2018 AASHTO SCOBS Bridge Meeting
T-1 Bridge Security & Hazards

Case Studies
Rehabilitation from extreme events

Artur D’Andrea
Presentation Topics

1. SAMPLE OF MULTI-HAZARD RESPONSES
2. EXAMPLES OF RESPONSES, TEMPORARY AND PERMANENT
3. RISK AND SOLUTIONS
4. FUNDING
5. OWNERS’ FLEXIBILITY
6. RECOVERY PERIOD, “TIME ELEMENT”
7. RESTORATION COSTS
RESPONSES TO MULTI-HAZARD EVENTS ARE:

1. DEPENDENT ON THE SIZE OF THE IMPACTS
2. LEVEL OF NATIONAL ATTENTION
3. OWNERS ABILITY TO MOBILIZE ADEQUATE RESOURCES
4. OWNERS EXPERIENCE WITH RECOVERY FROM EXTREME EVENTS
MAJOR EVENTS CAUSE SHORTAGES OF AVAILABLE RESOURCES AS VARIOUS PRIVATE AND PUBLIC ENTITIES COMPETE FOR THE SAME EQUIPMENT AND CAPABLE PEOPLE.

AT THE SAME TIME NORMAL ACCESS ROUTES, POWER, COMMUNICATIONS BECOME COMPROMISED, THUS WORKING WITH SCARCITY BECOMES THE NORM.
FOR EACH DAMAGED ASSET THE BASIC DECISION

REPAIR

OR

REPLACE
TYPICAL APPROACH DOT DEPLOYED DURING EXTREME EVENT

AN EMERGENCY MULTI-AGENCY TEAM IS DEPLOYED AND HOUSED AT SELECTED LOCATION. DOT’S TEAM MEMBER MAKES AVAILABLE RESOURCES IT CAN PROVIDE AT AFFECTED SITES

CRITICAL PROBLEMS AND INTERRUPTIONS ARE IDENTIFIED, CREWS ARE DISPATCHED FOR REPAIRS AND RESTORE SERVICE

SOON AFTER PRE-SELECTED TEAMS EVALUATE THE REPAIRS RECOMMEND ADDITIONAL WORK OR REPLACEMENT AS NECESSARY
March 2016 Flood

72-Hour Precipitation Ending
10 am EST March 11, 2016
DETAILED DAMAGE INSPECTION REPORT

(Title 23, Federal-aid Highways)

Location (Name of Road and Milepost)
I-20, C.S. 451-04, Logmile 1.54

Description of Damage
S.N. 040704510401542, R.N. 011750
Drift accumulation on northwest corner of bridge. Bridges are adjacent to recent clear cut. Cast-in-place revetment failure and wash out on east end between eastbound and westbound bridges ~ approximately 100 ft x 25 ft.
Artur D’Andrea, Mark Bucci, James Melton

Cost Estimate

<table>
<thead>
<tr>
<th>Description of Work to Date (Equipment, Labor, and Materials)</th>
<th>Unit</th>
<th>Unit Price</th>
<th>Quantity</th>
<th>Cost</th>
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<tr>
<td>Name</td>
<td>ID</td>
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<td>Equipment Class Code</td>
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<td>GRILLETTE, KYLE</td>
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<td>EA03 - EXC-PAY OT @ 1.5 RATE</td>
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**Equipment:**

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<th>Equipment Class Code</th>
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<th>Work Date</th>
<th>Total Hrs</th>
<th>Mileage</th>
<th>Total Cost</th>
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<td>124001</td>
<td>Truck, Pickup - 1 ton - HP</td>
<td>WILLIAM J RASBURY</td>
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<td>118</td>
<td>$ 260.00</td>
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<td>Kyle L Grillette</td>
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<td>Albert T Moreau</td>
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<td>$ 770.00</td>
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CASE 1

• TIME, EARLY 1980’S

• LOCATION I-59, PEARL RIVER BRIDGE MAIN SPANS

• CONDITION, MULTI FLOOD EVENTS AND ABANDONED BARGE CAUSED HEAVY SCOUR AND BRIDGE INSTABILITY
I-59 Bridges over the Pearl River
Affected bridges
AFFECTED BRIDGE ELEMENTS
Bridges' Dimensions:
2607' x 28'

