DISASTER STUDIES - 18BGE35S

UNIT – II

Earthquakes

Definition:

- **An earthquake may be defined as the vibration on the earth surface due to displacement of subterranean rocks.**

- Earthquake is one of the most destructive natural hazard. They may occur at any time of the year, day or night, with sudden impact and little warning.

- They can destroy buildings and infrastructure in seconds, killing or injuring the inhabitants.

- Earthquakes not only destroy the entire habitation but may de-stabilize the government, economy and social structure of the country.

- But what is an earthquake? It is the sudden shaking of the earth crust.

- The impact of an earthquake is sudden and there is hardly any warning, making it impossible to predict.

Cause of Earthquake :

A number of theories were developed to explain origin of earth quakes. But our knowledge about the interior of earth is very very limited. so giving reason for rock displacement in the interior earth is difficult. However few general theory important. They are;

i. Boiling Mantle Theory

ii. Elastic Rebound Theory

iii. Plate Tectonics

i. Boiling Mantle Theory:

We know that temperature increases from the surface to the interior of the earth. So at depth temperature is height that rocks are in liquid form. Water vapor in those are also become from very hot and becomes a super heated steam. The building up of pressure is suddenly released some time along weak areas reading to earth quakes. As evidence it is pointed out that super heated steam comes out from volcano. Thought this theory give reason in a general way it does not reason for displacement at a particular point.

ii. Elastic Rebound Theory:

As per this theory, the subterranean rocks act like a compressed iron spring due to the weight and pressure of over lying rocks. When erosion and other processes remove the pressure of over lying rocks, the subterranean rock expanded act like the recoiling of a iron spring. This causes rock displacement and earth quake. Here again there is no explanation for earth quake to occur at a particular point.

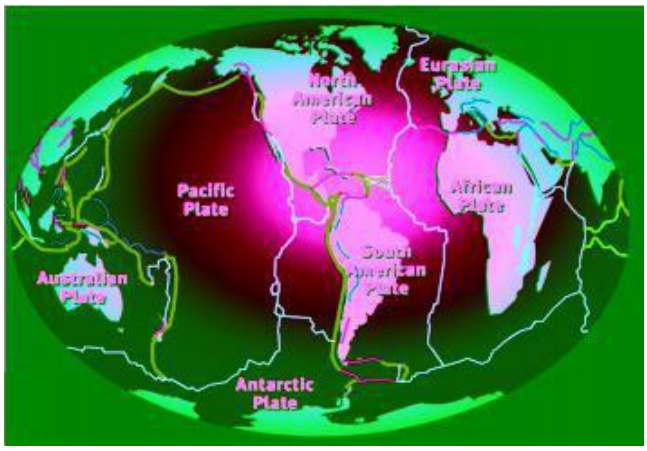
iii. Plate Tectonics:

The concept of continental drift, convection currents and sea floor spreading were synthesized and new idea was explained various scientists. We know have evidence that not only continents are drifting but also there is movement of ocean floor in short it may be said that the entire crust is moving in different directions at different places. Therefore this new concept is called plate tectonics. According to this there are major plates, small plates and minor plates on the crust. At least seven major plates were identified. They are;

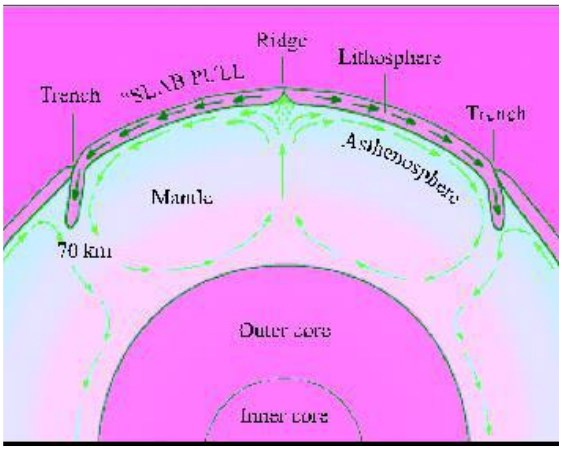
1) North American Plate
2) South American Plate
3) Eurasian Plate
4) Indo Australian Plate
5) African Plate
6) Antarctica Plate and
7) Pacific Plate

All these movements are associated with earthquakes.

