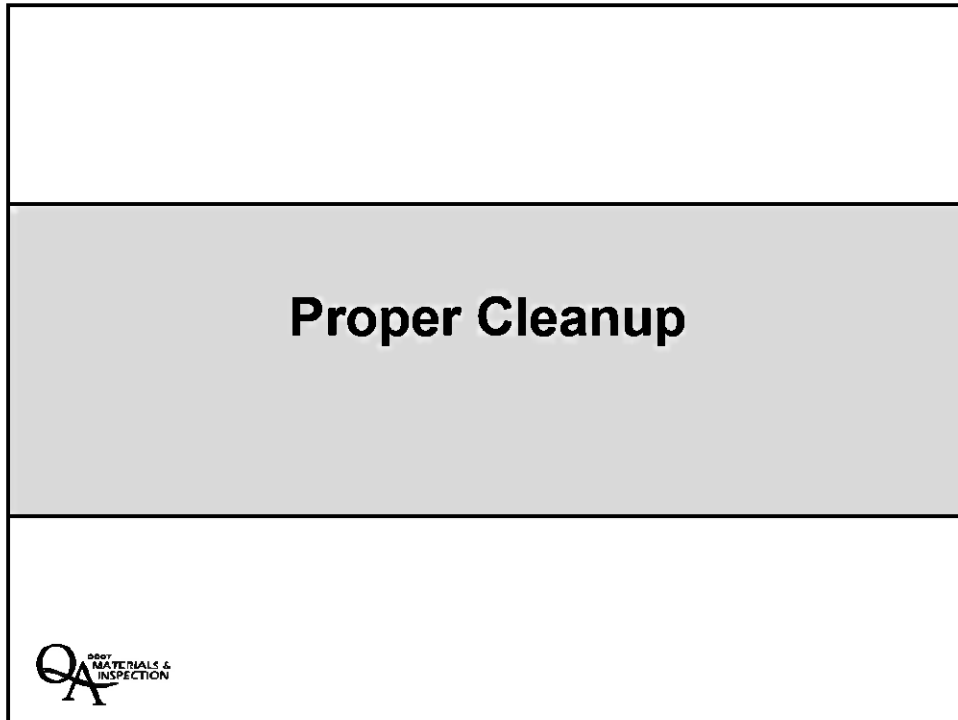
Project Information

Project Name (Section)		Contract No.	
Highway		Federal Aid No.	
Contractor or Subcontractor			

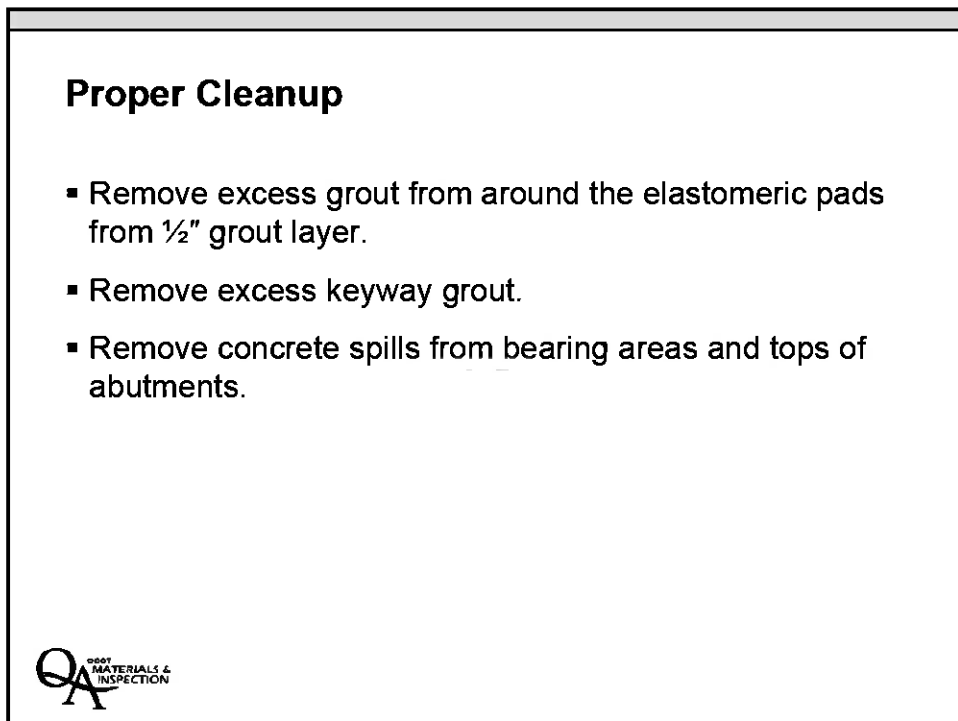
Item		Completed			Remarks
		Yes	No	N/A	
1	Beam seat elevations checked	☐	☐	☐	
2	Beam seats parallel to cross slope	☐	☐	☐	
3	Beam seats parallel to grade	☐	☐	☐	
4	1/2" grout layer on beam seat below elastomeric pads	☐	☐	☐	
5	Beam position checked	☐	☐	☐	
6	Correct beam location (inserts, rail stirrups, etc.)	☐	☐	☐	
7	Uniform bearing on beam seats	☐	☐	☐	
8	Tie rod DTI protrusions against hardened washer	☐	☐	☐	
9	DTI on end with open access	☐	☐	☐	
10	DTI checked with feeler gauge for correct number of refusals	☐	☐	☐	
11	Keyway grout on 6/1 slope	☐	☐	☐	
12	Keyway grout cured	☐	☐	☐	
13	No heavy loads until keyway grout cured	☐	☐	☐	

[illegible]

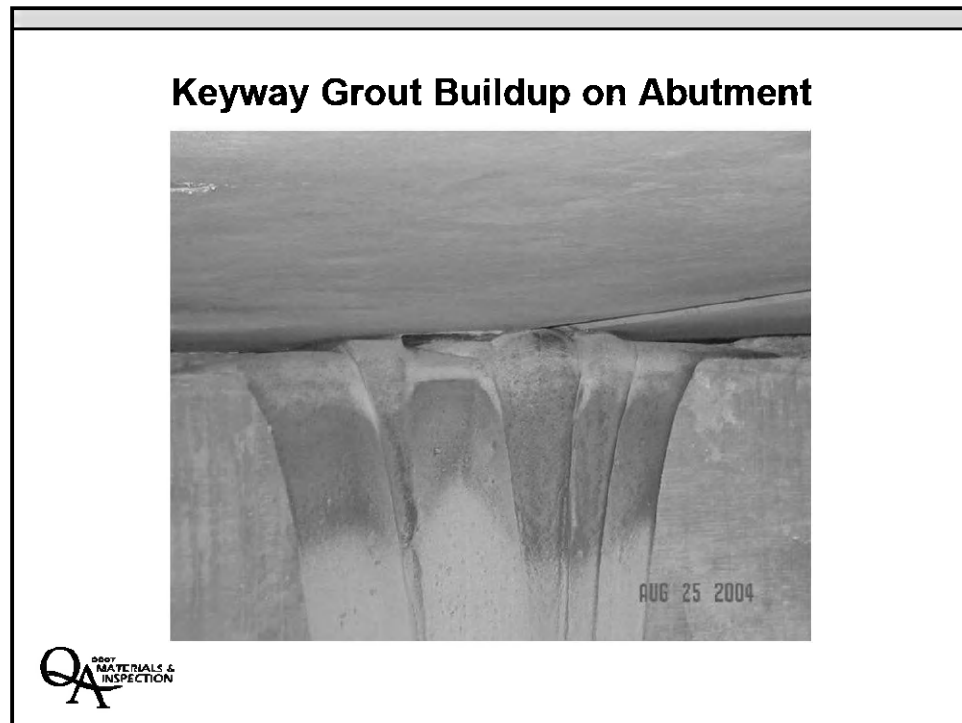
Inspected by		Date	
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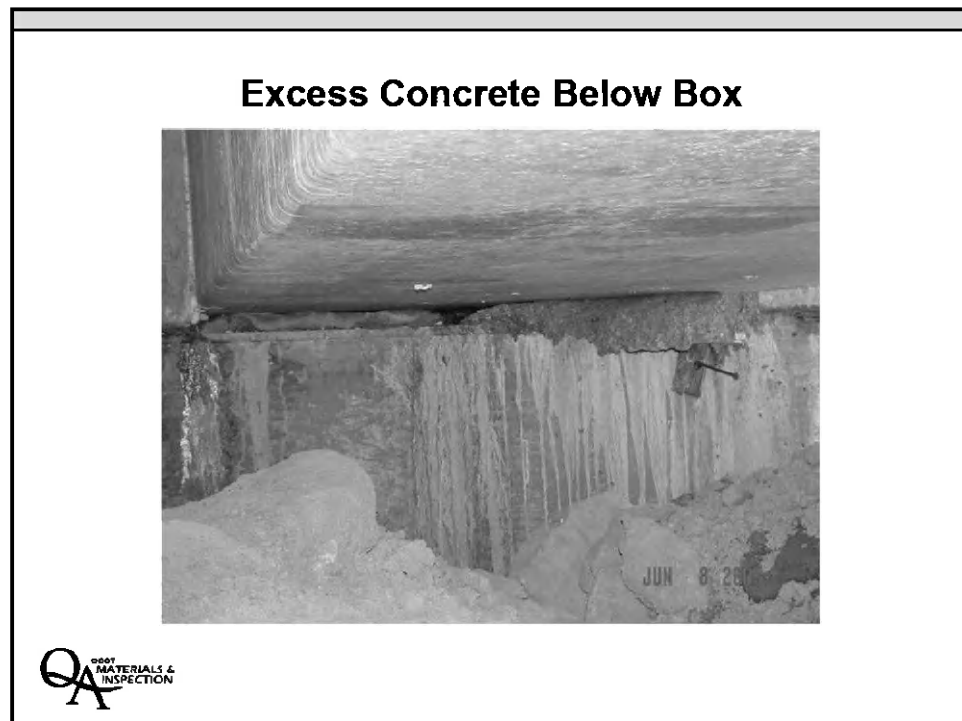
47



48



49



50

Patterson Slough Bridge

Setting Beams Using
a Beam Launcher

51

Girder Construction



52

Girder Transport and Delivery

As precast concrete beams are delivered to the site for erection, you should:

- See that they are kept in an upright position.
- Properly supported less than 2'0" from the end.



53



54

Picking Beams on a Super



55

Trailer Blocked To Keep Level



56

Dropped Beam



57

Inspect Concrete Girders for...

- Cracks, exposed re-steel, defects.
- Lengths and cross-section.



58

Concrete Girder Sweep

Alignment:

- 1/8" / 10' max. sweep allowed
- Actual for 150' was 3 3/4"



59

Sweep Example

150' Girder

Sweep of 3 3/4" Is this acceptable?

Allowable is 1/8" / 10'

$$150' / (10' / 1/8") = 15/8" = 1 7/8"$$

$$3 3/4" > 1 7/8"$$

Therefore, the girder is out of spec.



60

Sweep Exercise

180' Girder

Sweep of 2 1/2" Is this acceptable?



61.

Inserts



62.

Inserts on Interior of Exterior Beam for Diaphragm

Check for
correct beam
and correct
orientation



63

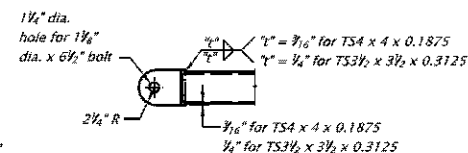
Temporary Bracing Details



64



(Bulb...i shown, other orders similar)



Drill 2" dia. hole thru end plate

Cut from
TS12 x 4 x 1/2

2" 4" 3" 1 1/8" dia. holes @ 3 1/2" ctrs. in
TS3 1/4 x 3 1/4 x 0.3125 only

TS4 x 4 x 0.1875
TS3 1/2 x 3 1/2 x 0.3125
as required.

LOWER CONNECTION DETAIL
TYPE II thru TYPE V GIRDERS



Install temporary diaphragm beams at exterior girders between end beams and permanent diaphragms prior to pouring permanent diaphragms and end beams. Space temporary diaphragms as needed to resist construction loads but not at more than 25 ft. apart. Assume the deck finishing machine carriage is at the most adverse position when computing construction loads. Remove temporary diaphragms after removing the deck overhang brackets.

Provide pipe conforming to ASTM Specification A53, Grade A or B. Provide structural tubing conforming to ASTM Specification A500, Grade A or B (or ASTM A513 with the strength and elongation characteristics of A500, Grade A or B).

Provide other steel conforming to AASHTO Specification M183 (ASTM A36).

Provide mechanically galvanized high strength bolts conforming to ASTM Specification A325 unless shown otherwise. Provide mechanically galvanized threaded rods conforming to ASTM Specification A449.

Tighten but do not torque high strength bolts and rods.

Hot-dip Galvanize all structural steel after fabrication.

Approved alternate designs prepared by a registered Professional Engineer may be used for temporary diaphragms.



LOWER CONNECTION
PLATE DETAIL

BULB-I and BULB-T GIRDERS

Effective Date: December 1, 2019 - May 31, 2020

☐ NO EXCEPTIONS TAKEN
☒ EXCEPTIONS NOTED, RESUBMITTAL NOT REQUIRED
☐ EXCEPTIONS NOTED, RESUBMITTAL REQUIRED
☐ REJECTED, RESUBMITTAL REQUIRED

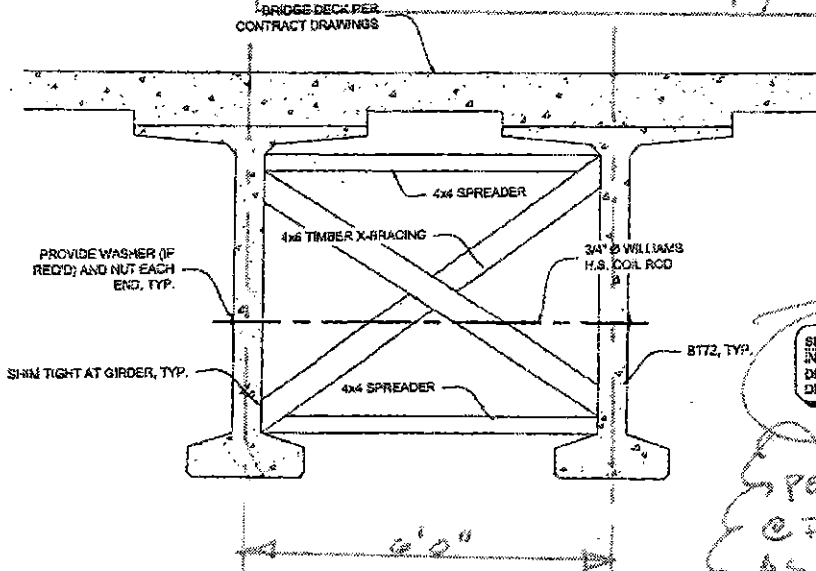
REVIEW IS ONLY FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE DRAWINGS AND DOES NOT EXTEND TO THE MEANS, METHODS, TECHNIQUES, SEQUENCES OR PROCEDURES OF THE CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS, DIMENSIONS TO BE CONFIRMED AND CORRELATED AT THE JOB SITE FOR FABRICATION, PROCESSING, COORDINATION OF THE WORK OF ALL TRADES AND FOR SATISFACTORY PERFORMANCE OF WORK.

BY JEP DATE 5/8/08

URS

PROJECT MANAGER - 4821
 THE DALLES
 RECEIVED
 MAY 20 2008

PM	APM	CS
DM	OO	
ASSIGN TO		



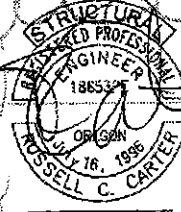
GENERAL NOTES:
 1. ALL BOLTS TO BE WILLIAMS B7S COIL ROD OR BETTER.
 2. ALL TIMBER TO BE DFLARCH #2 OR BETTER.

SPECIAL NOTE:
 INSTALL AT LOCATIONS AS DESIGNATED ON CONTRACT DRAWINGS.

101
 S1.1

TYPICAL GIRDER BRACING DETAIL
 1/2" = 1'-0"

PER BR 350, BRACING LOCATED @ DIAPHRAGMS & END BENTS & AS NEEDED, @ 25' MAX SPACING. VERIFY BY CALCULATION THAT TIGHTER SPACING IS NOT REQUIRED.



KEY CONSTRUCTORS, INC.
 BRIDGE CREEK M.P. 65.63 DECK
 FALSE WORK

PROJECT NO. K000000000
 DRAWN BY
 CHECKED BY
 DATE 04/25/07
 TYP. GIRDER BRACING
 S1.1

Temporary Diaphragm

TEMPORARY DIAPHRAGM BEAM GENERAL NOTES :

Install temporary diaphragm beams at exterior girders between end beams and permanent diaphragms prior to pouring permanent diaphragms and end beams. Space temporary diaphragms as needed to resist construction loads but not at more than 25 ft. apart.

Approved alternate designs prepared by a registered Professional Engineer may be used for temporary diaphragms.



65



66



67

Chains & Binders Used to Plumb and Support



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68

Bracing



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69

Bracing



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70

Bracing

Note the cable holding beams together



71

Falsedeck Construction: Thoughts?



72

Girder Collapse

I-10 Twin Span Bridge
Lake Pontchartrain, New Orleans, LA

Oct 30, 2008

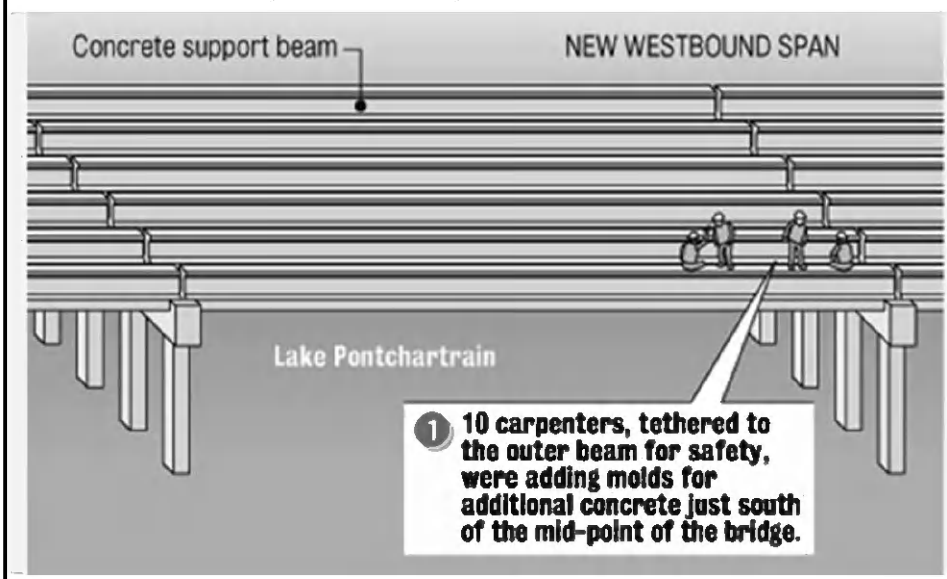
Fatalities: 1

Injuries: 2



73

Girder Collapse During Overhang Bracket Placement



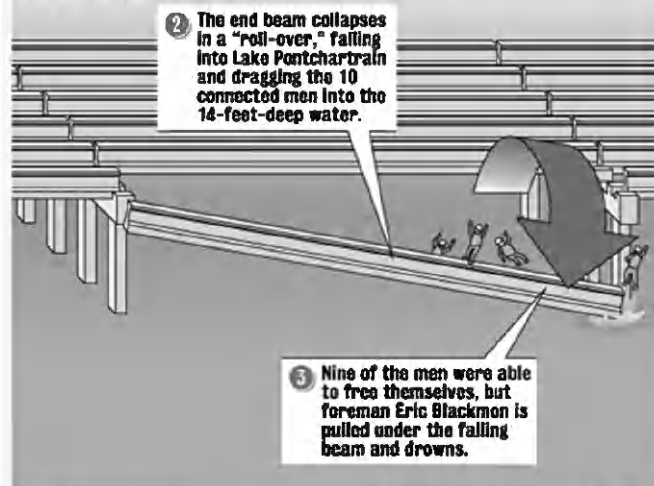
74

Girder Collapse

- 10 men
- 30' drop to water

SOMETHING WENT WRONG

The investigation is ongoing, but factors that may have caused the accident range from concrete failure in either the beam or the pillar cap it rested on, to something hitting the bridge.



Source: Boh Bros., staff research

EMMETT MAYER III / THE TIMES-PICAYUNE



75

Girder Collapse



76

**I-10 Twin Span Bridge
New Orleans, LA**

Cause:

Unknown cause at this time.
Ongoing investigation.

Exterior beam inserts did not line up with diaphragm.
Drilled new holes and epoxied in new inserts.



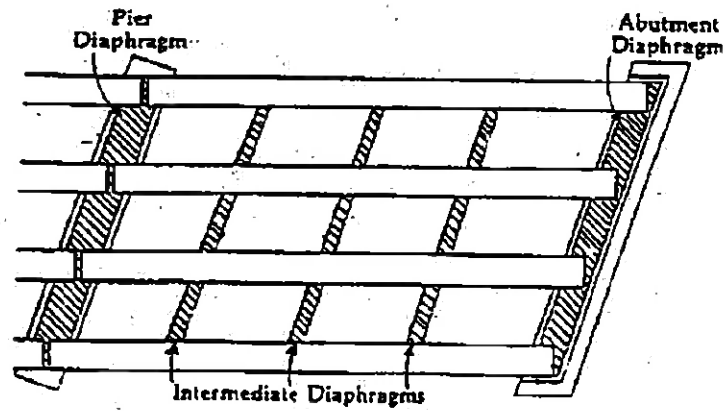
77

Diaphragms



78

Diaphragms



79

Diaphragms

Diaphragms provide the beams or girders with lateral support and tie them together. They include:

- Pier and abutment diaphragms, and
- Intermediate diaphragms.



80

Constructing Diaphragms

- Intermediate diaphragms are usually constructed first.
- Pier and abutment diaphragms constructed later (sometimes with deck).
- Outer girders have threaded inserts on interior sides for threaded rods and the interior girders have through-holes for rebar.



81

Holes in Girder for Rebar



82

Holes in Girder for Rebar



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83

Inserts with Threaded Rods on Exterior Girders



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84

Steel Plate Girder Construction



85

Girder Seats

- Construct girder seats to correct alignment and grade.
- Check bearing devices:
 - Fixed, expansion, sliding, or rocker types per plans.
 - Dimensions, positions, etc., of embedded anchor bolts.



86

Steel Girders

Grout is not required under the elastomeric pads.

- The steel plate is a flat surface.
- Elastomeric pads are thicker and tend to conform to the shape and distribute the load more than the thinner pads.
- More camber with steel girders results in more rotation.



87

Elastomeric Pad for Steel Girder



88

Cross Frame



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89

Elastomeric Pad Shift Due to Deck Deadload



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90

Anchor Bolts @ Abutments

Leave loose
to allow for
movement on
expansion ends



91

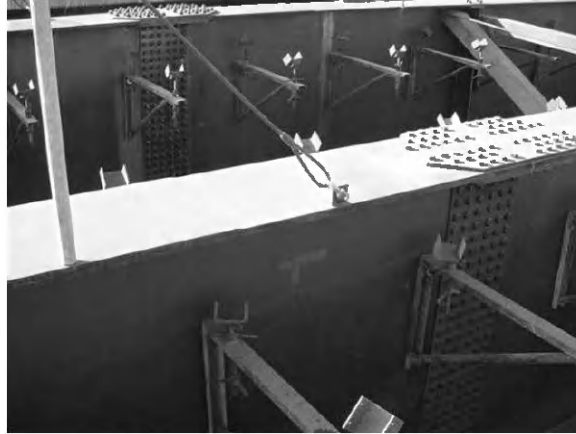
Bent Anchor Bolt @ Abutment



92

Cable anchor welded in tension member?

- Welds not allowed in tension members
- Exceptions require approval of design engineer



93

Cut Through Both Plates When Removing Deck?



94

Steel Delivery & Erection

Inspect girders and diaphragms for:

- General condition, twists, defects.
- Dimensions, etc., per plans and shop drawings.
- Erection marks to guide assembly.



95

Girder Markings

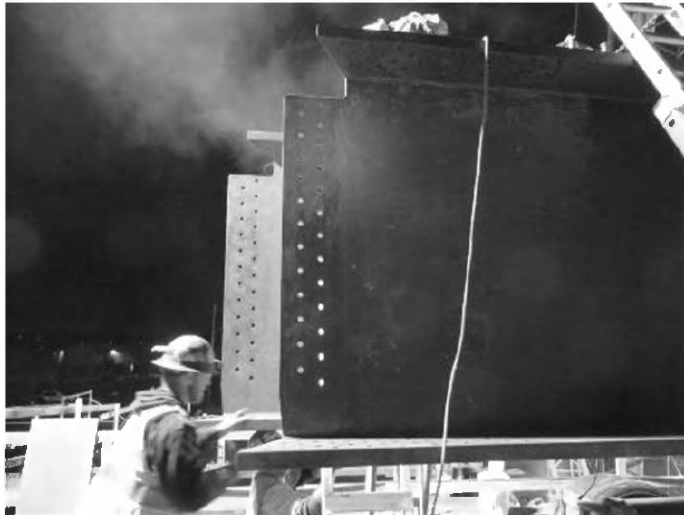


96

Girder Splice

Prepare Surfaces

00560.29(c)(2)



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97

Girder Splice

Sandblasted Splice
Surface



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98

Surface Conditions for Weathering Steel Slip Critical Connections

- Blast steel to steel contact surfaces to SSPC-SP 10 “Near White Blast” 00560.29(c)(2)
- Closely approximate SA 2-1/2 of SSPC-Vis 1
- Protect from corrosion 00560.24
- Prepare surfaces before assembly 00560.46(g)



99

250' Span Lift



100

	Brush Off	Industrial	Commercial	Near White	White Metal
	SSPC SP7 NACE No.4 ISO Sa 1	SSPC SP14 NACE No.8 ISO --	SSPC SP6 NACE No.3 ISO SA 2	SSPC SP10 NACE No.2 ISO ---	SSPC SP5 NACE No.1 ISO SA 3
			ISO SA 2 ^{1/2} up to 15% stains, shadows		
Loose Material	None	None	None	None	None
Tight Material	100%	up to 10%	None	None	None
Stains, Shadows	100%	100%	up to 33%	up to 5%	None

Unstable Due To Lack of Diagonal Supports

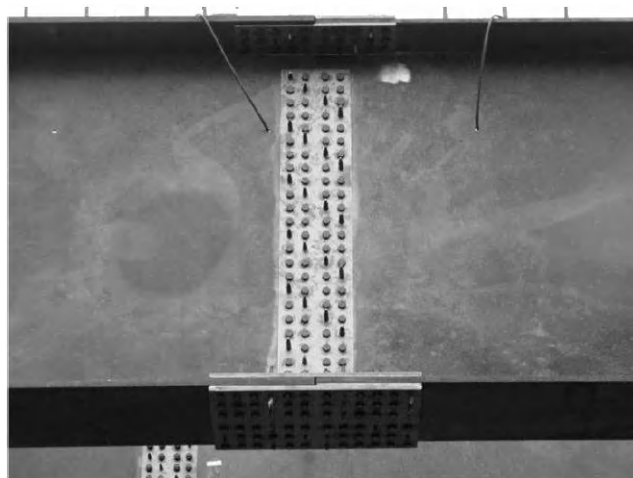


101

Bolt Installation

00560.46(g)

- 25% drift pins
- 25% fit up bolts



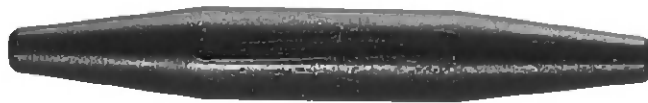
102

Drift Pins & Fitting-up Bolts**00560.46(g)**

- Fill 50% of holes with equal number of fitting-up bolts and cylindrical erection pins.
- Fill 75% of holes when connections are carrying added construction loads.



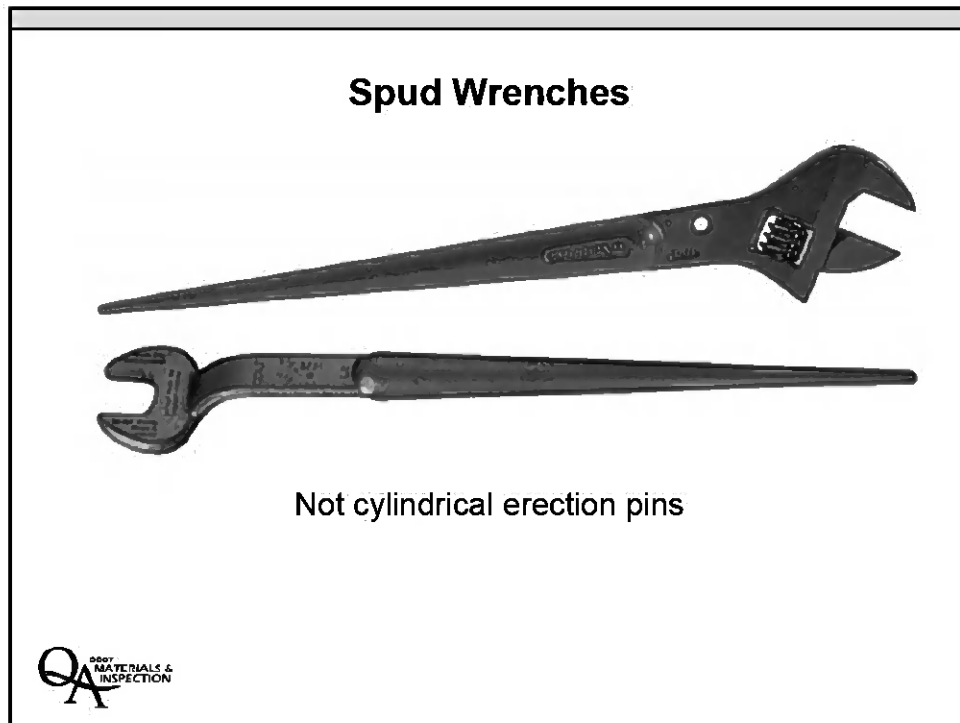
103

Drift Pins

- Cylindrical erection pins 1/32" larger than high strength bolts. 00560.46(g)
- Holes are 1/16" larger than high strength bolts. 00560.27(f)



104



105



106

**Girder Line Not Plumb & Straight
Crossframe was backwards**



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107

**Girder Line Is Straight
After Rotating Crossframe**



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108

Tennessee River Bridge Erection Accident



109

Steel Girder Collapse

State Route 69 Over Tennessee River
Near Clifton, TN

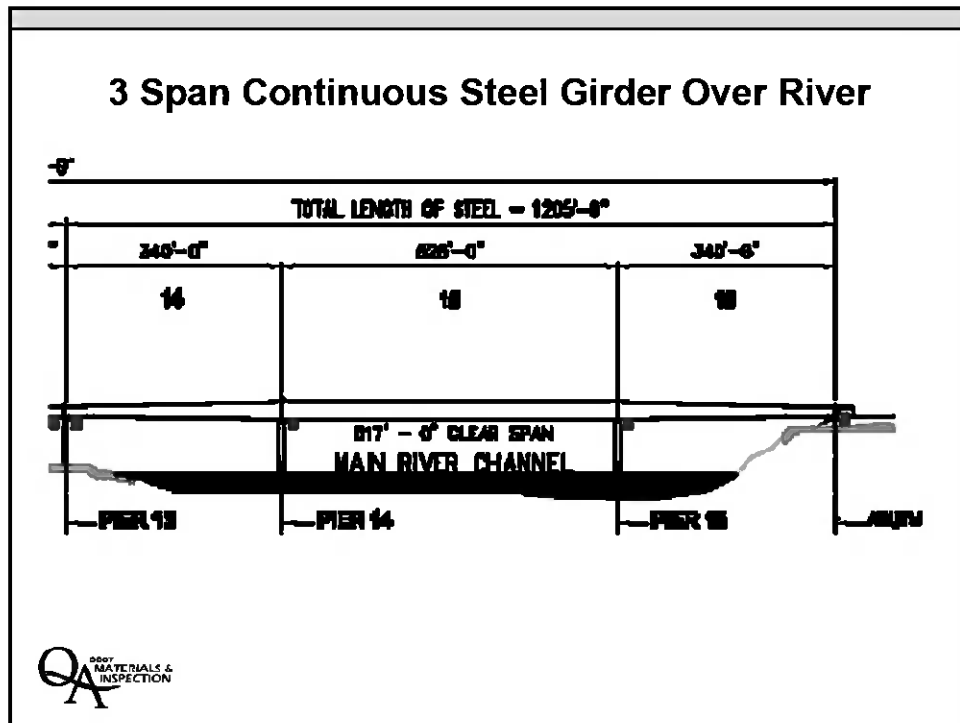
May 16, 1995

Fatalities: 1

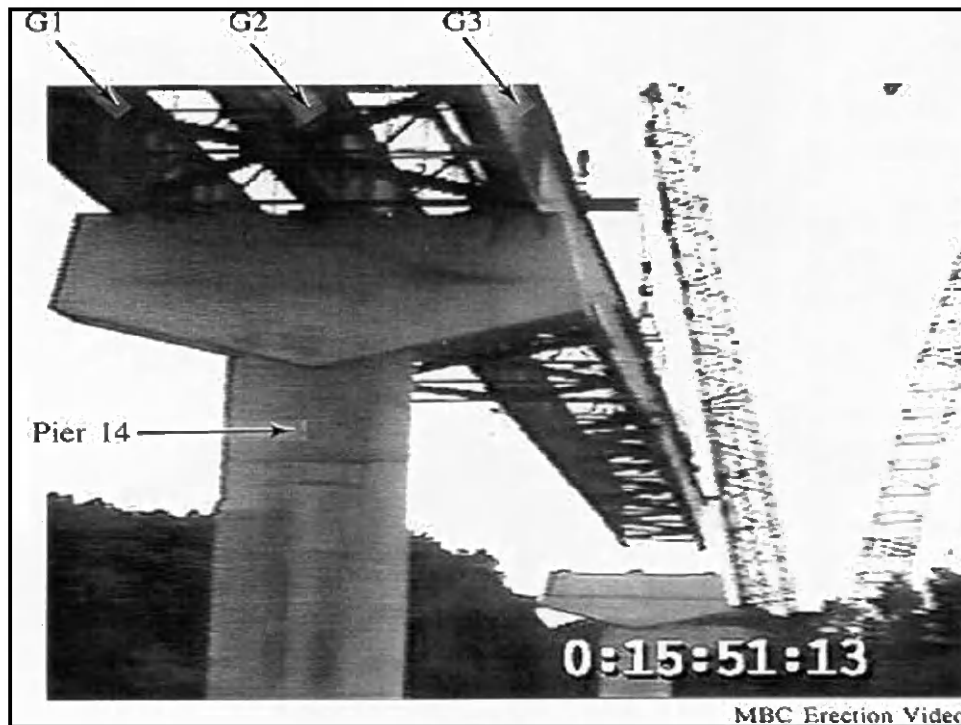
Injuries: 3



110



111



112



113

Steel Girder Collapse

Cause:

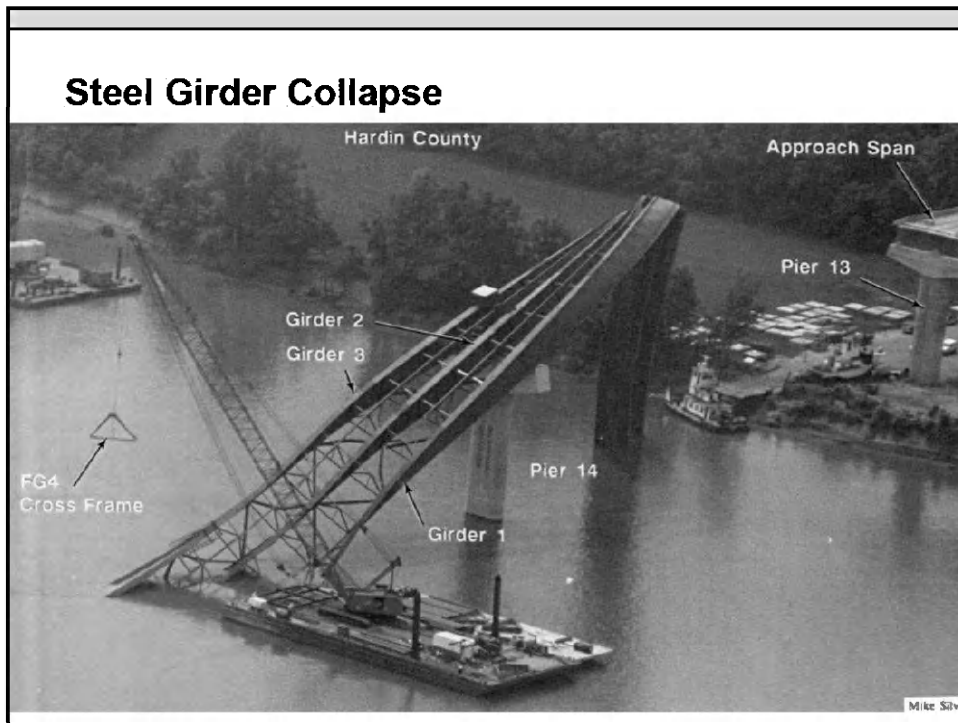
- 175 ft unbraced length of 14 ft deep girder.
- Removal of a cross frame in conjunction with missing or incomplete cross frames.
- Did not follow erection plan.



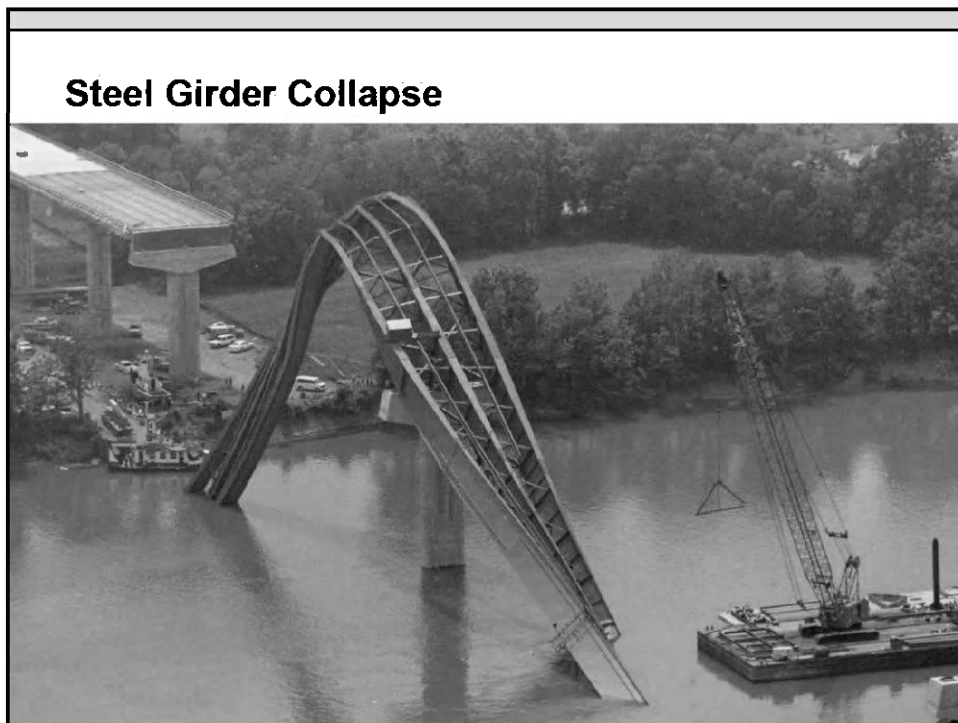
MBC Erection Video



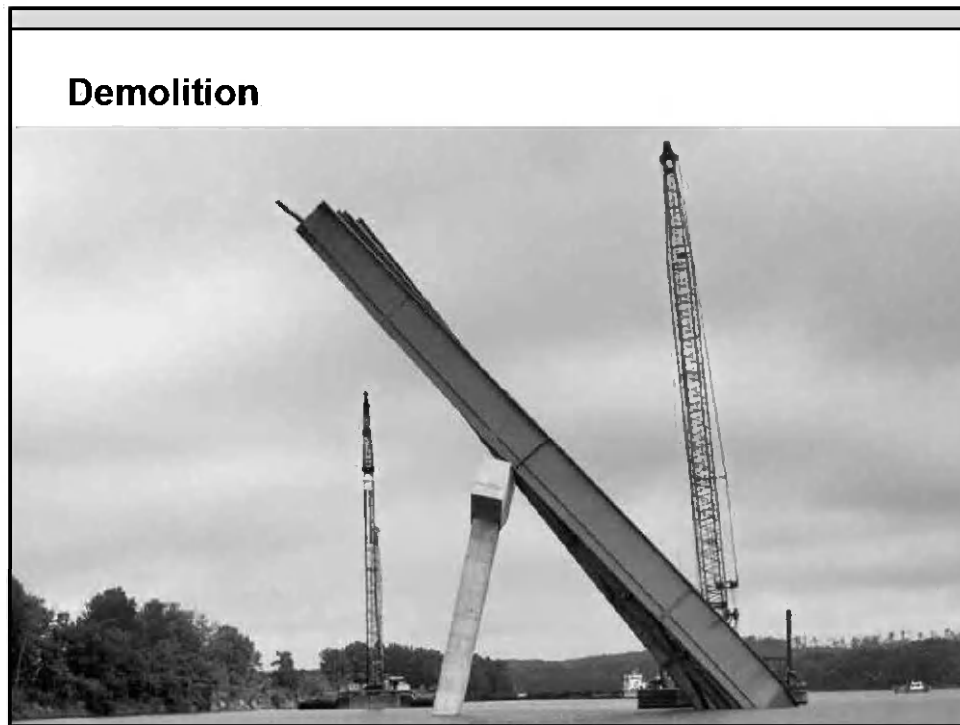
114



115



116



117

INSERT TAB

Unit 11
Bolting

Section 11

Bolting

High Strength Structural Bolting	1
Bolt Properties	2
Methods of Tightening	5
Field Tests	7
Rotational Capacity Test for Long Bolts	8
Rotational Capacity Test for Short Bolts	22
Verification Tests	23
Inspection Torque	26
Field Inspection	27
Other Types of Bolt Situations	32

Bolting

Section 11



1

High Strength Structural Bolting



2

High Strength Field Bolting

ASTM F3125 Bolt Types:

- A325 – Heavy Hex Head, 120 ksi
- A490 – Heavy Hex Head, 150 ksi
- F1852– Twist Off, 120 ksi – –
- F2280– Twist Off, 150 ksi



5

High Strength Field Bolting

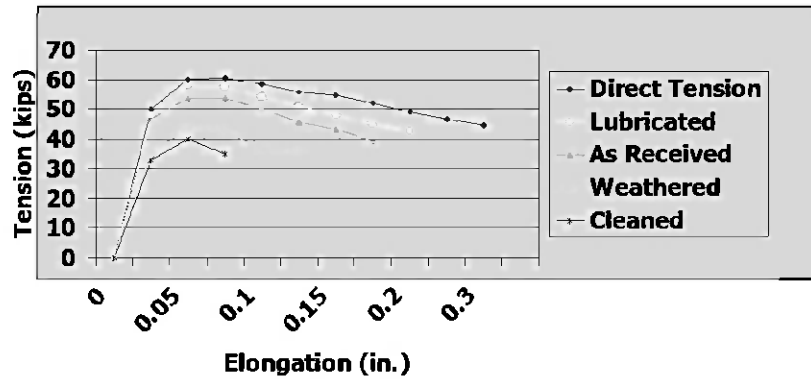
Bolt Types:

- A325 – High Strength Bolts for Structural Steel Joints
(Most common bolt type, 120 ksi)
- A490 – Heat Treated Steel Structural Bolts
(Used by exception only, 150 ksi)
- A307 – Carbon Steel Bolts
(Not used in high strength bolting applications,
60 ksi)



6

High Strength Field Bolting Theory & Behavior



A325 Load/Elongation Curve



7

High Strength Field Bolting

A325 Bolt Types:

Type 1 (medium carbon) 1/2" to 1 1/2"

Type 3 (weathering) 1/2" to 1 1/2"

A325 Strength Requirements:

Diameter (in.)	Yield (ksi)	Tensile (ksi)
1/2" - 1" 1/2"	92	120



8

High Strength Field Bolting

Bolt Type

Matching Nut

A325

A563

A194

Type 1 (plain)

C, D, DH

2, 2H

Type 1 (galvanized)

DH

2H

Type 3 (weathering)

– C3, DH3

Note: All nuts for high strength fasteners are **heavy hex**.

Non Heat Treated Nuts: Proof Load Stress = 150 ksi

Heat Treated Nuts: Proof Load Stress = 175 ksi



9

High Strength Field Bolting

Hardened Steel Washers:

- ASTM F436
- Type 1 – Carbon Steel (plain or galvanized)
- Type 3 – Weathering Steel –
- Rockwell Hard Values:
 - 38 to 45 (plain) - 170 ksi
 - 26 to 45 (galvanized) - 125 ksi



10

Methods of Tightening



11

Methods of Tightening

- Turn-of-Nut Method
- Direct Tension Indicators (DTIs)
- Tension Control Fasteners



12

Steel Girder Construction

- Most splice and connection bolts on our girders are installed using the Turn-of-Nut Method.
- DTIs are not used.
- TC bolts are used some.



13

Field Tests



14



HIGH STRENGTH BOLTING SUMMARY

TURN-OF-NUT METHOD (LONG BOLTS)

PROCESSES	PURPOSE
1. Rotational Capacity Test	Checks bolts for overall capacity, proper lubrication, and for damage during storage or transit
2. Verification Test	Demonstrates that Contractor's equipment & procedure will tighten bolts to proper tension
3. Inspection Torque	Determines torque value to be used in the random field inspection
4. Random Field Inspection	Checks bolt installation on structure using the Job Inspection Torque

PROCESSES	PROCEDURE
1. Rotational Capacity Test (02560.60 (a))	1. Sample 2 bolt, washer & nut assemblies 2. Assemble fastener with 3-5 threads within the grip 3. Snug tight (10% of Required Fastener Tension in Table 560-1); Tolerance= -0 kips, +2 kips 4. Mark the bolt, nut & plate 5. Tighten to Required Fastener Tension & record torque (torque must not exceed $T=0.25PD$) (P in lbs, D in ft) 6. Turn nut to twice the rotation in Table 560-3 (tension must exceed 115% of Required Fastener Tension) 7. Remove nut and check threads
2. Verification Test (00560.29 (c)(1 & 5))	1. Sample 3 bolt, washer & nut assemblies 2. Snug tight (Plies of joint in firm contact, full effort on 12" spud wrench; 10% of RFT < Tension < 50% of RFT) 3. Mark the bolt, nut & plate 4. Tighten nut to the rotation in Table 560-3 (max. of 10 seconds with impact wrench) 5. Verify tension is 5% greater than Required Fastener Tension
3. Inspection Torque (00560.29 (d))	1. Sample 3 bolt, washer & nut assemblies 2. Place in Skidmore & tighten to Required Fastener Tension in Table 560-1 3. Measure torque required to turn the nut 5 degrees (1" @ 12" radius) 4. Average the 3 tests to determine the Inspection Torque
4. Random Field Inspection (00560.29 (d))	1. Select at random 10% of the tensioned bolts in each connection (2 minimum) 2. Apply Inspection Torque. If none turn, the connection passes. 3. If one or more fasteners turn, inspection torque all fasteners in the connection. 4. Re-tension & inspect all fasteners that turned when applying the Inspection Torque.



HIGH STRENGTH BOLTING SUMMARY TURN-OF-NUT METHOD (SHORT BOLTS)

PROCESSES	PURPOSE
1. Rotational Capacity Test	Checks bolts for overall capacity, proper lubrication and for damage during storage or transit
2. Verification Test	Demonstrates that Contractor's equipment & procedure will tighten bolts to proper tension
3. Inspection Torque	Determines torque value to be used in the random field inspection
4. Random Field Inspection	Checks bolt installation on structure using the Inspection Torque

PROCESSES	PROCEDURE
1. Rotational Capacity Test (02560.60 (a))	1. Sample 2 bolt, washer & nut assemblies 2. Assemble fastener with 3-5 threads within the grip 3. Snug tight (10% of max allowable torque < Torque < 20% of MAT, MAT=1.15(0.25PD)) (P in lbs, D in ft) 4. Mark socket 5. Tighten nut to rotation in Table 560-3 & record torque (torque must not exceed T=1.15(0.25PD)) 6. Turn nut to twice the rotation in Table 560-3 7. Remove nut and check threads
2. Verification Test (00560.29 (c)(1 & 5))	1. Sample 3 bolt, washer & nut assemblies 2. Snug tight (Joint plies in firm contact, full effort on spud wrench; 10% of MAT < Torque < 50% of MAT) 3. Mark the bolt, nut & plate 4. Tighten nut to the rotation in Table 560-3 5. Verify torque is 5% greater than average of the recorded torques @ turn requirement in the RoCap Test
3. Inspection Torque (00560.29 (d))	1. Sample 3 bolt, washer & nut assemblies 2. Snug tight (10% of max allowable torque < Torque < 20% of MAT, MAT=1.15(0.25PD)) (P in lbs, D in ft) 3. Mark the bolt, nut & plate 4. Tighten nut to the rotation in Table 560-3 3. Measure torque required to turn the nut 5 degrees (1" @ 12" radius) 4. Average the 3 tests to determine the Inspection Torque
4. Random Field Inspection (00560.29 (d))	1. Select at random 10% of the tensioned bolts in each connection (2 minimum) 2. Apply Job Inspection Torque. If none turn, the connection passes. 3. If one or more fasteners turn, inspection torque all fasteners in the connection. 4. Re-tension & inspect all fasteners that turned when applying the Inspection Torque.

Field Tests at the Project Site

▪ Rotational Capacity Test

▪ Verification Test

▪ Inspection Torque

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Field

▪ Rotat

▪ Verifi

▪ Inspe

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Rotational Capacity Test
for Long Bolts

QA

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16

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16



HIGH STRENGTH BOLTS ROTATIONAL CAPACITY TEST & INSPECTION TORQUE (LONG BOLT METHOD)

☐ Turn of Nut Method ☐ Direct Tension Indicator ☐ Tension Control Fastener

Project		Contract No.
Company		Test No. RCT-
Torque Wrench Serial No.		Calibration Due Date
Skidmore Serial No.		Calibration Due Date
Bolt Diameter ▼	Bolt Length	Quantity
Bolt Mfg.	Lot No.	Heat No.
Nut Mfg.	Lot No.	Heat No.
Washer Mfg.	Lot No.	Heat No.
Ro-Cap Sample 1: Required Fastener Tension = _____ Lbs. (Table 00560-1) Snug Tight Tension = _____ Lbs. (0.10 x Req. Fastener Tension): Tol. = -0 kips + 2 kips Measured Torque = _____ Ft.-Lbs. @ Required Fastener Tension (Go to Insp. Torque) Maximum Allowable Torque = _____ Ft.-Lbs. (ASTM F3125 Table A2.2 $\approx T < 0.25PD$) Measured Tension = _____ Lbs. @ _____ Turn (2x Rotation In Table 00560-3) Minimum Tension Required = _____ Lbs. (ASTM F3125 Table A2.4 $\approx 1.15 \times RFT$) Sample 1 Results: ☐ Pass ☐ Fail		
Ro-Cap Sample 2: Required Fastener Tension = _____ Lbs. (Table 00560-1) Snug Tight Tension = _____ Lbs. (0.10 x Req. Fastener Tension): Tol. = -0 kips + 2 kips Measured Torque = _____ Ft.-Lbs. @ Required Fastener Tension (Go to Insp. Torque) Maximum Allowable Torque = _____ Ft.-Lbs. (ASTM F3125 Table A2.2 $\approx T < 0.25PD$) Measured Tension = _____ Lbs. @ _____ Turn (2x Rotation In Table 00560-3) Minimum Tension Required = _____ Lbs. (ASTM F3125 Table A2.4 $\approx 1.15 \times RFT$) Sample 2 Results: ☐ Pass ☐ Fail		
Rotational Capacity Test Results: ☐ Accept ☐ Reject		
Inspection Torque Sample 1: Required Fastener Tension = _____ Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)		
Inspection Torque Sample 2: Required Fastener Tension = _____ Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)		
Inspection Torque Sample 3: Required Fastener Tension = _____ Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)		
Inspection Torque = _____ Ft.-Lbs. (Average of the 3 Inspection Torque Samples)		
Comments:		
Inspector	Cert No.	Title
Contractor's Representative		Date

View Rotational Capacity Test for Long Bolts



17

Rotational-Capacity Test Equipment

- Skidmore-Wilhelm or equivalent
 - Calibrated yearly
- Standard torque wrench
 - 1000 ft. lb. capacity
 - Calibrated yearly
- Rigid steel joint
 - Short bolt fasteners



18

Table 560-1 Revision

A325	Bolt Size	Min. Tension
	(inch)	(kips)
	1/2	12
	5/8	19
	3/4	28
	7/8	39
	1	51
	1 1/8	65
	1 1/4	82
	1 3/8	98
	1 1/2	119

Note: A490 bolts
require higher tensions



19

Table 560-3

Table 00560-3
Nut Rotation from Snug-Tight Condition ¹

Bolt Length (underside of head to end of bolt)	Both faces normal to bolt axis	Disposition of Outer Faces of Bolted Parts	
		One face normal to bolt axis and other sloped not more than 1:20 (beveled washer not used)	Both Faces sloped not more than 1:20 from normal to bolt axis (beveled washer not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters ^{2,3}	2/3 turn (1 1/6 turn)	5/6 turn (1 1/2 turn)	1 turn (1 5/6 turn)

¹ Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by one-half turn and less, the tolerance shall be plus or minus 30°; for bolts installed by two-thirds turn and more, the tolerance shall be plus or minus 45°.

² No research has been performed by the Research Council on Structural Connections to establish the turn-of-nut procedure for bolt lengths exceeding 12 diameters. Therefore, the required rotation shall be determined by actual test in a suitable tension measuring device according to 00560.29(d)(3).

³ Values in parentheses are twice the rotation as defined in 02560.60(a)(1) and 02560.60(a)(2) for zinc coated ASTM A325 bolts only.



20

Ro-Cap Test for Long Bolts

1. Sample 2 Bolt/Washer/Nut Assemblies
2. Assemble fastener with 3-5 threads within grip
3. Snug tight (10% of req'd fast. tension, Table 560-1)
(Tolerance= -0 kips to +2 kips)
4. Mark socket
5. Tighten to req'd fast. tension and record torque (torque must not exceed $T=0.25PD$) (P in lbs, D in ft)
6. Turn nut to twice the rotation in Table 560-3 (tension must exceed 115% of req'd fast. tension)



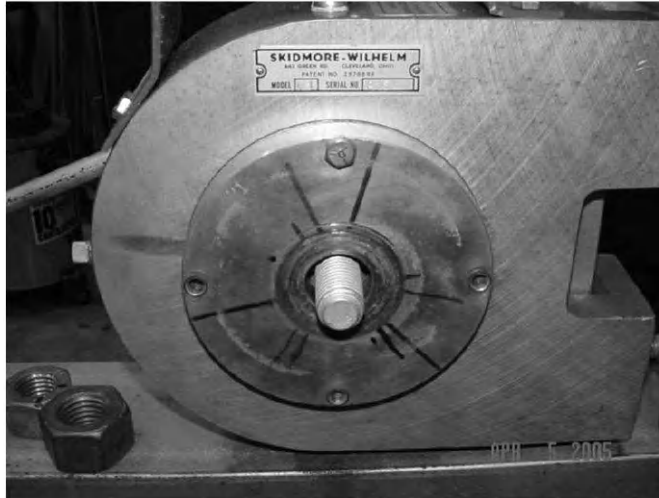
21

Skidmore/Wilhelm



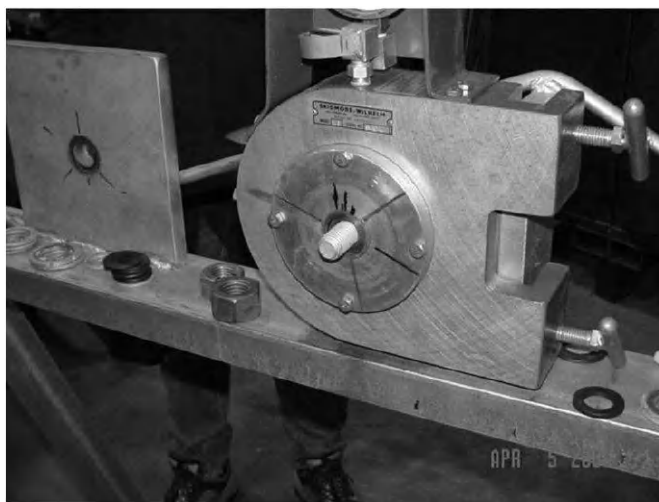
22

Change Plate to Correct Hole Size



23

Correct Size Plate Installed



24

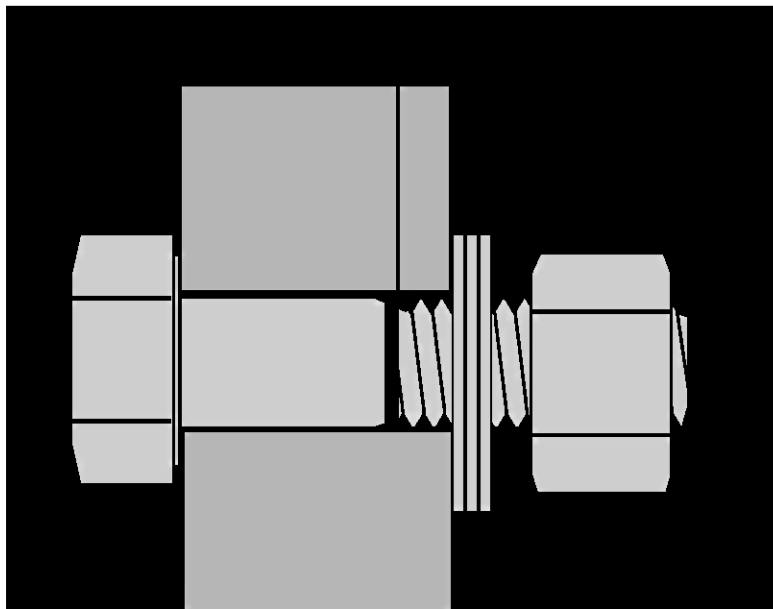
Bolt Head Insert on Backside



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25

3 - 5 Threads in Grip



26

3-5 Threads in Grip



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27

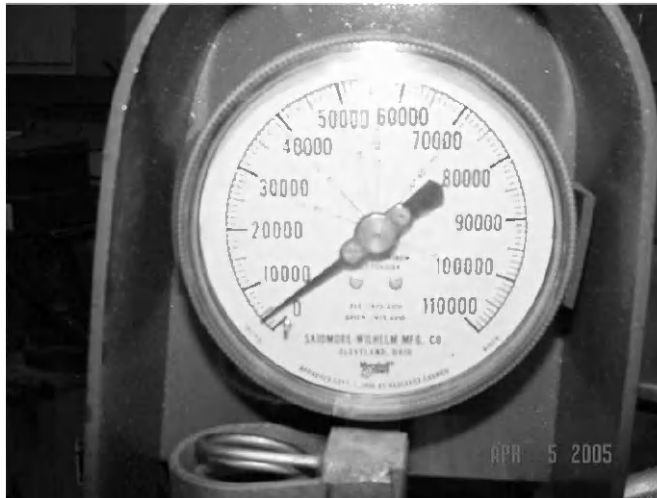
Added Washers to Maintain 3-5 Threads Within Grip



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28

Snug Tight (10% of Required Fastener Tension)



29

Table 560-1 Revision

A325	Bolt Size	Min. Tension
	(inch)	(kips)
	1/2	12
	5/8	19
	3/4	28
	7/8	39
	1	51
	1 1/8	65
	1 1/4	82
	1 3/8	98
	1 1/2	119

Note: A490 bolts
require higher tensions



30

Rotational Capacity Test Snug Tight (Long Bolts)

Bolt Diameter	3/4"
Required Fastener Tension (Table 560-1)	28 kips
Required Fastener Tension	28,000 lbs.
Snug Tight (10% Req'd. Fast. Tens.) = 0.10 (28,000lbs)	
	Snug Tight = 2,800 lbs.
Tolerance = - 0 kips to + 2 kips	



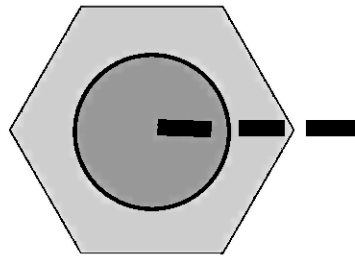
31

Mark Bolt, Nut & Plate



32

Mark Bolt, Nut & Plate



33

Tighten to Req'd Fastener Tension



34

Record Torque



35

Rotational Capacity Test Maximum Torque, $T=0.25 PD$

Diameter 3/4"

Required Fastener Tension 28 kips
(Table 560-1)

Max. Torque, $T = 0.25 PD$
(P in lbs, D in ft)

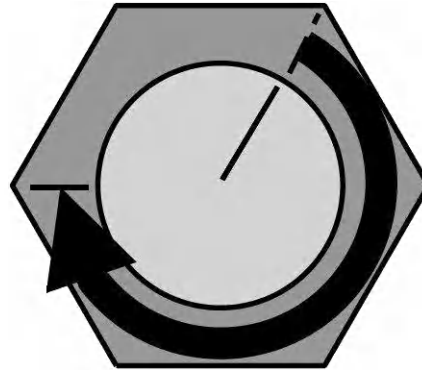
Max. Torque, $T = 0.25(28,000 \text{ lbs})(3/4")(1 \text{ ft}/12") = 438 \text{ ft-lbs}$
Max. Torque, $T = 438 \text{ ft-lbs}$



36

Turn Nut to Twice the Rotation

Turn Nut



Twice Rotation Specified in Table 560-3



37

Table 560-3

Table 00560-3
Nut Rotation from Snug-Tight Condition ¹

Bolt Length (underside of head to end of bolt)	Both faces normal to bolt axis	Disposition of Outer Faces of Bolted Parts	
		One face normal to bolt axis and other sloped not more than 1:20 (beveled washer not used)	Both Faces sloped not more than 1:20 from normal to bolt axis (beveled washer not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/8 turn
Over 8 diameters but not exceeding 12 diameters ^{2,3}	2/3 turn (1 1/6 turn)	5/6 turn (1 1/2 turn)	1 turn (1 5/6 turn)

¹ Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by one-half turn and less, the tolerance shall be plus or minus 30°; for bolts installed by two-thirds turn and more, the tolerance shall be plus or minus 45°.

² No research has been performed by the Research Council on Structural Connections to establish the turn-of-nut procedure for bolt lengths exceeding 12 diameters. Therefore, the required rotation shall be determined by actual test in a suitable tension measuring device according to Q0560.29(d)(3).

³ Values in parentheses are twice the rotation as defined in Q2560.90(a)(1) and Q2560.60(a)(2) for zinc coated ASTM A325 bolts only.



38

Rotation Example

What is the turn requirement in the rotational capacity test for a bolt with a diameter = $7/8"$ and a bolt length = $6"$?

4 Diameters = $4 (7/8") = 3.5"$

8 Diameters = $8 (7/8") = 7"$ _____

Single turn requirement from Table 560-3 = $1/2$ turn

Twice rotation = $2 (1/2 \text{ turn}) = 1 \text{ full turn}$



39

Rotation Exercise

What is the turn requirement in the rotational capacity test for a bolt with a diameter = $3/4"$ and a bolt length = $3"$?



40

Tension Must Exceed 115% of Req'd Fastener Tension



41

Minimum Tension Example

What is the minimum tension required for a 3/4" bolt during the Rotational Capacity Test when the nut is turned to twice the turn shown in Table 560-3?

Min. Tension = 115% of Required Fastener Tension
(Table 560-1)

Min. Tension = 1.15 (28,000 lbs.)

Min. Tension = 32,200 lbs.



42

Examine Bolt and Nut

Reject assemblies showing thread stripping or torsional failure.

Elongation of the threads in the grip is normal.



