Center for Integration of Composites into Infrastructure

Rutgers the State University of New Jersey

Site Director: Bala Balaguru

Date: February 1, 2011

Status of the Site

- Additional Researchers
- Professors Hani Nassif and Kaan Ozbay

List of Projects at Site

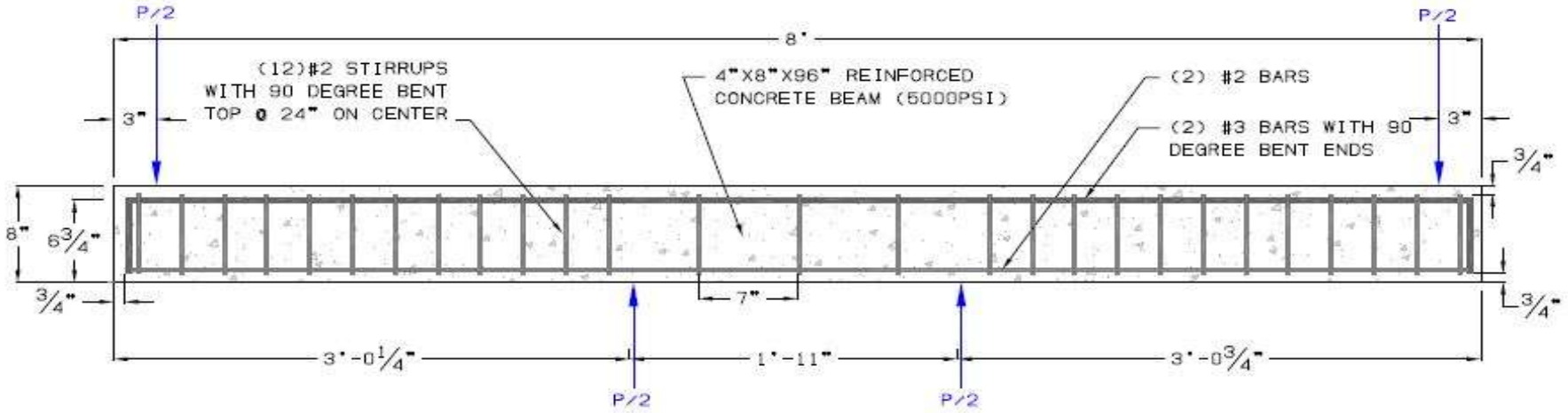
- Evaluation of Retrofitted RC Beams at High Temperatures
- Composite Guard Rail System
- Protective Multi-Purpose Coatings

Ongoing Project Title

Project Number: 1 Evaluation of RC Beams at Elevated Temperature

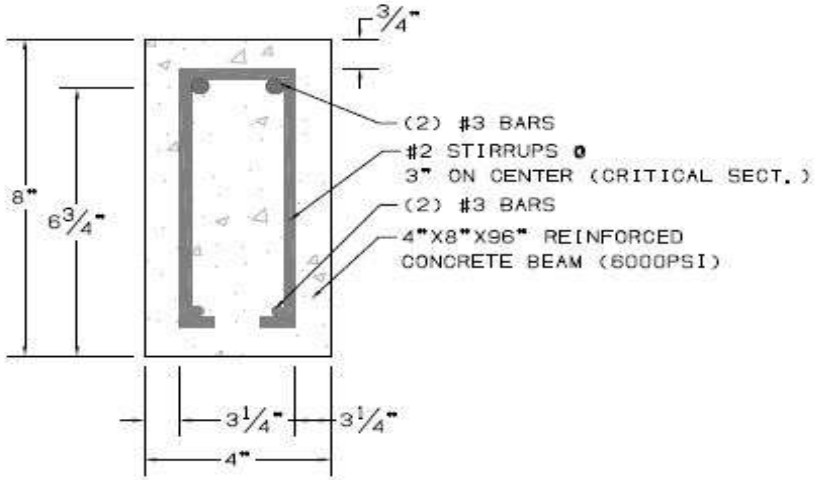
- Project Manager / PI: P.Balaguru
- Overview
- Evaluate RC Beams retrofitted using Inorganic Polymer at 500 F. The tests were conducted by heating the maximum bending moment region.

- Budget Update: New Project



BEAM ELEVATION

SCALE: 1"=1'



BEAM CROSS SECTION

SCALE: 1"=4"

