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International Workshop on Intercultural Aspects of Disaster Management

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Bhavan's Priyamvada Birla Institute of Management

M P BIRLA INSTITUTE OF MANAGEMENT, Bengaluru

Intercultural Aspects of DISASTER MANAGEMENT

INTERNATIONAL WORKSHOP SPECIAL ISSUE

आ नो भद्रा : क्रतवो यन्तु विश्वत : ।

"Let Noble Thoughts Come To Us From Every Side"

- Rig Veda 1-89-1

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Editorial Board

From the Editor-in-Chief's Desk

International Workshop on Intercultural Aspects of DISASTER Management

Disasters are classified into two categories: Man-made & Natural. Given this dichotomy, its implications are many and varied. While naturally occurring disasters are providential, man-made disasters are reactions to the immediate or long-drawn instigations. Management of disasters is to be attempted by considering various dimensions. Inter-cultural aspects was one of the dimensions considered in a recently concluded International workshop held at our sister institution Bhavan's Priyamvada Birla Institute of Management, Mysuru.

The workshop deliberated in detail, on ways of disaster-prevention and reducing the dilapidation of heritage structures such as temples, mosques and churches. In addition to considering development of institutional mechanisms under South East Asian Network for Disaster and Environmental Engineering (SEAN-DEE), environmental engineering skills and methods were also examined. The workshop discussed the addition of warning signals, prevention methods and ways to create awareness as ingredients of a course on Disaster Management in a post graduate level engineering program. The workshop highlighted on emergencies and exigencies on several facets that could lead to the sustainability of the wealth of a Nation.

This issue of Dharana is devoted to contributions made by experts. This may enable educators, administrators and leaders to work towards the safety and security of the wealth that civilization has created for posterity. In particular, the readers are advised to perceive the thought processes of the workshop-participants.

HIMALAYAN TRAGEDY HITS KATHMANDU

As this issue was ready to go to press (27.4.2015), a HIMALAYAN TRAGEDY hit Kathmandu. A powerful 7.9 (on the Richter scale)-strong earthquake having its epicenter near Kathmandu ripped through the upper part of the South Asian Peninsula on Saturday the 25th April, 2015. This resulted in the destruction of the landscape starting from Myanmar to Punjab. As per the Prime Minister of Nepal, the latest figures on death toll may touch 10,000 including the 100 dead in India (56 in Bihar alone). This disaster was followed by quakes of 6.9-strength. "The Saturday's 7.9-strong quake was as powerful as 20 hydrogen bombs, each several times more powerful than the atomic bomb that destroyed Hiroshima"- according to an expert. Reacting to this most unfortunate tragedy, our Prime Minister Sri Narendra Modi assured: "We will try to wipe the tears of all Nepalese".

We pray that the affected people of Nepal and India get enough strength to come out of this tragedy of Himalayan proportions.

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Challenges in Disaster Management

N. Ramanuja*

Abstract

According to the International Disaster Database and IMF, disasters have been hitting the world continuously and has increased steadily since 1960 dipping only in the past decade. During the last decade of last millennium, natural disasters have killed about 6.7 million people, accounting for 88 percent of all deaths due to disasters. Nearly two-thirds of the people killed in these disasters hail from developing countries. Millions of people are affected every year and natural disasters are huge economic burdens on developing economics as insured loss is less than economic losses compared to developed countries.

The need of the hour is to chalk out a multi-pronged strategy for total disaster management to reduce the toll of disasters in the country. The best strategy is to be Proactive rather than reactive in tackling natural disasters and in mitigating the disasters in case of natural or man-made disasters.

Key words and Phrases: Disasters, Impact, Earthquake, Cyclone, Floods and Challenges.

In Indian mythology, at the end of a 'Kalpa' which is about 4.32 billion year, there is supposed to be a huge deluge where the entire creation would be submerged in water after which creation would start again. Prior to one such deluge, King Satyavrata or Vaivasvata Manu the king of South India, when he was offering water oblation to God in a river, a tiny fish fell in his folded hands. As the king was about to throw away the fish, the fish pleaded not to be thrown in the water but to protect it. The fish grew larger and outgrew water reservoirs and lakes in the kingdom and finally had to be let in the ocean.

This supernatural fish or Matsya in Sanskrit,was none other than Lord Vishnu, who declared that a great deluge would come seven days from then and engulf the entire creation. He ordered Manu to assemble all kinds of seeds, herbs and various beings to load them on a boat, that would be sent by Vishnu on the fateful day. Vishnu reappeared as a horned fish on the day of the deluge to protect the boat, when torrential rains engulfed the earth. After last wave of the flood ended, the life on the earth began with the species stored in the boat again.

* *Chairman, B. P. Birla Institute of Management, Mysuru and M. P. Birla Institute of Management, Bengaluru.*
This is an abridged article of the Keynote Address.

Matsyavatara

Noah's Ark

A similar story is that of Noah's Ark which is the vessel in the Genesis flood narrative (Genesis chapters 6–9) by which God saves Noah, his family, and a remnant of all the world's animals from the flood.

The story goes on to describe the ark being afloat throughout the flood and subsequent receding of the waters before it came to rest on the Mountains of Ararat.

It is understood that such a story is also in the Holy Quran, where the ark appears as Safina Nuh. The Genesis flood narrative is similar to numerous other flood myths from a variety of cultures. Another earliest known such myth is the Sumerian flood myth found in the Epic of Ziusudra.

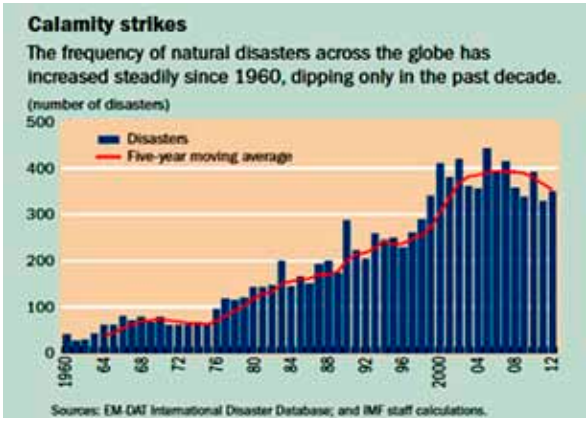
These are the earliest stories of Disaster Management as I can recollect.

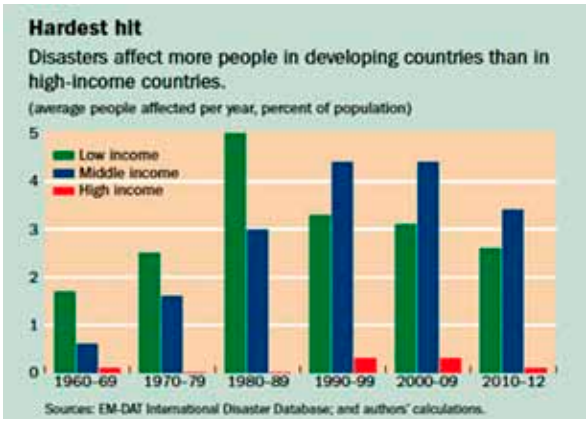
According to the International Disaster Database and IMF, disasters have been hitting the world continuously and has increased steadily since 1960, dipping only in the past decade. The hardest hit are only the developing countries.

The reasons are obvious- lack of knowledge and preparedness and demographical factors.

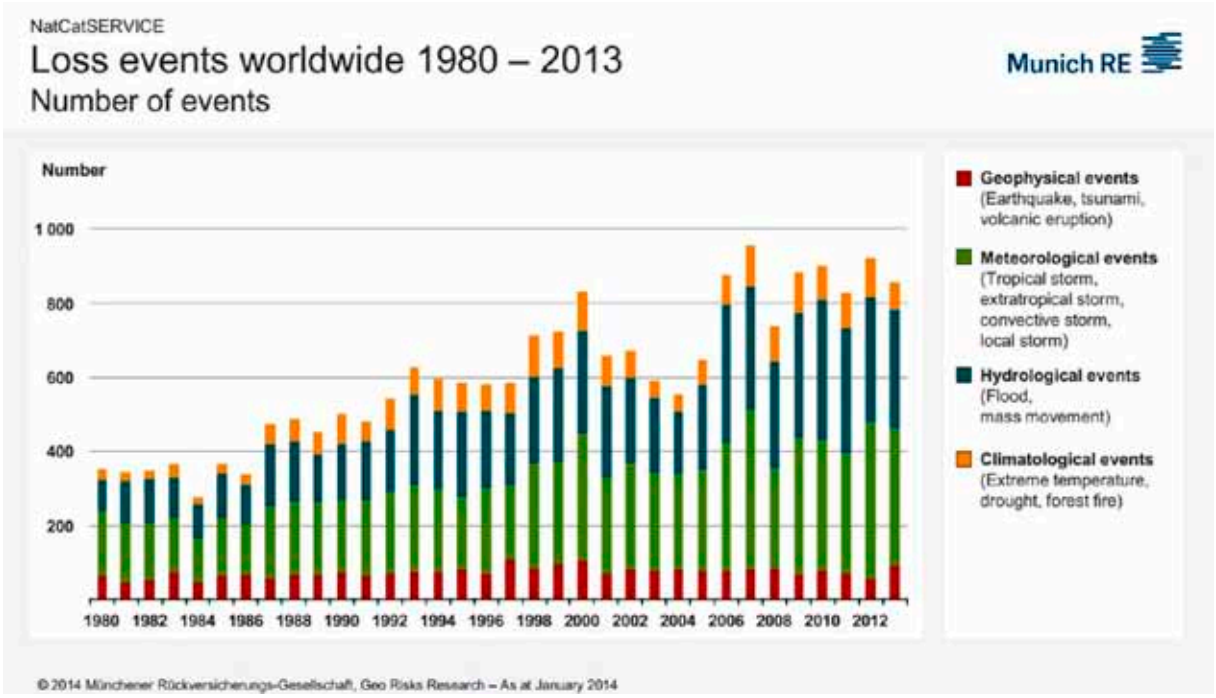
Disaster Management

According to World Development Report (International Federation of Red Cross and Red Crescent (IFRCRC), 2001) natural disasters are categorised as Hydro, Meterological, Geophysical and Climatological events. The manmade or unnatural disasters encompass conflicts, civil strife, riots and industrial disasters.





During the last decade of last millennium, natural disasters have killed about 6.7 million people, accounting for 88 percent of all deaths due to disasters. Similarly, unnatural disasters have killed about 87,000 people. Nearly two-thirds of the people killed in these disasters hail from developing countries like India, with



only four percent of the casualties being reported from highly developed countries (IFRCRC, 2001).

Disaster management is essentially a dynamic process. It comprises of management functions like planning, organizing, staffing, leading and controlling. It also involves many organizations working jointly to prevent, mitigate, prepare for, respond to and recover from the effects of disaster.

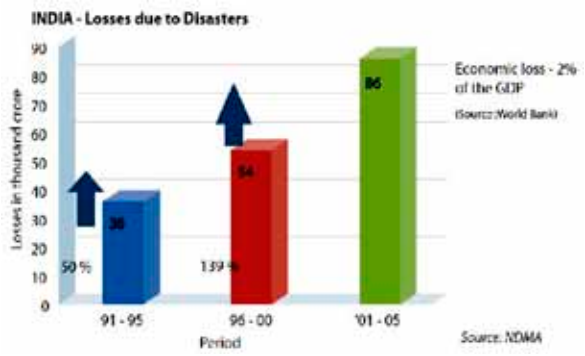
Floods, droughts, cyclones, earthquakes, and landslides have been a recurrent phenomena. About 60% of the landmass is prone to earthquake of various intensities; an area of over 40 million hectares is prone to floods; about 8 % of total area is prone to cyclones and 68% of the area is susceptible to drought. The loss in terms of private, community and public assets due to disasters has been astronomical. Apart from natural disasters, some cities in India are also vulnerable to chemical, industrial and other manmade disasters. Millions of people are affected every year and the economic losses caused by natural disasters amount to a major share of the Gross National Product (GNP). Natural Disasters are huge economic burdens on developing economies such as India.

Impact on Economics

It is seen that the disasters impact the economy of a country substantially. In the short term, economic output shrinks and the fiscal deficit worsens after a disaster. Country's export potential suffers, which leads to larger deficits in trade and services with the rest of the world.

The impact can be alleviated by foreign aid and investment, but after large disasters, the growth and income effects usually persist. A country's growth drops by an average 0.7 percent in the first year after a disaster, with a cumulative output loss after the disaster of about 1.5 percent over and above the immediate direct losses.

Per capita real GDP falls by about 0.6 percent on average and by 1 percent in low-income countries. Droughts have the broadest impact, except in small island states where hurricanes are the most damaging.



One can notice from the above chart that the losses due to disasters account for almost 2% of the GDP. The effect of natural disasters in the Caribbean on growth and debt are sizable. It is observed that, average hurricane reduces a country's output by nearly 1 percent, and a smaller impact from moderate storms by 0.5 percent. Though recovery is there but the negative impact on GDP cannot be ignored. The impact could be similar in case of central America and South America which are more earthquake prone.

Countries with sound financial structure—that is, where more people have bank accounts and more households and businesses have bank loans—suffer less after a disaster. Countries with well-developed financial systems and risk management systems generally run up fiscal deficits but lose less in output.

According to United Nations (UN) global assessment report (GAR) on disaster risk recently states that India loses an estimated Rs.60,915 Cr. annually on account of natural disasters. The figure includes an estimated Rs.46,326 Cr. loss due to floods alone.

During March 2015, the UN member countries met in Sendai, Japan to sign a new Disaster Risk Reduction (DRR) protocol. This protocol will replace the Hyogo Framework of Action (HFA) which came into existence in 2005, after the Indian Ocean tsunami.

Type of Disaster	Estimated Loss (in Cr. INR)
Earthquakes	118
Cyclones	2,771
Storm Surge	4,507
Tsunami	7,192
Flood	46,326
Total	60,915

Source: UN Global Assessment Report, 2015

The DRR protocol will have a 10 year commitment plan period.

The report also states that "an annual global investment of Rs.37,200 Cr. in disaster risk management strategies would generate total benefits in terms of risk reduction of Rs.22,32,000 Cr. This is equal to 20% reduction in annual losses. Around 48 lakh people are affected by disasters annually but if India doesn't invest in DRR then the number would increase to 1.9 crore by the year 2030.

Disasters and Lessons Learnt

Ten major natural disasters in the world in the last 10 years in the order of date of occurence.

1. **The Gujarat Earthquake, India, 26th May 2001** - With 20,000 fatalities, the Bhuj earthquake was a huge disaster.
2. **The Bam Earthquake, Iran, 26th December 2003** - The Bam earthquake was the first of the two "Boxing Day" disasters of the noughties. The earthquake was a direct hit on the ancient city of Bam, the centre of which collapsed almost completely. The death toll was fearsome (26,796 people).
3. **The summer 2003 heatwave in Europe** - The exceptional temperatures recorded in Europe in Summer 2003 is estimated to have killed over 60,000 people– probably for the first time scientists could say with justification that climate change is inducing severe weather events.

4. **The Indian Ocean earthquake and tsunami, 26th December 2004** - The two obvious aspects of this disaster are of course the huge death-toll (165,708 in Indonesia alone, probably 250,000 worldwide, according to the EM-DAT database) across a huge swathe of the coast around the Indian Ocean.
5. **The Simeule / Nias earthquake, Indonesia, 28th March 2005** - With a death toll of 915, this event may seem at first glance to be too small to justify a place in this list. However, this event confirmed the fears of many seismologists that large earthquakes can weaken unfailed sections of adjacent faults, allowing them to rupture in the aftermath of the big event.
6. **The Kashmir earthquake (Pakistan and India), 8th October 2005** - The true toll from the Kashmir earthquake remains unclear – the official total in Pakistan is 73,338, whilst the Red Cross has suggested that a more realistic number may be 100,000.
7. **Hurricane Katrina, USA, 29th August 2005** - The impact of Katrina on New Orleans remains one of the enduring images of the decade. That a major city in a developed country could be so disastrously affected by a hurricane was a shock to many.
8. **The Guinsaugon landslide, Philippines, 17th February 2006** - The tragedy of the Guinsaugon landslide is that the authorities and local people were aware of the threat posed by the slope, and evacuated the town. But, when the heavy rainfall (brought by a typhoon) stopped, the people returned to their homes and schools, only to be buried by the slide.
9. **The Wenchuan Earthquake, China, 12th May 2008** - The impact of the Wenchuan earthquake on the mountains of the Longminshan range was extraordinary. In the aftermath of the earthquake the world watched as the government strove to cope with both the disaster itself and the landslide dams that littered the landscape.
10. **Cyclone Nargis, Burma (Myanmar), 2nd May 2008** - Cyclone Nargis feels like the big event that everyone has forgotten but resulted in death toll of 138,366 people should serve to remind us that Indian Ocean cyclones remain a major threat.

Besides these,three major disasters struck India in 2013 and 2014 one by Phailin Cyclone that hit Odisha coast, cloud-burst in Uttarakhand and floods in Jammu and Kashmir, which wreaked havoc in the country.

Major Disasters in India during recent periods and actions undertaken

1. Cyclone Phailin

Cyclonic Storm Phailinmeaning "sapphire" has been the second-strongest tropical cyclone ever to make landfall in India, behind only the 1999 Odisha cyclone also known as **Cyclone 05B**. This became equivalent to a category 5 hurricane when it approached the Odisha Cost. Even with good preparedness, Odisha's state government estimated that, around 12 million people were affected. The cyclone prompted India's biggest evacuation in 23 years with more than 550,000 people moved up from the coastline in Odisha and Andhra Pradesh to safer places. Most of the evacuated people had been sheltered in 500 specially-built cyclone camps in the two states.

Phailin Hits Odisha

The World Bank praised India's evacuation of nearly 10 lakh people in Odisha and Andhra Pradesh, which ensured minimal loss of human lives.

"Successfully evacuating a million people is not a small task. This cannot be merely achieved by kicking the entire state machinery into top gear for three-four days following a cyclone warning," the World Bank said, days after the cyclone Phailin hit the eastern Indian shore. "This has taken years of planning, construction of disaster risk mitigation infrastructure, setting up of evacuation protocols, identification of potential safe buildings and most importantly, working with communities and local organisations in setting up volunteer teams who all knew exactly what needed to be done".

"The Odisha State Disaster Management Authority (OSDMA) and the Government of Odisha need to be given full credit for their unwavering commitment to disaster preparedness and risk mitigation," the Bank said.

Following the earlier disaster in 1999, Odisha set up the OSDMA, the first state agency focused exclusively on disaster management in India.

Relief Work in Odisha

Hudhud Hits Vishakapatnam

2. Cyclone Hudhud

Caused extensive damage to the city of Visakhapatnam and the neighbouring districts of Vizianagaram and Srikakulam of Andhra Pradesh in October 2014. Damages were estimated to be ₹21,908 crore (US$3.4 billion) by the Andhra state government. At least 124 deaths have been confirmed, a majority of them from Andhra Pradesh and Nepal, with the latter experiencing an avalanche due to the cyclone.

3. Uttarakhand Floods

In June 2013, a multi-day cloudburst centered on the North Indian state of Uttarakhand caused devastating floods and landslides becoming the country's worst natural disaster since the 2004 tsunami. Over 95% of the casualties occurred in Uttarakhand. According to figures provided by the Uttarakhand government, more than 5,700 people were "presumed dead." This total included 934 local residents.

Destruction of bridges and roads left about 100,000 pilgrims and tourists trapped in the valleys leading to

Uttarakhand Hit by Cloudburst

three of the four Hindu Chota Char Dham pilgrimage sites. The Indian Air Force, the Indian Army, and paramilitary troops evacuated more than 110,000 people from the flood ravaged area.

The Army, Air Force, Navy, Indo-Tibetan Border Police (ITBP), Border Security Force, National Disaster Response Force (NDRF), Public Works Department and local administrations worked together for quick rescue operations. Several thousand soldiers were deployed for the rescue missions. Activists of political and social organizations were also involved in the rescue and management of relief centres.

Rescue Work in Uttarakhand

Unlike in case of Phailin which hit Odisha, the unprecedented destruction by the cloud burst witnessed in Uttarakhand state was attributed, by environmentalists, to unscientific developmental activities undertaken in recent decades contributing to high level loss of property and lives. Roads constructed in haphazard style, new resorts and hotels built on fragile river banks and more than 70 hydroelectric projects in the watersheds of the state led to a "disaster waiting to happen" as termed by certain environmentalists.

The environmental experts reported that the tunnels built and blasts undertaken for the 70 hydro electric projects contributed to the ecological imbalance in the state, with flows of riverwater restricted and the streamside development activity contributing to a higher number of landslides and more flooding.

This disaster had left the country pondering over the environment concerns which could lead to disasters in the future.

4. Jammu and Kashmir Floods 2014

According to Government sources, in Jammu and Kashmir floods of September 2014, 300 people died and 25 suffered injuries. Apart from this, damage was caused to 2,61,361 structures, farm sector of 3.27 lakh hectares of agricultural land and 3.96 lakh hectares of horticulture land, 6,910 km of road, 559 bridges, 3,063 PHE schemes, 6,423 irrigation works and schemes, 4,202 sub-stations, 11,671 kms of electric conductors.

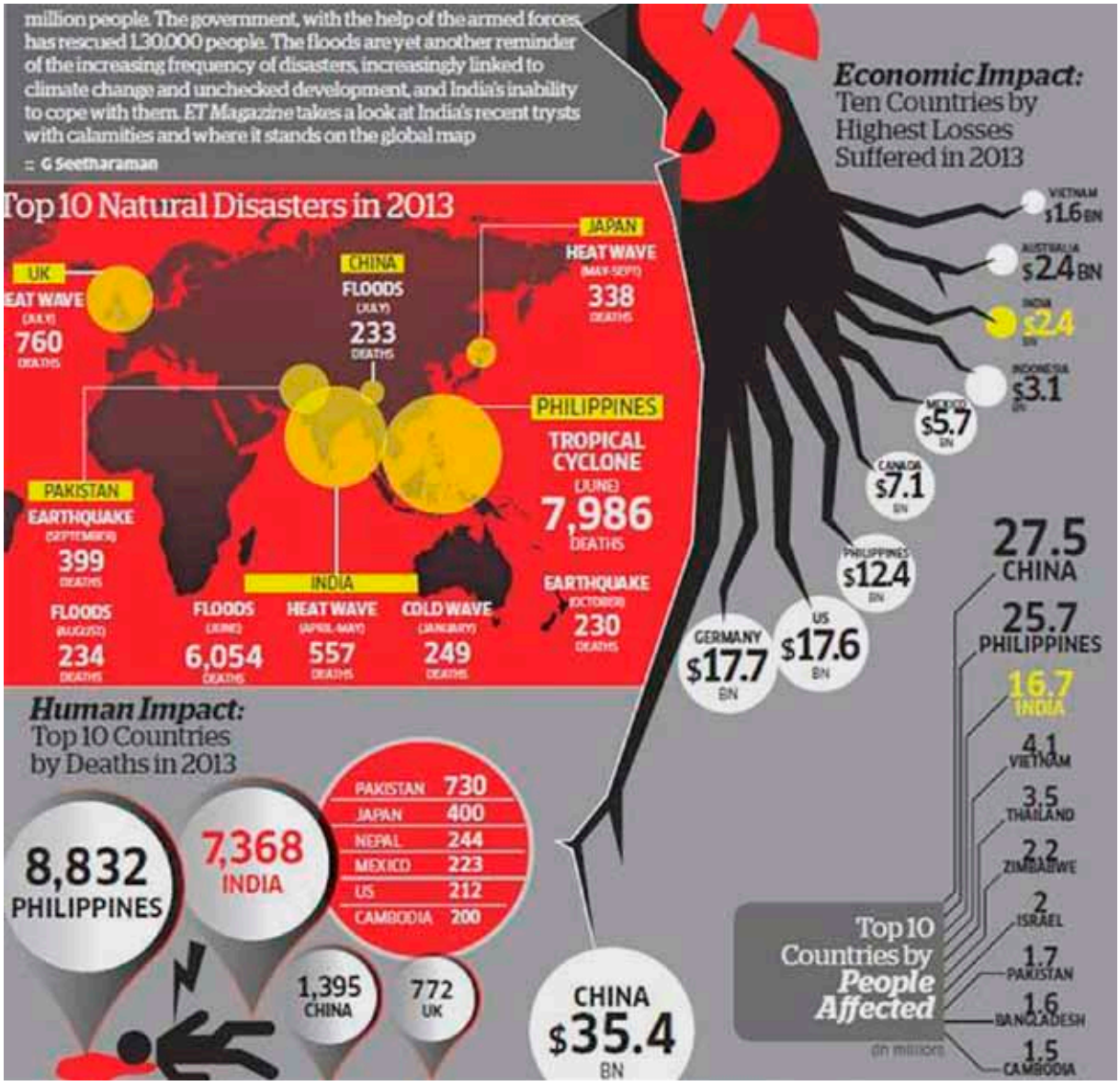
As in the case of Uttarakhand, it is believed that the state ignored warnings from weathermen, which resulted in the disaster.

