STRUCTURE ANALYSIS OF SIMMONS COLLEGE SCHOOL OF MANAGEMENT

Fang Xu , Kara Wetzel , Kevin Walsh, Yuting Song

General Building Data

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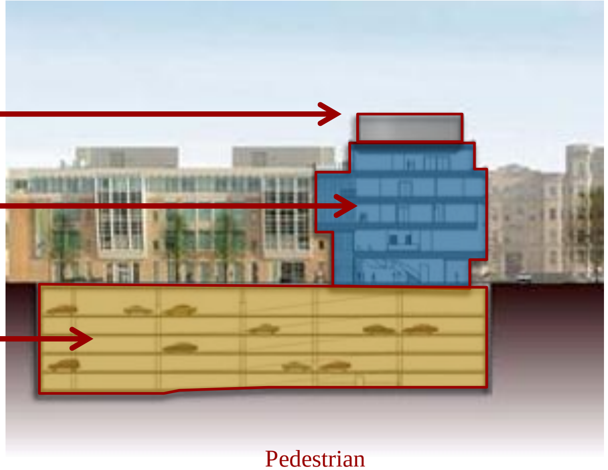
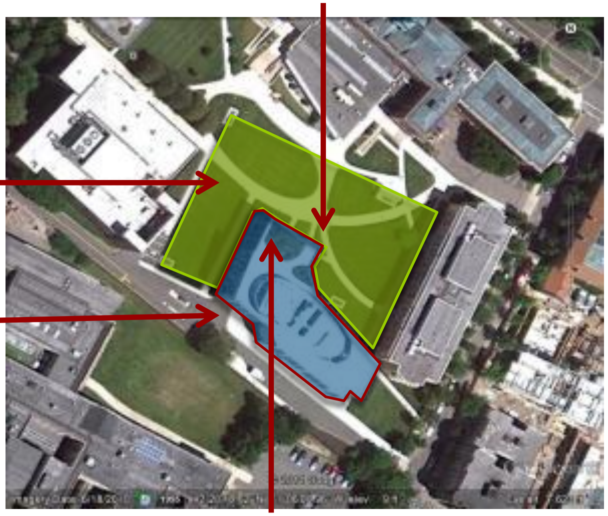
Building Name:	Simmons College School of Management	
Location & Site:	Boston Proper, Institutional Master Plan Area	
	300 The Fenway, Boston, Ma	
Building Occupant:	Simmons College	
Function:	Educational Facility	
Size:	66,500 sf	
Stories:	Five floors above grade, five below grade parking levels	
Project Team		
Owner:	Simmons College	
CM:	Lee Kennedy	
	Payton Construction	
Project Manager:	Lynne Deninger	Cannon Design
	Bill Massey	Cannon Design
Architect:	Andy Goetze	Cannon Design
Structural Engineer:	John Boekelman	Cannon Design
Mechanical Engineer:	John Swift	Cannon Design
Plumbing Engineer:	Mike Forth	Cannon Design
Geotechnical Engineer:	Bob Hoyler	McPhail Associates
Dates of Construction		
Start Date:	August, 2006	
Completion Date:	December, 2008	
Cost:	$63 Million, total project cost including the site	
Project Delivery Method:	Construction Manager at risk, Design, Bid, Build	

http://www.engr.psu.edu/ae/thesis/portfolios/2010/ktw5007/BuildingStatistics.html

Building Information

- The building is a five story educational facility with an additional five levels of sub grade parking.
- Interior spaces include classrooms, offices, and administrative areas.
- Vehicles access the building under its southwest corner and enter into a centrally planned garage.
- The parking garage transitions to the building at the plaza level.
- Here, much of the 222 foot square garage is covered by the landscaped quad to the north of the building.
- The superstructure sits on the southeast corner of the garage.
- Primary pedestrian access to the building is from the quad into the main lobby area.
- A green roof patio overlooking the quad is accessible from the fifth floor
- A curving metal screen hides mechanical units on the roof. See figure one above.





Code Requirement & Zoning

Design Codes

- Building Code, Design Loads: Massachusetts State Building Code CMR 780 6th Addition
- Reinforced Concrete: American Concrete Institute (ACI) 318
- Structural Steel: American Institute of Steel Construction (AISC)

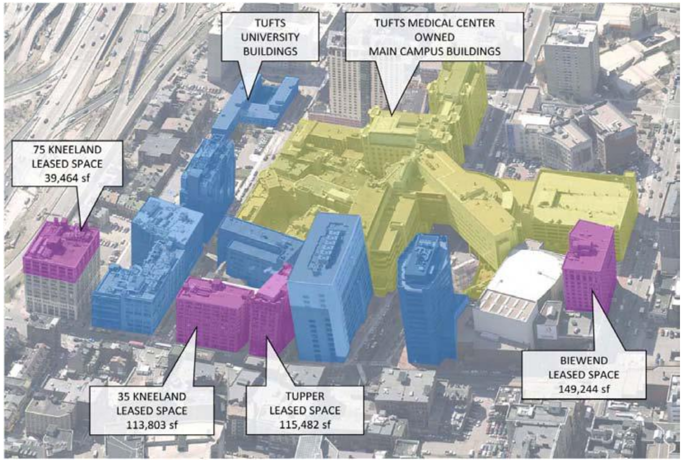
Substitute Codes

- Building Code: International Building Code (IBC) 2006
- Building Loads: American Society of Civil Engineers (ASCE) 7-05
- Structural Steel: American Institute of Steel Construction (AISC) 13th Edition 2005
- Reinforced Concrete: American Concrete Institute (ACI) 318-08
- Seismic Design: AISC Seismic Design Manual
- Diaphragm Design Steel Deck Institute, Diaphragm Design Manual 3rd Edition

Zoning

The Simmons College School of Management lies within the institutional master plan area of Boston Proper. The project met all local Boston Zoning requirements as well as the requirements of the Longwood medical and Academic Area interim guidelines.

●**The Longwood Medical and Academic Area** (also known as **Longwood Medical Area**, **LMA**, or simply **Longwood**) is a medical campus in Boston. It is most strongly associated with the Harvard Medical School and other medical facilities such as Harvard's teaching hospitals, but prominent non-Harvard and non-medical institutions are located there as well, such as museums, colleges and research centers.



