Universidad de las Fuerzas Armadas "ESPE"

TAMIA

EERI
Student Leadership Council

EERI

Geotechnics

SOIL CHARACTERISTICS

The city of Seattle, located in the state of Washington USA is in a region that is situated between the Cascade Range and the Olympic Mountains, and it stands below sea level. Resulting in an area with glacial and non-glacial deposits that overlie an irregular bedrock surface.

SOIL PROBLEMS

Several current and past studies have suggested that liquefaction can occur in saturated soils without cohesion during earthquakes.

POSSIBLE SOLUTIONS

Vibratory Methods
Deep Dynamic Compaction
Permeation Grouting

DEPTH BELOW THE GROUND SURFACE

Based on the preliminary information provided, the foundations are expected to have a depth of 110 ft (33.5 m), since at this depth we find a very dense soil layer.

Site class and Risk Category

This soil would be classified as Site Class F, in which they enter the sites of potential failure or collapse in case of seismic loads.

According to Chapter 1 of ASCE 7-16, the analyzed structure is classified as a category IV, due to its characteristic of being a structural addition for a hospital and its integrity must be insured in case of a seismic event.

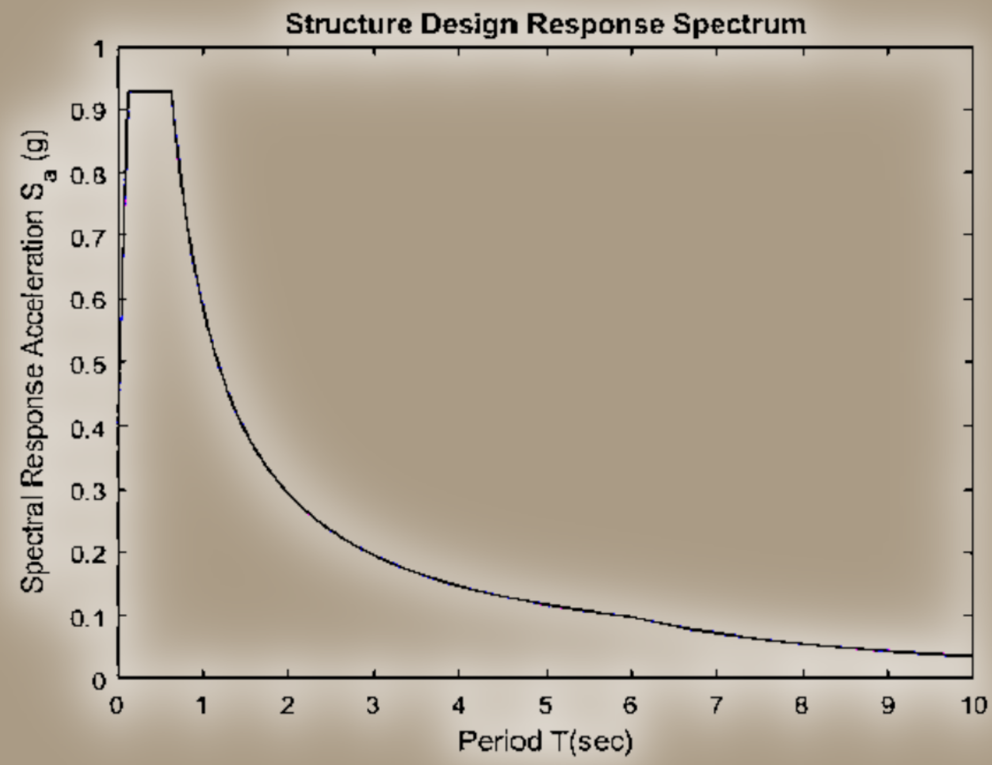


Table 3. Parameters for Structure Design Response Spectrum.

