NOVEL SUPPORT FOR A TOWER CRANE

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Learning Objectives

• Project Logistics
• Design Considerations for supporting a tower crane
• Tower Crane Assembly/Disassembly Process
• Requirements for Mobile Crane Installation in public way
THE PROJECT

NEW 18 STORY,
150,000 SQ. FT,
VERTICAL EXPANSION
TO EXISTING 4 STORY
1980’s GARAGE
ADJACENT TO 1930’s
VIADUCT
SITE
LOGISITCS

Dock and Hoist
- Limited Space
- Location Options
- One Small Hoist

No laydown area for materials
- Canopy over 405 Dr.
- Crane access to canopy
SITE LOGISTICS
CANOPY OVER RIVER PLAZA

No laydown area for materials
- Canopy over 405 Dr.
- Crane access to canopy
- Designed for 250 psf LL
- Large reaction loads on existing structure checked
THE DESIGN

PROBLEM:
• Need crane
• Logistics/public requirements
• Existing structure
• Adj. To 1930’s viaduct
• No new foundations

SOLUTION:
• Design “floating” crane pad that levitates 18’ out and 8’ over public way!
THE DESIGN

- No New Foundations!
- All crane loads supported by existing belled caissons
- No loads applied to Wabash Viaduct
- Sloping W14 struts supported on new conc corbels added to ex. 10” E-W walls btwn G-3 & G2
THE DESIGN

Review of 1973 boring logs, 1975 caisson field records & additional borings with pressure meter tests

Allowable design bearing pressure of 30ksf at -80CCD

Extensive concrete core testing

$f_c = 5500 \text{psi for ex. caisson & } f_c = 5000 \text{psi ex. cols, walls}$
THE DESIGN

- Tower Crane fdn added to shared SEOR ETABS model
- Load Combinations w/ TC forces added
- ETABS model include ASCE 37 temp. structure 0.85 reduction factor. During construction, LL is assumed to be 50% full design LL
- Building check for additional Tower Crane forces:
  - Caisson Vertical Reaction
  - Story Forces
  - Story Drift
- Tower Crane Beam Design
- W14x211 Strut Design
- Corbel Design
- Strut Connection Design
  - W14- TC Mat Connection
  - W14- Corbel Connection
- Existing column check
LIEBHERR 200 HC  
120' RADIUS MAX  
REACH  
14,110 LBS CAPACITY
LIEBHERR 200 HC
PHASE 1: FREE STANDING
- 8 TOWER SECTIONS 149’ HH
PHASE 2: TIED-IN
- 15 TOWER SECTIONS 244’ HH
NOTE: THE ABOVE CONNECTION PIN REACTIONS ARE FOR THE CLIMBING SEQUENCE SPECIFIED ON THE ATTACHED PAGES AND THE STRUT LAYOUT INDICATED ON THIS PAGE. IF AT ANY TIME THE CLIMBING SEQUENCE OR STRUT LAYOUT SHOULD CHANGE, MEC'S ENGINEERING DEPARTMENT MUST BE NOTIFIED TO DETERMINE IF THE CONNECTION PIN REACTIONS HAVE CHANGED.

TRANSFER OF UNBALANCED MOMENT IN SLAB-COLUMN CONNECTIONS

1. ALL TIE-IN ASSEMBLY COMPONENTS SUPPLIED BY CONTRACTOR MUST BE DESIGNED BY AN ENGINEER REGISTERED WITH THE PROJECT LOCAL JURISDICTION.
2. CYCLIC LOADS WITH REVERSAL WILL OCCUR. ALL BOLTS SHALL BE DESIGNED AND TENSIONED FOR CYCLIC LOADING CONDITIONS.
3. THE TRANSFER OF UNBALANCED MOMENT IS ONE OF THE MOST CRITICAL DESIGN CONDITIONS FOR TWO WAY SLAB SYSTEMS. THE CONCRETE FLOOR SHALL BE DESIGNED AND REINFORCED AT EACH TIE-IN ASSEMBLY FOR TRANSFER OF ECCENTRIC LOADS BY SHEAR AND FLEXURE IN THE SLAB PER ACI 318 BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE.

MANUFACTURER'S TIE-IN COLLAR (SUPPLIED BY MEC)
MANUFACTURER'S DOUBLE CONNECTION SHOE (SUPPLIED BY MEC)

ADJUSTABLE END PIECE (TYP.)

CONNECTION PLATES (DESIGNED AND SUPPLIED BY CONTRACTOR)

LEVEL 11 FRAMING PLAN SHOWN

REVISED TIE-IN FORCES AND TIE-IN FOOTING FORCES 09. 15. 18
Construction

- Critical path
- Field verification
- Select the right mix!
- Demo considerations
CONCLUSIONS

- Think outside the box
- Need LOTS of info, FAST!
- Requires team effort
- Careful planning & execution
Thank You!