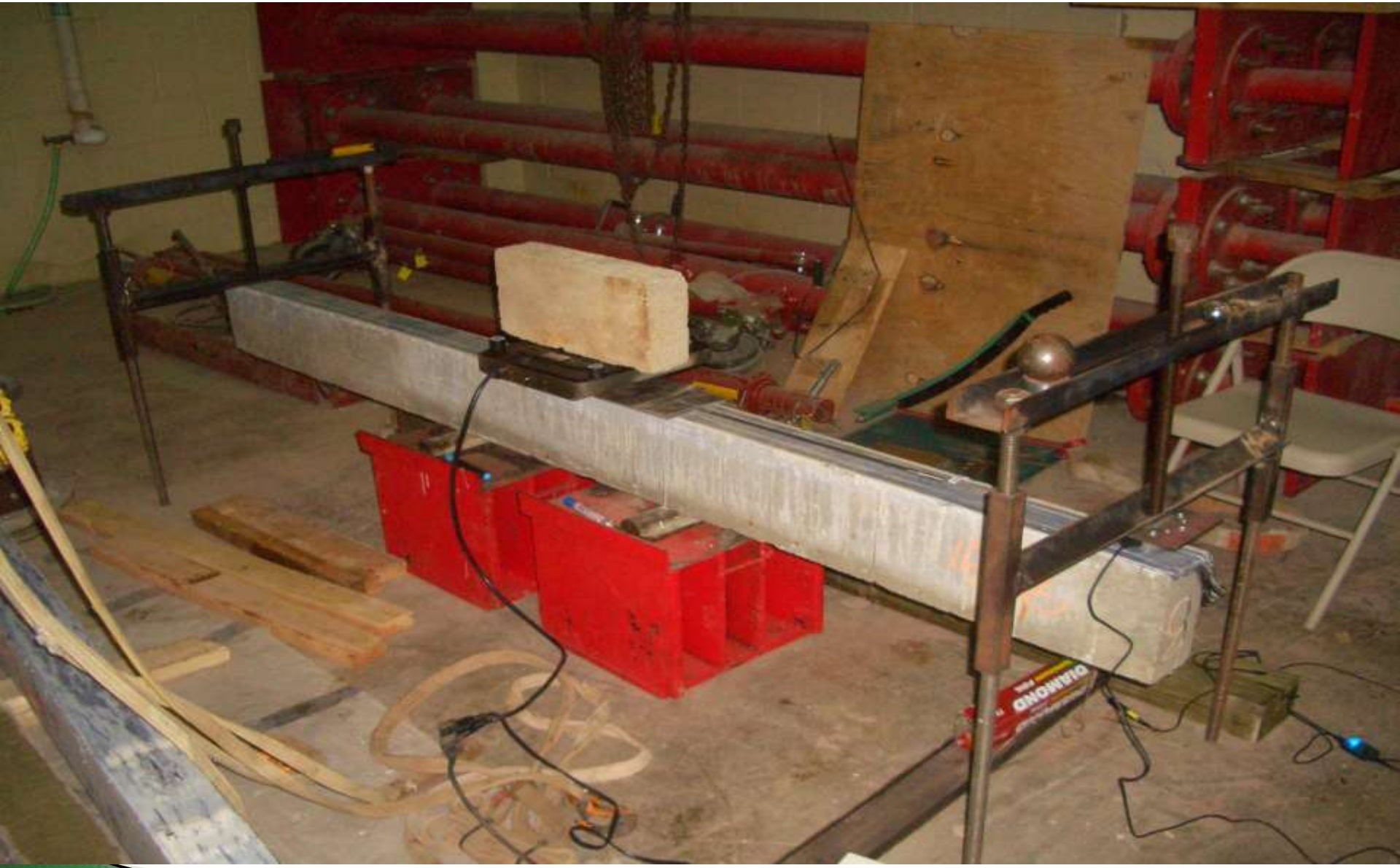
BEAM DESIGN

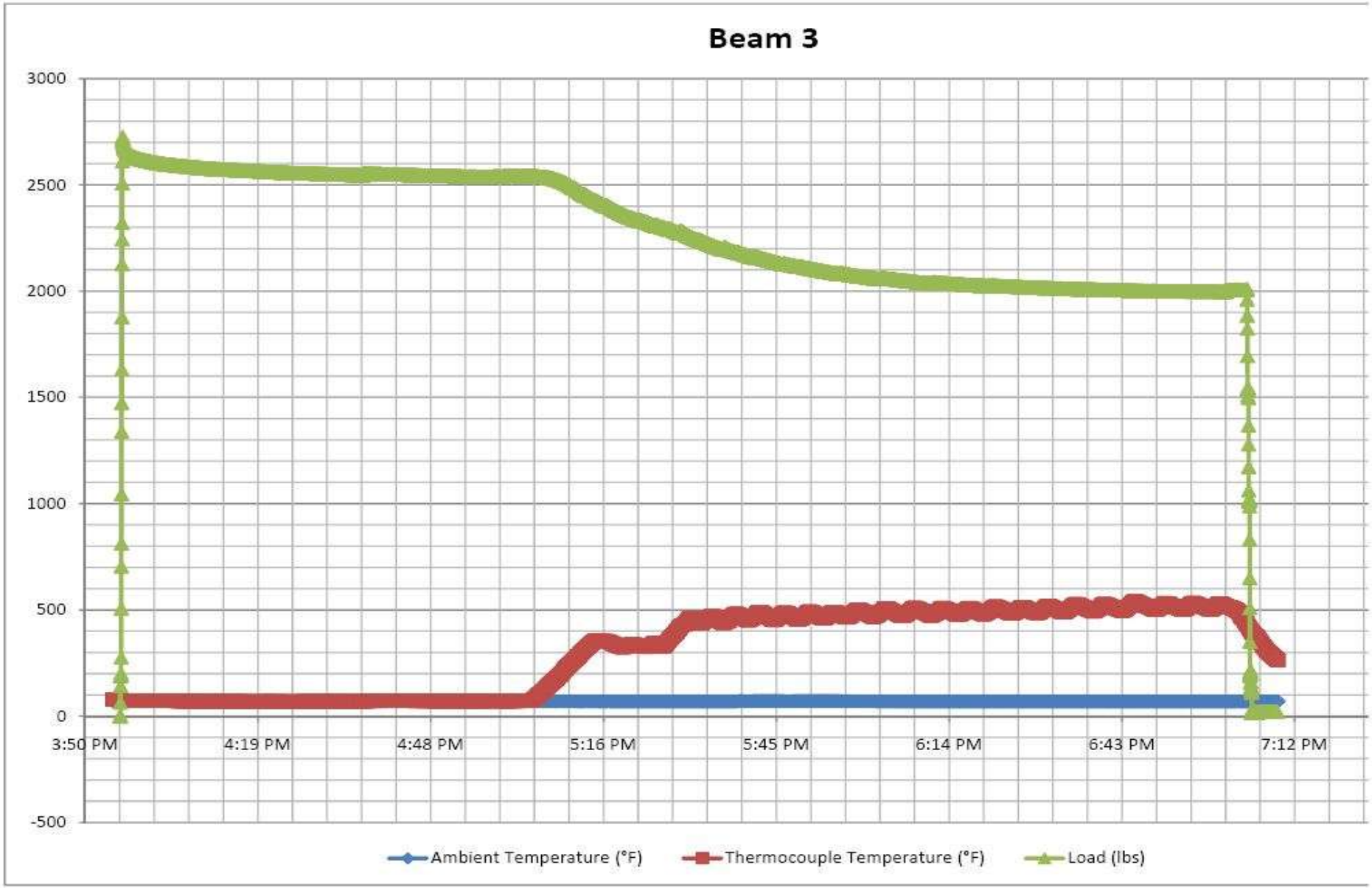
5000 PSI CONCRETE BEAM DESIGN

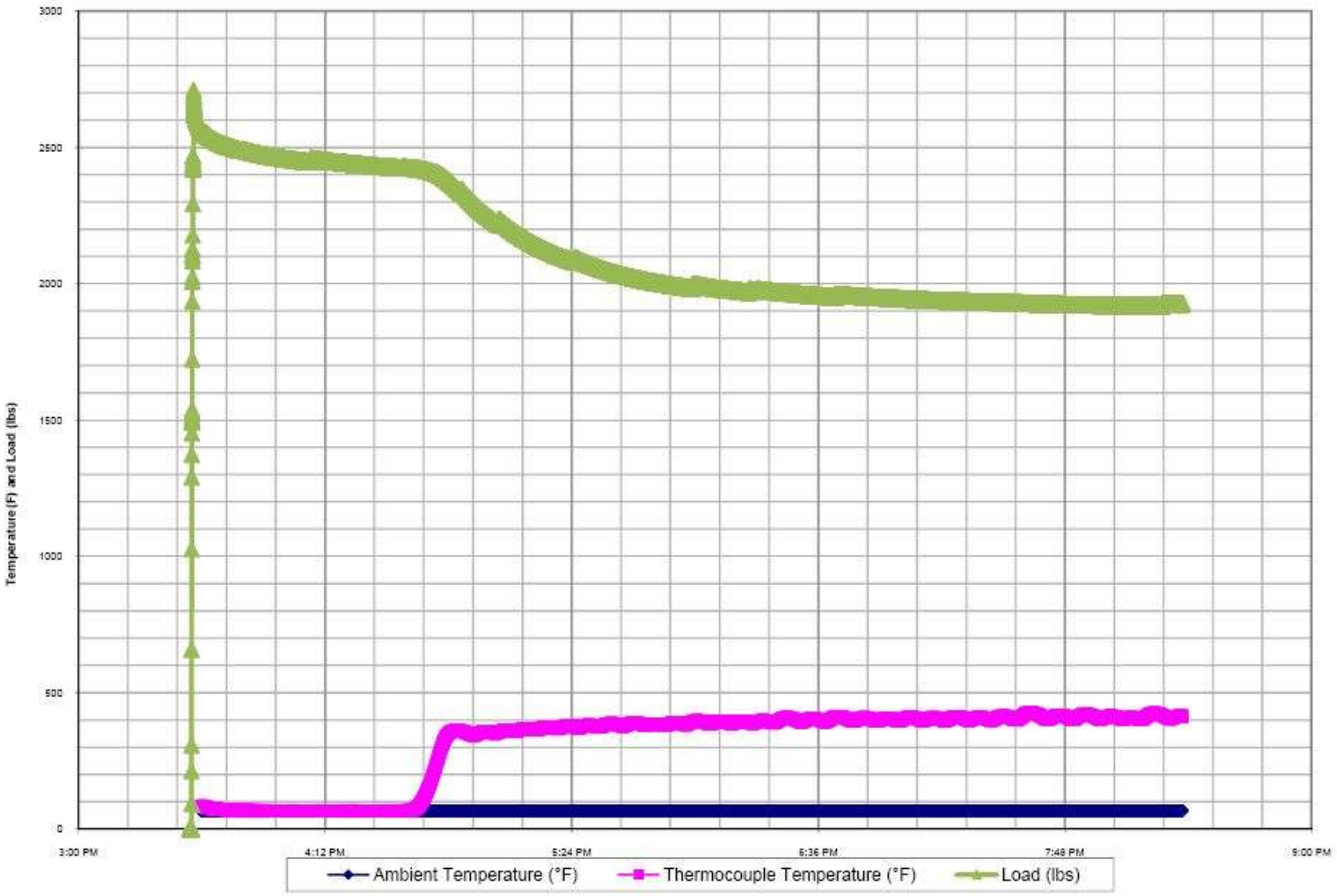
RESEARCH PROJECT

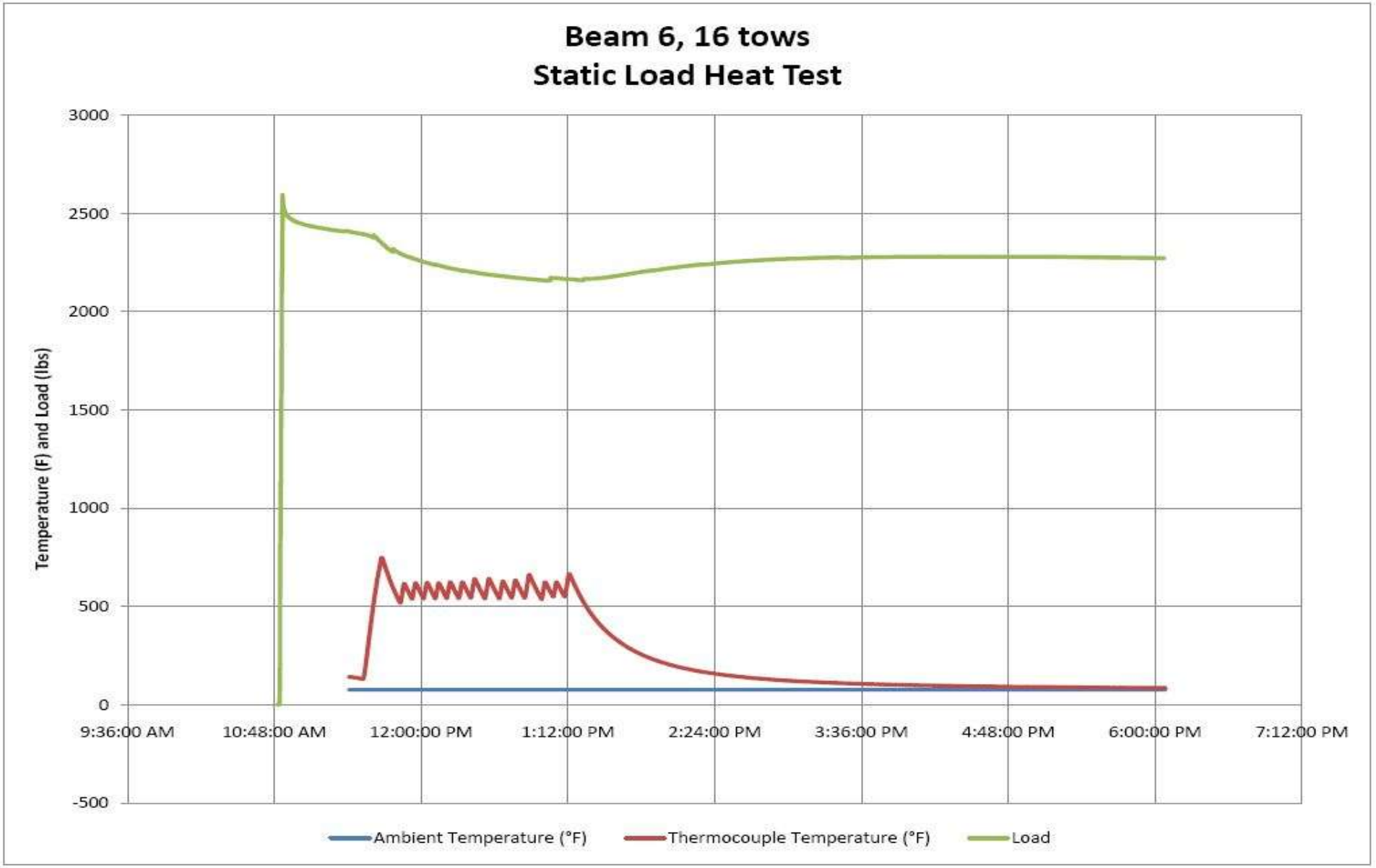
DATE: 4/26/09	SCALE: AS NOTED	DWG #: B-1

CARBON FIBER REINFORCEMENT RESEARCH PROJECT


DIAMOND


Beam 3
3000
2500
2000
1500
1000
500
0
-500
3:50 PM
4:19 PM
4:48 PM
5:16 PM
5:45 PM
6:14 PM
6:43 PM
7:12 PM
Ambient Temperature (°F)
Thermocouple Temperature (°F)
Load (lbs)


Beam 6, 4 Layers, 16 Tows
Temperature (F) and Load (lbs)
3000
2500
2000
1500
1000
500
0
3:00 PM
4:12 PM
5:24 PM
6:36 PM
7:48 PM
9:00 PM
Ambient Temperature (°F)
Thermocouple Temperature (°F)
Load (lbs)


Beam 6, 16 tows
Static Load Heat Test
Temperature (F) and Load (lbs)
3000
2500
2000
1500
1000
500
0
-500
9:36:00 AM
10:48:00 AM
12:00:00 PM
1:12:00 PM
2:24:00 PM
3:36:00 PM
4:48:00 PM
6:00:00 PM
7:12:00 PM
Ambient Temperature (°F)
Thermocouple Temperature (°F)
Load

