

Proposal for BDDM – Seismic Retrofit Cable - 2

Prepared by Craig Shike, October 22, 2009

Revise Section 1.2.5 to read as follows:

1.2.5 Structural Wire Rope (Cable) and Turnbuckles

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1.2.5.1 Structural Wire Rope (Cable) and Turnbuckles, General

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Structural wire rope (cable) may be used in seismic retrofit and safety cable applications. For these applications, structural wire rope must have zinc coating for corrosion protection. ASTM A 603 structural wire rope with a Class C coating is the preferred wire rope specification. This wire rope has large wires and significant zinc coating. However, A 603 wire rope is only available by special order at a minimum of 10,000 feet.

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ODOT currently has a stockpile of 7/8 inch diameter A 603 wire rope that is available for use on seismic retrofit applications (see 1.1.11.6). The stockpile material was purchased as part of the Willamette River (Abernethy) Br. (Seismic Retrofit) Section (Contract No. 12349). The wire rope was received at the District 2B Lawnfield facility in Clackamas on September 19, 2000. As of October 2009, 2500 ft of the stockpile wire rope was still available.

Use A 603 wire rope for all coastal seismic retrofit applications. If there is not sufficient quantity of wire rope available in the stockpile, a new order of 10,000 ft should be purchased using project funds. Such a purchase will require preapproval from FHWA since the excess wire rope will be stockpiled for use on future projects.

For non-coastal applications, A 603 wire rope is still preferred. However, ASTM A 1023 wire rope can be used where less corrosion protection is considered acceptable. A 1023 wire rope uses smaller wires and has approximately 1/3 the zinc coating compared to A 603. However, A 1023 wire rope is readily available on the market and so does not need to be stockpiled. Optional sizes of A 1023 wire rope are also readily available. Those sizes are listed in 1.2.5.5.

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A 603 and A 1023 are the only wire rope specifications recommended for seismic retrofit applications. Other types of wire rope investigated are ASTM A 586 and ASTM A 741. A 586 wire rope is used for high-strength structural tension members, but is not readily available on the market. A 741 wire rope is used for safety barrier applications (such as I-5 median between Portland and Salem). A 741 has less strength compared to A 603 and A 1023, is difficult to make swaged connections, and is also not readily available.

7/8" diameter wire rope is recommended for most seismic retrofit applications. 1/2" diameter wire rope is recommended for safety cable applications and seismic retrofit applications where the wire rope must be wrapped around tight corners. Bending radius for A 603 wire rope should be as follows:

	Suggested	Minimum
1/2" dia. wire rope	18"	11"
7/8" dia. wire rope	32"	18"

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ASTM A 1023 wire rope can be bent to a slightly smaller radius.

	Suggested	Minimum

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1/2" dia. wire rope . . .	13"	9"
3/4" dia. wire rope . . .	19"	13"
7/8" dia. wire rope . . .	23"	15"
1" dia. wire rope	26"	17"
1 3/8" dia. wire rope . .	35"	24"

The bending radius values above are based on a 1997 Bethlehem Wire Rope product catalog from Williamsport Wirerope Works, Inc.

1.2.5.2 General Notes for Structural Wire Rope, Turnbuckles and Wire Rope Connections

Use the following general notes on the plans for structural wire rope in seismic retrofit applications using the 7/8" diameter wire rope from the ODOT stockpile:

Zinc-coated 7/8" diameter structural wire rope for seismic restraint devices will be provided by the Agency.

Use the following general notes on the plans for structural wire rope in seismic retrofit and/or safety cable applications using ASTM A 1023 wire rope:

Provide zinc-coated X" (1/2", 3/4", 7/8", 1" or 1 3/8") structural wire rope for seismic restraint devices (and/or safety cables) according to ASTM A 1023.

Use the following general notes on the plans for turnbuckles and wire rope connections in seismic retrofit and/or safety cable applications:

Provide hot-dip galvanized turnbuckles according to ASTM F 1145.