●**Medical Center** has prepared an **Institutional Master Plan** to provide an up to date inventory and analysis of the current campus, its land and facilities. It provides for the continued use of the existing buildings within Tufts Medical Center Campus, and presents the facility initiatives anticipated within the next ten years, as well as provides directional guidance for development in the following 15- 20 years to meet the growing and evolving program needs described above.

Problem Statement

- Existing building stands on one side constraining expansion construction
- Water table near the surface, once dig down, water will gush in, which requires pumping all the time
- Standard construction method costs a lot

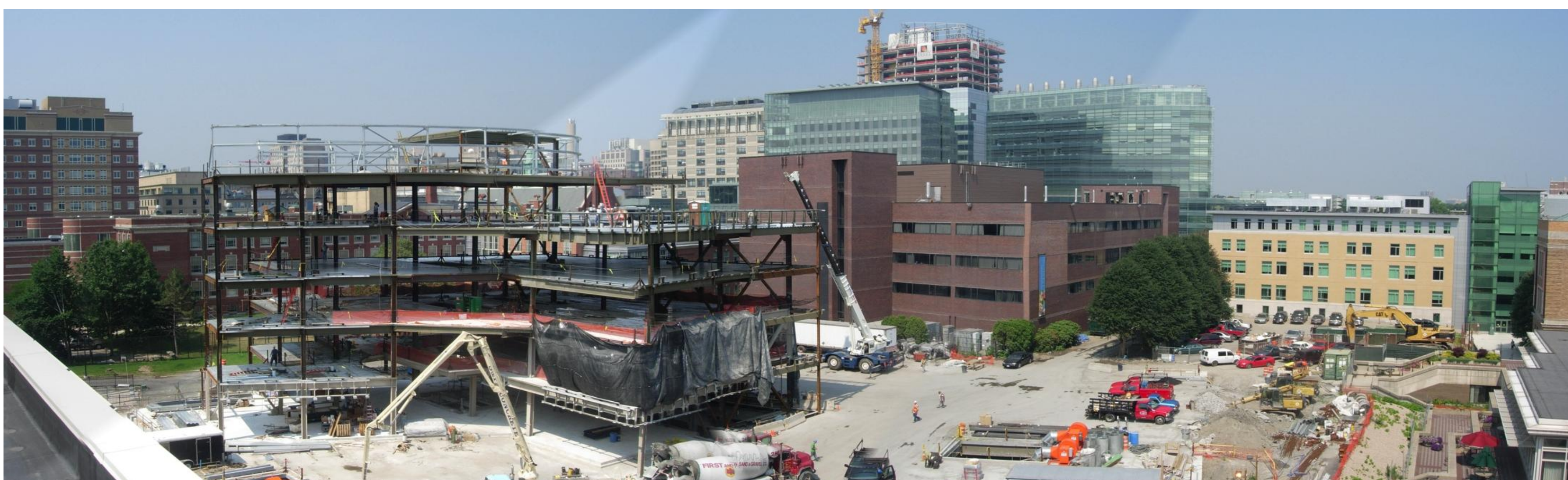
Design Criteria

- Resist all the dead loads and live loads according to ASCE 7-05
- Reduce torsional effects induced by eccentricity
- Reduce accidental torsional effects required in load analysis
- Design structural system to meet drift requirements
- Meet all structural requirements for the base and expanded systems




Design Structure

- Post tensioned underground parking
- 3 Feet slurry wall retaining system
- Steel framing structure above ground
- Composite action floor system
- Steel brace frame lateral system



Load Combinations

- Lateral load combinations applying to this building is determined from ASCE 7-05

ASCE 7-05 Lateral Load Cases

1.2D + 1.6 (Lr or S or R) + 0.8W

1.2D +1.6W + L + 0.5 (Lr or S or R)

1.2D + E + L + 0.2S

0.9D + 1.6W +1.6H

0.9D + E +1.6H

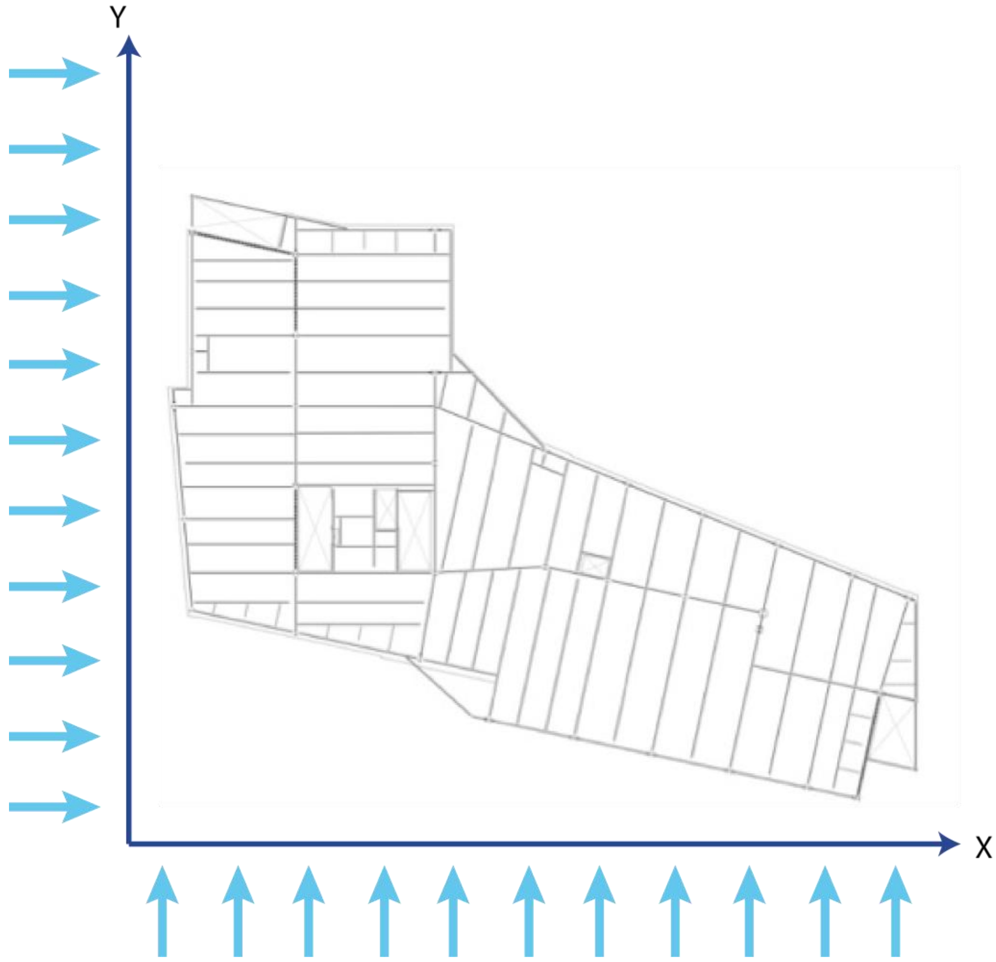
Dead Loads	Design Value (PSF)
FD01	43.2
FD02	42.7
FD03	69.0
FD04	96.8
PT floor slab	175
Structural Steel	Per AISC Manual
Green Roof	100

