GOVERNMENT POLYTECHNIC
BHUBANESWAR-23

DEPARTMENT OF CIVIL ENGINEERING
LECTURE NOTES

Year & Semester: 3rd Year, 6th Semester

Subject code/Name – CET-605, Disaster Management

CONTENT

CHAPTER-1
INTRODUCTION

1.1- Definition of hazards, disasters. Explain the difference between hazard and disaster

Hazards

A hazard is an agent which has the potential to cause harm to a vulnerable target. Hazards can be both natural or human induced. ... Risk is defined as the probability that exposure to a hazard will lead to a negative consequence, or more simply, a hazard poses no risk if there is no exposure to that hazard.

Disasters

A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. Though often caused by nature, disasters can have human origins.

Difference between hazard and disaster

- A hazard is a situation where there is a threat to life, health, environment or property.
- A disaster is an event that completely disrupts the normal ways of a community. It brings on human, economical, and environmental losses to the community which the community cannot bear on its own.
- Hazards are natural or manmade phenomenon that are a feature of our planet and cannot be prevented. In their dormant state, hazards just pose a threat to life and property.
- These hazards are termed as disasters when they cause widespread destruction of property and human lives. Once a hazard becomes active and is no longer just a threat, it becomes a disaster.
- Both hazards and disasters are natural as well as manmade.
- We can prevent hazards becoming disasters if we learn to live in harmony with nature and take precautionary steps.

1.2 – Concept of risk and vulnerability. Risk reduction: preparedness and mitigation. Preparedness for Disaster

preparedness

Disaster preparedness refers to measures taken to prepare for and reduce the effects of disasters. That is, to predict and, where possible, prevent disasters, mitigate their impact on vulnerable populations, and respond to and effectively cope with their consequences.

Disaster preparedness provides a platform to design effective, realistic and coordinated planning, reduces duplication of efforts and increase the overall effectiveness of National Societies, household and community members disaster preparedness and response efforts. Disaster preparedness activities embedded with risk reduction measures can prevent disaster situations and also result in saving maximum lives and livelihoods during any disaster situation, enabling the affected population to get back to normalcy within a short time period.

Disaster preparedness is a continuous and integrated process resulting from a wide range of risk reduction activities and resources rather than from a distinct sectoral activity by itself. It requires the contributions of many different areas—ranging from training and logistics, to health care, recovery, livelihood to institutional development.

Mitigation for Disaster

Disaster mitigation measures are those that eliminate or reduce the impacts and risks of hazards through proactive measures taken before an emergency or disaster occurs.

One of the best known examples of investment in disaster mitigation is the Red River Floodway. The building of the Floodway was a joint provincial/federal undertaking to protect the City of Winnipeg and reduce the impact of flooding in the Red River Basin. It cost $60 million to build in the 1960s. Since then, the floodway has been used over 20 times. Its use during the 1997 Red River Flood alone saved an estimated $6 billion. The Floodway was expanded in 2006 as a joint provincial/federal initiative.

All-hazards approach

An all-hazards emergency management approach looks at all potential risks and impacts, natural and human-induced (intentional and non-intentional) to ensure that decisions made to mitigate against one type of risk do not increase our vulnerability to other risks.

Types of disaster mitigation

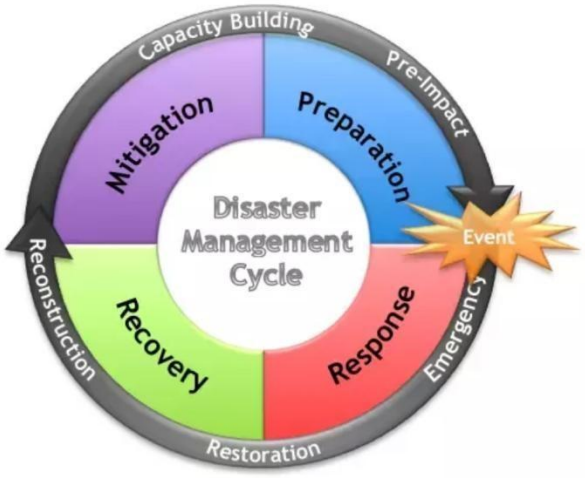
Disaster mitigation measures may be structural (e.g. flood dikes) or non-structural (e.g. land use zoning). Mitigation activities should incorporate the measurement and assessment of the evolving risk environment. Activities may include the creation of comprehensive, pro-active tools that help decide where to focus funding and efforts in risk reduction.

Other examples of mitigation measures include:

- Hazard mapping
- Adoption and enforcement of land use and zoning practices
- Implementing and enforcing building codes
- Flood plain mapping
- Reinforced tornado safe rooms
- Burying of electrical cables to prevent ice build-up
- Raising of homes in flood-prone areas

- Disaster mitigation public awareness programs Insurance programs

1.3 – Disaster management cycle



It is an ongoing process by which governments, civil (and military) society plan for and reduce the impact of disasters, react during and immediately following a disaster, and take steps to recover after a disaster has occurred.There are variations to the cycle but the most common version is the 4 phases of disaster cycle

Mitigation: involves implementing measures for preventing future threat of disaster and/or minimizing their damaging effects of unavoidable threat. It requires hazard risk analysis and the application of strategies to reduce the likelihood that hazards will become disasters, such as floodproofing homes or having flood/fire insurance, following safety standards of building materials and appliances. This phase (and the whole cycle disaster management cycle), includes the shaping of public policies and plans that either modify the causes of disasters or mitigate their effects on people, property, and infrastructure.

Disaster preparedness: preparedness efforts include plans or preparations made in advance of an emergency that help individuals and communities get ready to either respond or to recover. It aims to achieve a satisfactory level of readiness to respond to any emergency situation through programs that strengthen the technical and managerial capacity of governments, organizations, and communities. These measures can be described as logistical readiness to deal with disasters and can be enhanced by having response mechanisms and procedures, rehearsals, developing long-term and short-term strategies, public education and building early warning systems. The preparations may include the stocking of reserve food and water, the gathering and screening of willing community volunteers, or citizens education & evacuation plan, holding disaster drills, and installing smoke detectors, mutual aid agreements, development of hospital disaster plans, emergency medical service plans, etc.

Disaster response: Disaster response work includes any actions taken in the midst of or immediately following an emergency, including efforts to save lives and to prevent further property damage. Ideally, disaster response involves putting already established disaster preparedness plans into motion. It’s what

the public typically thinks of when imagining a disaster: Flashing lights, evacuation, search and rescue, and sheltering victims. Healthcare and psychosocial intervention response starts here. The focus in the response phase is on meeting the basic needs of the victims until sustainable community has been achieved.This phase may still continue even when recovery phase can already be started.

Disaster recovery: Recovery involves restoring, rebuilding, and reshaping the impacted area. It starts after damages have been assessed and adequate response effort is achieved and on-going. It involves actions to return the affected community to its pre-disaster state or better. As the emergency is brought under control, the affected population is capable of undertaking a growing number of activities aimed at restoring their lives and the infrastructure that supports them. Recovery activities continue until all systems return to normal or better. These measures, both short and long term, aim to return vital life-support systems to minimum operating standards; such as temporary housing, public information, health and safety education; continued health monitor and care, reconstruction of vital facilities; counseling programs; grants, and it may include economic impact studies.

1.4- Personal and community awareness.

Awareness are an essential component of community based disaster risk management. A sustained effort is required by the government, NGOs, Volunteers, electronic and print media through interactive meetings, audio-visuals, handbills/booklets/posters, competitions and quizzes, streetshows, mock drills and exercises for creating awareness among the public and preparing them to act appropriately for disaster risk reduction. Community involvement in disaster management cannot be over-emphasized since it is usually the first victim as well as responder to a disaster and hence, its role in containing damage or loss is of prime significance. The community campaigns emphasize on the prevalent landslide risk and vulnerability of the exposed elements. It highlights the roles, responsibilities and standard operational procedures for risk reduction and response by the communities. Information, maps and illustrations containing status of landslide hazards, landslide indicators or precursors, precautionary measures, possible causes, suggestive remedial options and early warning signals are shared with the community in a layman’s language. Communities are made aware of the likely major disasters that threaten the localities of immediate concern to them, and the projected disaster scenarios; the possible landslide hazard distribution and major known landslide spots.

1.5- Types of disasters Earthquake

Earthquake can be defined as the shaking of earth caused by waves moving on and below the earth's surface and causing: surface faulting, tremors vibration, liquefaction, landslides, aftershocks and/or tsunamis. Aggravating factors are the time of the event and the number and intensity of aftershocks.

Tsunami

A tsunami is a series of waves caused by earthquakes or undersea volcanic eruptions. Tsunamis are giant waves caused by earthquakes or volcanic eruptions under the sea. Out in the depths of the ocean, tsunami waves do not dramatically increase in height.

Landslide

A landslide or landslip are a natural disaster, something which is unfortunately unavoidable.A landslide can occur on shore or off shore and usually at coastal lines but it is the gravity that forces the debris and rocks to fall and for a total landslide to occur.

Cyclone

Cyclones, Hurricanes and Typhoons are powerful storms that have winds in excess of 119 kilometres per hour (74 MPH). ... Property damage is the most common after-effect, with windows, roofs and doors succumbing to the powerful winds battering them, and the most powerful storms can tear down small buildings.

Flood

A flood is an overflow of water that submerges land that is usually dry. ... Floods can also occur in rivers when the flow rate exceeds the capacity of the river channel, particularly at bends or meanders in the waterway. Floods often cause damage to homes and businesses if they are in the natural flood plains of rivers.

Drought

Drought is a prolonged dry period in natural climate cycle. It is a slow-onset phenomenon caused by rainfall deficit combined with other predisposing factors. ... Drought leads to water and food shortages and is likely to have a long-term environmental, economic and health impact on the population.

Forest fire

The most common hazard in forests is forests fire. Forests fires are as old as the forests themselves. They pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region. During summer, when there is no rain for months, the forests become littered with dry senescent leaves and twinges, which could burst into flames ignited by the slightest spark.

Chemical and industrial accidents

A chemical disaster may occur due to both, natural or human-made sources. Chemical disasters are occurrence of emission, fire or explosion involving one or more hazardous chemicals in the course of industrial activity (handling), storage or transportation.

