Parking Structure Maintenance

ICRI Luncheon
Maggiano's Little Italy, Perimeter
Thursday, September 19, 2024

ICRI CONCRETE REPAIR GEORGIA

The Pinnacle of Structural Engineering

Innovative EngineeringInc.

Learning Objectives

- **Parking Structures**
  - Structure Types
  - Cost Comparison
  - Lifecycle Costs
- **Conditions Facing Parking Structures**
- **Common Deficiencies**
- **Importance of Routine Maintenance & Timely Restoration**

Innovative Engineering, Inc.

- **Trey Thomas PE**
  - **BSCET, Southern Polytechnic State University**
  - **19 Years in Design and Restoration Engineering**
    - Co-author of Parking Structure & Forensic articles
  - **Mold, Lead & Asbestos Surveying**
  - **OSHA Competent Person for Boom & Scissor Lifts**
  - **OSHA 30 Certification**
  - **SPRAT Level 2 Rope Access Technician**
  - **FAA Part 107 Remote Pilot Certificate**
  - **Level I Certified Thermographer**
  - **NAVFAC CQM-C Certified**

Structural Systems

Cast-in-Place Concrete

Precast Concrete

Structural Steel

Cast-in-Place

- **Advantages**
  - Flexible Geometry
  - Monolithic, Fewer Joints
  - Reduced Maintenance Costs
  - Longer Life Expectancy
  - Higher Durability
- **Disadvantages**
  - Higher Initial Investment
  - Longer Schedule
  - More Labor Intensive
  - Difficult Quality Control
  - Weather Dependent

Precast Concrete - Advantages

- **Advantages**
  - Lower Initial Investment than CIP
  - Fabricated in Controlled Plant Environment
  - Not Weather Dependent
  - Accelerated Construction Schedule

Precast Concrete - Disadvantages

- **Disadvantages**
  - May be no local plant
  - Geometry not Flexible
  - Lower Perceived Ceiling heights
  - Shearwalls (Closed In)
  - More Joints
  - Prone to Thermal Expansion & Contraction Damage
  - Corrosion of Steel Embedments
  - Higher Maintenance Costs

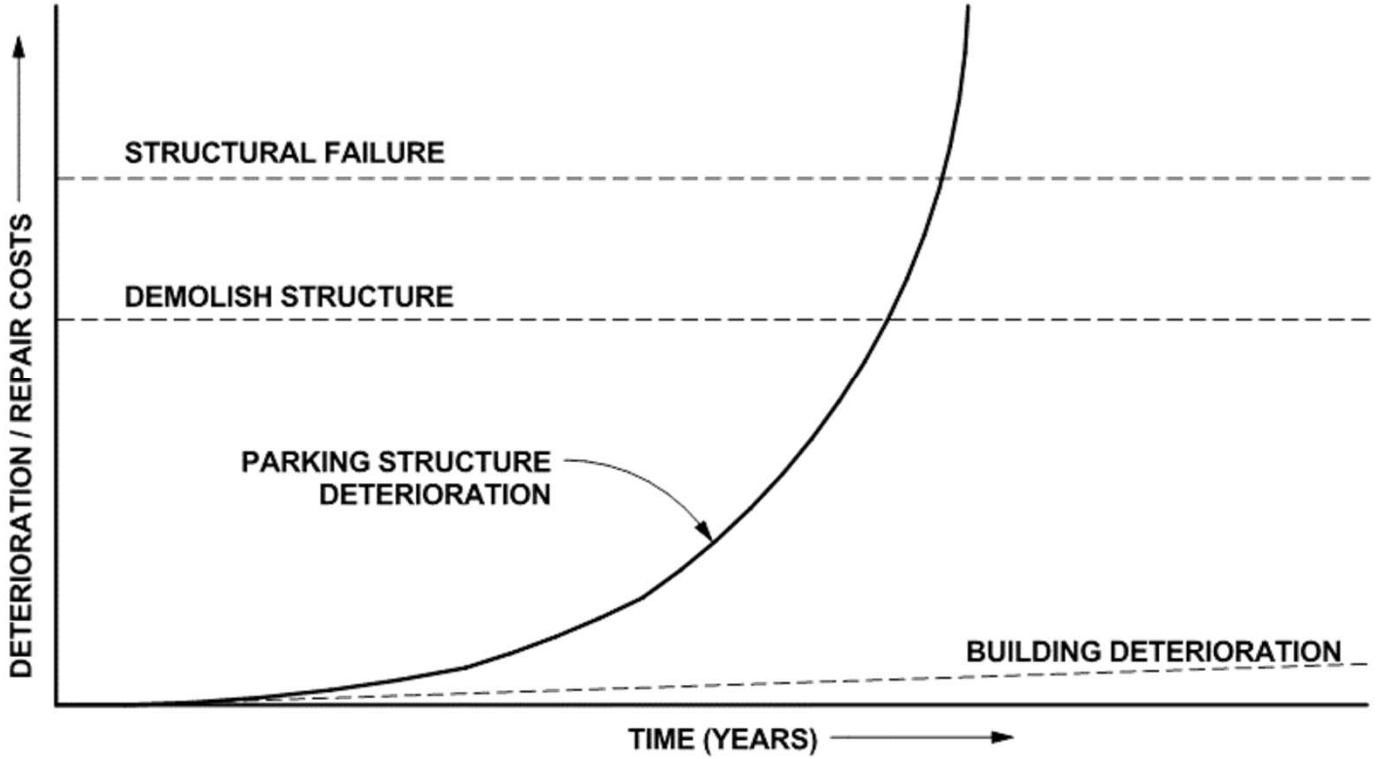
Structural Steel

- **Advantages**
  - Lower Initial Cost than Precast
  - Accelerated Construction Schedule
  - Fabricated in Controlled Environment
  - No Shearwalls (Open)
- **Disadvantages**
  - Corrosion Issues
  - Higher Maintenance Costs
  - Not Suitable for Fire Protection