SS (g) (ATC Online Tool)	S1 (g) (ATC Online Tool)	Fa (Table 11.4-1 ASCE 7-16)	Fv (Table 11.4-1 ASCE 7-16)	S_{MS} (g) (Eq. 11.4-1 ASCE 7-16)	S_{M1} (g) (Eq. 11.4-2 ASCE 7-16)	S_{DS} (g) (Eq. 11.4-3 ASCE 7-16)	S_{D1} (g) (Eq. 11.4-4 ASCE 7-16)	T_o (sec)	T_s (sec)	TL (sec) (Fig. 22-14 ASCE 7-16)
1,392	0,485	1	1,815	1,392	0,8803	0,928	0,587	0,126	0,632	6

Structural Challenges

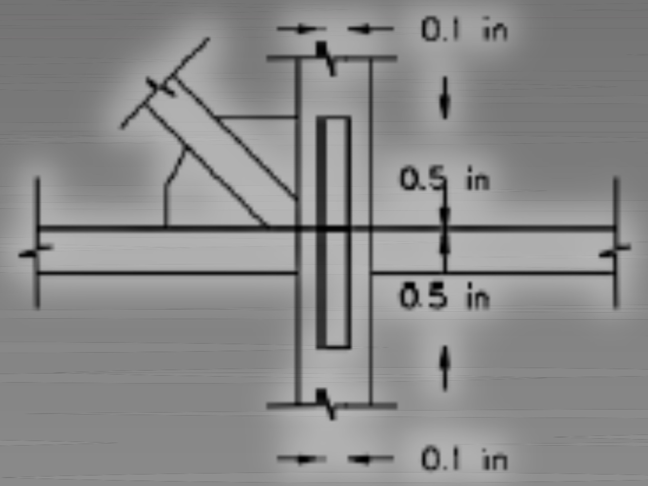
EXISTING BUILDING MODELING AND PERFORMANCE ASSESSMENT

The structure had a good deportment based on the analysis, both the drifts and the internal forces stayed within the limits established by the recommendations by the competition and in the American Wood Council's National Design Specification for Wood Construction. One of the special considerations that the team identified is that the structural system presents torsion problems due to the irregularity of its configuration due to the arrangement of the diagonals on its sides.

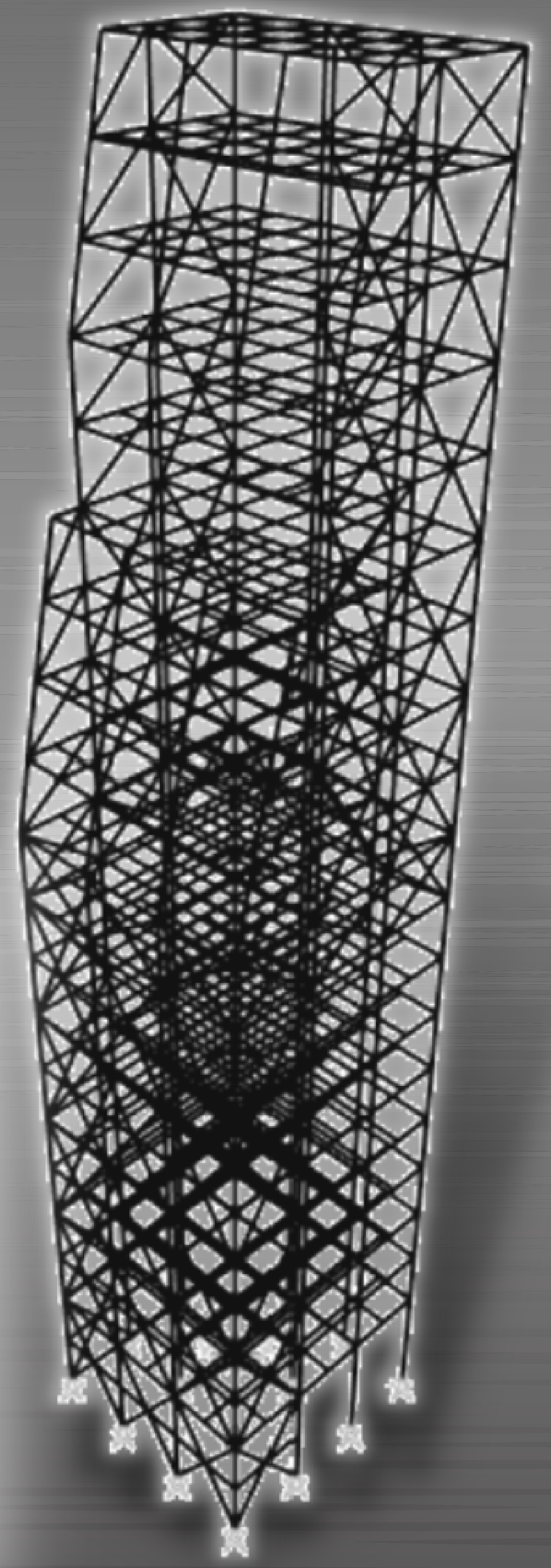
EXTENSION (ADDITION)