43

Rotational Capacity Test for Short Bolts



44



HIGH STRENGTH BOLTS ROTATIONAL CAPACITY TEST & INSPECTION TORQUE (SHORT BOLT METHOD)

☒ Turn of Nut Method ☒ Direct Tension Indicator ☒ Tension Control Fastener

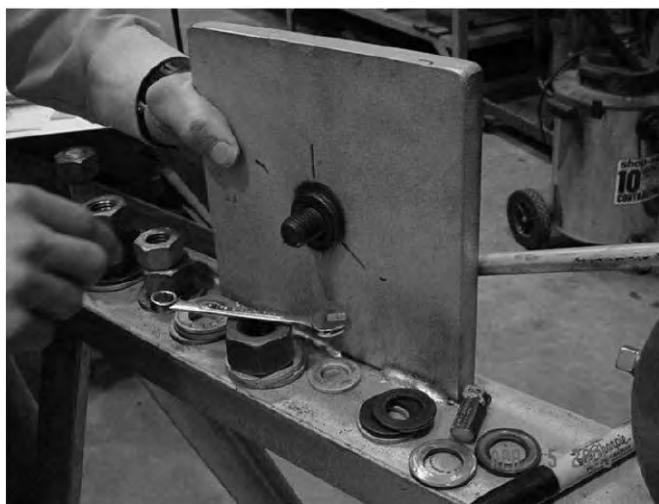
Project		Contract No.
Company		Test No. RCT-
Torque Wrench Serial No.		Calibration Due Date
Skidmore Serial No.		Calibration Due Date
Bolt Diameter ▼	Bolt Length	Quantity
Bolt Mfg.	Lot No.	Heat No.
Nut Mfg.	Lot No.	Heat No.
Washer Mfg.	Lot No.	Heat No.
Ro-Cap Sample 1: Required Fastener Tension = _____ Lbs. (Table 00560-1) Snug Tight Torque = _____ Ft.-Lbs.; T = 0.1(Maximum Allowable Torque) Measured Torque = _____ Ft.-Lbs. @ _____ Turn (Table 00560-3) (Go to Insp. Torque) Maximum Allowable Torque = _____ Ft.-Lbs.; (ASTM F3125 Table A2.6 $\approx$ T = 1.15(0.25PD) 2 x Rotation = _____ Turn (2x Rotation in Table 00560-3) Sample 1 Results: ☐ Pass ☐ Fail		
Ro-Cap Sample 2: Required Fastener Tension = _____ Lbs. (Table 00560-1) Snug Tight Torque = _____ Ft.-Lbs.; T = 0.1(Maximum Allowable Torque) Measured Torque = _____ Ft.-Lbs. @ _____ Turn (Table 00560-3) (Go to Insp. Torque) Maximum Allowable Torque = _____ Ft.-Lbs.; (ASTM F3125 Table A2.6 $\approx$ T = 1.15(0.25PD) 2 x Rotation = _____ Turn (2x Rotation in Table 00560-3) Sample 2 Results: ☐ Pass ☐ Fail		
Rotational Capacity Test Results: ☐ Accept ☐ Reject		
Inspection Torque Sample 1: Measured Torque = _____ Ft.-Lbs. @ _____ Turn (Turn Rotation in Table 00560-3) Sample Inspection Torque = _____ Ft.-Lbs. (= Measured Torque From Ro-Cap Sample 1)		
Inspection Torque Sample 2: Measured Torque = _____ Ft.-Lbs. @ _____ Turn (Turn Rotation in Table 00560-3) Sample Inspection Torque = _____ Ft.-Lbs. (= Measured Torque From Ro-Cap Sample 2)		
Inspection Torque Sample 3: Measured Torque = _____ Ft.-Lbs. @ _____ Turn (Turn Rotation in Table 00560-3) Sample Inspection Torque = _____ Ft.-Lbs. (= Measured Torque From 3rd Sample)		
Inspection Torque = _____ Ft.-Lbs. (Lowest Value of the 3 Inspection Torque Samples)		
Comments: 		
Inspector	Cert No.	Title
Contractor's Representative		Date

View Short Bolt Video



45

Short Bolt Method



46

Verification Testing Turn-of-Nut Method



47

Verification Testing for Long Bolts Turn-of-Nut Method

1. Sample 3 Bolt/Washer/Nut Assemblies
2. Snug the bolt using method to be used on the structure
(plies of joint in firm contact; full effort on 12" spud wrench)
(10% of RFT < Tension < 50% of RFT)
3. Mark the Bolt/Nut/Plate
4. Tighten nut to rotation in Table 560-3
5. Verify tension is 5% greater than proof load



48



HIGH STRENGTH BOLTS VERIFICATION TEST (LONG BOLT METHOD)

☒ Turn of Nut Method ☐ Direct Tension Indicator ☐ Tension Control Fastener

Project		Contract No.	
Company		Test No. VT-	
Torque Wrench Serial No.		Calibration Due Date	
Skidmore Serial No.		Calibration Due Date	
Bolt Diameter		Bolt Length	Quantity
Bolt Mfg.		Lot No.	Heat No.
Nut Mfg.		Lot No.	Heat No.
Washer Mfg.		Lot No.	Heat No.
Verification Sample 1:			
Required Fastener Tension	=	_____ Lbs. (Table 00560-1)	
Meas'd Tension @ Snug Tight	=	_____ Lbs. (Joint Plies in Firm Contact, Full Effort on Spud Wrench) (10% Req'd Fastener Tension < Snug Tight < 50% RFT)	
Measured Time	=	_____ Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Maximum Allowable Time	=	10 Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Measured Tension	=	_____ Lbs. @ _____ Turn (Turn Rotation In Table 00560-3)	
Minimum Tension Required	=	_____ Lbs. (1.05 X Required Fastener Tension)	
		Sample 1 Results: ☐ Pass ☐ Fail	
Verification Sample 2:			
Required Fastener Tension	=	_____ Lbs. (Table 00560-1)	
Meas'd Tension @ Snug Tight	=	_____ Lbs. (Joint Plies in Firm Contact, Full Effort on Spud Wrench) (10% Req'd Fastener Tension < Snug Tight < 50% RFT)	
Measured Time	=	_____ Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Maximum Allowable Time	=	10 Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Measured Tension	=	_____ Lbs. @ _____ Turn (Turn Rotation In Table 00560-3)	
Minimum Tension Required	=	_____ Lbs. (1.05 X Required Fastener Tension)	
		Sample 2 Results: ☐ Pass ☐ Fail	
Verification Sample 3:			
Required Fastener Tension	=	_____ Lbs. (Table 00560-1)	
Meas'd Tension @ Snug Tight	=	_____ Lbs. (Joint Plies in Firm Contact, Full Effort on Spud Wrench) (10% Req'd Fastener Tension < Snug Tight < 50% RFT)	
Measured Time	=	_____ Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Maximum Allowable Time	=	10 Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Measured Tension	=	_____ Lbs. @ _____ Turn (Turn Rotation In Table 00560-3)	
Minimum Tension Required	=	_____ Lbs. (1.05 X Required Fastener Tension)	
		Sample 3 Results: ☐ Pass ☐ Fail	
Verification Test Results:		☐ Accept ☐ Reject	
Comments:			
Inspector	Cert No.	Title	
Contractor's Representative		Date	

Turn-of-Nut Verification Testing Long Bolt Example

Diameter = $\frac{3}{4}"$
 Length = 3"
 Required Rotation (Turns) = $\frac{1}{3}$
 Required Fastener Tension = 28,000 lbs.
 Req'd Verification Tension = (105%) Req'd Fast Tension
 Req'd Verification Tension = $(1.05)(28,000) = 29,400$ lbs.



49

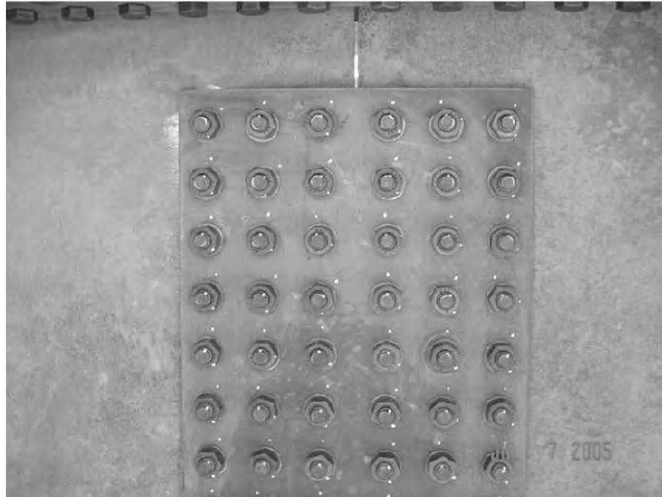
Turn-of-Nut Verification Testing Long Bolt Exercise

Diameter = $\frac{7}{8}"$
 Length = 4"
 Required Rotation (Turns) = _____
 Required Fastener Tension = _____ lbs.
 Req'd Verification Tension = _____



50

Marked Bolt Connection



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INSPECTION

51

Nuts Turned ½ Turn



QA
0007 MATERIALS &
INSPECTION

52

Inspection Torque Turn-of-Nut Method



53

Inspection Torque for Long Bolt Method (Turn-of-Nut)

1. Sample 3 Bolt/Washer/Nut assemblies
2. Place in skidmore and tighten to required tension in Table 560-1
3. Measure torque required to turn the nut 5 degrees (1" @ 12" radius)
4. Inspection torque is the average of the 3 tests



54



HIGH STRENGTH BOLTS ROTATIONAL CAPACITY TEST & INSPECTION TORQUE (LONG BOLT METHOD)

☐ Turn of Nut Method ☐ Direct Tension Indicator ☐ Tension Control Fastener

Project		Contract No.	
Company		Test No. RCT-	
Torque Wrench Serial No.		Calibration Due Date	
Skidmore Serial No.		Calibration Due Date	
Bolt Diameter	▼	Bolt Length	Quantity
Bolt Mfg.		Lot No.	Heat No.
Nut Mfg.		Lot No.	Heat No.
Washer Mfg.		Lot No.	Heat No.
Ro-Cap Sample 1: Required Fastener Tension = _____ Lbs. (Table 00560-1) Snug Tight Tension = _____ Lbs. (0.10 x Req. Fastener Tension): Tol. = -0 kips + 2 kips Measured Torque = _____ Ft.-Lbs. @ Required Fastener Tension (Go to Insp. Torque) Maximum Allowable Torque = _____ Ft.-Lbs. (ASTM F3125 Table A2.2 $\approx T < 0.25PD$) Measured Tension = _____ Lbs. @ _____ Turn (2x Rotation In Table 00560-3) Minimum Tension Required = _____ Lbs. (ASTM F3125 Table A2.4 $\approx 1.15 \times RFT$) Sample 1 Results: ☐ Pass ☐ Fail			
Ro-Cap Sample 2: Required Fastener Tension = _____ Lbs. (Table 00560-1) Snug Tight Tension = _____ Lbs. (0.10 x Req. Fastener Tension): Tol. = -0 kips + 2 kips Measured Torque = _____ Ft.-Lbs. @ Required Fastener Tension (Go to Insp. Torque) Maximum Allowable Torque = _____ Ft.-Lbs. (ASTM F3125 Table A2.2 $\approx T < 0.25PD$) Measured Tension = _____ Lbs. @ _____ Turn (2x Rotation In Table 00560-3) Minimum Tension Required = _____ Lbs. (ASTM F3125 Table A2.4 $\approx 1.15 \times RFT$) Sample 2 Results: ☐ Pass ☐ Fail			
Rotational Capacity Test Results: ☐ Accept ☐ Reject			
Inspection Torque Sample 1: Required Fastener Tension = _____ Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque Sample 2: Required Fastener Tension = _____ Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque Sample 3: Required Fastener Tension = _____ Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque = _____ Ft.-Lbs. (Average of the 3 Inspection Torque Samples)			
Comments:			
Inspector		Cert No.	Title
Contractor's Representative		Date	

Field Inspection Turn-of-Nut Method



55

Field Inspection (Turn-of-Nut Method)

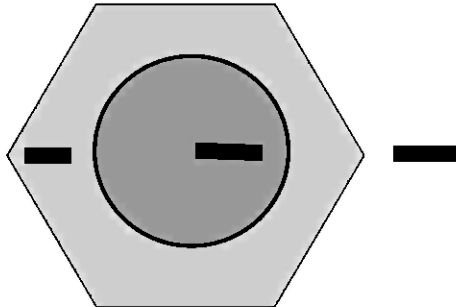
- Select at random 10% of the tensioned bolts (2 minimum) in each connection.
- Apply Inspection Torque. If none turn, the connection passes.
- If one or more fasteners turn, job torque the remaining fasteners in the connection.
- Re-tension and inspect all fasteners that turned for minimum Inspection Torque.



56

Field Inspection (continued)

- Nut turned to rotation in table 560-3
- $+ 60^\circ / - 0^\circ$
(SP00560, Table 3 Note 1)



57

High Strength Field Bolting All Applications

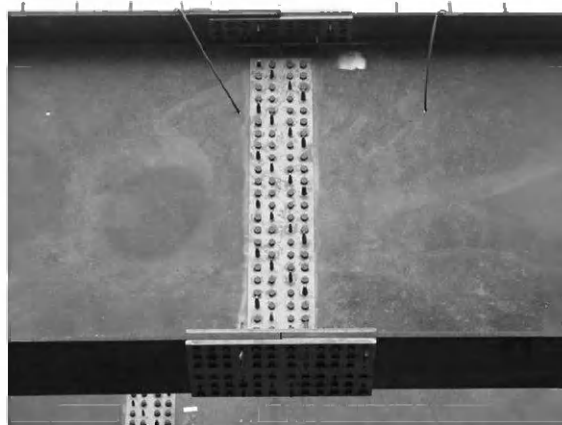
- Non-galvanized fasteners may be reused once.
- Galvanized fasteners may not be reused.
- Previously tightened fasteners, loosened by tightening of adjacent fasteners will not be considered a re-use.



58

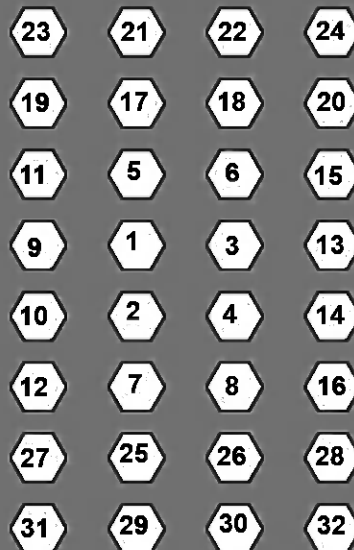
Bolt Installation (00560.46 (g))

- 25% Drift pins
- 25% Fit up bolts



59

Systematic Tightening



60

Bolts in water?



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61.

Nuts in water?



QA
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MATERIALS &
INSPECTION

62

Bolt Exercise

Bolt Diameter = 3/4"

Bolt Length = 5"

Measured Torque @ Req'd Fast. Tens. = 350 ft.-lbs.

Measured Tension @ 2x Rotation = 45,000 lbs.

Complete Ro-Cap Sample 1 on the Rotational Capacity Test Form for Long Bolts.



63

Table 560-3

Table 00560-3
Nut Rotation from Snug-Tight Condition ¹

Bolt Length (underside of head to end of bolt)	Both faces normal to bolt axis	Disposition of Outer Faces of Bolted Parts	
		One face normal to bolt axis and other sloped not more than 1:20 (beveled washer not used)	Both Faces sloped not more than 1:20 from normal to bolt axis (beveled washer not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/8 turn
Over 8 diameters but not exceeding 12 diameters ^{2, 3}	2/3 turn (1 1/6 turn)	5/8 turn (1 1/2 turn)	1 turn (1 5/6 turn)

¹ Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by one-half turn and less, the tolerance shall be plus or minus 30°; for bolts installed by two-thirds turn and more, the tolerance shall be plus or minus 45°.

² No research has been performed by the Research Council on Structural Connections to establish the turn-of-nut procedure for bolt lengths exceeding 12 diameters. Therefore, the required rotation shall be determined by actual test in a suitable tension measuring device according to 00560.29(d)(3).

³ Values in parentheses are twice the rotation as defined in 02560.60(a)(1) and 02560.60(a)(2) for zinc coated ASTM A325 bolts only.



64



HIGH STRENGTH BOLTS ROTATIONAL CAPACITY TEST & INSPECTION TORQUE (LONG BOLT METHOD)

☒ Turn of Nut Method ☐ Direct Tension Indicator ☐ Tension Control Fastener

Project		Contract No.	
Company		Test No. RCT-	
Torque Wrench Serial No.		Calibration Due Date	
Skidmore Serial No.		Calibration Due Date	
Bolt Diameter	3/4 inch ▼	Bolt Length	Quantity
Bolt Mfg.		Lot No.	Heat No.
Nut Mfg.		Lot No.	Heat No.
Washer Mfg.		Lot No.	Heat No.
Ro-Cap Sample 1: Required Fastener Tension = 28000 Lbs. (Table 00560-1) Snug Tight Tension = 3000 Lbs. (0.10 x Req. Fastener Tension): Tol. = -0 kips + 2 kips Measured Torque = _____ Ft.-Lbs. @ Required Fastener Tension (Go to Insp. Torque) Maximum Allowable Torque = 437 Ft.-Lbs. (ASTM F3125 Table A2.2 $\approx T < 0.25PD$) Measured Tension = _____ Lbs. @ _____ Turn (2x Rotation In Table 00560-3) Minimum Tension Required = 32000 Lbs. (ASTM F3125 Table A2.4 $\approx 1.15 \times RFT$) Sample 1 Results: ☐ Pass ☐ Fail			
Ro-Cap Sample 2: Required Fastener Tension = 28000 Lbs. (Table 00560-1) Snug Tight Tension = 3000 Lbs. (0.10 x Req. Fastener Tension): Tol. = -0 kips + 2 kips Measured Torque = _____ Ft.-Lbs. @ Required Fastener Tension (Go to Insp. Torque) Maximum Allowable Torque = 437 Ft.-Lbs. (ASTM F3125 Table A2.2 $\approx T < 0.25PD$) Measured Tension = _____ Lbs. @ _____ Turn (2x Rotation In Table 00560-3) Minimum Tension Required = 32000 Lbs. (ASTM F3125 Table A2.4 $\approx 1.15 \times RFT$) Sample 2 Results: ☐ Pass ☐ Fail			
Rotational Capacity Test Results: ☐ Accept ☐ Reject			
Inspection Torque Sample 1: Required Fastener Tension = 28000 Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque Sample 2: Required Fastener Tension = 28000 Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque Sample 3: Required Fastener Tension = 28000 Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque = _____ Ft.-Lbs. (Average of the 3 Inspection Torque Samples)			
Comments:			
Inspector		Cert No.	Title
Contractor's Representative		Date	

Other Types of Bolt Situations


65

Traffic Signal & Illumination Supports (00962)


66

TM629 General Note

Tighten anchor bolts and arm connection bolts according to 00962.46(j)(2).



67

Signal Base

- Use double nuts on anchor rods
- Snug tight top nut



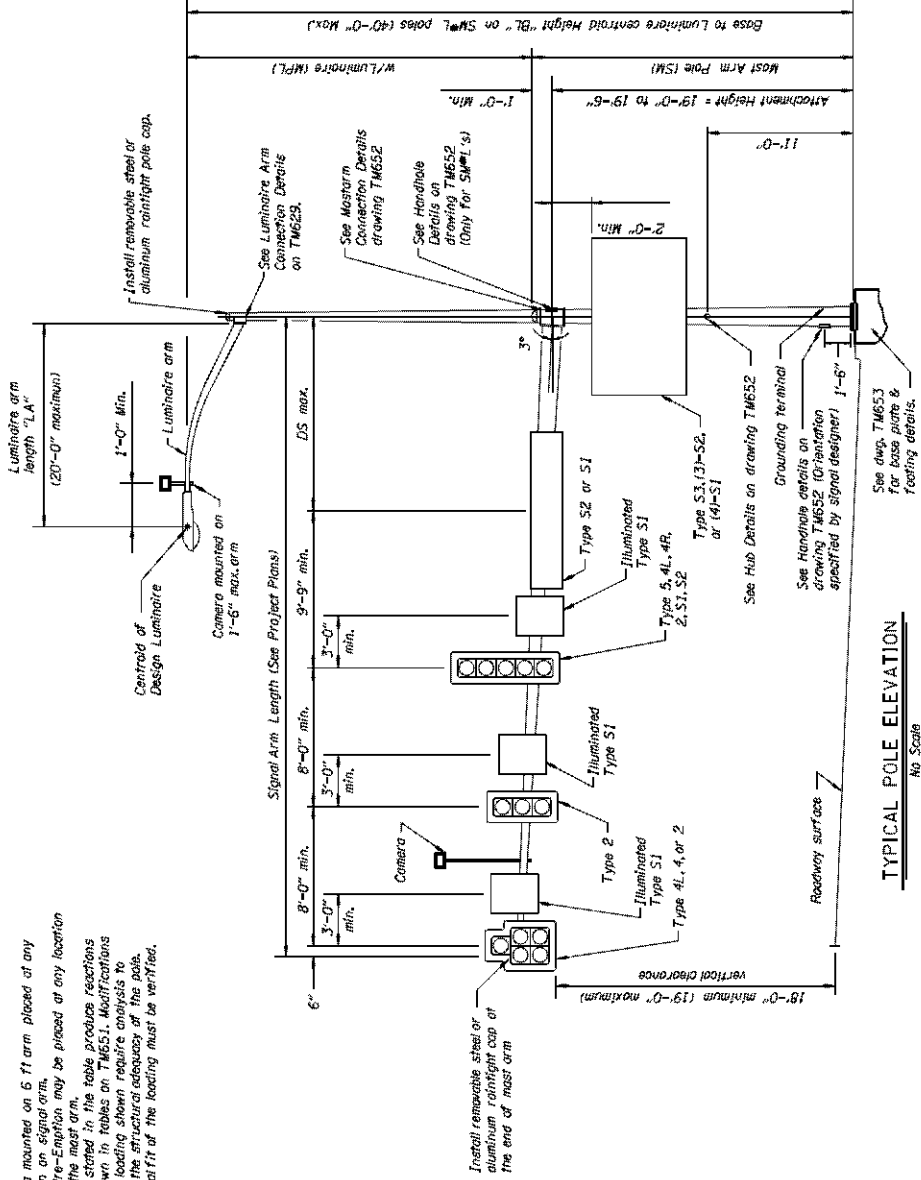
68

Signal Pole Type	STANDARD SIGNAL ARM LOADS					DS Max. for S2	
	Signal Arm Length	4L	2	S1	S2	Qty.	Qty.
SM1 or SM1L	15'	1	0	1	0	0	N/A
SM2 or SM2L	20'	1	1	1	0	0	N/A
SM3 or SM3L	30'	1	1	1	1	3	0
SM4 or SM4L	40'	1	1	1	1	4	1
SM5 or SM5L	50'	1	2	1	1	4	1
SM6	55'	1	2	1	1	4	1

• - Load location is the closest sign or signal of that type to the vertical post.

1. Camera mounted on 6 ft arm placed at any location.
2. Five ft arm may be placed at any location along the vertical post.
3. Loads shown in the table produce reactions as shown in tables on TM651. Modifications to the loading shown require analysis to verify the structural adequacy of the pole.
4. Physical fit of the loading must be verified.

SIGNAL ARMS DEFLECTION			
Signal Arm Length	Allowable Dead Load Deflection	Allowable Live Load Deflection	Total Allowable Deflection
15' or less	0.01" SA"	0.05" SA"	0.06" SA"
20'	0.01" SA"	0.05" SA"	0.06" SA"
25'	0.01" SA"	0.05" SA"	0.06" SA"
30'	0.01" SA"	0.05" SA"	0.06" SA"
35'	0.01" SA"	0.05" SA"	0.06" SA"
40'	0.01" SA"	0.05" SA"	0.06" SA"
45'	0.01" SA"	0.05" SA"	0.06" SA"
50'	0.01" SA"	0.05" SA"	0.06" SA"
55'	0.01" SA"	0.05" SA"	0.06" SA"

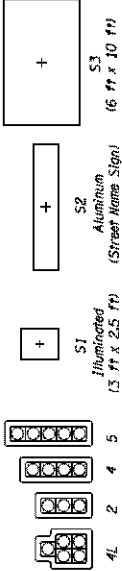


TYPICAL POLE ELEVATION

No Scale

Description	Maximum Height (Elev.)	VERTICAL POST LOADS				Area Front (sq.ft)	Area Side (sq.ft)	Area Bottom (sq.ft)	Weight (lbs)
		Height (Elev.)	Width (Elev.)	Depth (Elev.)	Area (sq.ft)				
2-Ped. Push Buttons	3'-5"	74"	5"	34"	0.27	0.18	0.12	3.0	3.0
Controller Cabinet	5'-9"	46"	24"	22"	2.67	2.03	3.67	300	300
2-Pedestrian Signals	8'-3 1/2"	19 1/2"	19"	2 1/2"	2.47	2.47	2.51	25.0	25.0
Terminal Cabinet	10'-9"	18 1/2"	6 1/2"	8 1/2"	0.85	1.05	0.39	25.0	25.0
Guide Sign (S3)	15'-0"	7 1/2"	12 1/2"	8 1/2"	0.00	1.00	1.67	300	300
Proactive Sign	35'-4"	2 1/4"	3 1/4"	3 1/4"	0.05	0.05	0.07	5.0	5.0

1. Physical fit of the loading must be verified.



SIGNAL POLE APPURTENANCE TYPES

APPURTENANCE LOADS			
Type	Area Front (sq.ft)	Area Side (sq.ft)	Weight (lbs)
4L	12.4	6.61	36.4
2	8.67	6.61	1.95
4	11.0	8.49	1.95
5	13.3	10.36	1.95
S1	7.50	2.38	1.72
S2	21.0	0.00	1.67

SCALE: AS SHOWN	5301	NOTES: 1. All material and workmanship shall be in accordance with the current Oregon Standard Specifications.	DATE: 07-JAN-2011	APPROVED BY: TM651, TM652, TM653, TM679	SHEET 1 of 4
The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without consulting a Registered Professional Engineer.			OREGON STANDARD DRAWINGS TRAFFIC SIGNAL SUPPORTS GENERAL DETAILS & DESIGN CRITERIA		
2015			REVISION DESCRIPTION		

Effective Date: December 1, 2015 - May 31, 2016

TM650

GENERAL NOTES:

Luminaire supports shall be designed in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals (1994).

The design wind velocity shall be 100 mph unless shown otherwise in the Special Provisions for the project.

All pole shafts may be round or hexagonal. Octagonal pole shafts may be used for fixed base poles only. Luminaire arm shafts shall be the same shape as the pole shaft except that octagonal arms may be used with hexagonal poles if the arm tip diameter does not exceed 3" and the maximum weight limitations are not exceeded.

Steel sheet piling and arms shall conform to ASTM A 595, Grades A or B, or approved equal. All other steel and plate shall conform to AASHTO Specification M223 (ASTM A572), or approved equal. Supplement S18 of ASTM A6 regarding maximum tensile strength shall apply.

Anchor rods for Slip Base Luminaire Supports shall be ASTM A49, Type 1.

Nuts for anchor rods and slip base bolts shall conform to ASTM Specification A563, Grade DH.

High strength bolts shall conform to ASTM Specification A325 (AASHTO M164).

All structural steel including fasteners shall be hot-dip galvanized after fabrication unless noted otherwise.

Galvanize Control Silicon, hot-dip. Silicon content of the base metal shall be in the range of 0.004% to 0.008% or 0.15 to 0.25%.

Feathered concrete shall be Commercial Grade Concrete, f'c = 3000 psi unless shown otherwise in the Special Provisions. Grad in pour beds shall be approximately high early strength 9" and 10" - 12" (except with a maximum strength of 5000 psi).

Reinforcing steel shall conform to AASHTO M31 (ASTM A615), Grade 60, A minimum top splice of 32 bar diameters shall be used unless shown otherwise.

For washers shall be hardened steel washers conforming to ASTM Specification F-436.

Longitudinal seam welds shall be complete penetration within 6" of a circumferential weld. 60 percent minimum penetration required for the remainder of the seam weld. Weld inspection shall comply with the special provisions.

The weight of the slip base pole and its attachments above the anchor plate shall be kept to a minimum and shall never exceed 1000 lbs.

Pole lengths shall be field verified before fabrication. Top of footing may be substantially above or below roadway surface. Design shall be adjusted as necessary for increase or decrease pole length.

The computed deflection of the poles at full design loading shall be limited to 5% of pole length for fixed base poles and 7% of pole length for slip base poles. The computed dead load deflection of the poles shall be limited to 1% of the pole length. Poles shall be rated to offset the computed dead load of deflection. Computed deflection (ignoring pole bending and/or rotation) of the luminaire arms shall not exceed that listed in the Luminaire Arm Design Data Table.

Hubs shall be 3000" threaded forged carbon steel flat weld hubs by Anvil Products Inc., Phoenix Forging Co., Bonney Forge & Tool Works or approved equal. Framing terminal shall be 1/2" UNC dia. x 1 1/2" Type 308, 309 or 310 threaded stainless steel weld studs.

See dwg. TM635 for guidelines in loading slip base poles.

Luminaire pole foundation shall meet minimum embankment requirements shown on TM653.

Assemble support on TM653.

According to 00362-46142.

Scale: 1/8" = 1'-0"

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DESIGN LUMINAIRE (PROPOSED)

Projected Area	Weight	Area for Ice
3.3 ft ²	60 lbs.	8.7 ft ²



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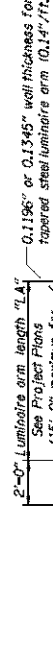
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POLE AND ARM SPICE



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POLE AND ARM SPICE

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TM651 Notes

21. Tighten 4 bolt arm connection bolts and tighten anchor rods in accordance with 962.46(j)(2).
22. Tighten 8 bolt arm connection bolts in accordance with 930.40(d).



69

Tightening Requirements (00962.46(j)(2)(a&d))

Snug Tight (All plies in firm contact and full effort on the end of 12" spud wrench.)

	Past Snug Tight
ASTM A 307 Anchor Rods	1/12 Turn
ASTM A 449 Anchor Rods	1/6 Turn
ASTM F 1554 Gr 55 Anchor Rd	1/6 Turn
ASTM A 325 Bolts	1/6 Turn



70

GENERAL NOTES:

1. Signal supports shall be designed in accordance with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals 4th edition, 2001, 2002 and 2003. Interim revisions.
2. All traffic signal supports shall conform to the design criteria and details shown on these drawings except as approved by the Engineer.
3. The design basic wind speed (3 second gust) shall be 110 mph, gust factor $G = 1.4$, $I_r = 1.0$ (50 yr recurrence interval), Fatigue Category II, no peeling and truck speed = 55 mph.
4. Signal poles from this standard are not allowed over highways I-5, I-84, I-205, I-405, US 26 (Sunset Hwy) between mile points 64.3 - 73.0, I-105, and I-82. Signal poles on these highways require a Fatigue Category I.
5. Pole and arm shafts may be either round, hexagonal, dodecagonal, or octagonal but shapes shall not be mixed on a project. Dimensional tolerances of ASTM A595 shall apply to all tapered steel tubing members. Additionally, the diameter of round tapered steel tubing members or the dimensions across the flats of octagonal tapered steel tubing members shall not vary more than 2% from specified dimension. Two pit and fluted poles or arms are not permitted.
6. Pole taper shall be equal to .0117 in./in.
7. Anchor rods shall conform to ASTM Specification F1554 Gr. 55, Supplementary Requirement "S2" then include grade and manufacturer's identification.
8. High strength bolts shall conform to ASTM Specification A325 Type 1.
9. Nuts for high strength bolts shall be heavy hex and conform to ASTM A563 Grade DH with supplementary requirements "S1" and "S2".
10. Hardened steel washers shall conform to ASTM F436 Type 1.
11. Direct tension indicators (DTI) shall be the compressible-washer type, mechanically galvanized conforming to ASTM F959.
12. Steel sheet for poles and arm shall conform ASTM A595, Grades A or B, ASTM A572 Gr. 50, or approved equal. All other steel sheet and plate shall conform to AASHTO specification M223 (ASTM A572), or approved equal. Supplement S18 of ASTM A6 regarding minimum tensile strength shall apply.
13. All structural steel including fasteners shall be hot-dip galvanized, unless otherwise noted.
14. Galvanneal-Silicon, Typical. Silicon content of the base metal shall be in the range of 0 to 0.04% or 0.15 to 0.25%.
15. Footing concrete shall be Commercial Grade Concrete (for 3000 psi per Specification Section 440. Grad in ground shall be non-shrink high early strength grout (non-ferruss) with a minimum strength of 5000 psi. Footing concrete may be used as an alternate to grout.
16. Reinforcing steel shall conform to AASHTO M31, Grade 60 (ASTM A615 or A706). A min. lap splice length of 32 bar diameters shall be used unless shown otherwise.
17. Computed deflection of these poles at full design loading shall be limited to 5% of the pole length. Computed dead load deflection of the poles shall be limited to 1% of the pole length. Pole shall be rated to offset the computed dead load deflection. Computed deflection (ignoring pole bending and/or rotation) of signal arms shall not exceed that listed in the Signal Arm Deflection Table on TM650. Additionally, the amplitude (maximum up to maximum down as measured at the tip of the arm) of wind induced vertical oscillations shall not exceed 15% of the signal arm length. Luminaires arms and pole extensions to support luminaires shall meet requirements of drawing TM629.
18. Hubs for cabinets and/or other appurtenances shall be welded into the pole prior to galvanizing. Poles may be tapped for up to 1" galvanized bolts after pole has been galvanized.
19. Longitudinal seam welds within 6" of a circumferential weld shall be complete penetration welds. Weld inspection shall be in accordance with AWS D1.1 and the special provisions. Inspect seam welds using cyclically loaded criteria. Hubs shall be 3000# threaded forged carbon steel flat weld hubs by Anvil Products Inc., Phoenix Forging Co., Bonney Forge & Tool Works or approved equal.
20. Grounding terminal shall be 1/2" UNC x 1 1/2" Type 308, 309 or 310 threaded stainless steel weld studs.
21. Tighten 4 bolt arm connection bolts and tighten anchor rods in accordance with 962.461 (K2).
22. Tighten 8 bolt arm connection bolts in accordance with 930.40(d).
23. Round and smooth all edges along electrical way.
24. The minimum arm flange thickness shall be equal to the value where prying action is not included in the bolt calculation.

Standard Maximum Base Reactions								
Signal Pole Type	Signal Arm Lengths	Wind Load Case II			Controlling Fatigue			
		Axial (kips)	Shear (kips)	Moment (kip-ft)	Shear (kips)	Torque (kip-ft)	Torque (kip-ft)	
SM1	15'	2.10	5.15	80.39	16.95	0.68	10.39	2.13
SM2	20', 25'	2.66	6.23	105.41	42.54	0.82	13.35	5.37
SM3	30', 35'	3.49	7.77	138.43	82.87	1.00	17.10	10.31
SM4	40', 45'	4.51	9.00	173.46	132.72	1.16	20.54	16.50
SM5	50', 55'	5.69	9.23	190.91	181.60	1.18	21.82	22.55
SM1L	15'	2.96	6.09	113.28	23.22	0.79	14.08	2.84
SM2L	20', 25'	3.69	7.23	139.41	48.81	0.94	17.17	6.08
SM3L	30', 35'	4.39	8.80	176.51	87.88	1.14	21.43	11.02
SM4L	40', 45'	5.94	10.14	215.11	136.97	1.31	25.27	17.21
SM5L	50', 55'	7.34	10.56	241.17	187.96	1.34	26.49	23.26

Standard Maximum Mast Arm Reactions						
Signal Pole Type	Signal Arm Lengths	Wind Load Case II			Controlling Fatigue	
		Axial (kips)	Shear (kips)	Moment (kip-ft)	Shear (kips)	Moment (kip-ft)
SM1, SM1L	15'	0.06	1.98	18.44	0.23	2.18
SM2, SM2L	20'-25'	0.10	3.14	46.20	0.37	5.48
SM3, SM3L	30'-35'	0.15	4.51	89.42	0.53	10.51
SM4, SM4L	40'-45'	0.23	5.91	146.67	0.67	16.82
SM5, SM5L	50'-55'	0.34	6.78	211.94	0.70	22.99

Luminaires Arm Reactions					
Arm Lengths	Wind Load Case II			Controlling Fatigue	
	Axial (kips)	Shear (kips)	Moment (kip-ft)	Shear (kips)	Moment (kip-ft)
6'	0.03	0.31	1.49	0.03	0.15
10'	0.06	0.38	2.85	0.04	0.29
15'	0.08	0.47	4.96	0.05	0.51
20'	0.05	0.55	7.24	0.06	0.74

SCALE: AS SHOWN	5301	REGISTERED REPORT DATE	07-JAN-2011	APPROVED BY ENGINEER	TM650, TM652, TM653	SHEET	2 OF 4
				NOTE: All material and workmanship shall be in accordance with the current Oregon Standard Specifications.			
				OREGON STANDARD DRAWINGS			
				TRAFFIC SIGNAL SUPPORTS			
				NOTES AND REACTIONS			
				2015			
				DATE	REVISION DESCRIPTION		

00930 & 00962

Direct Tension Indicator and Turn-of-Nut Tightening for Luminaires and Traffic Signal Supports

8 Bolt Mast Arm Connections

TM 650 – References Mast Arms and Luminaire Arms

TM 652 – 8 Bolt Arm Connection Details and Arm Connection Notes: See General Notes on TM651

TM 651 – Note 22: Tighten 8 Bolt Arm Connection bolts in accordance with 930.40(d)

*930.40(d)(2)(a) Direct Tension Indicator (DTI) Tightening

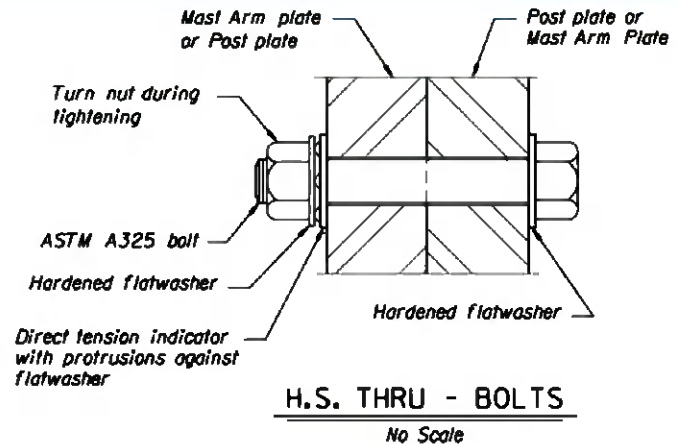
After attaining a snug-tight condition, tighten all fasteners in the connection by progressing systematically from the most rigid part of the connection to the free edges until all of the spaces between the direct tension indicator protrusions refuse entry to a 0.005-inch feeler.

*00930.49(e-2) – Bolt Inspection

Upon completion of bolted joint, inspect a minimum of 10 percent but not less than 2 bolts in each joint. (Check gaps with .005" feeler gauge.)

General

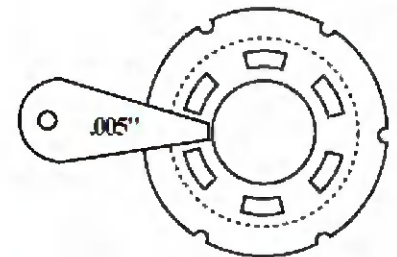
Direct Tension Indicator (DTI) Washers have protrusions that, when compressed, indicate adequate tensioning.



TM652 H.S. Through – Bolts Detail
(Detail 1 – Correct DTI Washer Orientation)

DTI – Key Inspection Points

- Ensure washer orientation is correct (protrusions facing hardened washer)
- Insert feeler gauge in each space between protrusions
- Insert the feeler gauge pointed towards the center of the bolt
- Inspect from the bucket truck (fall protection required)



Notches on the DTI mark the center of the protrusion spaces. A feeler gauge is included in the hardware shipment.

[Click here to see it on YouTube!](#)

**updated for projects bid on/after 12/1/2016*



Bolt Tightening with Cheater Bar
(May be difficult to achieve proper tensioning)



Bolt Tightening with Multiplier
(Best practice for achieving proper tensioning)

Continued on back

4 Bolt Luminaire Arm Connections & Anchor Rods (Turn-of-Nut)

TM 652 – 4 Bolt Arm Connection Details and Arm Connection
Notes: See General notes on TM 651

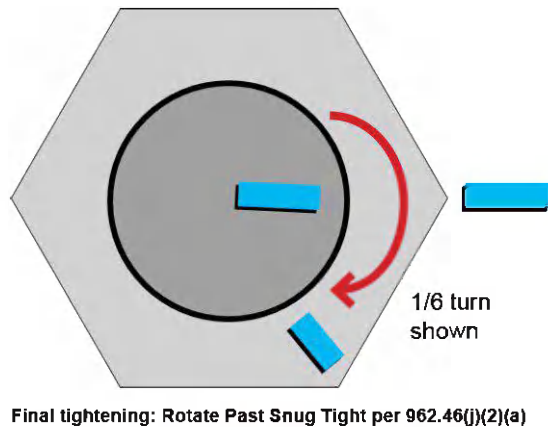
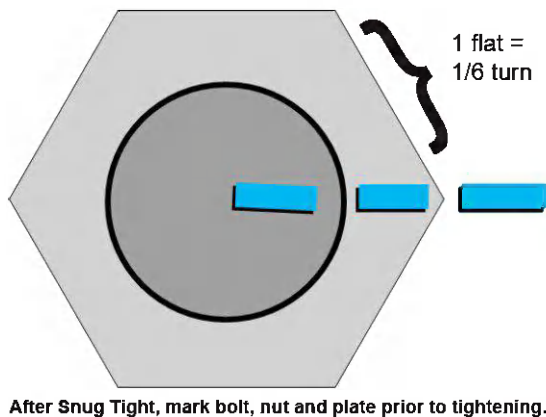
TM 650 – See details on TM 629

TM 629 – Tighten Anchor Bolts and Arm Connection bolts in accordance with 962.46(j)(2)

TM 651 – Note 21: Tighten 4 Bolt Arm Connection bolts and anchor rods in accordance with 962.46(j)(2)

962.46(j)(2)(a) Anchor Rods for Signal Supports
Rotate each top nut past snug as shown in (d).

962.46(j)(2)(c) High-Strength Bolts in Luminaire Arm-to-Pole
Install high-strength 4-bolt connections....Rotate each top nut past snug tight as indicated in (d).



Technical Contacts

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Assistant Structure Services Engineer
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962.46(j)(2)(d) – Final Tightening

Connection Type	Rotation Past Snug Tight
ASTM A307 Anchor Rods	30° (1/12 turn)
ASTM A449 Anchor Rods	60° (1/6 turn)
ASTM F1554 GR. 55 Anchor Rods	60° (1/6 turn)
ASTM A325 4 Bolt Connection	60° (1/6 turn)

00962.46(j)(2) – “Snug Tight” is the tighness that exists when all plies of the joint are in firm contact, and can be obtained by the full effort of a worker on the end of a 12-inch long wrench.

Turn-of-Nut Key Inspection Points

- Luminaire connections must be observed/inspected at ground level, prior to erecting pole
- Inspect leveling nuts and washers to ensure full contact with base plate prior to installation of top nut
- Be on-site for inspection



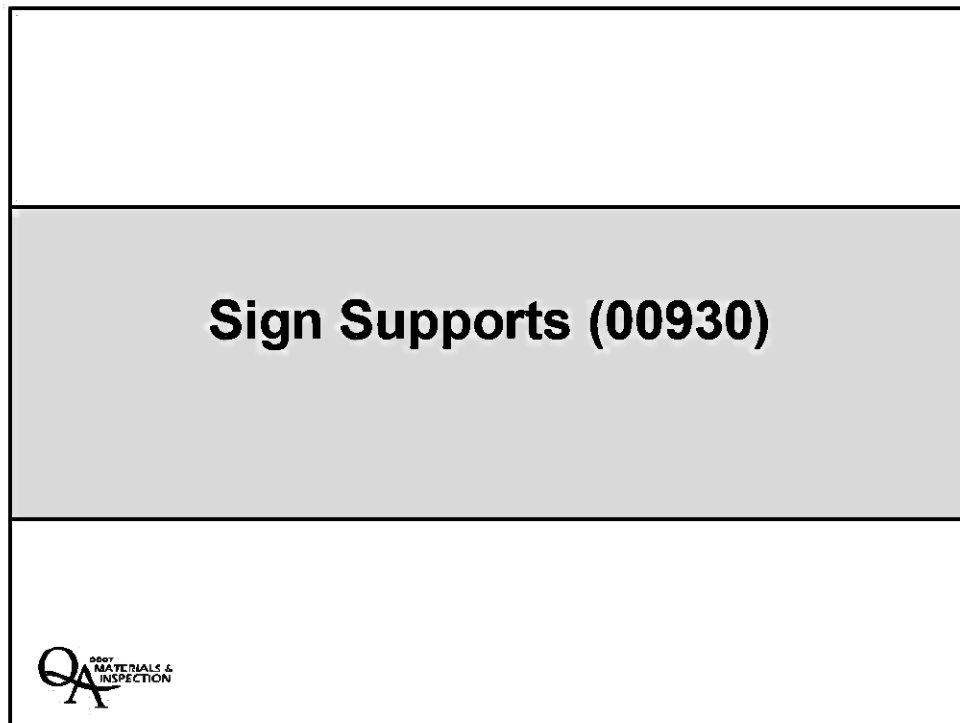
Tightened Bolts
Photo shown for illustration of bolt markings only.
Signal anchor bolts require two nuts per bolt.

Sampling of High Strength Bolts, Nuts, and Washers (NTMAG Section 00930 & 00962.10)

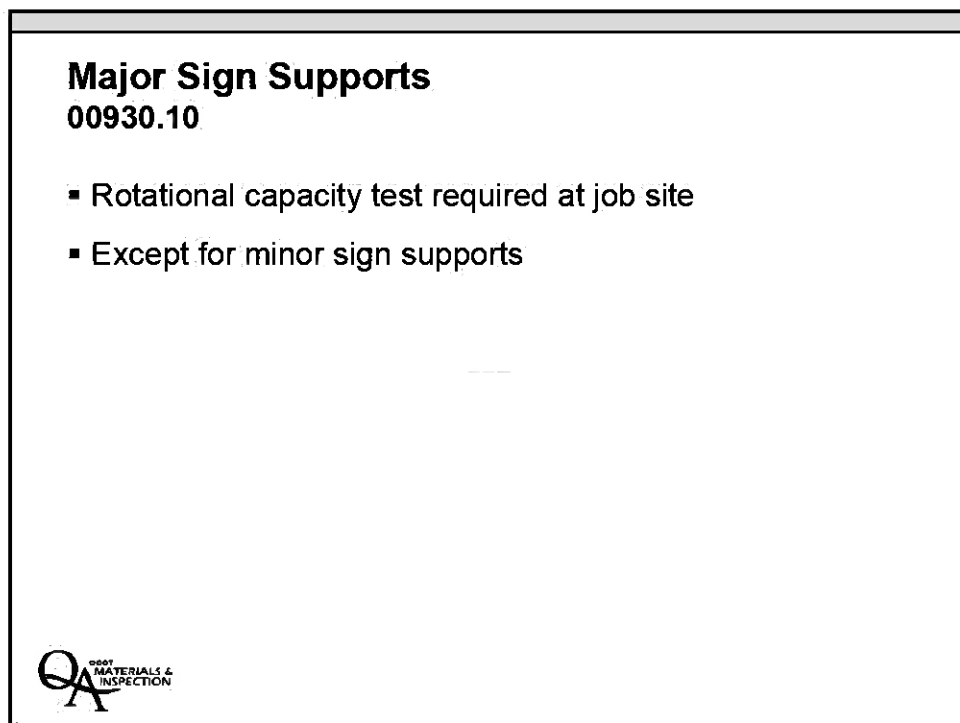
Check to see if ODOT Materials Lab (971-673-7002) has sampled and tested the bolts, nuts, and washers to be used. If not previously tested, sample in the field for each lot to be used on the Project. Submit samples to the ODOT materials laboratory for testing. Do not use high strength bolts, nuts, and washers without passing laboratory report and proper quality documents.

Spec Notes are prepared for inspectors by the Construction Quality Assurance Unit to provide background information around design elements and specifications. For additional Spec Notes, visit us at <http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/Pages/QAIndex.aspx>.

If you have an idea for a Spec Notes topic, please e-mail us at ODOTConstructionTraining@odot.state.or.us or contact us at 503.986.5453.



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GENERAL NOTES:

Standard Monotube Cantilever Sign Support Structures are designed in accordance with AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals 1st edition, 2015 and interim revisions thru 2017.

Basic wind speed (3 second gust) used for Extreme I Limit State is 145 mph. $G = 1.14$, 1700 year recurrence interval, fatigue importance factor $I_f = 1.0$ and Exposure C were used for design.

The maximum design sign area for the Standard Monotube Cantilever Sign Support Structure is shown on Dwg. TM621. The design sign panel and mounting members weigh 5 pounds per square foot. The design luminaire including mounting channels weighs 20 pounds per linear foot. The design luminaire wind loading area including mounting channels is 1 square foot per linear foot, has rectangular flat side shapes, is as long as the design sign, and the resulting projected area is not part of the maximum sign area. The sign lengths for structure design 1 is 25 feet, for structure designs 2 and 3 are 22 feet, for structural designs 4 through 6 are 17 feet, and for structural designs 7 through 8 are 9 feet.

The allowable variation from field verified working drawing camber is -0% to +25%, post length is -0" to +3", and overall length "LA" is -1/8" to +1/8". The maximum offset of the arm 3/4" square bar from straight shall be +1/8" to -1/8" on each member. These lengths shall be measured prior to galvanizing using a steel tape or other approved measuring method.

The VMS design loads include 100 pounds per linear foot applied from center of vertical post to end of arm for the weight of a walkway along with a 500 pound concentrated live load. The design walkway wind loading area is 1.0 square feet per linear foot, extends from center of vertical post to end of arm, and the resulting projected area is not part of the maximum sign area. VMS dimensions and design loads are shown on TM621.

Snow and ice loads are not included in the design loads. The Engineer shall evaluate the design in regions of heavy snow or ice accumulations.

The signs are to be positioned horizontally as shown on Project Data for Std. Monotube Cantilever Sign Support Sheet and vertically as shown on Dwg. TM621.

Material for circular tube sections shall be ASTM A53 Grade B; ASTM A500 Grade B or C; ASTM A501 Grade A or B; or API 5L PSL2 Grade B, X42, X42M, X52, and X52M. All other structural steel shall conform to ASTM A572 Grade 50, or A992, unless noted otherwise.

Bend tube using induction heating methods in accordance with TPA-IBS-98, "Recommended Standards for Induction Bending of Pipe and Tube."

Notch toughness of all structural steel members and plates greater than 1/2" thick shall conform to Zone 2 fracture critical requirements of ASTM A709.

High strength bolts shall conform to ASTM A325, Type 1. Nuts for high strength bolts shall be heavy hex and conform to ASTM A563 Grade DH, with supplementary requirements "S1" and "S2". Hardened steel washers shall conform to ASTM F436, Type 1. Use washers under turning element in tightening unless otherwise specified.

Bolts connecting galvanized steel members to aluminum members shall meet the requirements of ASTM A193 Class 2 Grade 88M. Nuts used with A193 bolts shall be heavy hex and shall meet the requirements of ASTM A194 Grade 8M with supplementary requirement "S1". Use a stainless steel flat washer and double nut at each bolt.

Final elevations shall be field verified prior to fabrication of the post members and footing reinforcement.

All fasteners, except mechanically galvanized direct tension indicator (DTI) washers, shall be hot-dip galvanized (except stainless steel and non-ferrous fasteners). All structural steel shall be hot-dip galvanized after fabrication, unless noted otherwise.

The silicon content of the base metal shall be in the ranges of 0.0% to 0.06% or 0.13% to 0.25% for all hot-dip galvanized steel, unless noted otherwise.

All H.S. bolts shall be considered slip critical and tightened according to Section 00930.40(d)(2)a, unless noted otherwise. Design slip resistance for bolts shall conform to the Bolt Specifications for Class C slip coefficient = 0.33.

This Standard Monotube Cantilever Sign Support has been designed for the stated loading only. No additional signs or additional loadings are permitted. Other uses and loadings shall be considered non-standard, and are outside the scope of this design.

Splices in posts or arms and welds connecting posts or arms to base connection plates shall be full penetration welds as shown on Dwg. TM623.

Fabrication drawings shall show the weight of all parts.

Verify that top of pedestal is level and at correct elevation, prior to post installation.

Install sign mounts and sign on fully erected structure. Do not install sign until after support structure erection and bolt tightening is 100% complete.

A preconstruction meeting is recommended to make sure the contractor understands ODOT requirements and that ODOT understands the contractor's plan.

Use self locking nuts on non-high strength (H.S.) bolts, unless otherwise shown or specified.

See Dwg. TM623 for typical high strength bolt connection.

If a 20 minute rolling traffic stop is used to install the overhead sign support arm, the rolling stop shall meet the following requirements:

- a) Verify (prior to arm lift) adequate crane capacity and boom length to perform complete installation from side of road.
- b) Set crane on side of road and do not re-set crane during lift.
- c) Verify (prior to lift) that lifting equipment and lifting points meet requirements of plans.
- d) Verify (prior to lift) that base plate is level and at the correct elevation.
- e) Rig lift before beginning rolling stop.
- f) Make sure all required tools and hardware are on site.
- g) Do not resume traffic until all arm to post connection bolts are at least snug tight.
- h) Support arm with crane until arm connection bolt tightening is 100% complete.
- i) Another rolling stop will be required to install the sign onto the arm.
- j) Rolling stops shall be at night and shall conform to the Special Provisions.
- k) Follow all required safety procedures.

FOUNDATION NOTES:

Foundation type shall be as shown on Project Plans. Spread footing details are shown on Dwg. TM627 and drilled shaft details are shown on Dwg. TM628.

Provide shoring for the footing if required. Installation of temporary guardrail or barrier should precede any other work involving the construction of the footing.

Top surface of concrete pedestal (including area under base plate and around anchor bolts) shall be floated and troweled to a flat and level surface. This surface shall not vary more than 1/8" from a horizontal plane. Provide a 3/4" chamfer on all exposed edges of the pedestal.

Concrete for spread footings shall be Class 3600 - 3/4" Commercial Grade Concrete classified as a structural item. Concrete for drilled shafts shall be as noted on Dwg. TM628.

Place bars 2" clear of the nearest face of concrete, unless shown otherwise.

Concrete shall be placed using a tremie when free fall exceeds 4'-0". Cold joints shall be cause for rejection of the foundation, except between footing and pedestal and top of drilled shaft.

All reinforcing steel shall conform to ASTM A706 or A615 Gr. 60, unless shown otherwise.

Anchor rods shall conform to ASTM F1554, Gr. 55, with supplementary requirements "S2" that includes grade and manufacturer's identification and "S4". Anchor rod washers shall conform to ASTM F436. Anchor rod nuts shall conform to ASTM A563 Grade DH with supplementary requirements "S1" and "S2".

Anchor rod template, temporary support members, and anchor plate shall conform to ASTM A36.

Anchor rods shall be hot-dip galvanized full length.

Provide 1 - 2" dia. rigid electrical conduit as shown on Dwgs. TM627 & TM628 and as directed. Extend sign support end of conduit to the center of the lower hand hole. If luminaires are not required, extend the other end of the conduit into the nearest illumination circuit junction box and identify conduit by attaching a tag which says "future sign lighting". Install "pull string" in conduit for future use. Install conduit cap on each end. When luminaires are required, extend the sign support end of conduit per Project Plans.

The elevation and location of anchor rods are critical. Use survey techniques to verify the elevation, location, and orientation of anchor bolt groups prior to placement of foundation concrete.

Where the footing of a Cantilever Monotube Sign Support interferes with guard rail posts, the depth of footing may be increased to the maximum shown on Dwg. TM627, or concrete barrier may be used instead of guard rail, or guard rail posts may be attached to footing in accordance with Dwg. BR266. All buried steel shall be coated for immersion exposure with an approved product from the qualified products for structural coatings (<http://www.odot.state.or.us/isconstruction/>). Prepare and coat surfaces according to Section 00594 of Oregon Std. Specifications for Construction.

CONSTRUCTION PROCEDURE AND SEQUENCE:

1. Construct foundation according to plans. Verify elevation, location and orientation of anchor bolts. Steel template, shown on Dwg. TM626, shall be used to accurately locate and hold the anchor rods plumb and in proper alignment. This template shall be in place during concrete placement and shall remain in place for a minimum of 24 hours after the concrete placement has been completed. Out of position anchor rods and anchor rods greater than 1:40 out of plumb are cause for rejection of the foundation. Bending of anchor rods to straighten or move them into position, or alterations of the base plate shall not be permitted and are cause for rejection of the foundation and/or post weldment.

2. Pedestal pour may begin after spread footing concrete has satisfied Section 00540.52. The post erection may begin after concrete has satisfied Section 00540.52.

3. Install bearing nuts on anchor rods. Level the bearing nuts. Install hardened flat washers above bearing nuts.

4. Use crane to lift post onto anchor rods. Maintain crane connection as a safety measure until post installation is complete. No grout shall be used under the base plate. Install hardened flat washers above base plate.

5. Generously apply an approved lubricant for galvanized fasteners from the QPL to the top nut bearing surface and internal threads, and install nut on anchor rods to snug tight condition. Snug tight is defined as the condition when all plies are in firm contact and can usually be obtained by the full effort of a worker on a 12 inch long wrench or a few impacts of an impact wrench. Several passes may be required to obtain uniform tightness.

6. Tighten bearing nuts upward against base plate in a similar manner, to assure a uniform snug tight condition.

7. Mark position of each anchor rod and top nut with a felt tip pen so subsequent nut rotation can be verified. Rotate all top nuts an additional 1/6 turn in two passes (1/12 turn per pass).

8. Lift the arm into position using a crane. Lubricate arm connection bolts with an approved lubricant for galvanized fasteners from the QPL. Maintain crane support during tightening.

9. Evenly tighten arm connection bolts to a snug tight condition, and then fully tension arm connection bolts according to Section 00930.40(d)(2)a.

LUMINAIRE NOTES:

Hubs, handholes, grounding terminals, hook and foundation conduit shall always be installed for possible future use. Luminaires, luminaire support arms and luminaire support channels noted on Dwgs. TM624 & TM625 should only be provided when luminaires are required (See Project Plans).

Conduit diameters shown on plans are nominal or trade sizes.

WALKWAY NOTES:

Grating shall be welded steel grating with 1 1/2" x 1/8" bearing bars spaced at 1 3/16" centers and 1/4" x 1/4" nominal square cross bars (or equivalent) spaced at 4" centers. Steel plates and bars including grating elements shall conform to ASTM A36 or approved equal.

Rail members and post brackets shall be structural steel tubing conforming to ASTM Specification A500, Grade A or B.

Grating may be spliced at an interior support by welding 1/8" x 1 1/2" bars to ends of bearing bars across full width of grating and bolting bars together with 1/4" dia. bolts at 12 inch maximum centers.

Top of walkway grating shall not be more than 6 inches below the threshold into the VMS cabinet.

Walkway contractor to verify prior to fabrication that walkway, grating and rails do not interfere with VMS door or VMS housing. No gaps greater than 1 inch between walkway rails, grating and toe board, and VMS housing are allowed. Walkways shall be installed on the structure by the manufacturer to verify physical fit and approved before galvanizing.

All bolts, including U-bolts, shall conform to ASTM Specification A307, unless otherwise noted.

Accompanied by dwgs. TM621, TM623, TM624, TM625, TM626, TM627, TM628, TM690, TM691	CALC. BOOK NO. 6921-6930, 6974	SDR DATE 10-JUL-2020
NOTE: All material and workmanship shall be in accordance with the current Oregon Standard Specifications		
OREGON STANDARD DRAWINGS		
STD. MONOTUBE SIGN/VMS CANTILEVER NOTES		
The selection and use of this Standard Drawing, while de-signed in accordance with generally accepted engineer-ing principles and practices, is the sole responsibility of the user and should not be used without consulting a Registered Professional En-gineer.		2021
DATE 07/20	REVISION	DESCRIPTION
	07/20	Added 3/4" bar tolerance, walkway fit-up, X42M, and X52M.

TM622 General Notes

All High Strength Bolts shall be considered slip critical and tightened according to 00930.40(d)(2)a unless otherwise noted.



73

Slip Critical Connections

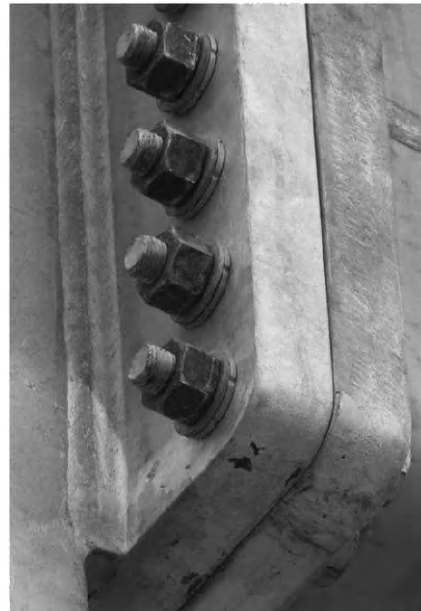
00930.40(d)(2)(a)

- Install new DTIs
- Snug Tight all
- Tighten to full refusal of .005 feeler gauge (SP00930.42(d)(2)(a))



74

Cantilever Sign



75

TM622 Construction Procedure (Notes 3 - 7)

For Anchor Rods:

- Level bearing nuts
- Lubricate top nuts
- Snug tight top nuts (full effort on 12" wrench)
- Snug tight bottom nuts
- Tighten all top nuts an additional 1/6 turn in two passes (1/12 turn per pass)



76

Cantilevered Sign Base



77

Racked Sign Anchor Rods?

1:40 max.
out of plumb
(TM622, Note1)



78

Resin Bonded Anchor Systems 00535



79

Drilling Holes 00535.40

- Drill bit 1/8" larger than anchor or as recommended by the manufacturer and 5/64" larger than rebar.
- When hole is more than 6" from a concrete edge use a 9 lb. air hammer or a carbide bit rotary hammer with 2 cutting edges
- When hole is 6" or less use a diamond bit core drill or a carbide bit rotary hammer with 4 cutting edges on the diameter.



80

Cleaning Holes

00560.40

- Clean holes with non-metallic brush, compressed air and water.
- Remove excess water from hole.



81

Resin Bonded Anchor System

Test Requirements

00535.45

- 3 demonstration anchors tested to Table 535-1 minimum pullout forces.
- Production test to 50% of Table 535-1 Values.
- Perform tests as indicated on the Test Summary and in the MFTP.



82

Table 00535-1

TABLE 00535-1

Minimum Pullout Force							
Anchor Bolts					Rebar		
	Grade 36	Grade 55	Grade 105		Grade 60		
Dia. (inch)	Force (Pounds)			Embed. Depth (inch)	Size	Force (Pounds)	Embed. Depth (inch)
1/2	7,400	9,700	15,300	4.50	3	7,900	3.25
5/8	11,700	16,900	24,300	6.00	4	14,400	5.25
3/4	17,300	22,500	36,000	7.50	5	22,300	6.50
7/8	24,000	31,200	49,900	9.25	6	31,700	7.50
1	31,700	40,900	65,400	11.00	7	43,800	8.75
					8	56,700	10.25



83

Anchor Rod Markings ASTM F1554

18. Product Marking

18.1 Unless otherwise specified, the end of each anchor bolt intended to project from the concrete shall be color coded to identify the grade as follows:

Grade	Color
36	Blue
55	Yellow
55- Weldable ^A	Yellow (projecting end) & White (encased end)
105	Red

^ASee S1.



84

**Resin Bonded Anchor System
Tightening Requirements
00535.40**

Tighten to ¼ turn past snug tight



INSERT TAB

Unit 12
Welding

Section 12

Welding

Field Welding	1
Welding Processes	5
Stud Welding	8
Welding Positions	17

Field Welding

Section 12



1

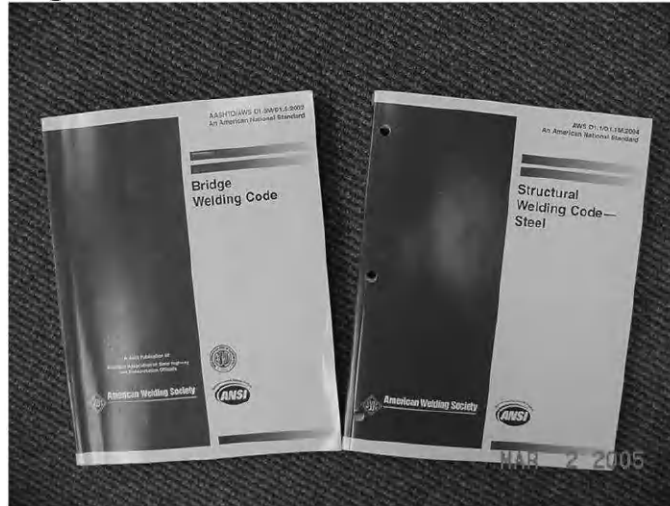
Field Welding

- Bridge Structures – AWS D1.5 (00560.26(a))
- Reinforcement – AWS D1.4 (00530.42(d))
- Non-Bridge Structures – AWS D1.1 (00560.26(b))
 - Sign supports
 - Luminaire poles
 - Expansion joints
 - Bridge rail
 - Seismic retrofit



2

Welding Codes



3

Special Provisions

Check Special Provisions for project specific requirements.



4

Documentation

- WPS – Welding Procedure Specifications
- PQR – Procedure Qualification Records
- WQTR – Welder Qualification Test Records
- MTR – Mill Test Reports – –



5

Welding Procedure Specifications (WPS)

- “Recipe” welders follow.
- Includes following variables:
 - Base metal material, process, position, volts, amps, travel speed, preheat, interpass temperature, joint configuration, shielding gas, etc.
- Also lists allowable ranges for those variables. These values are taken from the PQR.



6

Procedure Qualification Records (PQR)

- Contains all weld parameters for the weld procedure qualification:
 - Base metal material, process, position, volts, amps, travel speed, preheat, interpass temperature, joint configuration, shielding gas, etc.
- This document serves as written confirmation of the WPS.



7

Welder Qualification Test Records (WQTR)

Welder Test Record results qualifying the individual for specific weld processes, materials, joint configurations, positions, etc.



8

Mill Test Reports (MTR)

Test indicating material composition, strength, physical properties, etc. for material being welded.



9

Welding Certification Card

City of Portland # N/A	WELDERS CERTIFICATION PSI	Expiration Date: N/A
PORTLAND - EUGENE - SALEM - MEDFORD OREGON		
NAME: _____		
SOCIAL SECURITY NO. _____		
SPECIFICATION CODE	AWS D1.5-02	
DATE TESTED	12/20/05	PROCESS SMAW
MATL. TYPE	ASTM A36	FILLER METAL E7018
POSITIONS QUALIFIED	ALL	
THICKNESS QUALIFIED	1/8" UNLIMITED RPT. NO689-56238-5A	
EXAMINER	[Signature]	



10

Welding Processes



11

SMAW

**Shielded
Metal Arc
Welding
(Stick
welding)**



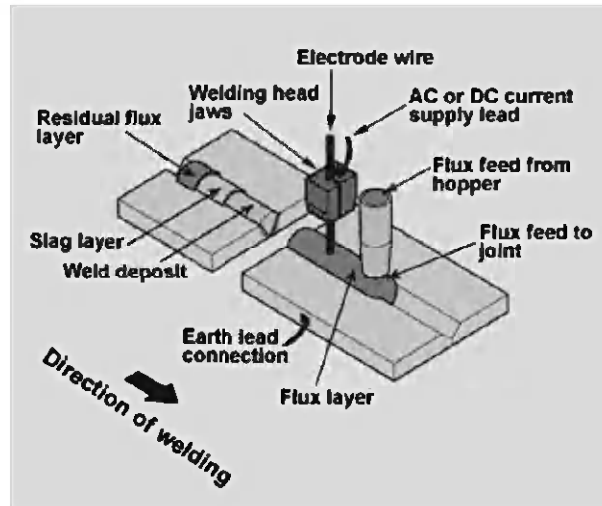
An arc is generated between the electrode and the weld pool. The electrode flux coating decomposition provides the shielding gas.



