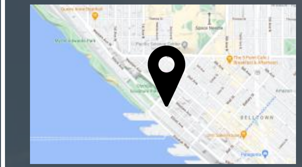
MALOOF SEATTLE HOSPITAL

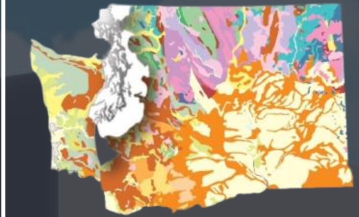
NYU TANDON SCHOOL OF ENGINEERING SEISMIC DESIGN TEAM

location



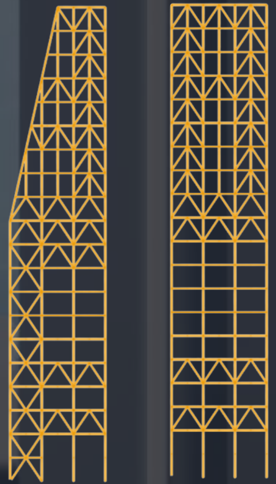
architecture

geotechnical

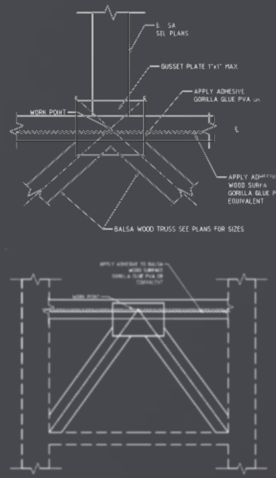


analysis of existing

structural system



retrofit



SDC team

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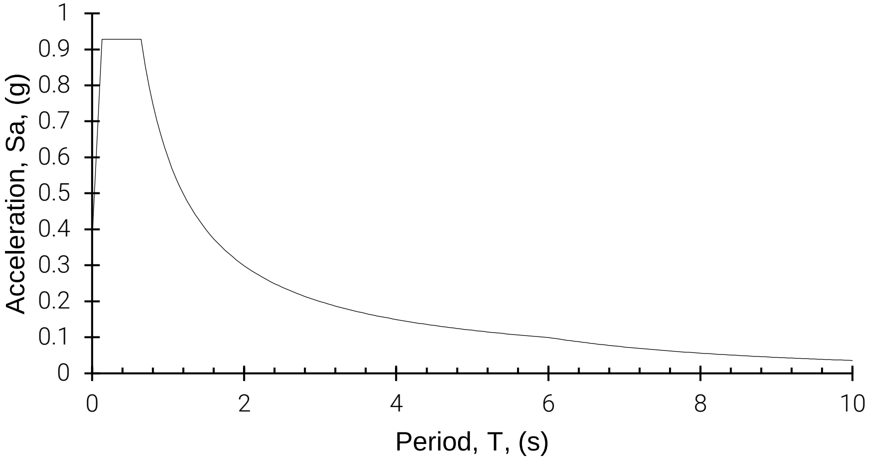
NYU TANDON SCHOOL OF ENGINEERING

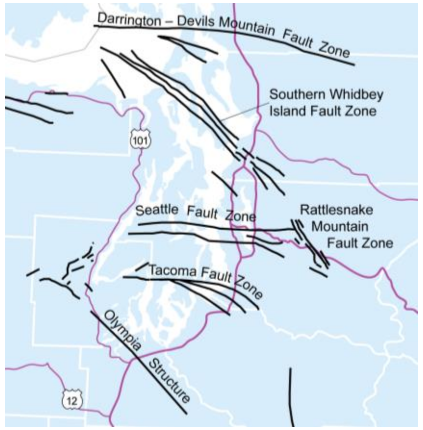
Site Conditions

Regional, site geology, groundwater conditions and seismicity were evaluated. A site class of C was determined through ASCE 7 Chapter 20, a response spectrum was prepared in accordance with ASCE 7 chapter 11. Following the probabilistic seismic deaggregation procedure, ground motions were selected and then scaled. It was found that the scale factor for all ground motions was 3.