The areas of stress at plate boundaries which release accumulated energy by slipping or rupturing are known as 'faults'. The theory of 'elasticity' says that the crust is continuously stressed by the movement of the tectonic plates; it eventually reaches a point of maximum supportable strain. A rupture then occurs along the fault and the rock rebounds under its own elastic stresses until the strain is relieved. The fault rupture generates vibration called seismic (from the Greek 'seismos' meaning shock or



Seven major plates and several minor ones- They move a few inches a year, riding on semi-molten layers of rock underneath the crust



Tectonic Plates

Scale of measurement:
Recording of Earthquake:

i. Seismograph

It is an instrument which records an earthquake. Here a pillar is raised from the bed rock. Attached to the pillar a weight is suspended with a spring. A pen is attached with a weight. The tip of the pen touches a slowing rotating drum on which a paper is pasted. During normal time the pen touches the paper at a particular point and a straight line is recorded. When earthquake occurs the bed rock vibrates which makes the pillar to sake. The suspended weight attached with the springs moves up and down along with the pen. This creating undulating marks on the paper. The paper is periodically removed and replace. The paper with record is called seismogram.

In model seismograph the weight has a mirror which reflects the beam of light to the rotating drum. There is no pen here, on the drum a light sensitive paper is pasted and it is processed to get a seismogram.

ii. Seismic wave

The energy relies in an earthquake is transmitted in the form of short waves, which travel in all direction. These short waves are called seismic waves. There are three main types of seismic waves.

a) Primary or "P" waves
b) Secondary waves or "S" waves
c) Surface or "L" waves

If any earthquake all the three waves are transmitted on the earth surface in some areas P, S, L waves recorded, in some areas only "P" and "S" waves recorded. In some regions only "P" wave is recorded. There is also a region on the earth surface were a particulars earthquake is not recorded at all this is called the "Shadow Zone". Let's see the characteristics of seismic wave.

Intensity and magnitude:

Magnitude of Earth Quake

Magnitude refers the measurement of intensity of earth quake. There are two types of scales. They are;

1. Richter Scale
2. Mercalli Scale

Both a scale has range from 0-12. The Mercalli scale is modified at a later period. However Richter scale is more commonly used.

1. **Richter Scale**
   a) It is devised by Charles Richter in 1935.
   b) Magnitude range from 0-12.
   c) It is a Logarithmic scale. Each increase in number indicates ten times stronger earth quake. For example Richter 2 is tem time's powerful than that of Richter one.
   d) A magnitude of 3 in Richter scale releases energy equal two the burning of about 4000 gallons of gasoline.
   e) On an average about 100 earth quakes of Richter 4 occur every year. Similarly about twenty earth quake of 5 magnitude, 10 earth quakes of 6 magnitude and 5 earth quake of 7 magnitude and 1 or 2 earthquake of occur every year.
   f) The strongest earth quake is very records 9.5 on Richter scale. It was recorded 1960 in Chile. The second strongest earth quake is in Sumatra ate 9.2 in December 26, 2004.

Earthquake prone zones:

List of significant Earthquakes in India

S.No	Year	Location	Magnitude of 6+
1.	1950	Arunachal Pradesh - China Border	8.5
2.	1956	Anjar, Gujarat	7.0
3.	1967	Koyna, Maharashtra	6.5
4.	1975	Kinnaur, Himachal Pradesh	6.2
5.	1988	Manipur - Myanmar Boarder	6.6
6.	1988	Bihar - Nepal Border	6.4
7.	1991	Uttarkashi - Uttar Pradesh Hills	6.0
8.	1993	Latur - Maharashtra	6.3
9.	1997	Jabalpur, Madhya Pradesh	6.0
10.	1999	Chamoli, Uttar Pradesh	6.8
11.	2001	Bhuj, Gujarat	6.9
12.	2005	Muzaffarabad (Pakistan) Impact in Jammu & Kashmir	7.4

Distribution of Earthquake

Earth quake occur mostly in two major belts.

i. **The Circum Pacific Belt**

Which is the coast line of the Pacific Ocean extending over Asia, North America, and South America. Is the major belt accounting for 50-60% of total earth quakes.

ii. **The Mid World Young Fold Mountain System**

It's extending from Alps in central Europe through Turkey and Iran to the Himalayan system. Is the second belt accounting for about 30% earth quakes. The rest of the earthquake is distributed in other part of the world.

