Paper: Intro to structural dynamics & Earthquake Engineering ①

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Q1- Describe the types of configurations depicted in fig 1, 2, & 3. How they can effects seismic performance of a structure & what are their possible solution?

Ans Figure 1:→

Building Configuration:→

The structure shown in figure 1 to be frame structure constructed over a raft foundation where all the beams & column have been monolithically tied. The seismic Performance of the building is such that it will develop major concern on mid section because of the taje greater opening here on The building seems to be non-symmetrical over mid there fore it may over turn partial settlement Phenomena occurs on left corner.

SEISMIC PERFORMANCE:→

As the structure is frame but here is wide opening available in mid Portion & all the column over lintel or much enough to swing long & buckle

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easily even durning small consideration of seismic ways. As the buckling is dangerous & all the load will then suddenly transform toward lower portion & may develop major stressess through out the structure.

POSSIBLE SOLUTION:—

To make the structure strong enough to absorb all over burden pressure produced due to earth quake, it is necessary to brace all the column inclindy so that buckling may be reduced the load may be tranferred to ward right or left portion of structure. In this way the stress over mid portion can mainly be made less & the building may servive in good possible way.

FIGURE 2:—

BUILDING CONFIGURATION:—

The figure 2 is a structure having isolated footing been damaged severly due to partial settlement or earth quake. Also the structure has been shored

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for the possible temporary stability. An isolated column is one having its own concern to resist load & stresses & is not dependable on other supporting parallel parts & they all act their own to tranfer loads towards the footing beneath it. Having this consideration, partial settlement in a single column may produced severe condition in whole building.

SEISMIC PERFORMANCE:—

The configuration in the current status is more easily exposed & it may not survive long enough against several shaking during seism as the weight of the building durning seism weight of the building durning 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 good saftety measure to decrease the

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the number of storeys so that the swing get difficult duorning seismic shake External column may be casted & beam may then laid through the available openings in the building so that to have good shear resistance during seism.

FIGURE 3:—

BUILDING CONFIGURATION:—

The build shown in figure 3 is a frame structure having long coloumns placed over wide spaces. The monolithically of beams & column can be question as it is keen obvious over here from the separations of beams & column from each other.

SEISMIC PERFORMANCE:—

The building is not stable & more in severe condition. It is no more easily to have used as service building because all the upper storey is on the verge to fall down as

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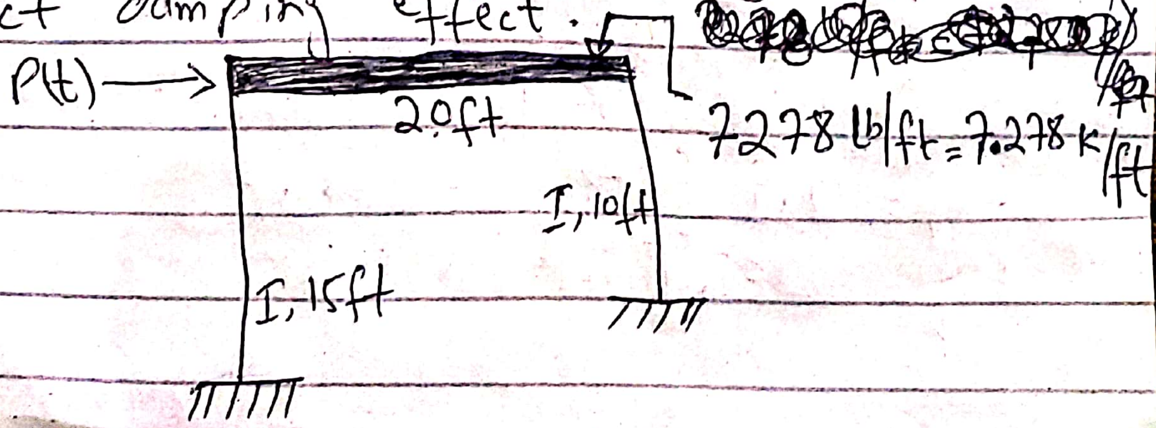
joints of columns & been have been fully damaged & separated.

