

IQRA NATIONAL UNIVERSITY

DEPARTMENT OF CIVIL ENGINEERING

MID-TERM EXAMINATION

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REG # 7720

SEMESTER 8<sup>th</sup>

SECTION B

SUBJECT INTRO TO STRUCTURE DYNAMICS & EARTHQUAKE ENGG

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Q.No.01

ANSWER

The type of serious configuration condition mention in figure is soft story.

The building in which the stiffness of lower story is less as compare to all the above storeys.

This phenomenon is called soft and weak storeys.

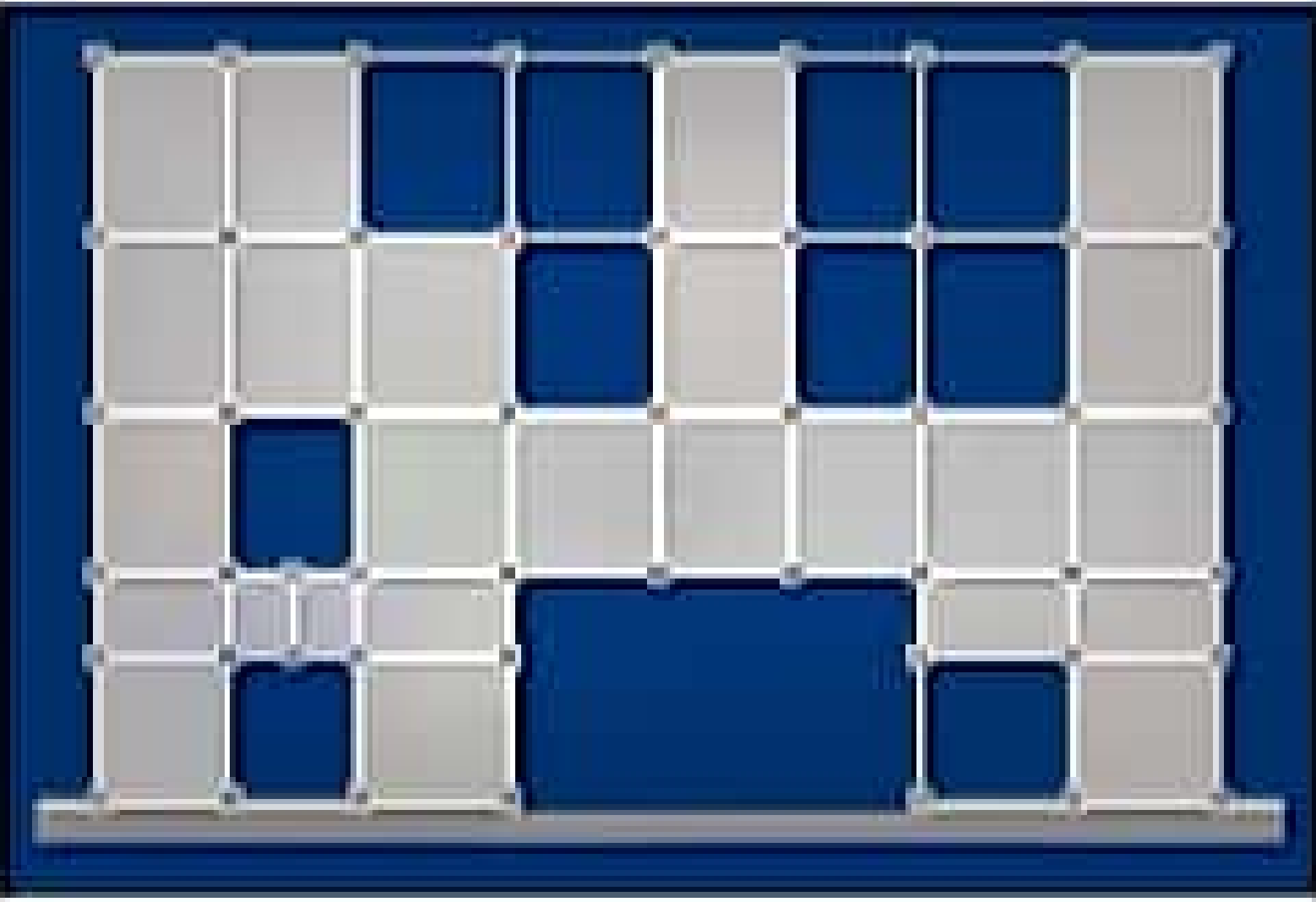
EFFECT:

The most prominent of the problems caused by severe stress concentration is that of the soft storey.

The presence of walls in upper storeys make them much stiffer than the upper ground storeys thus the upper storeys moves almost together as a single block and most of the horizontal displacement of the building occurs in soft ground storey itself.

