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Intr: Earthquake

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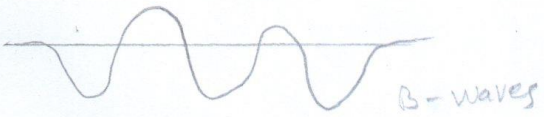
Q1 (A)

Seismic wave

A wave of Energy that is generated by an Earthquake or other vibration and that travels within the Earth or along its surface.

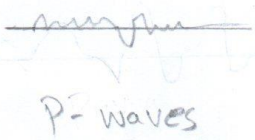
Types of Seismic Waves

Body Waves



Body waves are those waves which travels through the interior of the Earth, Body waves are Further divided into two parts.

(1) **Primary Waves (P-waves)**



=> Primary waves are compressional waves that are Longitudinal in nature.

=> P-waves are pressure waves that travel faster than other waves through the Earth.

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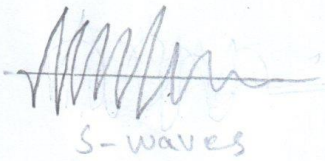
=> These waves can travle through any type of Material Including fluid and travel faster than S-waves.

=> In air these wave take the form of sound waves, Hence they travel at the speed of sound.

(2) Secondary Waves (S-Waves)

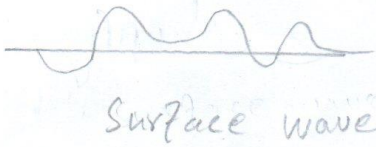


=> Secondary waves (S-waves) are Shear waves that ar transvers in nature.

=> S-waves arrived at seismograph station after faster moving P-waves and displace the ground Perpendicular to the direction of propagation.

=> Since fluid don't support the Shear stresses so, S-waves can't found in fluid.

Surface Waves



Surface waves are those waves which travels through the Surface of the Earth.

its have two parts.

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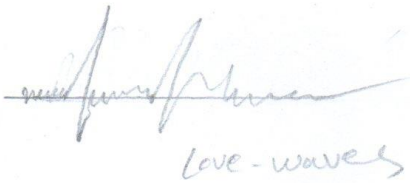
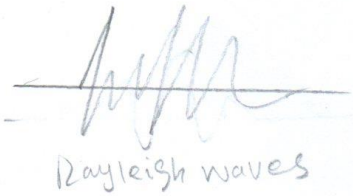
① Love waves



=> Love waves have a particle motion, which like the S-waves, is transverse to the direction of propagation but ~~which~~ with no vertical motion. Their side-to-side motion (like a snake wriggling) causes the ground to twist from side to side, that's why love waves cause the most damage to structures.

② Rayleigh waves



=> Rayleigh waves create a rolling, up and down motion with an Elliptical and retrograde particle motion confined to the vertical plane in the Direction of propagation. ~~Surface~~ Surface waves are generally not ~~gere~~ generated by deep Earthquakes.

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=> Particle motion for Rayleigh and loves waves are Different. Rayleigh waves have retrograde particle motion Confined to the vertical Plane of motion, Whereas Love waves have Purely transverse motion in the Horizontal Plane.

"Why P-waves Faster than S-waves"

P-waves and S-waves are Body waves that Propagation through the Planet. P-waves ~~travel~~ travel 60% Faster than S-waves on average B/c the Interior of the Earth does not react the Same way to Both of them. P-waves are Compression waves that apply a force in the direction of Propagation.

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Q1 B

Seismic Risk

=> It is refers to the risk of damage from earthquake to a building, system, or other entity.
Seismic risk has been defined in two parts.

① SEISMIC HAZARD

Depend upon the geology of site and therefore cannot be controlled.

② SEISMIC VULNRABILITY

Belong to structures and can therefore be reduced by appropriate design and construction.

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"How Seismic risk is Increasing day by day".

= = = =

=> The current building stock is enlarged by the addition of new buildings, many with significant or even excessive, earthquake vulnerability. This above all due to the fact that for new buildings, the basic principles of earthquake resistance design and also the earthquake specifications of the building codes. are often not followed.

