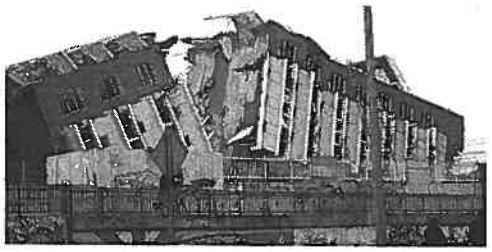
9 SCIENCE EARTH AND SPACE SCIENCE ASSIGNMENT

Earthquake proof buildings

Name:_____

Form:_____



Teacher:_____

Due date:_____

ANSWER KEY

Aim: This assignment will allow you to see how the design and construction of buildings in earthquake prone areas allows them to withstand the movements.

1. Take home this assignment for one night and complete as much as you like.

2. The next day back at school you will complete the rest of the assignment with a laptop/personal device and hand it in at the rest of the lesson.

- The in-class completion of the assignment is to be done under test conditions.
- Write the answers in your own words, do not copy and paste directly from any source.

Introduction:

- Earthquakes alone don't kill people; collapsed buildings do. In Chile, an 8.8 magnitude earthquake in March 2010 killed more than 700 people. On January 12, 2010 a less powerful earthquake, one measuring 7.0 magnitude, killed more than 200,000 in Haiti.

- The difference in those death tolls comes from building construction and technology. In Haiti, buildings were constructed quickly and cheaply. Chile, a richer and more industrialized nation, adheres to more stringent (strict) building codes.

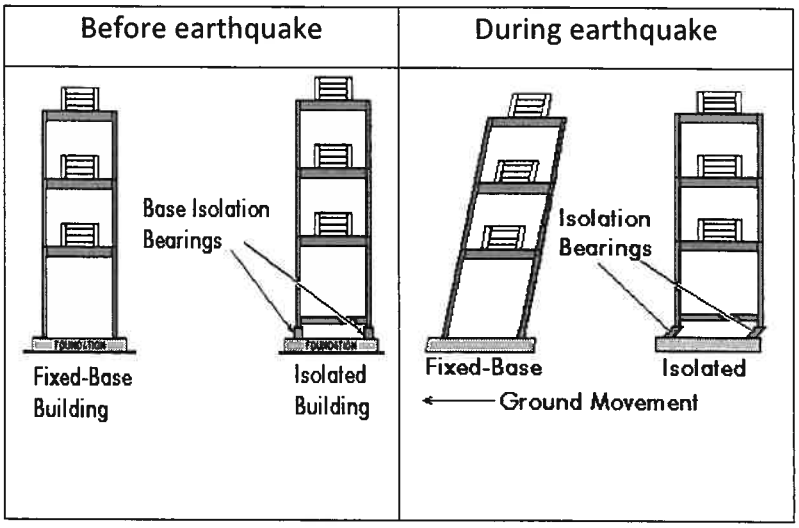
ANSWER KEY

Ways to make buildings earthquake-proof

Making buildings stronger

This can be done by using materials that are strong yet flexible. Also by putting the materials together in such a way that the buildings framework and structure is strong but also flexible.

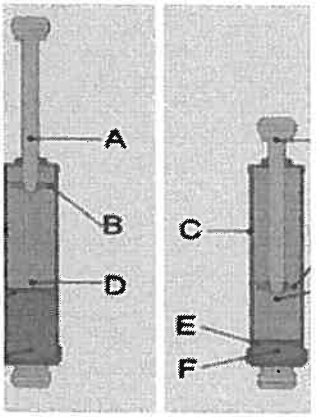
Base Isolation



By making buildings more flexible, so they sway and slide above the shaking ground rather than crumbling.

Engineers have constructed skyscrapers that float on systems of ball bearings, springs and padded cylinders. They don't sit directly on the ground, so skyscrapers are protected from some earthquake shocks. In the event of a major earthquake, they sway up to a few feet. These buildings also have a space left around them so that if they sway they do not crash into other buildings.

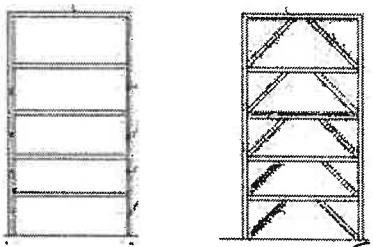
Dampers



These help slow down the movement of the building once the earthquake hits. Some of dampers are like pistons that slow the wave like motion of the building down. Other dampers work by having large masses (called tuned mass dampers) that move in the opposite direction to the earthquake movement, slowing the movement down.

Questions

1. Look at the diagrams on the right. **State** what the building frame on the right has that makes it more earthquake-proof than the building frame on the left. (2 marks)

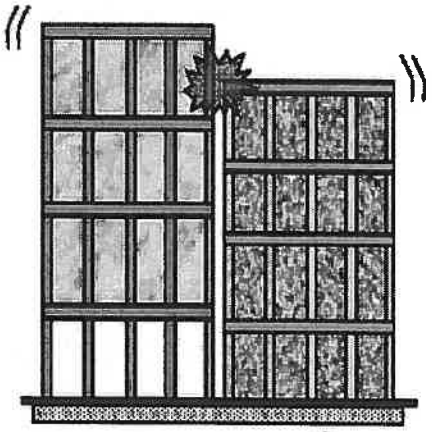


Explain why this feature makes the building structure more earthquake-proof

Triangular beams have been incorporated (1) and triangles are a stronger shape than rectangles (1).

