Automated Shipping Container Transport System Development

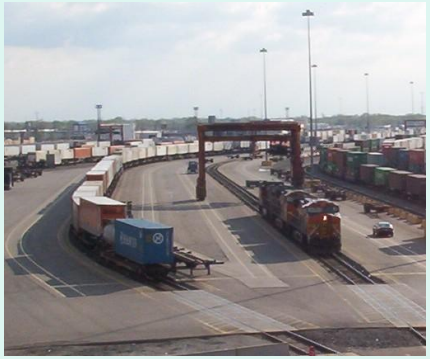
IIT/IPRO307
Spring2005

We are doing a third I-Pro on the same subject because

- Intermodal (rail-highway) is a defining industry in the region: 87,000 jobs **(ref Chicago Metropolis 2020 freight plan)**
- Future projections (volume growth) indicate serious issues (capacity; actual handling processes). Freight is doubling in 7 years.
- Potential for a win-win-win-win situation in the form of: Congestion relief; Air quality benefit; Livability improvement; Conservation.
- Big project

This semester's project consists of:

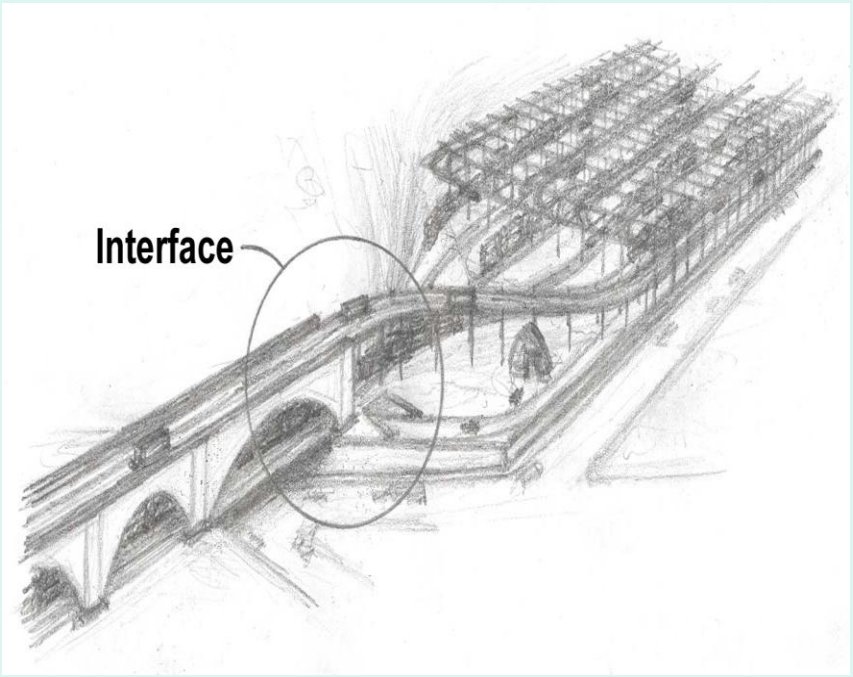
- Two parts-- which can be separate or complementary
- Part A: **Intra**yard handling



Part B: **Between**-yard movement (configured as a truckway expandable to serve the **Intra**yard shuttle)