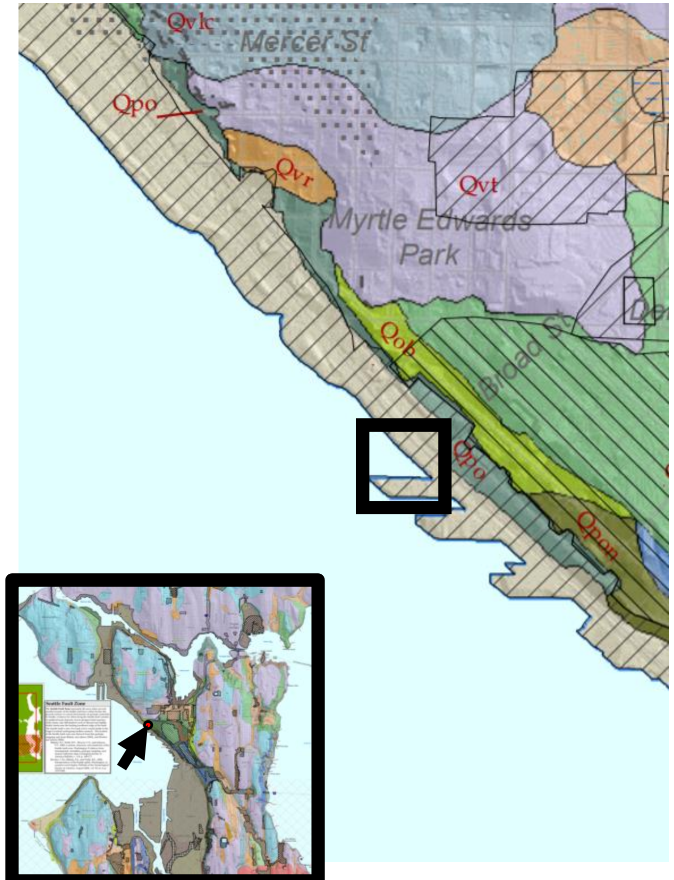
Response Spectrum of Seismic Design Category D