Superimposed Dead Loads	Design Value (PSF)
MEP	10
Partitions	20
Finishes/Misc	5
Curtain Wall	10

Live Loads Space	Design Value	ASCE 7-05
Parking Floors	50	40
Plaza	100	100
	300 Construction	
Exit Corridors	100	100
Stairs	100	100
Lobbies	100	100
Typical Floor	50	50 (office load)
Corridors above 1st Floor	80	80
Roof Garden	100	100
Flat Roof	-	20
Mechanical Areas	150	

Load Combinations

- Wind and seismic loads applying to the building are considered in the primary X and Y directions.
- Wind loads were applied to the building at the center of pressure
- Seismic loads were applied to the building at the center of the mass of each floor diaphragm , ASCE 7-05 categorizes the lateral system an R-factor of 6 in EW direction and 3.25 in NS direction.

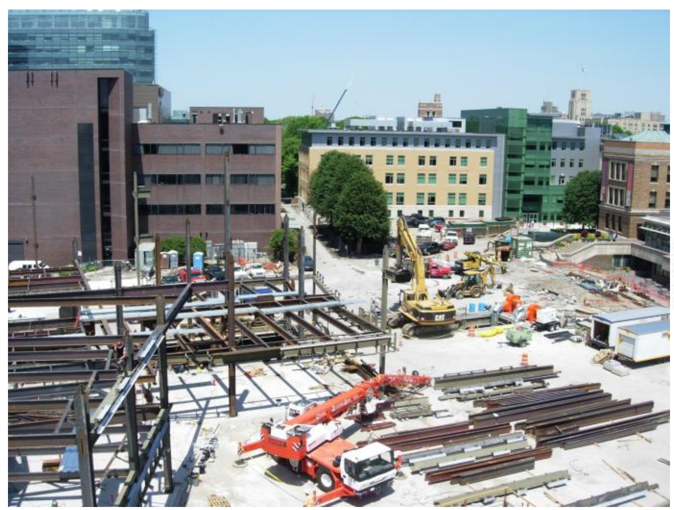


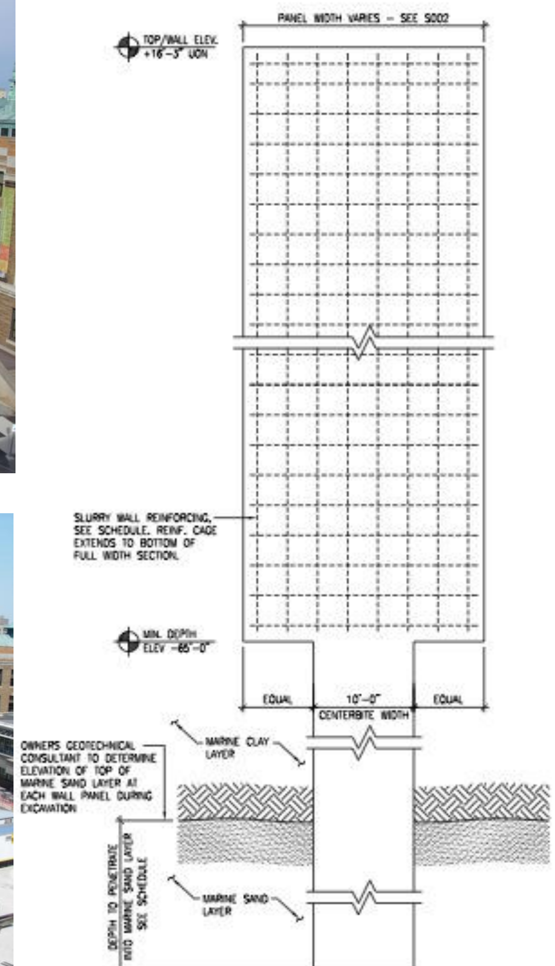
Structure System -- Foundations

- The system was constructed by Top Down method – Bendneath Slurry Wall, and installed load bearing elements prior to excavation

- Loading bearing elements are constructed with W14 columns from the garage embedded in concrete shafts.

- For the main building without underground garage, t=0.365” Φ=10.75” concrete steel pipes are used at column locations.



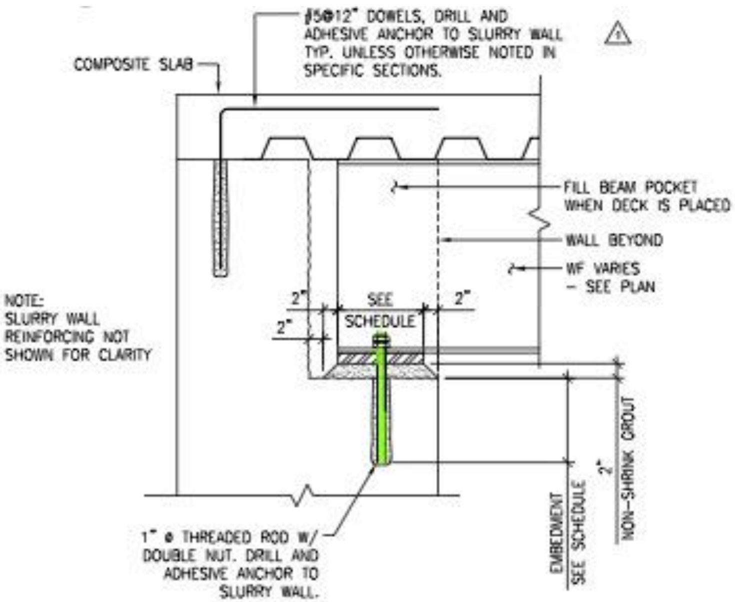


2 TYPICAL SLURRY WALL PANEL ELEVATION

SCALE: NTS

Structure System – Floor Systems

- The underground parking garage use post tensioned concrete slabs for floor system.
- The ground and +1st levels use steel beams with composite floor slabs.
- The upper ground levels use steel beams with composite actions.