The chosen model compensates the stiffness problem we had on the structure by its own. In order to maximize the rentable floor area, cantilever beams are supported by inclined members working on traction. Lateral X members that go until the top of the structure are considered to compensate the torsional effect produced by lateral tapering and the irregular distribution of stiffness in the structure.
The structure needs reinforcement on the right side of the existent structure to have a good performance throughout the presented ground motions. With an analysis just with dead load we could reach 5% drifts at the top story.

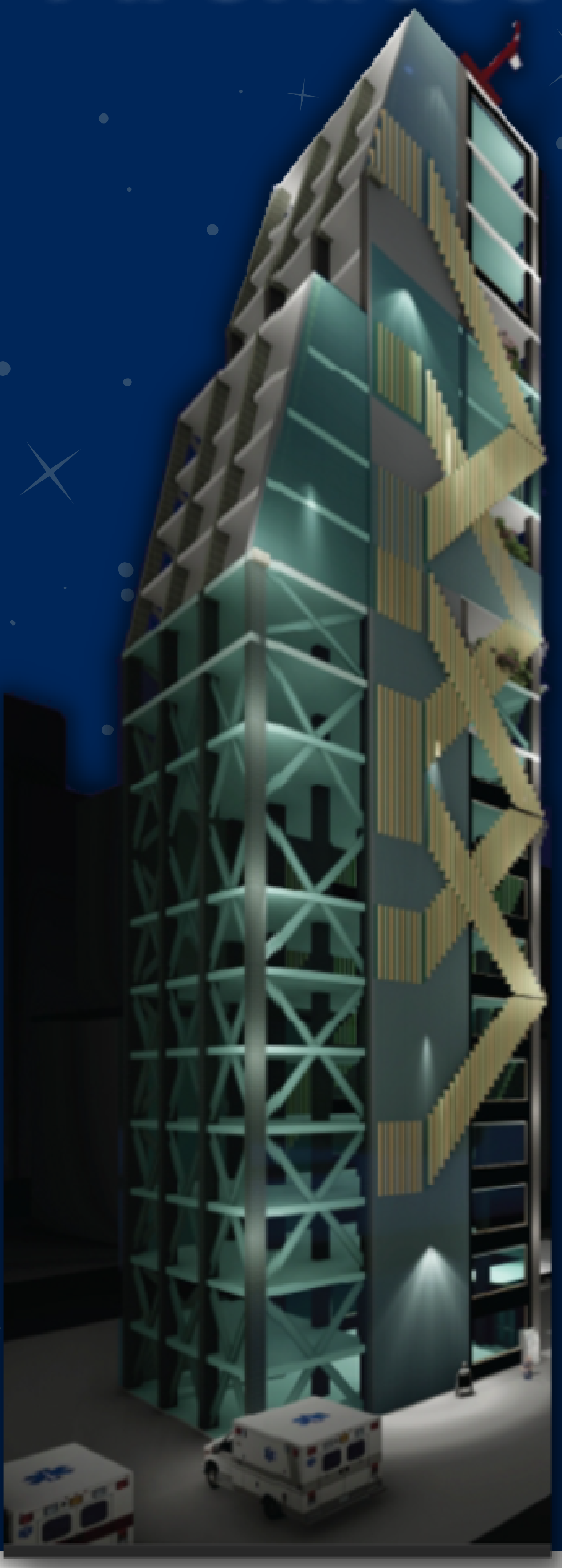
Proposed Connection Diagram



Floor	Rentable floor area [in2]
10	519,84
11	519,84
12	445,45
13	438,24
14	433,20
15	349,28
16	346,56
17	346,56
18	272,16
19	264,96
Total Area	3936,09



