



# Wind-Induced Vibration of Bridge Cables in the United States

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# US Cable-Stayed Bridges





# *Luling Bridge*

## Overview



- Bridge monitored since opening (1984)
- Occasional cable vibrations observed
- Comprehensive cable inspection underway (2006)



# *Luling Bridge*

## Stays and Cross-Girders



- Stays in groups of 2 or 4
- Stays are grouted
- Smooth PE pipe, no helical fillet

# Luling Bridge

## Neoprene Washer



- Black HDPE pipe
- Covered with white tape while in service



- Neoprene washer at cross-girder
- No internal neoprene bushings



# *Fred Hartman Bridge*

## Overview



- Vibrations during construction
- Cross-ties added shortly after opening
- Cross-ties later removed due to failure
- Dampers recently added

# *Fred Hartman Bridge*

## Original Cross Ties

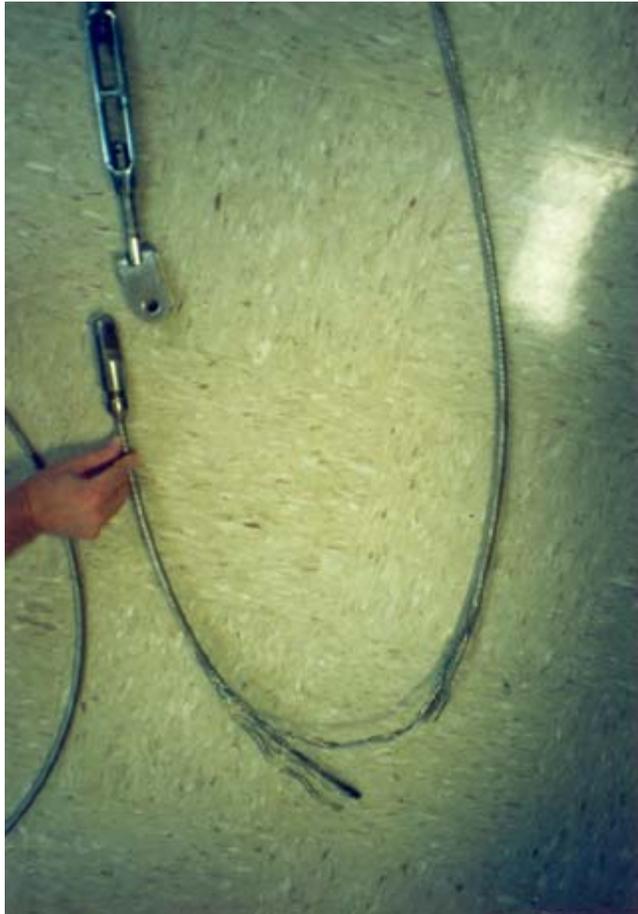


- Stays grouted
- Smooth surface
- Covered with yellow tape

Figure “8” Configuration

# *Fred Hartman Bridge*

## Wire Failures



## Guide Pipe Failures





# *Fred Hartman Bridge*

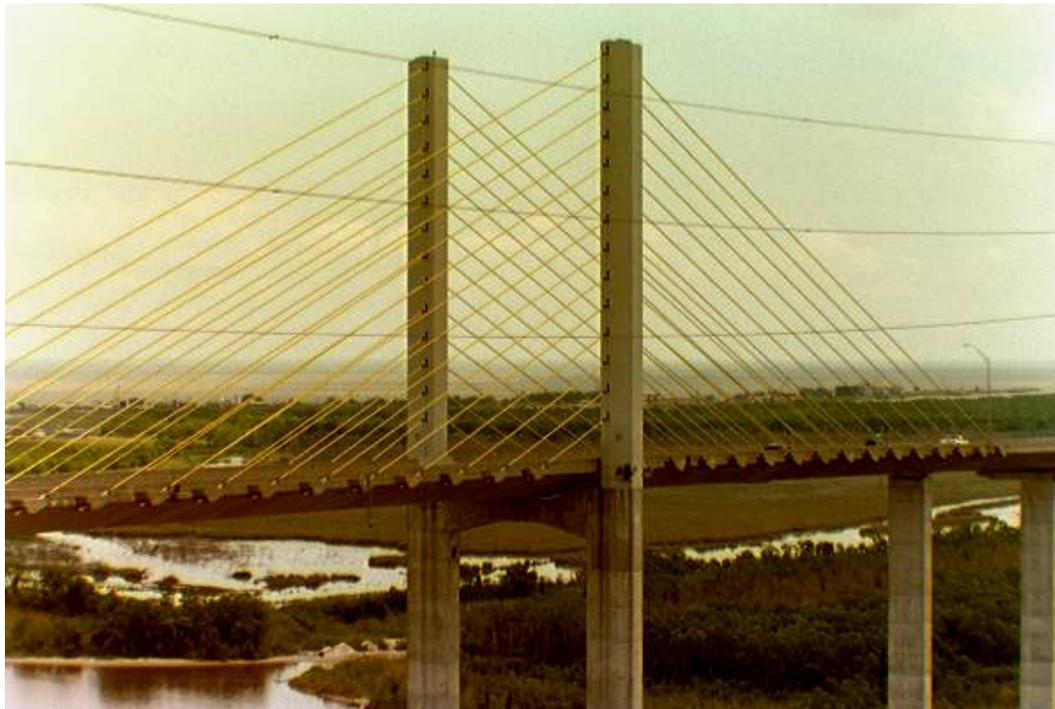
## Dampers





# *Veteran's Memorial Bridge*

## Overview



- Stays grouted
- Smooth surface
- Covered with yellow tape
- Vibrations observed in service



# *Veteran's Memorial Bridge*

## Dampers



- Aerodynamic rings and dampers evaluated
- Recently retrofit with dampers



# *Burlington Bridge*

## Overview

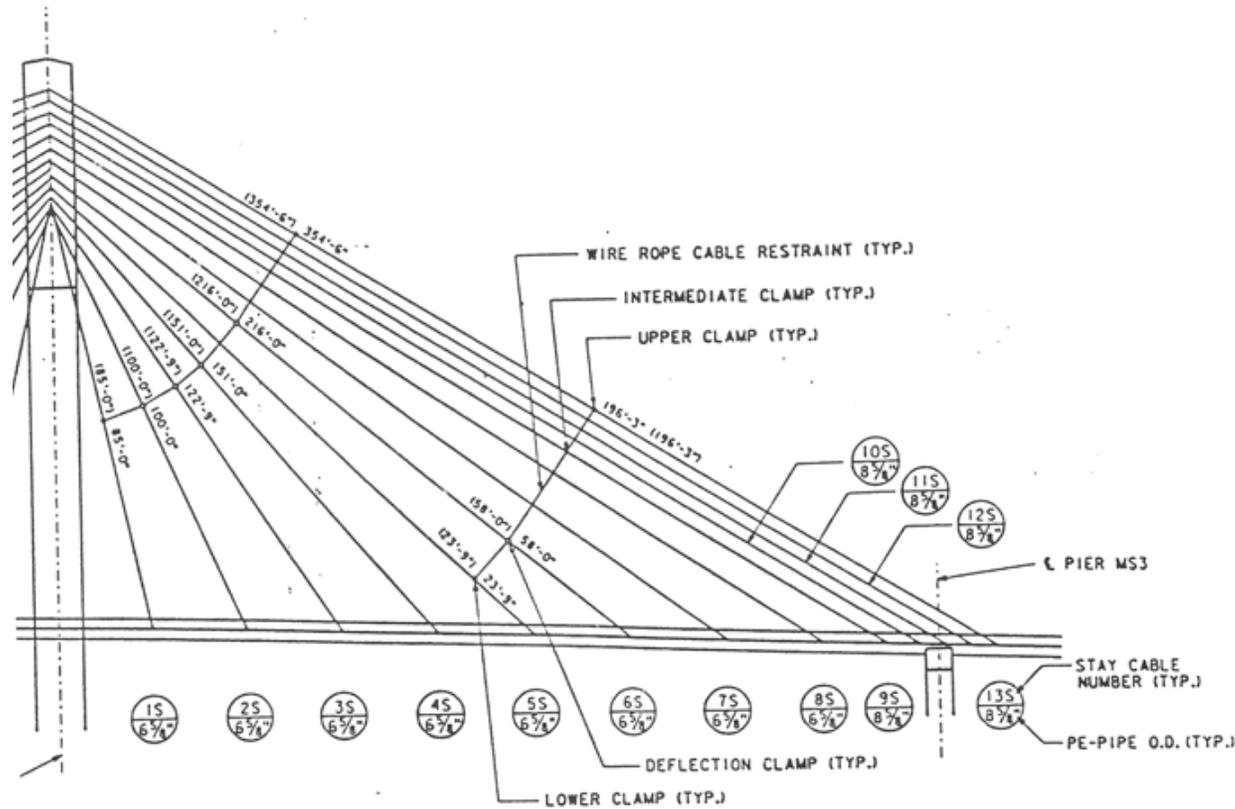


- Stays grouted
- Smooth surface
- Vibrations observed during construction
- Cross-ties added 1995 (1 year after opening)