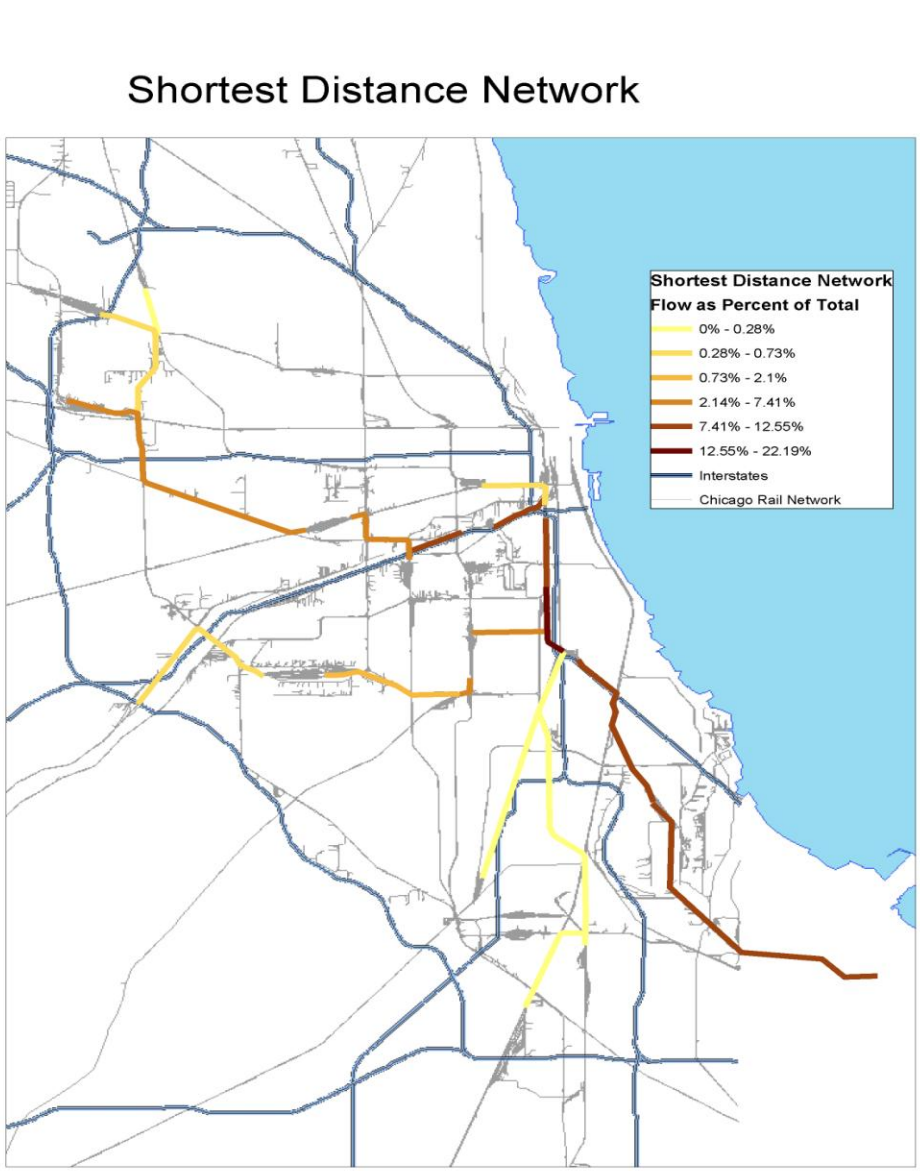
Spring ‘04 ACCOMPLISHMENTS

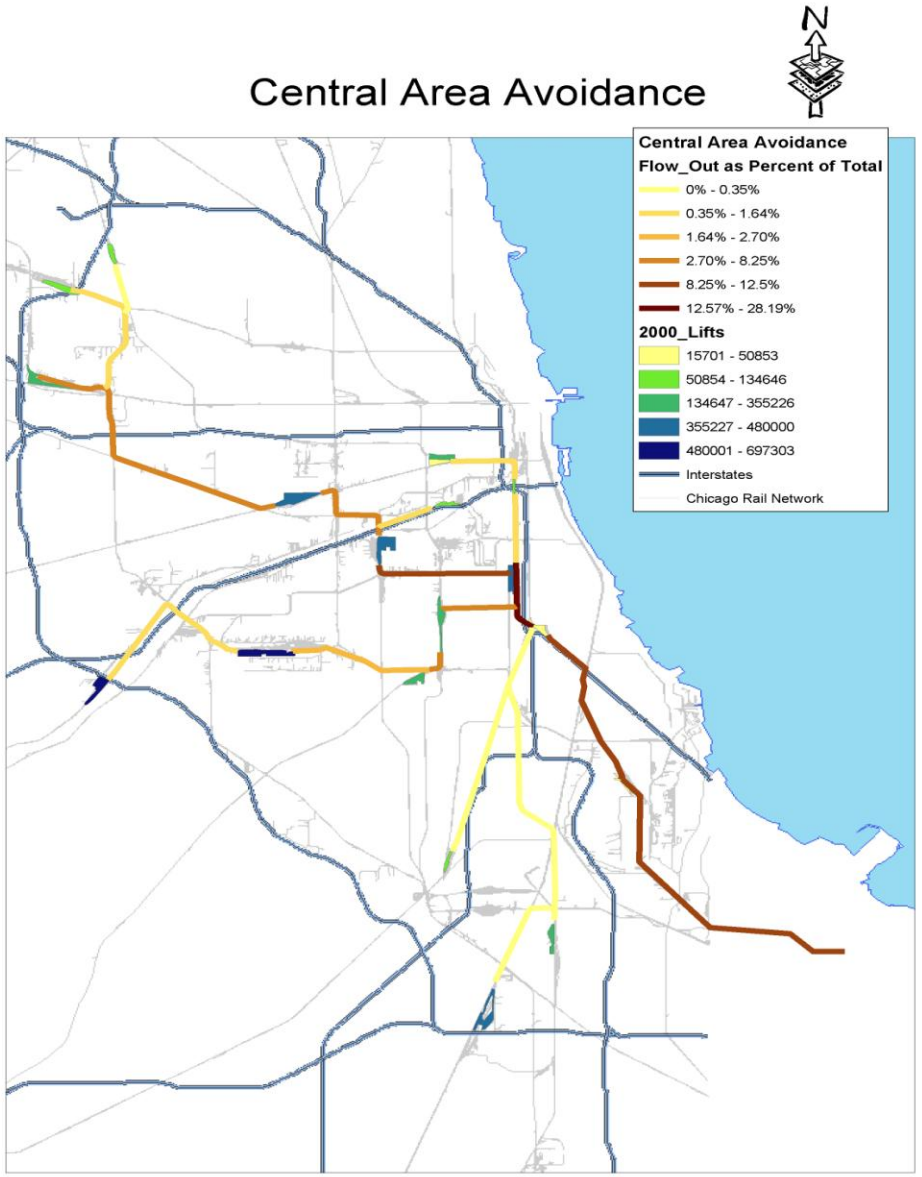
Grid-Rail (GRAIL) Over Head Lattice Concept