BEARING PLATE SCHEDULE		
BEAM SIZES	MINIMUM BEARING PLATE (TxWxL)	REMARKS
> W30x90 (UON)	1/2"x12"xBf	SETTING ℄
W24x55 – W30x90	1-1/2"x12"x18"	
W16x26 – W24x55	1-1/4"x12"x14"	
W14x22 <	1"x8"x12"	
W40x431 & W40x503	1-1/2"x12"x24"	

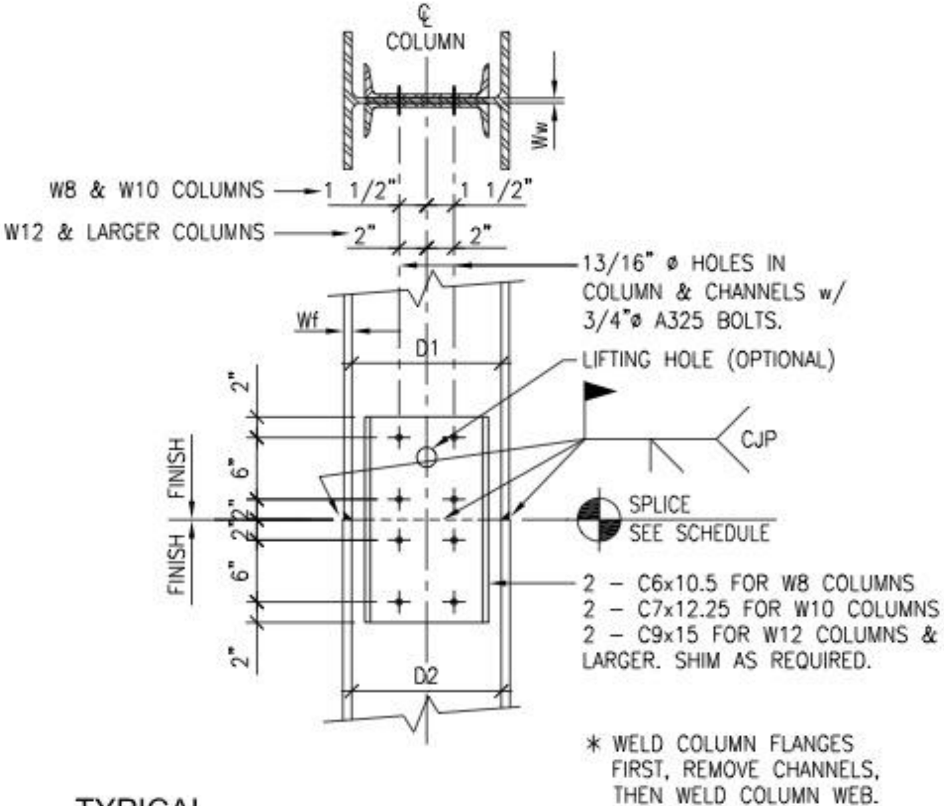
12 TYPICAL BEAM BEARING PLATE AT CONCRETE SLURRY WALL

SCALE: NTS

Structure System – Columns

- Typical column sections are wide flange sections with some usage of hollow structural steel (HSS). The most widely used column is W14*90.

- All columns below the -1st underground level use 2'-8" concrete diameter round columns.