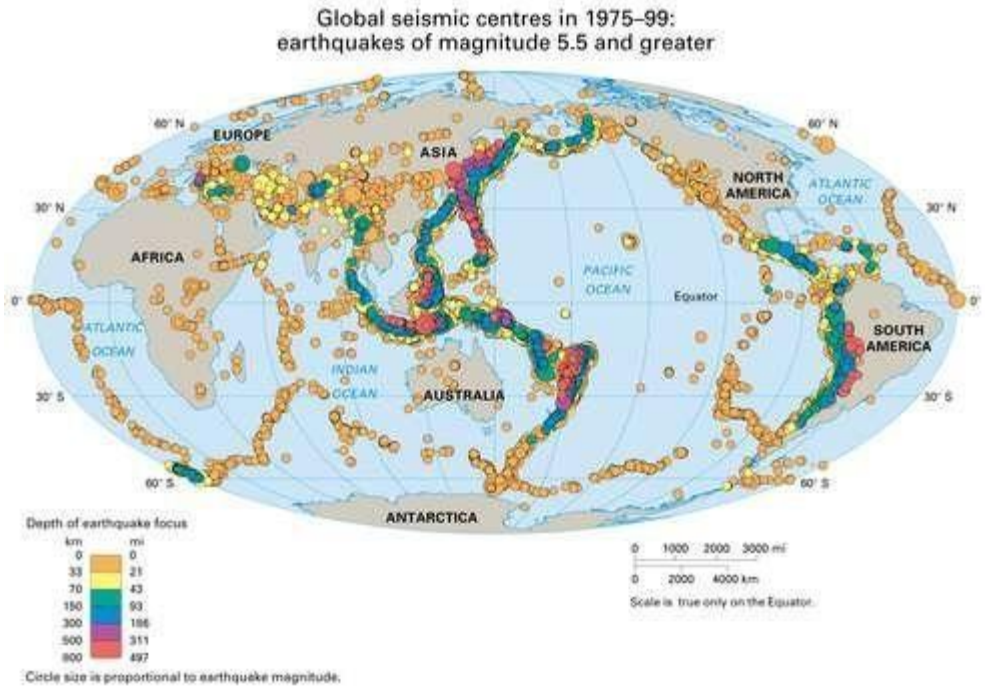
CHAPTER-2

EARTHQUAKE

1.1 Definition and concept, intensity, Richter's scale

Earthquake, any sudden shaking of the ground caused by the passage of seismic waves through Earth's rocks. Seismic waves are produced when some form of energy stored in Earth's crust is suddenly released, usually when masses of rock straining against one another suddenly fracture and "slip." Earthquakes occur most often along geologic faults, narrow zones where rock masses move in relation to one another. The major fault lines of the world are located at the fringes of the huge tectonic plates that make up Earth's crust. (*See* the table of major earthquakes.)

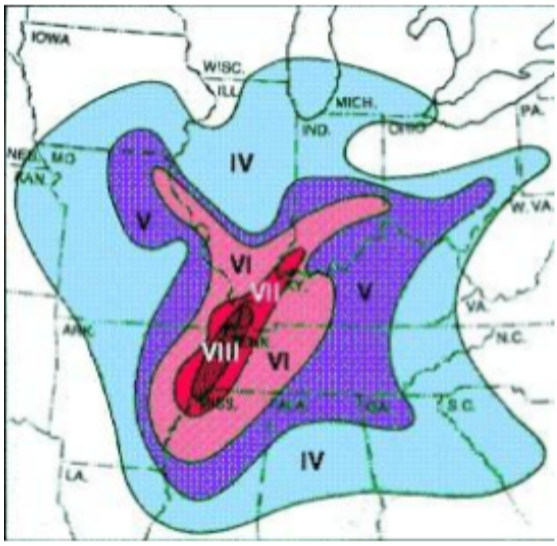
Little was understood about earthquakes until the emergence of seismology at the beginning of the 20th century. Seismology, which involves the scientific study of all aspects of earthquakes, has yielded answers to such long-standing questions as why and how earthquakes occur.



About 50,000 earthquakes large enough to be noticed without the aid of instruments occur annually over the entire Earth. Of these, approximately 100 are of sufficient size to produce substantial damage if their centres are near areas of habitation. Very great earthquakes occur on average about once per year. Over the centuries they have been responsible for millions of deaths and an incalculable amount of damage to property.

Intensity

The intensity is a number (written as a Roman numeral) describing the severity of an earthquake in terms of its effects on the earth's surface and on humans and their structures. Several scales exist, but the ones most commonly used in the United States are the Modified Mercalli scale and the Rossi-Forel scale. There are many intensities for an earthquake, depending on where you are, unlike the magnitude, which is one number for each earthquake.



Map showing intensity for the New Madrid earthquake. (Image courtesy of the Central U.S. Earthquake Consortium)

Richter's scale.

The Richter scale also Richter magnitude Richter magnitude scale, or Richter's magnitude scale – for measuring the strength of earthquakes refers to the original "magnitude scale" (as the author called it) developed by Charles F. Richter and presented in his landmark 1935 paper.[2] This was later revised and renamed the local magnitude scale, denoted as ML or M_L . Because of various shortcomings of the M_L scale most seismological authorities now use other scales, such as the moment magnitude scale (M_w), to report earthquake magnitudes, but much of the news media still refers to these as "Richter" magnitudes. All magnitude scales retain the logarithmic character of the original and are scaled to have roughly comparable numeric values (typically in the middle of the scale).

2.2- Element of risk.

Earthquake risk is the probable building damage, and number of people that are expected to be hurt or killed if a likely earthquake on a particular fault occurs. Earthquake risk and earthquake hazard are occasionally incorrectly used interchangeably.

2.3- Hazard Zones in India.

Seismic zones in Indian subcontinent is divided into four seismic zones (II, III, IV, and V) based on scientific inputs relating to seismicity, earthquakes occurred in the past and tectonic setup of the region.

Previously, earthquake zones divided into five zones with respect to the severity of the earthquakes, but Bureau of Indian Standards [IS 1893 (Part I):2002], has grouped the country into four seismic zones.; the first and second seismic zones were unified.

The bureau of Indian standards is the official agency for publishing the seismic hazard maps and codes. It has brought out versions of seismic zoning map: a six zone map in 1962, a seven zone map in 1966, and a five zone map 1970/1984.

Seismic Active Zone

Seismic Zone I

Area with minor damage (i.e., causing damages to structures with fundamentally periods greater than 1.0 second) earthquakes corresponding to intensities V to VI of **MM** scale (MM – Modified Mercalli Intensity scale). It covers the areas which are not covered by other three seismic zones discussed below.

Seismic Zone II

Moderate damage corresponding to intensity VII of **MM** scale. It comprises Kerala, Goa, Lakshadweep islands, remaining parts of Uttar Pradesh, Gujarat and West Bengal, Parts of Punjab, Rajasthan, Madhya Pradesh, Bihar, Jharkhand, Chhattisgarh, Maharashtra, Orissa, Andhra Pradesh, Tamilnadu and Karnataka.

Seismic Zone III

Major damage corresponding to intensity VII and higher of **MM** scale. It covers remaining parts of Jammu and Kashmir and Himachal Pradesh, National Capital Territory (NCT) of Delhi, Sikkim, Northern Parts of Uttar Pradesh, Bihar and West Bengal, parts of Gujarat and small portions of Maharashtra near the west coast and Rajasthan.

Seismic Zone IV

Area determines by pro seismically of certain major fault systems. It is seismically the most active region, and comprises entire northeastern India, parts of Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Rann of Kutch in Gujarat, part of North Bihar and Andaman & Nicobar Islands.

Earthquake zone IV is the most vulnerable to earthquakes, where historically some of the country's most powerful shock have occurred. Earthquakes with magnitudes in excess of 7.0 have occured in these areas, and have had intensities higher than IX.

2.4- Typical effects

The effects of an earthquake are terrible and devastating. Many building, hospitals, schools, etc are destroyed due to it. A lot of people get killed and injured. Many people lose their money and property. It affects the mental health and emotional health of people.

The environmental effects of it are that including surface faulting, tectonic uplift and subsidence, tsunamis, soil liquefaction, ground resonance, landslides and ground failure, either directly linked to a quake source or provoked by the ground shaking.

2.5- Main mitigation strategies,

Earthquake is one of the most devastating natural disasters on earth. Earthquake effects can cover hundreds of thousands of square kilometers; cause damage to structures or infrastructures facilities, result in loss of life and injury to hundreds of thousands of people, and disrupt the social and economic functioning of the affected area. Usually the effects will rise significantly as results of increasing in population and structures or infrastructure facilities. Although it is impossible to prevent earthquake from occurring, it is possible to mitigate the effects and to reduce loss of life, injuries and damage. The worst earthquake disaster in the modern years occurred in North Sumatra at Banda Aceh. The great Sumatran earthquake occurred on the 26th December 2004, measuring at 9.3 on the Richter Scale, had created tsunami that killed 283,100 people from surrounding countries, including Malaysia with 68 people died. With this incidence, Malaysia need to be prepared to confront with such disasters, which not only originate from our country but also from countries near by. Beside tsunami, earthquakes can create many more disasters such as liquefaction, landslides, earth ruptures and most prominently ground vibration. The ground vibration can cause structural collapse, loss of lives and property damages. Research in the field of earthquake engineering is still required even in the country with low to moderate seismic activity level such as Malaysia. Lessons learned from the 1985 Mexican earthquake and the 1957 San Francisco earthquake phenomena have shown that earthquake can have significant effects although at longer distance due to long period component of shear waves. Hence, the earthquake engineering research is needed in order to predict the possibility of earthquake in the future that can cause damages to the buildings and structures as well as to find the solution for mitigating the effects. The researches done by the author involve investigation and solution of the problems created by damaging earthquakes. The research work covers the seismic hazard assessment, vulnerability and risk studies of structures and infrastructures, practical application of new innovative products for earthquake disaster solutions, such as new types of base isolators, dampers, sensors and intelligent system in monitoring and managing earthquake-resistant structures and facilities.

safe Engineering practice

Earthquake engineering is an interdisciplinary branch of engineering that designs and analyzes structures, such as buildings and bridges, with earthquakes in mind. Its overall goal is to make such structures more resistant to earthquakes. An earthquake (or seismic) engineer aims to construct structures that will not be damaged in minor shaking and will avoid serious damage or collapse in a major earthquake. Earthquake engineering is the scientific field concerned with protecting society, the natural environment, and the man-made environment from earthquakes by limiting the seismic risk to socio-economically acceptable levels.[1] Traditionally, it has been narrowly defined as the study of the behavior of structures and geo-structures subject to seismic loading; it is considered as a subset of structural engineering, geotechnical engineering, mechanical engineering, chemical engineering, applied physics, etc. However, the tremendous costs experienced in recent earthquakes have led to an expansion of its scope to encompass disciplines from the wider field of civil engineering, mechanical engineering, nuclear engineering, and from the social sciences, especially sociology, political science, economics, and finance.

The main objectives of earthquake engineering are:

Foresee the potential consequences of strong earthquakes on urban areas and civil infrastructure. Design, construct and maintain structures to perform at earthquake exposure up to the expectations and in compliance with building codes.

A properly engineered structure does not necessarily have to be extremely strong or expensive. It has to be properly designed to withstand the seismic effects while sustaining an acceptable level of damage.

Indian Standard code

The list of Indian standard codes for earthquake design of structures include IS 1893–2002, IS 4928–1993, IS 13827–1992, IS: 13920–1997, IS: 13935–1993. These codes take several parameters into considerations for instance local seismology, accepted level of seismic risk, building typologies, construction materials, and methods used in construction.

Earthquake resistant building design guidelines are provided by set of Indian Standard codes (IS Codes). After observing Indian earthquakes for several years Bureau of Indian Standard has divided the country into five zones depending upon the severity of earthquake.

The role that codes of earthquake design structures play is of utmost important. This is because structures that designed and constructed in accordance with the specifications, procedures, and recommendations of these codes are capable of resisting seismic forces and associated deformations to certain extent.

These codes are the guidance of designers to plan, design, detail, and construct buildings to withstand earthquakes.

Finally, it should be known that, similar to other codes around the world, structures design based on these codes do not entirely immune from damages during earthquake of all magnitude.

