

EARTHQUAKES IN THE CLASSROOM: 'THE SEISMO-BOX: DO IT YOURSELF'

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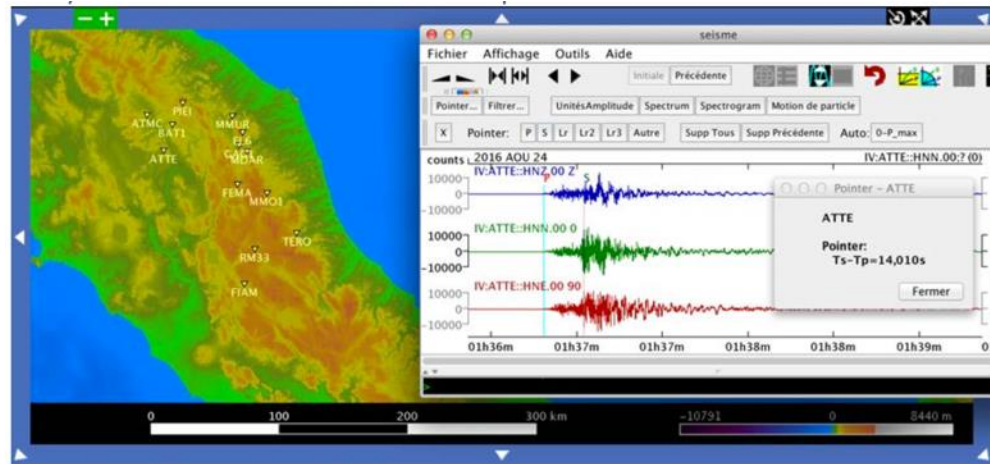


WHAT WE SEE/DO TODAY?

➤ WE'LL 'PLAY' WITH THE **SEISMO-BOX**



➤ WE'LL LOCALISE AN EARTHQUAKE (AND MORE...!)
USING THE **SOFTWARE EDUCARTE**



SEISMO-BOX: DO IT YOURSELF

www.sismobox.com

Very simple experiments/cheap equipment and free softwares

You can do it yourself

Understanding 'natural hazard'

What is an earthquake ?

How to record and locate it ?

Is it possible to predict it ?

Its consequences

Prevention



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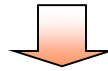
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HAZARDOUS EVENT

DENSELY POPULATED AREAS

RISK



RISK = f (hazard, vulnerability, exposure)

hazard → *probability of occurrence of an event with the potential for destruction in a defined area and a given time interval*

vulnerability → *expected degree of loss due to a destructive event*

exposure → *economic loss (people and properties)*



+



=



HAZARDOUS EVENT

DENSELY POPULATED AREA

RISK

RISK

(**exposure**)

hazard

*an event with the potential for
in a given area and a given time interval*

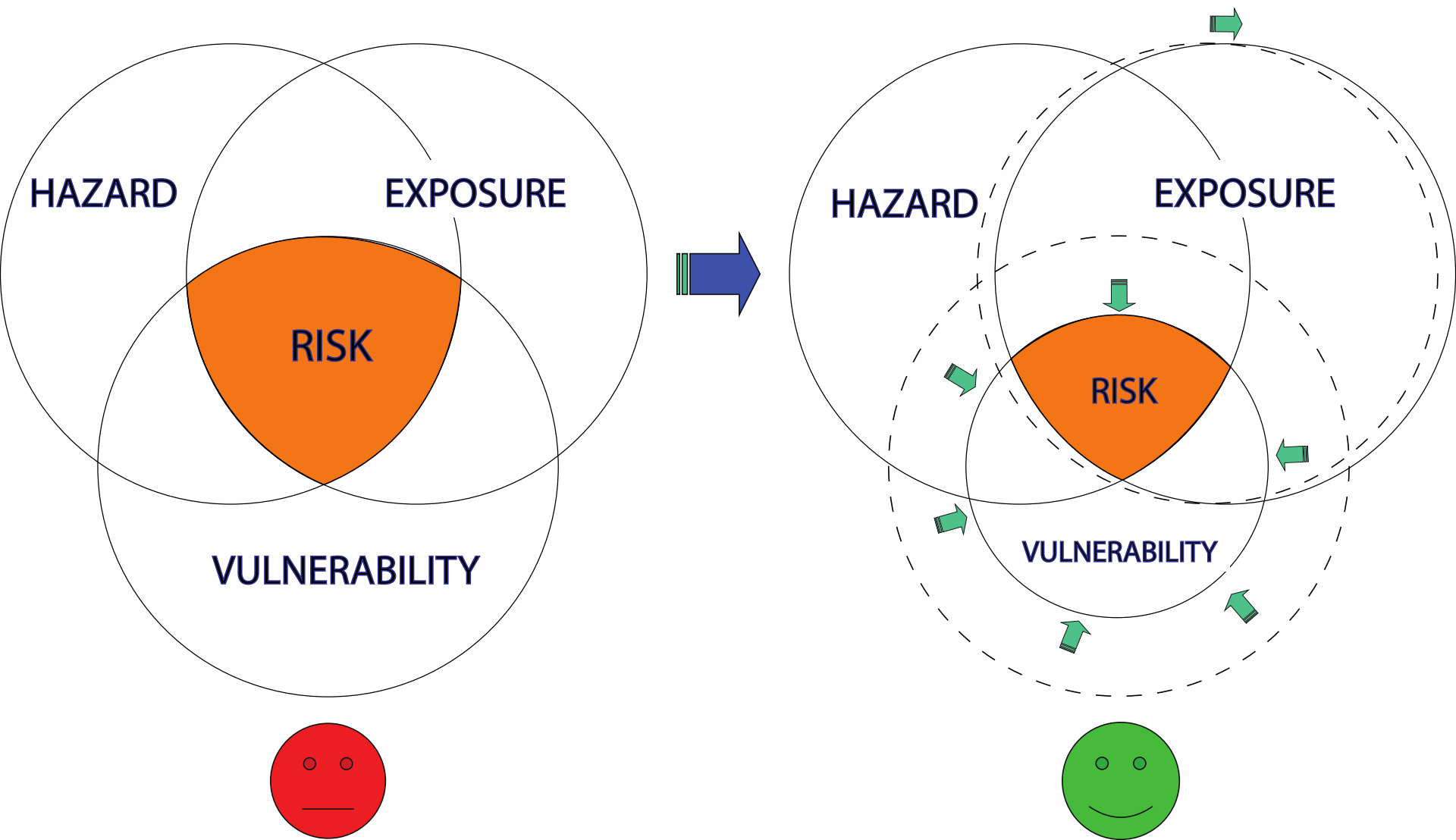
vulnerability

expected degree of loss due to a destructive event

exposure

→ economic loss (people and properties)

**HIGH HAZARD IS NOT
ALWAYS HIGH RISK!**



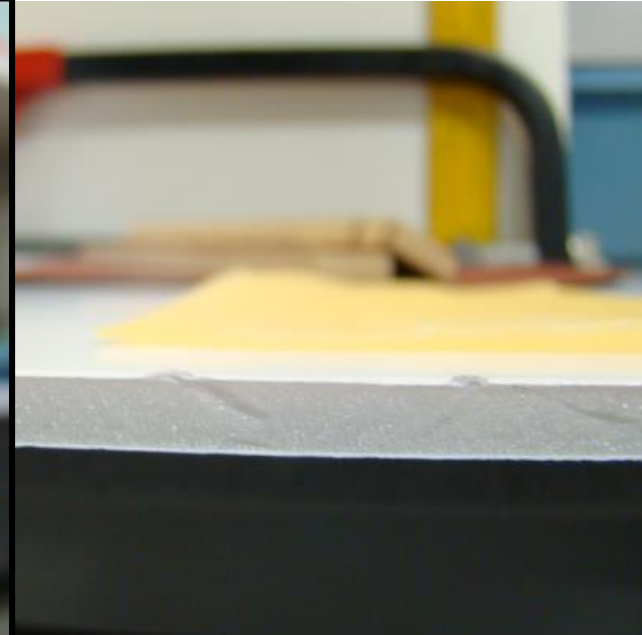
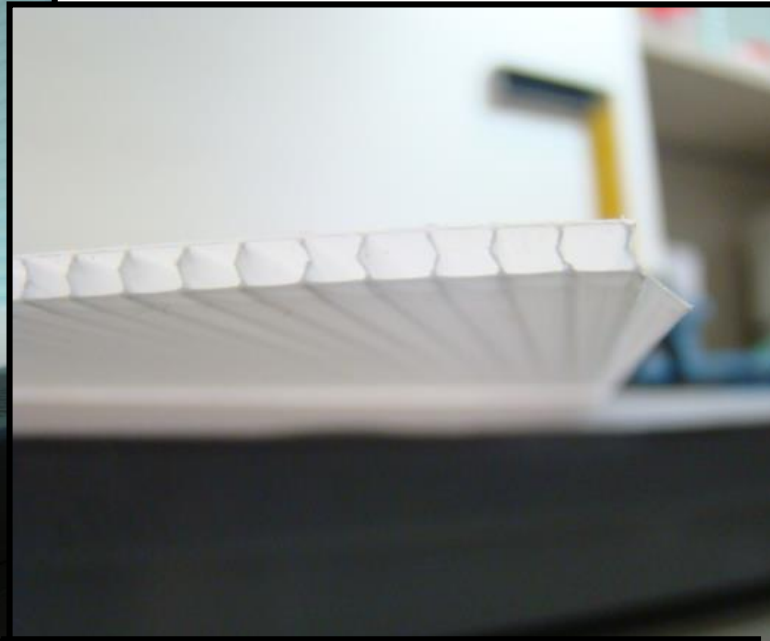
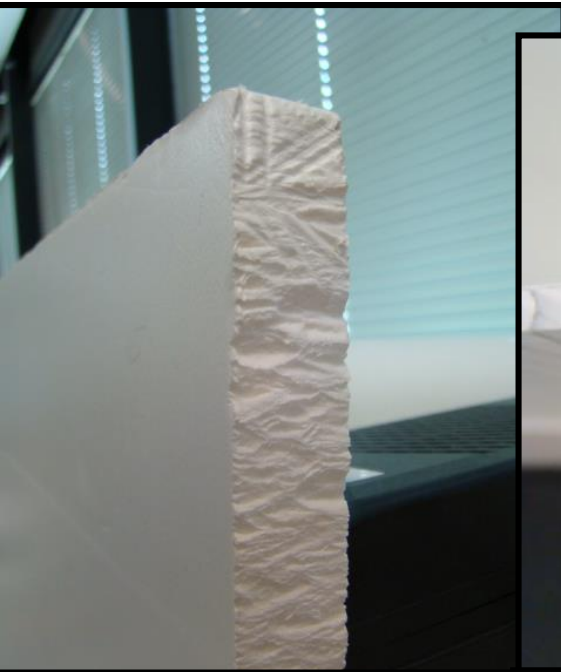
**NATURAL HAZARDS ARE INEVITABLE
BUT
NATURAL DISASTERS ARE NOT!**

MAIN GOALS OF THE SEISMO-BOX

- Stimulate students (citizens of tomorrow) to the knowledge of earthquake as a natural phenomenon
- To sensitize students to the consequences that an earthquake may have on buildings in relation to the type of soil (rock) on which buildings are constructed and the type of buildings itself.







HOW TO BUILD A SEISMO BOX?