7 TYPICAL FRAME COLUMN SPLICE $D_1 = D_2$

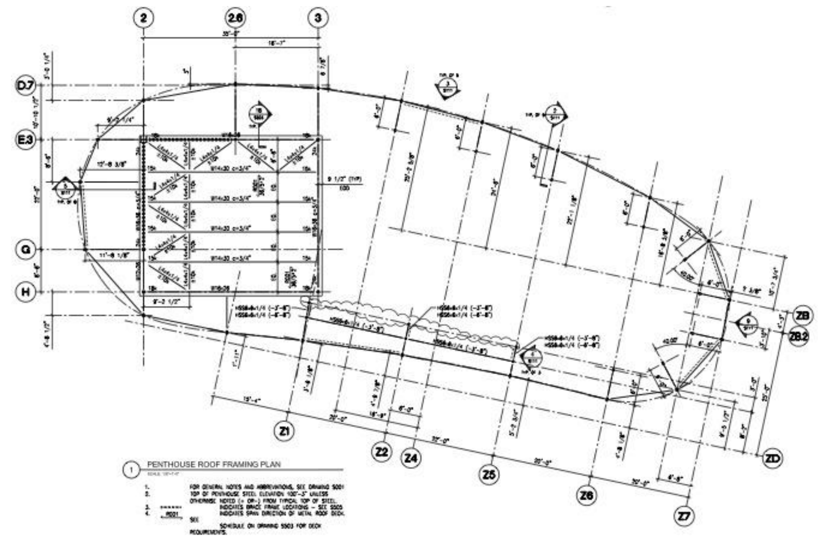
SCALE: NTS

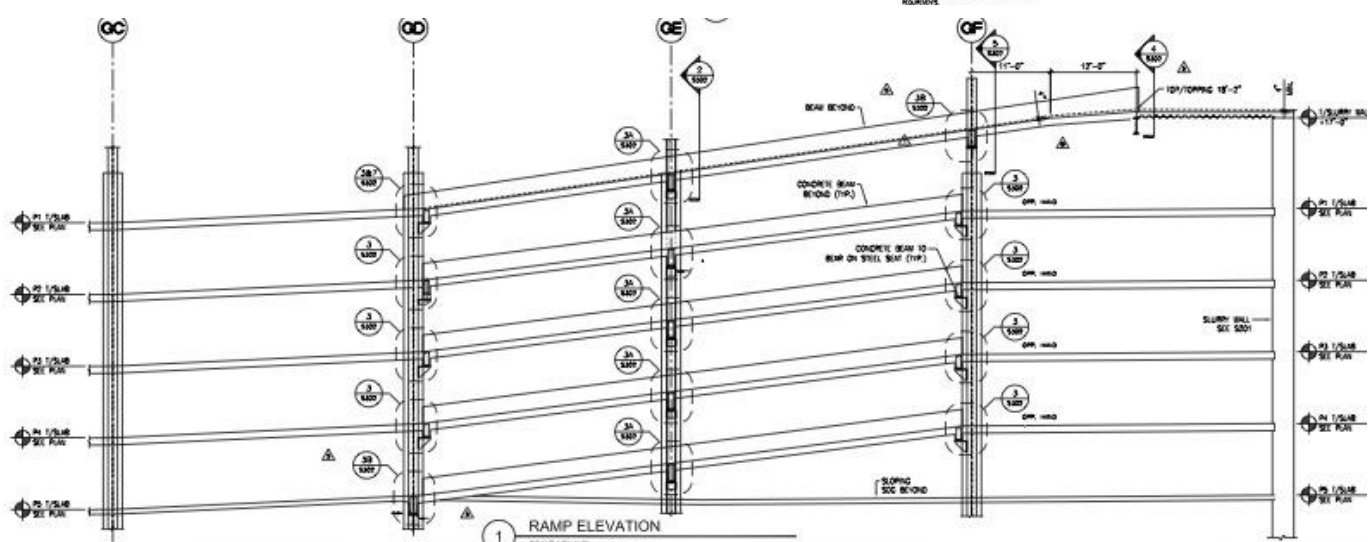
Structure System – Lateral Systems

- In NS direction, use steel braced frames
- In EW direction, use combination of steel braced frames and steel moments frames.

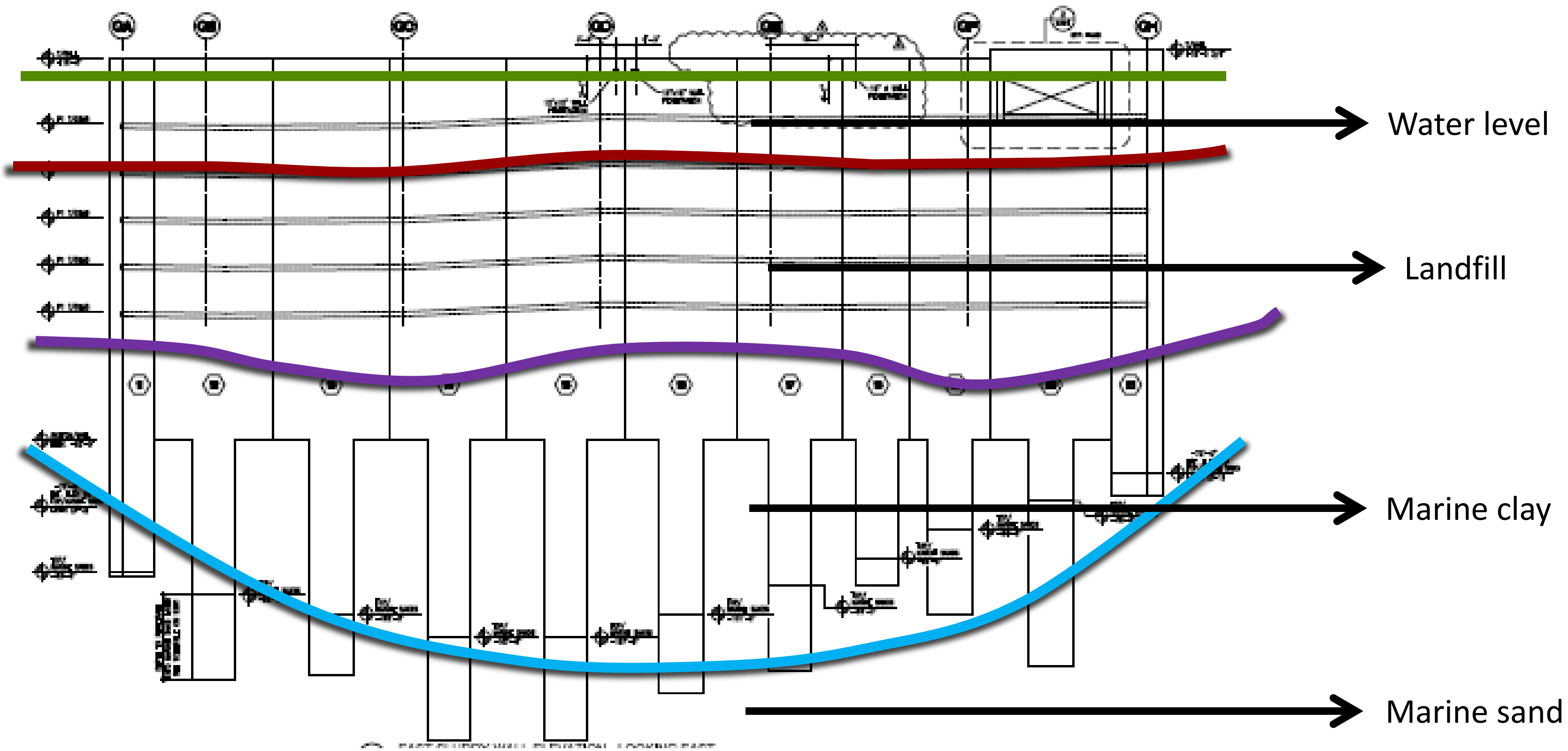
Structure System – Supplementary Systems

- At the roof, a braced frame screen is utilized to hide the penthouse and mechanical equipment.
- In the underground garage, reinforced concrete members are utilized to ramp access to all parking levels.

