Bridge Structure Rehabilitation

Field Application of Rapid Installation Method

Anthony J. Lamanna
Assistant Professor

September 26, 2003

Department of Civil and Environmental Engineering
Tulane University
lamanna@tulane.edu

US Army Corps of Engineers

Civil and Environmental Engineering

Outline

Current Method

Rapid Method

Bridge Selection

Bridge Details

Design Details

Field Installation

Installation Observations

Service Load Test

Cost

Conclusions

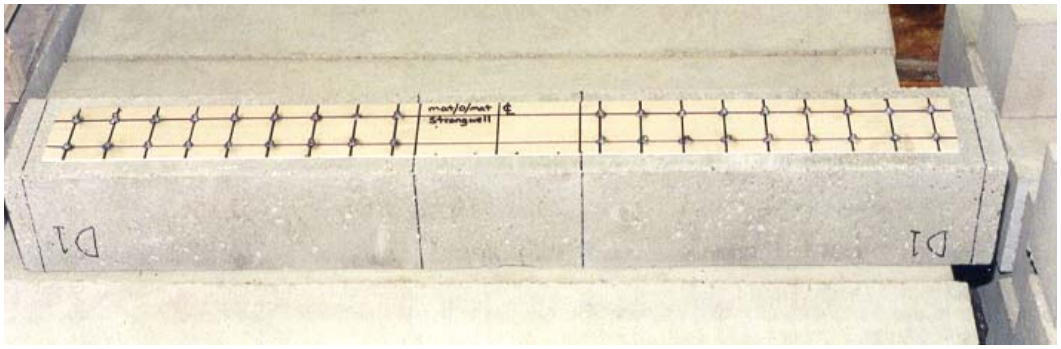
Current Method of Bonding FRP

Negatives:

- Surface preparation
- Cure time
- Skilled labor

Rapid Method of Attaching FRP

Rapid application
Simplified application
Minimal surface preparation
Application in adverse environments
Simplified design criteria
Ductile behavior of strengthened beam



Bridge Selection

- Flat slab bridge
- Constructed in 1930
- Designed for H15 truck loading
- HS 17.6 inventory rating
- HS 29.3 operating rating
- 32.7 sufficiency rating
- Efflorescence on edge of slab
- Scheduled for replacement 2003

