Earthquake Risk in Africa

A community leader's guide

By

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CONTENTS

1. EARTHQUAKE DISASTER AWARENESS: UNDERSTAND THE THREAT

1.1 Introduction

Earthquakes have occurred for billions of years. Many stories along the history of man show the considerable impact they have had on human's lives and property. Earthquakes are the most terrifying and destructive among the other natural phenomena like rain or wind. For many of African countries, earthquake hazard constitutes a serious threat to human life and property, sometimes causing major economic losses and disruption. The environment concerns and an increased official and public awareness of earthquake hazards have, in the last decade, led to a rapid rise of interest in seismicity and, seismic hazard and risk evaluations in the African countries.

Because earthquakes are a natural phenomenon, their occurrence cannot be avoided, due to our limited knowledge and ability at present; however, the impact of such events on people's lives and their proprieties can be considerably reduced. The effects of all destructive earthquakes which have occurred in the past could have been significantly reduced if pre-, during and post-disaster measures were adopted and implemented. The whole community through schools could have its awareness risen and be more active in taking initiatives by better understanding of the earthquake threat in the continent and the possible effects on human lives, housing, lifelines and other systems.

This booklet is written to help you as a community leader's guide, to understand better the complex earthquake phenomenon and its impact on our lives and properties.

> Do you know?
> A moderate or major earthquake in a densely populated area could cause a considerable number of deaths and injuries and millions or billions of dollars in property losses. It also could severely impact transportation, water, and electrical and other lifeline systems.

1.2 Definition of an earthquake

An earthquake is a natural phenomenon like wind and rain. It is a sudden, rapid shaking of the earth caused by the release of energy stored in rocks. This is a brief definition which people of all ages can master.

1.3 Understanding the causes of earthquakes

a. Earthquakes and geological times

An earthquake may last only a few seconds, but the processes that cause earthquakes have operated within the Earth for millions and millions of years. The development, during the last four decades of plate tectonic theory, has led to a better understanding of earthquake phenomenon causes.

Centuries before, and until seismology became formalized, the supernatural, in one form or another, was often accepted as the cause of earthquake events. Earthquakes have occurred throughout history and all over the world. As human societies have created larger settlements, the loss and damage from earthquakes has increased.

Do you know?
There are about 3,500,000 earthquakes occurring in the world every year. There are only about 1,000,000 of them are recorded. And only about 34,000 earthquakes are felt by humans every year.
Each year, around 800 moderate earthquakes (Magnitudes 5.0 – 5.9) that cause slight damage and about 120 strong earthquakes (6.0 – 6.9) that cause serious damage. There are about 18 major earthquakes (7.0 – 7.9) that potentially destructive. Once every 10 – 20 years, there is a great earthquake (8.0 – 8.9) that can be devastating.

b. Earthquake legends

Until very recently, the cause of earthquakes was an unsolved mystery. It was the subject of fanciful folklore.

Legends are traditional narrative explanations of natural phenomena, which prevail when scientific explanation is not available. From ancient times, legends (myths) were established to explain what we did not understand.

In North Africa, old people explained earthquakes by saying that the world was perched on the horns of a bull that tossed his head when tired to change the position of the world from one horn to another. In Mozambique, it was accepted that the earth is a living creature, and it has the same kinds of problems people have. Sometimes it gets sick, with fever and chills, and we can feel its shaking. In West Africa, a giant carries the earth on his head. All the plants that grow on the earth are his hair, and people and animals are the insects that crawl through his hair. He usually sits and faces the east, but once in a while he turns to the west (the direction earthquakes come from West Africa), and then back to the east, with a jolt that is felt as an earthquake. In East Africa, A giant fish carries a stone on his back. A cow stands on the stone, balancing the Earth on one of her horns. From time to time her neck begins to ache, and she tosses the globe from one horn to the other.

But our society has modern myths about earthquakes. As in Algeria, people were saying that the El-Asnam earthquake of 10 October 1980 happened because people were eating couscous (national meal) with wine and Allah punished them. Still some people and unfortunately some of government officials believe that disasters are act of God. "All of sudden there are so many earthquakes in the world as between 1999 and 2004. These are all legends. Although we have long-range predictions, no one can make short-term predictions yet about when an earthquake will strike. Modern myths cloud our vision of what we must do to protect ourselves. Let's reject these legends or myths; it is time to look at reality and learn how to be prepared to reduce the effects of earthquakes.

c. The layers of the earth

Although our earth feels solid as we walk along its surface, it is really only partly so. The earth is subdivided into three main layers that can be visualized by taking a hard-boiled egg as a model. There is a hard outer surface, a softer middle layer, and a central core. Figure 1 shows the layers of the earth and the types of the faults.

The easiest way of describing the earth's layers is to compare the globe to hard-boiled egg. It has a crust which may be considered as the shell, a middle layer, or mantle, which is like the white, and a core that is something like the yolk. The crust and the upper portion of the mantle are often referred to together as the lithosphere, or rock sphere. Scientists differentiate the core into the inner core and the outer core. The outermost layer of the earth is broken into irregular pieces, called plates, which make the earth look as a spherical jigsaw puzzle. These plates are in very slow but constant movement. Plates movement is generally of three kinds: spreading, colliding, or sliding; but kinds of boundaries. Earthquakes release the energy stored in rocks by any one or a combination of these three kinds of movement.

Do you know?
Earthquakes result from the build-up and release of energy stored in the rocks. Students may be surprised that we speak of rocks and rock layers, because in many places the rock material of the earth's crust is covered by accumulations of sand and soil. Remind them that even beneath the sediment in river valleys, plains, and beach areas, some kind of rock is always present.

d. Crust and lithosphere

The earth's crust varies in thickness from about 65 km on the continents to only about 10 km on the ocean floors. Even at its thickest, the crust is not closely as thick in respect to the whole bulk of the earth as the shell of an egg is to the egg. This is obvious when we compare 65 km to the radius of the globe, 6,370 km. The lithosphere is the outer solid portion of earth that includes the crust and the uppermost part of the mantle. The lithosphere has an average depth of 100 km.

e. Lower mantle and core

Directly under the lithosphere is the asthenosphere, a zone of the mantle with a plastic, semi-solid consistency, which may reach to about 200 km under the surface. The mantle continues to a depth of 2,900 km. The liquid outer core, which might be compared to the outer two-thirds of an egg's yolk, reaches from 2,900 km to a depth about 5,100 km. The solid metallic inner core goes the rest of the way to the centre of the earth. Both are composed primarily of iron and nickel. The oldest rocks of the crust have been dated by radioactive decay at about 4.0 billion years old; we do not know when the lithosphere began to form, but we assume that it broke into plates at this time.

Do you know?
In the mid-1960s, many scientific observations and explanations of earthquakes occurrence came together in the theory of plate tectonics.

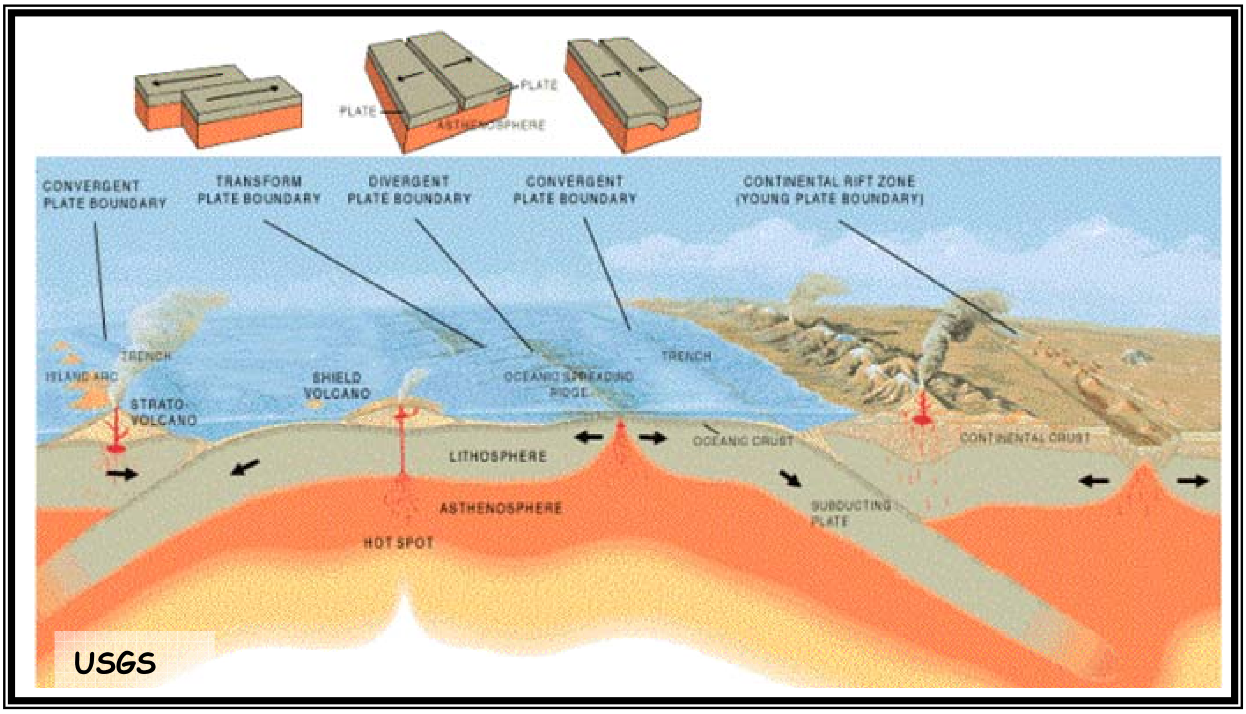
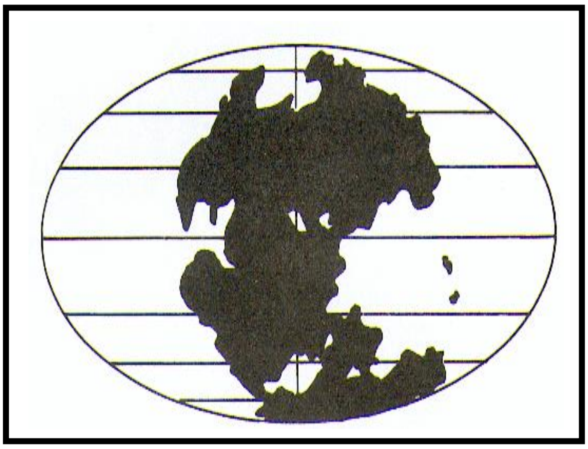


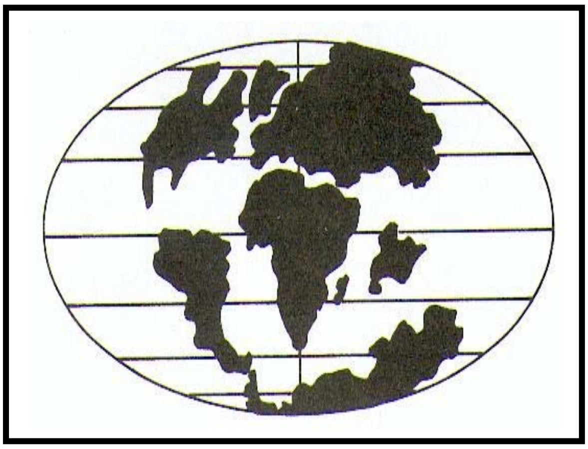
Figure 1: Illustrating the layers of the earth and types of faults

1.4 General theory of earth movements: Plate tectonics

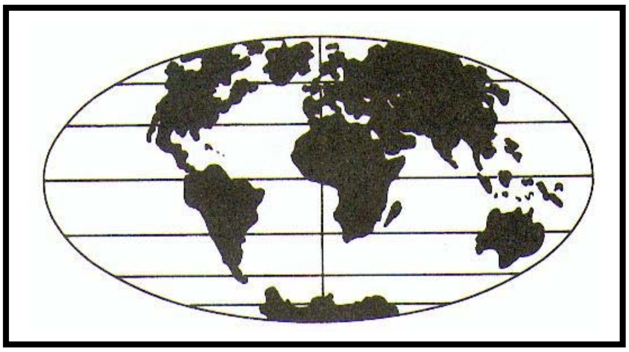
Tectonic Plate Theory gives us today a scientific explanation of the cause of earthquakes. This theory of plate tectonics, introduced in 1968, assumes that the mantle, or upper crust, of the earth is in constant movement as segments of its lithosphere, technically referred to as "plates" slowly, continuously, and individually slide over the earth's interior (Map 1). Originally, the crust of the earth was assumed to be a single mass, one supercontinent, called the Pangaea, without the existence of any ocean basins (Figure 2). About 200 million years ago, this supercontinent started to gradually broke apart and drift into plates of landmasses and oceans which we are observing today.



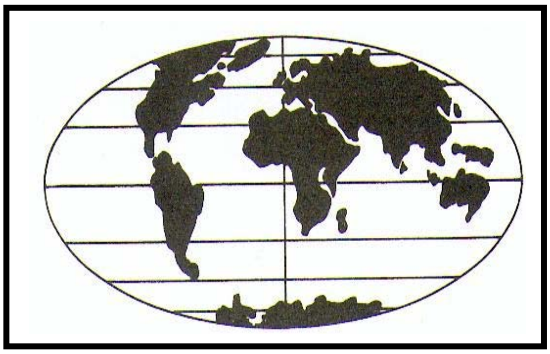
Earth's land masses about 200,000,000 years ago when there was one large land mass-Pangaea, or supercontinent



Earth's land masses about 65,000,000 years ago when the supercontinent broke up into smaller continents



Earth's land masses today where India has collided with Eurasia.



Earth's land masses about 50,000,000 years into the future

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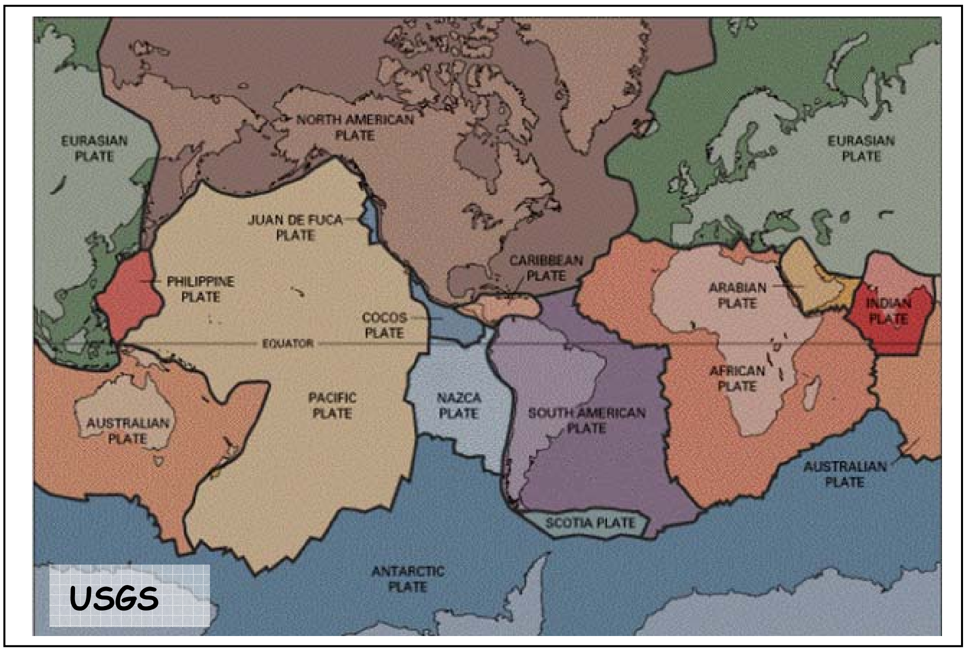
Figure 2: Illustrates the formation and break-up of the supercontinent (Pangaea)

Do you know?
The plates scrape and slip past each other in opposite direction. As the plates are in motion, friction prevents the movement, but eventually enough energy builds up that it overcomes the friction and is released along a fault line: An earthquake.
The earth's plates move at about the same rate that our fingernails grow – The fastest slipping faults move a rate of between 2mm and 8 cm per year.

a. Earthquakes at plate boundaries and within plates

Ninety five percent of all earthquakes occur in the vicinity of the borders of the tectonic plates. Where tectonic plates push into each other and/or one plate slides past the other, shallow earthquakes are common. The other five percent of earthquakes occur at faults located within plates (intraplate). They are much less frequent that those at plate boundaries.