Parking Structures

- **Not Bullet Proof**
- **No Protective Skin**
- **Deterioration Starts Immediately**
- **Subjected To:**
  - Moisture (Rain, Snow, Ice, Deicing Salts)
  - CO_2 Carbonation
  - Extreme Thermal Expansion & Contraction
  - Dynamic Vehicle Loads

Structure Degradation

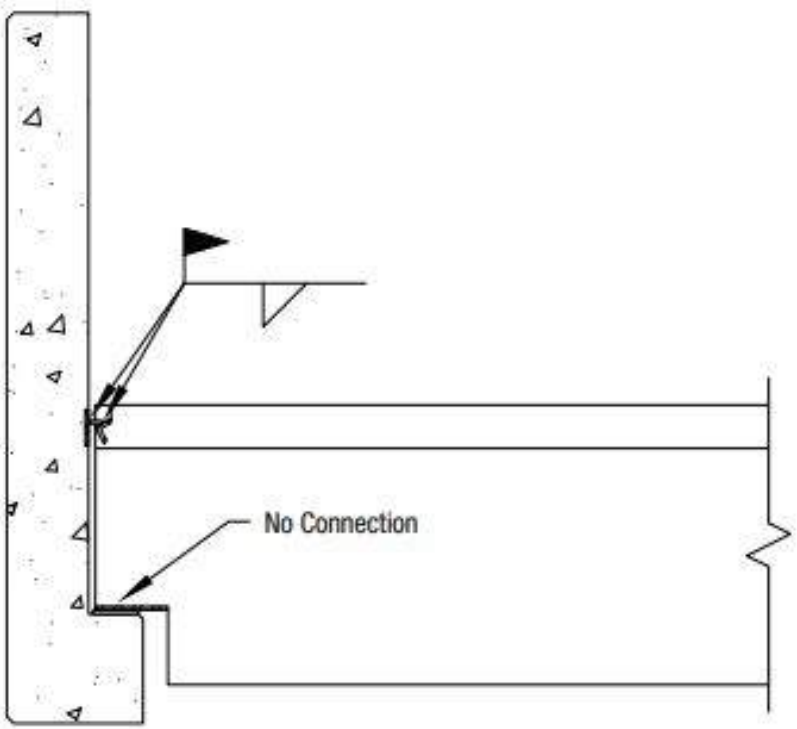


Irving Texas, O'Conner Ridge Blvd. Collapse

Irving Texas, O'Conner Ridge Blvd. Collapse

- **What we know**
  - Old Parking Structure
  - Expansive Soils in TX
  - Exterior Columns Leaning
  - Cracks Sealed with Sealant
  - No OSHA Report
  - Demolished

Irving Texas, O'Conner Ridge Blvd. Collapse



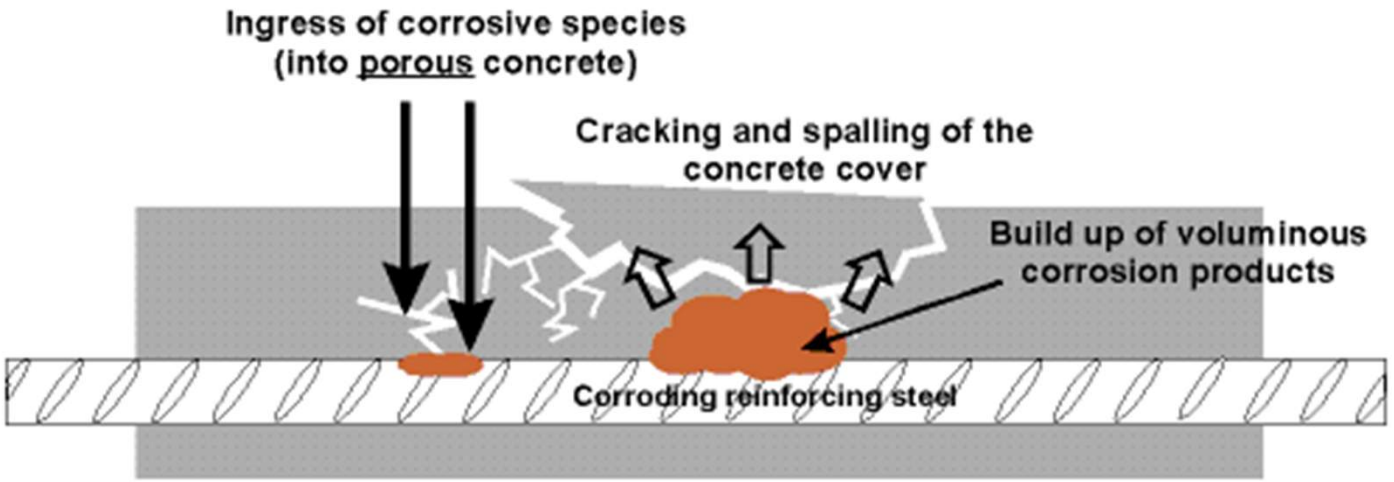
- **Typical Precast Double Tee Joist Seat**