Some information on the vulnerability of India to disasters is given in the following pictures. (Courtesy: Economic Times Magazine, 14-20th, September).

Increasing Natural Disasters

For Geophysical disasters like volcanoes, earthquakes, rockfalls, landslides, and avalanches, there may be no clear-cut causal relationship between the disaster and the weather. But, for climate-related disasters, one can draw direct causal relations between disasters and the weather. These include hydrological events such as floods, storm surges, and coastal flooding, plus meteorological events like storms, tropical cyclones, heat/cold waves, drought, and wildfires.

Another thing that has risen in the recent years are the financial costs incurred by natural disasters. International organizations such as the Red Cross say that, the world's yearly post-disaster cost is around 65 billion US dollars. Compared that to the four billion spent fifty years ago, adjusted for inflation, and one can realise how expensive preparations have become.



Because of our careless abuse of the environment, the number of natural disasters and the cost of cleaning them up will continue to rise. This should sound caution to us.

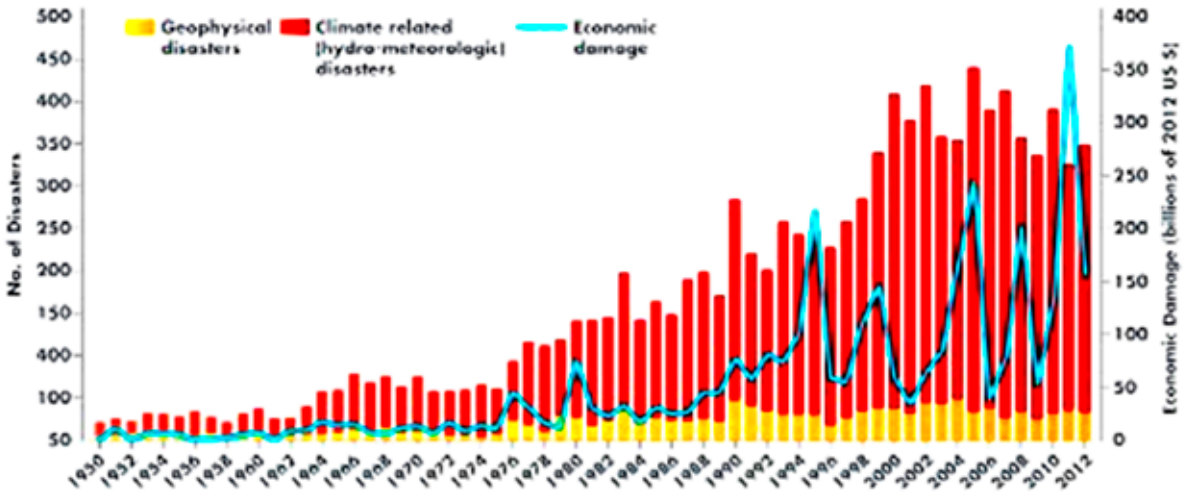
Challenges for the Future

There is a growing need to look at disasters from a development perspective. Disasters can have devastating effect on communities and can significantly set back development efforts to a great extent.

But then, it could also offer an opportunity to invest in development efforts in a post disaster scenario. Disasters are opportunities for communities to reinvent themselves.

One of the glaring lacunae in the process of Disaster Management in India has been the overlooking of unnatural disasters.

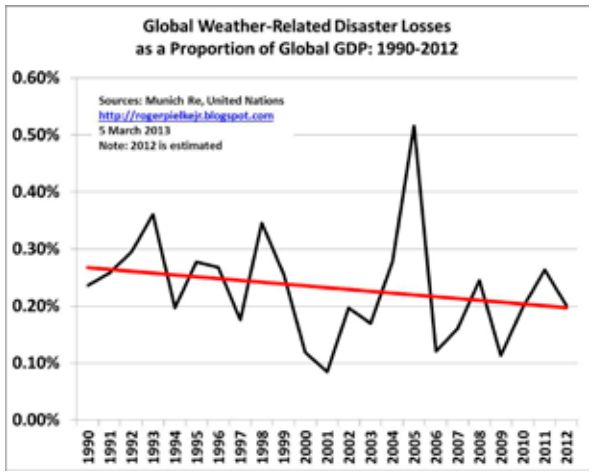
Current global situation also demands initiatives in managing the impact of unnatural disasters. Developments at the international level, particularly culminating on 9/11 have brought the issue of unnatural disasters at the forefront.



The Rising Cost of Global Warming: Increasing Frequency and Cost of Natural Disaster

Nuclear Power Plant Explosion in Chernobyl, Russia

The Exxon Valdez Oil Spill, Alaska, USA



The global community has recognized the serious consequences of Nuclear, Biological and Chemical (NBC) warfare. Hence, unnatural disasters remain a serious challenge for India to address in the near future.

The need of the hour is to chalk out a multi-pronged strategy for total disaster management comprising prevention, preparedness, response and recovery on the one hand and initiate development efforts, on the other.

The countries in the Asia-Pacific region should establish a regional co-ordination mechanism for space-technology based disaster mitigation.

Some of the initiatives in disaster management could be as follows:

- Frame good macroeconomic policies before and after shocks.
- Provision in the budget for emergency spending helps crisis mitigation and resolution, insurance coverage and low public debt bolster government spending flexibility if reconstruction needs arise.
- Public investment in risk reduction.
- Improvement in government policy frameworks to better manage risk and mitigate economic and social costs.
- Estimate the probability of shocks and identify local vulnerabilities and integrate into plans for contingencies, investing in risk reduction, insurance, self-insurance, and disaster response.
- Tax and spending policies need to be flexible, to allow rapid redeployment of spending when needed.
- Coordination with foreign partners before disaster strikes could mobilize external assistance for risk reduction, which is likely to earn a higher return than emergency help after the fact.

A pro-active stance to reduce the toll of disasters in the country requires a more comprehensive approach that comprises both pre-disaster risk reduction and post-disaster recovery. Such an approach should involve the following set of activities:

- Risk analysis to identify the kinds of risks faced by people and development investments as well as their magnitude;
- Prevention and mitigation to address the structural sources of vulnerability;
- Risk transfer to spread financial risks over time and among different actors;
- Emergency preparedness and response to enhance a country's readiness to cope quickly and effectively with an emergency; and
- Post-disaster rehabilitation and reconstruction to support effective recovery and to safeguard against future disasters.

Conclusion

'Should we be talking dollars and cents in the face of human tragedy? The first imperative of public policy should be to save lives, but efforts to reduce economic costs, which carry other human and social costs that can last for generations, are also important. When the economic costs are lessened resources are freed up for disaster preparedness, resilience, and mitigation, which can save lives in the future'say Nicole Laframboise and Sebastian Acevedo.

Sri Suresh Prabhu, Union Minister for Railways once remarked *'Because of the climate change, the intensity and frequency of natural calamities are bound to rise'* This has to be viewed with more concern.

It is learnt that the topic of the workshop on intercultural aspects of disaster management is a topic that is being researched to ensure effectiveness of disaster management and inculcating the cultural awareness and sensitivity which are important factors for the successful planning and implementation of disaster management efforts among multi-cultural expert groups. The workshop is addressing such an important concern.

Disaster management teams composed of experts from different countries have been more and more common in the past and will continue to be so in future. The disaster-management organizations from the affected countries will more frequently seek help from the international community. Hence, it is essential that the cultural aspects are integrated in disaster management work which would ensure an adequate appreciation for the cultural norms and values of the people working in the group to manage the disaster.

The best strategy is to be Proactive rather than reactive in tackling natural disasters and in mitigating the disasters in case of natural or man-made disasters.

References:

1. Disaster Management in India by Vishal Singh in Development Alternatives Newsletter.
2. U N praises India's disaster management system - Times of India 16.10.2014.
3. Cultural Influences on Disaster Management: A Case Study of the Mt. Pinatubo Eruption by C. Dominik Güss,University of North Florida and Oliver I. Pangan, Ateneo de Manila University.
4. Disaster Management In India, Daya Kaul, Md. Ayaz, Lohitkumar S.N., Department of Civil Engineering, IIT Kanpur-208016.
5. Man versus Mother Nature, Finance & Development, March 2014, Vol. 51, No. 1, Nicole Laframboise and Sebastian Acevedo.
6. http://www.skymetweather.com/content/climate-change/natural-disasters-cost-rs-60760-crores-every-year-to-india/ report of March 11th, 2015.
7. 'World Bank praises India's Phailin evacuation efforts'- Report in The Hindu dated October 18, 2013.
8. Economic Times, Magazine 14-20 September 2014.
9. The 5 Most Destructive Natural Disasters of the Past 10 Years-http://bostjanbb.hubpages.com/hub/Worlds-worst-natural-disasters.
10. Future Challenges in Disaster Management-Bihar Institute of Public Administration and Rural Development publication.
11. Publications of Government of India, Odisha, Uttarakhand, Jammu & Kashmir.
12. Various internet resources.

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Fire Loads in Heritage Buildings

N. Suresh*

Abstract

The results of a fire load survey carried out on Daria Daulath Bagh and Mahadwara Gopuram Ranganatha Swamy temple at Srirangapatna Taluk, Mandya District, Karnataka (India) are presented. Two heritage buildings with a floor area of 1068.64 m^2 were surveyed. The inventory method was used in the present survey. Analysis has been made to determine the influence of room use and floor level on fire loads. It is found that room use and room floor area are major parameters affecting the fire loads in a room. An attempt is made to calculate the composition of fire load in the buildings surveyed. In these buildings wood contributes to a substantial portion of the total fire load and the immovable contents contributes to about 90% of the total fire loads.

Key Words & Phrases: *Heritage buildings, protection of structures & moveable items / contents*

1.0 Introduction

"Conservation of Cultural Heritage" is a stated goal of the ISO Technical Committee on Fire Safety Engineering. Heritage buildings are exposed to the same fire threats as other buildings. Unlike most other buildings, heritage buildings are of significant architectural and historical importance, and often contain irreplaceable contents. Implementation of the modern prescriptive codes can even have an unfavorable effect on the architectural value of the building. As a consequence, the fire safety engineer needs to use different approaches to guarantee the fire safety level.

The Heritage structures are divided in three categories from the point of view of materials used in their construction viz wood, stone and bricks. Concerning wooden building, the most cause of damage is due to twisting, joints are crushed, and partially rotted these damages may occur in limited area of the structures but the major cause of destruction is due to fire accidents.

The fire protection of heritage buildings is necessary because a large proportion of the buildings are made of wood. They are historic wooden structures that are densely packed and where the threat from fire is high. Some buildings are located in rural areas which correspond to a high risk.

2.0 - Literature Review

2.1 - Case Studies

The Rova d' Antananarivo, Madagascar. This historic hill top complex of nine buildings (Royal palaces, tombs and temples) was built primarily in wood during 17^{th} to 19^{th} centuries. The cultural and religious heart of the country, it had been proposed for inclusion on the world heritage list.

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The Rova d' Antananarivo, Madagascar. Fanned by high winds, a fire devastated the complex on 6th November 1995. Five of the buildings were razed to the ground ; of the remainder, only basements and perilous masonry elements survived. It was observed that, out of 6175 inventoried objects, 1183 were saved.

Katarina church built between 1656-1695. The architect was Jean de la vallee. The church was damaged and re built again in 1723, but it was not an exact copy of the church. The magnificent tower was new and was finished in 1739. The architect was Goran Adelcrantz The church is on a hill in the south of Stockholm, sodermalm, and you can see it from a long way away. It is a very important part of the Stockholm skyline. The organ façade, which is from 1763, was by Jean Erik Rehn. The altar paice from 1732 and the pulpit from 1753 were by Goran Adelcrantz'son Carl Fredrik Adelcrantz. The altar painting from 1735 was by Lorenz Gottman.

The church was destroyed by the fire in May 1990. This was one of the most notorious fires on the cultural heritage building in Sweden. Only the outer walls made of stone (or bricks) survived. The cause of the fire was most probably an electric fault in the cable of the great hoist chandelier. The church had no smoke detectors. Had there been detectors, the fire would have been discovered at an early stage and probably been put out. The fire brigade was located next door to the church. But when the fire brigade came to the church there was already a big fire and they had no possibility to save the church. The church had an old sprinkler system in the tower but it could not be used because there was not enough water in the Municipal water pipes.

It is important to check old electrical installation regularly and to consider the effect of heating previously not heated spaces. In addition, it is important to have fire detectors in all the spaces, particularly in the attic. Fire brigades should have information concerning the historic buildings in order to act correctly. Remaining structures should be documented as this might have revealed something interesting about the wood joints or other details in the roof constructions. A Fire can be provided a researcher with an opportunity to find some thing that is normally invisible and unobtainable.

2.2 - Objective and Scope of Work

The objective of the present study is

i) Calculation of fire loads of different heritage buildings.

ii) Comparison of fire loads of different heritage buildings.

iii) Recommendation of the suitable solution for protection of the heritage structures against the fire accidents.

2.3 - Scope of The Present Work

Scope of the present work is limited to finding the fire loads in the following buildings.

i) **One heritage building** – Daria Daulath Bagh at Srirangapatna a national protected monument at Srirangapatna Taluk, Mandya district.

ii) **One heritage structure** – Mahadwara gopuram consisting of seven tiers, where wood has been used as reinforcing materials at Ranganatha Swamy temple at Srirangapatna Taluk, Mandya district.

The following are the heritage monuments, which have been considered for the fire load calculation and an brief description of the monuments are given below.

Daria Daulat Bagh (D.D. Bagh)

The D.D. Bagh, "the wealth of the sea" was built in the year 1784 on the bank of the River kaveri and their building served as Tippu sultan's summer palace. The building was built in Indo-Islamic style of Architecture. Rectangular platform with arched entrance. The main structure is a double storey building comprising of wide corridor, several pillars, canopied balconies, an audience hall and private chambers. It is surrounded on all sides by a garden designed in the Islamic char bagh, the water fountains and pathway with Cypresses on either sides were with area on which the garden was divided into four geometric solutions. The structure made by teak wood, bricks and lime mortar was used in the construction. The Northern and southern as well as the inner walls are adored with fine floral patterns and geometric motifs and there are several niches on the outside walls to hold lamps or flower vases. This heritage is an important tourist attraction in Srirangapatna.

Mahadwara Gopuram of Sri Ranganatha Swamy Temple at Srirangapatna Taluk, Mandya District

The Sri Ranganatha Swamy temple is one of the largest in the state and of great importance. An inscription dated 894 AD reveals the Thirumalaiah, the ganga Chieftaien, built the temple of Sriranganatha to commemorate the tradition. There came up a temple dedicated to the god in Sheshashayi form. On the cornices of the plinth on the southern side is an inscription of 1200 AD belonging to the period of Viraballala II, The hoysala king, stating about certain grants made to the priests and temples of the tituva-Ranga-Narayana –Chaturvedi Mangalam. This probably indicates the period of the foundation of the temple and the place as an Agrahara, a centre of traditional learning. Later the vijayanagara Kings, the Mysore wodeyars and Haider Ali enlarged and improved it. The structure is one of the important national protected monuments and the temple is in religious use. Further the significance cause of fire may be due to lighting caused by atmospheric action and by the rituals performed during Vishnu deep utsava The Lofty Mahadwara and imposing the gopura is constructed in vijayanagara period and consist of five tiers (five floors) with total of 131.14 Sqm of wooden floor area and 29470.66 cum of wooden members made of wood.

2.4 - Fire Load

The term fire load is defined as the heat energy that could be released per square meter of a floor area of a compartment of storey by the complete combustion of the contents of the building and any combustible parts of the building itself.

$$q_c = \frac{\sum m_v \times H_v}{A_f}$$

Where,

q_c = Fire load (MJ/m^2)

m_y = Total mass of the combustible material (kg)

H_v = Calorific value of combustible material (MJ/kg)

A_f = Floor are (m^2)

2.5 - Movable Contents

Movable content includes the combustible wooden antique furniture, barricades, Showcases made of ply wood, murals, clothes, and pencil sketches made on paper, Bamboo mats, plastic chairs, and signage's made both of wood and plastics.

2.6 - Immovable Contents

The immovable contents consist of the combustible materials viz wooden members used as supporting frame beams, columns, ceiling , canopied balconies an audience hall.

3.0 Calculations

A sample calculation of [Model Room (1)] shown below.

Model Room - 1

Floor area (A_f) = 27.00 m^2

Weight of immovable combustible material (m_v) = 2499.50 kg

Weight of movable Combustible material (m_v) = 741.00 kg

Total 3240.50 kg

Fire Load $q_c = \frac{\sum m_v \times H_v}{A_f}$ (MJ/m^2)

$= \frac{3240.50 \times 18.60}{27.00}$

$= 2232.34$ MJ/m^2

Calorific value for wooden items (H_v) = **18.60 MJ/kg**

Similar calculations have been adopted for the entire Structures. Tables in the next few pages gives the computation of weights and the corresponding fire load for the entire structures floor wise.

Daria Daulat Bagh at Srirangapatna

Total floor area = 937.50 Sqm

The following materials have been considered as Movable and Immovable contents inside the heritage structure.

Movable Items

Wooden antique furniture, barricades, Showcases made of ply wood, murals, and clothes, pencil sketches made on paper, Bamboo mats, plastic chairs, and signage's made both of wood and plastics.

Immovable Items

The immovable contents consist of the combustible materials viz wooden members used as supporting frame beams, columns, ceiling , canopied balconies an audience hall.

Mahadwara gopuram of Sri Ranganatha Swamy temple at Srirangapatna Taluk, Mandya District

Total floor area = 131.14 Sqm

The following materials have been considered as Immovable contents inside the heritage structure.

Immovable Items

The immovable contents consist of the combustible materials viz wooden members used as supporting frame beams, columns, floors.

Table 1: Fire Load for Daria Daulat Bagh

Sl. No.	Particulars	Floor area	Immovable content			Movable content			Total fire load (MJ/ m2)
			Wt of combustible material, mv (kg)	Calorific value Hv(MJ/ kg)	Fire load qc (MJ/ m2)	Wt of combustible material mv (kg)	Calorific value Hv (MJ/kg)	Fire load qc (MJ/m2)	
1	Front Varandha	115.50	74870.63	18.60	12057.09	109.00	18.60	17.55	12074.64
2	Left Side Varandha	115.50	63733.63	18.60	10263.60	104.00	18.60	16.75	10280.35
3	Rear Side Varandha	115.50	75783.30	18.60	12204.06	128.00	18.60	20.61	12224.68
4	Right Side Varandha	115.50	62275.39	18.60	10028.76	100.00	18.60	16.10	10044.87
5	Models Room-- 1	27.00	2499.50	18.60	1721.88	741.00	18.60	510.47	2232.35
6	Models Room-- 2	24.75	3956.23	18.60	2973.17	397.00	18.60	298.35	3271.52
7	Models Room-- 3	24.75	3956.23	18.60	2973.17	869.00	18.60	653.07	3626.23
8	Models Room-- 4	27.00	2499.50	18.60	1721.88	746.00	18.60	513.91	2235.79
9	Models Room-- 5	60.00	1910.72	18.60	592.32	464.00	18.60	143.84	736.16
10	Models Room-- 6	24.75	3956.232	18.60	2973.17	417.00	18.60	313.38	3286.55
11	Models Room-- 7	24.75	3956.232	18.60	2973.17	397.00	18.60	298.35	3271.52
12	Models Room-- 8	27.00	2499.504	18.60	1721.88	-	-	-	1721.88
13	Models Room-- 9	24.75	3956.232	18.60	2973.17	-	-	-	2973.17
14	Models Room-- 10	24.75	3956.232	18.60	2973.17	-	-	-	2973.17
15	Models Room-- 11	27.00	2499.504	18.60	1721.88	-	-	-	1721.88
16	Models Room-- 12	60.00	1910.72	18.60	592.32	-	-	-	592.32
17	Models Room-- 13	24.75	3956.232	18.60	2973.17	-	-	-	2973.17
18	Models Room-- 14	24.75	3956.23	18.60	2973.17	-	-	-	2973.17
19	Open Space--1	71.50	63567	18.60	16536.31	60767.00	18.60	15807.92	32344.23
20	Open Space--2	71.50	63567	18.60	16536.31	60577.00	18.60	15758.49	32294.80
									143852.45

Table 2: Fire Load for Sri Ranganatha Swamy Temple Main Entrance

GROUND FLOOR									
Sl. No.	FLOORS	Floor area	Immovable content			Movable content			Total fire load (MJ/m2)
			Wt of combustible material, mv (kg)	Calorific value Hv(MJ/kg)	Fire load qc (MJ/m2)	Wt of combustible material mv (kg)	Calorific value Hv(MJ/kg)	Fire load qc (MJ/m2)	
1	First Floor	52.80	6651.79	18.60	2343.24	-	18.60	-	2343.24
2	Second Floor	42.75	5856.45	18.60	2548.07	-	18.60	-	2548.07
3	Third Floor	33.88	5011.08	18.60	2751.07	-	18.60	-	2751.07
4	Fourth Floor	28.05	4392.19	18.60	2912.47	-	18.60	-	2912.47
5	Fifth Floor	17.76	3714.20	18.60	3889.87	-	18.60	-	3889.87
6	Sixth Floor	13.20	2287.43	18.60	3223.20	-	18.60	-	3223.20
7	Seventh Floor	6.60	1928.05	18.60	5433.60	-	18.60	-	5433.60
Total		**195.04**	**29841.19**	**-**	**23101.51**	**-**	**-**	**-**	**23101.51**

4.0 Conclusions

The following conclusions have been drawn based on the limited scope of the project work,

Daria Daulat Bagh

It has been found that the intensity of fire load is maximum in the open space 2 and minimum in the model room 12. In case of accidental fires, precautions have to be taken in open space 2.

Sri Ranganatha Swamy Temple at Srirangapatna

It has been found that the intensity of fire load is maximum in the first tier and minimum in the fourth tier. In case of accidental fires precautions have to be taken in fourth floor.

An efficient fire safety management is essential because these heritage buildings are visited by an average three thousand tourist per day hence the fire alarm, smoke detectors and suitable necessary equipments are to be installed for preventing the major fire disasters.

The most effective method to eliminate the risks of fire is to conduct a fire risk assessment regularly with close monitoring and reviewing; i.e. 'prevention is better than cure'.

Bibliography

1. Herb Stovel, Risk Preparedness: A Management Manual for world cultural Heritage. Chapter 5, pp.44-45.
2. Norwegian links, The Directorate for cultural heritage, The Norwegian fire research laboratory, Article (in Swedish) on fires in old wooden house areas.
3. Regulating Fire Safety in Historic and Cultural Structures; Prof. Vincent M. Brannigan J.D. Dept. of Fire Protection Engineering University of Maryland College Park Md. 20742 USA Firelaw@umd.edu
4. The protection of the architectural heritage against natural disasters proceedings of the European Colloquy on Regulatory Measures concerning the Protection of the architectural Heritage against Natural Disasters in Europe Ravello, Italy, 15-17 November, 1989.
5. V.K. Jain, 'Fire safety in buildings' New Age International Pvt. Ltd., Publishers, New Delhi.
6. 'National Building Code of India', Part IV, Fire and Life Safety.
7. 'A conceptual approach towards a probability based design guide on fire safety', (1983), CIB W14, Fire Safety J., 6, pp.1-59.
8. Andam K.A. (1986), 'Floor live loads for office buildings, 'Build and Envir., 21 (3/40), pp.211-219.
9. James G. Quintiere, (2006), 'Fundamentals of Fire Phenomena', John Wiley & Sons Ltd.

