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**QNO.1** **What causes earthquakes? If the Richter magnitude reaches at 8 or above what will be the consequences? Differentiate primary and secondary waves?**

**Ans: Causes Of EarthQuakes:**

An earthquake occurs because of the movements of tectonic plates beneath the surface of the earth. These movements create waves that propagate through the earth. These waves are known as seismic waves. It causes mild to heavy shaking and vibrations. The intensity of these vibrations can vary, but sometimes they can bring about great destruction. There are five main categories of causes of earthquakes:

1. **Volcanic Eruptions:**

 The main cause of the earthquake is **volcanic eruptions**. Such type of earthquakes occurs in areas, with frequent volcanic activities. When boiling lava tries to break through the surface of the earth, with the increased pressure of gases, certain movements caused in the earth’s crust. Movement of lava beneath the surface of the earth can also cause certain disruptions. This sends shockwaves through the earth, causing damage. These earthquakes are mild. Their range is also limited. However, there have been certain exceptions, with volcanic earthquakes bring havoc and death to thousands of people.

1. **Tectonic Plates:**

 The surface of the earth consists of some plates, comprising of the upper mantle. These plates are always moving, thus affecting the earth’s crust. These movements categorized into three types: constructive, destructive, and conservative. Constructive is when two plates move away from each other, they correspond to mild earthquakes. When two plates move towards each other and collide, this is known as destructive plate boundaries which is very destructive**.** Conservative corresponds to passing by of plates of crust. Earthquakes of this type have varying intensities.

1. **Geological Faults:**

 A geological fault is known as the displacement of plates of their original plane. The plane can be horizontal or vertical. These planes are not formed suddenly but slowly develop over a long period. The movement of rocks along these planes brings about tectonic earthquakes. These faults occur due to the impact of geological forces. The displacement of plates creates the fracturing of rocks, which releases a lot of energy. This type of earthquake can be disastrous.

1. **Man Made:**

 The interference of man with nature can also become a cause of the earthquake. The disturbance of crustal balance due to heavy clubbing of water in dams can cause earthquakes. **Nuclear bombing** can send specific types of shockwaves throughout the surface of the earth, which can disturb the natural alignment of tectonic plates. Mining can also cause disturbance due to the extensive removal of rocks from different areas.

1. **Minor Causes:**

 Some minor causes such as landslides, avalanches, the collapse of heavy rocks, etc. can also cause minor shockwaves. The gases beneath the surface of earth contract and expand, giving rise to movements in plates beneath the crust. The plutonic earthquake occurs because of adjustments in rock beds in the interior of the earth’s crust. All these factors correspond to minor earthquakes, but sometimes these can also vary to moderate earthquakes.

**If the Richter magnitude reaches at 8 or above what will be the consequences:**

The Richter scale is used to rate the **magnitude of an earthquake, that is the amount of energy released during an earthquake.**

The Richter magnitude involves measuring the amplitude (height) of the largest recorded wave at a specific distance from the seismic source. Adjustments are included for the variation in the distance between the various [seismographs](https://www.sms-tsunami-warning.com/pages/seismograph) and the epicentre of the earthquakes.

The Richter scale is a **base-10 logarithmic** scale, meaning that each order of magnitude is 10 times more intensive than the last one. In other words, a two is 10 times more intense than a one and a three is 100 times greater. In the case of the Richter scale, the increase is in wave amplitude.

Now when it goes from 0 to 1 we cannot even feel it. From 1 to 2 smallest quake of people can only feel. The damage start from 4 and when reaches 8 it causes major destructions and deaths. Destroyed Sans Francsico in 1906. If the level is exceeded by 8 which is rear but will cause and unbelievable damage.

