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From the Editor

That practical training during the course of technical education gives students a better understanding about the challenges of the professional world is beyond dispute. This has more or less already been instituted in the architecture program but has still to take roots in many of the other programs. The tenure as well as the timing of the practical training is, however, still being debated.

In the architecture program, Tribhuvan University sends students for a full semester of practical training during the seventh semester whereas according to Purbanchal University's curriculum the training is held in the ninth semester, just before the final year thesis project. Pokhara University earlier had provisions for the training after the thesis in the tenth semester but was later changed to the eighth semester. The timing of the practicum during the academic studies is often guided by the desired outcomes expected by the respective architecture schools. The ones that send students earlier expect them to clarify their career goals during their stint at the professional office and still have enough time to adjust their studies accordingly in the remaining period. The institutions, which have reserved the training for the later end of the studies, want to send their students better prepared to handle the demands of the offices. The disadvantage is that the students get no chance to make up for any deficiencies they may have identified during the course of their training. The choice is between less preparation but greater change of improvement and greater preparation but no opportunity to improve.

Recent architecture trainees of *nec* have acknowledged that the training has given them a new and wider perspective of the architecture profession which will benefit them in the remainder of the program. This is a lesson all the different programs of all the different institutions must absorb. Due to its long feudal past Nepalese are averse to taking risk and lack the culture of entrepreneurship. Practical training exposes students to the cut-throat competition in the real world and helps inculcate a sense of entrepreneurship in them. The timing should be such that the student have the minimum required skills to be of benefit to the firm or enterprise providing them the training but also have enough time remaining in their academic program to make up for any deficiencies. The training period should be long enough to enable students to judge the ongoing and future trend of technology and the adequacy of their academic course to prepare them to face the challenges. Their feedback will also help to continuously upgrade the curriculum of the different institutions.

CONTENTS

CAUSES AND COSTS OF SLOPE SOIL DISASTERS IN NEPAL AND MITIGATION EFFORTS

*Hari K. Shrestha**

ABSTRACT

Nepal is a small landlocked mountainous country in south Asia. Due to Nepal's steep physiography, young mountains and dense population, aided by heavy monsoon rain, the intensity of various types of catastrophic natural disasters in Nepal is high compared to other countries. The landslide is one of the major types of natural disasters in Nepal. This article summarizes the natural and man made causes of slope soil disasters in Nepal, and lists the costs of the disaster and current status of activities to mitigate disaster.

1. INTRODUCTION

Nepal is a landlocked country situated between China in the north and India in east, west, and south. Due to the tectonic activities of Indian plate collision with Eurasian plate, Nepal is tectonically dynamic. The very high and very steep mountains in the north are extremely beautiful to look at but are rather young and unstable. Consequently, the country experiences various types of natural disasters every year. Morikawa, S. and Shrestha, P. M., (2002) rate the probability of occurrence of disasters in case of landslide hazard in Nepal as very high, due to geophysical and climatological reasons. According to a 1984 study, landslide density in Nepal ranged from 0.2 per linear kilometer on stable land to 2.8 per kilometer on very susceptible lands fully exposed to human influence. About 12000 landslide/slope failures occur in Nepal annually (Bhattarai, D., Tsunkai, R and Mishra, A. N., 2002). Although technically different, the terms landslide and slope soil disasters are considered synonymous in this article.

Those disasters cause a considerable strain in the resource-constrained country like Nepal. According to the data of the Ministry of Home Affairs of His Majesty's Government of Nepal, from 1983 to 2001, an average of 322 people lost their lives in floods and landslides each year.

1.1 Location of Nepal

Nepal is situated between the latitudes of 26°20' to 30°27' North and between the longitudes of 84°04' and 88°12' East. Nepal shares 1236 kilometers of border with China and 1690 kilometers of border with India (figure 1). This unique location of Nepal between two giant Asian countries offers Nepal opportunities and obstacles. The total area of Nepal is 147181 square kilometers. Almost rectangular in shape, Nepal is 800 km long from east to west and ranges in width from 130 to 230 km.

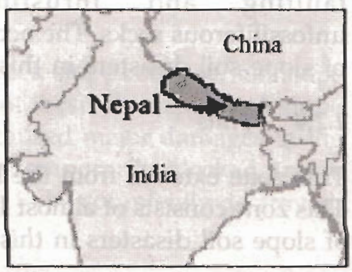

Fig. 1. Location of Nepal

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1.2 Geo-Physical Features of Nepal

Nepal can be divided into five geo-physical areas, namely the tarai, Siwalik, middle mountain, hill, and the high mountain, with the tarai in the south and the high mountain in the north (figure 2).

