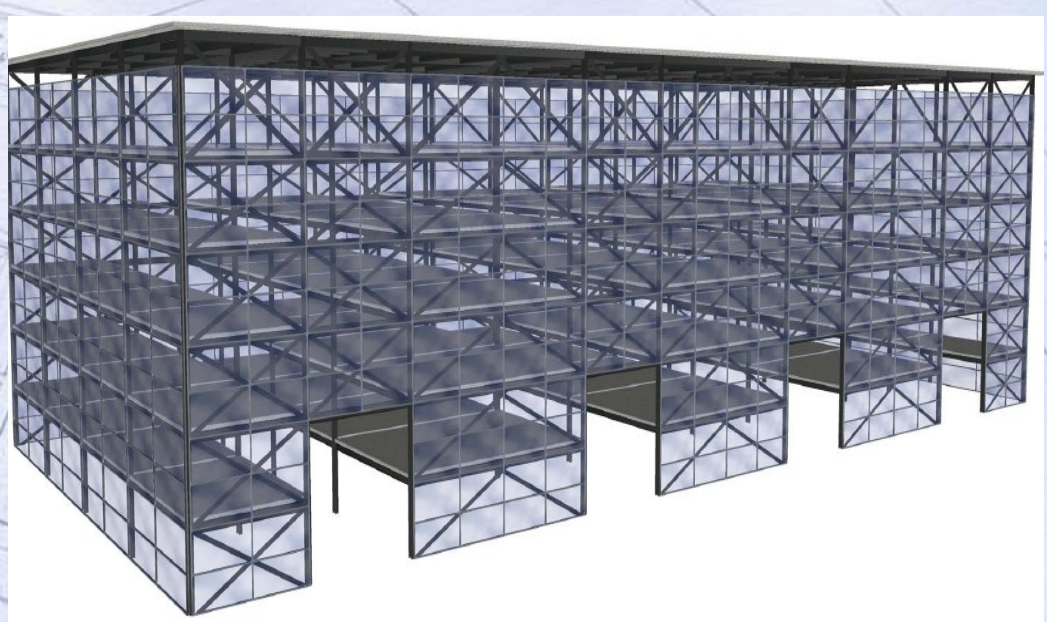
ILLINOIS INSTITUTE OF TECHNOLOGY

IPRO 457-315
Design of a Large Scale Structure



IPRO 315 large scale structure Team

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Professional Consultant: Jie-Hua Shen