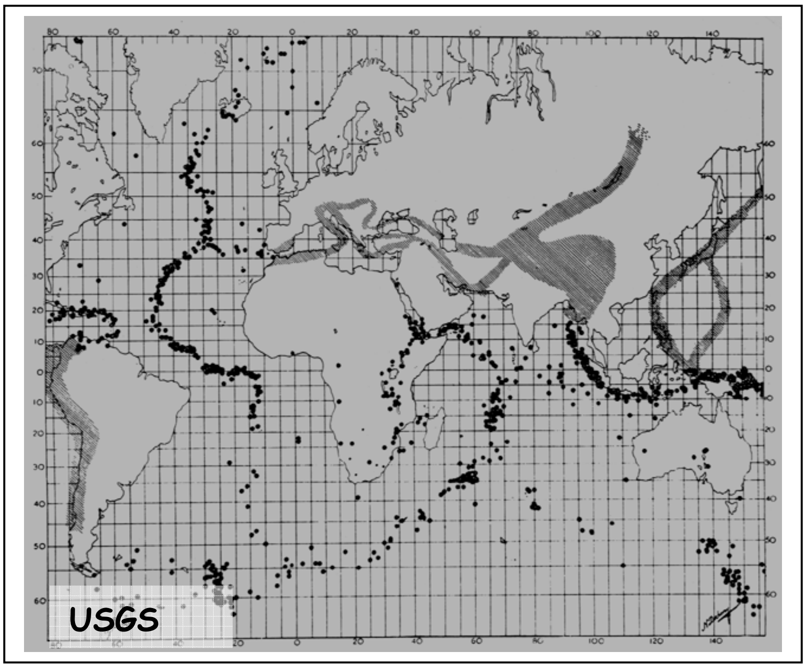
Do you know?
Before an earthquake, the tectonic forces that make the plates move cause the rock in the vicinity of a fault to deform and bend. Energy is stored in the rock as it deforms, in much the same way, as energy is stored in a rubber band as it is stretched. This energy is called elastic energy. When the forces exceed the resistance of the rock along the fault, the fault suddenly slips, just as the stretched rubber band snaps back to its original form when it is let go.



Map 1: Illustrates the various tectonic plates

1.5 Global seismicity

The present geographical distribution of earthquakes over the globe has been known since early 20th century. This result was the first to flow from the establishment of a worldwide system of seismographic stations. An illustration of the present earthquake catalogue for the main significant event is given in Map 2.



Map 2: Shows the main seismicity in the globe

1.6 Earthquakes in Africa

The seismicity of Africa is mainly concentrated in two main regions: North Africa and southeast Africa (Map 3). Since hundred million years ago, the same tectonic process marked by a relative motion alternating between left and right lateral along the border of the African and Eurasian plates. In North Africa, Algeria, Morocco and Tunisia, have a relatively moderate seismicity despite the apparent tectonic activity of that thrust zone of 2,300 km long and 400 km wide. This region, which comprises the Atlas ranges bordering the western Mediterranean Sea and the southern Iberic peninsula, has experienced, since hundred million years ago, a common tectonic evolution characterized by a relative motion between the left and right lateral along the African and Eurasian plates. Most of the seismic activity in North Africa is concentrated along the Atlas Mountains, mainly along the Mediterranean coast. Libya and Egypt have a low seismic activity. The seismic activity in Libya is concentrated in the northern part of the country particularly in the Hun graben and Al Jabal Al Akhdar regions. Whereas in Egypt, it is well observed around the Nile Valley and Nile Delta. There are four major seismic zones in Egypt which are known as Northern Red Sea-Gulf of Suez-Cairo-Alexandria trending NW-SE, Gulf of Aqaba-Levant Fault, NNE-SSW, Eastern Mediterranean-Cairo-Faiyum, NE-SW and Egypt-Mediterranean Coast, E-W.

Do you know?
That the average uplift rate was computed at 1.76 mm/year and the shortening rate as 1.48 mm/year for the whole Atlas ranges.

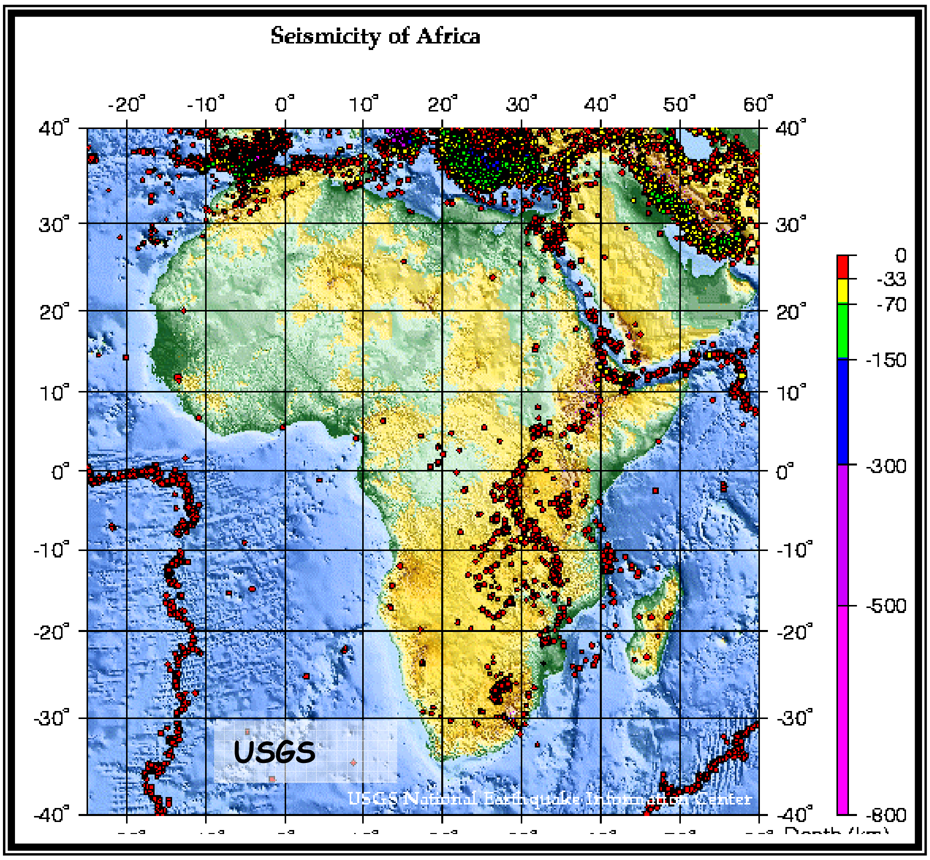
The south-eastern African region covers a region which is prone to a significant level of seismic hazard due to the presence of the East African rift system. The whole region is crossed by a tectonically active rift system within a stable African shield know as the East African Rift System (EARS). The east African Rift trends largely north south, following the great lakes: Albert, Edward, Kivi, Tanganyika and Nyasa. An active branch on the opposite side of Lake Victoria follows the Rift Valley of Kenya, through Lake Rudolf into Ethiopia. In Ethiopia, seismic activities follow narrow zones associated with structures of the Afar depression and the main Ethiopian rift. Kenya rift is almost devoid of seismic activity although micro-earthquake studies in the Kenya rift have shown that the rift floor is seismically active. Another highly active region on the Eastern branch is northern Tanzania. The area shows diffuse seismicity that starts close to Lake Victoria and stretches south-eastwards to the Indian Ocean. The Western branch is more seismically active than the Eastern branch. In the northern end, seismicity dies out abruptly in southern Sudan as the rift encounters the Aswa Shear zone. West of Lakes Edward, Kivu and Tanganyika in Zaire and Zambia, the seismicity is diffuse. The southern extension of the Western branch is well defined by a seismicity belt running through Malawi to southern Mozambique. Kariba is the most seismically active area in this part of the region. Most significant earthquakes for the African continent are listed in Table 1.

Table 1: Most important earthquakes in Africa

Date	Epicentre	Int or Mag.	Comment
600 B.C.	Thebes, Egypt	6.1	
28 B.C.	Thebes, Egypt	6.1	
262	E. Mediterranean, Libya	XII	Cyrene and cities destroyed.
320	Alexandria, Egypt	6.0	
365	E. Mediterranean, Libya	XII	Cyrene and cities destroyed.
704	Murzk (Sebha), Libya	XII	Towns and Sabha destroyed.
956 Jan 01	Alexandria, Egypt	6.0	
1183	Northern Libya, Libya	XI	20,000 killed.
1365	Algiers, Algeria	X	Several dead
1716 Feb. 03	Mitidja Atlas, Algeria	7.5	20,000 dead
1758 Jan	Constantine and Tunis		Several dead
1790, Oct. 09	Oran, Algeria	7.0	2,000 dead
1811	Libyan-Egyptian boarder	VIII	
1825, Mar. 2	Blida, Algeria	6.5	7,000 dead
1867, jan. 2	Blida, Algeria	7.5	100 dead
1891 Jan. 15	Gouraya, Algeria	6.5	38 dead

1906 Aug. 25	Central Ethiopia	6.8	
1910 Jun. 24	Aumale, Algeria	6.6	81 dead
1910 Dec. 13	Lake Tanganyika	7.1	
1912 Jul. 9	N. Uganda	6.7	
1915 May. 8	Mozambique Channel	6.8	
1915 Jul. 11	Tunis, Tunisia	6.2	
1915 Sep. 23	Coast of Eritrea	6.7	
1919 Jul. 8	W. Tanzania	6.7	
1928 Jan. 6	Mt. Kenya	7.0	
1932 Dec. 31	Coast of Natal	6.7	
1935 Apr. 19	Al-Qadahia, Libya	6.0	
1939 Jun. 22	Ghana	6.5	16 dead
1941 Dec. 27	Tunis, Tunisia	6.8	
1942 Oct. 9	Lake Nyasa	6.7	
1945 Mar. 18	Masaka, Uganda	6.0	5 dead
1954 Sep. 9	El-Asnam, Algeria	6.8	1,409 dead
1955 Sep. 12	Alexandria, Egypt	6.0	
1960	Awasa, Ethiopia	6.1	Several dead
1961 Jun. 1	Kara-Kore, Ethiopia	6.7	160 dead
1966 Mar. 20	Mt. Ruwenzori, Uganda	6.1	4 dead
1969 Mar. 31	Alexandria, Egypt	6.1	
1969	Serdo, Ethiopia	6.3	
1980 Oct. 10	El-Asnam, Algeria	7.4	3,000 dead
1989 Mar. 10	Salima, Malawi	6.1	8 dead
1989	Dobi Graben, Ethiopia	6.5	
1994 Feb. 5	Kismoro, Uganda	6.0	9 dead
1994 Aug. 18	Mascara, Algeria	6.0	171 dead
1992 Oct. 12	Cairo, Egypt	7.0	541 dead
2003, May 21	Boumerdes, Algeria	6.8	2,278 dead
2004, Feb. 24	El-Hoceima, Morocco	6.2	600 dead

Do you know?
Africa (North Africa not included) and Arabia contains active rift zones responsible for about 0.1% of the world's total seismicity.



Map 3: Shows the seismicity of Africa

Types of earthquake faults

A fault is a crack in rock or soil along which earthquake movement has taken place. There are various types of earthquake faults around the world. Displacement along these fault zones during an earthquake may result in various offsets: vertical, horizontal, or a combination of the two. Figures 3a, b, c indicate the various types of earthquake faults, simply classified by the configuration and direction of offset, or slip, as shown by the respective drawings.

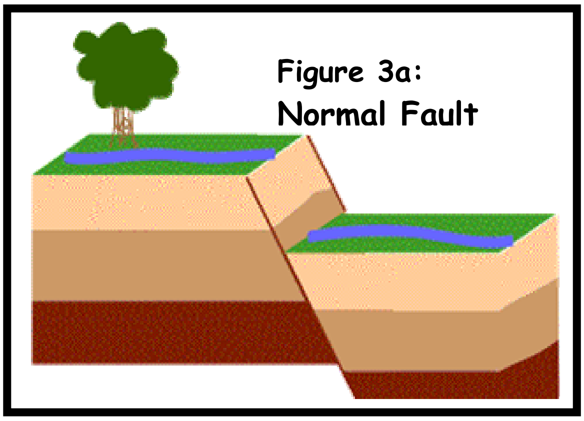
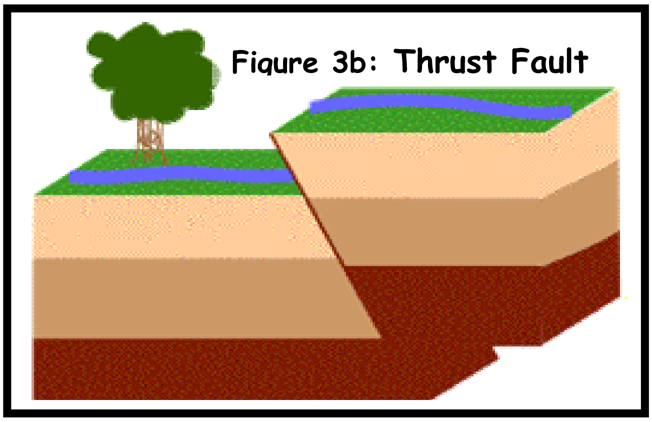
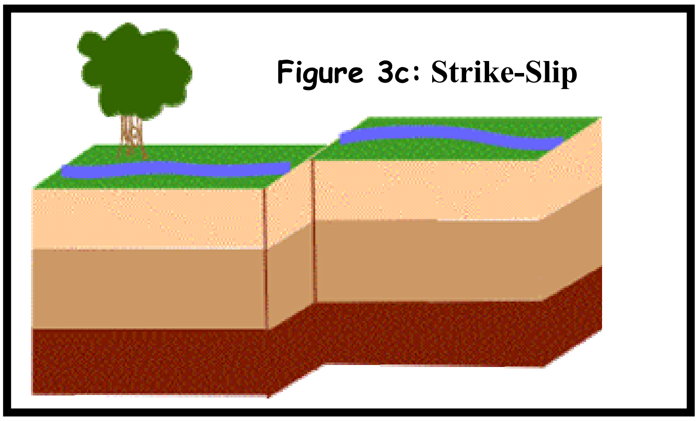


Figure 3a: Normal Fault



Fiqure 3b: Thrust Fault



Figures 3a, b, c : showing the main earthquake fault types

Do you know?
When the fault slips, the elastic energy stored in the rock is released as seismic energy in the form of seismic waves, or earthquake waves. These waves spread outward from the fault. Close to the earthquake fault, the seismic waves can be strong enough to knock people to the ground. They are weaker the farther one is from the earthquake fault. Consequently, shaking is greatest near the source of the earthquake.

Foreshocks.
Foreshocks are relatively smaller earthquakes that occur before the largest shock in a series, which is termed the mainshock. Not all mainshocks have foreshocks.

Mainshock.
The largest shock, sometimes preceded by one or more foreshocks, and almost always followed by a series of aftershocks.

Aftershocks.
Aftershocks are earthquakes that follow the mainshock. They are smaller than the mainshock and occurring within an area of radius equal to or less than half fault length of the mainshock fault. Aftershocks can continue over a period of weeks, months, or years. In general, the larger the mainshock, the larger and more numerous the aftershocks, and the longer they will continue.

Seismicity.
The geographic and historical distribution of earthquakes.

Duration of shaking
Depending on the size (magnitude) of the earthquake, the shaking may last from 10 seconds to 90 seconds.

Do you know?
The longer buildings shake the greater the damage may be.

Focus (Hypocenter)

The focus is the place where an earthquake starts (Figure 4). The rupture begins at a point called focus or hypocenter, usually kilometres below the earth's surface. Straight up above it is the epicentre. It may be classified as deep, medium, or shallow.

Do you know?
Earthquakes with focal depths from the surface to about 70 kilometres are classified as shallow. Earthquakes with focal depths from 70 to 300 kilometres are classified as intermediate. The focus of deep earthquakes may reach depths of more than 700 kilometres

Do you know?
Following an earthquake the energy dissipates as it travels, so a shallower earthquake will cause more damage on the surface.

Epicentre

The epicentre is the point on the Earth's surface directly above the focus. The location of an earthquake is commonly described by the geographic position of its epicentre and by its focal depth (Figure 4).

