Stay Cable Replacement for the Luling Bridge

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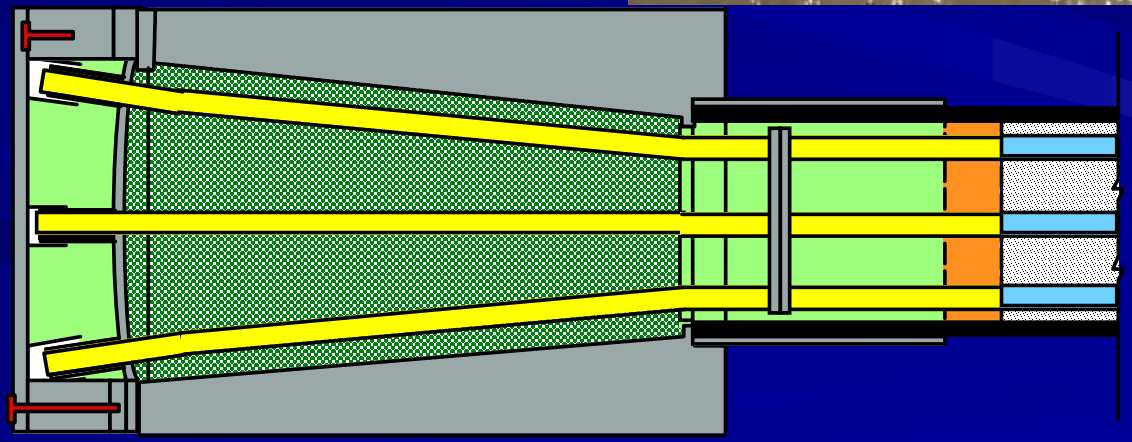
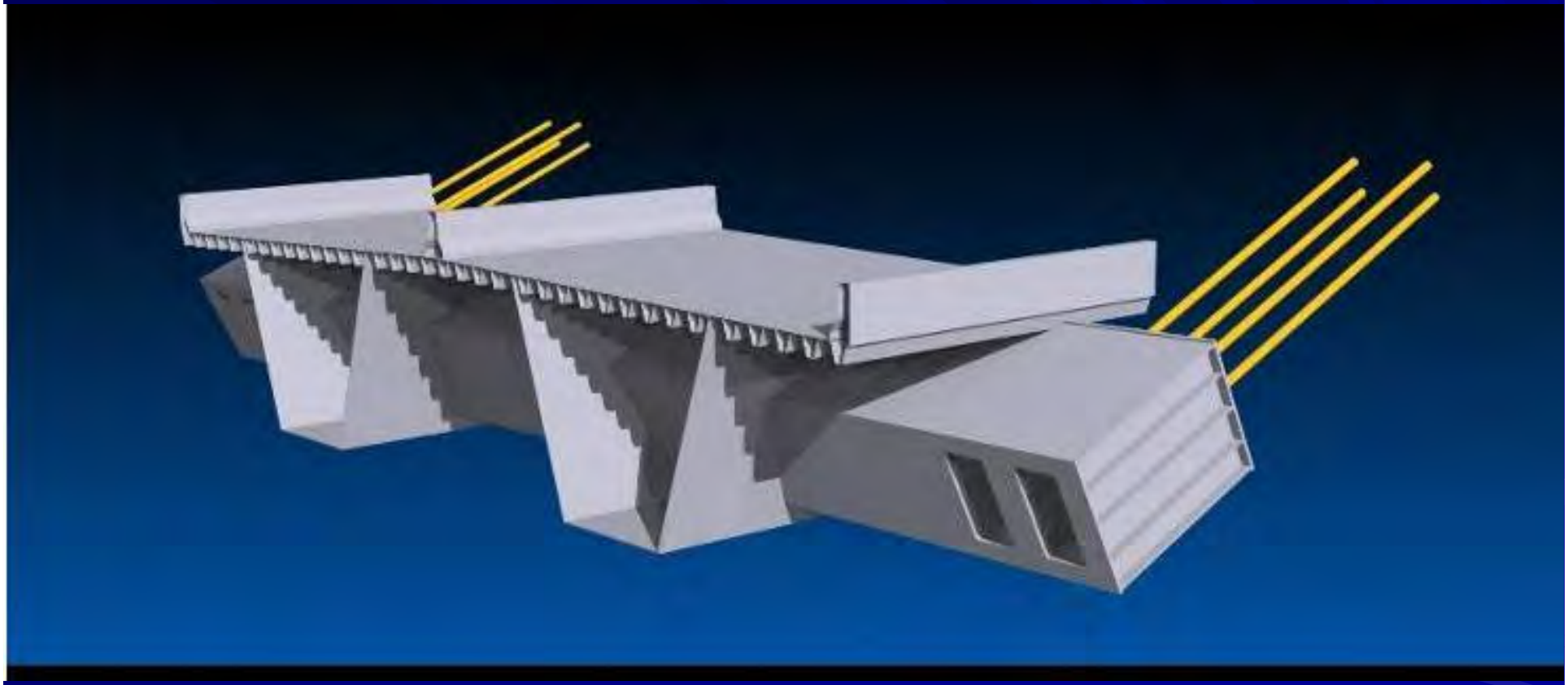
Stay Cables