Year Built: 1960
Main Span Steel: 175'
Min. Vert. Cl. = 35'
Min. Horiz Cl. = 130'

Substructure:
Pile Bents w/ 5-54" PC Piles
ORIGINAL CAP- BENT 23

5-54” precast concrete cylinder piles
<table>
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<tr>
<th>Rank</th>
<th>Year</th>
<th>Date</th>
<th>gage height, ft</th>
<th>Stream Flow (cfs)</th>
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<tr>
<td>1</td>
<td>1983</td>
<td>Apr. 09, 1983</td>
<td>21.05</td>
<td>230,000</td>
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<tr>
<td>2</td>
<td>2016</td>
<td>Mar. 14, 2016</td>
<td>20.58</td>
<td>206,000</td>
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<tr>
<td>3</td>
<td>1874</td>
<td>1874</td>
<td>20.2</td>
<td>198,000</td>
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<tr>
<td>4</td>
<td>1900</td>
<td>Apr. 19, 1900</td>
<td>19.7</td>
<td>179,000</td>
</tr>
<tr>
<td>5</td>
<td>1980</td>
<td>Apr. 02, 1980</td>
<td>19.75</td>
<td>173,800</td>
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<tr>
<td>6</td>
<td>1979</td>
<td>Apr. 26, 1979</td>
<td>19.25</td>
<td>155,000</td>
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<tr>
<td>#</td>
<td>Description</td>
<td>Width</td>
<td>Height</td>
<td>Note</td>
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<td>--------</td>
<td>---------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>25</td>
<td>Both sides wide open</td>
<td>5 1/8&quot;</td>
<td>5 1/8&quot;</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Crack in pedestal @ bt. #24</td>
<td>2 5/16&quot;</td>
<td>2 1/4&quot;</td>
<td>East side has worsened since</td>
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<tr>
<td>23</td>
<td>Last report, base plate not</td>
<td>2 1/4&quot;</td>
<td>2 3/4&quot;</td>
<td>Setting level.</td>
</tr>
<tr>
<td>22</td>
<td>Both sides closed tight</td>
<td>1 5/8&quot;</td>
<td>1 5/8&quot;</td>
<td>Both sides closed tight</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>3&quot;</td>
<td>2 3/4&quot;</td>
<td></td>
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</table>
In areas where stepped risers are spalled, they are to be cleaned and repaired with epoxy grout.

**REPAIRS**

- TYP. ANCH. FIXED BRG.
  - 1 - HEAVY HEX NUT
  - 1 - CUT WASHER

- TYP. ANCH. EXP. BRG.
  - 2 - HEAVY HEX NUTS
  - 1 - WASHER

**WEST PEARL RIVER**

**I-59**

**ST. TAMMANY**

### ESTIMATED QUANTITIES

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>BRG. PAD 7x20x2</td>
<td>1G EA.</td>
</tr>
<tr>
<td>BRG. PAD 9x21x1</td>
<td>1G EA.</td>
</tr>
<tr>
<td>BRG. PAD 7x22x2(\frac{1}{6})</td>
<td>1G EA.</td>
</tr>
<tr>
<td>BRG. PAD 9x22x3(\frac{3}{16})</td>
<td>8 EA.</td>
</tr>
<tr>
<td>STEEL (A-36)</td>
<td>6553 LBS.</td>
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</tbody>
</table>

**NOTE:** To be used only if conditions prohibit the use of the primary weld detail.

**BOLT SPACING DETAIL**

**NOTE:** After top flanges are welded to flange & in place, entire BRG. is to be sand blasted & painted with an approved paint system (typical).
<table>
<thead>
<tr>
<th>BENT Number</th>
<th>WEST Gutter Line</th>
<th>EAST Gutter Line</th>
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<tbody>
<tr>
<td>23</td>
<td>2&quot; 1/4&quot; *</td>
<td>2 1/2&quot; 3/4&quot; *</td>
</tr>
<tr>
<td>24</td>
<td>2&quot; 1/4&quot; *</td>
<td>2&quot; 1&quot; *</td>
</tr>
<tr>
<td>25</td>
<td>1 3/4&quot; 4 3/8&quot; *</td>
<td>2&quot; 5 3/8&quot; *</td>
</tr>
<tr>
<td>26</td>
<td>15/16&quot;</td>
<td>DK * 3/4&quot;</td>
</tr>
</tbody>
</table>