12

SAW

Submerged Arc Welding



A process that generates an arc between a bare metal electrode and weld pool. The arc and molten metal are shielded by granular flux.



13

GMAW



Gas Metal Arc Welding (MIG)

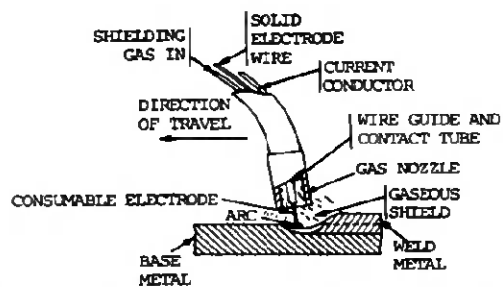


Figure 10-44. Gas metal arc welding process.

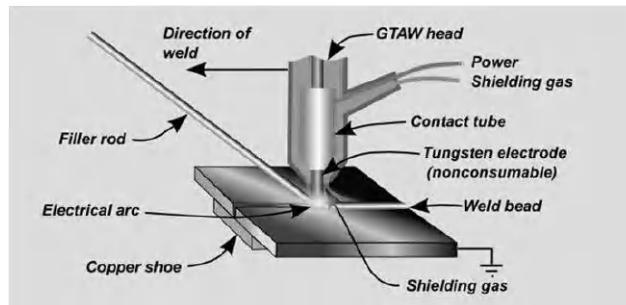
A semi or full automatic process with a continuous, consumable wire electrode and shielding gas fed through a welding gun.



14

GTAW

Gas Tungsten Arc Welding (TIG)



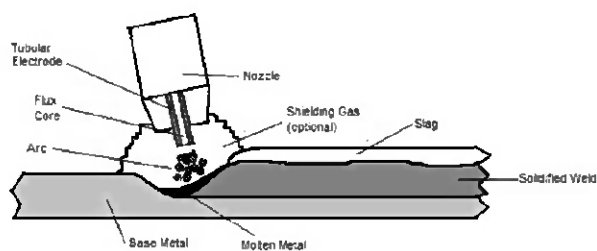
Creates an arc between a tungsten electrode and the weld pool. Shielding is from an external gas source.



15

FCAW

Flux Cord Arc Welding



Continuous, consumable tubular electrode containing the flux. Constant voltage or current power supply.



16

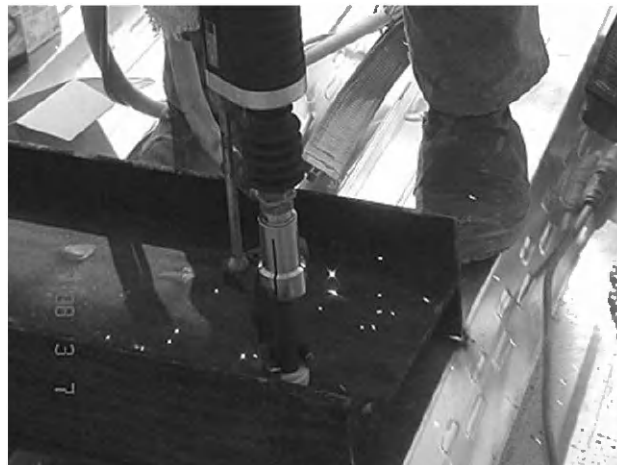
Stud Welding



17

Stud Welding

Stud Welding



Automatically timed equipment with a ferrule base.



18

Tests

- Stud Welding Application Qualification Test
- Pre-production Test
- Production Bend Test



19

Stud Welding Application Qualification Test (AWS D1.5 Sec 9.6)



20

Stud Welding Application Qualification Test (AWS D1.5 Sec 9.6.6.1)

- 10 stud specimens to qualify welding process.
- 90° bend test on all 10 studs.
- If any of the 10 specimens fail in the weld, the test must be repeated.
- Contractor, applicator, stud manufacturer or testing agency may perform the test.
- Once qualified, considered qualified until changes made.



21

Pre-production Test



22

Pre-production Test
AWS D1.5 Sec 9.7.1.4

- 2 stud test specimens required.
- 30° bend (one way) prior to beginning production welding each day or shift change or when any modification to the welding setup occurs.
- Qualifies operator also.



23

Production Bend Test
AWS D1.5 Sec 9.8.1 & 9.8.2

- Bend 15 degrees (one way) any specimen that weld does not go completely around the stud.
- Bend to be the opposite direction from portion of missing weld



24

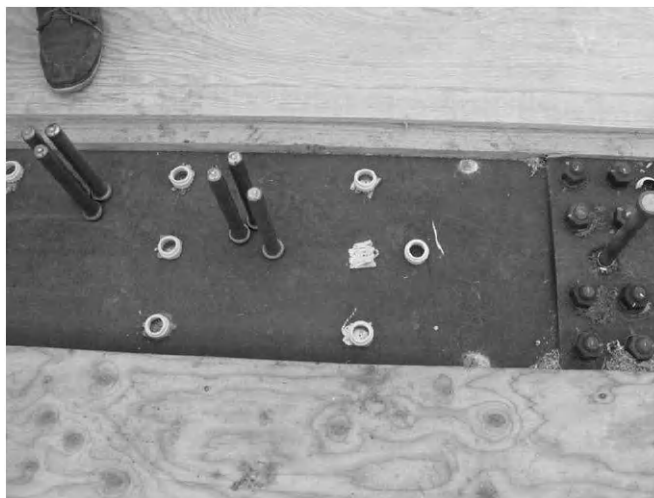
Stud Welding

- Stud welding has typically been done in the fabrication shops but now is done in the field on steel girders.
- Keep Studs free of rust, oil, moisture (Sec 9.4.1)
- Keep Ferrules dry. If wet, oven dry at 250°F for 2 hours (Sec 9.4.4)
- Repair failed stud locations per Sec 9.7.5



25

Prep Surface



26

Install in Dry



27

Remove Ferrules & Check Welds



28

Check Welds



29

Check Weld

15° bend test
if not
complete



30

Stud Failure



Wet conditions
Painted surface
Inadequate preheating



31

Stud Failure

- Failure left pits & ridges
- Repair pits
- Grind smooth



32

Stud Failure on A1010 Steel Girder

Divots left up
to 3/8" deep



33

Repaired Shear Stud Area AWS D1.5 Sec 9.7.5



34

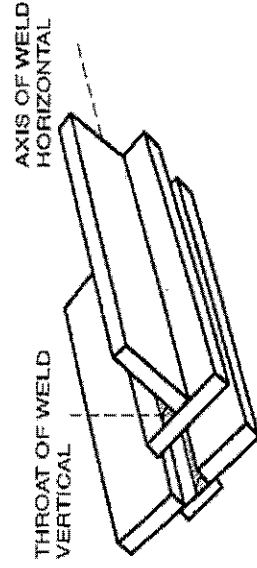
Welding Positions
 ODOT MATERIALS & INSPECTION

35

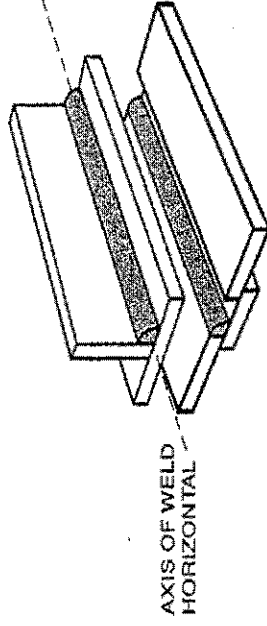
Fillet Weld Positions - AWS D1.5 & D1.1

CLAUSE 4. QUALIFICATION

AWS D1.1/D1.1M:2008

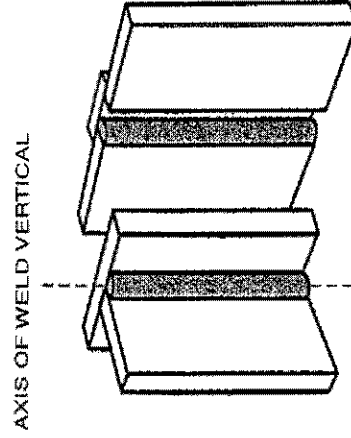


(A) FLAT WELDING TEST POSITION 1F

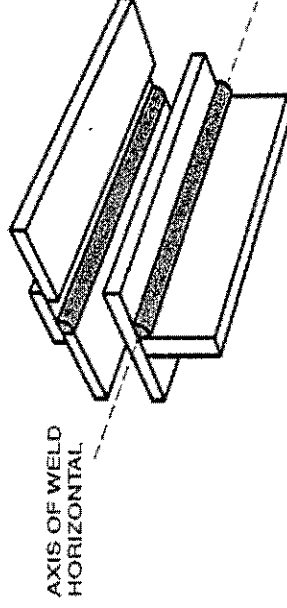


Note: One plate must be horizontal.

(B) HORIZONTAL WELDING TEST POSITION 2F



(C) VERTICAL WELDING TEST POSITION 3F



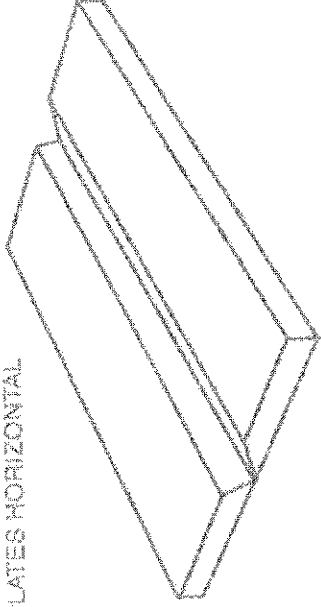
Note: One plate must be horizontal.

(D) OVERHEAD WELDING TEST POSITION 4F

Figure 4.5—Positions of Test Plate for Fillet Welds (see 4.2.4)

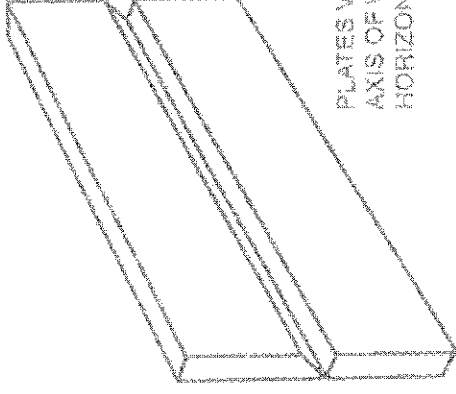
Groove Weld Positions - AWS D1.5 & D1.1

PLATES HORIZONTAL



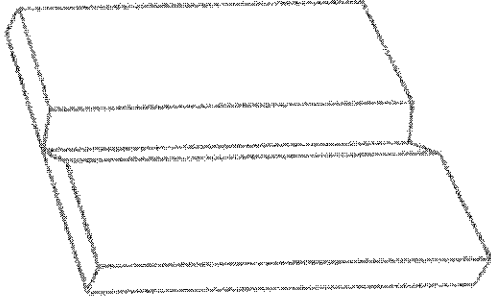
(A) FLAT WELDING TEST POSITION 1G

PLATES VERTICAL;
AXIS OF WELD
HORIZONTAL



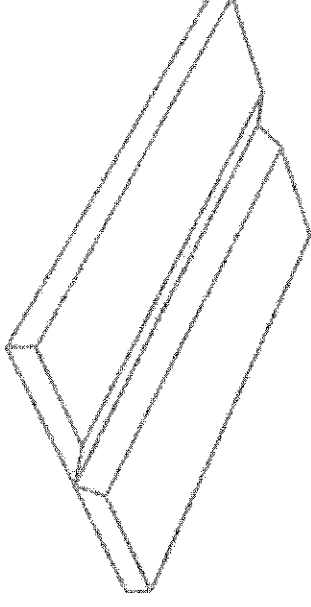
(B) HORIZONTAL WELDING TEST POSITION 2G

PLATES VERTICAL;
AXIS OF WELD
VERTICAL



(C) VERTICAL WELDING TEST POSITION 3G

PLATES HORIZONTAL



(D) OVERHEAD WELDING TEST POSITION 4G

Table 4.10

Welder and Welding Operator Qualification—Production Welding Positions Qualified by Plate, Pipe, and Box Tube Tests (see 4.18.1)^j

Qualification Test		Production Plate Welding Qualified			Production Pipe Welding Qualified			Production Box Tube Welding Qualified			
Weld Type	Positions ^a	Groove CJP	Groove PJP	Fillet	Butt Joint		Fillet	Butt Joint		T-, Y-, K-Connections	
					CJP	PJP		CJP	PJP	CJP	PJP
P L A T E	Groove ^b	1G	F	(F, H) ^h	F ^c	F ^c	(F, H) ^h	F ^d	F	F ^e	(F, H) ^h
		2G	F, H	(F, H) ^h	(F, H) ^c	(F, H) ^c	(F, H) ^h	(F, H) ^d	F, H	(F, H) ^e	(F, H) ^h
		3G	F, H, V	(F, H, V) ^h	(F, H, V) ^c	(F, H, V) ^c	(F, H, V) ^h	(F, H, V) ^d	F, H, V	(F, H, V) ^e	(F, H, V) ^h
		4G	F, OH	(F, H, OH) ^h	(F, OH) ^c	(F, OH) ^c	(F, H, OH) ^h	(F, OH) ^d	F, OH	(F, OH) ^e	(F, H, OH) ^h
		3G + 4G	All	All ^h	All ^c	All ^c	All ^h	All ^d	All	All ^e	All ^h
T U B E	Fillet	1F		F ^h			F ^h				F ^h
		2F		(F, H) ^h			(F, H) ^h				(F, H) ^h
		3F		(F, H, V)			(F, H, V) ^h				(F, H, V) ^h
		4F		(F, H, OH) ^h			(F, H, OH) ^h				(F, H, OH) ^h
T U B E	Plug	3F + 4F		All ^h			All ^h				All ^h
		1G Rotated ⁱ	F	(F, H) ^h	F ^d	F ^d	(F, H) ^h	F	F	F ^e	(F, H) ^h
		2G ⁱ	F, H	(F, H) ^h	(F, H) ^d	(F, H) ^d	(F, H) ^h	(F, H) ^d	F, H	(F, H) ^e	(F, H) ^h
		5G ⁱ	F, V, OH	(F, V, OH) ^h	(F, V, OH) ^d	(F, V, OH) ^d	(F, V, OH) ^h	(F, V, OH) ^d	F, V, OH	(F, V, OH) ^e	(F, V, OH) ^h
		6G ⁱ	All	All ^h	All ^d	All ^d	All ^h	All	All	All ^e	All ^h
T U B E	Groove ^a (Pipe or Box)	(2G + 5G) ^j	All	All ^h	All ^d	All ^d	All ^h	All	All	All ^e	All ^h
		6GR (Fig. 4.27)	All	All ^h	All ^d	All ^d	All ^h	All ^d	All	All ^e	All ^h
		6GR (Fig. 4.27 & 4.29)	All	All ^h	All ^d	All ^d	All ^h	All ^d	All	All ^e	All ^h
		1F Rotated		F ^h			F ^h				F ^h
		2F Rotated		(F, H) ^h			(F, H) ^h				(F, H) ^h
T U B E	Pipe Fillet	4F		(F, H, OH) ^h			(F, H, OH) ^h				(F, H, OH) ^h
		5F		All ^h			All ^h				All ^h
		1F Rotated		F ^h			F ^h				F ^h
		2F Rotated		(F, H) ^h			(F, H) ^h				(F, H) ^h
		4F		(F, H, OH) ^h			(F, H, OH) ^h				(F, H, OH) ^h

CJP—Complete Joint Penetration; PJP—Partial Joint Penetration

^a See Figures 4.3, 4.4, 4.5, and 4.6.^b Groove weld qualification shall also qualify plug and slot welds for the test positions indicated.^c Only qualified for pipe equal to or greater than 24 in [600 mm] in diameter with backing, backgouging, or both.^d Not qualified for joints welded from one side without backing, or welded from two sides without backgouging.^e Not qualified for welds having groove angles less than 30° (see 4.12.4.2).^f Qualification using box tubing (Figure 4.27) also qualifies welding pipe over 24 in [600 mm] in diameter.^g Pipe or box tubing is required for the 6GR qualification (Figure 4.27). If box tubing is used per Figure 4.27, the macroetch test may be performed on the corners of the test specimen (similar to Figure 4.29).^h See 4.25 and 4.28 for dihedral angle restrictions for plate joints and tubular T-, Y-, K-connections.ⁱ Qualification for welding production joints without backing or backgouging shall require using the Figure 4.24(A) joint detail. For welding production joints with backing or backgouging, either the Figure 4.24(A) or Figure 4.24(B) joint detail may be used for qualification.^j The qualification of welding operators for electroslag welding (ESW) or electrogas welding (EGW) shall only apply for the position tested.

Notes:

1. Not applicable for welding operator qualification (see Table 4.12).

2. Footnotes shown at the bottom of a column box apply to all entries:

Girder Stiffener to Web Was Welded with SAW Process

- Groove or fillet weld?
- What position qualifies this weld?
- Welder is qualified SAW 2F. Is he qualified?



37

Pile Exercise

- SMAW (Stick) welding process
- Groove or fillet weld?
- AWS D1.1 or D1.5? (00520.43(f)(1))
- What position qualifies this weld?
- Welder is qualified SMAW 1G & 2F. Is he qualified?



38

Steel Plate Girder Exercise

- Girder on side & flange being welded on by SAW.
- Groove weld or fillet weld?
- AWS D1.1 or D1.5? Welding position?
- Welder is qualified SMAW 1G & 2F. Is he qualified?



39

Field Welding

Contractor Responsibilities

AWS D1.5 & D1.1 Section 6 – Inspection:

Contractor shall perform inspection and testing prior to assembly, during assembly, during welding and after welding (NDT) as necessary to **assure material and workmanship conform to the requirements of the contract documents.**



40

Field Welding

ODOT QA Inspector Responsibilities

- Review submittal package – Assure proper documentation is provided (includes WPS, PQR, MTRs, WQTR, etc.).
- Forward copies of welding submittals to:
Steve Lovejoy (503-986-3326).
- Welding submittals for QA Inspection to:
Josh Barker (971-673-7006)



41

Field Welding (continued)

ODOT QA Inspector Responsibilities

- Assure proper QC Inspection by the Contractor.
- Perform appropriate QA Inspection including but not limited to:
 - Fit up, equipment setup, in-process welding, WPS compliance, post welding visual (including weld size, profile, defects etc.), review NDT reports as necessary.



42



American Welding Society Welding Symbol Chart

Basic Welding Symbols and Their Location Significance								
Location Significance	Fillet	Plug or Slot	Spot or Projection	Stud	Seam	Back or Backing	Surfacing	Edge
Arrow Side								
Other Side				Not Used			Not Used	
Both Sides		Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	
No Arrow Side or Other Side Significance	Not Used	Not Used		Not Used		Not Used	Not Used	Not Used

Location Significance	Groove							Scarf for Brazed Joint
	Square	V	Bevel	U	J	Flare-V	Flare-Bevel	
Arrow Side								
Other Side								
Both Sides								
No Arrow Side or Other Side Significance		Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

Supplementary Symbols			
Weld-All-Around	Field Weld	Melt-Thru	Consumable Insert
Backing/Spacer (Rectangular)		Contour	
		Flush or Flat	Convex

Basic Joints	
Identification of Arrow Side and Other Side Joint	
Butt Joint	Corner Joint
T-Joint	Lap Joint

Edge Joint	Letter Designations
	Where letter designations are to be included in the tail of the welding symbol, reference is made to Table 1, Letter Designations of Welding and Allied Processes and Their Variations, of AWS A2.4-98.

Location of Elements of a Welding Symbol

Finishing Symbol

Contour Symbol

Groove Weld Size

Depth of Bevel: Size or Strength for Certain Welds

Specification, Process, or Other Reference

Groove Angle: Included Angle of Countersink for Plug Welds

Root Opening: Depth of Filling for Plug and Slot Welds

Length of Weld Segment

Pitch (Center-to-Center Spacing) of Weld Segments

Field Weld Symbol

Weld-All-Around Symbol

Arrow Connecting Reference Line to Arrow Side Member of Joint or Arrow Side of Joint

Reference Line

Number of Spot, Seam, Stud, Plug, Slot, or Projection Welds

Elements in This Area Remain As Shown When Tail and Arrow are Reversed

Weld Symbols Shall Be Contained Within the Length of the Reference Line

Tail (May Be Omitted When Reference is Not Used)

Weld Symbol

Arrow Side

Other Side

Both Arrow Side

(N)

S(E)

L-P

American Welding Society
550 N.W. LeJeune Road
Miami, Florida 33126

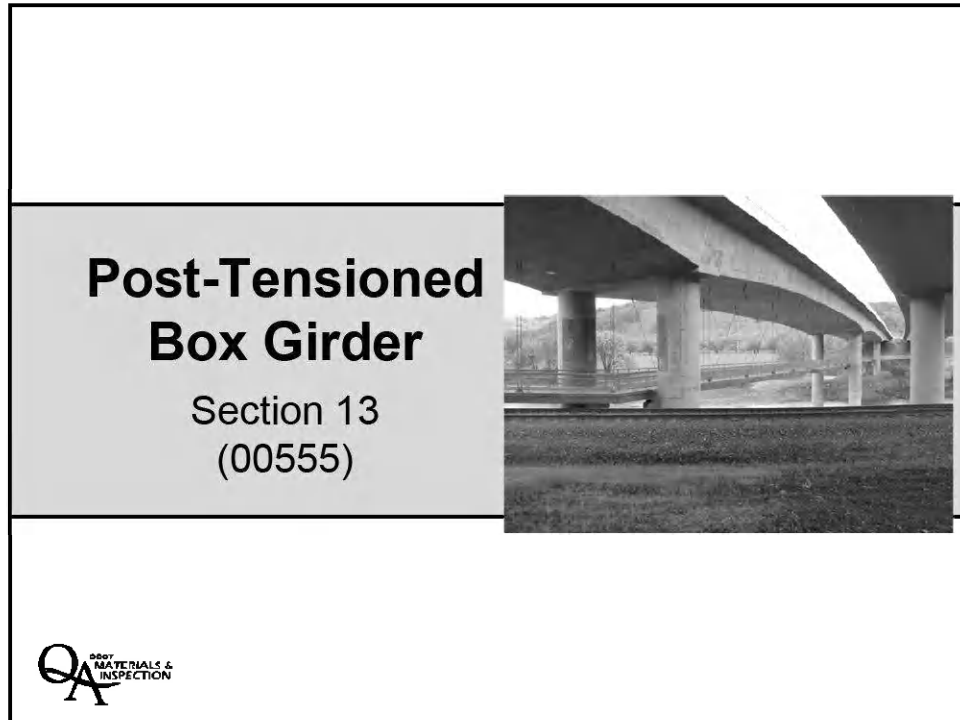
INSERT TAB

Unit 13
Post-Tensioned
Box Girders

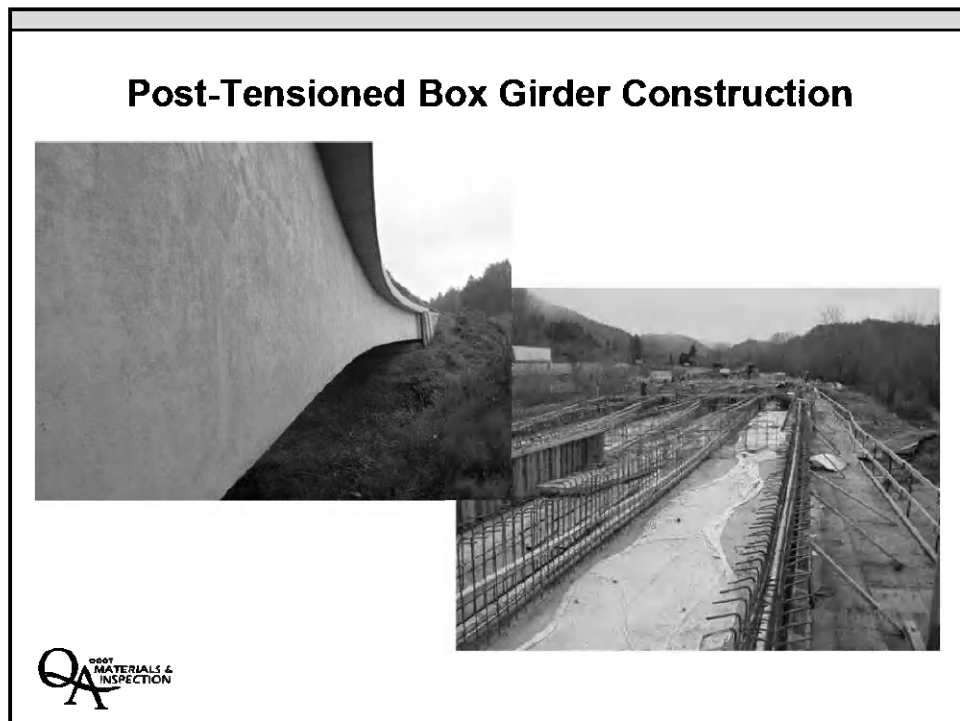
Section 13

Post-tensioned Box Girders

Post-tensioned Box Girder Construction	1
Preparations for Tensioning	28
Tensioning Operations	30
After Post-Tensioning	35
Grouting PT Ducts	37



1



2

Bearing Assembly



3

Bottom Slab



Rebar and stem wall layout marked on bottom slab forms.



4

Bottom Slab

- Completed first.
- Float to seal and provide smooth surface.

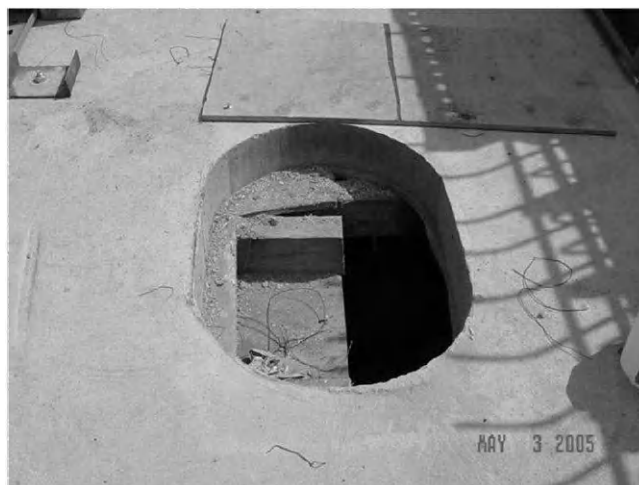


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5

Bottom Slab

Access hole



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6

Bottom Slab

Access hole



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7

Bottom Slab

- Construction joints at bottom of stems roughened or keyed per plans.
- Remove loose or unconsolidated material.



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8

Bottom Slab

- Check rebar placement.
- Rebar in stem wall not flared at abutment?
- Rebar and stem layout often marked on bottom slab forms.



9

Bottom Slab

- Drain in stem wall?
- Include drain at low point in each cell.



10

Bottom Slab

Drain



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11

Stem Wall

- Battered exterior wall
- Check for correct batter



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12

Stem Wall

- PT ducts at abutment
- Alignment is critical in curved areas of duct



13

Abutment

- Blockouts included for PT anchor plates and grout caps.
- Trumpets angled to match PT duct alignment.



14

Abutment

- Blockouts
- PT ducts



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15

Abutment

- Blockouts
- PT ducts



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16

Case Study

- Contractor wants to pour “E” beam of PT Box Girder bridge. The rebar shop drawings have not received final approval from EOR and EOR has told the contractor not to proceed. The contractor proceeds with the pour anyway.
- What should the inspector do in a case like this?



17

Abutment

Extra reinforcement at trumpets.



18

Lack of Consolidation Around Trumpets



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19

Lack of Consolidation Around Trumpets



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20

PT Ducts in Stem Wall Reinforcement Flare @ Abutment



21

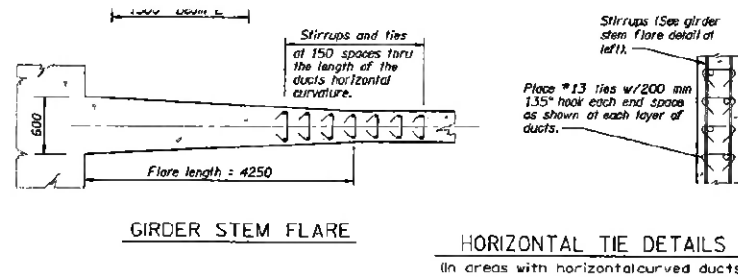
PT Ducts

- Check duct type, size and position
- No kinks, dents or holes
- Alignment is critical
(00555.42 (b)
Horiz. +/- 1/4"
Vert. +/- 3/8"



22

Tie Bar Details



Note:
Flare interior face only of exterior stems.



23

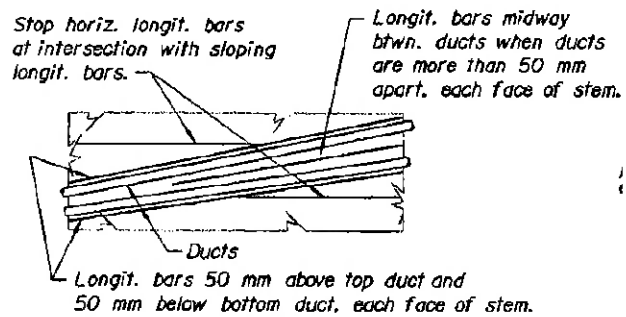
Stem Wall

Rebar ties
near
abutments
and in areas
of curvature



24

Intersecting Horizontal Bars



LONGITUDINAL STEM REINFORCING AT DUCT
PART ELEVATION OF GIRDER STEM



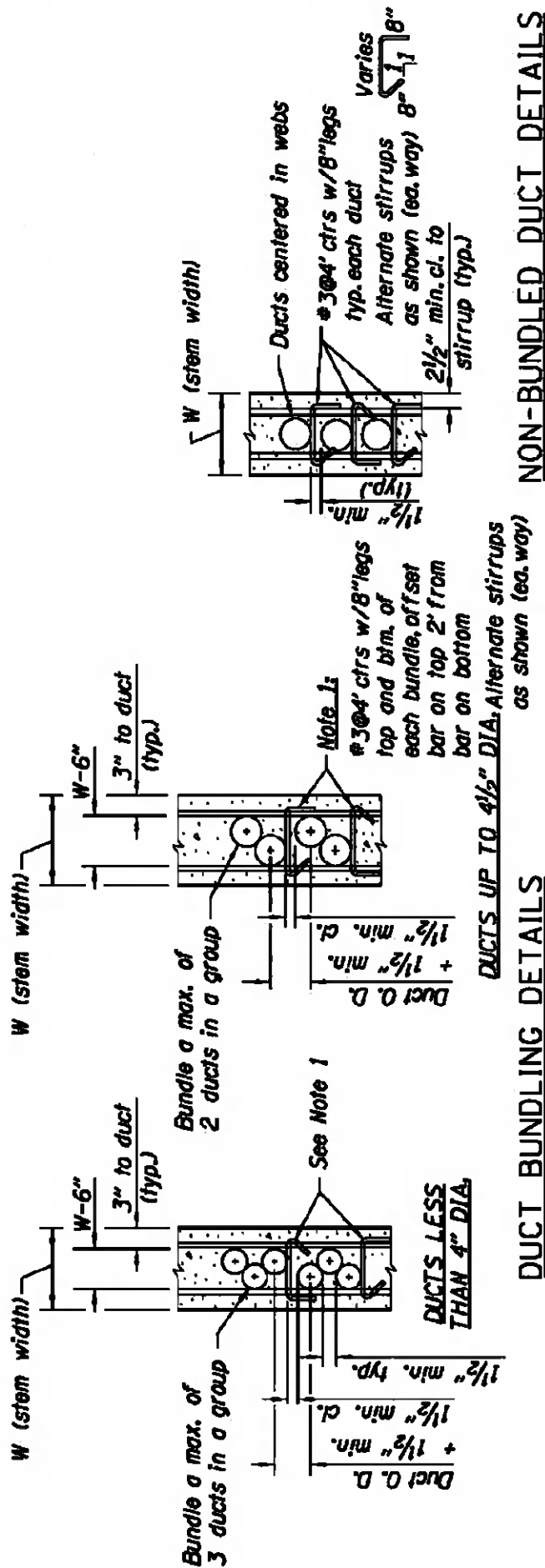
25

Remove Horizontal Bar at Duct



26

Duct Bundling Details



Stem Wall

- Anchor duct tie bars to vertical bars
- Stacked ducts in pairs
- Separation between pairs



27

Tensioning Exercise



28

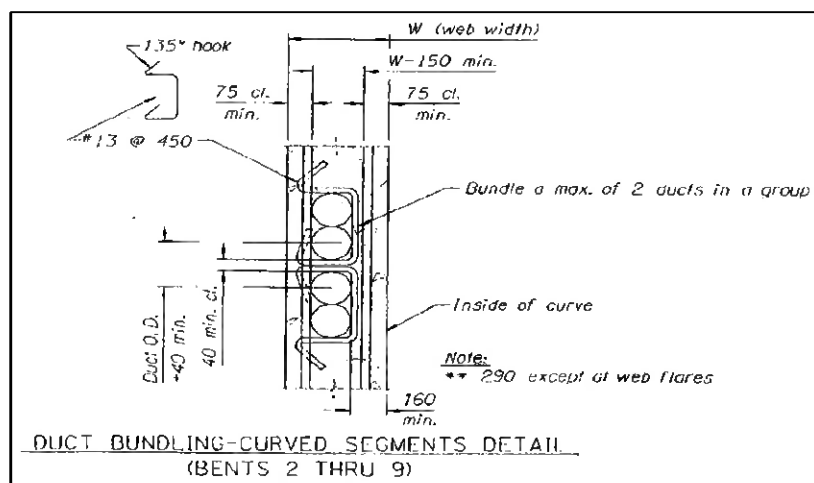
Stem Walls

In curved structure anchor the duct tie bars to vertical bars on outside of curve



29

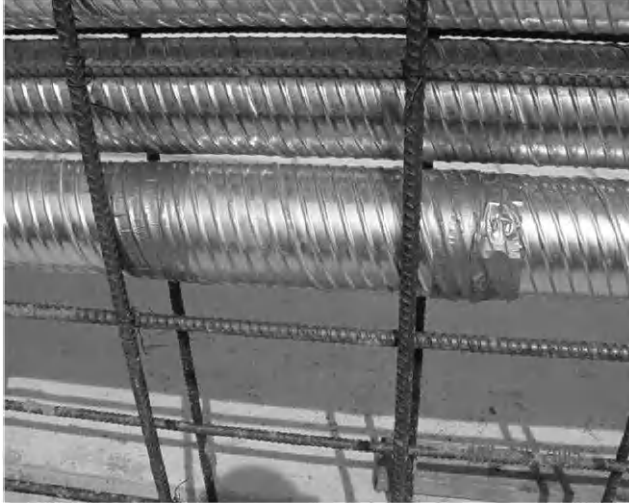
Stem Wall Tie Bars in Curved Structure



30

Stem Wall

Mortar tight
taped joints



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PT Ducts in Stem Wall at Abutment



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32

PT Ducts in Stem Walls



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33

Ducts High at Pier



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34

Stem Wall 00555.41(b)

- Vents at high points
- Ends taped to prevent infiltration of water and other materials
- Mortar tight connection to duct



35

Stem Wall

- Drains at low points
- Usually near midspan
- Open after stem pour to allow to drain
- Mortar tight connection to duct



36

Stem Wall

Drains
angled up?



37

Stem Wall

- Access hole to adjoining cell
- Note hooped rebar



38

Stem Wall

- Poor vibration
- Lift lines visible



39

Stem Wall

- Exposed duct
- Poor vibration



40

Stem Wall

Debris in
stem wall to
bottom slab
cold joint



41

Stem Wall

Sawdust
and gravel
debris



42

Stem Wall

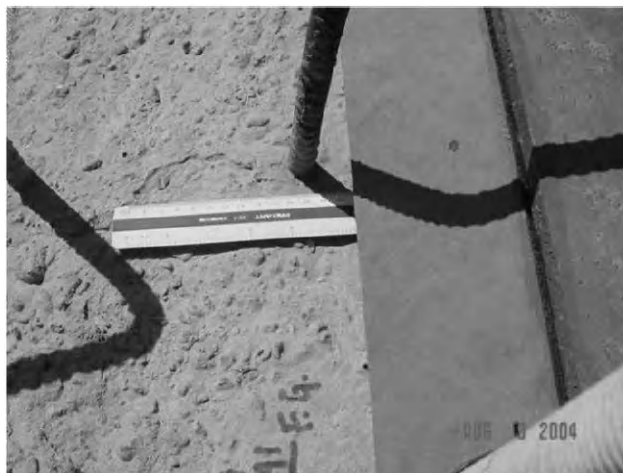
- Stirrups should point out
- Construction joint at bottom of fillet
- Remove excess foam



43

Stem Wall

- Form not to overlap stem
- Laitance not removed



44

Stem Wall

Well-consolidated?

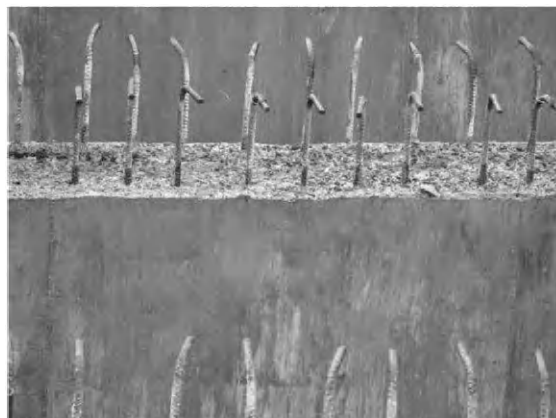


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Stem Wall Cold Joint

Well-consolidated with loose material removed exposing aggregate.



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46

Covered Anchorage to Prevent Infiltration of Water into Ducts



47

Deck Vent Blockouts

- Keep vents closed until grouting of PT ducts.
- Open vents allow water infiltration into ducts.



48

Preparations for Tensioning



49

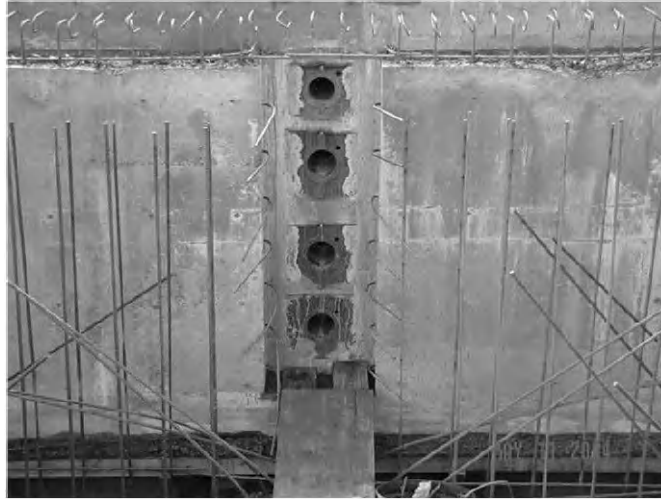
Installation of PT Tendons

- Check condition, rust, dirt, clean, reject, etc.
- Check sizes, numbers of strands, etc., per plans and approved shop drawings.
- Contractor must demonstrate free-movement, if previously installed.



50

PT Bearing Plates and Cut Rebar for Jacking Ram Access



51

Blockout

- Do not cut bars on sides.
- Resulted in dowelling in new bars.
- Cut in middle and bend out instead.



52

Installing Strands



53

Installing Strands



54

Installing Strands



55

Installed Strands



56



POST-TENSIONING STRAND INSTALLATION RECORD

[illegible]

R	Recorded information from plans, shop drawings, PT supplier
Fv	Field verified information

LOW-RELAXATION, 7-WIRE STRAND (ASTM A416)

TENSILE STRENGTH = 260.7 MN

ANCHOR SET = 10 mm

MEASURES THE JACKING FORCE

Row

① ② ③ ④

101,900 MN / (0.75)(260.7 MN) = 522 STRANDS

STRANDS EACH P JACK = 5,271 kN/EACH

STRANDS EACH P JACK = 5,075 kN/EACH

STRANDS EACH P JACK = 4,285 kN/EACH

ram length

$$1) \quad X = \frac{(132.9 \text{ m} \pm 0.75 \text{ m})(10^3)}{(140)(193,000 \text{ MPa})}$$

$$2) \quad X = \frac{(117.1 \text{ m})(10^3)}{(140)(193,000 \text{ MPa})} = 1,522 \text{ mm}$$

1,216 mm

ram length

$$\frac{(17.1 \text{ m} \pm 0.75 \text{ m})(10^3)}{(140)(193,000 \text{ MPa})} = 141 \text{ mm}$$

FOR ELONGATION CALCULATIONS TO BE VERIFIED
MAY VARY WHICH WOULD RESULT IN A

DETAILS.

M
ETRIC

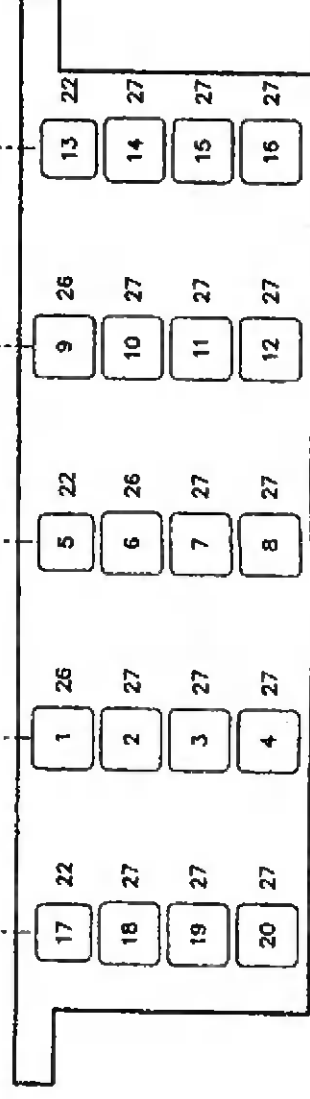
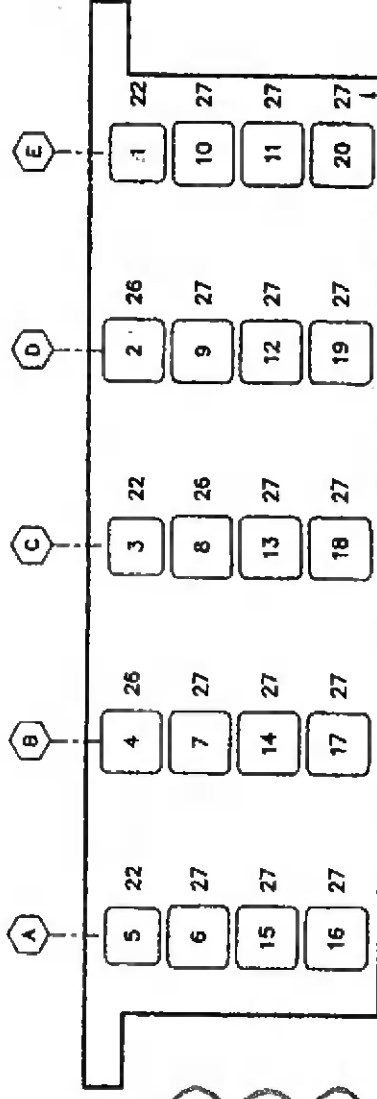
NOTE: IN THE STRAND

NOTE: A MIN. OF 1.5 m OF THE TENDON BEARING PLATE SHALL BE STRAIGHT PERPENDICULAR TO THE BEARING PLATE.

ALL DIMENSIONS ARE IN MILLIMETERS (mm) EXCEPT AS NOTED.

SHOWN AT 1st END STRESSING AT BENT 1

NO. OF STRANDS PER TENDON TYP.



SHOWN AT 2nd END STRESSING AT BENT 4

STRESSING SEQUENCE

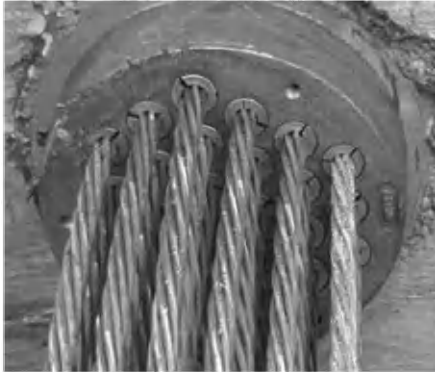
The use of these plans and specifications shall be restricted to the original job for which they were prepared. Any reproduction or distribution without the written consent of the Engineer is prohibited. These drawings and specifications are the property of the Engineer and shall remain in AIAAR.	SO	PROJECT	PROJECT	CONTRACT	CONTRACT
	NO.	DATE	REVISED		

AIAAR

Anchor Wedges

Use 3-piece wedges (00555.03)

3-Piece Wedges



2-Piece Wedges





57

Preparations for Tensioning

00555.42(c)

- Deck cure minimum of 14 days after last concrete is placed (days under 40°F for 4 hours do not count).
- 100% strength required before tensioning.



58

Preparations for Tensioning (continued)

- Remove side forms.
- Remove deck forms if accessible.
- Check certification of load-monitoring equipment to be used.



59

Tensioning Operations



60

Tensioning Operations

- Initially to 20% of load (to remove slack) and measure starting point of elongation.
- To 100% of load (or as specified) and measure elongation.
- Release pressure and measure to determine anchor seat loss.



61

Jacking Ram Supported



62

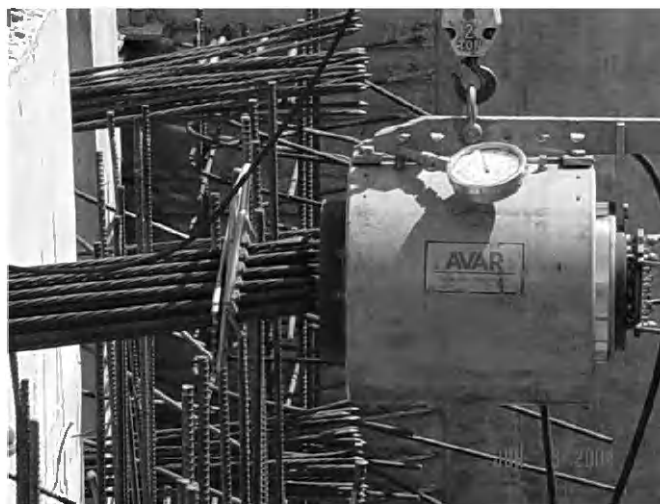
Aligning Strands



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63

Inserting Strands into Ram



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64

Strands Ready to Tension



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65

Keep Clear of Front When Tensioning



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66

Tensioning Strands

Avoid ends
for safety.



67

Documentation

- Record loads.
- Measure elongations.
- Check seating loss as transferred to anchors.



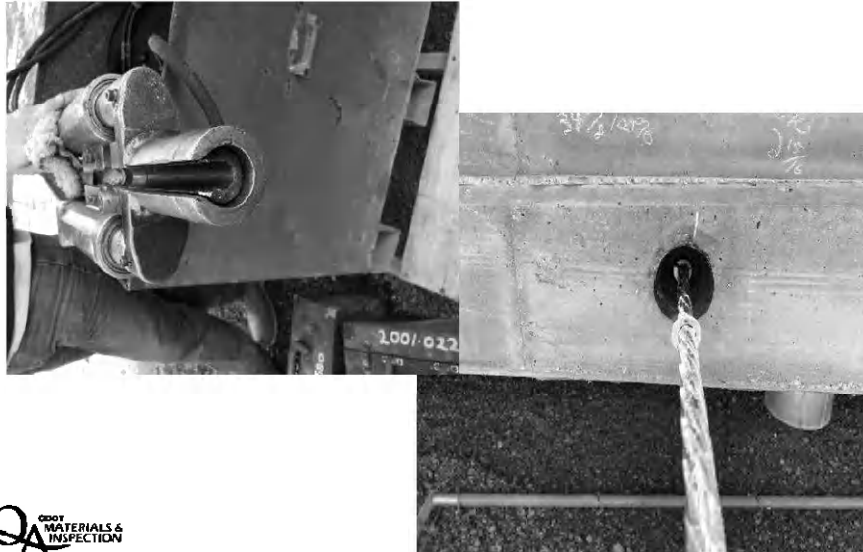
68



POST-TENSIONING RECORD (TENSIONING FROM ONE END)

734-2594 (12-2011)
<http://www.oregon.gov/ODOT/Hwy/CONSTRUCTION/HwyConstForms1.shtml>

Wedge Not Seated Correctly After Tensioning



69

After Post-Tensioning



70

After Post-Tensioning

- Inspect structure for damage **prior** to cutting strands.
- Grout tendons.
- Fill-in post-tension block-outs.
- Construct approach slabs.
- Remove falsework.
- Construct barrier walls, railings, curbs after falsework removal.



71

Lift After Tensioning



72

Lift After Tensioning



73

Cutting Off Tails of Strands

Saw cut tendons
1 inch from
anchor plate
(no torch).



74

Grouting PT Ducts



75

Purposes for PT Grouting

- Develop structural bond between concrete and prestressing steel.
- Provide protection to the prestressing strands against corrosion.



76

Grouting Exercise



77

PT Grouting

- Pre-packaged Thixotropic Grouts (00555.12)
- High Speed Colloidal Mixers (00555.21)
- PT Grout Technician must be ASBI Certified (00555.30)



78

Thixotropic Grout

Use grout on QPL
00555.12 & 02080.50



79

Colloidal Grout Mixer

CG-600 Colloidal Series



80

Preparations for Grouting

- Complete grout trial batch 48 hrs prior to production grouting.
- Clean ducts with compressed air.
- Install caps and valves.
- Provide standby flushing equipment.
- Close drains.



81

Purpose for Grout Trial Batching

- Test equipment prior to production.
- Test material for spec. conformance.
- Establish batch size/water quantities for production.
- Establish flow cone efflux time baseline.
- Establish mud balance specific gravity baseline.



82

Grout Trial Batching-Tests

00555.13

- ASTM C939 Modified Flow Cone.
- ASTM C1741 Schupack Pressure Bleed Test
- API RP 13B-1 Mud Balance.
- ASTM C109 Compressive Strength.



83

Flow Cone, Mud Balance and Grout Cubes



84



Print Form

[illegible]

Trial Batch Section 00555.13 Perform at least 48 hours before production grouting.	Flow Cone (ASTM C 939)	Efflux time between 5 and 30 seconds.
	Flow Cone Retest	Let the mixed grout sit for 30 minutes. Remix the grout for 30 seconds. Retest efflux time, to be within 10 seconds.
	Mud Balance (API RP 13B-1)	
	Bleeding (ASTM C 1741)	Perform the Schupack pressure bleed test, max allowed 0.0% at 5 minutes.
Production Testing Section 00555.43	Compressive Strength (ASTM c109)	Contractor to supply two sets of three grout cubes to the Engineer for informational testing.
	Flow Cone	At least once per day. Production Tolerance +/- 5 seconds of Trial Batch, and between 5 and 30 seconds. Efflux time of ejected grout within 5 seconds of efflux time at mixer.
	Mud Balance	Production Tolerance +/- 3.0 % from Trial Batch. Peroform for each production batch.

Filling Modified Flow Cone



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Modified Flow Cone Test



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86

Time for 1 Liter of Grout



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87

Mud Balance



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88

2" Compressive Grout Cubes



89

Grout Production Testing

- ASTM C939 Modified Flow Cone
- API RP 13B-1 Mud Balance



90

Grout Production Testing (continued)

ASTM C939 Modified Flow Cone 00555.43(c):

- Efflux Time immediately after initial mixing vs. Trial Batch Efflux baseline. Cannot vary more than 5 seconds and is between 5 and 30 sec.
- Efflux Time at mixer and Efflux Time at ejection point cannot vary more than 5 seconds.
- Check grout efflux time at least once daily at beginning of production.



91

Grout Production Testing (continued)

API RP 13B-1(American Petroleum Institute) Mud Balance Test (Wet Density) 00555.43:

- Compare production Specific Gravity vs. Trial Batch Specific Gravity baseline. Cannot vary by more than 3%.
- Mud Balance: Check specific gravity for each grout batch.



92

Grouting Operation

Blow out ducts just prior to grouting with oil-free air
00555.43c



93

PT Grout 00555.43(c)

- Maintain Temperature between 50° - 90° during mixing and pumping.
- Keep surrounding concrete at least 35° during grouting and until grout reaches 800 psi.



94

Grouting Operations

- Pump grout from low end of bridge.
- Bleed each vent and cap (at high points).
- Waste grout at exit end until uniform flow (no slugs or water or air).



95

Grouting Operations (continued)

- Close exit valve.
- Must maintain 60 psi, or pumping pressure whichever is greater, for at least 30 seconds and close inlet.
00555.43(c)
- All caps, plugs, valves closed, and remain in-place for at least 24 hours.



96

Pumping Grout



97

Grout Inlet End



98

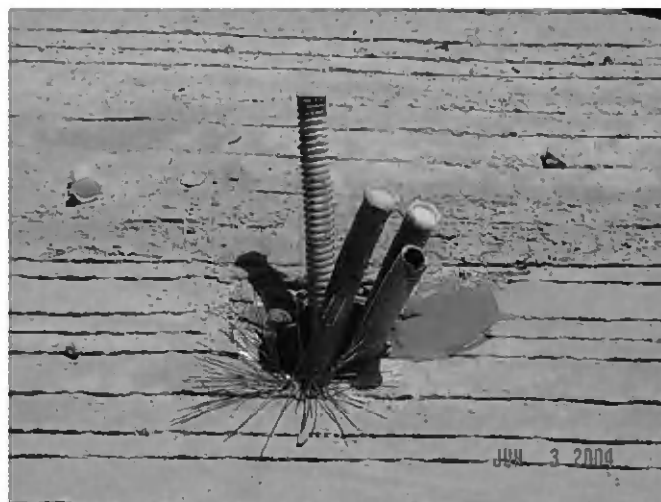
Pumping Grout In



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99

Vent Open for Discharge of Air



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100

Vent Discharge



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101

Closing Grout Outlet Valve



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INSPECTION

102

Grouted End After Cover Removed



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103

Form Up and Pour Blockouts



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104

PT Example 1

- Jack from Bent 1 @ Tendon C1
- 1030 Jacking Force
- 22 Strands
- 1456psi @ 20% of Jacking Force
- 7280psi @ 100% of Jacking Force
- 100% calculated elongation = 17.30"
- Jack elongation = 0.25"
- Plan Anchor Set = 0.375"



105

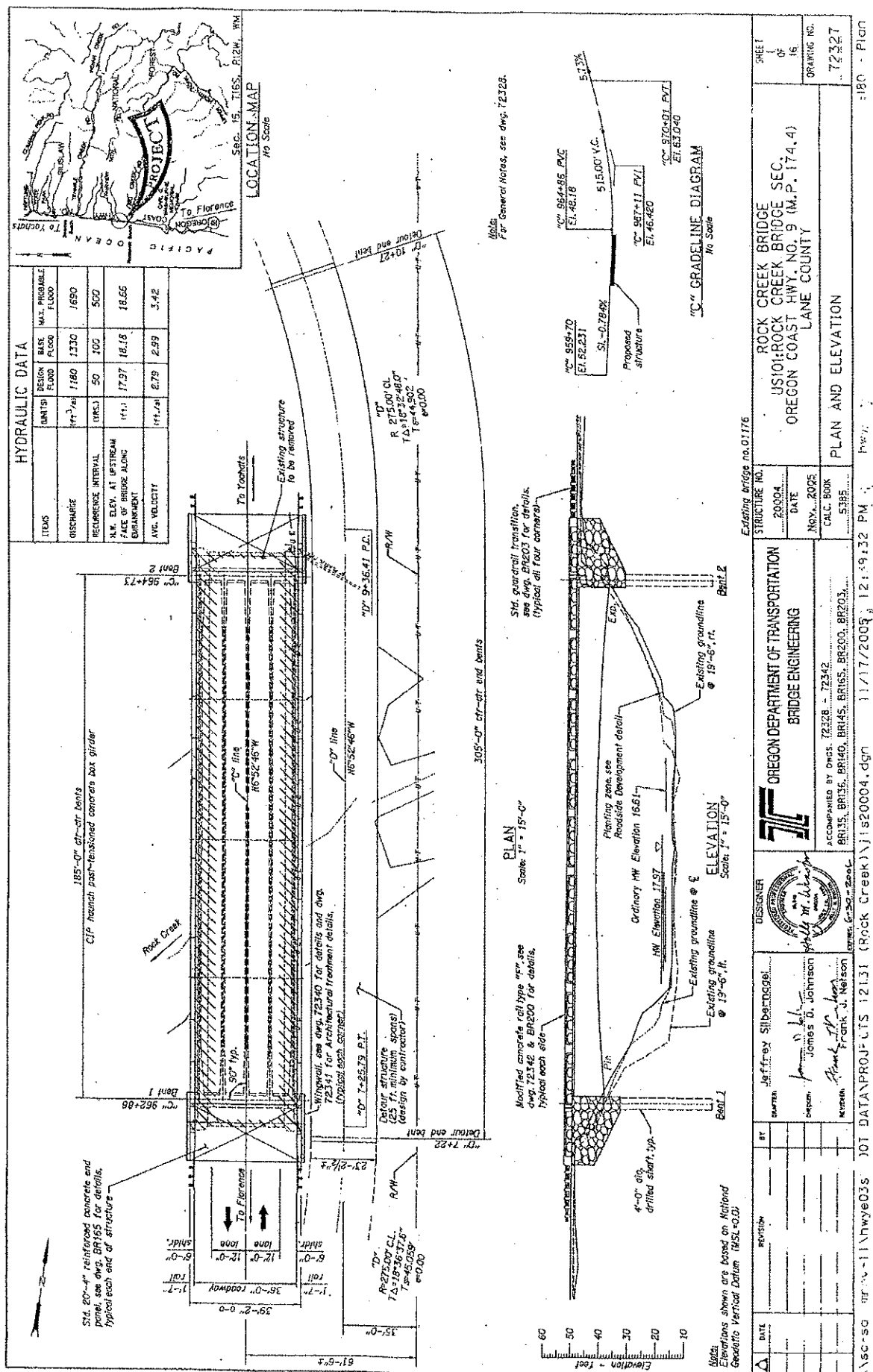
PT Example 1 (continued)

Field Measurements:

- 20% Tail Length = 5 5/8"
- 100% Tail Length = 18 3/4"
- Seated Tail Length = 18 1/4"



106



Udeld - 081-



POST-TENSIONING RECORD (TENSIONING FROM ONE END)

734-2594 (12-2011)
<http://www.oregon.gov/ODOT/Hwy/CONSTRUCTION/HwyConstForms1.shtml>



POST-TENSIONING RECORD (TENSIONING FROM ONE END)

<http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/HwyConstForms1.shtml>

PT Exercise 1

- Jack from Bent 1
- 950 Jacking Force
- 20 Strands
- 1300psi @ 20% of Jacking Force
- 6500psi @ 100% of Jacking Force
- Jack Elongation = $\frac{1}{4}$ "
- Plan Anchor Set = $\frac{3}{8}$ "



107

PT Exercise 1 (continued)

- Measured Tail Length @ 20% Gauge = $24 \frac{1}{4}$ "
- Measured Tail Length @ 100% Gauge = $36 \frac{3}{4}$ "
- 100% calculated elongation = 15.50"
- Seated Tail Length = $36 \frac{1}{4}$ "

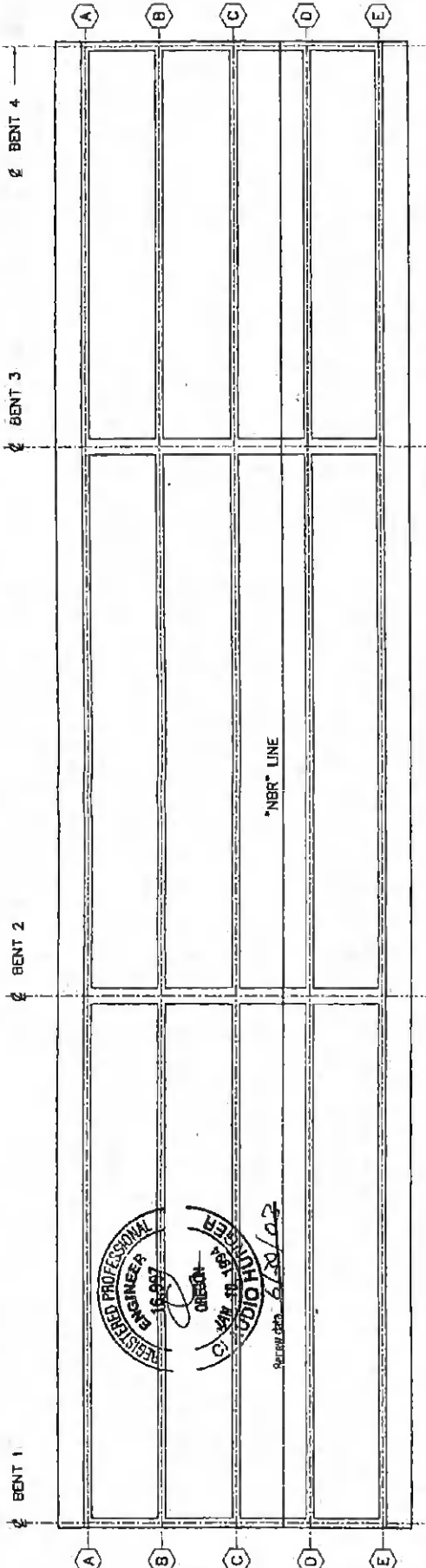


108



POST-TENSIONING RECORD (TENSIONING FROM ONE END)

734-2594 (12-2011)
<http://www.oregon.gov/ODOT/Hwy/CONSTRUCTION/HwyConstForms1.shtml>



PLAN VIEW

PRESTRESSING CALCULATIONS

1.54mm A GRADE 100% MIN. LOSS-RELAXATION, 7-WIRE STRAND (ASTM A421)
 GUARANTEED TENSILE STRENGTH = 260.7 MPa
 1 - 0.25, 1 - 0.0008 : ANCHOR SET = 10 mm
 INITIAL FORCE AT 28 = BASE TIMES THE ANCHOR FORCE

107,000 MPa NO. OF STRANDS 107,000/(177)(260.7 MPa) = 232 STRANDS
 14 - BONDING 1773 STRANDS EACH PUNCH = 0.201 MPa/STRAND
 3 - BONDING 1773 STRANDS EACH PUNCH = 0.201 MPa/STRAND
 3 - BONDING 1773 STRANDS EACH PUNCH = 0.201 MPa/STRAND

965.6K ← 59.92" ← 5.55"

CLAMPING
 $\Delta 1 = \frac{(107,000 \text{ MPa} \times 0.003)}{2} \times \frac{(107,000 \text{ MPa} \times 0.003)}{(140 \times 10^3 \text{ MPa})} = 0.0001$
 $\Delta 2 = \frac{(107,000 \text{ MPa} \times 0.003)}{2} \times \frac{(107,000 \text{ MPa} \times 0.003)}{(140 \times 10^3 \text{ MPa})} = 0.0001$
 $\Delta 3 = \frac{(107,000 \text{ MPa} \times 0.003)}{2} \times \frac{(107,000 \text{ MPa} \times 0.003)}{(140 \times 10^3 \text{ MPa})} = 0.0001$

1. ASSUMED A = 140.0 MPa AND E = 193,000 MPa USED FOR ELONGATION CALCULATIONS TO BE CORRECTED
 ON ACTUAL PRESTRESSING STEEL LOSS. THESE FIGURES MAY VARY WHICH WOULD RESULT IN A
 VARIANCE OF THE CALCULATED ELONGATION.
 2. SEE DRAWING IN FOR GENERAL NOTES AND ANCHORAGE DETAILS.



NOTE: A MAX. OF 1.5% OF THE TENSION RATIO
 IN THE AREA OF THE BLOTTING IN ORDER TO AVOID INTERFERENCE WITH
 STRESSING EQUIPMENT. FOR REQUIRED CLEARANCE SEE A421 DRAWING 10.

ISSUED
 JUL 1 1998
 for Construction

JUL - 5 2003
 No. 22 5991 & Co. Inc.

PRESTRESSING DETAILS		SOUTH UMOQUA RIVER & CORP, HWY 1 BR. 19105	
PROJECT: VETS BRIDGE		PROJECT NO: 12697	
CONTRACT NO: 1M-OTIA-5001(126)		CONTRACTOR: ROSS BROS & COMPANY, INC.	
NO.	DATE	BY	REVISION
1	8/12/03	ALJ	DATE: 8/12/03
2	8/12/03	ALJ	DATE: 8/12/03
3	8/12/03	ALJ	DATE: 8/12/03
4	8/12/03	ALJ	DATE: 8/12/03
5	8/12/03	ALJ	DATE: 8/12/03
6	8/12/03	ALJ	DATE: 8/12/03
7	8/12/03	ALJ	DATE: 8/12/03
8	8/12/03	ALJ	DATE: 8/12/03
9	8/12/03	ALJ	DATE: 8/12/03
10	8/12/03	ALJ	DATE: 8/12/03
11	8/12/03	ALJ	DATE: 8/12/03
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98	8/12/03	ALJ	DATE: 8/12/03
99	8/12/03	ALJ	DATE: 8/12/03
100	8/12/03	ALJ	DATE: 8/12/03

AVAR Construction Systems, Inc.
 501-F Venable Way
 Campbell, California 95008
 (408) 370-2100

AVAR
 B4
 REV. 0

STRESSING SEQUENCE

SHOWN AT 2nd END STRESSING AT BENT 4

PT Example 2

- Jack from Bent 1 & Bent 4
- Tendon C1
- 1400psi @ 20% of Jacking Force
- 7000psi @ 100% of Jacking Force
- Jack elongation = $\frac{1}{4}$ "
- Plan Anchor Set = $\frac{3}{8}$ "



109

PT Example 2 (continued)

Field Measurements

	Bent 1	Bent 4
▪ 20% Tail Length =	26 $\frac{1}{2}$ "	22 $\frac{1}{4}$ "
▪ 100% Tail Length =	75 $\frac{1}{2}$ "	27 $\frac{1}{4}$ "
▪ Seated Tail Length =	75"	26 $\frac{5}{8}$ "



110



**POST-TENSIONING RECORD
(TENSIONING FROM BOTH ENDS)**

<http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/HwyConstForms1.shtml>



**POST-TENSIONING RECORD
(TENSIONING FROM BOTH ENDS)**

<http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/HwyConstForms1.shtml>

PT Exercise 2

- Jack from Bent 1 & Bent 4
- Tendon C1
- 1400psi @ 20% of Jacking Force
- 7000psi @ 100% of Jacking Force
- Jack elongation = ¼"
- Plan Anchor Set = 3/8"



111

PT Ex

- Jack
- Tend
- 1400
- 7000
- Jack
- Plan



111

Exercise 2

	Bent 1	Bent 4
▪ 20% Tail Length =	26 ½"	22 ¼"
▪ 100% Tail Length =	74 ½"	26 ¼"
▪ Seated Tail Length =	74"	25 5/8"



112

Exerc

- 20%
- 100%
- Seate



112



**POST-TENSIONING RECORD
(TENSIONING FROM BOTH ENDS)**

<http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/HwyConstForms1.shtml>

INSERT TAB

Unit 14

**Deck
Construction**

Section 14

Deck Construction

Pour Sequence	1
Cracking of Bridge Decks	9
Deck Grades	15
Deck Pre-Placement Conference	18
Pouring Deck	24
Joints	41
MC Overlay Preparation	89
MC Overlay	94
MPCO Overlay	104
PPC Overlay	107
Polymer Membrane	112
Rolled Waterproofing Membrane	114
FHWA Video: Bridge Deck Const. Review	117

Deck Construction Section 14	
	

1

Pour Sequence	
	

2

Case Study

- 3 span steel plate girder bridge. Plans call for pouring the 3 spans at the same time.
- Contractor requests to pour span 1 first followed by span 2 two weeks later and span 3 a week after span 2. Closure pours after the other pours are all completed.
- Is this reasonable? What issues would you be concerned with? What do you do?

