



# Assessment and Repair of a Precast Parking Deck with Construction Defects

Kyle Stanish, Ph.D., S.E., P.E.

Klein & Hoffman

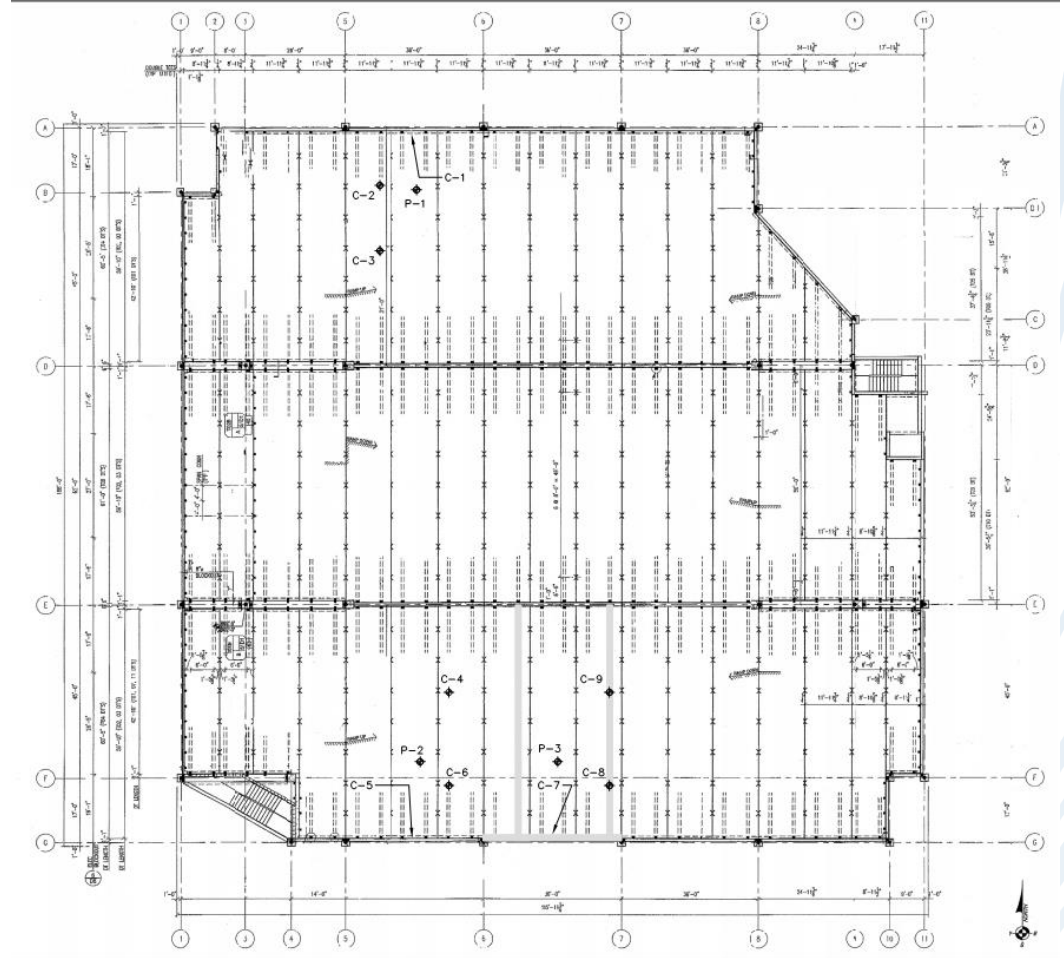
Dan Moser, S.E., P.E.

