

U.S. Grant Bridge Replacement - The Design Approach



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HNTB

Key Functional Requirements

- Roadway: Two 26-ft wide roadways
- Alignment: In-Line, within existing ROW
 - No piers on levees
- Navigational Clearances:
 - 55-ft vertical (above 2% flow line)
 - 850-ft horizontal
 - No hidden obstructions within 12-ft depth (485-ft to 532-ft MSL = 47-ft Range)

**ODOT
Project
Goals**

Key Project Priorities

- Cost Efficiency
 - Independent design alternatives,
 - Competitive bidding
- High Durability & Maintainability
- Public Acceptance
 - Aesthetic quality
 - Preservation of artifacts

**ODOT
Project
Goals**

Bridge Layout



- Overall Bridge Length 2155-ft
- Minimization of Bearings & Joints
 - Longitudinal edge girders fixed directly to towers
 - Single bearing location
 - Single expansion joint

Major Design Loads

- DL + LL (4-HS25 Lanes)
- Design Wind Velocities
 - Structural : 72 mph (100-yr return)
 - Stability : 100 mph (10,000 return)
 - Vortex Shedding & Cable Vibrations
- Temperature Rise / Fall

**Major
Design
Loads**

Major Design Loads



Vessel Impact

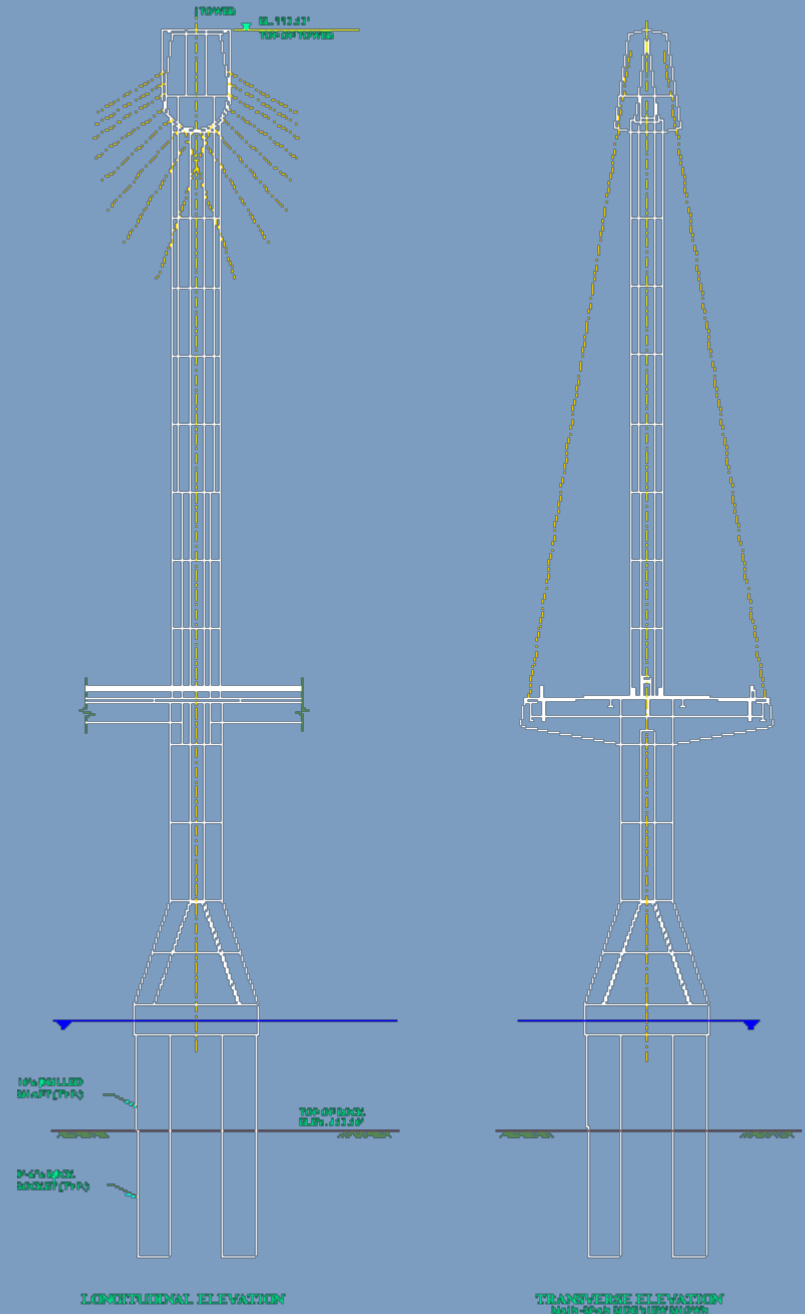
- 6400-kips
- Up to 50-ft above normal pool