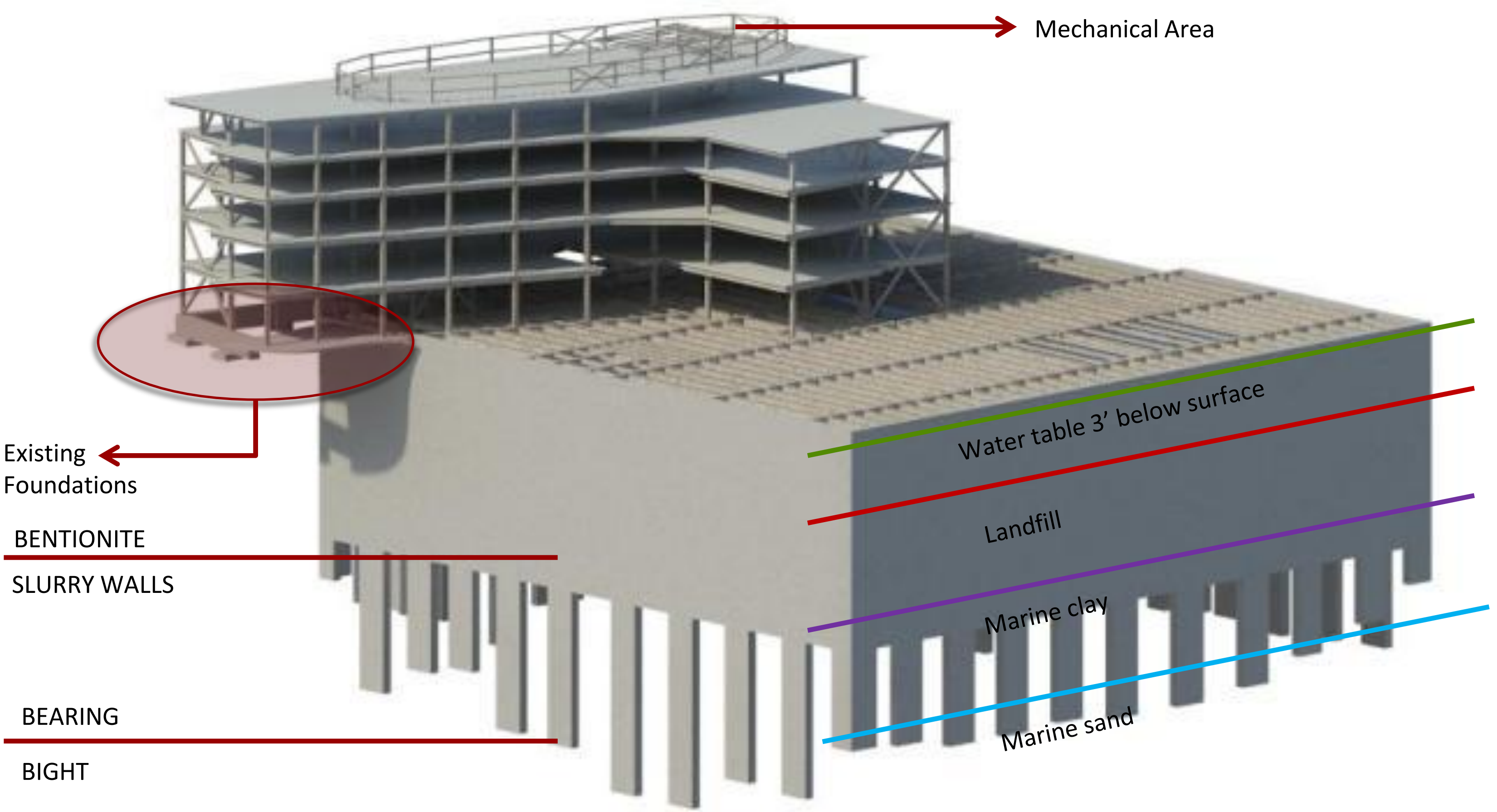




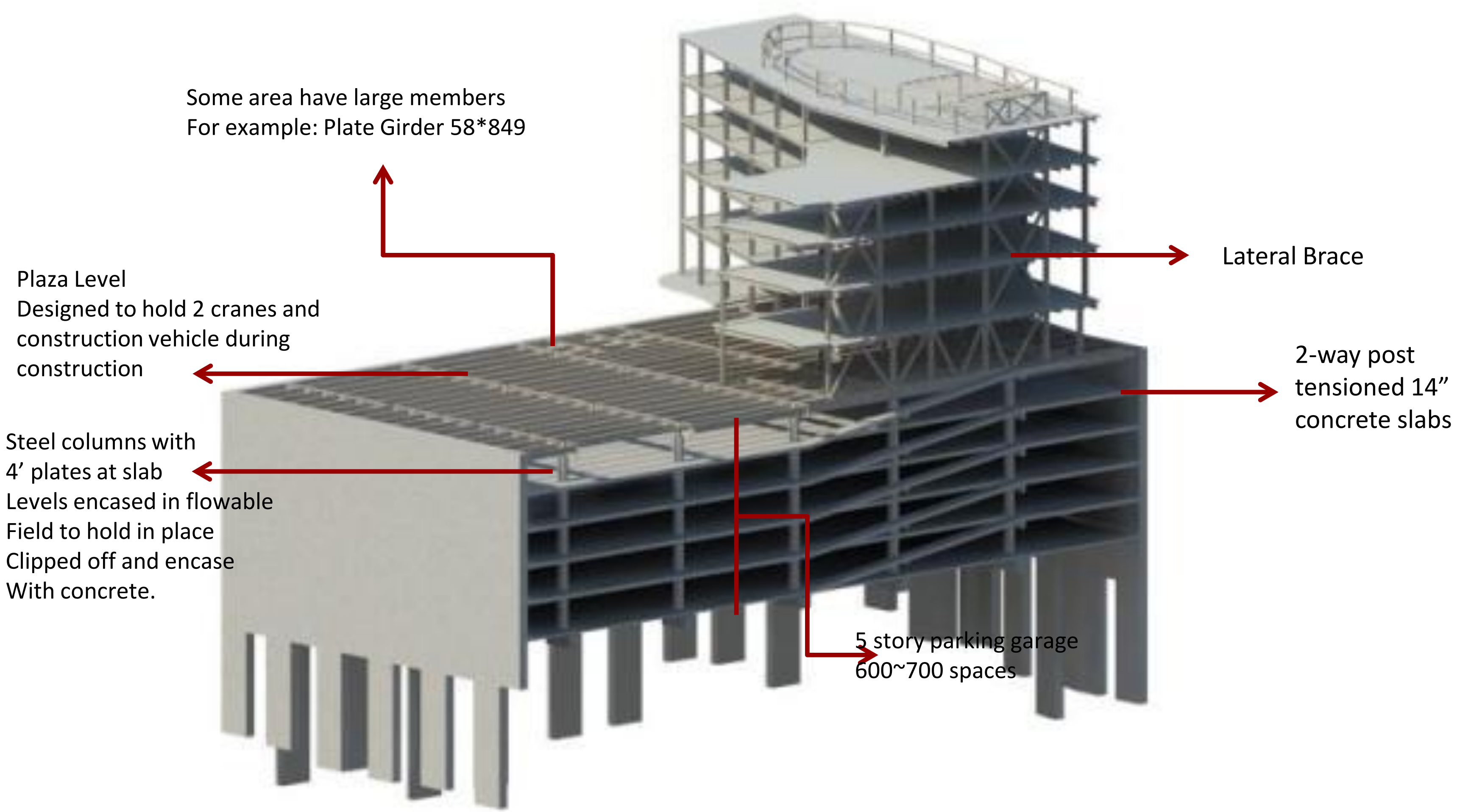
Foundation Analysis



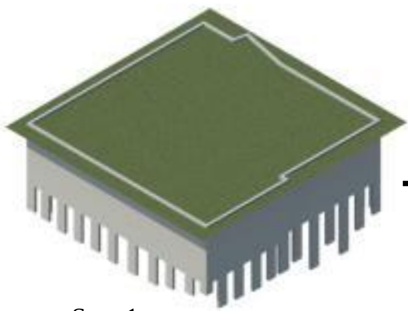
Structure Analysis



Structure Analysis



Construction Process



Step 1

Insert the slurry wall deep into the ground before excavation

