

Structural Evaluation of the Stay Cables of the Luling Bridge

Hossein Ghara

Louisiana Department of Transportation and Development

Armin B. Mehrabi

Construction Technology Laboratories, Inc.

Wind-Induced Vibration of Cable Stay Bridges
2006 Workshop, St. Louis, MO, April 25-27









Lower Anchorage





Upper Anchorage



Statement of Problem

- Rusting and water leakage in the anchorage zones at the deck level was reported
- Splitting of cable cover pipes had occurred during grouting process
- Unplugged grout ports were observed
- These are symptomatic signs of potential compromise in the safety of cables
- In 2002, LADOTD awarded CTLGroup a project for Structural Evaluation of the Stay Cable Array

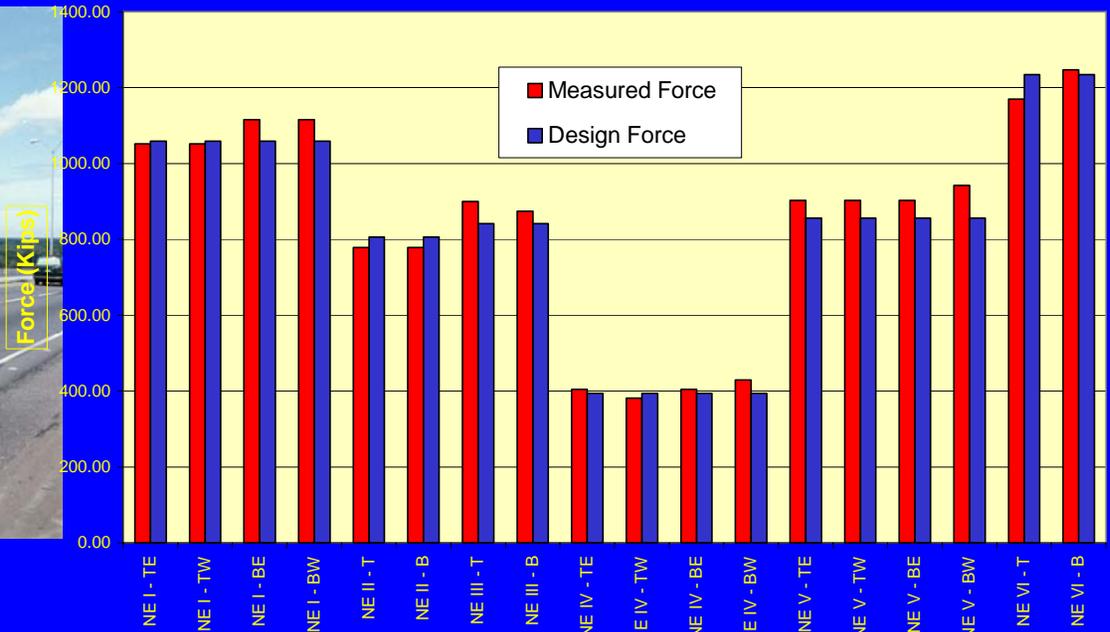
Two Phases of Investigation

- Phase 1: Assessing extent of problems and ascertaining the overall integrity
- Phase 2: Hands-on inspection of the suspect locations and critical elements, and designing repair schemes

