IQRA NATIONAL UNIVERSITY,

PESHAWAR

MID TERM EXAMINATION

ID : 7735

SECTION : A

MODULE : 8^{th} SEMESTER

Quiz/Assignment

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.

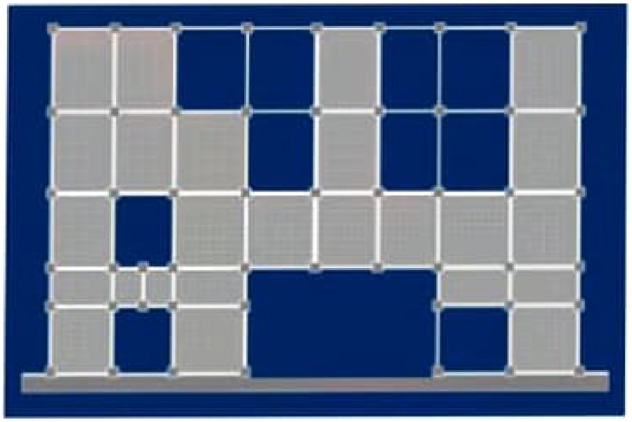


Figure 1

Figure 2

Figure 3

Figure 1

(Q1)

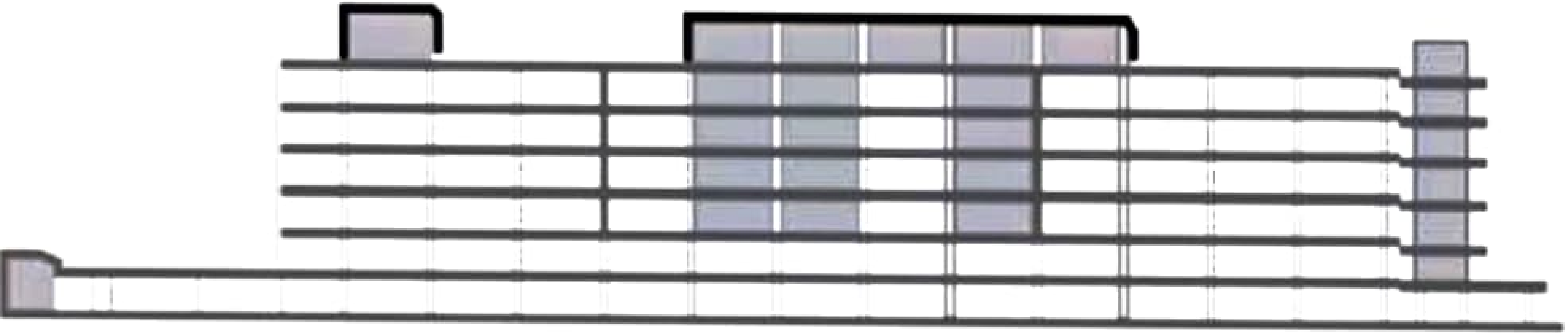
Fig (1)

Avoid Discontinuous Shear Walls:

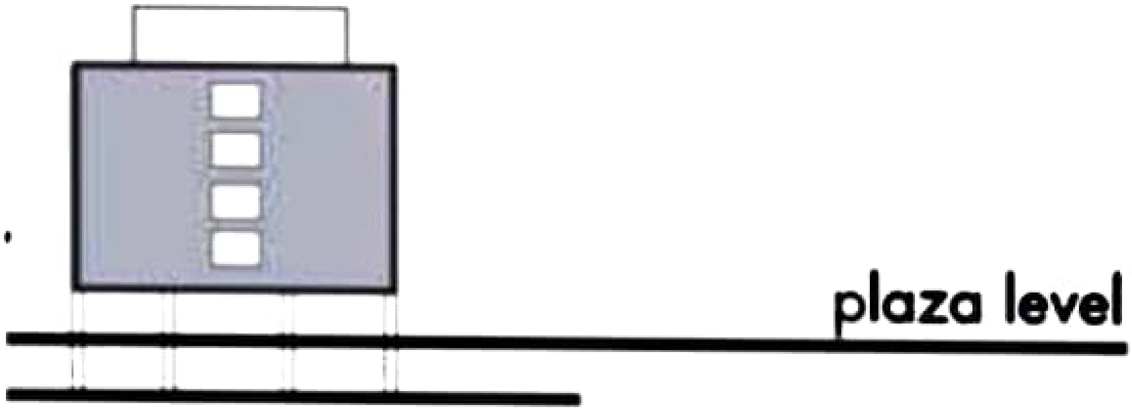
⇒ When shear walls from the main lateral resistant elements of a structure, and there is not a continuous load path through the walls from roof to foundations, the result can be serious overstressing at points of discontinuity. This discontinuous shear wall condition represents a special, but common, case of "soft" first story problem.