Inter-Yard Structure Concept

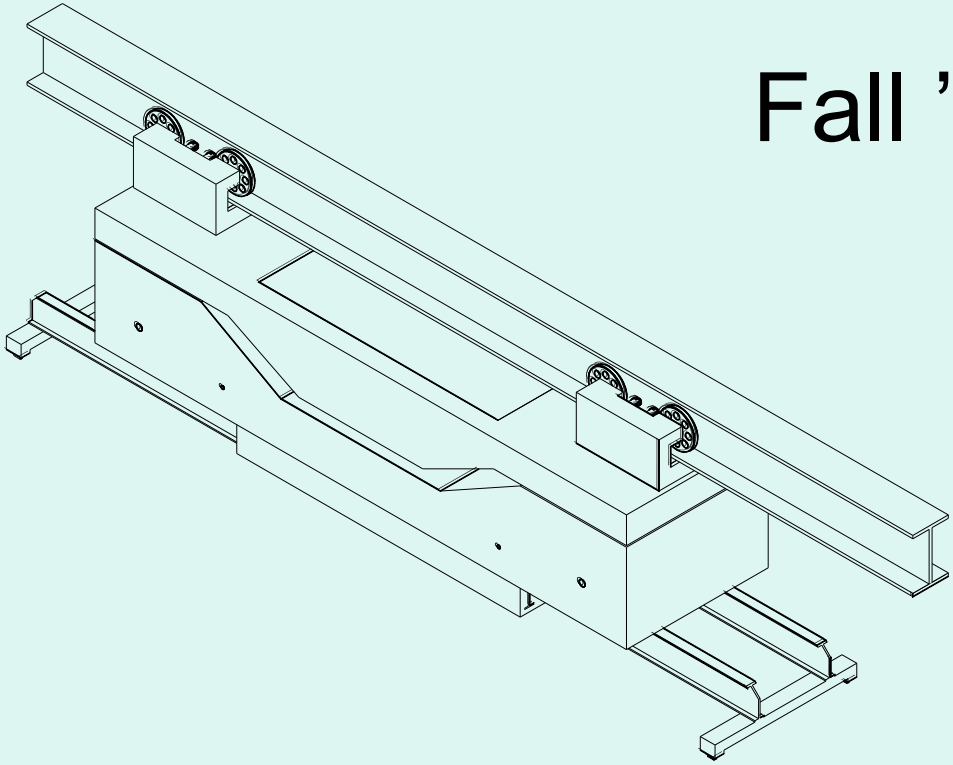
Fall ’04 ACCOMPLISHMENTS

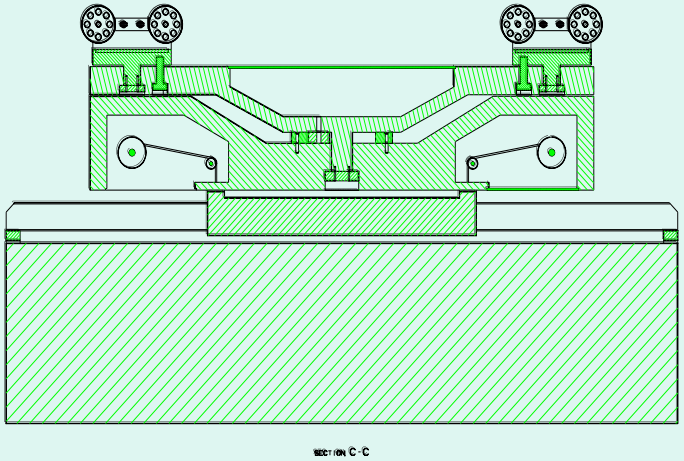


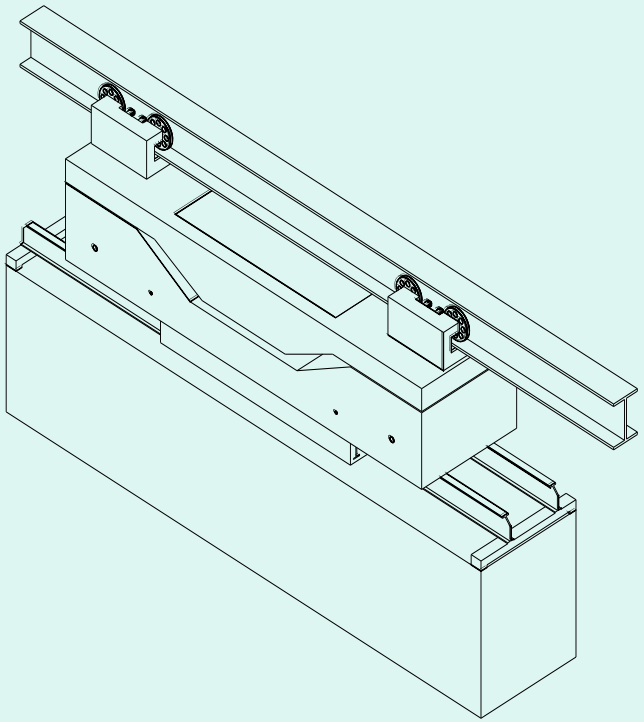


November 29, 2004

Fall ’04 Shuttle Design







TEAM MEMBERS-RESPONSIBILTIES
Spring ‘05

Project Aspect:	***Sub team Leader:***	**Major:**
Librarian	Carliss Jackson #	Psychology Project
LIM	Rafiu Amolegbe * #	Electrical Eng.
Propulsion	Paul Prusa	Mechanical Eng.
Between-yard	Charles Medrano #	Civil Eng.
Structures	Vladimir Grozdanov #	Civil Eng.
Civil	Mira Racheva	Civil Eng.
GIS and Network	Keegan Adcock * #	Computer Science
Modeling, Animation and Zoning	David Smreczak	Information Tech.
Cost Analysis Database	Joseph Tomal	Information Tech.
Plans/Reports/Drawings	Kallinikos Kechagias	Civil Eng.

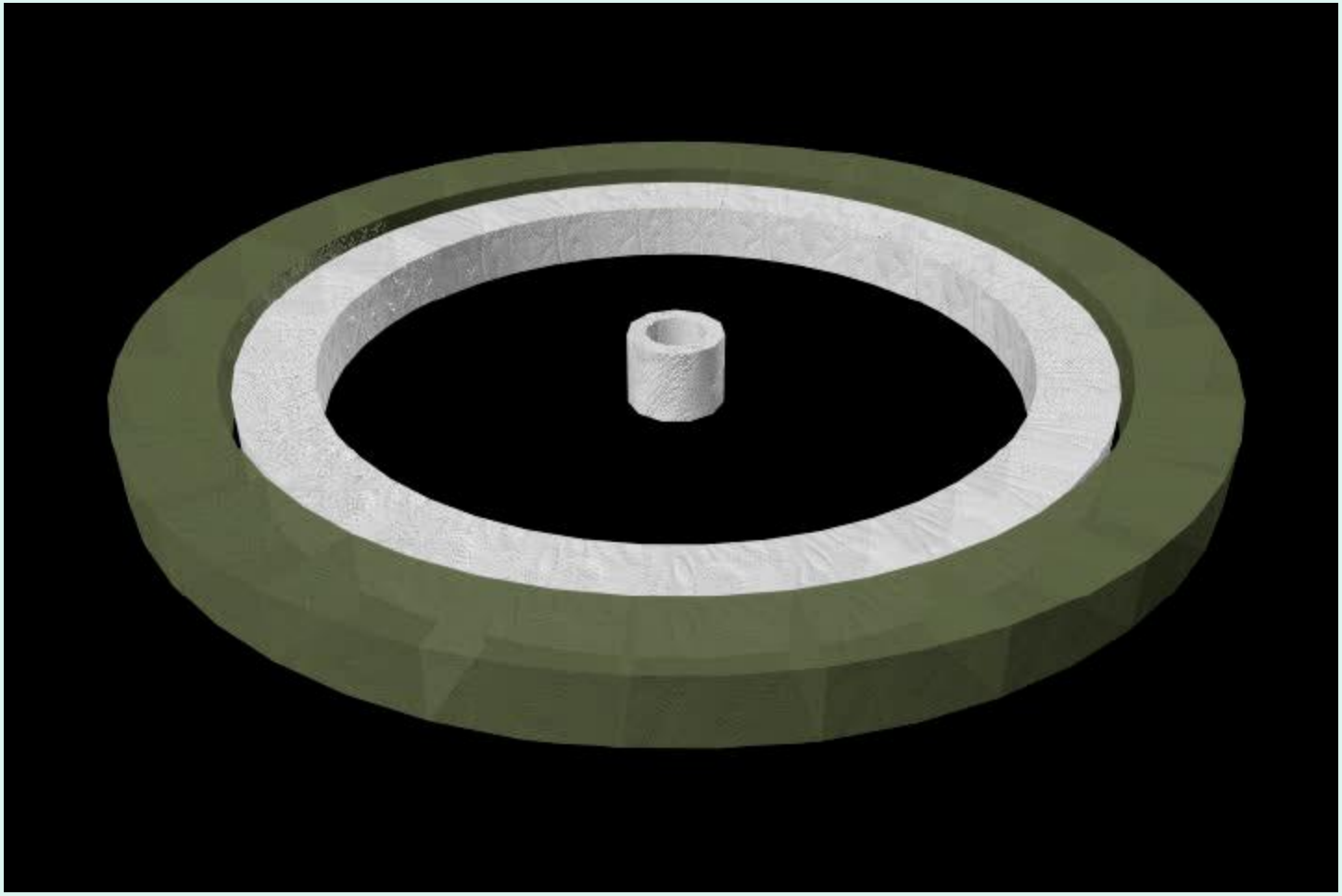
Advisors

Laurence Rohter, IIT
Bruce A. Dahnke, Skytech Transportation
Dr. Shen, IIT/CAE
Ariel Iris, Chicago Area Transportation Study
Gerald Rawlings, Chicago Area Transportation Study
Dr. Mohammadi, IIT/CAE