- Compact Foundations

- 36' x 36'
- 4 x 10-ft drilled shafts

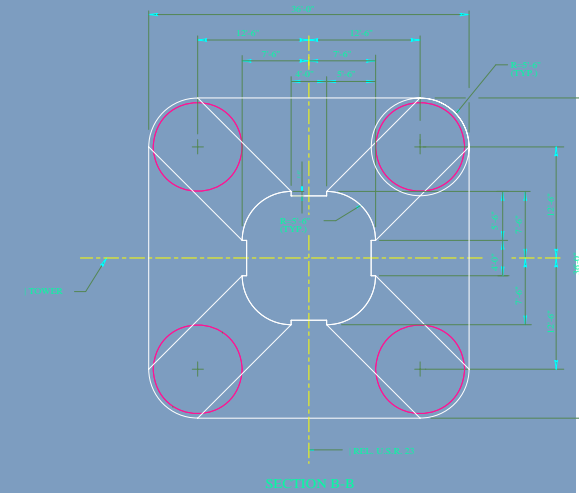
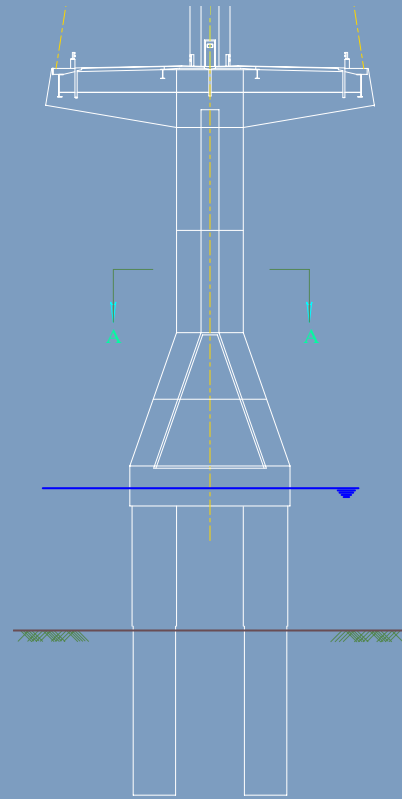
- Slender Tower Stem