Ongoing Project Title

Project Number:

- Future Work / Conclusion
- As expected the system behaves well at high temperatures
- More tests at higher temperatures

LIFE Form Completion

[Add a project picture, etc…]

Proposed Project Title

Project Number: 2 Composite Guard Rail System

- Project Manager / PI: P.Balaguru and Husam Najm
- Overview
- Budget: Baltek $15,000

Outline

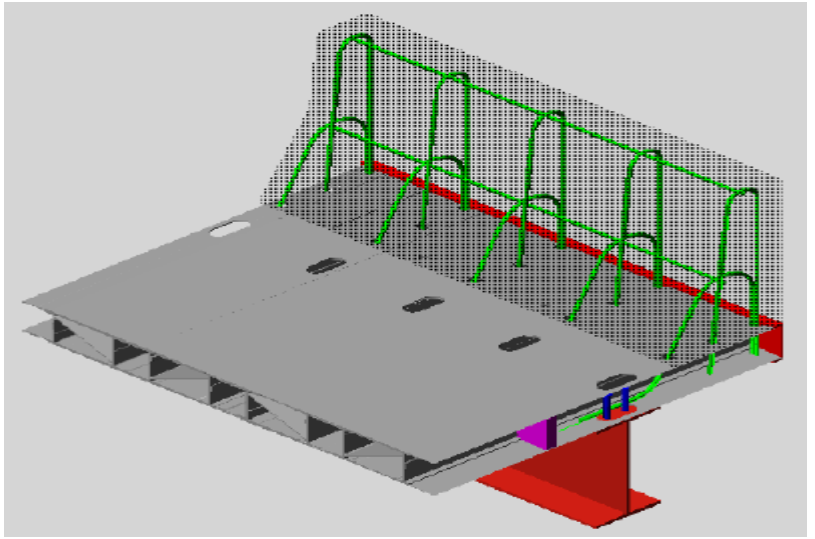
- Introduction
- Existing Railing Systems
- Suitable Railing System
- Proposed Railing Systems
- Comments

Introduction

- Different types of FHWA railing systems were studied to select a suitable railing system for BLATEK deck bridges

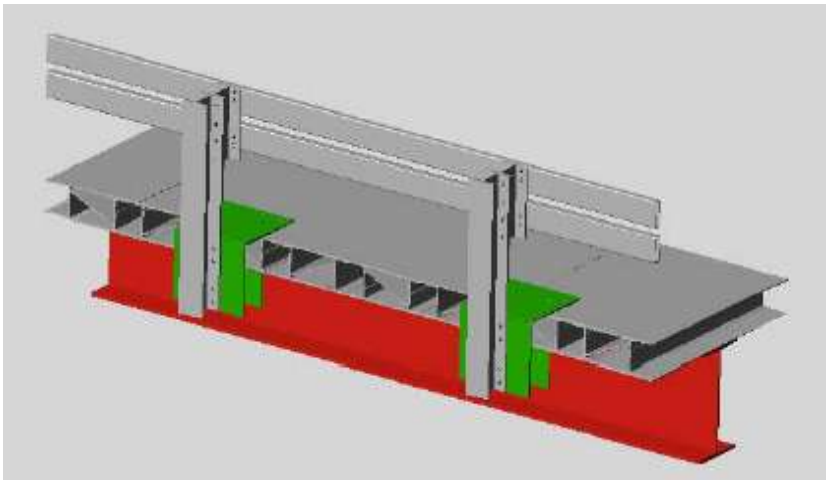
Existing Railing Systems

Concrete Barrier attached to the deck



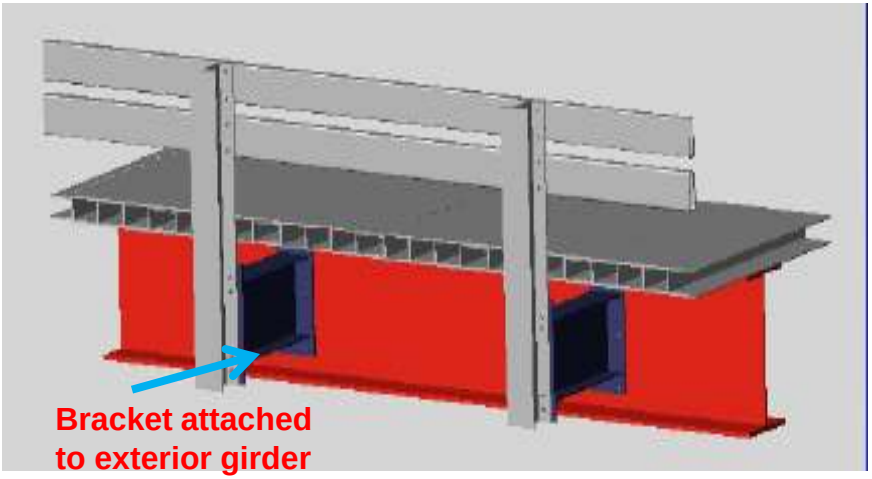
This system is not suitable for the project