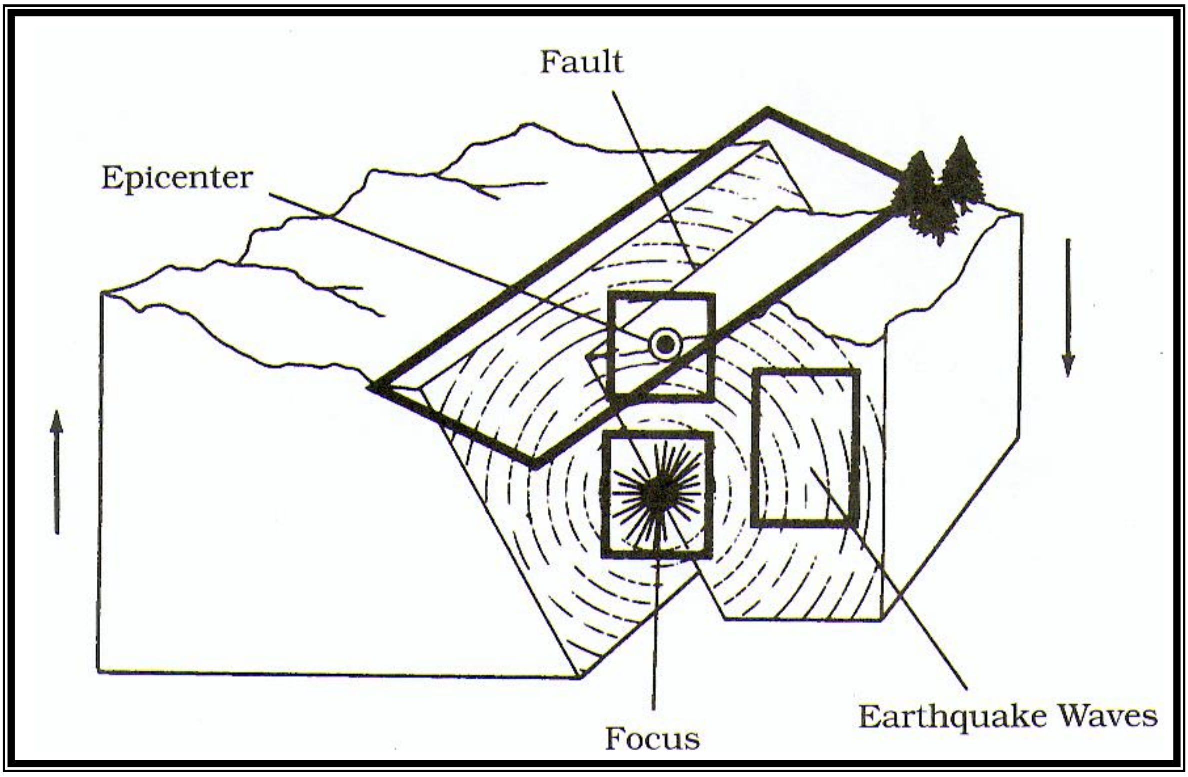


Figure 4: Showing the location of epicentre

Type of soil
Shaking is increased in soft, thick, wet soils. In certain soils the ground surface may settle or slide.

Plate tectonics: A theory, accepted today, which explain scientifically the cause of earthquakes.

Plates
Large, nearly rigid, but still mobile segments of blocks involved in plate tectonics, that include both crust and some part of the upper mantle.

Soil liquefaction
Soil liquefaction is likely to occur when a loose sand is in saturated and undrained conditions and shaken by a strong earthquake. It is a process in which loose sand loses the properties of solid material and instead behaves like a liquid. Liquefaction occurred during the 2003 Boumerdes (Algeria) earthquake and is shown in photo 2 which illustrates a sand volcano and the hole due to the water pressure.

Photo 2: Shows liquefaction phenomenon during the 2003 Boumerdes (Algeria) earthquake.

Do you know?
Sand blows or "volcanoes", is an indication of soil liquefaction. Soil liquefaction was reported in Orléansville (Algeria) 1954, Agadir (Morocco) 1960, El Asnam (Algeria) 1980 and Boumerdes (Algeria) 2003 earthquakes.

Tsunamis

Tsunamis are the water waves produced impulsively by earthquakes through tectonic displacement, submarine slides or landslides and Rockfall into deep water. Tsunamis merit great attention because of the loss of life, damage to the man-made structures and the alteration of the landscape that they may cause when they hit the land. Many earthquakes had their epicentres offshore in the Mediterranean Sea or the ocean, but because of their small magnitudes they do not produce any noticeable water waves.

Do you know?
Tsunami is a Japanese word and is pronounced as "soo-nah-me" which means "wave in the harbour" and misnamed as "tidal waves".

Do you know?
No evidence was found of tsunamis causing any concern in the Africa. The speed of a tsunami (seismic sea water) may reach 800Km/hour in deep ocean. Tsunami travelling in shallow water can reach coastlines with waves as high as 30 meters, causing significant damage. However, several sailors described a sea wave during the main shock of Chenoua-Tipaza 1989 earthquake and in the port of Tipaza, the sea was reported to have retreated by more than one meter, but no permanent changes in sea level were reported along the coast of the affected zone. Also, during the Boumerdes 2003 earthquake, it was reported that the sea retreated by more than two hundred meters and caused damage in southern Spain.

Earthquake waves

The release of energy generates earthquake waves. Earthquake waves are of two kinds, body waves and surface waves.

Body waves: Body waves that travel through the Earth are either P- (for Primary) or S – (for Secondary) waves. P- waves travel faster than S- waves. The two types together are called body waves because they travel through the body of the earth. Body waves are important because they allow us to locate the epicentres of the earthquakes. Figures 5a and 5b show the P-waves and the S-Waves forms respectively.

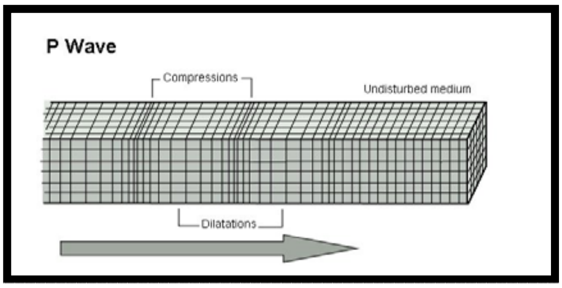


Figure 5a: Shows the P-wave form

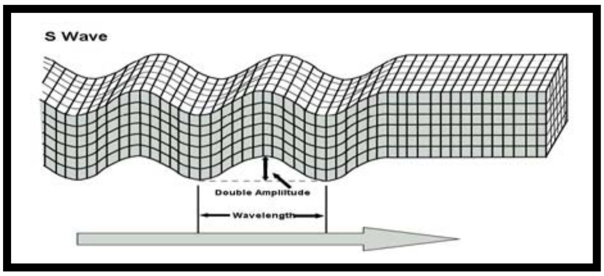


Figure 5b: Shows the S-wave form

Surface waves: Earthquake waves that travel at or near the surface of the Earth are called surface waves. They are primarily responsible for the shaking of the ground and damage to buildings. There are two types of surface waves: Love and Raleigh waves. Figures 6a and 6b show the Love and Raleigh waves respectively.

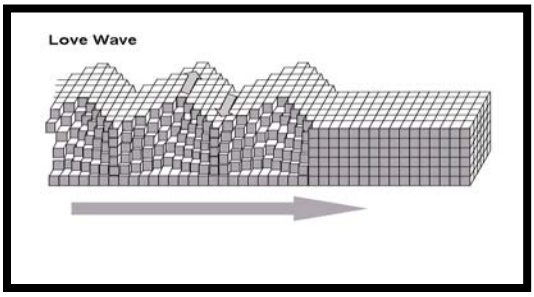


Figure 6a: Shows the Love wave form

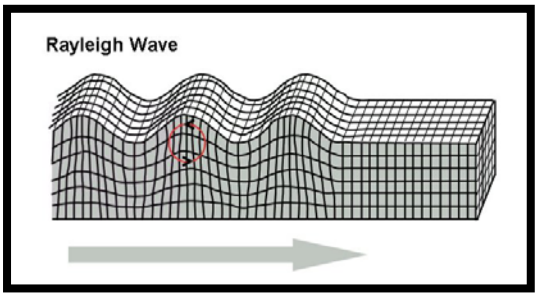


Figure 6b: Shows the Raleigh wave form

Do you know?
P-waves travel about 4.8 to 8.0 km/sec, while S-waves travel about 3.2 to 4.8 km/sec.
Surface waves: Surface waves are slower still and can cause even more damage due to their greater duration.

Measuring earthquakes

Only two methods exist today to measure the earthquakes. The first one is used for measuring the size or "magnitude" of an earthquake, and the second for measuring the effect, or "intensity" of an earthquake. It is interesting to note that the two methods measure different characteristics of an earthquake. **Magnitude** is a measure of the amplitude of the earthquake waves; it does not depend on space or time. The magnitude is proportional to the energy released. The magnitude does not give an idea of the physical effects (life loss, damage, etc.) of an earthquake on buildings. **Intensity** is a measure of the effects that the earthquake had on natural and human-made structures, which depends on several parameters as the soil, the state of the construction, the topography, etc.

Do you Know?
The larger the magnitude, the further the energy will travel and the larger the area that will be affected. Each earthquake has a single magnitude and a range of intensities.

Magnitude scale

First used in 1935, the Richter magnitude scale was named after its inventor, Professor Charles Richter of the Californian Institute of Technology in Pasadena (USA). The Richter scale reading is said to be an abstract number because it has no direct physical meaning, but rather "is intended to be a rating of a given earthquake independent of its place of observation". Because of the abstract nature of the Richter scale, earthquakes of similar Richter magnitudes may differ greatly from each other in the physical effects (Intensity) produced on the built environment because of the immense variety of local geological conditions. List 1 shows the severity of the earthquakes.

Do you know?
The volume of the small 63 mm sphere is assumed to be the equivalent of Richter magnitude 1. A magnitude 2 earthquake would be a sphere 38 mm in diameter; a magnitude 3 about 127 mm in diameter; the 6.4 magnitude would be a sphere of 30480 mm in diameter, and the 8.3 magnitude a sphere of 286464 mm. A correlation between the Richter scale and the amount of total energy released has been derived, with one-unit increase in magnitude approximating a 30 fold in energy. Thus, a three-unit increase in magnitude, from 5 to 8 for example, renders approximately a 30 x 30x 30, or a 27,000-fold increase in energy released. An example is given in Figure 7.
Although it has an open-ended scale with no upper limit, the largest known earthquakes have been those approaching a Richter 9.0.

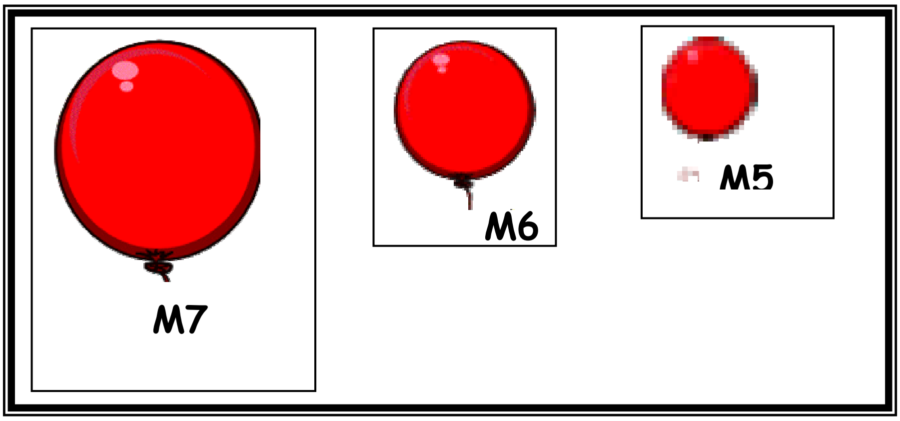


Figure 7: Shows an example of sizes from M5 to M7

List 1 shows the severity of the earthquakes.

Magnitude	Earthquake Impact	Estimation Number per year Worldwide
1.0 - 3.0	Generally not felt but recorded.	3,000,000
3.1 - 4.0	Often felt, but only minor damage.	50,000
4.1 - 6.0	Slight damage to buildings.	15,000
6.1 - 6.9	Can destructive in places where people live.	120
7.0 - 7.9	Major earthquake. Causes serious damage.	20
8.0 or greater	Great earthquake. Total destruction to nearby communities.	1

Intensity scale

The intensity scale measures local damage to structures and facilities. In order to obtain a more complete picture of the earthquake's size, and physical impact on buildings and facilities in the stricken area, both scales must be used.

Although a number of scales have been developed to describe the effects of ground shaking on the performance of buildings at a given location, the modified Mercalli intensity scale (MMI) is the most widely used. In contrast with the Richter magnitude scale, which uses Arabic numerals, the MMI utilizes Roman numerals, ranging from MMI-I to MMI-XII. This also to avoid confusion in distinguishing between the two scales: an Arabic numeral means we are dealing with the Richter magnitude scale, and a Roman numeral indicates the use of the Intensity scale as a measure of the relative amount of damage incurred. A shortened description of each intensity, from I to XII, used in the Modified Mercalli intensity scale (MMI) is given in Table 2.

Do you know?

The difference between the two scales is that while the Richter scale is open-ended with no theoretical upper limit, the intensity scale is a closed-ended measure, with the maximum intensity of XII used to indicate "damage nearly total, the ultimate catastrophe". At the other end of the scale, an area of damage that has been assigned intensity I is described as "earthquake shaking not felt. But people may observe marginal effects of large distance earthquakes without identifying these effects as earthquake caused. Among them: trees, structures, liquids, bodies of water sway slowly, or doors swing slowly."

Table 2: Illustrates the Intensity Value and shortened description on Modified Mercalli Scale (MMI)

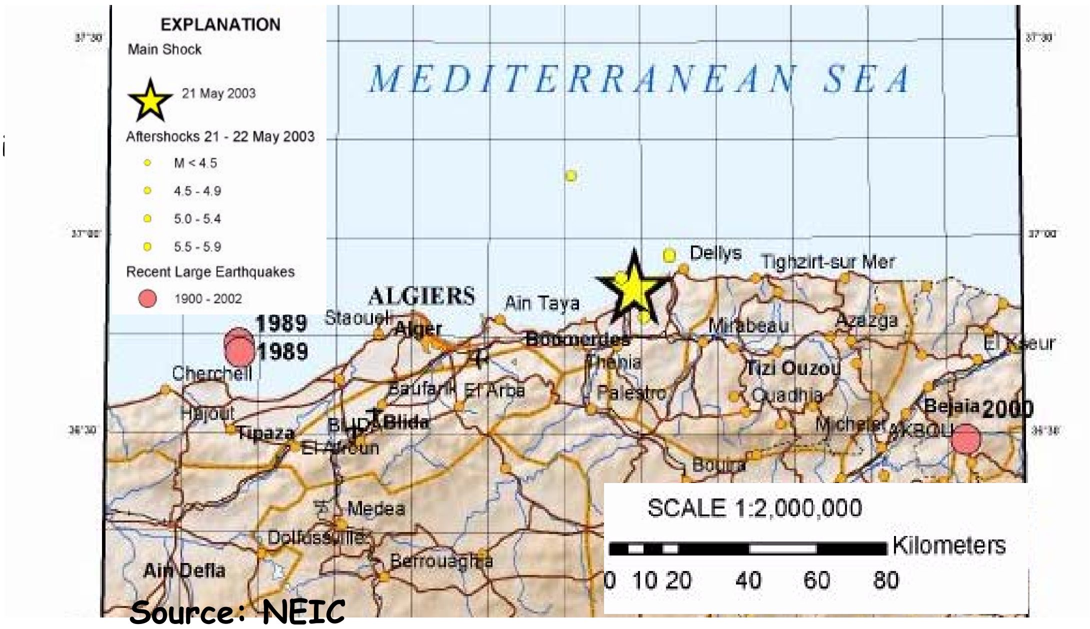
Intensity	Description
I	Only instruments detect it.
II	May be felt only by people lying down.
III	People on upper floors of buildings will feel it, but may not know it is an earthquake.
IV	People indoors will probably feel it, but those outside may not.
V	Nearly everyone feels it and wakes up if they are sleeping.
VI	Everyone feels it. It is hard to walk.
VII	It is hard to stand.
VIII	People will not be able to drive cars. Poorly built buildings may collapse; chimneys may fall.
IX	Most foundations are damaged. The ground cracks.
X	Most buildings are destroyed. Water is thrown out of rivers and lakes.
XI	Rails are bent. Bridges and underground pipelines are put out of service.
XII	Most things are levelled. Large objects may be thrown into the air.