Webliography: www.earth-house.com

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Why Are We Not Prepared For Extreme Natural Events?

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Abstract

In 2005, hurricane Katrina severely damaged New Orleans, which has not completely recovered yet. In 2010, an earthquake destroyed Port Au Prince leaving Haiti in shambles until this date. In 2004, the Indian Ocean tsunami killed thousands even as far as Africa, only to be followed in 2011 by the Tohoku tsunami that triggered one of the worst nuclear disasters in history. Each and every one of these extreme natural events was foreseen or foreseeable, given our knowledge about their nature. That knowledge also tells us that this will happen again and again and our losses will rise. What is keeping us from being prepared?

Before the advent of natural sciences, people believed that these events are an act of god to punish the wicked and humble mankind. In many so-called "developing" regions, this belief still exists and may be a reason for fatalism and lack of preparedness. Not so in the US and Japan, which also have been hit hard and have trouble recovering.

Modern societies over-emphasize short-term economic gains, which is certainly one major reason behind this un-preparedness. But economic principles also have the potential to change this in the future.

Key Words & Phrases: *Disaster, Tsunami, losses, short term gains.*

1. A sad history with a warning

The recent history of disasters triggered by natural events must serve as a warning to mankind that, if we continue on this path, irrecoverable losses will be incurred, especially by extreme natural events. Here is a short list of such events only during the last 10 years (data from MunichRE):

2004 Indian Ocean Earthquake and Tsunami

A rarely expected but possible moment magnitude M_w 9.0 earthquake triggered a tsunami with wave highs of more than 10m throughout the Indian Ocean. It probably killed around 4,00,000 people. There was no official warning and no evacuation plan in the affected regions. International tourist centers were destroyed as well as industrial facilities like harbors and petrochemical plants. More than 1,00,000 fishing boats were lost

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severely affecting the livelihood of millions of people. Within a coastal strip of about 2 km, the infrastructure (roads, rail roads) was largely destroyed.

Many regions have not recovered yet!

2005 Hurricane Katrina

A category 3 hurricane (can go up to 5, therefore not un-expected) hit New Orleans. Dykes failed and about 80% of New Orleans was flooded. 1300 persons died and 1.5 million had to be evacuated. 90% of all oil production in the Gulf of Mexico stopped. With 125 billion US$ estimated damage, this is so far the costliest disaster in US history.

Complete recovery has not been achieved!

2010 Haiti Earthquake

A M_w 7.0 earthquake (not un-expected) destroyed the capital, Port Au Prince killing an estimated 3,16,000 people and injuring another 3,10,000. 1.85 million were without homes. Many more were killed later due to an outbreak of cholera. More than 1/3 of the population of Haiti was directly affected. It was a "strategic" hit at the heart of a developing nation. Important infrastructure, like the port and government buildings were destroyed.

Complete recovery has not been achieved!

2011 Tohoku Earthquake and Tsunami

A M_w 9.0 earthquake (not un-expected) hit the northern shores of Honshu, the main island of Japan. It triggered a 10m tsunami with run-up heights of more than 40m. Tsunami warning worked, but shelters and protective measures were inadequate. About 16,000 people died and more than 3,00,000 homes were destroyed. The coastal infrastructure (ports, roads, rail lines etc.) was destroyed. A refinery as far away as Tokyo was destroyed by fire. Production was affected world-wide due to modern just-in-time supply concepts (especially car industry). The tsunami caused core melt-downs in 2, maybe 3 of 4 reactors at the Fukushima Daiichi nuclear power plant followed by several hydrogen explosions that resulted in wide-spread radioactive contamination, in particular in the Ocean due to the desperate cooling efforts. With an estimated damage of 210 billion US$, it is the most expensive disaster in history so far.

The long-term effects are still unknown and total recovery may not be possible!

These recent events highlight a development, which in its essence can be traced back to a rapidly increasing exposure of more and more people to natural events within a short period of time. A look at the growth of Istanbul (Fig. 1) emphasizes this fact. Other major urban centers around the world developed similarly within the last 50 to 100 years.

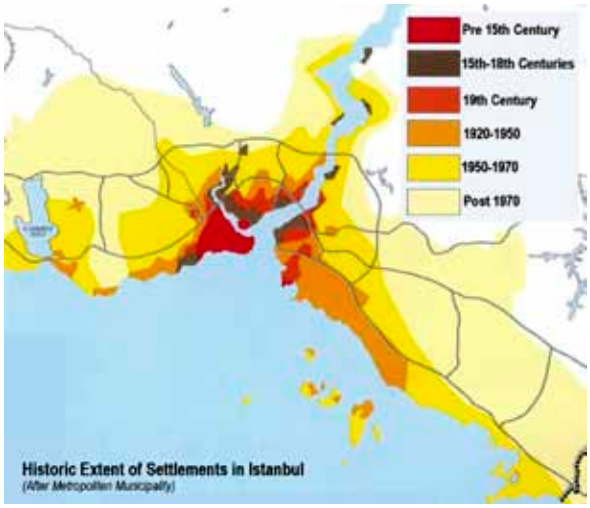


Figure 1: Growth of Istanbul metropolitan area (from Istanbul Earthquake Master Plan).

A focus on short-term economic gain paired with an almost religious belief in natural science made us more vulnerable especially to rare, extreme natural events, since they do not fit into human time scales and they do not obey the usual event statistics of natural scientists. This is particularly true for large earthquakes where the typical seismological hazard models seem to fail time and again.

Rare, extreme natural events like
- Mega quakes
- Mega tsunamis
- Large volcanic eruptions
- Mega storms

are obviously not properly considered and this has already resulted in irrecoverable losses, regardless of whether a developed (US, Japan) or developing nation (Haiti) was hit.

The warning is clearly written on the wall:
If we do not react properly to this challenge from nature, we will not prevail!

This danger was already recognized in 1994, when the Yokohama strategy was developed and further elaborated in a plan for action after the Indian Ocean Tsunami: The 2005 Hyogo framework for action. Unfortunately, it failed!

2. What went wrong with the Hyogo framework?

The Hyogo framework for action was designed to achieve the following outcome until 2015:

The substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries.

Looking at the numbers and past events during these 10 Hyogo years, this has not been achieved. Losses, especially from extreme events keep rising exponentially (Fig. 2).

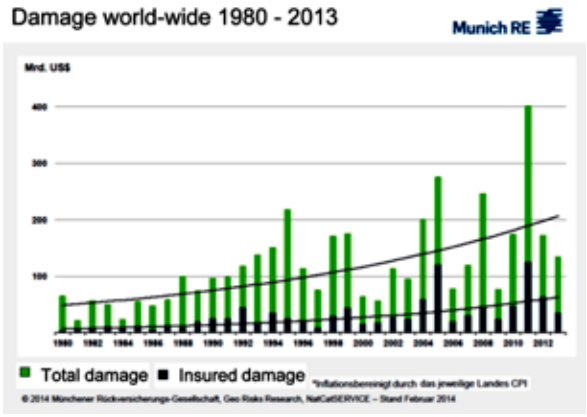


Figure 2: Damage in billion US$ world-wide (MunichRE).

A closer look at the distribution reveals that earthquakes cause most deaths and metrological events the most economic damage, but closely followed by earthquakes and hydrological events. Climate is a distant 10% (Fig. 3). This tells us the following:

- Because of its suddenness, there is no short-term reaction to earthquakes, like it is to flooding now, where warning systems have become very effective. People cannot "run away" from earthquakes, so the death toll is much higher.
- Meteorological and hydrological events (especially flooding) are more frequent and usually affect larger areas than earthquakes. Thus, their economic impact is larger. Economic losses due to earthquakes are rising rapidly and soon may break even with the other hazards, once large urban centers are hit more frequently.
- Climate change is the major topic for many years now and a lot of resources are spent. These numbers clearly call for a change of focus.

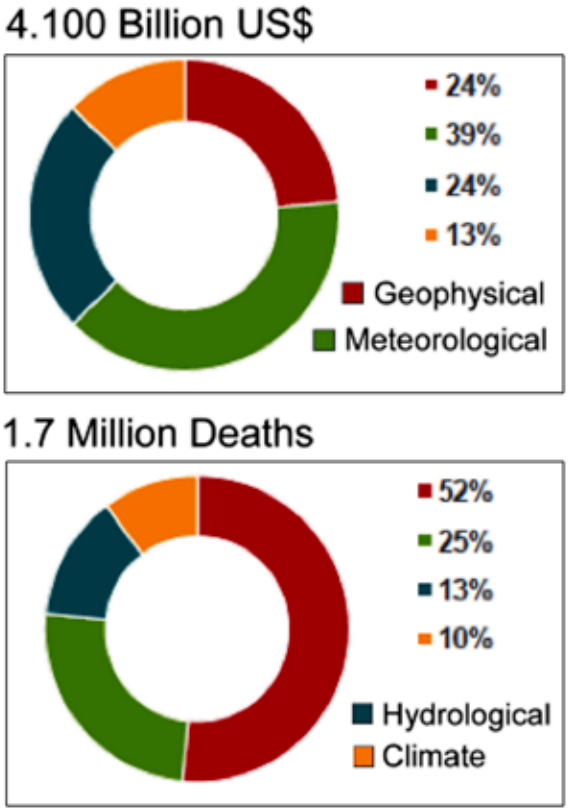


Figure 3: Distribution of losses according to natural hazards 1980-2013 (MunichRE).

Another important aspect is regional distribution. It can be seen from Figure 4, that

- Asia suffers the most, especially in terms of lives lost (earthquakes!).
- The US is hit hardest economically, but Asia is rapidly gaining. The past ten years have seen an unprecedented economic development, especially in India and China. This has magnified the economic exposure to natural hazards there.

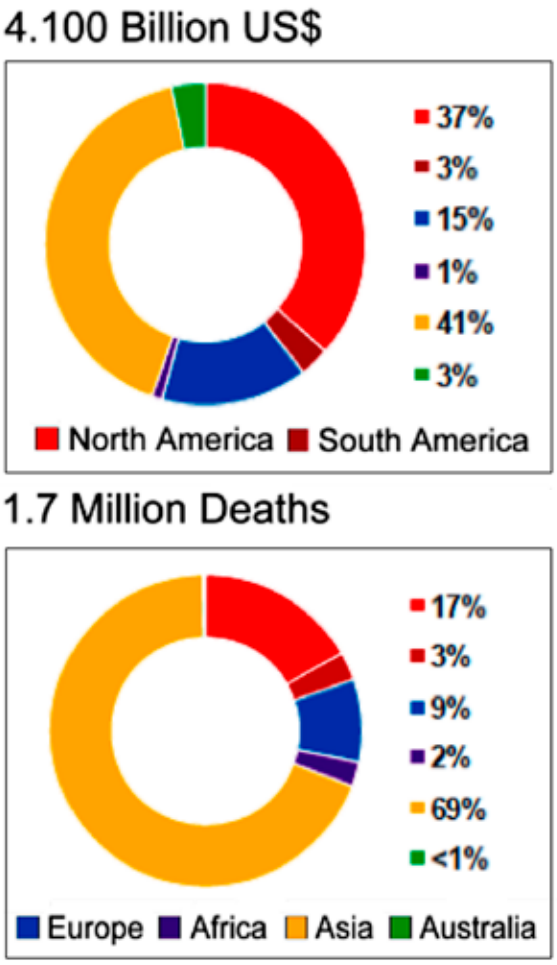


Figure 4: Regional distribution of losses due to natural events 1980-2013 (MunichRE).

The numbers tell us that we need to put more attention to earthquakes and to Asia, if it makes a real difference within the next decade!

Analyzing the Hyogo approach in light of these numbers reveals a peculiar shortcoming. Based on the 1994 Yokohama strategy, the Hyogo framework identified specific gaps and challenges in five main areas for the period 2005-15:

a) Governance: organizational, legal and policy frameworks;
b) Risk identification, assessment, monitoring and early warning;
c) Knowledge management and education;
d) Reducing underlying risk factors;
e) Preparedness for effective response and recovery.

The resulting key activities focused on *risk assessment, information, education, management* and *institution building* with its main focus still on *reaction,* not *pro-action.*

In particular, no specific actions for **Risk Reduction** were defined!

It is well known that any risk is a function of

Hazard - Vulnerability - Loss

Since the hazard in this case is natural and cannot be reduced, **Vulnerability Reduction** is the only key to risk reduction under natural hazards. In the Hyogo framework, there is no mentioning of **effective engineering concepts** and **economic mechanisms** that are capable of reducing such vulnerabilities, although they exist!

That's why Hyogo had to fail!

3. Vulnerability reduction cannot be achieved through disaster management

If our societies become serious about the reduction of vulnerabilities due to natural hazards (and they should: remember the warnings!), very different approaches are needed than Hyogo had to offer. This is too complex a task for disaster managers to shoulder. Other players in society must take over. The following is just a short list, where vulnerabilities exist:

- Buildings (residential, administrative, educational, commercial, health, historical)
- Transportation infrastructure (roads, railroads, bridges, waterways and harbors, airports)
- Other life lines (water, waste water, electricity, oil, gas)
- Regular industry (SMEs, large manufactures)
- Industry with large hazard potential (chemical, petrochemical, nuclear)
- Agriculture (life stock and crops)
- Economy (business interruptions, loss of income, short and long-term market impact, financial market reaction)
- Environment (industrial spills, waste water spills, oil spills, radioactive contamination)

Each of these poses particular challenges in different regions subjected to their particular natural hazards and this short paper obviously cannot address them all: Only concerted efforts involving all relevant players in a region are able to shed light on these issues and come up with successful regional actions for vulnerability reduction. In order to achieve this, it is suggested here that regional governments create standing vulnerability reduction conferences involving all stakeholders. Needless to say that, relevant international expertise will be very helpful in defining such actions.

Such actions will not come easy or cheap. Let me highlight this by just addressing the vulnerability of buildings under earthquakes. Certainly, this is one of our most pressing problem in this context, with millions of buildings and their inhabitants at risk, and the wellbeing of many urban centers and their respective countries at stake. How can we achieve a substantial reduction here within a reasonable amount of time, say within 20 years?

4. How to achieve large-scale reduction of seismic vulnerability of building stock?

The first task is *vulnerability assessment*. In terms of earthquake vulnerability of buildings, one must know how the buildings in a region behave during an earthquake. This is mostly unknown, because real damage data is mostly missing and design criteria and procedures in building codes are misleading: They are prescriptions for a limit state design of new structures, not criteria to assess the performance of existing ones. And they are changing with every major earthquake and will continue to do so in the foreseeable future, emphasizing the fact that even they have not been perfected yet. Just to highlight one of the issues we are facing here:

If buildings would behave according to code, their safety would not depend on the number of storeys. They would be equally safe. The undisputable fact from damage data is though, that buildings with more storeys are less safe (reliable data exists in some regions for up to 7 storeys, see e.g. Sucuoglu, Yazgan, Yakut).

So the first step must be the creation of a realistic regional damage database, where it does not exist. This can only be done through sophisticated numerical engineering models that are validated with large-scale testing of real buildings. Such testing should be done on site (see e.g. recent efforts in Turkey: ITÜ-Report) and supplemented by full-scale tests, especially on the large E-Defense shaking table near Kobe, Japan (up to 7-storey buildings can be tested full-scale, see www.bosai.go.jp/hyogo/ehyogo), or one of the large pseudo-dynamic testing facilities in the world (the European facility ELSA is at the JRC in Ispra, Italy: https://ec.europa.eu/jrc/en/research-facility/elsa?search). Considering the various building types that exist, just performing such experiments is not a small task and requires an international effort. But this could and should be done!

Once developed, the engineering models can be used to create "virtual cities" (Fig. 5) based on rapid local "walk through" observation (which already has been performed in many regions) and/or using commonly available satellite based tools with some of them even providing street views.

Source: Author

Figure 5: A "virtual city ward" with engineering models for buildings created by the BPS-tool under development at Kassel University, Germanyin cooperation with MunichRE (Mühlhausen, Dorka, Smolka, Stupazzini).

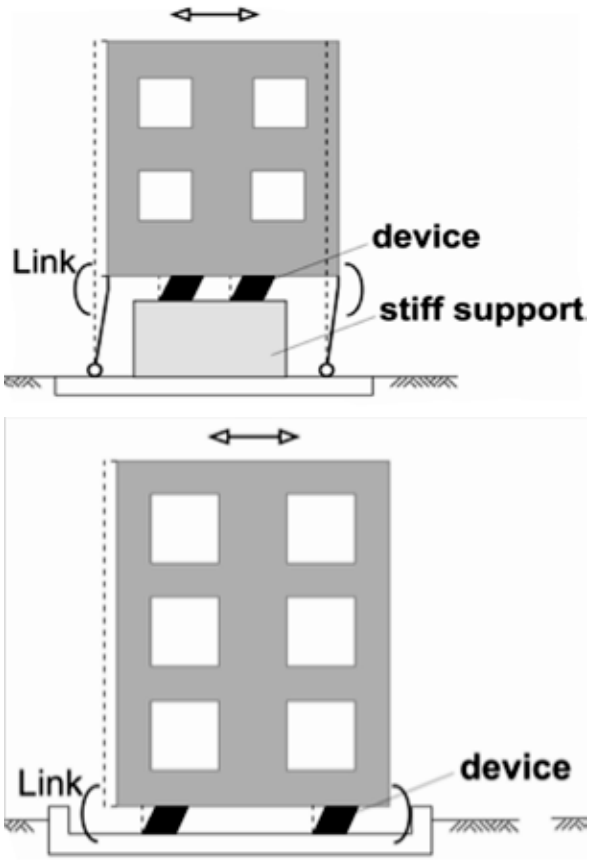
These "virtual cities" would now behave very similar to the actual ones in structural terms, thus providing realistic vulnerability scenarios for different regions.

The next step is *vulnerability reduction*. This has a *technological* as well as *economic* component.

The *technological component* calls for more robust structural concepts that have proven (or can be proven) to be more robust, yet not more costly than the typical reinforced concrete frame with masonry infill, which comprises roughly 90% of all modern buildings and

has been proven to be very vulnerable, mainly due to a lack of proper execution, but also due to typical and widespread design flaws.

Such seismically robust concepts do exist, some of them even for a long time. Among them are *reinforced masonry, confined masonry* and *seismic control concepts,* especially *Base Isolation* and the *Hyde-System* (Fig. 6), the latter being particularly suitable for retrofitting of so-called soft-storey buildings, which are among the most dangerous structures in the world.



Source: Author

Figure 6: Seismic control concepts like Base Isolation (right) and Hyde-System (left) are not only more robust than conventional structures, but also less expensive to build.

Rebuilding residential quarters in L'Aquila, Italy with Base Isolation (Calvi, Spaziante) and retrofitting an administrative building in Seattle, USA with a Hyde-System (Dorka, Conversano) have already demonstrated their superior economy and robustness. Still, widespread promotion is lacking, especially in Asia.

This brings us to the economic component. It is obvious that a short-sighted demand and supply cycle is mainly driving construction, often leading to un-checked urban sprawl, especially in Asia. Seismically robust structural concepts take a backseat, even though they are less expensive, simply for lack of knowledge and the capacity of local builders and their workers to apply them. That way, large urban regions have sprung up (and are still springing up!) that are seismically unsafe and potentially very dangerous.

Only urban renewal can cope with this and must do so within an economically and socially feasible environment. The Istanbul Earthquake Master Plan (MMI) is pointing in the right direction, although the recent urban renewal projects there, which are politically motivated in part, have drawn some serious criticism (e.g. Letsch in "The Guardian"). Despite of this, the underlying economic ideas outlined in the Master Plan by economic and financial experts are sound and applicable to other regions.

One drawback that is addressed in the Master Planis the lack of suitable financial instruments. Among those suggested are CAT bonds (CAT for catastrophe). Traded on the international bond market, this instrument can raise the necessary capital for large urban renewal projects: A regional Real Estate Investment Trust (REIT) can issue CAT-type bonds based on an economic disaster risk profile. This can be made very attractive to investors, if it is based on the application of robust building technologies that reduce vulnerabilities substantially or even eliminate them.

A regional Land Development Agency, which should be a public entity with strong involvement of local citizens to minimize graft and account for the necessary social input (something that is amiss in Istanbul!) designates areas for urban renewal. The REIT then provides credit to developers for buy-outs and new buildings. The REIT can also provide financial backing for "property swaps" old against new, which is a powerful tool to get current owners to support the renewal, and it can sell disaster risk insurance to future owners.

Thus a regional economic cycle with a win-win situation for all participants is created and fueled through international investment. Obviously, this will not only reduce the local seismic risk substantially, but also create economic growth and added value to the region and its people.

5. Summary and Conclusions

The past ten years must serve as a warning that we are not prepared for extreme natural events and that our losses will be irrecoverable, regardless whether a developed or developing nation is hit, unless there is a change in approach towards natural risks fundamentally. The Hyogo framework with its focus on disaster management could not deliver because *vulnerability reduction* was not properly addressed.

Being the key component on the way to acceptable natural risks, vulnerability reduction is a complex issue beyond the capabilities of disaster managers. It requires a concerted effort of all relevant players in a region and it has a strong engineering and economic component. Standing regional conferences on vulnerability reduction involving all stakeholders in society are therefore suggested here, which could develop and implement actions that are in line with the region's social, cultural and economic setting.

Taking earthquakes as one important example, this paper demonstrates that just the seismic vulnerability assessment of the existing building stock is a complex and costly engineering issue, which still lacks the necessary scientific backup to be reliable. In this case international cooperation, especially the use of existing large scale research facilities, can close this knowledge gap quickly and facilitate the necessary confidence in and spread of, already existing seismically robust and economically competitive structural concepts.

To deal with the large-scale urban sprawl created by shortsighted interests mainly in the last few decades, and which has created many seismically dangerous urban settlements around the world, urban renewal is the basic approach. As outlined in the Istanbul Master Plan, financial instruments like CAT bonds can fuel a local economic cycle for renewal that, if based on robust and economic technologies, not only reduces the seismic vulnerability drastically, but also creates economic growth and added value for a region.

Vulnerability reduction is not about costs, but must be seen as a motor for economic growth and wellbeing in order to succeed! This is also true for the other, non-seismic natural risks.

References

1. MunichRE: NatCatSERVICE, online data repository concerning natural disasters. Metropolitan Municipality of Istanbul (MMI): Earthquake Master Plan for Istanbul. 2003.
2. UN: Hyogo Framework for Action, 2005-15. Extract from final report, World Conf. on Disaster Reduction, Hyogo, Japan, 2005.
3. Mühlhausen, A., Dorka, U.E., Smolka, A., Stupazzini, M.: Seismic risk assessment for masonry buildings based on discriminant analysis of a virtual database. 15 World Conf. Earthquake Engineering, Lisboa, 2012.
4. Sucuoglu, H., Yazgan, U., Yakut, A.: A screening procedure for seismic risk assessment in urban building stocks. Earthquake Spectra, Vol.23, No.2, 441-458, 2007.
5. Dorka, U.E., Conversano, G.A.: Seismic retrofit of All state Building. Proc. IABSE Symposium, San Francisco, 1995.
6. Calvi, G.M., Spaziante, V.: Reconstruction between temporary and definitive: the CASE project. Italian National Report Research and Construction, Associazione Italiana Tecnico Economia del Cemento, p.124, 2010.
7. Letsch, C.: Istanbul sees history razed in the name of regeneration. www.theguardian.com/world/, March 1, 2012.
8. ITÜ Report by Comert, M., Demir, C., Ates, A.O., Tore, E., Ozeren, O., Moshfeghi, A., Khoshkholghi, S., Orakcal, K., Ilki, A.: Field testing of substandard full scale RC buildings for seismic performance assessment: Quasi-static tests. Istanbul Technical University, 2015.