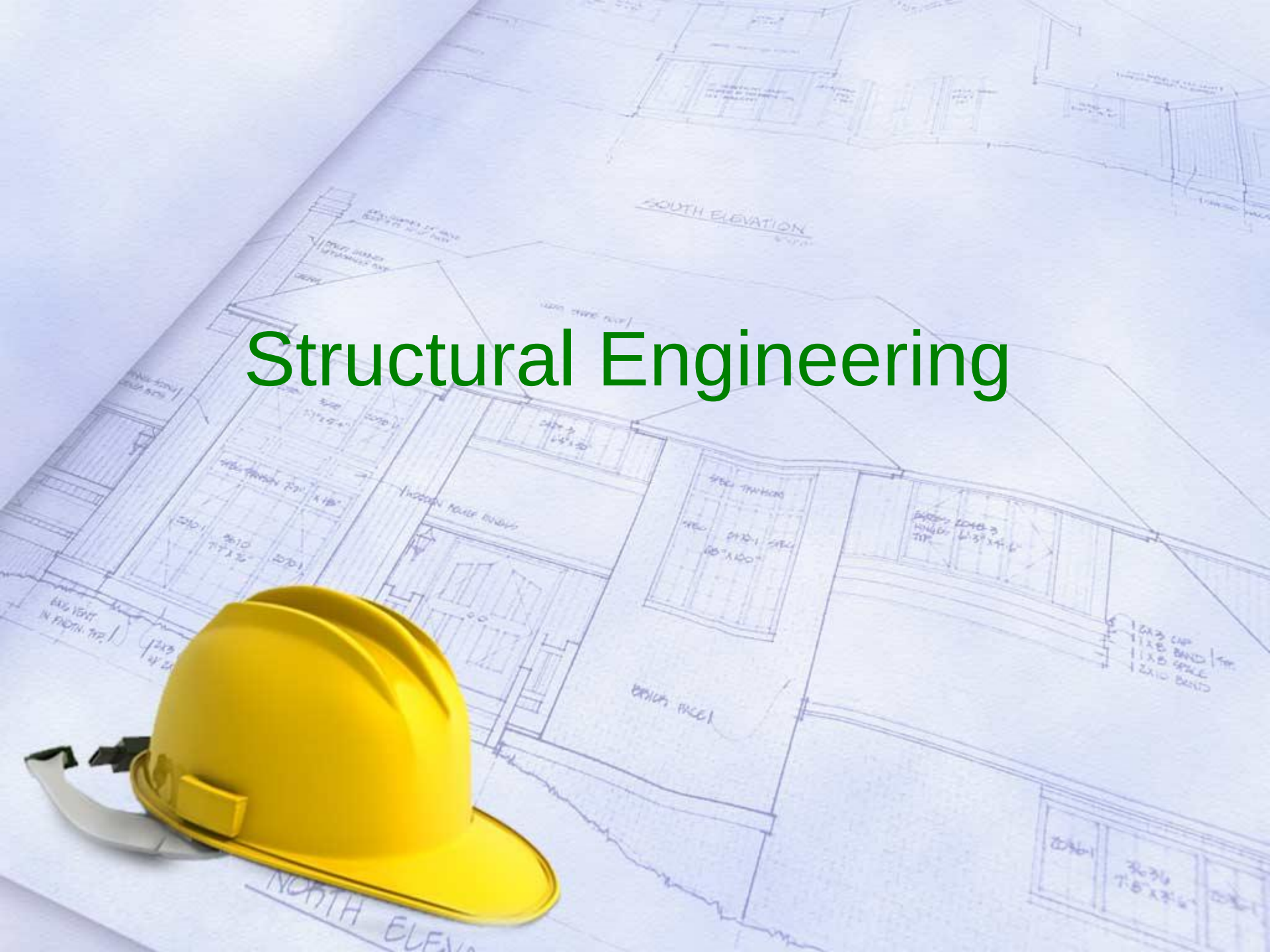
Research

- All research to date involves current automated automotive parking garage structures
- There are several similar projects both in the united states and Europe
- These projects utilize a variety of methods to lift the cars and place them in the parking racks

IPRO 315 Sub teams

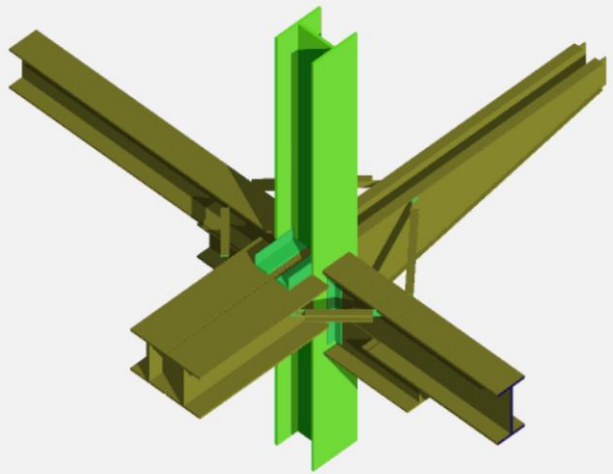
- Architecture
- Architectural Engineering
- Structural Engineering
- Mechanical Engineering
- Transportation Engineering
- Cost Estimating

Structural Engineering



Step 1: Conceptualization

- *Necessary Features*
  - ❑ Small Footprint
  - ❑ Reliable Strength and Safety
  - ❑ Attractive Appearance
- *Options*
  - Reinforced Concrete vs. Steel Frame Structure
  - Automated vs. Self Park



Step 2: Design

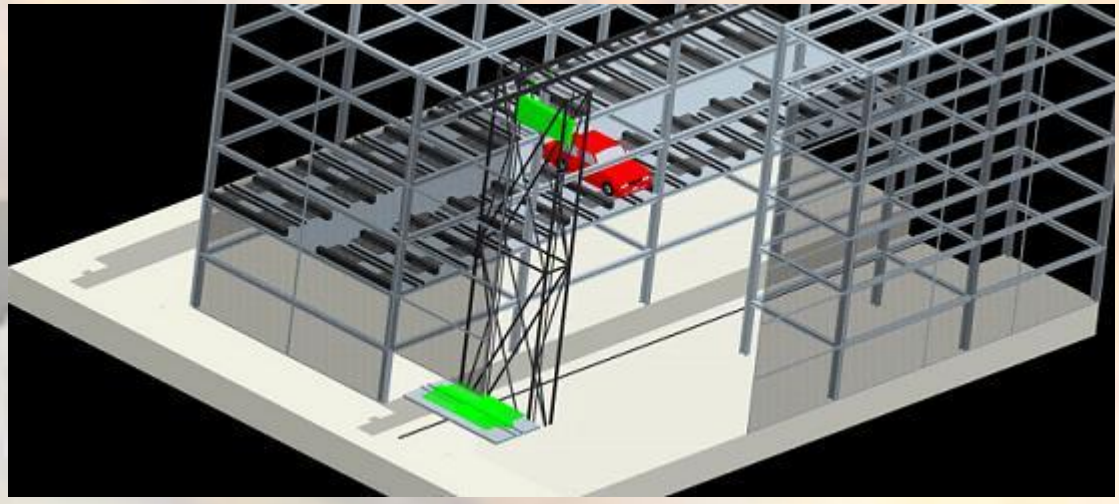
- *Steel Frame Structure*
  - ✓ Allows for Compact, Efficient Design
  - ✓ Lateral Force System:
    - ✓ Braced Frame in N-S Direction and Moment Resisting Frame in E-W Direction
    - ✓ Allows for Clearance Necessary for Automated Parking System
  - ✓ Gives Structure "Industrial" Look