Do you know?
We have successively used the intensity scales of Rossi-Forel (1874, 10 degrees, damages starting from degree VIII), of Mercalli (1888, 12 degrees, damage starting from degree VII), of Mercalli modified by Cancani (1917, 12 degrees, damage from VI). The initial Mercalli scale is included in the scale MSK (1964), which specifies the damage for each type of construction. From 1998, a new scale, with 12 degrees, came to practice, the European Macrosesmic Scale (EMS), which is used actually in Europe.

Isoseismal map
When a damaging earthquake occurs, trained engineers are sent into the field to assess damage at various buildings in various locations in the zone affected. They attribute intensity levels according to their evaluation of the damage that has been observed in accordance with the descriptions of damage states listed in the Modified Mercalli Scale in Table 2. Based on these field observations of damage after a destructive earthquake, an isoseismal map is prepared to indicate intensity degrees of damage attributed to the zone affected. The isoseismal map is constructed by drawing a line that connects points of equal intensity of damage observed in buildings and facilities located in the area affected.

Example of Earthquake Disaster in an African Country: Boumerdes (Algeria) Earthquake of May 21st, 2003

On Wednesday 21 May 2003, at 19h 44m 2s (18h 44m 2s UTC), a destructive earthquake occurred in the Boumerdes-Algiers region affecting a rather densely populated and industrialized region of about 3,500,000 people. It is one of the strongest recorded seismic events in North Africa. The depth of the focus was about 10 km. The magnitude of the earthquake was calculated at M = 6.8. The main shock, which lasted about 40 sec, and the two largest aftershocks (both reached M 5.8 on 27 and 29 May 2003) caused the loss of 2,278 lives, injuring more than 11,450, making 1,240 missing and 182,000 homeless; they destroyed or seriously damaged at least 200,000 housing units and about 6,000 public buildings in five wilayas (provinces). The extent of the socio-economic impacts of these events confirmed that Algerian buildings are highly vulnerable to the recurrence of destructive earthquakes. Estimates put the economic cost of the earthquake as high as US$ 5 billion. Maximum acceleration was recorded at 0.58g at about 20 km and 0.34g at about 60 km from the epicentre. Maximum intensity reached is re-evaluated at Io = X (MSK) scale at Zemmouri, Boumerdes, Bordj-El-Bahri and Dellys. The Wilaya of Boumerdes, including the coastal city of Boumerdes and the eastern part of the capital city of Algiers were most affected by the earthquake. Damage was observed in most cities and villages along the coast in from Algiers to Dellys, a distance of about 150 km long and 40 km wide. The epicentre was located at 36.89N-3.78E, about 10km offshore from the locality of Zemmouri in the Wilaya of Boumerdes, which is about 50 km east of the capital city of Algiers (See Map 4). This earthquake had large socio-economic and psychological impacts on the region. Widespread liquefaction, rock falls, landslides, ground cracking and lateral spreading were reported in the region of Zemmouri. The earthquake triggered a tsunami, which was observed on Southern coast of the Balearic islands (Spain). It was reported a retreat of seawaters in coastal zones of Algiers and Boumerdes of about 200 meters. Fishermen in the port of Zemmouri-El-Bahri in the epicentral region reported that the water depth in the port dropped to less than one meter and several fishing boats ended up on the bottom of the seabed before the water came back to its original position.



Map 4: Showing the epicentre location of the Boumerdes earthquake of May 21st, 2003

Inhabitants report that, in the most affected city of Boumerdes, the civil protection teams started joining the zone affected for search and rescue operations in about 6 hours after the earthquake. However, initial efforts to search for victims and to rescue them out of the damaged and collapsed structures were first done by the local population. Several countries have sent rescue and first aid teams immediately after the earthquake and were able to join in the efforts of finding survivals within 24 after the earthquake. The Algerian Red Crescent supported by several international humanitarian assistance organizations started the process of providing food, water, sanitation and health care to the victims in about 12 hours after the earthquake.

Civil protection Algerian Red Crescent, the Armed forces and foreign NGO's started the process of establishing official "tent-camps" about a week after the earthquake. The victims refused at the beginning to move into the government supplied tents. Families displaced from damaged multi-story buildings preferred to stay in camps but in close proximity to the buildings in fear of looters. They also preferred to remain within their neighbourhoods where they could support each other. However, families have slowly moved to the campsites where conditions are better than the makeshift camps. Schools and educational institutions were closed in the province of Boumerdes and Eastern part of Algiers, and in the western towns and villages of the province of Tizi Ouzou. The University of Science and Technology of Algiers, the largest university of the country, located in the district of Bab-Ezzouar in the eastern part of Algiers was also temporarily closed for security, damage assessment and repairs.

2. EARTHQUAKE HAZARD, VULNERABILITY AND RISK

Definition of key terms

As the notions of earthquake hazard, vulnerability and capacity constitute the basis for an efficient strategy of earthquake risk reduction and the operational base for a culture of prevention. Communication between people of different culture and background constitutes today a crucial problem. The same word may have several meaning depending on the discipline and cultures. Thus, it is of interest to define the main terms we are using in this booklet.

Earthquake Hazard

A destructive physical event, as earthquakes, which may cause the loss of life or injury, property damage, social and economical disruption or environmental degradation. The earthquake hazard is taken as the "punch of nature" or "external forces". Each earthquake hazard is characterized by its location, intensity and probability of occurrence.

Earthquake Vulnerability

A set of conditions and practice resulting from physical, social, economical and environmental factors, which enhance the susceptibility of a community to the effects of earthquake hazards.

Do you know?
Reducing the vulnerability of the African people to "natural disasters" is mentioned as a requirement to achieve the poverty reduction goals of the Millennium Declaration.

Earthquake Risk

Expected losses (of lives, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between the hazard and the vulnerability conditions. Conventionally risk is expressed by the following convolution:

$$\text{EARTHQUAKE RISK} = \frac{\text{EARTHQUAKE HAZARD * EARTHQUAKE VULNERABILITY}}{\text{DISASTER MANAGEMENT CAPACITY}}$$

Element at Risk
The element which vulnerability is considered, it may be population, buildings, environment, etc. Population could also be divided in several elements at risk: children, elderly, sick, women, handicapped, etc.

Value of an Element at Risk
An earthquake which occurs in the desert, or in remote area where few people live will cause much less damage than if the same size earthquake strikes an urban site. Thus, human is directly involved in the value of the element exposed to risk. Risks are interconnected to the density of population, and the concentration of economic and natural resources.

Earthquake Risk Assessment
A procedure to determine the nature and scope of the earthquake risk (consequences) by analysing potential earthquake hazards and evaluating existing conditions of vulnerability/capacity that could cause a potential harm to people, property, livelihoods and the environment on which they depend. Earthquake Risk assessment should be integrated in the overall decision-making process.

Do you know?
Around the globe 80 earthquakes produced economic losses of US$ 9 billion and insured losses of about US$ 900 million. (Source; Munich Re, 2001)

Earthquake Risk reduction
Earthquake Risk reduction concerns all the measures taken before the next earthquake, which lead to reduce the consequences of such an event. An example for a tool to reduce the physical impacts on buildings is the seismic building code.

Do you know?
The philosophy of the seismic codes is to:
·1. Resist minor earthquakes without damage,
·2.Resist moderate earthquake without structural damage but accept non-structural damage,
***3. Not accept complete collapse, but structural and non-structural damages are accepted.**

Disaster Management Capacity
The actions in which people and organizations use existing resources to accomplish various favourable ends during abnormal, unusual, and adverse conditions of a disaster event.

Resilience / resilient
The capacity of a system, community or society to defend against or to change in order that it may remain with an acceptable level in functioning and structure. This is

determined by the level to which the social system is able of organizing itself, and the capacity to increase its competence for learning and adaptation, including the capacity to recover from a disaster.

Disaster
A severe disruption of the functioning of a community or a society causing important human, property, economic or environmental losses which exceed the ability of the affected community/society to deal with using its own resources.

> **Do you know?**
> **There are no such things as natural disasters, but there are natural hazards.**

Earthquake Disaster Management
A comprehensive strategy based on a set of activities to reduce the risk by:

1. Reduction of the earthquake vulnerability of the elements at risk
2. Ensuring that adequate measures are implemented before the next earthquake strikes
3. Responding as efficiently and effectively as possible to earthquake disasters when they occur
4. Assuring a sustainable development of the region stricken.

Earthquake Disaster Reduction
The systematic development and implementation of procedures, strategies and practices to reduce earthquake vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) negative impact of earthquake hazards, within the wide perspective of sustainable development. Earthquake risk reduction measures are most successful when they involve the direct involvement of the people most likely to be exposed to earthquake hazards, in the planning, decision-making, and operational actions at all levels of responsibility.

> Do you know?
> Community awareness is a primary and fundamental tool for risk reduction.

Earthquake Prevention
Actions to reducing the negative impact of earthquake hazards. Prevention measures are permanent and for long term.

> "Much has been learnt from the creative disaster prevention efforts of poor communities in developing countries. Prevention policy is too important to be left to governments and international agencies alone. To succeed, it must also engage civil society, the private sector and the media" Kofi Annan, IDNDR, Geneva, July 1999.

Earthquake Mitigation
Structural and non-structural measures undertaken to limit the adverse impact of earthquake hazards. Mitigation measures can be:

* **Engineering and constructions measures** (Strengthening structures, control structures, etc.)
* **Physical planning measures** (Land use planning)
* **Economic measures** (legislation, tax, insurance, etc.)
* **Management and institutional measures**(Building capacity, expertise, education, training, etc.)
* **Social measures** (Awareness, public information and involvement, etc.)

Earthquake Preparedness
Activities and measures taken in advance to ensure effective response to the effects of earthquake disasters, together with the issuance of timely and effective early warnings and the temporary removal of people from a threatened site. Construct likely scenarios regarding to earthquake hazard and vulnerability and to evaluate the earthquake risk and establish planned arrangements to deal with the given disaster.

Response
Disaster response or risk management is the implementation of planning or arrangements put in place in the preparedness phase. Ensure survival of a maximum number of people affected, restore essential services as quickly as possible.

First responder Capacity
The preparation that community have in search and rescue, first aid and fire fighting, and their organization and communication skills are all important.

Recovery or rehabilitation
Rehabilitation or reconstruction is a set of activities of getting the population to normal life.

Level of Risk Accepted
It is utopian to think that risk can be totally eliminated. Risk will be always here and we should learn to live with it. Government and civil society, according generally to given existing social, economic, political, cultural and technical conditions, decide about the level of acceptable risk for the country.

Earthquake Prediction
Although we are still not able to know precisely when the next earthquake will occur, exactly where it will strike, or how severe it will be, we do identify from past experience which geographical areas are most vulnerable to certain types of earthquake hazards. The knowledge helps to better prepare for and respond to future disasters.

Early warning

To provide timely and effective information, through recognized institutions, that let individuals at risk of a disaster, to take action to avoid or reduce their risk and prepare for effective response. The vital goal of hazard forecasting and early warning systems is to protect lives and reduce property damage.

An effective early warning system is based on three fundamentals:

- Political responsibility to promote early warning strategies,
- Participation and knowledge of the public,
- Support at the international and regional levels;

Completed by the following three elements:

- Technical identification and monitoring of hazards,
- Multidisciplinary, multi-agency and inter-sectoral communications,
- Institutional services to react to warnings; and conclude with.

Earthquake Hazard Assessment

The purpose of an earthquake hazard assessment is to estimate the probability of occurrence of an earthquake, in a given time period, as well as in intensity and area of impact. For example, the assessment of an earthquake hazard is imperative in the design and setting of engineering structures and in zoning for land use planning. Earthquake hazard has well-established techniques available for their assessment.

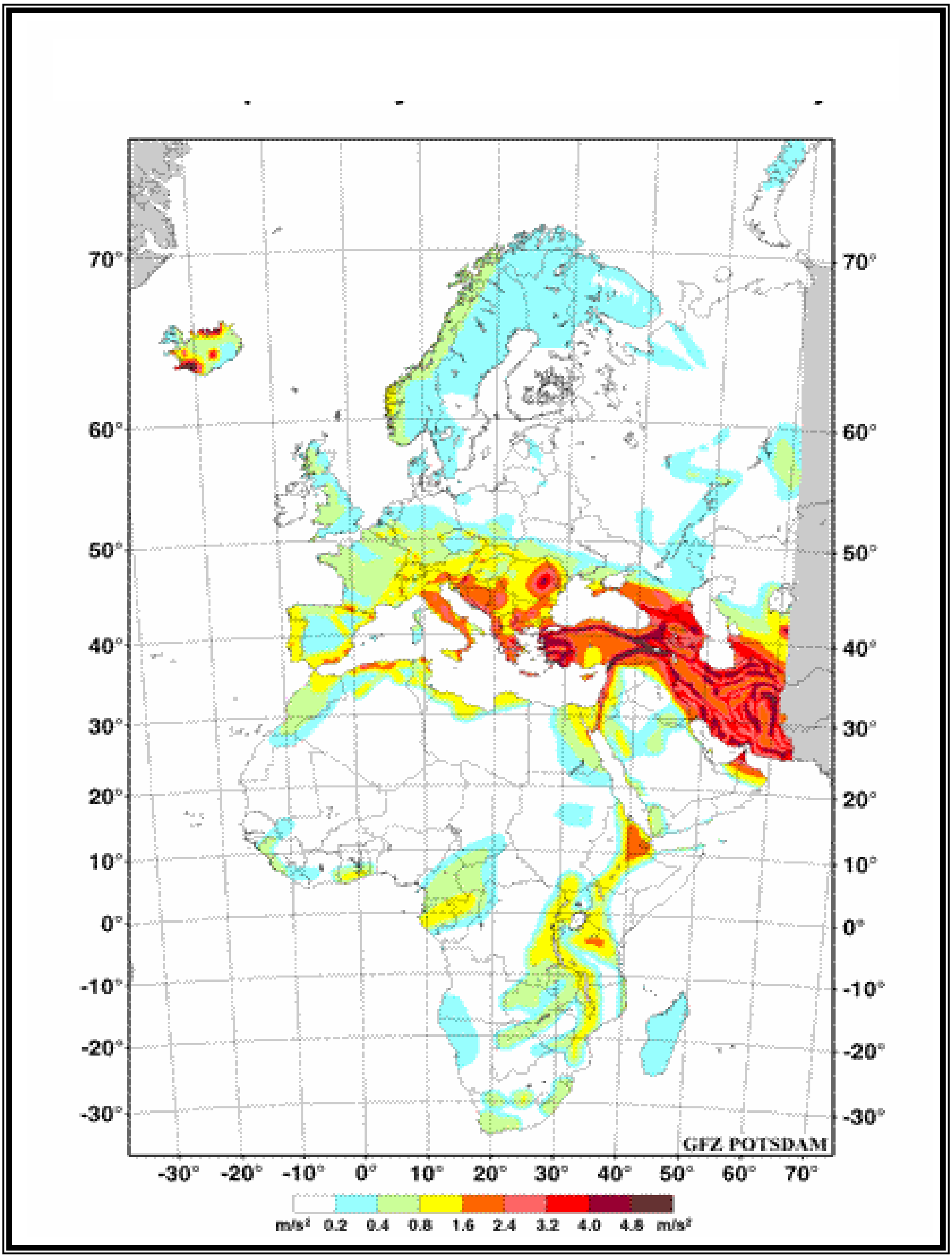
Do you know?

The best way today to assess earthquake hazard is to use the statistical approach of which objective is to evaluate that a particular level of ground motion at a site is reached or exceeded during a specified time interval.