Phase 1

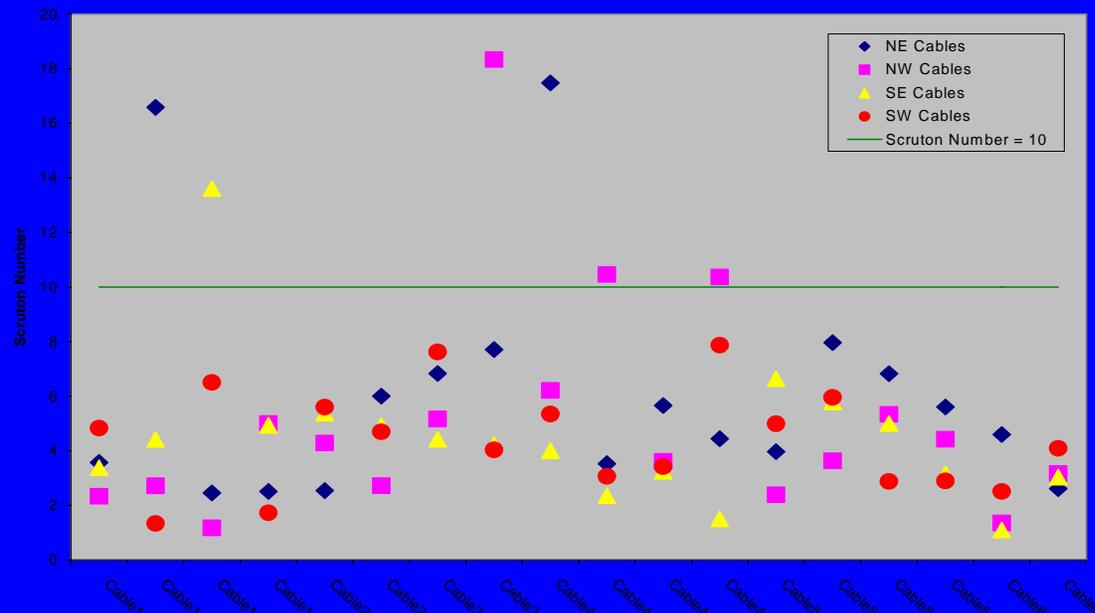
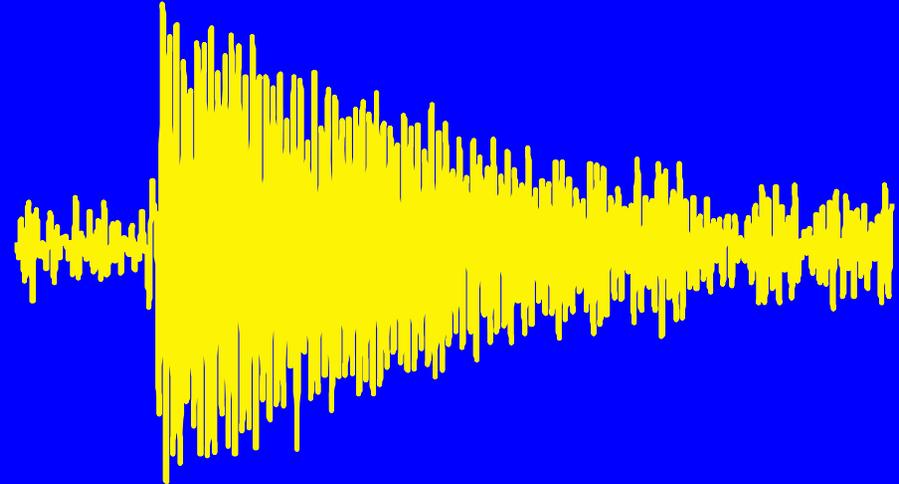
- Review of bridge details and prior investigations
- Cable force measurement and geometry survey
- Cable damping measurement and wind-induced vibration susceptibility
- Representative cable and anchorage inspection and sheathing dissection
- Development of FE analytical model of the superstructure
- Assessment of cable array safety and reliability

Cable Force Measurement



Stay Group		IA	IB	I Avg.	II	III	IV A	IV B	VA	VB	V Avg.	VI
Source	Year	Bottom Outside	Bottom Inside	Bottom	Bottom	Bottom	Bottom Outside	Bottom Inside	Bottom Outside	Bottom Inside	Bottom	Bottom
Tulane	1985	-	-	0.68	0.883	1.4	-	1.367	-	-	0.913	0.647
FHWA	1993	0.677	0.686	0.6815	0.898	1.425	-	1.369	0.927	0.925	0.926	0.648
FHWA	1995	0.675	0.685	0.68	0.884	1.418	-	1.355	0.921	0.918	0.9195	0.646
FHWA	1997	0.676	0.686	0.681	0.885	1.394	-	1.336	-	0.923	0.923	0.649
FHWA	1999	0.683	0.69	0.6865	0.887	1.398	-	1.367	-	0.925	0.925	0.648
FHWA	2001	0.685	0.693	0.689	0.906	1.431	-	1.377	0.936	0.933	0.9345	0.656
CTL	2002	0.6782	0.6857	0.6820	0.8857	1.3900	-	1.3330	0.9238	0.9143	0.9191	0.6571