POSSIBLE SOLUTIONS:

- Provides more ~~columns~~ columns in order to achieve the required strength and to increase the stiffness to over come soft storey configuration condition.
- Add bracing to the soft storey of the building.
- Add external buttresses.
- By specifically designing the first storey for much larger loads and smaller induced displacements than the rest of the structure.



The type of configuration condition in the figure is discontinuous shear walls. The purpose of the shear walls. The purpose of the shear wall is to collect ~~to collect~~ the diaphragm loads at each floor and transmit them as directly and efficiently to the foundation.

### EFFECTS:

→ In absence of shear walls the lateral forces caused by earthquake create powerful torsion.

→ When there is a discontinuity in shear walls it mean that all the stories of a building doesnot contain shearwall so this indicates that there is no continuous load pattern from roof to foundation in absence of shear wall. The result can be serious at point of discontinuity during on earthquake.

### SOLUTION

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

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.

Reinforcing a frame by attaching or placing a rigid wall inside it maintains the shape of the frame and prevents rotation at the joints.



The type of configuration condition in the figure is Re-entrant corners.

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

### EFFECTS:

→ Structure consisting of re-entrant corners tends to produce differential motions between different using of the building that because of stiff elements that tends to be located in this regions result in this regions results in located stress concentrations at at re-entrant corners.

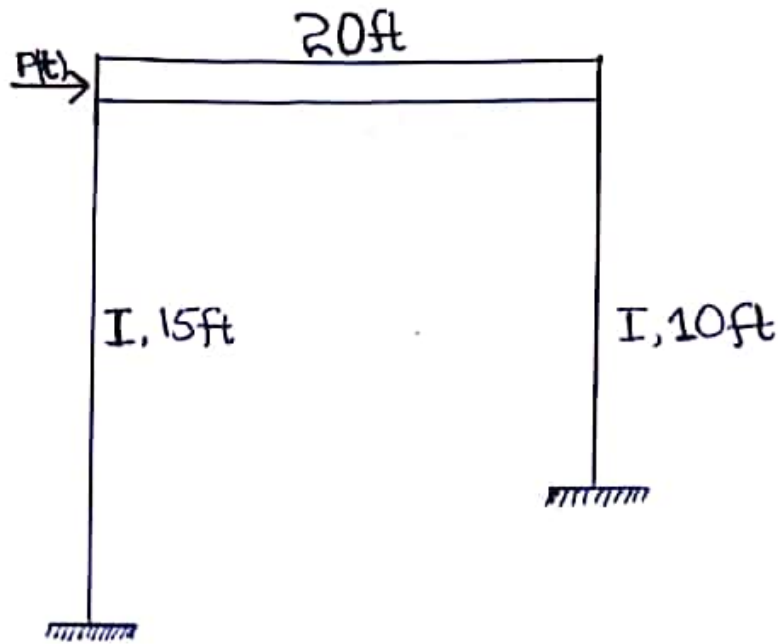
→ Other effects of re-entrant corner is torsion. Torsion is caused because the center of mass and the center of rigidity in this form cannot geometrically earthquake directions the result is rotation the resulting force are very difficult to analyze and predict.

### POSSIBLE SOLUTION:

→ Structurally to sepevate the building into simpler shapes or to tie the building together more strongly with elements positioned to provide a more balanced resistance.

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

Q. No. 02  
SOLUTION



GIVEN DATA

$$E = 29,000 \text{ Ksi}$$

$$I = 1200 \text{ in}^4$$

Uniformly Distributed Gravity load = 7720 lb/ft

REQUIRED DATA

Develop Equation of motion =  $p(t) = ?$

SOLUTION

$$\text{As, } K_{eq} = K_1 + K_2$$

$$K = 12EI \left[ \frac{1}{h_1^3} + \frac{1}{h_2^3} \right]$$

$$= 12 \times 29,000 \times 1200 \times \left[ \frac{1}{(15 \times 12)^3} + \frac{1}{(10 \times 12)^3} \right]$$

$$K = 313.29 \text{ K/in}$$

$$K = 3759 \text{ K/ft}$$



Now, using

$$m = W/g = \frac{7720 \times 20}{32.2 \text{ ft/sec}^2}$$

$$= 4.795 \text{ k} \cdot \text{sec}^2/\text{ft}$$

$$m = 4795 \text{ lb} \cdot \text{sec}^2/\text{ft}$$

Now using D'Alembert's principle of Dynamic Equilibrium

$$P(t) = k u + m \ddot{u} \longrightarrow \text{①}$$

As,  $k = 3759 = 3.759 \times 10^6 \text{ lb/ft}$

putting values we get

$$P(t) = 4795 \ddot{u} + 3.759 \times 10^6 u$$

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