Five-story Mid-rise Office Building Project

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BRANDOW & JOHNSTON

SAMUELI SCHOOL OF ENGINEERING
UNIVERSITY of CALIFORNIA · IRVINE

WINTER DESIGN REVIEW 2019 | GROUP S-5

Pictured (left to right): Bader Jaffan, Mstafa Al-Msari, Elisa Ihsan, Lewis Lin, Preston Kamada
Not Pictured: Aws Salahaldin, Jihad Moubayed

Five-story Mid-rise Office Building Project
Partnered with Brandow & Johnston

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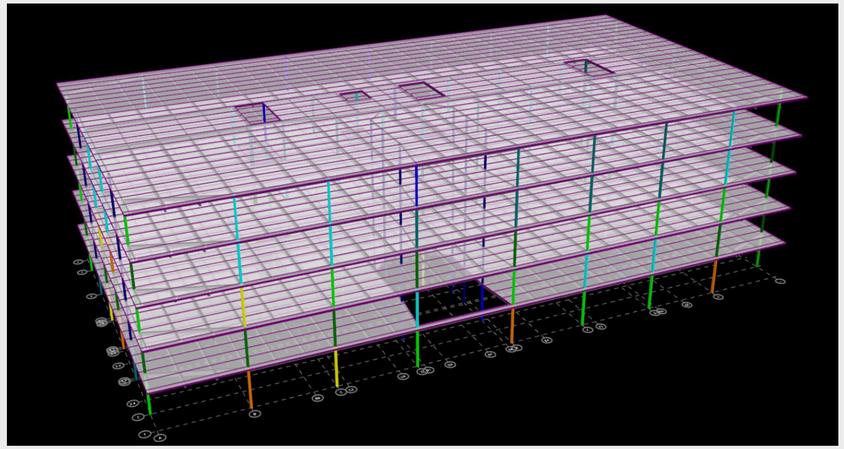
DESIGN APPROACH:

- The design of the structure must sustain a typical floor dead and live load and typical roof dead and live load as well as other constraints such as construction and soils report..
- The design of the building followed building codes such as the IBC, CBC, ASCE 7-16, ACI 318-14 and AISC Steel Construction Manual.
- The initial 30% design goal featured design for gravity loads only. The structural components consisted of composite beams, concrete over metal decking, steel girders, beams, columns, and connections.
- The process of designing the structure began with determine the demands on each floor, and subsequently; each beam, girder, and column.
- The choices of specific members and connections depended on load demands, special loading conditions, construction practices, and client

PROJECT DESCRIPTION SUMMARY:

Brandow & Johnston, a structural engineering firm, has tasked our group with designing a five-story mid-rise office building. Our goal for this project is to design the most cost effective building while also maintaining the architects' original vision for this space. Our first task was to determine the loading that the building will endure. Next, we developed a floor plan that abided by the constraints of the architectural plans. Finally, we created a RAM model to visualize our design, as shown below.

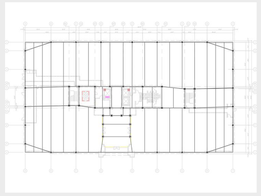


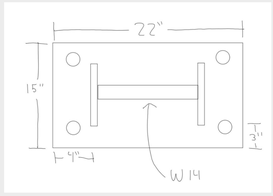
DESIGN CONSTRAINTS & PARAMETERS:

- The architecture of the building must be followed and allowed for little to no tolerance of column replacement.
- The large opening on the second floor required extra design components and calculations.
- The soils report provided restrictions on footing design, soil bearing capacities for foundations, and lateral at-rest pressures.
- The manufacturer recommended the use of typical lightweight concrete and typical grade steel for respective components

PRELIMINARY DESIGN KEY POINTS:

- Determine floor loading
- Develop a framing layout for all floors
- Calculate the effects of composite beams
- Design members due to gravity loading
- Detail connections at typical and atypical joints
- Design base plates and footings
- Use RAM to create 3D Model





COST ESTIMATION:

Item	Quantity	Cost per Quantity	Total
Steel Beams 21x48	230	$2000	$460,000
Steel Girders 18x50	120	$1080	$129,600
Metal Decking	4,400	$120	$528,000
Concrete	300 (Cubic Yards)	$90 /yrd^3	$108,000

Total Estimated Cost : 1,225,600$

PLAN FOR NEXT PHASE:

The next phase of this project will be to design the lateral support system of the structure. This will first involve determining the seismic activity in the region and the provided seismic design values.
Once the seismic region is analyzed, a lateral system of braced frames or moment frames will be designed based on the lateral forces acting on the building. The distribution and type of lateral system will be designed based on cost and distribution required.

References:

American Institute of Steel Construction, Manual of Steel Construction, 13th Edition. Chicago: AISC, 2005.
American Society of Civil Engineers, ASCE Standard 7-16 Minimum Design Loads for Buildings and Other Structures. Virginia: ASCE/AEI, 2017.