Step 2

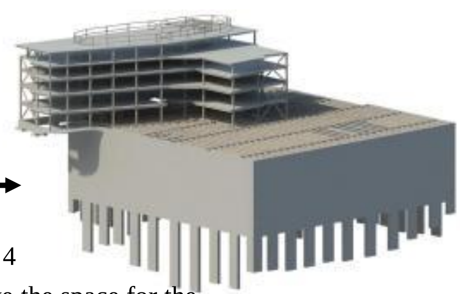
Build the plaza level and one level below as the construction platform.

Step 3

Then build the above floors

Step 4

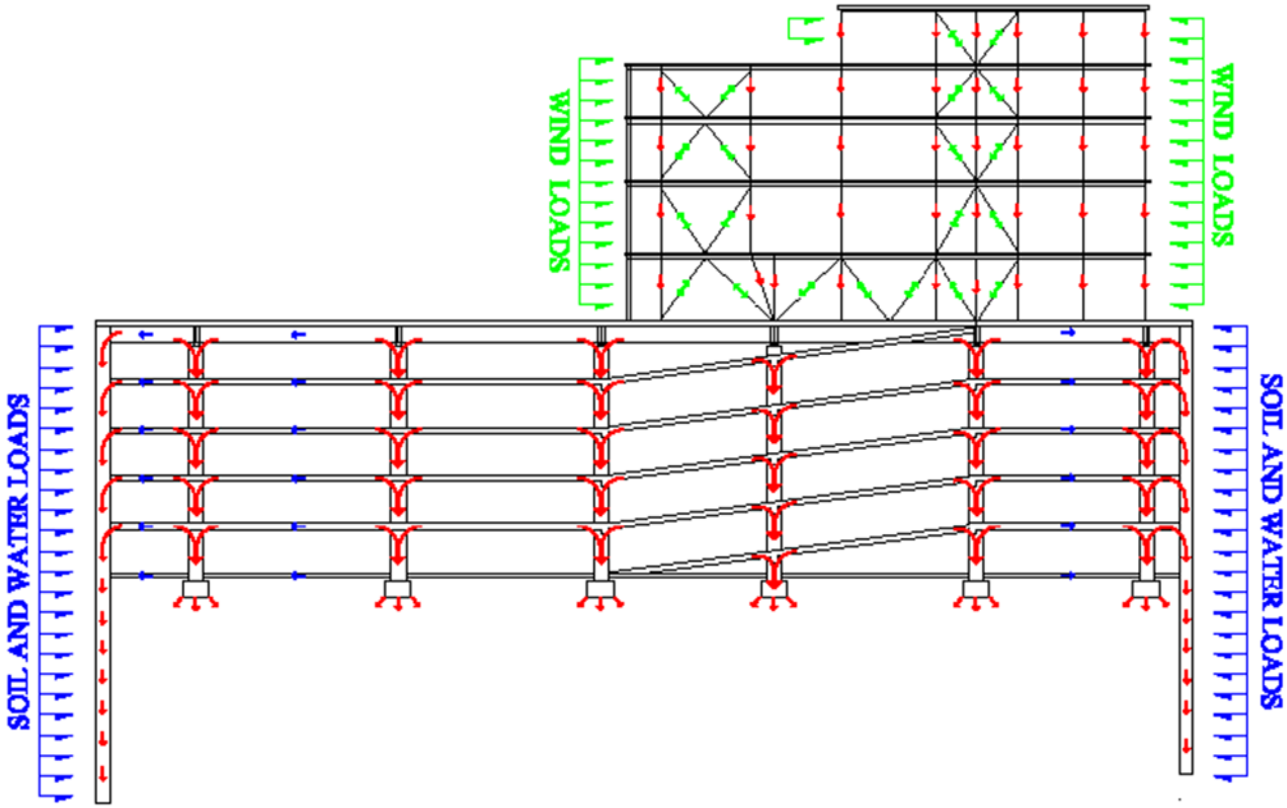
The ground floor and under ground floor was built simultaneously