Railing attached to the deck



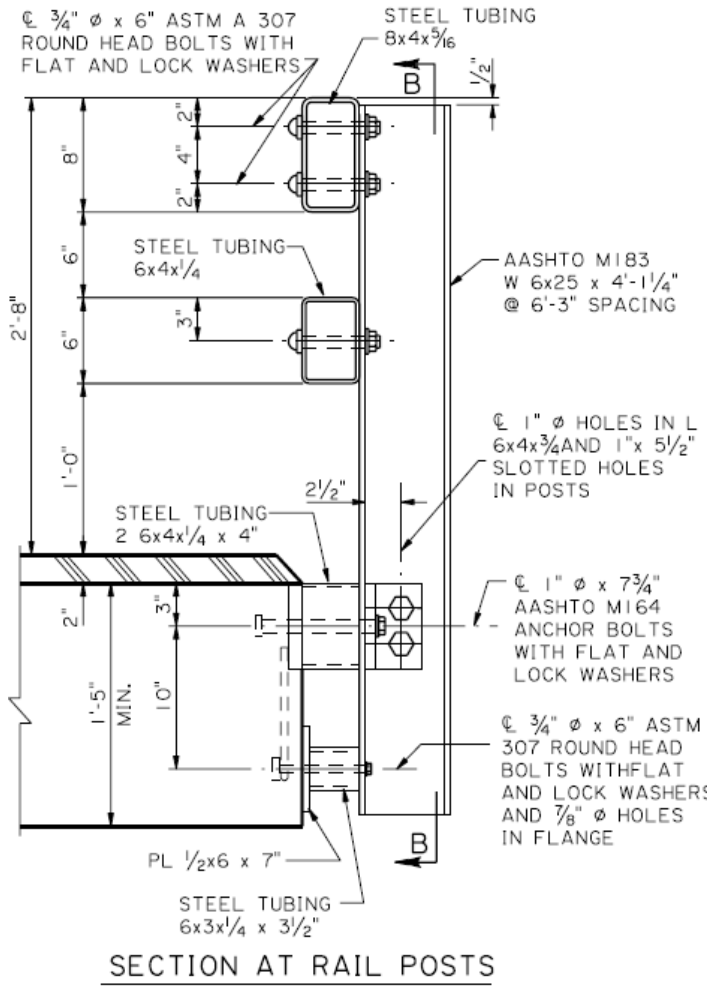
This system is also not suitable for the project

Railing cantilevered from girder



This system is suitable for the project

Railing cantilevered from girder/concrete wall

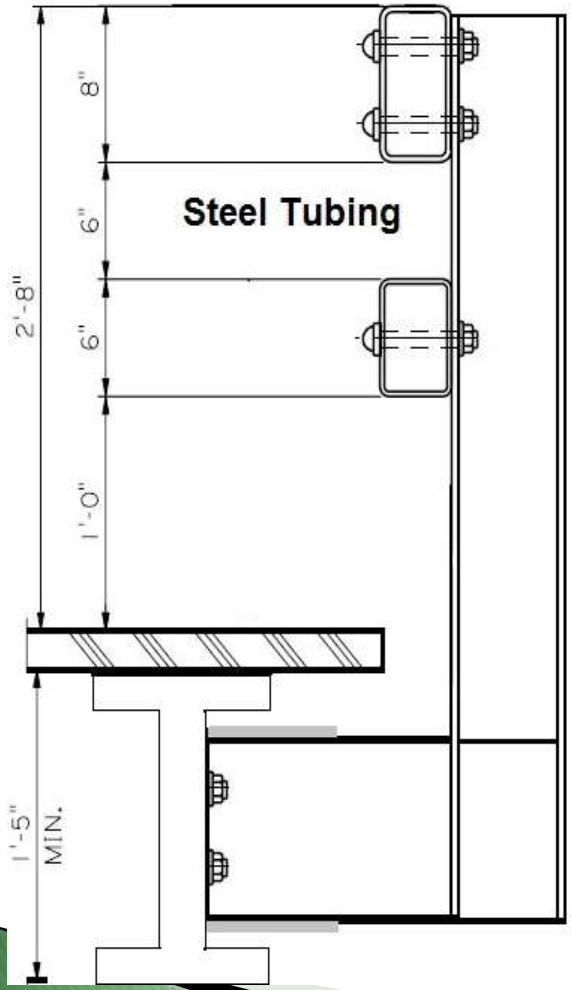


- A side mounted open rail system and a solid concrete vertical wall rail is shown here for a PL-2 application (Louisiana DOT).
- Open rail systems are particularly useful where sight distance, bridge drainage and aesthetics may be of concern.
- Although open rail systems are usually more expensive, they can significantly improve visibility and drainage. Steel plate barriers formed to an F-shape are used on movable bridges with steel grid floor.

