IQRA NATIONAL UNIVERSITY

SUBJECT: **INTRODUCTION TO STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING**

ID # 7708 SECTION: A CLASS: BE(C)

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

Ans **EXPLANATION**

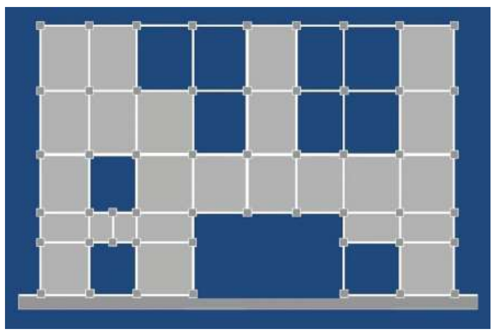

Figure 1

a) CONFIGURATION

This types of configuration of a structure of figure 1 is **Discontinuous shear walls.**

b) EFFECT OF SEISMIC PERFORMANCE OF A STRUCTURE

In this figure 1 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 middle point of a structure will be collapse due to over stressing not present of center shear walls.

The discontinuous shear wall condition represents a special but common case of soft first story problem.

The discontinuous shear wall is a foundation design contradiction the purpose of a shear wall is to collect diaphragm loads at each floor and transmit them as directly and efficiently as possible to the foundation. Due to seismic effect the collapse generate will be in the middle of a structure.

c) SOLUTION

The primary solution of this problem is to eliminate the shear walls from the structure.

If the decision is made to use shear walls, then their presence must be recognized from the beginning of the schematic design, and their size and location made the subject of careful architectural and engineering condition early. And make full foundation shear walls from roof to the foundation of the structure.

Figure 2

a) CONFIGURATION

The configuration of the figure 2 structure is **Soft and Weak Stories** building.

b) EFFECT OF SEISMIC PERFORMANCE OF A STRUCTURE

The most prominent of the problems caused by figure 2 is severe stress concentration is that of the “soft” story. The term has commonly been applied to buildings whose ground-level story is less stiff than those above. The soft-story buildings easiest to identify are the apartments with parking on the ground level, like in figure. When the building sways, the first story doesn’t remain stiff and strong enough to support the levels above it, so the first story “pancakes” or has the potential to “pancake.”

Due to earthquake the structure will be bend and collapse because a smaller number of supporting columns are given or less dimension of columns is provided due to unsafe in comfort.

The building code distinguishes between “soft” and “weak” stories. Soft stories are less stiff, or more flexible, than the story above; weak stories have less strength.

A soft or weak story at any height creates a problem, but since the cumulative 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.

c) SOLUTION

A soft story retrofit involves strengthening and stiffening the first story, so it does not “pancake” or collapse. The retrofit might involve the addition of steel moment frames, shear walls, diagonal bracing, or fusing systems. In all options, the added structural elements increase the stiffness of the first story and create new load paths (structural redundancy). Also, can add columns or bracings and buttress at the side.

Figure 3

a) **CONFIGURATION**

The type of configuration of the structure of figure 3 is **Re-entrant Corners.**

b) **EFFECT OF SEISMIC PERFORMANCE OF A STRUCTURE**

The re-entrant corner is the common characteristic of building forms that, in plan, assume the shape of an L, T, H, etc., or a combination of these shapes.

There are two problems created by these shapes. The first is that they tend to produce differential motions between different wings of the building that, because of stiff elements that tend to be located in this region, result in local stress concentrations 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 coincide for all possible earthquake directions. The result is rotation. The resulting forces are very difficult to analyze and predict.

The deformation produced between the two wings of figure 3 is the point of center in which cracks produces and deformation occurs.

c) **SOLUTION**

There are two basic alternative approaches to the problem of reentrant-corner forms: 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.

In case of separation building must be sufficiently away to ensure they do not pound together and damage each other in an earthquake.

The use of splayed rather than right angle re-entrant corners lessens the stress concentration.

This is analogous to the way a tapered beam is structurally more desirable than an abruptly notched one.

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**

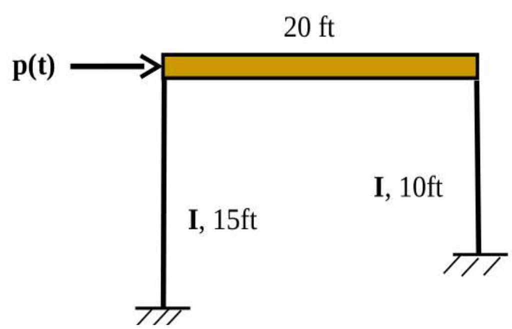

Figure 4

SOLUTION

As we know that

m = w/g = 7708 x 20k / 32.2 ft/sec^2

$m = 4787$ lb.sec^2/ft

Using D-Alembert's Principle of dynamic equilibrium

$$P(t) - f_1 - f_{s1} - f_{s2} = 0$$

$$P(t) - mu - (f_{s1} + f_{s2}) = 0$$

$$(k_1u + k_2u) + mu = P(t)$$

$$(ku) + mu = P(t)$$ As $k = 3759$ k/ft

Putting values

$$4787u + 3.76 \times 10^{6}\, u = P(t)$$

Where u and P(t) are in ft and lb. respectively

THE END