Volcanic Hazards:

Definition:

Volcano may be defined as a vent or opening (joint fissure) which connects the magna chamber in the interior of the earth with the surface of the earth.

Parts of a Volcano

It is possible to identify a few parts in a vent type volcano.

Neck or Conduit, Volcanic Cone, Creater, Caldera and Composite Cone.

Phyroclastic Materials: A volcano makes eject not only lava but also other materials. All other materials are collectively called Phyroclastic material. Depending upon the size shape of the material it is possible to classified Phyroclastic deposits is various types. They are;

Volcanic Dust, Volcanic Ash, Cinder, Volcanic Blocks, Volcanic Bums, Fiering Clouds and Pumice.

Classification of Volcano:

Volcano may be classified taking various aspects as the basis.

i. Based on Material Ejected

Under this volcano classified into three types;

a) Cinder Volcano,
b) Shield Volcano
c) Composite Volcano

ii. Based upon Activity

Here also we are identified three type of volcano.

a) Active Volcano
b) Dormand Volcano
c) Extinct Volcano

iii. Based upon Nature of the Opening

Here a number of subdivisions identified depending upon the strength of eruption and ejected materials. Most of the sub types are, named upon the particular volcano. Types here include.

a) Hawaiian Type
b) Plinian Type
c) Peleean Type
d) Strambolian Type
e) Vesuvian Type
f) Icelandic Type

In these types Icelandic type is a fissure eruption with Gentle flow of lava. While Hawaiian type is a vent eruption having gentle flow, Strambolian type is of moderate intensity. While Peleean and Plinian type have violent eruptions sending materials to play height in the atmosphere with noise.

Manna Loa

Is a volcanic peak in Hawaii and it taken from its based in the Pacific ocean floor it is a tallest peak.

Krakatoa

It is a volcano in the Sunda Strait area near Indonesia. It experiences the most violent eruption in 1883. It was an Island with a peak of about 2300 feet above sea level. After the exploitation not only the Island but also 700 feet land below sea level was also totally removed material was send to the upper layer of atmosphere and the volcanic dust sprit to other parts of the world in the upper atmosphere. This created mirror climatic variation because it blobbed isolation. The explosion was so load it could be heard in Australia, some 5000 kilometers away.

Effects of Volcano:

a. Volcano eruption mostly causes damage to the nearby area. However sometimes other area may also be affected. Lava which very hot destroy vegetation, animal life and buildings along with day.
b. Volcanic ash is a very great dangerous as. Vent deposited, volcanic ash is very rich soil and helps cultivation. It is the main reason for intensive cultivation in Jawa. However volcanic ash become dangerous when there is rain and the mud. They cover the entire surrounding area briniking destruction. For example in ancient period Pompeii city which was at this foot hill of mount Vesuvius was totally buried and volcanic ash killing thousands of people in the reason past an American Airways in Philippines has to be close due to deposits of very thick volcanic ass.
c. Volcanic dust may carry by upper layer of the atmosphere and it blobs isolation leading to mirror climatic variation. This dust also creates aurora borealis in area other than polar region.

Land Form Features Associated with Volcano

A number of land form are associated volcanic action important among them are;

i. Volcanic cone
ii. Crater/Caldera
iii. Volcanic neck/Plup/Spine
iv. Basaltic Plateau
v. Lava Domes
vi. Geyser/Hot Spring/Fume soles.

Landslides:
What is a Landslide?