Cable Damping Measurement



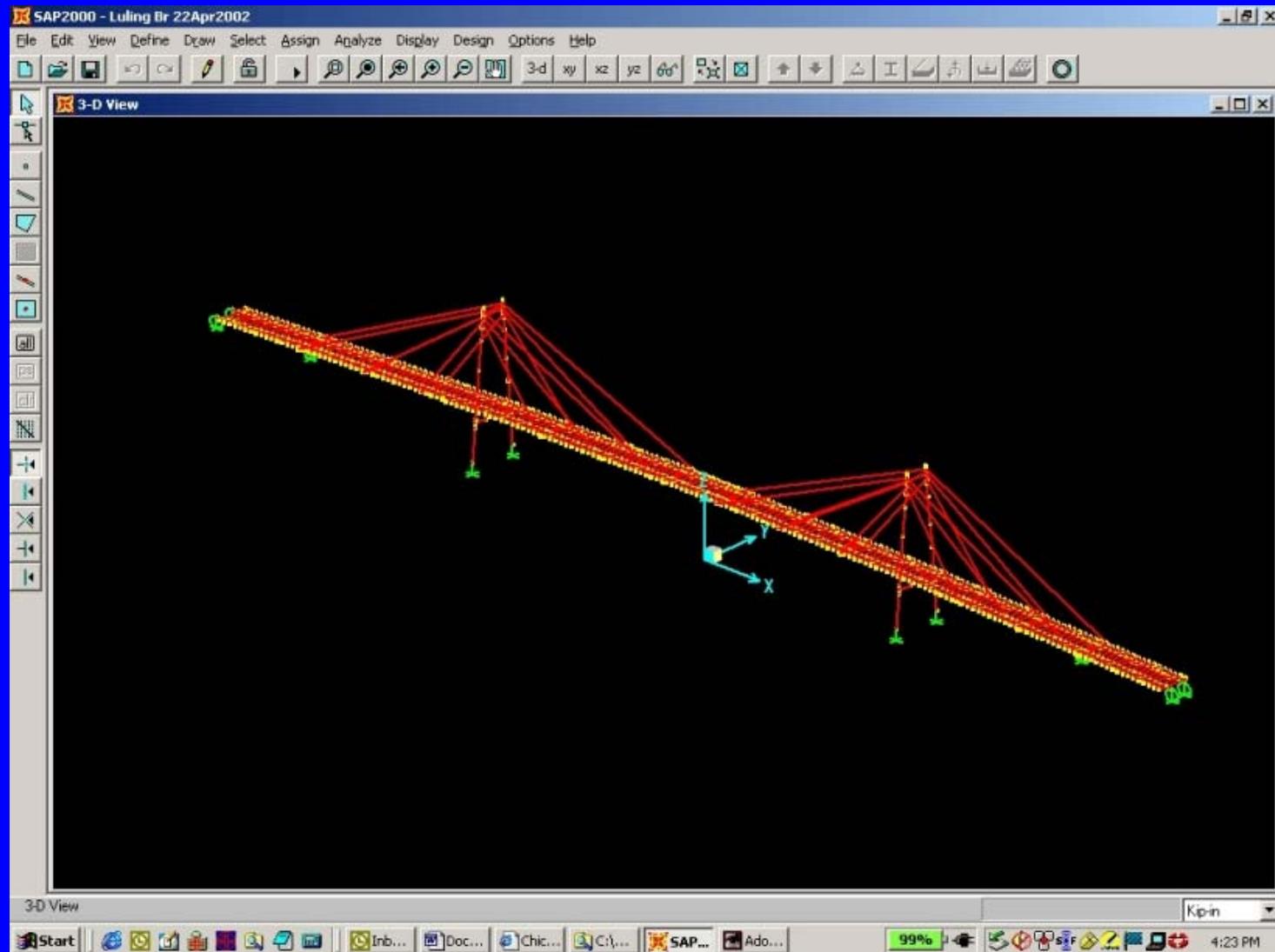
Cable Dissection



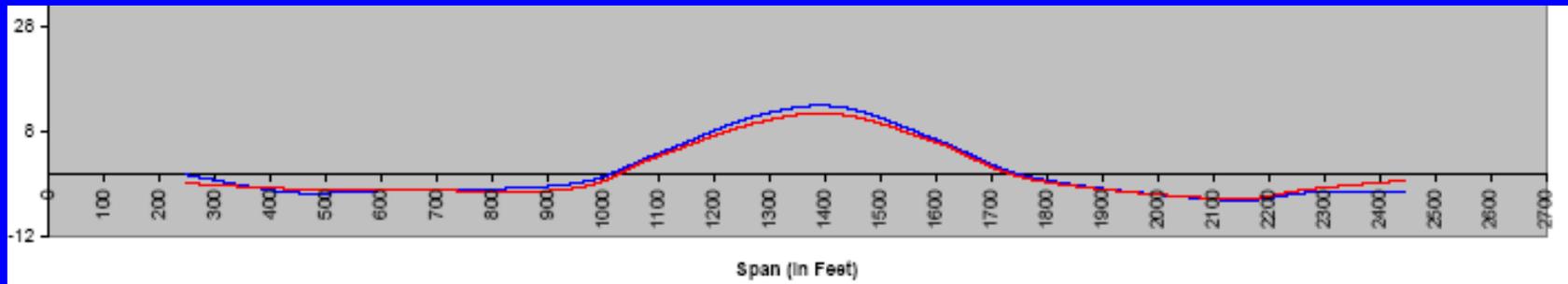
Selective Cable and Anchorage Inspection