Bridge Details

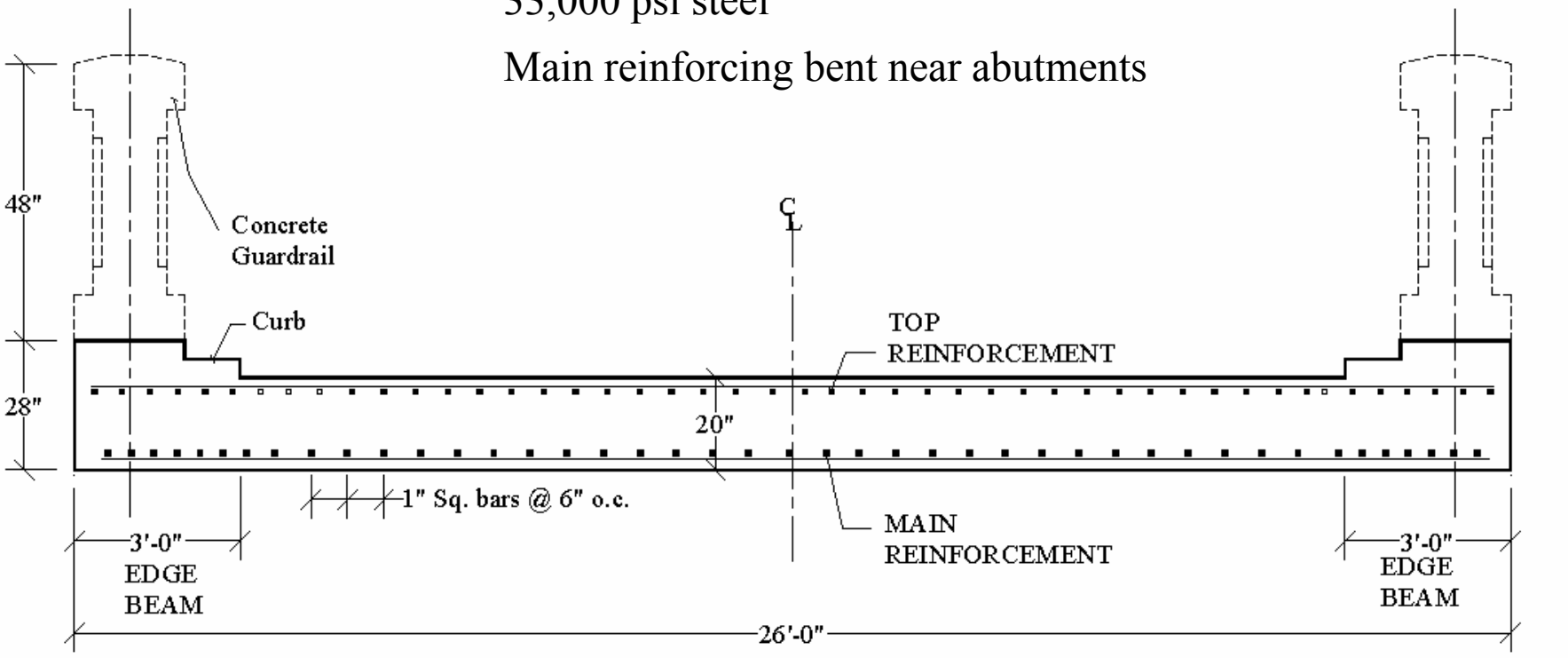
23 ft span

25.9 ft wide

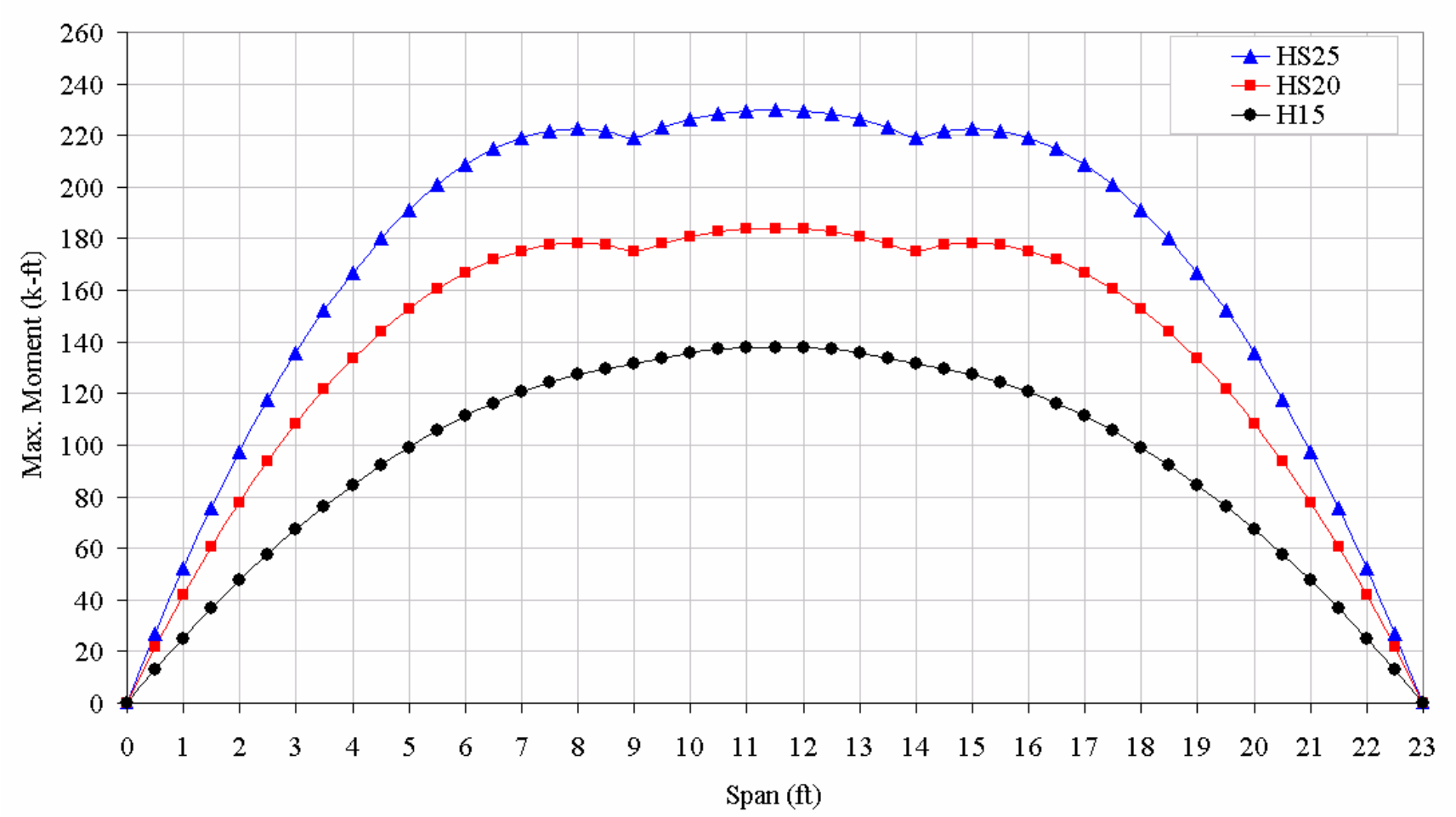
Square bars

33,000 psi steel

Main reinforcing bent near abutments



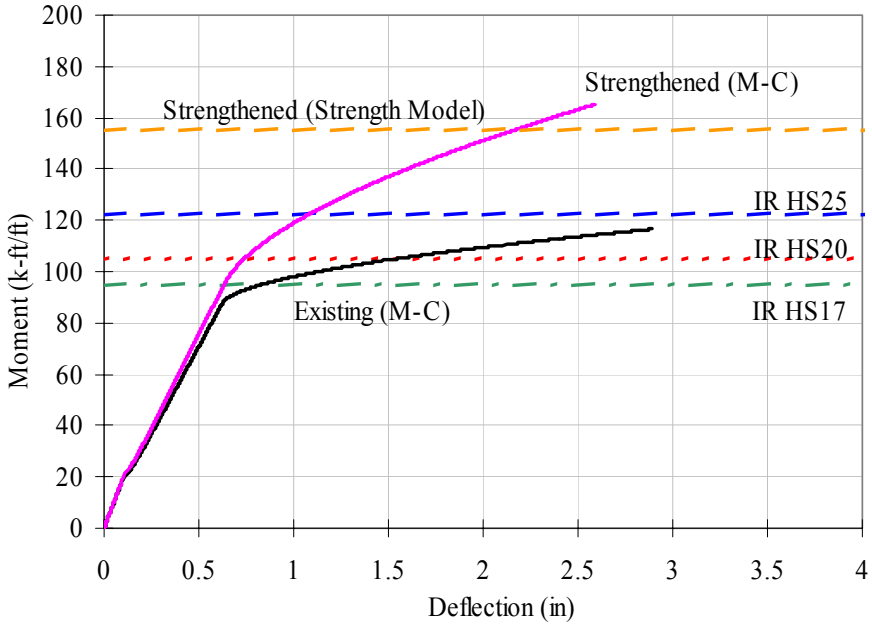
Design Details

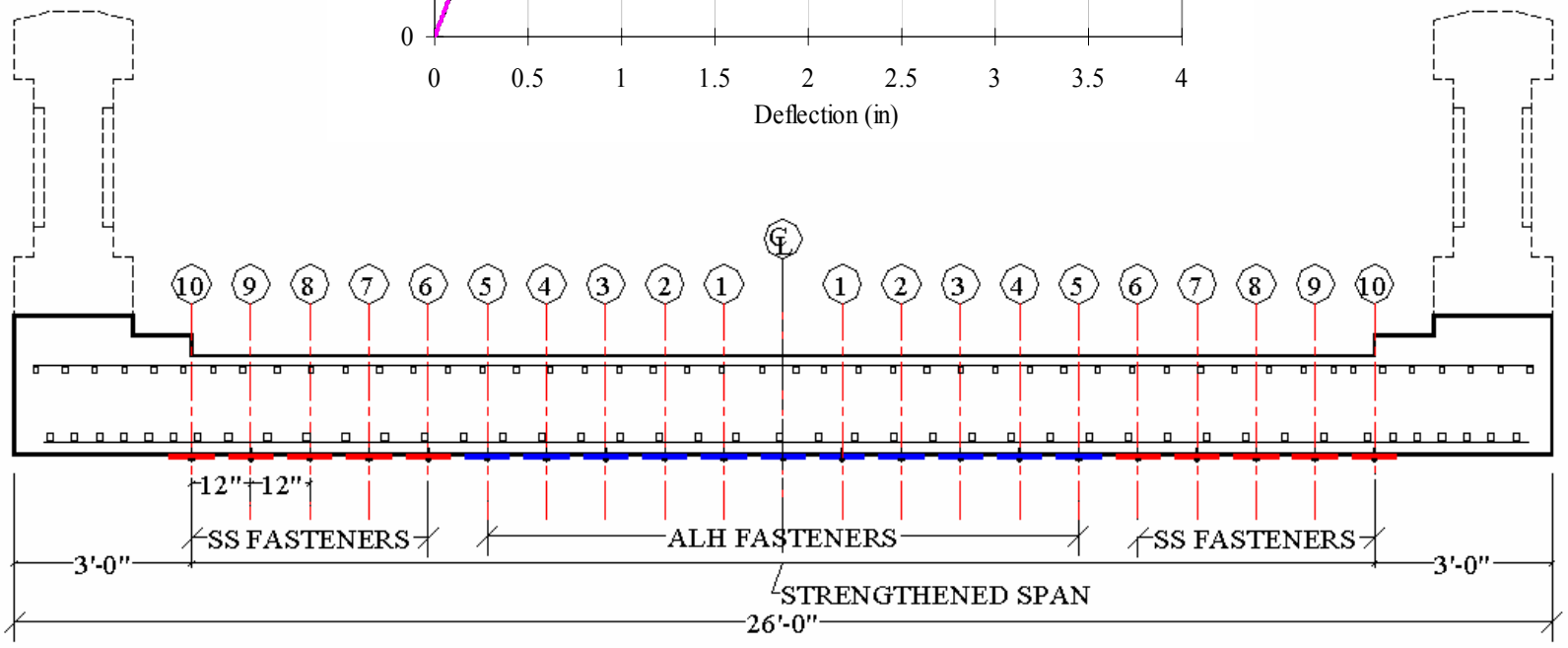


H15 to HS20 = 33% Increase

H15 to HS25 = 67% Increase

Design Details





Field Installation

Strip supplied in 100 ft rolls