POSSIBLE SOLUTION:-

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

Q2 Develop the equation of motion of frame shown in fig 4 under the action of a lateral dynamic force p(t). Consider a uniformly Distributed gravity load of registration number lb/ft acting on beam. Neglect damping effect.



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Sol:-

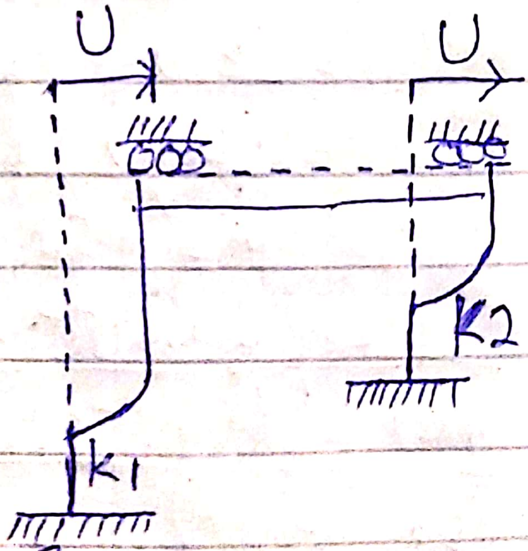
Uniformly distributed load = 7278 lb/ft
= 7.278 k/ft

Both the column are hinged
Height the column 1 = H_1 = 15 ft.
Height the column 2 = H_2 = 10 ft

Req:-

Equation of motion = ?

since value of E and I are not given.
So we will use as constant EI
first of all we need to calculate lateral stifness of columns.



For the given combination the equivalent shifness will be

$$k_{eq} = k_1 + k_2$$

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

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

$$k_{eq} = 12EI\left[1.29 \times 10^{-3}\right]$$

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

Now

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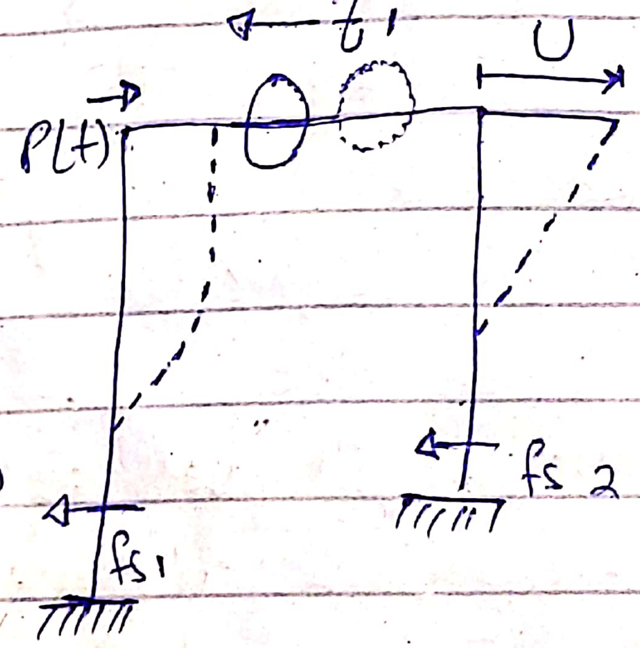
$$Mass = \frac{w}{g}$$

$$m = \frac{7.278 \times 20\ k}{32.2\ ft/sec}$$

$$m = 4.52\ k.sec^2/ft$$

$$m = 4.52\ slug$$



Now

using D.Alembert's Principle of dynamic equilibrium

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

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

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

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

$$P(t) = (k_{eq} u) + m\ddot{u} \rightarrow (A)$$

put $m = 4.52$ slug

$k_{eq} = 0.0155\ EI$ in eq (A)

$$\boxed{P(t) = (0.0155\ EI)u + 4.52\,\ddot{u}} \rightarrow (A)$$

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