Deck and Cross Girder



Lower Anchorage

Upper Anchorage

Statement of Problem

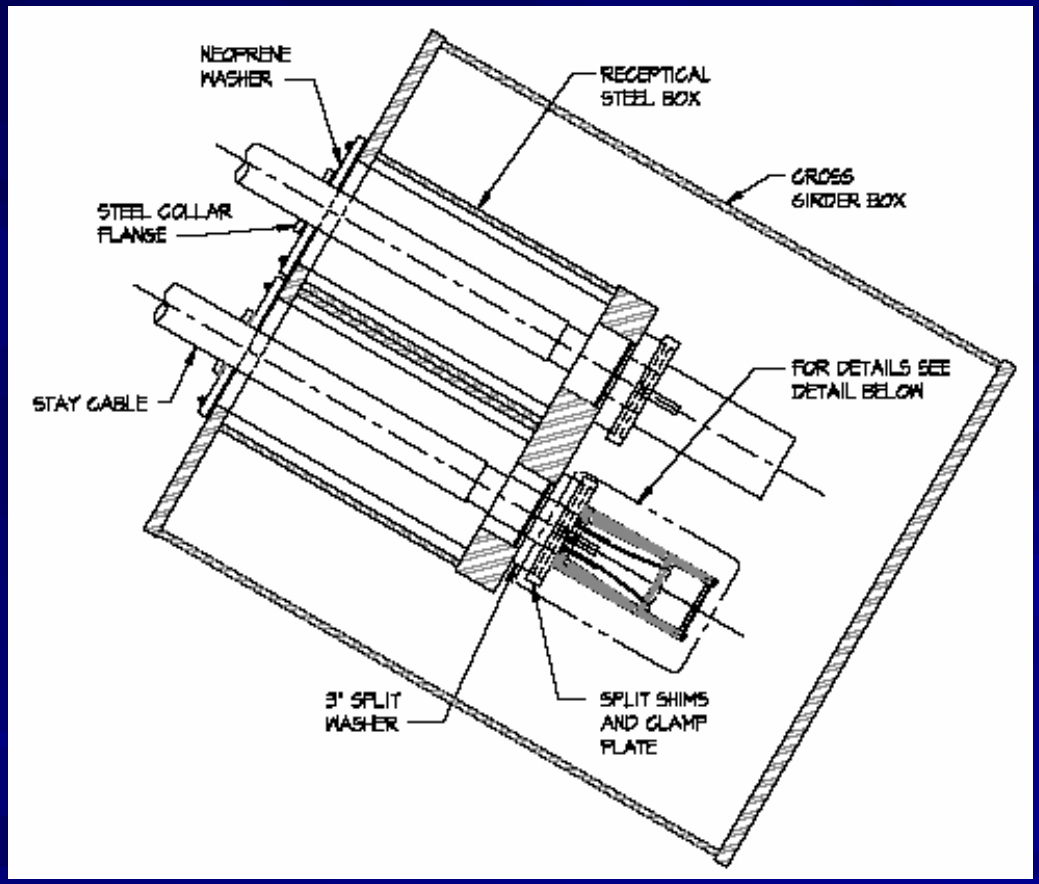
- Rusting and water leakage in anchorages
- Cracking/splitting of cable cover pipes
- Signs of compromise in cables safety
- In 2002, LADOTD initiated a project for Structural Evaluation of the Stay Cables

Three Phases of Investigation

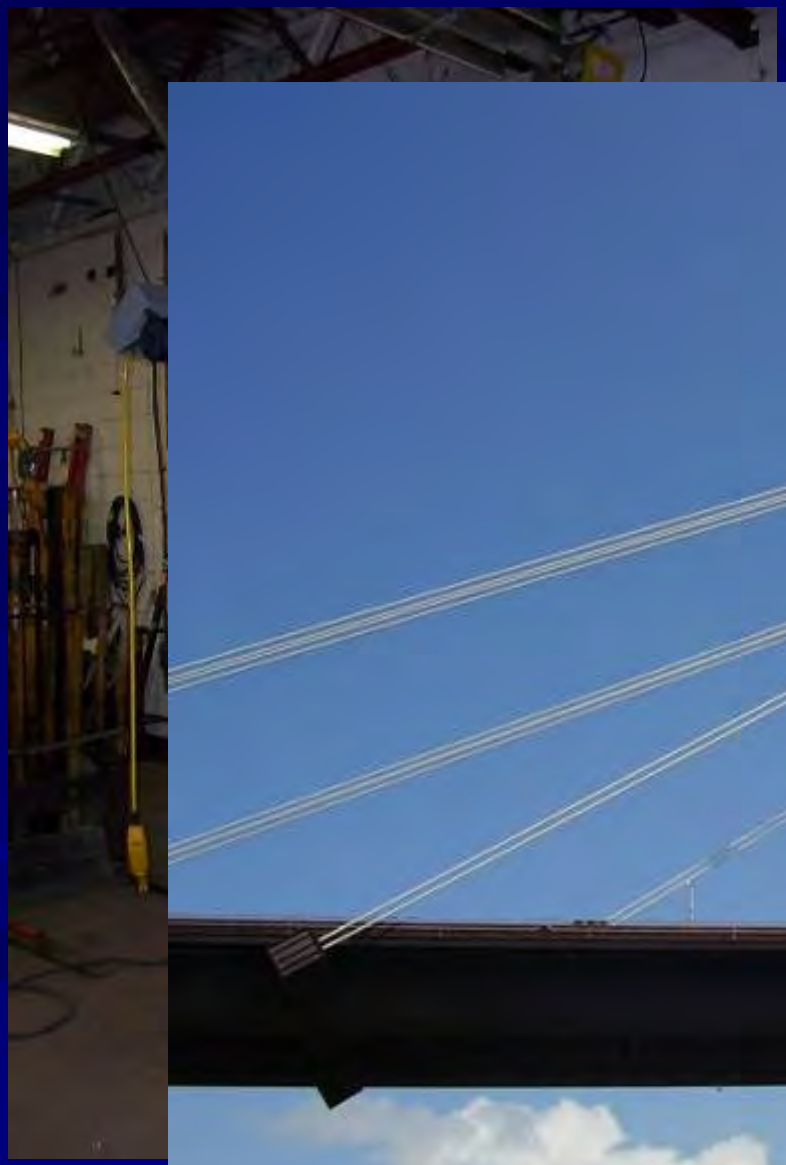
- Phase I: Assessing extent of problems and the overall integrity check
- Phase II: Hands-on inspection of the suspect locations and critical elements
- Phase III: Detailed design of repairs

Phase II- Inspection

Source of Problem



Cable Free Length Inspection



Cable Free Length Inspection

Hands-on inspection

Tap Testing

Thermography

Inspection findings
Damage Severity Levels

Severity Level	Status	Description
1	Satisfactory	Minor deterioration and anomalies noted
2	Poor	Deterioration of the protective elements and potential for degradation. Cables with this level of damages need to be routinely monitored and corrective action needs to be planned.
3	Critical	Deterioration or potential for deterioration of the main tension elements (steel wires) exists. Action (repair) is necessary. Cables with this level of damages shall be closely monitored until repairs are applied.

