Assignment/ Quiz: Structural Dynamics and Earthquake Engineering

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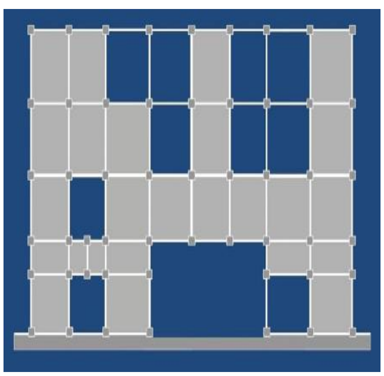
Section B

8th Semester

Q no. 1

Describe the types of the configurations depicted in Figure 1, 2 & 3. How they can effect seismic performance of a structure and what are their possible solutions.



Q1
Ans.

Figure - 1

Configuration Condition:

→ Soft and Weak stories

Effect on seismic performance of a structure:

→ A soft or weak story at any height creates a problem, but since the comulative loads are greatest towards the base of the building, a discontinuity between the first and second floor tends to result in the most serious condition.

Solution:
- Add Columns
- Add bracing
- Add external buttresses

-> Figure: 2

Configuration Condition

-> Discontinuous shear walls

Effect on seismic performance of a structure

-> When shear walls form the main lateral resistant elements of a structure, and there is not a continuous load path through the walls from roof to foundation, the result can be serious overstressing at the point of discontinuity. The discontinuous shear wall condition represents a special, but common case of the soft first-story problem.

-> Solution: Avoid discontinuous Shear Walls

-> The solution to the problem of the discontinuous shear wall is to eliminate the shear walls.

→ If the decision is made to use shear walls then their presence must be recognized from the beginning of schematic design, and their size and location made the subject of careful architectural and engineering coordination early.

→ Figure: 3

Configuration Condition

→ Re-entrant Corners

Effect on seismic performance of a structure

⇒ There are two problems created by these shapes. The first is that they tend to produce differential motions between wings of the building that, because of stiff elements that tend to be located in this region, result in local stress concentration at the re-entrant corner.

→ The second problem of this form is torsion which is caused because the center of mass and the center of rigidity in this form cannot geometrically concide for all possible earthquake directions. The result is rotation. The resulting forces are very difficult to analyze and predict.

→ Solution: There are two basic alternative approaches to the problem of re-entrant corner form: structurally to separate the building into simpler shapes or to tie the building together more strongly with elements positioned to provide a more balanced resistance. The latter solution applies only to smaller buildings.

The use of splayed rather than right angl re-entrant corners lessens the stress concentration. This is analogous to the way a tapered beam is structurally more ~~deris~~ desirable than a abruptly notched one.

Q no. 2

Develop the equation of motion of the frame shown in figure 4 under the action of a lateral dynamic force p(t). Consider a uniformly Distributed gravity load of (registration number) lb/ft acting on the beam. Neglect damping effect

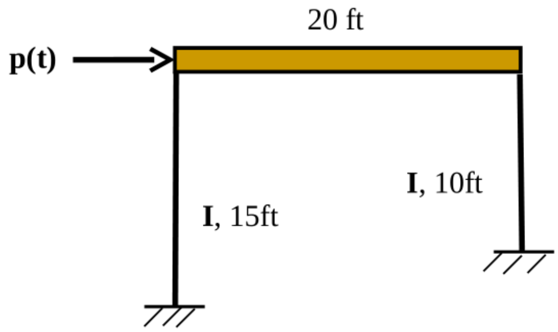
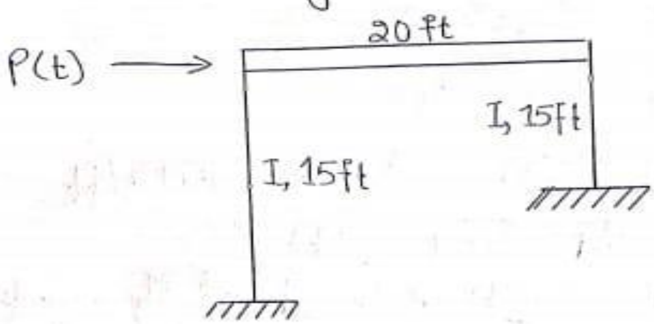


Figure 4

Q2
Sol.

Equation of Motion for a Frame under Lateral Dynamic Force



W = 7718 lb/ft

W = 3500.826 K/ft

$$m = \frac{W}{g} = \frac{3500.826 \times 20K}{32.2\ ft/sec^2}$$

$$m = \frac{70016.52}{32.2}$$

$m = 2174.42\ k.sec^2/ft$

$m = 2174420\ lb\ sec^2/ft$

$m = 2174.42$ slug

Using D-Alembert's Principle of dynamic equilibrium

$$P(t) - f_I - f_{s_1} - f_{s_2} = 0$$

$$P(t) - m\ddot{u} - (f_{s_1} + f_{s_2}) = 0$$

$$(k_1 u + k_2 u) + m\ddot{u} = P(t)$$

$$(ku) + m\ddot{u} = P(t) \quad \text{As, } k = 3759\ k/ft$$

$$3106\ddot{u} + 3.76 \times 10^6 u = p(t)$$

where u and $p(t)$ are in ft and lb respectively.