Date:

Day: M T W T F S S

ID :- 7379
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Subject :- Earth Quacke engineering
Department :- Civil

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

Figure :- 1

Building Configuration :-

The structure shown in figure 1 seems to be a frame structure constructed over a raft foundation where all the beams and columns have been monolithically tied. The seismic performance of the building is such that it will develop major concern on mid section of the structure regarding failure as all the load will dynamically concentrate at mid because of tje greater opening here on. The building seems to be non - symmetrical over mid therefore it may overturn if partial settlement phenomenon occurs on left corner.

Seismic Performance :-

As the structure is frame but here is wide opening available in mid portion and all the columns over lintel are much enough to swing long and buckle easily even during small consid-erations of seismic waves. As the buckling is dangerous and all the load will then suddenly transform towards lower portions and may develop major stresses throughout the structure.

Possible Solution :-

To make the structure strong enou-gh to absorb all the over burden pressure produced due to earthquake, it is necessary to brace all the columns inclindly so that buckling may be reduced and load may be transfered towards right or left portion of the structure. In this way the stress over mid portion can mainly be made less and the building may servive in good possible way.

figure : 2

Building Configuration :-

The figure 2 is a structure having isolated footing being damaged severly due to partial settlement or earthquake. Also the structure has been shored for the possible temprary stability. As isolated column is one having its own concern to resist loads and stresses and is not dependable on other supporting parallel parts and all they act their own to transfer load towards the footing beneath it. Having this consideration, partial settlement in a single column may produce severe conditions in the whole building.

Seismic Performance :-

The configuration in the current status is more easily exposed and it may not survive long enough against severe shaking during seism as the weight of the building during dynamic swinging may not be resisted by the shores.

Possible Solution :-

The structure can be made possibly stable by providing underpins at suitable locations. further it can be a good safety measure to decrease the number of storeys so that the swing gets difficult during seismic shake. External columns may also be casted and beams may then be laid through the available openings in the building so that to have good shear resistance during seism.

figure :- 3

Building Configuration :-

The building shown in figur 3 is a frame structure having long columns placed over wide spaces. The monolithicy of beams and columns can be questioned as it is keep obvious over here from the seperation of beams & columns from each other.

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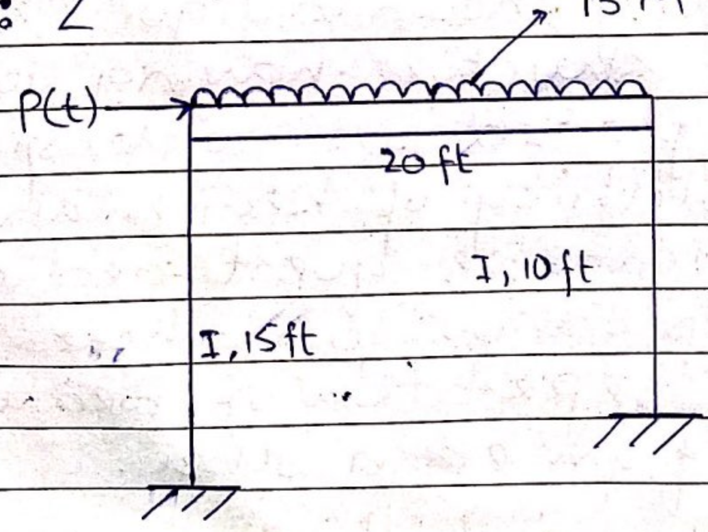
Seismic Performance :-

The building is not stable and more in severe condition It is more easy to have used as service building because all the upper storey is on the verge to fall down as joints of columns and beams have been fully damaged and separated.

Possible Solution :-

If possible, it is more regarded to demolish the upper storey and reconstruct by just providing new beam and columns for this second storey. Also it will be much better to provide intermediate columns in-between the existed so that to mitigate any discrepancy if it is there.

Q: 2



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Sol :-

Uniformly distributed Load = 7379 lb/ft
= 7.379 k/ft

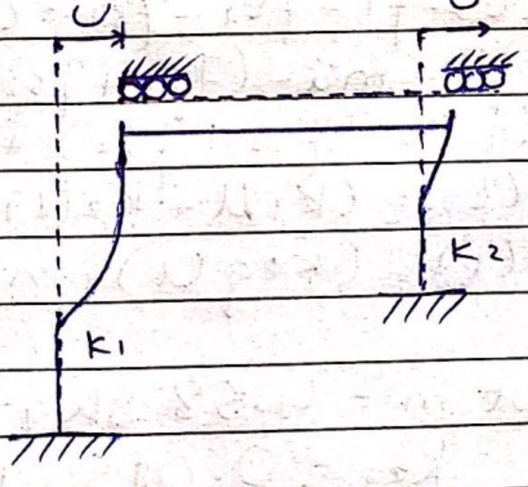
Both the columns are higned
Height of Column 1 = H_1 = 15 ft
Height of Column 2 = H_2 = 10 ft

Required :-
Equation of motion = ?

Since, value of E and I are not given so we will use it as constant EI.

First of all we need to calculate Lateral stiffness of the columns.

For the given combination the equivalent stifness will be.



$$K_{eq} = K_1 + K_2$$

$$K_{eq} = \frac{12EI}{H_1^3} + \frac{12EI}{H_2^3}$$

$$K_{eq} = 12EI\left[\frac{1}{(15)^2} + \frac{1}{(10)^3}\right]$$

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$$K_{eq} = 12EI\,[1.29 \times 10^{-3}]$$

$$k_{eq} = 0.0155\ EI\ \text{k/ft}$$

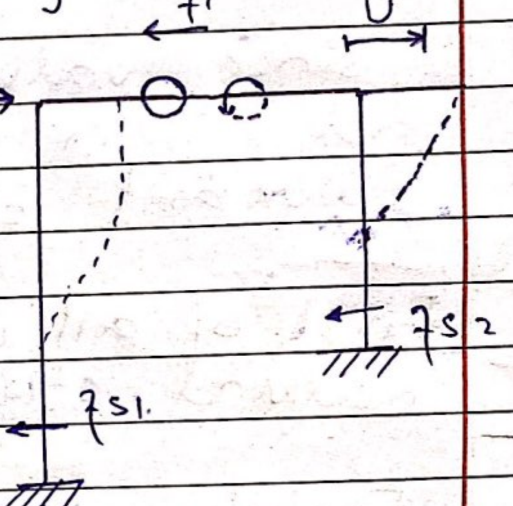
Now,

$$\text{Mass} = \frac{w}{g} = \frac{7.379 \times 20\,K}{32.2\,ft/sec^2}$$

$$m = 4.58\ k \cdot sec^2/ft$$

$$m = 4.58\ \text{slug}$$

Now using D. Alembert's principle of dynamic equilibrium.



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

$$P(t) - m\ddot{u} - (f_{s1} + f_{s2}) = 0$$

$$\Rightarrow P(t) = (f_{s1} + f_{s2}) + m\ddot{u}$$

$$\Rightarrow P(t) = (K_1 u + K_2 u) + m\ddot{u}$$

$$\Rightarrow P(t) = (K_{eq} u) + m\ddot{u} \quad (\star) \qquad \because K_{eq} = K_1 + K_2$$

Put $m = 4.58$ slug, $K_{eq} = 0.0155\ EI$ in eq $(\star)$

$$\boxed{P(t) = (0.0155EI)u + 4.58\,\ddot{u}} \longrightarrow (A)$$

So, eq (A) is the required Equation of motion for the given structure.