Severity Level 3, Damage Examples

Summary

- 40 out of 72 cables are rated critical
- All cables have at least damage Level 2
- Damage causes still present
- Increasing rate of deterioration is evident
- Timely corrective action was needed

Decision Making
Life Cycle Cost Analysis

- Define planning horizon
- Define repair strategies
- Estimate costs for strategies
- Calculate present values
- Select preferred strategy

Repair/Replacement Strategies

- Base Case
- Repair all
- Repair-Replace 1
- Repair-Replace 2
- Replace all

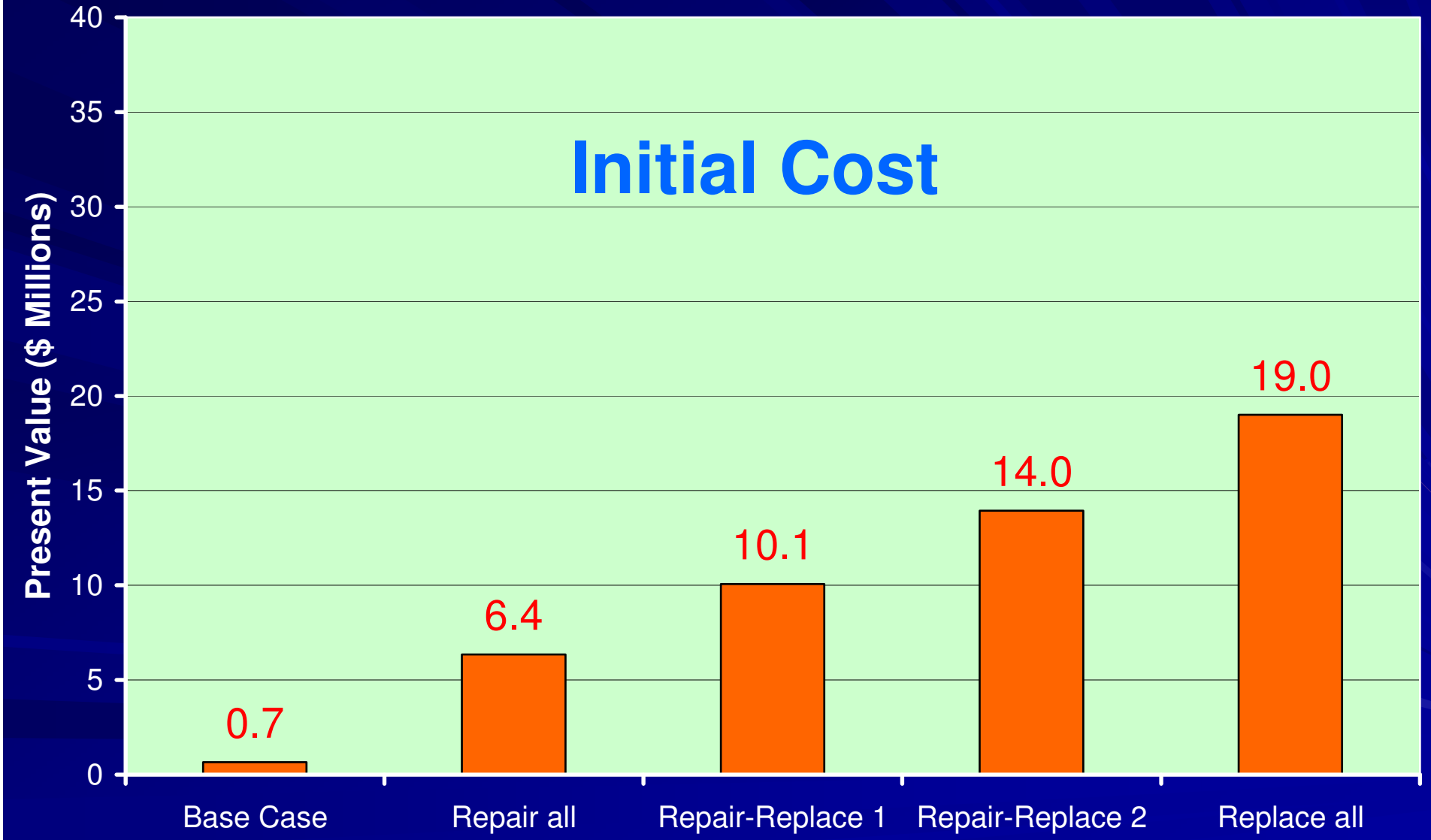
Cost Structure

- Initial Costs
- Distributed Annual Costs
- Periodic Repair Costs
- Vulnerability Costs