However, such buildings are able to withstand sizeable intensities without total collapse.

I.S. Codes on Earthquake Resistant Building Design IS 1893

IS 1893 (Criteria for Earthquake Resistant Design of Structures).It is divided into five different parts.

Part 1 Presents provisions that are general in nature and applicable to all structures. It deals with assessment of seismic loads on various structures and earthquake resistant design of buildings. Additionally, it provides specifications related to buildings only. The other parts of IS 1893 including Part 2, 3, 4, and 5 need to be read in combination with this part.

Part 2 cover liquid retaining structures including elevated and ground supported structures.

Guidance is also provided on seismic design of buried tanks.

Part 3 deals with bridge and retaining walls.

Part 4 contains industrial structures including stack like structures.

Part 5 provide design and construction guidance on dams and embankments.

IS 4326

IS 4326 (Code of Practice for Earthquake Design Resistant Design and Construction of Buildings). This code covers general principles for earthquake resistant buildings. It deals with the selection of materials and special features of design and construction for different types of buildings such as timber constructions, masonry constructions using rectangular masonry units, and buildings with prefabricated reinforced concrete roofing/flooring elements. **IS 13827**

IS 13827 (Improving Earthquake Resistance of Earthen Buildings). The guidelines provided in IS 13827 deals with the design and construction aspects for improving earthquake resistant design of earthen houses without the utilization of stabilizers for instance cement, admixtures, lime, and asphalt. The

provisions of this standard are applicable for seismic zones III, IV and V. No special provisions are considered necessary in Zone II.

IS 13828

IS 13828 (Improving Earthquake Design of Low Strength Masonry Buildings).It provides general principles of design and special construction features for improving earthquake resistance of buildings of low-strength masonry. This masonry includes burnt clay brick or stone masonry in weak mortars, like clay-mud. The provisions of this standard are applicable in all seismic zones. No special provisions are considered necessary for buildings in seismic zone II. Low strength masonry dealt with based on this standard is termed non-engineered, and are not totally free from collapse under seismic shaking intensities VIII (MMI) and higher.

IS 13920

IS 13920 (Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces). This standard provides requirements for designing and detailing of reinforced concrete structures in order to equip them with adequate toughness and ductility to withstand serious earthquake shocks without collapse. The provisions for reinforced concrete construction given in this standard apply specifically to monolithic reinforced concrete construction. Precast and/or prestressed concrete members may be used only if they can provide the same level of ductility as that of a monolithic reinforced concrete construction during or after an earthquake.

IS 13935

IS 13935 (Seismic Evaluation, Repair and Strengthening of Masonry Buildings – Guidelines). These guidelines cover general principles of seismic strengthening, selection of materials, and techniques for repair/seismic strengthening of masonry and wooden buildings. The code provides a brief coverage for individual reinforced concrete members in such buildings, but does not cover reinforced concrete frame or shear wall buildings as a whole. Some guidelines are also laid down for non-structural and architectural components of buildings.

enforcement Bye-Laws

A by-law (bylaw, bye-law, byelaw) is a rule or law established by an organization or community to regulate itself, as allowed or provided for by some higher authority. The higher authority, generally a legislature or some other government body, establishes the degree of control that the by-laws may exercise. By-laws may be established by entities such as a business corporation, a neighborhood association, or depending on the jurisdiction, a municipality.

CHAPTER-3
TSUNAMI

3.1- Definition concept

A tsunami or tidal wave is a series of waves in a water body caused by the displacement of a large volume of water, generally in an ocean or a large lake. Earthquakes, volcanic eruptions and other underwater explosions above or below water all have the potential to generate a tsunami.

3.2-onset,type and causes Types of Tsunami

A tsunami is a catastrophic sea wave that achieves landfall and causes destruction. Its source is a major geographic event under sea level, such as an earthquake, volcano eruption, or landslide. Though frequently called tidal waves, tsunamis have nothing to do with ocean tides. Many Pacific and Indian Ocean coastal countries maintain tsunami warning systems so local governments can establish timely evacuation routes. The warning systems specify what kind of tsunami may be moving toward land and provide evacuation information.

(1)Local Tsunami

A local tsunami is a tsunami that causes damage in relatively close proximity to the tsunamicausing event. Specifically, the underwater event -- usually an earthquake -- that produces a local tsunami happens within 100 km, which is a little over 60 miles, of the land damage that results. These tsunamis can be devastating because the time between the underwater event and the arrival of the tsunami can be under an hour -- and sometimes less than 10 minutes. This does not provide sufficient time for comprehensive evacuations.

(2)Regional Tsunami

A regional tsunami is one that causes damage from 100 km to 1,000 km from the underwater event that causes the tsunami. In some cases, more contained damages occur outside the 1,000 km perimeter. Regional tsunamis provide slightly more warning time than local tsunamis, making landfall between one and three hours of the event that causes them. Within the 1,000 km area, just one to three hours may not provide enough time for people to evacuate safely.

(3)Distant Tsunami

A distant tsunami, also called a tele-tsunami or ocean-wide tsunami -- originates with an exceptionally powerful and destructive event more than 1,000 km away from landfall. Though a distant tsunami may first appear like a local tsunami, it travels across wide swathes of ocean basin. There is more time to evacuate and escape a distant tsunami, but it also covers a larger mass of land and tends to cause extensive and widespread destruction.

Causes of Tsunami

Tsunamis are caused by sudden movements of the earth that happens under the sea. Often the most destructive Tsunamis are caused by **earthquakes** but causes can also include volcanic eruptions, landslides or even a comet hitting the sea.

Landslides cause tsunamis when the debris falls into the water. This has the same effect of dropping a large stone into a pool - big ripples are created. But when this happens in the sea and it is thousands of tonnes of rock and earth falling into the sea a very large ripple, more like a tidal wave is created. This travels across the sea until it comes into contact with land and a tsunami is formed.

Volcanoes cause tsunamis when there is an eruption. The volcano can either be on land or under the sea, in which case it is known as a submarine volcano. If the volcanic eruption happens on land, the tsunami is caused by debris and lava from the volcano flowing into the sea, which once again causes a bug ripple.

If the eruption happens under water, the enormous power of the eruption sends shudders through the earth and disrupts the water. The water in the sea then breaks into waves which travel across the ocean until they come into contact with a coast. Here, a tsunami is formed.

3.3- Warnning.

A tsunami warning is issued when a tsunami with the potential to generate widespread inundation is imminent, expected, or occurring. Warnings alert the public that dangerous coastal flooding accompanied by powerful currents is possible and may continue for several hours after initial arrival.

3.4- Elements at risk

The population, structures, utilities, systems and socio- economic activities constitute the “elements at risk” in urban areas. The physical elements are the built environment such as buildings and lifelines. Demographic data represent the social elements at risk.

3.5-Typical effects

Psychological effects

Victims of tsunami events often suffer psychological problems which can last for days, years or an entire lifetime. Survivors of the Sri Lankan tsunami of December 2004 were found to have PTSD (post traumatic stress disorder) when examined by the World Health Organization (WHO): 14% to 39% of these were children, 40% of adolescents and 20% of mothers of these adolescents were found to have PTSD 4 months after the tsunami.

These people were suffering from grief and depression as their homes, businesses and loved ones were taken from them. Many still had PTSD. Periliya Village counts 2,000 dead and 400 families became homeless. These people were found to still have psychological problems 2 years after the tsunami.

Environmental damage

Tsunamis not only destroy human life, but have a devastating effect on insects, animals, plants, and natural resources. A tsunami changes the landscape. It uproots trees and plants and destroys animal habitats such as nesting sites for birds. Land animals are killed by drowning and sea animals are killed by pollution if dangerous chemicals are washed away into the sea, thus poisoning the marine life.

The impact of a tsunami on the environment relates not only to the landscape and animal life, but also to the man-made aspects of the environment. Solid waste and disaster debris are the most critical environmental problem faced by a tsunami-hit country.

Recycling and disposal of this waste in an environmentally sensitive manner where possible (crushing concrete, bricks, etc. to produce aggregate for rebuilding and road reconstruction) are critical.

Combined with the issue of waste is that of hazardous materials and toxic substances that can be inadvertently mixed up with ordinary debris. These include asbestos, oil fuel, and other industrial raw materials and chemicals. Rapid clean-up of affected areas can result in inappropriate disposal methods, including air burning and open dumping, leading to secondary impacts on the environment.

Contamination of soil and water is the second key environmental impact of a tsunami. Salination of water bodies such as rivers, wells, inland lakes, and groundwater aquifers can occur in most cases. This also affects the soil fertility of agricultural lands, due to salination and debris contamination, which will affect yields in the medium and long term. Sewage, septic tanks and toilets are damaged contaminating the water supply.

Last but not least, there may be radiation resulting from damage to nuclear plants, as it happened in Japan in March 2011. Since radiation exists for a long time, it has the capacity to inflict damage upon anything exposed to it. Radiation is most dangerous to animals and humans causing destruction as molecules loose their electrons. The damage caused by radiation to the DNA structure determines birth defects, cancers even death.

Devastation of Homes

Tsunamis can destroy entire buildings and can cause serious property damage. Many individuals who live in an area hit by a tsunami lose everything they own, which leaves them homeless and without resources in the initial aftermath. Some of the tsunami effects include leveling homes down to their foundations and exposing bedrock. The rebuilding process is expensive, timeconsuming and psychologically tumultuous for people.

Loss of Life

Tsunami dangers are difficult to detect far out at sea, since waves do not begin to gain size until they reach shallower waters. As a result, they strike with very little warning, often resulting in a huge loss of human

life. The tsunami that struck northern Japan after an offshore earthquake on March 11, 2011, killed at least 14,340 people, which crushed buildings and left thousands trapped under debris or pulled out to sea.

Damage to the Economy

Daily life for individuals in a nation affected by a tsunami changes because of the damage the disaster causes to the economy. Locations that were previously popular destinations for visitors suffer depression as a result of lost tourism, with people staying away out of fear and during reconstruction. Rebuilding after a tsunami puts a significant financial strain on governments as well, resulting in an economic downturn that can affect entire regions of the world.

Disease and Contamination

After a tsunami, contaminated water and food supplies pose a risk to people's health. Flood waters can carry many sources of contamination such as dirt or oil. In addition, infectious diseases increase after a tsunami. Malaria and cholera may become more common. People may have to stay in shelters or other close quarters that make spreading diseases easier.

Other Health Effects

Tsunamis can lead to other devastating health consequences. People may have traumatic injuries from the destruction of property and landscapes. Many people may suffer from broken bones or brain injuries. The loss of normal shelters can also leave them exposed to wind and hot or cold temperatures. They may also suffer mental health issues such as post-traumatic stress disorder or anxiety.

Serious Environmental Changes

After a tsunami strikes, landscapes that previously constituted picturesque beaches or seaside towns become a wasteland. In addition to the destruction of human construction, tsunamis destroy vegetation such as trees, resulting in landslides and coastlines that slip into the sea as deep root systems that previously held land in place get ripped out. These changes force human inhabitants to rebuild in an entirely different way, redesigning their lifestyles and livelihoods around an altered environments

Specific preparedness:

If you are in a tsunami hazard zone and receive an official warning:

- Stay out of the water and away from beaches and waterways
- Get more information from radio, television, and your mobile device (text or data.)
- If officials ask you to evacuate, move quickly to a safe place. Follow evacuation signs or go as high or far inland (away from the water) as possible.