⇒ The discontinuous shear wall is a fundamental 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 foundation. To interupt this load path is undesirable.

Avoid discontinuous Shear Walls

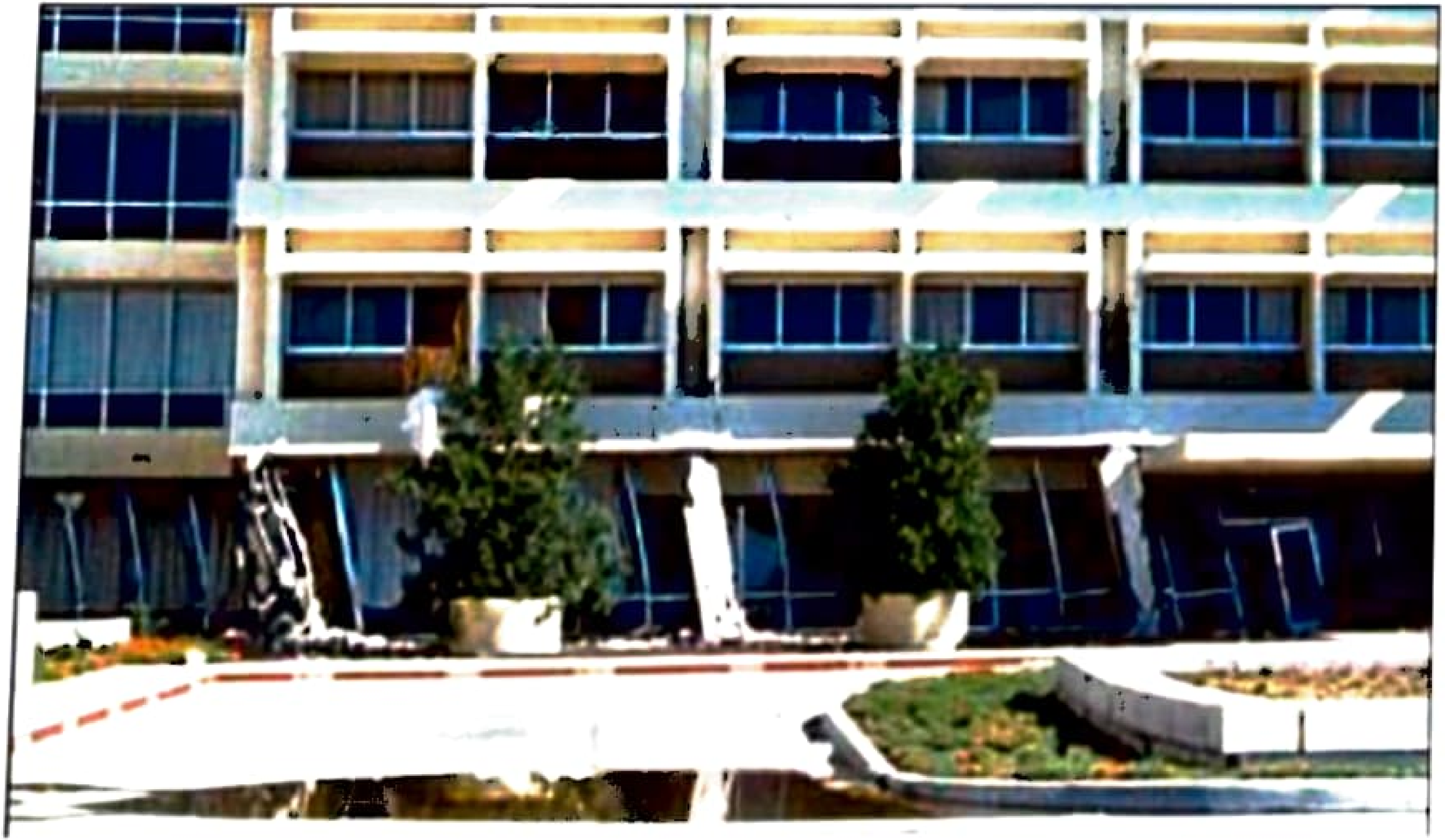


Long section, Olive View Hospital. Note that the shear walls stop at the third floor.