Side Mounted Rail (PL-2)
LADOTD

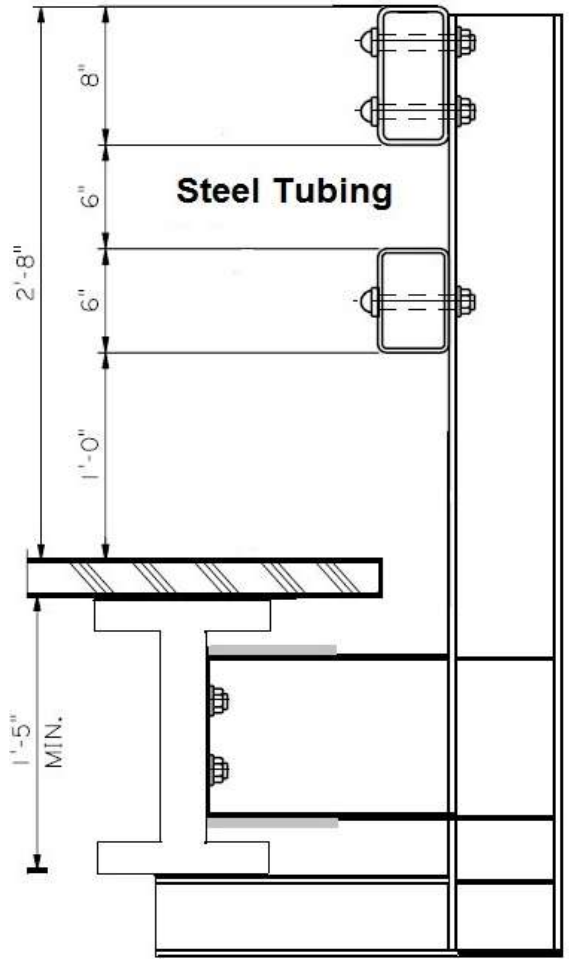
Proposed Railing Systems

By replacing concrete wall with steel girder in previous design, we can design suitable railing system for BALTEK deck



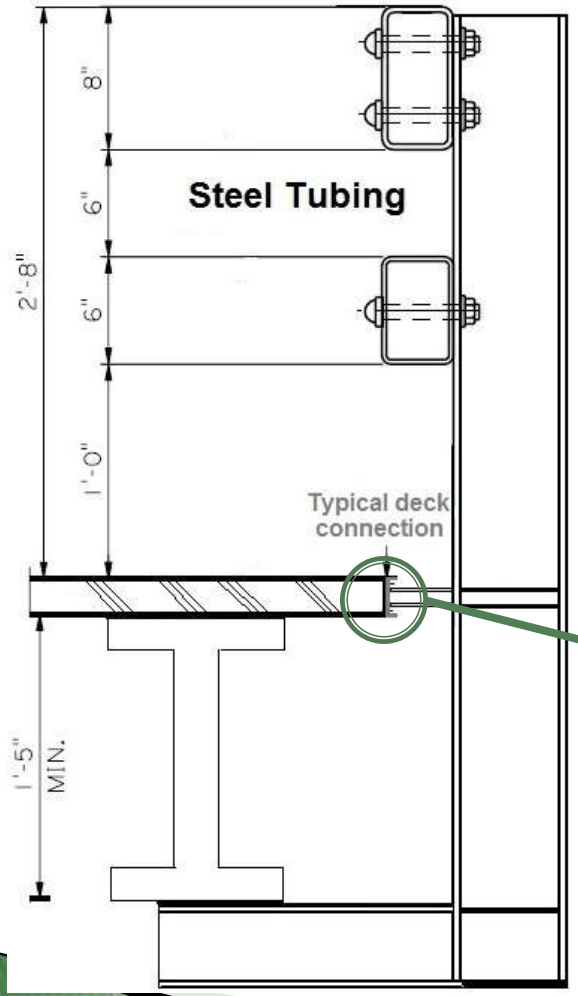
- Railing is attached to girder web
- The connection is designed as fully restrained moment connection for PL-4 loading case

2. Railing connected to I-beam web and bottom flange

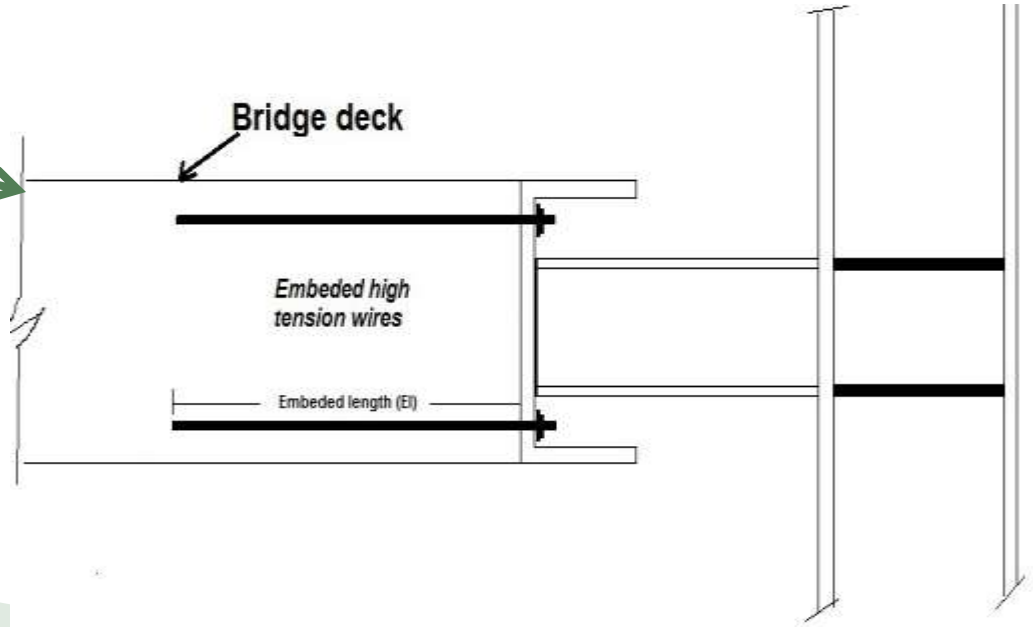


- Railing is attached to girder web and bottom flange
- The connections design for tension and compression forces for PL-4 loading case