MATERIAL












HOW TO BUILD A SEISMO BOX?

MATERIAL

<p>Réf : 952463 Castorama; 2*(Polystyrènes extrudé BD 1,25m x 0,60 m ép.20mm ; Unit 1,88 €)</p>	 <p>(for all supports: shake table, liquefaction, seismometer...)</p>	3,76
<p>Réf. : VMP0111 VPC display Plaque Polypro blanc ¼ *(Alvéolé 80 cm*120 cm ep :3mm Unit 2.03€)</p>	 <p>(basement of shake table, hanging walls of building to build)</p>	0,5
<p>Réf: 456988 http://www.rougier-ple.fr 1/12*(Carton mousse-plumes 50x65cm ep :5mm Lot de 4 :17,5€)</p>	 <p>(stairs of all the buildings)</p>	1,5
<p>1*(Cahier classeur Casino 2 .95 €)</p>	 <p>(wall of built building)</p>	2,95
<p>1/19 *(Epingles patafix élastique 1 € Buro+ 28,5 € 20,85 €)</p>	 <p>(to build buildings and fix stairs at walls)</p>	2
<p>Réf : 488105 Castorama 1* (Perceuse sans fil 12 V HP12CD. 12,9 €)</p>	 <p>(electric screw driver: shake-table and stick-slip)</p>	12,9



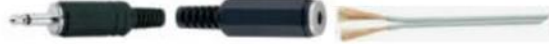
HOW TO BUILD A SEISMO BOX?

MATERIAL





<p>Réf : 592896 Castorama 0,5*(2 colliers de serrage inox L8 x ø 32 – 52 Unit :3,69 €)</p>	 <p>(to change rotation speed)</p>	<p>1,84</p>
<p>Réf : 811345 ; Castorama ¼ (Tube IRL tulipé gris. Ø : 16 mm. Long: 2 m. Unit 0,9 €)</p>	 <p>(rollers of the movment absorber)</p>	<p>0,2</p>
<p>Réf : 811347 ; Castorama ½ (Tube IRL tulipé gris. Ø : 20 mm. Longueur : 2 m Unit 1,1 €)</p>	 <p>(for the box-transport and high-speakers)</p>	<p>0,6</p>
<p>1/19 *(Tourillon Hêtre 1.5 €, 0,8 cm et 0,9 cm Tourillon sapin 10.5 €)</p>	 <p>(for shake table)</p>	<p>1,5</p>
<p>Réf : 123401 Castorama 22/20 * (Vis plaque de plâtre 3,5*25 1,5€ les 20)</p>	 <p>3,5x25mm (for the e⁻ shake table support)</p>	<p>1,5</p>
<p>Réf : 123509 Castorama 2 /20 * (3,5x55 2,7€ les 20)</p>	 <p>3,5x55mm (for the seismometer support)</p>	<p>0,27</p>
<p>Réf : 634175 Castorama 1/10 *(Tire-fond acier zingué 2,45€)</p>	 <p>5 x 50mm (for the seismometer)</p>	<p>0,24</p>
<p>Réf : 110562 Castorama 1/10*(10 Boulons tête fraisée acier zingué 4 x 50 mm 2,45€)</p>	 <p>(for the seismometer)</p>	<p>0,24</p>
<p>Réf : 110442 Castorama 1/10*(10 Écrou hexagonal acier zingué Ø 4 mm 1,5€)</p>	 <p>(for the seismometer)</p>	<p>0,15</p>

HOW TO BUILD A SEISMO BOX?

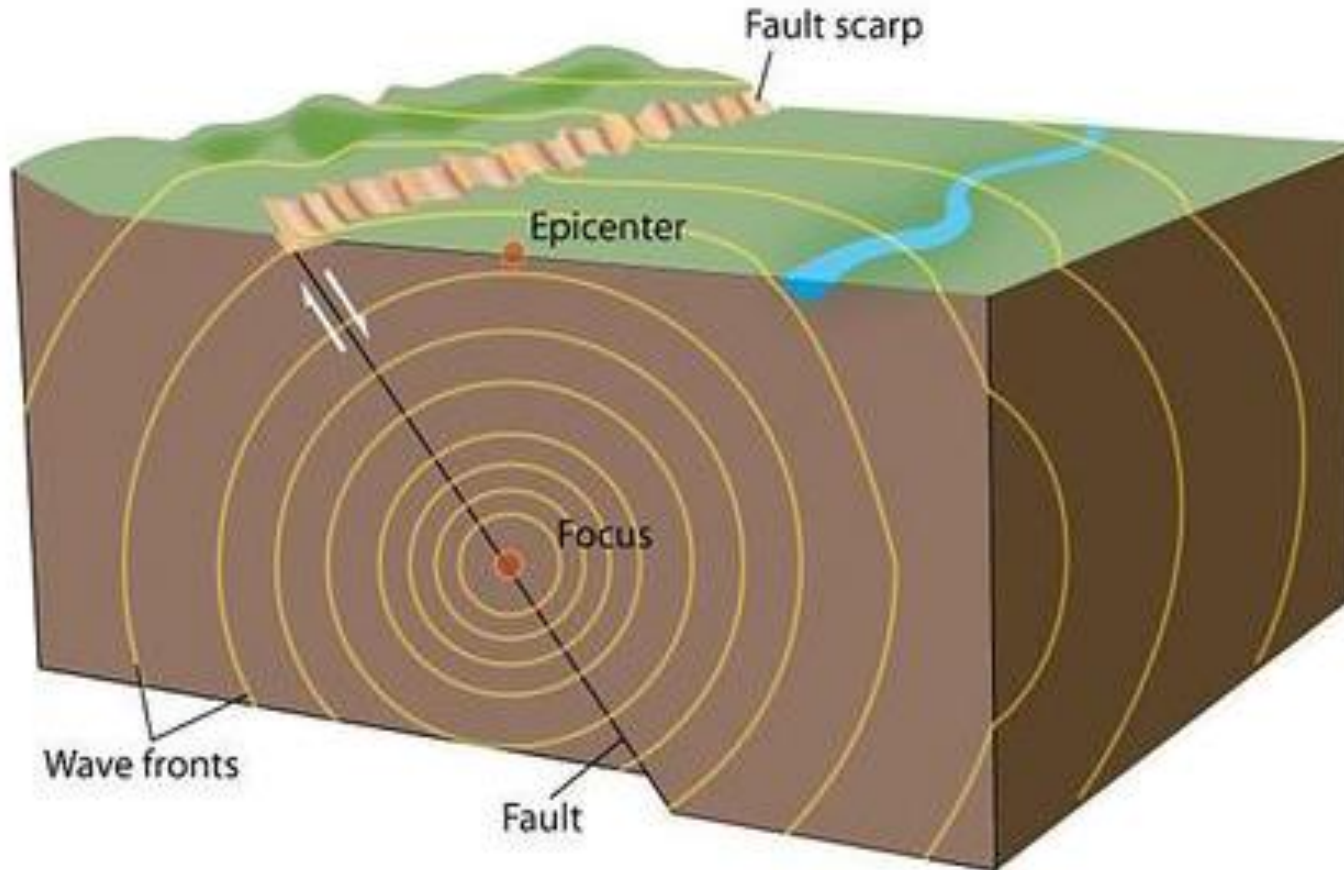
MATERIAL

Réf: 185106 Conrad 2* Petit aimant-puissant-permanent-PIC-M0805 unité :1,35 €	 (to make induction in the bobine of the seismometer)	2,7
Réf: 242536 Conrad 1*(Fil de cuivre peint 0,15 mm incolore Mayerhofer Modellbau)	 (to make the induction current of the seismometer)	4,8
(Earthquake's location in classroom Réf: 731471 Conrad :10* (Jack 3,5 mm 2 p. unit:0,45€) Réf: 731498 Conrad :10* (Jack 3,5 mm 2 p. unit: 0,45€) Réf: 604934 Conrad: 17/50 *(wire 50m 0.75mm unit 18,95€)	 (to simulate an earthquake in the classroom and locate it with 5 stations)	(15,5)
	Sum	70 €

Additional equipement for the electronic shaking table and experiments with laptop computer

Réf: 87176; 1*(Conrad USB 2.0 external sound card Sweex. Stereo acquisition for wave speed and good amplification of low frequencies etc...)	 (to replace the sound card of the laptop)	39,95
Réf: 062563-62 ou 76001 ; 1*(Conrad Dynavox mini-amplifier Hi-Fi CSPA1 silver)	 (to amplify output signal of the sound card to the high-speakers of the e ⁻ shake table)	39,90 ou 49,95
Réf: 300237; Conrad 2*(High speakers SPEAKA HP 75/90 à unit:12,95 €)	 (to make the movement of real earthquakes to the e ⁻ shake table)	25,9
Réf: 325090 ; Conrad 1*(Connexion RCA / jack, 2 m 4,7 € to connect sound-card to the amplifier)	 (to connect sound card to the amplifier)	4,7

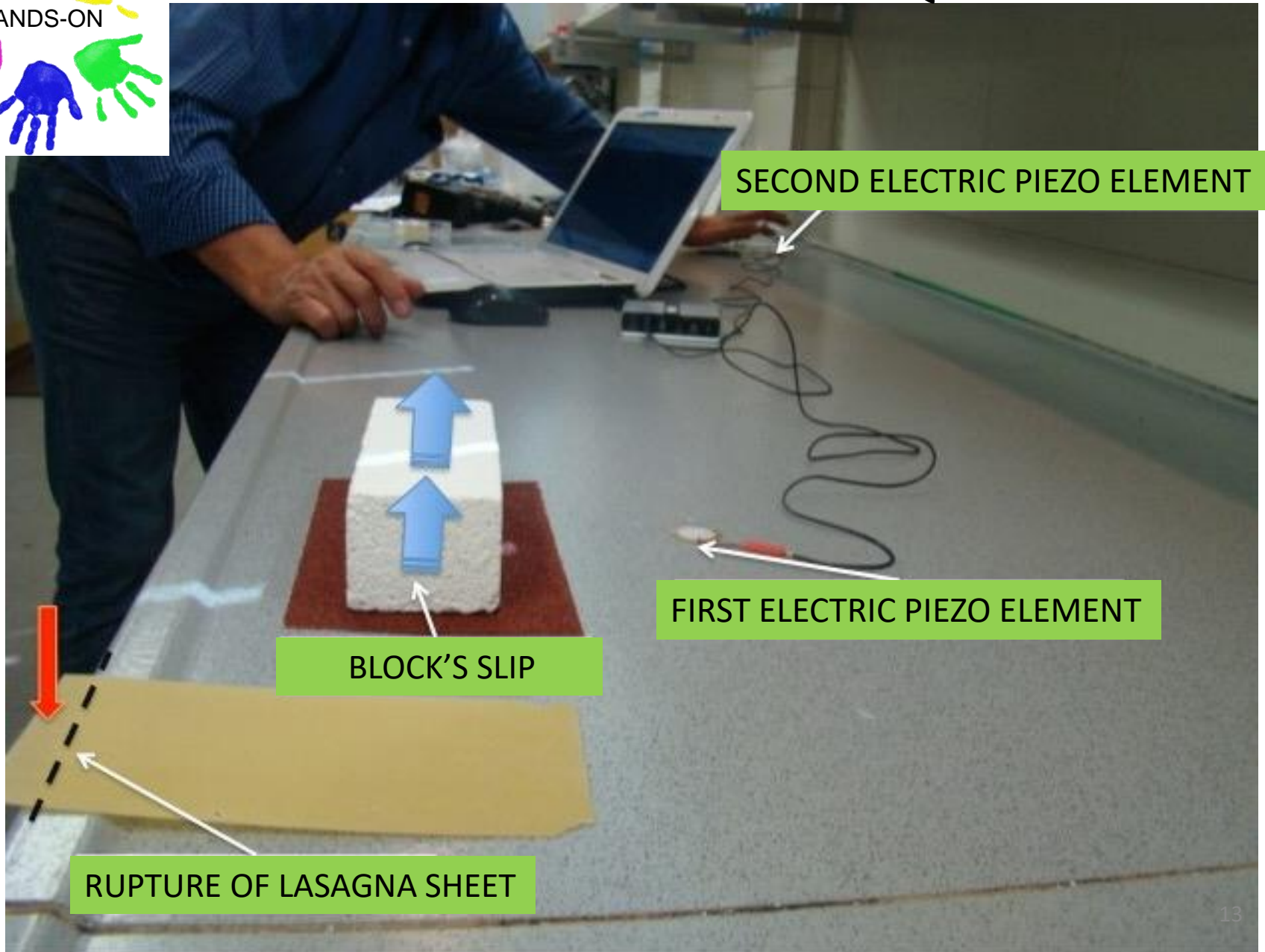
WHAT IS AN EARTHQUAKE



An **earthquake** is the shaking of the surface of the Earth resulting from the sudden release of energy in the Earth's lithosphere that creates **seismic waves** ¹²