***Differentiate primary and secondary waves?***

***d. Primary waves travel faster, move in a push-pull pattern, travel through solids, liquids and gases, and cause less damage due to their smaller size. Secondary waves travel slower, move in an up-and-down pattern, travel only through solids, and cause more damage due to their greater size.***

**QNO.2 Describe the role of geology in selection of sites for dams and reservoirs?**

**Ans*:*** Topographically most suitable place must be chosen for construction.Ideally it must be a narrow gorge or a small valley with enough catchment area available behind so that calculated amount of water can be easily stored in the reservoir created upstreamLocation of spillway.

Technically

The site must be sound as possible: strong, impermeable and stable. Strong rocks make the job of designer easy. Impermeable sites ensure better storage inventories. Site must be stable with respect to seismic shocks slope failures around dam.

Constructionally:

The site should be far from the materials which will be used for the construction. Their non-availability will make the cost of project high.

Human welfare:

site selection should be done in such a way that it must cause minimum damage to public in the destruction or failure.

a Lithology:

Geology of thesesurface and subsurface studies must be carried out. These studies reveal the type, the composition and texture of the rocks along the valley floor.

*On a large dam construction project the engineering geologist is concerned with:*

* the geology of the dam site including the foundation for the dam itself and the sites for other structures such as spillway, diversion tunnel and outlet works. Questions that need an answer include whether the dam foundation has sufficient strength and durability to support the type of dam proposed, whether the foundation is watertight and if not how much grouting will be required and whether the spillway will require concrete lining;
* the geology of the area to be occupied by the reservoir once the dam is completed. Questions often asked here include whether the storage area is watertight or are there areas of cavernous limestone which might lead to the dam not retaining water and whether landslides into the reservoir are possible which might cause a wave of water to be pushed over the top of the dam;
* finding sources of the construction materials which will be needed to build the dam.

Extensive Site investigations are usually required to answer these questions. No two dam sites are identical as far as geology is concerned so each new dam construction project must be investigated individually. Some dam sites may be relatively uniform in their geology ie one rock type with a simple structure and a regular pattern of surface weathering. More often though the geology will be complex with several different rock types with different physical properties such as strength, durability and susceptibility to weathering. The geological structure may also be complex with geological units folded and faulted into a complicated, difficult to interpret pattern. Degree of surface weathering may vary suddenly from one geological unit to another further complicating the task of the engineering geologist.

Dams are engineering structures constructed for different purposes. They are of different sizes, shapes and types. In all cases, many essential studies should be carried out before deciding the location, type and size of the dam. Among those studies is the geological investigations which should be carried out to deduce the geological conditions in the most relevant site, depth of the foundations and their types, cut-off depth, type of the available construction materials, and type of the expected geologicalhazards. Without proper geological investigations, the siting of a dam will cause serious hazards during construction and during commissioning of the dam. Similarly for reservoir different parameter are taken into account using geology such ashandling vertical variations in porosity, permeability, and capillary properties for a limited (or permeability, and capillary properties for a limited (or typical) area.

**QNo.3 What are the different types of mass wasting? Also explain the protective measures of landslides?**

**Ans:**

**Mass Wasting:**

Mass wasting can be defined as a geomorphic process. A geomorphic process is a natural course of Weathering,erosion and deposition that causes alteration of the surface materials and [landforms of the earth](https://www.eartheclipse.com/geology/what-are-landforms-and-major-types-of-landforms-on-earth.html).

##  Types of Mass Wasting

Once the force of gravity on a mass of rock or soil reaches the shear-failure point, it can fall, slide, flow or creep down a slope. These are the four types of mass wasting and are determined by the speed of the material’s movement downslope as well as the amount of moisture found in the material.

**Falls and Avalanches**

The first type of mass wasting is a rockfall or avalanche. A rockfall is a large amount of rock that falls independently from a slope or cliff and forms an irregular pile of rock, called a talus slope, at the base of the slope. Rockfalls are fast moving, dry types of mass movements. An avalanche, also called a debris avalanche, is a mass of falling rock, but also includes soil and other debris. Like a rockfall, an avalanche moves quickly but because of the presence of soil and debris, they are sometimes moister than a rockfall.