Step 3: Details

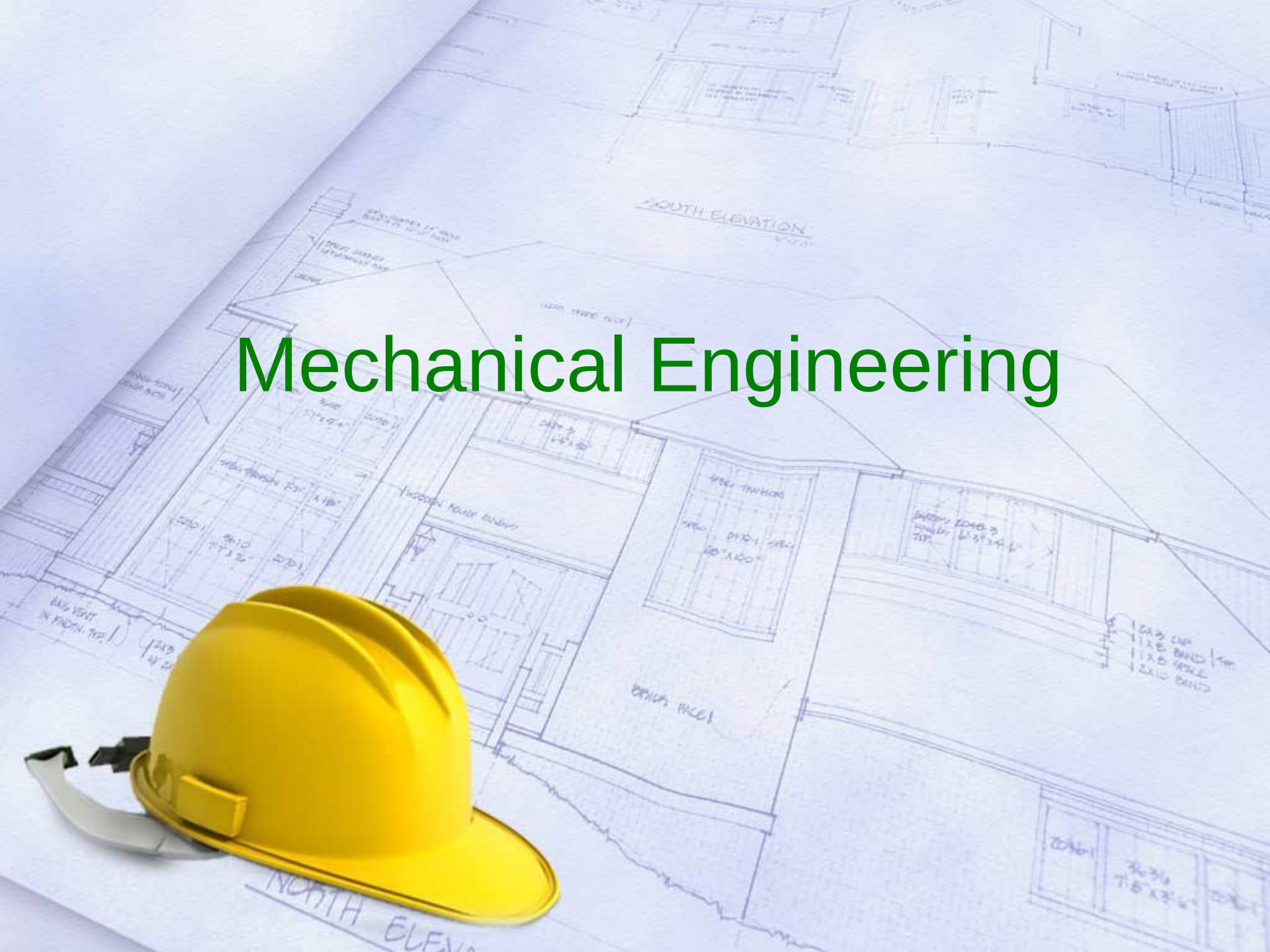
- *Braced and Moment Frame Details*
  - 3 Braced Frames on each side
  - Braced frame 1st Floor (2L6 X 4 X ½) 4th floor (2L5 X 3 ½ X ½)
  - 1st floor Center Columns (W14 X 61) – Moment Frame
  - 4th floor Center Columns (W14 X 48) – Moment frame
- *Roofing Detail*
  - non composite deck 4.5 deep, 2.5” thick and weighs 45 psf.
  - Interior beam design
    - Beam - W16 X 57
    - Girder – W18 X 35

Design Model

Example of part of the structure computer model.



Mechanical Engineering



Outline

- Moving elevator structure, steel construction. Elevator moves on rails in conveyor aisle between parking spaces.
- Driver leaves vehicle at entrance, elevator picks up vehicle at entrance, transfers to vacant bay on desired level
- Elevator retrieves vehicle from bay, moves vehicle to ground level exit, driver picks up vehicle at exit