WHAT IS AN EARTHQUAKE



SECOND ELECTRIC PIEZO ELEMENT

FIRST ELECTRIC PIEZO ELEMENT

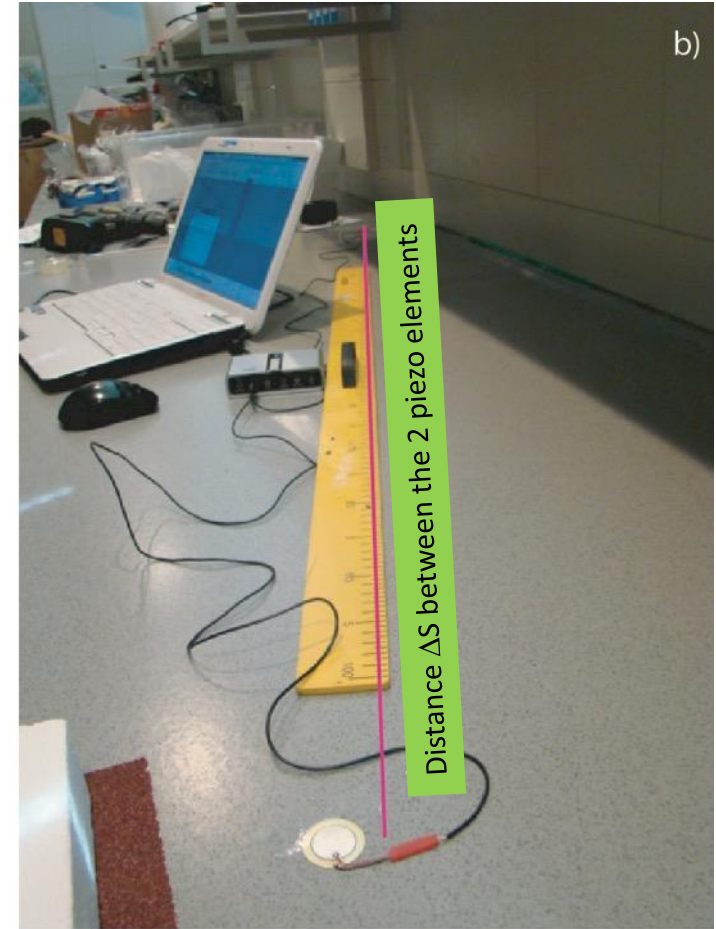
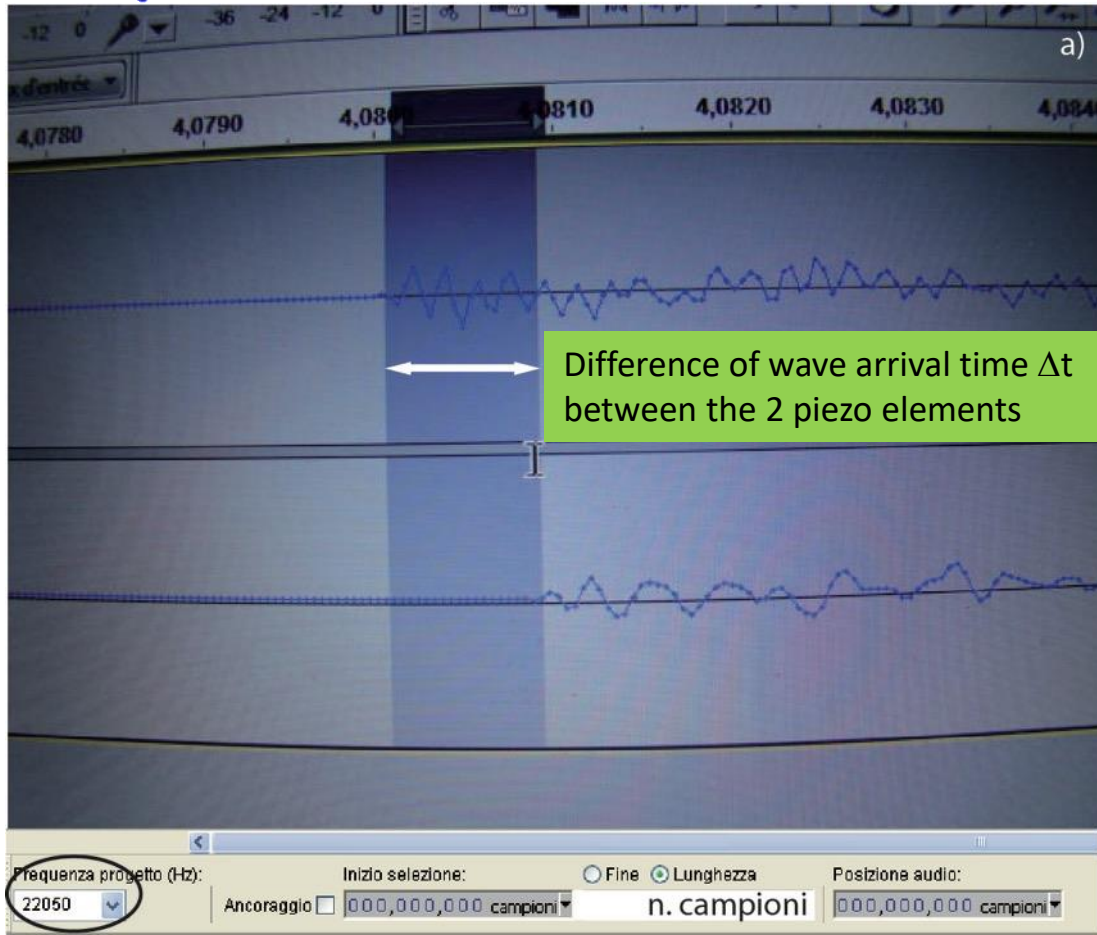
BLOCK'S SLIP

RUPTURE OF LASAGNA SHEET



WHAT IS AN EARTHQUAKE

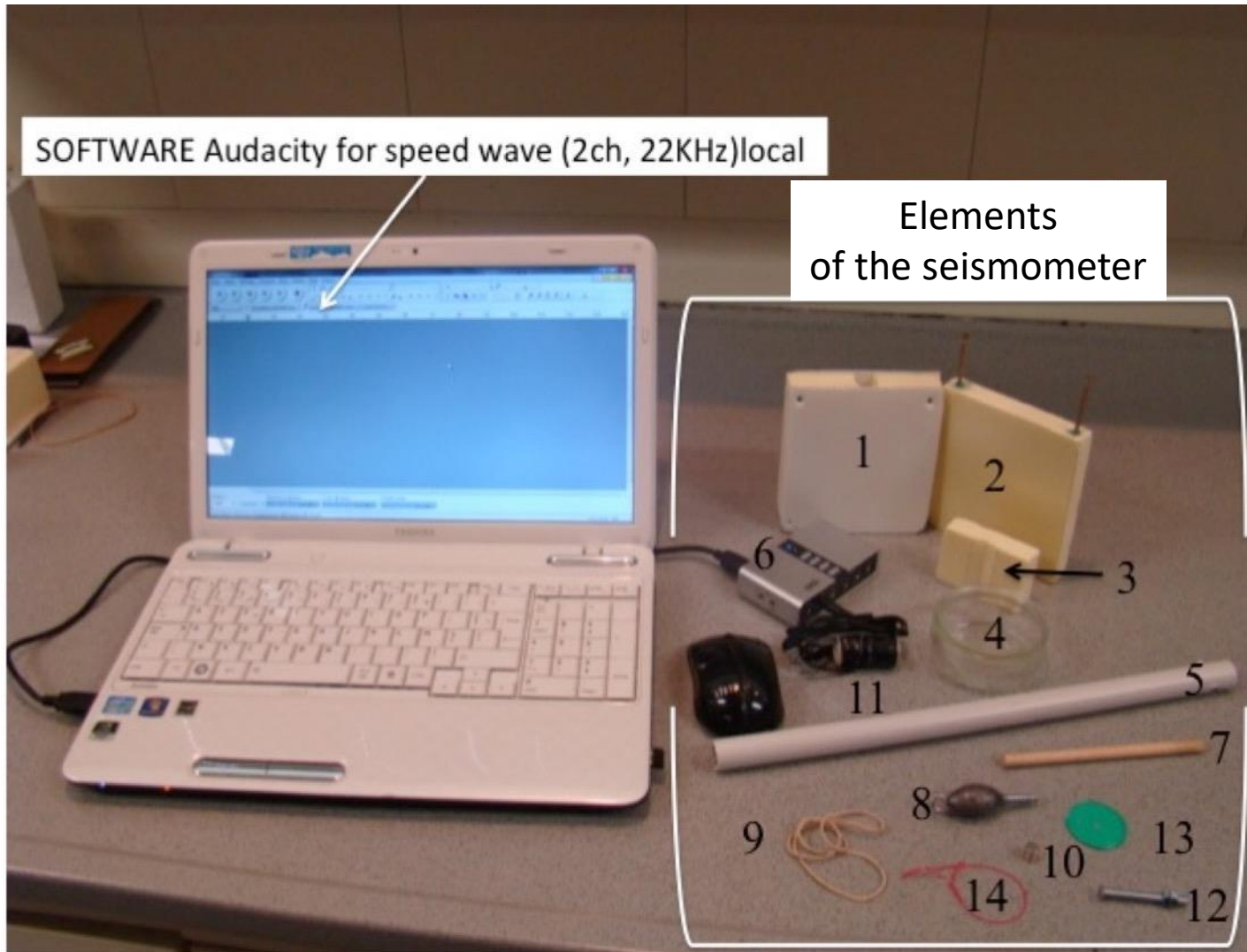
$$v = \frac{\Delta S}{\Delta t}$$



It is possible to calculate the wave speed in different materials!!