**LANDSlDES:**

Landslides are another type of mass wasting. They are sudden, fast movements of a cohesive mass of soil, rock or regolith. [Landslides](https://www.thoughtco.com/pictures-of-landslides-4122955) occur in two types- the first of which is a translational slide. These involve movement along a flat surface parallel to the angle of the slope in a stepped-liked pattern, with no rotation. The second type of landslide is called a rotational slide and is the movement of surface material along a concave surface. Both types of landslides can be moist, but they are not normally saturated with water.

Flow

**Creep**

The final and slowest moving type of mass wasting is called soil creep. These are gradual but persistent movements of dry surface soil. In this type of movement, soil particles are lifted and moved by cycles of moistness and dryness, temperature variations and grazing livestock. Freeze and thaw cycles in soil moisture also contribute to creep through [frost heaving](https://www.thoughtco.com/mechanical-or-physical-weathering-4122976). When soil moisture freezes, it causes soil particles to expand out. When it melts though, the soil particles move back down vertically, causing the slope to become unstable.

**Mass Wasting and Permafrost**

In addition to falls, landslides, flows and creep, mass wasting processes also contribute to [the erosion of landscapes](https://www.thoughtco.com/what-is-erosion-1440855) in areas prone to permafrost. Because drainage is often poor in these areas, moisture collects in soil. During the winter, this moisture freezes, causing ground ice to develop. In the summer, the ground ice thaws and saturates the soil. Once saturated, the layer of soil then flows as a mass from higher elevations to lower elevations, through a mass wasting process called solifluction.

The effects of landslides on people and structures can be lessened by total avoidance of landslide hazard areas or by restricting, prohibiting, or imposing conditions on hazard-zone activity. Local governments can reduce landslide effects through land-use policies and regulations. Individuals can reduce their exposure to hazards by educating themselves on the past hazard history of a site and by making inquiries to planning and engineering departments of local governments. They can also obtain the professional services of an engineering geologist, a geotechnical engineer, or a civil engineer, who can properly evaluate the hazard potential of a site, built or unbuilt.

The hazard from landslides can be reduced by avoiding construction on steep slopes and existing landslides, or by stabilizing the slopes. Stability increases when ground water is prevented from rising in the landslide mass by (1) covering the landslide with an impermeable membrane, (2) directing surface water away from the

landslide, (3) draining ground water away from the landslide, and (4) minimizing surface irrigation. Slope stability is also increased when a retaining structure and/or the weight of a soil/rock berm are placed at the toe of the landslide or when mass is removed from the top of the slope.

**QNO.4 Differentiate fault, joint and fold?**

**Ans: Fold:**

Fold is defined as bends or curvature develops at the crust of the rocks as a result of stresses on the rocks.This process is called folding.

**Fault:**

Fault is a type of fracture occure in rocks.faults occur due to stress and commonly this stress cause by plate tectonics.They exhibit visible or measurable lateral movement between the opposite surfaces of the fracture

**Joints:**

Joint is break or fracture naturally present in the body or layer of rocks.a joint may have been created by either strict movement of a rock layer or body perpendicular to the fracture .

**Part,a)** . a fault often forms a discontinuity that may have a large influence on the strength,deformation, etc. of soil and rock masses in different earth structure like tunnel, foundation, or slope construction.

**Part b**

Folds form under varied conditions of stress, hydrostatic pressure and temperature gradient as evidenced by their presence in soft sediments, the full spectrum of metamorphic rocks, and even as primary flow structures in some igneous rocks.

**Part c**

the most prominent effect observed after faulting and erosion is a horizontal shift between the two parts of the outcrop.For example Oblique faults with downthrow to the left side result in an offset with an overlap**.**

**Part d**

A civil engineering site must be avoid to locate at a place where folding,joint or faulting is exist as much as possible because any one of the above properties may demage the super structure present at such location.