Cut to 21 ft 2 in. lengths

Fastener locations marked & pre-drilled

Work platform constructed under bridge

Soft calcium removed with putty knife

Field Installation

Strip duct taped in position

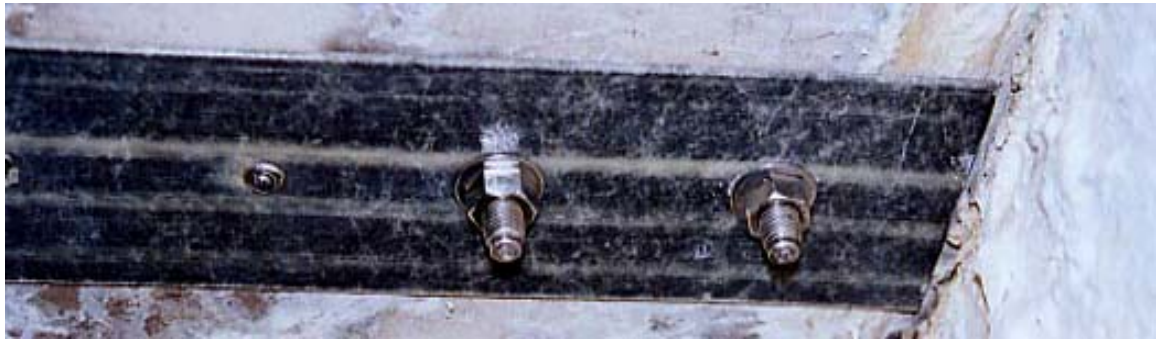
Midspan fastener installed

Midspan to abutment, repeated

15 minutes to position strip

15 minutes to attach strip

Field Installation

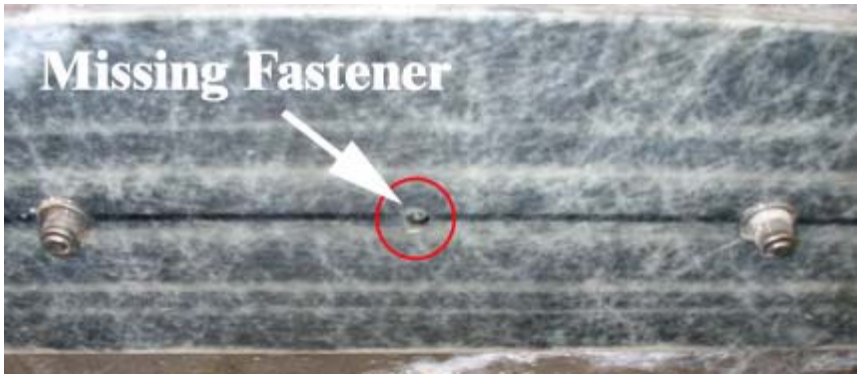


End Anchor Bolts

12” strip spacing