# Burlington Bridge

## Cross-Ties – Two Lines

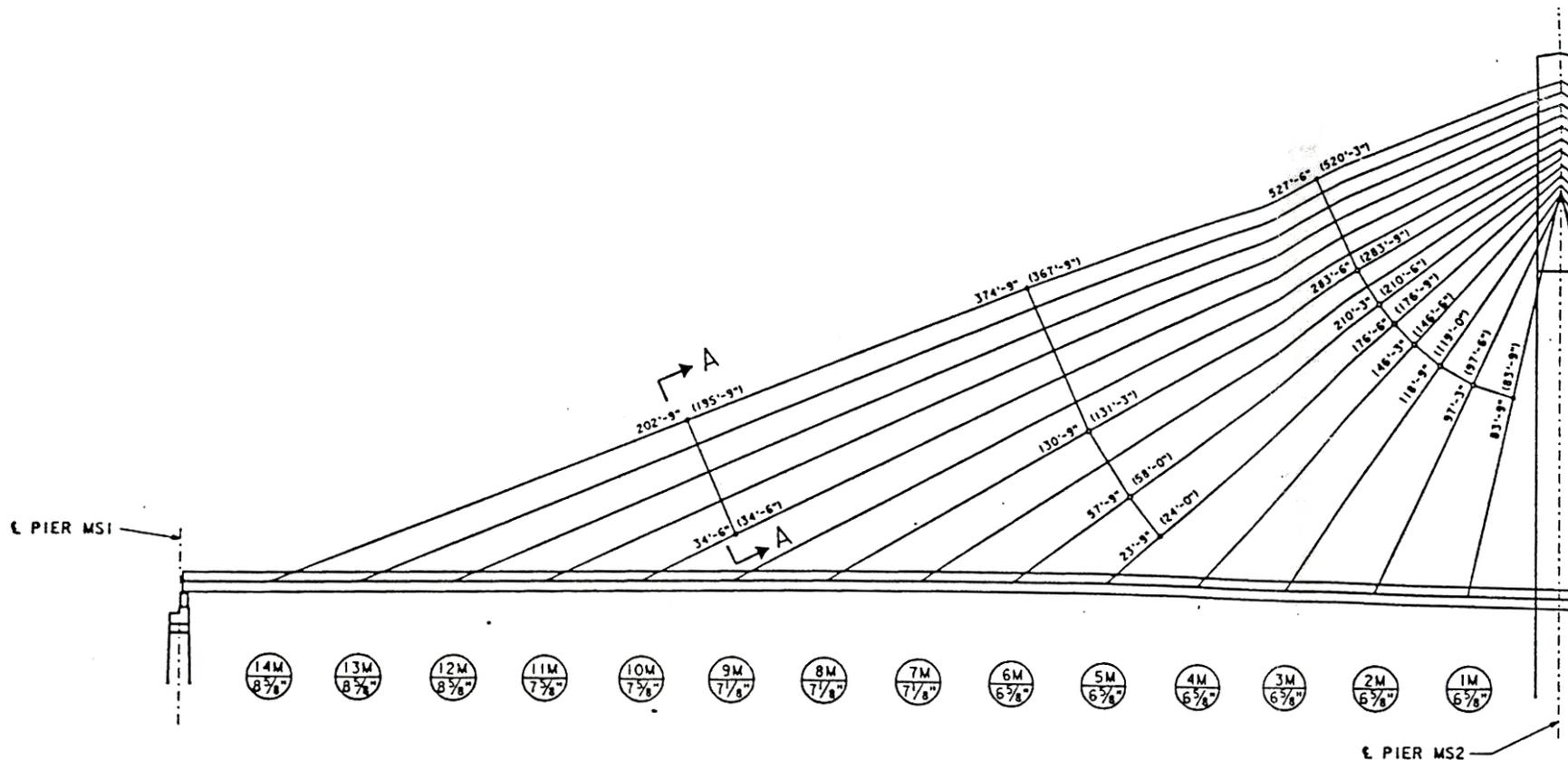


Cross-ties not anchored to deck



# Burlington Bridge

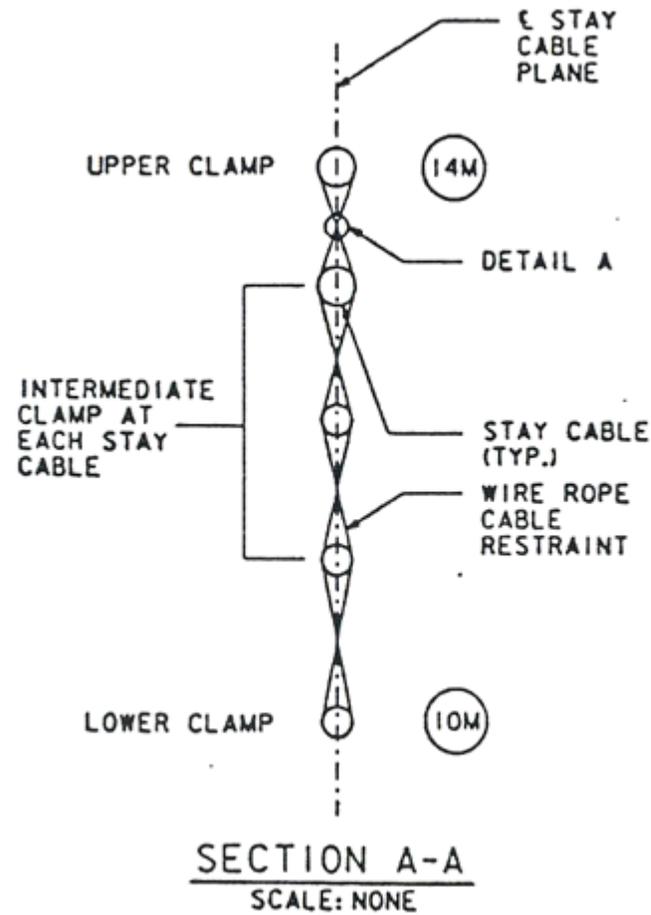
## Cross-Ties – Three Lines



Cross-ties not anchored to deck

# Burlington Bridge

## Cross Tie Configuration – Figure “8”





# *Weirton-Steubenville Bridge*

## Overview



- Stays grouted
- Smooth surface
- Covered with white tape
- Vibrations observed during construction