Cross section, Olive View hospital, showing the second-floor plaza and the discontinuous shear wall.

Avoid discontinuous Shear Walls



Olive View hospital, San Fernando earthquake, 1971, showing the extreme deformation of the columns above the plaza level.

Figure 2

(Q1)

Fig (2)

Soft and Weak Stories:

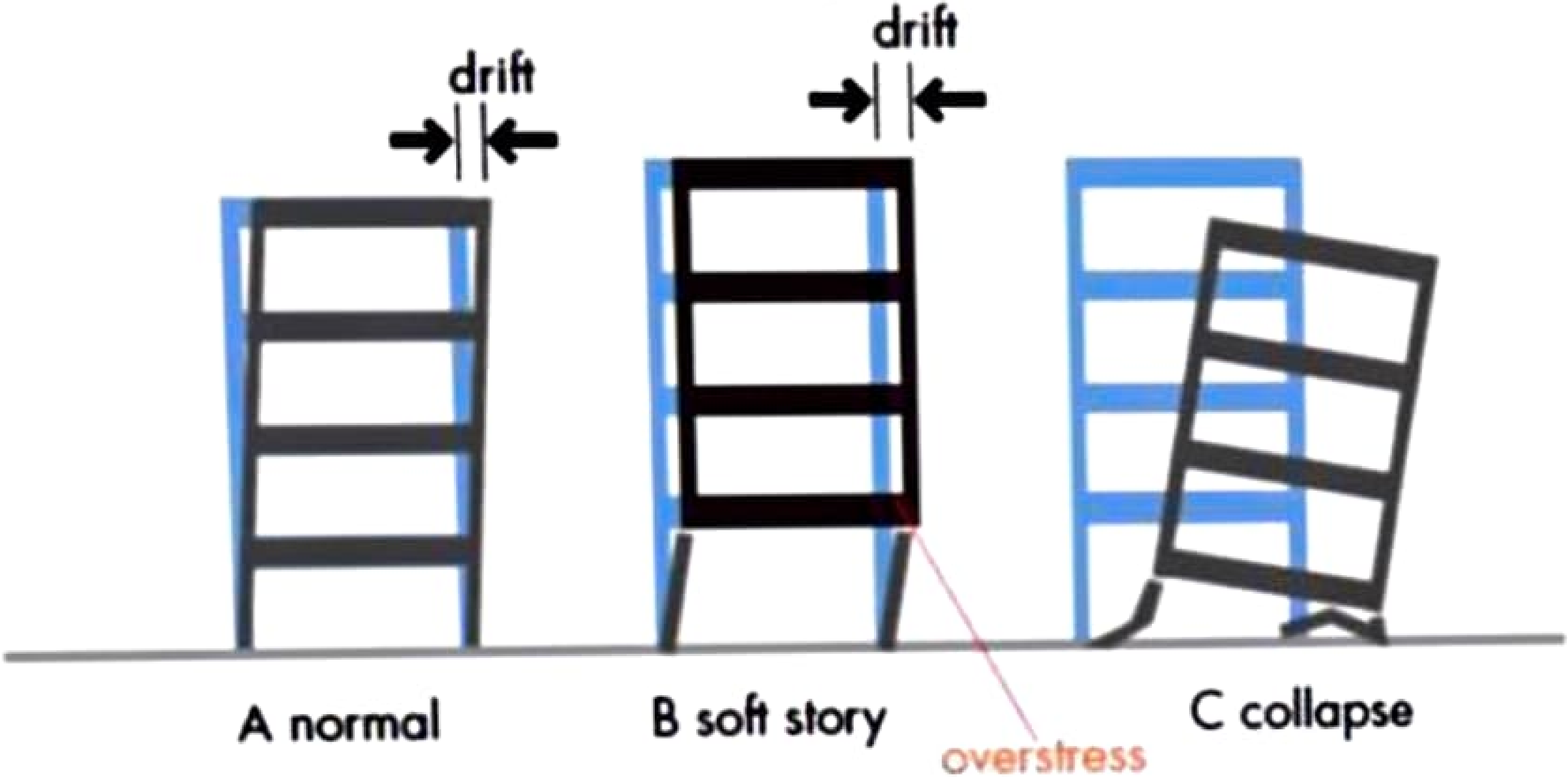
⇒ The most prominent of the problems caused by severe stress concentration is that of the "soft story". The term has commonly been applied to buildings whose ground-level story is less stiff than those above.