2. Look at the diagram on the right. (3 marks)

Describe three design problems with the buildings shown.



The buildings are too close together (1)
- they will hit each other if there is an earthquake.

There is no base isolation (the base is fixed). (1)
- An Earthquake will cause more swaying of a building that has a fixed base.

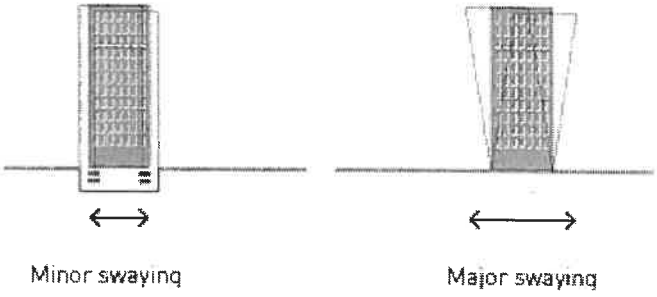
Very large windows create larger weak spots (1)
-

(or other design problem with description)

3. Look at the diagram on the right. (3 marks)

a. **State** the feature that helps to earthquake-proof the building.

Dampers



b. **Describe** two advantages of this feature.

- Dampers slow down movement of building when earthquake hits. (1)

- Reduces amount

4. Look at the photograph of the houses on the right. (3 marks)

This house was damaged by an earthquake in San Francisco, U.S.A.

Describe three reasons as to why you think the houses were was so badly damaged.

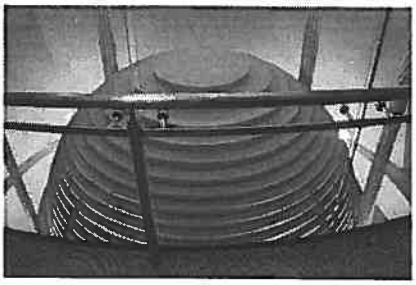
Houses very close together (1)
- Description

No isolated bases (1)
- Description

Materials (wood frame, weake materials & structure, large windows creating weakspots) (1)

~~Any~~ other point

5. This is the Taipei Tower in Taiwan. It is 508m tall. Designing a building this large presented unique challenges because Taiwan is subject to typhoons and earthquakes.



To counter movement, an 800-metric tonne, spherical steel ball is located in the building.

a. **State** the name given to this earthquake-proofing method. (1 mark)

Turned mass damper

b. **State** the floor level of the building that the spherical steel ball is located. (1 mark)

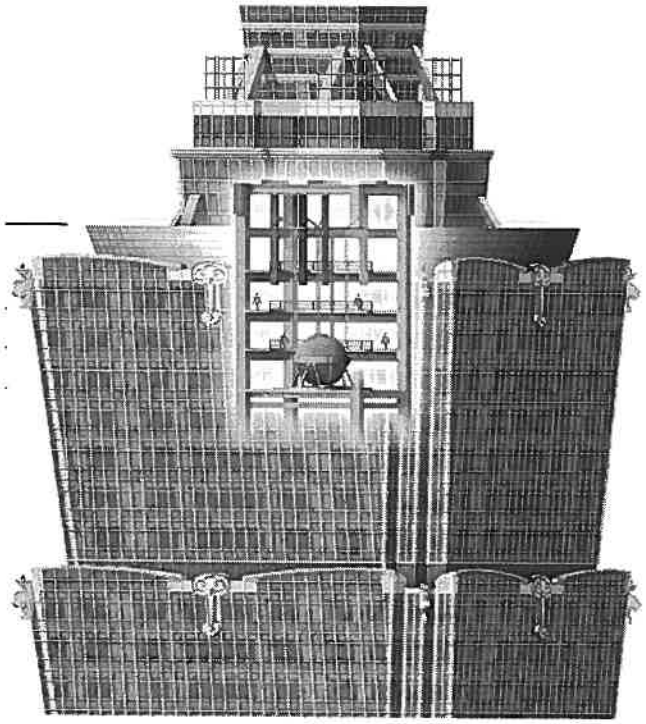
87th – 91st floor ball & cables | 87 - 88th floor just ball

either is fine

c. **Explain** how the large steel ball helps to reduce movements in the building caused by earthquakes. (2 marks)