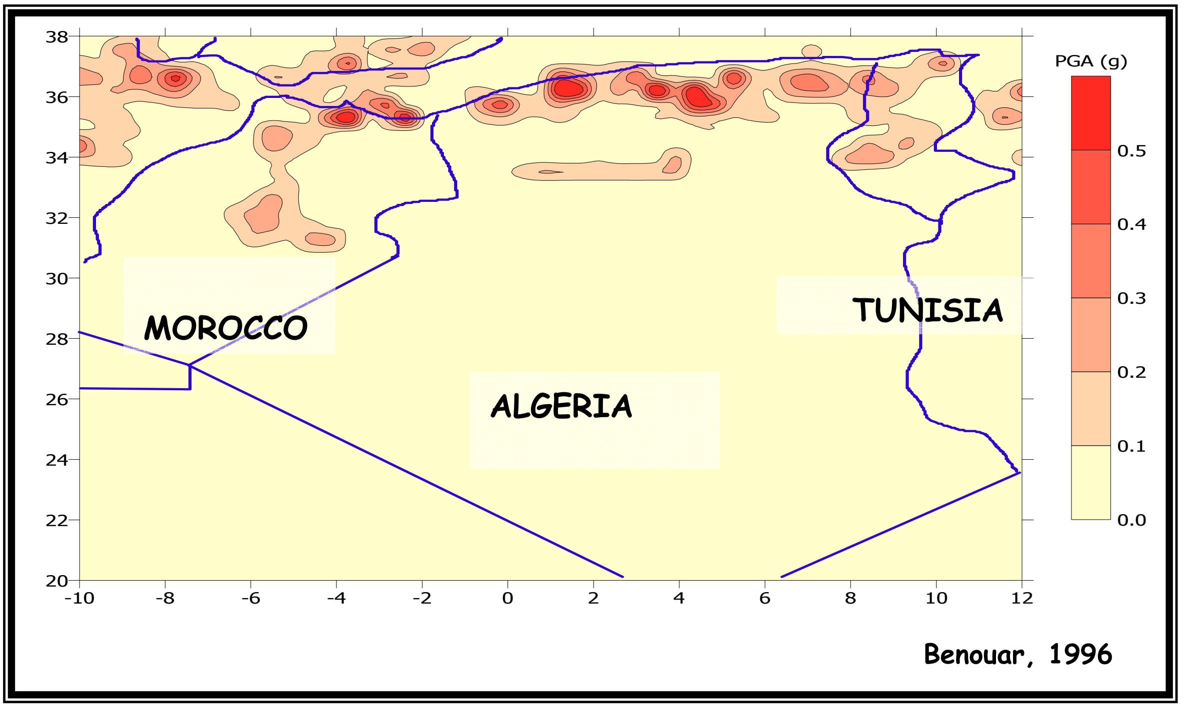
Earthquake Hazard Mapping

An essential aspect of hazard assessment is the presentation of the findings and the understanding of the added value by policy makers. Maps can be prepared manually. Mapping lies in the easy understanding and use of the information produced. The results of earthquake hazard assessment could be presented in a map of the region, the country or the continent.

The Global Seismic Hazard Assessment Programme (GSHAP) has produced earthquake hazard map for whole Africa (Map 5) and Benouar (1996) has produced earthquake hazard map for the North African countries (Algeria, Morocco, Tunisia) shown in Map 6.



Map 5 : Illustrating the earthquake hazard in Africa and Europe



Map 6: Showing earthquake hazard in the Maghreb countries

Earthquake Vulnerability and capacity Evaluation

Earthquake vulnerability and capacity estimations are a necessary complement to earthquake hazard assessment and thus to earthquake risk evaluation. At the conclusion of the analysis and the examination of special concerns at each element at risk, the analyst should collect the findings and compile a list of deficiencies (vulnerabilities) for each exposed element (population, buildings, public works, lifelines, economy, social, etc.).

Earthquake Vulnerability Mapping

The findings of analysis of weakness (vulnerability) in all elements at risk are to be mapped; this allows giving an overview of the various vulnerabilities existing within the community. Mapping should be done to represent the physical, social, economic and environmental aspects of vulnerability.

The analysis of the damages experienced in past disasters constitutes a major source of information for vulnerability/capacity identification.

Earthquake Risk Estimation

Earthquake risk estimation is the combination of earthquake hazard, vulnerability and the value of the element at risk; it allows assigning a quantifiable value to the consequences. Earthquake risk estimation is based on detailed earthquake hazard and vulnerability assessments, integrating the scientific geological information with the information on the built environment (building stock, infrastructure, critical facilities and lifelines), the population and the natural environment. Several models exist in the literature to estimate the earthquake risk (HAZUS, RADIUS, etc.).

The Earthquake Risk Assessment Tools for Diagnosis of Urban Areas against Seismic Disasters (RADIUS) provides a good example of comprehensive hazard-specific tools that contribute to define urban risk scenarios. The IDNDR secretariat launched the RADIUS initiative in 1996. It aimed to promote worldwide activities for reduction of earthquake urban risk. In Africa, the city of Addis Ababa (Ethiopia) participated to the pilot project, and thus an earthquake damage scenario has been developed. This model allows:

- To develop earthquake damage scenario and actions plans for a city,
- To produce practical tools for estimation and management of urban earthquake risk,
- To raise public awareness of earthquake risk among members of society,
- To promote information exchange for earthquake risk mitigation at city level.

Earthquake Risk Mapping

The findings of the assessment of the earthquake risk in a region/country are reported on a map. This map represents a scenario about the most probable consequences of an earthquake of a given intensity in a given region, in terms of casualties, damage to buildings, facilities, services, economic losses, etc. The earthquake risk map is of great importance for the community of relief and response as the civil protection, the civil defence, the NGO's, etc. It constitutes a fundamental tool to guide officials and the community to build awareness of the earthquake risk in their region or locality, and thus to invite to participation.

The good news is that while we can do nothing about the earthquake hazard, there is a lot we can do about the earthquake risk (consequences). Earthquake risks can be considerably reduced by human action.

3. ACTIONS BEFORE EARTHQUAKE

When it shakes, it is too late to think you have to be prepared well before. You will not have time to think where you will be safe. You need to think about it ahead of time so that you can react appropriately and automatically, and immediately.
As individuals and community can take significant actions to reduce the loss of life, property damage, and long-term economic negative impact in future earthquakes. Many actions can be taken now, without great expenditures that will make the community safer tomorrow.

Do you know?
Taking time to plan and prepare for a sound earthquake disaster risk reduction and management is the only way to minimize the negative effects that earthquakes can have on the community.

3.1 WHAT TO DO BEFORE AN EARTHQUAKE

- Make sure you have a fire extinguisher, first aid kit, a battery-powered radio, a flashlight, and extra batteries at home.
- Learn first aid.
- Learn how to turn off the gas, water, and electricity.
- Make up a plan of where to meet your family after an earthquake.
- Don't leave heavy objects on shelves (they'll fall during a quake).
- Anchor heavy furniture, cupboards, and appliances to the walls or floor.
- Learn the earthquake plan at your community, school or workplace.
- Inspect and eventually retrofit your house or building.

Do you know?

That earthquake does not kill but buildings do.

3.2 ACTIONS TO BE TAKEN FOR BUILDINGS IN YOUR COMMUNITY

There are some simple dos and don'ts

DO:

1. Have the buildings professionally designed by an architect and an earthquake engineer, so that the earthquake loads are distributed among the load-bearing

elements. A building with a large open ground floor space without supporting columns to carry the weight on top, support the roof and resist the lateral loads may be not safe.

2. Have your house built by a professional contactor.

3. Check that your building was designed and built according to seismic building codes.

4. Know your soil type at the building site, because the building has to be designed in consideration of the soil conditions. What is important is the top 30m of soil.

5. Use the correct quantity and quality of construction material specified in the engineering design. Each building design specifies the correct quantity and quality of materials required.

6. Make sure that construction is carried out by trained and supervised workers.

7. Make sure that non-structural elements like pipes are flexible and can move with shaking, and that false ceilings, lighting, water heaters, heater ducts, air conditioners and signs are fastened with earthquake in mind.

DON'T:

1. Alter the building design by removing load-bearing elements. This will make the building unsafe.

2. Build floors illegally.

3. Substitute materials that were not specified in the design. Don't use too much or too little steel, or the wrong kind. Don't mix sand or dirt into concrete. The concrete will not be reliable.

4. Use the building for something very different than it was designed for. For example, buildings that will be used for storage, libraries, warehouses, heavy machinery, classrooms and gyms must all be designed to carry much more weight than a normal home or office.

3.3 INSPECTIONS AND RETROFITTING OF EXISTING BUILDINGS

If you want to be sure about the safety of your house or building, you must have it inspected by a qualified earthquake engineer. If your house or building was not built according to seismic building code, then you should find out whether it can resist the next earthquake or to be reinforced.

Some of the questions an earthquake engineer will ask are:

- Is there a strong and deep foundation, well designed and built?

- Are columns and beams designed to support the weight of the building and the earthquake loads?

- Is there adequate bracing to resist the lateral loads generated by earthquakes?
- Is there an unsafe ground floor? For example, large spaces without proper support system (i.e. columns), large glass windows, high ceilings?
- Are all the columns where they should be? Have any columns been removed?
- Has adequate and quality building material been used?
- Have the steel frames, walls, floors and ceilings been linked to one another correctly?
- Are there deep cracks on walls in the building?
- How about the chimneys? Have they been reinforced and supported from below?

Do you know?

That minimum retrofit programs can save lives by adding columns and reinforcement to buildings that will greatly increase the ability of the buildings to protect the lives inside, even though it won't necessarily save the building. The reinforcement may not save your building, but it will save many lives.

Programs to increase the life-safety of buildings must start with schools, hospitals, and public safety buildings.

If a house or a building is not built according to seismic building code, and if it cannot be retrofitted to make it life-safe, **then it must be torn down**. Not only is it hazardous for the people who live or work in it, but also it is also a threat to the people next to it, or who pass by it. This is not a private risk, but a risk imposed on other innocent people.

Although it is costly, many houses or buildings will have to be demolished in order to prevent unnecessary deaths and injuries.

3.4 NON-STRUCTURAL HAZARDS AND RISK REDUCTION

A considerable percentage of the economic losses recorded in any earthquake are from non-structural elements. Non-structural damage can cause death, injuries, destroy historical and cultural valuables, and can cause considerable economic losses.

Non-structural damage can put hospitals and fire stations out of function and thus cause even more loss of life. It may close schools for months. It may destroy office equipment and machinery and cause loss of jobs and businesses. And it can wipe out inventories of food and supplies, raw materials and consumer products and thereby stop businesses.

By implementing some simple preventive measures to make safe the things that can slide or fall, by rearranging a few things in your home and office, you can cheaply protect your lives, your jobs, and everything you have worked hard to produce.

What are **"Non-Structural hazards"?** These are elements that are not part of the bearing structure of the building. Not the columns, beams or walls, but everything else.

You need to think of yourselves, as though you are on a boat, that you know will rock. Anything that is not flexible, or anything that can slide, or fall, may be risky. This is especially important where you sleep, as well as where you work, study, live, shop and play.

3.5 ARE YOU GETTING READY?

To reduce the risk in your community, the first phase is **hazard hunt** and the first place to start with is your home.

Do you know?
The Earthquake Hazard Hunt should begin at home, with all family members participating. Imagination, and common sense are all that are needed as you go from room to room and think about what can happen when the earth and house start shaking. Check places where your family spends most of its time – where the family sleeps, eats, works and plays. Do some detective work! Make a list of what needs to be done and tackle it one by one until it's finished!

3.5a EARTHQUAKE HAZARD HUNT

A good place to start is with an **Earthquake Hazard Hunt**. Your objective is to think about and change the things that could slide or fall, and hurt us (Figure 8).

How to do it?
Look around carefully at your living room. Which objects (of all sizes, large and small) could slide and fall during a strong shake? What kind of damage can these do? Cabinets, clocks, chandeliers, etc.

Now your kitchen. Look around carefully. Here too there are many items that could slide or fall. Cabinet doors can be shaken open, cabinets can be overturned by the shaking, even heavy appliances can move across the floor.

Now think about the bathroom. Are there heavy things that could slide or fall?

Look around your bedroom. Is there a wardrobe, a cabinet, etc.?

Finally, make a rapid check of your exit routes, in the corridors and behind the doors for things that could fall and block your exits.

What have you found during your short visit to your home that can injure you and your family by sliding and falling?

Please complete your Earthquake Hazard Hunt list at home. Walk around with your family and list all the hazards (Figure 9). Discuss what you must do to mitigate each one of the hazards you listed. Decide what supplies you need and who will do what. Decide which objects are the most important. Get started and record the date that you fixed each thing.

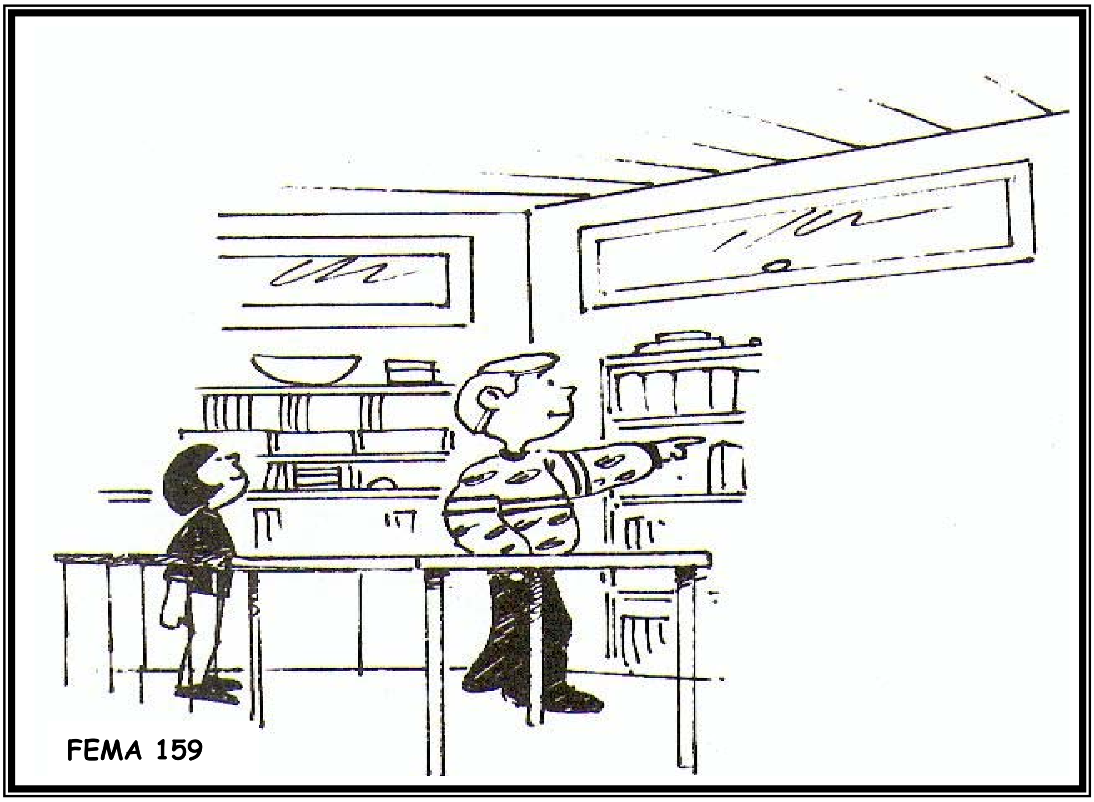
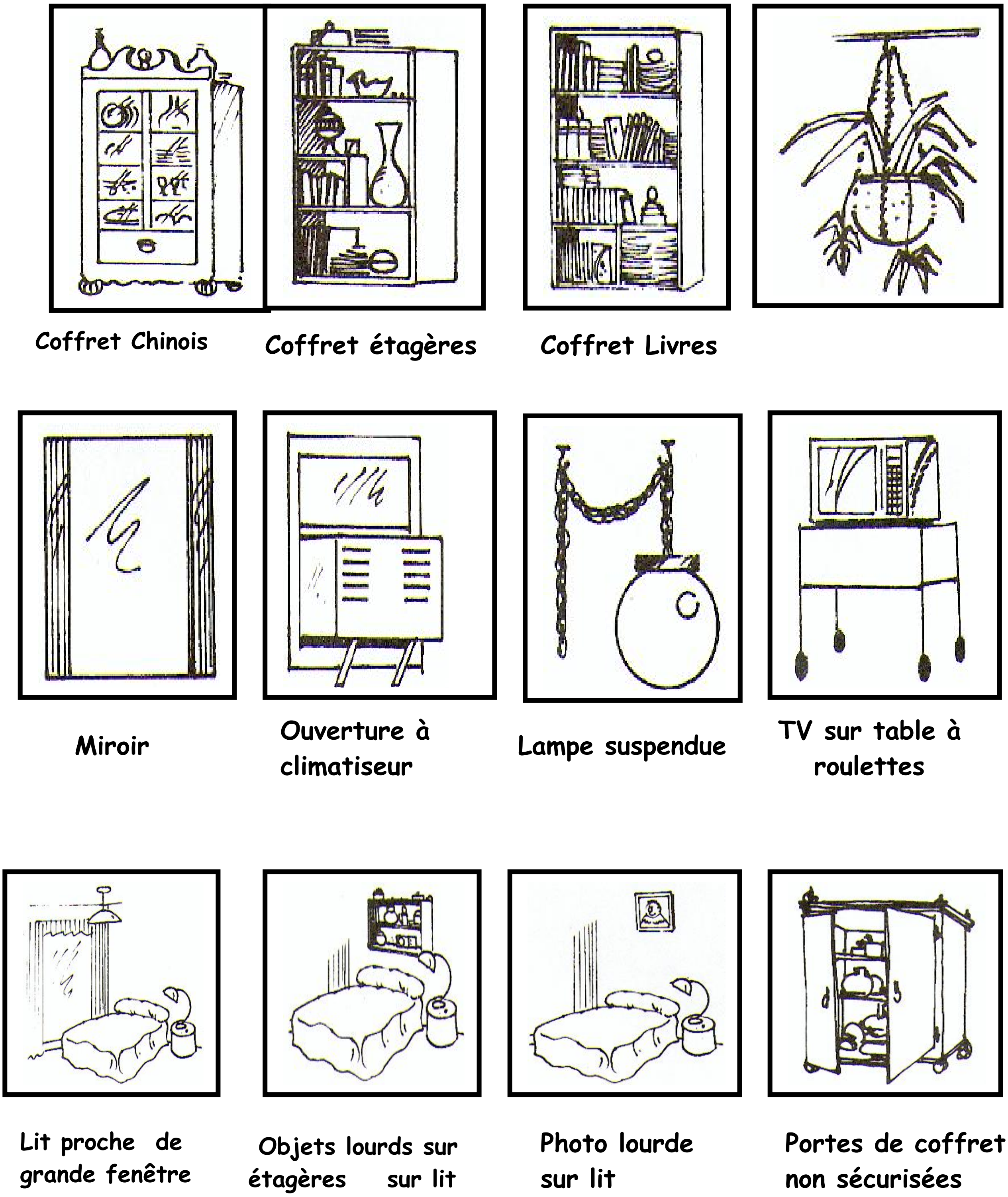
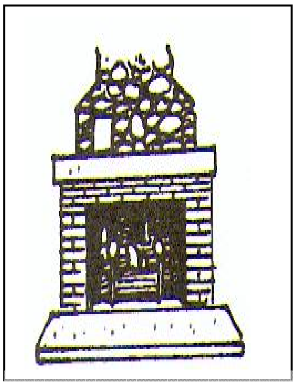