⇒ The building code distinguishes b/w "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.

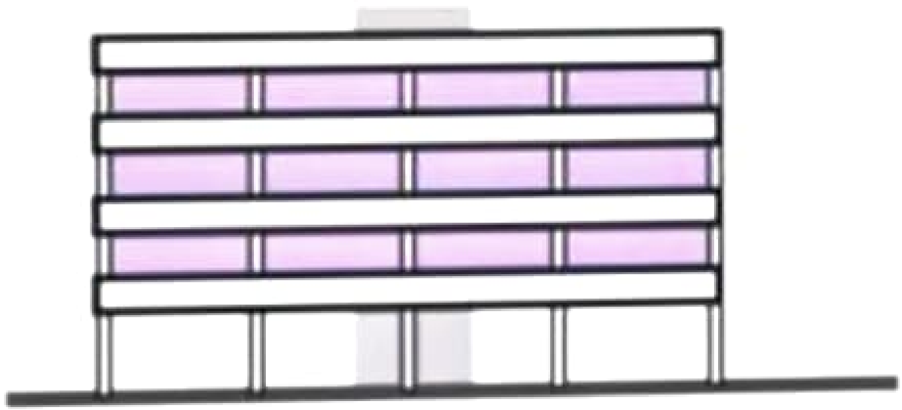
Soft-storey effect

- The most prominent of the problems caused by severe stress concentration is that of the "soft" story.

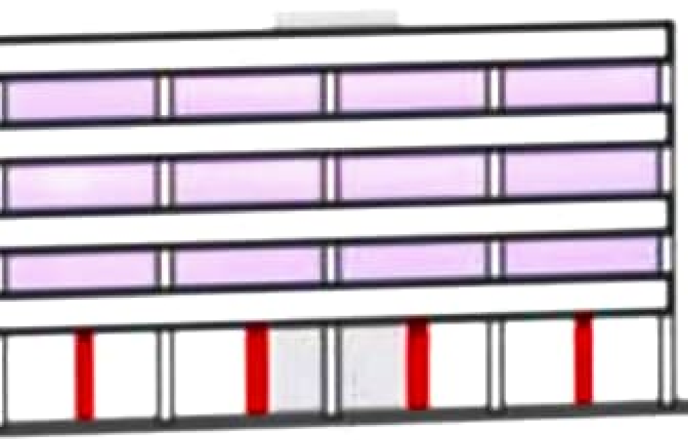


The soft first story failure mechanism.