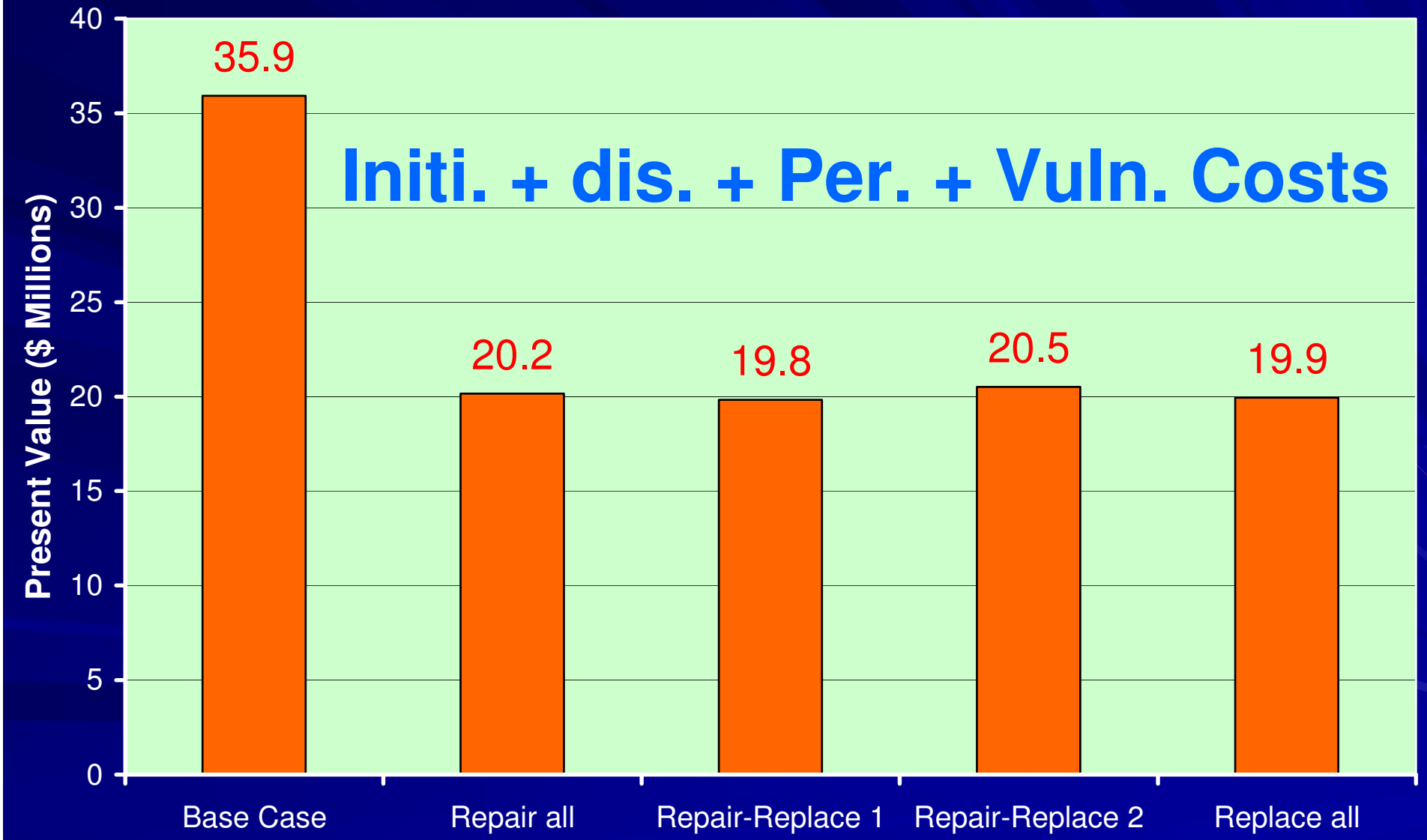
Each cost element includes:

- Agency Costs
- Users' Costs

Comparison among Cost of Various Strategies



Comparison among Cost of Various Strategies



Phase III

Cable Replacement Design

Cable Replacement Design Team

Client: Louisiana Department of Transportation and Development (LADOTD), Paul Fossier, Project Manager

Project Manager: Armin Mehrabi, Bridge Engineering Solutions

Prime Consultant: CTLGroup

Cable replacement design: International Bridge Technologies, Inc.

Deck repair design: TranSystems

MOT, Survey & Plans: ABMB Engineers, Inc.

Cable Replacement Design

Objectives:

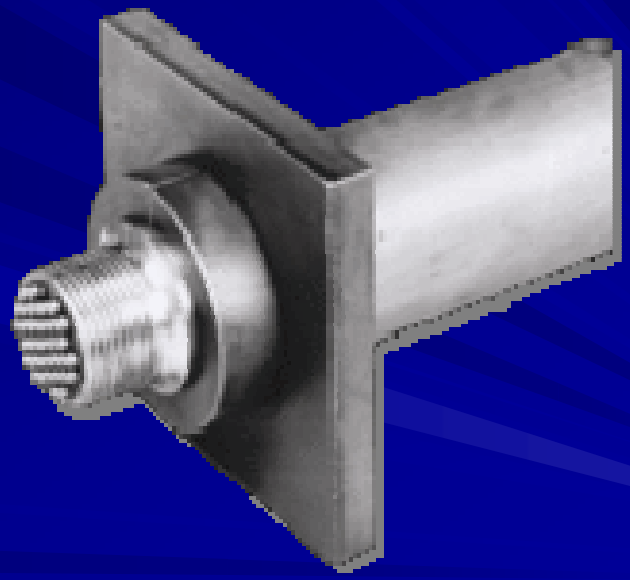
- Develop a cost effective design that requires minimal engineering by contractors.
- Minimize impact on traffic.
- Analyze for live load, wind force, and construction load effects.

Replacement Cable Design

- Cable systems considered

Parallel strand system

Parallel wire system



Replacement cable design

- Parallel strand, preferred system
- Availability in the US
- Used in most new bridge constructions
- Ease of inspection and replacement
- Corrosion protection system
- Strand-by-strand installation

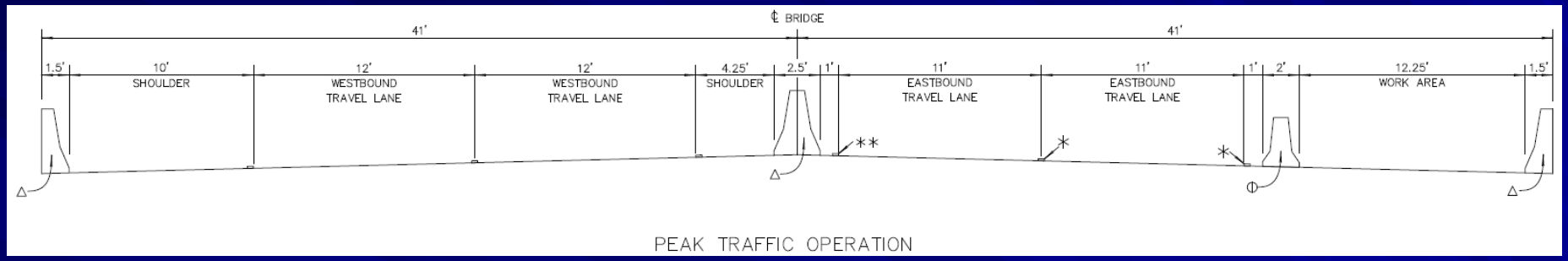
- No major failures documented in bridges using this system