Provide hot-dip galvanized socket connections. Ensure socket connections can develop the minimum breaking strength of the connecting wire rope.

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Caltrans uses 3/4" cable manufactured to Federal Specification RR-W-410D. The only difference between this cable and A 603 cable is the quantity of zinc coating. ASTM A603 (with Class C coating) requires three times the zinc quantity. RR-W-410D 3/4" cable, however, can be bent around a 4" minimum radius. For applications where this increased flexibility is required, RR-W-410D cable may be substituted. RR-W-410D cable will not be stockpiled, so the Designer must verify the availability of the material if the project quantity is less than 10,000 feet. Do not use RR-W-410D cable for coastal applications.¶

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1.2.5.3 Special Provisions for Wire Rope

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Under the heading "Structural Wire Rope for Seismic Restraints & Safety Cables" use the following:

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[When using 7/8" wire rope from the ODOT stockpile for seismic retrofit:]

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Zinc coated 7/8" diameter structural wire rope for seismic restraint devices will be provided by the Agency. Agency provided wire rope was manufactured according to ASTM A603 with Class C coating. Wire rope construction is 6 x 7 with a Wire Strand Core (WSC). Agency provided wire rope has been previously certified to meet a minimum breaking strength of 71,600 pounds. Wire rope is stored on spools with up to 2500 ft on each spool.

Deleted: Cable for seismic restraint devices shall be z... conforming... throughout...Cable ...hall be...Class A coating will be allowed for the center wire in the center strand. Supply cable on spools with a cable length of at least 2000 feet, but not more than 5000 feet. Minimum breaking strength = 46,000 lb. (... [2]

Agency provided wire rope is stored at the following location:

c/o District 2B Manager
Oregon Department of Transportation
9200 SE Lawnfield Rd
Clackamas, OR 97015
Phone: 503-653-3086

Deleted: only 3/4" RR-W-410D

Notify Bridge Engineering Headquarters of the quantity of wire rope removed within 24 hours. Follow up this notification with a written memo documenting the time of removal, quantity removed (to the nearest foot), and the project for which it will be used. Send the memo to:

Deleted: Cable for seismic restraint devices shall be... 3/4...conforming...Federal Specification RR-W-410D...Cable construction shall be...Wire Strand...C... (WSC) or Independent Wire Rope Core (IWRC)...Cable shall be m...d... and shall have...21 (... [3]

Craig Shike, Concrete Design Standards Engineer
Bridge Engineering Headquarters
355 Capitol St. NE, Room 301
Salem, OR 97301-3871
Phone: 503-986-3323
FAX: 503-986-3407

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The quantity of wire rope included for use in this project, including both testing and installation, is () linear feet. This quantity of wire rope will be provided at no cost to the Contractor. Additional wire rope required by the Contractor due to fabrication errors and/or waste must be purchased from the Department at the Department's cost as established by the Engineer.

Deleted: Wire rope for safety cables shall be... conforming ...60... with Class C coating throughout...Cable construction shall be ...7...Wire Strand ...C... (WSC)...Class A coating will be allowed for the center wire in the center strand. Supply cable on spools with a cable length of at least 5000 feet, but not more than 10,000 feet. ...M...1...0...lb...¶ (... [4]

[When using ASTM A 1023 wire rope for seismic retrofit:]

Provide zinc coated X" (1/2", 3/4", 7/8", 1" or 1 3/8") diameter wire rope for seismic restraint devices according to ASTM A 1023. Provide 6 x 19 wire rope construction with a steel core. Manufacture wire rope from extra improved plow steel. Ensure a minimum breaking strength of XX.XXX pounds (insert appropriate strength from design properties in 1.2.5.5).