Figure 8: Shows Family Earthquake Hazard Hunt

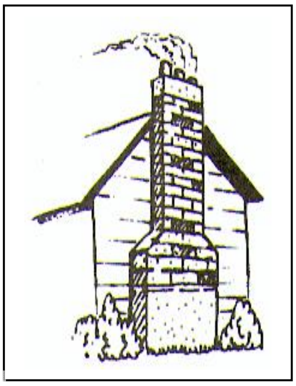
Do you know?
Sometimes you can reduce a risk just by moving a piece of furniture. Move your bed away from the windows. Secure large objects that could fall on your bed or block your doorway.

Figure 9: Illustrates an Earthquake Hazard Hunt list at home (FEMA 159)





Cheminée à Briques



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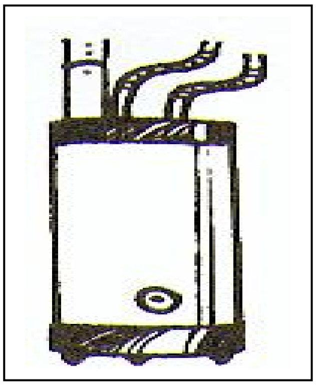

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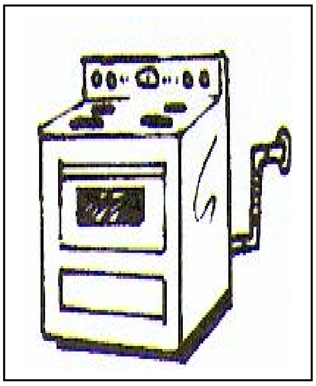

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3.5b As you begin your earthquake Hazard Hunt, prioritise the items as follows:

1. Secure life threatening items first (e.g. Wardrobe in bedroom, things blocking exit, etc.).
2. Secure those things that would cause significant economic loss (e.g. Computer, equipment, etc.)
3. Secure those items that will let you live more comfortably (e.g. Family heirlooms, breakables, etc.).

Continue to use the Earthquake Hazard Hunt list to check your progress in non-structural risk reduction.

3.6 THE FAMILY DISASTER PREPAREDNESS PLAN

The family disaster preparedness plan should start with a Family gathering.

3.6a Family gathering:
In preparation for a disaster, all the family members, including school age children should come together for a meeting. In this meeting, family members will discuss preparations prior to, during and after an earthquake disaster.

3.6b Safe Locations:
Spot danger areas in your home where to stay away from: in front of windows, there are large and heavy hanging light fixtures, heavy and large objects that can slide and fall, sources of fire. Look for safer spaces where you can be protected: under a strong table, next to a strong sofa or chair, next to your bed, in a corner, or by an inside wall.

3.6c Exit Routes:

Identify the regular exit routes and also substitute exits that you may not have thought about, through windows and back doors. Learn all the exits from your building. If there are iron bars on an outside window or door, you should keep a heavy iron pry bar inside the building, in case you need to break these open. If there are any objects that can block the exit routes by sliding and falling, these should be removed. For example, objects which stand behind a door, i.e. rolled up carpets or vacuum cleaner.

Do you know?
During the Algiers-Boumerdes (Algeria) earthquake of 21 May, 2003 many families lost their lives because the exit routes were blocked, mainly by iron bars on and outside the windows. Electric doors were blocked by the lack of electricity and thus people could not exit and thus were killed by the collapse of the building.

3.6d Food and water:
Water is essential for survival. During an earthquake you can expect that many pipes will be broken, both in the streets, and the pipes that bring water into your home. Water may be contaminated along the way by many sources. Immediately after an earthquake, if your home is safe, you can still fill your bathtub and sinks with water immediately to give you an extra supply. It is almost certain that water supplies will be interrupted for some time.

Do you know?
Store four litres per person per day. Three days is the absolute minimum for which you should be prepared. It would be better to store water for a week. Store water in sturdy, opaque plastic jugs or bottles, but not concrete.

3.6e Turning off Utilities:
Following an earthquake the major threat is from fire. If there is any risk of gas leakage, these valves should be turned off first. Also, there are possible breaks in the electrical wires, then electricity should be turned off. **Everyone should learn to turn off these utilities.**

3.6f Assembly Places:
Identify an assembly place inside your home, outside your home, and outside your neighborhood. Family members may not be together when an earthquake occurs. You will save yourself a lot of anxiety and worry, if you know where to find each other. It may take a lengthy time to get in touch with each other, and you must first help the people nearest to you. But this plan will save you from panicking about how to contact each other.

First decide on a place to gather inside your house. It should be safe, central place or on the way to exit. This is where you will meet after the earthquake stops. Then decide on a safe place outside your building, away from overhead risks where you can meet if your neighbourhood is safe. This might be a park or square. This is where you will meet if your building is not safe. Finally, decide on a place to gather outside your neighbourhood; in case your neighbourhood is unsafe, or it is impossible to get there. For many people this location will be their child's school, or a relative's home at each one is familiar with.

You should plan for children to remain at school until their parents or another pre-approved relative or friend arrives to pick them up after an earthquake.

Identify a secure location outside your home where family members can leave messages for each other. This way if you are separated, and unable to remain in your home, your family will know where to go to find you. You do not want to publicize that you are not at home. That is why this location should be secure and discreet, i.e. under a paving stone, inside a tin can, in the back yard.

3.7 OUT OF AREA CONTACTS:

It is very important after an earthquake that all telephone lines are kept open to get help. The telephones lines will be disrupted by damage and by too many calls. The local lines and the lines to the capital city will be heavily overloaded. Therefore, choose a person who lives outside of your area and outside of the capital, and designate that person as your out-of-area contact. Give that person a list of all your friends and relatives that will want to know about your safety.

3.8 DO NOT USE THE TELEPHONE UNLESS YOU HAVE A PHYSICAL EMERGENCY

Do not use the telephone **after** an earthquake unless there is a life-threatening emergency. Otherwise telephone lines will not be able to be used by those who are in need. What feels small to you may be large somewhere else.

During an earthquake telephone receivers can be removed from the hook. Replacing the telephone receivers after an earthquake will help get telephone services back to normal more quickly.

Keep a flashlight, shoes and work gloves next to your bed:
In case an earthquake happens at night while you are in bed you will need to protect your hands and feet and find your way in the dark. Keep a flashlight, shoes or hard-soled closed slippers by your bed. You can place these in a plastic bag right under your bed where you can grab them when you feel an earthquake. Practice reaching out these objects in a dark room.

DO NOT LIGHT ANY FLAME AFTER AN EARTHQUAKE:

Unless you are hundred percent sure that there is no gas leak after an earthquake you should **never** light a flame of any kind. **Extinguish all fires around you**.

3.9 PERSONAL EARTHQUAKE KIT:

It is important to prepare survival provisions for your family. Although you may not need to evacuate, you may decide to stay outside your house or building until you are sure it is safe. So it will help to have these provisions with you – and to have another set in your car, and at the office, in case you are away from home.

Supplies to be put into this bag are:

- Water
- Radio (with spare batteries)
- Flashlight (with spare batteries)
- First aid kit
- Some cash
- A pocket knife
- A whistle
- A plastic bag including copies of important documents and out-of area contact information
- Individual prescription medication sufficient for 1 week (e.g. For heart conditions, diabetes, blood pressure).

Review your plan; replace your food and water, medicine and batteries every 6 months.

3.10 EARTHQUAKE DRILL

The human brain responds to emergencies in one of three primitive ways: fight, running away, or freeze. All are form of panic. They do not work well for us now that you live in buildings and cities. You need to plan and practice our responses so that you do not panic.

You need to have earthquake drills at home, at school, at work and at community level.

When an earthquake occurs, the solid earth will pitch and roll like a ship for a minute or two. The shaking may start out gentle and then you may feel a sharp jolt followed by swaying or rolling. If you are near strongest ground shaking it will be impossible to move around much. Keep calm and ride it out. Your chances of getting through it safely are good if you act calmly and protect yourself from falling objects.

The rules are simple. Everyone should:

DROP, COVER AND HOLD

- Find a safe place and **drop**
- **Cover** your head and neck
- **Hold** on to something secure
- Stay where you are and do not move until the shaking stops.

Drop, means get down low. **Cover** means, cover your head and neck especially. **Hold** means hold on to something stable so that you do not go sliding.

Drop, cover and hold under a strong table, next to your bed, next to a sofa, by an inside corner or wall (Figure 10).

How to make yourself safe? **Practice**. You should have formal earthquake drills at school or at work and the community level. You can also play this informal **Earthquake Drill Game** at home. Playing this game now may save yourself and your family from serious injury.

Rules:

1. Find the safest places in each room. Physically go to those spots and practice your positions.
2. In the days that follow this initial exercise hold surprise earthquake drills. Call **"EARTHQUAKE"** from the living room or kitchen. Each family member should respond by moving to the nearest safe place. Stay in place for one minute. Then move towards your meeting place in the house. A minute or two later, shout **"AFTERSHOCK"** and do the same thing.
3. Once a month let a child call a surprise **"EARTHQUAKE"** and follow through with what you have learned. Test each other. Was your choice the safest? Did the person in the kitchen turn off the stove? Did you meet afterwards where you said you would? Did you do the same things during the aftershock?
4. Now you know what to do! When the shaking is over, stay close. Share the clean-up chores. Talk about what happened and be sure to let all the children say what they felt, how afraid and how brave they were.

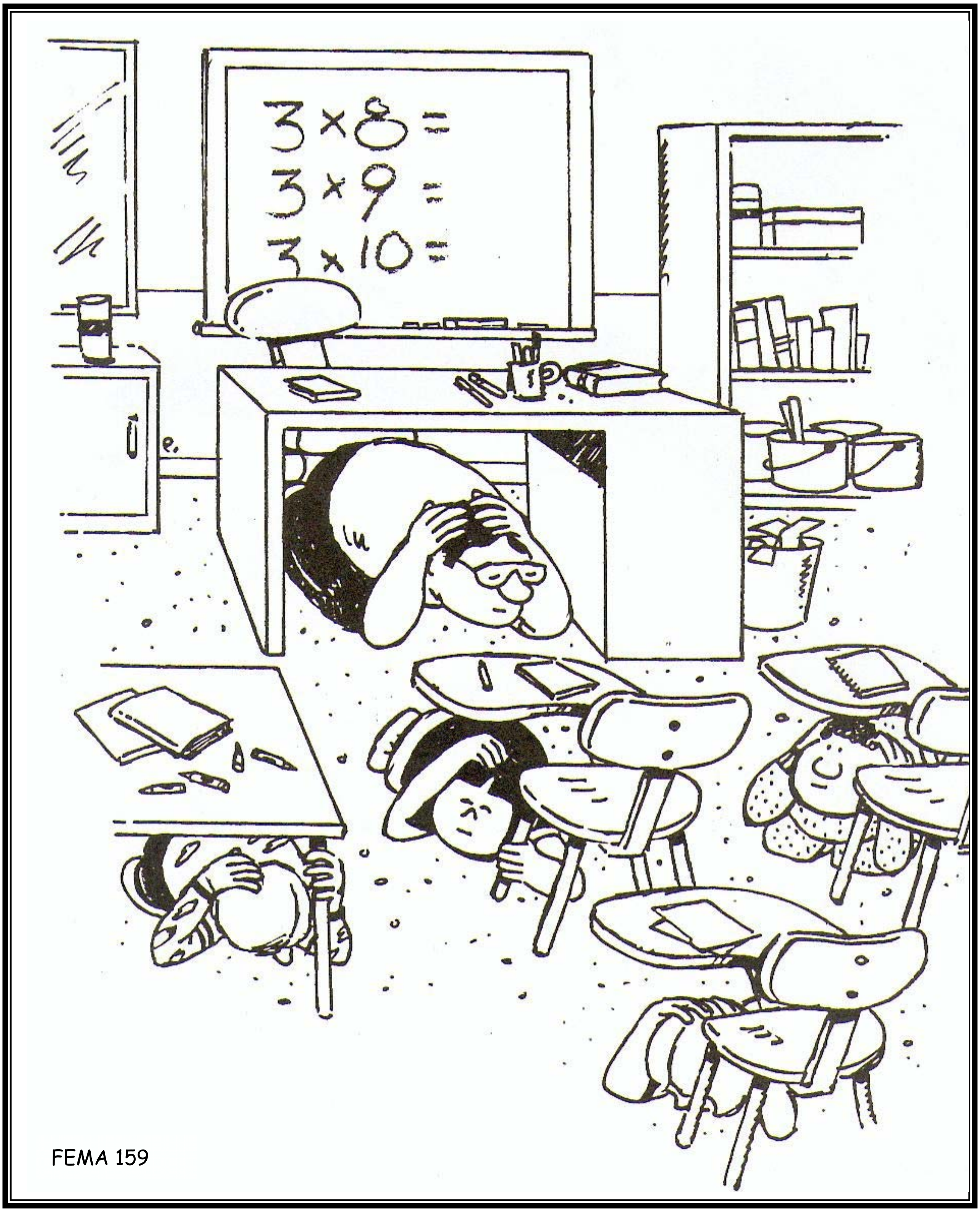


Figure 10: Shows the earthquake drill of DROP, COVER AND HOLD

3.11 COMMUNITY LEVEL

Please complete your Earthquake Hazard Hunt list at your community. Walk around with responsible members of your community and list all the hazards. Discuss what you must do to mitigate each one of the hazards you listed. Decide what resources you need and who will do what. Decide which objects are the most important. Get started and record the date that you fixed each thing.