Walker Consultants

# Background



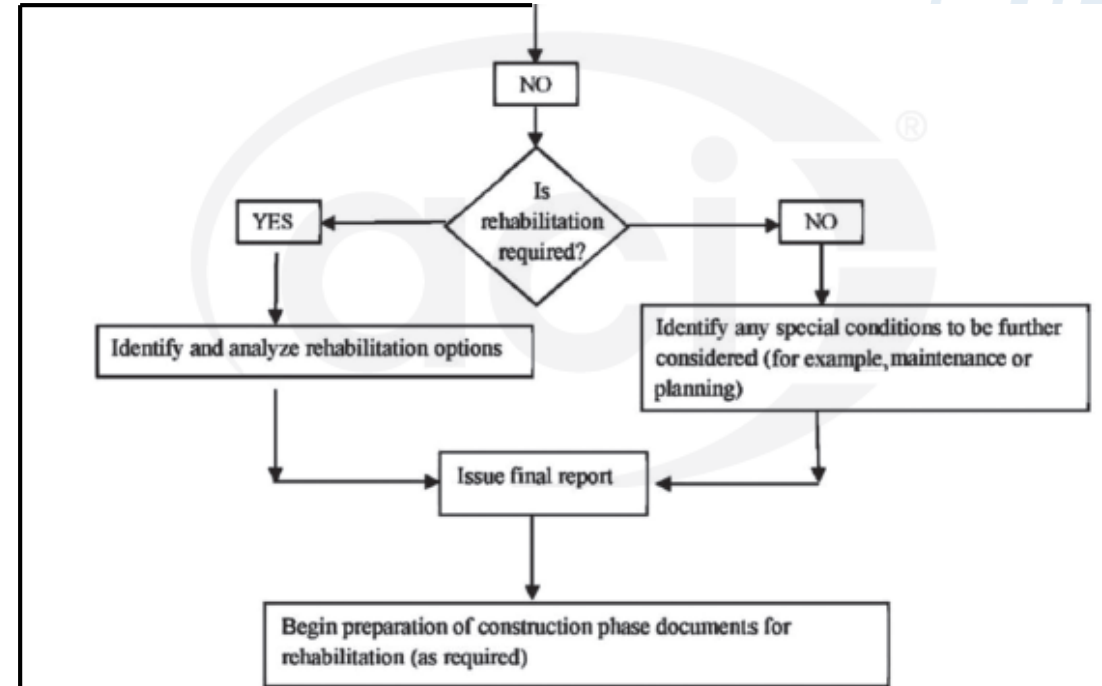
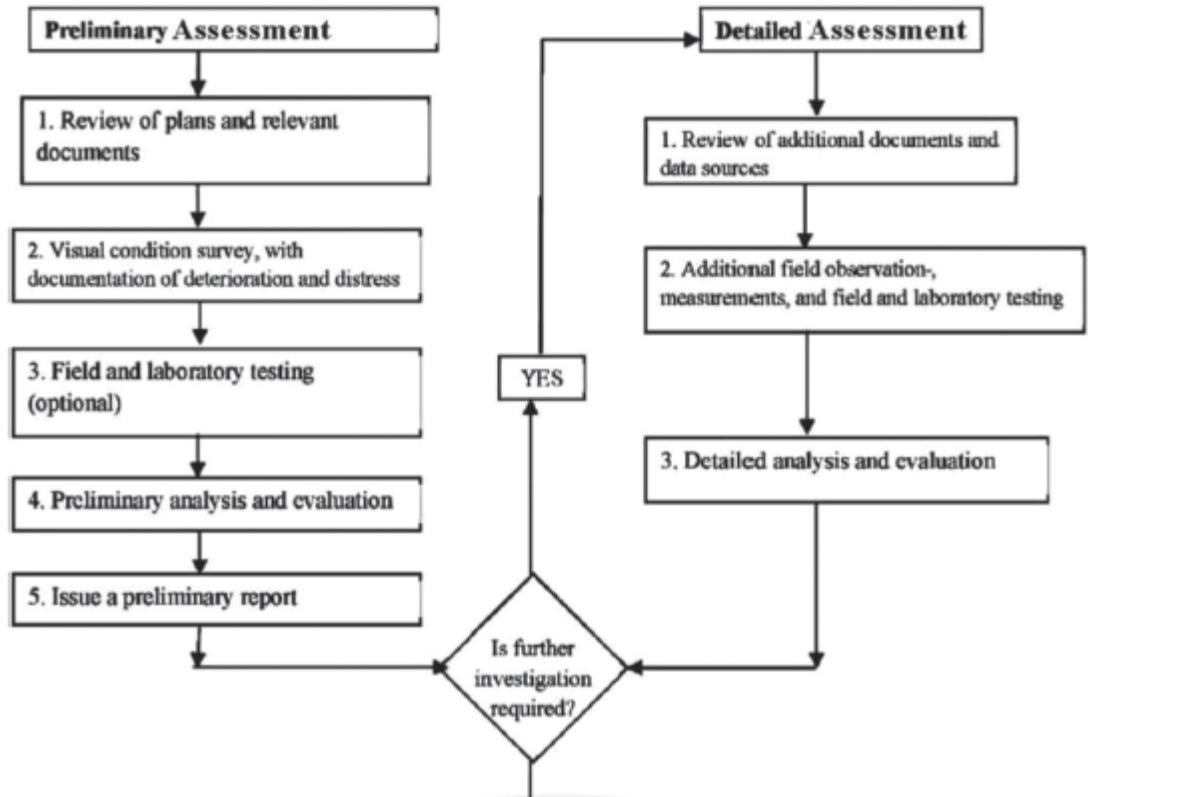
- Precast Parking Structure
- Two supported levels
- Three bays
- Field-topped double tees
- Central bay is a ramp between levels
- Seven years old