Architectural Challenges

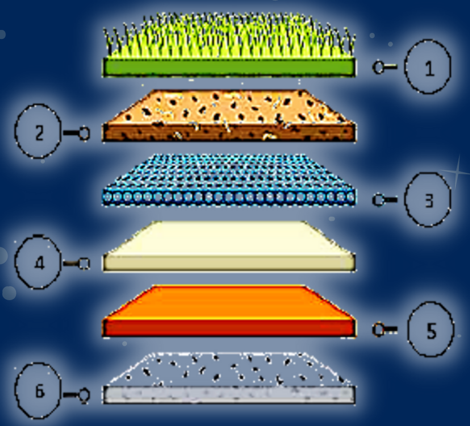


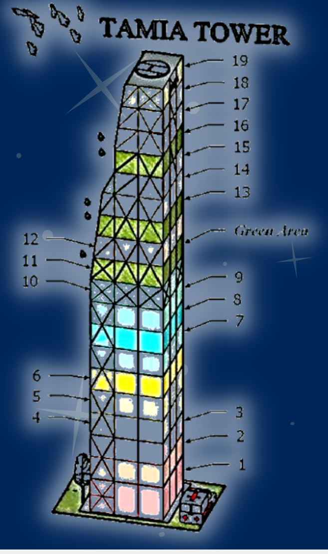
TAMIA

The ecological design of the Tamia hospital, an original word from the Quichua language whose meaning is rain, refers to the high rainfall that occurs in the area.