- Compact Cable Anchorage
 - Eliminates P/T in Tower Walls



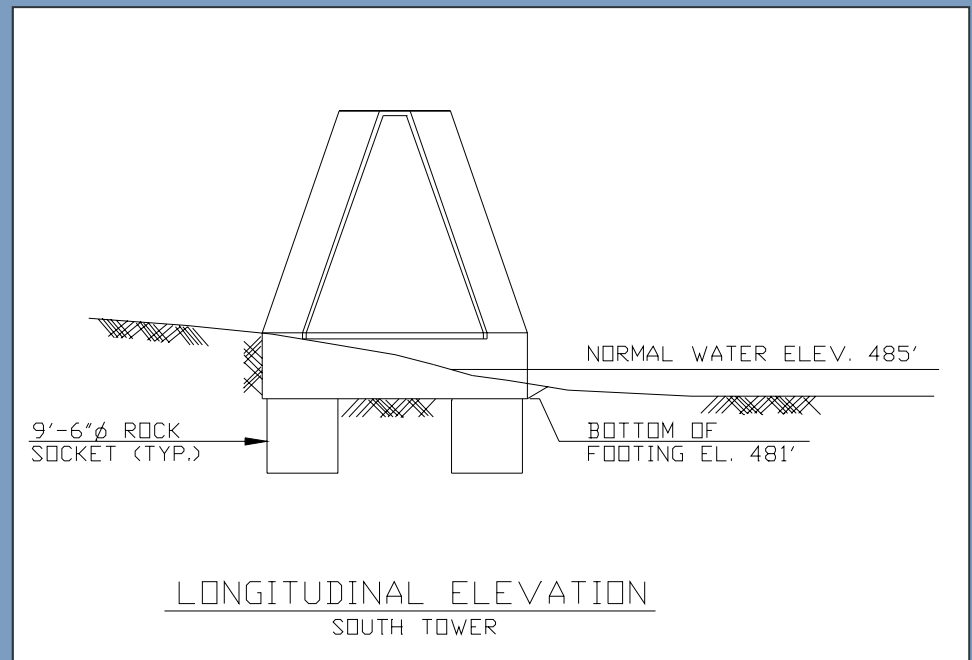
Tower & Foundation Design

Tower & Foundation Design



- Compact Form Water-Line Footing
 - Does not require deep cofferdams
 - No hidden obstructions
 - Drilled shafts socketed 40-ft into rock (Ohio)

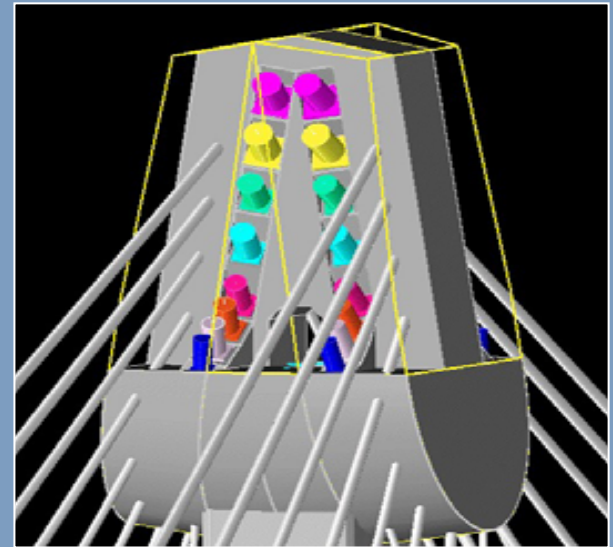
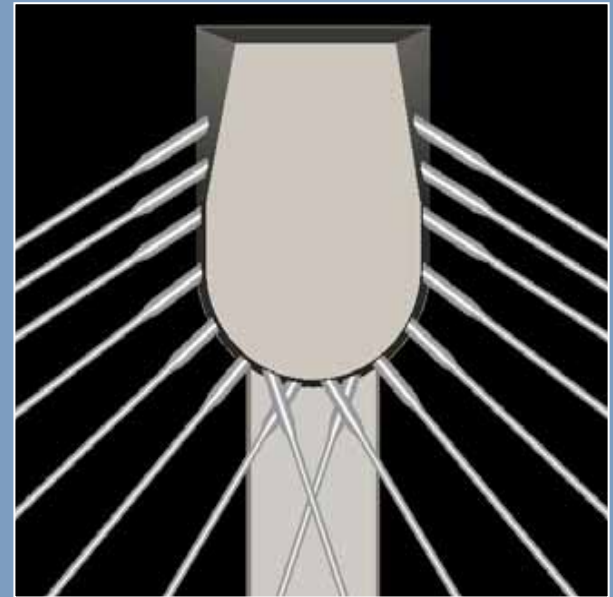
Tower & Foundation Design