Deleted: [When using both 1/2" and 7/8" wire rope for seismic retrofit:]¶

¶ Cable for seismic restraint devices shall be zinc coated structural wire rope conforming to ASTM A603 with Class C coating throughout. Cable diameter shall be 1/2" or 7/8" as shown on the plans. Cable construction shall be 6 x 7 with a Wire Strand Core (WSC). Class A coating will be allowed for the center wire in the center strand. Supply cable on spools with cable lengths as follows:¶

[When using 1/2" wire rope for safety cable:]

Provide zinc coated 1/2" diameter structural wire rope for safety cable according to ASTM A-1023. Provide 6 x 19 wire rope construction with a steel core. Manufacture wire rope from extra improved plow steel. Ensure a minimum breaking strength of 23,900 pounds.

	minimum
1/2" diameter	5000'
10,000'¶	
7/8" diameter	2000'
5000'¶	

¶ Minimum breaking strength of cable shall be 21,000 lb. for 1/2" cable and 63,600 lb. for 7/8" cable.¶

1.2.5.4 Special Provisions for Turnbuckles and Socket Connections

Use the following special provisions for turnbuckles and/or socket connections in seismic retrofit and/or safety cable applications:

Provide Type 1 hot-dip galvanized turnbuckles according to ASTM F 1145.

- Ensure turnbuckles develop the minimum breaking strength of the connecting wire rope.
- Provide turnbuckles with a 24" take-up unless shown otherwise.
- Test turnbuckles according to the requirements outlined in ASTM A 1023.
- For seismic restraint devices, provide either a jam nut or lock wire at each end of each turnbuckle. For safety cables, provide lock wire at each end of each turnbuckle. Provide 14 gage or heavier lock wire that is either hot-dip galvanized or plastic coated.

Testing for Socket Connections – Select an independent laboratory to test three sets of wire rope assemblies. Provide approximately 3 foot segments of wire rope with galvanized stud attachments at each end. Provide stud attachments of similar size and material as to be used on the project. Test each wire rope assembly to failure in tension. Ensure the tested wire rope assembly develops the minimum breaking strength of the wire rope and ensure that failure does not occur in the connecting parts. Ensure all three wire rope segments meet the minimum breaking strength requirement. However, if the wire rope breaks at a load less than the minimum breaking strength of the wire rope and at a location at least 6 inches from a connection, that test will be disregarded. If any wire rope assembly fails to meet these requirements, except as noted above, revise the connection details and prepare and test three new wire rope assemblies.

1.2.5.5 Design Properties

Modulus of elasticity for wire rope (non-prestretched) = 10,000 ksi.

Approximate gross metallic area and minimum breaking strength for wire rope:

	<u>Area (in²)</u>	<u>Strength (lb)</u>	<u>Weight (lb/ft)</u>
1/2" diameter <u>wire rope</u>	0.119	23,900	0.46
3/4" diameter <u>wire rope</u>	0.268	52,900	1.04
7/8" diameter <u>wire rope</u>	0.361	71,600	1.41
1" diameter wire rope	0.471	93,000	1.85
1 3/8" diameter wire rope	0.906	173,000	3.49

Area values above are approximate and are based on ASTM A 603. Minimum breaking strength and weight values above are based on ASTM A 1023. Note that A 1023 does not provide area values. Weight values for A 603 are slightly smaller.

The sizes of ASTM A 1023 zinc-coated wire rope shown above are readily available from northwest suppliers.

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There have been significant changes to the industry specifications for structural wire rope. These BDDM revisions are necessary to ensure designers have the latest and most accurate information available.

Specification terminology has been revised to use the term “wire rope” rather than “cable” to match the terminology used by industry.

The specification for turnbuckles has also been changed from a federal specification to an ASTM version. Actual requirements for turnbuckles, however, have not changed.

Proposed general notes and special provisions have also been revised to conform to the department’s imperative mood language requirement.

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Use the following special provisions for turnbuckles in safety cable applications:

Test turnbuckles according to the requirements outlined in Federal Specification FF-T-791B.

Provide a lock wire at each end of each turnbuckle. Lock wires shall be 14 gage or heavier and shall be either hot-dip galvanized or plastic coated.