Finite Element Modeling

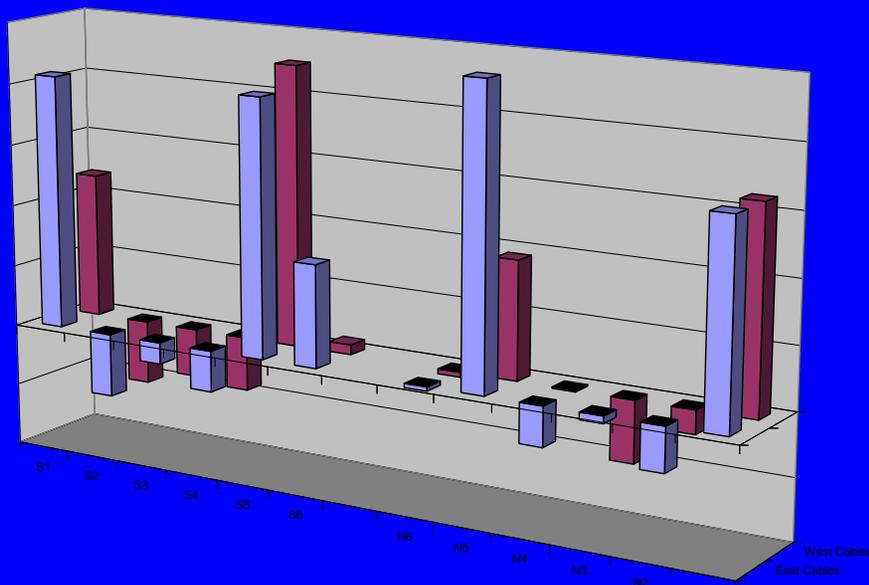


Assessment of Overall Integrity

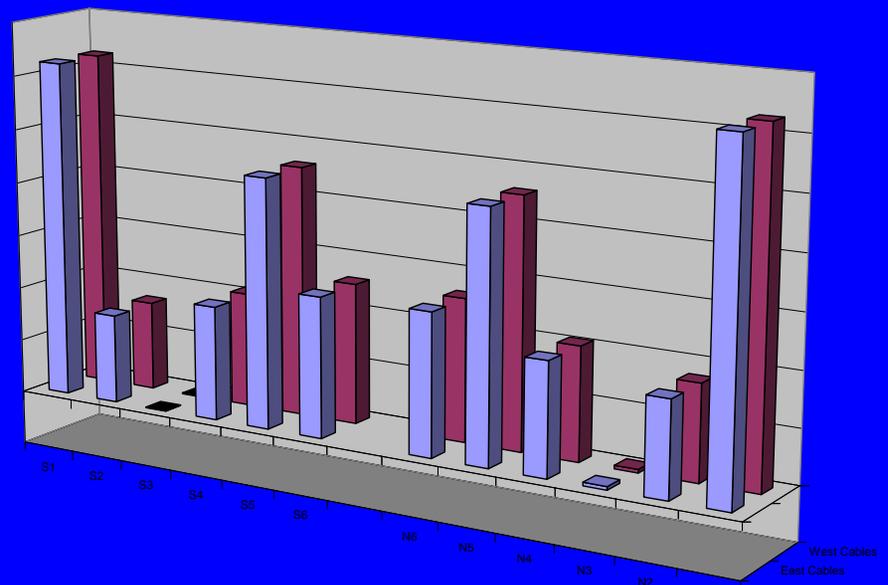


Difference between design and measured profile

Difference between design and measured forces



Force change with additional dead load FE Analysis



Major Observations

- Corrosive Environment in the lower anchorage zones
- Damaged seals- aging and vibration
- Progressive deterioration in PE split and repaired locations
- Potential for progressive PE split
- Potential for excessive cable vibration

Phase 2