Replacement cable design

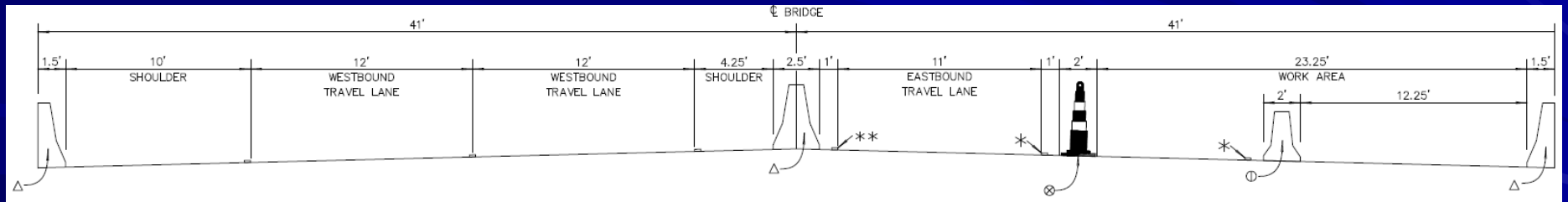
Parallel strand, preferred system

- Larger anchorages
  - Require modifications of existing structure
  - Increase wind load
  - Change aerodynamic characteristics
- New Cables; 24,45,57,68 strand
- Additional 24 reference strand