# *Weirton-Steubenville Bridge*

## Damper Assembly – Behind Facia Panel



- Retrofit with dampers (2004)
- Dampers at upper end
- Two dampers per cable



# *East Huntington Bridge*

## Overview

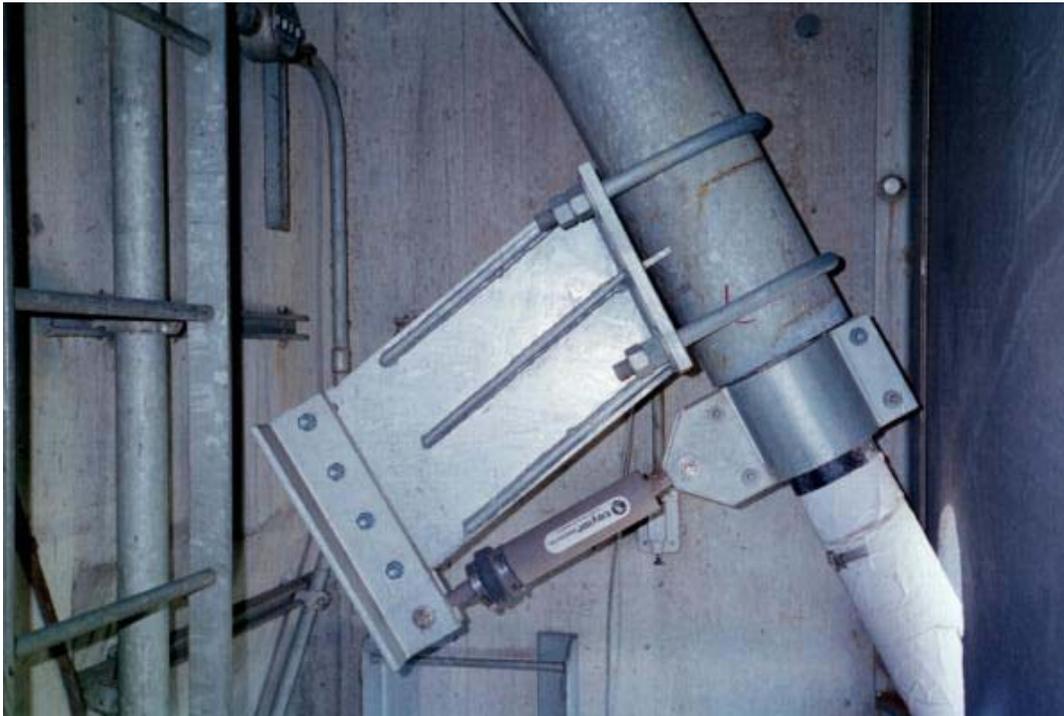


- Stays grouted
- Smooth surface
- Covered with white tape
- Vibrations observed in service