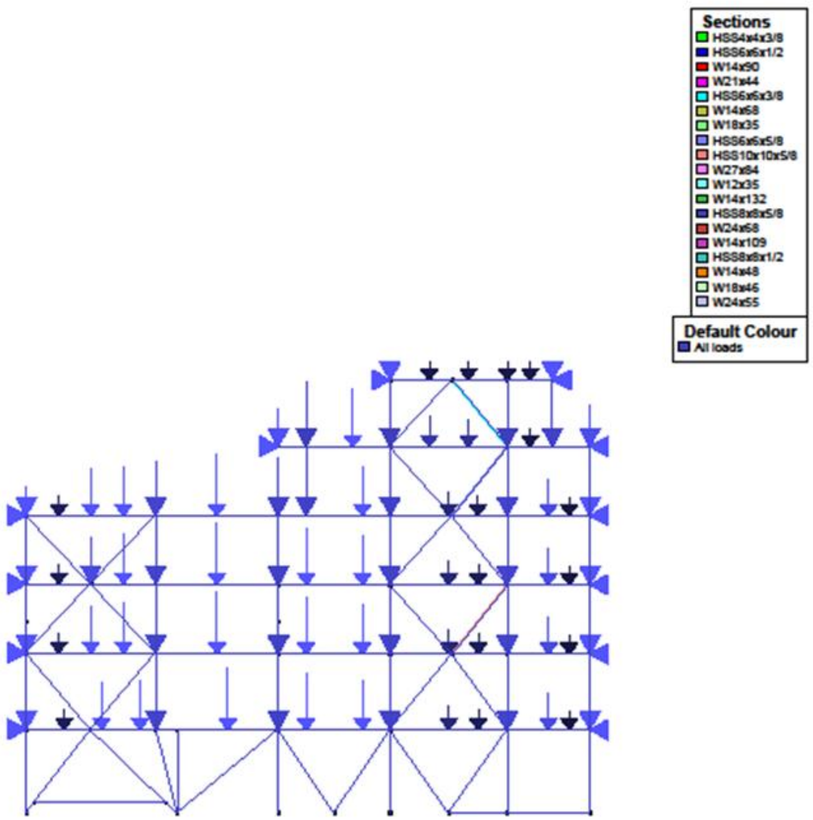
Step 4

Leave the space for the future expansion

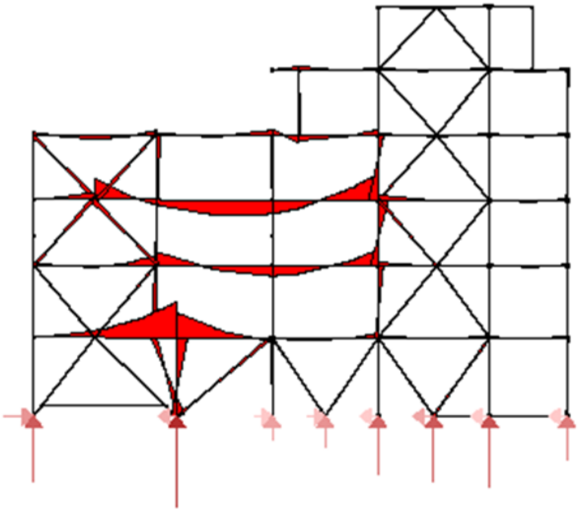
Load Tracing



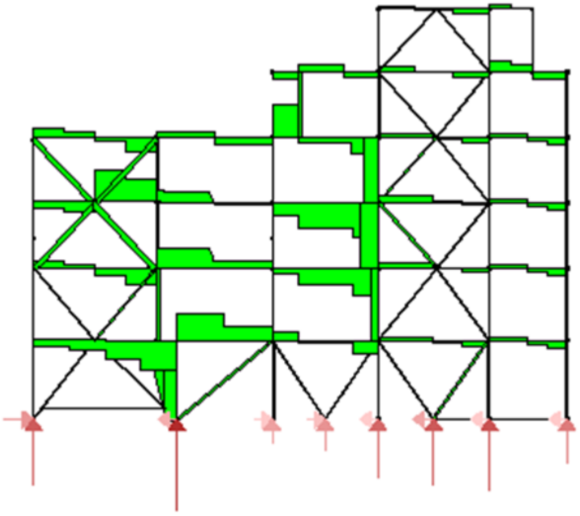
Loading


Sections
HSS4x4x3/8
HSS6x6x1/2
W14x90
W21x44
HSS6x6x3/8
W14x68
W18x35
HSS6x6x5/8
HSS10x10x5/8
W27x84
W12x35
W14x132
HSS8x8x5/8
W24x68
W14x109
HSS8x8x1/2
W14x48
W18x46
W24x55
Default Colour
All loads

Moment and Shear

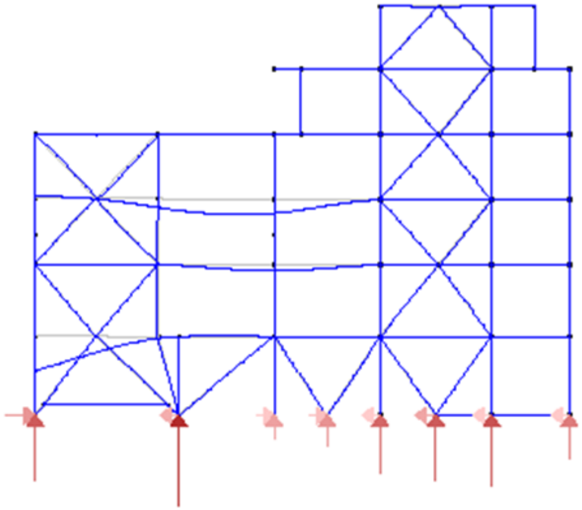


Moment

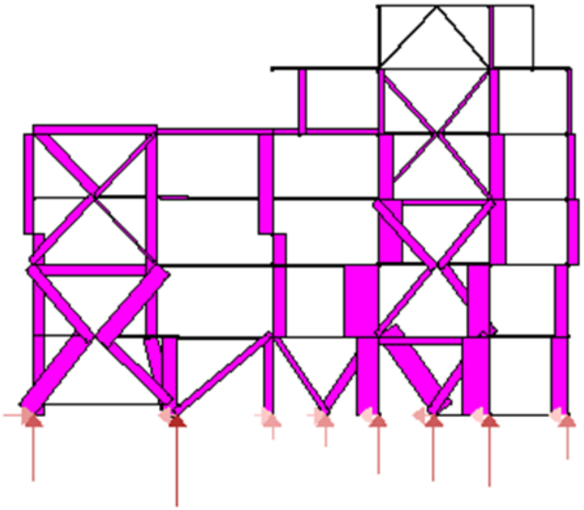


Shear

Deflection and Axis Forces



Deflection



Axis Forces

Reference

East Coast Slurry
http://www.eastcoastslurry.com/simmons.html

Boston Ground Water Trust
http://www.bostongroundwater.org/let020.html

Academic Thesis
http://www.engr.psu.edu/ae/thesis/portfolios/2010/ktw5007/BuildingStatistics.html

Structure Drawings of *Simmons School of Management and New Main Quad*, Cannon Design, 2006

Special Thanks to:
Dr. Matt Dates
John Boekelman

Questions?

THANK YOU!