- Verification of NDE method(s) for detection of PE cover pipe flaw without removing protective tape
- Inspection of top and bottom anchorages
- Visual inspection of cables within deck anchorage boxes
- Visual inspection of cable free lengths
- Non-destructive evaluation of cable free length
- Design of repairs for damages and mitigation measures
- Design of dampers for suppression of stay cable Vibration
- Implementation of the repair and retrofit

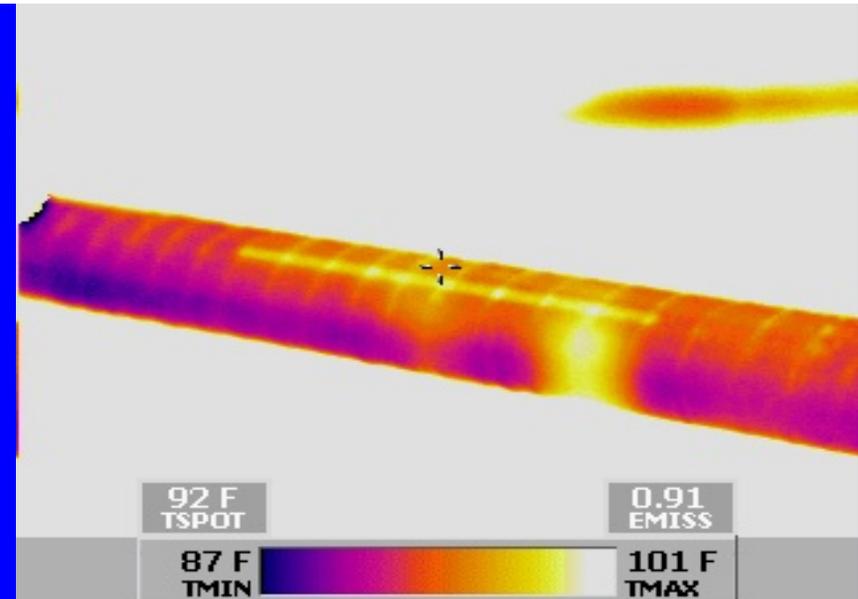
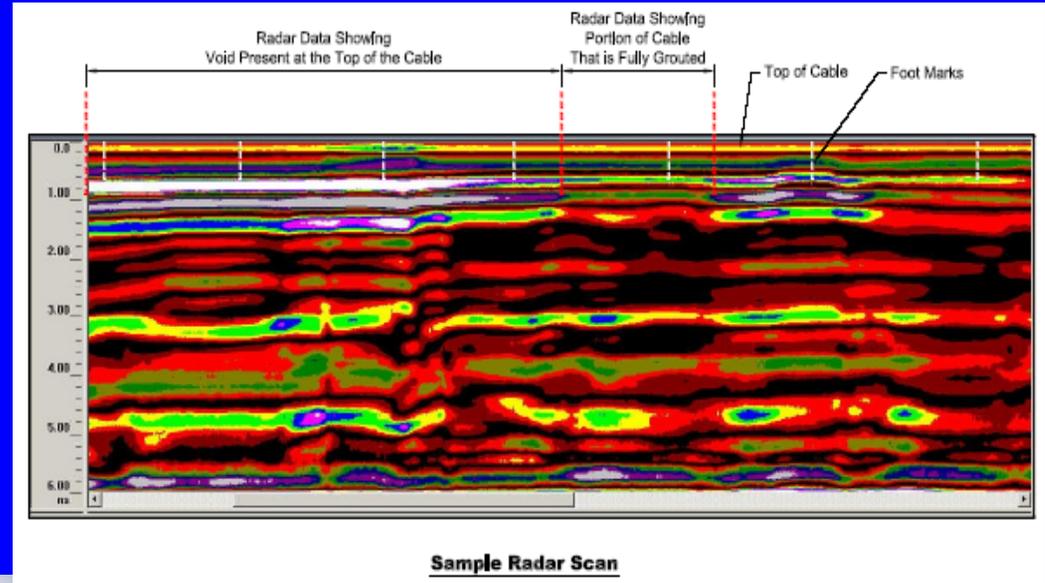
NDE Method for PE Cover – Cable Mock-up