# *East Huntington Bridge*

## **Damper Assembly – Behind Facia Panel**



- Retrofit with dampers
- Dampers at upper end
- Single damper per cable



# *East Huntington Bridge*

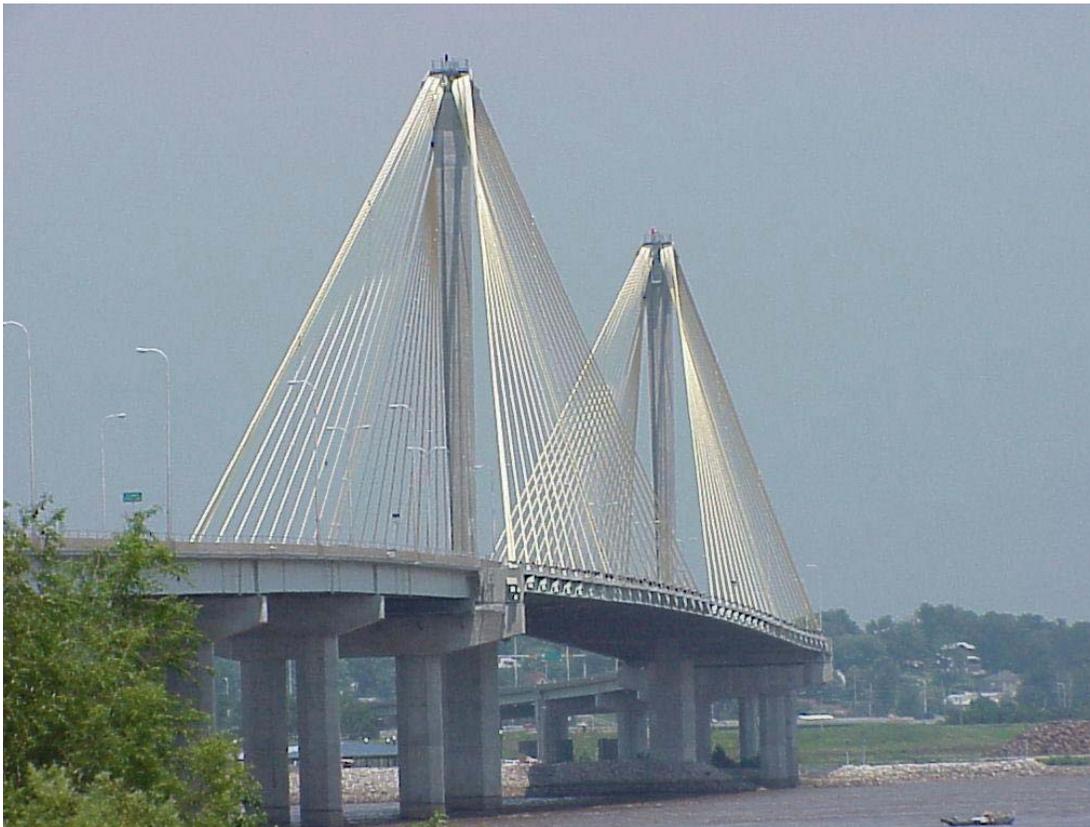
## Damper Array – Looking Up Tower





# Clark Bridge

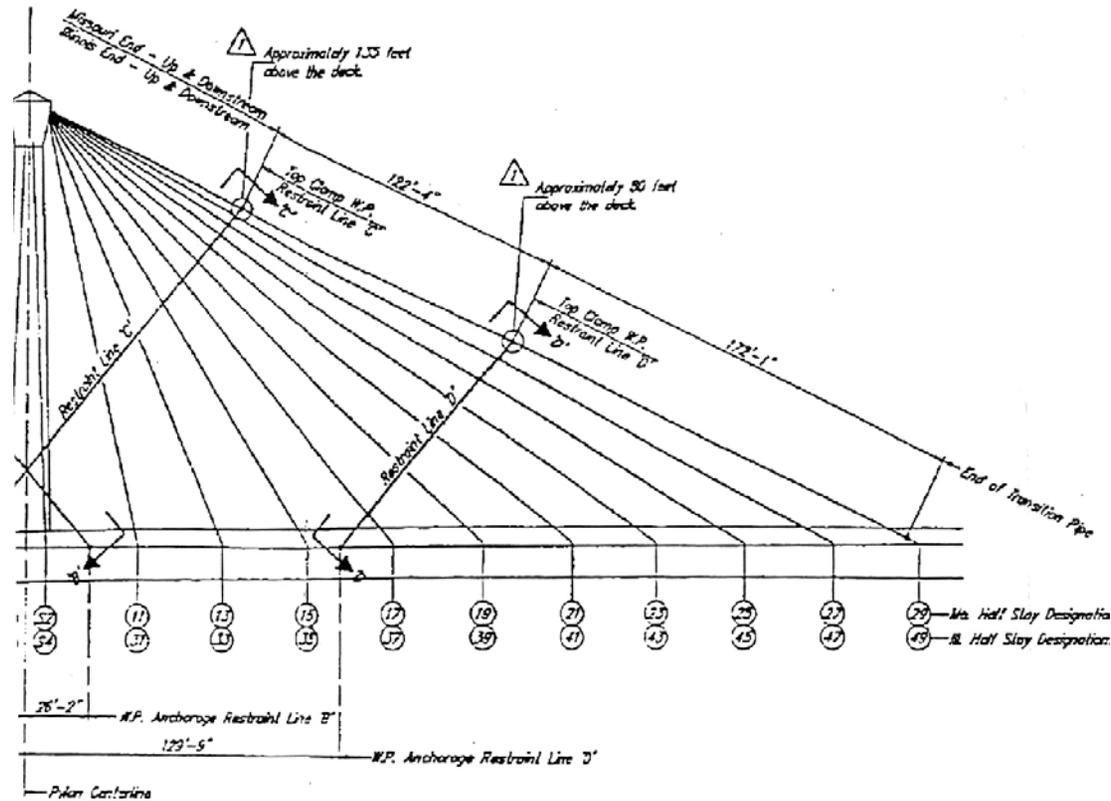
## Overview



- Stays grouted
- Smooth surface
- Vibrations observed during construction

# Clark Bridge

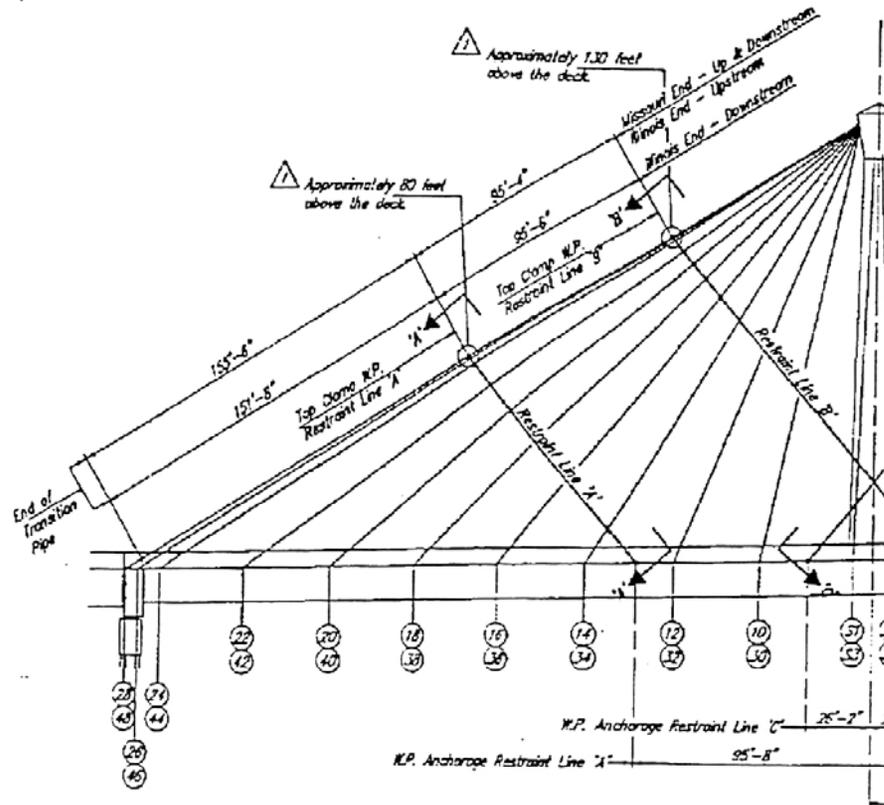
## Cross-Ties – Two Lines



Cross-ties anchored to deck

# Clark Bridge

## Cross-Ties – Two Lines



Cross-ties anchored to deck



# *Talmadge Bridge*

## Overview



- Stays grouted
- Smooth surface
- Covered with white tape