3. Railing connected to deck and I-beam bottom flange



- Railing is attached to deck and girder bottom flange
- The system is designed for high tension wires and welded connections

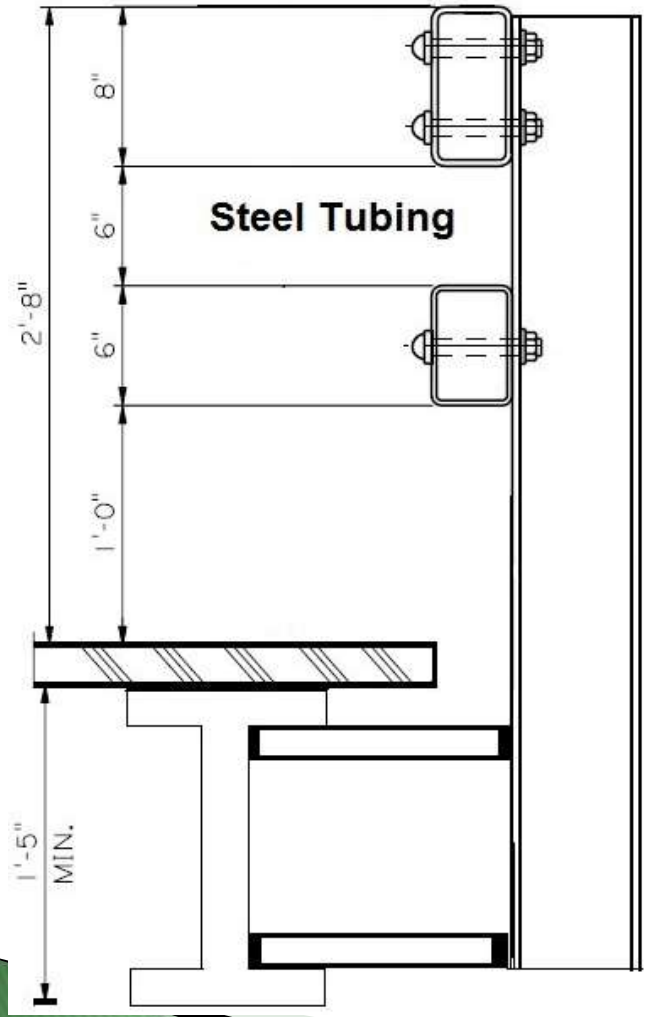


Simple railing connection

Railing welded to top and bottom flanges of girder

Aitken Road Bridge (1950-2005)
(Sanilac County, Michigan)

4. Railing connected to I-beam top and bottom flange



- A welded connection
- Railing is attached to girder top and bottom flanges
- The connection is designed for tension and compression forces for PL-4 loading case

Proposed Project Title

Project Number: 3 Protective Multi-Purpose Coatings

Rutgers Facilities Department

Parking Decks
Animal Facilities
Graffiti Resistant Coatings
Stadium

Fire Test: CMU

- The following 3 slides show the fire test for the coated CMU (hollow core block)
- It can clearly seen from these slides that a high temperature flame does not produce any distress
- Additionally there is no smoke or any other fumes
- The coating does not disintegrate during the fire event or fuel the fire
- Once the flame is taken off the coating looks exactly like the initial applied coating

Fire Test: CMU Before the Flame

August 12, 2010

Fire Test: CMU with Flame

Flame Applied Directly to Surface for 60 Seconds

Fire Test: CMU After the Flame

Enlarged Image shows Absolutely No Fire Damage

Scarlet Red

Light Post Base on Rutgers Busch Campus

Color Schemes

- A number of color schemes have been developed using inorganic pigments
- The following slides present some of these colors on concrete and hollow core block surfaces
- There is also one slide that shows the various colors for side-by-side comparison
- Additionally other colors can be formulated using these basic colors

White

Hollow-Core Block

Yellow

Hollow-Core Block

List of Current Color Schemes

More colors can be formulated

Tests for the Effects of Moisture Ingress

- Hollow core blocks (CMU) were coated on one side and submerged in a tub of water
- The blocks were submerged such that only a 0.25 inch of top coated side was not covered with water as shown in the next slide
- After 15 day analysis showed there were NO changes to the coated surface
- Note that the block is very permeable and therefore water will reach the top to the “interface of the block and coating” in a few minutes and DID NOT create any problems
- The coating self-cleaning property also helps to keep the surface unaffected

Tests for the Effects of Moisture

CMU in Water (only top 0.25in left uncovered)

Graffiti Proof

- This organic paint comes off easily (even with a fingernail!)
- Light abrasion, citric based remover, or high pressure water can be used to easily remove graffiti

LIFE Form Completion

[Add a project picture, etc…]