Earthquake Model

Description, Technical Specifications & Demonstrations

This website details the model made by Ross Stein and demonstrated most recently at the May 2000 USGS Open House by the Earthquake Hazards Team. The website has been constructed due to the great public interest shown at the Open House, particularly by teachers.

This website includes an animation and photographs of the model 'in action', a lengthy model description, and associated diagrams. It also includes technical specifications (bottom of this page) to aid those wishing to build their own model.

Model Description

The following is a description of Ross Stein's "spring and rider" (also known as the "brick and bungee") earthquake simulation machine.

The apparatus consists of a wooden board 3-4 feet in length with a winch on one end. There is a pulley leading from the winch to the brick that is oriented so that the force acting on the brick has no vertical component. The board has a strip of sandpaper down half of it to increase friction.

Two types of material connect a brick to the winch. The first is a non-stretching cord, which is used to ensure that all of the accumulated stress is transferred into the second material - surgical rubber tubing. This tubing is connected directly to the brick and is extremely elastic, which allows stress to build when the crank on the winch is turned. The brick also has a strip of sandpaper on one side, for additional friction. This is the basic set-up of the experiment.

With this, students can mark off "rupture length" during each "earthquake" by seeing how far the brick slips. They likely will find that the lengths are not consistent. They may also wish to time the "earthquakes" assuming a constant speed by the person turning the crank. Again, time is not always consistent either. If they turn the crank slowly as the cord nears "failure" they may hear the sandpaper crackle a moment before the brick moves, thus simulating a foreshock.

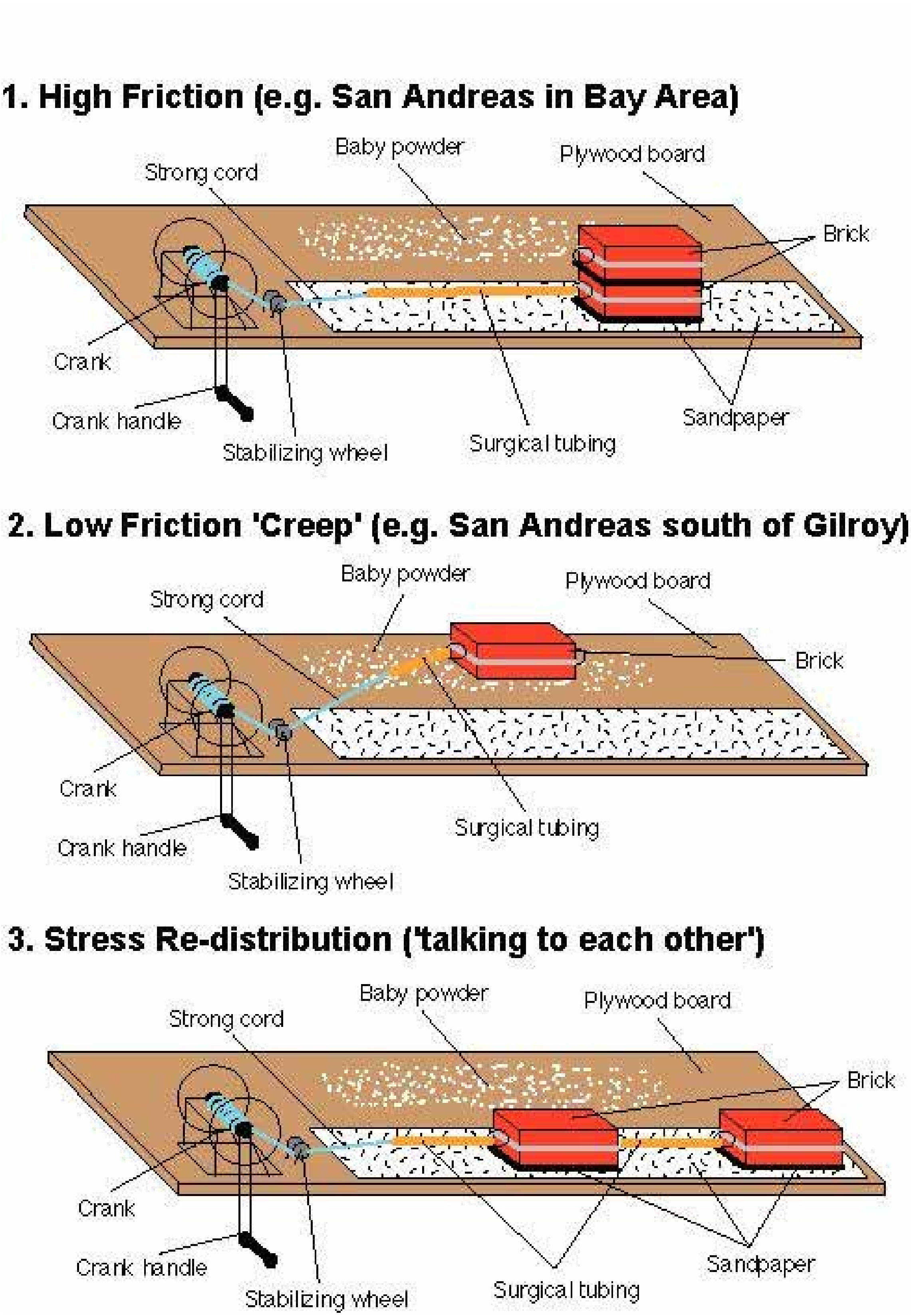
There are some accessories to this model as well. The first is talcum powder, which can be sprinkled on the board next to the sandpaper. When the brick is placed on the powder (the side of the brick without the sandpaper) students will observe an almost constant rate of motion. This simulates creeping faults, such as is found on part of the San Andreas. An additional brick is included in the demonstration as well. This may be stacked atop the first brick to produce larger "earthquakes." It can also be removed from atop the first brick just at the moment of failure to show that slippage can occur even without additional stress, just by removing the additional brick.