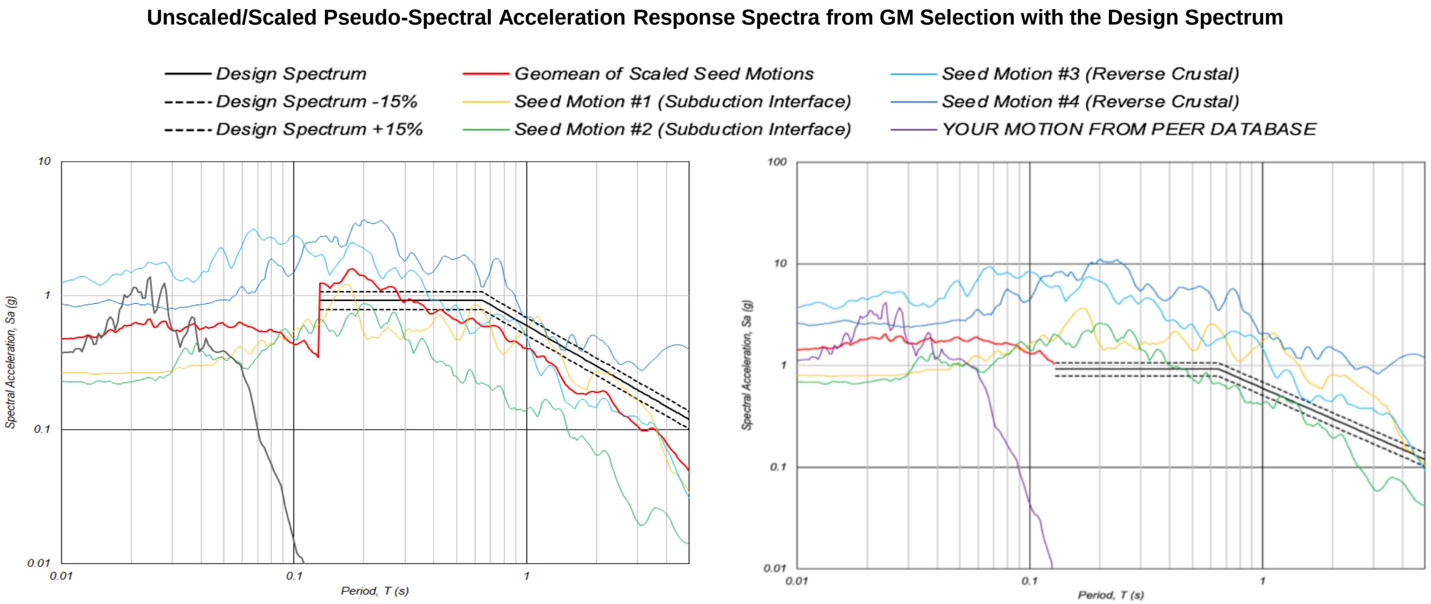
Local Faults



Geologic Map



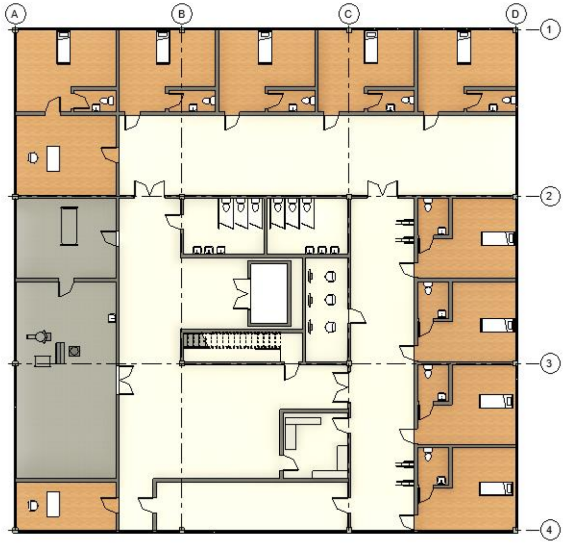
Scaled Response Spectrums

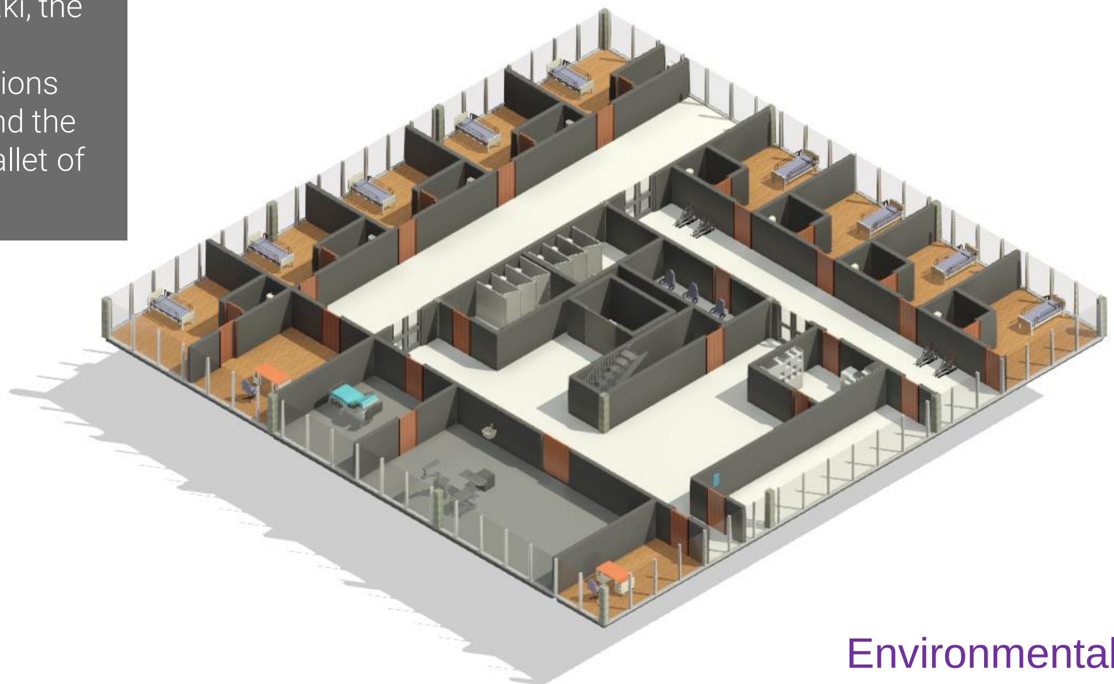


Architectural and Environmental

Inspiration

Inspired by Seattle's native son Minoru Yamasaki, the Maloof Hospital follows the new formalism architectural style, steps back on distinct elevations with green spaces, mimicking Mount Rainier, and the building unassumingly conforms to the color pallet of black and white, typical of the Seattle skyline.





Layout

Well equipped to treat patients of COVID-19, the layout of the hospital follows around a central core that holds MEP spaces, ADA elevators, ADA bathrooms, and EGRESS stairs. Through partitions, the layout is designed so that the intensive and progressive care unit may be sectioned in the event of a quarantine, while still being accessible, accommodating of bed surcharging, and a non impediment to hospital operations.

Environmental

With a three-pane façade system holding inert gases, a natural light focused interior, and special building systems for waste management, Maloof Hospital will be a leader in sustainable hospital design, reaching for LEED Platinum certification upon commissioning.

U.S. GREEN BUILDING COUNCIL LEED PLATINUM USGBC