**QNo5; Describe tunneling on the basis of geology? Also determine geological investigation for tunnels?**

Before understanding what is the role of geological studies on tunnel construction, let’s first understand what tunnels actually are:

**Tunnel**

A **tunnel** is basically an underground passageway, excavated through the natural surrounding soil/earth/rock and enclosed except for entrance and exit, commonly at each end. A man made pipeline is not a **tunnel**, though some recent **tunnels** have used immersed tube construction techniques rather than traditional **tunnel** boring methods.

**Importance of Geology in Tunnel Construction**

Geologic conditions are among the greatest studies to be done prior to actual

construction of underground excavations, especially for deep tunnels in natural hard rock. These unknowns usually exist in great proportional to the amount, nature and quality of the geotechnical know-how. Also, the adequacy of a site investigation program cannot be measured by cost alone. Over the past few years the authors have analyzed the investigation strategies followed along several projects weighing the cases of success or failure that finally means the ratio between foreseen, unforeseen and unforeseeable conditions as experienced after construction. In most of the cases, also after expensive investigation campaigns, the absence of a rigorous preliminary field survey left many off-ramps along the diagnostic pathway, leading to a wrong “diagnosis, misdiagnosis or delayed diagnosis”. All the collected data must be interpreted inside a robust conceptual framework that in Geology primarily comes from field surveys, today enhanced by new tools and methodologies for investigating and modelling.

**Geological Investigations for Tunneling**

Tunneling is a complex process. It requires more than 10 industries engaged at a single site and many experts of those Industries working their minds together to make a construction plan executable. Tunneling through weakness land zones under deep underground levels involves significant risks and may have disastrous consequences. This paper presents a case study of geological investigation and excavation aspects of subsea tunnels in major weakness zones. The subject is the Xiang’an subsea tunnels, the first subsea tunnel project in mainland China. The Xiang’an subsea tunnels passed through four major weakness zones, mainly consisting of highly to completely weathered rock mass. The weakness zones were characterized by a combination of long-distance and short-distance, destructive and nondestructive methods, which supplement and verify information with each other. The weakness zones were treated by full-face curtain grouting, using both cementations and chemical grouts. The interrelationship between the settlement at tunnel crown and ground surface, as well as the interrelationship between ground settlement and ground cracking, were explored based on instrumentation data recorded during tunneling on land. The pre-warning, warning, and limiting values of tunnel crown settlement during excavation of each heading of subsea sections were established to protect the seabed against cracking. Engineering means and methods were developed to control the ground deformation during excavation.

**Assessment of Cost and Stability:**

These aspects of the tunneling projects are also

closely interlinked with the first three considerations.

Since geological investigations will determine the line

of actual excavation, the method of excavation and

the dimensions of excavation as also the supporting

system (lining) of the excavation, all estimates about

the cost of the project would depend on the

geological details.

**Selection of Design for the Tunnel:**

The ultimate dimensions and design parameters of a proposed tunnel are

controlled, besides other factors, by geological constitution of the area along

the alignment. Whether the tunnel is to be circular, D-Shaped, horse-shoe

shaped or rectangular or combination of one or more of these outlines, is more

often dictated by the geology of the alignment than by any other single factor.

D-shape or horse-shoe shape may be conveniently adopted but these shapes

would be practically unsuitable in soft ground or even in weak rocks with

unequal lateral pressure. In those cases circular outline may be the first choice.

**Selection of Tunnel Route (Alignment**):

There might be available many alternate alignments

that could connect two points through a tunnel.

However, the final choice would be greatly

dependent on the geological constitution along and

around different alternatives: the alignment having

least geologically negative factors would be the

obvious choice.

It is obvious that with the help of above information,

the engineers could propose a number of alternative

tunnel routes to connect the two places, and in most

cases, even decide about the general run of the

tunnel.