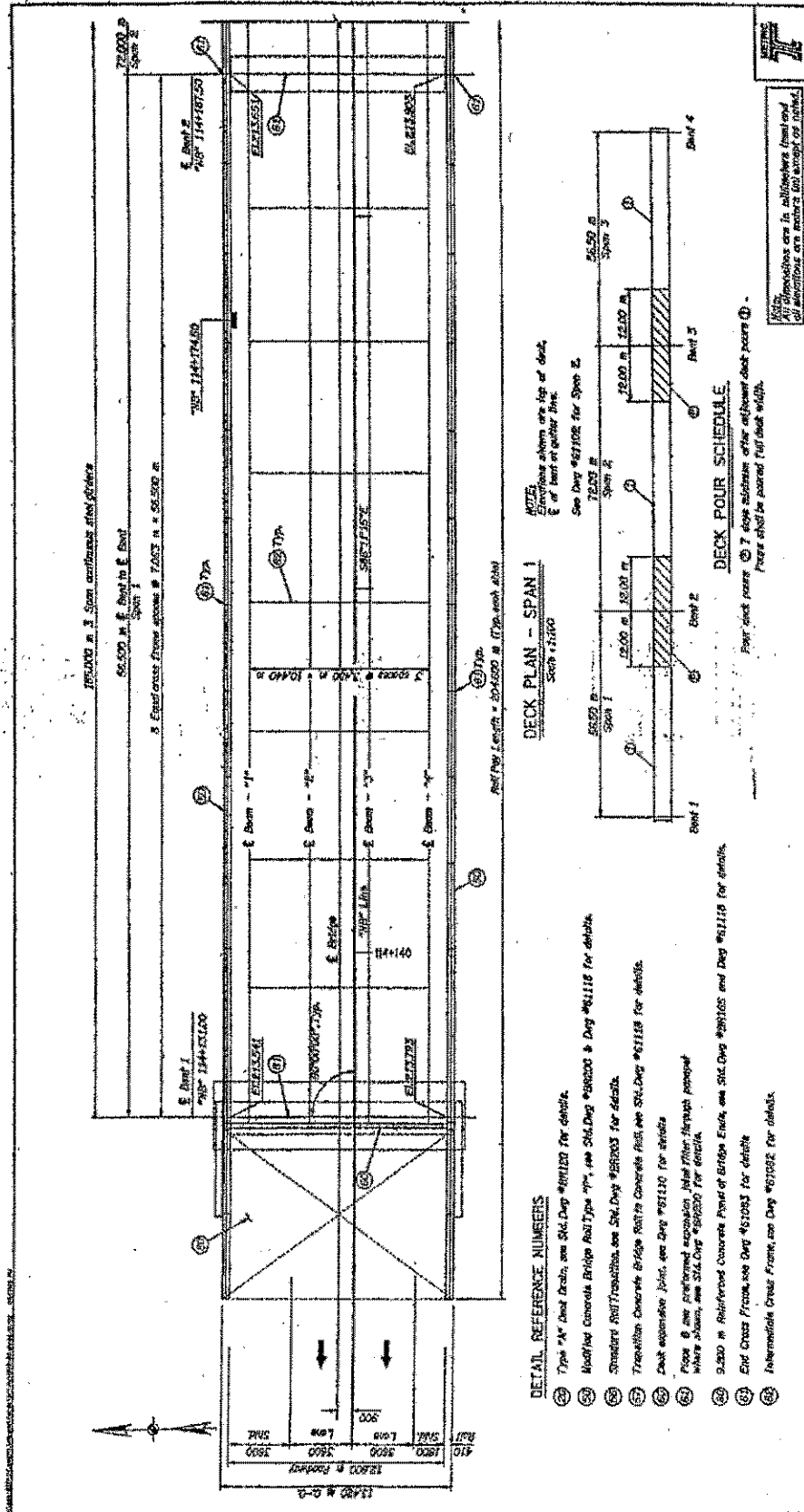


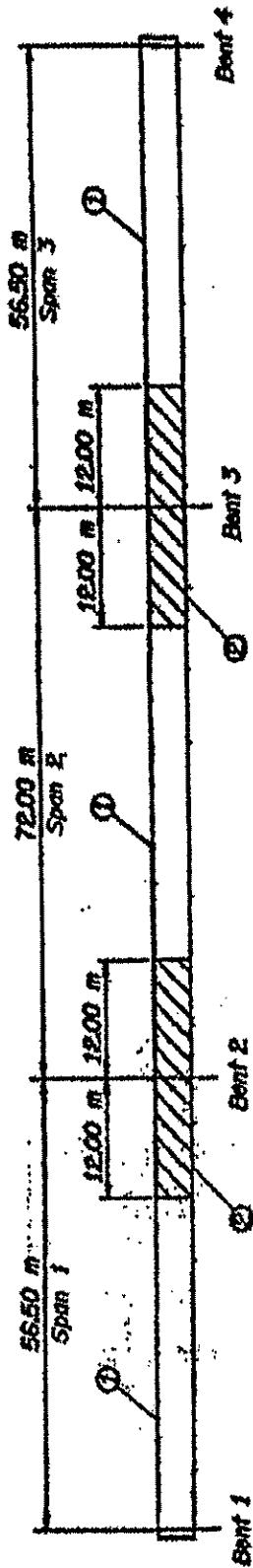
3

Structure in Question



4





DECK POUR SCHEDULE

Four deck pours ② 7 days minimum after adjacent deck pours ① -
 Pours shall be poured full deck width.

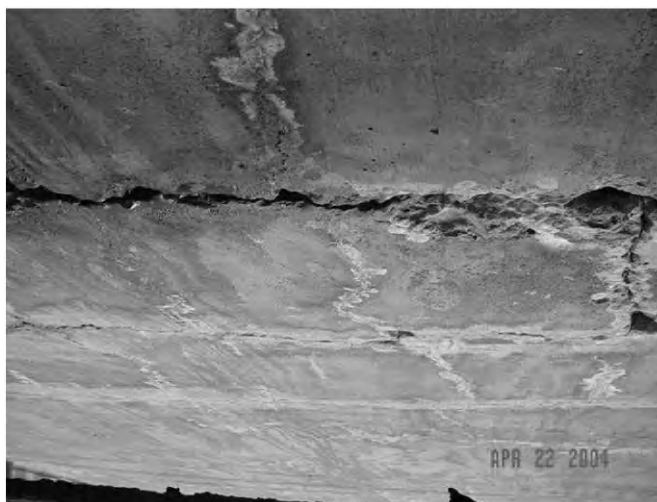
Deck Cracking



QA
0001 MATERIALS &
INSPECTION

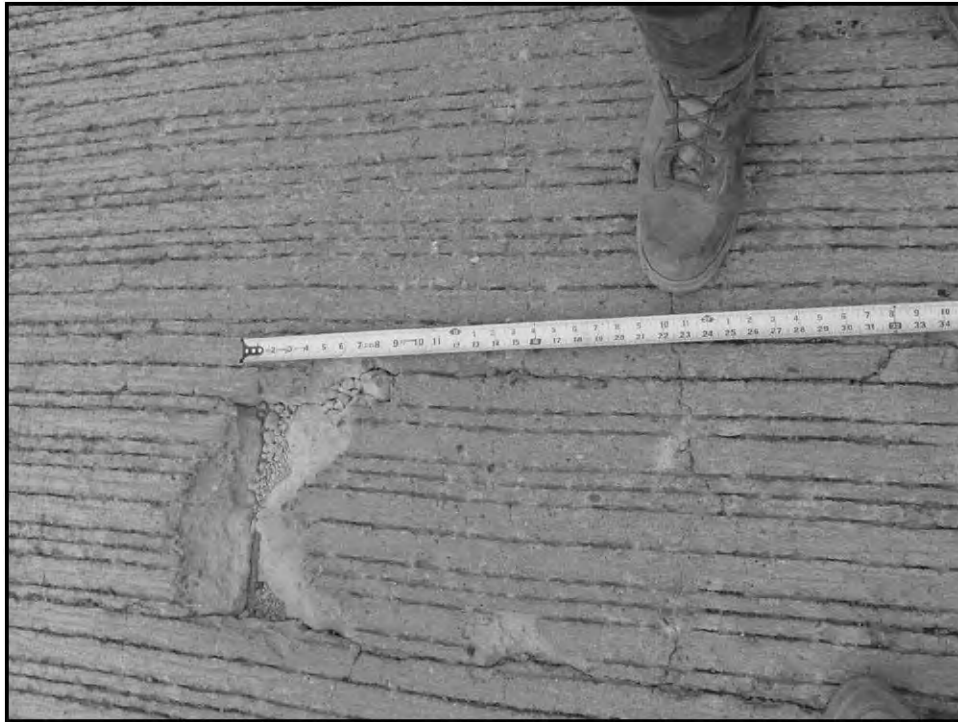
5

Loose Block



QA
0001 MATERIALS &
INSPECTION

6



7



8

**Since span 3 was placed last,
how does it look?**

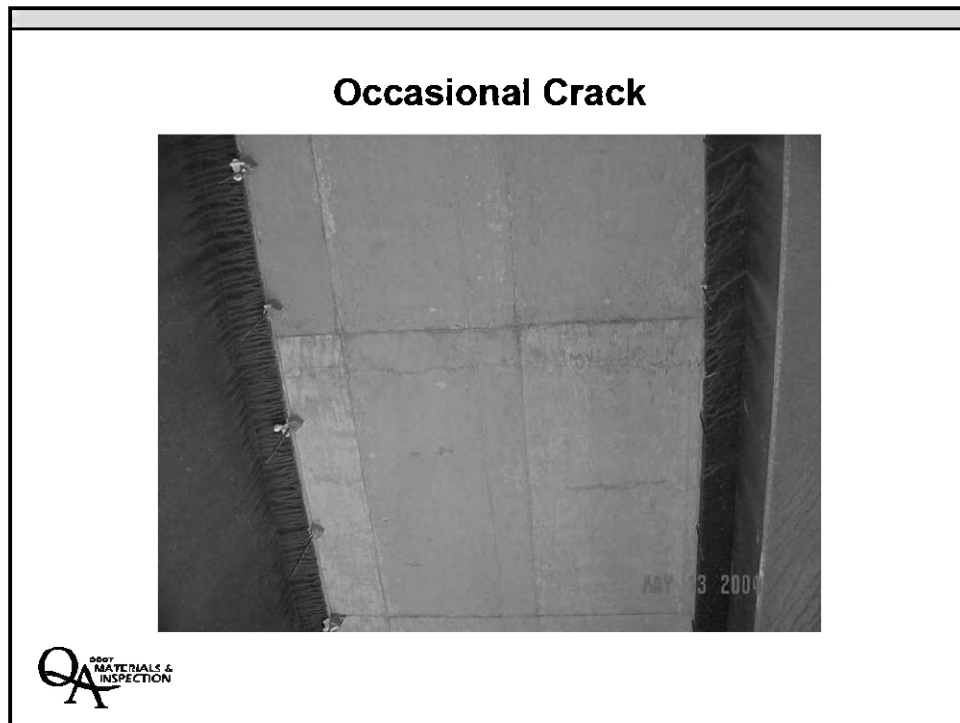


9

Looks Good



10



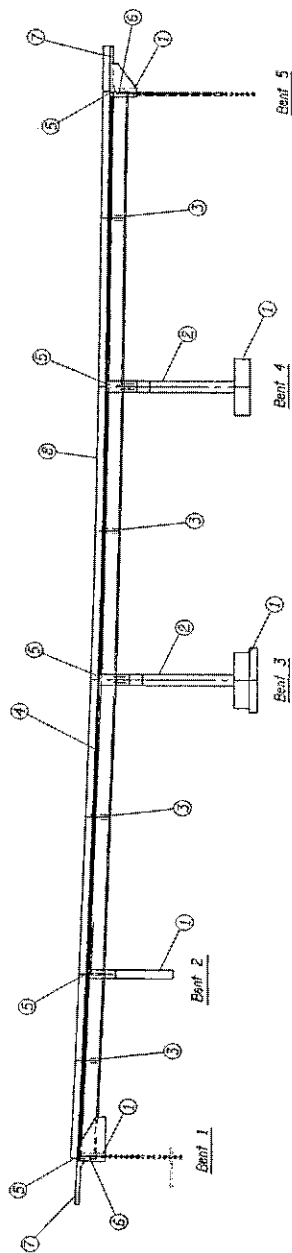
11

Pour Sequence

- Follow per plans
- Changes must be approved by the Engineer of Record.
- Improper pour sequence can lead to significant cracking and premature failure of a structure.

QA MATERIALS & INSPECTION

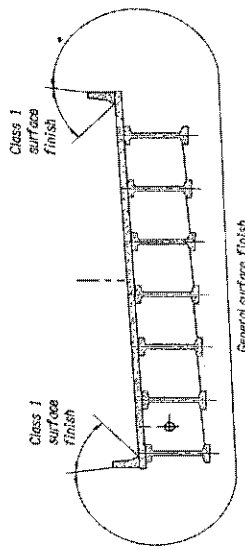
12



POUR SCHEDULE
No Scale

Pour Schedule Notes

1. Pours ① include footings, wall Bent 2, pile caps and wing walls (Class 25 - 37.5, 25.4 or 19).
2. Pour ② includes columns (Class 25 - 37.5, 25.4 or 19).
3. Place prestressed beams & temporary diaphragms a minimum of 7 days after pours ① & ② are complete and design strength has been reached.
4. Pours ③ include Diaphragm Beams "D1" and "D2" to bottom of deck (Class 30 - 19).
5. Pours ④ include deck pours (Class 30 - 19), no less than 50 days after the transfer of stress in prestressed beams. Stop deck pours short of Beams "C" and "E".
6. Pours ⑤ include Beams "C" and "E" (Class 30 - 19).
7. Pours ⑥ include back walls on pile caps (Class 25 - 37.5, 25.4 or 19).
8. Pours ⑦ include bridge end panels (Class 30 - 37.5, 25.4 or 19).
9. Pours ⑧ include bridge rolls (Class 25 - 37.5, 25.4 or 19).



CONCRETE FINISH DETAILS
No Scale

		SHEET 5 OF 25 DRAWING NO. 60799	
NOTE: All dimensions are in millimeters (mm) except as noted.		BRIDGE NO. 18804 DATE 22-MAR-2002 CALC. BOOK 5018	
		MIDDLE FORK JOHN DAY RIVER (ITTER) BRIDGE BRIDGE ENGINEERING SECTION	
DESIGNER 		CHECKED Mark E. Luby REVIEWED In-Ten Log	
DATE	BY	DATE	BY

Pour Sequence

- It's not just a deck issue.
- Loads can be built into structural members that they were not designed for.



13

Case Study

- Simple span, concrete bulb-I girders resting on pilecaps. Plans call for pouring the “E” beams as a separate pour after the deck pour.
- Contractor pours the “E” beams prior to the deck pour.
- What issues does this raise?



14

Construction Material Storage



15

I-35 Bridge in Minneapolis



16

I-35 Bridge Gusset Plates

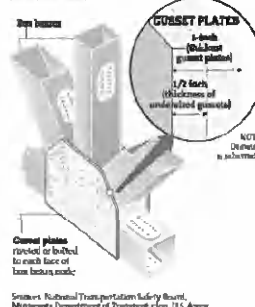
A CRUCIAL, UNDETECTED DESIGN FLAW

Federal investigators have pinpointed key gusset plates in the center portion of the Interstate 35W bridge that were undersized and bowing. They are meeting today for a two day public hearing with the National Transportation Safety Board into its determination of what led to the I-35W bridge collapsed 15 months ago in Minneapolis. The main focus as of late has been on the node U-10 east and west gusset plates.



GUSSET PLATES EXPLAINED

Gusset plates are flat pieces of steel used to connect adjacent truss members such as box beams and "H" beams. They are either riveted or bolted into place. Gusset plates were used in large numbers throughout the truss structure. The NTSB says that due to a design error, the node U-10 east and west gusset plates were only one-half inch thick instead of the 2-inch thickness that the NTSB says would have been safe.



17

I-35 Material Storage

- Milling concrete on bridge
- Previously stored material on ramps and approaches
- Inspector allowed storage on main span without review by bridge design



18

Cracking of Bridge Decks



19

Why does concrete crack?

It cracks when it is stressed beyond its structural capacity.



20

What causes stress in concrete?

- Shrinkage
- Dead loads
- Live loads



21

Shrinkage Cracks



22

Shrinkage Cracks Are Caused By:

- Autogenous deformation
- Plastic shrinkage
- Thermal shrinkage
- Drying shrinkage



23

Autogenous Deformation

The change in volume taking place of the concrete mixture as the hydration process chemically changes the material and it becomes a solid mass.



24

Plastic Shrinkage

Results from surface evaporation prior to the cure being put on.



25

Thermal Shrinkage

- Shrinkage caused by temperature differences
- PADOT Study
 - Temperature difference induces 5.5 microstrains per 1 degree F.
 - 228 microstrains of thermal shrinkage would initiate cracking.



26

Drying Shrinkage

- Short term (several days)
- Long term (about 1 year).
- It results from the process of the deck drying out.



27

Concrete Cracks

When total stress in the concrete exceeds the modulus of rupture of the concrete.

400+/- microstrains of total stress?



28

Other Factors Affecting Shrinkage Cracking

- W/C Ratio
- Aggregate Absorption
- Aggregate Size
- Cement Type & Source
- Timely & Proper Cure



29

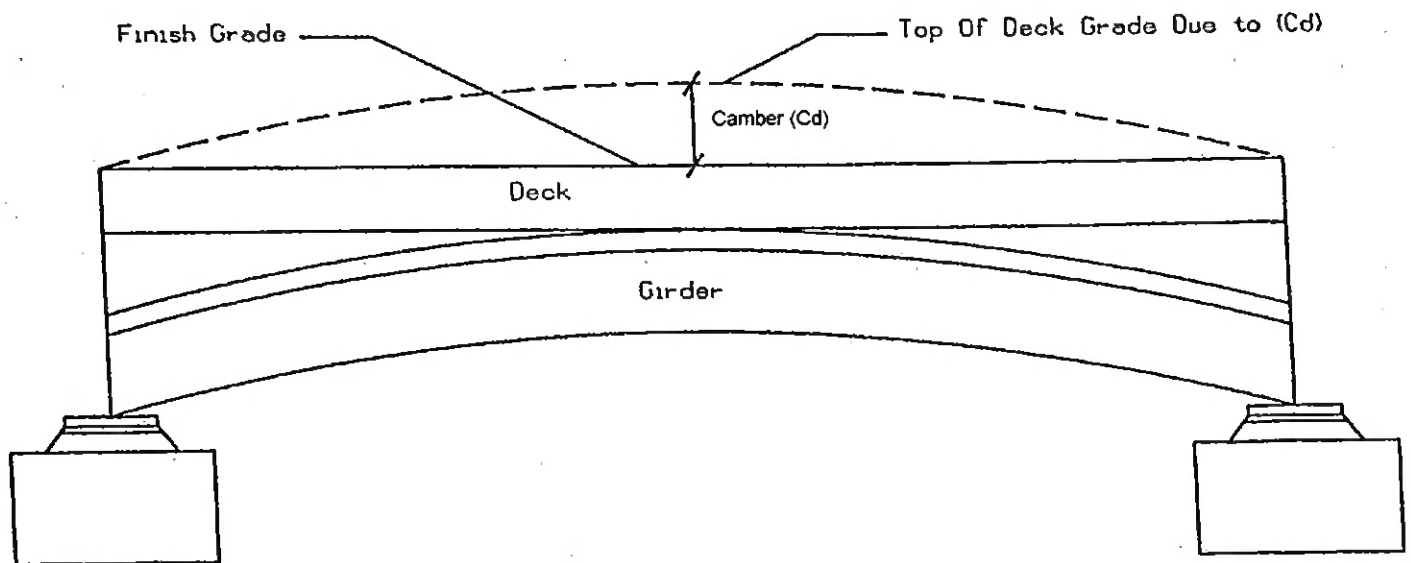
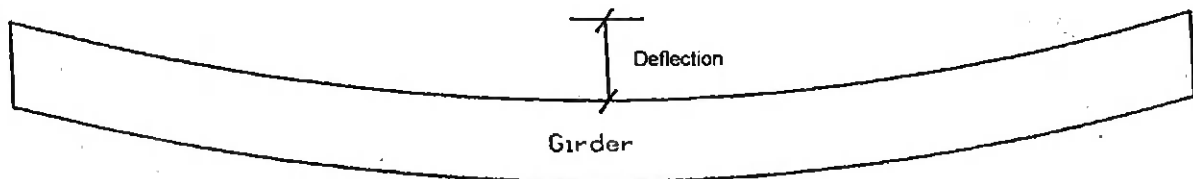
Deck Grades



30

TOP OF DECK GRADE CALCULATION

Girder Deflections Due to Deck Dead Load



$$\text{Top Deck Grade} = \text{Finish Grade} + (Cd) + \text{Crush (If Applicable)}$$

PRECAST PRESTRESSED GIRDERS WITH CIP DECK

DRAWING NO.
53922

Add Camber



31

Add Crush



32

Deck Grade Example

Location	FG	Camber
0.0	100.00	0.00
0.1	100.00	0.05
0.2	100.00	0.09
0.3	100.00	0.13
0.4	100.00	0.15
0.5	100.00	0.17
0.6	100.00	0.15
0.7	100.00	0.13
0.8	100.00	0.09
0.9	100.00	0.05
1.0	100.00	0.00



33

Deck Grade Example Key

Location	FG		Camber		DG
0.0	100.00	+	0.00	=	100.00
0.1	100.00	+	0.05	=	100.05
0.2	100.00	+	0.09	=	100.09
0.3	100.00	+	0.13	=	100.13
0.4	100.00	+	0.15	=	100.15
0.5	100.00	+	0.17	=	100.17
0.6	100.00	+	0.15	=	100.15
0.7	100.00	+	0.13	=	100.13
0.8	100.00	+	0.09	=	100.09
0.9	100.00	+	0.05	=	100.05
1.0	100.00	+	0.00	=	100.00



34

Excess Camber?



35

Deck Pre-Placement Conferences



36



Deck Placement Conference Outline

(00540.02(a)(b))

Contract No. _____

Print Form

Project Name (Section) _____

Contract No. _____

Highway _____

County _____

Date _____

Contractor _____

Estimated Date _____

Estimated Quantity/Day _____

Project Manager _____

Mix Design

Approved? ☐ Yes ☐ No

Mix Design No. _____

List types of admixtures to be used (Superset extender required to extend initial set by 90 min. 02001.30(e). Extra for travel, time or struct. type.)

Slump Range _____ W/C _____ Air Content _____

Concrete Mix

Supplier Name _____

- ☐ Supplier notified well in advance.
- ☐ Supplier aware of specification on truck mixer equipment. 02001.40, ASTM C94
- ☐ Communication between batch plant and project. How? Who? _____
- ☐ Continuous delivery assured for cubic yards needed per hour, at what intervals? _____
- ☐ Supplier has sufficient material on-hand for quantity required.
- ☐ Mix temperature of 50°F minimum and 80°F maximum when air temperature is 40°F or higher. Mix temperature of 60°F minimum and 80°F maximum when air temperature is or forecast to be below 40°F during cure period.

Contractor Quality Control

CCT Name _____

Certification No. _____

QCT Name _____

Certification No. _____

Individual authorized for acceptance and rejection of materials _____

Weather Conditions

- ☐ Precipitation forecast less than 30% during placement window (2 hours before to 2 hours after). 00540.49(b)
- ☐ Surface evaporation rate of less than 0.10 psf per hour. Fig. 00540-1
- ☐ Cold weather plan approved if temperature is or forecast to be below 40°F. 00540.49(1-2-a) ☐ Yes ☐ No ☐ N/A
- ☐ No frost or ice on forms or rebar.

Deck Finishing Machine☐ Type 00540.24 _____

Brand Name

☐ Approved working drawings showing location of deck machine rails 00540.24(a).☐ Deck machine to set up and run over full length of area of placement 00540.24(g).☐ Experienced operator with good knowledge of machine operation. _____

Operator Name

☐ Changes in crown or super? _____

How will changes be handled?

☐ Dry run rebar clearance is +/- 1/4" from clearance shown. 00540.48(g)

Method of checking rebar clearance:

Forms☐ Top mat, tie bar at every intersection if spacing is more than 6", otherwise every other intersection. 00530.41(b)☐ Bottom mat, tie every other intersection.☐ At least 3 ties per lap splice.☐ Monitor falsework, tattle-ails installed (when needed).☐ All forming and bulkhead in place prior to start of placement.☐ Stay-in-place forms are not allowed for bulkheads.☐ Apply form release to forms.☐ Cleanliness of bottom and rebar. _____

How?

When? _____

☐ Edge of forms set to line and grade. _____

How?

When? _____

☐ Supports for outside edge.**Deck Placement**☐ Saturate the tops of precast beam and formwork 2 hours immediately prior to beginning deck placement.☐ Minimum rate of placement 20 ft/hr 00540.48(g) third bullet.☐ Calculated cubic yards to be placed _____

Method of Placement

Backup Method

Estimated time to place mix

Deck Placement (continued)☐ Vibrators 00540.48(c)

Experienced vibrator person _____
 Operator Name

Size of vibrators to be used _____

☐ Meet requirements of 00540.23

Number of vibrators to be used (minimum 2) _____

Discuss methods of consolidation 00540.48(c)

Power Source: ☐ Generators ☐ Direct Power ☐ Backup

Type _____

☐ Placement direction 00540.48(g)☐ Transverse work bridge (2 minimum)☐ Emergency bulkheads, how will this be addressed if needed?☐ 12-foot straightedge is on-site prior to start of pour. Check gutters, lane lines, ends of pours and "as directed". 00540.55**Environmental**☐ Where will concrete trucks clean out? _____

Containment? _____

☐ Where will deck machine clean out? _____

Containment? _____

☐ Steps to assure containment of in forms? _____**Curing Concrete**☐ Provide pressure washers with fog nozzles.☐ Provide wind breaks for spray or other approved methods to prevent premature drying during placement operations.☐ Presoaked wet burlap or dry non-woven polypropene fabric with 4-mil polyethylene film. Color as weather dictates.☐ Additional soaking to keep the deck moist at all times during the cure period.☐ Water availability during and after placement

Where? _____

How? _____

If above information is not available, who will advise the PM prior to start of placement?

During non-working days, who will be able to add water for cure?

Name _____

Phone No. _____

☐ Bridge deck cure time is 14 calendar days.

General Information

Check special provisions for additional information.

- ☐ **Construction joint surfaces:** Use surface retarder to aid in laitance removal. 00540.43 (a)
- ☐ **Closure pour prep:** Sawcut top 1" of deck, may be waived if joint is straight without spalls.
Hand rub or brush fresh concrete paste onto the existing surface of vertical joints down to the top mat.
- ☐ **Deck roadway texturing:** Cut grooves no sooner than 14 days after deck is cast. 00540.50
- ☐ **Striping forms:** 80% of specified strength and 7 days. Table 00540-1
Early removal of forms does not eliminate the curing requirement of 00540.51

Deck Pre-Placement Conferences**00540.02**

- A pre-pour conference should be held 3 weeks ahead of placing concrete. This conference is to discuss all phases of the deck pour and the responsibilities of all parties involved.
- Any problems that arise should then be resolved well ahead of the day of concrete placement.



37

Deck Pre-Placement Conferences (continued)

- A second pre-pour conference should be held at the job site one-half hour before the placement begins to discuss placement duties and procedures with the contractor's entire placement crew and the Engineer.



38

Preparations for Concrete

- Before the contractor orders any concrete for delivery and placement at the site, you should:
 - Ensure that an approved mix design is on file with the Material Section.



39

Preparations for Concrete (continued)

- Make sure the contractor has adequate resources for the pour:
 - A steady supply of mix.
 - Adequate labor and equipment.
 - Back-up equipment at the jobsite.



40

Screed Rails

- Place outside the finished area.
- Rail supports are at about every 3 feet
- Ensure all rail supports are checked. If every other support is shot in, then stringline in between.



41

Screed Rails (continued)

- Removable to at least 2 inches below surface, if within deck limits.
- The rail and supports extend far enough beyond the end of the deck to provide all equipment with full access to the deck.



42

Detour so close, machine rails set on beam



43

What is so bad about machine rails in the deck?



44

Possible Voids from Footprints



45

Deck Finish Machine

00540.24

- Capable of finishing the entire surface.
- Self-propelled with positive control in both forward and reverse directions.
- Capable of raising rolls or screed to clear the screeded surface.
- Equipped with augers.



46

Deck Finish Machine (continued)

- Equipped with rollers or a vibrating screed.
- Run on the skew of the bridge.



47

Deck Machine Dry Run

- Run machine over the entire deck to ensure proper deck thickness and clearances prior to the deck pour.
- Past the end bulkheads to ensure all areas have been checked.
- Do not allow adjustments in machine crown or leg heights after clearances checked and approved.
- **Note:** The drum will usually float up about 1/8 inch on the concrete mix.



48

Pouring Deck



49

Typical Deck Machine



50

Typical Deck Machine

- Like to see small ball of mix in front of screed roll
- Keep mix about halfway up auger



51

Texas Screed Type Equipment for Narrow Pours



52

Roller Screed



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53

Prevent Splatter



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54

Length of Vibration

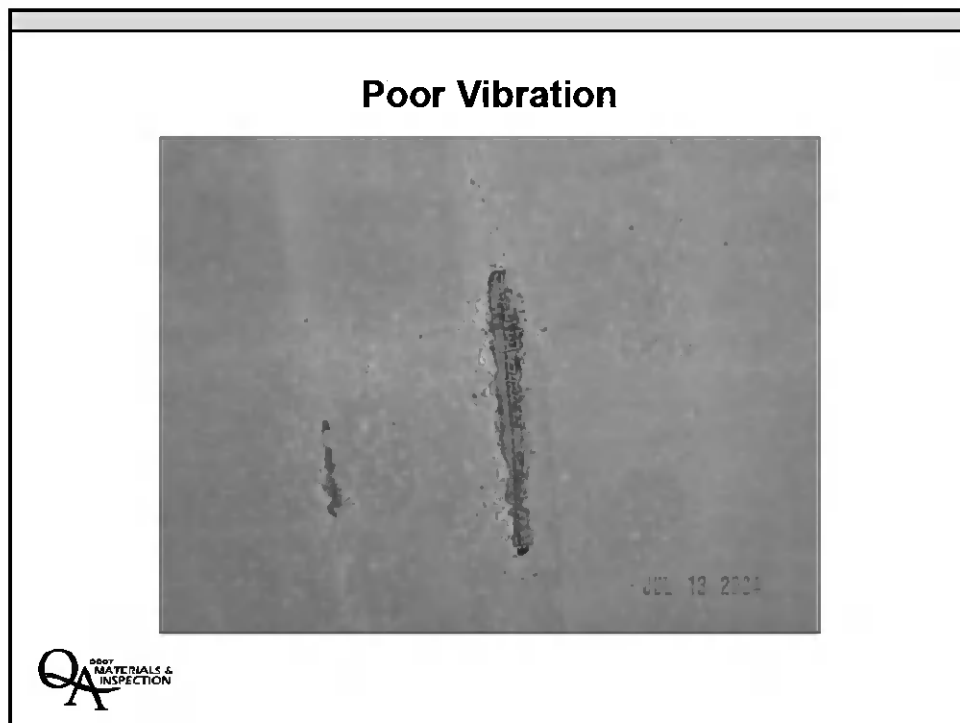


55

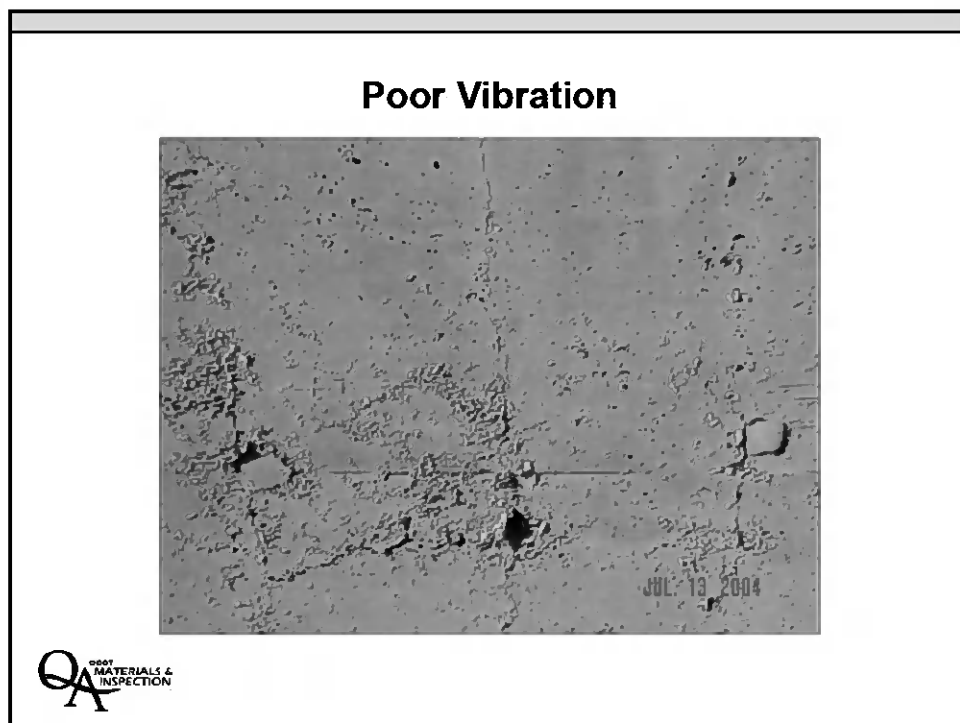
Void at Chair



56



57



58

Unconsolidated Concrete in Sidewalk Area



59

Footprints in Sidewalk Area?



60

Part of Deck Poured at Wrong Grade



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61

Deck Removal Damaged Bulb-T



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62

Pan Decking on Temporary Structure



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63

Form Collapse During Deck Pour



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64

Float Finishing

- Floats at least 4 feet wide.
- Used in overlapping passes.



65



66

Straightedge Checks

- With 12-foot straightedge.
- Both parallel and perpendicular to roadway centerline.
 - At lane lines
 - At bridge ends
 - In gutters



67

Straightedge Checks (continued)

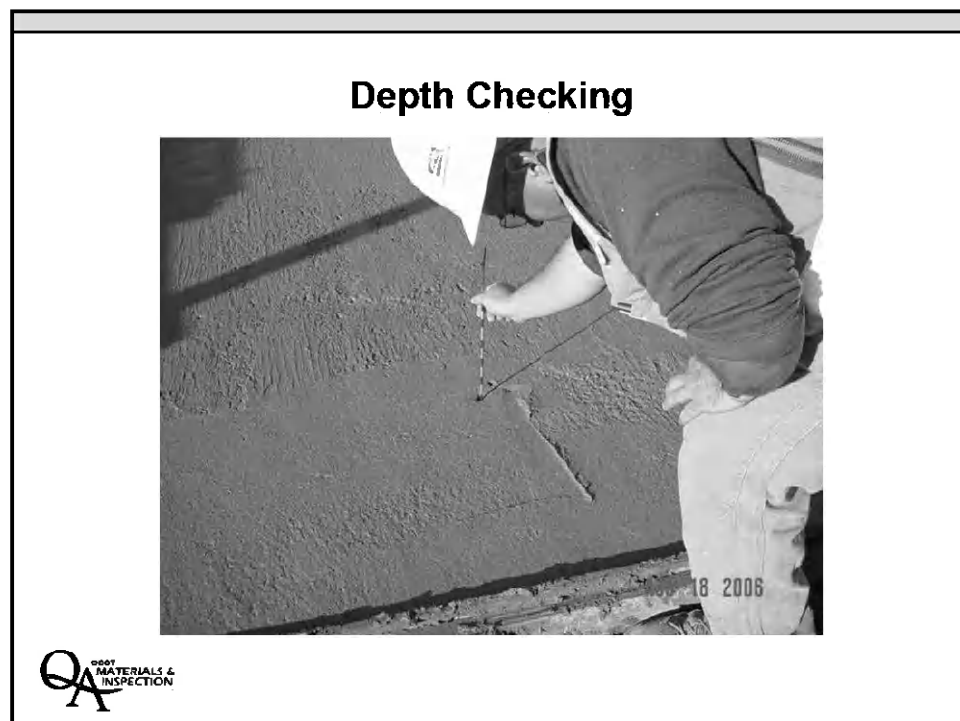
- Must be within 1/8 inch per 12 feet.
- In timely manner to allow for contractor to correct deficiencies while the mix is still workable.



68



69



70

Handwork

- Some hand-finishing is needed in areas that cannot be reached by the mechanical screeding equipment.
- These are the areas where you will tend to see problems.



71

Standing Water on Both Sides of Inlet



72

End Dropoff?



73

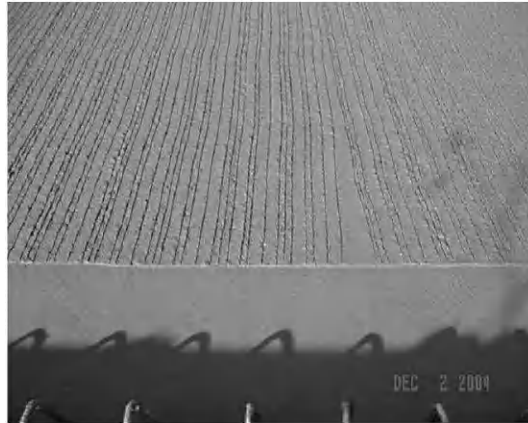
What happened to the rail stirrups?



74

Deck Roadway Texturing

- Saw cut after cure is complete.
- 1/8" – 3/16" deep
- Randomly spaced
- 16" Smooth @ Gutters



75

Deck Roadway Texturing (continued)

- Transverse to centerline
- Avoid overlaps
- 6" From joints



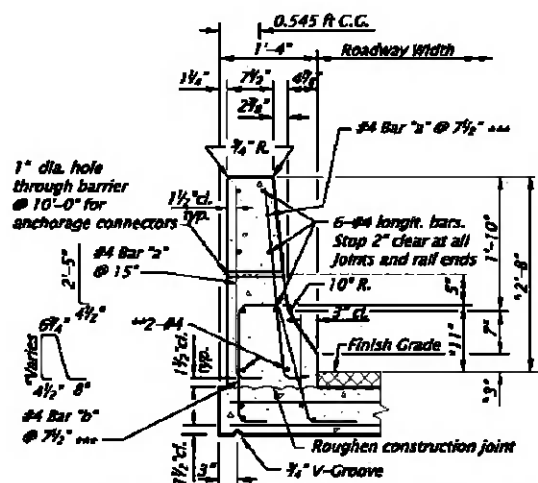
76

Edge of Deck Treatment

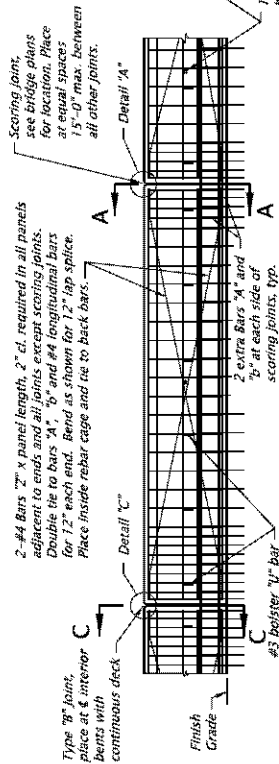


77

Edge of Deck Treatment (1 1/4")

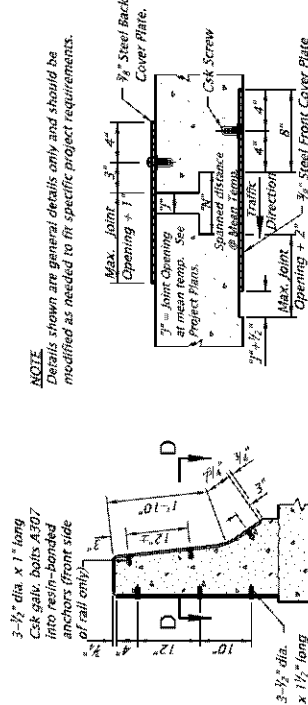


78



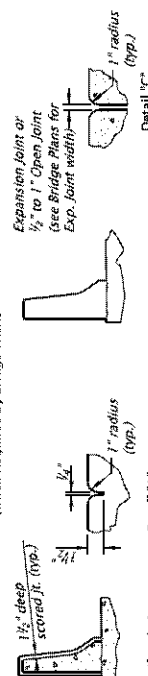
ELEVATION: CONCRETE BRIDGE RAIL (Slip Formed)

NOTE:
Details shown are general details only and should be modified as needed to fit specific project requirements.



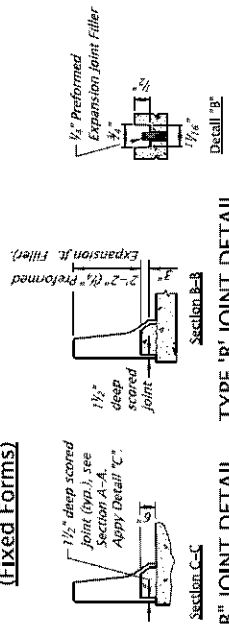
SECTION D-D EXPANSION JOINT COVER PLATE

(When Required by Bridge Plans)



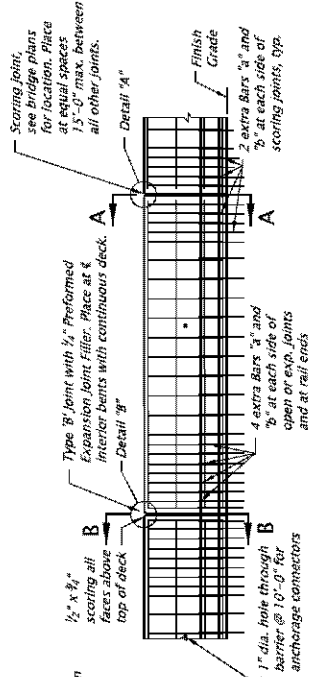
SECTION A-A SCORING JOINT DETAIL (Slip-Formed) (Fixed Forms)

OPEN OR EXPANSION JOINT DETAIL

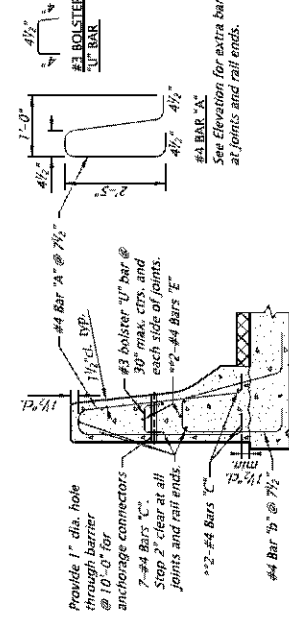


TYPE 'B' JOINT DETAIL (Slip-Formed)

TYPE 'B' JOINT DETAIL (Fixed Forms)



ELEVATION: CONCRETE BRIDGE RAIL (Fixed Forms)



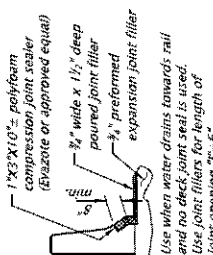
TYPICAL SECTION (Slip Formed)

See TYPICAL SECTION (Fixed Forms) and Elevation for details not shown.
2" bars not shown for clarity.

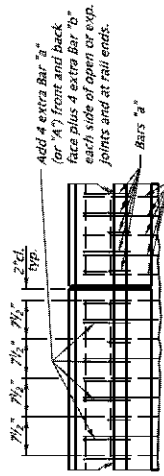
ESTIMATED QUANTITIES

	2"-8" HL	1" added HL
Concrete	2.23 ft. ³ /ft.	0.11 ft. ³ /ft.
Bars "A", "B", "C", "D", "E", "F", "G", "H", "I", "J", "K", "L", "M", "N", "O", "P", "Q", "R", "S", "T", "U", "V", "W", "X", "Y", "Z"	10.81 #/ft.	14.83 #/ft.
Fixed Forms		
Slip Forms		

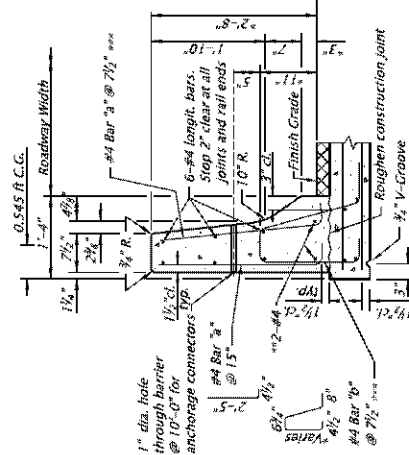
Bar weight assume joints at 15'-0" cts.



DETAIL "D"



PLAN: BARS AT OPEN OR EXPANSION JOINTS AND RAIL ENDS



TYPICAL SECTION (Fixed Forms)

GENERAL NOTES
Rail designed and crashed tested to meet NCHRP 350 TL-4 requirements.
Provide all reinforcing steel conforming to ASTM A706 or AASHTO M31 (ASTM A615) Grade 60.
Place all bars 2" clear of the nearest face of concrete unless shown otherwise.
Provide Class 3300 - 1/2" or 3/4" concrete.
Provide steel cover plates conforming to AASHTO M183 (ASTM A36).
Hot dip galvanize after fabrication.
At skewed bents up to 20' make joints parallel to the bent center line.
For skewed greater than 20' make joints normal to rail.

Accompanied by DWG. BR203

CALC. BOOK NO. _____

BASELINE REPORT DATE: 20-April-2018
NOTE: All material and workmanship shall be in accordance with the current Oregon Standard Specifications.

OREGON STANDARD DRAWINGS TYPE "F" CONCRETE RAIL

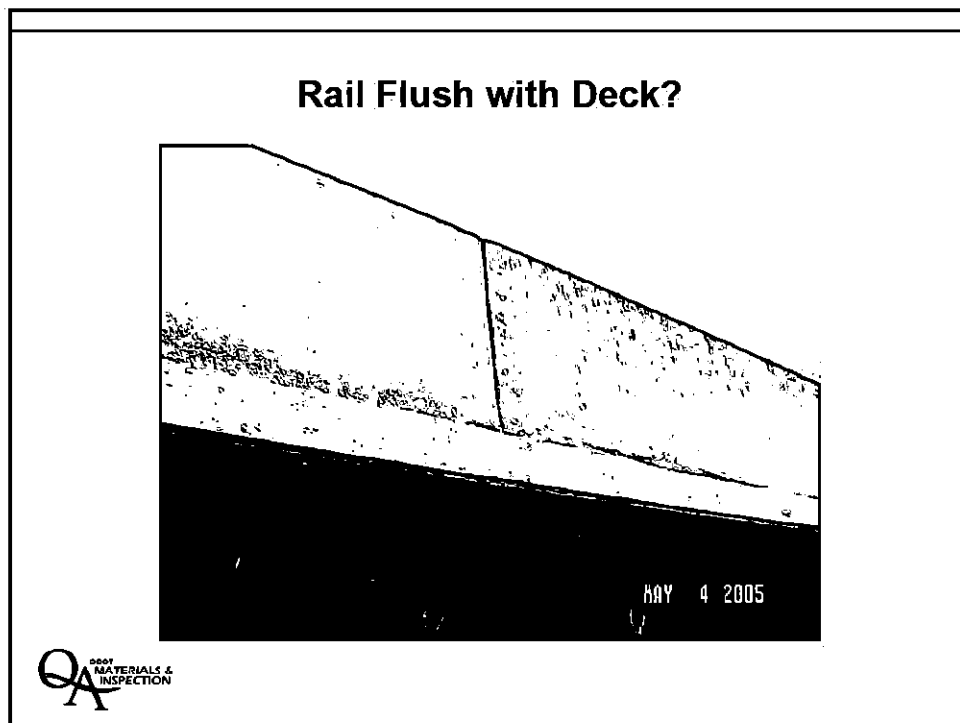
2018

DATE	REVISION DESCRIPTION
2/13/18	Updated drawing title to match BR200

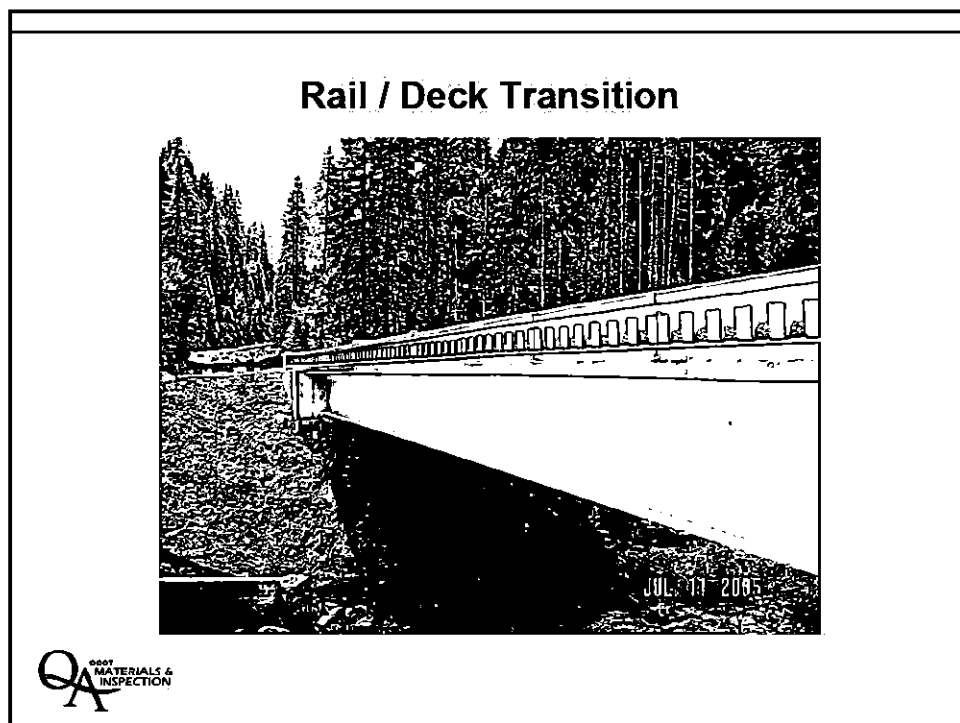
The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without consulting a Registered Professional Engineer.

Effective Date: December 1, 2019 - May 31, 2020

BR200



79



80

Rail Overhangs Deck?

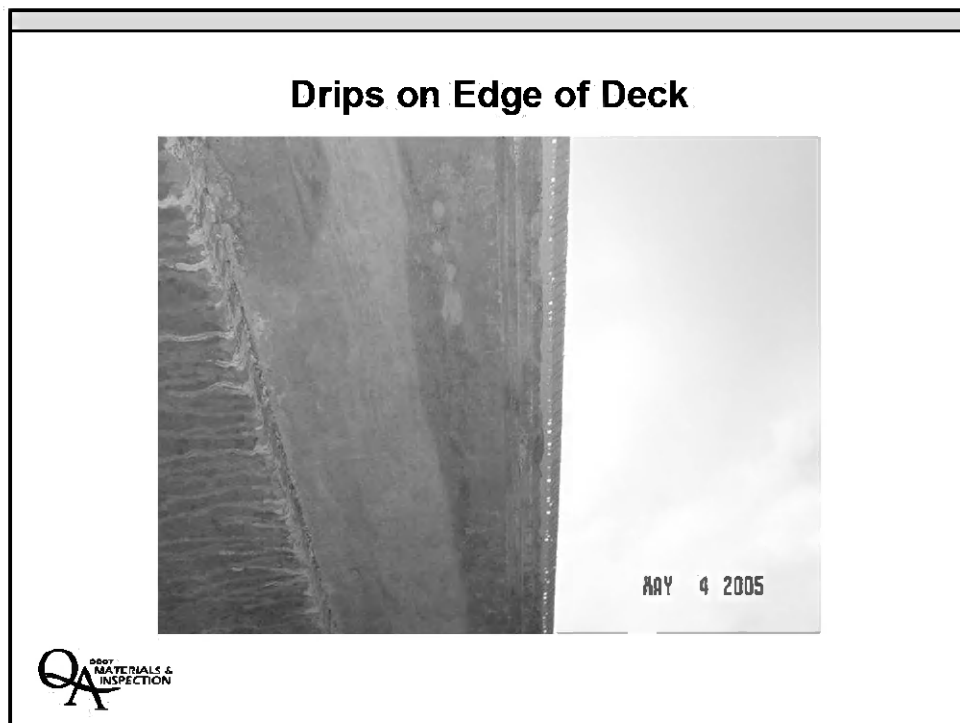


81

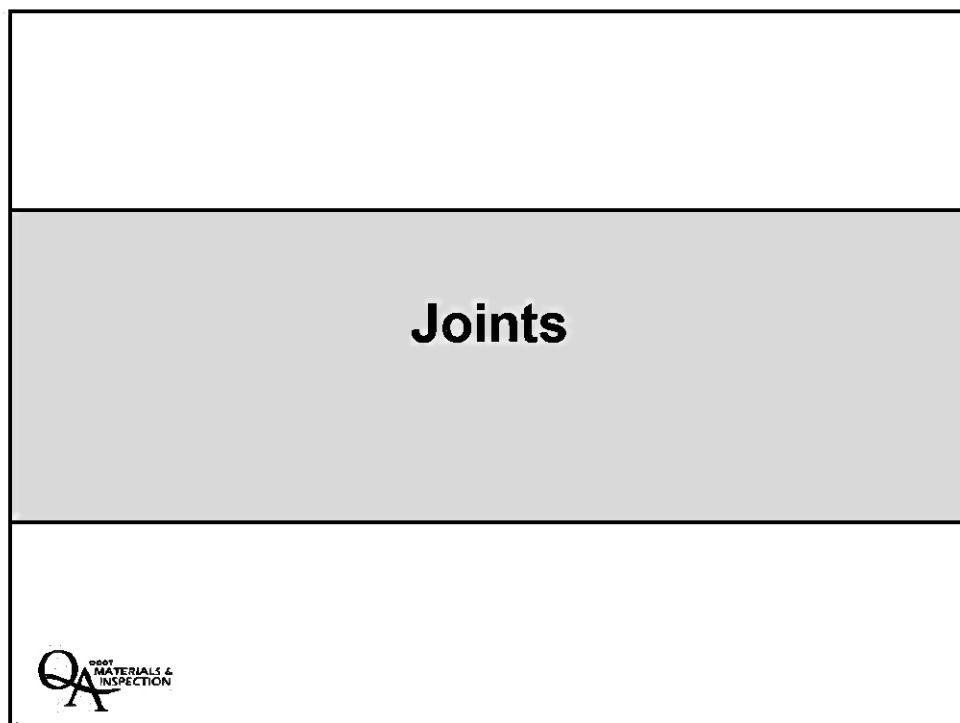
Checking Edge of Deck Location on Curve



82



83



84

Construction Joint

- Only at planned/approved locations.
- Surface retarder required (00540.43).
- “Roughened-surface” or “shear-key” type per plans.
- Pre-wet for next pour.



85

Roughened Surface

Surface retarder
required
00540.43



86

Shear Key in 30" Deep Deck



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87

Shear Key in 30" Deep Deck



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88

Construction Joints (continued)

- Use extra care to vibrate adequately against the existing surface. Increase the number of insertion points.
- If bonding agent is used, it must not be dry when the concrete is placed, or it will do the opposite and create a bond breaker.



89

Open gaps at closure pour?



90

Voids Behind Stay-in-Place Form

Stay-in-place joint forms are not allowed in bridge deck construction joints. 00540.43(a)



91

Voids



92

Voids Behind Stay-in-Place Form



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93

Transverse Joint with Stay-in-Place Form Material?



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94

Shear Key Blockout



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95

Shear Key



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96

Expansion Joints



97

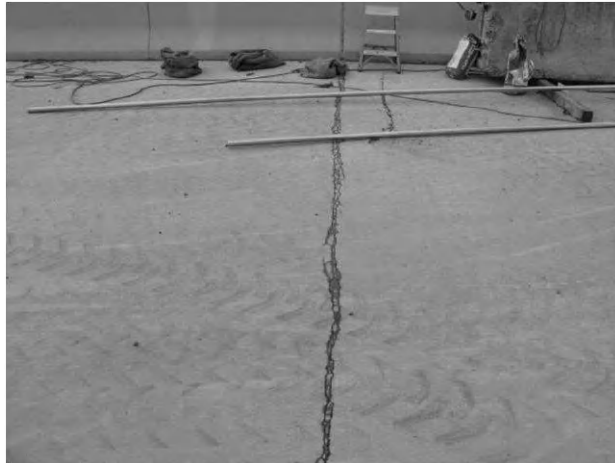
Protect Edges



98

Joint Edges?

Joint wanders



99

Repaired Joint Edge

Repaired with
Kwikbond
Polymer PPC
Easy Patch Fine
Mix



100

Repaired Joint Edge

Repaired with
Propoxy 2500

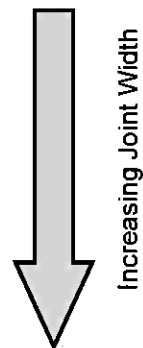


101

Expansion Joints

Common Joint Types

- Sawcut
- Preformed joint material
- Poured joint
- Asphalt plug joint
- Compression seal
- Strip seal
- Segmental joint
- Finger joint
- Modular Joint



102

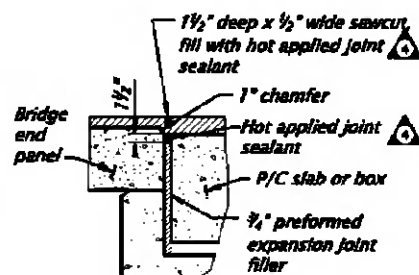
Sawcut



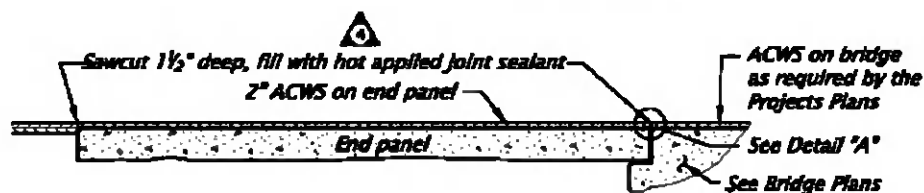
103

Sawcut Detail

- Sawcut 1½"
- Fill with hot applied joint sealant



**JOINT DETAIL with
SLABS or BOXES
DETAIL "A"**



END PANEL WITH ASPHALT PAVEMENT ON BRIDGE

104

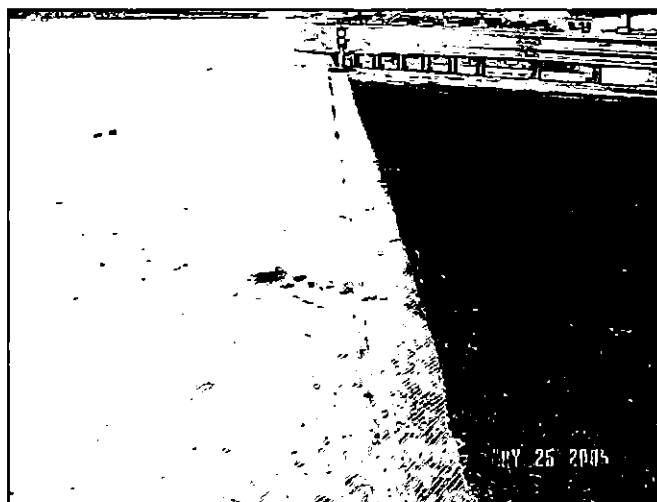


Preformed Joint Material



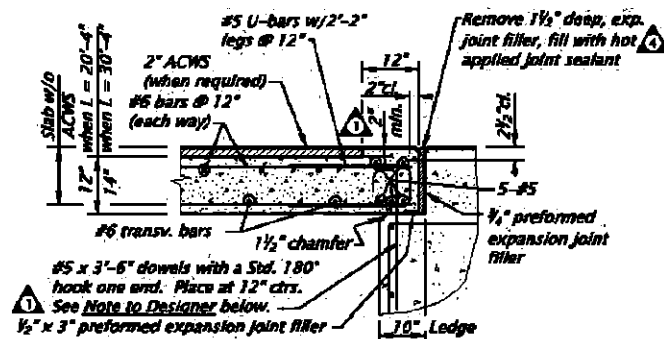
105

Preformed Joint Material



106

Preformed Expansion Joint Filler



TYPICAL BRIDGE END DETAIL
WITHOUT EXPANSION JOINT BLOCKOUT

- Remove 1½ " deep
- Fill with hot applied joint sealant

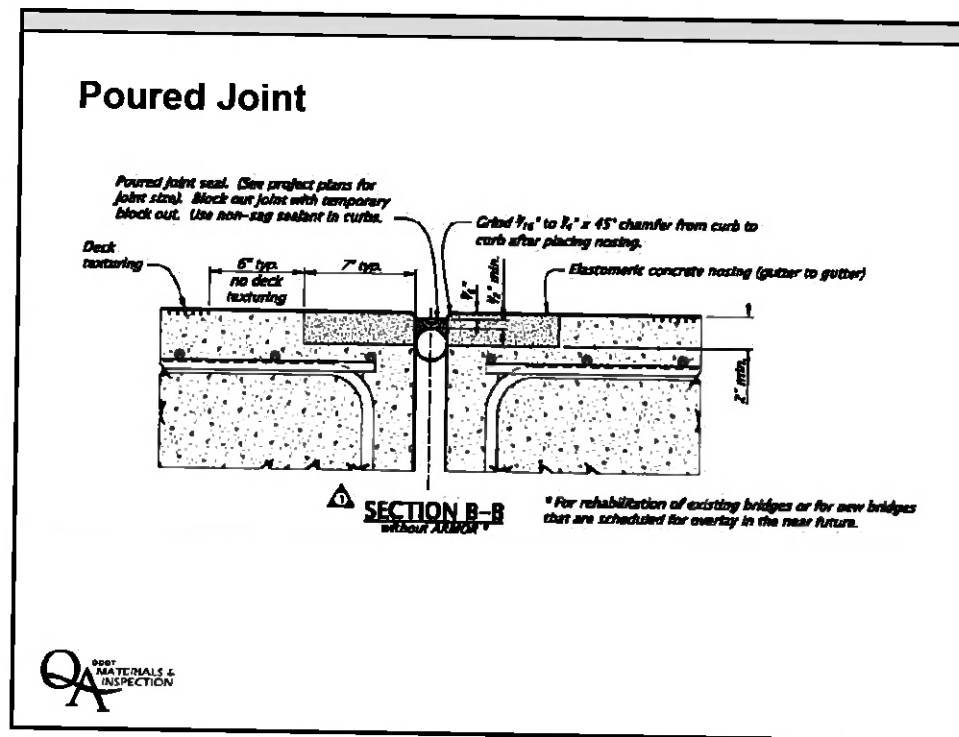


107

Poured Joint



108



109



110



111



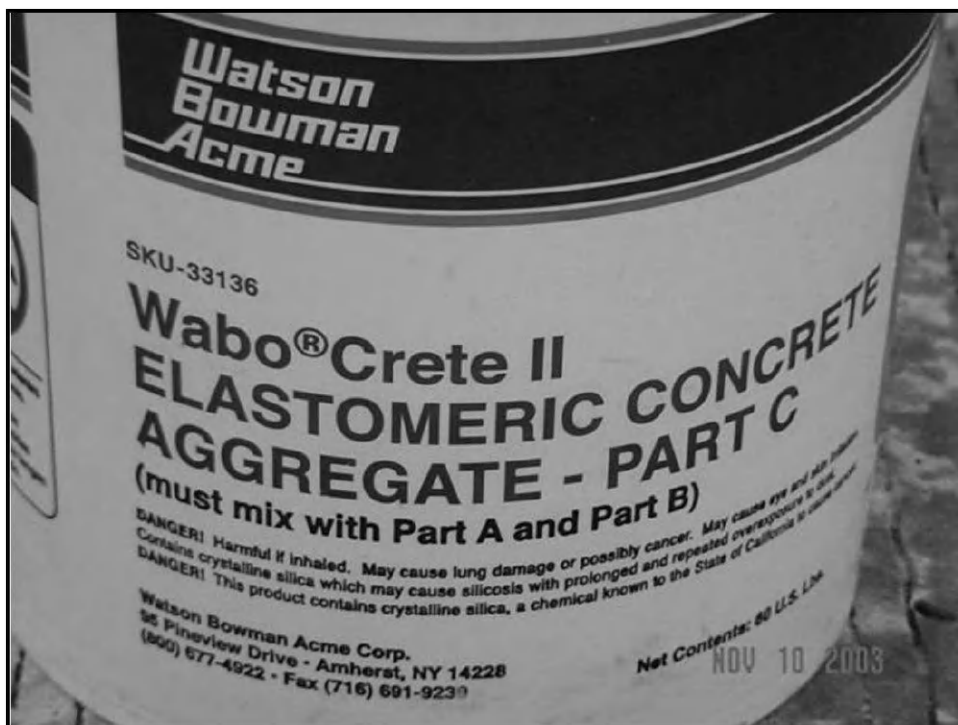
112



113



114



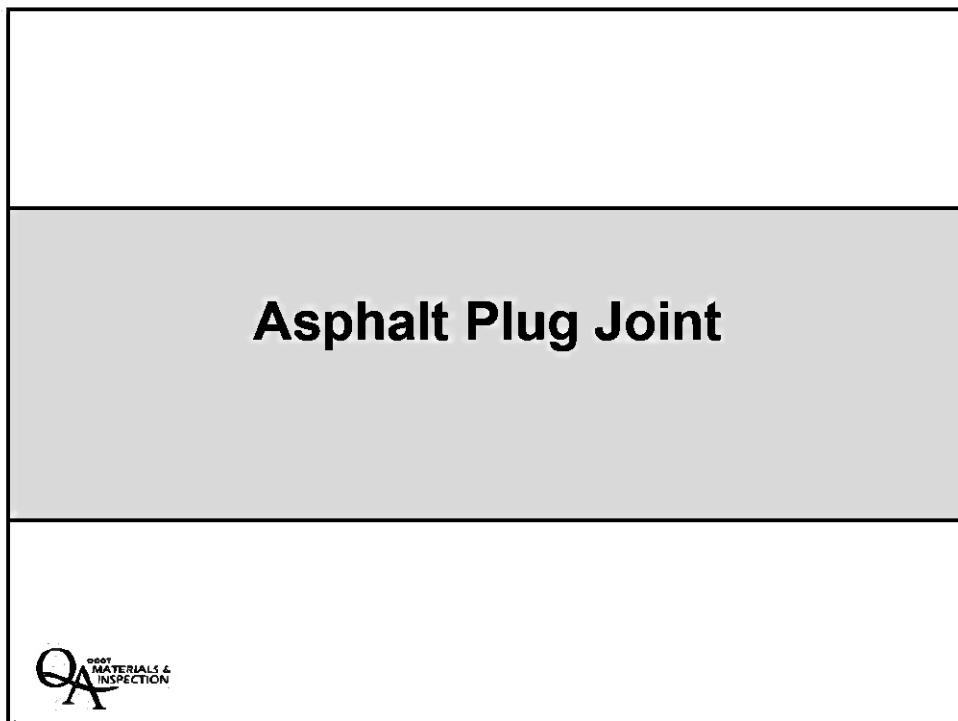
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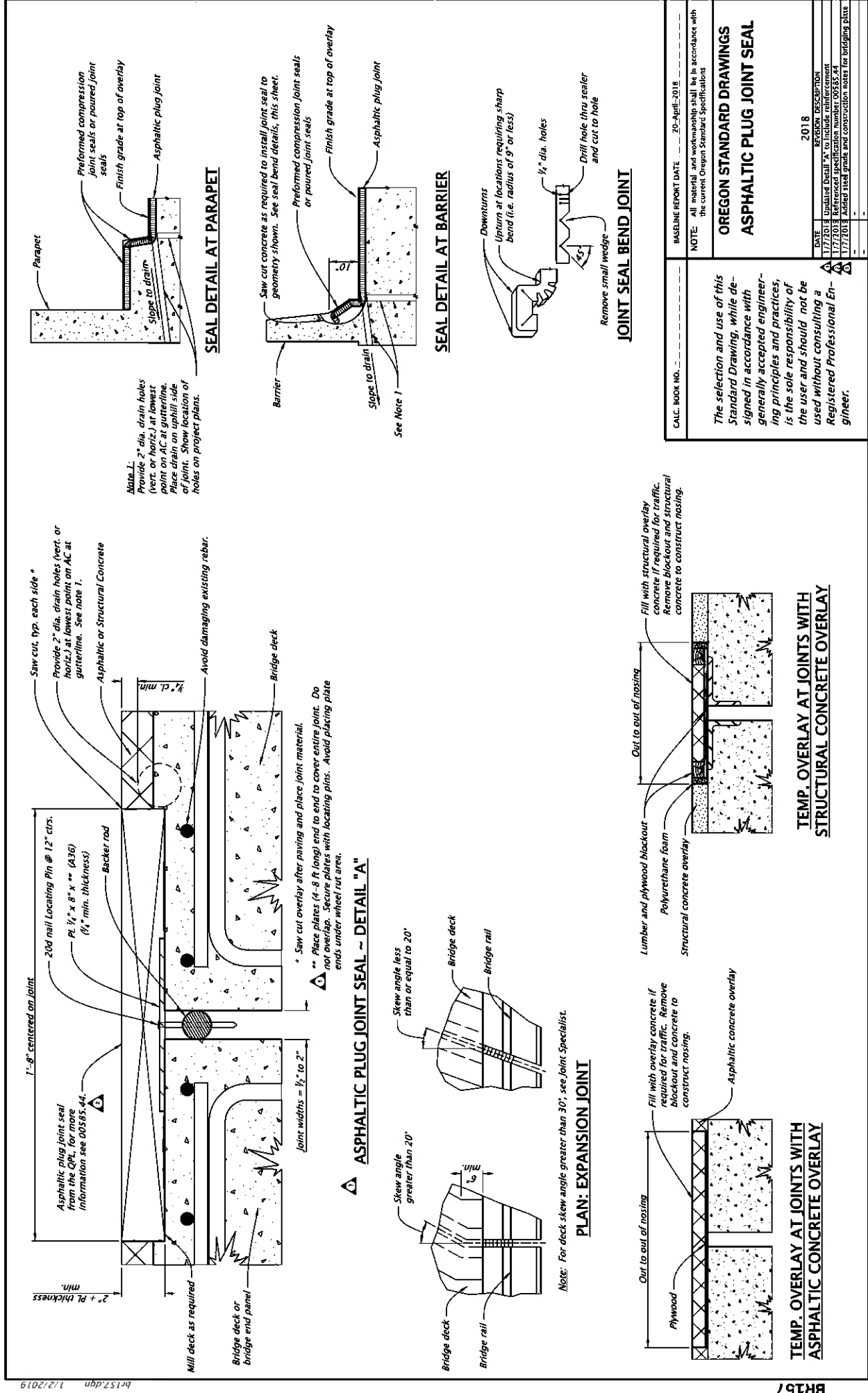
116



117



118



SEAL DETAIL AT PARAPET

Parapet

Preformed compression joint seals or poured joint seals

Finish grade at top of overlay

Asphaltic plug joint

Slope to drain

Note 1: Provide 2" dia. drain holes (vert. or horiz.) at lowest point on AC at gutterline. Place drain on uphill side of joint. Show location of holes on project plans.