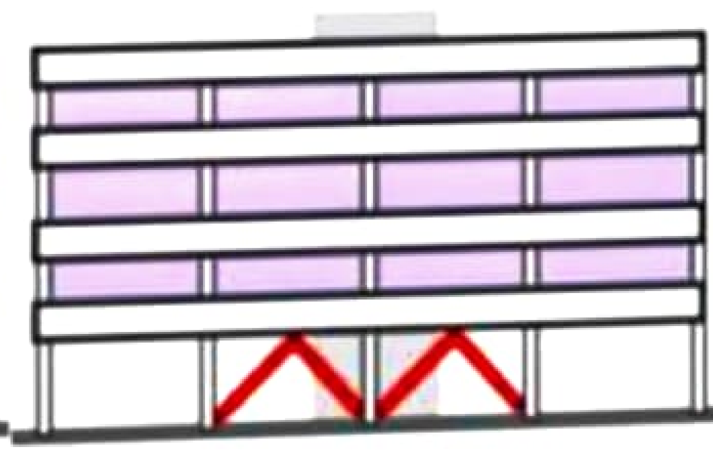
Solutıons



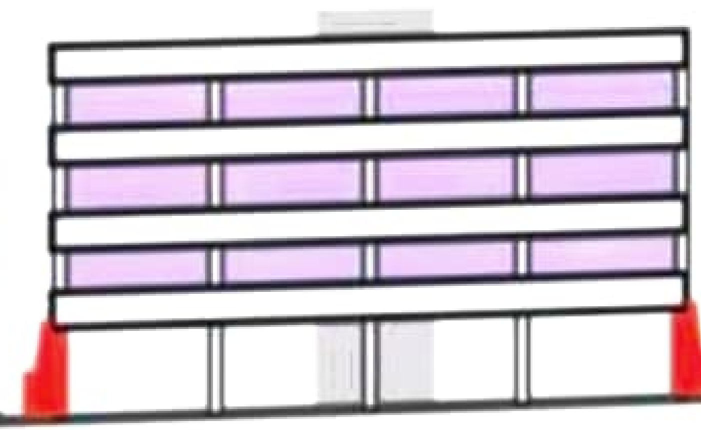
soft story



Add columns



Add bracing



Add external buttresses

Solutions:

⇒ 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 appearance must be recognized from the begining of schematic design, and their size and location made the subject of careful architectural and engineering coordination early.

Solutions

Fig A

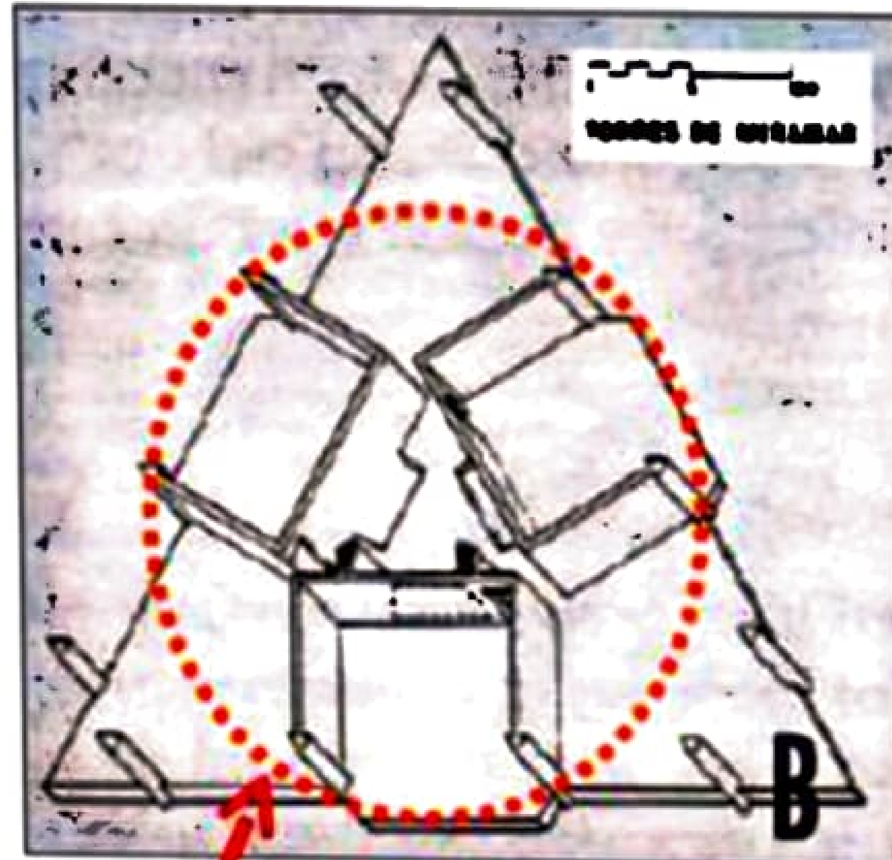


Fig B

This apartment house appears to have a soft first story (Figure A), but the lateral force-resisting system is a strong internal shear wall box, in which the shear walls act as party walls between the dwelling units (Figure B).

Figure 3

Re-entrant corner plan forms.