=> The reason is either unawareness, convenience or intentional ignorance.

=> As a result the, the earthquake risk continues to increase unnecessarily.

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Seismic risk Minimized

=> The preceding remarks clearly illustrate that there is a large deficit in the structural ~~means~~ Measures to ~~Sem~~ seismic protection in many Parts of the world.

=> New buildings must be designed to be reasonably Earthquake resistance ~~of~~ (resistant) to prevent the constant addition of new vulnerable structures to a building stock that is already seriously threatened.

=> Yo "Introduction to Earthquake Engineering" Aims at conveying the fundamental knowledge to civil engineers regarding seismic resistant design and construction of structures.

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Q2 (A)

Soft Storey

A soft storey, also known as a weak story, is defined as a story in a building that has substantially less resistance or stiffness, than the stories above or below it. This is B/c many buildings are design to have an open first floor area that is easily accesible to the Public.

Soft Storey Failure

The failure of soft storey is B/c of demand of strength of the column in the 1st storey which is high when compared to other floors, in top Floor the column forces are decreased due to the presence of brick walls that share the force and the upper floors are stiff and strong when compared to 1st soft storey. so the lateral displacement of the structure is present mostly at the 1st storey of the structure. Thus when the lateral force acting has less stiffness it may affect the whole structure and the structure may fail.

Prob

Shear Walls

=) 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 points of discontinuity. This discontinuity or discontinuous shear walls condition represents a special, but common, case of the "soft storey".

=) 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 the foundation. To interrupt this load path is undesirable

Sol =) 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.

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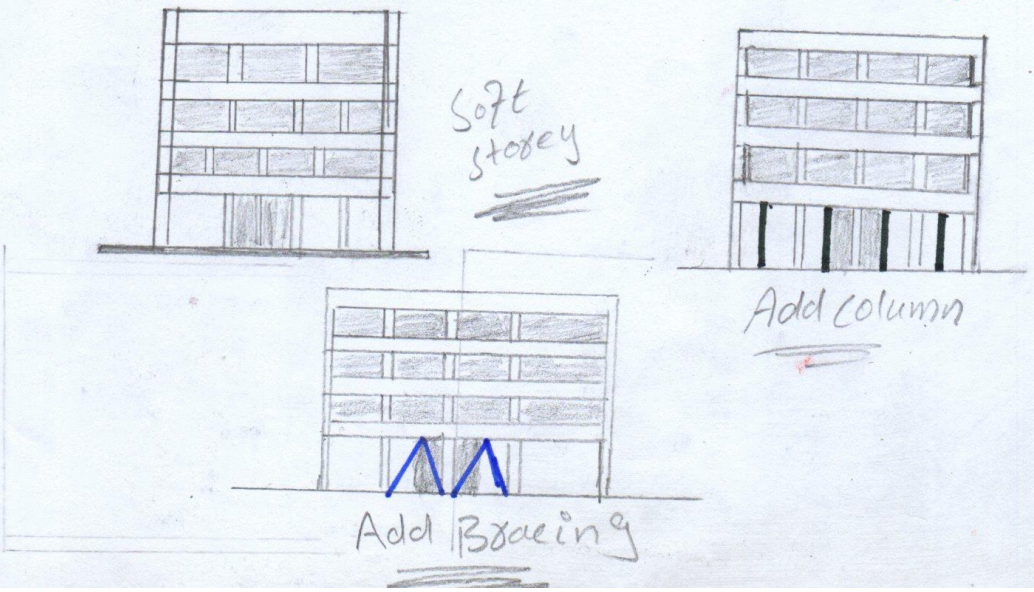
Cross Bracings

=> Cross ~~bracing~~ bracings are usually placed with two diagonal membeo in an x shaped manner. Cross bracings help the structure to reduce displacements and make the structure strong during disasters. The cross bracings help the structure to given strength B/c the open ground floor of soft storey structure has no walls that Effect the structure. So they are added to the structure to increase their strength and to reduce the ~~dip~~ displacements. When compared to shear wall they have less capacity but also bracings help the structure to build up strength and resist the damage.