Research

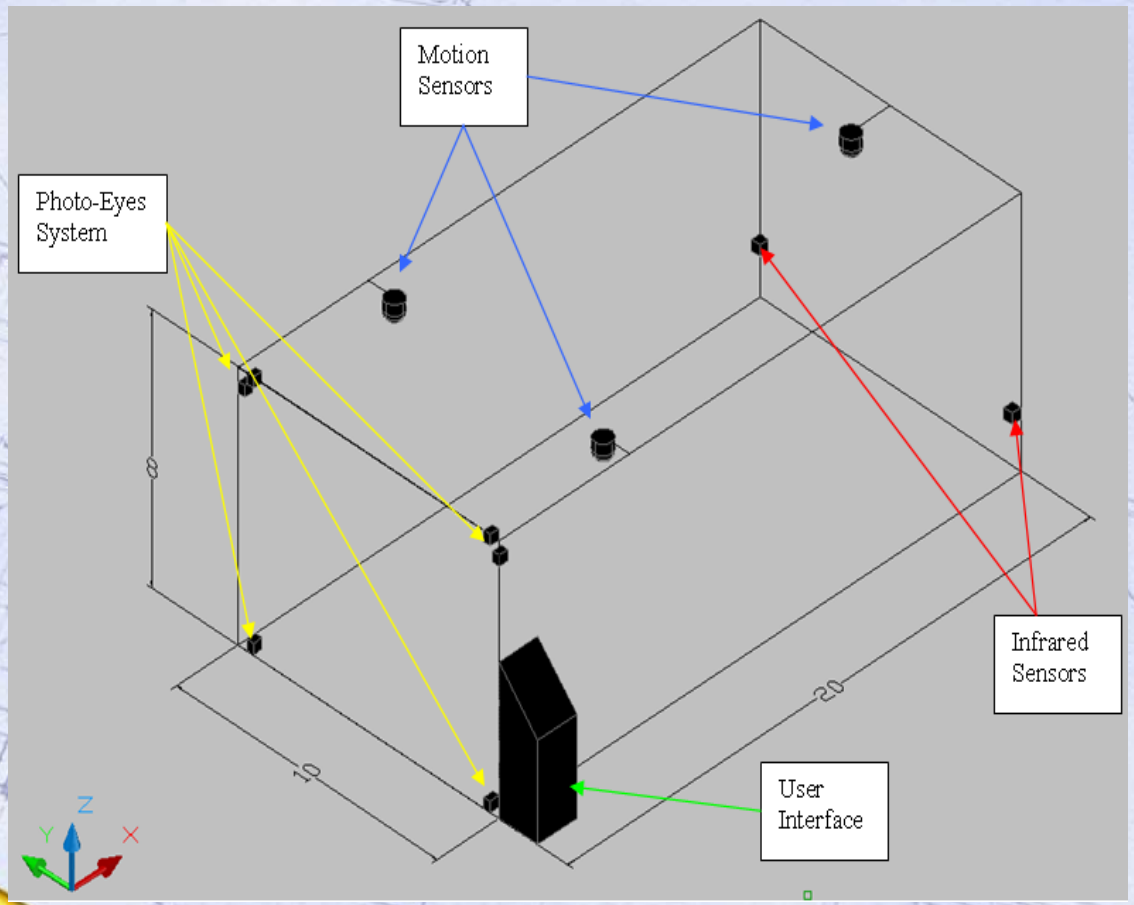
- Types of elevator systems, hydraulic, pulley systems.
- Types of vehicle transfer systems; pallet system, roller system, comb system
- Research on sensor systems
- Research on elevator structure and construction
- Research on elevator components

Design and Calculation

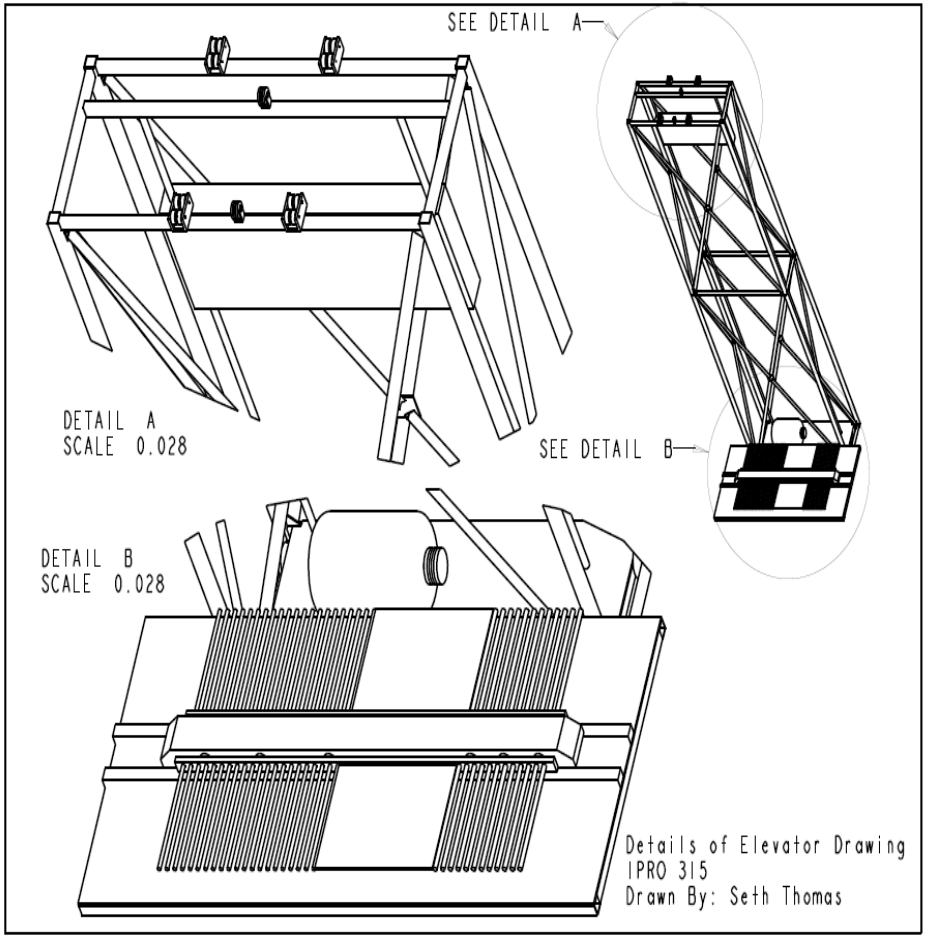
- Elevator structure, total weight of moving structure
- Elevator platform design, pulley system and counterweight design
- Elevator-to-bay transfer mechanism design
- Structure movement mechanism