NDE Method for PE Cover

Thermal Imaging

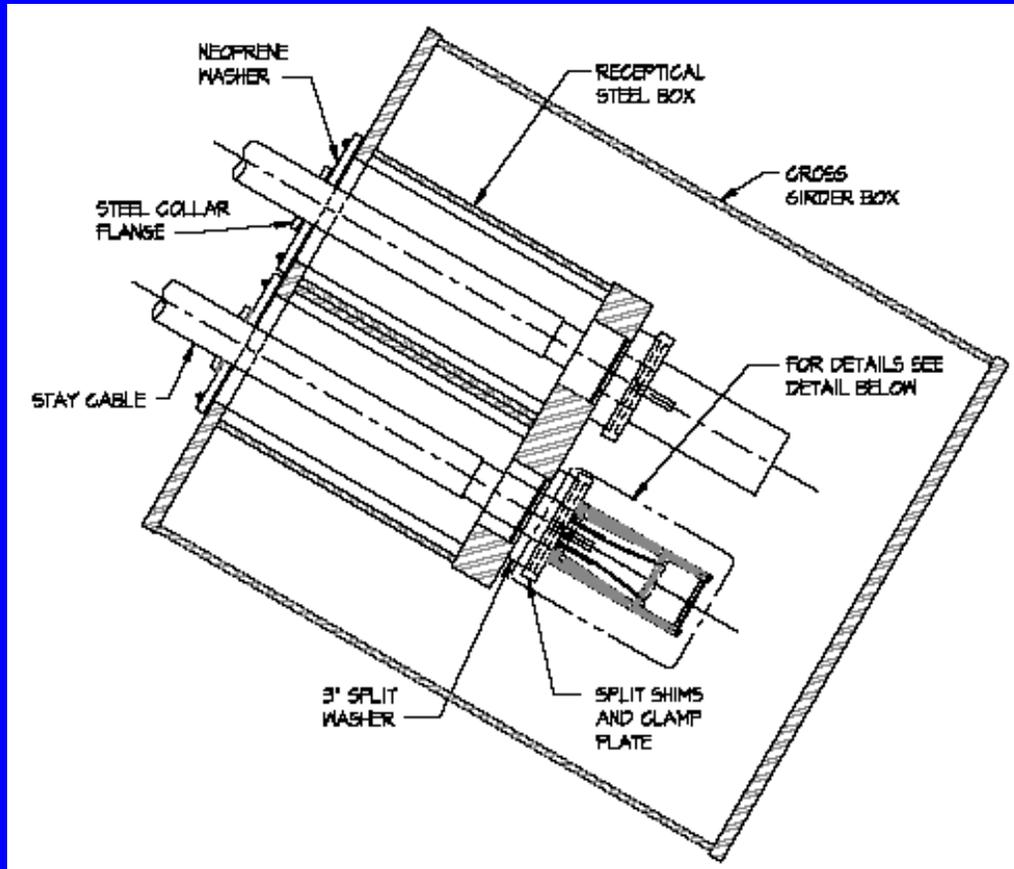
Impulse Radar



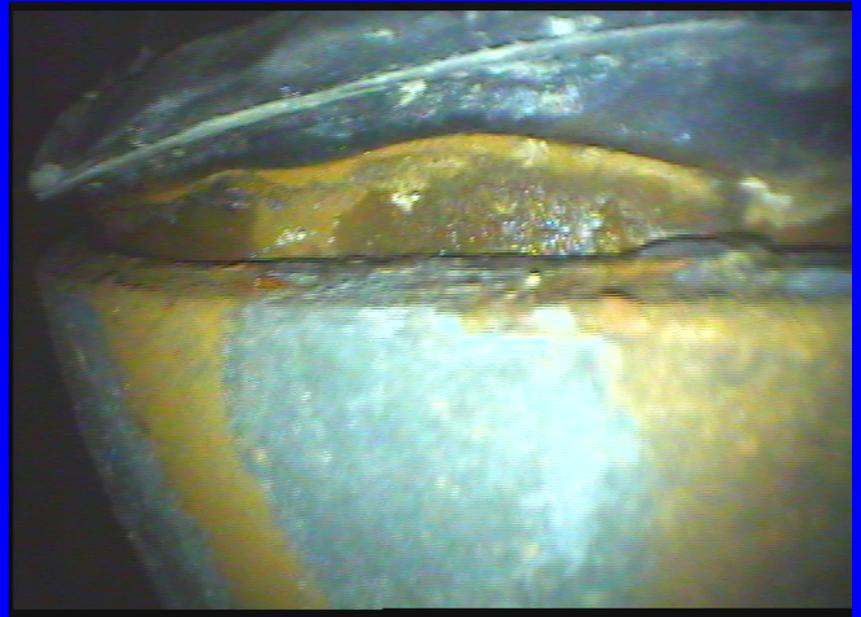