Analysis of Existing Structure and Addition

Analysis of Existing

From the as-builts of the existing hospital structure, a FEM model was built to evaluated the serviceability and strength of the structure.

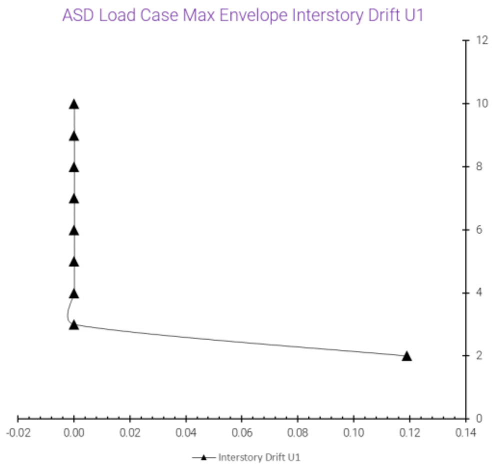
A modal analysis and 4 scaled time histories were applied to the structure.

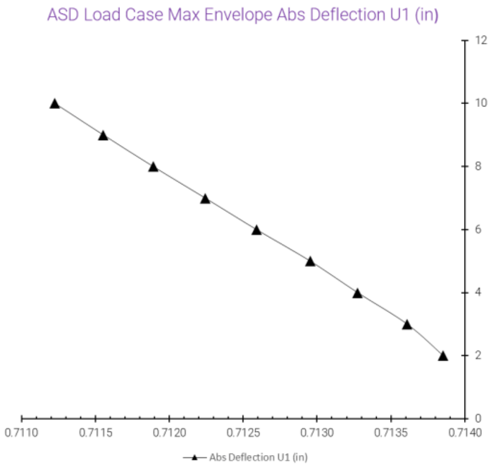
The serviceability was judged against a limit of 5% as prescribed by ASCE 7 and the Seattle Building Code Chapter 16. Strength was evaluated with ASD and the NDS design guide.

Modal Analysis

Natural Periods of the first three modes.	
Mode	**Period (sec)**
1	0.213784
2	0.133545
3	0.096628

Serviceability





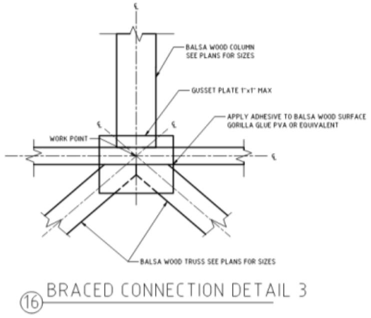
Strength

ASD 5.5 Demand to Capacity Ratios					
Design Stress	**Max V, T, C, M (lbs/lb-in)**	**Location/Piece**	**Section (in)**	**Stress (psi)**	**D/C**
Fc	0.0154	LV1 Column 3C	0.2	0.3850	0.010%
Ft	0.003533	LV2 Beam 1B 1C	0.12	0.2453	0.007%
Fv	0.0002798	LV7 Beam 4C 4D	0.12	0.0291	0.012%
Fb	0.0001926	LV9 Beam 4C 4D	0.12	0.6688	0.018%

Although the existing structure is adequate in terms of strength, it has failed in serviceability with a large 12% interstudy drift ratio. Accelerations peaked at 6.29 in2/sec on floor 3 and retrofit is required.