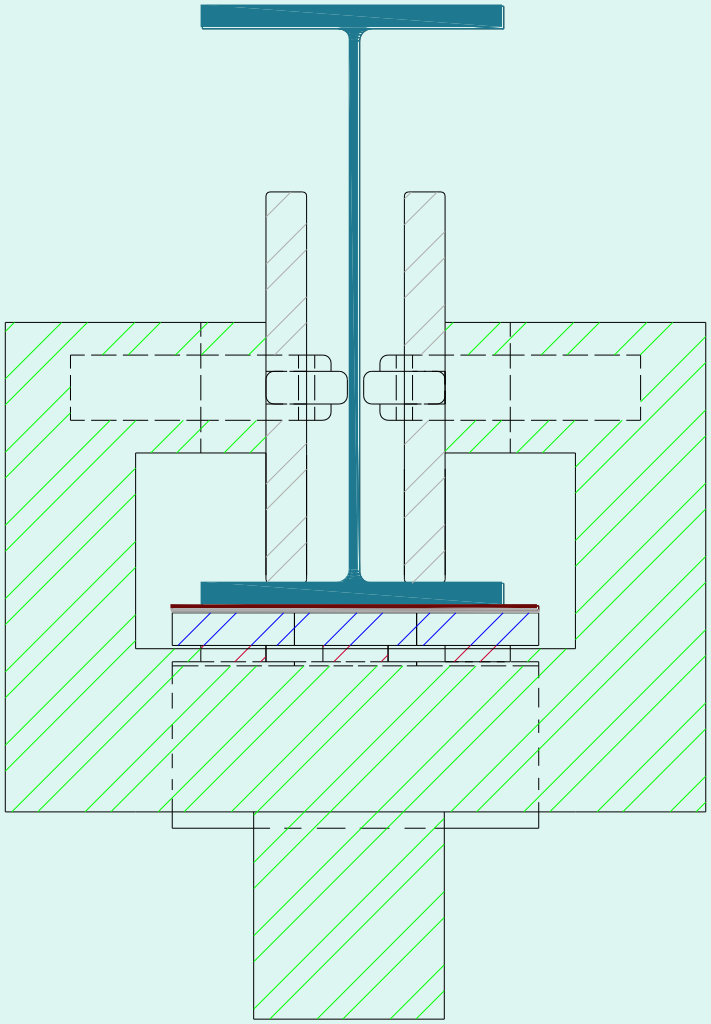
Second semester in an I-Pro

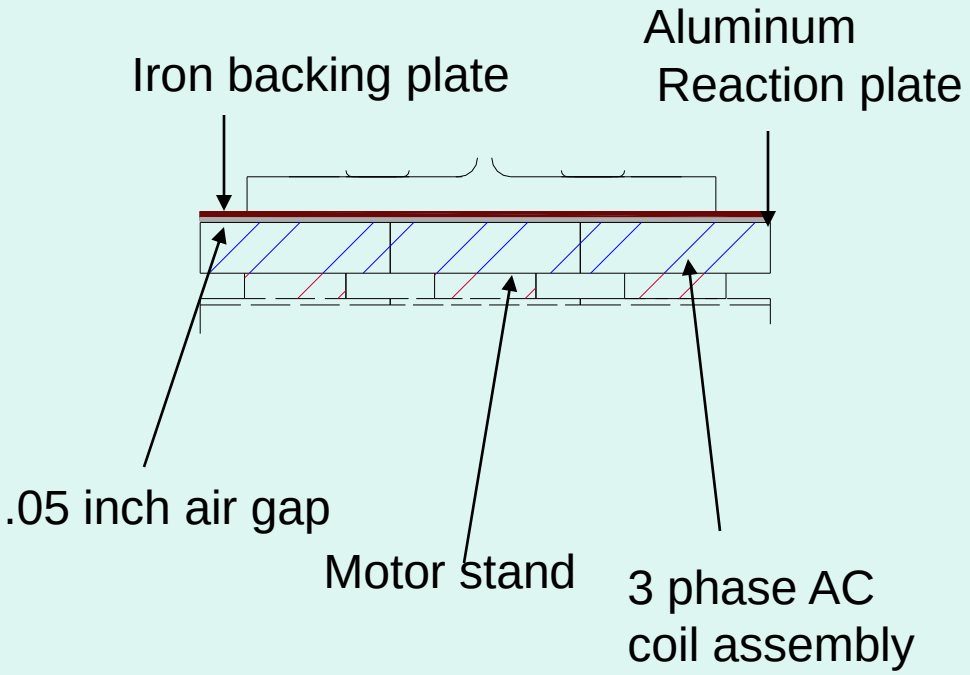
* Second semester with I-Pro 307

What is a Linear Induction Motor?