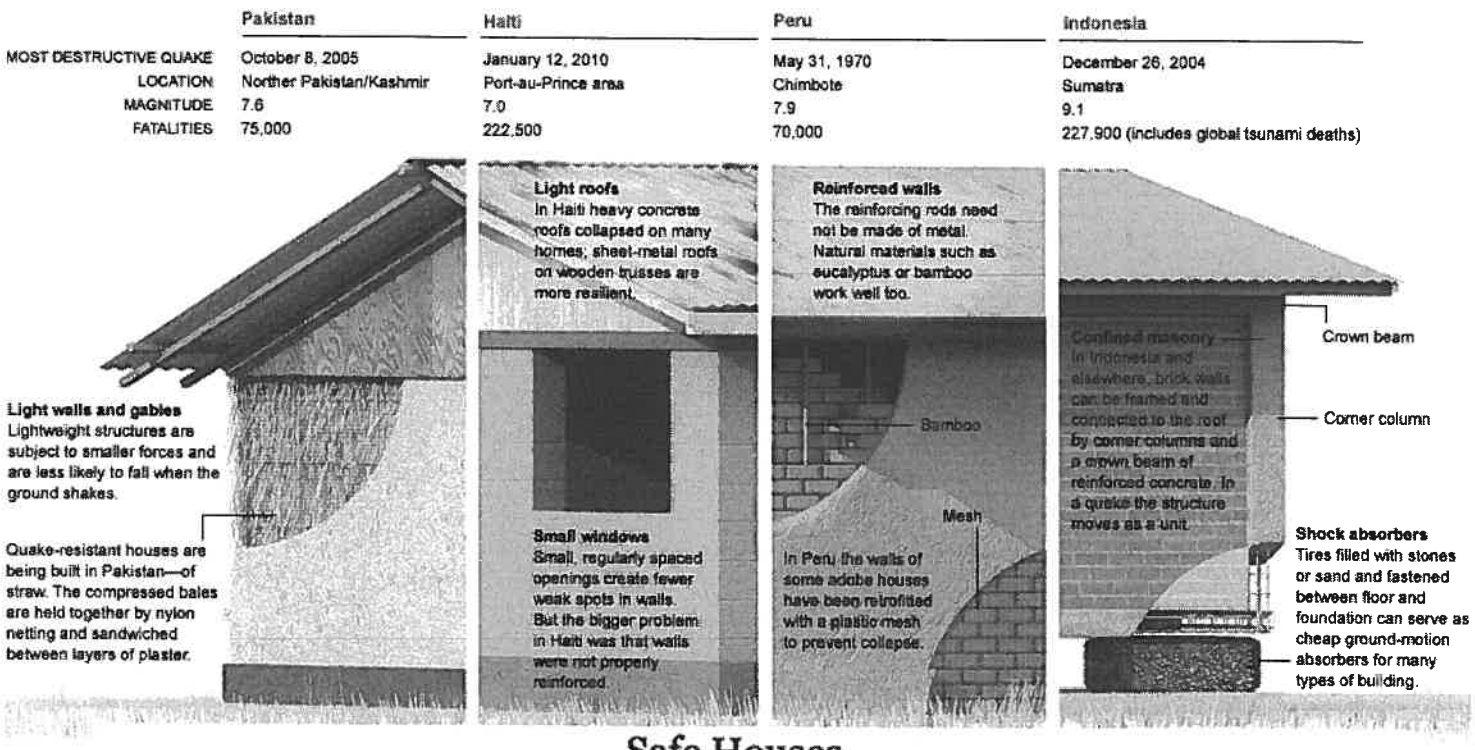
The turned mass damper is suspended from cables sways like a pendulum to offset movements in the building caused by strong winds. (1)

The turned mass damper damps the seismic waves and reduces the sway of the building. (1)



5. Answer the following questions using the diagram and information below.

Visit the webpage: http://ngm.nationalgeographic.com/big-idea/10/earthquakes to see the below image in colour.



Safe Houses

The earthquake in Haiti was a reminder: Billions of people live in houses that can't stand shaking. Yet safer ones can be built cheaply—using straw, adobe, old tires—by applying a few general principles.

In Los Angeles, Tokyo, and other rich cities in fault zones, the added expense of making buildings earthquake resistant has become a fact of life. Concrete walls are reinforced with steel, for instance, and a few buildings even rest on elaborate shock absorbers. Strict building codes were credited with saving thousands of lives when a magnitude 8.8 quake hit Chile in late February. But in less developed countries like Haiti, where a powerful quake in January killed some 222,500 people and left more than a million homeless, conventional earthquake engineering is often unaffordable. "The devastation in Haiti wouldn't happen in a developed country," says engineer Marcial Blondet of the Catholic University of Peru, in Lima. Yet it needn't happen anywhere. Cheap solutions exist.

a. **State** which earthquake caused the greatest number of fatalities. (1 mark)

Indonesia

b. **Describe** two examples of cheap ways that buildings can be isolated from the base (ground). (2 marks)

- Tires filled with stones. (1)

- Tires filled with sand. (1)

c. **Explain** why buildings in earthquake prone areas are safer if they have small windows. (2 marks)

Small, regularly spaced openings create (1) fewer weak spots in walls. (1)

d. **Explain** why the devastation following the earthquake in Haiti would not have been as severe in a developed country. (2 marks)

A developed country can put more money into developing safer structures and buildings designed to better withstand earthquakes (1). A developed county would have better facilities for people who lost their homes, more medical facilities etc. (1)

Correct spelling. (1 mark)

Correct grammar. (1 mark)

Total Marks: / 24

%