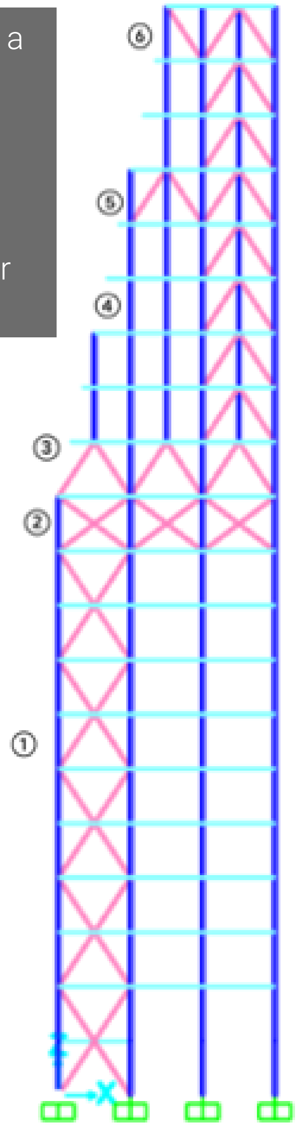
Structural Addition

Column Transfer

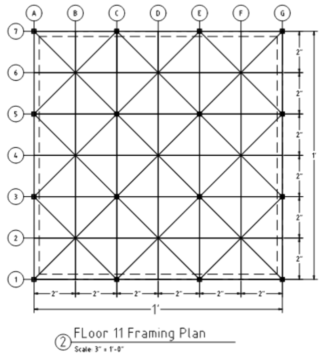


To control drifts at a minimum material cost, a perimeter moment encompasses the building and is transferred on floor 11

1) Existing Lateral Bracing
2) Transfer Level
3) Chevron Column Transfer
4) Efficient Moment Frame
5) Chevron Outrigger
6) Roof Outrigger



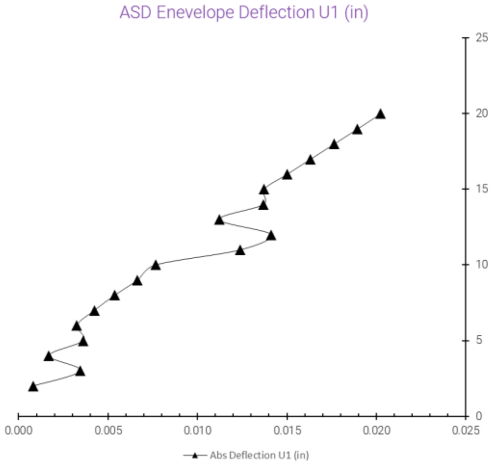
Lateral Transfer Floor

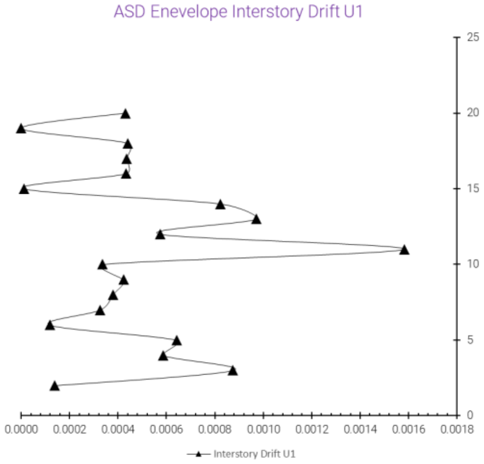


To avoid crushing the floor diaphragm where the lateral system transfers, floors 11 and 12 are braced in plane.