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Earthquake Disaster Management in Different Countries - Influence of Culture of Region

S.K. Prasad*

Abstract

This paper attempts to provide an insight to some of the problems associated with infrastructure from earthquakes and the performance of infrastructure during earthquake all over the globe. The Indian scenario is briefly discussed in comparison to other countries and hence emphasis is made to enhance practices of earthquake resistant construction in the country. Some of the concepts of earthquake engineering are explained through pictures from past earthquakes. It is emphasised that the places where the seismic design is followed, the damaging effects of earthquake are minimum. It is also stressed that earthquake disaster management in India should further improve so as to reduce loss of life and economic loss during disasters. Besides, the influencing effects of culture of the region on effective earthquake disaster management are briefly discussed. It is inferred that cultural barriers may hinder the disaster management process at least in the present situation. However, gradually disaster management is likely to become global and reduce the inter-cultural barriers.

Key Words & Phrases: *Performance of structures, cultures& liquefaction*

Introduction

Earthquakes are perhaps the most unpredictable and deadliest of all the natural disasters. It is impossible to predict when the next big earthquake strikes, for how long and at what location. Fig. 1 and Fig. 2 indicate the disastrous effects of earthquake compared to other natural disasters such as cyclone, flood, volcanic eruption, forest fire etc. Both the total number of deaths and economic loss to build environment exceed 50 % of total during earthquake. The Fig. 3 and Fig. 4 present the catastrophic effects of earthquake. Bhuj earthquake of 2001 that struck the western part of Gujarat on the republic day resulted in about twenty thousand loss of life. Most of the infrastructure suffered serious damage and many towns and villages were reduced to rubble. Fig. 3 presents a small town called Rapar close to Bhuj immediately after the earthquake that was reduced to ruins. The situation of Port Au Prince, the capital city of Haiti (near West Indian Islands) is even worse. Out of the total population of 30 lakh people in Port Au Prince, 2.5 lakh people perished during one earthquake of 10th January 2010. Can we imagine any other disaster taking away so many lives (one out of twelve)? Infrastructure was completely reduced to devastation and life of the people was in dire state. Fire in the city could not be extinguished for days as there were no fire personnel

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to fight fire, dust in the atmosphere created by falling concrete and masonry structure could not be removed for days. Even the presidential palace could not survive the jolt. Worse was the fact that even after two years of the event, much of the debris was not removed indicating poor effort by the government to bring back the normalcy.

At this moment, it is useful to look at Table 1. The table compares the performance of different countries, namely, Haiti, India and Japan during different earthquakes. The damaging effect is measured in terms of loss of life. The earthquakes are so chosen that their effect at the ground level in terms of energy released or power generated is nearly the same.

For this purpose, earthquakes of similar magnitude and similar focal depths are chosen. Though there can be other factors affecting the performance, the comparison clearly shows that loss of life is exorbitant in Haiti and is hardly anything in Japan. Loss of life in India lies in between.

This indicates the importance of practice of earthquake engineering. Japan has good awareness of earthquakes and is affected by many big earthquakes often. Hence, research in the area of earthquake engineering is substantial permitting the construction of engineered structures. However, the knowledge of earthquake engineering is poor in Haiti and India has a long way to catch up with Japan.

Table 1 : Comparison of Damaging Effects of Earthquakes in Different Countries

HAITI	INDIA	JAPAN
Haiti Earthquake	**Bhuj Earthquake**	**Ryukyu Island Earthquake**
Port Au Prince	Bhuj, Gujarat	26 February, 2010
12 January, 2010	26 January, 2001	Mw 7.0, **1 Death**
Mw 7.0	Mw 7.3	**Izu Island Earthquake**
MM X	MM X	9th August, 2009
Focal Depth 13 km	Focal Depth 15 km	Mw 7.1, **0 Death**
2.5 Lakh Deaths	**20,000 Deaths**	**Iwate Miyagi Nairiku Earthquake**
3 Lakh Injured	1.67 Lakh Injured	14 June, 2008
1.3 Lakh Displaced	-	Mw 6.9, **12 Deaths**
1.0 Lakh Houses Destroyed	2.0 Lakh Houses Destroyed	**Noto Peninsula Earthquake**
2.0 Lakh Houses Damaged	4.0 Lakh Houses Damaged	25 March, 2007
		Mw 6.9, **1 Death**
		Kuril Island Earthquake
		15 November, 2006
		Mw 7.9, **0 Death**

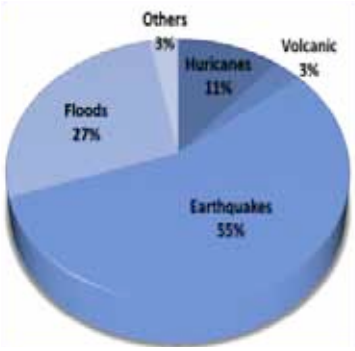

Fig. 1: Loss of life from natural disasters

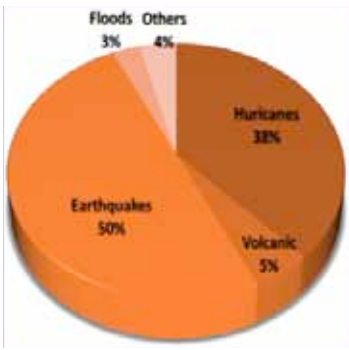

Fig. 2 : Loss of built environment from natural disasters

The Table 2 provides another important statistics of damage during different earthquakes in terms of loss of life and other loss. It is interesting that the countries where the knowledge of earthquake engineering is substantial suffered fewer loss of life. Countries like India, Indonesia, Iran, Turkey and Haiti suffered big loss of life. Japan was vulnerable in 1920s, but is equipped to handle big earthquakes better. Presently, Japan, USA, New Zealand produced well engineered structures under all circumstances, while others are behind. The Table 3 presents the top ten earthquakes ever recorded globally. It is interesting that among them five were experienced in the last nine years, six of them generated tsunami and vulnerable countries suffered more damage in terms of loss of life.

Fig. 3: Rapar town in Gujarat reduced to rubble after the Bhuj earthquake of 2001

Fig. 4: Down town area of Port Au Prince, capital city of Haiti after the earthquake in 2010

Table 2: Country-wise damage assessment in terms of loss of life during earthquake

Region	Date	M	Death	Injured & Homeless
Kanto, Tokyo	1st September, 1923	7.9	123000	381000 houses burnt, 694000 houses damaged
Nicaragua	23rd December, 1972	6.2	8000	20000 injured, 260000 fled from city
Izmit, Turkey	17th August, 1999	7.8	18000	50000 Injured
Chi Chi, Taipei	21st September, 1999	7.3	2500	Thousands Injured
Gujarat, India	26th January, 2001	7.9	20000	12 Lakh Homeless
Seattle, USA	28th February, 2001	6.8	1	272 Injured
Kaman, Iran	26th December, 2003	6.6	20000	80000 Casualties in 1 Lakh Population
Sumatra, Indonesia	26th December, 2004	9.1	226000	Huge loss
Ryukyu Island, Japan	26th February, 2010	7.0	1	Insignificant
Haiti	10th January, 2010	7.3	250000	300000 injured, city reduced to rubble
Canterbury, New Zealand	4th September, 2010	7.1	185	Many buildings collapsed

Table 3: Top Tem earthquakes ever recorded based on magnitude

Sl. No.	Magnitude	Date	Place	Damage
1	9.5	22/05/1960	Chile	5000 deaths, 20 Lakh homeless
2	9.2	28/03/1964	Alaska	125 deaths, Tsunami
3	9.1	26/12/2004	Indonesia	2.26 Lakh killed, Tsunami
4	9.0	04/11/1952	Russia	0 death, Tsunami
5	9.0	11/03/2011	Japan	15000 deaths, Tsunami
6	8.8	27/02/2010	Chile	500 deaths, Tsunami
7	8.8	31/01/1906	Ecuador	1000 deaths
8	8.6 – 8.9	11/04/2012	Indonesia	0 death
9	8.7	04/02/1965	Alaska	0 death, Tsunami
10	8.6	28/03/2005	Indonesia	1300 deaths

Indian Scenario

India is not free from earthquakes. India has suffered many big earthquakes in the past. Many earthquakes of magnitudes 7 and above have hit Gujarat, Kashmir, North East and Andaman Islands. Latur earthquake of 1993, Jabalpur earthquake of 1987, Uttarakashi earthquake of 1991, Chamoli earthquake of 1999, Bhuj earthquake of 2001, Sumatra earthquake of 2004, Kashmir earthquake of 2005 and Sikkim earthquake of 2011 are the more recent ones to cause damage to infrastructure and loss to built environment in addition to taking away many lives and injuring many. Considering the seismic activity, closeness to Indo-Australian Plate Boundary and vulnerability at different locations, India is divided in to four seismic zones. Zone II is seismically least active and Zone V is seismically most active. In seismically most active zones, earthquakes generating higher levels of shaking are expected more often. Hence, the structures are to be designed for bigger horizontal force to take into effect the shaking. Many builders always argue that cost of construction increases by considering earthquake force. It should be noted that the present day's emphasis is not on economy, but on safety. By constructing structures considering all unexpected and extreme loadings, we will let the occupants of the building have a lot of confidence to live in. Further, it should be noted that we normally spend 70 % of total expenses on construction towards cosmetics such as wooden fixtures, granite cladding and other beautification measures. The increase in cost is only for the structural members that amount to about 30 % of total cost. Even if the cost increase is 15 % of structural cost due to consideration of seismic effects, the resulting increase in total cost is less than 5 % which should easily be affordable. Another issue with most architects is saving in space with reduced size of members such as columns or concealing the column inside the wall. This amounts to putting narrow columns with stiffness different in different directions. If earthquake strikes in the direction of highest stiffness, it is definitely advantageous and the structure performance well. However, in other directions structure will be vulnerable. Hence strong columns with equal stiffness in all directions are the best solutions for structures in seismically active zones. Hence, there is an urgent need for proper coordination between policy makers, architects, structural engineers and builders to aim at very strong foundation, strong columns and not so strong beams and slabs that provide overall ductility and flexibility to structures.

Issues on Performance of Structures During Earthquakes

As it is well known, earthquakes induce horizontal, dynamic and oscillatory force. Earthquake force is totally unpredictable. Many peculiar things happen because of lack of knowledge about nature's behaviour under extreme loading. All structures are built on ground and hence performance of ground during earthquake requires extra care. Soil is perhaps the most complex and most used among all construction materials. But, it possesses many interesting characteristics. It exists in different colours, it is sensitive, it possesses memory and it changes its properties with time. All these properties match those of human beings. Hence, soil should be treated as a material with life. Any mistake committed on part of engineer may result in a huge problem. We should therefore avoid abusing soil.

Structures built on and with soil may be referred to as geotechnical structures. Foundations, slopes, retaining walls, embankments, earth and rockfill dams, tunnels are such structures which are in direct contact with soil. Soil is a complex material and earthquakes are unpredictable. Hence earthquake geotechnical engineering deals with highly complex and unpredictable aspects and it is therefore a big challenge to engineers to understand the performance of different geotechnical structures during earthquakes. Some of peculiar performances of these structures during earthquakes are presented in the photos.

Fig. 5 presents cars taking bath in a pond. There never was a pond before the earthquake. Effect of Hyogo Ken Nambu earthquake in 1995 in Japan was such that an underground metro station in Kobe collapsed and foundation soil experienced liquefaction resulting in ground water moving up and ground experiencing settlement. Fig. 6 presents the case of four storeyed apartment buildings in group built of Reinforced Concrete framed construction at Kawagishi Cho in Niigata. The foundation soil comprised of saturated loose silty sand that experienced liquefaction during

the 1964 Niigata earthquake. This resulted in different buildings experiencing different levels of rotation and one of them almost completely toppled. The studies related to liquefaction started gaining importance after this earthquake.

Fig. 5: Effect of liquefaction and collapse of underground metro station during Kobe earthquake of 1995

Fig. 6 :Toppling of Apartment buildings at Kawagishi Cho due to foundation soil liquefaction during Niigata earthquake of 1964

The Fig. 7 presents the performances of a twenty one storeyed steel building and another multi storeyed Reinforced Concrete building in the background during the 1985 Mexico earthquake. While the steel structure was completely destroyed the other building was intact after the earthquake. This earthquake clearly brought out the site effect. The depth of overburden, number of layers, depth of ground water table and type of soil etc., provide different responses at the ground level and different structures perform differently. There are possibilities of resonance affecting a particular type of building during some earthquakes at different locations. The Fig. 8 presents the level of deformation experienced at the ground level during the Canterbury earthquake of 2010 in New Zealand. The amount of shear experienced by the ground is visible by the distortion suffered by railway track.

Fig. 7: Total collapse of 21-story steel frame office Building and building standing in background during Mexico earthquake of 1985

Fig. 8: Railway track subjected to shear due to ground movement during Canterbury earthquake of 2010

The Fig. 9 shows the performance of a two lane highway on a gentle manmade slope during the East Japan earthquake of 2011. It is interesting that the lower half of the road suffered a slide down wards along the slope while the other half remained intact. It is really difficult to answer why exactly one half experienced slope failure. Perhaps the compaction was not proper, the effect of shaking was more or soil was poor in the lower half. The Fig. 10 shows a manhole 373 km away from the epicentre of the same earthquake in Tokyo having come up as if to see what is on ground. It appears that manhole was bored to be underneath the ground. This is due to the effect of liquefaction

that generated excess pore water pressure which was sufficient to lift the relatively light weight manhole up to ground level. What is surprising is how much seismic force was generated to liquefy the ground so far away from the epicentre.

Fig. 9: Half of the highway on gentle slope experienced slide while the other half was intact during the East Japan earthquake of 2011

Fig. 10: Manhole above ground during East Japan earthquake of 2011 at Tokyo 373 km away from epicentre. (Photo: Prof. Towhata)

The Fig. 11 shows the performance of two reinforced concrete buildings in Adapazari during the Izmit earthquake of 1999 in Turkey. It is interesting that the two buildings experienced lean in opposite directions as if they are angry on each other. This is the effect of liquefaction of foundation soil leading to loss of strength and stiffness. Liquefied ground resulted in the buildings to be unstable and tilt in the direction where the weight was more concentrated. The Fig. 12 shows a bus precariously standing on the elevated Hanshin express way in Kobe after the Hyogo Ken Nambu earthquake of 1995 in Japan. The movement of foundation soil below shifted the piers relative to one another resulting in the slide of top deck slab. The driver of the bus must be really praying for his luck.

Fig. 11: Two apartment buildings leaning in opposite directions because of ground liquefaction during Izmit earthquake of 1999

Fig. 12: Deck slab of elevated road displaced due to support movement during the Hyogo Ken Nambu earthquake of 1995 leaving the bus cantilevering precariously

The Fig. 13 presents the case of a collapse of multi-storeyed Reinforced Concrete apartment building during the Bhuj earthquake of 2001. While the entire building collapsed, the lift portion survived. Perhaps the designer was more cautious while dealing with the lift portion as lift generated dynamic force during its motion and provided the lift portion within four columns. What he forgot was to properly connect this portion with the neighbouring structure and did not perhaps design that portion for any lateral resistance. While the entire frame collapsed, the lift portion stood erect without

any damage. This portion is the earthquake resistant construction and not the rest. The Fig. 14 presents the structure of olden days called Bunga that was common in Gujarat and Rajasthan about 200 years back. NGOs built a model of Bunga to state that such Bungas survived many earthquakes and testing time with other extreme loadings while the present day structures built by today's engineers cannot survive such lateral forces. Hence, the inference drawn by the NGOs is that it is the civil engineers who kill people and not the earthquakes. Can we accept such statements as Civil Engineers? Definitely, it is not possible to accept. Today's Civil engineer is much more knowledgeable than the one of the past. We can design and construct more complex structures under difficult conditions. However, we still have a long way to go to understand nature. As a Civil Engineer, one cannot accept that we are the killers. But, we all have to work with more caution, and proper coordination for construction under difficult situations.

Culture stands for the habit of majority of people in a region. The habits include the effects of language, religion, level of education, knowledge, whether rich or poor, influence of other places, convenience of transportation and so on. It should be noted that all forms of disaster management from Response to Recovery, Mitigation and Preparedness should address the fact that the local culture should be respected and practiced. Normally, many relief workers from across the globe will work during the event and they should be well trained to stick to the habits of the region. The dresses worn, type of food consumed, even the type of medicine administered will all have local effects. For instance, disaster management in Japan requires the provision of Japanese food with chop sticks, in Europe and America local food with spoon and fork should be served. Whereas in India, hands will act as chop sticks, spoons and forks and extreme care is necessary to maintain the hygiene. During the response period, care should be taken to not upset already suffering citizens with practices that they are not used to. Further, during the recovery stage, most important aspect is to repair, rehabilitate and retrofit the existing structures to bring back normalcy at the earliest. Familiar construction methods with locally available materials and technology should be adopted. Further, the local design methods and code provisions should be followed to effectively transfer normalcy back in the region. All these involve understanding the culture of the locality before adopting relief work for effective disaster management.

Conclusions

This paper is written to present some peculiar happenings during the earthquake with special emphasis on the performance of geotechnical structures. The following are some inferences from the paper.

1. Earthquakes are unpredictable, and most scary among all the natural disasters both in terms of loss of life and loss to the built environment.
2. The effects of earthquake are less pronounced in places where seismic design is adopted and the damage is more pronounced in countries with poor understanding of earthquake resistant design and construction.
3. Liquefaction is one of the major problems in the foundation soil. Though, not every soil experience liquefaction, soil that liquefies creates loss in bearing capacity, changes in earth pressure, and increase in stress level etc. Mitigation against liquefaction is essential.
4. Site effect is another important geotechnical aspect. Ground amplification, degradation in strength and stiffness of soil etc., should be evaluated to properly assess the performance of site during earthquake.
5. Land slide and slope failure are other problems that should be tackled considering seismic effects.
6. The overall performance of system during earthquake considering super structure – foundation – soil taking part in vibration should be given emphasis.
7. No structure can be made earthquake proof under all situations. Hence, ductility should be imparted to the structure to give sufficient warning before failure.
8. It is important to give emphasis to safety first and then economy. No sacrifice in terms of safety should be permitted to achieve economy in either cost or space.
9. Culture of a region has influencing effects on disaster management. This issue should be addressed by the policy makers and involve personnel who can understand adhere to the local culture.

Fig. 13: Lift portion of an apartment building intact while the rest of the structure has collapsed in Ahmedabad during Bhuj earthquake of 2001

Fig. 14: NGOs during Bhuj earthquake of 2001 presenting BUNGAs of past to state that Civil engineers are killers, not earthquakes

References

1. Chen W.H. and Scawthorn C. (2003): Earthquake Engineering Handbook, C R C Press.
2. Das B.M. (1993): Principles of Soil Dynamics, Elsevier.
3. Day R.W. (2003): Geotechnical Earthquake Engineering Handbook, Mc Graw Hill.
4. Krammer S.L. (1996): Geotechnical Earthquake Engineering, Prentice Hall.
5. Several web sites are acknowledged.

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Seismic Vulnerability & Retro Fit of RC Flat Plate Structure

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Abstract

Flat-plate system has become one of the most popular practices now-a-days, primarily for architectural flexibility, use of space, easier formwork and shorter construction time. However, the structural efficiency of the flat-plate is hindered by its poor performance under earthquake loading. Post-earthquake observations and experimental testing have shown that lateral movements induced by earthquake can make the connections between slabs and columns susceptible to punching shear failures. Though Reinforced Concrete Frame (RCF) is widely used in Bangladesh, flat-plate constructions are also becoming a common practice. BNBC and ACI have suggested that flat-plate frames can be designed either by Direct Design or Equivalent Frame Method. The present study deals with the seismic evaluation of existing flat plate structure using inelastic method (Pushover analysis). The load-deformation curve (i.e. capacity curve) is obtained using ETABS. The performance point has been determined by superimposing the capacity spectrum with the normalized response spectra for 5% damping ratio as mentioned in BNBC. The methods for evaluating the performance level have been determined using procedures presented in FEMA-356 & ATC-40. Many existing flat plate buildings in Bangladesh may not have been designed for seismic forces. Hence, it is important to study their response under seismic conditions and to evaluate seismic retrofit schemes. Based on the seismic evaluation results, two possible retrofit techniques were applied to improve the seismic performance of an existing Nine-storied flat plate building which was considered as a model representative of all flat plate buildings in Bangladesh.

Key Words & Phrases: *Punching shear, Pushover, Retrofit, unbalanced moment.*

1. Introduction

Earthquake phenomenon is not new in Bangladesh and often feels tremors that are caused by earthquake activities from countries nearby. The occurrence of earthquake does not only cause damage to properties but also threats to public safety.

Based on geometric location that quite near to an earthquake act zone, any structure has a chance to fail especially for flat Plate structures.

Many existing flat plate structures located in seismic regions are inadequate for lateral resistance based on current seismic design codes. In general, flat plate

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buildings that were constructed before the 1980s have significant deficiencies in their overall structural configuration, such as insufficient thickness of slab, discontinuity of positive reinforcement in edge beams and slabs, or wide spacing of transverse reinforcement.

A serious problem that can arise in flat plates is brittle punching failure due to the transfer of shearing forces and unbalanced moments between slabs and columns (Hueste and Wight, 1997; Megally and Ghali, 2000). Under earthquake actions, the unbalanced moments can produce high shear stresses in the slab-column connection. Because of the absence of deep beams and shear walls, are resulting in low transverse stiffness. This induces excessive deformations which in turn causes damage of structural & non-structural members even when subjected to earthquakes of moderate intensity.

This paper investigates the seismic performance of existing RC flat plate structure using both linear and non-linear analysis and evaluates of seismic performance of strengthened structure and compares it with the original structure.

2. Methodology

Seismic lateral forces on primary framing systems shall be determined by using either the Equivalent Static Force Method or the Dynamic Response Method as mentioned in Bangladesh National Building Code (BNBC). The Dynamic Response method, where used, shall be based on one of the dynamic analysis procedures like Response Spectrum Analysis. The normalized response spectra as given in Figure 1 shall be used in the dynamic analysis. The site soil characteristics as mentioned in BNBC are presented in Table 1.

The capacity curve is derived from an approximate nonlinear analysis (pushover) for the structure. In the process of performing this incremental nonlinear static analysis, a capacity curve is developed for the building. This capacity curve is simply the plot of the total lateral seismic demand "V", on the structure, at various increment of loading, against the lateral deflection of the building at the roof level, under that applied lateral force. The push-over analysis is performed using ETABS software. A Typical capacity curve has been shown in Figure 2.

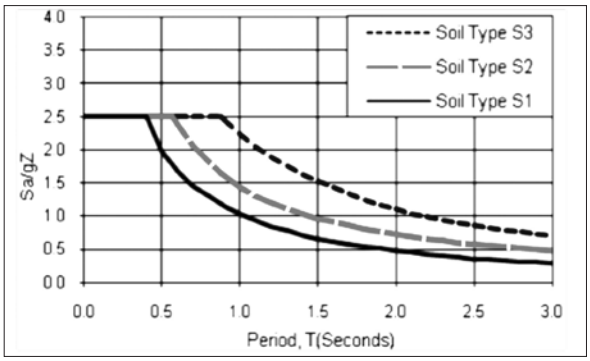

Figure 1: Normalized Response Spectra for 5% Damping Ratio as per BNBC

The existing flat plate structure is modeled using the concrete strength 3,000 psi and steel strength 60,000 psi and assigned all the columns, edge beams and slabs including with their reinforcement, all loads (dead load, live load and seismic load) and user defined hinges. P-M-M hinges are considered at the end of the column members.

Table 1 : The site soil characteristics for seismic lateral forces

Type	Description
S1	Rock and Stiff Soils
S2	Deep Cohesion less or Stiff Clay Soils
S3	Soft to Medium Clay and Sand

The frame is modeled considering the beam or girder as 'equivalent beam' having depth equal to thickness of the slab whereas the slab is considered as shell element.