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Q2 B

Base Isolation

=> Base Isolation is a passive vibration Controlk system.

=> The goal of Base Isolation is to reduce the Energy that is transferred from the ground Motion to the structure.

The Purpose of Base Isolation

=> As for all the load cases encountered in the design Process, such as gravity and wind Should work to meet a single base Equation

Capacity > Demand

This can be achieved by,

* Ductility

Effects of Ductility

=> Leads to higher floor Accelerations.

=> Damage to Structural components, which may not be Repairable.

— x — x — x

=> BaseIsolation is a seismic Design Philosophy.

=> Decouple the superstructure from Ground with or without Flexible Mountings.

=> Period of the total systems is Elongated.

=> A Damper Energy Dissipating Device provided at the Bas Mountings => Rigid under wind or Minor Earthquake.

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Advantages of Base Isolation

=> Reduced Floor Acceleration and Inter-Storey Drift.

=> less (or no) Damage to Structural Members

=> Better Protection of Secondary Systems.

=> Prediction of Response is more Reliable and Economical.

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Types of Base Isolation

(i) Laminated Rubber Bearing (LRB)

=) The Bearing is very stiff and strong in the vertical direction, but flexible in the horizontal direction.

=) Laminated rubber Bearing. Lead Rubber Bearing Lead Plug in the middle of Bearing experience the same deformation as the rubbers.

=) However, it also generates ~~heat~~ heat as it does so. In the other words the lead plug reduces, or dissipates, the energy of Motion... i-e Kinetic energy -- by converting that Energy into heat Base Isolation.

(2)

Spherical Sliding Base Isolation System

=> Spherical Sliding Isolation Systems are another type of Base Isolation. The building is supported by bearing pads that have a curved surface and low friction.

=> During an Earthquake, the building is free to slide on the bearing. Since the Bearing have a curved surface the building slides both vertically and Horizontally.

=> Note

Base Isolation is most Effective for Short to Medium Rise buildings located on hard soil.

Seismic Dampers

=> Another Method for Controlling Seismic damage in building is the Installation of Seismic dampers In this case the dampening is provided by a Lead-based device.

=> Ground Movement force the lead to pass through a Narrow gap. When the direction of Movement changes, the flow of Lead is reversed. The principle is still the same as the Lead rubber bearing, with Kinetic energy being converted into heat energy, thereby preventing the building absorbing the Kinetic energy.

Type of Seismic Dampers

(1) Viscous Dampers.

(2) Friction Dampers.

(3) Yielding Dampers.

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Q3 EFFECT OF SHEAR WALL ARRANGEMENT ON THE TORSIONAL RESISTANCE OF BUILDING.

=> Greatest Torsional resistance is obtained by Concentrating the Longitudinal walls at the Comers of the Building, as the center of rigidity is at the center of the plan (from symmetry) and the Longitudinal walls. being Placed as distant as possible from this center produce the greatest torsional resistance.

=> Although the position of the center of rigidity of the Symmetrical arrangement, Remains at the center of the plane, the Longitudinal walls are not Entirely Placed at the Extremities thus resulting in a reduced Torsional Resistance.

=> B/c of lack of Symmetry about one axis, the center of rigidity will move Slightly off centroid axis and Lateral forces will have an Increased Torsional Effect due to this offset of the

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Center of rigidity. Also the distances from the center of rigidity of the flanged sections created with longitudinal walls have been reduced, thus reducing the torsional resistance.

=) Although the arrangement of walls is symmetrical, the longitudinal walls have been moved close to the center of rigidity and the sections produce have a greatly reduced influence on the torsional resistance of the total arrangement.

=) A very poor arrangement of longitudinal walls is, Here they are clustered toward one corner, displacing the center of rigidity a large distance from the center of the plan and greatly Increasing the Torsional effects of the lateral loads. In addition the longitudinal walls are at a short distance from the center of rigidity and therefore contribute less to the overall torsional ~~loss~~ resistance.