Maintenance of Traffic



PEAK TRAFFIC OPERATION



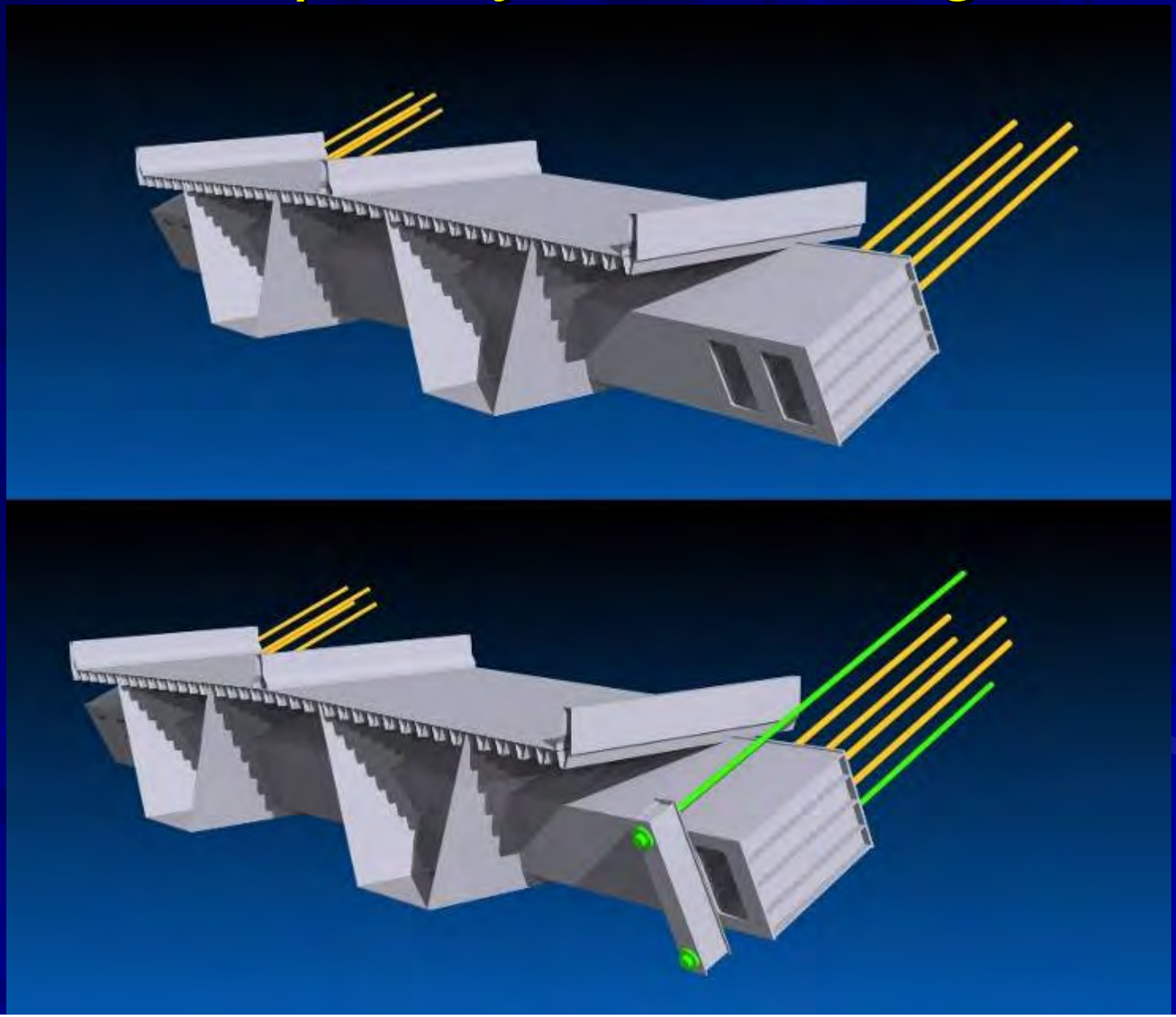
NON-PEAK TRAFFIC OPERATION

Temporary cable design

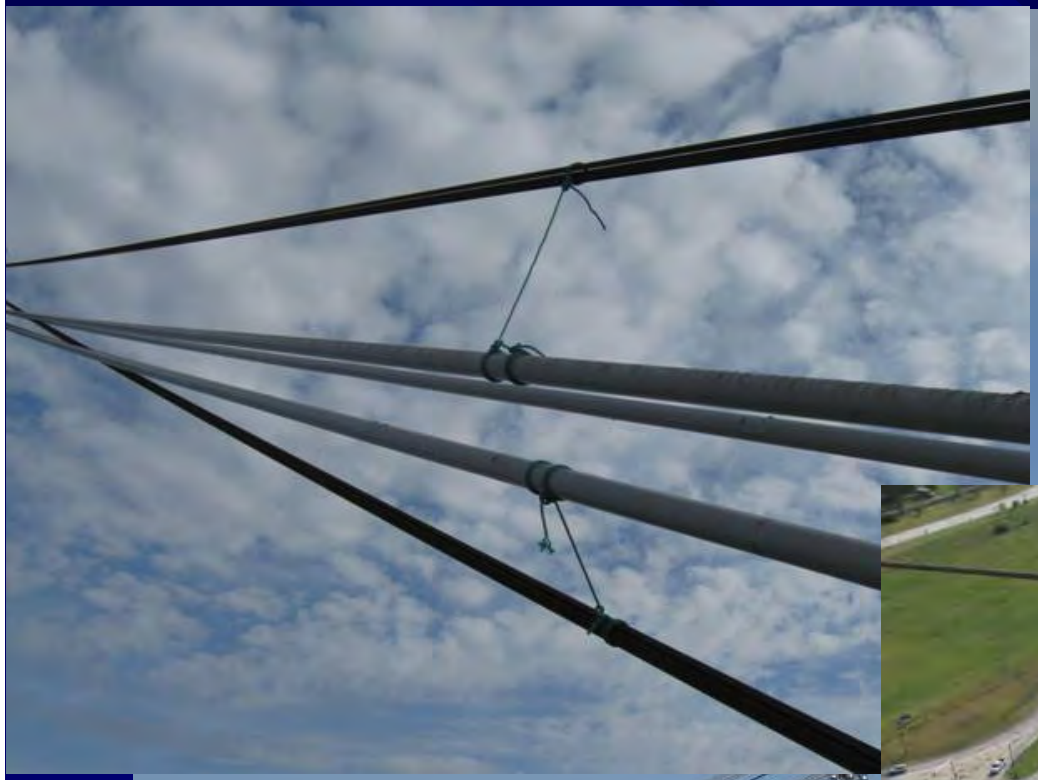
Need for Temporary cables

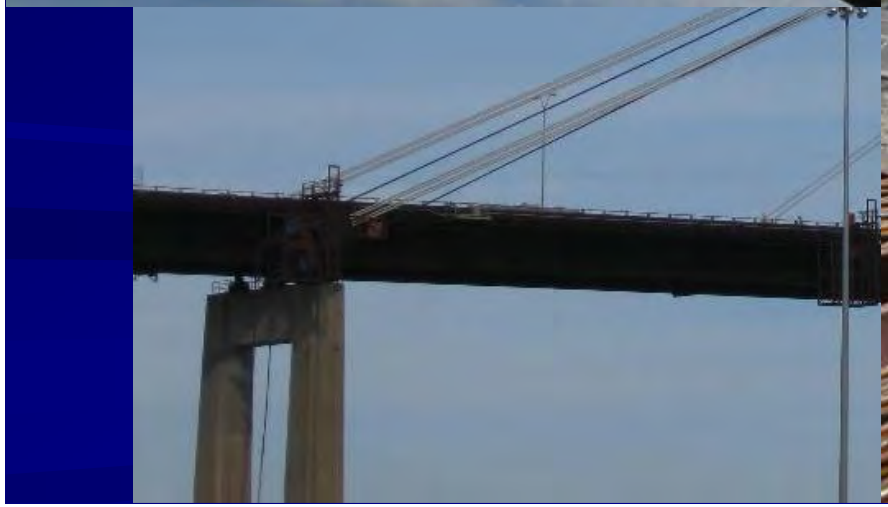
- Uncertainty in cable condition
- Large cable group spacing
- Need to maintain traffic w/o load limits