# Cracking of Double Tee Stem



# Assessment Procedure



# Assessment Procedure

- 1. Document Review**
2. Field Investigation
3. Testing
4. Evaluation
5. Reporting

## Document Review

- Original Design Drawings :
  - Architectural
  - Structural
- Precast shop drawings and details
- Precast design calculations

# Compared Calculations & Shop Drawings

## CALCULATIONS

- Loads comparison and calculations
- Compare to the structural drawings/requirements
- Span, width, depth requirements

## SHOP DRAWINGS

- Piece drawings for each member
- Compared the shop drawings to the calculations
- Overall Dimensions - Agreed
- Concrete Strength – Agreed
- Number of Tendons – Agreed
- Size of Tendons:
  - Calculations: 0.6 in diameter tendons
  - Shop Drawings: 0.5 in diameter tendons



# Assessment Procedure

1. Document Review
- 2. Field Investigation**
3. Testing
4. Evaluation
5. Reporting

## Crack Documentation

- Characterized the primary crack
  - Location, width at different points, height, looked at both sides
- Other tee stems
  - General location of cracks and width
  - Less detailed look
- Other locations in the parking facility
- **CONCLUSIONS** – the majority of the double tee stems on the lower level were cracked, but not under the roof level

## Hairline Cracking of Other Tee Stems



# Field Investigation



## Other Field Work

- Visual review
- Confirm dimension of members
- Chain Dragging
- Examined tee-to-tee connections