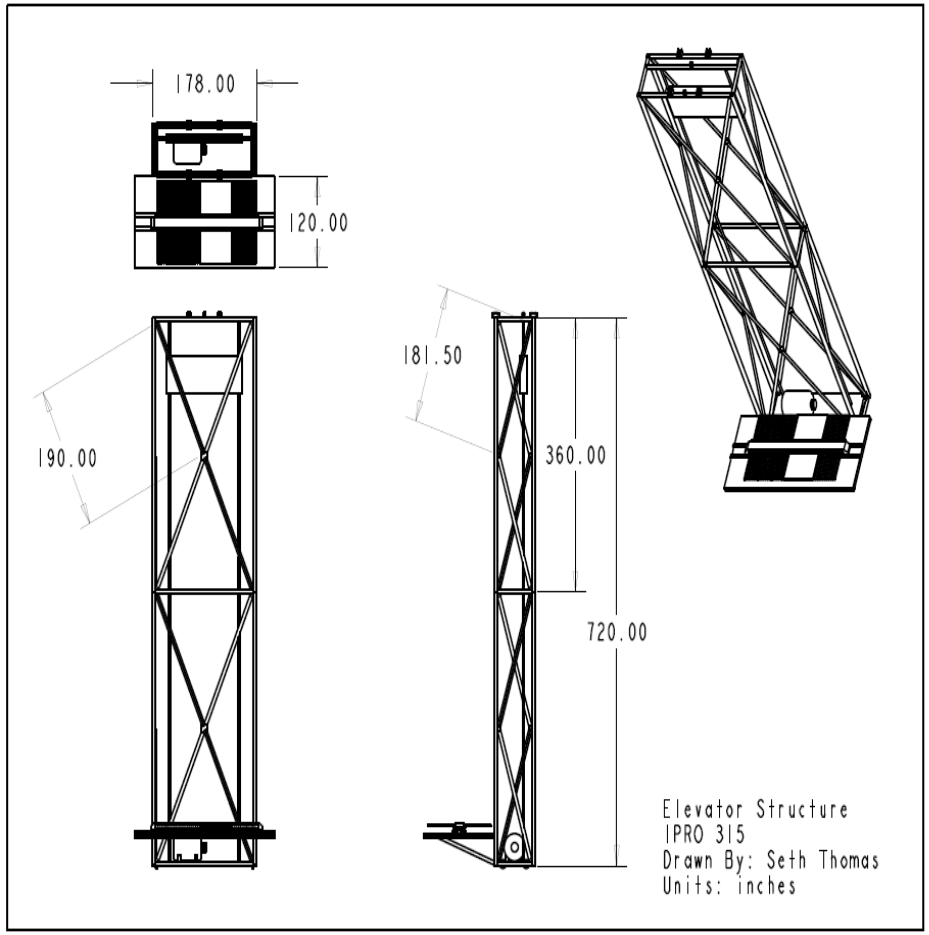
Parking Entrance Sensor Requirements

- Entrance must complete the following tasks:
  i. Check the vehicle dimensions.
  ii. Check if vehicle is correctly placed on elevator platform.
  iii. Check if anyone is in vehicle before parking.
- Requirements (i) and (ii) are met by using LTW's system manufactured by SICK called the "Photo-eyes" system and infrared sensors.
  – Patron will be directed by light system.
- Requirement (iii) is met by using motion sensors
- All systems routed to outside control box and user interface.