HOW TO REGISTER AN EARTHQUAKE?

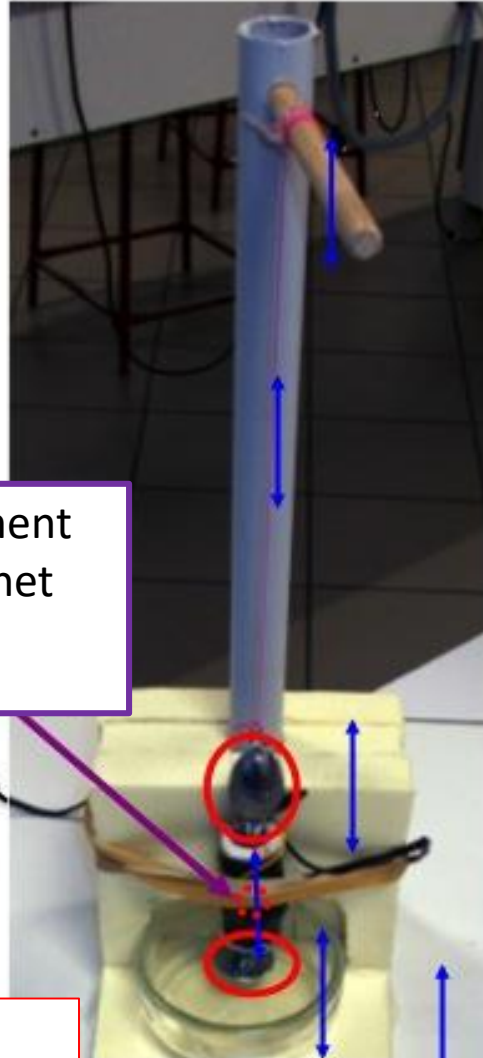


SOFTWARE Audacity for speed wave (2ch, 22KHz)local

Elements of the seismometer



HOW TO REGISTER AN EARTHQUAKE?



relative movement
between magnet
and coil

COMPUTER

SOUND
CARD

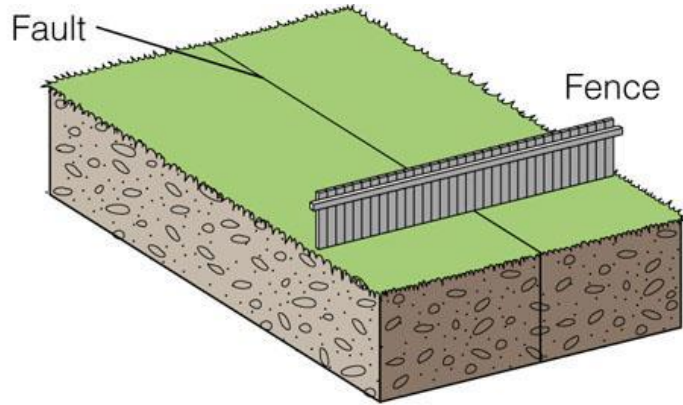
Fixed part

'shaking' part

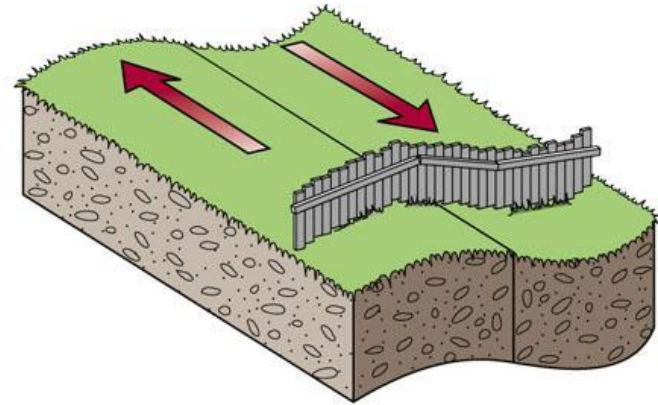
Knocking the table..