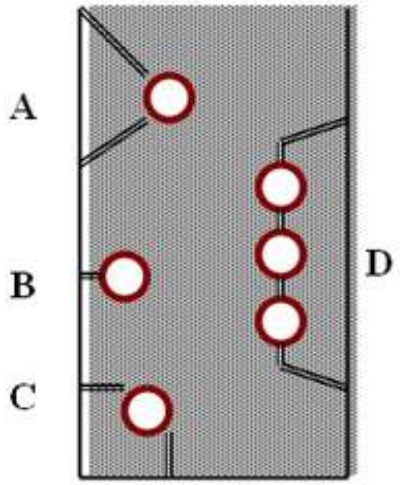
Common Deficiencies

- **Number 1 Enemy**

WATER

Common Deficiency: Corrosion





A: Spall
B: Crack
C: Corner Spall
D:Delamination

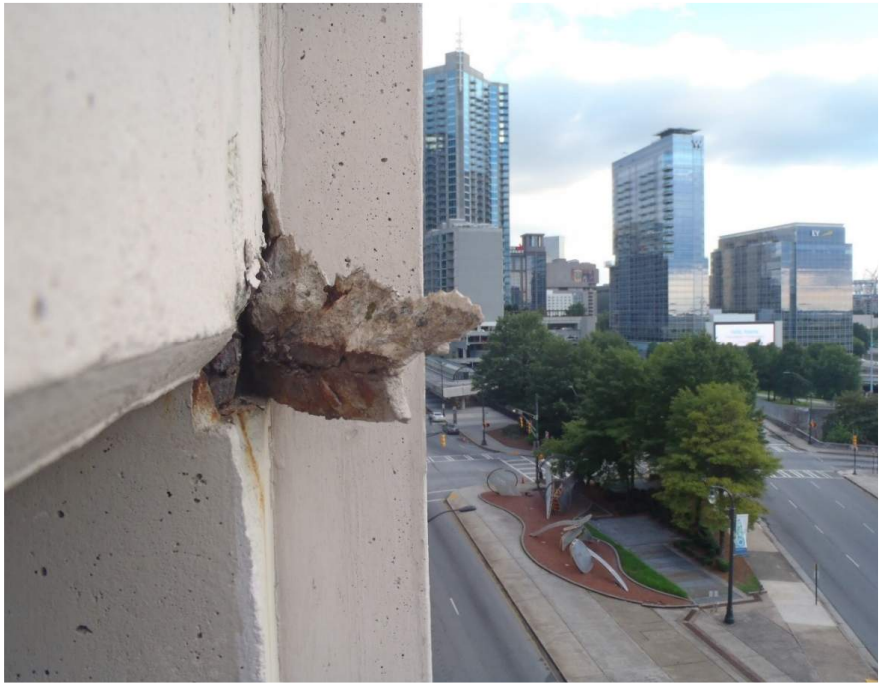
Common Deficiency: Concrete Spalls

Spall

Delamination

Section Loss

Common Deficiency: Exterior Spalls



Spall Over Sidewalk

Spall Size

Common Deficiency: Sounding

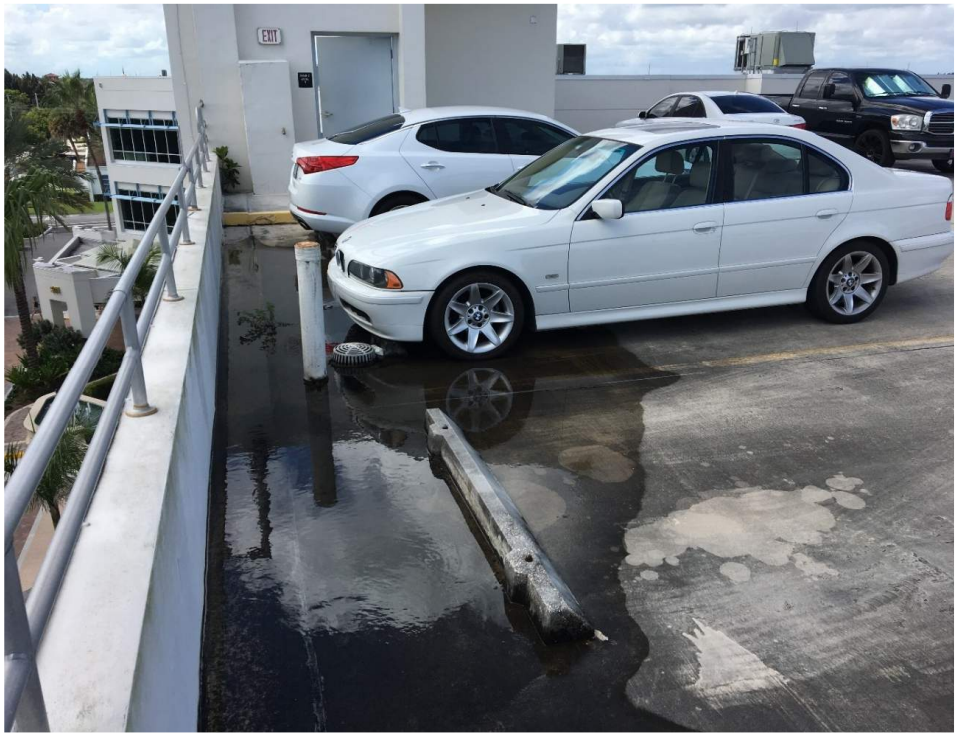