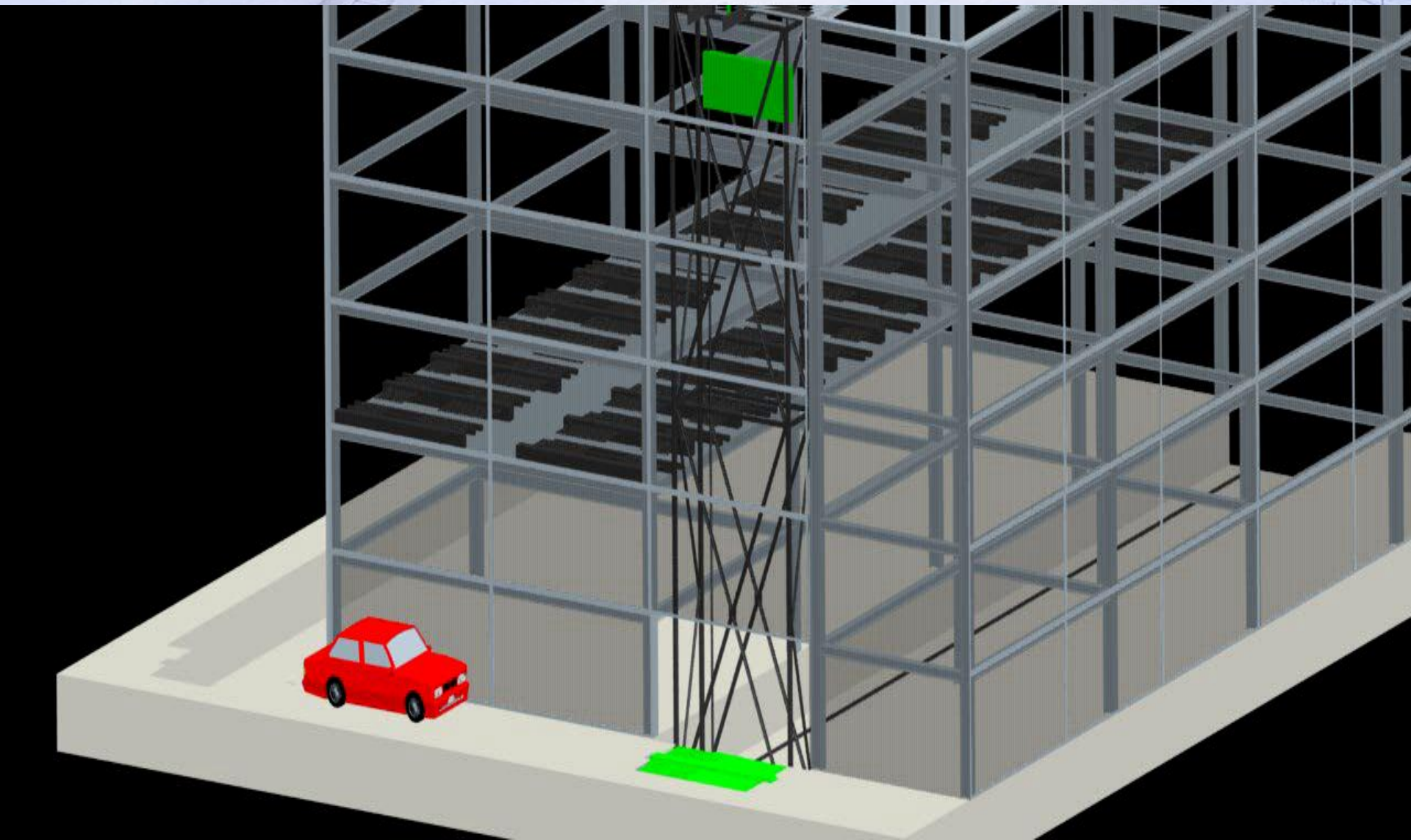


Elevator Structure

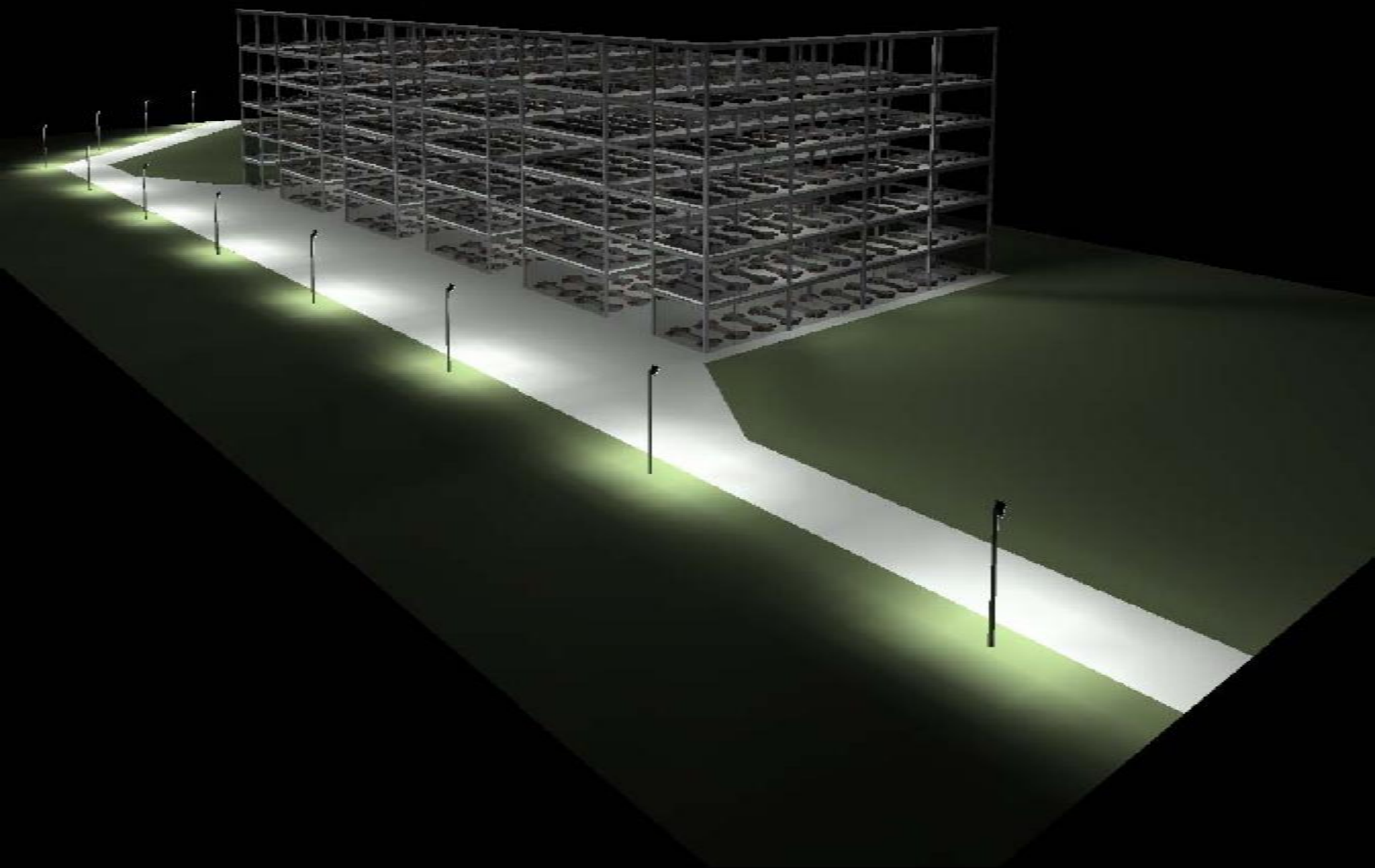




Elevator Platform



Architectural Engineering



LIGHTING DESIGN

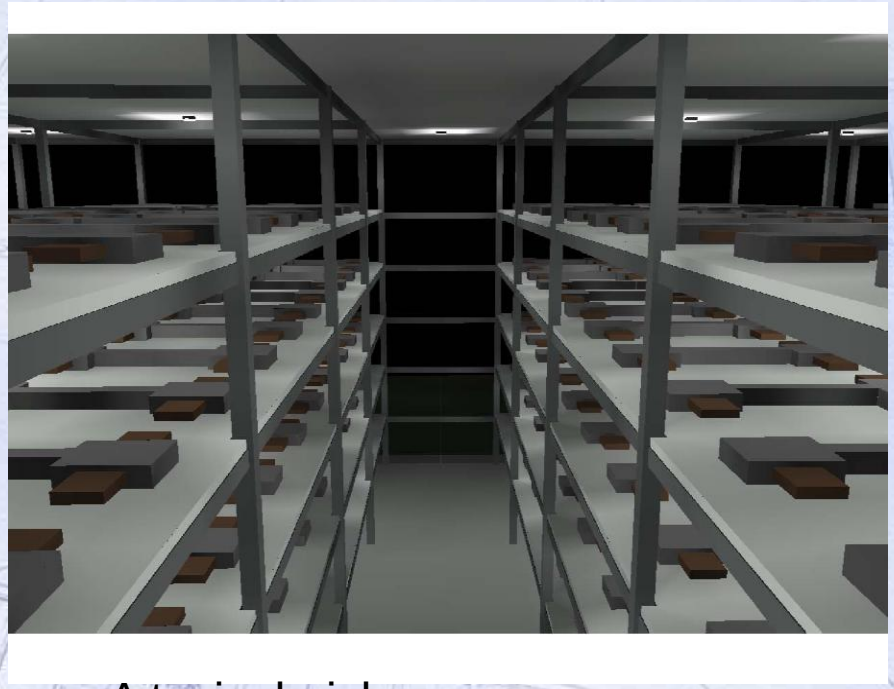
Bay:
- Metal Halide
- 95 Watts

Aisle:
