

Answer on Question #57752, Physics / Mechanics | Relativity

Explain in detail the causes of tsunamis. Also mention the precautions needed to be taken to minimize the damage.

Solution:

Tsunami – a wave length of 500 m, which are formed in the sea or ocean. These waves cover the entire water column. This is the main difference from other types of waves on water.

Causes of:

- 1) undersea earthquake (the most common);
- 2) volcanic eruptions;
- 3) falling large amounts of soil in water (eg, shift Glacier);
- 4) falling asteroids, meteorites, comets;
- 5) powerful explosions under or above water;
- 6) dramatic change in air pressure or rapid movement atmospheric pressure abnormalities (meteotsunami).

In 1958 recorded the earthquake in Alaska that caused a shift the Glacier in Bay Lituyya (USA). The height of the tsunami reached a height of 525 m. It was the highest wave of the registered documents.

The physical explanation

Wavelength is calculated using the formula:

$$\lambda = vT \quad (1),$$

where v – velocity of wave,

T – period of oscillation.

Wind waves have a period of 10 s and wavelength to 150 m. Tsunami have extremely long period (from two minutes to an hour). So of formula (1) \Rightarrow the tsunami waves have a greater length (tens or hundreds of kilometers).

The wavelength of a tsunami much larger than the depth of the reservoir. And so the distribution of such waves could apply the so-called approaching shoals «approaching of shoals», wave on the rocks moving at a speed, which is a numerical value determined by the formula (2).

The velocity of a tsunami:

$$v = \sqrt{gH} \quad (2),$$

where g – acceleration of gravity in the area,

H – depth of reservoir.

Of (2) \Rightarrow if $H=400$ m, then v reaches 200 m/s.

The highest speed of a tsunami, which was able to measure, amounted to 1,000 km/h.

From the formula (2) \Rightarrow when the depth of the reservoir is low, the speed of a tsunami slows down considerably. Typically, at the shore of the reservoir depth is small. So tsunami slowing down near the coast and the wave height increases dramatically (waves raid each other). Its height can reach tens of meters.

Danger:

- 1) during tsunami moves the whole sequence, and so ashore pouring a lot of water;
- 2) tsunami velocity larger the velocity of much wind waves and kinetic energy so much more ($E = \frac{mv^2}{2}$);
- 3) tsunami comes suddenly (during the wind storm waves gradually increased, providing the opportunity to move away to a safe place);
- 4) usually tsunami comes in several waves (the first wave is not the largest, but it wets the surface of the land and reduces resistance to these).

Intensity scale: from 1 to 6 points.

Precautions:

Tsunami warning systems are based largely on seismic data processing. If the earthquake has a magnitude of more than 7 points and its epicenter located under water, then fed tsunami warning.

Another possibility warning – «warning on the fact». It is used to alert teletsunami. This global tsunami affecting the whole ocean. These tsunamis come to other ocean limits in a few hours. For example, after the tsunami in Aleutian can be seen tsunami in Hawaii. To detect tsunamis in the open ocean using the bottom sensors of hydrostatic pressure. This system DART (Deep-ocean Assessment and Reporting of Tsunamis), which was developed in the US. Sensors associated with near-surface buoys. Near-surface buoys to transfer the information received by satellite. Recording the tsunami. Then provide the time of its arrival in some areas.



A sign indicating the way to escape from a tsunami on the road (Washington, USA)