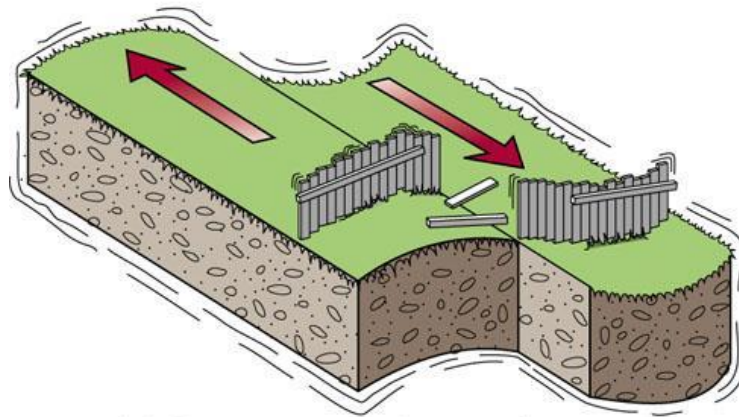
THE SEISMIC CYCLE



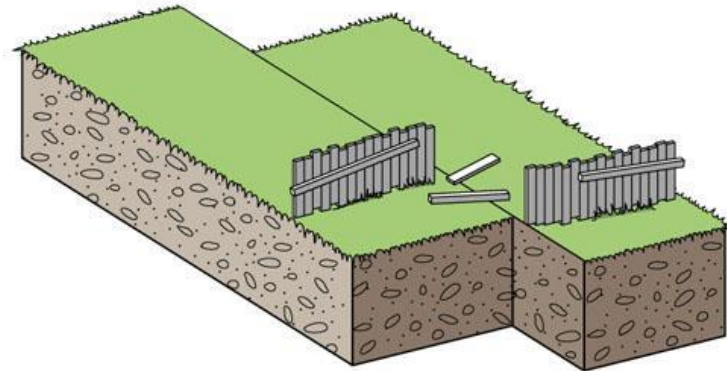
(a) Original position



(b) Deformation

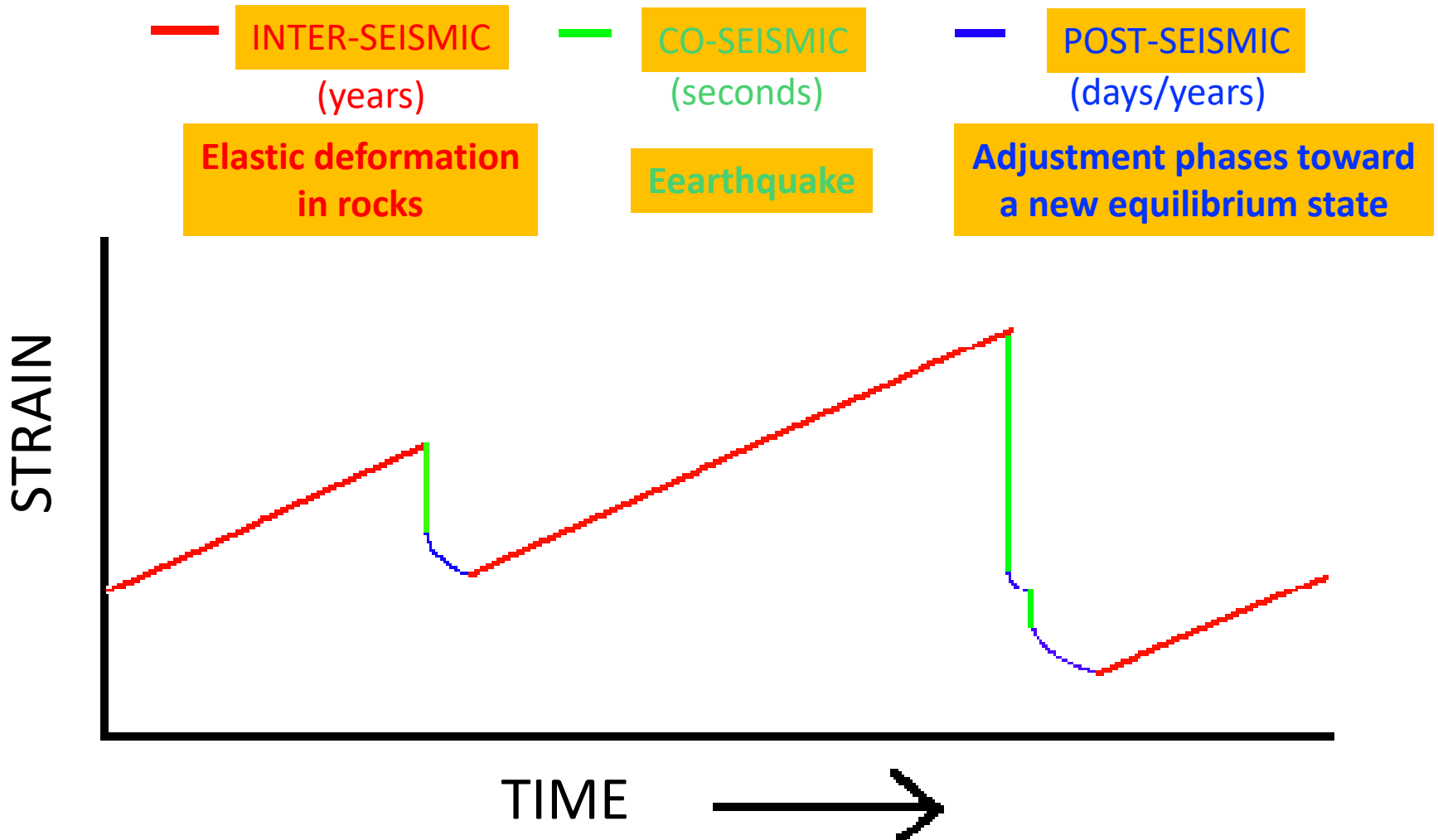


(c) Rupture and release of energy



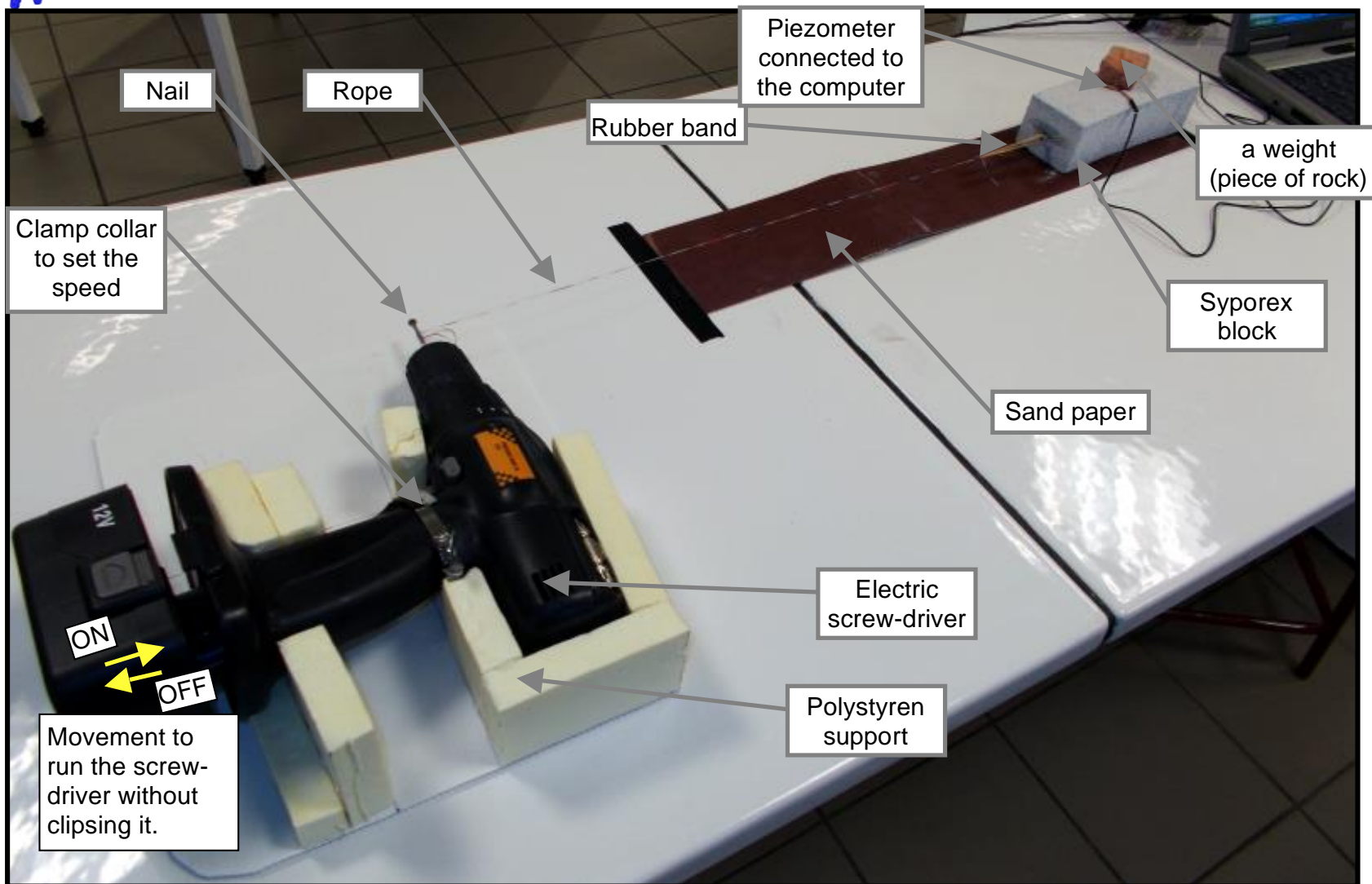
(d) Rocks rebound to original undeformed shape

THE SEISMIC CYCLE

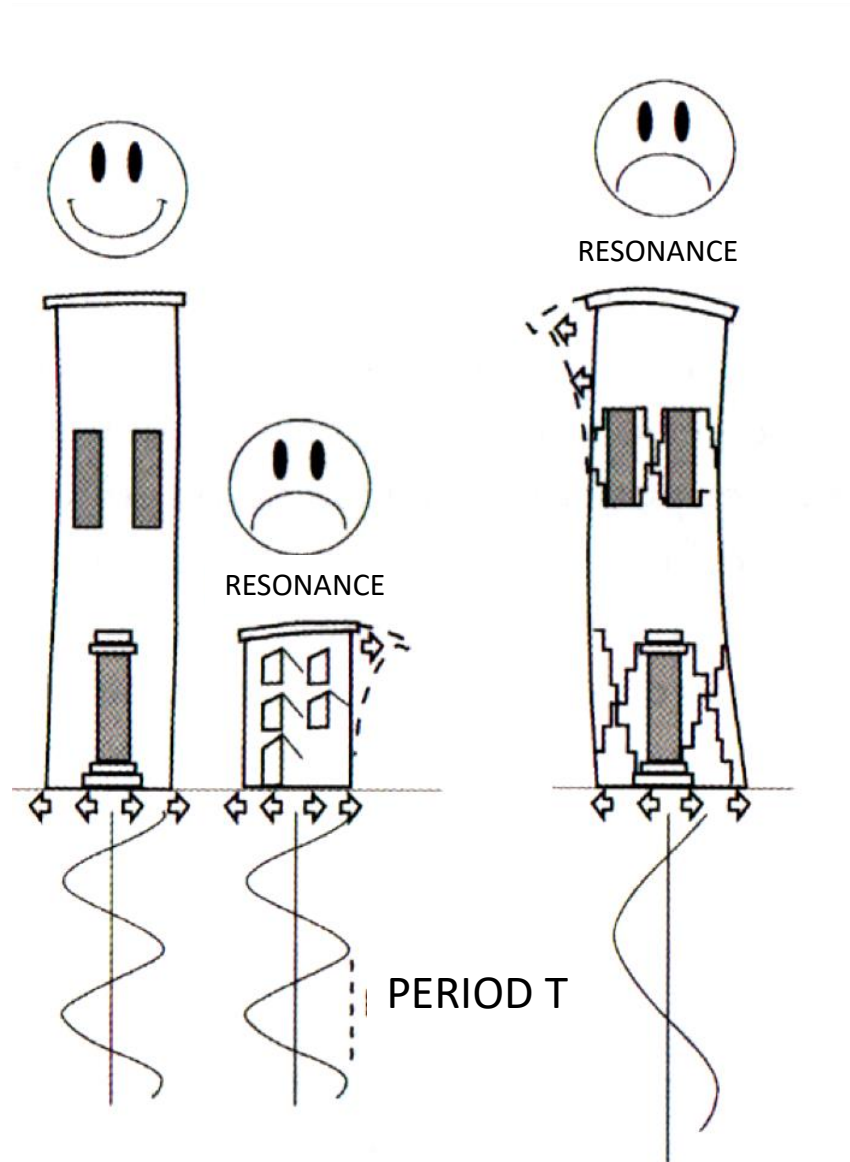




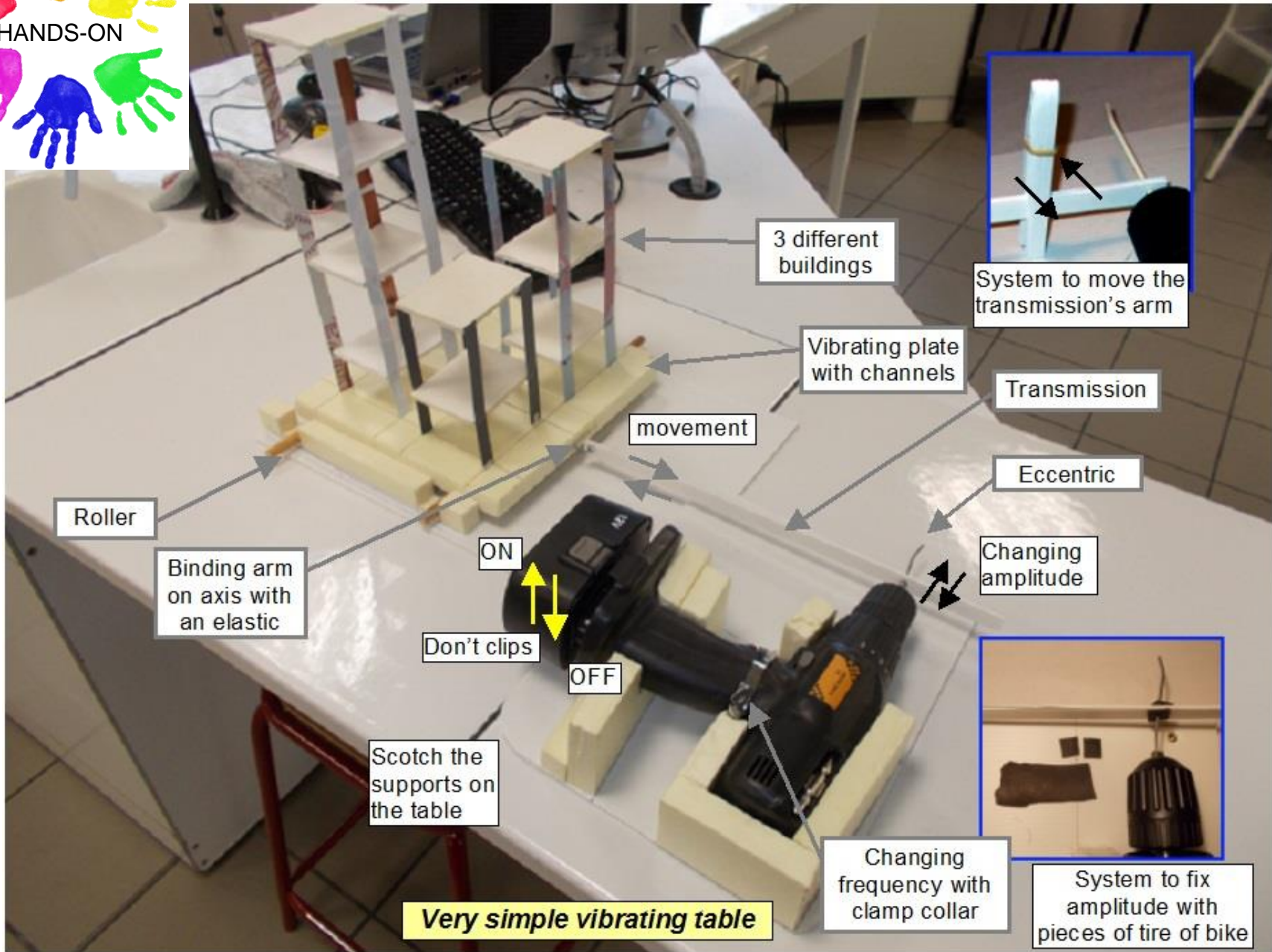
IS IT POSSIBLE TO PREDICT EARTHQUAKES???