# Assessment Procedure

1. Document Review
2. Field Investigation
- 3. Testing**
4. Evaluation
5. Reporting

# Testing

- GPR Scanning
- Compressive Strength Testing
- Bond Pull-Off testing

# Compressive Strength & Bond Testing

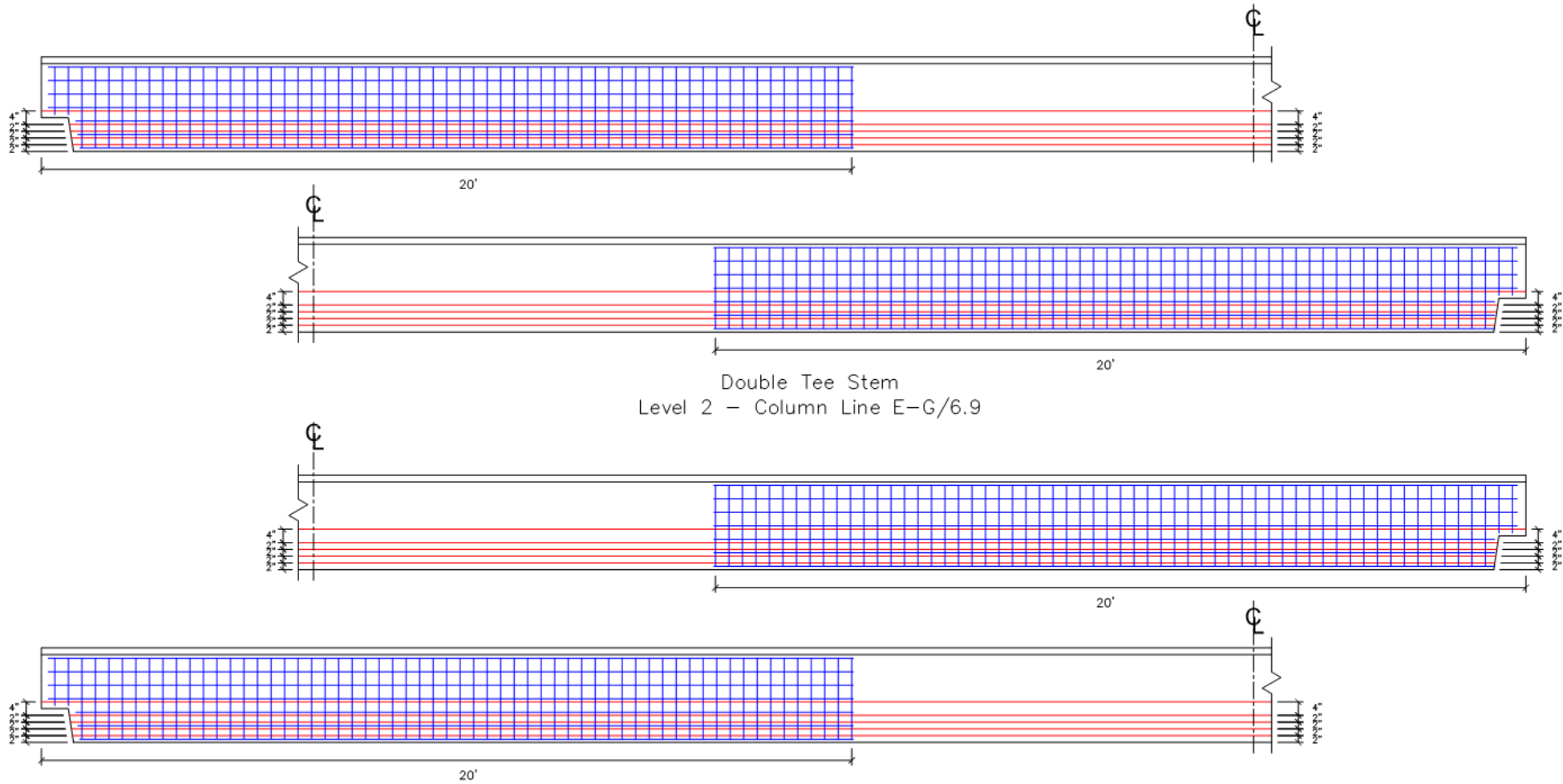
**Table 1- Compressive Strength Test Data**

Core No.	Location	Compressive Strength
		psi
1	Exterior Spandrel Beam Level 2, Column Line A/5-6	15,600
2	Concrete Topping Level 2, Column Line A.5/5.3	5,200
3	Floor Double Tee Level 2, Column Line B.4/5.3	11,660
4	Floor Double Tee Level 2, Column Line E.6/5.6	14,140
5	Exterior Spandrel Beam Level 2, Column Line G/5-6	12,430
6	Concrete Topping Level 2, Column Line F.5/5.6	8,190
7	Exterior Spandrel Beam Level 2, Column Line G/6-7	14,000
8	Concrete Topping Level 2, Column Line F.5/6.8	5,020
9	Floor Double Tee Level 2, Column Line E.6/6.8	9,140
10	Column Line G/5 Level 1	13,580
11	Column Line G/6 Level 1	14,190
12	Column Line G/7 Level 1	15,050

**Table 2- Bond Pull-Off Test Data**

Test No.	Location	Pull-Off Strength psi	Plane of Failure
1	Level 2, Column Line B.2/5.5	286	Concrete Topping
2	Level 2, Column Line E.8/5.5	234	Concrete Topping/Concrete Substrate Interface
3	Level 2, Column Line E.5/6.5	286	Concrete Topping/Concrete Substrate Interface





Double Tee Stem  
Level 2 - Column Line E-G/6.9

Double Tee Stem  
Level 2 - Column Line E-G/6.3

**Legend**

- P/T Tendon
- W.W.F. Reinforcement

# Assessment Procedure

1. Document Review
2. Field Investigation
3. Testing
- 4. Evaluation**
5. Reporting

## Structural Evaluation

1. Confirmed load requirements
2. Calculated member applied load effects
3. Calculated capacities
  1. 0.6 in Strands - OK
  2. 0.5 in Strands – Did not meet strength requirements

# Assessment Procedure

1. Document Review
2. Field Investigation
3. Testing
4. Evaluation
- 5. Reporting**

## Conclusions

- Exterior Post-tensioning of the Double Tee with the large crack
- FRP Strengthening of remaining double tees

# Repairs



















# Conclusions

## ASSESSMENT PROCEDURE

1. Document Review
2. Field Investigation
3. Testing
4. Evaluation
5. Reporting

Following a process for assessment improves the quality and completeness of the assessment.