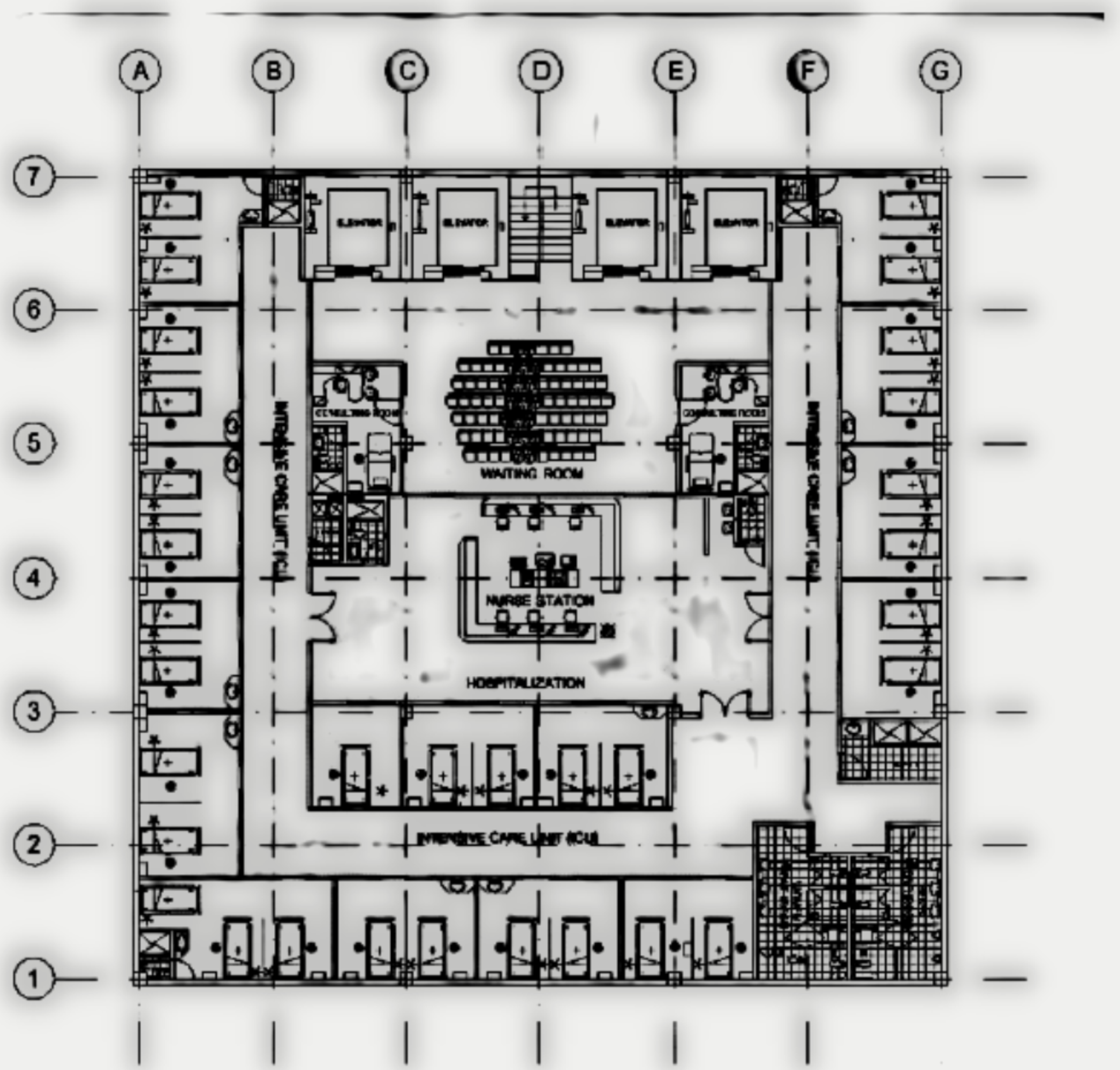
COMPONENTS OF FACADE

The implementation of green terraces in the design will fulfill various functions such as improving the stay of patients in the hospital. With a facade mainly composed of double glazing, the center of which will consist of AeroShield transparent material that provides thermal comfort by being insulating .





Distribution of areas within the intensive care type floor



BUILDING WITH LEED CERTIFICATION

- The hydrosanitary certification, it is planned to install a system for the use of rainwater for the supply of water for toilets in addition to surface cleaning on terraces.
- The lighting sensors and light fixtures will be installed for the occupation of 90% of the spaces, with a luminosity of less than 7,000 candela per square meter.
- Additionally, flow pressure compensation aerators.