If you are in a tsunami hazard zone and receive a natural warning*, a tsunami could arrive within minutes.

- In case of an earthquake, protect yourself. Drop, cover, and hold on. Be prepared for aftershocks. Each time the earth shakes, drop, cover, and hold on.
- Take action. Do not wait for an official warning or instructions from officials.
- As soon as you can move safely, move quickly to a safe place. Follow evacuation signs or go as high or far inland (away from the water) as possible.
- If there is earthquake damage, avoid fallen power lines, and stay away from weakened structures.
- When you are in a safe place, get more information from radio, television, or your mobile device (text or data.)

If you are on the beach or near water and feel an earthquake of any size or length, move quickly to high ground or inland (away from the water) as soon as you can move safely.

Tsunami risk is a combination of the danger posed by tsunami hazard, the vulnerability of people to an event, and the probability of destructive tsunami. ... Tsunami risk map described five classes of risk. It described that coastal area with a low elevation and almost flat identified as high risk to the tsunami.

early warning systems

There are two distinct types of tsunami warning systems: international and regional. When operating, seismic alerts are used to instigate the watches and warnings; then, data from observed sea level height (either shore-based tide gauges or DART buoys) are used to verify the existence of a tsunami.

3.7- Main mitigation strategies

- Listen to radio for emergency and evacuation information.
- Climb to higher ground as soon as warning of a tsunami is released.
- Stay away from the beach - if you can see the wave, you are too close to escape it.
- Do not assume that one wave means the danger is over - the next wave may be larger than the first.

CHAPTER-4
LANDSLIDES

4.1-Definition

A landslide is defined as the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of "mass wasting," which denotes any down-slope movement of soil and rock under the direct influence of gravity. ... These landslides are called submarine landslides. **4.2- Onset time and warning**

Landslides occur suddenly, and they usually result in extensive monetary, material, and social losses. They are caused due to the elevation of the water level in the ground, usually after a prolonged rainfall.

In order to provide a solution to the problem, developed an early warning system that informs people about the likelihood of a landslide in a particular area. The system measures the water level in the ground, using measuring devices called piezometric sensors; obviously we did not have the time and resources needed to develop this component, so we used fictitious data. The water level data are read in real time through a computer console that runs a computer program that we developed. The console then runs a computational geotechnical mathematical model that we developed, which evaluates the potential of a landslide. In particular, the geotechnical model uses Bishop's method, which is a widely used method in geotechnical engineering for the evaluation of the stability of a soil slope. The stability of a slope is expressed in terms of the 'Factor of Safety'. After the geotechnical model is run, the console posts the results about the likelihood of a landslide on a website using a color code: a green color indicates that the area is safe, an orange color indicates that there is a low potential for a landslide, and a red color indicates that the area should be immediately evacuated. A smartphone application was also developed, using the Android operating system, which displays the color code on people's smartphones.

4.3- Causes of landslides (a) Natural Causes of Landslides (i) Climate

Long-term climatic changes can significantly impact soil stability. A general reduction in precipitation leads to lowering of water table and reduction in overall weight of soil mass, reduced solution of materials and less powerful freeze-thaw activity. A significant upsurge in precipitation or ground saturation would dramatically increase the level of ground water. When sloped areas are completely saturated with water, landslides can occur. If there is absence of mechanical root support, the soils start to run off.

(ii)Earthquakes

Seismic activities have, for a long time, contributed to landslides across the globe. Any moment tectonic plates move, the soil covering them also moves along. When earthquakes strike areas with steep slopes, on numerous occasion, the soil slips leading to landslides. In addition, ashen debris flows instigated by earthquakes could also cause mass soil movement. **(iii)Weathering**

Weathering is the natural procedure of rock deterioration that leads to weak, landslide-susceptive materials. Weathering is brought about by the chemical action of water, air, plants and bacteria. When the rocks are weak enough, they slip away causing landslides.

(iv)Erosion

Erosion caused by sporadic running water such as streams, rivers, wind, currents, ice and waves wipes out latent and lateral slope support enabling landslides to occur easily.

(v)Volcanoes

Volcanic eruptions can trigger landslides. If an eruption occurs in a wet condition, the soil will start to move downhill instigating a landslide. Stratovolcano is a typical example of volcano responsible for most landslides across the globe.

(vi)Forest fires

Forest fires instigate soil erosion and bring about floods, which might lead to landslides.

(vii)Gravity

Steeper slopes coupled with gravitational force can trigger a massive landslide.

(b)Human causes of landslides (i)Mining

Mining activities that utilize blasting techniques contribute mightily to landslides. Vibrations emanating from the blasts can weaken soils in other areas susceptible to landslides. The weakening of soil means a landslide can occur anytime.

(ii)Clear cutting

Clear cutting is a technique of timber harvesting that eliminates all old trees from the area. This technique is dangerous since it decimates the existing mechanical root structure of the area.

4.4-Elements at risk

Each year, landslides are responsible for hundreds of millions of dollars' worth of damage and, on average, claim more than 1000 lives around the world. Although most common in mountainous areas, landslides can occur anywhere with enough local relief to generate gravitational stresses capable of causing rock or soil to fail. In recent decades, research rooted in engineering and the physical sciences, new technologies, and improvements in computational power have greatly advanced our understanding of the causes, triggers, and mechanics of landslides. However, these improvements and advances bear on only part of the landslide risk equation – hazard and exposure; other factors that affect risk are much less understood. Notably, vulnerability and coping capacity, two concepts most developed in the social

sciences, play an important – but poorly understood – role in landslide risk. We provide an example of an attempt to estimate landslide risk, which illustrates the difficulty of adequately quantifying vulnerability. We also argue that landslide risk will almost certainly increase over the rest of this century, due to a large increase in global population, settlement and development of previously sparsely populated landslide-prone regions, and climate change.

4.5-Hazard zones and Indian landslide Landslide hazard zonation maps were prepared for selected pilgrim routes in the country. These zones are delineated based on geological, topological and anthropogenic factors. These factors include lithology, soil, slope, drainage, lineament, landuse, etc. At present these maps are available for pilgrim routes in Himachal Pradesh, Uttarakhand, Meghalaya. n addition, event-based and seasonal landslide inventory is also carried out. The information on landslide inventory and hazard zones help the decision makers for better planning in these areas

4.6-Typical effects (i) Lead to economic decline

Landslides have been verified to result in destruction of property. If the landslide is significant, it could drain the economy of the region or country. After a landslide, the area affected normally undergoes rehabilitation. This rehabilitation involves massive capital outlay. For example, the 1983 landslide at Utah in the United States resulted in rehabilitation cost of about $500 million. The annual loss as a result of landslides in U.S. stands at an estimated $1.5 billion.

(ii)Decimation of infrastructure

The force flow of mud, debris, and rocks as a result of a landslide can cause serious damage to property. Infrastructure such as roads, railways, leisure destinations, buildings and communication systems can be decimated by a single landslide.

(iii)Loss of life

Communities living at the foot of hills and mountains are at a greater risk of death by landslides. A substantial landslide carries along huge rocks, heavy debris and heavy soil with it. This kind of landslide has the capacity to kills lots of people on impact. For instance, Landslides in the UK that happened a few years ago caused rotation of debris that destroyed a school and killed over 144 people including 116 school children aged between 7 and 10 years. In a separate event, NBC News reported a death toll of 21 people in the March 22, 2014, landslide in Oso, Washington.

(iv)Affects beauty of landscapes

The erosion left behind by landslides leaves behind rugged landscapes that are unsightly. The pile of soil, rock and debris downhill can cover land utilized by the community for agricultural or social purposes.

(v)Impacts river ecosystems

The soil, debris, and rock sliding downhill can find way into rivers and block their natural flow. Many river habitats like fish can die due to interference of natural flow of water. Communities depending on the river water for household activities and irrigation will suffer if flow of water is blocked.

4.7- Main mitigation strategies

Landslides pose a recurrent hazard to human life and livelihood in most parts of the world, especially in some regions that have experienced rapid population and economic growth. Hazards are mitigated mainly through precautionary means—for instance, by restricting or even removing populations from areas with a history of landslides, by restricting certain types of land use where slope stability is in question, and by installing early warning systems based on the monitoring of ground conditions such as strain in rocks and soils, slope displacement, and groundwater levels. There are also various direct methods of preventing landslides; these include modifying slope geometry, using chemical agents to

reinforce slope material, installing structures such as piles and retaining walls, grouting rock joints and fissures, diverting debris pathways, and rerouting surface and underwater drainage. Such direct methods are constrained by cost, landslide magnitude and frequency, and the size of human settlements at risk.

CHAPTER-5
CYCLONE

5.1-Definition, concept

In meteorology, a cyclone is a large scale air mass that rotates around a strong center of low atmospheric pressure. Cyclones are characterized by inward spiraling winds that rotate about a zone of low pressure. ... Warm-core cyclones such as tropical cyclones and subtropical cyclones also lie within the synoptic scale.

5.2-Onset type, Warning

The cyclone warnings are issued to state government officials in four stages. The First Stage warning known as "PRE CYCLONE WATCH" issued 72 hours in advance contains early warning about the development of a cyclonic disturbance in the north Indian Ocean, its likely intensification into a tropical cyclone and the coastal belt likely to experience adverse weather. This early warning bulletin is issued by the Director General of Meteorology himself and is addressed to the Cabinet Secretary and other senior officers of the Government of India including the Chief Secretaries of concerned maritime states.

The Second Stage warning known as "CYCLONE ALERT" is issued at least 48 hrs. in advance of the expected commencement of adverse weather over the coastal areas. It contains information on the location and intensity of the storm likely direction of its movement, intensification, coastal districts likely to experience adverse weather and advice to fishermen, general public, media and disaster managers. This is issued by the concerned ACWCs/CWCs and CWD at HQ.

The Third Stage warning known as "CYCLONE WARNING" issued at least 24 hours in advance of the expected commencement of adverse weather over the coastal areas. Landfall point is forecast at this stage. These warnings are issued by ACWCs/CWCs/and CWD at HQ at 3 hourly interval giving the latest position of cyclone and its intensity, likely point and time of landfall, associated heavy rainfall, strong wind and storm surge alongwith their impact and advice to general public, media, fishermen and disaster managers.

The Fourth Stage of warning known as "POST LANDFALL OUTLOOK" is issued by the concerned ACWCs/CWCs/and CWD at HQ at least 12 hours in advance of expected time of landfall. It gives likely

direction of movement of the cyclone after its landfall and adverse weather likely to be experienced in the interior areas

5.3-Elements at risk

All lightweight structures and those built of mud, wood, older buildings with weak walls and structures without proper anchorage to the foundations will be at great risk. Settlements located in low lying coastal areas will be vulnerable to the direct effects of the cyclones such as wind, rain and storm surge. Settlements in adjacent areas will be vulnerable to floods, mud-slides or landslides due to heavy rains. Other elements at risk are fences, telephone and electricity poles, cables, light elements of structures – roofs, signboards, hoardings, coconut crowns, fishing boats and large trees.