- Compact fluorescent
- 426 Watts

Outdoor:
- Metal Halide
- 465 Watts

•17.1 kW required to run lights

Driving up to the garage



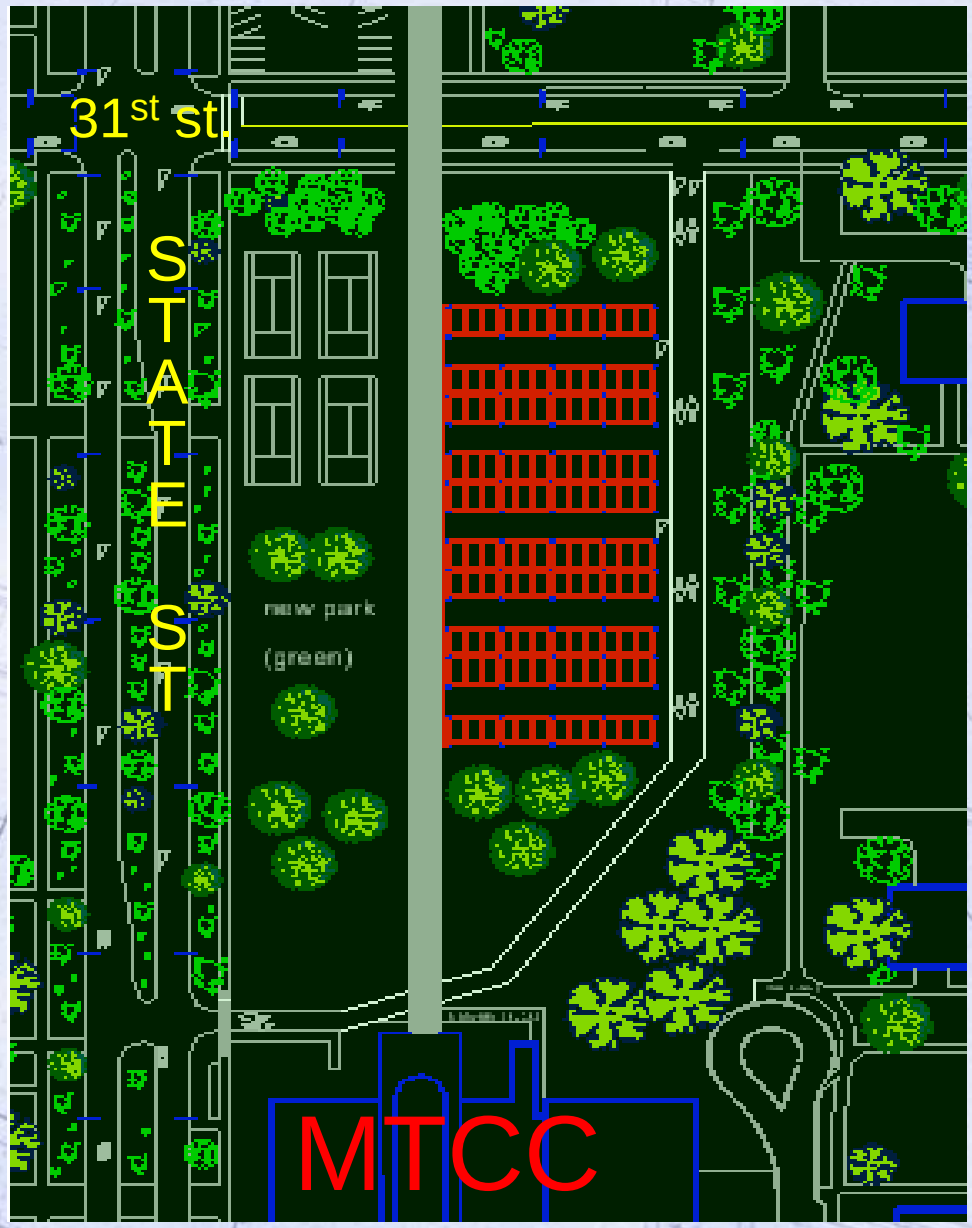
•A typical aisle

•Fluorescent lamps will last up to 20,000 hours. Metal halides up to 30,000 hours.