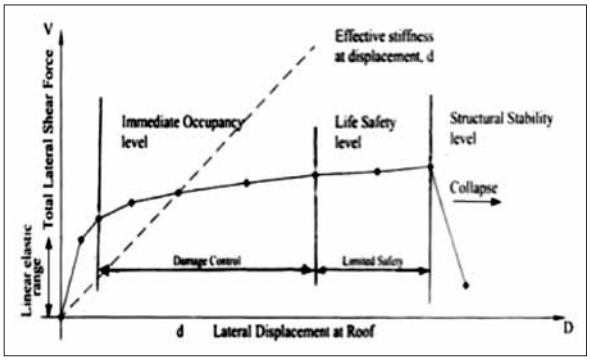

Figure 2: Typical Capacity Curve (ATC-40)

3. Push Over Analysis

Non-linear static pushover analysis is an attempt to evaluate the real strength of the structure and it promises to be a useful and effective tool for performance based design. The ATC-40 and FEMA-356 documents have developed modeling procedures, acceptance criteria and analysis procedures for pushover analysis. These documents define force-deformation criteria for hinges used in pushover analysis. As shown in Figure 3, five points labeled A, B, C, D, and E are used to define the force deflection behavior of the hinge and three points labeled IO, LS and CP are used to define the acceptance criteria for the hinge. (IO, LS and CP stand for Immediate Occupancy, Life Safety and Collapse Prevention respectively.)

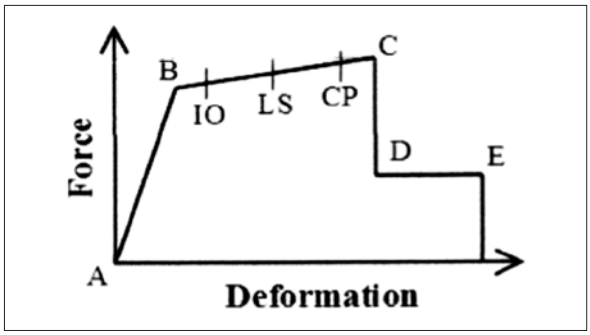

Figure 3: Force-Deformation for Pushover Hinge

A pushover analysis is performed by subjecting a structure to a monotonically increasing pattern of lateral loads, representing the inertial forces which would be experienced by the structure when subjected to ground shaking. Under incrementally increasing loads various structural elements may yield sequentially. Consequently, at each event, the structure experiences a loss in stiffness. Using a pushover analysis, a characteristic non linear force displacement relationship can be determined.

The ETABS having static pushover analysis capabilities, which are fully integrated into the program, allow quick and easy implementation of the pushover procedures prescribed in the ATC-40 and FEMA-356 documents for both two and three-dimensional analysis of structures.

4. Performance Point & Levels

Performance point can be obtained by superimposing capacity spectrum and demand spectrum and the intersection point of these two curves is called performance point. The main output of a pushover analysis is in terms of response demand versus capacity. If the demand curve intersects the capacity envelope near the elastic range, then the structure has a good resistance. If the demand curve intersects the capacity curve with little reserve of strength and deformation capacity, then it can be concluded that the structure will behave poorly during the imposed seismic excitation and need to be retrofitted to avoid future major damage or collapse.

The structural performance level shall be selected from three discrete performance levels as mentioned in section 3. For evaluating the structure based on the FEMA 356 global-level criteria, the maximum inter story drift values (Table 2) are taken from the inter story drift limits for three structural performance levels for concrete frame structure.

Table 2 : Global-level drift limits in FEMA 356

Structural performance level	Drift (%)
Immediate Occupancy (IO)	1
Life Safety (LS)	2
Collapse Prevention (CP)	4

5. Case Study

To evaluate the seismic performance of a flat plate RC frame structure, analyses of a typical prototype of a nine storied residential building in Chittagong, port city of Bangladesh has been selected as shown in Figure 4. The soil profile has been characterized and selected as S3. Beams are found at the periphery of the structure. Ground floor is used for parking space (soft story). The structure is found irregular in plan and elevation. A three-dimensional model for this structure has been established using ETABS as shown in Figure 5. The structure has been considered as Ordinary Moment Resisting Frame (OMRF).

Linear static & dynamic analysis has been performed and the seismic lateral force and shear force at each floor have been presented in Table 3. The dynamic properties e.g. natural periods and mode shapes have been carried out by free vibration analysis. The three mode shapes with different time periods T1=0.841 sec for mode 1, T2=0.382 sec for mode 2 and T3=0.254 sec for mode 3 have been calculated and represented in Figure 6.

It has been seen that the first mode excites 82% of the total mass. Hence, in this case, total requirements on number of modes to be considered tends to or more than 90% of the total mass is excited will be satisfied by considering the first mode of vibration only. However, for illustration, solution to this example considers the first three modes of vibration.

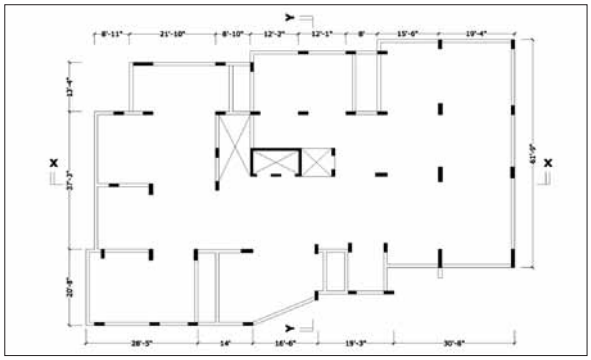

Figure 4: Characteristic plan of the structure

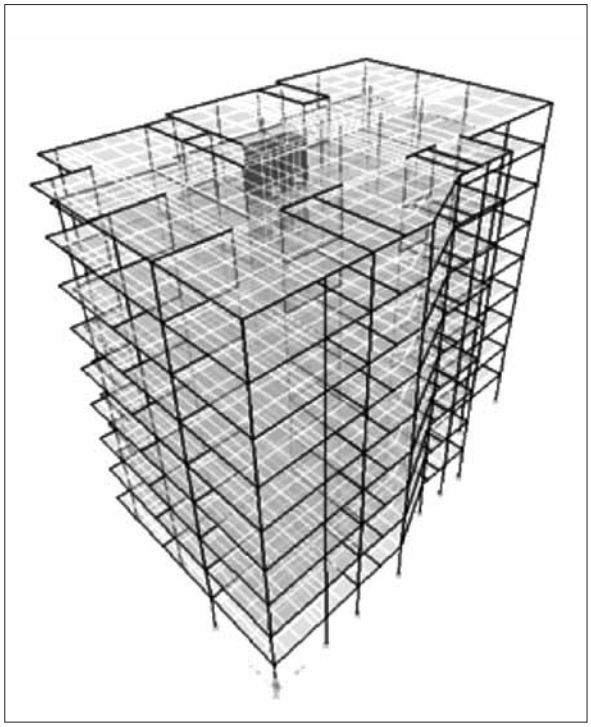

Figure 5: Characteristic 3D model of the structure

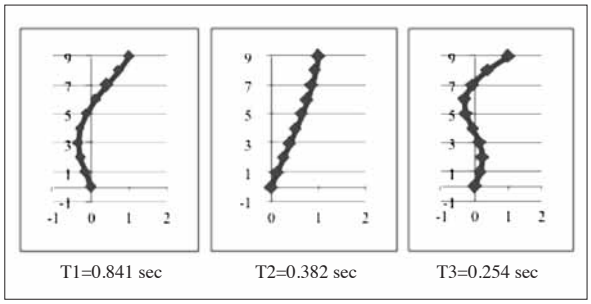

Figure 6: The Mode shapes of first three modes

Table 3 : Comparison of seismic lateral force (Q) and shear force (V) at each floor by linear analysis

Mass No.	Q		V	
	Static	Dynamic	Static	Dynamic
i	kN	kN	kN	kN
9	606.65	163.31	606.65	163.31
8	582.74	254.46	1189.39	417.77
7	509.90	239.61	1699.29	657.38
6	437.05	216.24	2136.34	873.61
5	364.21	185.18	2500.55	1058.79
4	291.37	147.53	2791.92	1206.32
3	218.53	104.65	3010.45	1310.97
2	145.68	58.04	3156.13	1369.01
1	72.84	9.37	3228.97	1378.37

6. Result And Discussions

The building performance level has been evaluated by FEMA 356 acceptance criteria as shown Table 2 and obtained close to as Immediate Occupancy (IO) level for both X & Y direction as shown in Figure 7 and Figure 8. In Push over analysis hinges started forming in A-B stage and subsequently proceeding to B-IO and IO-LS stage.

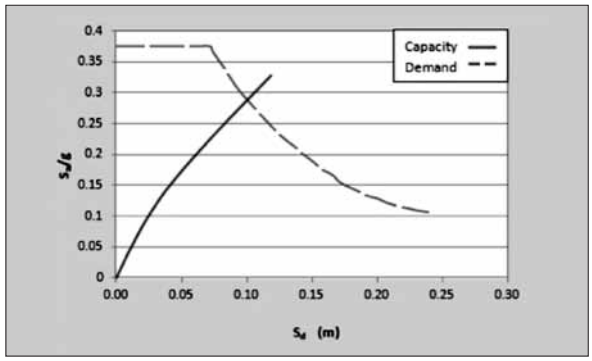

Figure 7: Seismic Demand vs Capacity in X direction

At performance point, where the capacity meets demand, in X direction out of 2124 assigned hinges 1653 were in A-B stage, 460, 11 and 0 hinges are in B-IO, IO-LS and LS-CP stages respectively. Similarly, in Y direction out of 2124 assigned hinges 1685 were in A-B stage, 391, 48 and 0 hinges are in B-IO, IO-LS and LS-CP stages respectively.

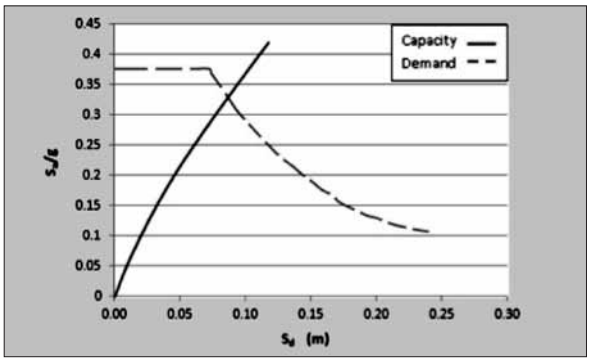

Figure 8: Seismic Demand vs Capacity in Y direction

7. Retrofitting Techniques

The retrofitting of the reinforced concrete structures usually has the objective of increasing the strength, the stiffness and/or the capacity of post-elastic deformation of the existing structural elements (e.g. beam, column, slab) or the transformation of the entire structural system. In present case study the following two cases have been modeled and analyzed in order to increase the structural performance by strengthening of the existing structure.

Retrofit level	Retrofit Technique	Rehabilitation objective
Global	Addition of shear wall at Parking floor.	To reduce the lateral deflection.
Member	Addition of column drop panel.	To resist the punching shear failure.

For Global level retrofitting, the shear walls are selected to add in Ground floor in both x and y directions at suitable locations without making any obstacles for the drive ways. Both exterior and interior shear walls have been selected for this purpose. The connection between the existing column and the new shear wall has been considered as pinned joint. The thickness of new shear wall has been considered as 0.30 m which is as equal as column width. All geometry, load, material, support data are same as previous analysis.

Non-linear Pushover analysis has been performed and the performance of the structure has been found improved as compared to original structure in both x and y direction as shown in Figure 9 and Figure 10.

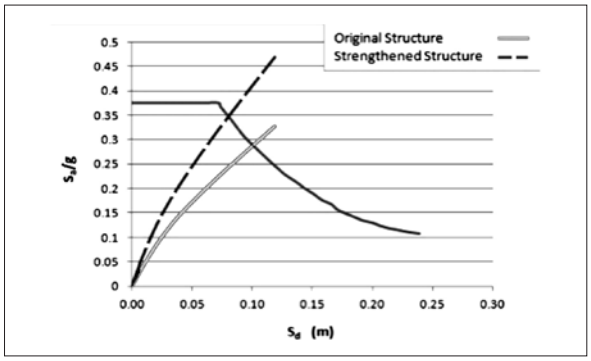

Figure 9: Effect of structural strengthening (X direction)

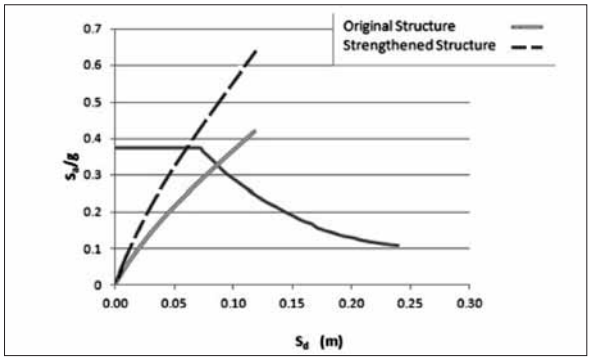

Figure 10: Effect of structural strengthening (Y direction)

For Member level retrofitting, addition of column drop panel may be the suitable solution to resist the punching shear failure. The punching phenomenon is preceded by the opening of circular cracks around the top part of the column due to radial negative bending moments, then radial cracks start to open from the column due to tangential bending moments.

8. Conclusion & Recommendation

Based on the present study, the following conclusions can be drawn:

a) From the study, it can be concluded that the purely flat-slab RC structural system is considerably more flexible for horizontal loads than the traditional RC frame structures which contributes to the increase of its vulnerability to seismic effects.

b) The shear force distribution given by the linear static

method on the higher side as compared to the linear dynamic method. The linear static method may be deemed to be a sort of upper bound.

c) The capacity curves developed for flat plate slab system gets steeper even in the inelastic range. This is due to the high structural stiffness especially for the columns. The variability of the inter-story drift at high seismic intensity levels is much more pronounced relative to the variability at low intensity levels.

d) In case of strengthening the structure using shear walls at parking floor, the lateral deflection has been reduced by 25.81% in X direction and 29.63% in Y direction. Because the stiffness of the shear wall in Y direction is more than in X direction.

e) In this study when shear wall is provided in the X direction of the building, an increase of 15.28% of base shear results a decrease of 23.53% of lateral drift and whereas in the Y direction an increase of 15.32% of base shear results a decrease of 30.0% of lateral drift.

9. References

1. "Bangladesh National Building Code (BNBC), 2006", Housing and Building Research Institute, Mirpur, Dhaka, Bangladesh.
2. "Seismic Evaluation and Retrofit of Concrete Building (volume 1)", Applied Technology Council (ATC) -40, California Seismic Safety Commission, USA.
3. "Pre-standard and Commentary for the Seismic Rehabilitation of Buildings", Federal Emergency Management Agency (FEMA)- 356, 2000, Washington, D.C., USA.
4. Computer and Structures Inc., ETABS Nonlinear Version 9.7.0, Berkeley, California, USA.
5. "Seismic Evaluation of Reinforced Concrete Buildings", Singh Taranpreet, Kwatra Naveen, PhD, Master's Thesis, Department of Civil Engineering, Thapar Institute of Engineering & Technology, Patiala, India.
6. "Study on Seismic Performance of Existing Buildings in Romania", Postelnicu Tudor, Cotofana Dragos, Chesca Basarab, Ionescu Raluca, Vacareanu Radu, Technical University of Civil Engineering, Bucharest, Romania.
7. "Seismic Performance of Flat-Slab Building Structural Systems. Apostolska R.P., Necevska-Cvetanovska2 G.S., Cvetanovska J.P., and Mircic N., The 14th World Conference on Earthquake Engineering (14WCEE) October 12-17, 2008, Beijing, China.
8. Elements of Earthquake Engineering (second edition)", Krishna Jai, Chandrasekaran A.R., Chandra Brijesh.
9. "Seismic Performance of Existing RC Flat-Plate Structures", Alam M. Jahangir, PhD & Paul Ajoy. published in the 9th International Conference on Earthquake Engineering (9CUEE) & 4th Asia Conference on Earthquake Engineering (4ACEE), 6-8 March 2012, Tokyo Institute of Technology, Tokyo, Japan. Paper ID: 11-373.
10. "Earthquake Resistant Design of Structures" Agarwal Pankaj, Shrikhande Manish.
11. "Geotechnical Earthquake Engineering", Kramer Steven L., University of Washington, Prentice-Hall International Series in Civil Engineering and Engineering Mechanics.
12. "Performance Based Seismic Design of Buildings", Sood Sudhanshu, Kwatra Naveen, PhD, Master's Thesis, Department of Civil Engineering, Thapar University, Patiala, India.
13. "Seismic Performance of Reinforced Concrete Frames", Kashyap Jaya, Master's Thesis, Department of Civil, Environmental and Mining engineering, University of Adelaide, Australia.
14. "Evaluation of the Seismic Performance of Reinforced Concrete Buildings", Bagchi Ashutosh, PhD Thesis, Department of Civil and Environmental Engineering, Carleton University, Ottawa, Canada.
15. "Generation of Liquefaction Potential Map for Chittagong City Area", Alam M. Jahangir, Bhuiyan A. Rahman, Roy Tuhin, Barua A.K., 4th International Conference on Earthquake Engineering, Taiwan, 2006.

16. "Design of Concrete Structures", Thirteenth Edition, Nilson Arthur H., Darwin David, Dolan Charles W.
17. "Earthquake Resistant Design of Structures" Pankaj Aarwal, Manish Shrikhande.
18. FEMA 356, 273, (2002), "Pre-standard and Commentary for the Seismic Rehabilitation of Buildings", Federal Emergency Management Agency, Washington, D.C., USA.
19. "Reinforced Concrete Design", Fourth Edition, Wang Chu-Kia, Salmon Charles G.
20. "Explanatory Examples on Indian Seismic Code IS 1893 (Part I)", Jain Sudhir K, IITK-GSDMA-EQ21-V2.0.
21. "Non-Linear Pushover Analysis of Flat slab Building by using SAP2000", Priya K. Soni, Durgabhavani T., Mounika K., Nageswari M., Poluraju P.
22. "Nonlinear Static Analysis of RCC Frames (Software Implementation ETABS 9.7)", Shah Mrugesh D., Patel Sumant B.
23. "Performance Based Pushover Analysis of RCC Frames", Pambhar Dakshes J.

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Disaster Management - Some Issues Through Examples

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Abstract

Disasters – both natural and man-made have been occurring all over the world, causing huge loss of lives, apart from economic losses. Disaster management involves organizing resources (including human resources) for dealing with the immediate needs when disaster occurs, including the humanitarian aspects, and the long-term management, which involves mitigation and rehabilitation. The lessons-learnt in the wake of each disaster, after analysis of data collected, will help in planning for disaster preparedness. In this paper a few earthquake disasters, the recent tsunami of 2004 and the Uttarakhand cloudburst of 2013, and a couple of fire disasters have been discussed to illustrate the management principles involved in disasters. Besides, a special aspect of disasters, which is trauma, the mental shock faced by some victims has been discussed, to highlight the aspect of skill-development of personnel involved in disaster mitigation.

Key Words & Phrases: *Disaster management, trauma, preparedness & brain stem.*

Preamble: The occurrences of disasters both natural and man-made are as old as the history of mankind. While efforts are being made all over the world to prevent disasters. Disasters do occur frequently in some part of the world or another, causing huge losses to human lives, apart from unbearable economic losses. The occurrence of a disaster calls for immediate attention through crisis management; it calls for a well – thought off plan on a large-scale, in the longer scale, in the longer time-frame, for redressed, rehabilitation and mitigation for those affected in the disaster. An attempt has been made in this presentation to study the principles of disaster management through a few cases of disaster management through a few cases of disasters which occurred in India. Further, a brief description of how the human mind is affected due to the traumatic experience of the victims has also been discussed.

Definition of Disaster (W.H.O): A disaster is any event natural or man-caused, which creates an intense negative impact on people, goods and services, and/or the environment, and exceeds the affected community's internal capability to respond, prompting the need to seek outside assistance.

Disaster Management refers to the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies,

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in particular preparedness, response and recovery in order to lessen the impact of disasters.

Preparedness refers to the activities prior to a disaster such as preparedness plans, emergency exercises and developing early warning systems. Response refers to the activities during the disaster such as warning announcement, emergency operations to save and rescue affected people, etc. The recovery activities that follow a disaster could be providing temporary shelter, medical assistance, food & clothing and such assistance.

Mitigation activities include collection of data and analysis to identify the causes of disaster and taking measures such as vulnerability analysis and prevention public education on both awareness and mutual help and cooperation with people and agencies dealing with the disaster. Rehabilitation measures are required in case of disasters where in habitats have seen destruction as a result of disaster. Hence the management of disaster is quite a challenge which involves immediate management of the crisis and a long – term action plan for recovery, mitigation, rehabilitation and prevention.

Hence disaster management involves dealing with and avoiding both natural and man-made disasters, preparedness to face the disaster and rebuilding and supporting the society after natural disasters.

Classification of disasters; Disasters are classified into natural and man-made disasters. Natural disasters are those which occur due to sudden changes in meteorological, topographical or environmental factors. Examples are cloud bursts, floods, earthquakes, tsunami, cyclones, volcano eruption etc. Man-made disaster occurs due to technological, industrial accidents, security – related, terrorism and such factors. Examples are gas leakages, oil-spills, fire accidents, vehicle crashes.

Since the disasters are of different, varied nature, there are a number of factors which affect the disasters. Factors such as age, immunization status, degree of mobility and emotional stability are amongst the host factors. There are many environmental factors such as psychological factors. There is a need to collect data on all such factors of each disaster that has occurred and subject them to careful analysis.

There are many characteristic features for any disaster which include predictability, controllability, and speed of onset, length of forewarning, duration, scope and intensity of impact.

Disaster management involves three phases – pre-impact, during impact and post – impact phases. The first phase involves the preparedness, the second phase involves managing the crisis in-situ and third phase involves rehabilitation and mitigation.

Principles of Disaster management: The stake holders in the onerous and stupendous task are those affected (the victims of disaster), the government and its related departments and the voluntary non-governmental organizations. All stake-holders are equally responsible in the management of disasters. Each person must be totally involved and discharge his/her assigned role. Co-ordination and cooperation of the human resources involved, and judicial use of available resources-particularly the resources in short-supply are very essential for the success of the management exercise. The first managerial function of planning should focus on large scale events. Coordinating amongst the different agencies during implementation and dealing with the requirements of the victims require handling of the several human factors mentioned earlier.

Five phases of management of disaster:

i) Disaster preparedness should be in the form of money, manpower and materials, evaluation of risk, location of disaster prone areas, effective communication and spread of warning through awareness programs, etc.

ii) Disaster Impact – involves to collect information and study the effects of the disaster

iii) Disaster response involves immediate action such as shifting the victims to safer places meeting food and health needs, etc.

iv) Rehabilitation Phase involves arrangement of water supply, food, basic sanitation, medical supply etc

v) Mitigation phase – involves analysis of causes through extensive collection of data and evolving preventive measures, providing economic, health, shelter assistance through a long range plan, Mitigation complements the disaster preparedness and disaster response activities.

What are the effects of disaster? These involve handling particularly large-scale deaths, handling deformities and disabled people, spread of communicable diseases, psychological problems of victims affected by trauma, food shortage, socio-economic losses with local economy requiring years for recovery environmental disruption, etc. Recovery from the permanent damages takes a lot of time – sometime years.

Disasters, in particular, the natural disasters are unpredictable. They involve high risk and are vulnerable. Eg. Nearly 57% of the land area in India is earthquake prone, with 12% prone for severe earthquakes.

Hence preparedness to face disaster is the best measure to face disasters. Hence most countries have established agencies for disaster management with trained personnel.

Some Examples of Disasters in India

1. Koyna Earthquake which occurred on December 11, 1963. The quake had a magnitude of 6.3, with a death toll of about 200.
2. The earthquake which occurred in Killari in Maharashtra on 30th September 1993 which measured 6.4 on Richter and had 7928 dead.