- Kentucky Tower Foundation
 - Hybrid design exploits higher rock profile

Tower Cable Anchorage

- Higher Cable Efficiency
- Improved Constructability
- Improved Accessibility & Inspectability

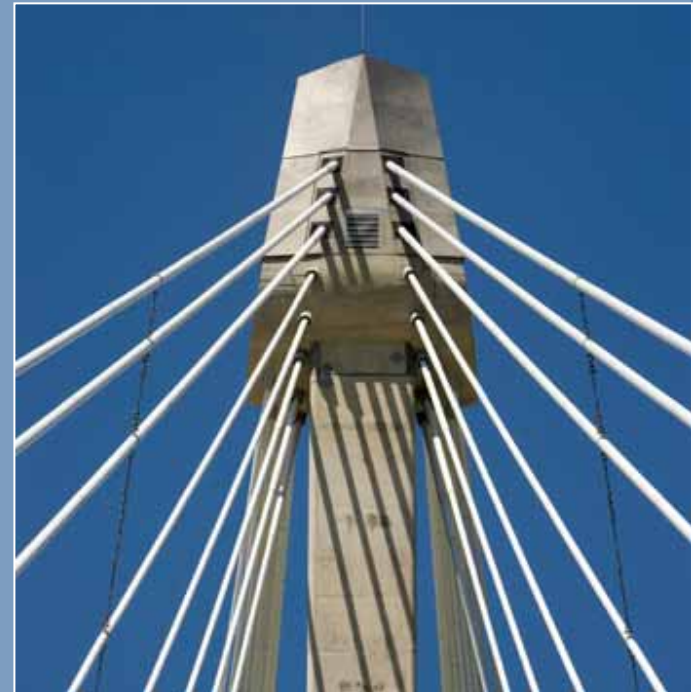


**Tower &
Foundation
Design**

Steel Weldment

- Precise Cable Geometry Control
- Improved Schedule

**Tower &
Foundation
Design**