5.4-Typical effects

A cyclone is a system in which winds rotate inward toward an area of low atmospheric pressure. In the northern hemisphere, cyclones circulate counterclockwise and in the southern hemisphere they circulate in a clockwise direction. There are six types of cyclones, including what is typically referred to as hurricanes, as well as polar cyclones and mesocyclones. All types of cyclones are capable of causing massive destruction depending on where they strike.

Strong Winds in Cyclones

Cyclones, especially those in the tropics, are known for their strong winds. These winds are typically stronger on the right side of the storm in the northern hemisphere, but even the weaker winds on the left side of the storm can cause major damage. In addition to wind speeds, gusts and sustained heavy winds affect how much damage is done. Flying debris also contribute to the effect of cyclone damage on populated areas.

A Dangerous Rain Event

As cyclones develop, they pull warm water from the oceans into their cloud systems. This precipitates out as heavy rainfall. Heavy rains associated with cyclones lead to flash floods, a major cause of deaths during a cyclone. Whether or not flooding will occur depends on how much rain the cyclone is putting out, the speed of the system and the geographical characteristics of the area. Even systems that are not putting out much rainfall can cause flash floods if they sit over a certain area of land for long periods of time. Soil that does not absorb water well, as well as mountains and hills that cause runoff and plants that prevent runoff, are all geographical characteristics that contribute to flash flooding.

Storm Surges

Storm surges are caused by wind blowing across the open ocean. As waves build up speed and size, they become too big to crash against the beach without surging inland. Storm surge causes coastal flooding, especially in low-lying areas. As storm surges recede, they contribute to one of the prominent environmental impacts of cyclones: beach erosion. There are several factors that affect the size and strength of storm surges, including the slope of the ocean floor, the coastline's shape and the absence or presence of coral reefs.

Tornadoes: Another Type of Tropical Storm Damage

Hurricanes, or tropical cyclones, frequently cause tornadoes – a weather phenomenon that isn't typically associated with the tropics. These tornadoes are formed as the hurricane crosses islands or coastlines. The wind force of a tornado, along with the sudden drop in pressure it causes, is responsible for much of the damage attributed to a tornado.

In order to occur, tropical cyclones generally require ocean temperatures of at least 80 F. The systems begin with heat generated from spiraling water vapor in the atmosphere. This spiraling vapor forms into the convective clouds discussed earlier. Typhoon incidence rate is correlated with sea-surface temperature. Because of this, there may be a connection between global warming and tropical cyclones; as the temperature of the waters increase, so does the incidence of tropical cyclones.

5.5-Indian Hazard Zones.

India is highly vulnerable to natural hazards like earthquakes, floods, drought, cyclones and landslides. According to the meteorological department, there are 13 coastal states and Union Territories in India are Cyclone prone region. Four states like West Bengal, Andhra Pradesh, Odisha, Tamil Nadu-and one UT Puducherry on the east coast and Gujarat on the west coast are more vulnerable.

5.6- Main mitigation strategies

- Early warning systems to alert the public in advance to move to safer locations.
- Protecting the coast by planting trees and mangroves forests along the coast. They can reduce the intensity of cyclone falling on the land.
- Proper urban planning in which the low lying areas are not heavily populated. As we have seen in Chennai floods, the urban planning in India is haphazard leading to problem of floods.
- Drainage system in urban areas should be revamped so that the cyclone water can exit easily.
- Wetlands should be conserved since they act as buffers in case of cyclones.
- Trained and well equipped disaster management force to handle the disaster.
- Since most often during cyclones, the normal communication lines are disrupted, the provision of satellite communication should be strengthened in the cyclone prone areas to effectively handle the cyclone disaster.
- Provision of cyclones shelter houses to which people can take shelter during cyclones.

CHAPTER-6

Flood

6.1- Definition

Floods are natural occurrences where an area or land that is normally dry abruptly becomes submerged in water. In simple terms, flood can be defined as an overflow of large quantities of water onto a normally dry land. Flooding happens in many ways due to overflow of streams, rivers, lakes or oceans or as a result of excessive rain.

6.2- Warning

A flood warning is closely linked to the task of flood forecasting. The distinction between the two is that the outcome of flood forecasting is a set of forecast time-profiles of channel flows or river levels at various locations, while "flood warning" is the task of making use of these forecasts to make decisions about whether warnings of floods should be issued to the general public or whether previous warnings should be rescinded or retracted.

The task of providing warning for floods is divided into two parts:

decisions to escalate or change the state of alertness internal to the flood warning service provider, where this may sometimes include partner organisations involved in emergency response; decisions to issue flood warnings to the general public.

The decisions made by someone responsible for initiating flood warnings must be influenced by a number of factors, which include:

- The reliability of the available forecasts and how this changes with lead-time.
- The amount of time that the public would need to respond effectively to a warning.
- The delay between a warning being initiated and it being received by the public.
- The need to avoid issuing warnings unnecessarily, because of the wasted efforts of those who respond and because a record of false alarms means that fewer would respond to future warnings.
- The need to avoid situations where a warning condition is rescinded only for the warning to be re-issued within a short time, again because of the wasted efforts of the general public and because such occurrences would bring the flood warning service into disrepute.

A computer system for flood warning will usually contain sub-systems for:

flood forecasting

automatic alerting of internal staff; tracking of alert messages and acknowledgements received; diversion of messages to alternates where no acknowledgement received.

6.3- Elements at risk.

Flood risk is a combination of the probability (likelihood or chance) of an event happening and the consequences (impact) if it occurred. Flood risk is dependent on there being a source of flooding, such as a river, a route for the flood water to take (pathway), and something that is affected by the flood (receptor), such as a housing estate.

Without a pathway linking the source to the receptor, a flood may be a hazard, but not a risk. This concept is known as the source-pathway-receptor model.

The likelihood of a flooding event happening can often be misleading or confusing. Return periods are often used to describe how often a flooding event will occur, but using terms such as 1 in 50 years or 1 in 500 years can mislead the public into thinking that a 1 in 50 year flood event will only occur every 50 years. Return periods are an average of how often a flood event of that magnitude will occur, and so the probability or chance of flooding should be used instead, so for example, a 1 in 50 year flood has a 2 per cent probability of occurring in any one year.

The consequences of a flood depend on two factors, exposure and vulnerability. Exposure is a measure of the number of people or things that may be affected by a flood while vulnerability is a measure of the potential of people or things to be harmed.

For example, the consequences of a flood will be less severe in an area with very few people (low exposure) who are able to evacuate quickly and easily (low vulnerability). Flooding in an area with lots of people (high exposure) who have difficulty with evacuation (high vulnerability) is likely to have more serious consequences.

6.4- Hazard zones and Indian floods

The major flood prone regions in India are Punjab, Haryana, most of the Gangetic plains, including Uttar Pradesh, North Bihar and West Bengal, the Brahmaputra valley, coastal Andhra Pradesh and Orissa, and southern Gujarat. Now-a-days Kerala and Tamil Nadu also feel the fury of the floods. In September 2014, the Kashmir region witnessed disastrous floods across the majority of its districts caused by torrential rainfall across the Indian administrated Jammu and Kashmir. In June 2013, a multi-day cloudburst centred on the North Indian state Uttarakhand, caused devastating floods and landslides.

6.5- Typical effects

• Damage to pipelines and appurtenances (such as different types of chambers and valves) may include:

• Soil erosion leading to sections of pipe being uncovered, displaced, or washed away;

- As ground water levels rise, pipes and chambers can be displaced and float, causing ruptures in the installations;

- Displacement and total loss of sections of pipe.

- Damage to partially buried tanks. These tanks are usually located in high terrain and flood damage is rare. However, the following has been observed:

- Erosion of foundations, causing cracks and/or partial cave-in of tanks, especially when constructed of masonry rather than reinforced concrete;

- If a large part of the tank is underground, flooding combined with high ground water levels (likely in terrain where there has been prolonged rainfall), can cause the tank to float. The risk is greater if the tank is not full of water.

- Damage to pumping equipment and electrical installations. This may occur in the following cases:

- If the flood level is sufficient, it can wet electrical engines, pumps, starters, or switchboards;

- Voltage lines can fall owing to erosion at the base of the poles causing damage to lines, switchboards, and substations.

- Damage to intakes, dams, and other surface construction. If the dynamic forces of the flood are strong enough they can cause erosion around any of the installations. These conditions have an impact on water intakes and corresponding structures such as channels and water conduits, engine houses, treatment plants, etc.

- Damage to dams and reservoirs. Dams and reservoirs located in river channels are at high risk to flooding. Dams designed for drinking water supply are vulnerable particularly if there is limited overtopping capacity. If the spillway and waste gates are inadequate, there is a risk that the dam could collapse, causing yet another disaster and enormous additional losses as a result of the avalanche of stored water.

Casualties and Public health

The immediate health impacts of floods include drowning, injuries, hypothermia, and animal bites. Health risks are also associated with the evacuation of patients, loss of health workers, and loss of health infrastructure including essential drugs and supplies.

6.6- Main mitigation strategies

It is important to understand the effectiveness of individual measures in terms of flood mitigation impact when considering structural solutions for flood mitigation.

Depending on locality and the nature of the flooding, a number of structural and non-structural mitigation measures may be available. However, flood mitigation measures may only lessen the impact of flooding. No amount of intervention can stop heavy rain or high tides.

(1)Structural flood mitigation

Structural flood mitigation is where physical structures are constructed or modified to reduce the impact of flooding on individual properties or whole catchments and include:

Infrastructure, including dams, levees, bridges and culverts

When considering structural solutions, it is important to understand the effectiveness of individual measures in terms of flood mitigation impact. For example, some works may reduce flooding to a large area by centimetres which provides minimal benefit to a large number of homeowners that are least affected by flooding and almost no benefit to those homeowners that are worst affected.

Maintenance of existing infrastructure

Ongoing maintenance to existing creeks and stormwater drainage systems is vital to maintain the hydraulic performance of drains. Developing and reviewing a regular maintenance schedule for flood prone areas can provide significant benefit during seasonal rains. While targeted clearing of creek systems does not always help reduce the impact of large flood events, it does help reduce the impact of smaller, more frequent floods.

Individual flood proofing measures

Where the inundation of flood water is relatively low (nominally less than 700mm), it may be possible to keep flood waters out of homes by installing solid fences, raising windows, sealing doors with ‘stop boards’ and limiting sewage contamination through reflux or backflow valves.

Improved traffic access

Improving the flood resilience of roads provides a benefit to flood-affected residents by allowing residents to escape floods and allowing emergency service access. Key routes to essential services such as hospitals and emergency shelters should have at least a Q100 flood immunity.

(2)Non-structural flood mitigation Property surveys

Detailed surveys of flood affected residences can increase the accuracy of flood modelling so that homeowners, insurers and buyers can understand the actual impact of flooding on each property.

Land use planning controls

Strategic land use planning will identify the extent of flood impacted land to limit the construction of urban and rural residential, commercial and industrial land. The NT Planning Scheme requires all new developments to undertake land suitability investigations to determine the extent of constrained land.

Building and development controls

Existing building controls require new homes or substantial renovations to construct habitable floor levels 300mm above Q100 year flood levels, to provide some level of protection from flooding.

Catchment flood modelling

Maintaining up-to-date flood models of developing catchments assists the Development Consent Authority to understand the impact of new development on existing residents in the catchment. New land developments are required to manage the rate at which stormwater leaves the development to maintain the pre-development rate of flow.

