IRPO Day Presentation

IPRO 315, Spring 2008
Design of Large Scale Structure
Automated Parking Garage

Name  Major  Name  Major
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* Group Leader
** Project Record Keeping/Liaison
with IPRO Office
Civil Group

Completed in Fall 2007
- Preliminary traffic flow
- Preliminary site plan

Completed in Spring ‘08
- Design horizontal curves or intersections for traffic flow conditions
- Correct/update site plan
Problem

- spillover of cars onto 31st Street due to parking garage
Solution

• Provide access between 31st St. and 33rd St. via Wabash
HOLLOWCORE FLOOR PLANK BEARING ON INTERIOR STEEL BEAM

STAIR DETAIL

SCALE: 3/32" = 1'-0"
Architectural Group
Structural Group - Members

Three Common Failure Modes to Check For:

- Bending
- Vertical Shear
- Horizontal Shear
Shear Diagram

Moment Diagram
Structural Group - Members

Connection Detail

Diagram with labels: E70, 4x4x1/2
Structural Group – Wind Load

Loads: LC 6, DL + .75LL + .75SL + .75WL

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Moment Frame cl_E

Apri 24, 2008 at 5:12 PM

Moment Frame cl_E-04.13.r2d
Moment Diagram – Indicates High Stress Points

Results for LC 2, DL + LL
Member Bending Moments (k-ft)
Reaction units are k and k-ft

Moment Frame cl_E

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Apr 24, 2008 at 5:18 PM
Moment Frame cl_E-04.13.r2d
Structural Group – Wind Load
Structural Group - Foundation
Placing Cars via Comb System
Logistics

• # Cars Parked vs. Time

• Time to park a car:
  Max: 1 min 27 sec
  Min: 40 sec

• Time to fill up garage:
  2 hr 10 min
Sensors

- Photo-Eye & Infrared
- Heat sensors
- Cameras
Engine / Gearbox Selection

High Torque GE Motor
- Vertical
- Horizontal

Optimization
- Created excel spreadsheet
- Designed gearbox
- Reduced est. cost by 1751%

1800 RPM → 100 RPM
Elevator Structure
SAP 2000 11 Analysis

- Find Resonant Frequency
  - Why?
- Force and deflection at joints
  - Why?
  - Failure
Dynamic Analysis

- Resonant Frequency
  Analysis $f = 0.52$ Hz
  Motor $f = 30$ Hz
  Analysis $f \neq$ Motor $f$

- Deflection
  Analysis $\delta = 0.0015$ in
  Standard $\delta < 0.0025$ in

- Force at joints
  Negligible
Construction Management Group

Current Status

- Completed AIA A201 General Conditions Contract
- Completed parametric estimate

Goals for Spring 2008

- Provide contract documents needed to complete a project manual
- Provide a project cost estimate
Utilized standard AIA documents for contracts to be included in project manual.
Construction Management Group

- Parametric Cost Estimate: $9.8 M
- Final Cost Estimate: $13.3 M
Green Options

- Costs $2,459,000
- 21.4 years to pay back
- 30 years predicted
- 25 year Warranty
- Green Roof
- Grants