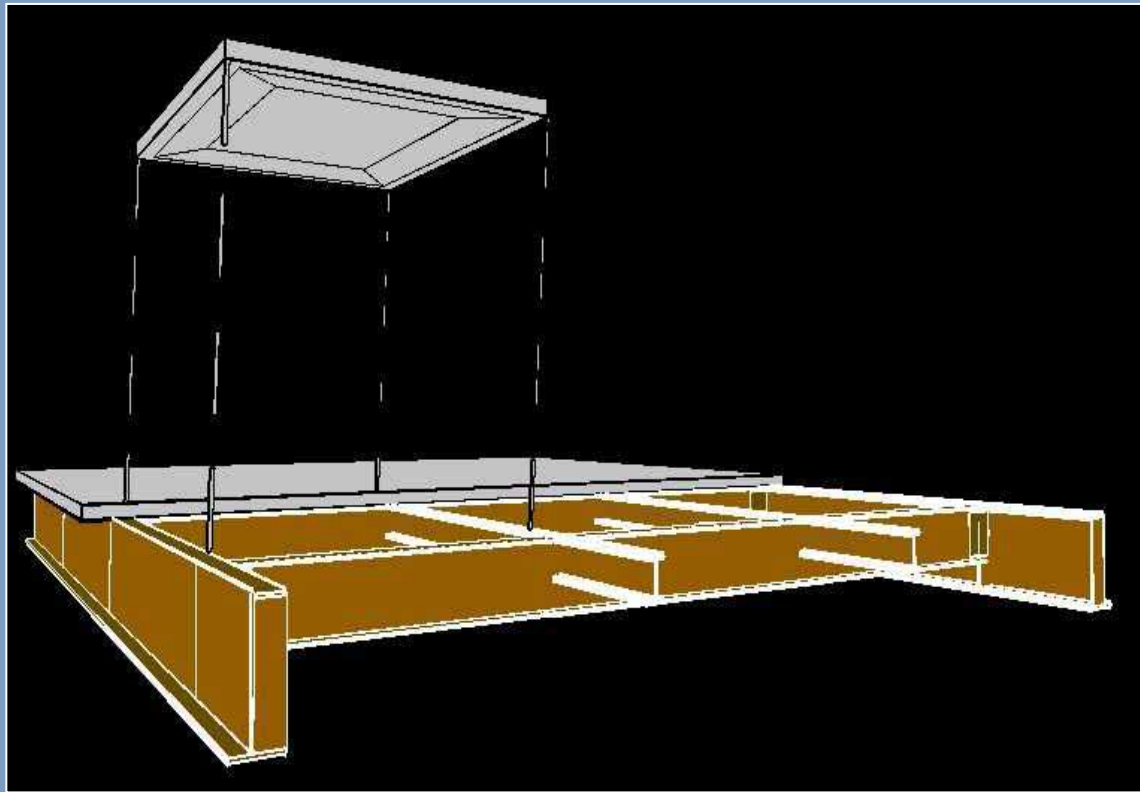
Precise Cable Geometry Control

- Tower cable anchorage weldment

Tower & Foundation Design



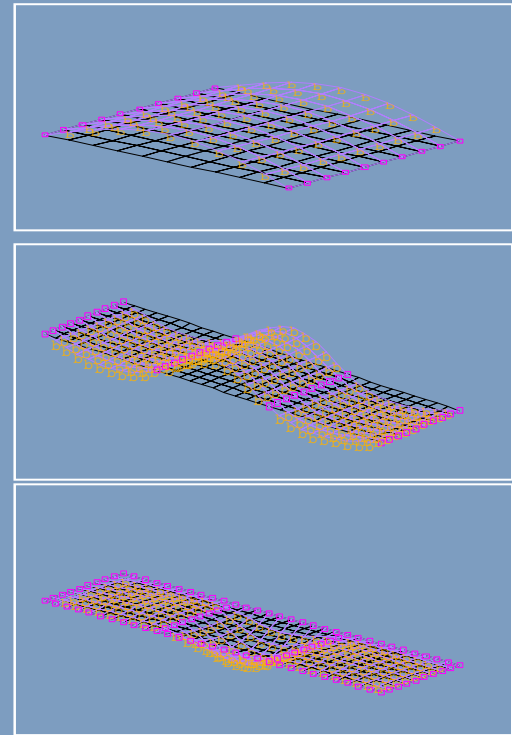
Deck System Design



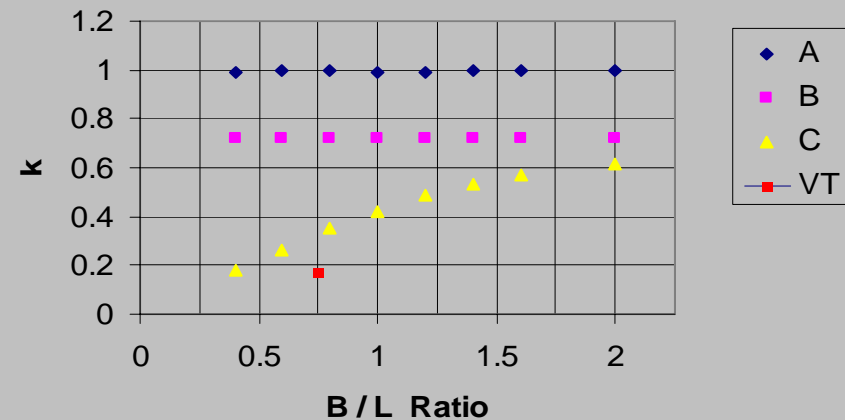
- 25-ft F/B Spacing
 - 1/3 Less construction cycles
 - Reduced steel usage
- Two-way acting variable-thickness slab design