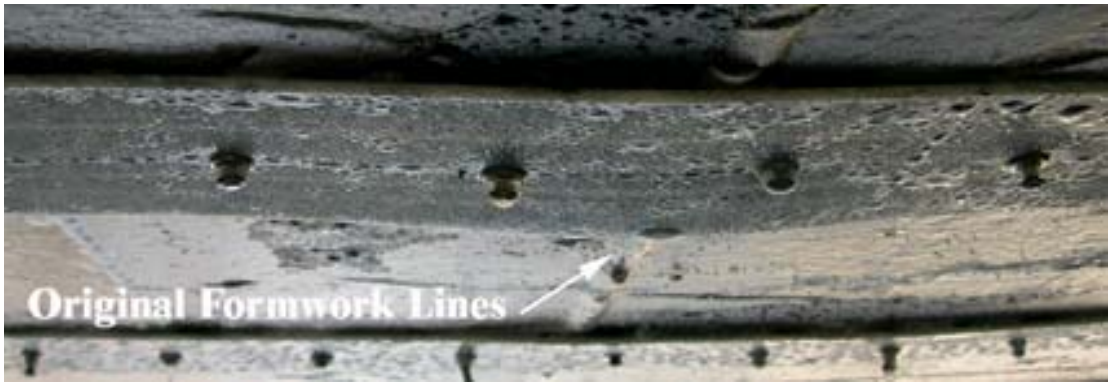
Strengthened bridge

Installation Observations



Due to deterioration
or poor consolidation

Over driven fastener



Out of plane variations

Installation Observations

Strips relocated a few inches to avoid major damage

Service Load Test

- 25.4 Tons
- Strains very small

(Strains reduced in some cases up to 88%)

- Strips left in place 1 year
- Service load test repeated
- Bridge tested to failure

Cost

Total Cost (Materials + Labor) = $7,995.00

Unit Cost = $ 12.72 / ft^2

(Existing Epoxy Bonded Systems cost well over $25/$ft^2$)

DOT Workers had no prior training

Conclusions

1. Economical
2. Strips successfully attached to deteriorated concrete
3. Design calculations show increase from HS17 to HS25
4. Both stainless steel & galvanized fasteners install well
5. Service testing inconclusive

Questions?