- Occasional vibrations observed in service

# Talmadge Bridge



Concrete spalling and cracked guide pipe



# *Cochrane Bridge*

## Overview



- Significant vibrations observed in service
- Cables retrofit with dampers



# *Cochrane Bridge*

## Damper





# *Charles River Bridge*

## Overview



Included in design:

- UngROUTED stays
- HDPE pipe with helical fillet
- Cross-ties
- Elastomeric dampers



# *Charles River Bridge*

## **Cross Tie and Deck Anchorage**



Single line of cross-ties  
anchored to deck



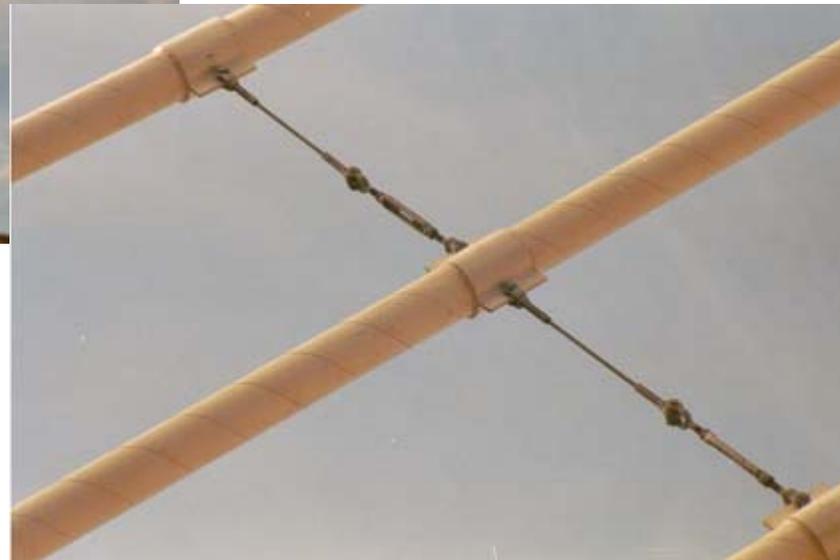


# *Charles River Bridge*

## Cross Ties and Aerodynamic Surface



In-line configuration





# *Charles River Bridge*

## Elastomeric Damper

During Installation





# *Cape Girardeau Bridge*

## Overview



- Stays are grouted
- HDPE pipe with helical fillet



# *Cape Girardeau Bridge*

## **Cross Tie and Aerodynamic Surface**



Included in design:

- Four lines of cross-ties
- In-line configuration
- Aerodynamic surface

# *Cape Girardeau Bridge*

## Cross Tie Deck Anchorage



Each cross-tie line anchored to edge girder



# *Cooper River Bridge*

## Overview



Included in design:

- Helical fillet
- Several types of dampers
- Provisions for future cross-ties



# Cooper River Bridge

## Provisions for Future Wind Ties



Wind tie fitting

Helical fillet



# Cooper River Bridge

## Dampers



Internal



External