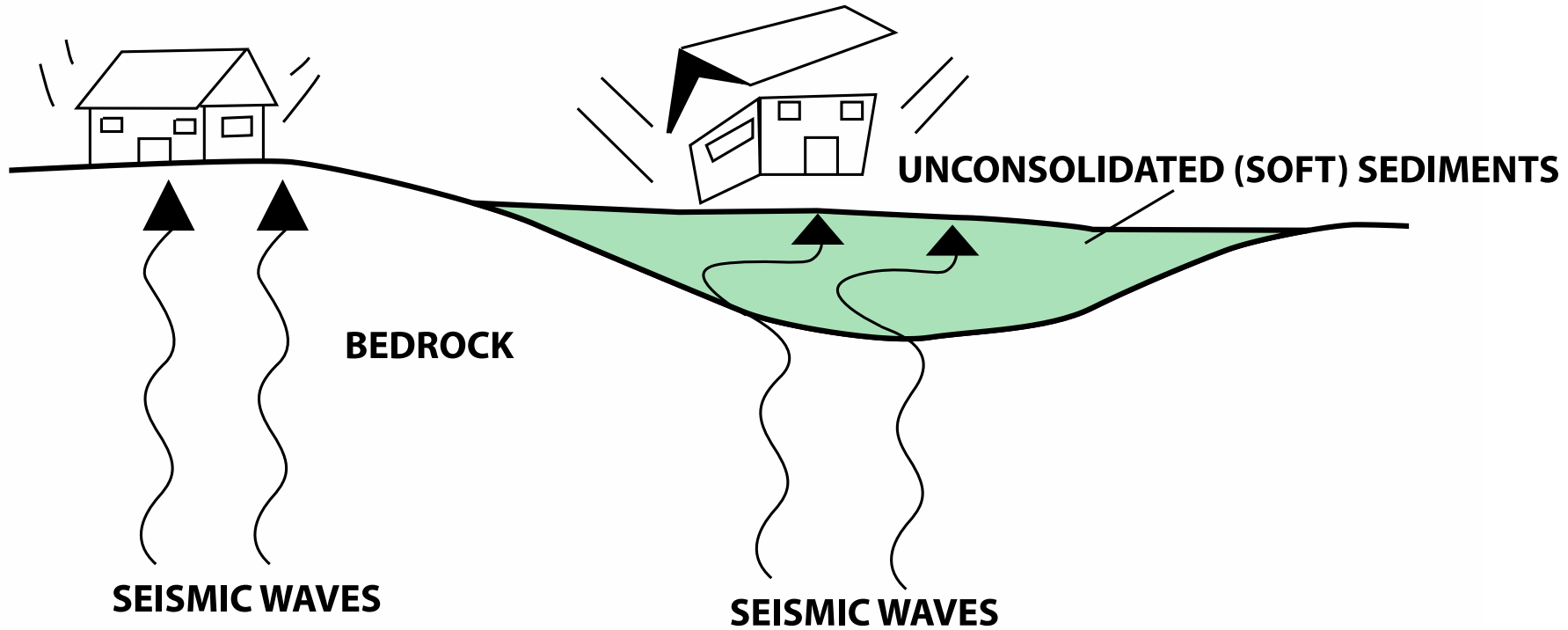
BUILDING RESONANCE



BUILDING RESONANCE



SITE EFFECT



SEISMIC AMPLIFICATION

SITE EFFECT

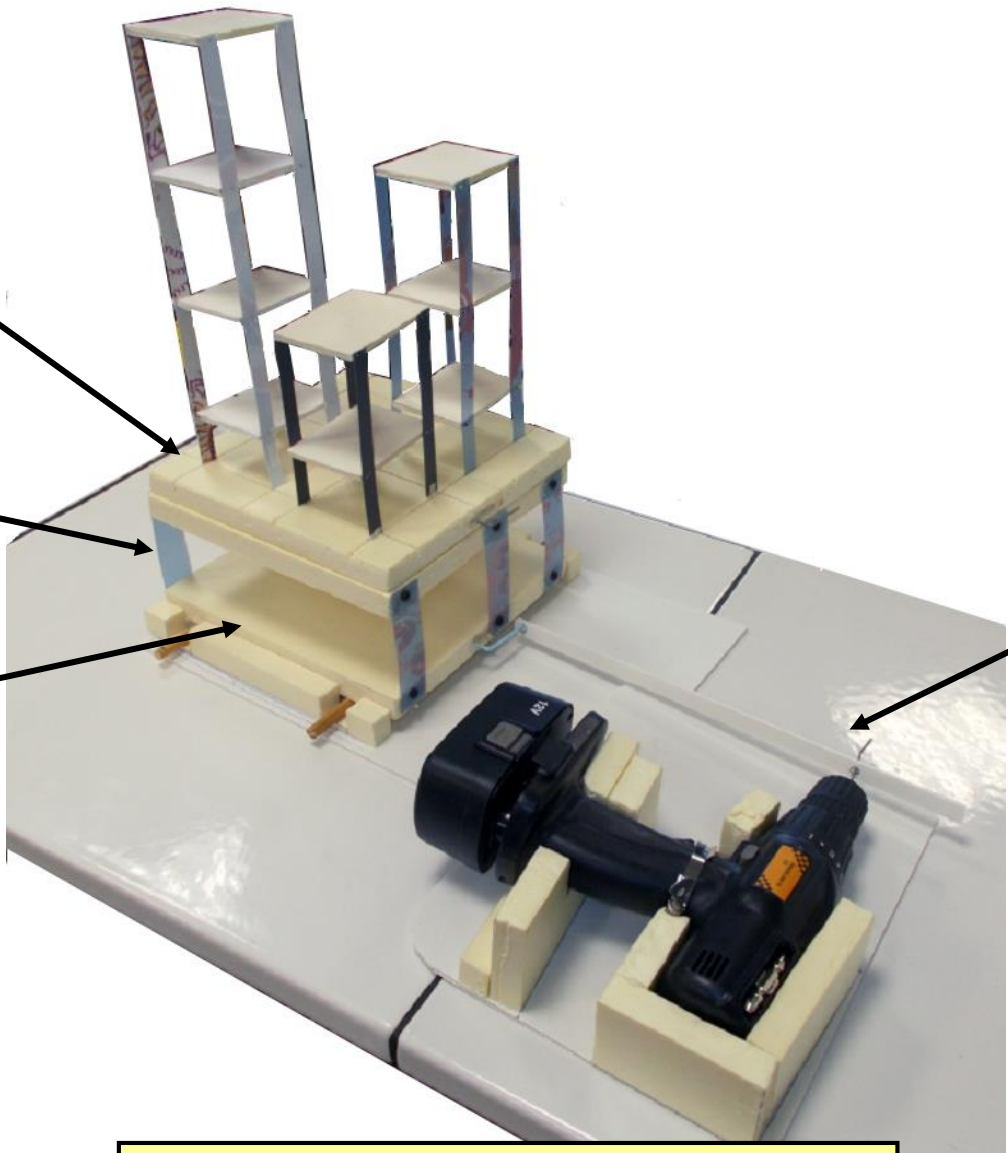


Ground and buildings

Alluviums (plastic blades)

Bedrock

Vibrator with different frequencies



Site effect: alluviums resonance

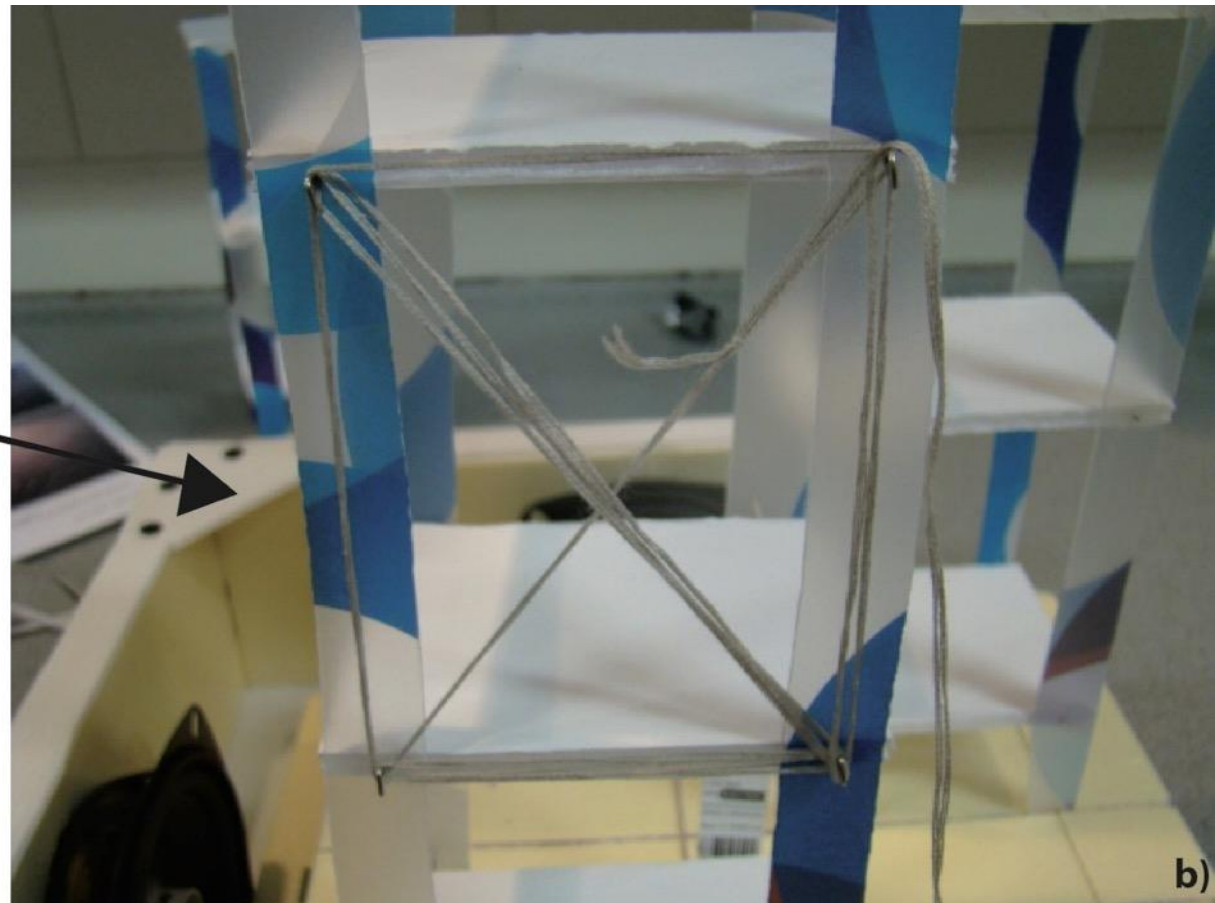
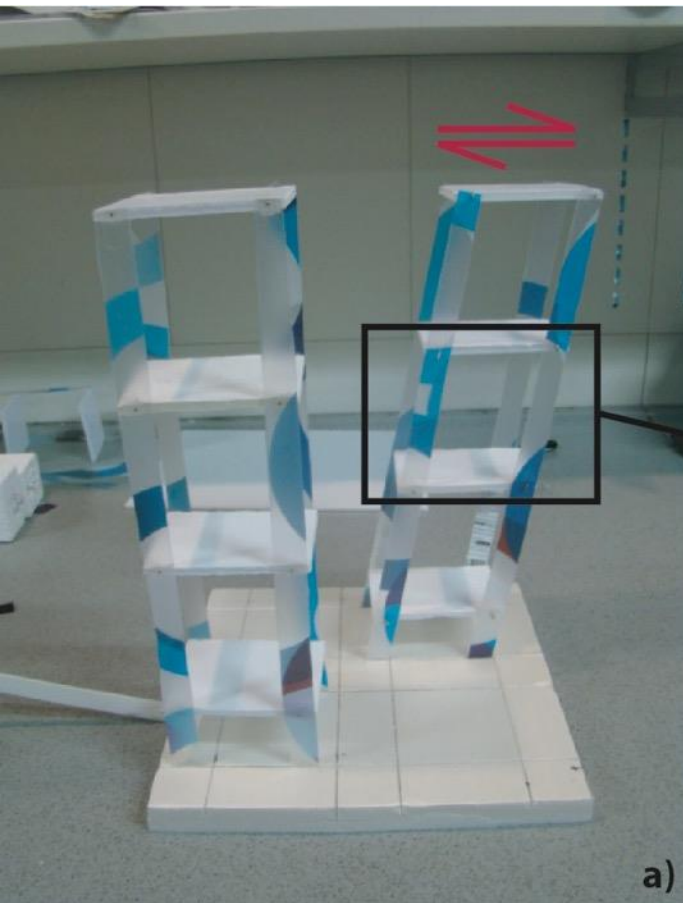
COLLAPSE OF BUILDING - PREVENTION