Temporary cable design



Temporary Cables





Construction Sequence

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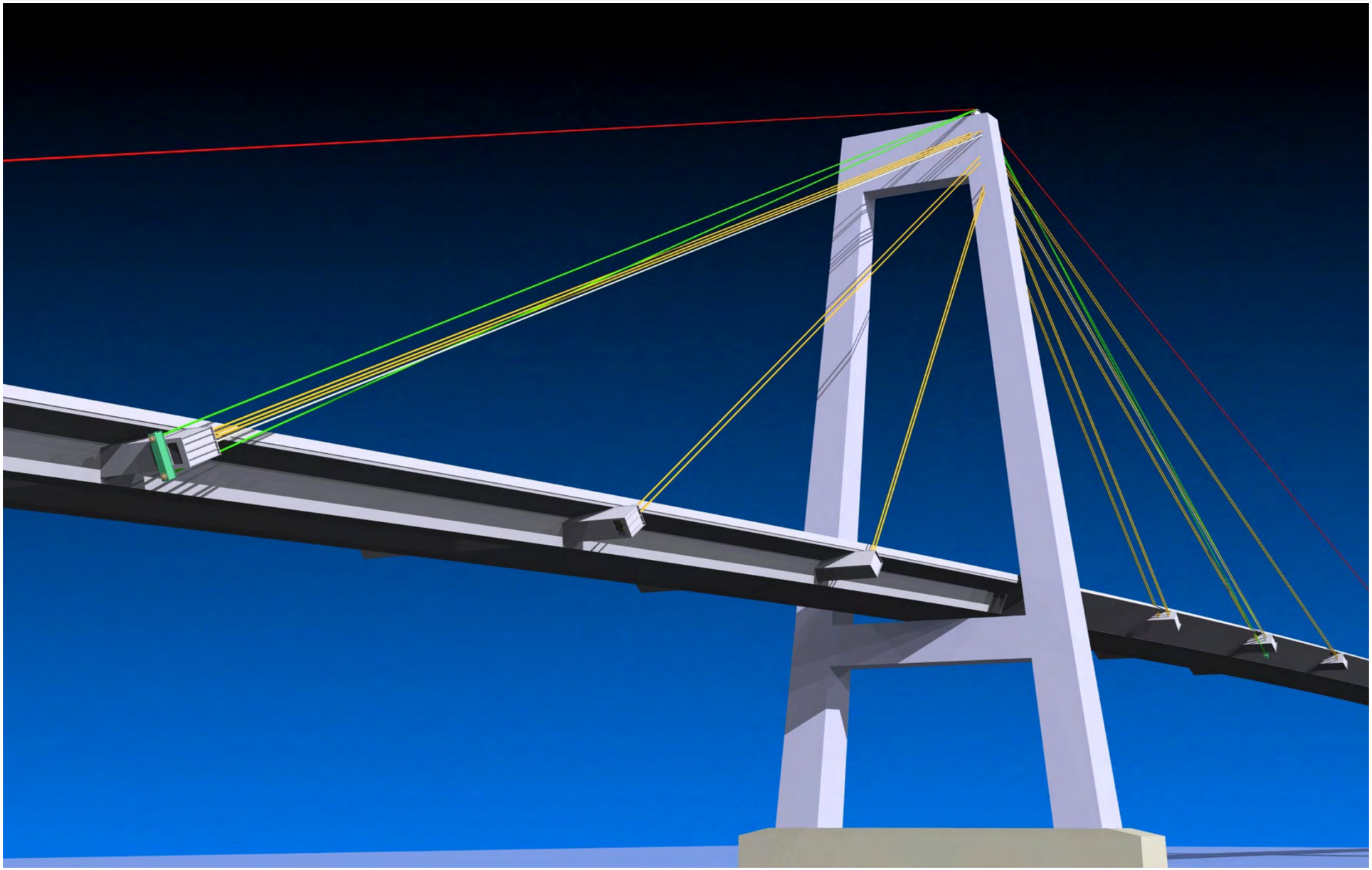
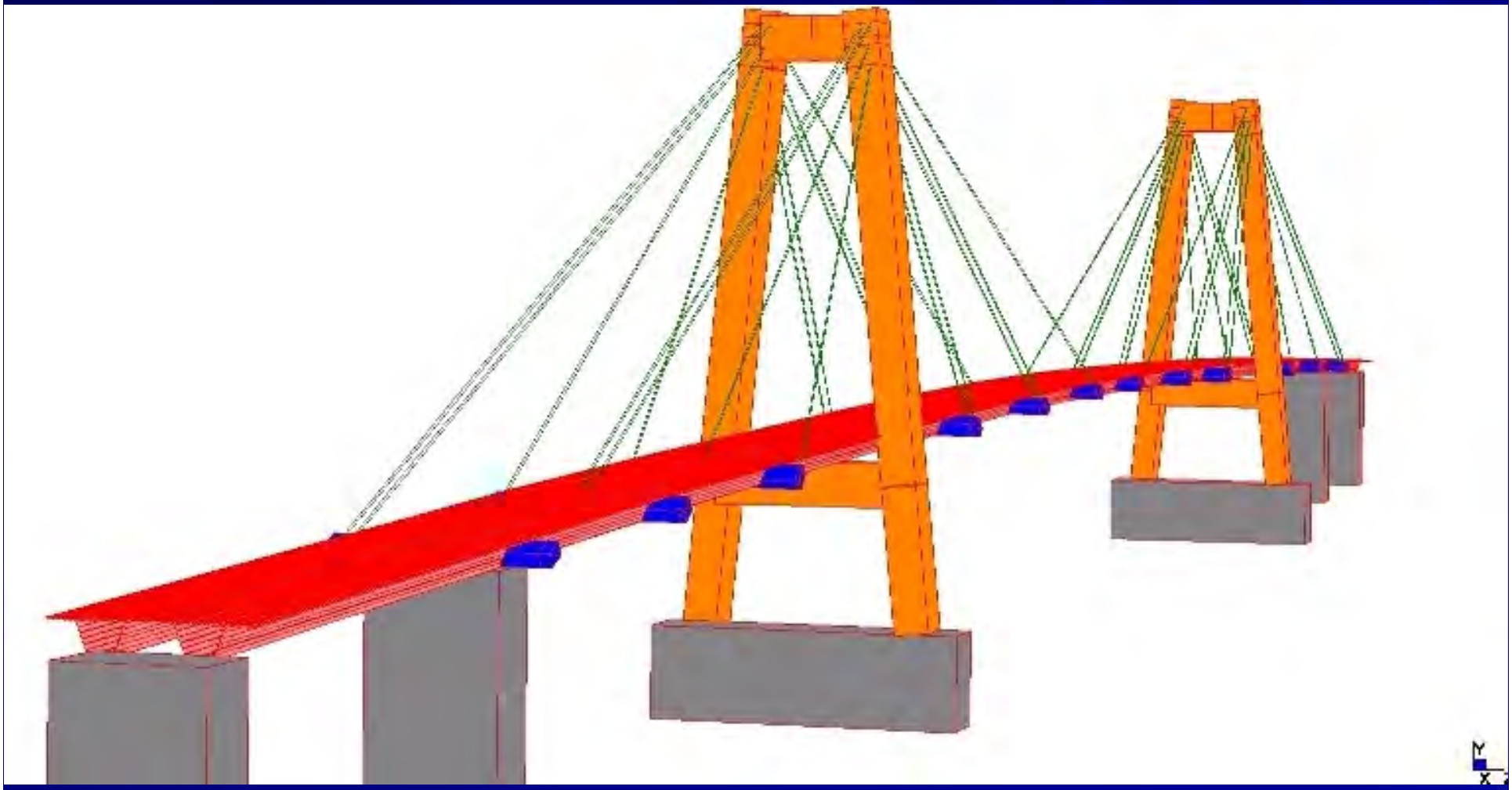