TRANSPORTATION ENGINEERING

Site Design

- Site geometric redesign using programs such as Google Earth and Microstation.

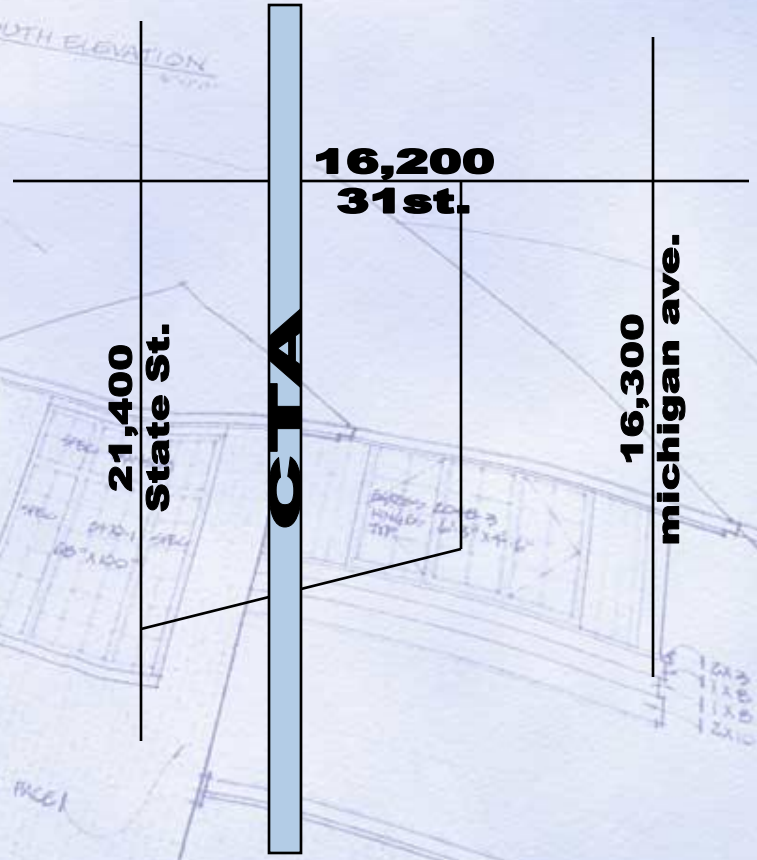


(Pavement marking and traffic flow plans being creat

Average Annual Daily Traffic

Surrounding Streets of Site

- State Street 21,400
  about 15cars/min
- 31st st. 16,200
  about 12cars/min
- Michigan Ave. 16,300
  about 12cars/min



Traffic conclusion:

Countermeasure studies show that lane widening or turn lane additions are not recommended because the garage wont affect traffic flow considerably. The existing lane conditions are more than adequate.

Return of Green Area

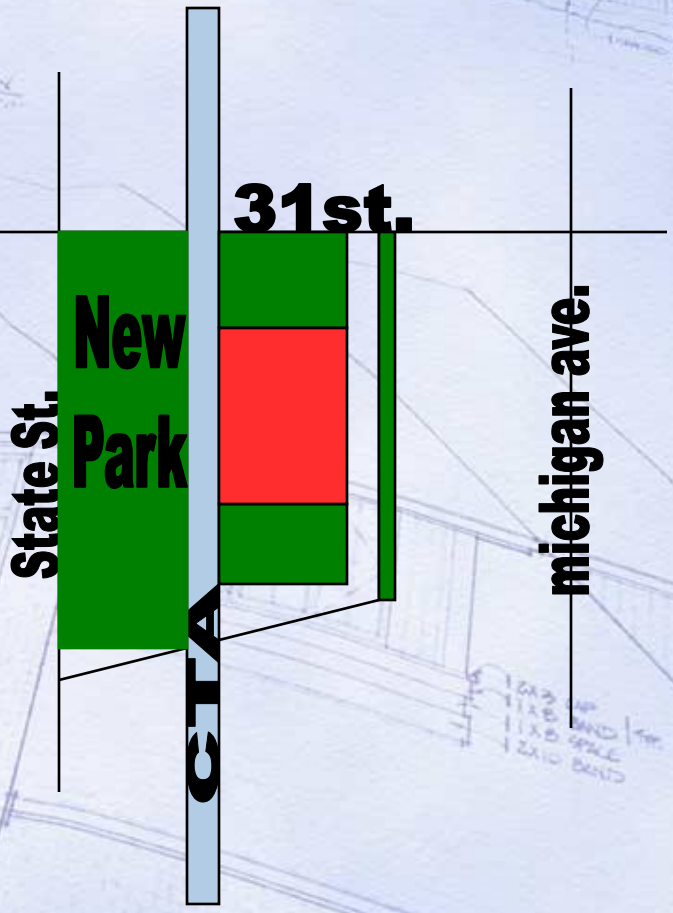
New IIT Park
(Existing pay lot
west of track) 51,000sf

Improved Landscaping
(East of track, north,
south, and east of garage
driveway.) 41,000sf

Total Square Feet = 92,000

Existing conditions are at about 450 spaces.

Proposed garage is at 600 spaces.



Final Layout

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