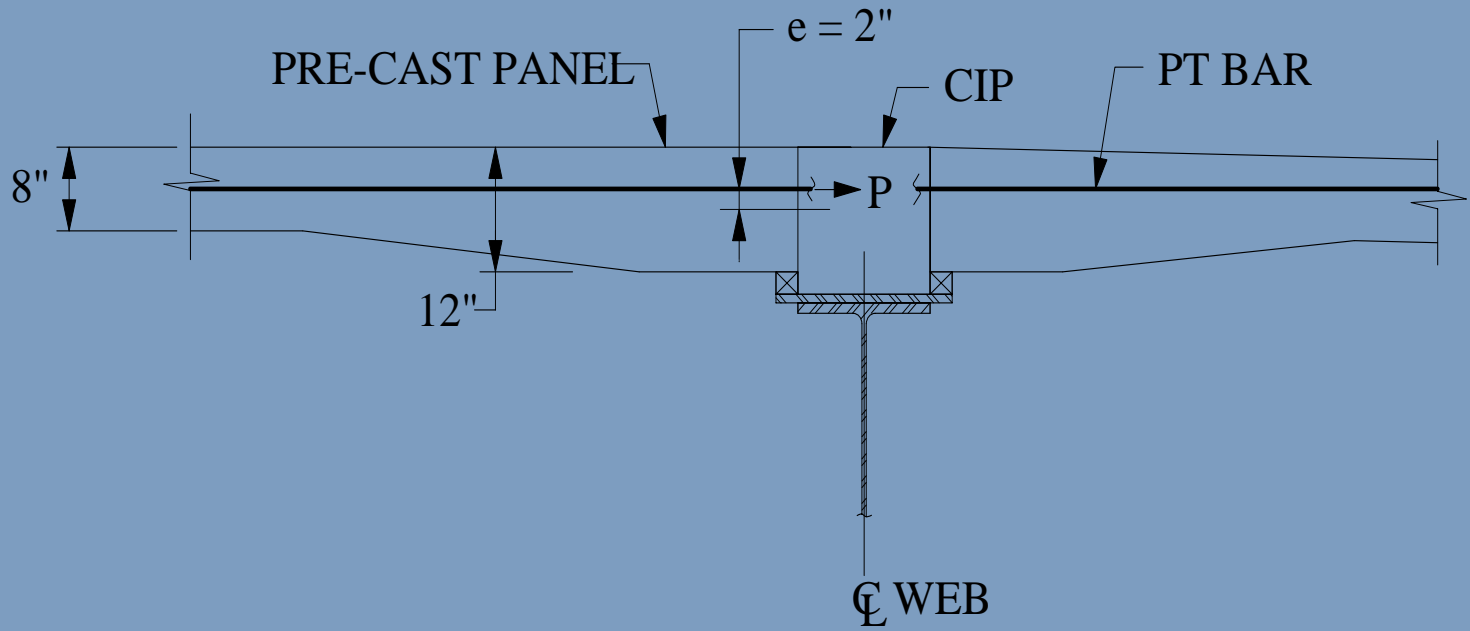
Two-Way Slab Design Improves

- Stability
- Structural Efficiency
 - Reduced BM
 - Reduced P/T
- Serviceability



Effective Span Parameter for Deck Slabs in Compression





- Variable Thickness Slab
 - Minimum weight design
 - Reduced tensile stresses due to LL
 - Higher serviceability standards
 (Top of slab concrete in compression under LL)

Deck System Design

Summary

Improved Maintainability

- Minimization of joints & bearings
- Met tighter slab tensile stress control
- Improved accessibility to tower cable anchorages

Improved Constructability

- Compact water-line foundations
- Simplified tower design
- Reduced superstructure constriction cycles

Improved Design Efficiency

- 10% Lighter superstructure
- 20% Less structural steel
- 40% Less longitudinal deck P/T

Summary



Summary



U. S. Grant Cable-Stayed Bridge