SEAL DETAIL AT BARRIER

Barrier

Saw cut concrete as required to install joint seal to geometry shown. See seal bend details, this sheet.

Preformed compression joint seals or poured joint seals

Finish grade at top of overlay

Asphaltic plug joint

Slope to drain

See Note 1

JOINT SEAL BEND JOINT

Downturns

Upturn at locations requiring sharp bend (i.e. radius of 9" or less)

1/2" dia. holes

Drill hole thru sealer and cut to hole

Remove small wedge

CALC. BOOK NO. _____

BASELINE REPORT DATE: 20-April-2018

NOTE: All materials and workmanship shall be in accordance with the current Oregon Standard Specifications

OREGON STANDARD DRAWINGS

ASPHALTIC PLUG JOINT SEAL

2018

DATE: 1/2/2019

DESIGNED BY: J. L. BROWN

CHECKED BY: J. L. BROWN

APPROVED BY: J. L. BROWN

PROJECT NO.: 00555-41

1/2/2018 Revised specifications for bridge plate

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without consulting a Registered Professional Engineer.

1'-8" centered on joint

20d nail Locating Pin @ 12" ctrs.

Pl. 1/2" x 8" x 1/4" (A36) (1/4" min. thickness)

Backer rod

Asphaltic or Structural Concrete

2" + Pl. thickness

Mill deck as required

Bridge deck or bridge end panel

Joint widths = 1/2" to 2"

1/2" cl. min.

Avoid damaging existing rebar.

Bridge deck

1'-8" centered on joint

20d nail Locating Pin @ 12" ctrs.

Pl. 1/2" x 8" x 1/4" (A36) (1/4" min. thickness)

Backer rod

Asphaltic or Structural Concrete

2" + Pl. thickness

Mill deck as required

Bridge deck or bridge end panel

Joint widths = 1/2" to 2"

1/2" cl. min.

Avoid damaging existing rebar.

Bridge deck

ASPHALTIC PLUG JOINT SEAL - DETAIL "A"

1'-8" centered on joint

20d nail Locating Pin @ 12" ctrs.

Pl. 1/2" x 8" x 1/4" (A36) (1/4" min. thickness)

Backer rod

Asphaltic or Structural Concrete

2" + Pl. thickness

Mill deck as required

Bridge deck or bridge end panel

Joint widths = 1/2" to 2"

1/2" cl. min.

Avoid damaging existing rebar.

Bridge deck

PLAN: EXPANSION JOINT

Note: For deck skew angle greater than 30°, see Joint Specialist.

Skew angle greater than 20°

Skew angle less than or equal to 20°

Bridge deck

Bridge rail

Bridge deck

Bridge rail

TEMP. OVERLAY AT JOINTS WITH ASPHALTIC CONCRETE OVERLAY

Fill with overlay concrete if required for traffic. Remove blockout and concrete to construct nosing.

Asphaltic concrete overlay

Plywood

Out to out of nosing

TEMP. OVERLAY AT JOINTS WITH STRUCTURAL CONCRETE OVERLAY

Fill with structural overlay concrete if required for traffic. Remove blockout and structural concrete to construct nosing.

Structural concrete overlay

Polyurethane foam

Lumber and plywood blockout

Out to out of nosing



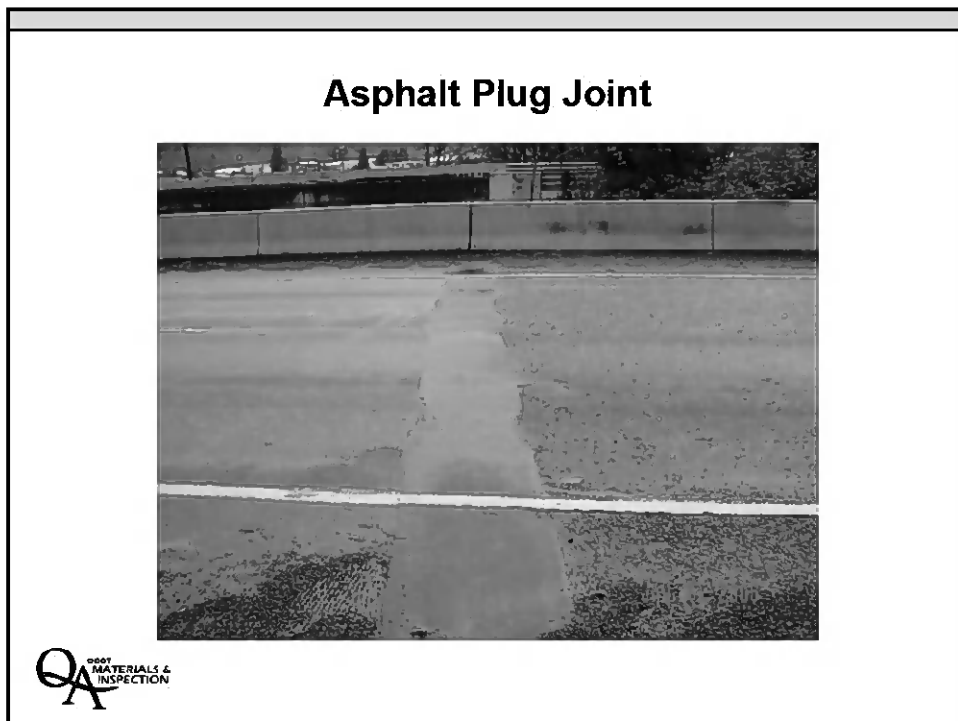
121



122



123



124

Pothole in Asphalt Plug Joint



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125



126

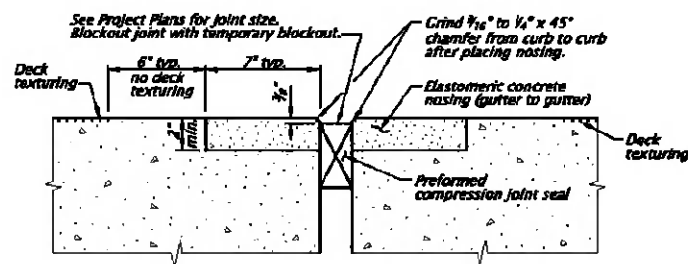
Compression Seal



127

Compression Seal For movement up to 1½"

Seal Type	Total Movement Range	Nominal Size		Joint Width		Minimum Installation Width
		Width	Height	Min.	Max.	
A	½"	1½"	1½"	½"	1"	¾"
B	¾"	2"	2"	¾"	1½"	1¼"
C	1"	2½"	2½"	1"	2"	1½"
D	1¼"	3"	3¼"	1¼"	2½"	1¾"
E	1½"	3½"	3½"	1½"	2¾"	2¼"



SECTION B-B
without ARMOR*

* For rehabilitation of existing bridges or for new bridges that are scheduled for overlay in the near future.

128

Technical drawing of a bridge deck showing the expansion joint and bridge rail details. The drawing includes the following labels and annotations:

- Bridge rail**: Points to the top and bottom railings of the bridge deck.
- For skew angles see PLAN; EXPANSION JOINT (this sheet)**: A note pointing to the expansion joint area.
- See Note 1**: A note pointing to a detail of the expansion joint.
- Bridge deck**: Points to the main structural surface of the bridge.
- Stoage**: Points to a sloped section of the bridge deck.
- A or B**: Two points indicating specific locations on the bridge deck, likely related to the expansion joint.

REHABILITATIVE BRIDGE JOINT (Armored joint with AC or PCC Overlay)

SECTIONS AT RAIL

CALC. BOOK NO. -

See Project Plans for details not shown.

PLAN: EXPANSION JOINT

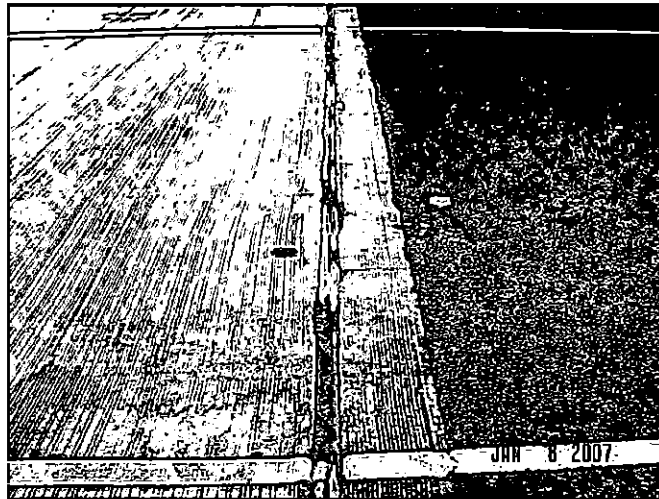
810c

DATE	REVISION DESCRIPTION	2010
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BR139

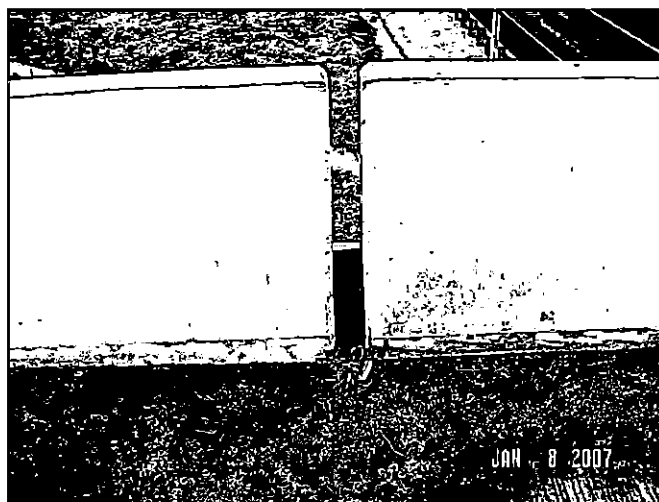
Compression Seal without Armor



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129

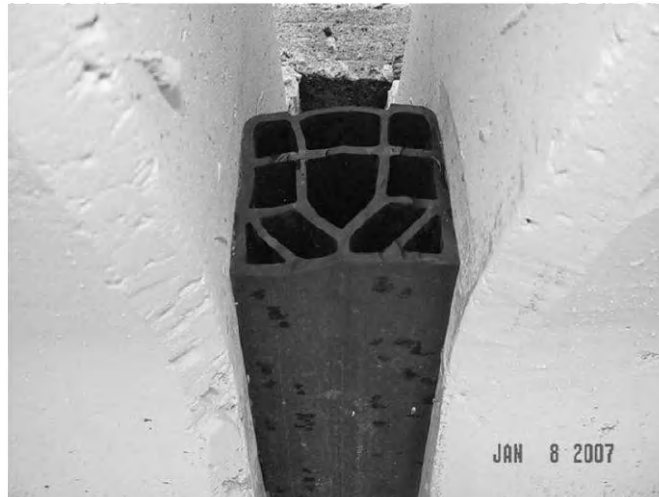
Compression Seal End in Rail



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130

Compression Seal End



131

Compression Joint Repair

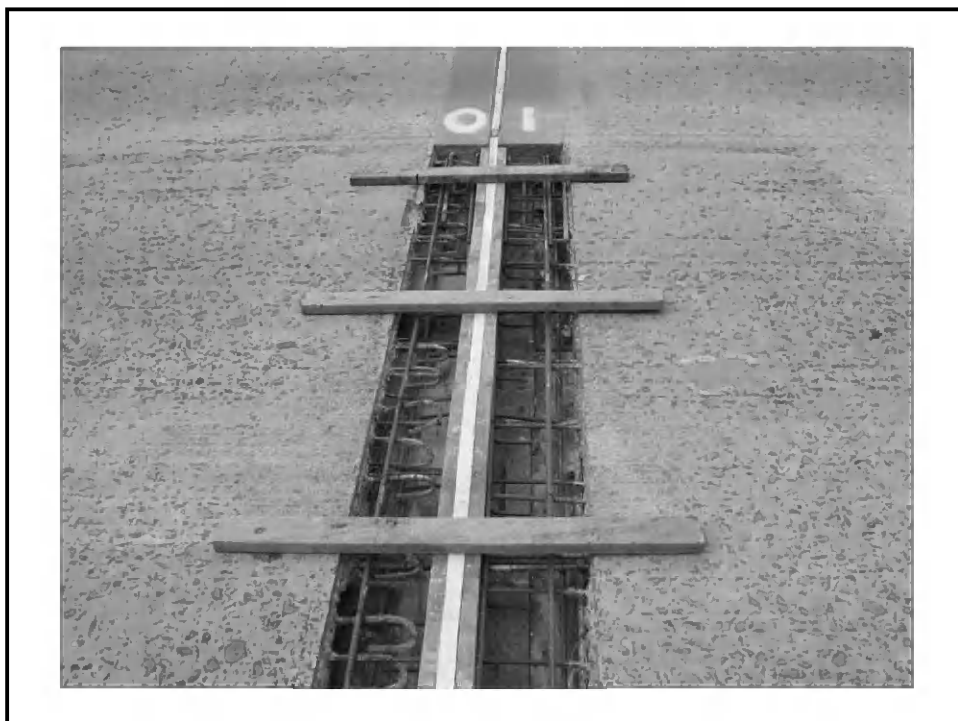
N Fk Quartz Cr



132



133



134



135



136



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138



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140



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143



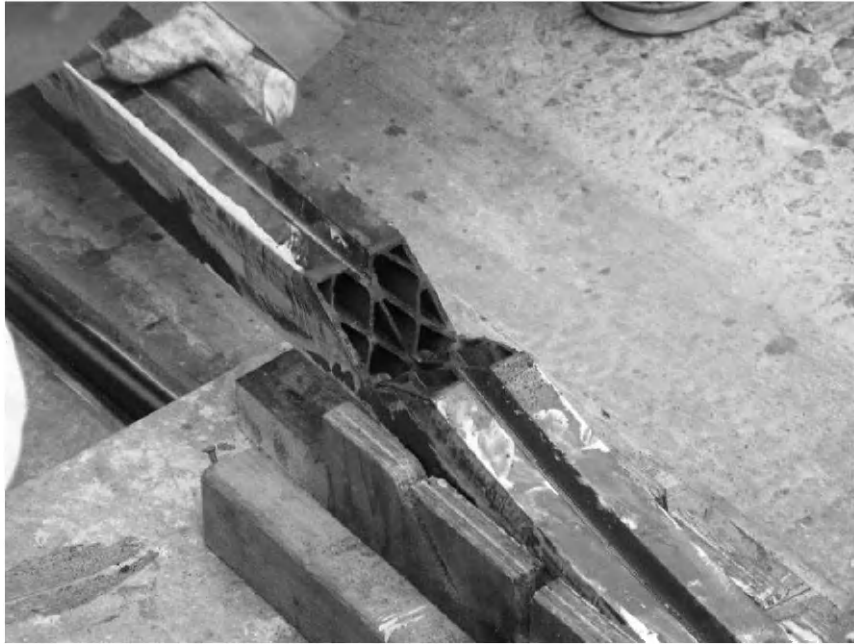
144



145



146



147



148



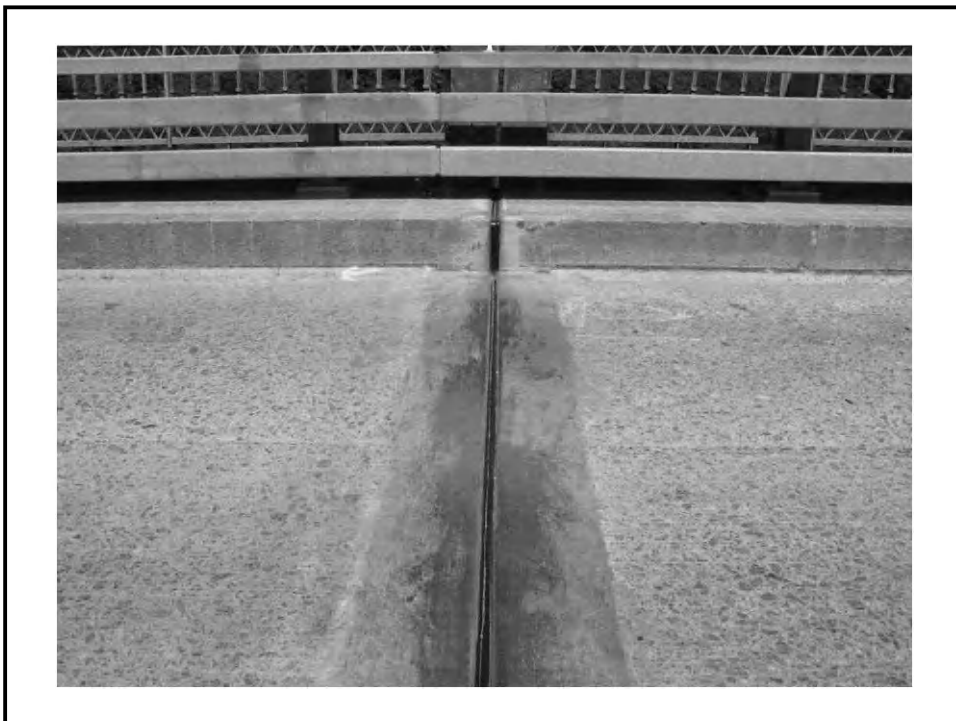
149



150



151



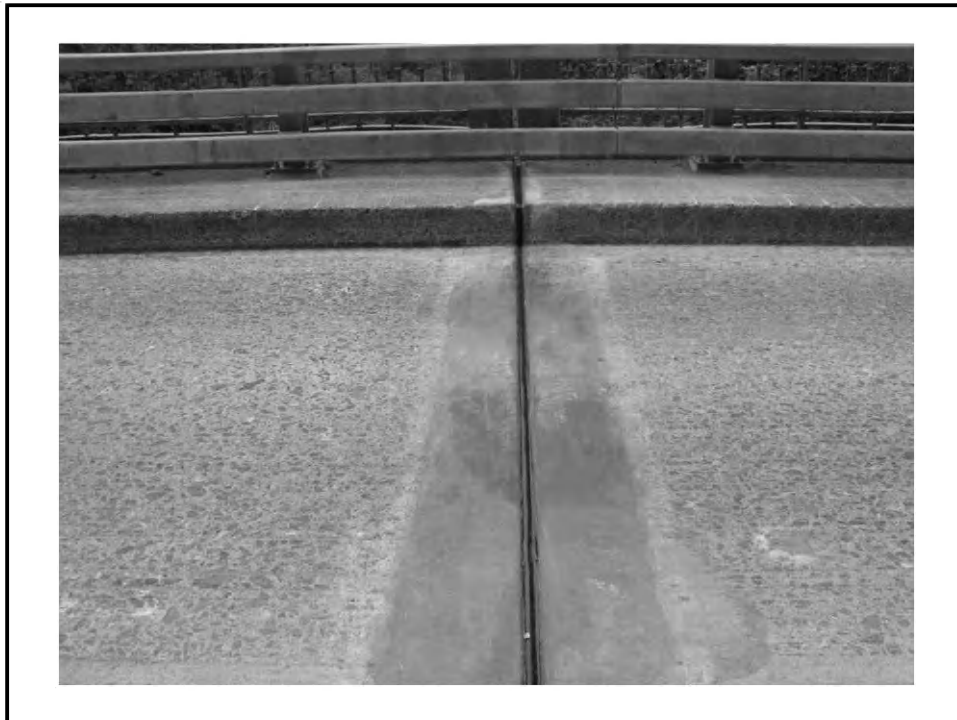
152



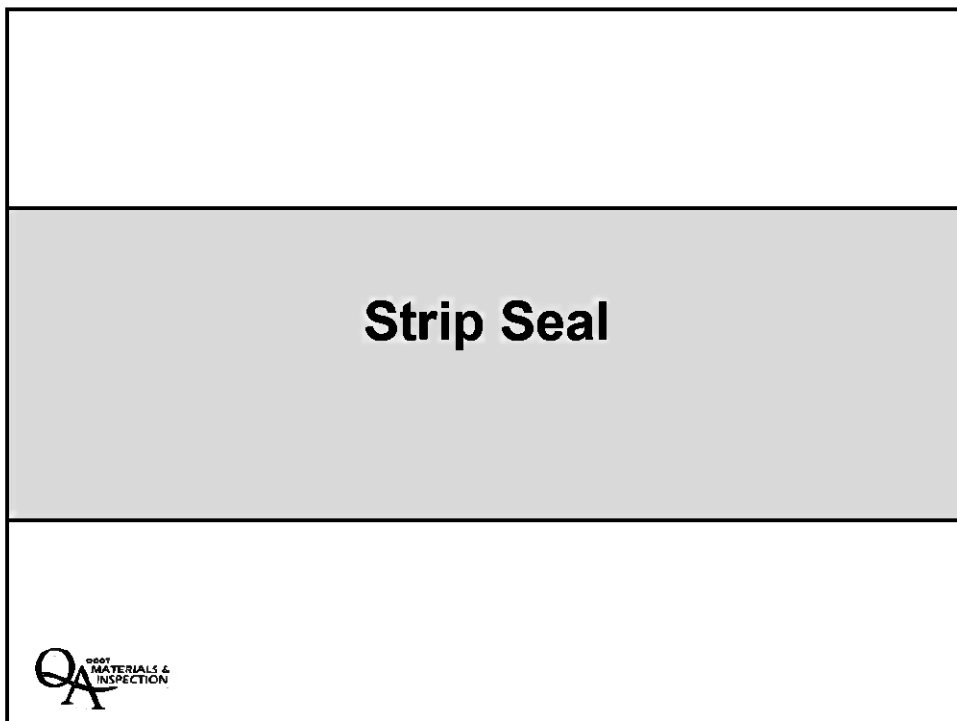
153



154

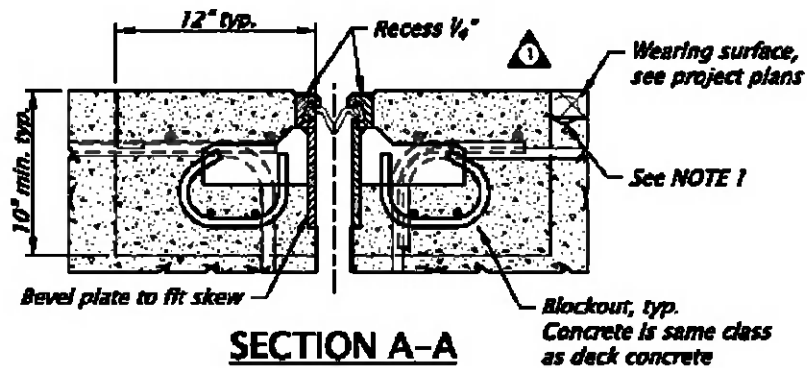


155



156

Strip Seal



For movement up to 4"



157

Adjust for Temperature Variations

Install extrusions to a manufacture's recommended installation width. Check detail drawings. Adjust as required for variations in structure temperature as shown on project plans.



158

Coefficient of Expansion

- Steel $6.5 \times 10^{-6} / ^\circ\text{F}$
- Concrete $5.5 \times 10^{-6} / ^\circ\text{F}$
- Aluminum $13.1 \times 10^{-6} / ^\circ\text{F}$



159

Thermal Movement Example

- 100 ft steel girder bridge
- How much movement would you expect from a 15°F temperature change?

$$(0.0000065 / ^\circ\text{F}) (100 \text{ ft})(15^\circ\text{F}) = 0.01 \text{ ft}$$

$$0.01 \text{ ft} = 1/8''$$



160

Thermal Movement Exercise

- 600 ft steel girder bridge with joints at both ends.
- If the average temperature for the area is 70°F, how much would you adjust the joint for a closure pour if the beam temperature is 40°F?
- Do you increase or decrease the joint opening?



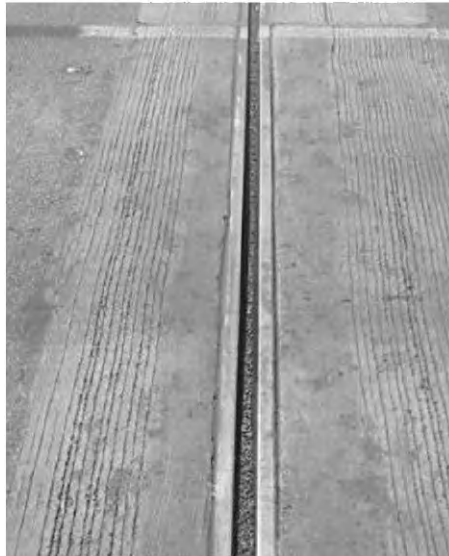
161

Strip Seal



162

Strip Seal



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163

Strip Seal



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164

Strip Seal



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165

Surface Not Level

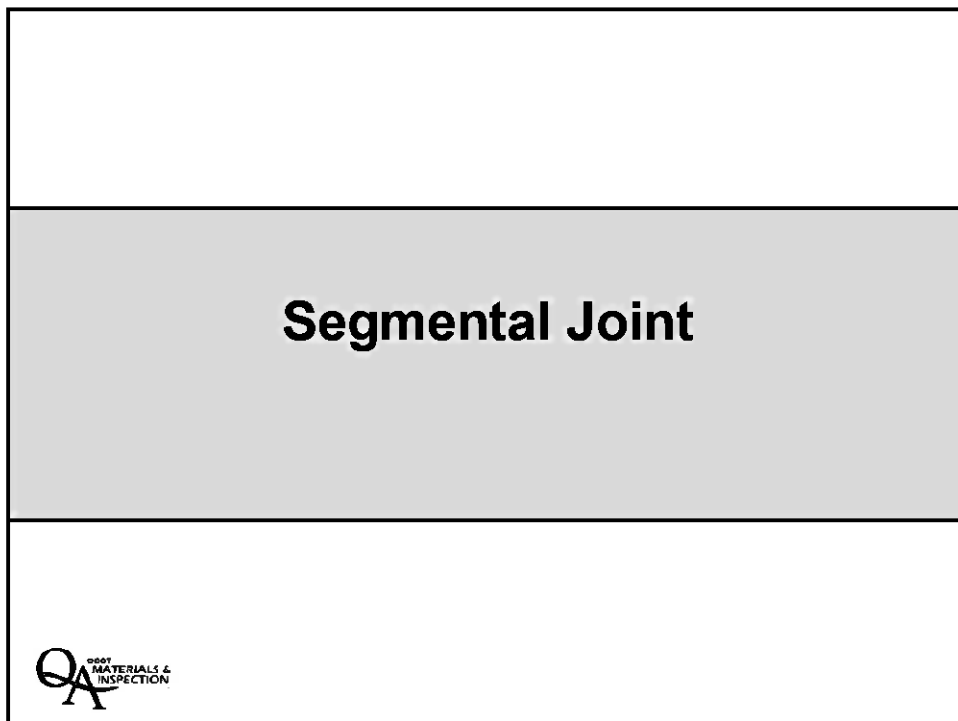


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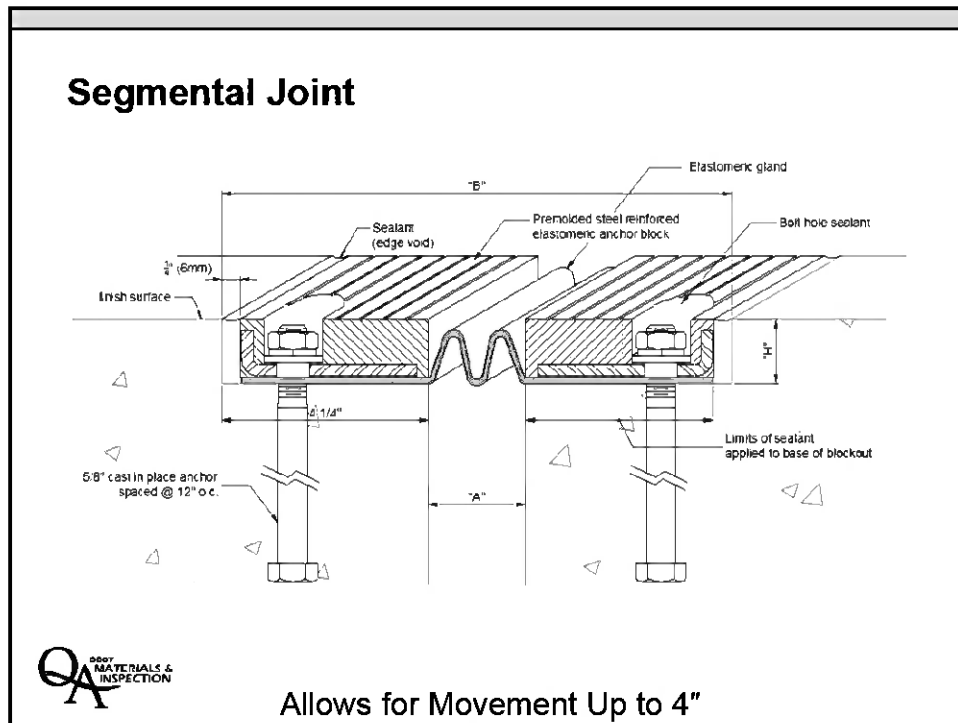
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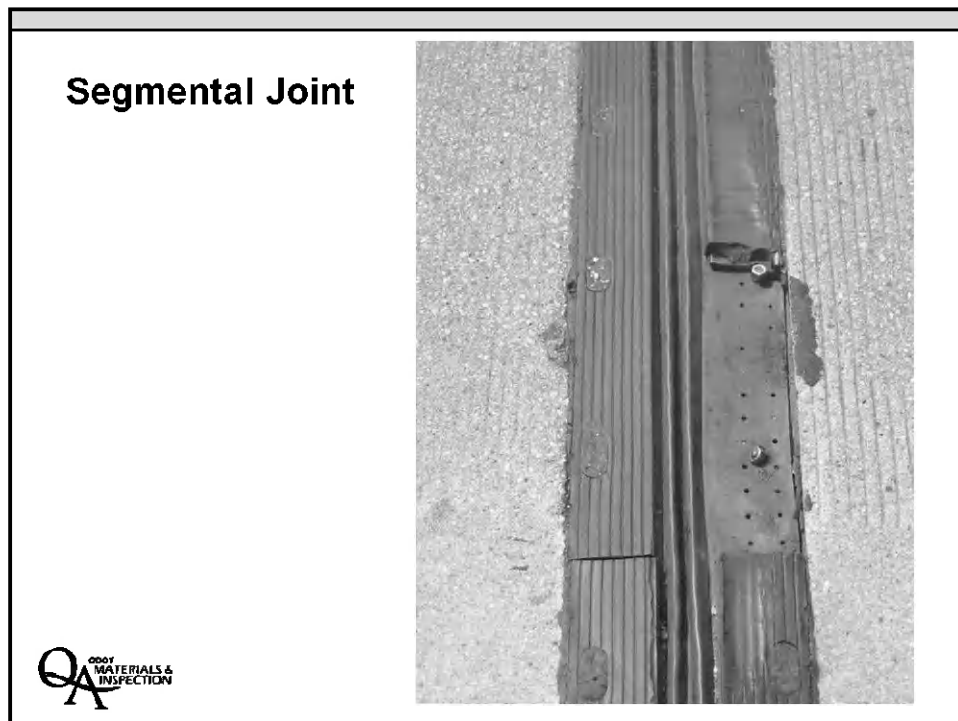
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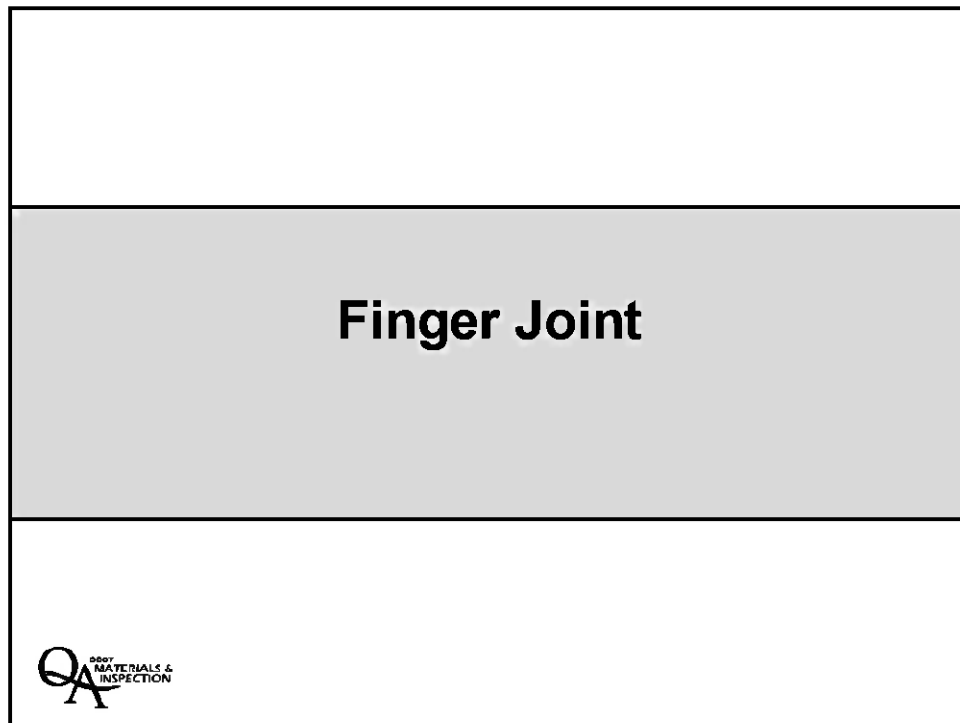
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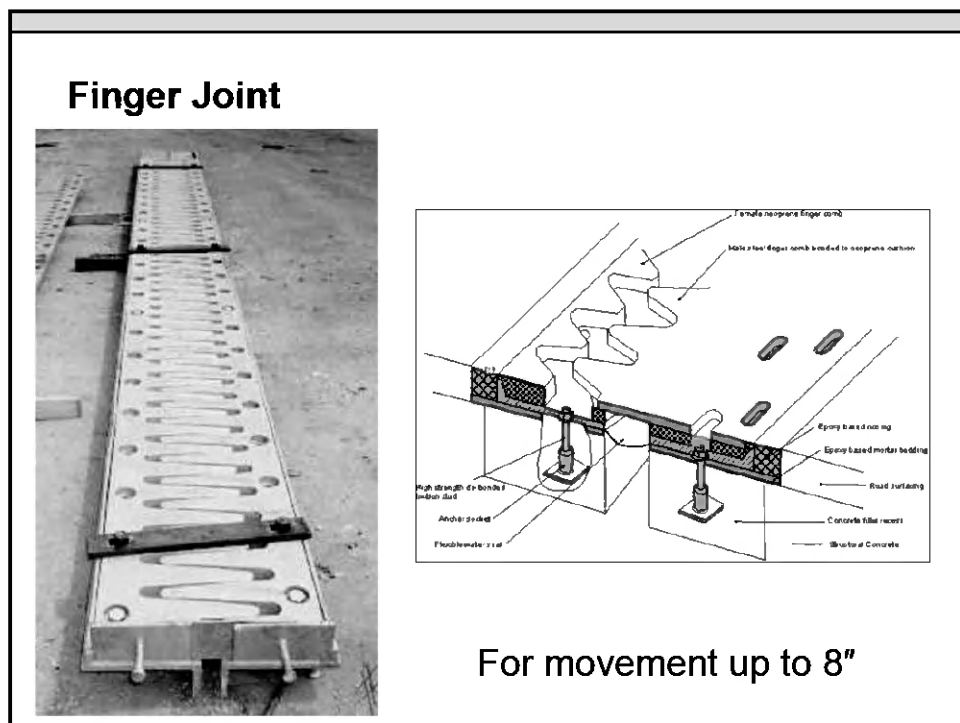
169



170



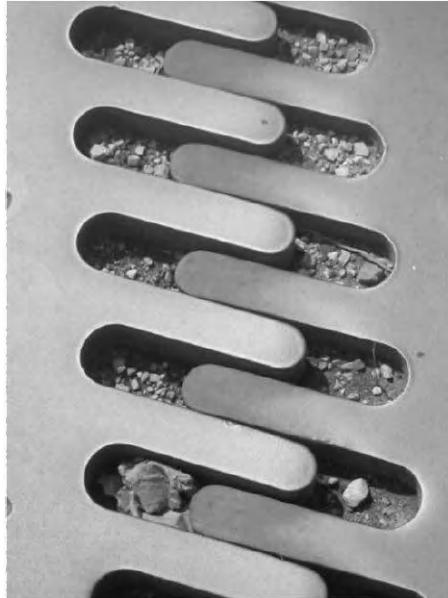
171



172

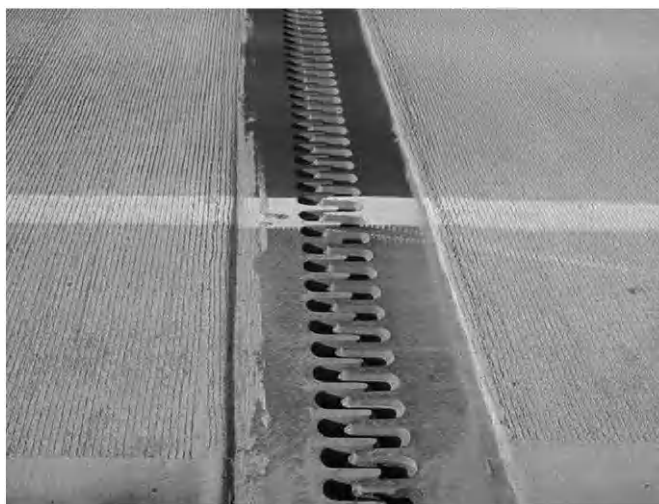
Finger Joint

Allows for movement
up to 8"



173

Finger Joint



174

Modular Joint



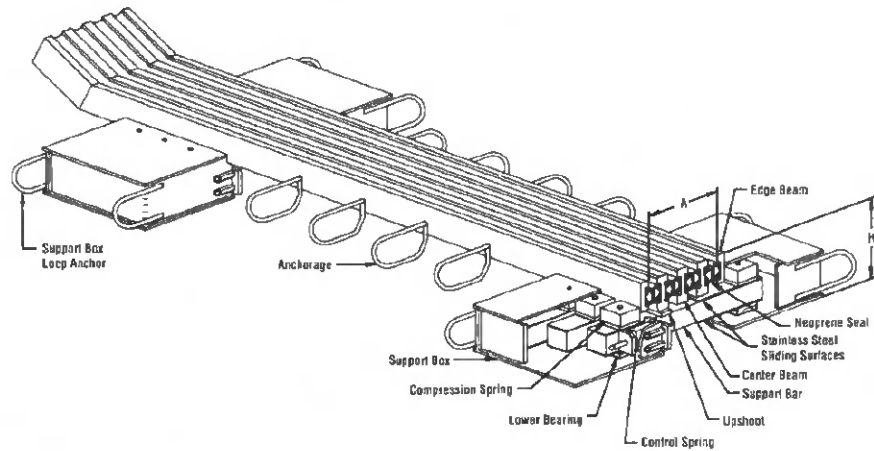
175

Modular Joint



176

Modular Joint



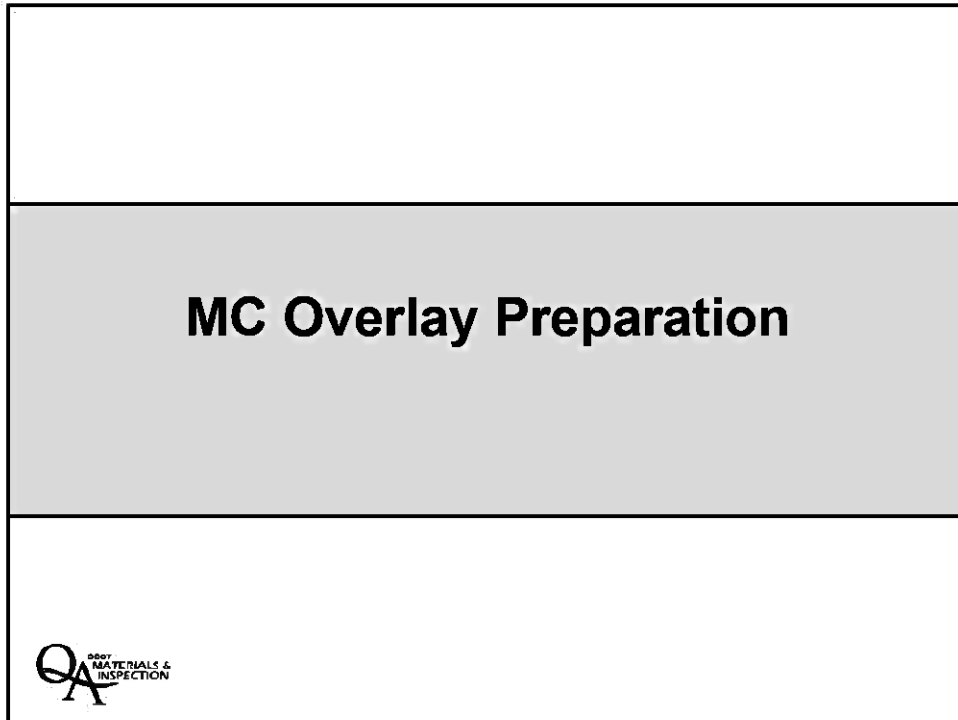
Allows for large movements.

177

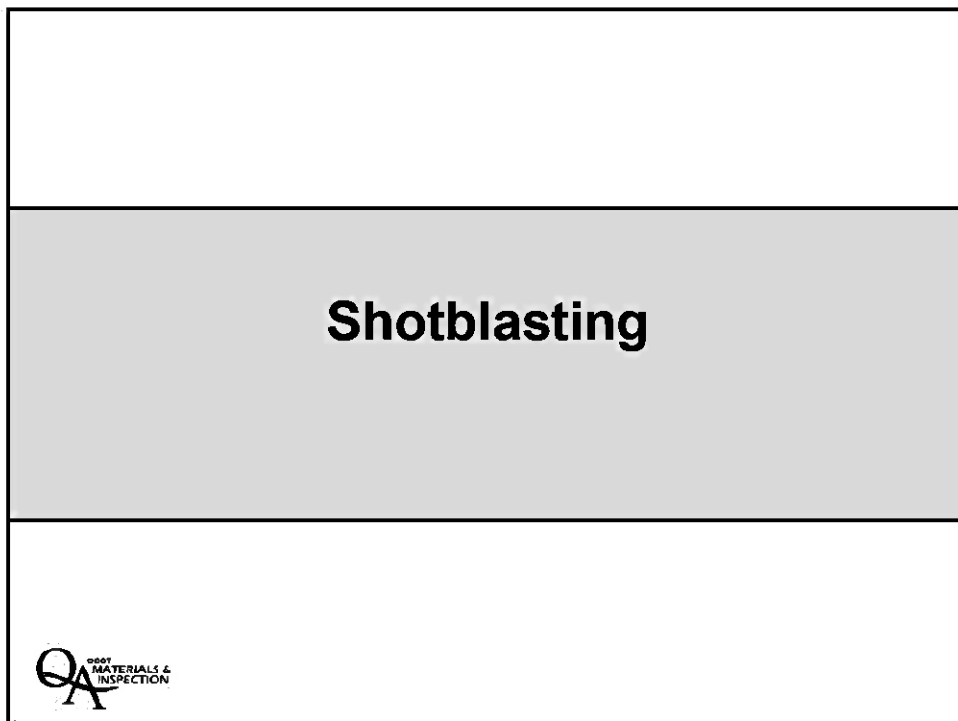
Modular Joint



178



179



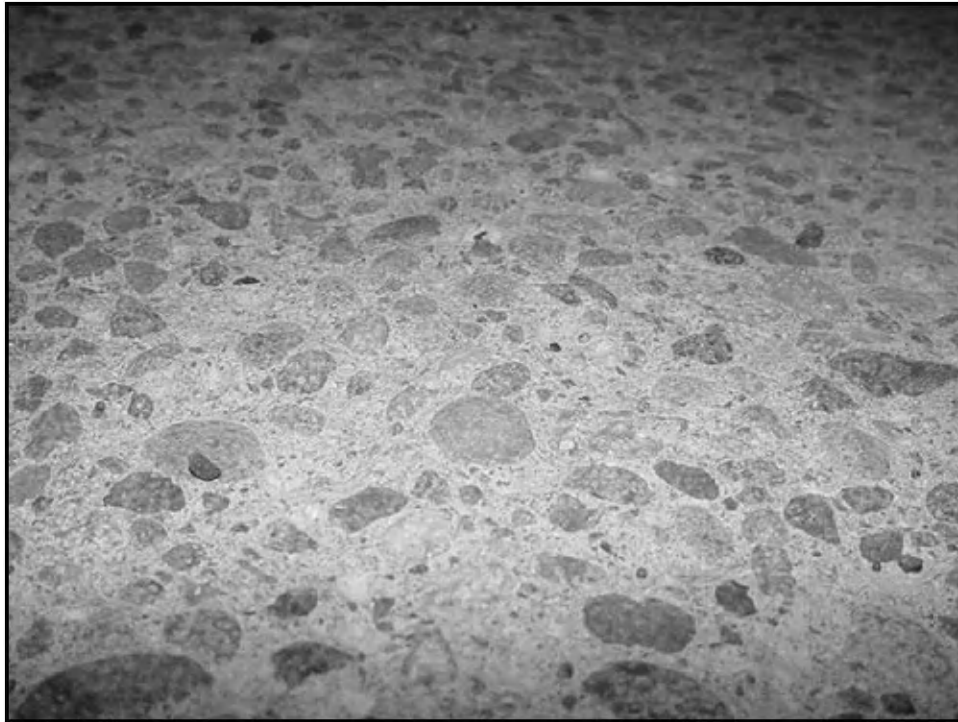
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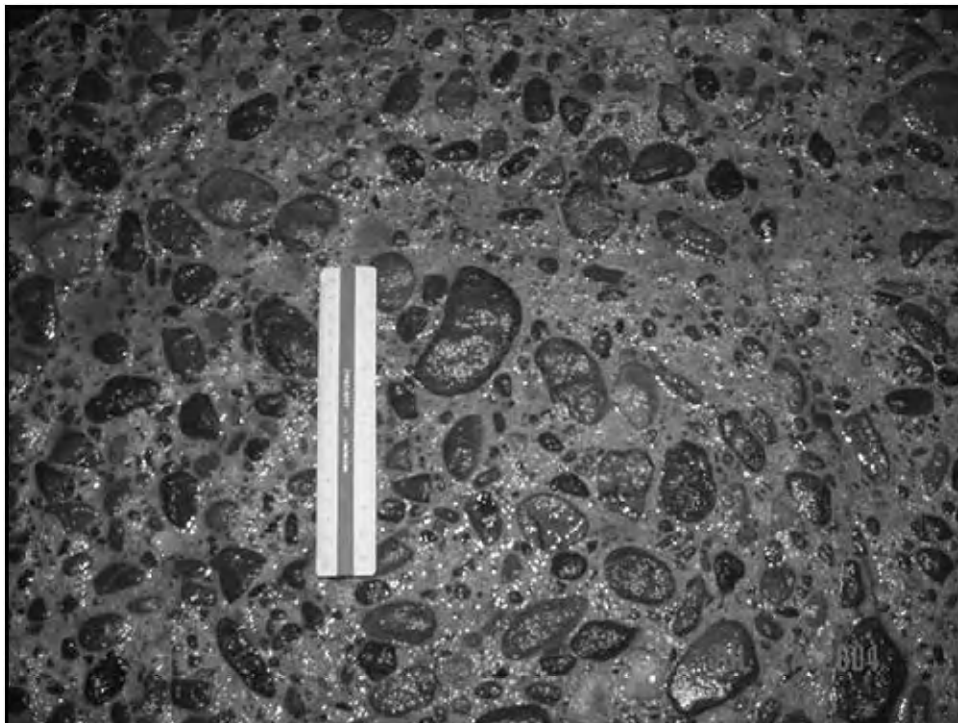
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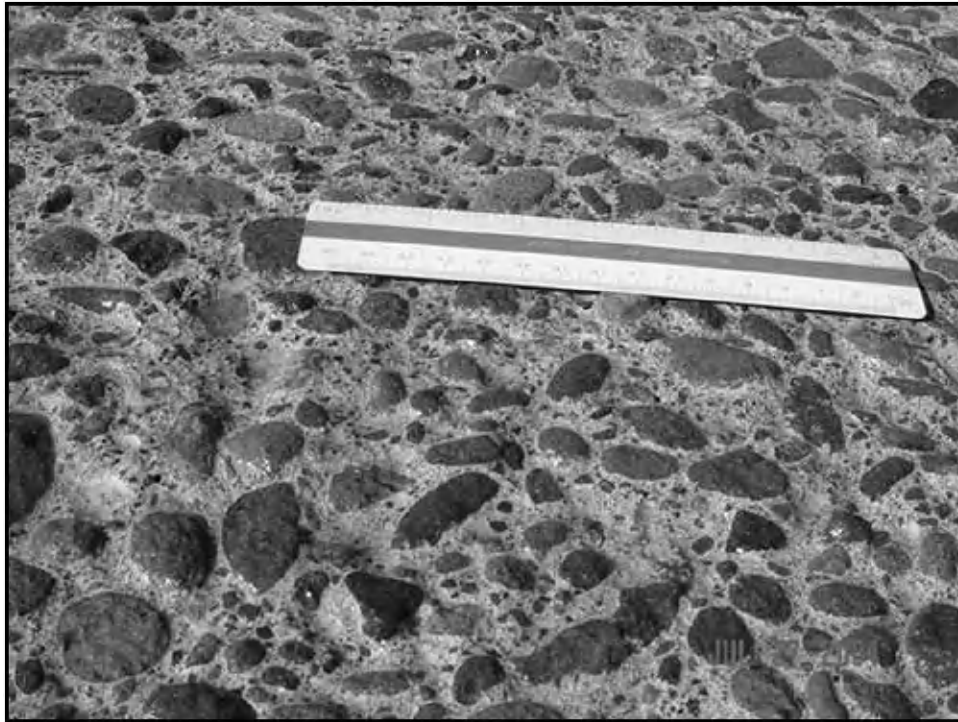
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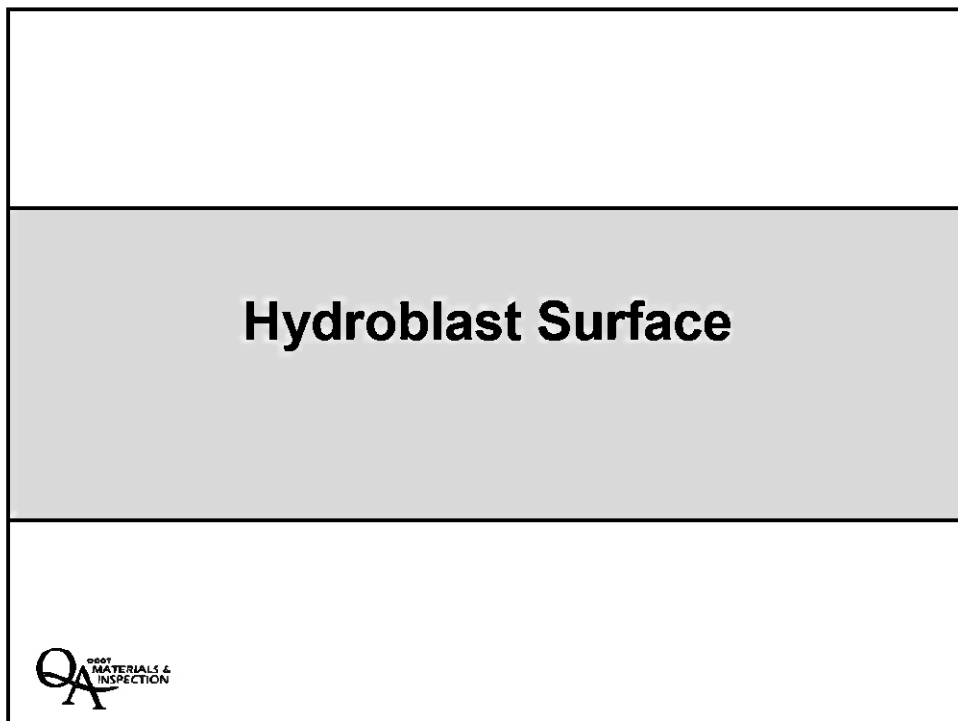
183



184



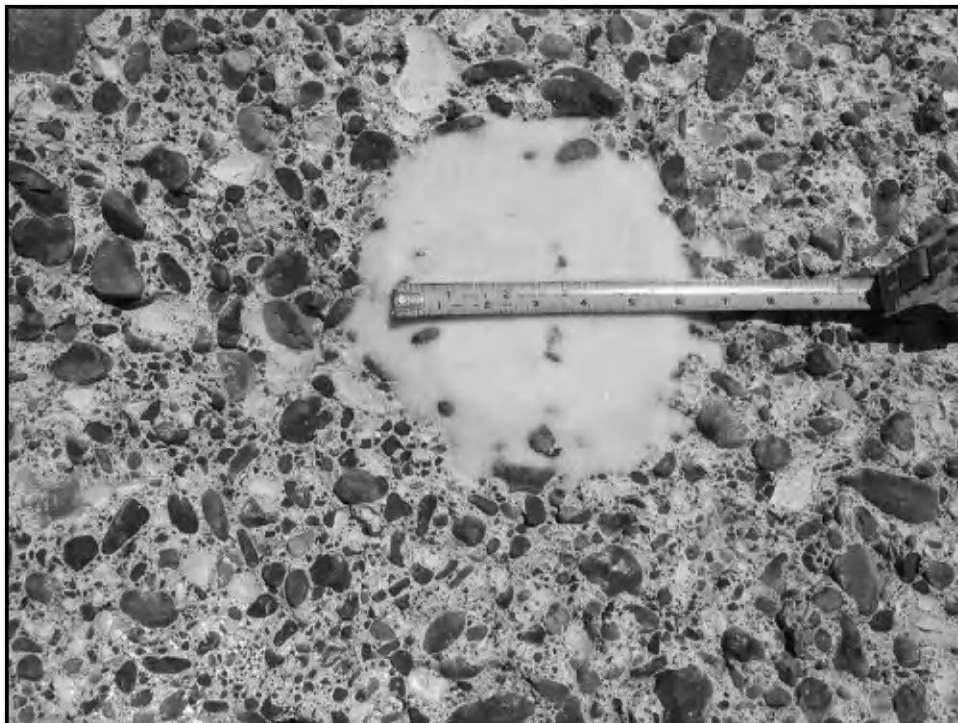
185



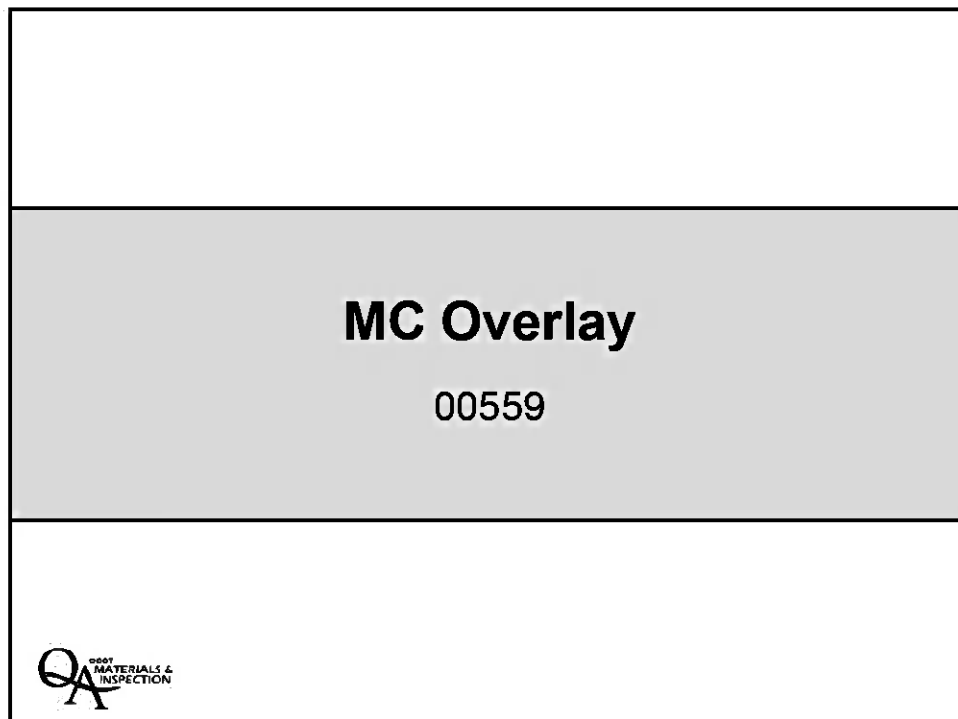
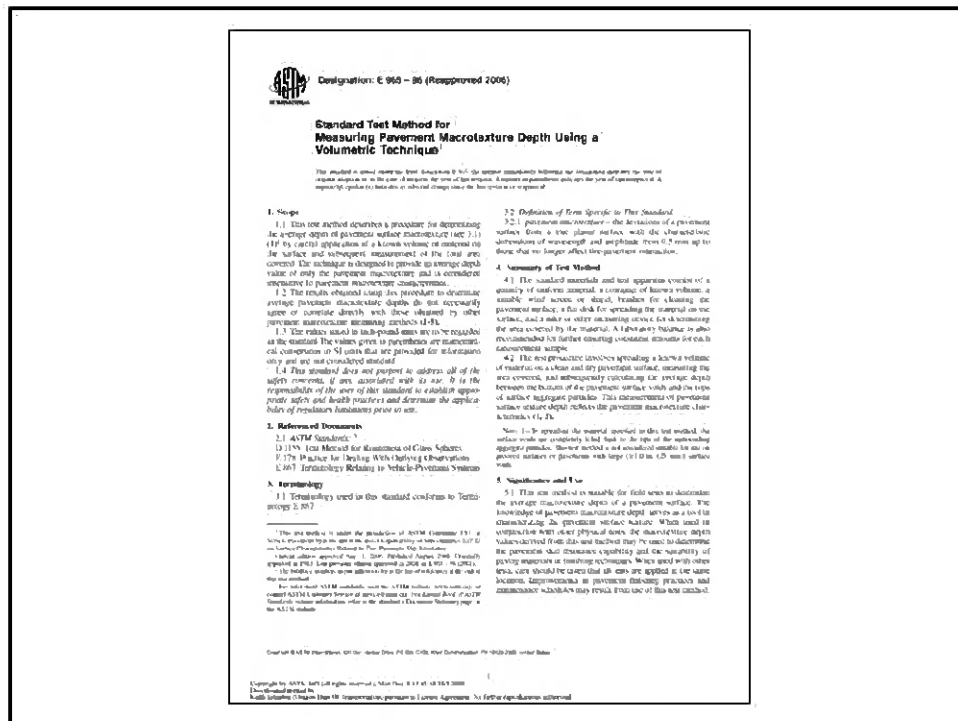
186