Early warning systems

As many floods occur at night, early warning systems are extremely important in flash flooding events to provide residents with the ability to respond to impending flood waters. This may include relocating of parked vehicles, collecting pets and valuables and implementing personal emergency plans.

Develop a household emergency plan

In conjunction with a household emergency kit, a household emergency plan is essential for all Territorians. Regardless of any mitigation measures, every household must be prepared for extreme weather, including flooding.

Access to information and warnings

The Northern Territory Government's Secure NT website gives advice on planning for emergencies and provides up-to-date information during and after emergencies including major flooding, extreme weather and cyclones. Other useful sites include:

Bureau of Meteorology (BOM) - you can also find the latest river heights for Northern Territory Rivers on the BOM site.

Understanding and awareness

Knowing your local flood history and developing an understanding of how floods behave in your area provides you with the ability to respond in time to an impending flood. Monitoring tide and rainfall forecasts can alert residents when the conditions that may result in flooding could occur.

CHAPTER-7

DROUGHT

7.1- Definition, concept

Drought is a continuous period of dry weather, when an area gets less than its normal amount of rain, over months or even years. ... Its effects often build up slowly over a long period of time and may last from months to years after rain resumes.

7.2- Onset type and warning

A drought early warning system's main purpose is to warn local communities when there is risk of a drought, improving preparedness and decreasing risks associated with crop and food loss. This technology is particularly important for agriculture and water resource management. Effective warning systems require drought monitoring using appropriate drought indicators, meteorological data and forecasts, a warning signal, public awareness and education, institutional cooperation, and data sharing arrangements. The unpredictable weather patterns resulting from climate change, such as the occurrence of increasingly severe droughts, make this technology important for climate change adaptation efforts in many countries. Assessing risks and vulnerabilities and improving preparedness for natural disasters can minimize threats and avoid expensive relief efforts following such an event. An early warning system combined with the slow onset of a drought can give sufficient lead-time to local decision makers to mitigate drought threats, for example by arranging for emergency food supply, planning water harvesting programmes or introducing improved dryland farming initiatives.

7.3- Elements at risk

Drought is a environmental condition of long period of low rainfall causes shortage of water in certain territory. different animals of the environment of the ecosystem are at several risks during the drought period. 4)animals and birds can also die due to water thirst.

7.4- Typical effects

Drought affects all parts of our environment and our communities. The many different drought impacts are often grouped as "economic," "environmental," and "social" impacts. All of these impacts must be considered in planning for and responding to drought conditions.

Let's take a closer look at all kinds of drought impacts.

Economic Impacts

Economic impacts are those impacts of drought that cost people (or businesses) money. Here are just a few different examples of economic impacts:

- Farmers may lose money if a drought destroys their crops.
- If a farmer's water supply is too low, the farmer may have to spend more money on irrigation or to drill new wells.

- Ranchers may have to spend more money on feed and water for their animals.
- Businesses that depend on farming, like companies that make tractors and food, may lose business when drought damages crops or livestock.
- People who work in the timber industry may be affected when wildfires destroy stands of timber.
- Businesses that sell boats and fishing equipment may not be able to sell some of their goods because drought has dried up lakes and other water sources.
- Power companies that normally rely on hydroelectric power (electricity that's created from the energy of running water) may have to spend more money on other fuel sources if drought dries up too much of the water supply. The power companies' customers would also have to pay more.
- Water companies may have to spend money on new or additional water supplies.
- Barges and ships may have difficulty navigating streams, rivers, and canals because of low water levels, which would also affect businesses that depend on water transportation for receiving or sending goods and materials.
- People might have to pay more for food.

Environmental Impacts

Drought also affects the environment in many different ways. Plants and animals depend on water, just like people. When a drought occurs, their food supply can shrink and their habitat can be damaged. Sometimes the damage is only temporary and their habitat and food supply return to normal when the drought is over. But sometimes drought's impact on the environment can last a long time, maybe forever. Examples of environmental impacts include:

- Losses or destruction of fish and wildlife habitat
- Lack of food and drinking water for wild animals
- Increase in disease in wild animals, because of reduced food and water supplies
- Migration of wildlife
- Increased stress on endangered species or even extinction
- Lower water levels in reservoirs, lakes, and ponds
- Loss of wetlands
- More wildfires
- Wind and water erosion of soils
- Poor soil quality

Social Impacts

Social impacts of drought are ways that drought affects people’s health and safety. Social impacts include public safety, health, conflicts between people when there isn't enough water to go around, and changes in lifestyle. Examples of social impacts include:

- Anxiety or depression about economic losses caused by drought
- Health problems related to low water flows and poor water quality
- Health problems related to dust

- Loss of human life
- Threat to public safety from an increased number of forest and range fires
- Reduced incomes
- People may have to move from farms into cities, or from one city to another Fewer recreational activities

7.5- Main mitigation strategies

Strategies for drought protection, mitigation or relief include:

Dams – many dams and their associated reservoirs supply additional water in times of drought. **Cloud seeding –** a form of intentional weather modification to induce rainfall. This remains a hotly debated topic, as the United States National Research Council released a report in 2004 stating that to date, there is still no convincing scientific proof of the efficacy of intentional weather modification.

Desalination – of sea water for irrigation or consumption.

Drought monitoring – Continuous observation of rainfall levels and comparisons with current usage levels can help prevent man-made drought. Careful monitoring of moisture levels can also help predict increased risk for wildfires, using such metrics as the Keetch-Byram Drought Index or Palmer Drought Index.

Land use – Carefully planned crop rotation can help to minimize erosion and allow farmers to plant **less water-**dependent crops in drier years.

Outdoor water-use restriction – Regulating the use of sprinklers, hoses or buckets on outdoor plants, filling pools, and other water-intensive home maintenance tasks. Xeriscaping yards can significantly reduce unnecessary water use by residents of towns and cities.

Rainwater harvesting – Collection and storage of rainwater from roofs or other suitable catchments. **Recycled water –** Former wastewater (sewage) that has been treated and purified for reuse. **Transvasement –** Building canals or inter-basin transfer of river water as massive attempts at irrigation in drought-prone areas.

Famine

A famine is a widespread scarcity of food, caused by several factors including crop failure, population unbalance, or government policies. This phenomenon is usually accompanied or followed by regional malnutrition, starvation, epidemic, and increased mortality. Nearly every continent in the world has experienced a period of famine throughout history. Some countries, particularly in sub-Sahara Africa, continue to have extreme cases of famine.

CHAPTER-8

Forest Fire

8.1- Definition and concept

Forest fire" means a fire burning uncontrolled on lands covered wholly or in part by timber, brush, grass, grain, or other flammable vegetation. It is the most common hazard in forests. ... Forest fires may be caused due to natural or man made reasons.

8.2- Forest fire damages in India

I. The recent Bandipur forest fire destroyed more than thousand hectares of the forest, also, claiming the life of a forest guard and injuring four others. It had spread through most of the north-western part of the reserve, also posing danger to the adjoining Wayanad Wildlife Sanctuary in Kerala.

II. Last year's dreadful and destructive forest fire of Uttarakhand burnt down more than 4000 hectares of forest and claimed seven lives. The fire was finally doused using IAF helicopter fitted with Bambi buckets.

III. This brings us to one of the most alarming challenges of our times – forest fires.

IV. According to a report by Parliamentary Standing Committee on Science and Technology, India, the country has seen a 55% rise in the number of forest fires as on December 2016.

V. The Himalayan regions and the dry deciduous forests of India, particularly in Andhra Pradesh, Assam, Chhattisgarh, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra and Odisha are ecologically sensitive areas and are most affected by these fires.

VI. Forest fires are as old the forests themselves and are mostly good for the ecology as well as for regeneration. They often helping the forests to get rid of its natural wastes like dry grass, tree needles, and thick bushes.

VII. But as the saying goes: fire is a good servant, but a bad master.

VIII. A problem erupts when the fire becomes untamed and destroys the entire, or most of the flora and fauna of the region, hence severely affecting the ecological balance. The effects of forest fires include – depletion of the ozone layer, soil erosion, and loss of forest cover, habitat and the livelihood of many tribal and rural people.

IX. However, the results of a forest fire are more grievous than those mentioned above. For instance, fires clear forests to such extent that the rainwater simply flows through the area without recharging the ground water level.

8.3- **Operational fire management systems and organizations.**

The “disaster” brought by fire is though usually very small in geographical scales, yet its effects can spell devastation. The High Powered Committee (HPC) on Disaster Management, constituted on behalf of Prime minister in 1999, in its report submitted in October' 2002 identified forest fire as one of the 33 major types of disasters prevalent in the country enlisted under the category of "Accident Related Disasters".

In general there is a lack of concern about the detrimental impact of forest fire on society, mainly because the direct loss in terms of human lives and property damage (houses buildings, infrastructure etc.) is not much in comparison to other natural disasters like flood, cyclones, tsunami etc. However, if viewed in terms of intangible impact of forest fire, it is much more than that of other common disasters. The intangible loss due to forest fire includes impact on biodiversity, damage to watershed services, loss of soil fertility, increase in soil erosion and landslides etc. In the present day context forest fire is said to have developed a dangerous relationship with the global warming by adding Green House Gases. Albeit, the direct loss due to forest fire may not be much evident in economic terms, its long term impacts mainly on environment are more devastating and need serious efforts to manage forest fires in more effective manner.

8.4- **Community involvement.**

The majority of wildfires in developing countries of the tropics and subtropics, and in temperateboreal countries in transition, are caused by human activities usually associated with land-use practices and changes. Many land-use systems in these regions are vulnerable to wildfires. The property, health and welfare of people in these areas are negatively affected by direct and indirect consequences of fire and air pollution. Active involvement of the local people has therefore been recognised as a condition for the successful implementation of fire management programmes, especially at the interfaces between wildlands, managed systems and residential areas.

During the 1980s and 1990s, several technical co-operation projects were implemented in developing countries, funded bilaterally or supported by international organizations (e.g. the Food and Agriculture Organization of the United Nations (FAO) and the World Bank). Many projects were implemented in partnership with national institutions responsible for the prevention and control of forest fires, often designated as “Forest Fire Control” or “Forest Fire Prevention and Control” projects, with a purely technical approach to reduce fire hazard and improve fire suppression capabilities. This resulted predominantly in working with and through government agencies. Local people, who use fire in land-use systems and/or are major agents of wildfires, and who are also directly and adversely affected by wildfires, were not involved in project activities. There was little or no recognition of local people as important actors and stakeholders.

8.5-Public policies concerning fire.

Gaps to be addressed: The present policy/ planning documents do not give due consideration to Forest Fire Management. Revised key policy documents need to incorporate clear guidance about Forest Department and other stakeholders’ role and contributions to FFM.

Goal: Revised policy and planning framework which includes FFM in more comprehensive and systematic manner Proposed strategies Incorporate FFM issues in existing policy and planning documents in more systematic way: There is a need to incorporate clear cut guidelines and

responsibilities of different role players to capacitate forest department and other stakeholders to manage forest fire in more systematic manner.

Develop/ update forest fire manuals for field staff guiding them in simple way to detect/ report about and suppress forest fire. Incorporate FFM issues into other national / regional/ local level Disaster Risk Management programmes.