Preparedness is based on the basic cell in the community which is the family. A resilient community is made of resilient families. All the preparedness plans mentioned above for the family should be applied to the community as a whole.

3.11a Community Disaster Volunteers Course Syllabus

Because during the first 72 hours, after a disaster, most help comes from the community. Thus the community need a well-trained civilian emergency workforce. These teams will help by responding during disaster situations when usual emergency services are not yet on the site or overwhelmed.

Through this unique programme, people from neighbourhood and community organizations will receive training to support teams and to perform as individual leaders by directing untrained volunteers in the initial phase of an emergency.

The ability to effectively recover from the devastating effects of an earthquake requires the dynamic contribution, planning, and collaboration of all levels of the community. The fundamental responsibility for preparedness, however, lies with every individual within the community. By encouraging preparedness efforts and risk mitigation, the negative effects of a disaster can be reduced considerably.

The benefits of the plan are numerous. It will enhance our overall level of disaster preparedness, provide emergency skills that people may use in day-to-day emergencies, improve the link between local authorities and community, raise community awareness, and improve the quality of life for the people of the community.

The training programme provides greater community self-reliance through the development of multi-functional response teams who will act as an adjunct to government emergency services during disasters.

Class1: Introduction, Earthquake Awareness

Registration. Introduction. Earthquake risk. Personal, Family and Community Preparation. Non-structural Risk Mitigation.

Class 2: Disaster Firefighting techniques

Fire chemistry, Fire Extinguishers Use, Utility Control, aeration, Creative Firefighting Techniques, Hazardous Materials.

Class 3: Disaster First Aid Operations (part.1)

Recognizing & Treating Life-threatening Emergencies, Triage, handling Area Management.

Class 4: Disaster First Aid Operations (Part.2)
Head-to-Toe assessment, Recognizing and Treating Non-Life Threatening Emergencies.

Class 5: Light Search & Rescue Operations
Evacuation, Damage estimation, search techniques and rescue Methods.

Class 6: Team Organization and Management
Developing a response team, Incident Command Systems, Damage assessment, Disaster Psychology.

Class 7: Course Review & Disaster Simulation
Disaster Simulation, Critique.

3.12 EARTHQUAKE-SAFE HOME CHECKLIST

- ☐ 1. Place beds away from large windows.
- ☐ 2. Place beds away from below hanging lights.
- ☐ 3. Place beds away from right below heavy mirrors.
- ☐ 4. Place beds away from right below framed pictures
- ☐ 5. Place beds away from right below shelves with things that can fall.
- ☐ 6. Replace heavy lamps on bed tables with light, no-breakable lamps.
- ☐ 7. Change hanging plants from heavy pots into lighter pots
- ☐ 8. Remove all heavy objects from high shelves
- ☐ 9. Remove all fragile objects from high shelves
- ☐ 10. Take glass bottles out of medicine cabinets and put them on lower shelves
- ☐ 11. Remove glass containers that are around the bathtub
- ☐ 12. Move materials that can easily catch fire so they are not close to heat sources
- ☐ 13. Attach water heater to the studs of the nearest wall.
- ☐ 14. Move heavy objects from exit routes in your house.
- ☐ 15. Block wheeled objects so they cannot move.
- ☐ 16. Attach tall furniture such as bookshelves to studs in walls.
- ☐ 17. Employ flexible connectors where gas lines meet appliances such as stoves, water heater and dryers.
- ☐ 18. Fasten heavy appliances such refrigerators to studs in walls.
- ☐ 19. Make sure heavy mirrors are well fixed firmly to walls.
- ☐ 20. Make sure heavy pictures are well fixed firmly to walls.
- ☐ 21. Make sure heavy air conditioners are well fixed firmly to walls.
- ☐ 22. Take away dead or diseased tree limbs that could fall on the house.

4. ACTIONS DURING AN EARTHQUAKE

As events progress rapidly during an earthquake, you will have little time to think. First you hear a sound, then shaking starts.

If there are others in your surroundings, shout "**EARTHQUAKE – EARTHQUAKE**" just as you practiced in your drill, to warn them to take cover. If it was just a small earthquake or a passing truck, don't be humiliated –you just had another good earthquake drill. This exercise is necessary.

4.1 WHAT YOU MUST DO DURING AN EARTHQUAKE

- **Stay calm!** If you're indoors, stay inside. If you're outside, stay outside.
- **If you're indoors**, stand against a wall near the centre of the building, stand in a doorway, or crawl under heavy furniture (a desk or table). Stay away from windows and outside doors. **DROP, COVER and HOLD:**
- **If you're indoors**
- Find a secure place and **drop** (move away from windows and glass and away from large heavy things). **Drop** under a solid table or a similar object.
- **Cover** your head and neck. Take cover beside the inner walls, corners and doors.
- **Hold** on to something secure
- If you are in a **high-rise building**, and you are not near a desk or table, move against an interior wall, and protect your head with your arms. Don't be surprised if the alarm or sprinkler systems is triggered. **Stay indoors**. Glass windows can dislodge during the shaking and be thrown for hundreds of meters.
- Stay where you are and do not move until the shaking stops.
- **If you're outdoors**, stay in the open away from trees and power lines or anything that might fall. Stay away from buildings (objects might fall off the building or the building could fall on you).
- If you are in the kitchen, move away from the refrigerator, stove, and overhead cupboards.
- Don't use matches, lighters, candles, or any flame. Broken gas lines and fire don't go together.
- **If you're in a car,** stop the car and stay inside the car until the shaking stops. Keep away from bridges, underpasses or electric poles.
- Don't use elevators (they'll probably get stuck anyway).
- **In narrow city streets:** There are very few places outside that are secure. In fact, running out of the building may be the most hazardous thing to do.
- If you are on a **sidewalk near buildings**, go inside the doorway to protect yourself from falling bricks, glass, plaster and other objects.
- If you are in a **crowded store** or **other public place**, do **not** rush for the exit. Move away from display shelves containing objects that could fall.

- If you are in a **stadium** or **theatre**, stay in your seat and protect your head with your arms. Do not try to leave until the shaking is over. Then leave in a calm, orderly manner.

- If you are in a wheelchair, stay in it. Move to cover, if possible. Lock your wheels and protect your head with your arms.

4.2 WHAT YOU MUST NOT DO DURING AN EARTHQUAKE

- Do not run to the stairs or exit doors,

- Do not go out to the balcony,

- Do not jump from balconies or windows,

- Do not use the elevator.

- Do not rush toward exits.

5. ACTIONS AFTER AN EARTHQUAKE

5.1 What You Must Do After an Earthquake

- **Stay calm. Do not panic.** If you don't feel calm pretend to be calm. That will help members of your family and all others around you.

- **Check yourself, members of your family and all others around you for injuries**. Provide first aid for anyone who needs it.

INSIDE

- **Check for fire**. Take appropriate measures and precautions.

- **Check water, gas, and electric lines for damage**. If any are broken, shut off the valves. Check for the smell of gas. If you smell it, open all the windows and doors, leave immediately, and report it to the authorities (use someone else's phone). Don't use matches, flashlights, appliances or electric switches.

- **Turn on the radio**. Listen to emergency broadcast station on radio or television.

- **Don't use the phone** unless it's an emergency.

- **Stay out of damaged buildings.** If your building is damaged you should not panic. You should calmly and carefully exit your building. On your way out pick up your evacuation bag and water and go to a secure place.

- Be careful around broken glass and other hazardous objects. Wear boots or strong shoes to keep from cutting your feet.

- **Be careful of chimneys** (they may fall on you).

- **Stay away from beaches.** Tsunamis and seiches sometimes hit the seashore after the ground has stopped shaking.

- **Stay away from damaged areas**.

- If you're at school, work, shop or public building, follow the emergency plan or the instructions of the person in charge.

- **Expect aftershocks.** Earthquakes come in clusters. Several aftershocks usually occur within the first hour after the main shock. Aftershocks generally occur during the following days, weeks, months and even years, but getting smaller and less frequent. During an aftershock you should behave exactly as you did during the main earthquake. **Aftershocks are natural.**

OUTSIDE

- If you have been trained a **Community Emergency Response Volunteer** or have skills in first aid, search and rescue, or fire, first check that those around you are secure. Then take your supplies bag and make your way to your community meeting point, observing and noting damage in your way.

- If you have not been trained as a volunteer, but you want to help, first help those around you. Go to your neighbourhood assembly place and volunteer to help.

5.2 What You Must Not Do After an Earthquake

- Do not panic, scream or run.

- **Do not use telephone except to report physical emergency and fire**. You may have seriously shaken and be well –but somewhere else someone needs help and your phone call will prevent theirs from getting through. Leave the telephones free so that neighbourhoods with real emergencies will be able to get the help they need and so that authorities and media can get information through to speed help. Make only one call to your out-of-area contact.

- **Do not light any match, lighter, candle or fire** until you are sure that all risk of escaping gas and other flammables is gone. If you smell gas, turn it off where possible, open the windows and doors and exit immediately. If it is dark, turn on your flashlight.

5.3 EVACUATION

5.3a BUILDING EVACUATION

Building evacuation is conducted in order to make sure that everyone is secure and accounted for, and to assess damage before re-entering the building. Building evacuation should be done calmly and carefully.

There may be more risk outside your building that inside.

There may be no secure assembly area outside.

There may be no clear routes to get outsides.

Alternative routes may need to be cleared.

5.3b AREA EVACUATION

Evacuation should never be automatic. It must be planned and checked before it can be implemented.

There are two main reasons why some areas should be evacuated:

1. Low lying areas immediately by the coast should be evacuated because the ground may be particularly unstable. Everyone should move carefully to higher stable ground away from the shore.

2. Fire or chemical risks may require people to move quickly out of the way of hazard.

However, in general, an earthquake itself is **NOT** a reason for evacuation. Before beginning an evacuation, it must be determined that there is a secure place to go and a safe way to get there.

After a severe earthquake, children in the affected area **should not be sent anywhere** on service buses, until it has been determined that the route and the destination are both safe. Instead, everyone should be prepared for children to stay at school until their safety can be assured, and until they can be released to parents or pre-designated relatives or friends.

5.4 PSYCHOLOGICAL SUPPORT

Disasters affect people in so many ways. There is a variety of behaviour that is normal under these unusual circumstances.

People experience many different losses in an earthquake disaster. There is a natural grieving process following any loss and a disaster causes much anguish.

Some normal initial responses to disaster include:

- Fear
- Disbelief
- Disorientation and numbing
- Reluctance to abandon property
- Need for information
- Seeking help
- Offering help

Soon after there may be other responses

- Change in appetite
- Anxiety

- Anger and suspicion
- Apathy and depression
- Crying
- Frustration and feelings of powerlessness
- Moodiness and irritability
- Increased illnesses
- Difficulty sleeping
- Headaches
- Disappointment with and rejection of outside help
- Isolating oneself from family and friends
- Guilt
- Domestic violence
- Inability to enjoy normal activities

Young children may also experience:

- Return to earlier behaviours
- Clinging to parents
- Reluctance to go to bed
- Nightmares
- Inability to concentrate
- Refusal to attend school.

To help the best things you can do are:

- Recognize your own feelings
- Talk to others about your feelings
- Accept help from others in the spirit in which it is given
- Get enough rest
- Get physical activity
- Give someone a hug, physical touching helps
- Learn to really listen and show that you are listening

- Accept the feelings of others without trying to change them
- Spend extra time with your child
- Be tolerant of others

5.5 THE FIRST 72 HOURS

During the first 72 hours after an earthquake disaster, most help comes from those immediately around us. There is no government anywhere in the world that has the resources to meet all the needs in an earthquake disaster. In order to be prepared there are many skills you can be trained:

- First Aid
- Light Search and Rescue
- Fire fighting techniques
- Response Organisation

You can take a course for **Community Emergency Volunteers** and be trained skills in first aid, search and rescue, and fire fighting. You can learn how to operate a wireless radio. You can volunteer on your Local Disaster Preparedness Committee where you live or where you work in order to help prepare your community and reduce your risk.

There are many ways you can help, even without extra skills: find supplies and transportation, collect and prepare food and water, set up shelters and temporary toilets, supervise elderly and children, secure the perimeter of unsafe areas, offer psychological support to those in need.

6. ACTIONS FROM COMMUNITY TO REDUCE IMPACT OF EARTHQUAKES

Developing community-based programmes of disaster risk management that make the best use of existing organizational and administrative structures. Community should be an integrated part of earthquake risk management in all its phases: preparedness, public awareness, education, training, disaster scenarios and risk reduction. Facilitating the identification of local resources and opportunities for support. Resources mobilization (human, material, financial, etc.), community building (capacity, solidarity, unity, trust, etc., and strengthening existing community structures. Use of indigenous knowledge and expertise when available. The greater the role of the community, the greater the chance of promoting psychological recovery from scars of disaster, restoring dignity and self-esteem.

6.1 fundamentals and characteristics of community based disaster management

From past earthquake disaster in various countries, it is well known that most help comes from the community. It is always the people at the community level who endure most the negative effects of the disaster. They make use of the local means and survival strategies to react to the situation long before exterior help arrives. Thus, the local people should be involved to protect themselves from the damage and suffering through community based disaster preparedness, reduction and response. The objective is to reduce vulnerabilities by strengthening capacities; the aim is building disaster resilient communities.

The following fundamentals of Community Based Disaster Risk Reduction and Management can be derived form experience in CBDRRM in other countries which went through disasters:

1. *Comprehensive*: structural (physical) and non-structural (health, literacy, public awareness, education and training, livelihood, community organisation, advocacy, etc.) preparedness and mitigation measures are implemented; short-, medium- term and long-term measures to address reduction of vulnerabilities.

2. *Community participation* - community members should be the main actors; while sustaining the Community Based Disaster Risk Reduction and Management (CBDRRM) process, they also directly share in the benefits of disaster prevention, preparedness, mitigation and reconstruction.

3. R*isk reduction measures* – They are community-specific and are identified after an identification of the community's disaster risk (earthquake hazard, vulnerabilities and capacities).

4. Community Prioritisation: Priority is given for the most vulnerable groups, families, and people in the community – in the urban areas, the urban poor and informal sector are usually the most vulnerable sectors while in the rural areas, these are the farmers and indigenous people; also most vulnerable are the elderly, the differently disabled, children and women.

5. Community mechanisms and capacities: *Community Based for Disaster Risk Reduction and Management builds upon and improves* existing coping strategies and capacities; most common social/organizational values and mechanism are cooperation, community/people's organizations, and local knowledge and resources.

6. Exterior Help: Outsiders should have supporting and facilitating role - NGOs have supporting, facilitating and catalytic role. The government's role is to make possible and institutionalise the CBDRRM process.

Closely related to the fundamentals and characteristics mentioned above are the philosophy behind the CBDRRM actions and programmes. These also provide overall goals to work for performance indicators to stay on the track of:

P*articipatory process*: involvement of community members, particularly the most vulnerable sectors and groups in the whole process of risk assessment, prevention, identification of mitigation and preparedness measures, decision making, implementation.

R*eceptive*: based on the community's urgent needs; considers the community's perception and prioritisation of disaster risks and thus risk reduction measures so the community can claim tenure

I*ntegrate*d: pre-, during and post-disaster measures are designed and implemented as required by the community; there is an association of the community with other communities, organizations and government agencies at various levels especially for the reduction of vulnerabilities which the local community can not generally reduce by itself.

***Multi-sectoral and multi-disciplinary*:** considers roles and participation of all stakeholders in the community; combines indigenous/local knowledge and resources with science and technology and support from outsiders.

***Empowering*:** community's options and capacities are strengthened; more access to and control of resources and basic social services through combined action; more significant involvement in decision making which affects their lives; more control over the natural and physical environment; involvement in CBDRRM develops the self-confidence of community members to participate in other development activities.