Common Deficiency: Failed Spall Repair

Improper Surface Preparation

Common Deficiency: Failed Spall Repair

Improper Surface Preparation

Common Deficiency: Ponding



Common Deficiency: Delamination

Delaminating Topping

Common Deficiency: Ponding

Supplemental Drain

Precast Girder Bearing Pad Failure

Compressed & Moving

Deterioration

Precast Girder Bearing Pad Failure

Concrete to Concrete Contact

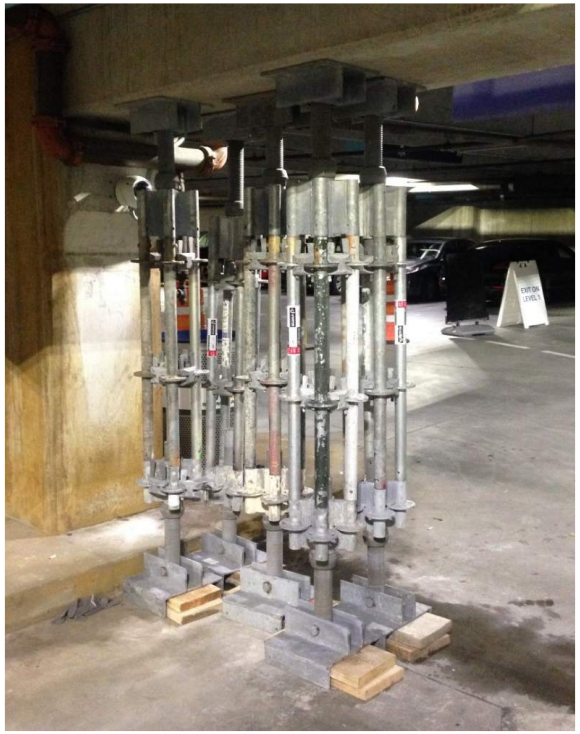
Close-Up

Precast Corbel Failure

Precast Beam Corbel

4 Months Later

Precast Corbel Repair



Shoring to Remove Load

Applying Epoxy Bonding Agent

Precast Corbel Finished Repair

Good as New

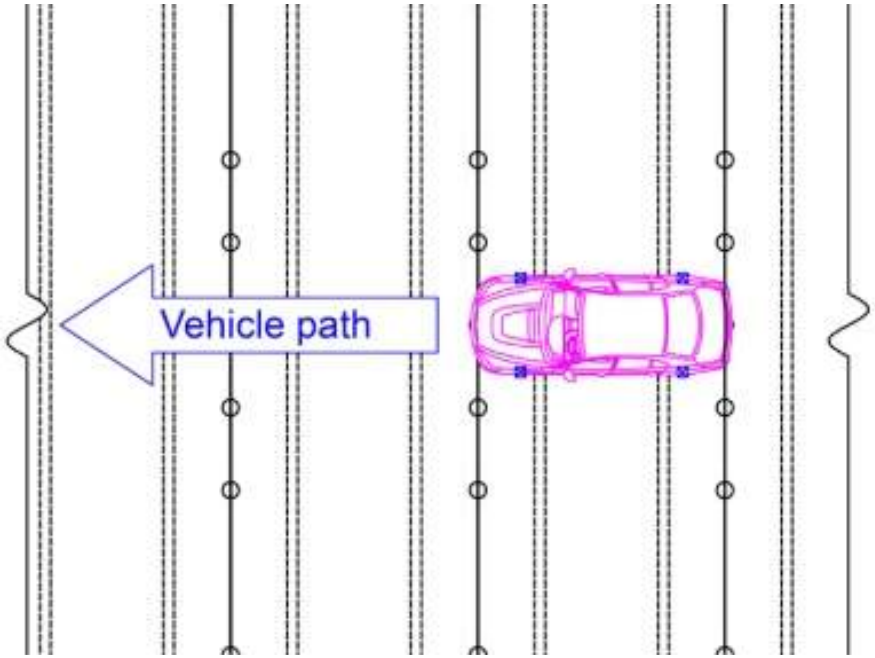
Common Deficiency: Curbs & Wheel Stops

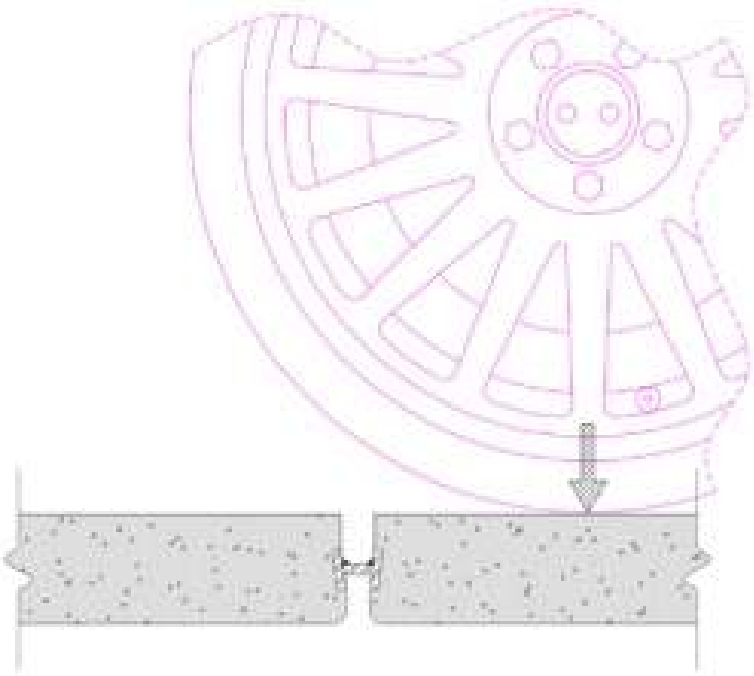
Broken Curb

Broken Wheel Stop