3. The Bhuj Earthquake in Gujarat on 26th January 2001 was one of the severest which shook the earth in the recent past with a high magnitude. This quake killed 19,727 people with 1,66,000 injured and over 3 million people affected.

4. The Deadliest Tsunami in history occurred on 26th Dec. 2014, in the Indian ocean with a magnitude of 9.0, causing waves of over 15 meters height in the Indian ocean, resulting in a rupture of 1000 km length in the tectonic plates. Tsunami traveled a distance of 5000 km up to Africa, affecting 11 countries, leaving 150,000 people dead. The Tamilnadu coast affected in India took years for rehabilitation. Many NGO's including the Mysore citizens forum were involved in the rehabilitation work.

5. Cloud burst and floods in Uttarakhand which happened on 16th June 2013 was one of the largest ecological tragedies. To quote a report – "when clouds burst over the sacred mountains, even Gods could not protect them." The floods ravaged the entire Kedarnath valley wiping out many villages, including the pilgrim town of Kedarnath. Death toll over 1000 was reported and the economic loss was estimated at 12,000 crores. Most challenging rescue operations were carried out by the defence forces. The cause of the disaster was attributed to construction of dams and diversion of 60-70% of water flowing in rivers in the valley.

Now let us look at a few man made disasters:

6. The Gory Fire mishap that occurred at Mysore on 8th Feb., 1989 in the floor of a film studio, while shooting a tele-serial resulted in the death of 50 people and left 40-50 injured. The cause was attributed to bursting of flower pot crackers, and blocking of main exists by studio equipment. It took a long 20 year legal battle in court for victims to receive compensation.

7. Fire at AMRI Hospital in Kolkata on December 9, 2011 caused death of 89 and left 67 injured. Cause was attributed to using the basement of the seven-floor structure as a storehouse with combustible substances like beds and switching-off of the fire alarm system, which resulted in the choking to death of the victims on the upper-floors.

Trauma During Disasters

On experiencing life-threatening situations during disasters, many victims suffer from mental shocks, which linger in their minds, even after recovery. In fact some victims, with weak minds do not recover totally. This section provides a brief note on how such things happen and how the victims are to be handled.

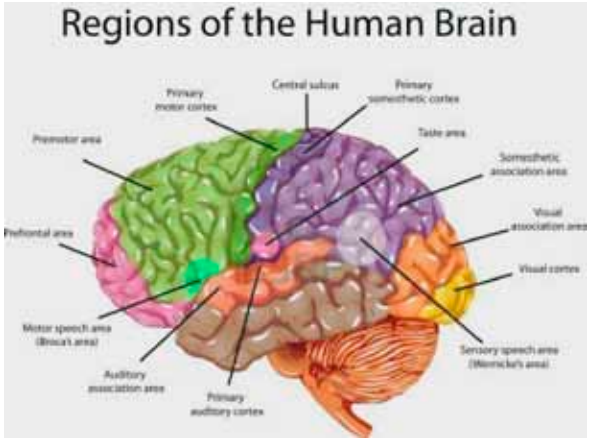
Trauma is defined as a deeply distressing of life threatening experience. Psychological trauma is a type of damage to the psyche that covers as a result of a severely distressing event. Traumatic experiences shake the very foundations of our beliefs about safety.

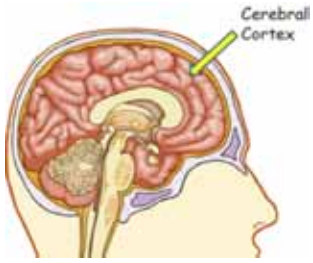
Most victims during any disaster experience a trauma. Victims take time to recover from this state of mind. There is hence a need for raising the morale of the victims. This calls for people endowed with skills to handle and counsel trauma-affected victims.

To understand the state of mind during trauma one should know how the human brain functions.

Human Brain

Composed of two hemisphere, the human brain, which has a very complex structure, weighs about 1.5 kgs. The live brain gives the feel of the consistency of a tooth paste. The two hemispheres are connected by a band of fibers called corpus callosum. The hemispheres contain uncountable number of cells called neurons, which are responsible for the action of the brain. These neurons have complex chemical structure which can change and also handle electrical pulses. The left hemisphere of the brain controls the right part of the body and vice-versa. The right hemisphere tends to excel at non-verbal, spatial tasks: it helps with things like awareness, sociability, intuition, holistic thinking, estimation, intonation of speech, and visual memories, among other things. The left hemisphere excels in language and verbal and logical tasks, including things like writing and speaking, calculating, analyzing, tending to grammar and literal meaning of speech and thinking linearly.





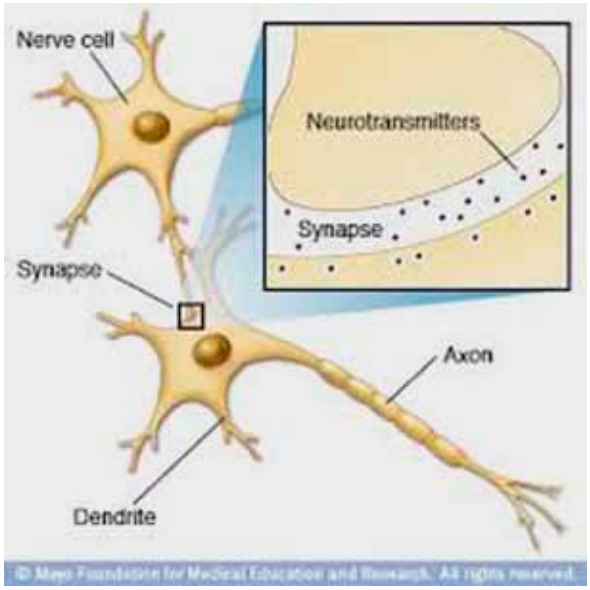
CORTEX: The covering over the hemispheres looks like a wrinkled blanket, with folds and undulations called Sulci (grooves) and gyri (bumps). This covering is called cortex. The cortex is six layers thick and packed with nerve cells called neurons, which account for the grey appearance of the cortex. The cortex is wrinkled to provide extra space to accommodate the large number of neurons.

CEREBELLUM: is another part of the brain in the back of the brain, tucked underneath the cortex. Cerebellum has striated tissues, which looks more like muscle. It has more neurons than any other part of the brain, and it supports motor and mental dexterity. Cerebellum receives enormous information from other parts of brain through cortex and sorts and processes the information received by it.

BRAIN STEM: This is located in the middle of the base of the brain, and connects the brain to the spinal cord. Functions of brain stem include automatic functions like breathing, the beating of the heart and blood pressure functions of brain stem are absolutely necessary to sustain life.

How The Brain Communicates?

The brain is packed with neurons, about 100 billion. Each neuron is a self – contained functioning unit. The three basic parts of a neuron are – the cell body, the dendrites, which receive incoming information and the axon, which sends outgoing information. The communication occurs through complex chemical changes and electricity.



What Happens During Trauma?

The communication mechanism in the brain comes to a stand-still. Sometimes there will be permanent damage if neurons are damaged. If there is no damage to the cells, patient can recover, but recovery takes time. Damage to the psyche due to trauma can be cured, (because it is not physical damage) but it takes time. Duration depends on extent of damage and the patient.

Providing help for such patients for recovery from trauma requires special skills and special training by experts.

Conclusion:

Disasters create physical damage as well as intra-personal effects. The time has come to recognize the need for recovery that would lead to quick revival. Fear and anxiety are to be removed for turning around to normalcy Traumatic effects destroy human lives.

Webliography:

1. www.disasterready.org
2. www.ob.org
3. www.humanityroad.org
4. www.ifrc.org/en/
5. www.ndma.gov.in
6. www.ndmindia.nic.in
7. www.traumahealing.com
8. www.traumahealing.org

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Newsclip

DECCAN HERALD
Excerpts from Deccan Herald Report by Shemin Joy dated 17.04.2015

Govt prepares 'Blue Book' on disaster management

Move is aimed at ensuring zero casualty during crises

The government is looking at ensuring "zero casuality" during natural disasters through proper mitigation measures but has warned states against "artificial suppression" of data on death and destruction.

The suggestion is part of a draft 'Blue Book' to guide relief and rehabilitation efforts before cyclones, learning from the experience of successful management cyclone Hudhud in 2013.

The draft report was sent to states seeking comments by April 30.

Relief Measures

- **Comprehensive state insurance cover to people, homes and cattle**
- **Underground duct for power, communication, gas lines should be planned in all urban bodies**
- **Evacuation routes should be laid or restored before onset of monsoon**
- **Telecommunication systems should be robust and foolproof**
- **Coastal mobile towers need to be built to withstand 250 kmph speed**
- **Alternatives to electricity should be kept ready.**

The proposal for 'Blue Book' came from the Prime Minister's Office (PMO) and the Union Home Ministrey set up an inter-ministerial panel in October last.

Another proposal was the construction of helipads at regular intervals along highways.

With the National Disaster Management already publishing 'Guidelines on Management of Cyclones', the official said the 'Blue Book' does not seek to duplicate the work.

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Invited Article

Role of Renewable Energy and Sustainable Technologies in Building an Eco-friendly and Sustainable Anti-poaching Unit in a Forest

Shamsundar Subbarao[1] Dhananjaya K.N.[2]

Natural calamities/Disasters can hit any part of the world and thereby damage the networks of water, energy, food and other amenities as well by and large. Although Disasters/Natural calamities are beyond the control of humans, the impact of the disaster can be localized and minimized by incorporation of Renewable Energy and Sustainable Technologies. The present article illustrates the effectiveness of Renewable Energy and Sustainable Technologies in building a sustainable habitat. The article is based on the case study of an implemented project by NIE-CREST.

NIE-CREST (Centre for Renewable Energy and Sustainable Technologies) is a centre of excellence at the premises of NIE (National Institute of Engineering), Mysuru. The centre is promoting eco-friendly energy systems, Renewable energy and sustainable technologies. The centre itself has successfully implemented numerous projects on eco-friendly and renewable energy systems and sustainable technologies in and around Karnataka.

Major technologies promoted by NIE-CREST include Waste to wealth Systems, Kitchen Waste Biogas Plants, Biodiesel from non edible seeds like Pongamia (Honge), Jatropha, Simarouba, Neem, Mahua (Hippe) and many others, Solar energy technologies - Design & implementation of Solar lighting systems, Parabolic concentrators, Solar cookers and many others, Sustainable building materials like Stabilised Mud Blocks, Alternative building;

Apart from the promotion and implementation of these technologies, the centre is actively involved in Research and Development (R&D) of the eco-friendly technologies. Exhibits of all the technologies promoted are arranged for visitors. The centre is continually involved in conducting Awareness and Training Programmes for all the technologies mentioned above.

Case study of project implemented by NIE-CREST

Aranyaka is an antipoaching unit constructed deep inside the Bandipur forest, Karnataka, India. The project is executed by NIE-CREST. The unit is self sustainable owing to the incorporation of renewable energy and sustainable technologies. The ant poaching unit is rugged, eco friendly and can sustain natural calamities.

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"Aranyaka"

"Aranyaka" An Eco friendly, Sustainable, Renewable Energy based "Anti Poaching Unit"

Source: Authors

"A joint venture of **Wild Life Conservation Trust, Mumbai and Tiger Conservation Foundation, Bandipur,** Designed and Implemented by **NIE-CREST *[NIE-Centre for Renewable Energy and Sustainable Technologies, www.niecrest.in], NIE, Mysore* and Voice for Wildlife Trust – Mysore".**

'Aranyaka'- is a first ever of its kind in Indian Forest Zones. It is built at Avarepura, Moleyur, Bandipur. The uniqueness of the unit lies in the fact that the unit has been planned and designed with emphasis on two major aspects viz. ***Basic amenities and Renewable Energy & sustainable Technologies.***

Basic Amenities: Basic amenities provided in the unit include spacious living room well ventilated with ample natural lighting, a fire place, Kitchen, Beds of Kadapa slab, Good sanitation via toilet and bathroom. These provisions render the unit a pleasant and comfortable place for the forest personnels to stay even for longer periods in the forest region which in turn helps in conservation of forest.

Renewable Energy and sustainable Technologies: Renewable energy and sustainable technologies include the following

Stabilised Mud Blocks: The camp is built with stabilized mud blocks which were prepared at Moleyur RFO Office site using local soil, sand and 9% cement. About 5000 blocks were used for construction. Unlike traditional clay bricks, these blocks do not require fire for burning instead they are cured for 21 days. They look natural and provide thermal comfort inside the unit. In addition to this, the stabilized mud block masonry does not require plastering.

Rain water Harvesting: Considering the deficit of water, rain water harvesting has been implemented to fulfill the water demand for major part of the year, for a roof area of 54m^2 about 40000L of water can be harvested in an year at 93% efficiency. This also contributes towards conservation of water. A total of 9000L storage facility is provided **Thaijar**-A storage tank of capacity 1000L above ground level for storing rainwater, is an other attractive feature of the system

Solar Lighting: Utilisation of solar energy does not essentially fulfill the objective of conservation of energy, if solar energy is utilized with LEDs, the efficiency will be far better. Solar LED (8 Nos.) lights along with a provision for walkie-talkie charger and mobile charger ensures uninterrupted electric power supply and also makes the unit self reliable in terms of energy.

Fuel Efficient Biomass Stoves: The efficiency of conventional cook stoves is less than 10% with release of enormous smoke within the surroundings. These stoves are poor in thermal insulation as lot of heat is wasted in to the surroundings. Fuel efficient Biomass Cook Stove (with a higher efficiency of 45%) and Bath stove have been provided to conserve wood, create a smoke free surroundings.

Sl. No.	Particulars/ Technology	Specifications/ Components of the Systems	Picture
1.	Construction of Building with Stabilized mud block	Construction of building with Stabilized Mud Block Masonry includes Portico, Hall, Kitchen, Toilet and Bath room	

Sl. No.	Particulars/ Technology	Specifications/ Components of the Systems	Picture
2.	Rain Water Harvesting + Thaijar	Includes Trapezoidal channels, PVC Pipes and fixtures, Storage of 9000L (Thaijar of capacity 1000L, Under ground storage tank of capacity 8000L), Settling tank and Sand filter, Simple Hand Pump	
3.	Solar Lighting	Solar LED Lighting includes Solar Photovoltaic Panel of capacity 175W Battery of 12 V rated 100Ah, Wireless set charging point and cell phone charging point and LED Lights (8No.s)	
4.	Fuel Efficient Biomass Cook Stove	2+1 Fuel Efficient Cook Stove including Grate, Door with frame, concrete top plate, ash tray, cooking vessels, heat recovery pan	
5.	Fuel Efficient Biomass Bath Stove	Fuel Efficient Bath Stove including Grate, Door with frame, concrete top plate, ash tray and water heating Vessel	

Source: Authors

Conclusions

Renewable energy and sustainable technologies are effective tools for minimizing the damage which can result from natural calamity, and also help in achieving self reliability in terms of energy, water and hence achieve sustainability.

The implementation of renewable energy and sustainable technologies is likely to reduce the impact of natural calamities like floods, drought to an extent and minimize the after effects of the calamity. With this one can achieve a sustainable habitat.

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Security Returns Spectrum- An Analysis of Seasonality and Sensitivity of Indian Stock Markets

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Abstract

Calendar anomalies have been found to be prevalent in major markets throughout the world. The thesis extends the existing literature on calendar anomalies by considering indices (broad and sectoral) over a longer time frame. The specific comparisons between multiple indices helped retest the conclusions on several calendar anomalies examined previously in other countries but not analyzed in Indian Stock markets to reach conclusion with few confounding factors. The results were modelled using econometric models to handle the issues of normality in the univariate time series analysis. The results obtained show 360 degree causal relationship, interlinking one calendar anomaly results with other anomalies more so in the recent times. The results obtained also show calendar anomalies converging with patterns observed across major global economies.

Keywords & Phrases: Seasonality, Anomalies, Econometric models and Indices.

1.0 Introduction

A phenomenon can be global in nature, only if, it has the capability to cut across borders, by truly adapting itself to the regional diverse factors and most importantly, capable of giving identical results. The markets become truly integrated, when the advancements in satellite technology made it possible for everyone, anywhere, in the world to receive uninterrupted information consistently and competitively. Information Technology and Institutional advancements facilitated dissemination of information quickly across economies and thus helped to understand and recognize the true intrinsic values of asset prices and to find various opportunities which were truly global in nature. Inspite of these advancements a phenomenon which has consistently baffled researchers across various disciplines, by being mysterical in nature, irrespective of abundant literature available has been the "patterns in stock returns".

The current stock market prices are often considered to be the indicators of investors' current and future expectations. The patterns in stock returns reflect these expectations of the investors which might be based on rational and seemingly irrational behavior.

Considering this, the stock markets would then be considered as the indicators of future economic trends.

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The presence of patterns in stock returns through empirical analysis is found to be complex to explain, and do not agree with the current asset pricing theories. These price change predictions or patterns, known as anomalies, can be an indication for investors to adopt unique trading strategies to make abnormal profits, or an indication of errors in current asset-pricing theories. The study tries to examine the former possibility, which violates the idea of market efficiency. The EMH is considered to be the central paradigm in finance. According to EMH, past prices of shares should have no predictive power in judging the future prices. The EMH relates to how quickly and accurately the market reacts to new information. New information refers to new data which constantly enters the market such as government's reforms, economic reports, company announcements, political statements, or public surveys. If markets are informationally efficient, then security prices would incorporate the new information rapidly and accurately. In particular, stock returns would follow a random walk, which is unpredictable and without pattern. The market inefficiencies have been generally, documented in three categories. The first category is based on the belief that employing specific trading strategies based on past information which are freely available to all investors can be utilized in making extraordinary profits. But, excess returns should vanish when investors as a whole massively make decisions on such information. The second category believes in earning abnormal returns by selecting stocks based on firm based information which is also freely available to all investors. The third category of market inefficiency has been documented to make extraordinary profits by analyzing the unexpected return patterns due to news announcements such as calendar based news, which is the research theme of the study. Studies on empirical regularities in security returns have rejected the hypothesis of markets being efficient and models especially, the asset pricing models to be not adequate. These results have paved way for research on explaining the market anomalies. The studies spanning nearly a century provided very interesting but, versatile explanation to the occurrence of seasonal anomalies which were unique to respective markets across the globe. The initial investigations however, provided evidence of seasonal anomalies in the U.S. capital markets and other developed markets but the pattern and types of anomalies varied from one study to another. With further investigations, the presence of calendar anomalies was understood to be omnipresent occurring in stock markets throughout the world. Thus the empirical investigations on the behavior of the stock market patterns across the world have raised several interesting questions about market efficiency of several developed and developing economies. The search for an explanation of stock market anomalies, however, has largely been unsuccessful. None of the attempts to modify the Capital Asset Pricing Model (CAPM) to account for taxation, transaction costs, skewness of preference and asymmetric information adequately explain the anomalies. Thus, our understanding of the economic or statistical causes of the apparent excess returns generated by anomalies is incomplete.

2.0 Review of Literature

The following calendar effects are taken into account for the study namely: The month-of-the-year effect, the day-of-the-week effect, the turn-of-the-month effect, the half-month effect, half-year effect and the Holiday effect were considered for study. The most important literature and possible explanations for the above mentioned calendar effects are summarized below;

2.1 Month-of-the-Year Effect

According to EMH, the mean stock returns spread over the different months of the year should be equal. The presence of seasonal patterns in the monthly returns is called the month-of-the-year effect. It is observed from the literature that numerous studies have been done on month-of-the-year effect. Wachtel (1942), Rozeff and Kinney (1976), Lakonishok and Smidt (1988), Rozeff and Kinney, Roll (1983), Keim (1983) and Reinganum (1983), Schwert (2003), Gultekin and Gultekin (1983), Agarwal and Tandon (1994) found the presence of January effect in U.S. and other developed economies. Though there exists abundant literature examining the presence of January effect, the explanation provided in the literature to the cause of January effect are not yet proven satisfactory across different countries. Some of the possible explanations to the presence of January effect are mainly the sample selection bias, tax-loss selling hypothesis, tax-loss selling hypothesis from the

point of view of retail and institutional investors and portfolio revaluation by managers.

2.2 Day-of-the-week Effect

Day-of-the-week effect is the most discussed calendar anomaly in literature on calendar anomalies. Day-of-the-week effect states that the daily mean stock returns in context of an efficient market should be equally distributed over different days of the week. Any violation reflects irregularity and gives chances for investors to make profits by exploiting this difference. The well known anomaly is the weekend effect, which states that mean Monday returns are consistently negative while mean Friday returns are positive in nature. The Day-of-the-week effect was documented first by Fields (1930) in stock return pattern of Dow Jones Industrial Average (DJIA). It was observed that the stock returns were continuously positive from Friday to Saturday except for Monday returns. The patterns lead to higher closing prices on Fridays (Saturday, if trading day). Later various studies by researchers mainly French (1980), Fama (1965) Clark's (1973), Jaffe and Westerfield (1985), Agarwal and Tandon (1994), Lakonishok and Smidt (1988), Schwert (2003), Gu (2004), Gibbons and Hess (1981) added further evidence to the presence of the anomaly. Closed market effect, Settlement effect, market capitalization, announcements effect were some reasons considered for explanation of Monday effect.

2.3 Half-Month Effect

Half-month effect states that high returns primarily occur during the first half of the month, while the second half of the month mean returns are almost zero or negative. One of the earliest papers to document half-month effect was by Ariel (1987). He found that the last trading day of the past month and first nine days of the new month were having higher returns than the average returns of the month. Similarly later, Lakonishok and Smidt (1988), Jaffe and Westerfield (1989), Penman (1987) and Peterson (1990) Mills and Coutts (1995) examined the indices in major countries and found conclusive evidence of half-month effect. Though studies have been done in other countries, no conclusive evidence has been found. Very few explanations were noted to be the reasons for this anomaly such as dividend payments and contamination of the data considered, announcements on first half of the month. Buying decisions of investors around the end of the month. Throughout the literature, it has been found that inclusion of the last trading day of the month, which yields significantly higher returns than the average daily returns might by due to methodology used by Ariel in his study and there is little evidence in favor of this anomaly and little evidence to support it.

2.4 Turn-of-the-month Effect

Turn-of-the-month effect states that high positive returns are concentrated during the last and first trading days of each month. In evidence of the half-month effect, it was found that high positive returns seem to occur around the turn of the month especially significant high returns seem to occur on the last trading day of the month and first three trading days of the new month. Lakonishok and Smidt (1988) examined the anomaly and found turn-of-the-month to be independent of other anomalies and to persist in several sub-periods over the examined data frame. They observed that excluding January effect or turn of the year effect still resulted in significant turn-of-the-month anomaly. After the results obtained by Lakonishok and Smidt (1988), similar studies were conducted in other countries to the presence of the turn-of-the-month anomaly by Agarwal and Tandon (1994), Kunkel, Compton and Beyer (2003), Kallunki and Martikanen (2001), Jakobs and Levy (1988), Odgen (1987) etc. None of the explanation given are considered satisfactory for explaining the anomaly across developed and developing economies.

2.5 Holiday Effect

Holiday effect states that day preceding a holiday yields much higher stock returns compared to the average daily returns. The initial documentation of the holiday effect was done by Fields (1934). He argued that since depressed Monday returns is caused by market closing, the day after a holiday where markets are closed should also yield negative returns. But the results showed not seasonal patterns after the holidays. Similar studies by Lakonishok and Smidt (1988), Ariel (1990), Kim and Park (1994), Agarwal and Tandon (1994), Brockman and Michayluk (1998), Vergin and McGinnis (1999), Chong, Hudson, Keasey and Littler (2005), Pettengill (1989)

found returns around holidays to be not a random occurrence but for which there is no conclusive or satisfactory explanation.