LIM/I-Beam Connection





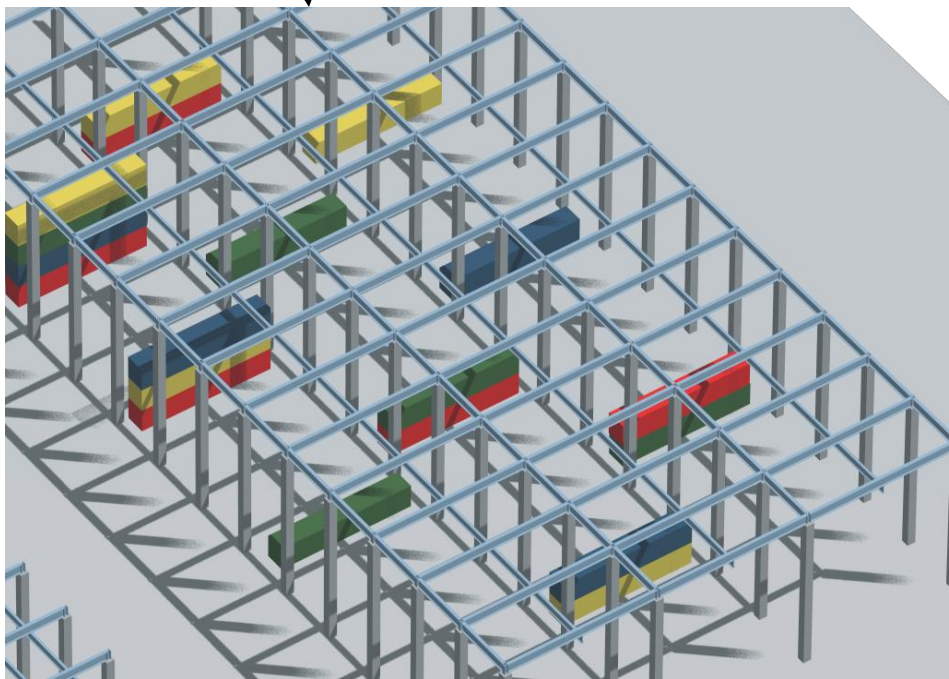
LIM Design Specifications

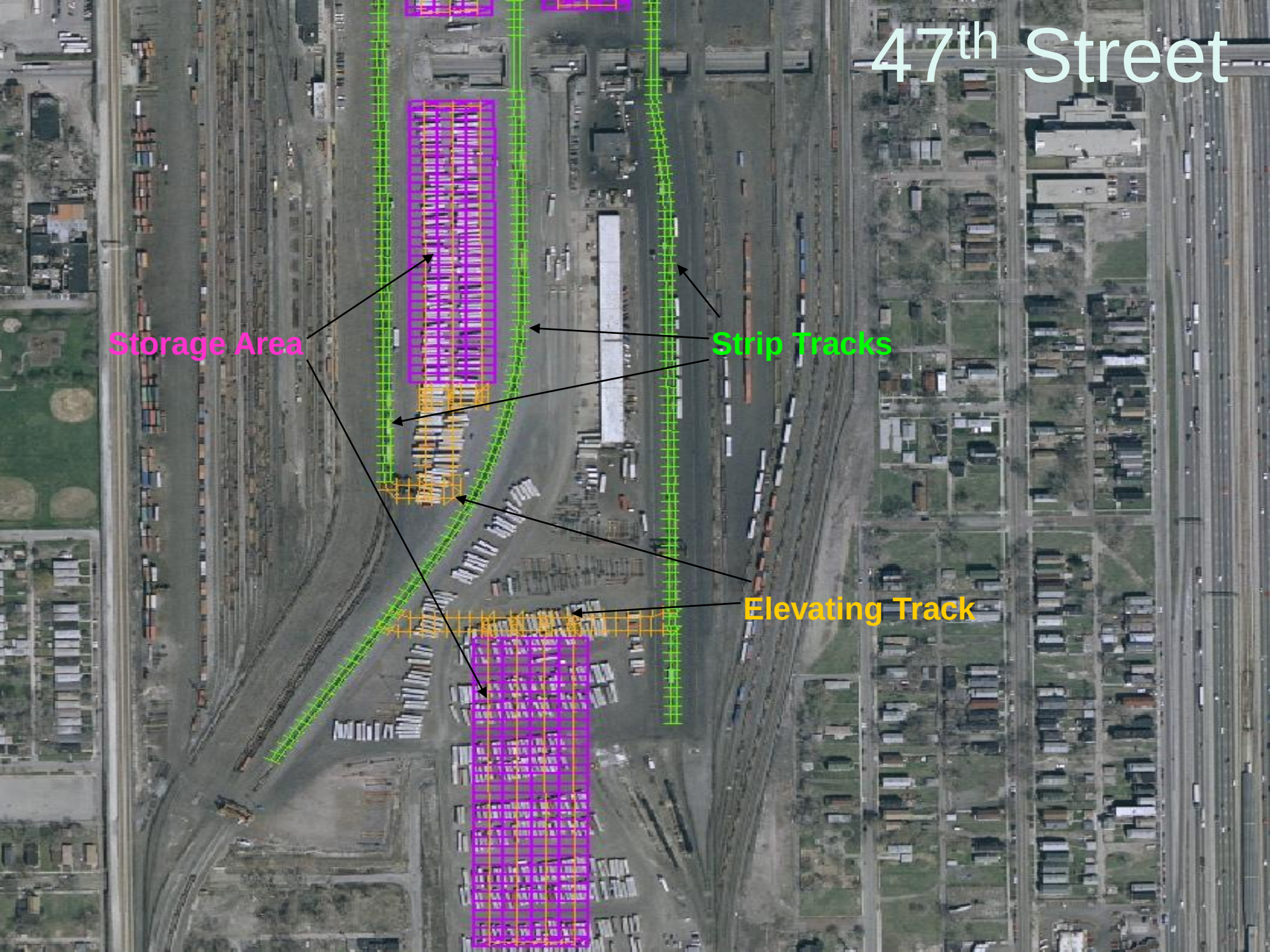
- **Maximum System**
  - 45 motors tied in series
  - 22.5 inch width for the reaction plate
  - Total area of the motors is 36.1 square feet (1.875 ft X 19.25 ft)
  - Acceleration of 0.0166 g's
  - Time to reach operating speed is 1 minute and 50 seconds
  - Power is 175.95 kW or 235.9 horsepower
  - Total cost of motors $ 67,498.92
  - Total cost to operate 12.32 $ per hour
- **Minimum System**
  - 21 motors tied in series
  - 22.5 inch width for the reaction plate
  - Total area of the motors is 16.8 square feet (1.875 ft X 9 ft)
  - Acceleration of 0.0077 g's
  - Time to reach operating speed is 3 minute and 55 seconds
  - Power is 82.11 kW or 110 horsepower
  - Total cost of motors $ 31,499.50
  - Total cost to operate 5.75 $ per hour