*Red Notes Before Repairs 12-14-81*

**NOTE:** Joint opening measured at gutter line on sliding plate joint's.
MEMORANDUM TO:

MR. JACK R. REID
DIRECTOR OF PRECONSTRUCTION

ARE ALL EXISTING CONDITIONS & CHANGES TO ORIGINAL AS BUILT PLANS SHOWN ON THE BRIDGE INSPECTION REPORT? PARTICULAR EXIST BEARING OF EACH GIRDER AT EACH END. LUBERITE PLATE LOCATION JUXTAPOSED AT GIRDER BEARING WILL NEED FOR PLAN PREP.

The Plan-in-Hand Inspection on the above captioned project was made on June 4, 1982. Personnel making this inspection are listed on the attached Plan-in-Hand Memorandum Review.

1. Bents No. 21 thru 26 to be moved to correct position. This will be determined from bridge inspection reports and by using measurements from bents no. 21 and 26.

2. Top 20' of piles to be encased if jetting is used.

3. Existing fender system to be removed.

4. All bearing plates, shoes and anchor bolts to be corrected on bents 21 thru 26.

5. It is recommended that our Legal Section take whatever action is necessary to have a sunken barge removed from the channel on the upstream side of the bridge.

6. CARS SHOULD BE DESIGNATED TO FACILITATE FUTURE LEAD DECL. & SHOULDER WIDTHS WHEN LIGHT WEIGHT DECKS HAVE TO BE REPLACED.

EUGENE P. WAGUESPACK
DOTD CHIEF CONSTRUCTION ENGINEER

T. W. BERGERON
BRIDGE CONSTRUCTION ENGINEER
1. SCOUR CAUSING HEAVY LOSS OF PILE PENETRATION AT BENTS 23 AND BENTS 24

2. EXCESSIVE MOVEMENTS AT THEIR TOPS, 3" TO 4"

3. BTS23 & 24 WERE TIED OFF TO PREVENT FURTHER MOVEMENT

4. THEIR REPLACEMENT WAS BEING PLANNED

5. UNACCEPTABLE LONGITUDINAL MOVEMENT WAS SET AT FIVE INCHES MAXIMUM

6. TILTMETER WAS INSTALLED

Dear Mr. Lane:

This is to request a proposal to install a Tilt Sensor Alignment System on the two referenced bridges. The attached plan sheets show that these bents 23 and 24 of each bridge have lost a significant amount of penetration due to scour. These bents have somewhat slender and have experienced excessive movement of 3" to 4".

Plans are being prepared to replace these bents. They are now tied to prevent further excessive movement. An installation to monitor the position of the bents and warn of any movement beyond a predetermined amount would make the situation substantially safer.

We understand that systems are available which provide continuous monitoring with intermittent recording. Additionally, a warning device can be triggered when a predetermined degree of tilt occurs. The warning threshold can be set from 1 to 20 arc minutes and fixed at the factory or is it user adjustable?
The low cost, reliable leveling monitor.

Sperry's Tilt Sensor simply, economically and continuously monitors vertical and/or horizontal alignment of the structure on which it is mounted.

Proven hardware

The heart of the Tilt Sensor is a miniature Electrolytic Gravity Sensor used as a leveling device in highly accurate aircraft and marine gyroscope systems. Advanced electronics and the gravity sensor are mounted in a rugged, lightweight sealed housing.

Versatile

The Tilt Sensor can be preset to give a warning signal of deviation. The warning threshold may be set as low as 1 minute of arc. Various warning devices, including strobe lights, horns and radio links, may interface with the Tilt Sensor, or it may be hard-wired to a central location. With a recorder, it can provide a permanent log of the actual alignment angle.

The extremely low operating power of the Tilt Sensor allows months of battery use. It can also be powered from a ± 5VDC supply.