3.0 Problem Statement, Objectives and Hypotheses

3.1 Problem Statement

The literature review provides evidence that the research on calendar anomalies has received less attention and thus this lack of research in India on calendar anomalies across broader and sectoral markets makes study of calendar anomalies important and imminent. The literature has further revealed that there are a lot of calendar anomalies which have not been examined for their presence across broader and sectoral markets in the Indian Stock markets for a longer time frame. The Literature review clearly emphasizes that in examining the seasonality or calendar anomalies in emerging markets such as India, methodology should be more robust and should be able to capture the issues of normality, autocorrelation, heteroscedasticity etc. Since the seasonal effects are straightforwardly detectable in market indices or large portfolio of shares rather than in individual shares (Boudreaux, 1995) broader and sectoral indices should be considered for the study in investigating presence of seasonal anomalies which represent the broader and diverse sectors of Indian Economy. The specific comparisons between multiple indices would help study with fewer confounding factors and to reach a broader conclusion which is ignored in many earlier investigations. Further, it would be pertinent to retest the conclusions drawn by the earlier studies inview of the changes in the widereconomic scenario in India, widened choice of benchmark portfolios and methods of measurement and techniques. Thus considering the stock markets as the indicators of future economic trends, and price change predictions or patterns as indications for investors to adopt trading strategies to make abnormal profits, or indications of errors in asset pricing theories, the study tries to examine the former possibility of presence of calendar anomalies in the context of the Indian stock markets, which violates the idea of market efficiency. In case these anomalies exist and are apparent, differentiating from most other research, we would examine if investors would benefit from the results and use these results in investment decision-making.

In light of this backdrop, the following objectives and sub-objectives are arrived at for the current research investigation:

3.2 Objectives of the Study

3.2.1 To investigate the presence of calendar anomalies in Indian stock markets.

The sub-objectives are:

a. To investigate whether month-of-the-year effect is present in Indian stock markets.

b. To analyse the presence of turn-of-the-month effect in Indian stock markets.

c. To assess whether semi-month effect is present in Indian stock markets.

d. To look for whether half-year effect is present in Indian stock markets.

e. To identify whether holiday effect is present in Indian stock markets and

f. To search whether the weekend-effect is present in Indian stock markets.

3.2.2 To make appropriate suggestions to individual investors and institutional investors on various trading strategies in investment decision-making and to suggest possible policy changes required based on whether calendar anomalies exist in Indian stock markets.

3.3 Hypotheses of the Study

The study intends to test the following Null Hypotheses:

H_{01}: All months of the year have the same rate of return.

H_{02}: Mean returns during turn-of-the-month and rest of the month are same.

H_{03}: Mean returns between first half of the month and second half of the month are same.

H_{04}: Mean returns between first half of the year and second half of the year are same.

H_{05}: Mean returns during holidays and rest of the days are the same.

H_{06}: Mean returns on all the days of a week are equal.

4.0 Data Collection and Research Methodology

4.1 Sample Selection For The Study

In order to search for the presence of calendar anomalies, nineteen indices comprising of both broader and sectoral indices listed on the both BSE and NSE exchanges were considered for the study. Which are as follows:

S&P BSE SENSEX, S&P BSE CAPITAL GOODS (BSE-CG), S&P BSE CONSUMER DURABLES (BSE-CD), S&P BSE FMCG (BSE FMCG), S&P BSE HEALTHCARE (BSE HC), S&P BSE AUTO, S&P BSE METAL, S&P BSE Oil & Gas (BSE O&G), S&P BSE-PSU, BSE-TECH INDEX, BSE Mid-Cap, BSE Small-Cap INDEX, CNX NIFTY, CNX NIFTY JUNIOR, CNX MIDCAP, CNX IT, BANK NIFTY and CNX INFRA.

Literature review on seasonal anomalies conducted in India concentrate mainly on BSE Sensex and NSE CNX Nifty index respectively. Though these two indices are barometer of the performance of Indian economy, both the indices give more weightage to specific sectors as shown in Table 1 and Table 2. BSE Sensex gives more weightage to financial services sector, Fast Moving Consumer goods (FMCG) sector, Oil and Gas sector, Information technology and media & publishing sectors. Thus companies with large free float market capitalization can bias the movement of the BSE Sensex index prices. In order to concentrate on Mid-cap and Small-cap stocks which were given less importance in BSE Sensex, Mid-cap and Small-cap indices were formed. As observed from Table-2, financial services, Capital goods, Healthcare, Housing related companies are given more weightage based on free float in Mid-cap and Small-cap indices. If seasonal anomalies exist in Indian stock markets then the study has to be justified by generalizing the phenomenon across sectors first and then to the broader economy, which is the research gap. It was thus felt that the true presence of seasonal anomalies could be understood by considering sectoral indices study separately. To understand seasonal anomalies, it is necessary to understand if these sectors exhibited seasonal anomalies separately which inturn would have confounding effects on the broader indices.

Table 1: Sector-wise distribution of indices listed on BSE considered for the study

SECTORS/INDICES	BSE SENSEX	BSE MIDCAP	BSE SMALL CAP	BSE FMCG	BSE HC	BSE OIL AND GAS	BSE IT	BSE CD	BSE TECK	BSE PSU	BSE AUTO	BSE METAL	BSE CG
Finance	26.93	21.68	10.28	0	0	0	0	0	0	26.54	0	0	0
FMCG	14.61	7.79	5.05	100	0	0	0	0	0	0	0	0	0
Oil & Gas	13.72	2.38	1.67	0	0	100	0	0	0	31.04	0	0	0
Information Technology	13.11	5.7	4.97	0	0	0	100	0	74.07	0	0	0	0
Media & Publishing	13.11	2.55	2.9	0	0	0	0	0	7.56	0	0	0	0
Transport Equipments	9.95	7.67	4.28	0	0	0	0	0	0	0	100	0	0
Transport Services	9.95	2.39	0.9	0	0	0	0	0	0	1.09	0	0	0
Capital Goods	6.14	7.57	12.64	0	0	0	0	0	0	4.02	0	0	100
Chemical & Petrochemical	6.14	5.37	5.03	0	0	0	0	0	0	0	0	0	0
Consumer Durables	6.14	2.71	3.21	0	0	0	0	100	0	0	0	0	0
Diversified	6.14	1.74	1.92	0	0	0	0	0	0	0	0	0	0
Healthcare	5.17	10.18	5.73	0	100	0	0	0	0	0	0	0	0
Housing Related	5.17	7.81	10.61	0	0	0	0	0	0	0	0	0	0
Metal,Metal Products & Mining	4.96	2.01	6.39	0	0	0	0	0	0	19.83	0	100	0
Miscellaneous	4.96	2.49	8.5	0	0	0	0	0	0	2.04	0	0	0
Power	2.84	1.81	1.9	0	0	0	0	0	0	15.05	0	0	0
Telecom	2.58	0.68	1.68	0	0	0	0	0	18.37	0.1	0	0	0
Textile	2.58	1.47	4.54	0	0	0	0	0	0	0	0	0	0
Tourism	2.58	1.46	1.55	0	0	0	0	0	0	0	0	0	0
Agriculture	0	4.46	5	0	0	0	0	0	0	0.3	0	0	0
Other	13.72	0.06	1.25	0	0	0	0	0	0	0	0	0	0

Source: Author

Table 2: Sector-wise distribution of indices listed on NSE considered for the study

SECTORS/INDICES OF NSE	NSE NIFTY	NSE NIFTY JUNIOR	NSE MIDCAP	NSE IT	BANK NIFTY	NSE INFRASTRUCTURE
FINANCIAL SERVICES	28.53	30.12	17.28	0	100	0
ENERGY	15.71	4.83	9.78	0	0	32
IT	14.45	4.46	8.67	100	0	0
CONSUMER GOODS	13.14	19.51	7.24	0	0	0
AUTOMOBILE	7.84	5.31	5.39	0	0	0
PHARMA	5.16	7.5	6.09	0	0	0
CONSTRUCTION	4.95	0.75	6.38	0	0	36.23
METALS	3.92	3.3	9.29	0	0	0
CEMENT & CEMENT PRODUCTS	3.34	0	1.22	0	0	0
TELECOM	1.91	4.01	2.42	0	0	20.08
INDUSTRIAL MANUFACTURING	1.04	4.1	5.81	0	0	9.14
HEALTHCARE SERVICES	0	2.01	0	0	0	0
FERTILISERS & PESTICIDES	0	1.2	2.52	0	0	0
MEDIA & ENTERTAINMENT	0	3.57	4.05	0	0	0
SERVICES	0	7.56	8.51	0	0	2.55
CHEMICALS	0	1.77	5.35	0	0	0

Source: Author

4.2 Sources of Data and Period of Study

For the present study mainly secondary data was considered. The data used in the study are the daily closing values of the nineteen market indices listed on Bombay/Mumbai Stock Exchange (BSE) and National Stock Exchange (NSE). The data for nineteen indices were collected from PROWESS, a corporate database maintained by Center for Monitoring Indian Economy Private Limited (CMIE) and was checked for quality from respective stock exchanges website databases i.e., BSE India website (www.bseindia.com) and NSE India website (www.nseindia.com). Daily, weekly, monthly and yearly share price data of nineteen indices were considered for the study. The period of study for each of the indices has been shown in Table-3 below. The other information pertaining to the study was obtained from various websites, journals and books mentioned below in the references.

In order to study Holiday effect, Hindu Lunar Holidays during which the Indian stock markets especially BSE and NSE stock exchanges remain closed for trading were considered from the year 1990 to 2011 as shown in Table 4 below.

Sl.no	Index	Base Period	Base Index value	Date of Launch	Data for study
1	S&P BSE SENSEX	1978-79	100	Jan 1,1986	Feb1,1991 to july 31,2011
2	S&P BSE CAPITAL GOODS	Feb 1,1999	1000	August 9, 1999	Aug 9, 1999 to july 31,2011
3	S&P BSE CONSUMER DURABLES	Feb 1,1999	1000	August 9, 1999	Aug 9, 1999 to july 31,2011
4	S&P BSE FMCG	Feb 1,1999	1000	August 9, 1999	Aug 9, 1999 to july 31,2011
5	S&P BSE HEALTHCARE	Feb 1,1999	1000	August 9, 1999	Aug 9, 1999 to july 31,2011
6	S&P BSE IT	Feb 1,1999	1000	August 9, 1999	Aug 9, 1999 to july 31,2011
7	S&P BSE PSU	Feb 1,1999	1000	June 04,2001	June 04,2001 to july 31,2011
8	S&P BSE TECK	Apr 2,2001	1000	July 11,2001	July 11,2001 to july 31, 2011
9	S&P BSE AUTO	Feb 1,1999	1000	August 23, 2004	Aug 23, 2004 to july 31,2011
10	S&P BSE METAL	Feb 1,1999	1000	August 23, 2004	Aug 23, 2004 to july 31,2011
11	S&P BSE OIL AND GAS	Feb 1,1999	1000	August 23, 2004	Aug 23, 2004 to july 31,2011
12	S&P BSE MID CAP	2002-03	1000	Apr 11,2005	Apr 11,2005 to july 31,2011
13	S&P BSE SMALL CAP	2002-03	1000	Apr 11,2005	Apr 11,2005 to july 31,2011
14	CNX NIFTY	Nov 3, 1995	1000	Apr 3,1993	Nov 3,1995 to july 31, 2011
15	CNX NIFTY JUNIOR	Nov 3,1996	1000	Jan 1, 1997	Jan 1, 1997 to July 31, 2011
16	CNX MIDCAP	Jan 1, 2004	1000	Jan 1, 2005	Jan 1, 2005 to July 31, 2011
17	CNX IT	Jan 1,1996	1000	Jan 1, 1997	Jan 1, 1997 to July 31, 2011
18	BANK NIFTY	Jan 1, 2000	1000	Jan 1, 2000	Jan 1, 2000 to July 31, 2011
19	CNX INFRA	Jan 1, 2004	1000	August 23, 2004	August 23, 2004 to July 31, 2011

Table 3: Data on broader and sectoral indices considered for the study
Source: www.bseindia.com and www.nseindia.com

YEAR	MAHA SHIVARATRI	RAMA NAVAMI	RAMZAN ID	GANESH CHATURTHI	DUSSERA MAHANAVAMI	DIWALI-LAXMI PUJA	DIWALI- BALI PRATIPADA	BAKRID	GURU NANAK JAYANTHI	MOHURRAM
1990	23 March 1990	03 April 1990	27 April 1990	24 August 1990	28 September 1990	18 October 1990	19 October 1990	04 July 1990	07 November 1990	02 August 1990
1991	13 February 1991	24 March 1991	17 April 1991	11 September 1991	16 October 1991	05 November 1991	06 November 1991	23 June 1991	21 November 1991	23 July 1991
1992	02 March 1992	11 April 1992	04 April 1992	31 August 1992	06 October 1992	25 October 1992	26 October 1992	11 June 1992	14 November 1992	11 July 1992
1993	19 February 1993	01 April 1993	25 March 1993	19 September 1993	24 October 1993	13 November 1993	14 November 1993	01 June 1993	04 November 1993	30 June 1993
1994	10 March 1994	20 April 1994	14 March 1994	09 September 1994	13 October 1994	03 November 1994	04 November 1994	21 May 1994	23 November 1994	19 June 1994
1995	27 February 1995	09 April 1995	03 March 1995	29 August 1995	02 October 1995	23 October 1995	24 October 1995	11 May 1995	07 November 1995	09 June 1995
1996	17 February 1996	28 March 1996	21 February 1996	16 September 1996	21 October 1996	10 November 1996	11 November 1996	29 April 1996	25 November 1996	28 May 1996
1997	07 March 1997	16 April 1997	09 February 1997	06 September 1997	10 October 1997	30 October 1997	31 October 1997	18 April 1997	14 November 1997	18 May 1997
1998	25 February 1998	05 April 1998	30 January 1998	26 August 1998	30 September 1998	19 October 1998	19 October 1998	08 April 1998	04 November 1998	07 May 1998
1999	14 February 1999	25 March 1999	20 January 1999	13 September 1999	19 October 1999	07 November 1999	08 November 1999	29 March 1999	23 November 1999	27 April 1999
2000	04 March 2000	12 April 2000	28 December 2000	01 September 2000	06 October 2000	26 October 2000	27 October 2000	17 March 2000	11 November 2000	16 April 2000
2001	21 February 2001	02 April 2001	17 December 2001	22 August 2001	25 October 2001	14 November 2001	16 November 2001	06 March 2001	30 November 2001	05 April 2001
2002	12 March 2002	21 April 2002	07 December 2002	10 September 2002	14 October 2002	04 November 2002	05 November 2002	23 February 2002	19 November 2002	25 March 2002
2003	01 March 2003	11 April 2003	26 November 2003	31 August 2003	04 October 2003	25 October 2003	25 October 2003	12 February 2003	08 November 2003	14 March 2003
2004	18 February 2004	30 March 2004	15 November 2004	18 September 2004	21 October 2004	12 November 2004	13 November 2004	02 February 2004	26 November 2004	02 March 2004
2005	08 March 2005	17 April 2005	04 November 2005	07 September 2005	12 October 2005	01 November 2005	02 November 2005	21 January 2005	15 November 2005	20 February 2005
2006	26 February 2006	06 April 2006	25 October 2006	27 August 2006	01 October 2006	21 October 2006	22 October 2006	11 January 2006	05 November 2006	09 February 2006
2007	16 February 2007	27 March 2007	14 October 2007	15 September 2007	20 October 2007	09 November 2007	10 November 2007	21 December 2007	24 November 2007	30 January 2007
2008	06 March 2008	13 April 2008	02 October 2008	03 September 2008	08 October 2008	28 October 2008	29 October 2008	09 December 2008	13 November 2008	19 January 2008
2009	23 February 2009	03 April 2009	21 September 2009	23 August 2009	27 September 2009	17 October 2009	18 October 2009	28 November 2009	02 November 2009	01 January 2008
2010	12 February 2010	24 March 2010	10 September 2010	11 September 2010	16 October 2010	05 November 2010	06 November 2010	17 November 2010	21 November 2010	17 December 2010
2011	02 March 2011	12 April 2011	31 August 2011	01 September 2011	06 October 2011	26 October 2011	27 October 2011	07 November 2011	10 November 2011	06 December 2011
2012	20 February 2012	01 April 2012	20 August 2012	19 September 2012	24 October 2012	13 November 2012	14 November 2012	26 October 2012	28 November 2012	24 November 2012

Table 4: Important National Holidays for Indian exchanges from the period 1990 to 2012
Source: www.bseindia.com and www.nseindia.com

4.3 Data Methodology

The following steps were followed in the present study for the analysis of behavior of the returns of sample indices considered for the study:

i) STATIONARITY TESTS: The data of all the nineteen indices were considered for the study. Daily, monthly and yearly closing prices of the nineteen indices as shown in Table 4 above were considered for the study. Before proceeding with further tests, closing prices were tested for stationarity. It was observed that the data considered over specified periods for all the indices were non-stationary in nature. The Augmented Dickey-Fuller test (ADF) on the closing price values was applied to test if the series considered was stationary or not-stationary. Thus, the actual tests were not performed on the daily prices themselves but on the first differences of their natural logarithms as shown below:

$$R_t = \log_e p_t - \log_e p_{t-1}$$

Where R_t represents the return on an index, p_t is the price of the index at the end of the day't', and p_{t-1} is the price of the index at the end of day't-1'.

For the return series R_t, the ADF test consists of a regression of the first difference of the series against the series lagged k times as follows:

$$\Delta r_t = \alpha + \delta r_{t-1} + \sum_{i=1}^{p} \beta_i \Delta r_{t-i} + \varepsilon_t$$

Where, $\Delta r_t = r_t - r_{t-1}; r_t = \ln(R_t)$

The null hypothesis is H_0: δ=0 to be tested against H_1: δ<1. The acceptance of null hypothesis implies nonstationarity. Thus all the indices were transformed to stationary time series by differencing or by detrending depending upon whether the time series were difference stationary or trend stationary. Since the time series data of all the indices considered were log-differenced and thus stationary in nature, the order of integration (differencing) is one.

ii) Descriptive Statistics: Under Descriptive statistics for returns of all indices the following measures like average returns (Mean), Standard Deviation, Median, Minimum and Maximum values, Number of observations, Percentage of positive months, Skewness and Kurtosis, and finally the Jarque-Bera test statistics and its probability were included.[1]

iii) Comparison of Mean Returns: Comparison of mean returns for each month/weekday was performed statistically using the difference in mean Test (Ajayi, Mehdian, & Perry 2004; Wong, Hui & Chan 1992). The test statistically compares the mean return of month/weekday/semi-month/turn-of-month to mean return of a consecutive month/ weekday/semi-month/rest of months respectively. The hypothesis states that there is no difference between the mean returns of consecutive month/ weekday/semi-month/turn-of-month etc.

The hypothesis is stated as follows;

$$H_O : \alpha_i - \alpha_j = 0 \quad against \quad H_1 : \alpha_i - \alpha_j \neq 0$$

Where, for the weekly data, *i*=1(Monday),….., 5(Friday) representing the weekday and *j*=1(Tuesday),….,5(Monday) representing the weekday that is consecutive to *i*. The hypothesis is tested with a difference of means test; where α_i represents the mean return for each weekday (*i*=1(Monday),…5(Friday)), where α_j represents the mean return for each weekday (*i*=1(Tuesday),… 5(Monday)), σ_i is the standard deviation of return for each weekday *i*and N is the sample size. DM_j is the t-statistic to test the hypothesis.

$$DM_j = \frac{\alpha_i - \alpha_j}{\sigma_i / \sqrt{N}}$$

For the monthly data, *i*=1(January),….., 12(December) representing the months and *j*=1(February),….,5(January) representing the months that is consecutive to *i*. The hypothesis is tested with a difference of means test; where α_i represents the mean return for each month (*i*=1(January),…5(December)), where α_j represents the mean return for each month (*i*=1(February),… 5(January)), σ_i is the standard deviation of return for each month *i*and N is the sample size. DM_j is the t-statistic to test the hypothesis. Similarly difference in means tests were conducted considering other seasonal anomalies.

[1] *Reference: Levin and Rubin, "Statistics for Management", seventh edition*

iv) Non-Parametric Tests: Apart from different parametric methods, non-parametric methods were also employed to test seasonality because of their robustness arising from lack of restrictive assumptions such as population normality and homoscedastic variance. Both ***Kruskal-Wallis (H) test[2] and Mann-Whitney U test[3]*** were applied to the return series since these are the most scientific and logical non-parametric tests employed across literature for calendar anomalies.

The Kruskal-Wallis Test is employed for testing the equality of mean returns. It requires the entire set of observations to be ranked and then arranged into n_j matrix where n_j represents the rank of the returns and columns represent the month-of-the-year/day-of-the-week/semi-months etc. Statistically, the value of 'H' is calculated as follows: (Levin and Rubin).

$$H = \frac{12}{n(n+1)} \sum \frac{R_J^2}{n_j} - 3(n+1)$$

Where R_j is the sum of ranks of all items in j^{th} column

n_j is the number of cases in the j^{th} column &

N is the sum of observations in all the columns.

Mann-Whitney U Test was also used to test the difference between the mean return of the day exhibiting highest return during the study period and remaining days for the day-of-the-week or for month-of-the-year as a group.

Statistically, the value of 'U' is calculated as follows:

$$U = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

Where n_1 = number of items in study period

n_2 = number of items in remaining days/months group

R_1 = sum of the ranks of the items in study period

R_2 = sum of the ranks of the items in remaining days/months group

[2]is a non-parametric alternative to the one way analysis of variance F-test

[3]Wilcoxon ranked sum test which is essentially identical (though uses different test statistic) to Mann-Whitney U test is also considered in the study. Wilcoxon ranked sum test is also a non-parametric test used alternatively to two-sample t-test. The test is much less sensitive to outliers than the two sample t-test.

v) Ordinary Least Square (OLS) Regression Model with Dummy Variables: In order to identify the seasonal patterns in the indices, ordinary least square (OLS) regression with dummy variables was considered for the study (Chan, Anya and Thomas, 1996), which is as follows:

$$R_t = \sum_{i=0}^{h} \alpha_i D_{it} + \varepsilon_t$$

Where R_t = the return on the portfolio at time t;

α_i = the return component attributable to the i^{th} characteristic;

$D_{i,t}$ = the dummy variable taking on the value 1 where the i^{th} observation has the characteristic *i* and 0 otherwise; and

ε_t = an error term

In regression analysis the dependent variable is frequently influenced not only by ratio scale variables (e.g. income, output, prices, and costs) but also by variables that are essentially qualitative or nominal scale in nature such as color and religion. Dummy variables usually indicate the presence or absence of a "quality" or an attribute by constructing artificial variables that take on values of one or zero. One indicates the presence of that attribute and zero indicates the absence of that attribute. Variables that assume such values are called as dummy variables. Such variables are thus essentially a device to classify data into mutually exclusive categories such as presence or absence of an attribute. In our study, the dummy variables incorporated were exclusively considered as dummy or qualitative in nature. These regression models are also called Analysis of variance (ANOVA) models (Damodar N. Gujurati, 2005). Using the OLS regression model with dummy variables, the model for testing seasonal anomalies such as Month-of the-year effect, Day-of-the-week effect were formalized.

For testing monthly seasonality, the model used is as follows;

$$R_t = \alpha_1 + \alpha_2 D_{Feb} + \alpha_3 D_{Mar} + \alpha_4 D_{Apr} + \alpha_5 D_{May} + \alpha_6 D_{June} + \alpha_7 D_{July} + \alpha_8 D_{Aug} + \alpha_9 D_{Sept} + \alpha_{10} D_{oc} + \alpha_{11} D_{Nov} + \alpha_{12} D_{Dec} + \varepsilon.$$

The dummy variable takes a value of unity for a given month and a value of zero for all other months. For all *t,* no separate intercept term was run. In cases where the set of dummy variables was not collinear

with an intercept term, a separate intercept term was employed. The intercept terms were specified with dummy variables for all the months except for January month. Thus the omitted month is the benchmark month. The coefficient of each dummy variable measures the incremental effect of that month relative to the benchmark month of January. Thus the existence of monthly seasonal effect will be confirmed if the coefficient of atleast one dummy variable is statistically significant (Pandey, 2002). The intercept term α_1 indicates mean return for the month of January and coefficients α_2 to α_{12} represents the average differences in returns between January and each other month. These coefficients should be equal to zero if the returns for each month is the same and if there is no seasonal effect. ε_t is the white noise error term.

