Data and Performance Measures for LRFD
Design of Open Grid Steel Bridge Decks

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BGFMA

• Manufacturers association reformed in June 2006

• Goal is to promote use of grid deck systems

• Composed of 4 full member and 5 associate member companies

www.bgfma.org
Background

- The BGFMA funded research at Oregon State University to improve understanding and design of open grid decks – move to LRFD
- Combines analytical and experimental work
- Expected completion Fall 2012
Experimental Work

- Open Grid Deck types:
  - Diagonal
  - Rectangular
Experimental Work

- Open Grid Deck types:
  - Diagonal
  - Rectangular
- Orthogonal stiffness property tests
- Load distribution with respect to main bar spacing and different span lengths and boundary conditions (span continuity)
- Alternative deck-to-girder attachment details
- Fatigue characterization of standard and alternative weld details
  - Focus on weak direction fatigue performance
Stiffness Tests

- Stiffness properties ($D_x$, $D_y$, $D_{xy}$) must be established for computing design demands.
- Stiffness properties determined experimentally and compared with theoretical stiffness properties (based on section properties calculated from shop drawings).

Typical Strong Direction Stiffness Test
Stiffness Tests

Directional Stiffness Test (strong shown below)
• Produce one-way behavior
• Strain gages and displacement sensors mounted to ensure one-way bending in strong and weak \((D_x, D_y)\) direction stiffness tests

Torsional Stiffness Test (shown above)
• 4-point load with free corner loaded
• Study Load vs. Displacement of free edge

• All three directional stiffness's used to create an analytical model to predict behavior of deck
Load Distribution Tests

- Grid deck specimen mounted on stringer supports, multiple span lengths, and different end conditions investigated
- Hydraulic actuator attached to rollers on crossbeam above test setup allows quick and efficient movement of tire patch configurations
- One quarter of specimen heavily instrumented, superposition used to quantify behavior at other locations
- Identify stress ranges and reversals in grid elements
Alternative deck-to-stringer connection

• Headed shear studs and concrete fill over stringer supports used to attach grid deck, as opposed to typical weld detail
• Sacrificial ½” plate bolted to stringer (shown below)
Fatigue Tests of Grid Deck System

- Highest negative moment stresses at free edge of deck over center support with axle oriented transverse to the main bars
- Puddle welds in the negative moment region near supports are controlling details
- As main bars supporting axle load crack, load was redistributed and weak direction crossbar stress increased
- Change in stiffness and stress redistribution were measurable over lifetime
Subcomponent Fatigue Testing

- Characterization of weak-direction fatigue behavior
- Specimens consist of 3 weak direction cross-bars
- Standard weld detail performance compared against specimens with alternative weld details
- Specimens monitored closely during cyclic testing to determine first cracking and crack propagation
Subcomponent Fatigue Testing

- Strain gages placed on each crossbar determine strain profiles and assure target stress range
- A 20 ksi stress range at welded joint is targeted
- As crossbars begin to crack, redistribution of stresses are tracked