Wide application range

The many potential uses of Tilt Sensors include monitoring of:

- Building structural integrity during construction, and collection of movement data during building life.
- Roofs, floors and ramps of public assembly facilities.
Mr. Doyle and our project personnel were informed that with the heavy loads in Span No. 22 and the removal of the restraining properties of Span No. 23, the Bent No. 23 would tend to try to move toward the river. Because of this, the bearing of Span No. 22 on both Bents No. 22 and 23 should be checked to ensure proper bearing and to be sure that the fixed bearing on Bent No. 22 were fully functioning and that the anchor bolts were not sheared or the embedment concrete cracked. If there are problems with the restraints on Bent No. 22 then another restraining method should be devised.
SUNKEN BARGE

BENT 23 AND 24 NB AND SB
1. Spans removed
2. Bent cap demolished
3. Existing piles driven down 30’
4. New cap/footing poured
5. New columns built
6. Spans placed back on top of the new cap
Low bidder, selected pay items

Concrete Cap Demolition (4) = $165,000
Mobilization = $100,000
Interstate CrossOver Detour = $399,360
Removal and Reinstallation
4 Spans = $300,000
And Girder Restoration = $67,000
Re-driving all 54” piles

Total = $1,752,494
• AUGUST 2016 FLOOD EVENT
LA 10: AMITE RIVER SCOUR REPAIR

state_route_number
LA0010
AMITE RIVER @ DARLINGTON
i109_pct_adt_truck 23
i29_adt 002300
Year Completed 1963
Dimensions=605’x28’
1) 22.54 ft on 08/13/2016
(2) 22.05 ft on 01/25/1990
(3) 21.76 ft on 04/22/1977
(4) 21.17 ft on 04/13/1955
(5) 20.29 ft on 04/07/1983
(6) 20.20 ft on 01/07/1950
(7) 20.19 ft on 03/25/1973
(8) 20.17 ft on 01/28/1994
(9) 19.69 ft on 03/18/1961
(10) 19.59 ft on 03/28/1980
LA 10 Amite River
Channel Migration

Photos from Atlas Louisiana GIS & Google Earth
LA 10 Amite River
Channel Migration: December 2015 Aerial
LA 10 Amite River
August Flood Photos

NOTES

1. HYDRAULIC LAYERS TO BE PLACED AS SHOWN ON SHEETS 102 AND 104 FOR ADDITIONAL INFORMATION.

2. FOR DETAILS ON THE PROJECTED AND ADOPTED ALIGNMENT FOR WEST BANK OF ANTELOPE RIVER SEE SHEET 103.

3. STONE HYDRAULIC LAYERS SHALL BE USED. RECYCLED CONCRETE MAY NOT BE USED.

4. TACK LAYER SHALL BE PAID FOR UNDER ITEM 303-07-001000, "PAVING - VOLUMETRIC MEASUREMENT."
LA 10 Amite River
Construction Photos
LA 10 Amite River
Construction Photos
<table>
<thead>
<tr>
<th>Line Number</th>
<th>Item Number</th>
<th>Item Description</th>
<th>Unit of Measure</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Amount</th>
<th>Unit Price</th>
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<tbody>
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<td>0001</td>
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<td>Removal of Pipe (Side Drain) 15” DIA RCP</td>
<td>LNFT</td>
<td>22</td>
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<td>550.00</td>
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<td>40.0</td>
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<td>72.00</td>
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<td>CUYD</td>
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<td>30.00</td>
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<td>6,708.75</td>
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<td>Side Drain Pipe (18” RCP/PP/CMP)</td>
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<td>26</td>
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<td>TON</td>
<td>20,512.5</td>
<td>61.00</td>
<td>1,251,262.50</td>
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<td>21.00</td>
<td>42,000.00</td>
<td>24.00</td>
<td>48,000.00</td>
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**CONTRACTOR TOTAL**: $1,478,655.50

Low bidder, selected pay items:
- **Borrow**: 4860 cu.yds. (4) = $145,800
- **Mobilization**: $20,000
- **Riprap**: 20513 tons (440 lb), $1,251,253
- **Geotextile fabric, 8800sqyds**: $8,800
- **Landscaping**: $20,000

**Total**: $1,478,655
Questions?