VULNERABILITY

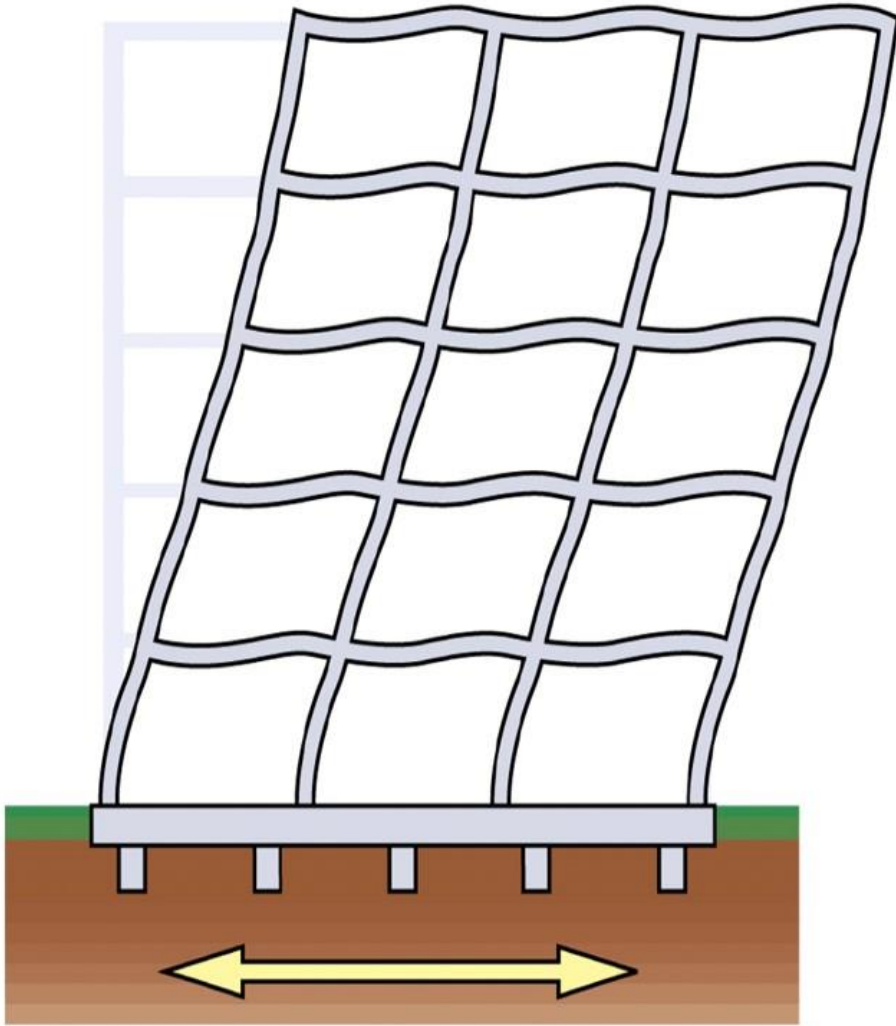


COLLAPSE OF BUILDING - PREVENTION

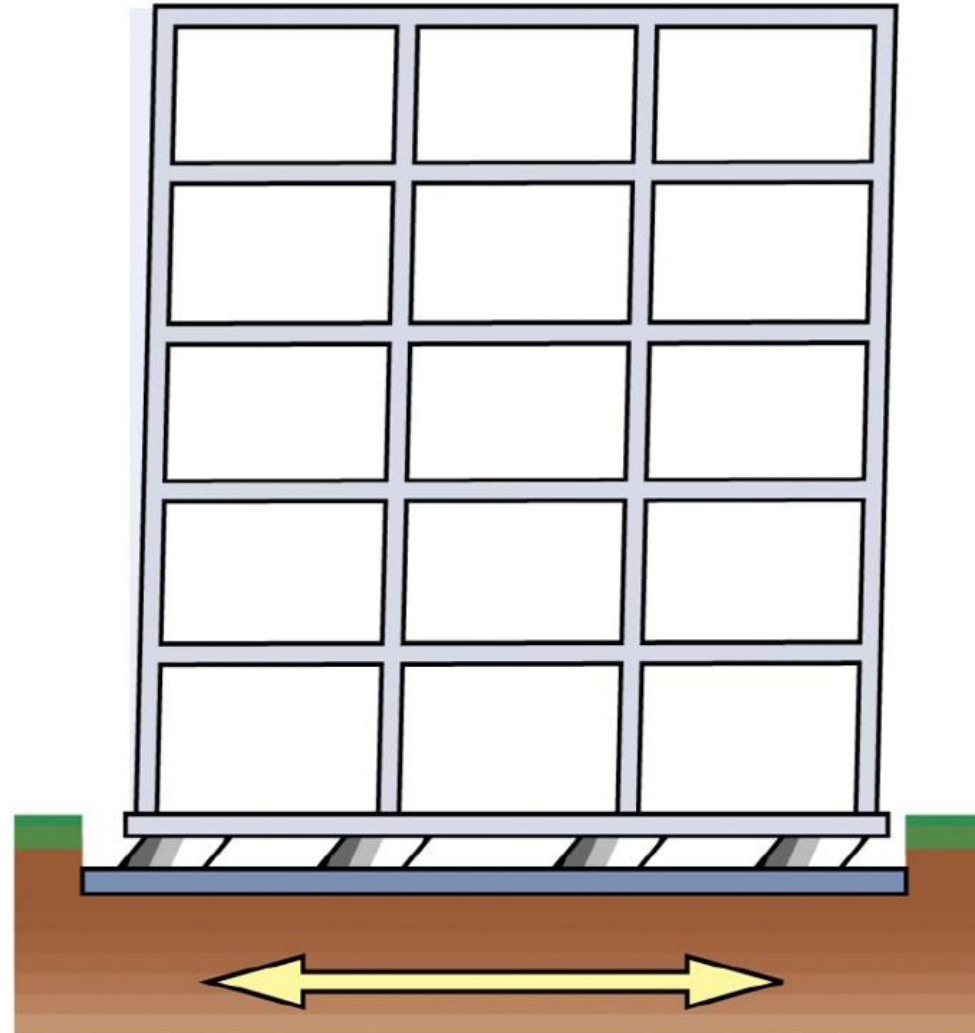


VULNERABILITY

SEISMIC INSULATION - PREVENTION



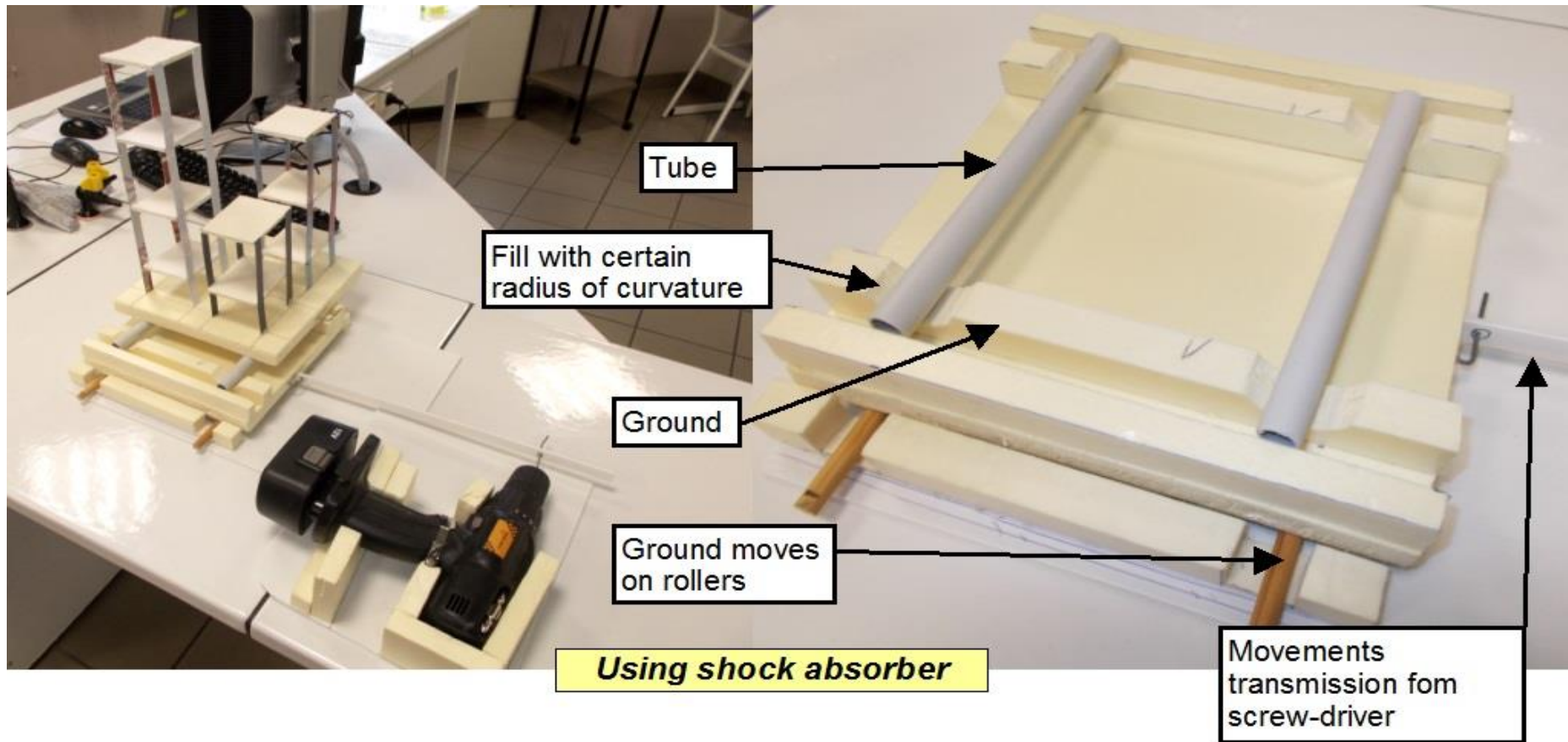
FIXED BASE



BASE ISOLATION



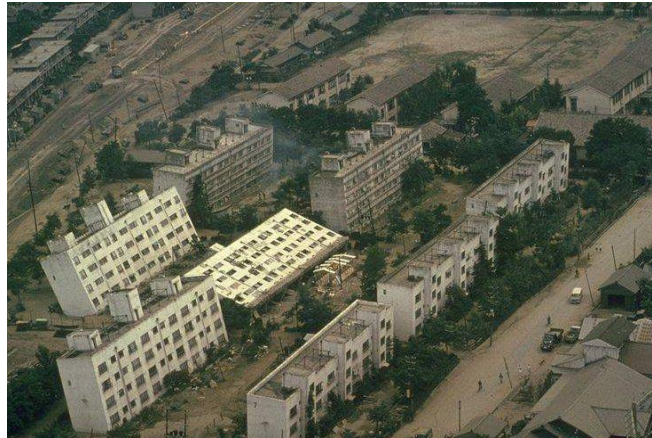
SEISMIC INSULATION - PREVENTION



SOIL LIQUEFACTION

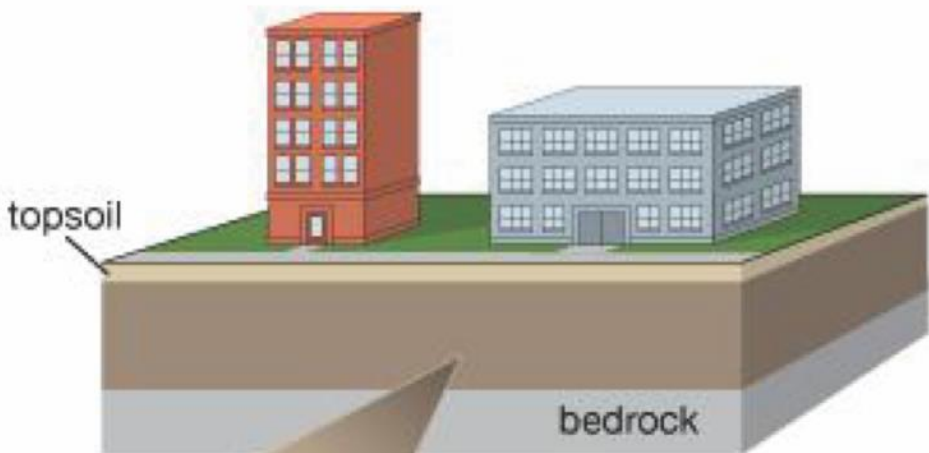


Emilia (Italia) 2011



Soil liquefaction

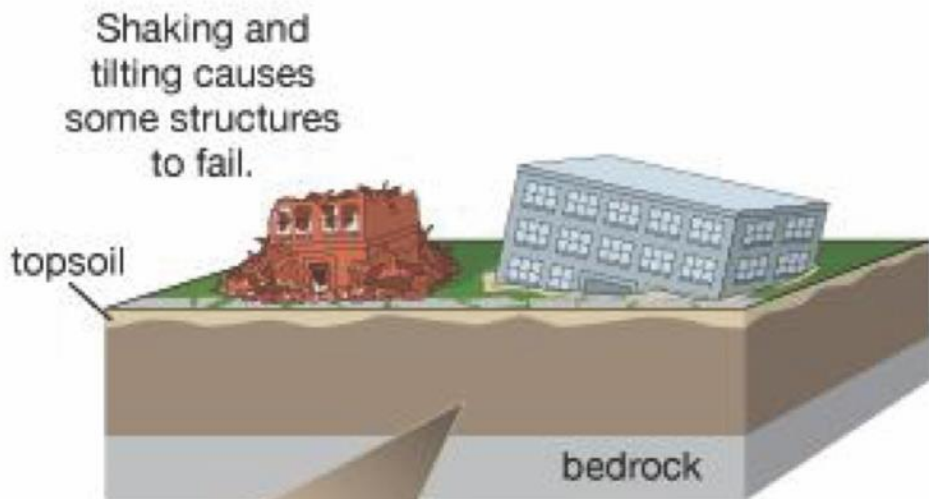
stable soil



Building stands erect on stable soil.

Loosely packed grains of soil are held together by friction. Pore spaces are filled with water.