Though legal and policy framework exists in favour of fire protection, there is a need to strengthen and make it more practical and implementable. Existing acts though quite effective in forest and wild life conservation, do not give specific attention to forest fire management. As in more than 90 % cases forest fire is a human induced phenomenon, there is urgent need that some special Act be enacted to provide appropriate legal frame-work at national and state level both. Such Forest Fire Prevention Act will also strengthen the forest department in controlling and checking the illegal activities within or near the forest, leading to severe forest fires.

Subject to the enactment of suitable legislation, it is also necessary to evolve detail regulations to help in enforcement of the law.

The existing codes/regulations/laws related to forest / wildlife protectionand preservation are to be reviewed and suitable mechanism be evolved for their effective enforcement.

8.6- the needs of fire management.

There are 5 needs of fire management

1) Fire Prevention.

Learning how to prevent fires from occurring is a good enough reason alone to book yourself onto a Fire Safety course. It is so important to know what simple measures you can take such as keeping fire exits clear, keeping the workplace tidy, effective management of waste and understanding how to reduce the risk of electrical fires occurring.

2) Saving Lives and Minimising the Damage.

Having effective procedures and measures in place can save lives. Fire alarms, smoke detectors, emergency lighting, fire exits and escape routes are all measures that can be taken to minimise the damage of fires when they do occur. You can learn about all the fire protection measures on a Fire Safety course and what measures best suit your premises.

3) Fire extinguishers.

Depending on what type of material is burning in a fire, the extinguishers required can vary. Knowing when to use each extinguisher is vital knowledge to minimise the damage from fire. On our Ajuda Fire Safety and the Role of the Fire Marshal courses each delegate gets the chance to use a fire extinguisher after learning all about their different purposes.

4) Cost.

The average cost to a business is £21,000 per fire. In learning how to prevent fires from occurring you are largely reducing the risk of a fire in your place of work.

5) The Law.

According to gov.uk you are responsible for fire safety in business or other non-domestic premises if you are: an employer, the owner, the landlord, an occupier, anyone else with control of the premises, for example, a facilities manager, building manager, managing agent or risk assessor.

CHAPTER-9
Other type of Hazards and disasters

9.1- Chemical and Industrial disasters: brief description, effects, preparedness.

Chemical and Industrial disasters

A chemical disaster is the unintentional release of one or more hazardous substances which could harm human health and the environment. Chemical hazards are systems where chemical accidents could occur under certain circumstances. Such events include fires, explosions, leakages or release of toxic or hazardous materials that can cause people illness, injury, or disability.

While chemical accidents may occur whenever toxic materials are stored, transported or used, the most severe are industrial accidents, involving major chemical manufacturing and storage facilities. The most dangerous chemical accident in recorded in history was the 1984 Bhopal gas tragedy in India, in which more than 3,000 people had died after a highly toxic vapour, (methyl isocyanate), was released at a Union Carbide Pesticides factory.

Effects

Explosions may cause destruction of buildings and infrastructure. Transportation accidents damage vehicles and other objects on impact, with possible loss of hazardous materials into the environment. Industrial fires may reach very high temperatures and affect large areas.

Many people may be killed and numerous injured may require emergency medical treatment. Hazardous substances released into the water or the air may travel long distances and cause contamination of air, water supply, land, crops and livestock, making affected areas uninhabitable for humans. Wildlife may be destroyed and ecological systems disrupted. Large scale disasters may even threaten the stability of global ecology.

preparedness

- Do not smoke, lit fire or spark in the identified hazardous area.
- Sensitize the community living near the industrial units and they should be more vigilant about the nature of industrial units and associated risks.
- Keep the contact numbers of nearest hazardous industry, fire station, police station, control room, health services and district control room, for emergency use.
- Avoid housing near the industries producing or processing the hazardous chemicals, if possible.
- Participate in all the capacity building programmes organized by the government/ voluntary organizations / industrial units.
- Take part in preparing disaster management plan for the community and identify safe shelter along with safe and easy access routes.
- Prepare a family disaster management plan and explain it to all the family members.

- Make the family/ neighbours aware of the basic characteristics of various poisonous/ hazardous chemicals and the first aid required to treat them.
- Adequate number of personal protective equipments needs to be made available, to deal with emergency situation.
- Prepare an emergency kit of items and essentials in the house, including medicines, documents and valuables.

9.2- Epidemic: Onset type, warning,causes and effects, risk reduction measures.

Causes

There are 4 main causes of accidents in a chemical plant: human error, improper training, manufacturing defects, and improper maintenance.

(i)Human Error

A majority of the industrial accidents that occur every year are a result of human error. Many of these accidents are a result of the worker failing to follow the safety procedures that have been put into place by the company where he or she works. As of 2009, a majority of industrial injuries (74.8%) happened in the service-related industry, according to the Bureau of Labor Statistics. When the proper equipment is not used by personnel, accidents can occur. Many injuries happen when personnel attempt to use improper tools to work on equipment. This can damage the machines and create a safety hazard.

(ii)Improper Tanning

When personnel are not trained properly or adequately, industrial accidents are more likely to occur. Workers should be taught how to operate the equipment in the way it was designed to be used. They should also learn to employ correct safety procedures when they are operating the equipment. Employees should be well versed in what to do if something goes wrong so that they can work to correct the problem quickly before it gets out of control.

During 2009, 4.3 out of every 100 workers in the manufacturing industry were involved in industrial accidents. A majority of these accidents occurred as a result of improper training of personnel.

(iii)Manufacturing Defects

Accidents that occur in a chemical plant can also be the result of a manufacturing defect. These defects can be present in a piece of equipment or in the materials used. Although companies employ several quality-control measures during the manufacturing process, some of these may fail. This is because many of these control measures are handled by employees. Where humans are involved there is always a chance of human error. An inspector may miss a defect that occurred during manufacturing. The problem may not be recognized until after an accident has occurred.

(iv)Improper Maintenance

A common reason that industrial accidents occur in chemical plants is the improper maintenance of equipment. Regular maintenance at scheduled intervals following the manufacturer’s recommendations

is important for ensuring that the equipment runs smoothly and safely. When a piece of equipment is not properly maintained, it can malfunction and ultimately fail. This can result in dire consequences to the personnel who are operating and working around the machine.

Effects Effects of chemical Disaster

Every day, we are exposed to chemicals and pollutants - in our air, food and water. There are chemicals in everyday products we use at work, at home and at play. While some chemicals may be beneficial to our health, others may pose a health risk if they're not handled properly.

There are 4 types

1. Types of exposure
2. Potential health risks
3. Potential health effects
4. Reducing risks

1.Types of exposure (i)Air and inhalation

We take over 20,000 breaths a day. This number can be much higher for infants and children. The chemicals and pollutants we inhale can end up in our lungs and blood stream. Sometimes, we can smell or taste harmful chemicals, but it isn't always so easy. Some chemicals, like radon or carbon monoxide, are odourless, tasteless, and invisible.

(ii)Skin and eye contact

You can be exposed to chemicals by coming into contact with them through your skin and eyes. These organs can be more sensitive to chemicals and may react more quickly than the rest of our bodies. Wearing protective equipment, such as gloves and eye goggles, can protect you from direct exposure. It can also prevent you from spreading substances onto other objects and people.

(iii)Food, water, and ingestion

Many chemicals can be found in both our food and water sources. As we eat and drink, we might swallow chemicals that can harm us. However, there are actions you can take to limit your exposure, such as replacing older lead pipes or refraining from heating food in plastic containers not intended for that purpose. You can also keep your community safe by disposing of hazardous chemicals according to your municipal guidelines.

2. Potential health risks

The health risks of chemicals depend on several factors, including:

- the type of chemical
- the amount you're exposed to
- when and how long you are exposed
- how you're exposed (through food, water, air, products)
- your age and general state of health

Some people may be more sensitive to chemical exposure than others. Groups that may be at higher risk include children, pregnant women, seniors, people with pre-existing health conditions and Indigenous peoples.

3. Potential health effects

Accidents or incorrect use of household chemical products may cause immediate health effects, such as skin or eye irritation or burns, or poisoning.

There can also be longer-term health effects from chemicals. When these occur, they are usually the result of exposure to certain chemicals over a long period of time.

Depending on the chemical, these longer-term health effects might include:

- organ damage
- weakening of the immune system
- development of allergies or asthma
- reproductive problems and birth defects
- effects on the mental, intellectual or physical development of children 🎬 cancer

4.Reducing risks

You can take steps to protect yourself and your family from chemical risks:

- Read and follow all directions when using household chemical products. If you don't understand something on the label, contact the manufacturer.
- Open windows to provide ventilation during and after use of certain household chemical products, since some of these can release chemicals into your indoor air. However, during periods of high levels of outdoor air pollution, you should take measures to reduce the air entering your home from outside, such as closing your windows and turning on your air conditioning.
- Keep all household chemical products out of sight and out of reach of children and animals. Make sure closures on child-resistant containers are working.
- Consult the Air Quality Health Index, and consider adjusting outdoor activities when air quality is poor, especially if you have heart or breathing problems.

9.3- Heat waves:, dangers and effects, Forecasts and warning, awareness.

Definition

A heat wave, or heatwave, is a period of excessively hot weather, which may be accompanied by high humidity, especially in oceanic climate countries. ... A heat wave is considered extreme weather that can be a natural disaster, and a danger because heat and sunlight may overheat the human body.

Dangers and effects

Here is a list of some of the detrimental effects of heat waves:

(i)Power Outages Are Common During Heat Waves

It is normal for areas experiencing heat waves to have unusually high levels of electricity consumption. Air conditioners are kept on for long hours in both offices and homes in such areas. People usually avoid going outdoors and consume more electricity by staying indoors. The sudden spike in electricity consumption challenges the available electricity supplies of the area. This means that power outages are common during this time as the power lines are unable to meet the high demands of the people. Power outages were very common during the 2006 North American heat wave. During this time, thousands of offices and homes in California were left without power for several days. Similar situations happened in Australia during the 2009 South Eastern Australia Heat Wave when nearly half a million people in the country had to stay for days without power. The heat wave had overloaded the power grid and blown up transformers in the affected area leading to such consequences.

(ii)Heat Waves Can Trigger Devastating Wildfires

When a heat wave is accompanied by an episode of drought that dries out the vegetation, it creates the ideal environment for the break-out of a wildfire or a bushfire. Once such a fire starts, it is extremely difficult to put it out. Such fires often wipe out entire forests or farmlands and kill all flora and fauna inhabiting the region. One of the worst wildfires in recent times happened in Portugal during the 2003 heat wave in Europe. Fires destroyed more than 3,010 square kilometers of forest and over 440 square kilometers of farmland in the country.

(iii)Heat Waves Can Cause Infrastructural Damage

As heat causes metals to expand, heat waves can lead to major infrastructural defects. Power transformers can detonate causing fires. Water lines can burst to cause the loss of water and water shortage. Heat waves can also induce the kinking or buckling of railroads. Highways can melt or develop cracks in extreme heat. For example, two traffic lanes in Oklahoma City, US, had to be closed during the 2006 North American heat wave after they buckled under the heat. Blackouts resulted during this event due to damaged power transformers.

