Prefabricated Girders
Section 10

Common Beam Types

- Slab
- Bulb-I
- Box
Common Beam Types

- Bulb-T
- Steel Plate Girder

Precast Concrete

- Anchorage
- Beam
- Jack
- Prestressing Steel
- Casting Bed
Precast Slab Bed

Precast Slab Bed
Prefabricated Girders

Section 10.1

Inserts for Tierods

Precast Girder Bed
MOAB

Girder Reinforcement in MOAB
Steel Plate at End of Girder

Bridge Girders

Common characteristics include:
- Camber & Deflection
- Bearing points
- Diaphragms
Beam Camber & Deflection

Camber Is Curvature Of Beam Without Load

Deflection Is Sagging Of Beam Under Loading
Bearing Points

Bearing Pad or Plate Assembly Between Top Of Bent & Bottom Of Beam

One End Usually Fixed & The Other Allows Movement
Expansion End of Beam

Stainless Steel Plate
Teflon Bearing Pads

Expansion Bearing Assembly
Grout Layer

No Grout Layer
Under Elastomeric Pad

Depends On
Design Of
Endwall
Setting Beam
After Placing Grout Layer

Cleaning Up Grout
After Setting Beam
Poor Consolidation in Crossbeam Above Bearing Assembly

Large Void Under Gusset Plate Above Bearing Assembly
Good Bearing Support

Slabs & Boxes
Prefabricated Girders

Section 10.1

Typical End Bent Detail

Bearing Detail

BEARING DETAIL
No Scale
Bearing Details

Gap Under Slab?

- Need uniform bearing
- Reset slab until no gap shows
3⁄4” Gap Under Slab Above Pad?

- 5% grade
- Slope beam seat to match grade and cross-slope
- ½” grout layer missing?

1” Gap Above Elastomeric Pad
Slabs on Steel Pilecap

Gap Over Elastomeric Pad
Details for Slabs & Boxes

BR445
BR445: Tie Rod DTI 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)
DTI with Hardened Washer

DTI Only, No Hardened Washer?
Plate Not Flush in Pocket?

BR445: Keyway Grout Detail

Top mismatch: 6 to 1 Taper
Keyway Grout

No Vertical Edges Under Waterproof Membrane

Keyway Grouting (00550.50)

- Keep keyways moist for 24 hours prior to grouting
- 45 degrees minimum for grouting
- Water cure grout per manufacturer’s recommendations
Slab / Box Beam Checklist

Proper Cleanup
Proper Cleanup

• Remove excess grout from around the elastomeric pads from ½” grout layer.
• Remove excess keyway grout.
• Remove concrete spills from bearing areas and tops of abutments.

Keyway Grout Buildup on Abutment
Excess Concrete Below Box

Patterson Slough Bridge

Setting Beams Using a Beam Launcher
Girder Construction

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.
Prefabricated Girders

Section 10.1

Picking Beams on a Super
Prefabricated Girders

Section 10.1

Trailer Blocked To Keep Level

Dropped Beam
Inspect Concrete Girders for…

- Cracks, exposed re-steel, defects.
- Lengths and cross-section.

Concrete Girder Sweep

Alignment:

1/8” / 10’ max. sweep allowed

Actual for 150’ was 3 ¾”
Sweep Example

150’ Girder
Sweep of 3 ¾” Is this acceptable?

Allowable is 1/8” / 10’
150’ / (10’ / 1/8”) = 15/8” = 1 7/8”

3 ¾” > 1 7/8”

Therefore, the girder is out of spec.

Sweep Exercise

180’ Girder
Sweep of 2 1/2” Is this acceptable?
Sweep Exercise Key

180’ Girder
Sweep of 2 1/2” Is this acceptable?

Allowable is 1/8” / 10’
180’ / (10’ / 1/8”) = 18/8 = 2 1/4”

2 1/2” > 2 1/4”

Therefore, the girder is out of spec.

Inserts
Prefabricated Girders

Section 10.1

Inserts On Interior Of Exterior Beam For Diaphragm

Check For Correct Beam & Correct Orientation

Temporary Bracing Details
BR350

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.
Contractor Submittal
Chains & Binders Used to Plumb and Support
Bracing

Bracing
Bracing

Note the cable holding beams together

Falsedock Construction Thoughts?
Girder Collapse

I-10 Twin Span Bridge
Lake Pontchartrain, New Orleans, LA

Oct 30, 2008
Fatalities: 1
Injuries: 2

Girder Collapse During Overhang Bracket Placement

10 carpenters, tethered to the outer beam for safety, were adding molds for additional concrete just south of the mid-point of the bridge.
Girder Collapse

10 men
30’ drop to water

Girder Collapse

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 pier cap it rested on, to something hitting the bridge.

2. The end beam collapses in a “roll-over,” falling into Lake Pontchartrain and dragging the 10 connected men into the 14-foot-deep water.

3. Nine of the men were able to free themselves, but foreman Eric Blackmon is pulled under the falling beam and drowns.

Source: Bob Bros, staff research
EMMETT MAYER III / THE TIMES-PICAYUNE
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.
Diaphragms provide the beams or girders with lateral support and tie them together. They include:

- Pier and abutment diaphragms, and
- Intermediate diaphragms.
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.

Holes in Girder for Rebar
Holes in Girder for Rebar

Inserts with Threaded Rods on Exterior Girders
Steel Plate Girder Construction

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.
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.

Elastomeric Pad For Steel Girder
Cross Frame

Elastomeric Pad Shift
Due to Deck Deadload
Anchor Bolts @ Abutments

Leave Loose To Allow For Movement On Expansion Ends

Bent Anchor Bolt @ Abutment
Cable anchor welded in tension member?

Welds not allowed in tension members

Exceptions require approval of design engineer

Cut Through Both Plates When Removing Deck?
Steel Delivery & Erection

Inspect girders and diaphragms for:

• General condition, twists, defects.

• Dimensions, etc., per plans and shop drawings.

• Erection marks to guide assembly.

Steel Delivery & Erection Cont’d

• Proper handling to avoid damage to structure or surroundings.

• Accurate seating at each end.

• Initial girder and diaphragm connections:
  – Contact surfaces free of paint, grease, or other foreign material.
  – With partial bolts until complete span in place.
250’ Span Lift

Unstable Due To Lack Of Diagonal Supports
Bolt Installation
(00560.46 (g))

• 25% Drift Pins
• 25% Fit Up Bolts

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)
Girder Markings

Girder Splice

Prepare Surfaces
00560.46 (g)
Prefabricated Girders

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Girder Line Not Plumb & Straight

Cross-frame Installed Backwards
Cross-frames Installed Correctly

Girder Line Is Straight
Tennessee River Bridge Erection Accident

Steel Girder Collapse
State Route 69 Over Tennessee River
Near Clifton, TN
May 16, 1995
Fatalities: 1
Injuries: 3
3 Span Continuous Steel Girder Over River

TOTAL LENGTH OF STEEL = 1225'-4"

G1  G2  G3

0:15:51:13

MBC Erection Video

45'-0" CLEAR SPAN
MAIN RIVER CHANNEL

PIER 13  PIER 14  PIER 15

PIER 14

January, 2018 58
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.
Steel Girder Collapse

Steel Girder Collapse
Prefabricated Girders

Section 10.1

Demolition

[Image of a bridge girder being demolished]

[Image of a bridge with the date 6/26 and time 12:49]