6.2 Essential Components of Local and Community Based Disaster Management Process

The goal of CBDRRM is to transform vulnerable communities to disaster resilient communities. Although steps may vary from community contexts and organizational mandates, the process and requisites for disaster risk reduction can be generalized as follows:

1. **Community Profiling** - understanding of disaster situation and orientation on CBDRRM.
2. **Community Risk Identification** – participatory assessment of hazards, vulnerabilities, capacities and people's perception of risks
3. **Formulation of Initial Disaster Risk Reduction Plan** - community counter disaster, disaster management, development plan or action plan; identification of appropriate risk reduction and preparedness measures including public awareness, training and education; action plan
4. **Establishment of Community Disaster Response Organization** – community organizing and mobilization, capability building in preparedness and mitigation, organizational development and strengthening (see Incident Command System Chart).
5. **Implementation of short-, medium-, and long-term risk reduction measures, activities, projects and programs** - implementation strategies and mechanisms; organizational/institutional strengthening
6. **Monitoring and Evaluation** - continuous improvement of disaster risk reduction plan/community counter disaster plan, identification of success factors and improvement of weak areas, documentation and dissemination of good practices for replication.

6.3 Incident Command System Activity

There is an international system for the organization and emergency response. This is known as an **"Incident Command System"** or a **"Standard Emergency Management System".** In this system in any given area one person functions as a leader or incident Commander with assistance from a Communication Operator, and then establishes two branches, Operations and logistics, as needed. The Operations branch has responsibility for damage assessment, search and rescue, fire and hazardous materials control, and first aid. The logistics branch is responsible for obtaining supplies, volunteers,

transportation, food and water, shelter and sanitation, and psychological support and supervision.
Your community can use the lists below to organize work after an earthquake disaster and also to mobilize volunteers for planning and drills.

INCIDENT COMMANDER

1. Establish the command post in a safe and secure place.
2. Find a wireless radio operator to be your shadow
3. Establish response teams
4. Establish priorities from incoming damage assessment reports
5. Keep track of all incidences on the Incident Status Record Form
6. Maintain Order

COMMUNICATION

You are the Incident Commander's shadow. Stay with him and provide communications between him and the emergency operations Centre.

7. Contact the Emergency Operations Centre through, Follow their instructions and be brief.
8. Monitor Emergency radio.
9. Identify yourself and your neighbourhood and your district.
10. Work with Logistics Commander to find additional communication channels.

Reminders:

- Maintain contact between Command Post and the Emergency Operations centre
- Never leave radio unattended.

OPERATIONS

11. Supervise **Search And Rescue (SAR)**, **Fire Fighting/Hazard Control**, **First Aid** teams.
12. Centralize damage, injury and death reports.
13. Maintain contact with **Command Post.**

III.1 Light Search & Rescue

1. Appoint someone to compile initial damage assessment reports.
2. Simultaneously: **A**. Form at least one team to do a complete home-to-home check.

   B. Form teams to systematically assess all homes in this order:
   - **a.** Heavy damage (needs professional SAR team).
   - **b.** Moderate damage (needs light SAR team)
   - **c.** Light and no damage
3. As problems at each residence are identified and resolved make the universal SAR marking in an obvious place that can be seen from the front of the house.
4. Each team must document activities using the Damage assessment Form.
5. Maintain contact with the Command Post.

Reminders:

- All teams must have at least two people.
- Damage assessment must be conducted again after every aftershock.

III.2 Fire extinguishments

Form teams to safety

1. * Fight small fires
   * Isolate potential hazardous materials situations
   * Evaluate utilities
2. Let the damage assessment reports determine which teams should be established and in which order.

III.3 First Aid

1. **Establish treatment area and begin triage.**
2. Establish a morgue if necessary in a separate area.
3. Care for injuries.
4. Use psychosocial support and supervision team in a separate location.
5. Work with communications to identify nearest hospitals and clinics.
6. Work with logistics to identify alternative methods of transportation.
7. Document activities on medical team form (Photo 1).
8. Maintain contact with psychological support/supervision team.
9. Maintain contact with Command Post.
10. Report number of injuries requiring medical attention.

Photo 1: Shows some items of the first aid kit

IV. LOGISTICS

1. Supervise shelter/Sanitation and Food/water teams.
2. As necessary establish groups to coordinate: Communications, Supplies, Transportation, Volunteers and Security.

a. Identify alternative methods of communications (wireless, telephone, e-mail, radio, T.V., etc.).
b. Identify alternative methods of transportation and volunteers.
c. Find supply needs of all teams.
d. Organize traffic flow if necessary.
e. Provide food and beverages to all teams.
f. Maintain contact with Command Post.

IV.1 Food and water

1. Organize food and beverages storage.
2. Provide snacks and beverages to all teams.
3. Organize provision of snacks and beverages.
4. Organize provision of meals.

IV.2 Shelter and sanitation

1. Identify and set up safe and secure locations for shelter and sanitation.
2. Establish shelter from weather.
3. Check on previously identified vulnerable populations (school children, disabled, elderly).
4. Maintain names and addresses of people in shelter.
5. Establish temporary toilets.
6. Maintain contact with Command Post.

IV.3 Psychosocial Support and Supervision

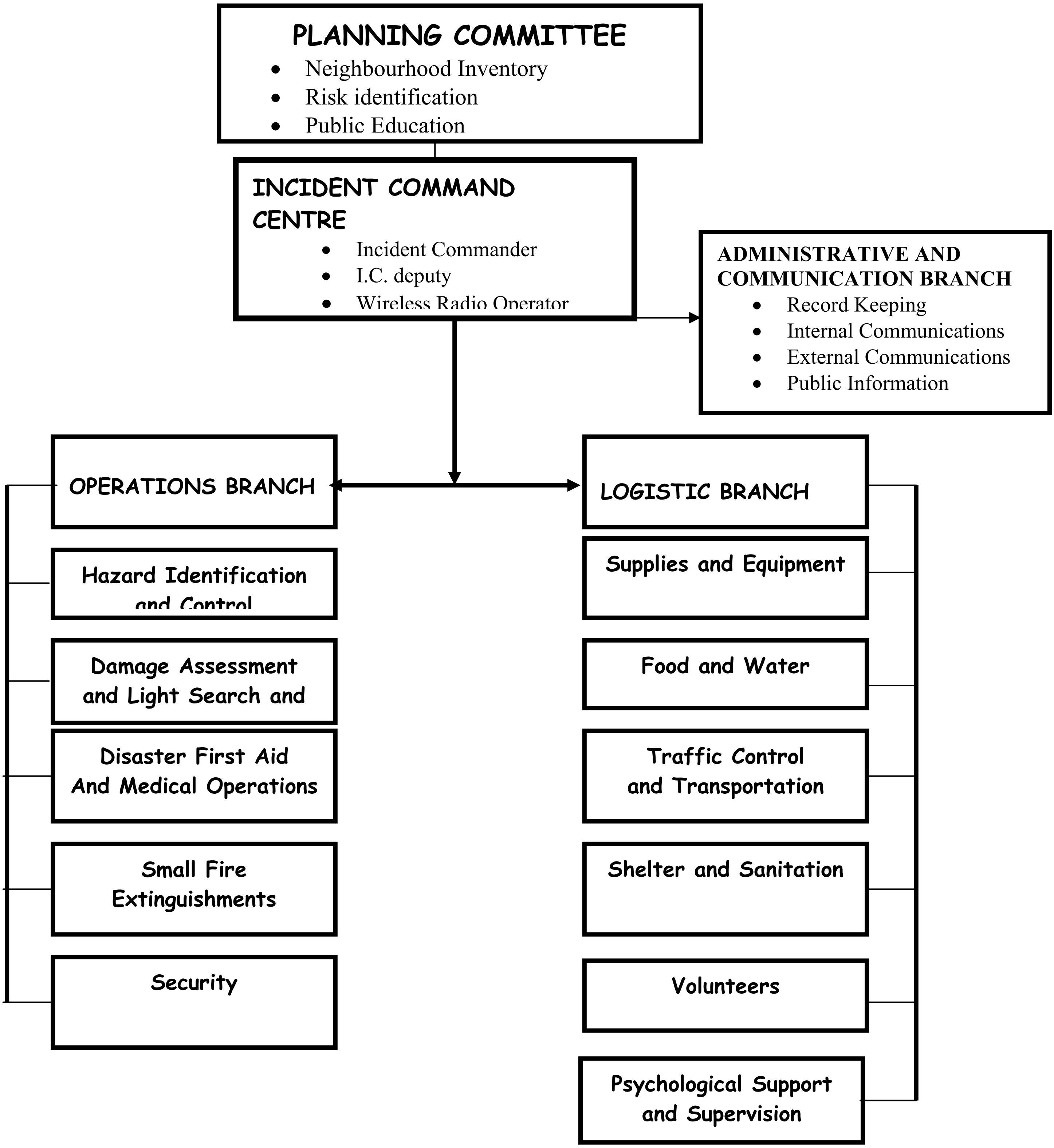
1. Establish safe area and begin triage.
2. Care for psychological needs of bereaved and traumatized.
3. Organize activities to occupy young children, elderly and disabled persons.
4. Maintain contact with First Aid Team.

ELDERLY, DISABLED, OR PERSONS UNDER MEDICATION: These people may have difficulty moving around after an earthquake. Plan to have someone help them to evacuate if necessary. Also, they may need special foods or medication. Be sure to store several days' supply of these special provisions.

These features of Standard Emergency Management Systems make it especially useful for disaster planning:

- May be adapted to different situations
- Unified command structure
- Shared terminology
- Flexibility
- Centralized communications
- Effective action planning
- Management of resource allocation

- Manageable span of control
- Redundancy planning
- Cross-disciplinary training.



Incident Command System Chart

7. CASE STUDIES OF IMPACTS OF A SAME EARTHQUAKE IN A DEVELOPED COUNTRY AND IN A DEVELOPING COUNTRY

Strong earthquakes of magnitude 7 and above when occurring cause large scale of damage and loss of life in developed as in developing countries. During the past century, statistics show that both types of countries are really concerned about seismic risk reduction and management. It is true that the human life losses are larger in developing countries but economic losses are far larger in developed ones. Building contents, more important in developed countries, are liable to damage in the same way as non-structural building elements. They may have a value far in excess of that of the building itself such as in major banks, computer centres or laboratories, or they may have a major significance in post earthquake conditions such as hospitals, telephone exchanges and electrical sub-stations, or they may be irreplaceable such as in museums or art galleries. In what follow, two destructive earthquakes occurred in Boumerdes-Algiers (Algeria) on May 21st, 2003 (M6.8) and Kobe (Japan) on January 17th, 1995 (M7.2).

BOUMERDES-ALGIERS (ALGERIA) ON MAY 21ST, 2003 (M6.8)

On Wednesday 21 may 2003, at 18 hours 44 minutes UTC (19h 44 local time), a destructive earthquake occurred in the provinces (Wilaya) of Algiers and Boumerdes affecting a rather densely populated region of about 3,000,000 people within 1,000 km2. The magnitude of the earthquake was calculated at Ms = 6.6 (Mw 6.8). The epicentre was located at 36°.89N –3°.78E at about 10 km offshore from the locality of Zemmouri in the province of Boumerdes about 50 km east of the capital city of Algiers. The main shock caused the loss 2.278 lives, injuring more than 11,450 others, causing 200.000 homeless and recording about 1.200 missing, economic losses were preliminary estimated at US$ 5 billion which represent about 10% GNP of Algeria. The earthquake stopped the function between 400 and 500 industrial plants in the epicentral zone which caused the loss between 30,000 and 40,000 jobs.
It destroyed or seriously damaged at least 128,000 housing units distributed as follows: Algiers (78 000), Boumerdes (34 000), Tizi ouzou (7 000), Bouira (4 300), Blida (2 500), Tipaza (1 700), Béjaia (850) and Médéa (150) in eight provinces. The extent of the socio-economic impacts of these events confirmed that Algerian buildings are highly vulnerable to the recurrence of destructive earthquakes. Maximum intensity reached is evaluated at Io = X (MSK) scale at Zemmouri, Boumerdes, Corso, Thenia, Reghaia, Boudouaou, Bordj-El-Bahri and Bordj-El-Kiffan. This paper illustrates the issues as damage and loss assessment, housing reconstruction, relocation or in situ reconstruction, debris removal, reconstruction multi-hazard resistant, steps for capacity building (training of engineers, masons, etc..), insurance, urban reconstruction, livelihood, psychological and medical rehabilitation, social rehabilitation, infrastructure reconstruction and disaster management capacity building. This earthquake disaster has seriously risen the awareness of the government and the whole population alike.

Photo 3 : Typical damage during the 2003 Boumerdes earthquake

Photo 4: Effect of the earthquake on the rail system during the 2003 Boumerdes earthquake.

Photo 5 : An Algerian walking on the ruins of the disaster

Photo 6 : Algerian volunteers helping in relief operations

KOBE (JAPAN) EARTHQUAKE OF 17 JANUARY 1995 (M7.3)

On January 17th, 1995 at5: 46 AM (local time), A strong earthquake occurred off of the northern coast of Awaji Island, Hyogo Prefecture. The main shock, which had a magnitude of M7.3, caused the loss of more 6,400 lives (dead or missing), injuring 40,092 others, made about 316,678 homeless. Not only did houses and other buildings collapse but also fires broke out in many places and completely destroyed or seriously damaged 240,956 houses. The number of houses destroyed by fire was 7,456. Road and railway networks were torn apart, with the collapse of bridge girders supporting the Hanshin Expressway, the main trunk line connecting Osaka and Kobe, as well as those of the JR Sanyo Shinkansen. Harbour facilities were seriously damaged as well, raising the total damage on the area to approximately U.S.$ 100 billion. About 320,000 people evacuated to evacuation shelters, parks and schools, shivering in the winter's cold and fearful aftershocks. To make matters worse, supplies of electricity, gas, and water were cut off, and telephone communications were interrupted by vast traffic, forcing people in the affected areas to live in very difficult conditions and endure the lack of both food and water. Severed in places; regional transportation was paralyzed immediately after the earthquake. The earthquake caused an electricity blackout in 1 million households, Gas service cut off to 845,000 households and Water service cut off to 1.27 million households

This shows that more a country is developed more the economic losses are larger. Thus it of interest that both types of countries: developed and developing should integrate disaster management into their strategy for social and economic development.

Photo 7 : Typical damage during the 1995 Kobe earthquake

Photo 8 : Effets of the earthquake on reinforced concrete struture

Photo 9 : Extensive fire caused by the earthquake in the city of Kobe

Photo 10 : A Japanese sitting on the ruins of the disaster

8. CONCLUSIONS AND RECOMMENDATIONS

Experiences in community disaster management involvement confirm the effectiveness of participating communities in disaster risk preparedness and reduction. However, local communities cannot reduce all vulnerabilities on their own. While communities have built on local coping strategies and capacities to reduce some vulnerability, many necessary structural mitigation measures involve big capital outlay. More important, vulnerability is also a complex net of conditions, factors, and processes, which can only be reduced through complementary and concerted action among multiple-stakeholders from various disciplines and levels of the disaster management and development planning system.

To achieve a certain of reliable of disaster risk reduction, community leaders throughout earthquake-prone Africa should lobby their respective governments and international institutions in:

- Increasing public awareness and public participation on how to reduce vulnerability to hazards. This involves programmes related to formal and non-formal education and needs to be addressed through public information, education and multi-disciplinary professional training. Needless to say that media and school systems around the countries have a crucial role to play.
- Capacity building at a community level needs to include the development of an integrated disaster risk management plan that covers areas of hazard assessment, risk identification, early warning systems, training and public awareness programmes, as well as emergency response management, recovery resources, including the strengthening of community based organizations.

- Prioritisating actions in the various phases of disaster risk reduction and management (prevention, preparedness, response, rehabilitation and recovery) have to be agreed upon to cope with such situations.
- Stimulating inter-disciplinary and inter-sectoral partnerships and the expansion of risk reduction networking amongst governments at national and local levels, greater involvement of the private sector, academic institutions, NGOs and community-based organizations (CBOs). This calls for strong coordination mechanisms, such as appropriate institutional structures for disaster management, preparedness, emergency response and early warning, as well as the incorporation of disaster reduction concerns in national planning processes.
- Developing of gender sensitive public awareness programmes and campaigns on the relationships between sustainable development, earthquake hazards, vulnerabilities and disaster to enhance disaster reduction measures. The process starts in schools with educational programmes including curricula revision, teachers training and development of resource centres. It needs to expand to all levels of society by training efforts, with special emphasis on professionals and community based leaders and organizations.

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