Construction Sequence

Modeling and Structural Analysis



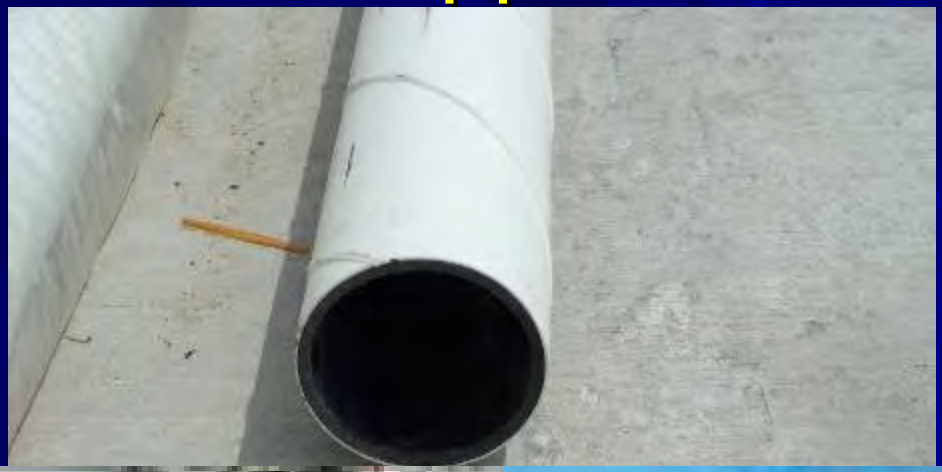
Finite Element Analysis

- Analyze each stage of construction
- Generate member action envelopes for all load combinations
- Provide geometry control variables
- Determine stressing sequences
- Analyze Live load, wind load and construction load effects

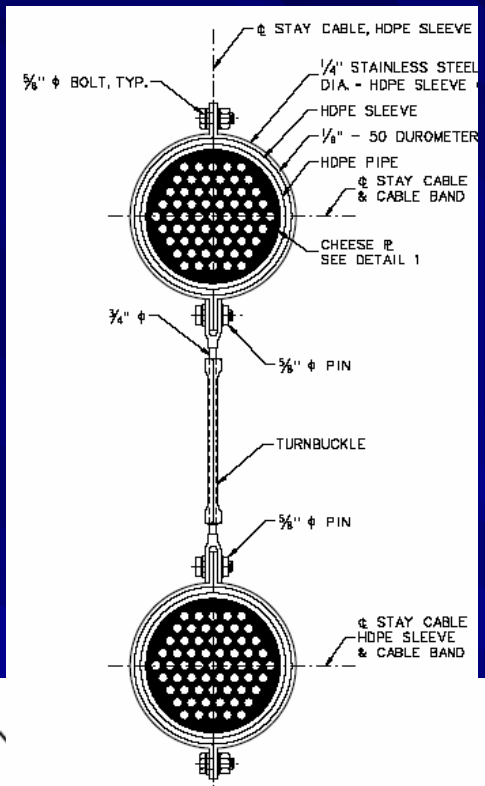
Design for Peripherals

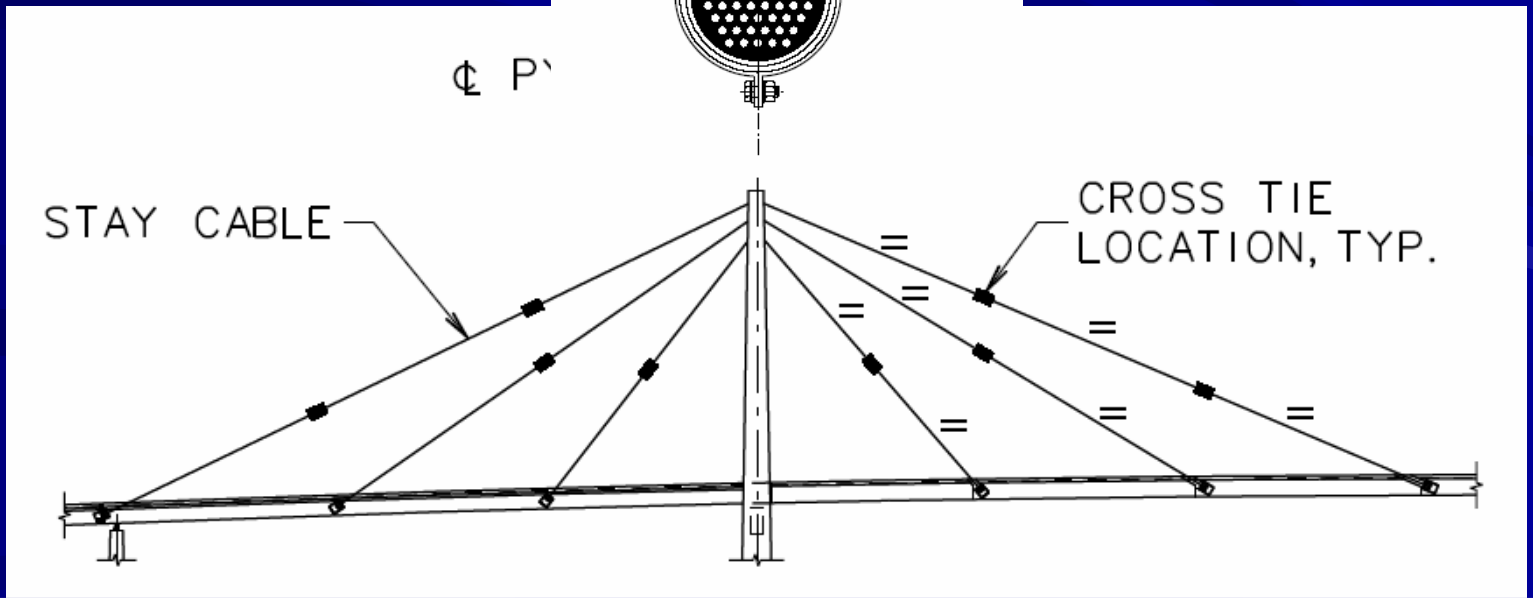
Cable vibration suppression measures

Cable Vibration Suppression Measures



Cable Vibration Suppression Measures





Summary

- Inspection performed 2004-2006
- Cable replacement design 2007-8
- Construction project bid Feb. 25, 2009
- Construction began Fall 2009


Questions?
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