Corwith

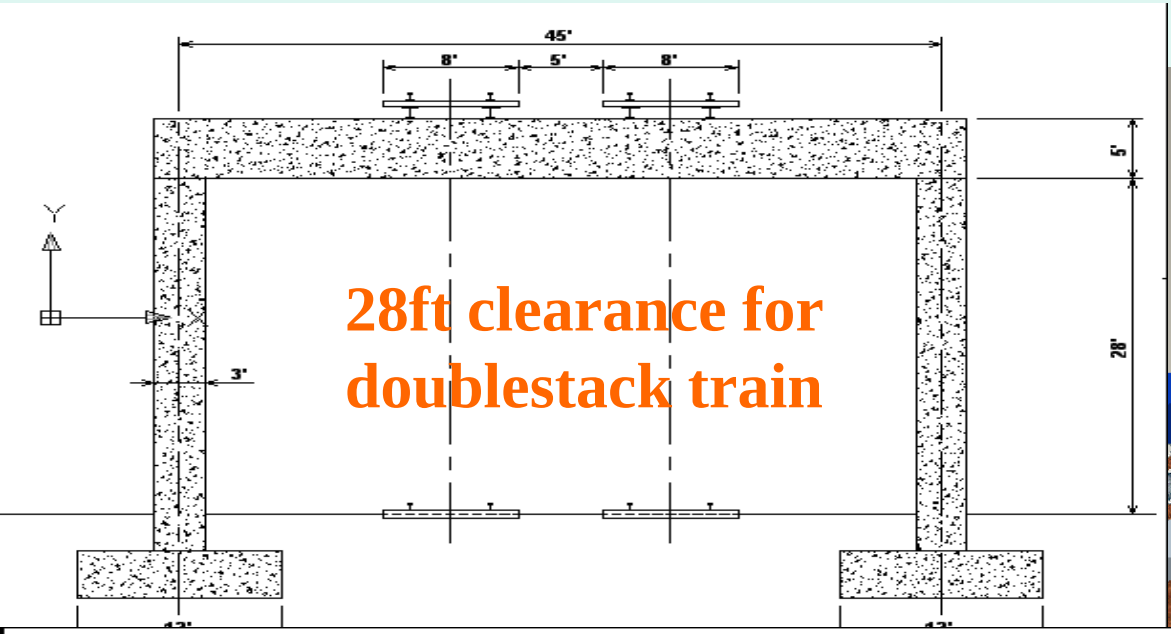
Storage Area

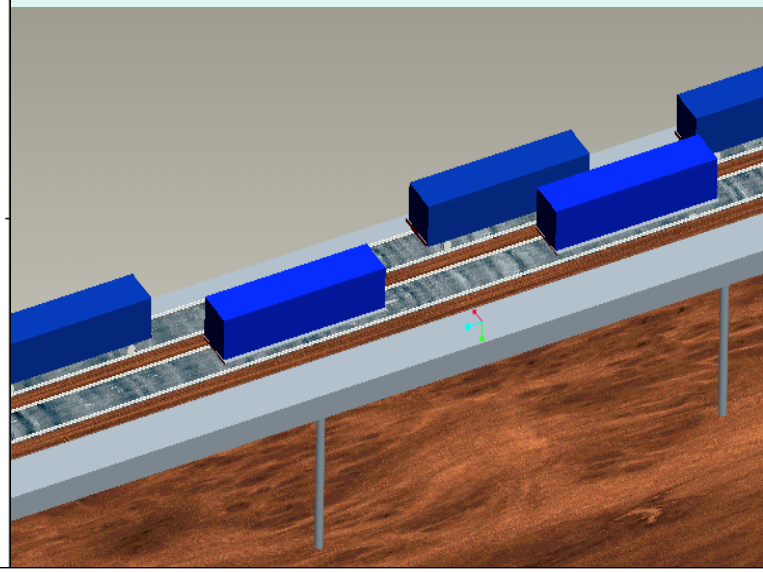
Strip Tracks

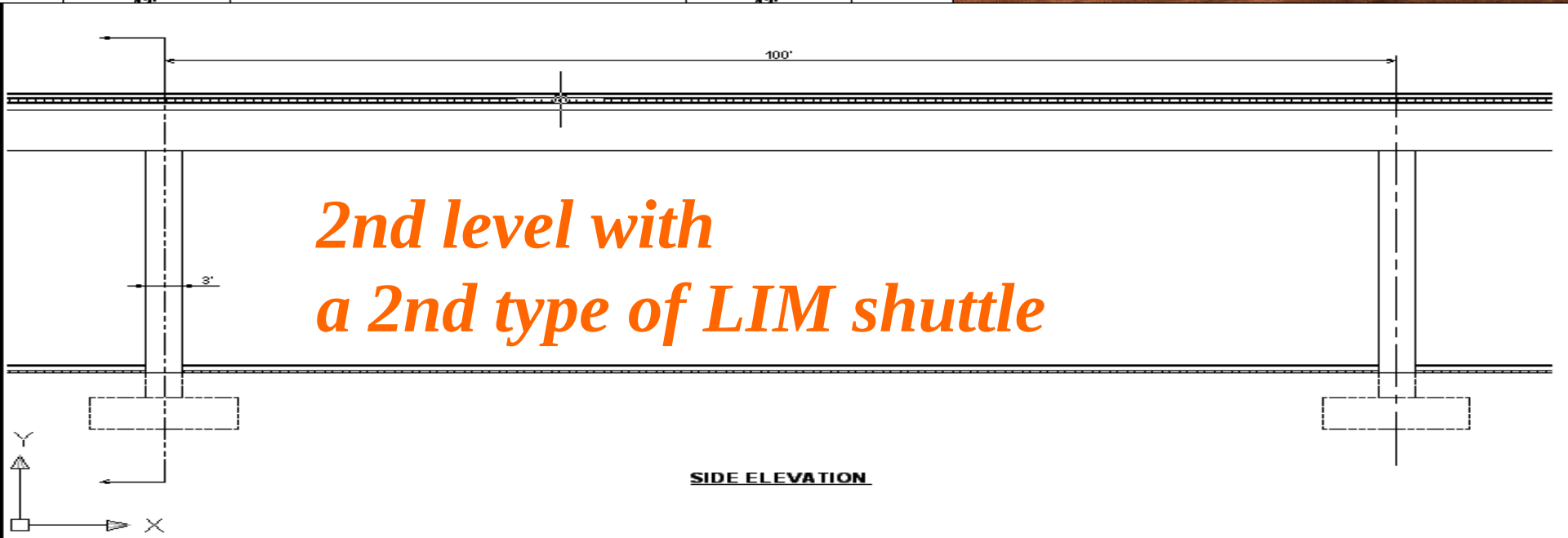



47th Street
Storage Area
Strip Tracks
Elevating Track

Between-Yard Structure Semester 1&2



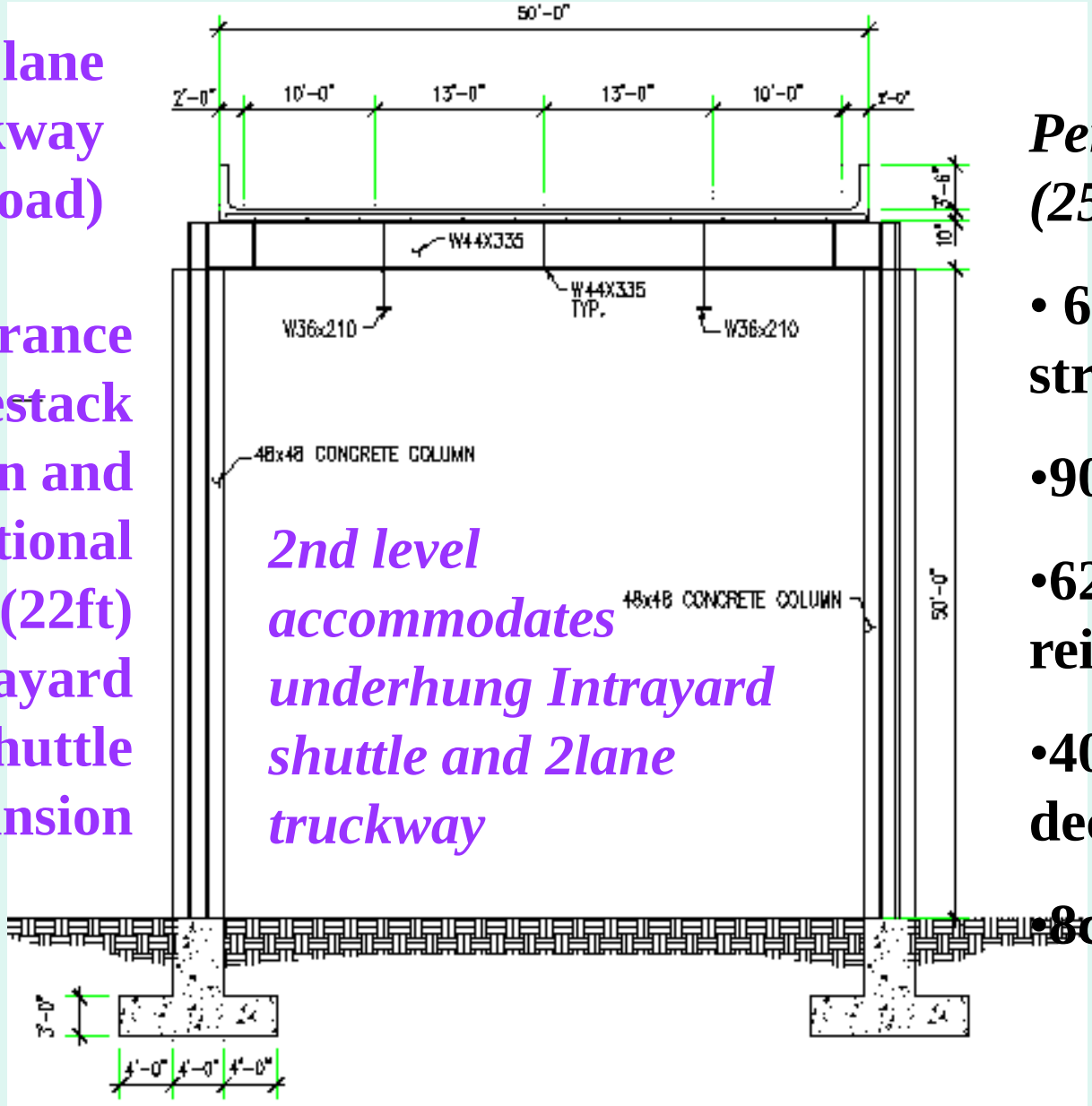




Between-Yard Structure Semester 3

2lane truckway (tollroad)

28ft clearance for doublestack train and additional clearance(22ft) for intrayard shuttle expansion