For testing day of the week effect, the model used is as follows;

$$R_t = \alpha_1 + \alpha_2 D_{Tue} + \alpha_3 D_{Wed} + \alpha_4 D_{Thur} + \alpha_5 D_{Fri} + \varepsilon$$

The intercept terms were specified with dummy variables for all the days except for Monday. Thus the omitted day is Monday. The coefficient of each dummy variable measures the incremental effect of that day relative to the benchmark day which is Monday. Thus the existence of day of the week effect will be confirmed if the coefficient of atleast one dummy variable is statistically significant. The intercept term α_1 indicates mean return for Monday and coefficients α_2 to α_5 represents the average differences in returns between Monday and each other days. These coefficients should be equal to zero if the returns for each day is the same and if there is no seasonal effect. ε_t is the white noise error term.

vi) Holiday Effect: Ten Holidays were considered for the study from the Stock exchanges calendar for the period 1990 to 2011. Cads by (1992) and Ariel (1990) tested holiday effects confining to pre-holiday and post-holiday periods. For testing the holiday effect, dummy variable was set to one for the three days prior to and three days following the holiday, creating, for a one-day holiday where the market is closed, a window of one week with no observation for the actual day of the holiday. In the event that holiday fell on a Sunday without compensating market closure on the Monday or Friday, the dummy variable window would be the preceding Thursday and Friday and following Monday, Tuesday and Wednesday.[4]

vii) Econometric Approach:

The literature review provides evidence that while examining seasonality in the emerging economies such as India, most studies adopted the methodology similar to the study of the developed stock markets (Keim, 1983; Kato and Schallheim, 1985; Jaffe and Westerfield, 1989). These studies have failed to handle the issues of normality, autocorrelation, heteroscedasticity etc. Thus in order to understand seasonal anomalies, we intend to follow a more robust econometric approach. A combined regression time series model with dummy variables specified with an autoregressive integrated moving average (ARIMA) and generalized autoregressive conditional Heteroscedasticity (GARCH) model is found to be robust to handle the issues of normality, autocorrelation and heteroscedasticity respectively.

In our study, we attempt to test the presence of seasonal anomalies mainly month-of-the-year effect and day-of-the-week effect in both return and volatility equations. From the literature, we know that majority of the studies document seasonal anomalies in only mean returns without considering issues of normality, serial autocorrelation and heteroscedasticity[5]. Thus to overcome all these problems we followed the methods as mentioned below where we will address both autocorrelation and time-varying variance issues and correct for them.

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[4]Lakonishok J. and Smidt S. (1988) found that in examining the day of the week, the last trading day before a holiday and the first trading day after a holiday were excluded to avoid confounding day-of-the-week and holiday effects. We have followed this method in our analysis.

[5]According to literature, using of only OLS methodology in regressing market returns on dummy variables representing various calendar events has two major drawbacks. First, returns in the emerging markets tend to be serially correlated due to market efficiency and the existence of asymmetric information (Bekaert and Harvey,1997), and if autocorrelation is not corrected, this leads to model misspecifications and incorrect inferences (LeBaron, 1992). Secondly, the variance of the error term that OLS assumes to be constant might be in reality time varying or Heteroscedastic.

As mentioned before, in all the studies surveyed in the literature, investigated calendar anomalies using the Standard Ordinary Least Square (OLS) methodology in regressing market returns on dummy variables representing various calendar events which are mainly month-of-the-year effect and day-of-the-week effect in our case. The equation is as follows:

$$R_t = \sum_{i=0}^{h} \alpha_i D_{it} + \varepsilon_t \quad \text{.....(1)}$$

Where R_t = the return on the portfolio at time t;

α_i = the return component attributable to the i^{th} characteristic;

$D_{i,t}$ = the dummy variable taking on the value 1 where the i^{th} observation has the characteristic i and 0 otherwise; and

ε_t = an error term

To eliminate the possibility of having autocorrelated errors, we include the lag values of the return variable to the above equation-1. Thus equation becomes.

$$R_t = \sum_{i=0}^{h} \alpha_i D_{it} + \sum_{i=1}^{p} R_{t-1} + \varepsilon_t \quad \text{.....(2)}$$

Where, R_t represents returns, D_{it} are dummy variables which get the value of 1 if $i = t$ and zero otherwise with i ϵ (Monday, Tuesday, Wednesday, Thursday, Friday for weekdays and April to March for months). The number of dummies included will have to be the number of trading days minus one (including constant) or number of trading days (excluding constant).[6]

The equation 2 above, assumes the existence of a constant variance, which may result in inefficient estimates, if there is a time varying variance. Therefore, we include the changing variance into estimation. Here we assume that the error term of the return equation has a normal distribution with zero mean and time varying conditional variance of $h_t(\varepsilon_t = N(O,h_t))$. Though from the literature, we find various types of modeling of conditional variances, Engle (1982)[7] suggests a model that allows the forecast variance of return equation to vary systematically over time. Here the assumption is that conditional variance, h_t, depends upon the past squared residuals from the return(R_t) equation, $h_t = V_C + \sum_{j=1}^{q} V_j \varepsilon_{t-j}^2$, which is known as Autoregressive Conditional Heteroscedastic (ARCH) Models. Bollerslev (1986)[8] then extended the ARCH process by making h_t a function of lagged values of h_t as well as the lag values of ε_t^2. i.e.,

$h_t = V_C + \sum_{j=1}^{q} V_{Aj} h_{t-j} + \sum_{j=1}^{r} V_{Bj} \varepsilon_{t-j}^2$. This type of modeling is known as GARCH models. Here this specification requires that $\sum_{j=1}^{q} V_{Aj} + \sum_{j=1}^{r} V_{Bj} < 1$ in order to satisfy the non-explosiveness of the conditional variances and that each of V_A, V_B, and V_C is positive in order to satisfy the non-negativity of conditional variances. Thus the time varying variance model by using a GARCH process would be $h_t = V_C + \sum_{j=1}^{q} V_{Aj} h_{t-j} + \sum_{j=1}^{r} V_{Bj} \varepsilon_{t-j}^2$ where, the volatility is measured by conditional variance.

Thus, we employ Bollerslev's (1986) GARCH (p,q) model as our platform and add to it calendar dummy variables to investigate calendar anomalies on the variance similar to Berument and Kiymaz (2001) and Apollinario *et.al.* (2006). The GARCH (p,q) model assumes that the conditional time-varying variance is both a function of past innovations (ARCH component with order *p*) and past volatility (GARCH component with order *q*). Hence the model would be as follows

$$h_t = V_C + \sum_{j=1}^{q} V_{Aj} h_{t-j} + \sum_{j=1}^{r} V_{Bj} \varepsilon_{t-j}^2 + \delta_{st} D_{st} \quad \text{.....(3)}$$

where, s ϵ(Monday to Friday for weekdays and April to March for months) and D_{st} are defined above.

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[6] *The reason for this is to avoid the dummy variable trap which gives rise to perfect collinearity among the dummy variables and the constant term (Damodhar N. Gujarati, 2007).*

[7] *Engle, R. 1982. "Autoregressive Conditional Heteroscedasticity with Estimates of the variance of United Kingdom Inflation." Econometrica, volume 50, pp: 987-1007.*

[8] *Bollerslev, T. 1986. "Generalized Autoregressive Conditional Heteroscedasticity." Journal of Econometrics, volume 31, pp: 307-327.*

The model is estimated using the Quasi-Maximum Likelihood Estimation (QMLE) method introduced by Bollerslev and Wooldridge (1992)[9]. This estimator, however, is inefficient, with degree of inefficiency increasing as departure from normality increases (Engle and Gonzalez-Rivera, 1991). Hence it is imperative to test explicitly the validity of the normality assumption using two tests at the end. The first is Jarque-Bera statistics and the second is the ARCH-LM test[10]. In addition, we test explicitly for the possibility of existence of a risk premium (variance) in the return (mean) equation known as the GARCH-in-Mean model (GARCH-M) test[11].

viii) Model Specification Tests: In order to investigate the validity of time-series models, specifications tests are very crucial. For our study, a 'bottom-up' strategy[12] will be used when performing specification tests.

In other words, bottom-up strategy would involve the following steps;

a. ***Specifying the order of mean equation*** (equation-1), followed by

b. ***Attempting to specify the Auto-Regressive order of the mean equation*** (equation-2). Here autocorrelations in the return series will be examined employing both Auto-Correlation Function (ACF) and the Partial Auto-Correlation Function (PACF). Furthermore, the standard Box-Pierce procedure is also followed. Lastly, Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC) values were considered to specify the ARMA order of the mean equation.

In detail, for the study, the residual correlogram, which is a graph that plots series of correlations between residuals against a time interval is used. Using Correlogram and Bartlett bands which represent 95% confidence bounds we will identify statistically significant auto- and partial-correlation lags in order to narrow the search for the optimal ARMA specification. For clarity and easy interpretation of the series under study as white noise, Box-Pierce Q-statistic and Ljung-Box Q-statistic and their p-values were considered. As we know, Box-pierce Q-statistic and Ljung-Box Q-statistic and their p-values are usually considered under the null hypothesis of white noise for the number of terms in the sum that underlies the Q-statistic.

Box-Pierce Q-statistic is approximately distributed as a χ^2_m random variable under the null hypothesis that y is white noise i.e.

$$Q_{BP} = T\sum_{\tau=1}^{m}\hat{\rho}^2(\tau)$$

A slight modification of Box-Pierce Q-statistic which is designed more closely to follow the χ^2 distribution in small samples is Ljung-Box Q-statistic, which is also distributed approximately as χ^2_m random variable, under the null hypothesis that variable considered is a white noise. The Ljung-Box Q-statistic is represented as follows:

$$Q_{LB} = T(T+2)\sum_{\tau=1}^{m}\left(\frac{1}{T-\tau}\right)\hat{\rho}^2(\tau)$$

Ljung-Box Q-statistic is same as the Box-pierce Q-statistic except that sum of squared autocorrelations is replaced by a weighted sum of squared autocorrelations, where the weights are (T+2)/ (T-τ).

After executing various ARMA specifications, the model with the lowest Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC) values were considered. The AIC and SIC are goodness of fit measures- the lower the value, the better the model is at accounting for the variation in the data. Adding additional lags to the model

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[9]The advantage of this method is that even in case where the residuals are not conditionally normally distributed, the ARCH parameter estimates and the covariance matrix are still consistent given that the conditional mean and the conditional variance are correctly specified.

[10]The GARCH-LM test is a Lagrange Multiplier test to examine whether the standardized residuals exhibit additional ARCH effects.

[11]Engle et.al, 1987.

[12]Following Tooma and Sourial (2004) and recommendations of Wooldridge(1991), Hagerud (1997) , Kamaly A. and Tooma A.E. (2009)

will only reduce the value of the criteria only if the fall in the residual sum of squares outweighs the penalty for the loss of degrees of freedom from adding additional parameters.

The Akaike Information Criteria (AIC) is effectively an estimate of the out-of-sample forecast error variance, but it penalizes degrees of freedom more harshly. It is used to select among various ARMA models.

$$AIC = e^{\left(\frac{2k}{T}\right)} \frac{\sum_{t=1}^{T} e_t^2}{T}$$

where, k is the degrees of freedom used in model fitting.

The Schwarz Information Criteria (SIC) is an alternative to the AIC but penalizes degrees of freedom more harshly than AIC.

$$AIC = T^{\left(\frac{k}{T}\right)} \frac{\sum_{t=1}^{T} e_t^2}{T}$$

Thus optimal Auto-Regressive order of the mean equation would be found out by considering AIC and SIC values but, in case of disagreement between AIC and SIC values, SIC values would be given preference as it penalizes degrees of freedom more harshly than AIC[13].

c. ***Testing for the conditional variance equation and testing the validity of normality assumption.***

   As discussed above, two tests will be conducted. The first is Jarque-Bera statistics and the second is the ARCH-LM test.

d. Lastly, ***we test explicitly for the possibility of existence of a risk premium (variance)*** in the return (mean) equation known as the GARCH-in-Mean model (GARCH-M) test.

[13]*Cosimano and Jansen (1988) argue that the presence of the autocorrelation in the residual terms may misleadingly indicate the presence of the ARCH effect. Hence, to the OLS regression analysis, sufficient numbers of lags are included in order to avoid the auto-correlated errors.*

4.4 Limitations of the Study

The following are some of the limitations of the present study which are as follows;

a) The present study is restricted to only Indian stock markets;

b) It considers indices belonging to two major stock exchanges namely BSE and NSE stock exchange respectively;

c) It is based mainly on secondary data; and

d) The present study considers only nineteen indices listed on both BSE and NSE stock exchanges due to lack of data availability. The index for which the data availability was less than three years was ignored from the study.

5.0 Findings of the Study

The research mainly aimed at understanding;

i. Whether the selected indices confirm the existence of a certain anomaly?

The studies found presence of all major calendar anomalies in the Indian stock markets.

With respect to Day-of-the-week effect, high positive returns were observed on Wednesday and Monday for broader indices and sectoral indices respectively. The largest mean returns was observed on Monday especially for sectoral indices (when compared to higher returns of Friday and lowest returns on Monday as observed in developed countries) which point towards lagging effect of Indian sectors taking cues from the global markets. The results confirm towards "wait and watch principle" followed by investors. These high returns towards the beginning of the week followed by lowest returns on Tuesday is in contrast to the evidence obtained from other markets.

Considering Month-of-the-Year effect, from the analysis we can notice that, the mean monthly returns are significantly different from zero mainly in the Months of January, February, and December. The higher Positive December mean returns followed by negative returns in the months of January and February could be caused by a change in investor's behavior, anticipating January effect and March effect in Indian stock markets and

other stock markets since the fiscal year in India starts in April and ends in March, whereas it is January to December in other developed countries. Furthermore, a closer look at the sub-period values reveals that, December month is statistically significant in recent period i.e., 2002-2011. The significant February effect observed in Indian markets in the first sub-periods seems to have changed. Thus from the analysis, we can conclude that though tax loss hypothesis helps explain monthly effect in Indian stock markets for a brief period, but all the indices indicate a disappearing March/April effect over the whole sample period. Even after considering the time-varying volatility, the results reconfirm the OLS regression results. December is found to be very significant in all the broader indices except for BSE Sensex index wherein January is observed to be significant. Whereas in case of sectoral indices, December was observed to be significant for all the indices except for BSE FMCG, BSE Teck, BSE O & Gand CNX INFRA Indices respectively. Thus the results obtained indicated higher integration of Indian markets than ever in the recent period.

In the order of the occurrence of Holidays on weekdays, Wednesday and Friday are observed to be the days highly likely to have holidays than rest of the other days. If we sub-divide the calendar year based on occurrence of holidays, important holidays such as Ganesh Chaturthi, Dussehra, Diwali and Bakrid occur mainly during the later part of the calendar year i.e. between September and December. Especially, these holidays seem to occur mainly in the second half of the month. Similarly, other holidays namely Mohurram, Maha Shivaratri and Rama Navami usually occur during January and April months. Considering these holidays, the percentage of occurrence of holidays on Tuesday is found to be highest (27%) followed by Wednesday (20%). The holidays namely Maha Shivaratri, Rama Navami, Ramzan are observed to occur towards the first half of the calendar month during the entire study period. Thus, there is very likely chance that holiday effect is the reason for semi-month effect and Wednesday effect as the behavior of Wednesday return behavior is found to be dissimilar to security returns around holidays (Ariel, 1990).

Lastly, considering the Turn-of-the-month effect, when compared to sectoral indices, broader indices seem to reveal anomaly among daily returns towards the turn-of-the-month. The sectoral indices have minor or no indication for turn-of-the-month effect, while broader indices especially mid-cap and small-cap indices seem to show significant turn-of-the-month effect. Thus, turn-of-the-month effect seems to be mostly present in the broader indices.

ii. If anomalies exist, whether these anomalies are stable and consistent over time and across indices considered i.e., are they true anomalies?

Considering the results of the econometric analysis, we observe disappearing pattern of major anomalies. These anomalies observed showed consistency with the existing literature on Indian sector.

6.0 Observations, Suggestions & Conclusions

6.1 Observations And Suggestions

The following are some of the important revelations' of the study;

a. Integration of the markets is observed to be happening at a rapid pace and trading strategies adopted have to consistently revised and retested as returns are observed to be not stable and consistent over the entire study period and sub-periods. Thus investors should be aware of the changing environment in the financial markets throughout the world.

b. Day-of-the-week effect was observed to be present in the Indian capital markets.

c. It is found true that the, investments are observed to be high on Mondays causing Monday effect in the pre-rolling settlement period, and after the introduction of rolling settlement, Monday effect is insignificant. In the recent times after 2002, Wednesdays have highest returns and Tuesday has the lowest returns in majority of the indices.

d. The higher proportion of announcements after the close of trading on Friday than on any other day of the week (Patell and Wolfson, 1982) and the pattern of trade by FIIs in India matching with

the occurrence of pattern of day anomalies might give us clues on occurrence of day-of-the-week effect in India stock market. Thus, lower Tuesdays returns followed by higher Wednesday returns in Indian stock markets point towards markets taking more time to absorb the news announcements and decisions by companies, policy makers and institutional investors throughout the world.

e. FIIs play a very significant role in ensuring momentum of the Indian capital markets and thus a constant vigilance by regulators with respect to the investment patterns/trading strategies adopted by FIIs and its relevance with calendar anomalies can help regulators in ensuring disappearance of day anomalies in Indian stock market.

f. The analysis finds semi-month effect and turn-of-the-month effect to be present in Indian stock markets.

g. Holiday effect is observed in the Indian stock market. The mean returns around holidays namely Ganesh Chaturthi, Dussehra, Bakrid and Mohurram are significantly lower when compared to other days.

h. Month-of-the-year effect is observed in the Indian stock markets. The results show patterns changing in the recent periods. Tax-loss hypothesis though helps in explaining February effect in the first sub-period (1991-2001), the theory is insignificant as we observe patterns changing in the recent time periods. We infer month-of-the-year effect aligning with the effects seen globally. December effect is observed in the recent period and a trading strategy of buying in the month of January and February and selling in the month of April and August (for short term gain) or November and December months (for long term gain) would be profitable to the investors in case of majority of the indices.

i. The results obtained from the study can be used in forming various trading strategies by the retail, Institutional and non-Institutional investors to make abnormal profits. The study also finds higher risk during these periods and hence is advisable to form trading strategies knowing the risks associated with it.

j. We observed that, calendar anomalies exist in both broad and sectoral indices respectively. The study also found non-linearity between risk and returns, which is contrary to the capital market theory in terms of higher returns considering lower risks for the portfolio's. Thus, the market regulators can take appropriate steps to stabilize the market by taking some corrective steps and adopting various regulatory measures.

k. The study found changes in the pattern of the anomalies over various sub-periods in case of all the five anomalies considered for the study. This encourages us to believe that the appropriate regulatory measures taken by the regulators over the years have been successful to control these anomalous behaviors in the capital markets, which inturn has helped protect the interest of the investors.

l. The global integration of the domestic markets, more so in the recent years reinforces regulators to recommend and impose still tougher rules and regulations to ensure transparency in reporting information by the companies and also in reporting transactions done by the foreign and domestic investors in the future such as mutual funds.

6.2 Conclusions

The study examined the Indian stock market, to determine whether the empirical anomalies of seasonality detected in the U.S. market and other international market is also present in India. In the study, we observe that the Indian stock market presents different patterns in stock returns and the study brings forth distinct conclusions to prove the validity of several popular beliefs regarding calendar anomalies across various sub-periods. It is observed that the strategies to make profits may lose ground very quickly with global economies changed outlook to liberalization, political stability, increased foreign trade and commerce, and rise of multinational companies. The study finds that the markets may be fast converging to a point where opportunities will become faint, especially after 2002. With Advanced trading systems put in place and markets seamlessly integrated by operating

24 hours in different time zones across the world, markets seem to become efficient with India being more in sync with the global markets now than ever. The study provides conclusive results to the presence of calendar anomalies, but, at the same time, points finger towards the extent of influence the stock markets throughout the world has had on Indian counterpart which appears slow in the initial periods but very fast in the recent times mainly after 2002.

Considering the results obtained for all the calendar anomalies, one can find the results indicating towards a 360 degree causal relationship. There seems to appear a causal impression of one calendar anomaly on the other i.e., there appears to be interlinking of one calendar anomaly results on the other anomaly more so in the recent times. The studies done before concentrated on explaining the anomalies completely independently which might have been the rationale for not arriving at any conclusive evidence on explaining the cause of these anomalies.

Thus it can be concluded that, the results observed indicates the presence of significant calendar anomalies which also seem to be associated with releases of information, and the indices act as proxy for differentials in the speed with which companies release information to the market, and anomalies are displayed due to inadequate adjustment of prices to available information. Calendar anomalies exist in Indian stock markets, but, the calendar anomalies seem to get converged with the patterns observed across major global economies which might be the result of integration of the markets. Holiday effect can be considered as a key calendar anomaly in explanation of other calendar anomalies mainly day-of-the-week effect, Month-of-the-year effect and semi-month effect. With Indian capital markets striving to achieve global standards, calendar anomalies would be just a reflection of markets to the global clues and information and would thus provide no opportunities to the investors to make abnormal profits. The convergence of the patterns also points towards higher integration and less insulation of the Indian markets today than in the earlier time periods. The Indian stock markets seem to be more sensitive to the movements and clues provided by the global stock exchanges. Hence, though the markets are considered inefficient, they are slowly moving towards integration and thus efficiency. Indian market can be considered as the best example of this phenomenon.

BOOK REVIEW
Reviewer: N.S. Viswanath

S. BISALIAH, S. MAHENDRA DEV, SYED SAITULLAH & DHRITISREE SARKAR: ASSET AND LIABILITY PORTFOLIO OF FARMERS – MICRO EVIDENCES FROM INDIA: ACADEMIC FOUNDATION, NEW DELHI-110 012 FIRST EDITION, 2014, pp.1-212.

The book under review is as on asset and liability portfolio of Indian farmers. The theme has been analyzed on the basis of panel data sets obtained from two major institutions– Central Statistical Organization (CSO) and National Sample Survey Organization (NSSO). The data sets related to the time points between 1991-92 and 2005-06. The authors have made numbers to reveal facts. The investors' portfolio structure of Indian cultivator house holds have been analyzed in terms of farm business, non-farm business, household and financial assets.

The determinants of non-farm business assets and the liability structure have been analyzed using financial analytical tools. The data analysis has been attempted by cultivator household type by asset accumulation and by liability patterns. The concept of financial inclusion, leading to cultivator type differentials, credit worthiness and expenditure patterns, have been lucidly explained to draw evidence based results. The results partly explained the nature of asset accumulation in respect of small cultivator households and on liability of big cultivator households. The major determinants of household have critical difference in terms of the type of assets and pattern of expenditure. The education, age, household size, net worth and farm size have been established to have positive impact on non-farm business assets. The farm business asset is yet to acquire minimum influence on the nature of income delivered from household assets or non-farm business assets. Financial income is considered a major policy instrument along with cultivator household characteristics. The best of urban facility and the best of rural serenity are yet to come! The income distribution and spread of expenditure are yet to make a mark. Some major policy instruments are suggested based on inferences. Assets accumulation should be concentrated on house- hold assets to be acquired and on non business financial assets. The policy is to drive towards augmenting income from non-business assets. With respect to expenditure the debt portfolio has to be restructured by creating enlarged credit base. This requires updated knowledge of markets to allocate for capital expenditure and to make info available at all times for the cultivator households to take right decisions. The book is an incredible document for financial institutions and policy makers at the Federal Bank and at the level of different states as Agriculture is a State subject in the constitution. There should be convergence in terms of policies, strategy and actions to enable them to reach all agricultural households. The design, layout and printing of the book are immaculate and deserve a special praise.

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