(Q1)

Fig 3

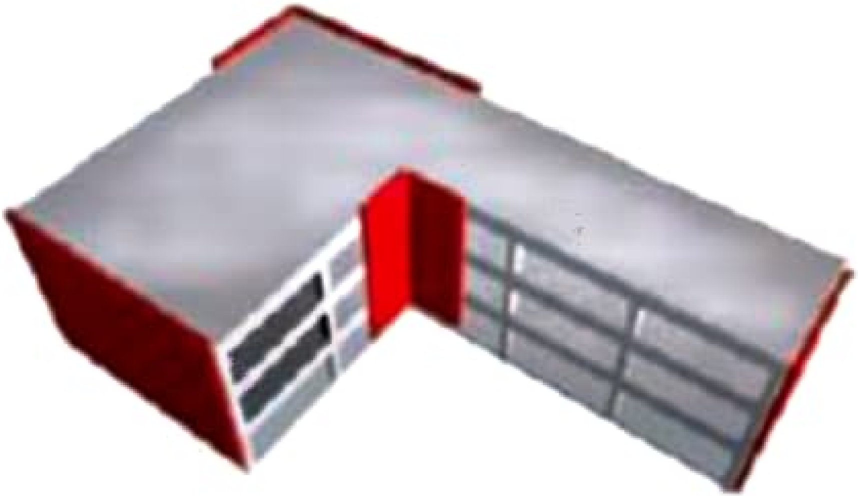
Re-entrant Corners

The 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 centre of mass and the centre of rigidity in

Seperation



Stiff resistant elements

In case of separation building must be sufficiently away to ensure they do not pound together and damage each other in an earthquake this form cannot geometrically coincide for all possible earthquake directions. The result is rotation. The resulting forces are very difficult to analyze and predict.

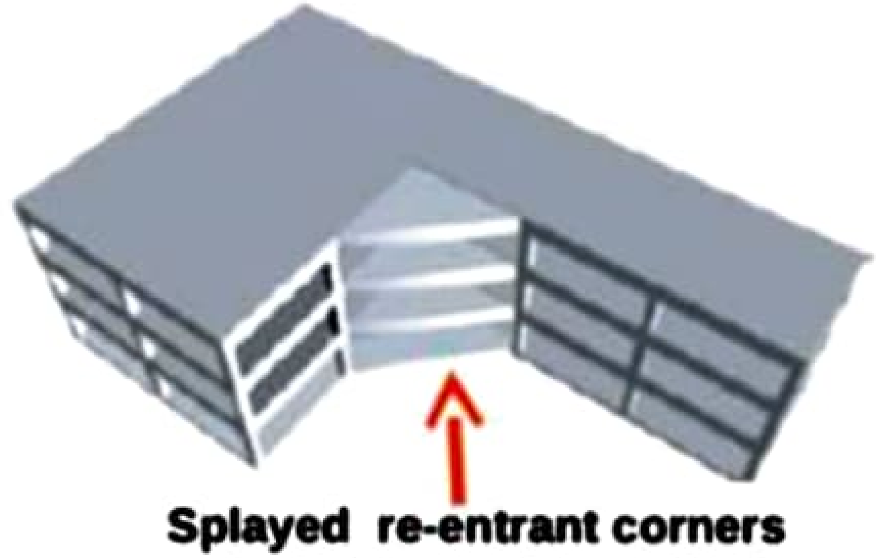
Solutions:

There are two basic alternative approaches to the problem of re-entrant forms; structurally to seperate the building into simpler shapes, or to tie the building together more strongly with elements positioned to provide a more balanced resistance (see later solution applies only to smaller buildings.

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

Solutions

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.