- The term' landslide' includes all varieties of mass movements of hill slopes and can be defined as the downward and outward movement of slope forming materials composed of rocks, soils, artificial fills or combination of all these materials along surfaces of separation by falling, sliding and flowing, either slowly or quickly from one place to another.

- Although the landslides are primarily associated with mountainous terrains, these can also occur in areas where an activity such as surface excavations for highways, buildings and open pit mines takes place.

- They often take place in conjunction with earthquakes, floods and volcanoes.

- At times, prolonged rainfall causing landslide may block the flow of river for quite some time.

- The formation of river blocks can cause havoc to the settlements downstream on its bursting.

Landslide Hazard refers to the potential of occurrence of a damaging landslide within a given area; such damage could include loss of life or injury, property damage, social and economic disruption, or environmental degradation.

Landslide Vulnerability reflects the extent of potential loss to given elements (or set of elements) within the area affected by the hazard, expressed on a scale of 0 (no loss) to 1 (total loss); vulnerability is shaped by physical, social, economic and environmental conditions.

Landslide Risk refers to the probability of harmful consequences-the expected number of lives lost, persons injured, extent of damage to property or ecological systems, or disruption of economic activity –within a landslide prone area. The risk may be individual or societal in scope, resulting from an interaction between the hazard and individual or societal vulnerability.

Landslide Risk Evaluation is the application of analyses and judgments (encompassing physical, social, and economic dimensions of landslide vulnerability) to determine risk management alternatives, which may include determination that the landslide risk is acceptable or tolerable.

Causes of Landslide:
There are several causes of landslide. Some of the major causes are as follows:

1. Geological Weak material: Weakness in the composition and structure of rock or soil may also cause landslides.
2. Erosion: Erosion of slope toe due to cutting down of vegetation, construction of roads might increase the vulnerability of the terrain to slide down.

3. Intense rainfall: Storms that produce intense rainfall for periods as short as several hours or have a more moderate intensity lasting several days have triggered abundant landslides. Heavy melting of snow in the hilly terrains also results in landslide.

4. Human Excavation of slope and its toe, loading of slope/toe, draw down in reservoir, mining, deforestation, irrigation, vibration/blast, Water leakage from services.

Type of Landslides:

The common types of landslides are described below. These definitions are based mainly on the work of Varnes (Varnes, D.J., 1978).

- **Falls:** Abrupt movements of materials that become detached from steep slopes or cliffs, moving by free-fall, bouncing, and rolling.

- **Flows:** General term including many types of mass movement, such as debris flow, debris avalanche, lahar, and mudflow.

- **Creep:** Slow, steady downslope movement of soil or rock, often indicated by curved tree trunks, bent fences or retaining walls, tilted poles or fences.

- Debris flow Rapid mass movement in which loose soils, rocks, and organic matter combine with entrained air and water to form slurry that then flows down slope, usually associated with steep gullies.

- Debris avalanche A variety of very rapid to extremely rapid debris flow.

TSUNAMI:

- The term Tsunami has been derived from a **Japanese term Tsu meaning 'harbor' and nami meaning 'waves'.**

- Tsunamis are popularly called tidal waves but they actually have nothing to do with the tides.

- These waves which often affect distant shores, originate by rapid displacement of water from the lake or the sea either by seismic activity, landslides, volcanic eruptions or large meteoroid impacts.

- What ever the cause may be sea water is displaced with a violent motion and swells up, ultimately surging over land with great destructive power.

- The effects of a tsunami can be unnoticeable or even destructive.

Causes of a Tsunami:

- The geological movements that cause tsunamis are produced in three major ways.
- The most common of these are fault movements on the sea floor, accom-panied by an earth-quake.
- They release huge amount of energy and have the capacity to cross oceans.
- The degree of movement depends on how fast the earthquake occurs and how much water is displaced.
- The second most common cause of the tsunami is a landslide either occurring under water or originating above the sea and then plunging into the water.
- The largest tsunami ever produced by a landslide was in Lituya Bay, Alaska 1958. The massive rock slide produced a wave that reached a high water mark of 50 - 150 meters above the shoreline.

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