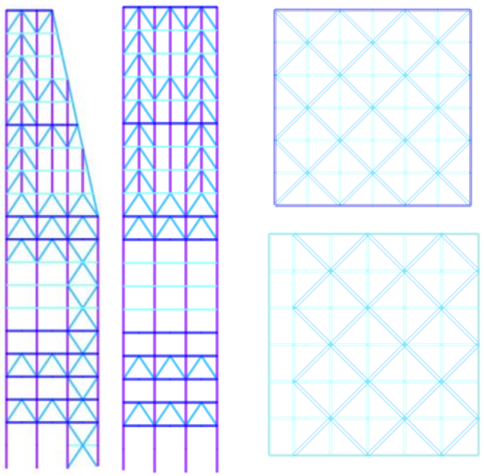
The objective of the retrofit was to control inter story drifts, accelerations and deflections. Where floors exceeded performance expectations, such as floors 3,4,5,6,10,11 and 15, spandrel beams are jacketed, and outriggers are designed as required.

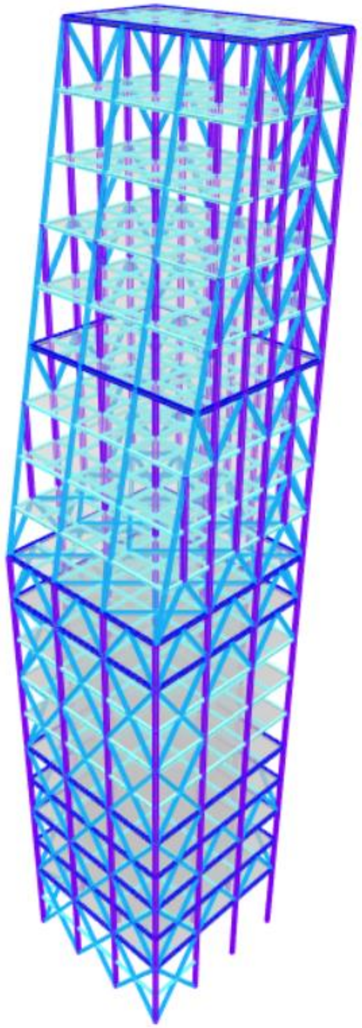
Serviceability





FEM

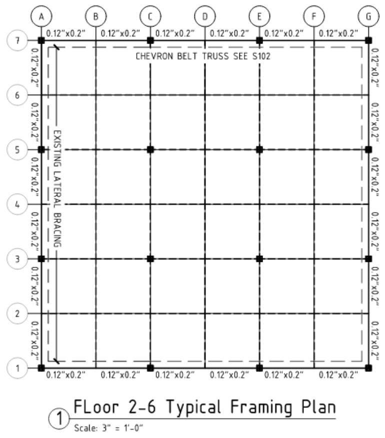


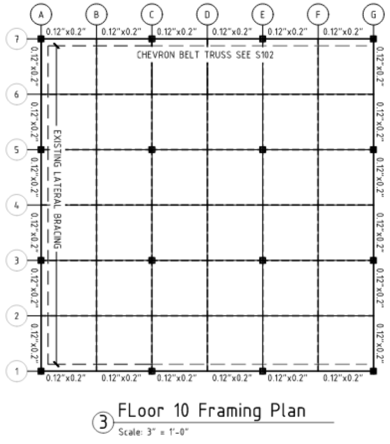


Strength

ASD 5.5 Demand to Capacity Ratios					
Design Stress	Max V, T, C, M (lbs/lb-in)	Location/Piece	Section (in)	Stress (psi)	D/C
Fc	0.0397	LVL 1 Column 5G	0.2	0.993	0.03%
Ft	0.0075	LVL 1 Beam 1AB	0.2	0.188	0.01%
Fv	0.0006	LVL 12 Beam 3D 3E	0.12	0.062	0.03%
Fb	0.0005	LVL12 Beam 3D 3E	0.12	1.760	0.05%

Spandrel Jacketing





The total building weight with the final addition and retrofit design is 0.3 lbs. and the total rentable floor area is 1,143.44 in2

Deep Beam	
Normal Beam	
Column	
Truss	

Connections