187



188



Deck Prep



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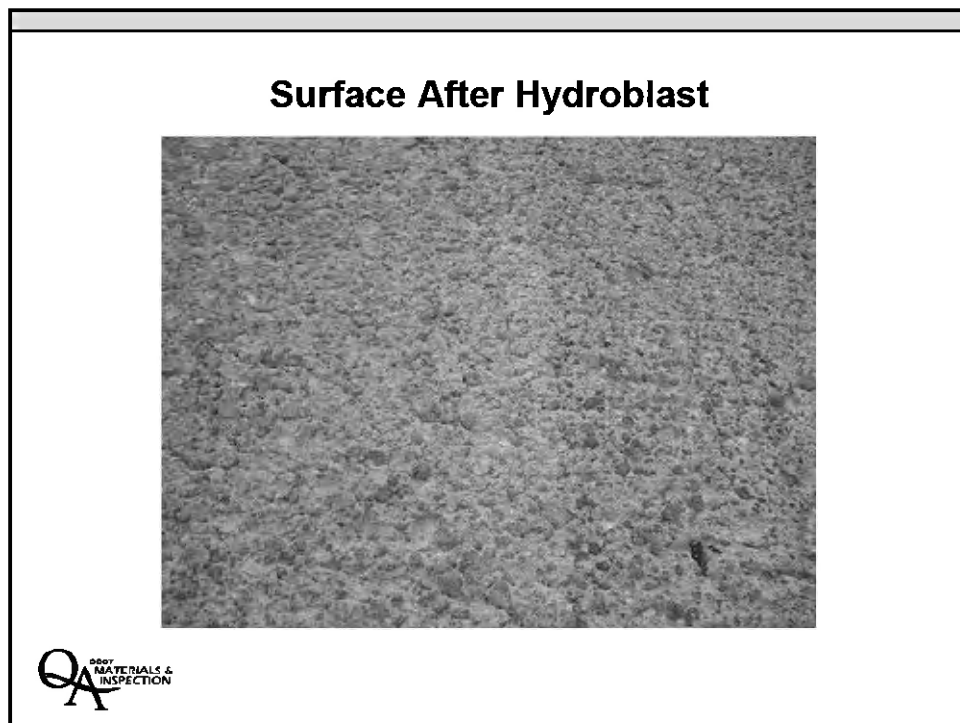
191

Hydroblast Deck Prep

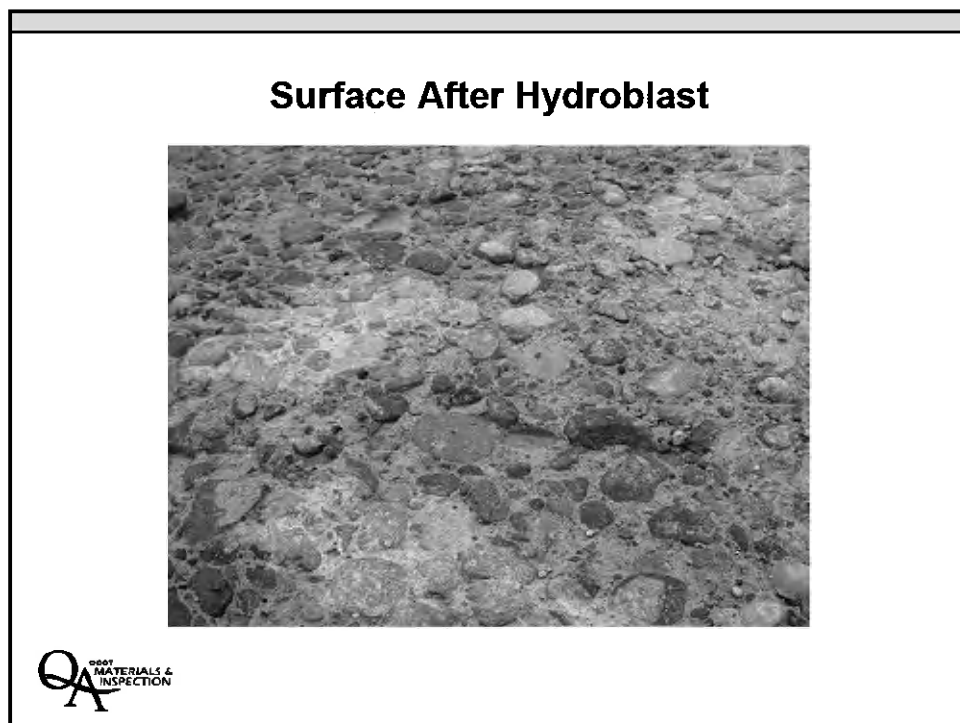


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192



193



194

Class 2 Repair



195

Sealed Large Cracks



196

Soak Deck 8 Hours Prior to Pour



197

Plastic to Keep Deck Clean



198

Brooming Grout



199

Placing Mix



200

Deck Machine



201

Look for Clumps in Mix



202

Deck Machine



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203

Deck Machine



QA
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204

Cure Fabric



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205

Cure Fabric



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206

Deck Cure



207

Bond Test



208

Bond Test



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209

Bond Test



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INSPECTION

210

Multi-layer Polymer Concrete Overlay

00556



211

Shotblasted Surface



212

Spreading Flexolith



213

Blowing #8 Basalt on Top



214

Completed Lane



215

**Premixed Polymer Concrete
Overlay**

00557
(Polyester Polymer Concrete)



216

Methacrylate Layer



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INSPECTION

217

Slip Form Paver



QA
0001 MATERIALS &
INSPECTION

218

PPC Placement



219

Hand Finishing End



220

Completed End



221

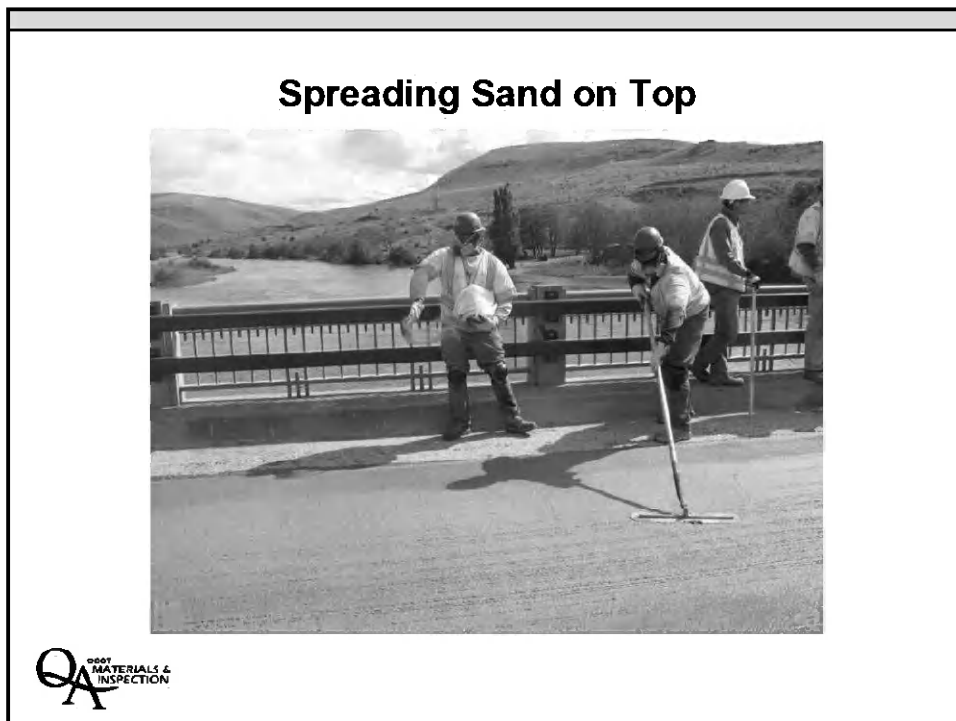
Angled Edge for Traffic



222



223



224



225

Polymer Membrane

00590



226

Epoxy Prime Coat



227

Epoxy Polymer Main Layer



228

Rock to Refusal



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INSPECTION

229

Finished Surface



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INSPECTION

230

Rolled Waterproofing Membrane

00592



231

Spraying Prime Coat



232

Placing Rolled Product



233

Placing Rolled Product



234

Placing Rolled Product



235

Spraying Emulsion on Rolled Membrane



236

Paving on Emulsion Surface



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237

Middle 2 Lanes Paved on Membrane



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0007
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238

View FHWA Video Bridge Deck Construction Review


239

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P.O. BOX 97
CANTON, SOUTH DAKOTA 57013
AREA CODE 605 PHONE 987-2603
TELEX 295001

ROLLER PAVER SET-UP INSTRUCTIONS

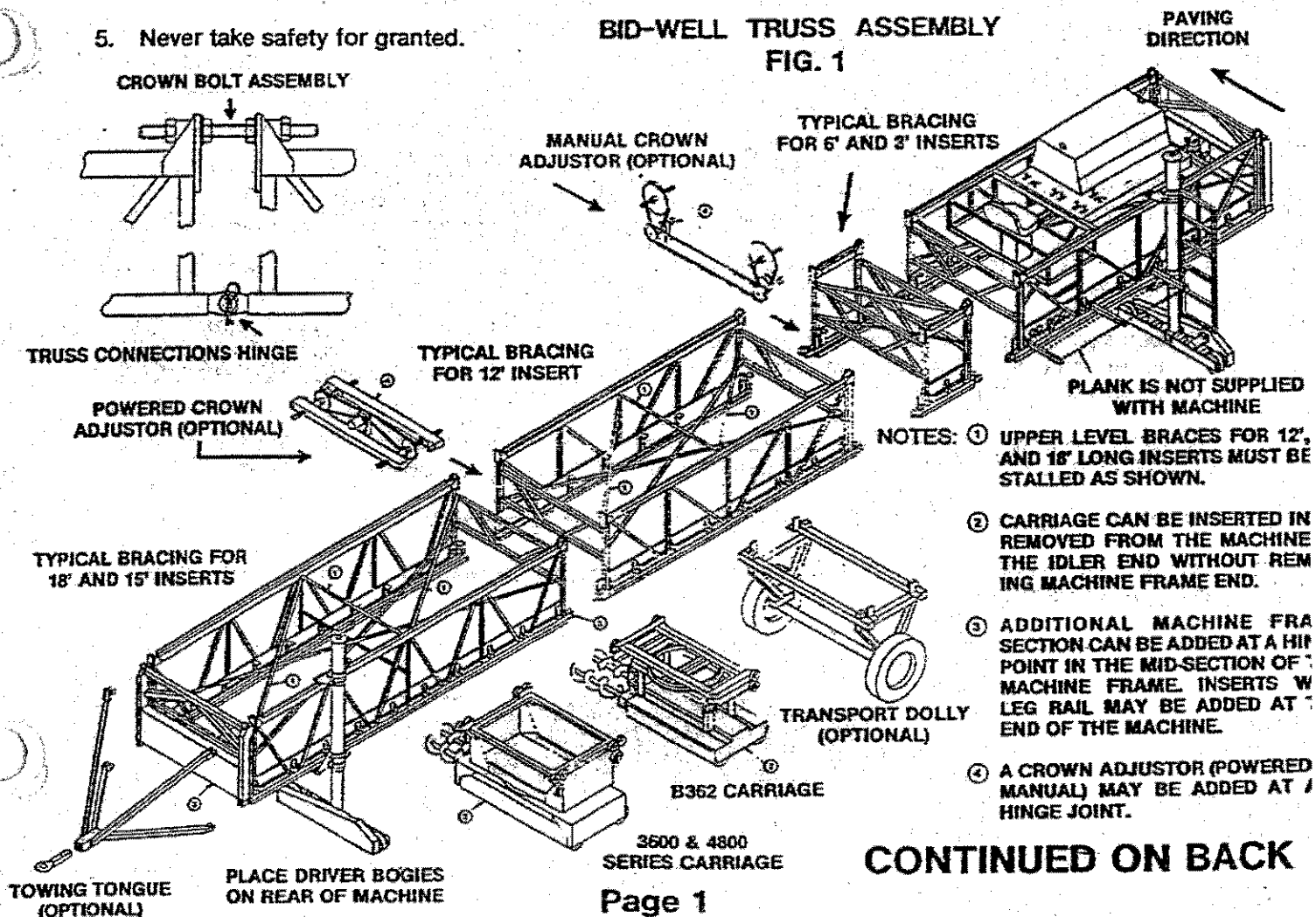
(To Be Used With Manual)

FOR ADDITIONAL HELP CALL BID-WELL (605)987-2603

⚠ CAUTION:

1. Put safety first - read operators manual.
2. Assemble machine with all cross braces and safety shields - consult owners manual for safe lifting.
3. Clear machine of all personnel before starting and operating.
4. Stop engines before cleaning machine.
5. Never take safety for granted.

BID-WELL TRUSS ASSEMBLY
FIG. 1



CONTINUED ON BACK

MACHINE SET-UP AND ALIGNMENT PROCEDURES

NOTE: MACHINE SHOULD BE ASSEMBLED ON GROUND BEFORE PLACING ON DECK

1. Assemble machine to fit job requirements - refer to diagram on page 1.
2. Install carriage and position at center of machine.
3. Mount bogies on legs - with drive bogies on rear.
4. Position legs to fit screed rails with hinge point over crown (see step 10.)
5. Consult owners manual for safe lift procedures, then lift and place machine on screed rails.
6. Remove truss frame twist with leg cranks.
7. Set carriage rails to the same relative mid-adjustor position at all corners and hinge points. Use carriage rail adjuster.
8. Set a stringline over the carriage rail above carriage wheels and adjust crown bolts at truss hinge points to straighten and align machine frame. (Fig. 2 & Fig. 1)

⚠ CAUTION: COMPENSATE FOR STRING SAG - DO NOT USE PIANO WIRE.

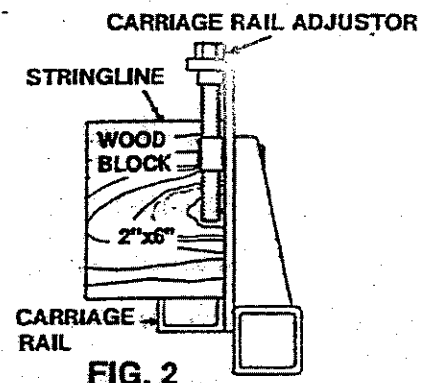


FIG. 2

9. Adjust carriage rail to stringline with adjustors. (Fig. 2). Set finishing rollers parallel to the carriage rails and to each other. (Fig. 3)

- A) Check and tighten turntable pivot nut to maintain contact at all four slide blocks.
- B) Stretch a stringline across top of carriage rail from front to rear on each side of carriage.
- C) Place a 4 ft. straight edge across ends of both rollers.
- D) Measure down from stringline to top of straight edge at all four corners and adjust to same distance.

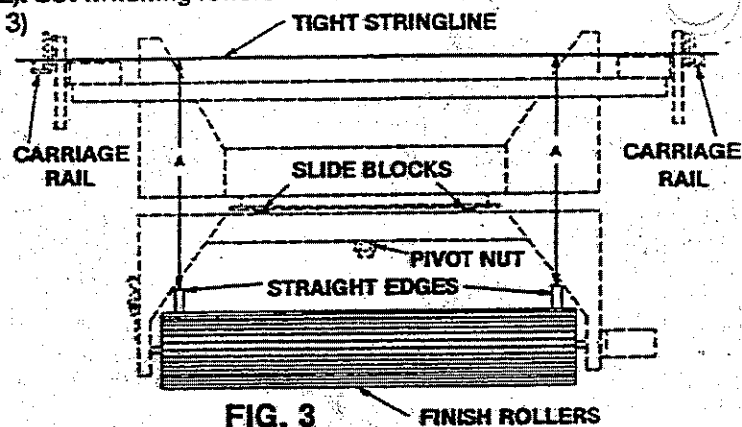


FIG. 3

FINISH ROLLERS

10. Set crown by placing truss hinge point over crown and adjust by opening or closing top crown bolt. Consult owners manual for safe lift procedures, then lift and place machine on screed rails.
11. Attach reversing lugs to carriage travel chain for suitable paving width.
12. Attach roller reversing push rod activator plates to carriage rail - two inches inside maximum carriage travel width on each side.

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ROLLER PAVER OPERATING INSTRUCTIONS

NORMAL MACHINE OPERATION

1. Carriage travel direction automatically reverses at the end of each carriage pass.
2. Finish rollers automatically reverse rotation and skew slightly at the end of each carriage pass.
3. Machine automatically travels forward a preset distance at the end of each carriage pass.

FINAL GRADING ADJUSTMENTS

1. Set front and rear ends of finish rollers to final grade using leg cranks.

EXAMPLES:

- A) Grade to a bulkhead, end dam or expansion joint.
2. Set augers approximately 1/8 to 1/4 inch above grade of rollers. Use crank with pin lock.
3. Dry run machine from end to end of pour to preload falsework and check bulkheads.
 - A) Match grade of bulkheads and end dams by feathering screed rails, but do not change machine leg cranks.

FINAL PAVING ADJUSTMENTS

1. Set rear end of finish rollers approximately 1/8 to 3/16 inches above front end by raising rear of machine 3/4 to 1 turn of leg crank.
2. Augers may need to be readjusted during the pour, to maintain a golf ball size roll of concrete at the front of rollers, which should feather out no more than half way back.
3. Rear leg setting may need to be readjusted at either side, during the pour, so rear of roller is just touching the concrete without leaving a mark.
4. Drag pans are attached to pull in either direction. Adjust to obtain a slight leading edge rise.
5. Astro turf or burlap drag may be attached and adjusted to give surface texture.

CAUTION: Before starting machine, all safety shields to be in place, set all controls to off or stop position, and clear all personnel from machine.

TO START ENGINES

- 1) Set power selector level to 'stop'
- 2) Start engine and allow for warm-up
- 3) Set engine to operating speed

TO TRAVEL MACHINE

- 1) Set machine travel direction control levers to direction needed
- 2) Set power selector lever to machine travel
- 3) Use machine travel speed lever to start, travel and stop machine

TO PAVE - CARRIAGE SETTINGS

- 1) Set power lever at end of carriage to 'run'
- 2) Set finish roller rotation direction with valves on rear of carriage so both rollers rotate up into concrete on each pass.

TO PAVE - CONTROL CONSOLE SETTINGS

- 1) Set machine travel direction control levers
- 2) Start carriage travel, by moving power selector lever to 'pave'
- 3) Select automatic machine advance distance with machine travel speed control

TO MANUALLY REVERSE CARRIAGE TRAVEL

- 1) Slowly move power selector lever to 'stop'
- 2) Shift carriage travel reversing lever in direction of travel required
- 3) Slowly move power selector lever back to 'pave'

TO STOP AUTOMATIC FINISH ROLLER REVERSING

- 1) Pull valve knob out on side of carriage
- 2) Set finish roller rotation in desired direction with valves mounted on rear of carriage (for Model 362, change quick disconnect hoses)

TO STOP AUTOMATIC SKEWING OF FINISH ROLLERS

- 1) Disconnect skew cylinder by removing mounting pin and secure skew ring clamps.



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ROL-A-TAMP SET UP INSTRUCTIONS

(To Be Used With Manual)

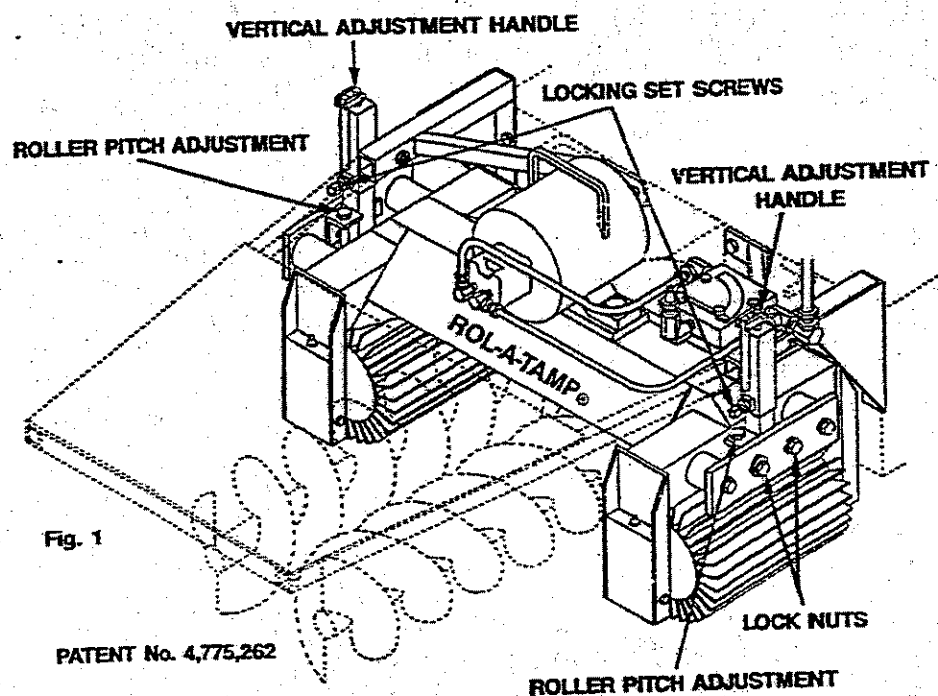
FOR ADDITIONAL HELP CALL BID-WELL (605)987-2603

CAUTION:

1. Put safety first - read operators manual.
2. Assemble machine with all cross braces and safety shields - consult owners manual for safe lifting.
3. Clear machine of all personnel before starting and operating.
4. Stop engines before cleaning machine.
5. Never take safety for granted.

SPECIFICATIONS FOR BID-WELL ROL-A-TAMP

The BID-WELL Rol-A-Tamp finishing attachment provides a means of achieving a more uniform concrete surface with desired density. This facilitates sealing difficult to finish concrete, due to harsh mix designs, low slump specifications, wind exposure causing abnormal surface drying and unforeseen and unpredictable delays.

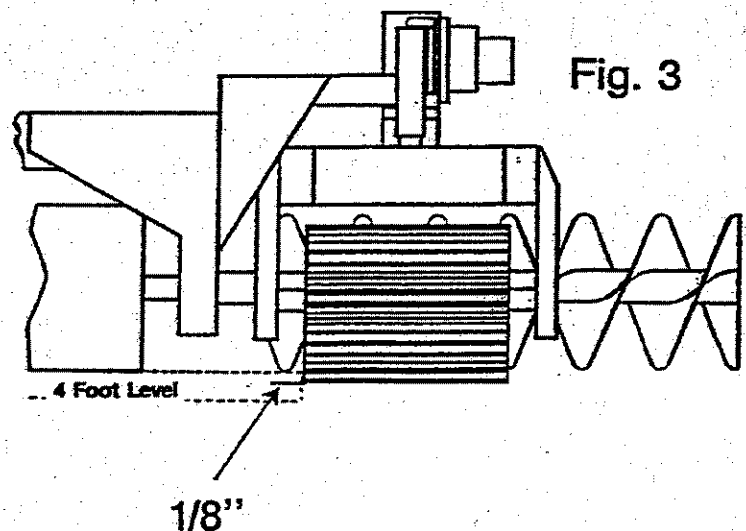
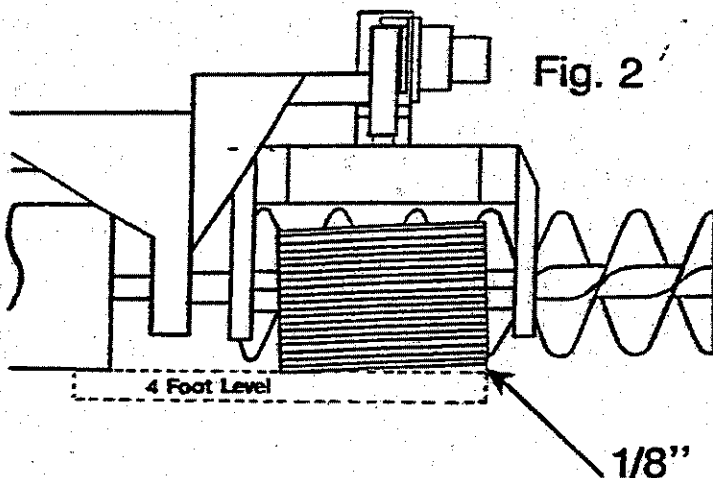


CONTINUED ON BAC

ROL-A-TAMP SET-UP AND ALIGNMENT PROCEDURES

The Rol-A-Tamp's finned rollers are vertically adjustable from $\frac{1}{2}$ inch above concrete grade to $\frac{1}{8}$ inch below concrete grade. The depth of penetration can be varied, according to job requirements. A $\frac{1}{8}$ inch penetration will normally yield good results.

1. Place a four foot level under the finishing rollers and under the Rol-A-Tamp. Refer to fig. 2.
2. Loosen locking set screws. Refer to fig. 1
3. Loosen lock nuts for the roller pitch adjustment. Refer to fig.1
4. Set the front of the rollers approximately $\frac{1}{8}$ of an inch higher than the rear of the rollers, by using the pitch adjustment. Refer to fig. 1
5. Pitching the front end of the finned rollers up $\frac{1}{8}$ to $\frac{1}{4}$ of an inch allows the Rol-A-Tamp to become parallel to the concrete surface, when the rear of the machine is raised using the rear leg cranks.
6. Lower the finned rollers by using the vertical adjustment handles. Refer to fig. 1
7. Set the finned rollers to $\frac{1}{8}$ of an inch below the finishing rollers or desired depth. Refer to fig. 3. Maximum recommended depth $\frac{3}{16}$ ".
8. Lock all set screws and lock nuts.
9. Run the vibrator at the speed that does the best job of keeping the fins of the rollers clean. (Do not exceed 5000 vibrations per minute, normally 3500-4500 VPMS is a good operating speed)



INSERT TAB

Unit 15

Miscellaneous

Section 15

Miscellaneous

Concrete Repairs	1
Crack Injection	9
Cathodic Protection	13
Bridge Rail	16
Slip Form Bridge Rail	21
Guardrail	25
Slope Paving	29

Miscellaneous Section 15	
	

1

Concrete Repairs SP 00542	
	

2

Concrete Removal SP 00542.41

- Sound with 16 oz. hammer
- No angles less than 45° at repair edges
- At least 2" wide in all directions



3

Concrete Removal SP 00542.42

- Sawcut 1/2" deep @ edges (just missing bar if less)
- No corner overcuts
- 15 lb. hammers or less



4

**Rebar Surface Prep
SP 00542.46**

Commercial Blast
SSPC SP6



5

**Concrete Surface Prep
SP 00542.46**

ICRI Surface
Profile CSP6



6

	Brush Off	Industrial	Commercial	Near White	White Metal
	SSPC SP7 NACE No.4 ISO Sa 1	SSPC SP14 NACE No.8 ISO --	SSPC SP6 NACE No.3 ISO SA 2	SSPC SP10 NACE No.2 ISO ---	SSPC SP5 NACE No.1 ISO SA 3
			ISO SA 2 ^{1/2} up to 15% stains, shadows		
Loose Material	None	None	None	None	None
Tight Material	100%	up to 10%	None	None	None
Stains, Shadows	100%	100%	up to 33%	up to 5%	None

Concrete Surface Preparation Profiles for Overlay or Restoring Existing Concrete

Proper surface preparation of existing concrete is essential for achieving a successful project including resurfacers, polymer-modified or self-leveling overlays, sealers, coatings, or stains. Since there are many products available for overlays and restoration, it is important you know the surface condition requirements for the specific product you plan to use. Taking steps to correctly prepare the existing concrete surface will save you time and money, and can substantially reduce the possibility of coating failure.

These Concrete Surface Profiles were developed by the International Concrete Repair Institute (ICRI), are divided into ten classifications (CSP 1-10) of surface textures based on the average distance from the peaks of the surface to the valleys. They are accepted industry standards to help guide the installer achieve the proper texture for successful bonding of the overlay or coating. The lower number profiles are smoother (CSP 1 is nearly flat), and the higher numbers have more “tooth” and get progressively rougher.

- **These surface profile pictures provide guidelines based on the requirements of the system or products being used.**
- **Use the chart on the next page to validate the method for surface preparation.**



CSP 1 (acid etched)



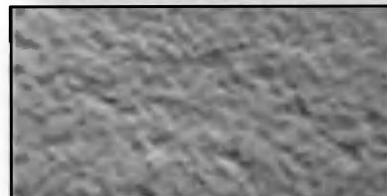
CSP 2 (grinding)



CSP 3 (light shotblast)



CSP 4 (light scarification)



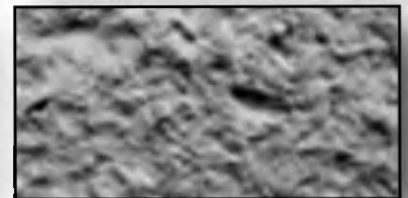
CSP 5 (medium shotblast)



CSP 6 (medium scarification)



CSP 7 (heavy abrasive blast)



CSP 8 (scabbed)



CSP 9 (heavy scarification)



CSP 10 (course planing)

NOTE: ICRI CSP profiles should reference ICRI Technical Guideline No 310-2

Crossbeam Repair



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INSPECTION

7

Crossbeam Repair



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INSPECTION

8

Concrete Anchors



9

Concrete Repair Prep SP 00542.48(b)

- Removable forms
- Presoak 24 hr.
- Pressure wash @ 60psi
- Compressed air to SSD
- Immediately install patch material



10

Cure SP 00542.48(a) & .49

- Leave forms in place 3 days min.
- Cure according to manufacturer's recommendations



11

Patch Material SP 00542.10

MasterEmaco
S 440 MC



12

Pumping Mortar SP 00542.48(d)

Do not place during freezing weather or if temperature will drop below freezing during cure period.



13

Concrete Repair Bond Test SP 00542.52(b)

- 175 psi



14

Completed Crossbeam Repair



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15

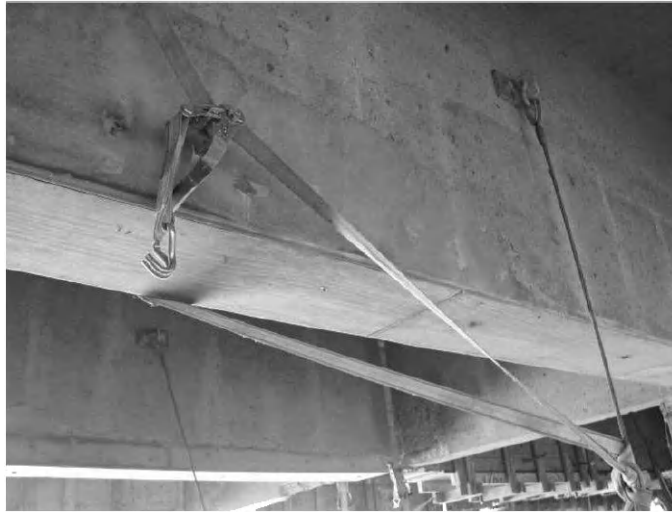
Completed Repairs



QA
0007 MATERIALS &
INSPECTION

16

Completed Crossbeam Repair



17

Crack Injection



18

Crack Injection 00538.40

- Cracks 1/64 inch (0.016") & greater (00538.00)
- Perform injection work when girders are above 40° or manufacturer's recommendations, whichever is higher



19

Sealing Crack with Paste



20

Installing Epoxy Ports



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INSPECTION

21

Ready for Injection

Start @
bottom port



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22

Epoxy Injection



23

Stemwall Epoxy Injection



24

Stemwall Epoxy Injection



25

Cathodic Protection



26

Surface Prep
SP 01260.42

- 80 psi
abrasive blast
- ICRI surface
profile CSP4
- Air blast
80-100 psi



27

Surface Prep

- 50 psi air blast
within 15 min of
applying zinc
(SP 01260.01)
- 150° F max
surface temp
when heating
(SP 01260.44)



28



CSP 1 (acid etched)



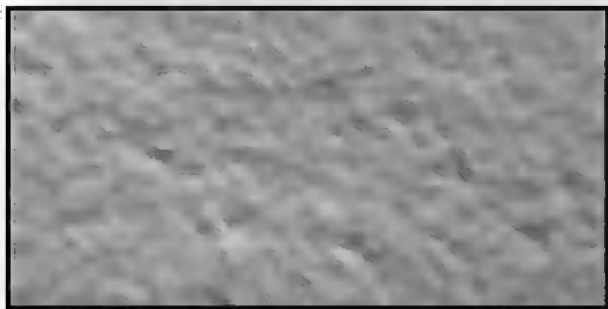
CSP 2 (grinding)



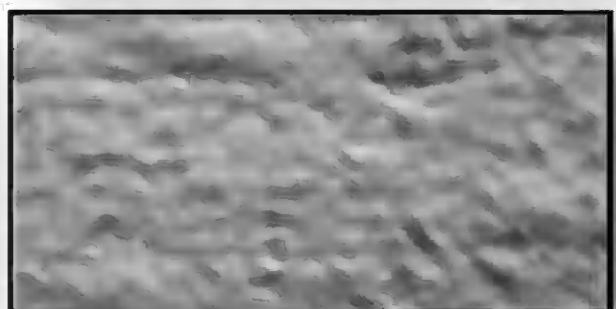
CSP 3 (light shotblast)



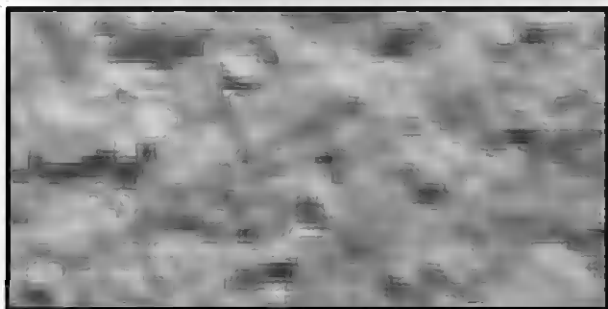
CSP 4 (light scarification)



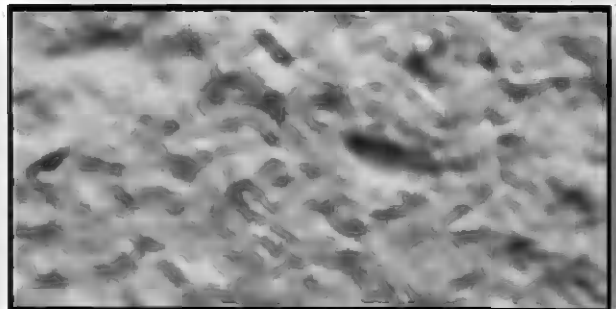
CSP 5 (medium shotblast)



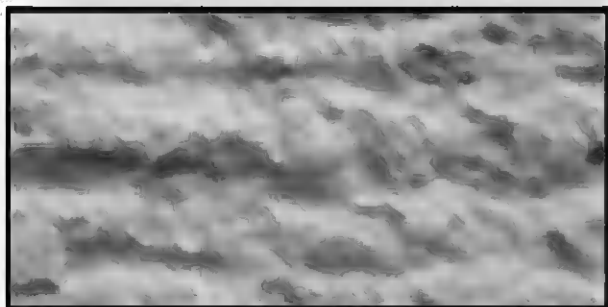
CSP 6 (medium scarification)



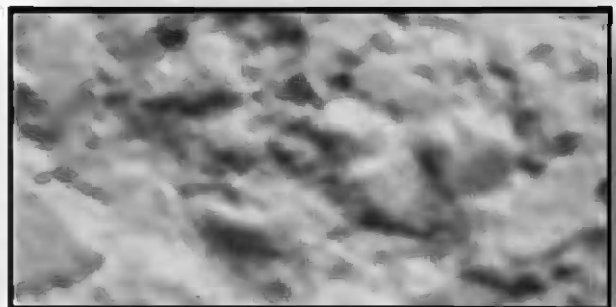
CSP 7 (heavy abrasive blast)



CSP 8 (scabbed)



CSP 9 (heavy scarification)



CSP 10 (course planing)

Apply Zinc Coating to Cells SP 01260.43 & 01260.44

- 4" wide masking between zones
- Enclosure & surfaces $\geq 6^{\circ}$ F above dew point
- Surface $\geq 65^{\circ}$ F



29

Apply Zinc Coating to Cells SP 01260.01 & 01260.03

- Apply within 24 hours of surface prep
- 0.015 -0.02" thick
- 50 psi bond



30

Excessive Bugholes



33

Rail Finish



34

Look for Straight Lines



35

Uneven Rail Height?



36

Rail Alignment?



37

Rail Drop on Impact Panel



5-inch drop



38

Rail Drop on Impact Panel



5-inch drop



39

Rail Joint Location?



40

Slipform Bridge Rail



41



42



43

Slip Form Machine Vibrators

- Varies from 3 to 7
- The more are used the better the consolidation

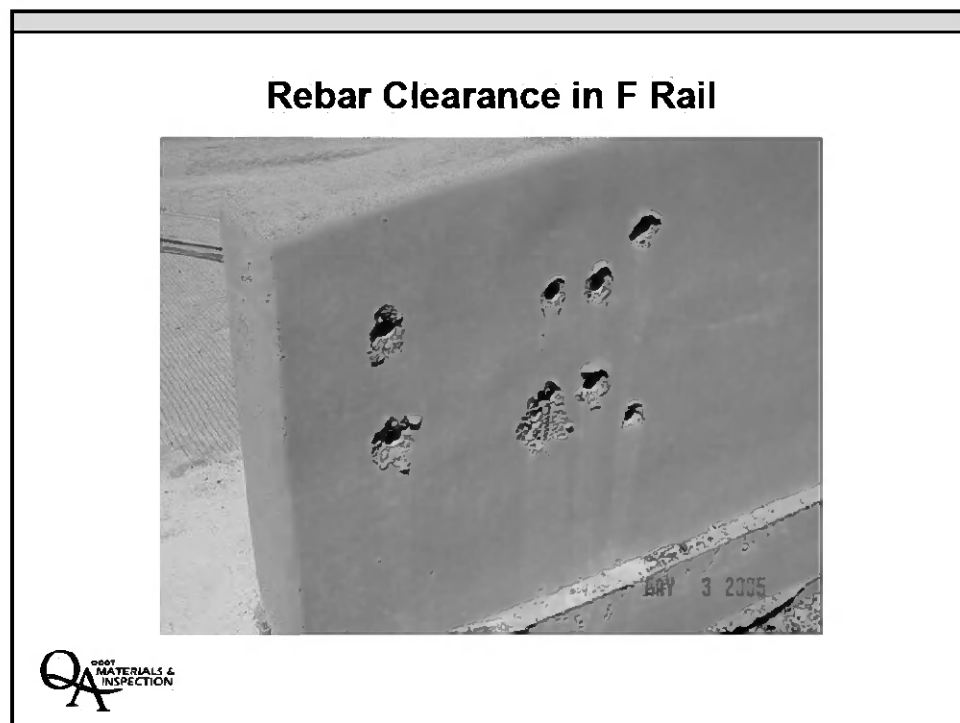


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INSPECTION

44



45



46

Rebar Clearance in F Rail



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0007
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47

Rail Alignment?



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48

Slipformed Rail Failure



49

Guardrail

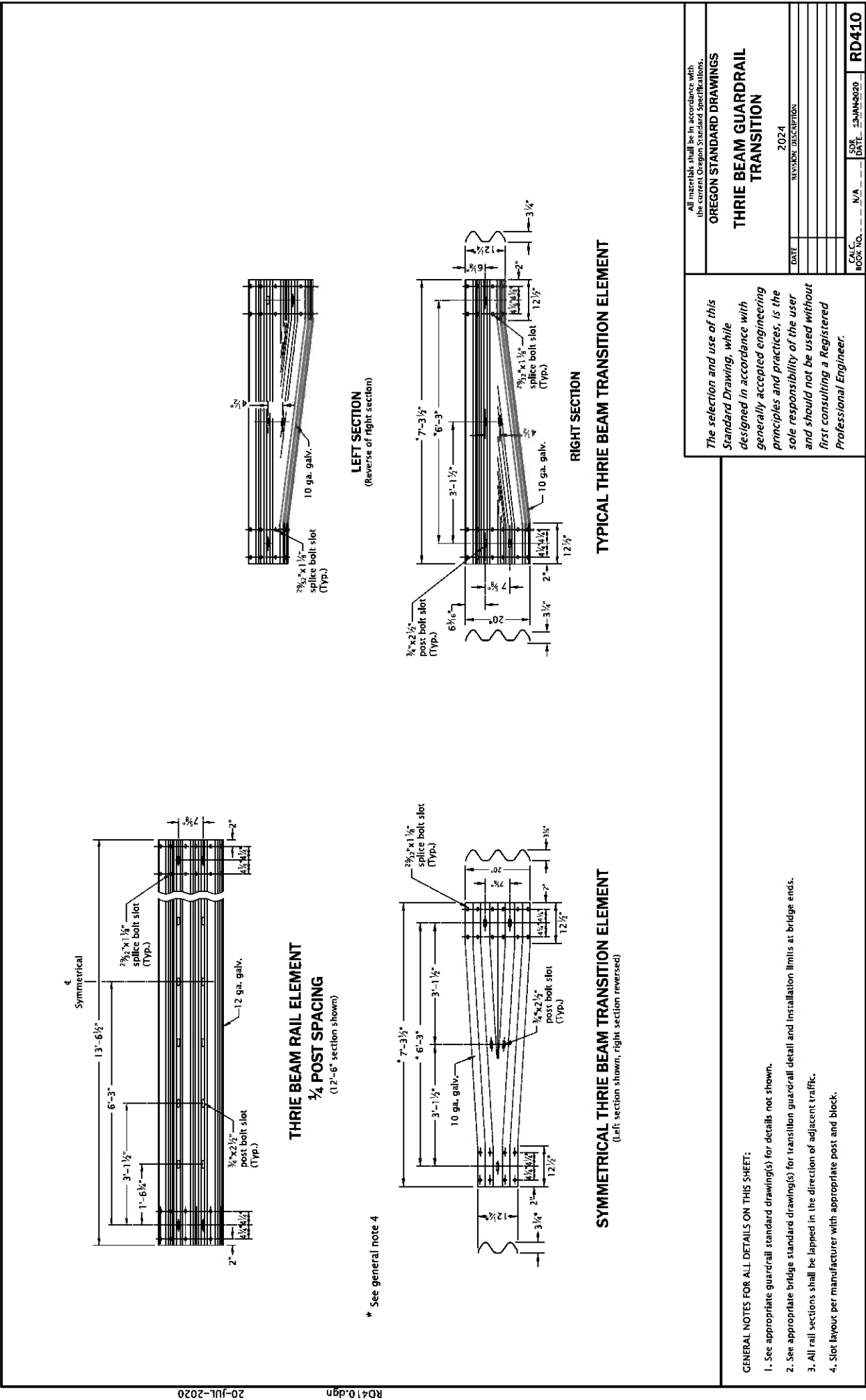


50

Guardrail @ Bridge Ends

- 31" rail
- Need asymmetrical transition element

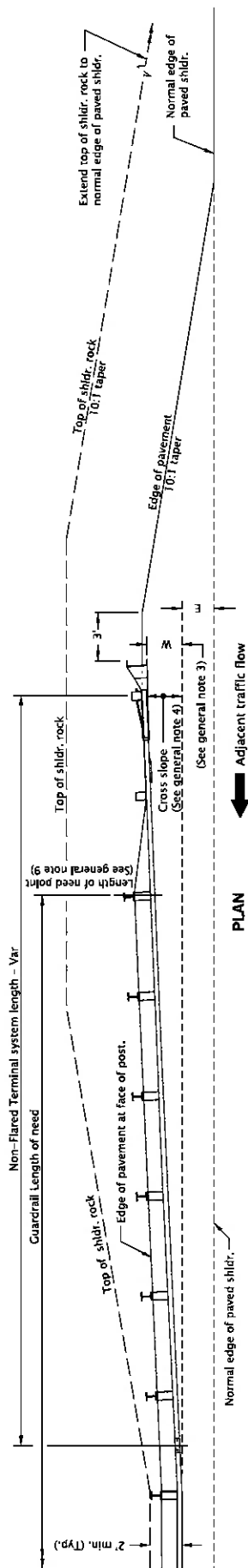




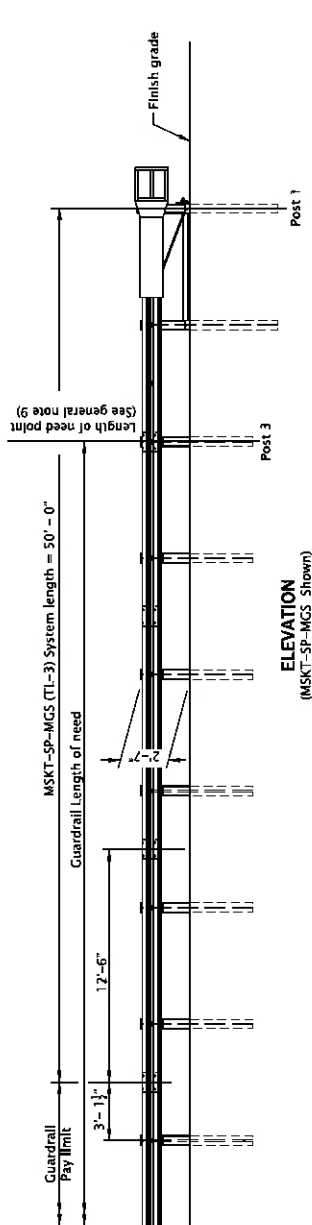
20-JUL-2020

RD410.dgn

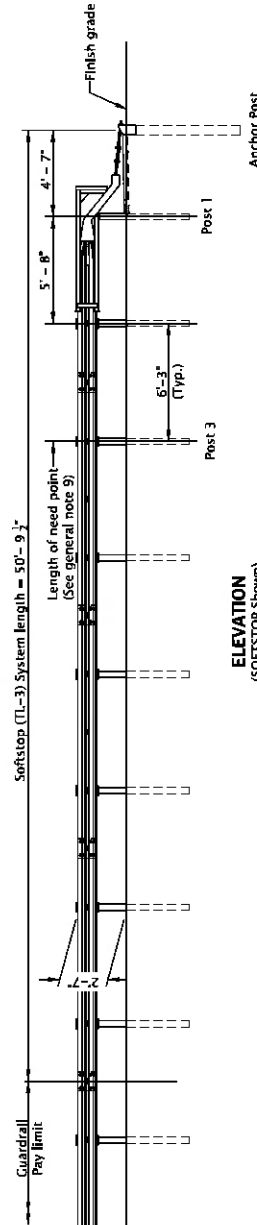




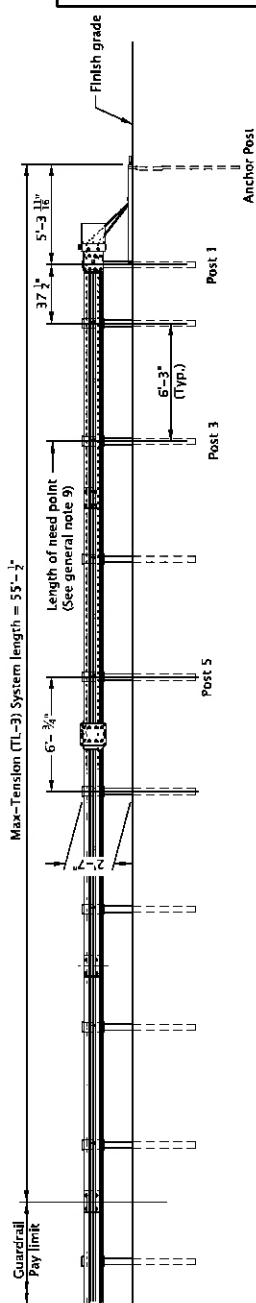
PLAN



ELEVATION



ELEVATION
(SOFTSTOP SHOWN)



ELEVATION
(MAX-TENSION SHOW)

GENERAL NOTES FOR ALL DETAILS ON THIS SHEET:

1. Use details shown as a general guide since manufacturer's details may vary. Install a guardrail terminal system that meets MASH requirements per manufacturer's recommendations. Ensure that guardrail terminal meets appropriate test level for the project.
2. See appropriate guardrail standard drawing(s) for details not shown. See project plans for details not shown.
See Std. Dwg. RD701 for drainage curbs, where required.
E=2' or as shown on project plans.
3. Guardrail Non-flared terminal shall be installed with a min. 1 foot offset ensuring that the end piece is entirely off normal shldr.
4. Cross slope to match adjacent roadway cross slope (preferred).
If required, maximum shoulder slope 10% for guardrail widening.
If required, maximum grade break at normal edge of shoulder: 8%.
5. On two way two lane highways, both ends of guardrail runs shall be provided with a terminal flared or non-flared. Paving of widened shldr. to the face of posts on both ends of guardrail runs is required.
6. Provide guardrail terminal from ODOT's QPL. Install according to manufacturer's recommendations (post count varies). Provide shop drawings to Engineer.
7. Install a reflectorized object marker on head of every guard rail terminal with "W" 4 feet or less according to manufacturer's recommendations.
8. "W" distance is measured to face of guardrail at end post, exclusive of end piece.
9. Length of need post location varies by manufacturer.

All materials shall be in accordance with the current Oregon Standard Specifications.

**OREGON STANDARD DRAWINGS
MIDWEST GUARDRAIL SYSTEM
NON-FLARED ENERGY-ABSORBING
TERMINAL**

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without first consulting a Registered Professional Engineer.

	DATE	REVISION DESCRIPTION
CALC. REVISED BY:	N/A	SQR NOTES: 19-JUL-2023
		RD420

Effective Date: December 1, 2023 – May 31, 2024

MSKT Guardrail Terminal



Pushes rail away
from roadway



MSKT



MSKT Terminal After Being Hit



MSKT Guardrail Terminal

- Pushes rail toward roadway?
- Pushing away is the latest standard

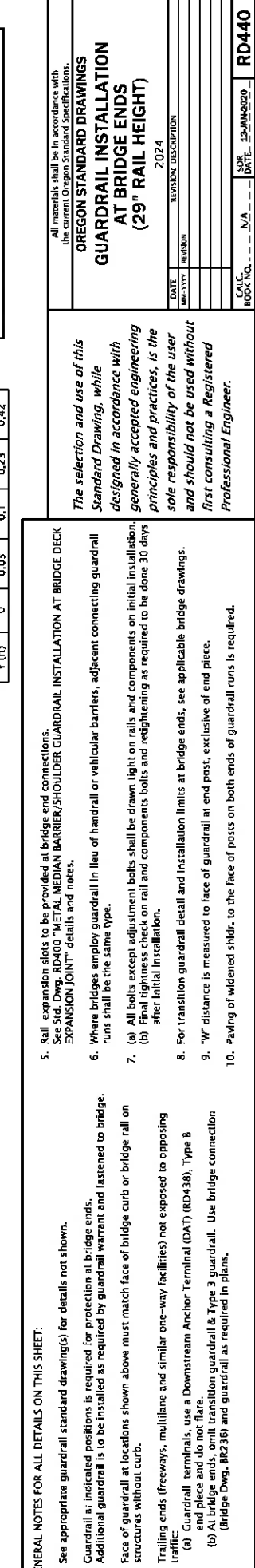
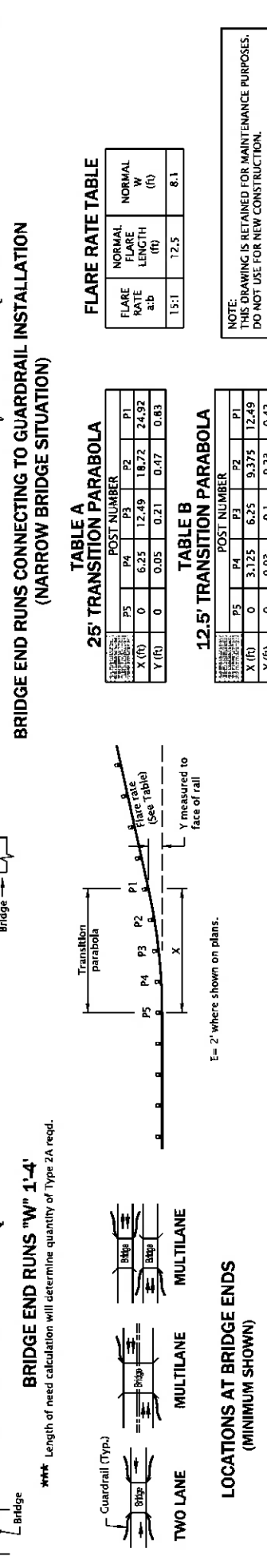
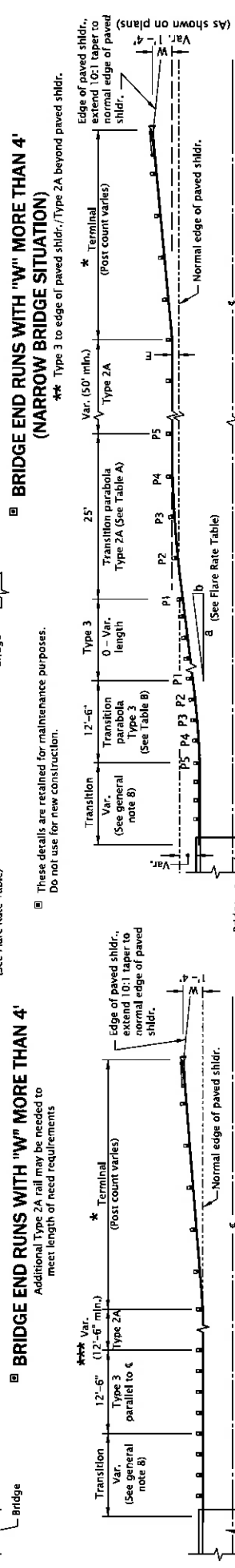
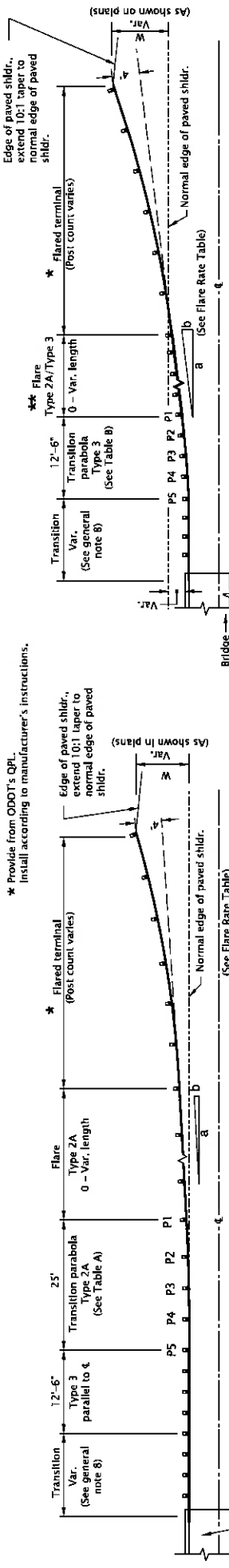


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Softstop Guardrail Terminal



56



20-JUL-2020 RD440.dgn

*** Provide from ODOT's QPL. Install according to manufacturer's instructions.

Edge of paved shldr., extend 10:1 taper to normal edge of paved shldr.

Flare Type 2A (Post count varies) 0 - Var. length

Transition Type 3 (See general note 8) 12'-6"

Normal edge of paved shldr.

Edge of paved shldr., extend 10:1 taper to normal edge of paved shldr.

Flare Type 2A (Post count varies) 0 - Var. length

Transition Type 3 (See general note 8) 12'-6"

Normal edge of paved shldr.

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Edge of paved shldr., extend 10:1 taper to normal edge of paved shldr.

Flare Type 2A (Post count varies) 0 - Var. length

Transition Type 3 (See general note 8) 12'-6"

Normal edge of paved shldr.

Thoughts?



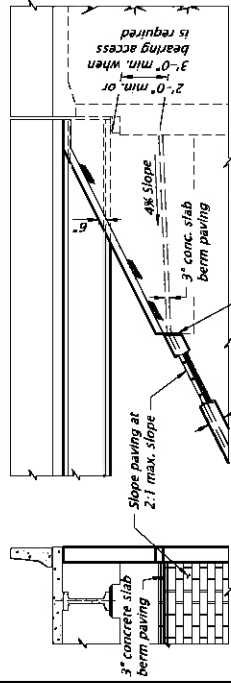
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MATERIALS &
INSPECTION

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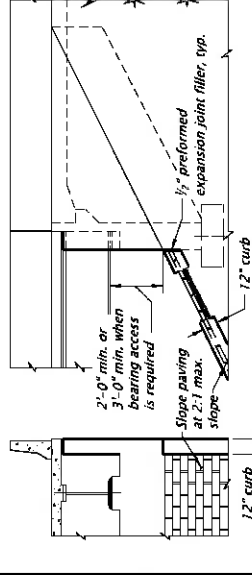
Slope Paving

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MATERIALS &
INSPECTION

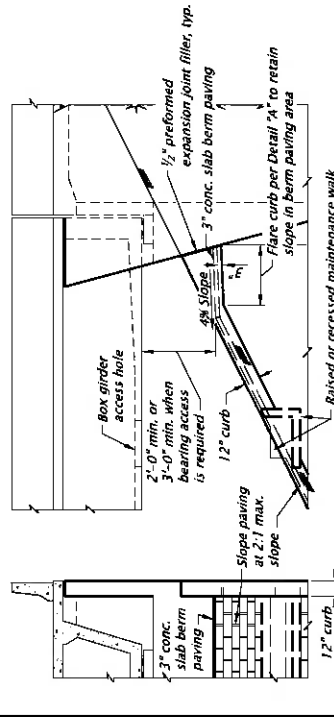
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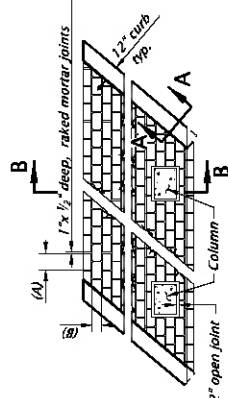
**PARTIAL TRANSVERSE
ELEVATION**



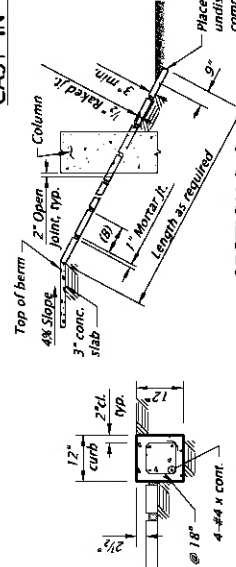
PARTIAL TRANSVERSE
ELEVATION



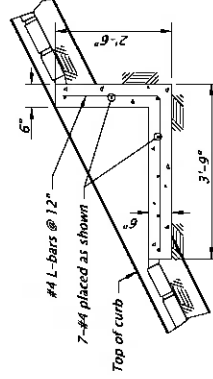
PARTIAL TRANSVERSE ELEVATION **PARTIAL ELEVATION: CASE 3**
section, curb to curb, set back from
for location and when required.



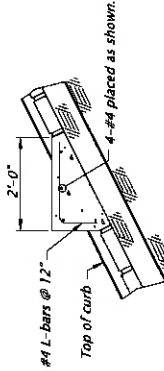
PRECAST BLOCK ALTERNATE PLAN



SECTION A-A

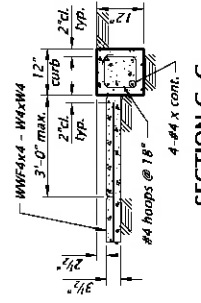


RECESSED MAINTENANCE WALK SECTION



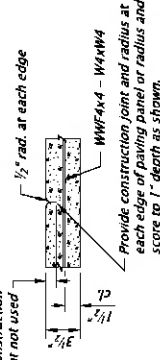
RAISED MAINTENANCE WALK SECTION

CAST-IN-PLACE BLOCKS
Blocks may vary in size up to a maximum of 3'-0" in length (L) and width (W). Provide the width to length ratio within the range of $W/L = 0.5$ to 1.0.
Blocks may be cast-in-place individually, in rows, or all simultaneously. Each block shall have a full depth construction joint or 1" deep scored joint between each adjacent block or curb.

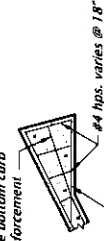


SECTION C-C

1" deep scoring
if construction
joint not used



SECTION D-D



DETAIL "A"

GENERAL NOTES

Provide all reinforcing steel according to ASTM Specification A706, or AASHTO M31 (ASTM A615), Grade 60. Use the following splice lengths unless shown otherwise:

Bar Size		#3	#4	#5
Splice Length	Uncoated	1'-0"	1'-4"	1'-8"
	Epoxy Coated	1'-5"	1'-10"	2'-4"

Provide all welded steel wire fabric according to AASHTO M55 (ASTM A185) or AASHTO M221 (ASTM A497). Place all fabric edge laps with no less than one mesh in width.

Place all bars and beams as shown.

Construct all berm slabs with 3" deep cast-in-place unreinforced concrete.

Provide precast blocks or cast-in-place concrete panels for slope paving.

Use same size blocks at any bridge site.

All materials shall be in accordance with the current Oregon Standard Specifications.

OREGON STANDARD DRAWINGS

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without first consulting a Registered Professional Engineer.

SLOPE PAVING

[illegible]

Effective Date: December 1, 2023 – May 31, 2024

Slope Paving Preparation



QA
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MATERIALS &
INSPECTION

59

Slope Paving



QA
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MATERIALS &
INSPECTION

60

INSERT TAB

Unit 16

Glossary

Appendix A

Glossary & Abbreviations

(From ODOT's BDM-Section 1 Appendix)

APPENDIX – SECTION 1 – Glossary

A

Abutment - Supports at the end of the bridge used to retain the approach embankment and carry the vertical and horizontal loads from the superstructure. Current terminology is bent or end bent.

Access Control - The condition where the legal right of owners or occupants of abutting land to access a highway is fully or partially controlled by the Department of Transportation.

Advance Plans – 95-100% complete plans including special provisions, normally sent at 15 weeks.

Advertisement - The period of time between the written public announcement inviting proposals for projects and the opening of the proposals (bid or letting date).

Aggregate - Inert material such as sand, gravel, broken stone, or combinations thereof.

Aggregate, Coarse - Aggregates predominantly retained on the No. 4 sieve for portland cement concrete and those predominantly retained on the 1/4" for asphalt concrete.

Aggregate, Fine - Those aggregates which entirely pass the 3/8" sieve.

Aggregate, Dense Graded - A well-graded aggregate so proportioned as to contain a relatively small percentage of voids.

Aggregate, Open Graded - A well-graded aggregate containing little or no fines, with a relatively large percentage of voids.

Aggregate, Well-Graded - An aggregate possessing proportionate distribution of successive particle sizes.

Air-Entraining Agent - A substance used in concrete to increase the amount of entrained air in the mixture. Entrained air is present in the form of minute bubbles and improves the workability and frost resistance.

Allowable Headwater - The maximum elevation to which water may be ponded upstream of a culvert or structure as specified by law or design.

Allowable Span – The greatest horizontal distance permitted between supports.

Anchor Bolts - Bolts that are embedded in concrete which are used to attach an object to the concrete such as rail posts, bearings, steel girder-to-crossbeam connections, etc.

Annual Average Daily Traffic (AADT) – The average 24-hour traffic volume at a given location over a full 365 day year.

Anode - The positively charged pole of a corrosion cell at which oxidations occur.

Apron - The paved area between wingwalls at the end of a culvert.

Arch - A curved structure element primarily in compression, producing at its support reactions having both vertical and horizontal components.

Arch Pipe - A conduit in the form of a broad arch without a bottom.

Average Daily Traffic (ADT) - The average 24-hour traffic volume at a given location for some period of time, being the total volume during a stated period divided by the number of days in that period. Unless otherwise stated, the period is a year.

Axle Load - The load borne by one axle of a traffic vehicle.

Award - Written notification to the bidder that the bidder has been awarded a contract.

B

Backfill - Material used to replace or the act of replacing material removed during construction; also may denote material placed or the act of placing material adjacent to structures.

Backwater - The water upstream from an obstruction in which the free surface is elevation above the normal water surface profile.

Bar Chair - A device used to support horizontal reinforcing bars above the base of the form before the concrete is poured.

Bar Cutting Diagram - A diagram used in the detailing of bar steel reinforcement where the bar lengths vary as a straight line.

Base Course - The layer of specified material of designed thickness placed on a subbase or a subgrade to support a surface course.

Bascule Bridge - A bridge over a waterway with one or two leaves which rotate from a horizontal to a near-vertical position, providing unlimited clear headway.

Base Flood - Flood having 1% chance of being exceeded in any given year.

Battered Pile - A pile driven in an inclined position to resist horizontal forces as well as vertical forces.

Beam - Main longitudinal load carrying member in a structure, designed to span from one support to another (girder).

Bearings - Device to transfer girder reactions without overstressing the supports.

Bearing Capacity - The load per unit area which a structural material, rock, or soil can safely carry.

Bearing Failure - A crushing of material under extreme compressive load.

Bearing Seat - A prepared horizontal surface at or near the top of a substructure unit upon which the bearings are placed.

Bearing Stiffener - A stiffener used at points of support on a steel beam to transmit the load from the top of the beam to the support point.

Bedrock - The solid rock underlying soils or other superficial formation.

Bench Mark - A relatively permanent material object bearing a marked point whose elevation above or below an adopted datum is known.

Bent - Supports at the ends or intermediate points of a bridge used to retain approach embankments and/or vertical and horizontal loads from the superstructure.

Bicycle Lane - A lane in the traveled way designated for use by bicyclists.

Bicycle Path - A public way physically separated from the roadway, that is designated for use by bicyclists.

Bid Schedule - The list of bid items, their units of measurement, and estimated quantities, bound in the proposal booklet. (When a contract is awarded, the Bid Schedule becomes the Schedule of Contract Prices.)

Bidder - Any qualified individual or legal entity submitting a proposal in response to an advertisement.

Biennium - For the State of Oregon, a two-year period, always odd numbered years, starting July 1 and ending two years later on June 30.

Bleeding (Concrete) - The movement of mixing water to the surface of freshly placed concrete.

Bowstring Truss - A general term applied to a truss of any type having a polygonal arrangement of its top chord members conforming to or nearly conforming to the arrangement required for a parabolic truss.

Box Beam - A hollow structural beam with a square, rectangular, or trapezoidal cross-section.

Box Culvert - A culvert of rectangular or square cross-section.

Breakaway - A design feature that allows a device such as a sign, luminaire, or traffic signal support to yield or separate upon impact. The release mechanism may be a slip plane, plastic hinges, fracture elements, or a combination of these.

Bridge - A structure spanning and providing passage over a river, chasm, road, or the like, having a length of 20 feet or more from face to face of abutments or end bents, measured along the roadway centerline.

Bridge Approach - Includes the embankment materials and surface pavements that provide the transition between bridges and roadways.

Bridge Approach Slab - A reinforced concrete slab placed on the approach embankment adjacent to and usually resting upon the abutment back wall; the function of the approach slab is to carry wheel loads on the approaches directly to the abutment, thereby eliminating any approach roadway misalignment due to approach embankment settlement.

Bridging - A carpentry term applied to the cross-bracing fastened between timber beams to increase the rigidity of the floor construction, distribute more uniformly the live load and minimize the effects of impact and vibration.

Bridge Railing - A longitudinal barrier whose primary function is to prevent an errant vehicle from going over the side of the bridge structure.

Brush Curb - A curb 10" or less in width, which prevents a vehicle from brushing against the railing or parapet.

Buckle - To fail by an inelastic change in alignment as a result of compression.