Precast Shear Transfer

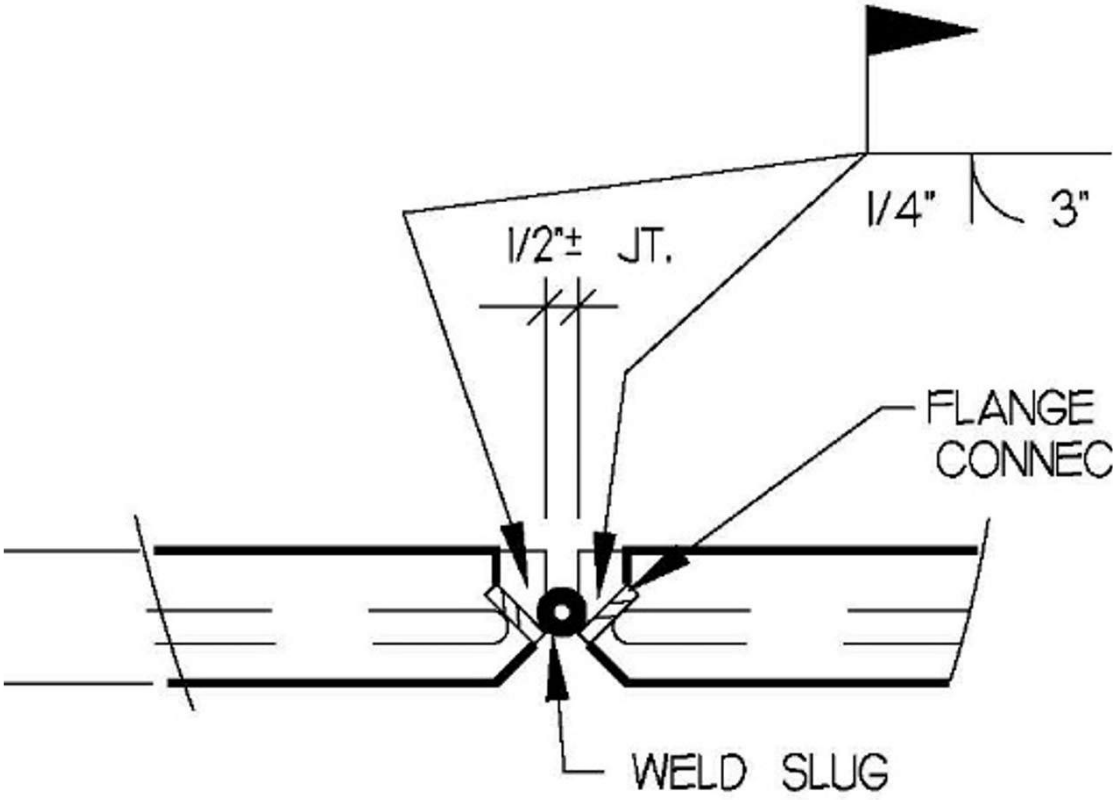
Precast Shear Transfer



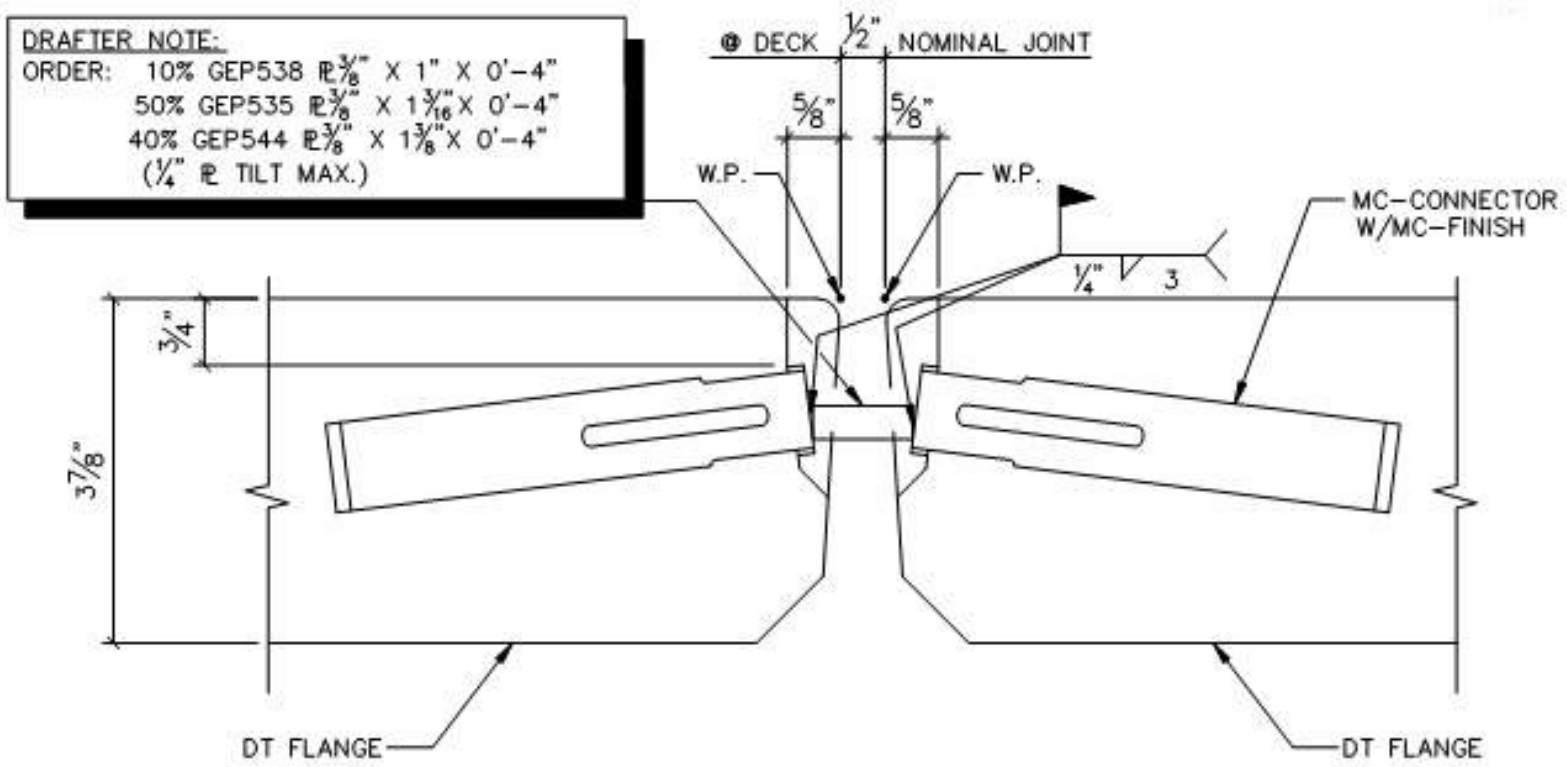


Credit: Hendricks, Naito, and Osborn

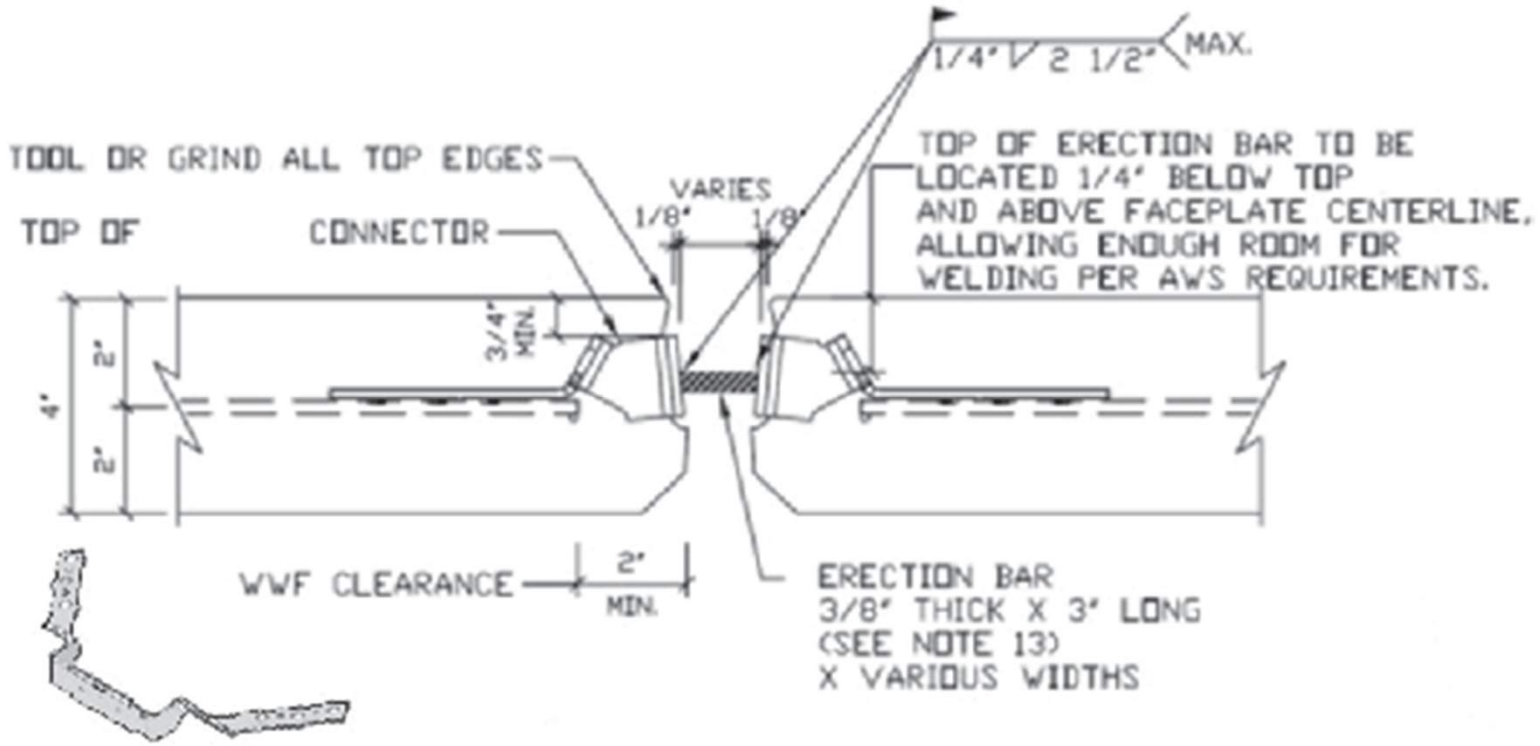
Precast Shear Transfer Repair



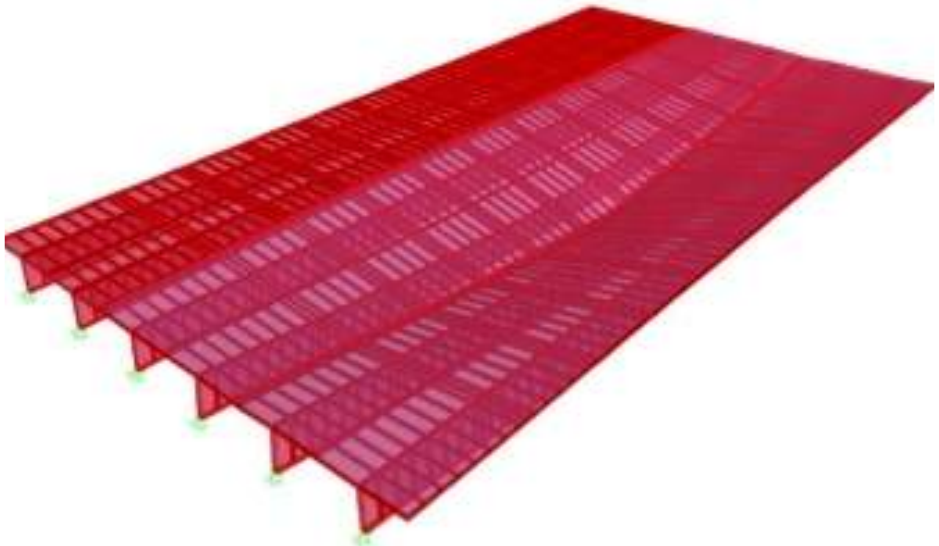
Precast Shear Transfer Repair

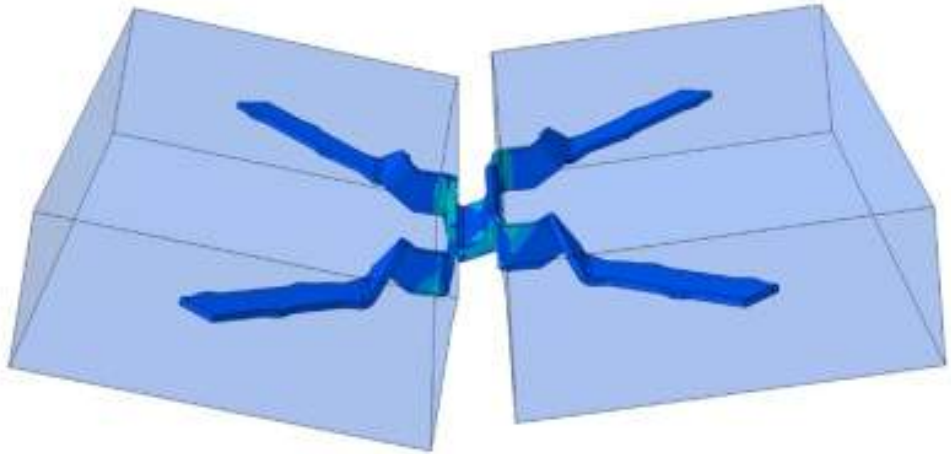


Precast Shear Transfer Repair



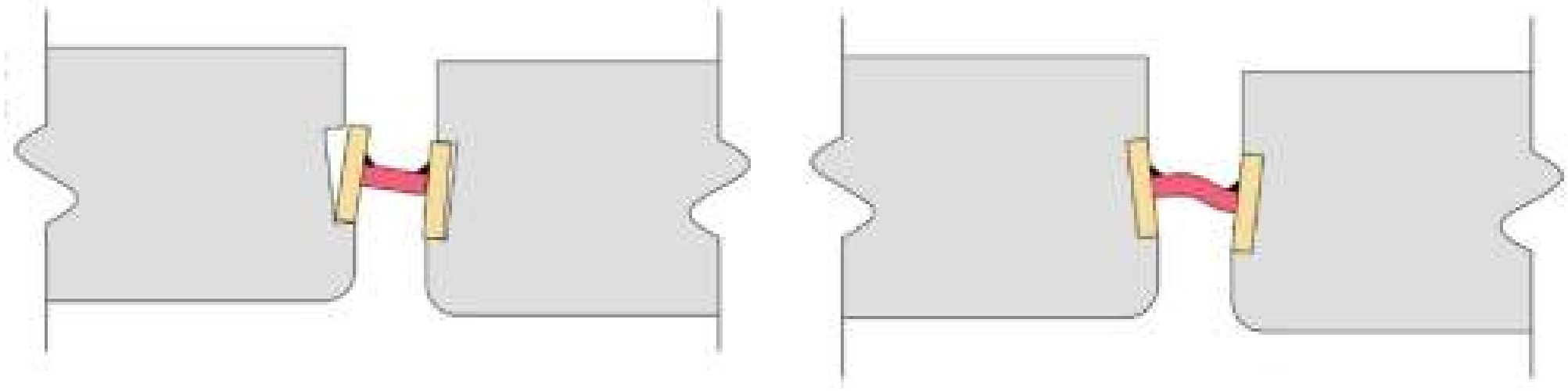