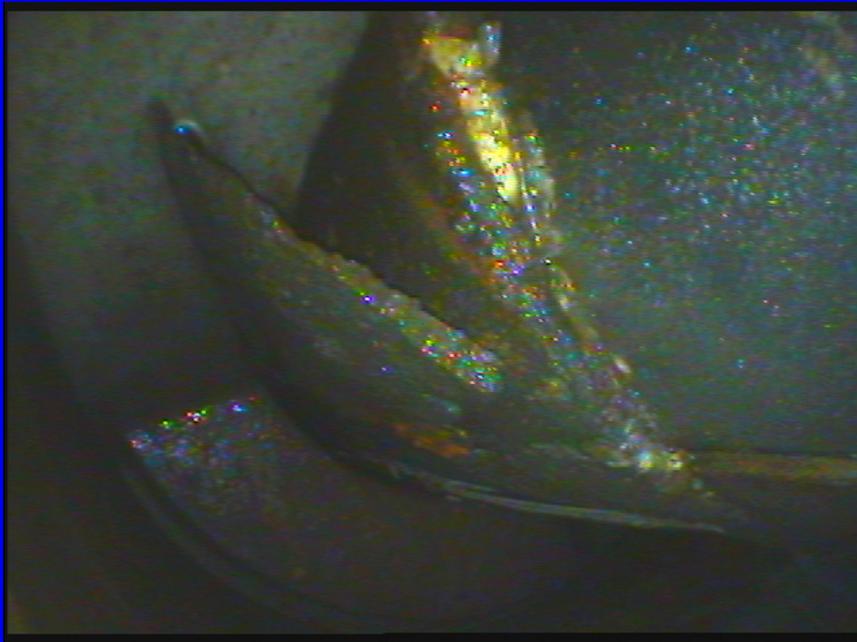
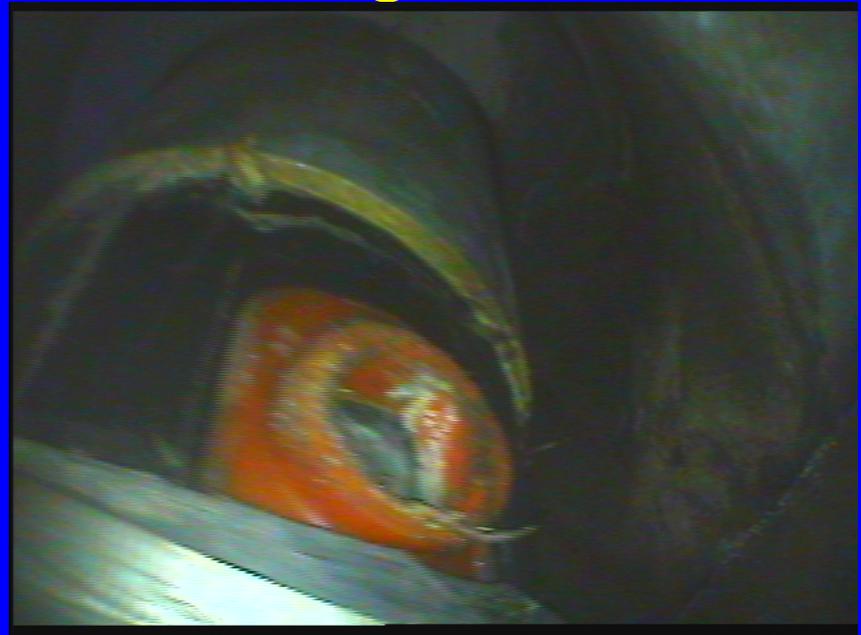
Inspection of All Anchorages