Built-Up Member - A column or beam composed of plates and angles or other structural shapes united by bolting, riveting or welding.

Bulkhead – A partition built into wall forms to terminate each placement of concrete.

Buoyancy - Upward force exerted by the fluid in which an object is immersed.

Bushings - A lining used to reduce friction and/or insulate mating surfaces usually on steel hanger plate bearings.

Butt Splice - A splice where the ends of two adjoining pieces of metal in the same plane are fastened together by welding.

Butt Weld - A weld joining two abutting surfaces by combining weld metal and base metal within an intervening space.

C

Cable-Stayed Bridge - A bridge in which the superstructure is directly supported by cables, or stays, passing over or attached to towers located at the main piers.

CADD - Computer-Aided Design and Drafting.

Caisson - A watertight box of wood or steel sheeting; or a cylinder of steel and concrete, used for the purpose of making an excavation. Caissons may be either open (open to free air) or pneumatic (under compressed air).

Camber - A predetermined vertical curvature built into a structural member, to allow for deflection and/or vertical grade.

Cast-in-Place - The act of placing and curing concrete within formwork to construct a concrete element in its final position.

Catch Basin - A receptacle, commonly box shaped and fitted with a grided inlet and a pipe outlet drain, designed to collect the rain water and floating debris from the roadway surface and retain the solid material so that it may be periodically removed.

Catenary - The curve obtained by suspending a uniform rope or cable between two points.

Cathode - The negatively charged pole of a corrosion cell that accepts electrons and does not corrode.

Cathodic Protection - A means of preventing metal from corroding; this is done by making the metal a cathode through the use of impressed direct current and by attaching a sacrificial anode.

Catwalk - A narrow walkway to provide access to some part of a structure.

Chain Drag - A series of short medium weight chains attached to a T-shaped handle; used as a preliminary technique for inspecting a large deck area for delamination.

Chamfer – A beveled edge formed in concrete by a triangular strip of wood (chamfer strip) placed in a form corner.

Change Order - A written order issued by the Engineer to the Contractor modifying work required by the contract and establishing the basis of payment for the modified work.

Chord - A generally horizontal member of a truss.

Clay - Soil passing a No. 200 sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents.

Clear Zone - Roadside border area, starting at the edge of the traveled way, that is available for safe use by errant vehicles. Establishing a minimum width clear zone implies that rigid objects and certain other hazards with clearances less than the minimum width should be removed and relocated outside the minimum clear zone, or remodeled to make breakaway, shielded, or safely traversable.

Closed Spandrel Arch - A stone or reinforced concrete arch span having spandrel walls to retain the spandrel fill or to support either entirely or in part the floor system of the structure when the spandrel is not filled.

Cobbles - Particles of rock, rounded or not, that will pass a 12" square opening and be retained on a 3" sieve.

Cofferdam - A barrier built in the water so as to form an enclosure from which the water is pumped to permit free access to the area within.

Cohesionless Soil - A soil that when unconfined has little or no strength when air-dried and that has little or no cohesion when submerged.

Cohesive Soil - A soil that when unconfined has considerable strength when air-dried and that has significant cohesion when submerged. Clay is a cohesive soil.

Commission - The Oregon Transportation Commission.

Composite Section - Two sections made of the same or different materials together to act as one integral section; such as a concrete slab on a steel or prestressed girder.

Compression Seals - A preformed, compartmented, elastomeric (neoprene) device, which is capable of constantly maintaining a compressive force against the joint interfaces in which it is inserted.

Concept Plans – plans to determine the basic features of a project including alignments, typical sections, slopes, preliminary drainage and TS&L bridge plans.

Concrete Overlay – 1.5" to 2" of concrete placed on top of the deck, used to extend the life of the deck and provide a good riding surface.

Contract - The written agreement between the Division and the Contractor describing the work to be done and defining the obligations of the Division and the Contractor.

Contract Plans - Detailed drawings and diagrams usually made to scale showing the structure or arrangement, worked out beforehand, to accomplish the construction of a project and/or object(s).

Contract Time - The number of calendar days shown in the proposal which is allowed for completion of the work.

Contraction Joint - A joint in concrete that does not provide for expansion but allows for contraction or shrinkage by the opening up of a crack or joint.

Contractor - The individual or legal entity that has entered into a contract with the Division.

Coordinates - Linear or angular dimensions designating the position of a point in relation to a given reference frame. It normally refers to the State Plane Coordinate System.

Core - A cylindrical sample of concrete removed from a bridge component for the purpose of destructive testing.

Counterfort Wall - A reinforced concrete retaining wall whose vertical stem has triangular-shaped ribs projecting into the soil and spaced at regular intervals to provide strength and stability.

Crash Cushion - An impact attenuator device that prevents an errant vehicle from impacting fixed object hazards by gradually decelerating the vehicle to a safe stop or by redirecting the vehicle away from the hazard.

Crash Tests - Vehicular impact tests by which the structural and safety performance of roadside barriers and other highway appurtenances may be determined. Three evaluation criteria are considered, namely (1) structural adequacy, (2) impact severity, and (3) vehicular post-impact trajectory.

Creep - Time dependent inelastic deformation under elastic loading of concrete or steel resulting solely from the presence of stress.

Cross-bracing - Bracing used between stringers and girders to hold them in place and stiffen the structure.

Cross-section - The exact image formed by a plane cutting through an object usually at right angles to a central axis.

Crown Section - Roadway section with the height of the center of the roadway surface above its gutters.

Culvert - Federal Highway Administration definition: "A structure not classified as a bridge having a span of 20 feet or less spanning a watercourse or other opening on a public highway"; a conduit to convey water through an embankment.

Curb - A vertical or sloping member along the edge of a pavement or shoulder forming part of a gutter, strengthening or protecting the edge, and clearly defining the edge of vehicle operators. A curb is a horizontal offset varying from 10" to less than 18". The surface of the curb facing the general direction of the pavement is called the "face".

Curing - The preparation of a material by chemical or physical processing for keeping or use; treating concrete by covering its surface with some material to prevent the rapid evaporation of water.

Cut-Off-Wall - A wall built at the end of a culvert apron to prevent the undermining of the apron.

D

Dead End - End of post-tensioned bridge where tendons are anchored but no jacking takes place (opposite of jacking end).

Dead Load - Structure weight including future wearing surface on deck and attachments.

Deadman - A concrete mass, buried in the earth behind a structure, that is used as an anchor for a rod or cable to resist horizontal forces that act on the structure.

Deformed Bars - Concrete reinforcement consisting of steel bars with projections or indentations to increase the mechanical bond between the steel and concrete.

Delamination - Subsurface separation of concrete into layers.

Department - The Department of Transportation of the State of Oregon.

Design Volume or Design Hourly Volume - A volume determined for use in design representing traffic expected to use the highway. Unless otherwise stated, it is an hourly volume.

Diaphragm - Structural: A structural member used to tie adjoining girders together and stiffen them in a lateral direction as well as to distribute loads.

Diamond Grinding - Process to abrade or remove a surface, such as concrete, by the cutting action of rotating circular blade with diamond-tipped teeth.

Direct Tension Indicator - Load-indicating washer for bolts.

Doby - A precast block of concrete of various sizes used to support or provide clearances between reinforcing bars and formwork.

Dolphins - A group of piles or sheet piling driven adjacent to a pier. Their purpose is to prevent extensive damage or possible collapse of a pier from a collision with a ship or barge.

Draped Strands - Strand pattern for prestressing strands, where strands are draped to decrease the prestressing stress at the ends of the girder where the applied moments are small.

Drift Pin - A metal pin, tapered at both ends, used to draw members of a steel structure together by being driven through the corresponding bolt holes.

Drip Groove - A groove formed into the underside of a projecting concrete sill or coping to prevent water from following around the projection.

E

E - modulus of elasticity of a material; the stiffness of a material.

E&C – Engineering & Contingencies. Engineering costs are ODOT's costs to administer the construction contract. Contingencies are unforeseen costs due to construction extra work price agreements or types of problems caused by weather, accidents, etc. by the contract pay item.

Elastomeric Bearing Pads - Pads $\frac{1}{2}$ " and less in thickness made of all rubber-like material that supports girders and concrete slabs; pads over $\frac{1}{2}$ " in thickness consist of alternate laminations of elastomer and metal.

End-Bearing Pile - A pile which provides support primarily due to reaction at its tip.

Environmental Classes – Classes (1, 2 or 3) that ????????

Environmental Class I Environmental Impact Statement: Projects that normally involve significant changes in traffic capacities and patterns. These projects generally involve major right-of-way acquisitions. Both draft and final Environmental Impact Statements are required.

Environmental Class II Categorical Exclusions: Projects that normally involve the improvement of pavement conditions on traffic safety, but little, if any, change in traffic capacities or patterns. Right-of-way requirements must be minor. These projects are categorically excluded from further environmental documentation, unless permit requirements indicate otherwise.

Environmental Class III Environmental Assessment: Projects that do not clearly fall within Class I or Class II. These projects require assessments to determine their environmental significance.

Epoxy - A synthetic resin which cures or hardens by chemical reaction between components which are mixed together shortly before use.

Epoxy Coated Rebar - Steel reinforcement coated with a powdered epoxy resin, to prevent corrosion of the bar steel.

Expansion Bearings - Bearings that allow longitudinal movement of the superstructure relative to the substructure and rotation of the superstructure relative to the substructure.

Expansion Device - A device placed at expansion points in bridge superstructures to carry the vertical bridge loads without preventing longitudinal movement.

Expansion Joint - A joint in concrete that allows expansion due to temperature changes, thereby preventing damage to the structure.

Extra Work - Work not included in any of the contract items as awarded but determined by the Engineer necessary to complete the project according to the intent of the contract. This may be paid on a negotiated price, force account, or established price basis.

Extrados - The curved edge of an arch rib or barrel formed by the intersection of the top and side arch surfaces.

F

Falsework - In general, a temporary construction work on which a main or permanent work is wholly or partially supported until it becomes self-supporting. For cast-in-place concrete or steel construction, it is a structural system to support the vertical and horizontal loads from forms, reinforcing steel, plastic concrete, structural steel, and placement operations.

Fatigue - The tendency of a member to fail at a lower stress when subjected to cyclical loading than when subjected to static loading.

Fatigue Crack - Any crack caused by repeated cyclic loading.

Federal-Aid System of Highways - The national system of interstate highways, Federal-aid highway system,

system of secondary and feeder roads, Federal-aid grade crossing projects, federal forest highway systems and projects and other highway and related projects, all within the meaning of the Federal-Aid Road Act (1916), and all acts amendatory thereof and supplementary thereto, and the federal regulations issued under such acts.

Fender - A structure that acts as a buffer to protect the portions of a bridge exposed to floating debris and water-borne traffic from collision damage.

Fiscal Year - For the State of Oregon, July 1 through June 30 of the next year; for the Federal government, October 1 through September 30 of the next year. The Federal fiscal year (FY) is broken into quarters:

F1Q (October, November, December)

F2Q (January, February, March)

F3Q (April, May, June)

F4Q (July, August, September)

Felloe Guard - Timber curb, usually 10" x 12", bolted to timber deck and timber rail post. Sometimes called wheel guard.

Filler Plate - A steel plate or shim used for filling in space between compression members.

Fixed Bearings - Bearings that do not provide for any longitudinal movement of the superstructure relative to the substructure, but allows for rotation of the superstructure relative to the substructure.

Flat Slab - A reinforced concrete superstructure that has a uniform depth throughout.

Flood Plain - An area that would be inundated by a flood.

Floodway - A stream channel plus any adjacent flood plain areas that must be kept free of encroachment so that the 100-year flood can be conveyed without substantial increases in flood heights.

Floor Beam - A transverse structural member that extends from truss to truss or from girder to girder across the bridge.

Flux - A material that protects the weld from oxidation during the fusion process.

Force Account Work - Items of extra work ordered by the Engineer that are to be paid for by material, equipment, and labor.

Forms - A structural system constructed of wood or metal used to contain the horizontal pressures exerted by plastic concrete and retain it in its desired shape until it has hardened.

Fracture Critical Members - Members of a bridge where a single fracture in a member can lead to collapse.

Fracture Mechanics - Study of crack growth in materials.

Free-Standing Retaining Wall - A retaining wall that is not part of the bridge abutment walls.

Friction Pile - A pile that provides support through friction resistance along the surface area of the pile.

Functionally Obsolete Bridges - Those bridges which have deck geometry, load carrying capacity (comparison of the original design load to the current state legal load), clearance, or approach roadway alignment which no longer meet the usual criteria for the system of which they are a part as defined by the Federal Highway Administration.

G

Gabions - Rock-filled wire baskets used to retain earth and provide erosion control.

Galvanic Action - Electrical current between two unlike metals.

Galvanize - To coat with zinc.

Geotextiles - Sheets of woven or non-woven synthetic polymers or nylon used for drainage and soil stabilization.

Girder - Main longitudinal load carrying member in a structure (beam).

Glare Screen - A device used to shield a driver's eye from the headlights of an oncoming vehicle.

Grade Separation - A crossing of two highways or a highway and a railroad at different levels.

Gravity Wall - A retaining wall that is prevented from overturning by its weight alone.

Green Concrete - Concrete that has set but not appreciably hardened.

Grid Flooring - A steel floor system comprising a lattice pattern which may or may not be filled with concrete.

Grout - A mixture of cementitious material and water having a sufficient water content to render it a free-flowing mass, used for filling (grouting) the joints in masonry, for fixing anchor bolts and for filling post-tensioning ducts.

H

Hammerhead Pier - A pier that has only one column with a cantilever cap and is somewhat similar to the shape of a hammer.

Hanger Plate - A steel plate that connects the pins at hinge points thus transmitting the load through the hinge.

Haunch - An increase in depth of a structural member usually at points of intermediate support.

Haunched Slab - A reinforced concrete superstructure that is haunched (has an increased depth) at the intermediate supports.

Headwall - A concrete structure at the ends of a culvert to retain and protect the embankment slopes, anchor the culvert, and prevent undercutting.

High Performance Concrete (HPC) – Concrete with enhanced properties including higher strength, greater durability and decreased permeability.

High Performance Steel (HPS) - Steel with enhanced properties including increased durability and weldability.

Hinge - A device used to hold the ends of two adjoining girders together, but does not allow for longitudinal

movement of the superstructure. A point in a structure where a member is free to rotate.

Holddown Device - A device used on bridge abutments to prevent girders from lifting off their bearings as a result of the passage of live load over the bridge.

Honeycomb - A surface or interior defect in a concrete mass characterized by the lack of mortar between the coarse aggregate particles.

Howe truss - A truss of the parallel chord type with a web system composed of vertical (tension) rods at the panel points with an X pattern of diagonals.

Hydration - The process by which cement combines with water to form a hard binding substance.

Hybrid Girder - A steel plate girder with the web steel having a lower yield strength than the steel in one or both flanges.

Hydrodemolition - Process to abrade or remove a surface, such as concrete, by streams of water ejected from a nozzle at high velocity.

I

Incidental Work - Work necessary for fulfillment of the contract but which is not listed as a pay item in the contract and for which no separate or additional payment will be made.

Initial Set (Concrete) - Initial stiffening of concrete, with time based upon penetration of a weighted test needle. In the field, it is commonly assumed to be the time when the dead weight of vibrator does not penetrate into the concrete.

Inlet Control - The case where the discharge capacity of a culvert is controlled at the culvert entrance by the depth of headwater and the entrance geometry, including barrel shape, cross-sectional area, and inlet edge.

Intermediate Stiffener - A vertical transverse steel member used to stiffen the webs of plate girders between points of support.

Internal File Number - Number assigned by the Bridge Front Office as part of office automation (computerized files) and used to track all files.

Invert - The bottom or lowest point of the internal surface of the transverse cross-section of a pipe.

Inventory Rating (Design Load) - Load level that produces normal design stresses in the structures. The inventory rated load is the load that can safely utilize an existing structure for an indefinite period of time.

International System of Units (SI) - The modernized metric system.

Intrados - The curved edge of an arch rib or barrel formed by the intersection of the bottom and side arch surfaces.

Isotropic - Have the same material properties in all directions, e.g., steel.

J

Jacking End - End of post-tensioned bridge where jacking takes place (opposite of dead end).

Jetting - Forcing water into holes in an embankment to settle or to compact the earth. Forcing water through holes in piles to install the piles to a specified depth before driving.

K

Key Number - Number assigned to a project by Program Section to identify it in the Project Control System (PCS). All structures in a project have the same key number.

Kilogram (kg) - The base unit for mass in the International System of Units (metric).

King Post Truss - Two triangular panels with a common center vertical; the simplest of triangular trusses.

L

Lacing - Small flat plates used to connect individual sections of built up members.

Laitance - A weak mortar that collects at the surface of freshly placed concrete, usually caused by an excess of mixing water or by excessive finishing.

Lamellar Tear - Incipient cracking between the layers of the base material (steel).

Lateral Bracing - Bracing placed in a horizontal plane between steel girders near the bottom and/or top flanges.

Latex Modified Concrete (LMC) - Emulsion of synthetic rubber or plastic obtained by polymerization used as a concrete additive to decrease permeability.

Leaf - The movable portion of a bascule bridge which forms the span of the structure.

Lenticular Truss - A truss having parabolic top and bottom chords curved in opposite directions with their ends meeting at a common joint; also known as a fish belly truss.

Level of Performance - The degree to which a longitudinal barrier, including bridge railing, is designed for containment and redirection of different types of vehicles.

Liquid Penetrant Inspection - Nondestructive inspection process for testing for continuities that are open to the surface, by using a liquid dye.

Live Load - Force of the applied moving load of vehicles and/or pedestrians.

Load Rating - Evaluation of the safe live load capacity of the weakest member of a bridge.

LRFD - Load Resistance Factor Design.

Longitudinal Stiffener - A longitudinal steel plate (parallel to girder flanges) used to stiffen the webs of welded plate girders. Normally thicker webs are used to eliminate longitudinal stiffeners.

Low Relaxation Strands - Prestressing tendons that are manufactured by subjecting the strands to heat treatment and tensioning causing a permanent elongation. This increases the strand yield strength and reduces strand relaxation under constant tensile stress.

M

Magnetic Particle Inspection (MT) - Nondestructive inspection process for testing for the location of surface cracks or surface discontinuities, by applying dry magnetic particles to a weld area or surface area that has been suitably magnetized.

Microsilica (Silica Fume) (MC) - Very fine non-crystalline silica used as an admixture in concrete to improve the strength, permeability and abrasion resistance.

Minor Structure Concrete (MSC) - Nonstructural concrete furnished according to contractor proportioning, placed in minor structures and finished as specified. Previously called commercial concrete.

Modular Expansion Joints - Multiple, watertight joint assemblies for bridges requiring expansion movements greater than 4 inches.

Mud Sill - A timber platform laid on earth as a support for vertical members or bridge falsework.

Mylars - Full-size drawings on mylar. The final "legal" drawing used for signatures and printing contract plans.

N

NDT - Nondestructive testing, a method of checking the structural quality of materials that does not damage them.

Negative Moment - The moment causing tension in the top fibers and compression in the bottom fibers of a structural member.

Negative Reinforcement - Reinforcement placed in concrete to resist negative bending moments.

Newton (N) - The derived unit for force (mass times acceleration or kg times m/s²) in the International System of Units (metric).

Nominal - Used to designate a theoretical dimension, size, or slope that may vary from the actual by a very small or negligible amount. Example: a 1" nominal diameter steel pipe has an actual 0.957" inside diameter.

Nominal Pile Resistance – LRFD term for the maximum axial pile bearing resistance. Equivalent to the ultimate pile capacity term used in allowable stress design.

Non-Redundant Structure - Type of structure with single load path, where a single fracture in a member can lead to the collapse of the structure.

Nosing – A bulkhead at the ends of bridges or at expansion joints made of a durable material to protect and reinforce the slab edge. It also provides a smooth edge or surface at expansion joints to facilitate

installation and provide a better seal.

O

Operating Rating (Permit Loads) - The absolute maximum permissible stress level to which a structure may be subjected. It is that stress level that may not be exceeded by the heaviest loads allowed on the structure. Issue special permits for heavier than normal vehicles only if such loads are distributed so as not to produce stress in excess of the operating stress.

Outlet Control - The case where the discharge capacity of a culvert is controlled by the elevation of the tail water in the outlet channel and the slope, roughness, and length of the culvert barrel, in addition to the cross-sectional area and inlet geometry.

Orthotropic - A description of the physical properties of a material that has pronounced differences in two or more directions at right angles to each other.

P

Parapet - A low concrete rail designed and placed to prevent traffic from passing over the edge of a bridge deck or end of box culvert.

Pascal (Pa) - The derived unit for pressure or stress ($\text{Pa}=\text{N}/\text{m}^2$) in the International System of Units (metric).

Paving Dam – (see Nosing) – A bulkhead at the ends of bridges or at expansion joints made of a durable material to protect and reinforce the slab edge and provide a stopping place for the wearing surface.

Paving Ledge – A ledge or corbel attached to the end beam of a bridge, to provide support for a current or future approach slab.

Performance Level - See Level of Performance.

Pier - Intermediate substructure unit of a bridge. Current terminology is bent.

Pile - A long, slender piece of wood, concrete, or metal to be driven, jettied, or cast-in-place into the earth or river bed to serve as a support or protection.

Pile Bent - A pier where the piles are extended to the pier cap to support the structure.

Pile Cap - A member, usually of reinforced concrete, covering the tops of a group of piles for the purpose of tying them together and transmitting to them as a group the load of the structure that they support.

Pipe Arch - A conduit in the form of a broad arch with a slightly curved integral bottom.

Plastic Deformation - Deformation of material beyond the elastic range.

Positive Moment - In a girder the moment causing compression in the top flange and tension in the bottom flange.

Post-Tensioning - Method of prestressing in which the tendon is tensioned after the concrete has cured.

Pot Bearing - A bearing type that allows for multi-directional rotation by using a neoprene or spherical bearing element.

Prestress Camber - The deflection in prestressed girders (usually upward) due to the application of the prestressing force.

Pratt Truss - A truss with parallel chords and a web system composed of vertical posts with diagonal ties inclined outward and upward from the bottom chord panel points toward the ends of the truss; also known as N-truss.

Preliminary Plans – 85-90% complete plans, normally sent at 20 weeks.

Prestressed Concrete - Concrete in which there have been introduced internal stresses (normally pretensioned steel) of such magnitude and distribution that the stresses resulting from given external loadings are counteracted to a desired degree

Pretensioned - Any method of prestressing in which the strands are tensioned before the concrete is placed.

Project Manager - The Engineer's representative who directly supervises the engineering and administration of a contract.

Proposal - A written offer by a bidder on forms furnished by the Division to do stated work at the prices quoted.

PS&E - Literally, Plans, Specifications, and Estimates. Usually it refers to the time when the plans, specifications, and estimates on a project have been completed and referred to FHWA for approval. When the PS&E has been approved, the project goes from the preliminary engineering phase to the construction phase.

Pumping - The ejection of mixtures of water, clay and/or silt along or through transverse or longitudinal joints, crack or payment edges, due to vertical movements of the roadway slab under traffic.

Q

Queen-post Truss - A parallel chord type of truss having three panels with the top chord occupying only the length of the center panel; unless center panel diagonals are provided, it is a trussed beam.

R

Radiographic Inspection - Nondestructive inspection process where gamma rays or X rays pass through the object and cast an image of the internal structure onto a sheet of film as the result of density changes.

Redundant Structure - Type of structure with multiple-load paths where a fracture in a single member cannot lead to the collapse of the structure.

Reflection Crack - A crack appearing in a resurfacing or overlay caused by movement at joints or cracks in the underlying base or surface.

Rehabilitation – Work required to restore the structural integrity of a bridge, or bridge element, as well as work necessary to correct major safety defects. Rehabilitation activities are considered bridge preservation.

Reinforced Pile Tip - Metal reinforcement fastened to the pile tip to protect it during driving.

Replacement – Total reconstruction of a structurally deficient or functionally obsolete bridge, or bridge element, with a new one constructed in the same vicinity. The replacement structure, or element, must comply with current design codes, policies and practices.

Residual Camber - Camber due to the prestressing force minus the dead load deflection of the girder.

Retrofit – Work required to upgrade a bridge, or bridge element, beyond its original intended purpose and design capacity. This work often includes strengthening to add structural capacity.

Right of Way - Land, property, or property interest, usually in a strip, acquired for or devoted to transportation purposes.

Riprap - A facing of stone used to prevent erosion. It is usually dumped into place, but is occasionally placed by hand.

Roadside Barrier - A longitudinal barrier used to shield roadside obstacles or non-traversable terrain features. It may occasionally be used to protect pedestrians from vehicle traffic.

Roadway - The portion of a highway, including shoulders, for vehicular use.

Rubble - Irregularly shaped pieces of varying size stone in the undressed condition obtained from a quarry.

S

Sacrificial Anode - The anode in a cathodic protection system.

Sand - Particles of rock that will pass a No. 4 sieve and be retained on a No. 200 sieve.

Scaffolding - Temporary elevated walkway or platform to support workmen, materials and tools.

Scarify - To loosen, break up, tear up, and partially pulverize the surface of soil, or of a road.

Scour - Erosion of a river bed area caused by water flow.

Scour Protection - Protection of submerged material by steel sheet piling, riprap, mattress, or combination of such methods.

Screeding - The process of striking off excess material to bring the top surface to proper contour and elevation.

Seal - A concrete mass (usually not reinforced) poured under water in a cofferdam that is designed to resist hydrostatic uplift. The seal facilitates construction of the footing in dry conditions.

Shear Connector - A connector used to joint cast-in-place concrete to a steel section and to resist the shear at the connection.

Shear Lag - Nonuniform stress pattern due to ineffective transmission of shear.

Shed Roof - Roadway section with the height of one gutter greater than the centerline and other gutter.

Sheet Pile - A pile made of flat or arch cross-section to be driven into the ground or stream bed and meshed or interlocked with like members to form a wall, or bulkhead.

Sheet Pile Cofferdam - A wall-like barrier composed of driven piling constructed to surround the area to be occupied by a structure and permit dewatering of the enclosure so that the excavation may be produced in the open air.

Shoofly - Detour alignment of temporary railroad track and bridge around the site of a permanent railroad bridge replacement.

Shotcrete - Mortar or concrete pneumatically projected at high velocity onto a surface.

Shoulders - The portions of the roadway between the traveled way and the inside edges of slopes of ditches or fills, exclusive of auxiliary lanes, curbs, and gutters.

Shy Distance (E-Distance) - The distance from the edge of the traveled way beyond which a roadside object will not be perceived as an immediate hazard by the typical driver, to the extent that the vehicle's placement or speed will be changed.

Shrinkage - Contraction of concrete due to drying and chemical changes, dependent on time.

Silt - Soil passing a No. 200 sieve that is non-plastic or exhibits very low plasticity.

Simple Spans - Spans with the main stress carrying members non-continuous, or broken, at the intermediate supports.

Skew or Skew Angle - The acute angle formed by the intersection of a line normal to the centerline of the roadway with a line parallel to the face of the abutments or piers, or in the case of culverts with the centerline of the culverts. Left hand forward skew indicates that, look up station, the left side of the structure is further up station than the right hand side. Right hand skew indicates that the right side of structure is further up station than the left side.

Slip Base - A structural element at or near the bottom of a post or pole that will allow release of the post from its base upon impact while resisting wind loads.

Slope - The degree of inclination to the horizontal. It is sometimes described by such adjectives as steep, moderate, gentle, mild or flat.

Slope Paving - Pavement placed on the slope in front of abutment to prevent soil erosion.

Soffit - The bottom surface of a beam or an arch rib or barrel.

Spandrel - The area between the roadway and the arch in the side view of an arch bridge.

Special Provisions - The special directions, provisions, and requirements peculiar to the project that augment the standard specifications. They are commonly referred to as "specials".

Specifications - The body of directions, provisions, and requirements, together with written agreements and all documents of any description, made or to be made, pertaining to the method or manner of performing the work, the quantities, and the quality of materials to be furnished under the contract.

Spread Footing - A footing that is supported directly by soil or rock.

Spur Dike - A wall or mound built or extended out from the upstream side of an abutment used for training

the stream flow to prevent erosion of stream bank. May also be used where there is no bridge, but the stream flows along the side of highway embankment.

Stainless Steel Teflon Bearings - Incorporated stainless steel and teflon with steel to provide the necessary expansion movement.

St. Venant Torsion - Uniform torsion resulting in no deformation of the cross-section.

State Plane Coordinates - The plane-rectangular coordinate system established by the United States Coast and Geodetic Survey. Plane coordinates are used to locate geographic position.

Station - A distance of 100 feet measured horizontally.

Stirrup - Vertical U-shaped or rectangular shaped bars placed in concrete beams to resist the shearing stresses in the beam.

Strengthening – Work to add structural capacity to a bridge element or structure.

Stress Relieved Strands - Any prestressing tendons that are manufactured by relieving the high residual stresses that were introduced into the steel during the wire drawing and stranding operations. Stress relieving is not a heat treatment and does not change the strand yield strength.

Strip Seal Joint - Molded neoprene glands inserted and mechanically locked between armored interfaces of extruded steel sections.

Structurally Deficient Bridges - Those bridges which have been (1) restricted to light vehicles only, (2) closed, or (3) require immediate rehabilitation to remain open, as defined by the Federal Highway Administration.

Subgrade - The top surface of completed earthwork on which subbase, base, surfacing, pavement, or a course of other material is to be placed.

Substructure - Those parts of a structure which support the superstructure, including bents, piers, abutments, and integrally built wingwalls, up to the surfaces on which bearing devices rest. Substructure also includes portions above bearing surfaces when those portions are built integrally with a substructure unit (e.g. backwalls of abutments). When substructure and superstructure elements are built integrally, the division between substructure and superstructure is considered to be at the bottom soffit of the longitudinal or transverse beam, whichever is lower. Culverts and rigid frames are considered to be entirely substructure.

Sufficiency Rating - A method of evaluating data by calculating four separate factors to obtain a numeric value which is indicative of bridge sufficiency to remain in service. The result of this method is a percentage in which 100 percent would represent an entirely sufficient bridge and zero percent would represent an entirely insufficient or deficient bridge.

Superelevation - The difference in elevation between the inside and outside edges of a roadway in a horizontal curve; required to counteract the effects of centrifugal force.

Superplasticizer - A high range water-reducing admixture that increases the slump of freshly mixed concrete without increasing the water content.

Superstructure - Those parts of a structure above the substructure, including bearing devices.

Surcharge - Any load that causes thrust on a retaining wall, other than backfill to the level of the top of the wall. Also preloading of an embankment to minimize the time for initial consolidation of the subsurface soils.

Suspension Bridge - A bridge in which the floor system is supported by catenary cables which are supported upon towers and are anchored at their extreme ends.

Suspender - A wire cable, metal rod or bar connected to a catenary cable of a suspension bridge at one end and the bridge floor system at the other, thus transferring loads from the roadway to the main suspension members.

T

Tack Welds - Small welds used for temporary connections.

Telltale (Tattletale) - Any device designed to indicate movement of formwork or falsework.

Tendon - A name for prestressed reinforcing element whether wires, bars, or strands.

Tenon - A constant diameter extension welded to the tip of the tapered metal arm of a luminaire support pole to receive the luminaire.

Thixotropy - Property of a material that enables it to stiffen in a short period on standing, but to acquire a lower viscosity again on mechanical agitation. A property desirable for post-tensioning duct grout.

Three-Dimensional Finite Element Analysis - Analysis in which a three-dimensional continuum is modeled as an assemblage of discrete elements in three-dimensional space.

Three-Hinged Arch - An arch which is hinged at each support and at the crown.

Through Structure - A structure that has its floor connected to the lower portion of the main stress-carrying members, so that the bracing goes over the traffic. A structure whose main supporting members project above the deck or surface.

Tining - Is used on finished concrete deck or slab surfaces to provide friction and reduce hydroplaning. Grooves are placed in the plastic concrete or cut into the hardened concrete.

Torsional Stress - Shear stress on a transverse cross-section resulting from a twisting action.

Transformed Section - A hypothetical section of one material so as to have the same elastic properties as a section of two materials.

Transition - A section of barrier between two different barriers or, more commonly, where a roadside barrier is connected to a bridge railing or to a rigid object such as a bridge pier. The transition should produce a gradual stiffening of the approach rail so vehicular pocketing, snagging, or penetration at the connection can be avoided.

Traveled Way - The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

Tremie - A pipe or tube through which concrete is deposited underwater.

Trial Batch - A batch of concrete prepared to establish or check proportions of the constituents.

Turnbuckle - A long, cylindrical, internally threaded nut used to connect the elements of adjustable rod and bar members.

Turn-of-the-Nut - A bolt-tightening method.

Two-hinged Arch - A rigid frame which may be arch-shaped or rectangular but is hinged at both supports.

U

Ultrasonic Inspection - A non-destructive inspection process where by an ultra-high frequency sound wave induced into a material is picked up in reflection from any interface or boundary.

Unbonded Strands - Strands so coated as to prevent their forming a bond with surrounding concrete. Used to reduce stress at the ends of a member.

Underpinning - The addition of new permanent support to existing foundations to provide additional capacity.

Uplift - A force tending to raise a structure or part of a structure and usually caused by wind and/or eccentric loads, or the passage of live-load over the structure.

Utility - A line, facility, or system for producing, transmitting, or distributing communications, power, electricity, heat, gas, oil, water, steam, waste, storm water not connected with highway drainage, or any other similar commodity which directly or indirectly serves the public. The term utility shall also mean the utility company, district, or cooperative, including any wholly owned or controlled subsidiary.

V

Vierendeel Truss - A Pratt truss without diagonal members and with rigid joints between top and bottom chords and the verticals.

Vibrator - An oscillating device inserted at selected locations to consolidate fresh concrete.

W

Wales - Horizontal support members in close contact with a row of sheet piles in a cofferdam or shoring wall. Sometimes called whalers.

Warrants - The criteria by which the need for a safety treatment or improvement can be determined.

Warren Truss - A triangular truss consisting of sloping members between the top and bottom chords and no verticals; members form the letter W.

Water/Cement Ratio - The weight of water divided by the weight of cement in a concrete; ratio controls the strength of the concrete.

Waterproofing Membranes - Impervious material overlaid with bituminous concrete to protect decks from the infiltration of chlorides and resulting deterioration.

Wearing Surface - The top layer of a pavement designed to provide structural values and a surface resistant to traffic abrasion.

Weep Hole - A drain hole through a wall to prevent the building up of hydraulic pressure behind the wall.

Weld Inspection - Covers the process, written procedure, and welding in process. Post weld heat maintenance if required, post weld visual inspection and non-destructive testing as specified in contract and Standard Specifications.

Welded-Wire Fabric - A two-way reinforcing mat, fabricated from cold-drawn steel wire, having parallel longitudinal wires welded at regular intervals to parallel transverse wires.

Well-Graded - An aggregate possessing a proportionate distribution of successive particle sizes.

Wetlands - Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Wheel Load – Half of an axle load.

Wingwall - A wall attached to the abutments of bridges or box culverts retaining the roadway fill. The sloping retaining walls on each side of the center part of a bridge abutment.

X

Y

Yield - Permanent deformation (permanent set) which a metal piece takes when it is stressed beyond the elastic limit.

Young's Modulus - modulus of elasticity of a material (E); or the stiffness of a material.

Z

APPENDIX – SECTION 1 – Abbreviations (Initialisms and Acronyms)

A

A&E	Architectural and Engineering
AADT	Annual Average Daily Traffic
AASHO	American Association of State Highway Officials (1921-1973)
AASHTO	American Association of State Highway and Transportation Officials (since 1973)
AB	Anchor bolt
ABC	Accelerated Bridge Construction
AC	Asphalt Concrete
ACEC	American Council of Engineering Companies of Oregon
ACI	American Concrete Institute
ACP	Asphalt Concrete Pavement
ACT	Area Commission on Transportation
ACWS	Asphalt concrete wearing surface
ADA	Americans with Disabilities Act
ADT	Average daily traffic (see Definitions)
ADTT	Average Daily Truck Traffic
AEE	Association of Engineering Employees
AHP	Analytic Hierarchy Process
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
a.k.a.	Also known as
ANSI	American National Standards Institute
AOC	Association of Oregon Counties
AOH	Access Oregon Highways
AP	Angle Point
APA	American Plywood Association

API	Area of Potential Impact
APJ	Asphaltic Plug Joint
APM	Area Project Manager
APWA	American Public Works Association
AREA	American Railway Engineering Association
AREMA	Manual for Railway Engineering of the American Railway Engineering and Maintenance-of-way Association
ARRA	American Response and Recovery Act
ARS	Accident Records System (Accident Data Unit, Transportation Research Section)
ARTBA	American Road and Transportation Builders Association
ASAP	As soon as possible
ASCE	American Society of Civil Engineers
ASCII	American Standard Code for Information Interchange (refers to files that are pure text)
ASTM	American Society for Testing and Materials
ATA	Agreement to Agree
ATC	Applied Technology Council
ATR	Automatic Traffic Recorder
ATPM	Asphalt-treated permeable material
AWPA	American Wood Products Association
AWS	American Welding Society

B

B-Team	Team of Bridge Engineering Section Supervisors & Engineers
BCM	Bridge CAD Manual
BAMS	Bid Analysis Management System
BBS	Bulletin Board System (computers)
BDC	Bridge Design Coordinator
BDM	Bridge Design Manual
BDS	Bridge Design System (AASHTO software)
BDS	Bridge Data System (ODOT software)
BDWO	Bridge Design Work Order
BIOS	Basic Input/Output System (computers)
BLM	Bureau of Land Management (U.S. Dept. of Interior)
BLT	Bridge Leadership Team
BMP	Best Management Practice

BMS	Bridge Management System
BNRR	Burlington Northern Railroad
Bot.	Bottom
BPR	Bureau of Public Roads (now FHWA)
BRASS	Bridge Rating and Analysis of Structural Systems (software)
BRSFUP	Bridge Rail Safety Features Upgrade Program
Bt.	Bent
BUBB	Bargaining Unit Benefit Board
BVC	Begin vertical curve

C

C	Degrees Celsius Compression
CAC	Citizens Advisory Committee or Community Action Committee
CAD	Computer-aided drafting/computer-aided design
CADD	Computer-aided drafting and design
CAE	Computer-aided engineering
CAFL	Constant Amplitude Fatigue Limit
CalTrans	California Department of Transportation
CBC	Conventional Bridge Construction
CBR	Major Steel Bridges
CCT	Concrete Control Technician
CETAS	Collaborative Environmental and Transportation Agreement for Streamlining
CD-ROM	Compact Disk - Read-Only Memory
CF	Cubic feet
CFRP	Carbon Fiber Reinforced Polymer
CFS	Cubic Feet per Second
CG	Center of Gravity
CICS	Customer Information and Control System (Transportation inventory and Mapping Unit software on the mainframe)
CIM	Corporate Information Management
CIP	Cast-in-place
CIS	Career Information System (Training & Employee Development Sect.)
CLT	Construction Leadership Team
CMP	Construction Mitigation Plan Construction Management Plan

	Corrugated metal pipe
CMR	Change Management Request
COGO	Coordinate Geometry language
COM	Communications port (serial port on a computer)
CP	Cathodic protection
CPM	Critical Path Method (method of scheduling)
	Consultant Project Manager
CPU	Central Processing Unit (computers)
CQC	Complete Quadratic Combination (method of combining seismic forces or displacements)
CRF	Code of Federal Regulations
CRSI	Concrete Reinforcing Steel Institute
CRT	Cathode Ray Tube display (monitor)
CS ³	Context Sensitive and Sustainable Solutions
CSL	Crosshole Sonic Log
CTP	Continuous Trip Permit
CUP	Conditional Use Permit
CWI	Certified Welding Inspector
CY	Cubic yard
CZM	Coastal Zone Management

D

DAP	Design Acceptance Plans
DAW	Design Acceptance Workshop
DB	Design-Build
DBA	Doing Business As
DBE	Disadvantaged Business Enterprises
DCSA	Bridge Design Criteria and Standards Assessment
DD	Bridge Design Deviation
DE	Design Exception
DEC	Digital Equipment Corporation
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality (Oregon)
DHV	Design hourly volume
Dia.	Diameter
DL	Dead load

DLCD	Department of Land Conservation and Development (Oregon) (formerly LCDC)
DLT	Discipline Leadership Team
DOGAMI	Department of Geology and Mineral Industries (Oregon)
DM	District Manager
DMS	District Maintenance Supervisor (old)
DMV	Division of Motor Vehicles
DOJ	Department of Justice
DOS	Disk Operating System for personal computers
DOT	Department of Transportation
DQP	Design Quality Plan
DS	Top of deck to streambed distance
DSL	Division of State Lands (Oregon)
DTI	Direct Tension Indicator (load indicating washer for bolts)

E

E	East
E&C	Engineering and Contingencies (used in cost estimates)
EA	Expenditure Account
	Environmental Assessment
EAC	Emulsified Asphalt Concrete
EAP	Employee Assistance Program
EB	Eastbound
ECL	East city limits
EDMS	Electronic Data Management System
EEO	Equal Employment Opportunity program
EEO/AA	Equal Employment Opportunity/Affirmative Action
EF	Each face
EIS	Environmental Impact Statement
El.	Elevation
Elev.	Elevation
ELT	Environmental Leadership Team
Emb.	Embankment
EOR	Engineer of Record
EP	Edge of pavement
EPA	Environmental Protection Agency (U.S.)
ES	Edge of shoulder

ESA	Endangered Species Act or Environmental Site Assessment
ESR	Evaluation Service Report
EVC	End vertical curve
EW	Each way
Exp.	Expansion

F

F	Degrees Fahrenheit
FAPG	Federal Aid Policy Guide (replaced FHPM 12/9/91)
FAS	Federal Aid Secondary (class of highways)
FAT	File Allocation Table (on a computer disk)
FBN	Film base negative
FBPM	Film base positive matte
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FF	Far face (don't use for "fill face")
FFO	Full Federal Oversight
FHP	Federal-Aid Highway Program
FHPm	Federal Highway Program Manual (replaced by FAPG)
FHWA	Federal Highway Administration (formerly BPR)
FIPS	Federal Information Processing Standards system (IBM software)
FIS	Flood Insurance Studies (conducted by FHWA)
FONSI	Finding Of No Significant Impact
FRP	Fiber Reinforced Polymer
FS	Far side
ft-k	foot-kips
ft-lbs	foot-pounds
FTA	Federal Transit Administration
FTP	File Transfer Protocol
FWS	Future Wearing Surface

G

Ga.	Gauge
GAO	General Accounting Office
GDM	Geotechnical Design Manual

GFRP	Glass Fiber Reinforced Polymer
GHLT	Geo-Hydro Leadership Team
GIS	Geographic Information System
GLO	Government Land Office
GPR	Ground Penetrating Radar
GPS	Global Positioning System
GR	Guard Rail
Gr.	Grade
GSA	General Services Administration
GSP	Galvanized Steel Pipe
GUI	Graphical User Interface for computers (such as Windows)

H

HBP	Highway Bridge Program (funding)
HBR	Highway Bridge Replacement (type of funding)
HBRR	Highway Bridge Replacement and Rehabilitation (type of funding)
HDD	Hard Disk Drive
HDM	Highway Design Manual
HIP	Highway Improvement Plan (6-year plan of ODOT)
HLT	Highway Leadership Team
HMAC	Hot Mix Asphalt Concrete
HOV	High Occupancy Vehicle
HP&R	Highway Planning & Research program
HPC	High Performance Concrete
HPS	High Performance Steel
HQ	Headquarters
HS	High Strength
HSIS	Highway Safety Information System (FHWA database)
Ht.	Height
HW	High Water
HWM	High Water Mark

I

I/O	Input/Output
I4R	Interstate Resurfacing, Restoration, Rehabilitation and Reconstruction (funding category)

IAMP	Interchange Area Management Plan
IBC	International Building Code
IBM	International Business Machines
IC	Internal Curing
ICC-ES	International Code Council Evaluation Service, Inc.
ID	Inside diameter
IDE	Internal Drive Electronics (type of computer hard disk)
IDT	Idaho Department of Transportation
IF	Inside face (don't use!)
IGA	Inter-Governmental Agreement
IO	Intermodal Oregon
ILT	Intermodal Leadership Team
IS	Information Systems
ISB	Information Systems Branch
ISPF	Integrated System Productivity Facility (IBM mainframe software)
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
IT	Information Technology
ITIS	Integrated Transportation Information System
ITS	Intelligent Transportation Systems
IWRC	Independent Wire Rope Core (cables)

J

J	Joule, metric energy unit
JCL	Job Control Language (mainframe)
JTA	Oregon Jobs and Transportation Act of 2009

K

k	Kilo, one thousand
K	Kip (kilopound, 1000 pounds)
kg	Kilogram, metric mass unit
km	Kilometer (1000 meters)
kN	KiloNewton, metric force unit
KSF	Kips per Square Foot
KSI	Kips per Square Inch

L

LAN	Local Area Network (computers)
Lbs	Pounds
LC	Length of curve
LCD	Liquid Crystal Display (computers)
LCDC	Land Conservation and Development Commission (Oregon) (now DLCD)
LF	Linear feet
LL	Live load
LMC	Latex Modified Concrete
LOC	League of Oregon Cities
LPA	Local Public Agency
LPT	Line Printer (parallel computer port)
LRFD	Load Resistance Factor Design
<i>LRFD</i>	<i>AASHTO LRFD Bridge Design Specifications</i>
L.S.	Lump Sum
LSDC	Low slump dense concrete
LT	Leadership Team

M

m	Meter, metric length unit
	Milli, one thousandth
M	Mega, one million
MALT	Modes and Area Leadership Team
MAPS-21	Moving Ahead for Progress in the 21 st Century (funding)
MASH	Manual for Assessing Safety Hardware
MBJS	Modular Bridge Joint System
MBM,MFBM	Thousand feet board measure
MBM	Major Bridge Maintenance
MC	Microsilica modified concrete
MCTD	Motor Carrier Transportation Division
MH	Manhole
MHz	MegaHertz (millions of cycles per second)
MLT	Maintenance Leadership Team
MP	Microfilm print
	Milepoint, milepost (even milepoint)

MPCO	Multi-Layer Polymer Concrete Overlay
MPO	Metropolitan Planning Organization
MOA	Memorandum of Agreement
MOT	Maintenance of Traffic
MOU	Memorandum Of Understanding
MSC	Minor structure concrete
MSCS	Management Scheduling Control System (to replace PCS)
MS-DOS	Microsoft Disk Operating System
MSDS	Material Safety Data Sheet
MSE	Mechanically Stabilized Earth (retaining walls)
MSL	Mean Sea Level
MT	Magnetic Particle
MTPA	Major Transportation Projects Agreement

N

N	North
	Newton, metric force unit
NACE	National Association of Corrosion Engineers
NAVD 88	North American Vertical Datum 1988
NB	Northbound
NBI	National Bridge Inventory
NBIS	National Bridge Inspection Standards
NCEER	National Center for Earthquake Engineering Research (Buffalo, NY)
NCHRP	National Cooperative Highway Research Program (from the Transportation Research Board)
NCL	North city limits
NDE	Non-destructive Evaluation
NDT	Non-destructive Testing
NEPA	National Environmental Protection Act of 1969
NF	Near face
NGVD	National Geodetic Vertical Datum (MSL = 0.0)
NHI	National Highway Institute
NHPP	National Highway Performance Program
NHS	National Highway System
NHTSA	National Highway Traffic Safety Administration
NICET	National Institute for Certification in Engineering Technologies

NLF	No Load Fit
NMFS	National Marine Fisheries Service
NOAA	National Oceanic & Atmospheric Administration (U.S. Dept. of Commerce)
NSBA	National Steel Bridge Alliance
NSM	Near Surface Mount
NSPE	National Society of Professional Engineers
NT	New Technology (new version of Microsoft Windows)
NTS	Not to Scale

O

OAR	Oregon Administrative Rule
OBIS	Oregon Bridge Inventory System
OC	On Center (center-to-center)
OCAPA	Oregon Concrete & Aggregate Producers Association, Inc.
OD	Outside Diameter
ODF&W	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OERS	Oregon Emergency Response System
OG	Original Ground
OHP	Oregon Highway Plan
OHWM	Ordinary High Water Mark
OIT	Oregon Institute of Technology
OMUTCD	Oregon Manual on Uniform Traffic Control Devices
OO, O-O	Out-to-out
OPEU	Oregon Public Employees Union
OPL	Office of Project Letting
OPO	ODOT Procurement Office
Ops.	Operations
ORS	Oregon Revised Statutes
OS	Operating System
OSHA	Occupational Safety and Health Administration (U.S.)
OSHD	Oregon State Highway Division
OSP	Oregon State Police
	Oregon State Parks
OSU	Oregon State University
OTC	Oregon Transportation Commission

OTIA	Oregon Transportation Investment Act (I, II, & III)
OTP	Oregon Transportation Plan
Oxing	Overcrossing
OZ	Ozalid print

P

Pa	Pascal, metric stress or pressure unit
PA	Price Agreement
PBLT	Planning Business Line Leadership Team
PC	Point of curvature Polymer Concrete
P/C	Precast Concrete
PCA	Portland Cement Association
PCC	Portland Cement Concrete Point on compound curve
PCF	Pounds per Cubic Foot
PCI	Prestressed Concrete Institute
PCP	Prestressed concrete pipe
PCS	Project Control System (to be replaced by MSCS) Point of change from circular curve to spiral
PDG	Project Delivery Guide
PDLT	Project Delivery Leadership Team
PE	Professional Engineer (registered) Preliminary engineering
PEBB	Public Employees Benefit Board
PERS	Public Employees Retirement System
PFSJ	Precompressed Foam Silicone Joint
PI	Point of intersection Public Information
PL	Project Leader Performance Level of bridge rail
PM	Project Manager
PMC	Polymer-modified concrete
PMS	Pavement Management System
PMT	Photo transfer paper
PO	Purchase Order

POC	Point on circular curve
POR	Professional of Record
POS	Point on spiral
POT	Point on tangent
PP	Pipe Pile
PPC	Premixed Polymer Concrete
	Precast Prestressed Concrete
PQR	Pre-Qualification Request
PR	Project Request (Federal-Aid Program)
	Public Relations
Prest.	Prestressed
PRC	Point of reverse curve
PRN	Printer port (parallel port on computer, =LPT)
PS	Point of change from tangent to spiral
P/S	Prestressed Concrete
PS&E	Plans, Specifications & Estimate
PSBS	Project Specifications Bid System
PSC	Point of change from spiral to circular curve
PSF	Pounds per Square Foot
	Precast Spread Footing
PSI	Pounds per Square Inch
PSK	Personal Services Contract
PSU	Portland State University
PT	Point of tangency
P/T	Post-tensioned concrete
PTI	Post-Tensioning Institute
PUC	Public Utility Commission
PVC	Point on vertical curve
	Polyvinyl chloride
PVI	Point of vertical intersection
PWRR	Portland Western Railroad
PWS	Present Wearing Surface

Q

QA	Quality Assurance
QC	Quality Control

QCT	Quality Control Technician
QPL	Qualified Products Listing

R

R	Radius
R, 1R	Resurfacing
R.	Range (surveying)
R/D	Rough Draft
R/W	Right of Way
R&D	Research and Development
RAM	Random Access Memory
RBI	Region Bridge Inspector
RBLE	Regional Bridge Lead Engineer
RC	Reinforced Concrete
RCB	Reinforced Concrete Box
RCBC	Reinforced Concrete Box Culvert
RCBG	Reinforced Concrete Box Girder
RCDG	Reinforced Concrete Deck Girder
RCP	Reinforced Concrete Pipe
Rdwy.	Roadway
REA	Revised Environmental Assessment
RE-CP	Resident Engineer – Consultant Projects
Rev.	Revised; revision date
RFI	Request for Information
RFP	Request for Proposals
RFQ	Request for Qualifications
RLT	Roadway Leadership Team
RMS	Root Mean Square (statistical average)
ROD	Record of Decision
ROM	Read-Only Memory
RR	Railroad
RRR, 3R	Resurfacing, Restoration and Rehabilitation
RRRR, 4R	Resurfacing, Restoration, Rehabilitation and Reconstruction
RSA	Response Spectrum Analysis
RT	Radiographic

S

S	South
S.	Section (surveying)
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy of Users of 2005
SB	Southbound
SC	Structural Concrete
SCL	South city limits
SCSI	Small Computer Systems Interface (type of computer hard disk)
SDC	Seismic Design Category
SDCL	Simple for Dead and Continuous for Live Load
SDLF	Steel Dead Load Fit
SEAO	Structural Engineers Association of Oregon
SEAOC	Structural Engineers Association of California
Sec.	Section (map location)
Sect.	Section (on a drawing)
SF	Square feet
SFC	Silica Fume Concrete
SFLMC	Silica Fume Latex-Modified Concrete
SH, Shld	Shoulder
SHPO	State Historic Preservation Office
SHRP	Strategic Highway Research Program
SI	"Système Internationale" (International System of units)
SI&A	Structure Inventory and Appraisal
SIBC	Slide In Bridge Construction
SIMM	Single In-line Memory Module (type of memory chips)
SLT	Safety Leadership Team
SOQ	Statement of Qualifications
SOW	Statement of Work
SP	<i>ODOT Construction Specifications</i>
SPC	Seismic Performance Category
SPFPC	System Productivity Facility for Personal Computers (data file editing software)
SPIS	Safety Priority Index System
SPMT	Self-Propelled Modular Transporters
SPRR	Southern Pacific Railroad
SPT	Standard Penetration Test for soils

SR	Sufficiency Rating
SRCM	Soils and Rock Classification Manual (ODOT)
SRSS	Square Root of the Sum of the Squares (method of combining seismic forces or displacements)
SSDM	Strategic Systems & Data Management (a unit within Technical Services)
SSPC	Structural Steel Painting Council
STE	Supervising Transportation Engineer
STIP	State Transportation Improvement Program
STP	Single Trip Permit
	Surface Transportation Program
S.T.R.	Section, Township and Range (surveying)
STRAHNET	Strategic Highway Corridor Network
STRUDL	Structural Design Language
SW	Sidewalk
SY	Square Yard

T

T.	Township (surveying)
	Tangent
	Tension
T&E	Threatened and Endangered
Tan.	Tangent
TAC	Technical Advisory Committee
TAG	Technical Advisory Group
TB	Test boring
TCP	Traffic Control Plan
TDLF	Total Dead Load Fit
TEAMS	Transportation Environment Accounting System
TF	Top Face
TFE	Polytetrafluoroethylene (sliding surface for bearings)
TH	Test hole
Thk	Thick, thickness
TIFIA	Transportation Infrastructure Finance and Innovation Act (FHWA)
TIP	Transportation Improvement Plan
	Thermal Integrity Profile

TL	Test Level
TLC	Technical Leadership Center
TLT	Technical Leadership Team
TMOC	Transportation Management Operations Center
TMP	Traffic Management Plan
TP&DT	Temporary Protection and Direction of Traffic
TPAR	Temporary Pedestrian Accessible Routes
TPM	Transportation Project Manager
TRB	Transportation Research Board
TS	Tube, Structural
TS&L	Type, Size and Location (formerly called preliminary)
TSF	Tons per Square Foot (don't use)
TSO	Time Sharing Option (on mainframe computer)
TTS	Tracings To Specifications
Typ.	Typical

U

UBC	Uniform Building Code
UBIT	Under Bridge Inspection Truck
UFAS	Uniform Federal Accessibility Standards
U of O	University of Oregon
UHPC	Ultra High Performance Concrete
UP	University of Portland
UPRR	Union Pacific Railroad
URLT	Utility Relocation Leadership Team
USACE, ACOE	U.S. Army Corps of Engineers
USC&GC	United States Coast and Geodetic Survey
USCG	United States Coast Guard
USFS	U.S. Forest Service (Dept. of Agriculture)
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
USRS	U.S. Reclamation Service
UST	Underground Storage Tank
UT	Ultrasonic
Uxing	Undercrossing

UV Ultraviolet

V

V. Version (software)
Var. Varies
VC Vertical curve
VE Value Engineering
VGA Video Graphical Array (computers)
VM Vicinity Map
VMT Vehicle miles of travel

W

W West
W/ With
W/O Without
WAN Wide Area Network (computers)
WATS Wide Area Telephone Service
WB Westbound
WCL West city limits
WCLIB West Coast Lumber Inspection Bureau
W.M. Willamette Meridian
WOC Work Order Contract
WPS Welding Procedure Specifications
WS Wearing surface
WSDOT Washington State Department of Transportation
WSC Wire Strand Core (cables)
Wt. Weight
WWF Welded Wire Fabric
WWM Welded Wire Mesh
WWPA Western Wood Products Association
WYSIWYG What-you-see-is-what-you-get (computer interface)

X

X'Sect Cross-section
XF Xerox film

Xing Crossing
XV Xerox vellum

Y

Z

INSERT TAB

Unit 17
Checklists

Appendix B

Checklists



Deck Rebar Checklist

Project Information

Project Name (Section)		Contract No.	
Highway		Federal Aid No.	
Contractor or Subcontractor			

Deck Placement Date:

Item	Inspected				Remarks
	Yes	No	N/A	Date (mm/dd/yyyy)	
1 Bottom Mat Bar Size & Spacing	☐	☐	☐		
2 Bottom Mat Ties @ 50%	☐	☐	☐		
3 Bottom Mat Clearance	☐	☐	☐		
4 Epoxy Ties (if epoxy bars)	☐	☐	☐		
5 Supports @ 2' Centers	☐	☐	☐		
6 Clearance @ Drip Strip	☐	☐	☐		
7 Lap Splices have three (3) ties	☐	☐	☐		
8 Top Mat Bar Size & Spacing	☐	☐	☐		
9a Top Mat Ties @ 100% if spacing is greater than or equal to 6"	☐	☐	☐		
9b Top Mat Ties @ 50% if spacing is less than 6"	☐	☐	☐		
10 Top Mat Bars directly over Bottom Mat Bars	☐	☐	☐		
11 Top & Bottom Mat Bars installed parallel to skewed joint at both ends of deck	☐	☐	☐		
12 Side & End Form Clearances	☐	☐	☐		
13 Rail Stirrup Size & Spacing	☐	☐	☐		
14 Additional Rail Stirrups @ Joints	☐	☐	☐		
15 Rail longitudinal bars cut at joint except bottom two	☐	☐	☐		
16 Rail 1-1/4" inside Edge of Deck	☐	☐	☐		
17 Rebar Support @ Corners	☐	☐	☐		
18 Dry Run Clearance Check	☐	☐	☐		

Remarks

Inspected by Date



PREPOUR CHECKLIST

PROJECT NAME (SECTION)			CONTRACT NO.	
HIGHWAY			FEDERAL AID NO.	
CONTRACTOR OR SUBCONTRACTOR				
PLACEMENT:				
	<u>DATE</u>	<u>INITIALS</u>	<u>REMARKS</u>	
REINFORCEMENT				
FABRICATION				
INSTALLATION				
CLEARANCE				
FORMS				
DIMENSIONS				
CONST JOINTS				
IMBEDDED ITEMS				
BLOCKOUTS				
SURVEY/GRADE				
CONCRETE PLACEMENT				
PLACING METHOD				
QUANTITY				
POUR CREW				
VIBRATION				
LIFT SIZE				
WEATHER				
DURATION			START	FINISH
TESTING				
MIX DESIGN #				
QCT				
TEST RESULTS				
REJECTED LOADS				
REMARKS				
REMARKS				
PREPARED BY:			WORK DATE:	



PREPOUR CHECKLIST

PROJECT NAME (SECTION) <u>FORM SAMPLE</u>			CONTRACT NO. <u>12345</u>
HIGHWAY <u>THE DALLES - CALIFORNIA</u>			FEDERAL AID NO. <u>BRF-RSTP-S004 (32)</u>
CONTRACTOR OR SUBCONTRACTOR <u>JD CONTRACTORS, INC.</u>			
PLACEMENT: <u>BOTTOM SLAB POUR 3; SPANS 2/3 & 8/9</u>			
	DATE	INITIALS	REMARKS
REINFORCEMENT			
FABRICATION	<u>2-29-00</u>	<u>BAP</u>	<u>MOSTLY STRAIGHT BARS, ALL CORRECT LENGTH</u>
INSTALLATION	<u>2-29-00</u>	<u>BAP</u>	<u>PLACED AS PER PLANS</u>
CLEARANCE	<u>2-29-00</u>	<u>BAP</u>	<u>40' CLEAR OF FORMS, TOP BETWEEN MATS</u>
FORMS			
DIMENSIONS	<u>3-13-00</u>	<u>BAP</u>	
CONST JOINTS	<u>3-13-00</u>	<u>BAP</u>	<u>SPAN 1/10 BUSH HAMMER & PRESS WASH, SPAN 3 & 8 SURFACE RETARDER</u>
IMBEDDED ITEMS	<u>3-13-00</u>	<u>BAP</u>	<u>VENT TUBES IN WING SECT & HIGH PT EACH SPAN</u>
BLOCKOUTS	<u>3-13-00</u>	<u>BAP</u>	<u>FALSWORK LOWERING & DRAIN HOLES</u>
SURVEY/GRADE			
CONCRETE PLACEMENT			
PLACING METHOD	<u>3-14-00</u>	<u>BAP</u>	<u>PUMP, 32m SCHWING - PCP</u>
QUANTITY	<u>3-14-00</u>	<u>BAP</u>	<u>250 m³</u>
POUR CREW	<u>3-14-00</u>	<u>BAP</u>	<u>3 FINISHERS (LARGO), 2 VIB (KPC)</u>
VIBRATION	<u>3-14-00</u>	<u>BAP</u>	<u>ONE HIGH CYCLE</u>
LIFT SIZE	<u>3-14-00</u>	<u>BAP</u>	<u>FULL DEPTH 250mm</u>
WEATHER	<u>3-14-00</u>	<u>BAP</u>	<u>FAIR, 50 1/2 (°F) & WINDY (10-15 MPH CONSISTANT)</u>
DURATION			<u>START _____ FINISH _____</u>
TESTING			
MIX DESIGN #	<u>3-14-00</u>	<u>BAP</u>	<u>2 M1 ROUND ROCK</u>
QCT	<u>3-14-00</u>	<u>BAP</u>	<u>DON BRANDON & MIKE LESNEQUE 2 M1</u>
TEST RESULTS	<u>3-14-00</u>	<u>BAP</u>	<u>AIR 6-7%, SLUMP 150 TO 175 mm</u>
REJECTED LOADS	<u>3-14-00</u>	<u>BAP</u>	<u>NONE</u>
REMARKS	<u>3-14-00</u>	<u>BAP</u>	<u>VERY SMOOTH</u>
REMARKS			
FIRST USE OF ROUND ROCK CLASS 35 MIX, VERY CONSISTANT TESTING, SLUMPS SAME THRU LOADS. PUMPING VERY EASY. SCREEDING & FINISHING WENT VERY WELL. PLACED ABOUT 35 m³/HR, 9 HRS TOTAL TIME.			
PREPARED BY: <u>IM INSPECTOR</u>			WORK DATE: <u>6-26-06</u>



Post Pour Checklist

Project Information

Project Name (Section)		Contract No.	
Highway		Federal Aid No.	
Contractor or Subcontractor			
Placement Description:			

Cure Materials 540.51	Placed			Date/Time Placed	Remarks
	Yes	No	N/A		
Burlap	☐	☐	☐		
Polypropylene	☐	☐	☐		
Polyethylene (plastic)	☐	☐	☐		
Continuous water for decks	☐	☐	☐		
Soaker hoses at 10 feet on decks	☐	☐	☐		

Water Source:

Joint Preparation 540.43(a)

When

How

Cold Weather Protection 540.29(a)

Plan Approved: ☐ Yes ☐ No

Date Approved:

Description	
Temp. Monitoring	

CURE DURATION	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
Wet Cure	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Protection	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Forms Removed	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

WEATHER	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
High Temp														
Low Temp														
Sky Conditions														

Curing Compound on Non-Structural Items (only if approved)

Area (yd²) Amount Applied (gallons) Rate gallon/yd²

Remarks

Prepared by

Work Date

Pile Driving Checklist

It is intended that all checklist items will be used when inspecting pile projects.