2nd level accommodates underhung Intrayard shuttle and 2lane truckway

Per frame (25feet):

- **60tons structural steel**
- **90cy concrete**
- **6200linear ft reinforcing steel**
- **40cy concrete deck**
- **8cy asphalt**

Corwith to 47th Corridor

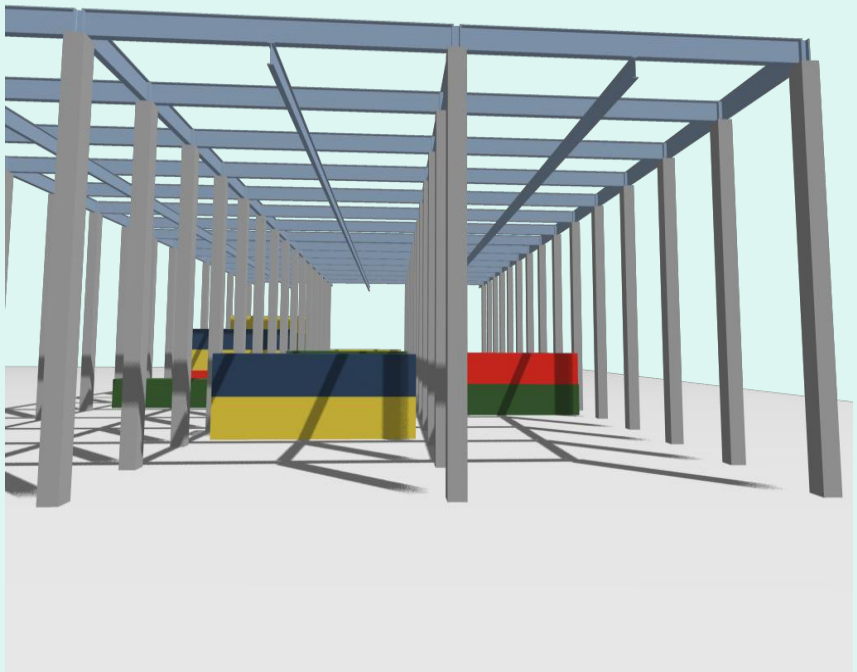
Approx total length=5miles (1000frames @25ft each)

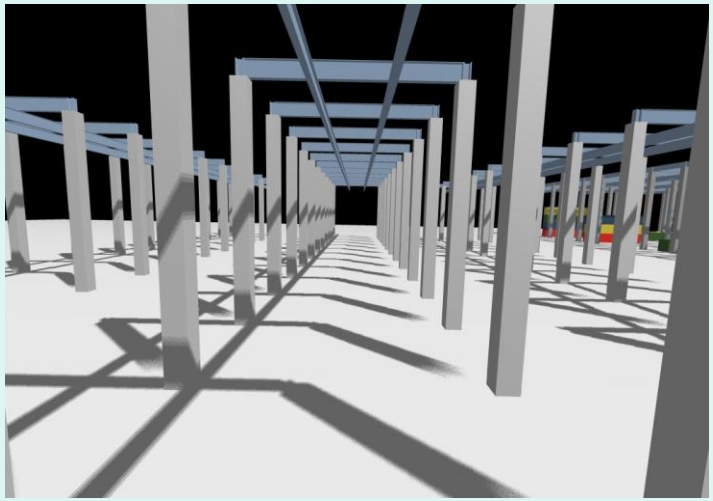
East end is rehabbed railroad and residential.

West end is active railroad, CTA and industrial.