(iv)Heat Waves Can Kill People

Heat and humidity prevalent during heat waves can cause physical harm to people in affected areas. Heat exhaustion is common during this time which involves the depletion of electrolytes in the body and excessive dehydration. The symptoms of dehydration include nausea, dizziness, headache, diarrhea, malaise, etc. Heat exhaustion often precedes a heat stroke or hyperthermia which can be lethal in nature. Usually, children, the elderly, the overweight, and the sick are more susceptible to heat stroke than others. Heat-related deaths are common in most parts of the world experiencing heat waves. For example, the 1995 Chicago heat wave claimed the lives of nearly 739 people in the city.

Forecasts and warning, awareness

With climate change, there has been an increase in the frequency, intensity and duration of heatwave events. In response to the devastating mortality and morbidity of recent heatwave events, many

countries have introduced heatwave early warning systems (HEWS). HEWS are designed to reduce the avoidable human health consequences of heatwaves through timely notification of prevention measures to vulnerable populations. To identify the key characteristics of HEWS in European countries to help inform modification of current, and development of, new systems and plans. We searched the internet to identify HEWS policy or government documents for 33 European countries and requested information from relevant organizations. We translated the HEWS documents and extracted details on the trigger indicators, thresholds for action, notification strategies, message intermediaries, communication and dissemination strategies, prevention strategies recommended and specified target audiences. Twelve European countries have HEWS. Although there are many similarities among the HEWS, there also are differences in key characteristics that could inform improvements in heatwave early warning plans.

CHAPTER-10
Policy, Planning and Institution for disaster mitigation

10.1 Role of policy makers in disaster risk reduction

Disaster risk management falls under global trends of causing policymakers to rethink the institutional setup of governments, and the roles and responsibilities of different levels of government in achieving developmental objectives. Actors such as local governments, municipal authorities and local communities play an increasingly important role in emerging national disaster risk management systems. There is a wide variety of ways in which disaster risk can be reduced as part of development policies. These involve institutional reforms, improved analytical and methodological capabilities, education, awareness, financial planning and political commitment. Di aster reduction is aimed at motivating societies at risk to become engaged in the conscious management of risk and reduction of vulnerability. This must expand beyond traditional response (Relief & Rehabilitation) to defense against the impact of natural hazards, as an ongoing process that does not focus on singular disaster events. Based on the lessons from the International Decade for Natural Disaster Reduction (IDNDR, 199o-99) four overriding objectives have been formulated in Order to effectively reduce the impact of disaster, as the guidance principles for the International strategy for Disaster Reduction.

These overall objectives set the stage for the course of action for Governments, regional bodies and civil society organizations

Obtaining the commitment from public authorities This objective needs to be addressed through an increased inter-sectoral coordination at all levels, risk management strategies the allocation of appropriate resources including development of new funding mechanisms. Disaster reduction should be dealt with as a separate policy issue as well as cross cutting in relevant fields of government (public works, rural development, health agriculture, food security, environment. Etc.) aiming at policy integration among the various sectors.

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.

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 legislators, private sector, academic instiutions, 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/state planning processes. Efforts to link natural resource management with disaster reduction should also be encouraged.

Fostering better understanding and knowledge of the causes of disasters through, the transfer and exchange of experience and greater access to relevant data and information The issues to be addressed in this context are the assessment and analysis of socio-economic impacts of disasters, disaster databases, coping strategies of different social groups, early warning processes, as well as the promotion

of scientific research, valuing of indigenous knowledge and the development and transfer of knowledge and technologies.

The causes and impacts of natural hazards some times occur m a number of neighboring States, highlighting the need for a harmonized approach in the management of such a phenomenon. Efficiency can be optimized via exchange of experiences amongst states and constructive dialogue amongst stakeholders via participatory processes Prioritization of tasks in the various phases of disaster management (Prevention, preparedness, response, rehabilitation and recovery) has to be agreed upon to cope with such situations.

Course for specific action

The policy makers can play a very vital role for fulfillment of the objectives outlined above.

The following areas should be considered as key elements for development actions

1. **To help create the legislative instruments** in the State for framing of Disaster Management Policy.
2. **Capacity building and strengthening of institutional arrangements** at all levels to address risk reduction as an ongoing function, including disaster reduction related legislation, covering land-use regulation, building codes and reinforced links to environmental protection. Capacity building at State level needs to include the development of an integrated disaster risk management plan that covers areas of risk assessment, early warning systems, training programmes, as well as emergency response management, recovery resources, including the strengthening of community based organizations. It also includes the increased capacity and sectoral synergies for sustainable management of forest and water-resources.
3. **Development of public educational programmes** and campaigns on the relationships between sustainable development, natural 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 centers. It needs to expand to all levels of society by training efforts, with special emphasis on professionals and community based leaders and organizations.
4. **Creating and implementing comprehensive urban development strategies and land use plans**, which provide a number of opportunities to mitigate damages caused by hazards. As location is the key factor, which determines the level of risk associated with a hazard, land-use plans and mapping should be used as tools to identify the most suitable usage for vulnerable areas (e. g., location of buildings, roads, power plants, storage of fuels). Local governments need to play an increasing role with regard to factors such as building standards, land and property markets, land and housing taxation, planning processes and infrastructure construction and management.
5. **Legally mandate building codes :-**To improve resistance to the effects of natural hazards, better building practices are essential. Until there are building codes with the force of law, they will not be taken seriously by the construction industry. Such codes must incorporate modern technical standards.
6. **Enforce codes effectively :-**Legally mandating codes is not enough ; they must be enforced. Great care should be exercised in selecting the enforcement system for he codes, since some are easier to ignore, manipulate, or corrupt than others.
7. **To help develop techno-financial regime.**

-Allotment of some percentage development funds for disaster mitigation.
-To earmark some percentage of Local Area Development Funds for retrofitting of lifeline buildings (like schools, hospitals etc.).

10. 2 Institutional arrangements in India

The institutional and policy mechanisms for carrying out response, relief and rehabilitation have been well-established since Independence. These mechanisms have proved to be robust and effective in sofar as response, relief and rehabilitation are concerned. The changed policy/approach, however, mandates a priority to pre-disaster aspects of mitigation. prevention and preparedness and new institutional mechanisms are being put in place to address the policy change.

Central level

Although the primary responsibility for disaster management is of the concerned state Governments, the central Government plays a key role for providing financial and logistic Ministries/Departments/organizations. cabinet committee on Natural Calamities is placed at mitigation and preparedness measures also. Cabinet Secretary, who is the highest executive concerned Ministries/Departments as well as organizations are the members of the necessary. The secretary, Ministry of Home Affairs is responsible for ensuring that all developments are brought to the notice of the NCMC promptly. The NCMC gives direction to any

Ministries/Departments/organizations for specific action needed for meeting the crisis situation. The central Relief commissioner in the Ministry of Home Affairs is the chairman of various concerned Ministries. The CMG's functions are to review every year contingency the crisis Management Group (CMG) consisting of senior officers (called nodal officers) from various concerned ministries. Mitigation, preparedness and response are multi-disciplinary functions, involving a number of all possible assistance required by the affected states to overcome the situation effectively. approach are being put in place. It is proposed to create Disaster/Emergency Management Authorities, both at the National and state levels, with representatives from the relevant covering a large number of branches. The National Emergency Management Authority is proposed to be constituted, The organization wilt be multidisciplinary with experts converting a combined Secretariat/Directorate structure-a structure which will be an integral part of the Government while, at the same time, retaining the flexibility of a field organization.

The authority will be responsible for :

- providing necessary support and assistance to State Governments by way of resource data, macro-management of emergency response, specialized emergency response teams, sharing of disaster related data base etc.
- Coordinating/mandating Government's policies for disaster reduction/mitigation.
- Ensuring adequate preparedness at all levels in order to meet disasters.
- Coordinating. Response to a disaster when it strikes.
- Assisting the provincial Government in coordinating post disaster relief.
- Coordinating resources of all National Government Department/agencies involved.

- Monitor and introduce a culture of building requisite features of disaster mitigation in all development programmes.
- Any other issues of work, which may be entrusted to it by the Government.

States level

The States have also been asked to set up Disaster Management Authorities under the chief Minister with Ministers of relevant Departments as members, 11 States and UTs- Tamil Nadu, Arunachal Pradesh, Uttaranchal, Orissa, Gujarat, Kerala, Nagaland, Rajasthan, Delhi, A & N administration and Chandigarh Administration have notified the authority. The other States are in the process of setting up similar authorities. Re-structuring of the Relief Department in the States : At the State level, the work of post calamity relief was being handled by the Departments of Relief & Rehabilitation. The Government of India is working with the State Governments to restructure the Departments of Relief & Rehabilitation into Departments of Disaster Management with an enhanced area of responsibility to include mitigation and preparedness apart from their present responsibilities of relief and rehabilitation. The changeover has already happened in 11 States/UTsAndhra Pradesh, Arunachal Pradesh, Bihar, Himachal Pradesh, Rajasthan Tamil Nadu, Uttaranchal, Nagaland, Andaman & Nicobar Administration, Sikkim and Lakshadweep. The change is under process in other states. The states have been advised to restructure/regroup the officers/staff within the Department of Disaster Management with definite functions to pursue the holistic approach to disaster management. The four functional groups to be assigned with specific tasks within the departments are as indicted below- Functional Group 1 : Hazard Mitigation

- Functional Group 2 : Preparedness and Capacity Building
- Functional Group 3 : Relief and Response
- Functional Group 4 : Administration and Finance

District level

At the district level, the District Magistrate who is the chief coordinator will be the focal point for coordinating all activities relating to prevention, mitigation and preparedness apart : from his existing responsibilities pertaining to response and relief. The District coordination and Relief Committee is being reconstituted re-designated into Disaster Management Committees with officers from relevant departments being added as members. Because of its enhanced mandate of mitigation and prevention, the district heads of the departments engaged in development are now being included in the Committee so that mitigation and Prevention is mainstreamed into the district plan. The existing system of drawing up preparedness and response plans will continue. There will, however, also be a long term mitigation plan. District Disaster Management Committees have already been constituted in 256 districts and are in the process of being constituted in the remaining districts.

Block/taluka level

Similarly, sub-divisional and Block)Taluka level Disaster Management Committees are also being constituted. At the village level Disaster Management Committees and Disaster Management Teams are being constituted. Each village in multi-hazard prone district will have a Disaster Management Plan. The process of drafting the plans at all levels has already begun. The Disaster Management Committee which

draws up the plans consists of elected representatives at the village level, local authorities ; Government functionaries including doctors/paramedics of primary health centers located in the village, primary school teachers etc. The plan encompasses prevention, mitigation and preparedness measures. The Disaster Management Teams at the village level will consist of members of youth organizations like Nehru Yuvak Kendra Sanghathan (NYKS) and National Service Scheme (NSS) and other nongovernmental organizations as well as able bodied volunteers from the village. The teams are provided basic training in evacuation, evacuation, search and rescue, first aid trauma counseling etc. The Disaster Management Committee will review the disaster management plan at least once in a year. It would also generate awareness among the people in the village about dos' and don'ts for specific hazards depending on the vulnerability of the village. A large number of village level Disaster Management Committees and Disaster Management Teams have already been constituted.

10. 3 List of major Institutions in National & state level

National Institute of Disaster Management (NIDM)
(Ministry of Home Affairs)
I.P. Estate, Ring Road
New Delhi-110002