Pre-Construction

- | | | | |
|------------------------------|-----------------------------|-----------------------------|---|
| ☐ Yes | ☐ No | ☐ NA | 1. Is the Contractor using the same approved hammer system provided in the Pile & Driving Equipment Data Sheet? |
| ☐ Yes | ☐ No | ☐ NA | 2. Do you have the Hammer Approval Letter? |
| ☐ Yes | ☐ No | ☐ NA | 3. Has the Contractor met the requirements for Protection of the Existing Structures (vibration and excavation)? |
| ☐ Yes | ☐ No | ☐ NA | 4. Has the embankment and excavation work been completed according to Section 00520.40(a) and (b)? |
| ☐ Yes | ☐ No | ☐ NA | 5. If a cofferdam is required, has the Contractor submitted a design in accordance with the specifications? |
| ☐ Yes | ☐ No | ☐ NA | 6. If jetting is required, are the jets and supporting equipment approved? |
| ☐ Yes | ☐ No | ☐ NA | 7. If preboring is required, have the equipment and methods been approved? |
| ☐ Yes | ☐ No | ☐ NA | 8. If followers are to be used, were they approved by the Engineer or specified in the contract documents? |
| ☐ Yes | ☐ No | ☐ NA | 9. Do you have a reference elevation so that you know where the pile cut-off is and can determine tip elevations and penetration? |
| ☐ Yes | ☐ No | ☐ NA | 10. Do you have the required inspection and reporting forms? |

Piles Arrive On Site

- | | | | |
|------------------------------|-----------------------------|-----------------------------|---|
| ☐ Yes | ☐ No | ☐ NA | 11. Are the piles the right size, length, type and grade for the job? |
| ☐ Yes | ☐ No | ☐ NA | 12. Are there any visual defects on the pile? (If yes, please explain in the Notes / Comments section below.) |
| ☐ Yes | ☐ No | ☐ NA | 13. Did the Contractor supply you with the mill certification reports on the piles? |
| ☐ Yes | ☐ No | ☐ NA | 14. Do the piles on site match the mill certification reports on the piles? |
| ☐ Yes | ☐ No | ☐ NA | 15. Is all pile splicing properly performed (00520.43(f))? |
| ☐ Yes | ☐ No | ☐ NA | 16. Are the pile tips the right type and size and welded on properly (reinforced tips or closed end plates)? |

Prestressed Concrete Piles (00520.44)

- | | | | |
|------------------------------|-----------------------------|-----------------------------|--|
| ☐ Yes | ☐ No | ☐ NA | 17. During delivery, are the piles being lifted by the correct number of pick points and at the correct locations? |
| ☐ Yes | ☐ No | ☐ NA | 18. Do the piles have the required information on the pile (stamp, casting date, pile #, length, prestressed yard #)? |
| ☐ Yes | ☐ No | ☐ NA | 19. Is the casting date older than 21 days for normal installation and 30 days for exposure to seawater and sulfate soils? |
| ☐ Yes | ☐ No | ☐ NA | 20. Is the length/cross-section/size/prestress configuration correct for the job? |
| ☐ Yes | ☐ No | ☐ NA | 21. Did you physically measure the piles? |
| ☐ Yes | ☐ No | ☐ NA | 22. Are the lifting eyes removed and coated with epoxy? |
| ☐ Yes | ☐ No | ☐ NA | 23. Are there spalling/cracks or other damage visually apparent? Any damage should be reported to your supervisor for evaluation. (If so, please explain in the Notes / Comments section below.) |
| ☐ Yes | ☐ No | ☐ NA | 24. Are prestress strands cut off below the surface of concrete? |
| ☐ Yes | ☐ No | ☐ NA | 25. For storage on job site, is dunnage placed at correct lifting positions and is it placed so that it won't settle? |
| ☐ Yes | ☐ No | ☐ NA | 26. Other special details that are in the specifications, such as vents, centerhole jet pipes, voids, etc., should be explained in the Notes / Comments section below. |

Begin Pile Driving

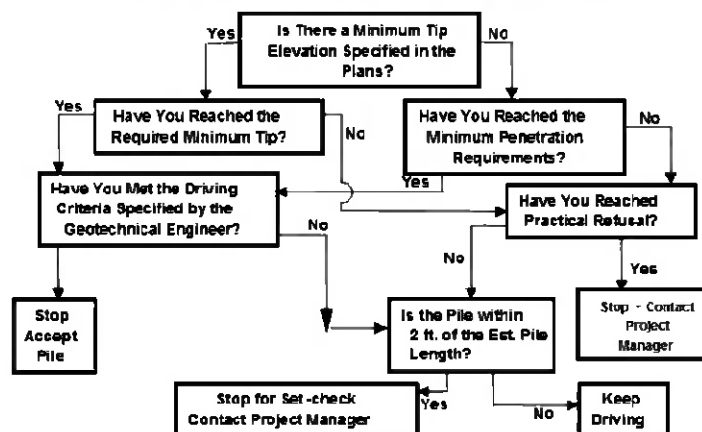
- | | | | |
|------------------------------|-----------------------------|-----------------------------|---|
| ☐ Yes | ☐ No | ☐ NA | 27. Is the ODOT Pile Record Book properly filled out? |
| ☐ Yes | ☐ No | ☐ NA | 28. Has all available pre-driving data been entered into the Pile Record Book? |
| ☐ Yes | ☐ No | ☐ NA | 29. Is the saximeter being used to record stroke? |
| ☐ Yes | ☐ No | ☐ NA | 30. Has the "Minimum Tip" mark been determined? |
| ☐ Yes | ☐ No | ☐ NA | 31. Has the "Stop for Set-Check" mark been determined? |
| ☐ Yes | ☐ No | ☐ NA | 32. Are the piles within allowable tolerances (00520.41(f))? |
| ☐ Yes | ☐ No | ☐ NA | 33. Are the piles marked in the correct intervals? |
| ☐ Yes | ☐ No | ☐ NA | 34. Is the hammer warmed up and set on the proper fuel setting for starting out? |
| ☐ Yes | ☐ No | ☐ NA | 35. If using jetting to advance pile, has the Contractor removed the jets a minimum of 5 ft. above the specified tip elevation and used an impact hammer to drive to the required bearing capacity (00520.41(e))? |
| ☐ Yes | ☐ No | ☐ NA | 36. If concrete piles require splicing, is it in accordance with 00520.44? |
| ☐ Yes | ☐ No | ☐ NA | 37. If steel piles require splicing, is it in accordance with 00520.43(f) and (g)? |
| ☐ Yes | ☐ No | ☐ NA | 38. Are the proper number of record piles being recorded? |
| ☐ Yes | ☐ No | ☐ NA | 39. If using a pile cushion, does it need replacing? |
| ☐ Yes | ☐ No | ☐ NA | 40. Is the hammer cushion being regularly checked out? |

When to Stop

- | | | | |
|------------------------------|-----------------------------|-----------------------------|---|
| ☐ Yes | ☐ No | ☐ NA | 41. Is there a Required Tip Elevation specified? |
| ☐ Yes | ☐ No | ☐ NA | 42. If "Yes" to #41, has the pile reached the Required Tip Elevation? |
| ☐ Yes | ☐ No | ☐ NA | 43. If "No" to Required Tip Elevation specified, has the pile achieve Minimum Penetration requirements (00520.41(c))? |
| ☐ Yes | ☐ No | ☐ NA | 44. Is the top of pile within 2 feet of cut-off elevation. |
| ☐ Yes | ☐ No | ☐ NA | 45. Has the pile met the Driving Criteria specified by the Geotechnical Engineer? |
| ☐ Yes | ☐ No | ☐ NA | 46. Has the pile reached Practical Refusal? |
| ☐ Yes | ☐ No | ☐ NA | 47. Have any of the piles heaved (00502.41(g))? |

NOTES / COMMENTS

Sample Pile Acceptance Decision Chart



Drilled Shaft Inspector's Checklist

The following is a general checklist to follow when constructing a drilled shaft. The answer to each of these questions should be "Yes" or "NA" unless plans, specifications or specific approval has been given otherwise. Any answer of "No" should be explained in the Notes/Comments.

CONSULT WITH PROJECT MANAGER FOR YOUR SPECIFIC PROJECT RESPONSIBILITIES.

Pre-Construction

- | | | | |
|------------------------------|-----------------------------|-----------------------------|--|
| ☐ Yes | ☐ No | ☐ NA | 1. Has the Drilled Shaft Installation Plan been submitted and approved (00512.40)? |
| ☐ Yes | ☐ No | ☐ NA | 2. Has a list of project personnel been submitted and approved (00512.30)? |
| ☐ Yes | ☐ No | ☐ NA | 3. Have the Contractor's quality control technicians been submitted and verified? |
| ☐ Yes | ☐ No | ☐ NA | 4. Does the Contractor have an approved concrete mix design according to 02001.35? The Inspector should have a copy on the project site. |
| ☐ Yes | ☐ No | ☐ NA | 5. Has the Contractor run the required plastic concrete tests (slump loss tests) for their concrete mix design (02001.35(h))? |
| ☐ Yes | ☐ No | ☐ NA | 6. If the Contractor proposed a polymer slurry, do you have a copy of the quality control plan for the slurry (00512.40 and 00512.43(f)) and the name and phone number of the slurry manufacturer's representative who will be providing technical assistance? |
| ☐ Yes | ☐ No | ☐ NA | 7. If the Contractor plans to use a manufactured slurry, do they have the proper equipment to mix it? |
| ☐ Yes | ☐ No | ☐ NA | 8. Have you reviewed the Foundation Data sheet and drill logs and understand the subsurface conditions? |
| ☐ Yes | ☐ No | ☐ NA | 9. Has the Contractor addressed the Protection of Existing Structures (00512.40)? |
| ☐ Yes | ☐ No | ☐ NA | 10. Does the Contractor have all the equipment and tools shown in the Drilled Shaft Installation Plan (00512.40)? |
| ☐ Yes | ☐ No | ☐ NA | 11. If permanent casing is required, is it the right size and material in accordance with the plans and Section 00512.13? |
| ☐ Yes | ☐ No | ☐ NA | 12. If temporary casing is to be used, is it in accordance with the Drilled Shaft Installation Plan (00512.40)? |
| ☐ Yes | ☐ No | ☐ NA | 13. If there are contaminated media (materials), hazardous materials, or contaminated groundwater present, are they being treated in accordance with 00290 and 00294? |
| ☐ Yes | ☐ No | ☐ NA | 14. Do you have all the required drilled shaft forms that need to be filled out during shaft construction?
a. Drilled Shaft Excavation Log (form 734-2604) c. Drilled Shaft Concrete Placement Log (form 734-2597)
b. Drilled Shaft Concrete Volume Log (form 734-2603) d. Drilled Shaft Inspection Report (form 734-2598) |
| ☐ Yes | ☐ No | ☐ NA | 15. Has the drilled shaft coordination meeting been held (Section 00512.41)? |

Shaft Excavation & Cleaning

- | | | | |
|------------------------------|-----------------------------|-----------------------------|---|
| ☐ Yes | ☐ No | ☐ NA | 16. Have the locations for the drilled shafts been accurately located and marked, and both the Contractor and Inspector understand the survey markings? |
| ☐ Yes | ☐ No | ☐ NA | 17. Is the shaft being constructed in the correct location and vertical alignment according to tolerances in Section (00512.42)? |
| ☐ Yes | ☐ No | ☐ NA | 18. Is the slurry level being properly maintained in accordance with 00512.43(f)? |
| ☐ Yes | ☐ No | ☐ NA | 19. Are the proper number and types of tests being performed on the slurry and reported in accordance with 00512.43(g)? |
| ☐ Yes | ☐ No | ☐ NA | 20. Are all excavated materials (spoils) properly contained and disposed of in accordance with 00512.43(a)? |
| ☐ Yes | ☐ No | ☐ NA | 21. If temporary casing is being used, does it meet the requirements of Section 00512.43(c)? |
| ☐ Yes | ☐ No | ☐ NA | 22. Is the shaft of proper depth? |
| ☐ Yes | ☐ No | ☐ NA | 23. Does the shaft bottom meet the clean-out requirements of Section 00512.43(h)? |
| ☐ Yes | ☐ No | ☐ NA | 24. Have the drilled shaft excavation forms been completed? |

Reinforcing Cage (Construction & Placement)

- ☐ Yes ☐ No ☐ NA 25. Is the rebar the proper grade steel, correct sizes and correct configurations as shown in the project plans and shop drawings?
- ☐ Yes ☐ No ☐ NA 26. Is the rebar properly tied in accordance with Section 00530.41(b)?
- ☐ Yes ☐ No ☐ NA 27. Are the proper number of Crosshole Sonic Log (CSL) tubes furnished and installed according to the project plans?
- ☐ Yes ☐ No ☐ NA 28. Does the Contractor have the proper number and type of spacers for the steel cage in accordance with the approved Drilled Shaft Installation Plan and Section 00512.45(d)?
- ☐ Yes ☐ No ☐ NA 29. If the steel cage was spliced, was it done in accordance with the details shown on the contract plans?
- ☐ Yes ☐ No ☐ NA 30. Is the steel cage adequately secured to maintain vertical tolerance during concrete placement operations (00512.45(a) and 00512.47(e))?

Concrete Operations

- ☐ Yes ☐ No ☐ NA 31. Prior to concrete placement, has the slurry (both manufactured and natural) been tested in accordance with Section 00512.43(g)?
- ☐ Yes ☐ No ☐ NA 32. If required, was the casing removed in accordance with Section 00512.47(e)?
- ☐ Yes ☐ No ☐ NA 33. Does the Contractor's tremie meet the requirements of Section 00512.47(a)?
- ☐ Yes ☐ No ☐ NA 34. Was the discharge end of the tremie maintained in the concrete mass with proper concrete head above it at all times (00512.47(c))?
- ☐ Yes ☐ No ☐ NA 35. For shafts with non-contact splices, have the cold joints been properly cleaned and roughened in accordance with Section 00512.47(a)?
- ☐ Yes ☐ No ☐ NA 36. For shafts without non-contact splices, did the Contractor overflow the shaft until good concrete flowed out of the top of the excavation (00512.47(a))?
- ☐ Yes ☐ No ☐ NA 37. Have the Concrete Placement and Concrete Volume logs been completed?
- ☐ Yes ☐ No ☐ NA 38. Were the concrete acceptance tests performed as required?
- ☐ Yes ☐ No ☐ NA 39. Were the Crosshole Sonic Log (CSL) tubes filled with water and capped in accordance to Section 00512.46?

Post Installation

- ☐ Yes ☐ No ☐ NA 40. Is all casing removed to the proper elevations in accordance with 00512.47(e)?
- ☐ Yes ☐ No ☐ NA 41. Is the concrete being cured in accordance with Section 00540.51?
- ☐ Yes ☐ No ☐ NA 42. Has all Crosshole Sonic Log (CSL) Testing been completed in accordance with Section 00512.48?
- ☐ Yes ☐ No ☐ NA 43. Is the shaft within the allowable construction tolerances (00512.42)?
- ☐ Yes ☐ No ☐ NA 44. Has the Contractor completed the Drilled Shaft Inspection Report (00512.40(c))?
- ☐ Yes ☐ No ☐ NA 45. Has the Inspector completed the Drilled Shaft Inspection Report (00512.40(c))?

NOTES / COMMENTS

Precast, Prestressed Slab / Box Beam Placement Checklist

Project Information

Project Name (Section)		Contract No.	
Highway		Federal Aid No.	
Contractor or Subcontractor			

Placement Date:

Item	Completed			Remarks
	Yes	No	N/A	
1 Beam seat elevations checked	☐	☐	☐	
2 Beam seats parallel to cross slope	☐	☐	☐	
3 Beam seats parallel to grade	☐	☐	☐	
4 1/2" grout layer on beam seat below elastomeric pads	☐	☐	☐	
5 Beam position checked	☐	☐	☐	
6 Correct beam location (inserts, rail stirrups, etc.)	☐	☐	☐	
7 Uniform bearing on beam seats	☐	☐	☐	
8 Tie rod DTI protrusions against hardened washer	☐	☐	☐	
9 DTI on end with open access	☐	☐	☐	
10 DTI checked with feeler gauge for correct number of refusals	☐	☐	☐	
11 Keyway grout on 6/1 slope	☐	☐	☐	
12 Keyway grout cured	☐	☐	☐	
13 No heavy loads until keyway grout cured	☐	☐	☐	

Remarks

Inspected by		Date	
--------------	--	------	--

INSERT TAB

Unit 18

Forms

Appendix C

Forms



DAILY FORCE ACCOUNT RECORD

Forms must be ordered. Select here to open up order form

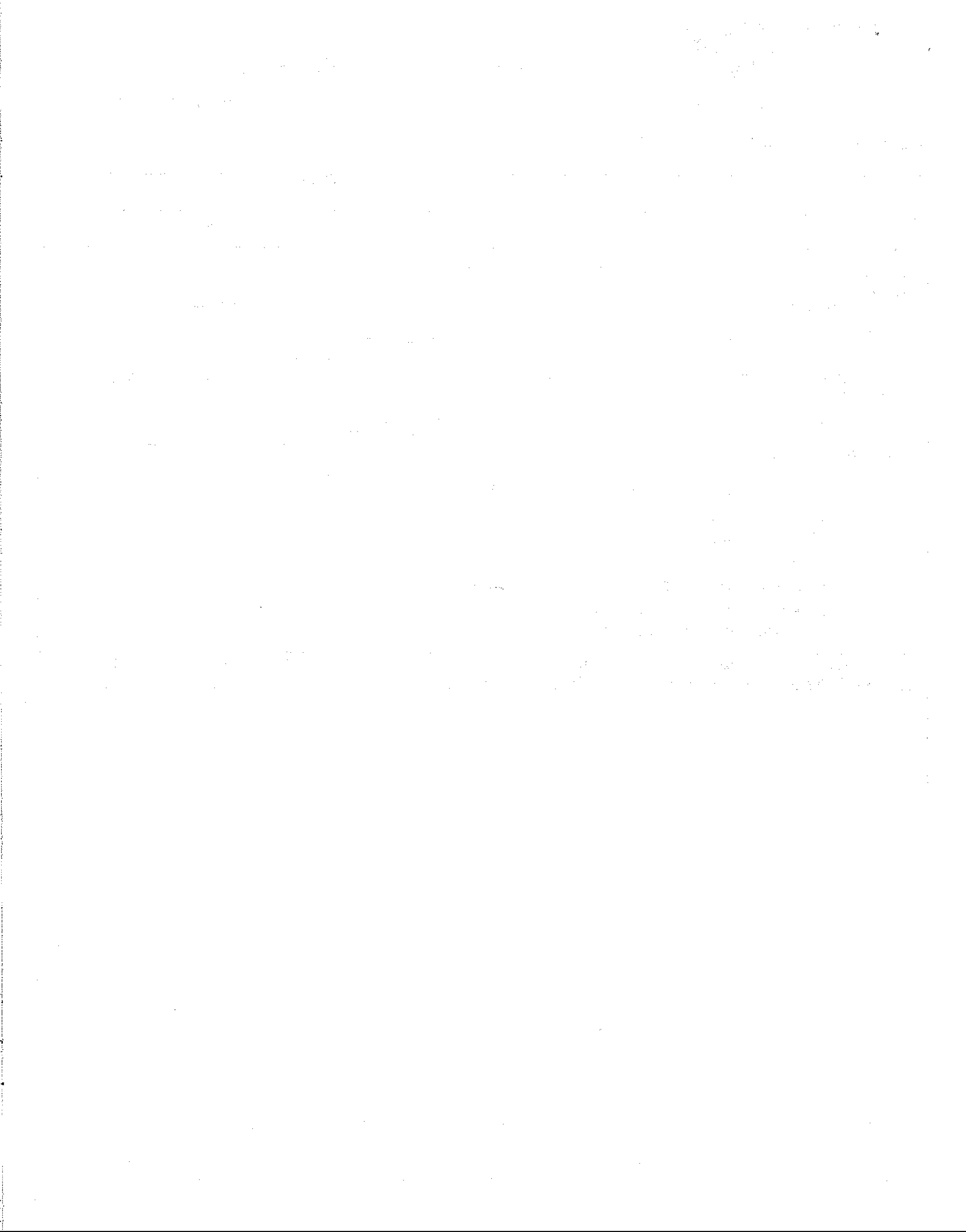
CONTRACTOR			PROJECT NAME (SECTION)					CONTRACT NO.		
SUB-CONTRACTOR			HIGHWAY			COUNTY		EWO NO.	DATE OF WORK	
DESCRIPTION OF WORK										
REMARKS										

LABOR	NAME		CRAFT GROUP NO.	HOURS		MATERIALS	DESCRIPTION	QUANTITY	UNIT
				ST	OT				

DO NOT LIST:
"ALL"
"LUMP SUM"
OR
"PER ATTACHED INVOICE"

EQUIPMENT	CONTR.	TYPE OF EQUIPMENT	MANUFACTURER	MODEL NO.	YEAR AND/OR SERIAL #	GAS	DIESEL	SIZE, CAPACITY, HP CFM, AXLE CONFIG.	PAY ATTACHMENT	OPER	STDBY

SEE THE INSTRUCTIONS ON THE COVER. The Daily Force Account Record is prepared each day by the Inspector and signed by the Contractor's Representative. Original to the Contractor Representative, copy one to Construction Contract Services with Contractor's billing, copy two to Project Manager, copy three to Originator.				CONTRACTOR'S REPRESENTATIVE SIGNATURE			PREPARED BY SIGNATURE			CERT NO.
---	--	--	--	---------------------------------------	--	--	-----------------------	--	--	----------



FIELD INSPECTION REPORT

		REPORT NO.	FOR BID ITEM NO.
PROJECT NAME (SECTION)		CONTRACT NO.	
HIGHWAY		F.A. PROJECT NO.	
PROJECT MANAGER			
REASON FOR THIS REPORT ☐ INSPECTION OF MATERIAL ☐ MATERIALS ON HAND ☐ OTHER (EXPLAIN)			
MATERIALS DELIVERED FOR PROJECT	TYPE OF MATERIAL		DATE DELIVERED
	SOURCE OF MATERIAL (MANUFACTURER OR FABRICATOR)		DELIVERED TO (NAME OF CONTRACTOR/SUBCONTRACTOR)
	QUANTITY DELIVERED	UNIT	QUANTITY APPROVED
	QUANTITY REJECTED (EXPLAIN)		
TOTAL APPROVED TO DATE		ESTIMATED TOTAL REQUIRED	SAMPLE DATA SHEET NO. FOR SAMPLE SENT TO MATERIALS LAB FOR TESTS
SUPPORTING DATA	☐ MATERIALS INSPECTION LABORATORY REPORT NO. I- _____ TEST _____ LABORATORY REPORT NO. _____ ☐ MATERIALS LABORATORY INSPECTION LABEL OR MARK. ☐ TEST RESULTS CERTIFICATE ☐ QUALITY COMPLIANCE CERTIFICATE ☐ QPL ITEM ☐ CONFORMANCE TO EQUIPMENT LIST AND DRAWINGS (EXPLAIN) ☐ CERTIFICATE OF MATERIAL ORIGIN FOR PERMANENTLY INCORPORATED IRON OR STEEL MATERIALS AND THEIR COATINGS ON FEDERAL AID PROJECTS ☐ FIELD TESTS OR OBSERVATIONS (EXPLAIN)		
REMARKS AND EXPLANATIONS, MATERIALS DESCRIPTIONS, DATES OF MANUFACTURE, HEAT AND LOT NOS. DAMAGED OR SUBSTANDARD MATERIALS, REASONS FOR REJECTION AND DISPOSITION OF REJECTED MATERIALS.			
WHERE INSPECTED		DATE	INSPECTOR SIGNATURE
			CERT NO.

General Daily Progress Report

Project Name (Section)

Work Date

Effects on Work (weather, accidents, breakdowns, delays, personnel, etc.)

Photo(s) ☐ Yes ☐ No

Materials Rejected

Photo(s) ☐ Yes ☐ No

Project Visitors

Photo(s) ☐ Yes ☐ No

Remarks

Photo(s) ☐ Yes ☐ No

Include condition of traffic control and roadway; important discussions with contractors regarding rejected work or materials and reasons; delays, difficulties, accidents, utility damage and other unusual conditions and events; arrivals and departures of major equipment, visitors.

Prepared by

Cert No.

Signature

Shift

☐ Sunday ☐ Monday ☐ Tuesday ☐ Wednesday ☐ Thursday ☐ Friday ☐ Saturday

Work Date

General Daily Progress Report

PHOTOGRAPHS

Project Name (Section)

Work Date

Insert photo in this box. (Click in box and upload photo from computer or source.)

X

Insert photo in this box. (Click in box and upload photo from computer or source.)

X

Photo #

Photo #

Brief Description

Brief Description

Insert photo in this box. (Click in box and upload photo from computer or source.)

X

Insert photo in this box. (Click in box and upload photo from computer or source.)

X

Photo #

Photo #

Brief Description

Brief Description

Insert photo in this box. (Click in box and upload photo from computer or source.)

X

Insert photo in this box. (Click in box and upload photo from computer or source.)

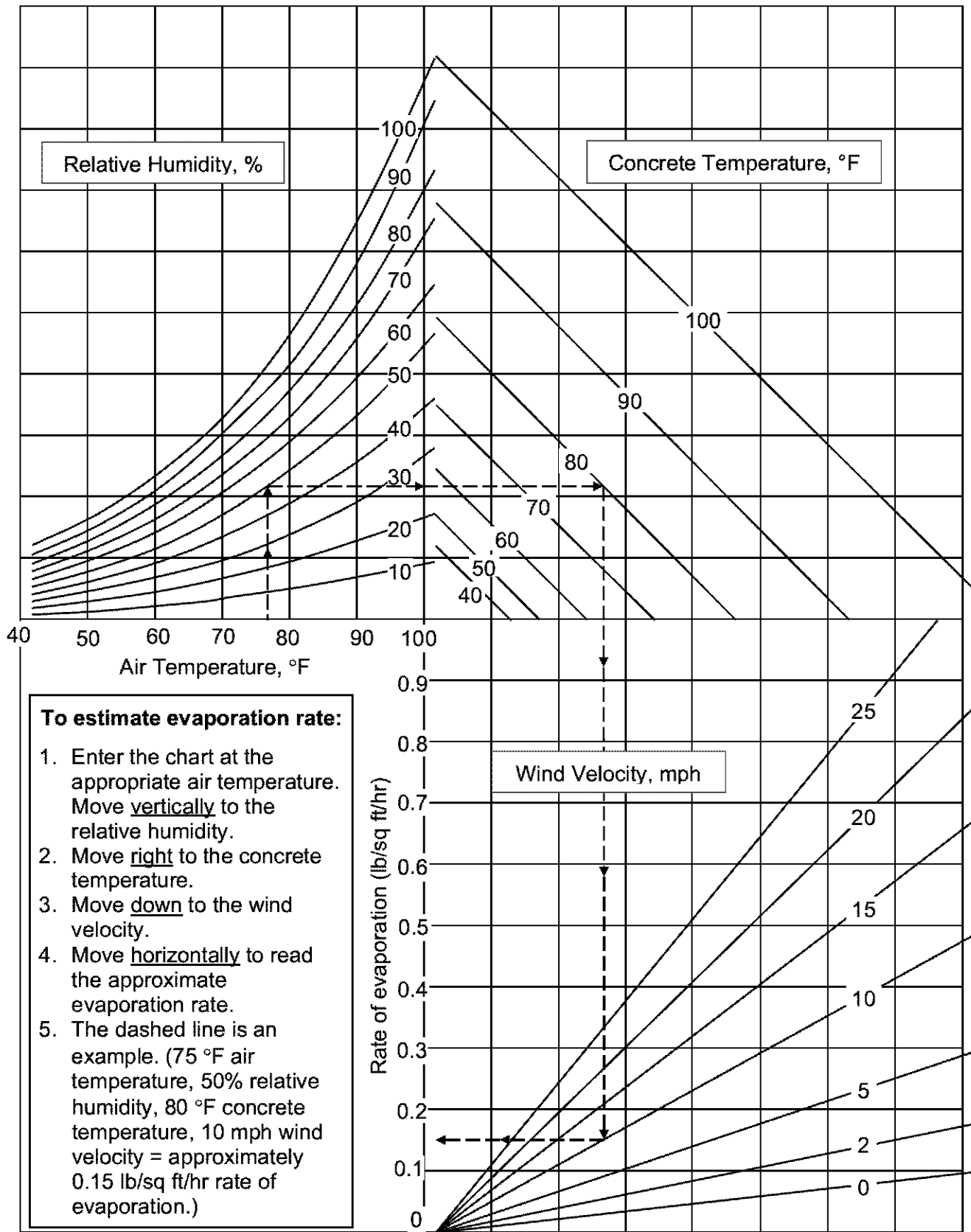
X

Photo #

Photo #

Brief Description

Brief Description

FIGURE 00540-1 SURFACE EVAPORATION FROM CONCRETE ¹¹ Based on ACI 305 R, "Hot Weathering Concreting"

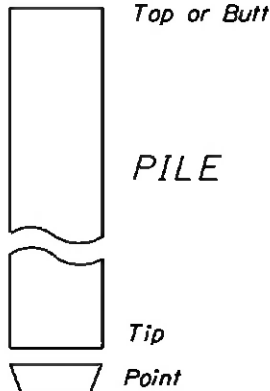
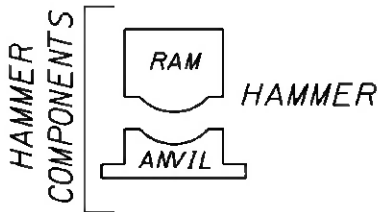
PILE AND DRIVING EQUIPMENT DATA

HIGHWAY		MILEPOST	
CONTRACT NO.		STRUCTURE NAME AND NO.	
PROJECT NAME (SECTION)			
PROJECT MANAGER		CONTRACTOR	
COUNTY	PILE DRIVING SUBCONTRACTOR (Piles Driven By):		

TYPE OF LEADS: ☐ Fixed ☐ Semi-Fixed ☐ Swinging

OTHER (Provide Description):

LEAD DIMENSIONS Depth _____ Width _____



MANUFACTURER	MODEL	TYPE
SERIAL NO.	OWNER:	
RATED ENERGY (KN-m)	@ LENGTH OF STROKE (m)	RAM WT. (KN)
MODIFICATIONS		

MATERIAL	THICKNESS (mm.)	AREA (mm ²)
----------	-----------------	-------------------------

MATERIALS	
TOTAL THICKNESS (mm.)	AREA (mm ²)
MODULUS OF ELASTICITY (E): (MPa)	
COEFFICIENT OF RESTITUTION (e)	

ALL COMPONENTS	WEIGHT (KN)	MODIFICATIONS
----------------	-------------	---------------

CUSHION MATERIALS		AREA (mm ²)
NO OF LAYERS	THICKNESS (EACH) (mm.)	TOTAL THICKNESS (mm.)
MODULUS OF ELASTICITY (E): (MPa)		COEFFICIENT OF RESTITUTION (e)

PILE TYPE & SIZE	Weight (KN/m)
LENGTH IN LEADS (m)	
WALL THICKNESS (mm)	TAPER

NOMINAL PILE RESISTANCE (KN)	ACCEPTANCE BY WAVE EQUATION ☐ Yes ☐ No
------------------------------	--

DESCRIPTION OF SPLICE

TIP TREATMENT DESCRIPTION (TYPE, MANUFACTURER, MODEL NO., ETC.)

NOTE: If mandrel is used to drive the pile, attach separate manufacturer's detail sheet(s) including weight and dimensions.

SUBMITTED BY:	DATE
---------------	------



MICROPILE INSTALLATION LOG

Project Name				Contract No.
Bridge No.	Bent No.	Pile No.	Design Load (kips)	Installation Date:

Micropile Type (A, B, C, or D)		Start of Drilling (date & time)	
Drill Rig/Drill Method		End Drilling	
Flushing Media (air/water)		Start of Grouting	
Drill Rig #, Operator		Pile Completion	
Grout Plant #, Operator		Total Duration	

Drill Bit Type and Size		Cement Type*	
Casing Dia./Wall Thickness		w/c ratio	
Casing (temporary/permanent)		Grout Strength (psi)	
Pile Inclination		Reinforcement Size/Grade/Length	

* describe any grout admixtures below in grout comments

Pile Length Above B.O.F.		Tremie Grout Quantity (bags)	
Upper Cased Length		Pressure Grout Quantity (bags)	
Casing Plunge Length		Grouting After Plunge (bags)	
Bond Length Below Casing		Total Grout Quantity (bags)	
Total Pile Length		Grout Ratio (bags/ft. bond)	

COMMENTS - PILE DRIVING

Depth from B.O.F. (ft)	Soil / Rock Description	Flush Description	Comments

COMMENTS - PILE GROUTING

Depth from B.O.F. (ft)	Pressure Range Max/Average (psi)	Comments

B.O.F. = Bottom of Footing

Was a load test performed? ☐ Yes ☐ No

If load test was performed attach load test results.

Did micropile pass load test? ☐ Yes ☐ No ☐ N/A

DRILLED SHAFT CONCRETE PLACEMENT LOG

PROJECT		BRIDGE NO.	CONTRACT NO.	
BENT	STATION	SHAFT NO.	SHAFT DIAMETER	
DRILLED SHAFT CONTRACTOR		INSPECTED BY	CERT. NO.	DATE

REFERENCE ELEVATION	SHAFT TOP ELEVATION	REBAR CAGE TOP ELEVATION:		AT START	AT FINISH
DEPTH TO WATER OR SLURRY	SHAFT BOTTOM ELEVATION	REBAR DESIGN ELEV.	WITHIN SPEC? ☐ YES ☐ NO		
TOP OF ROCK ELEVATION	SHAFT LENGTH	REBAR CAGE CENTERED WITHIN SPEC? ☐ YES ☐ NO			

SHAFT CONCRETE INFORMATION					
Placement Method	Volume in Lines				Begin Pour: Date: _____ Time: _____ End Pour: Date: _____ Time: _____
____ Free Fall	#	ID	Length	Volume	Shaft Completion Time: _____ (including casing removal)
____ Tremie	_____	_____	_____	_____ cy	
De-Airing Method	_____	_____	_____	_____ cy	
____ Tremie Plug	_____	_____	_____	_____ cy	Total Concrete Volume Delivered (TVD) Total Concrete Volume In Shaft; cy (=TVD-VL-VW)
____ Tremie Cap	Total Volume in Lines (VL)			_____ cy	
____ Relief Valve	Estimated Waste Concrete (VW)			_____ cy	

Truck No.	Concrete Volume	Slump	Arrival Time	Start Time	Finish Time	Tremie Depth	Depth To Concrete	NOTES (delays, additives, breaching, casing removal)

_____ **Total Concrete Volume Delivered (TVD)**

INSPECTOR SIGNATURE _____ DATE _____

NOTES: _____

CASING REMOVAL					
	OD	Top Elev.	Bot. Elev.	Start	Finish
Permanent Casing	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____
	_____	_____	_____	_____	_____



DRILLED SHAFT CONCRETE VOLUMES

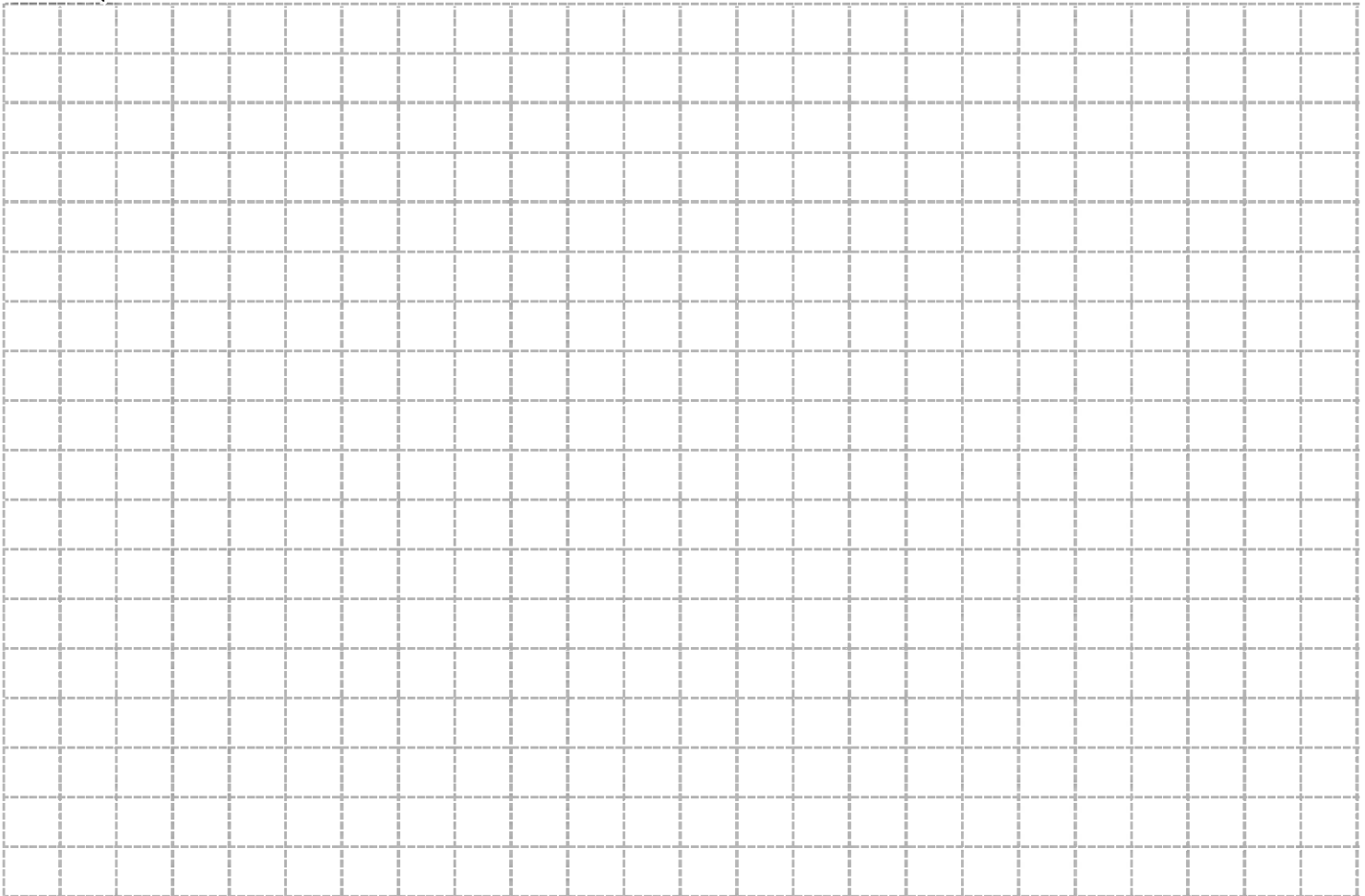
PROJECT		BRIDGE NO.	CONTRACT NO.	
BENT	STATION	SHAFT NO.	SHAFT DIAMETER	
DRILLED SHAFT CONTRACTOR		INSPECTED BY	CERT. NO.	DATE

CONCRETING CURVE

Prior to pouring concrete, a plot should be made showing the theoretical concrete surface (by depth or elev.) vs. concrete volume placed. During concrete placement the actual concrete surface vs. the actual concrete volume placed is then plotted.

Shaft Top

DEPTH/ELEVATION (Feet)



Shaft Bottom

CONCRETE VOLUME PLACED (cubic yards)

VOLUME CALCULATIONS		
Volume Delivered	TVD ____ cy	Notes/Comments: _____
Volume in Lines	VL ____ cy	_____
Wastage	VW ____ cy	_____
Volume Placed (= TVD-VL-VW)	VP ____ cy	_____
Theoretical Volume $(\pi(D^2/4)(\text{Shaft Length,ft})/27)$	VT ____ cy	_____
Overpour (VP-VT)	OP ____ cy	_____

DRILLED SHAFT EXCAVATION LOG

PROJECT		BRIDGE NO.	CONTRACT NO	
BENT	STATION	SHAFT NO.	SHAFT DIAMETER	
DRILLED SHAFT CONTRACTOR		INSPECTED BY	CERTIFICATION NO.	DATE

START	DATE/TIME EXCAVATED	TYPE OF CONSTRUCTION
FINISH:		☐ DRY ☐ WET

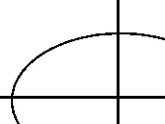
ELEVATIONS	
Reference Elev.	_____
Grd. Surface Elev.	_____
Water Table Elev.	_____
Top Shaft Elev.	_____
Msd Top Rock Elev.	_____
Msd Avg. Shaft Bot Elev.	_____

DIMENSIONS	
Soil Auger Dia.	_____
Soil Shaft Length	_____
Rock Auger Dia.	_____
Rock Socket Length	_____
Construc. Shaft Length	_____

DRILLING SLURRY		
Slurry Type & Manufacturer : _____		

Slurry Meets Specifications?	Y	N
CLEANOUT METHOD		
Bucket _____	Airlift _____	Pump _____
Other: _____		

CASING INFORMATION (if applicable)		
<u>Casing (Temp / Perm)</u>	<u>Casing (Temp / Perm)</u>	<u>Casing (Temp / Perm)</u>
Type _____	Type _____	Type _____
OD (in.) _____	OD (in.) _____	OD (in.) _____
Thickness _____	Thickness _____	Thickness _____
Top Elev. _____	Top Elev. _____	Top Elev. _____
Length: _____	Length: _____	Length: _____

BOTTOM INSPECTION			
Visual	_____	Tape/Probe	_____
Record 5 depths to the bottom of finished shaft:			
1 _____			3 _____
_____			4 _____
2 _____			5 _____
Ave. Shaft Bottom Elev.: _____			
Meet Cleanout Specification?			Y
Meet Alignment Specifications?	Y	N	

Record and describe all materials encountered during drilled shaft excavation, water table information, depths of seepage and seepage rates, obstructions encountered, equipment used and equip. breakdowns (use additional sheets if necessary).

[illegible]

INSPECTOR SIGNATURE _____

DATE _____

NOTES: _____



DRILLED SHAFT INSPECTION REPORT

BRIDGE NAME				PROJECT:			CONTRACT NO.:
BRIDGE NO.	BENT	STATION	SHAFT NO.	SHAFT DIAMETER	INSPECTED BY	CERTIFICATION NO.	DATE
DRILLED SHAFT CONTRACTOR				PRIME CONTRACTOR			

Time Excavation Started: _____ STOPPED _____

Date/Time Bottom Inspected: _____

Date Concreting Started: _____ STOPPED _____

	Plan Measurements	"As-Built" Measurements
--	----------------------	----------------------------

Top Elevation _____

Bottom Elevation _____

Shaft Diameter _____

Rock Socket Diameter
(if appl.) _____

Shaft Length* _____

*Was longer shaft approved for payment? ☐ Yes ☐ No

Concrete Volume (cy) _____

Concrete Mix Design _____

Concrete Placement Method ☐ Tremie ☐ Free Fall

Concrete Slump @ time or pour _____

Water Inflow Rate _____ gal/min (est.)

Bottom of Shaft Cleanliness Meets Specification? ☐ Yes ☐ No

Proper reinforcement and CSL tubes installed: _____

Description of bottom of shaft: _____

COMMENTS (Obstructions Encountered, etc.):

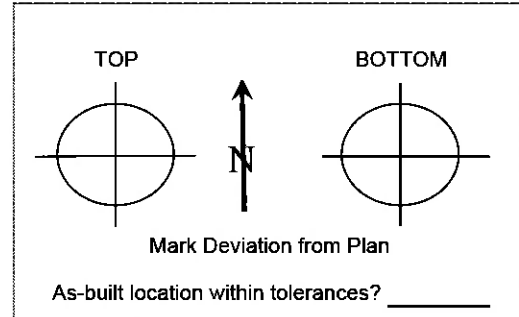
CSL Test Performed: ☐ Yes ☐ No

CSL Test Results Approved: ☐ Yes ☐ No* *If not approved, describe results and resolution

Shaft Approved by:

INSPECTOR SIGNATURE

DATE



Ref. Elev. _____		Reinforcement Elev. Before Conc. _____ Elev. After Conc. _____
Ground Surface or Mudline Elev. _____		Casing OUTER (Perm/Temp) Diameter _____ Top Elev. _____ Length _____
Groundwater Elev.: _____		MIDDLE Diameter _____ Top Elev. _____ Length _____
		INNER Diameter _____ Top Elev. _____ Length _____
Top of Rock Elevation _____		
Bottom of Shaft Elevation _____		

Note: Forward completed reports to ODOT Bridge Section.

<http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/HwyConstForms1.shtml>



HIGH STRENGTH BOLTING SUMMARY

TURN-OF-NUT METHOD (LONG BOLTS)

PROCESSES	PURPOSE
1. Rotational Capacity Test	Checks bolts for proper lubrication & for damage during storage or transit
2. Verification Test	Demonstrates that Contractor's personnel, equipment & procedure will tighten bolts to proper tension
3. Inspection Torque	Determines torque value to be used in the random field inspection
4. Random Field Inspection	Checks bolt installation on structure using the Inspection Torque

PROCESSES	PROCEDURE
1. Rotational Capacity Test (02560.60 (a))	1. Sample 2 bolt, washer & nut assemblies 2. Assemble fastener with 3-5 threads within the grip 3. Snug tight (10% of Required Fastener Tension in Table 560-1); Tolerance= -0 kips, +2 kips 4. Mark the bolt, nut & plate 5. Tighten to Required Fastener Tension & record torque (torque must not exceed $T=0.25PD$) (P in lbs, D in ft) 6. Turn nut to twice the rotation in Table 560-3 (tension must exceed 115% of Required Fastener Tension) 7. Remove nut and check threads
2. Verification Test (00560.29 (c)(1 & 5))	1. Sample 3 bolt, washer & nut assemblies 2. Snug tight (Plies of joint in firm contact, full effort on 12" spud wrench; 10% of RFT < Tension < 50% of RFT) 3. Mark the bolt, nut & plate 4. Tighten nut to the rotation in Table 560-3 (max. of 10 seconds with impact wrench) 5. Verify tension is 5% greater than Required Fastener Tension
3. Inspection Torque (00560.29 (d))	1. Sample 3 bolt, washer & nut assemblies 2. Place in Skidmore & tighten to Required Fastener Tension in Table 560-1 3. Measure torque required to turn the nut 5 degrees (1" @ 12" radius) 4. Average the 3 tests to determine the Inspection Torque
4. Random Field Inspection (00560.29 (d))	1. Select at random 10% of the tensioned bolts in each connection (2 minimum) 2. Apply Inspection Torque. If none turn, the connection passes. 3. If one or more fasteners turn, apply inspection torque to all fasteners in the connection. 4. Re-tension & inspect all fasteners that turned when applying the Inspection Torque.



HIGH STRENGTH BOLTING SUMMARY

TURN-OF-NUT METHOD (SHORT BOLTS)

PROCESSES	PURPOSE
1. Rotational Capacity Test	Checks bolts for proper lubrication & for damage during storage or transit
2. Verification Test	Demonstrates that Contractor's personnel, equipment & procedure will tighten bolts to proper tension
3. Inspection Torque	Determines torque value to be used in the random field inspection
4. Random Field Inspection	Checks bolt installation on structure using the Inspection Torque

PROCESSES	PROCEDURE
1. Rotational Capacity Test (02560.60 (a))	1. Sample 2 bolt, washer & nut assemblies 2. Assemble fastener with 3-5 threads within the grip 3. Snug tight (10% of max allowable torque < Torque < 20% of MAT, MAT=1.15(0.25PD)) (P in lbs, D in ft) 4. Mark socket 5. Tighten nut to rotation in Table 560-3 & record torque (torque must not exceed T=1.15(0.25PD)) 6. Turn nut to twice the rotation in Table 560-3 7. Remove nut and check threads
2. Verification Test (00560.29 (c)(1 & 5))	1. Sample 3 bolt, washer & nut assemblies 2. Snug tight (Joint plies in firm contact, full effort on spud wrench; 10% of MAT < Torque < 50% of MAT) 3. Mark the bolt, nut & plate 4. Tighten nut to the rotation in Table 560-3 5. Verify torque is 5% greater than average of the recorded torques @ turn requirement in the RoCap Test
3. Inspection Torque (00560.29 (d))	1. Sample 3 bolt, washer & nut assemblies 2. Snug tight (10% of max allowable torque < Torque < 20% of MAT, MAT=1.15(0.25PD)) (P in lbs, D in ft) 3. Mark the bolt, nut & plate 4. Tighten nut to the rotation in Table 560-3 3. Measure torque required to turn the nut 5 degrees (1" @ 12" radius) 4. Average the 3 tests to determine the Inspection Torque
4. Random Field Inspection (00560.29 (d))	1. Select at random 10% of the tensioned bolts in each connection (2 minimum) 2. Apply Inspection Torque. If none turn, the connection passes. 3. If one or more fasteners turn, apply inspection torque to all fasteners in the connection. 4. Re-tension & inspect all fasteners that turned when applying the Inspection Torque.



HIGH STRENGTH BOLTS ROTATIONAL CAPACITY TEST & INSPECTION TORQUE (LONG BOLT METHOD)

☐ Turn of Nut Method ☐ Direct Tension Indicator ☐ Tension Control Fastener

Project		Contract No.	
Company		Test No. RCT-	
Torque Wrench Serial No.		Calibration Due Date	
Skidmore Serial No.		Calibration Due Date	
Bolt Diameter	▼	Bolt Length	Quantity
Bolt Mfg.	Lot No.	Heat No.	
Nut Mfg.	Lot No.	Heat No.	
Washer Mfg.	Lot No.	Heat No.	
Ro-Cap Sample 1: Required Fastener Tension = _____ Lbs. (Table 00560-1) Snug Tight Tension = _____ Lbs. (0.10 x Req. Fastener Tension): Tol. = -0 kips + 2 kips Measured Torque = _____ Ft.-Lbs. @ Required Fastener Tension (Go to Insp. Torque) Maximum Allowable Torque = _____ Ft.-Lbs. (ASTM F3125 Table A2.2 $\approx T < 0.25PD$) Measured Tension = _____ Lbs. @ _____ Turn (2x Rotation In Table 00560-3) Minimum Tension Required = _____ Lbs. (ASTM F3125 Table A2.4 $\approx 1.15 \times RFT$) Sample 1 Results: ☐ Pass ☐ Fail			
Ro-Cap Sample 2: Required Fastener Tension = _____ Lbs. (Table 00560-1) Snug Tight Tension = _____ Lbs. (0.10 x Req. Fastener Tension): Tol. = -0 kips + 2 kips Measured Torque = _____ Ft.-Lbs. @ Required Fastener Tension (Go to Insp. Torque) Maximum Allowable Torque = _____ Ft.-Lbs. (ASTM F3125 Table A2.2 $\approx T < 0.25PD$) Measured Tension = _____ Lbs. @ _____ Turn (2x Rotation In Table 00560-3) Minimum Tension Required = _____ Lbs. (ASTM F3125 Table A2.4 $\approx 1.15 \times RFT$) Sample 2 Results: ☐ Pass ☐ Fail			
Rotational Capacity Test Results: ☐ Accept ☐ Reject			
Inspection Torque Sample 1: Required Fastener Tension = _____ Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque Sample 2: Required Fastener Tension = _____ Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque Sample 3: Required Fastener Tension = _____ Lbs. (Table 00560-1) Measured Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque = _____ Ft.-Lbs. (Average of the 3 Inspection Torque Samples)			
Comments:			
Inspector		Cert No.	Title
Contractor's Representative		Date	

HIGH STRENGTH BOLTS ROTATIONAL CAPACITY TEST & INSPECTION TORQUE (SHORT BOLTS)

☒ Turn of Nut Method
 ☒ Direct Tension Indicator
 ☒ Tension Control Fastener

Project		Contract No.	
Company		Test No. RCT-	
Torque Wrench Serial No.		Calibration Due Date	
Skidmore Serial No.		Calibration Due Date	
Bolt Diameter		Bolt Length	Quantity
Bolt Mfg.	Lot No.	Heat No.	
Nut Mfg.	Lot No.	Heat No.	
Washer Mfg.	Lot No.	Heat No.	
Ro-Cap Sample 1: Required Fastener Tension = _____ Lbs. (Table 00560-1) Snug Tight Torque = _____ Ft.-Lbs.; T = 0.1(1.15)(0.25PD); (P in Lbs., D in Ft.) Measured Torque = _____ Ft.-Lbs. @ _____ Turn (Table 00560-3) (Go to Insp. Torque) Maximum Allowable Torque = _____ Ft.-Lbs; T = 1.15(0.25PD); P in Lbs., D in Ft.) 2 x Rotation = _____ Turn (2x Rotation in Table 00560-3) Sample 1 Results: ☐ Pass ☐ Fail			
Ro-Cap Sample 2: Required Fastener Tension = _____ Lbs. (Table 00560-1) Snug Tight Torque = _____ Ft.-Lbs.; T = 0.1(1.15)(0.25PD); (P in Lbs., D in Ft.) Measured Torque = _____ Ft.-Lbs. @ _____ Turn (Table 00560-3) (Go to Insp. Torque) Maximum Allowable Torque = _____ Ft.-Lbs; T = 1.15(0.25PD); P in Lbs., D in Ft.) 2 x Rotation = _____ Turn (2x Rotation in Table 00560-3) Sample 2 Results: ☐ Pass ☐ Fail			
Rotational Capacity Test Results: ☐ Accept ☐ Reject			
Inspection Torque Sample 1: Measured Torque = _____ Ft.-Lbs. @ _____ Turn (Turn Rotation in Table 00560-3) Sample Inspection Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque Sample 2: Measured Torque = _____ Ft.-Lbs. @ _____ Turn (Turn Rotation in Table 00560-3) Sample Inspection Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque Sample 3: Measured Torque = _____ Ft.-Lbs. @ _____ Turn (Turn Rotation in Table 00560-3) Sample Inspection Torque = _____ Ft.-Lbs. @ Additional 5 Degrees (Apprx. 1" @ 12" Radius)			
Inspection Torque = _____ Ft.-Lbs. (Average of the 3 Inspection Torque Samples)			
Comments:			
Inspector		Cert No.	Title
Contractor's Representative		Date	



HIGH STRENGTH BOLTS VERIFICATION TEST (LONG BOLT METHOD)

☒ Turn of Nut Method ☐ Direct Tension Indicator ☐ Tension Control Fastener

Project		Contract No.	
Company		Test No. VT-	
Torque Wrench Serial No.		Calibration Due Date	
Skidmore Serial No.		Calibration Due Date	
Bolt Diameter		Bolt Length	Quantity
Bolt Mfg.		Lot No.	Heat No.
Nut Mfg.		Lot No.	Heat No.
Washer Mfg.		Lot No.	Heat No.
Verification Sample 1:			
Required Fastener Tension	=	_____ Lbs. (Table 00560-1)	
Meas'd Tension @ Snug Tight	=	_____ Lbs. (Joint Plies in Firm Contact, Full Effort on Spud Wrench) (10% Req'd Fastener Tension < Snug Tight < 50% RFT)	
Measured Time	=	_____ Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Maximum Allowable Time	=	10 Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Measured Tension	=	_____ Lbs. @ _____ Turn (Turn Rotation In Table 00560-3)	
Minimum Tension Required	=	_____ Lbs. (1.05 X Required Fastener Tension)	
		Sample 1 Results: ☐ Pass ☐ Fail	
Verification Sample 2:			
Required Fastener Tension	=	_____ Lbs. (Table 00560-1)	
Meas'd Tension @ Snug Tight	=	_____ Lbs. (Joint Plies in Firm Contact, Full Effort on Spud Wrench) (10% Req'd Fastener Tension < Snug Tight < 50% RFT)	
Measured Time	=	_____ Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Maximum Allowable Time	=	10 Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Measured Tension	=	_____ Lbs. @ _____ Turn (Turn Rotation In Table 00560-3)	
Minimum Tension Required	=	_____ Lbs. (1.05 X Required Fastener Tension)	
		Sample 2 Results: ☐ Pass ☐ Fail	
Verification Sample 3:			
Required Fastener Tension	=	_____ Lbs. (Table 00560-1)	
Meas'd Tension @ Snug Tight	=	_____ Lbs. (Joint Plies in Firm Contact, Full Effort on Spud Wrench) (10% Req'd Fastener Tension < Snug Tight < 50% RFT)	
Measured Time	=	_____ Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Maximum Allowable Time	=	10 Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Measured Tension	=	_____ Lbs. @ _____ Turn (Turn Rotation In Table 00560-3)	
Minimum Tension Required	=	_____ Lbs. (1.05 X Required Fastener Tension)	
		Sample 3 Results: ☐ Pass ☐ Fail	
Verification Test Results:		☐ Accept ☐ Reject	
Comments:			
Inspector	Cert No.	Title	
Contractor's Representative		Date	

HIGH STRENGTH BOLTS VERIFICATION TEST (SHORT BOLTS)

☒ Turn of Nut Method
 ☒ Direct Tension Indicator
 ☒ Tension Control Fastener

Project		Contract No.	
Company		Test No. VT-	
Torque Wrench Serial No.		Calibration Due Date	
Skidmore Serial No.		Calibration Due Date	
Bolt Diameter	▼	Bolt Length	Quantity
Bolt Mfg.		Lot No.	Heat No.
Nut Mfg.		Lot No.	Heat No.
Washer Mfg.		Lot No.	Heat No.
Required Fastener Tension = _____ lbs. (Table 00560-1)			
Verification Sample 1:			
Maximum Allowable Torque	=	_____ Ft.-Lbs.; MAT = 1.15(0.25PD), (P in Lbs., D in Ft.)	
Meas'd Torque @ Snug Tight	=	_____ Ft.-Lbs. (Joint Plies in Firm Contact, Full Effort on Spud Wrench) (10% MAT < Snug Tight < 50% MAT)	
Measured Time	=	_____ Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Maximum Allowable Time	=	10 Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Measured Torque	=	_____ Ft.-Lbs. @ _____ Turn (Turn Rotation In Table 00560-3)	
Minimum Torque Required	=	_____ Ft.-Lbs. (1.05 X Avg. RoCap Torque @ Rotation in Table 00560-3)	
Sample 1 Results: ☐ Pass ☐ Fail			
Verification Sample 2:			
Maximum Allowable Torque	=	_____ Ft.-Lbs.; MAT = 1.15(0.25PD), (P in Lbs., D in Ft.)	
Meas'd Torque @ Snug Tight	=	_____ Ft.-Lbs. (Joint Plies in Firm Contact, Full Effort on Spud Wrench) (10% MAT < Snug Tight < 50% MAT)	
Measured Time	=	_____ Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Maximum Allowable Time	=	10 Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Measured Torque	=	_____ Ft.-Lbs. @ _____ Turn (Turn Rotation In Table 00560-3)	
Minimum Torque Required	=	_____ Ft.-Lbs. (1.05 X Avg. RoCap Torque @ Rotation in Table 00560-3)	
Sample 2 Results: ☐ Pass ☐ Fail			
Verification Sample 3:			
Maximum Allowable Torque	=	_____ Ft.-Lbs.; MAT = 1.15(0.25PD), (P in Lbs., D in Ft.)	
Meas'd Torque @ Snug Tight	=	_____ Ft.-Lbs. (Joint Plies in Firm Contact, Full Effort on Spud Wrench) (10% MAT < Snug Tight < 50% MAT)	
Measured Time	=	_____ Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Maximum Allowable Time	=	10 Seconds (From Snug Tight to Turn Rotation in Table 00560-3)	
Measured Torque	=	_____ Ft.-Lbs. @ _____ Turn (Turn Rotation In Table 00560-3)	
Minimum Torque Required	=	_____ Ft.-Lbs. (1.05 X Avg. RoCap Torque @ Rotation in Table 00560-3)	
Sample 2 Results: ☐ Pass ☐ Fail			
Verification Test Results: ☐ Accept ☐ Reject			
Comments:			
Inspector	Cert No.	Title	
Contractor's Representative		Date	



Post-Tensioning Grouting Record

Print Form

Project Name (Section) _____ County _____ Contract No. _____

Highway _____ Section _____ Structure No. _____ Date _____ Page No. _____

Contractor _____ Post-Tensioning Contractor _____ Post-Tensioning Foreman _____

Project Manager _____ Inspector _____ Cert No. _____

Trial Batch	Specific Gravity (mud balance)	Flow Cone 0 sec queseence	Flow Cone 30 min retest	Wick Test

Certified Grouting Technician	
Grout Brand (from QPL)	
Water per bag	
Number of bags/batch	
Water per batch	
Mixer (brand/model)	

Production	Specific Gravity Mud Balance +/- 3% from trial batch	Flow Cone 0 seconds quiescent time

Trial Batch Section 00555.13 Perform at least 48 hours before production grouting.	Flow Cone (ASTM C 939)	Efflux time between 5 and 30 seconds.
	Flow Cone Retest	Let the mixed grout sit for 30 minutes. Remix the grout for 30 seconds. Retest efflux time, to be within 10 seconds.
	Mud Balance (API RP 13B-1)	
	Bleeding (ASTM C 1741)	Perform the Schupack pressure bleed test, max allowed 0.0% at 5 minutes.
	Compressive Strength (ASTM c109)	Contractor to supply two sets of three grout cubes to the Engineer for informational testing.
Production Testing Section 00555.43	Flow Cone	At least once per day. Production Tolerance +/- 5 seconds of Trial Batch, and between 5 and 30 seconds. Efflux time of ejected grout within 5 seconds of efflux time at mixer.
	Mud Balance	Production Tolerance +/- 3.0 % from Trial Batch. Perofrm for each production batch.

[illegible]



734-2594 (12-2011) <http://www.oregon.gov/ODOT/HWY/CONSTRUCTION/HwyConstForms1.shtml>

POST-TENSIONING RECORD (TENSIONING FROM BOTH ENDS)

PROJECT NAME												CONTRACT NO.									
HIGHWAY								SECTION						COUNTY							
CONTRACTOR								POST-TENSIONING CONTRACTOR						POST-TENSIONING FOREMAN							
STRUCTURE NO.				DATE				PAGE NO.		PROJECT MANAGER				INSPECTOR				CERT NO.			
	R	R	R	R	R	R	R	R	R	R	Fm	Fm	PTc	Fc	PTc	Fc	Fm	PTc	Fc	R	
											A	B	C	D	E	F	G	H	I		
Date	Gir. No.	Tendon No.	Reel No.	Jack Serial No.	Gauge Serial No.	Jack Location	Req'd Jacking Force Per Tendon (Kips)	Strands per Tendon	Gauge @ 20% Jacking Force (p.s.i.)	Gauge @ 20% Jacking Force (p.s.i.)	Measured Tail Length @ 20% Gauge (in.)	Measured Tail Length @ 100% Gauge (in.)	Calc. 100% Elong. (in.)	(B - A) = Measured 80% Elong. (in.)	Calc. 80% Elong. (in.)	% Elong. Per Tendon	Seated Tail Length (in.)	Jack Elong (in.)	(B - G - H) = Measured Anchor Set (in.)	Plan Anchor Set (in.)	
																		0.25			
																		0.25			
																		0.25			
																		0.25			
																		0.25			
																		0.25			
																		0.25			
																		0.25			
																		0.25			
																		0.25			
																		0.25			
																		0.25			

R: Recorded info. From Plans, Shop Drawings, PT Supplier, Equipment. PTc: PT Supplier Calculations from Shop Drawings. Fm: Field Measured Values Fc: Field Calculations	Note: % Elong. Per Tendon (F) = The sum of columns (D) for both ends of the tendon divided by the sum of columns (E) for both ends of the tendon x 100 Note: % Elong. Per Tendon shall be between 95% minimum and 105% maximum. If Measured Anchor Set is > Plan Anchor Set, contact Engineer of Record.
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Deck Placement Conference Outline

(00540.02(a)(b))

Contract No. _____

Print Form

Project Name (Section) _____

Contract No. _____

Highway _____

County _____

Date _____

Contractor _____

Estimated Date _____

Estimated Quantity/Day _____

Project Manager _____

Mix Design

Approved? ☐ Yes ☐ No

Mix Design No. _____

List types of admixtures to be used (Superset extender required to extend initial set by 90 min. 02001.30(e). Extra for travel, time or struct. type.)

Slump Range _____ W/C _____ Air Content _____

Concrete Mix

Supplier Name _____

- ☐ Supplier notified well in advance.
- ☐ Supplier aware of specification on truck mixer equipment. 02001.40, ASTM C94
- ☐ Communication between batch plant and project. How? Who? _____
- ☐ Continuous delivery assured for cubic yards needed per hour, at what intervals? _____
- ☐ Supplier has sufficient material on-hand for quantity required.
- ☐ Mix temperature of 50°F minimum and 80°F maximum when air temperature is 40°F or higher. Mix temperature of 60°F minimum and 80°F maximum when air temperature is or forecast to be below 40°F during cure period.

Contractor Quality Control

CCT Name _____

Certification No. _____

QCT Name _____

Certification No. _____

Individual authorized for acceptance and rejection of materials _____

Weather Conditions

- ☐ Precipitation forecast less than 30% during placement window (2 hours before to 2 hours after). 00540.49(b)
- ☐ Surface evaporation rate of less than 0.10 psf per hour. Fig. 00540-1
- ☐ Cold weather plan approved if temperature is or forecast to be below 40°F. 00540.49(1-2-a) ☐ Yes ☐ No ☐ N/A
- ☐ No frost or ice on forms or rebar.

Deck Finishing Machine☐ Type 00540.24 _____

Brand Name

☐ Approved working drawings showing location of deck machine rails 00540.24(a).☐ Deck machine to set up and run over full length of area of placement 00540.24(g).☐ Experienced operator with good knowledge of machine operation. _____

Operator Name

☐ Changes in crown or super? _____

How will changes be handled?

☐ Dry run rebar clearance is +/- 1/4" from clearance shown. 00540.48(g)

Method of checking rebar clearance:

Forms☐ Top mat, tie bar at every intersection if spacing is more than 6", otherwise every other intersection. 00530.41(b)☐ Bottom mat, tie every other intersection.☐ At least 3 ties per lap splice.☐ Monitor falsework, tattle-tales installed (when needed).☐ All forming and bulkhead in place prior to start of placement.☐ Stay-in-place forms are not allowed for bulkheads.☐ Apply form release to forms.☐ Cleanliness of bottom and rebar. _____

How?

When?

☐ Edge of forms set to line and grade. _____

How?

When?

☐ Supports for outside edge.**Deck Placement**☐ Saturate the tops of precast beam and formwork 2 hours immediately prior to beginning deck placement.☐ Minimum rate of placement 20 ft/hr 00540.48(g) third bullet.☐ Calculated cubic yards to be placed _____

Method of Placement

Backup Method

Estimated time to place mix

Deck Placement (continued)☐ Vibrators 00540.48(c)Experienced vibrator person _____
Operator Name

Size of vibrators to be used _____

☐ Meet requirements of 00540.23

Number of vibrators to be used (minimum 2) _____

Discuss methods of consolidation 00540.48(c)

Power Source: ☐ Generators ☐ Direct Power ☐ Backup

Type _____

☐ Placement direction 00540.48(g)☐ Transverse work bridge (2 minimum)☐ Emergency bulkheads, how will this be addressed if needed?☐ 12-foot straightedge is on-site prior to start of pour. Check gutters, lane lines, ends of pours and "as directed". 00540.55**Environmental**☐ Where will concrete trucks clean out? _____
Containment?☐ Where will deck machine clean out? _____
Containment?☐ Steps to assure containment of in forms? _____**Curing Concrete**☐ Provide pressure washers with fog nozzles.☐ Provide wind breaks for spray or other approved methods to prevent premature drying during placement operations.☐ Presoaked wet burlap or dry non-woven polypropene fabric with 4-mil polyethylene film. Color as weather dictates.☐ Additional soaking to keep the deck moist at all times during the cure period.☐ Water availability during and after placement

Where? _____

How? _____

If above information is not available, who will advise the PM prior to start of placement?

During non-working days, who will be able to add water for cure?

Name _____

Phone No. _____

☐ Bridge deck cure time is 14 calendar days.

General Information

Check special provisions for additional information.

- ☐ **Construction joint surfaces:** Use surface retarder to aid in laitance removal. 00540.43 (a)
- ☐ **Closure pour prep:** Sawcut top 1" of deck, may be waived if joint is straight without spalls.
Hand rub or brush fresh concrete paste onto the existing surface of vertical joints down to the top mat.
- ☐ **Deck roadway texturing:** Cut grooves no sooner than 14 days after deck is cast. 00540.50
- ☐ **Striping forms:** 80% of specified strength and 7 days. Table 00540-1
Early removal of forms does not eliminate the curing requirement of 00540.51