Precast Shear Transfer





Credit: Hendricks, Naito, and Osborn

Precast Shear Transfer



Credit: Hendricks, Naito, and Osborn

Precast Shear Transfer Repair

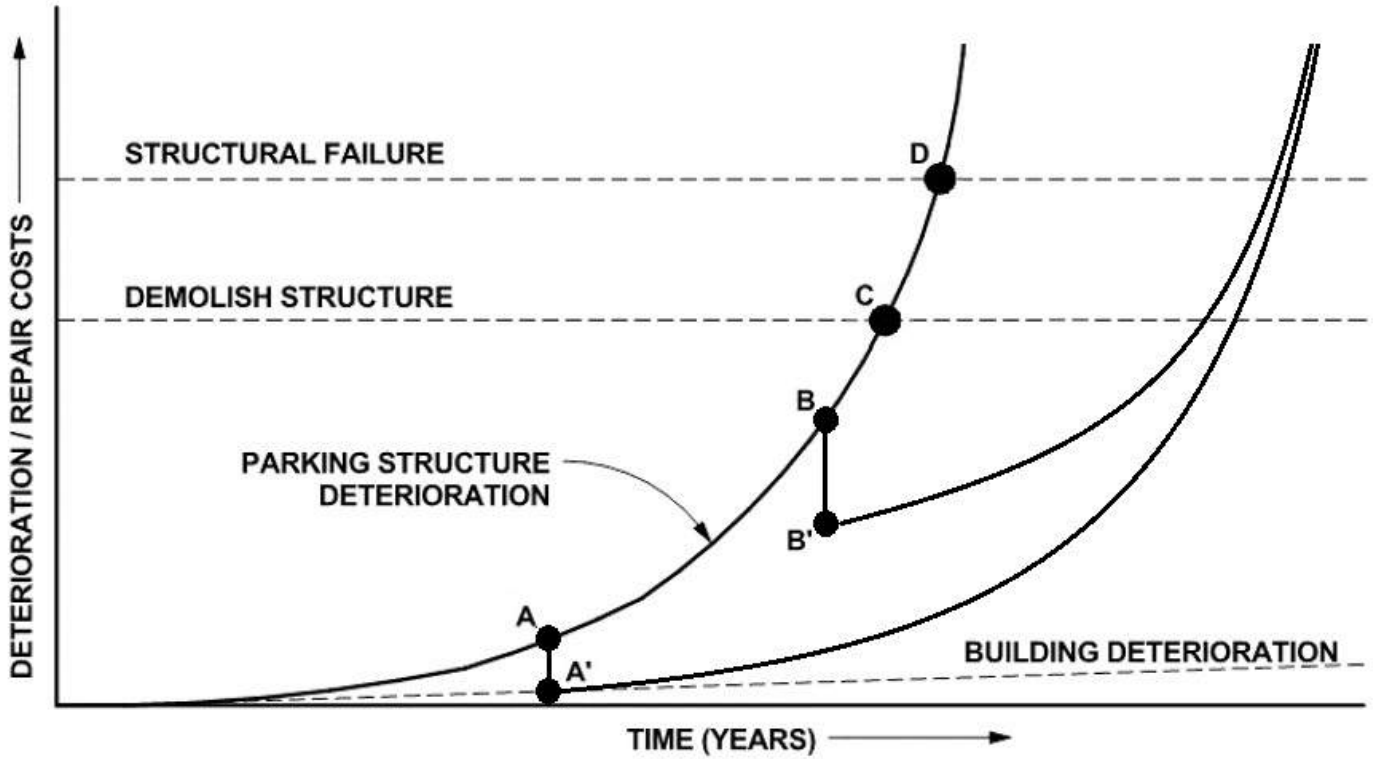
Saw Cut Slab

Prepared Joint
& Biscuit

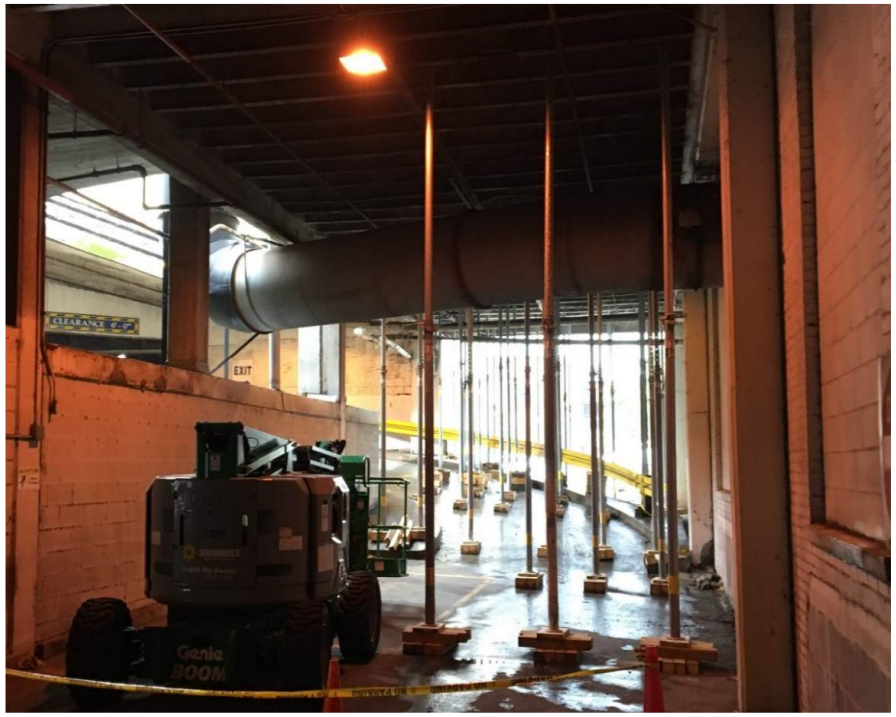
Repair

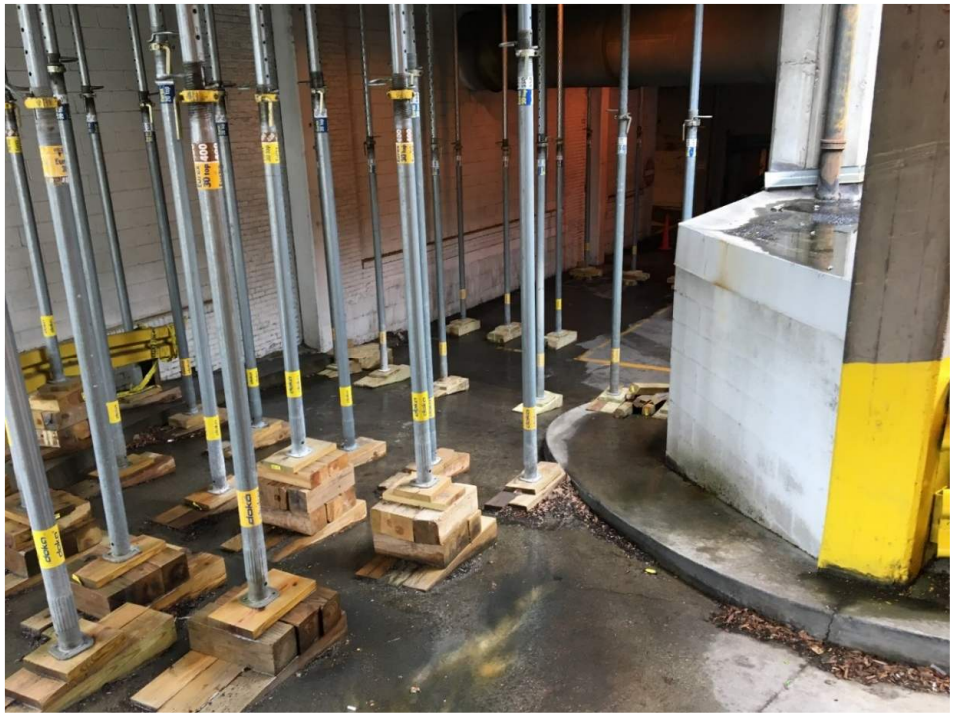
Images by V2 Composites

Maintenance Cost Curve



Reactive Maintenance





Now Demolished

Learning Objectives

- Parking Structures
  - Structure Types
  - Cost Comparison
  - Lifecycle Costs
- Conditions Facing Parking Structures
- Common Deficiencies
- Importance of Routine Maintenance & Timely Restoration

Questions?

Trey Thomas PE
Innovative Engineering Inc.
3380 Trickum Road
Bldg. 500, Suite 100
Woodstock, Georgia 30188
tthomas@ieiusa.com
770-517-5507 Ext. 204