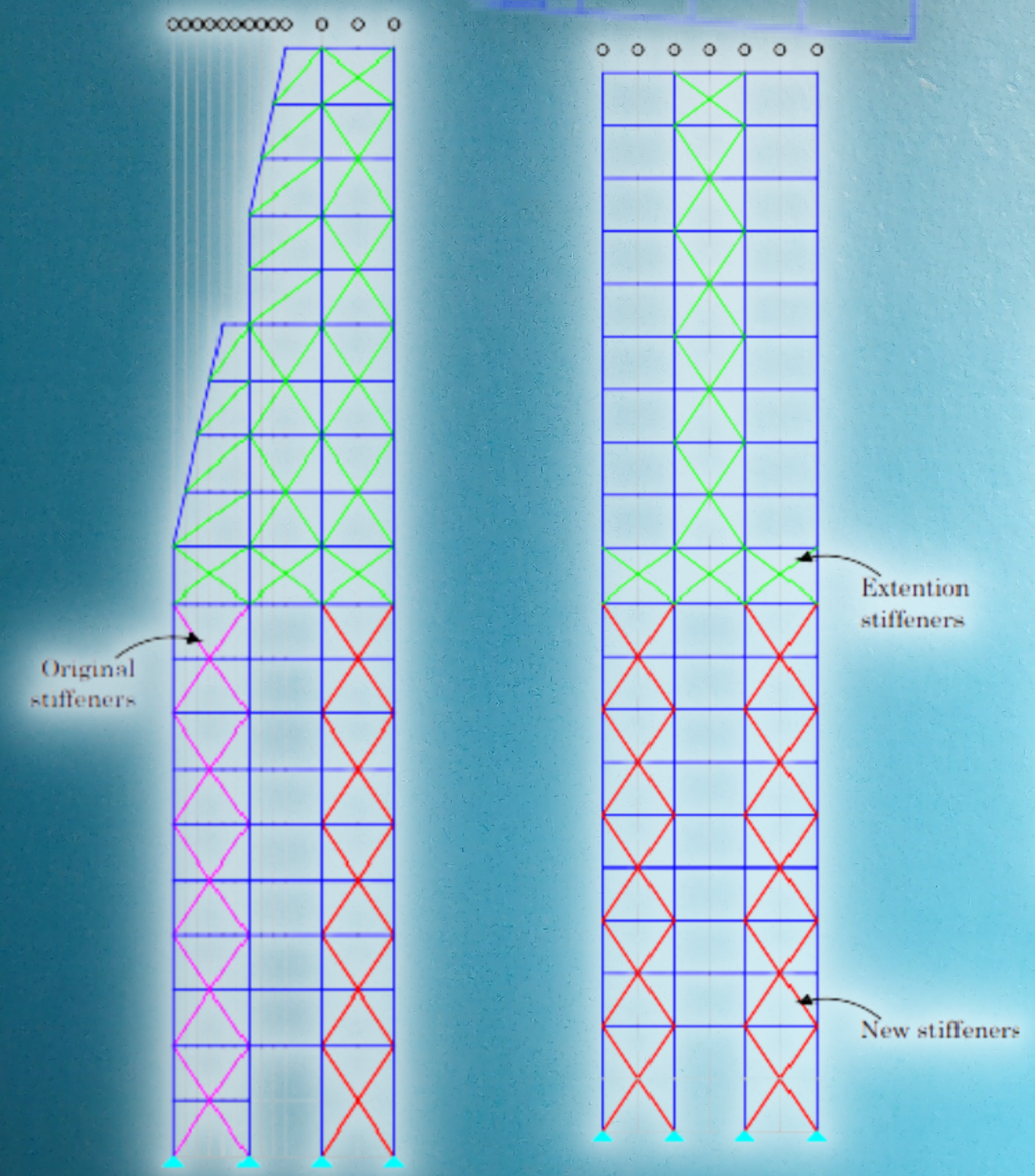
RETROFIT

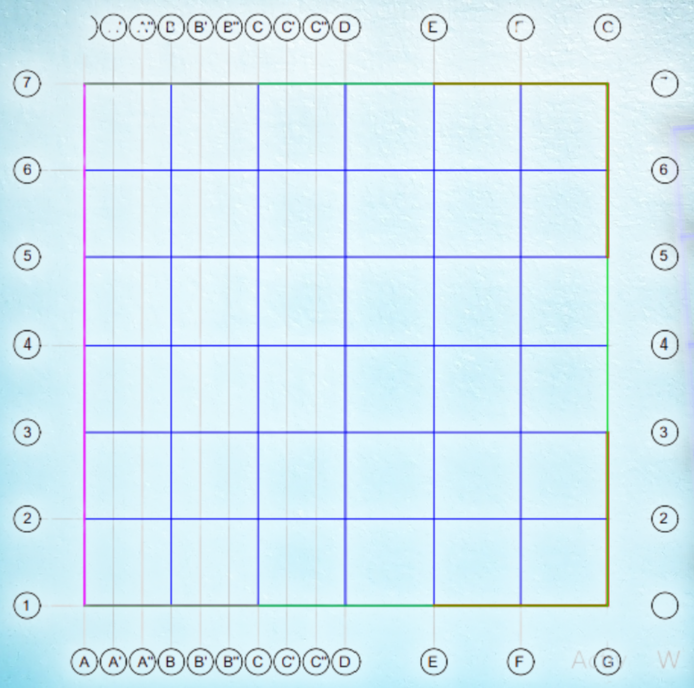
Modernization methods are very varied today and are adjusted to the energy dissipation requirements of the structures and the available budget, supplementary damping and seismic isolation for buildings is presented as a combination of period change and additional energy dissipation. The various types of modernization can be applied to reinforced concrete or steel structures.

1. Supplemental Damping System:

By means of elements that work mechanically, the energy is dissipated and the main structural elements are protected. When these are located as structural elements, these contribute to the rigidity of the structure (Christopoulos & Filiatrault, 2007). The most important kind of Damping System are Viscous Damper and Hysterical damper.

Example: Torre Mayor (CDMX- México) with Taylor viscous seismic dampers.





2. Seismic isolation system

Its function is to limit the transfer of seismic energy to the superstructure. It is installed under the support points of the structure. It allows to lengthen the period of the structure and reduce accelerations. It works for any structure, however some factors make it more effective:

- Short period structures (T1 <1.0s).
- Heavy buildings.
- It is ideal on rigid floors.
- Location above foundation level

Example: Los Caras Bridge (Bahía de Caraquez-Ecuador) with triple pendulum insulators.