Finally, the second brick is equipped with surgical tubing as well, so the two can be placed on the board in tandem. In this way, the machine demonstrates how earthquakes "talk" to each other. When stress is sufficient, the first brick moves forward, increasing stress on the second brick. Eventually the second brick slips, reducing the backwards force on the first brick, and the first brick can slip again.

One additional accessory for the machine is a mass balance that can be used as a strain gauge. Although it was previously shown that earthquakes are not consistent with time or in their rupture length, the brick tends to slip at the same reading on the gauge. With this set-up and the various accessories, this demonstration can show a variety of earthquake concepts. If the students use the mass balance to weigh the bricks, they can calculate the coefficient of friction on the board, and predict what force is necessary to cause an "earthquake."

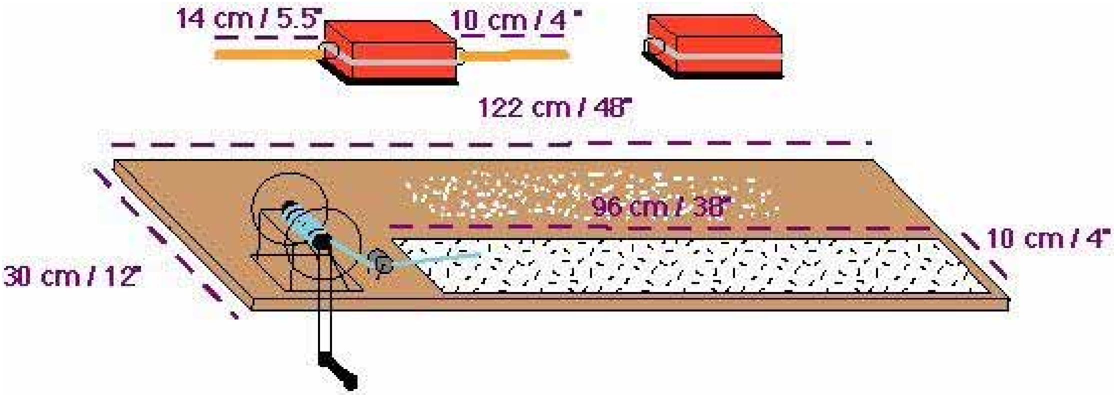
Despite being relatively simple and elegant, the machine is remarkably true to the actual earth. Thus students get a fun, hands-on look at stress and rupture in the laboratory.

Diagrams



1. High Friction (e.g. San Andreas in Bay Area)
Baby powder
Plywood board
Strong cord
Brick
Crank
Crank handle
Stabilizing wheel
Surgical tubing
Sandpaper
2. Low Friction 'Creep' (e.g. San Andreas south of Gilroy)
Baby powder
Plywood board
Strong cord
Brick
Crank
Crank handle
Surgical tubing
Stabilizing wheel
3. Stress Re-distribution ('talking to each other')
Baby powder
Plywood board
Strong cord
Brick
Crank
Crank handle
Stabilizing wheel
Surgical tubing
Sandpaper

Technical Specifications



Text, Diagrams and Page Design by D.G. Cornwell & S.T. Detweiler, May 2000.

The USGS library maintains a wonderful teacher resource facility with materials any teacher can check out.
Tel 1-650 329 5026 or 5028, USGS Library on Survey lane off 345 Middlefield Road, Menlo Park
(map http://online.wr.usgs.gov/kiosk/mparea3.html)