liquefied soil



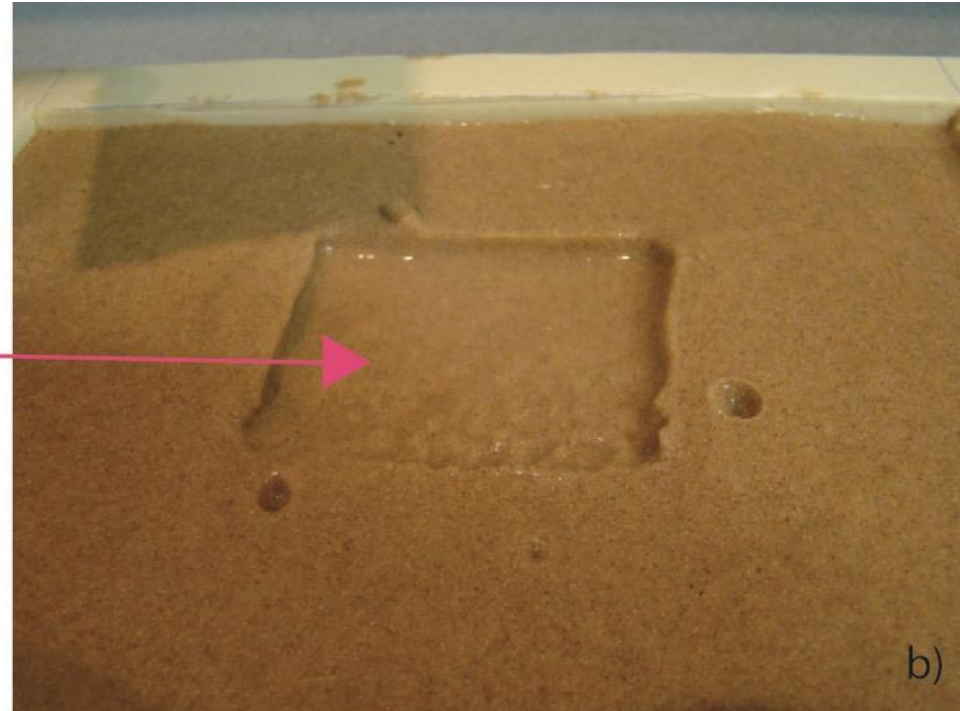
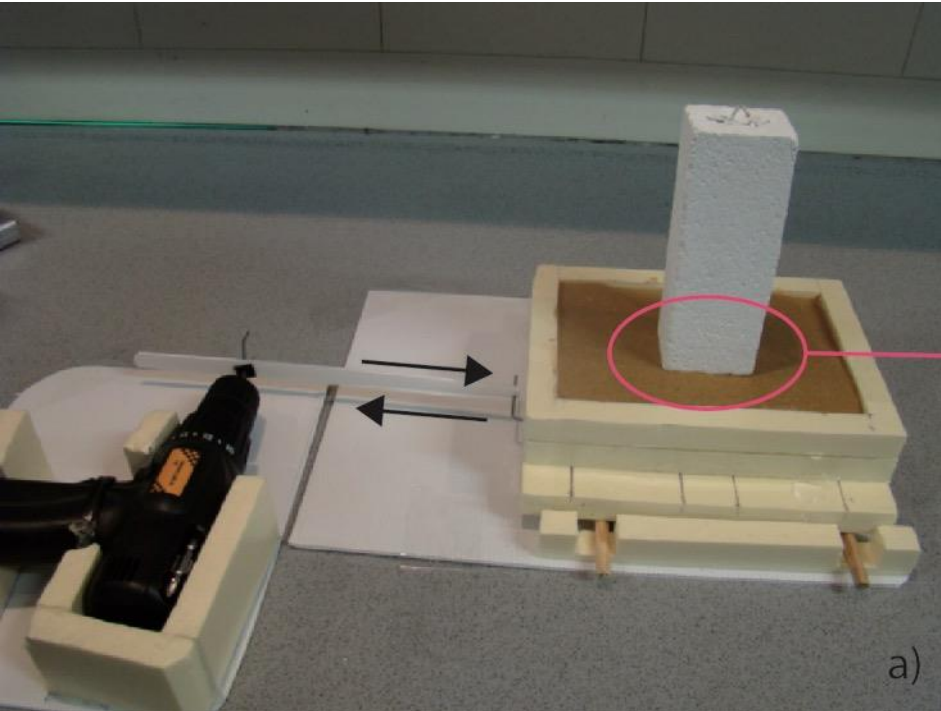
Shaking and tilting causes some structures to fail.

Building tilts and sinks as soil stability declines.

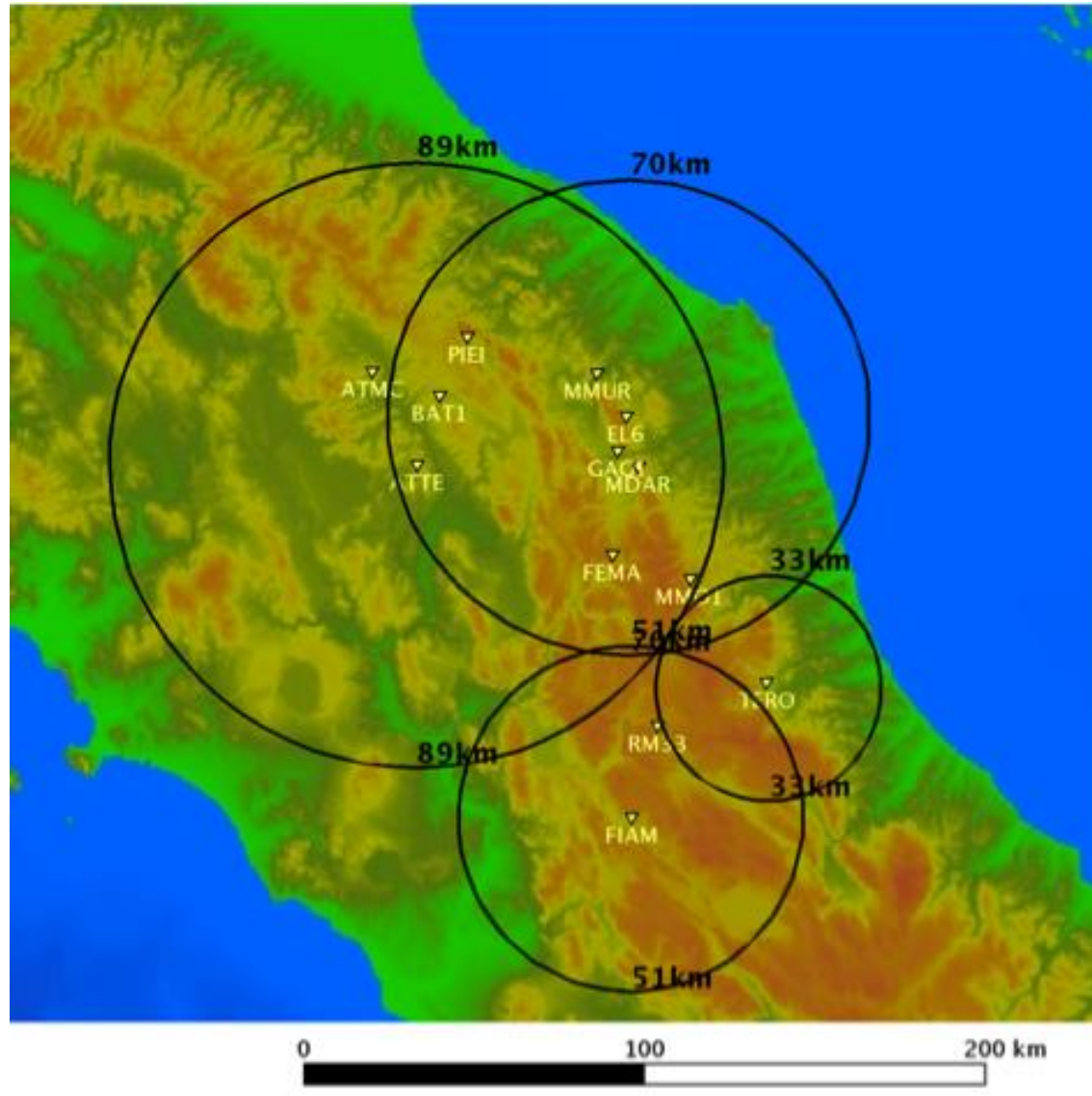
Shaking destabilizes the soil by increasing the space between grains. With its structure lost, the soil flows like a liquid.



SOIL LIQUEFACTION



Quake epicenter investigation EDUCARTE



Quake epicenter investigation

EDUCARTE

link to download specific edition for Educarte Amatrice quake datas

http://www.edusismo.org/ftpsismo/base/EDUCARTE_GIFT_EGU_2017.zip