Source of Problem



Inspection of Deck Anchorage Boxes



Remaining Tasks

- Visual inspection of cable free length
- NDT of cable free length for PE cover flaw
- Determining extent of splits, deteriorated split repairs and damage to wires
- Repair design
- Design of damper for cables
- Implementation of repair and mitigation

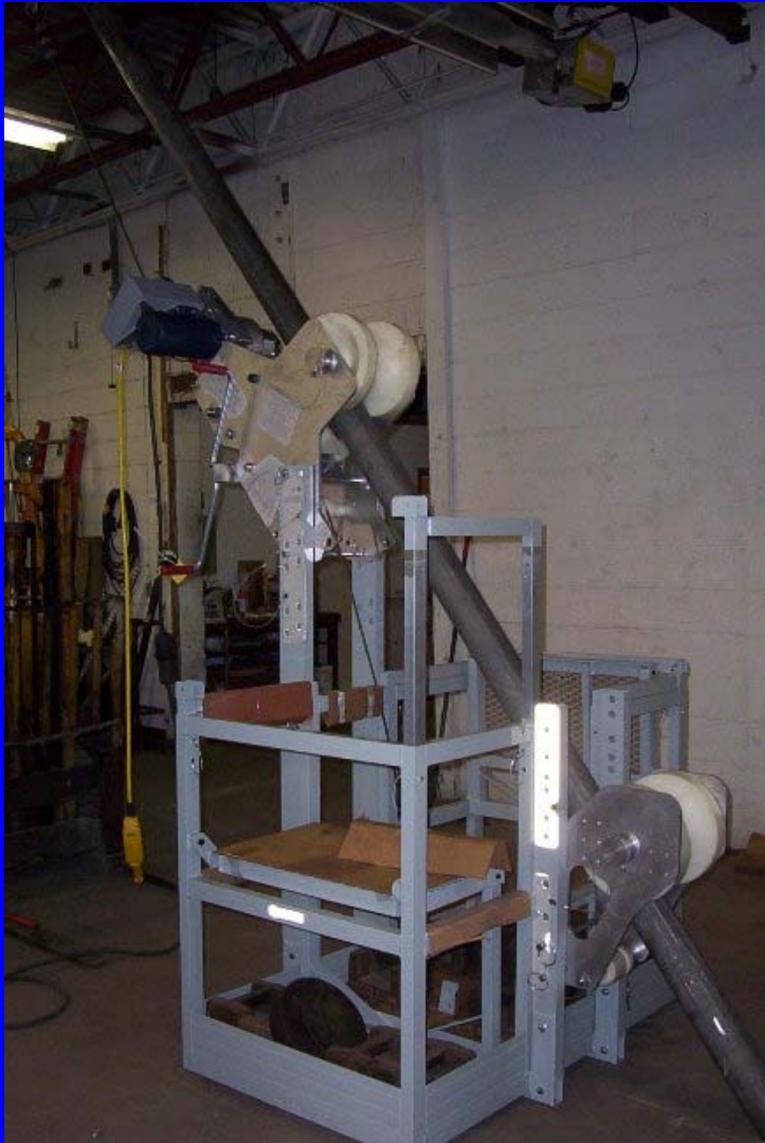
Borescope Video



Borescope Video



Cable Inspection in Progress



Cable Inspection in Progress



Cable Inspection in Progress



Cable Inspection in Progress