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

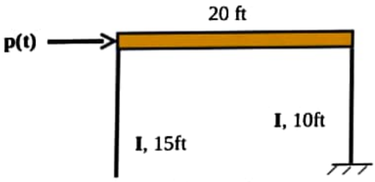
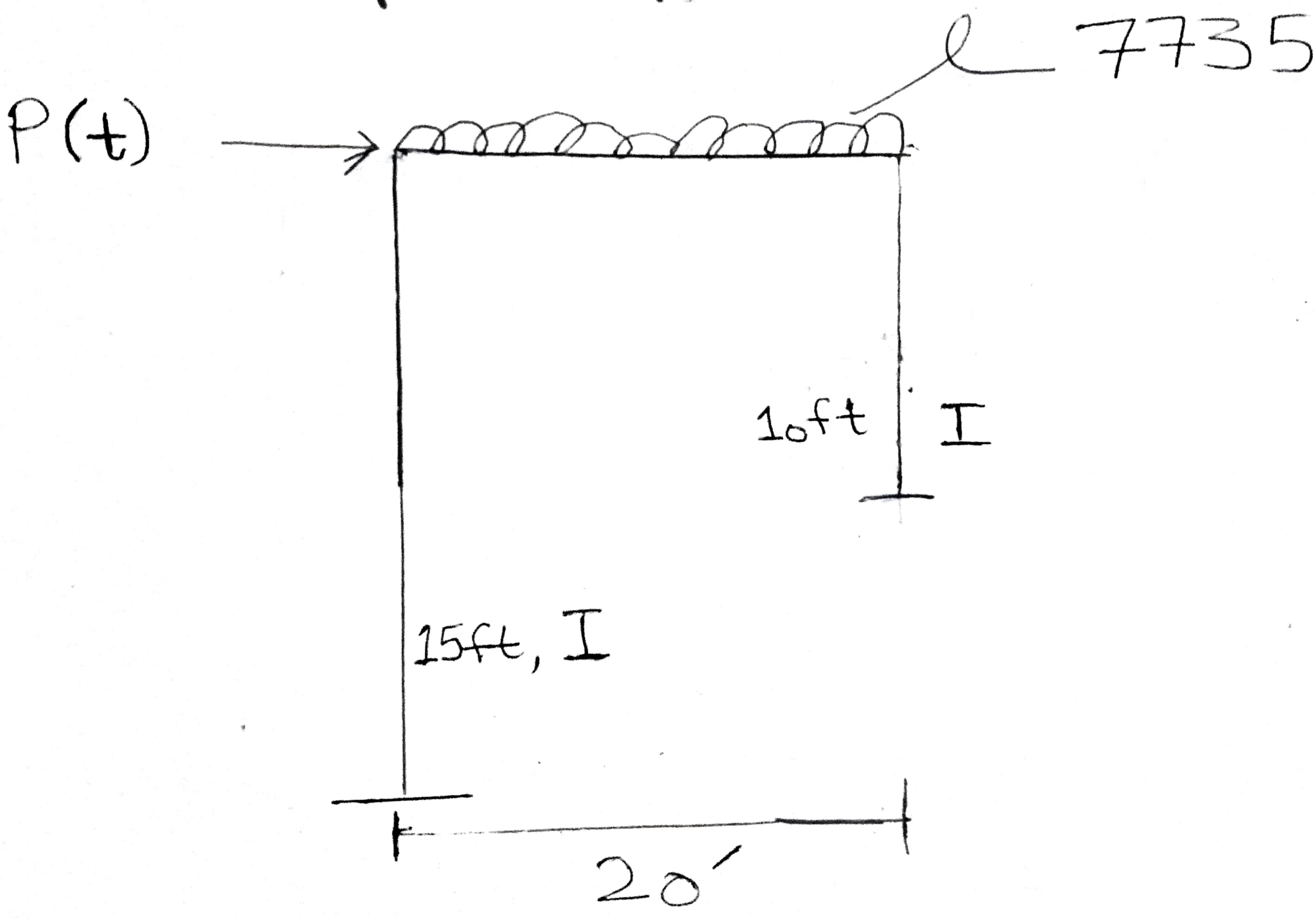


Figure 4

Q2



Equation Of Motion (EOM)

★ General form of (EOM)

$$m\ddot{u} + c\dot{u} + ku = p(t)$$

As $\Sigma f_x = m\ddot{u}$

$$p(t) - f_{s_1} - f_{s_2} = m\ddot{u}$$

$$m\ddot{u} + f_{s_1} + f_{s_2} = p(t) \quad \text{— (A)}$$

$$f_{s_1} = \frac{12EI}{L^3} = \frac{12EI}{15^3} \quad \text{— (1)}$$

$$f_{s_2} = \frac{12EI}{L^3} = \frac{12EI}{15^3} \quad \text{— (2)}$$

$$m = \frac{7735 \times 120}{g} = \frac{7735 \times 20}{32.2} = 4804\,kg \quad \text{— (3)}$$

put eq (1), (2) & (3) in A

$$4804\ddot{u} + 12EI\left[\frac{1}{15^3} + \frac{1}{10^3}\right]u = p(t)$$

$$\boxed{4804\ddot{u} + (0.0156EI)u = p(t)}$$

Required Equation