Overall Material Qty:

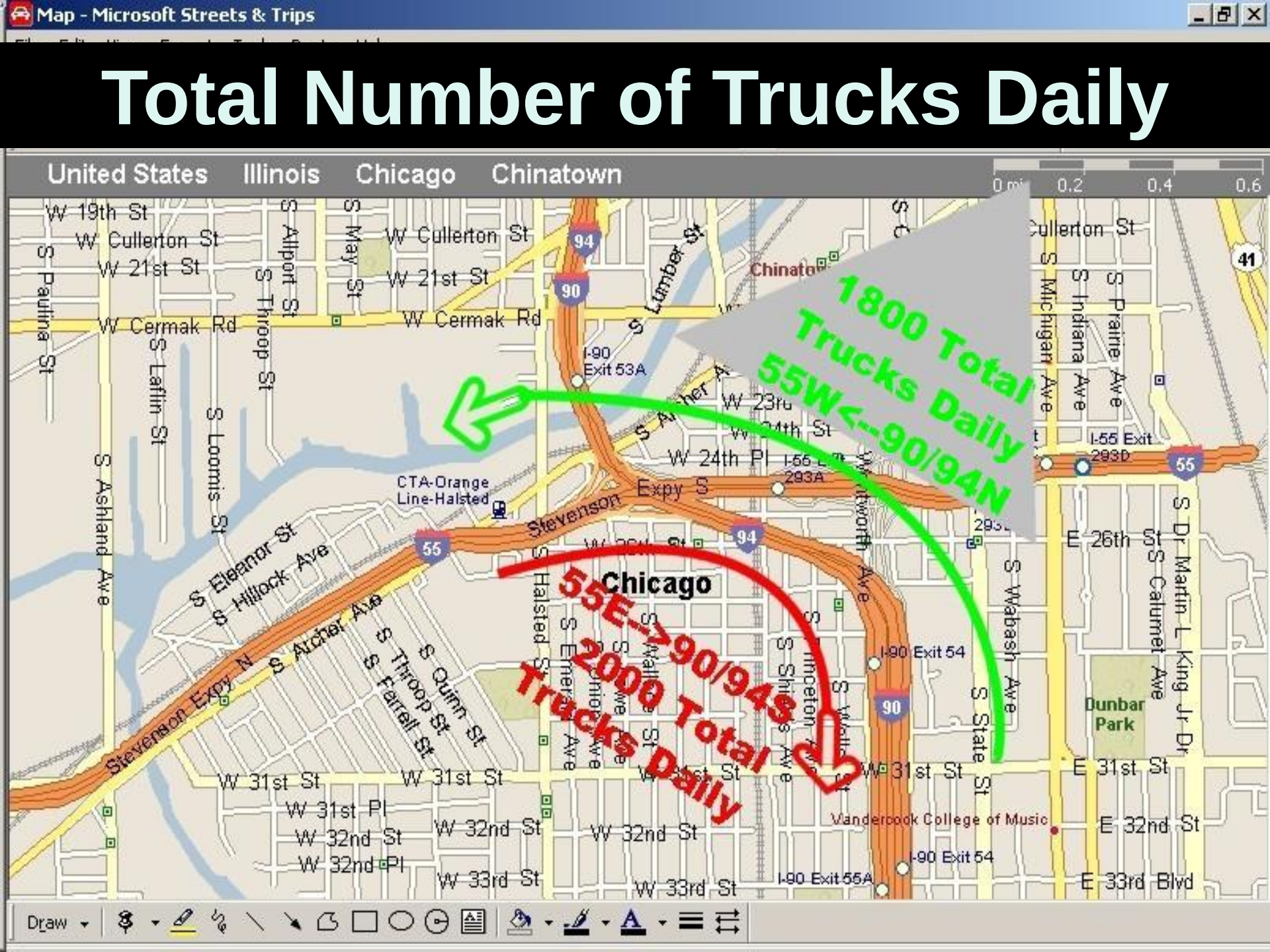
		Corwith	Between	47th St	total
		Yd	Yards	Yd	
Steel structural	tons x1000	56	60	38.5	154.5
Concrete	cubic yd x1000	94	90	64	248.0
Steel reinforcing	linear ft x1000k	7	6.2	5	18.2
Concrete deck	cy x1000	0	40	0	40.0
Asphalt	cy x1000	0	8	0	8.0





ZONING


RS-3
C1-2
B3-1
C1-2
B3-2
B3-2
C1-2
RS-3
M2-2
PD 568
B3-2
Hedges
Hedges Branch
C1-2
PD 818
RS-3
C1-2


Map - Microsoft Streets & Trips
Total Number of Trucks Daily
United States
Illinois
Chicago
Chinatown
1800 Total Trucks Daily 55W<--90/94N
55E-->90/94S 2000 Total Trucks Daily
Chicago
Stevenson Expy
CTA-Orange Line-Halsted
I-90 Exit 53A
I-90 Exit 54
I-90 Exit 55A
I-55 Exit 293D
Dunbar Park
Vandercook College of Music
W 19th St
W Cullerton St
W 21st St
W Cermak Rd
W 24th Pl
W 31st St
W 31st Pl
W 32nd St
W 32nd Pl
W 33rd St
E 26th St
E 31st St
E 32nd St
E 33rd Blvd
S Ashland Ave
S Loomis St
S Laflin St
S Throop St
S Allport St
S May St
S Lumber St
S Halsted St
S Wabash Ave
S State St
S Michigan Ave
S Indiana Ave
S Prairie Ave
S Calumet Ave
S Dr Martin L King Jr Dr
S Eleanor St
S Hillock Ave
S Archer Ave
Stevenson Expy N
S Quinn St
S Farrell St
Draw

Why a $5.00 Toll?

- **$4.00 = Truck Plaza Rate on all Tollways**
- **$6.00 = Truck Skyway Rate**
- **$7.50 = Waukegan Exit on the Tri-State**
- **$5.00 = Truck Toll on Golf Road, Willow Road, Lake Cook Road, and Touhy Avenue Ramp Exits on the Tri-State**

***An average toll of **$5.00** a truck was found on all plazas, the skyway, and major street exit ramps so we find a **$5.00** toll sufficient for the truck tolls on our ramps.

Number of Trucks and Revenue Produced from Both Ramps at $5.00 Toll Per Truck

Percent of Trucks Using 55E → 90/94S Ramp	Number of Trucks	Amount of Money Produced Daily
10%	200	$ 1,000.00
25%	500	$ 2,500.00
50%	1,000	$ 5,000.00
Percent of Trucks Using 90/94N → 55W Ramp	**Number of Trucks**	**Amount of Money Produced Daily**
10%	180	$ 900.00
25%	450	$ 2,250.00
50%	900	$ 4,500.00

Equal Percentage of Trucks On Each Toll	Total Combined Trucks at % From Both Ramps	Total Revenue Produced Daily From Combined Ramps
10%	380	$ 1,900.00
25%	950	$ 4,750.00
50%	1,900	$ 9,500.00

Conclusions

- **Despite its potential advantages, our research has failed to identify the Linear Induction Motor as the best option for propelling the shuttle.**
- **Much improvement was made this semester in regards to the structural analysis and design of columns, girders, beams, monorails, and foundations.**
- **Use of a toll collecting truckway opportunely allows for spreading construction costs and advantages over a wider set of stakeholders.**

Next steps

- Assess “Time and Motion” of current method (spotting) to set a performance bar (i.e. time/cost/cycle time to beat with alternative system)
- Consider other means of propulsion such as synchronous or rotary motors.
- Explore route alignments for interconnecting additional container handling facilities.
- Evaluate alternative methods that consolidate operations.