1.2.1 Tarai

The Tarai is the Nepalese portion of the Indo-Gangetic fertile flat area that extends from the Indian Shield in the South to the Siwalik in the North. The tarai is only a few hundred meters above sea level and the aquifers in this area are usually 400 to 600 m thick. The soil of tarai is composed of Quaternary alluvium, boulder, gravel, silt and clay. Due to the relatively gentle nature of the terrain in this area, the slope failures in higher areas deposit debris in the tarai.

1.2.2 Siwalik

The Siwalik lies immediately to the north of the tarai belt and extends throughout the country, in the direction roughly parallel to the southern border of Nepal. It is delineated by the Himalayan Frontal Thrust (HFT) and Main Boundary Thrust (MBT) in the south and north, respectively. This zone consists of very thick fluvial sedimentary deposits (Gansser, 1964). The occurrence of slope soil disasters in this zone is comparatively low.

1.2.3 Middle Mountain

The Middle Mountain lies in between the Siwalik and the Hills separated by MBT and the Main Central Thrust (MCT), respectively. The total width of the Middle Mountains ranges from 60-80 km and extends throughout the country in east-west direction. The Middle Mountain is composed of the sedimentary and meta-sedimentary rocks. The geology of Middle Mountain is complex due to folding, faulting and thrusting of unfossiliferous rocks. The occurrence of slope soil disasters in this zone is comparatively high.

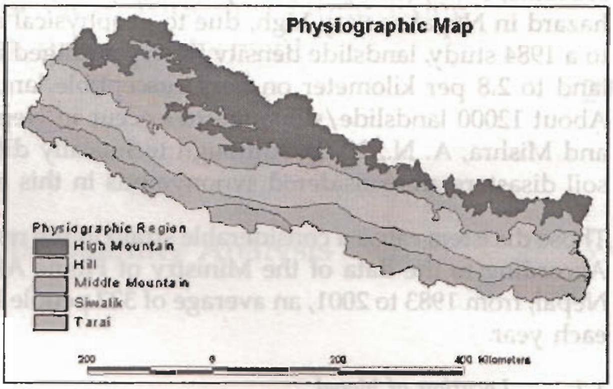

Fig. 2. Physiographic Map of Nepal

1.2.4 Hills

This zone extends from the MCT to High Mountains and runs throughout the country. This zone consists of almost 10km thick succession of the crystalline rocks. The occurrence of slope soil disasters in this zone is comparatively high.

1.2.5 High Mountains

The High Mountains generally begin from the top of the Hills and extends to the north in Tibet. This zone consists of fossiliferous sedimentary rocks such as shale, sandstone and limestone rocks. This zone is about 40km wide. The existence of these fossiliferous rocks indicates the initial boundary of Asian plate before its collision with the Indian plate. Due to very light population density in this area, the loss of life and property due to slope soil disasters in this area is relatively low. This area experiences frequent avalanches.

2. MAJOR FORMS OF WATER INDUCED DISASTERS IN NEPAL

Nepal experiences various types of natural disasters every year, such as earthquake, fire, flood, landslide, avalanche, glacial lake outburst flood, epidemics, hail storm, wind storm, thunderbolt, and drought. A study of disaster history in Nepal showed that the most "effective" disasters are flood, landslide and avalanche. The natural disasters caused by excess water are mainly flood and landslide.

2.1 *Flood*

River flooding is very common in Nepal, especially in the rainy season. Due to the steep gradient of the mountain rivers, the time of concentration of those rivers at any section is very small. There is very little time for warning in case of a flooding event. On top of that, due to very limited land suitable for agriculture, human settlement is very close to the riverbanks. In many cases the natural flow path of the river is partially obstructed due to encroachment. So, every time there is a major flood, hundreds of people die, scores of houses are washed away, agricultural fields are inundated with sediment laden water, slope soils begin to collapse as the lower portions of the slope are eroded, and major infrastructures like roads and bridges are damaged.

2.2 *Landslides*

Landslide is both the cause and the effect of flooding in Nepal. In many cases a landslides blocks the river for several hours, forming a temporary lake upstream of the landslide area. Once the landslide dam bursts, then there is a major flood in the river, without any rainfall immediately preceding the flood event. In other cases, the torrential rainfall causes flooding, which erodes the base of the sloped riverbanks. With the bases swept away, the groundwater flow begins to accelerate and the saturated heavy soil layer on a sloped surface cannot withstand the increased effective pressure, and creates a slope soil disaster. The villages inhabiting those sloped areas also flow down the hill along with the soil.

3. TYPES OF SLOPE SOIL DISASTERS IN NEPAL

The various types of slope soil disasters in Nepal are rapid rock slope collapse, soil slope collapse, debris and mudflow, and creeping landslides. Out of these, the rapid rock slope collapse and massive and sudden soil slope collapse have caused major damages in the recent past. Both types of collapses have caused rivers to be temporarily blocked, traffic in national highways to be blocked for weeks, whole villages to be completely destroyed, and scores of people to lose life and property.

The creeping landslides tend to inflict damage to infrastructures and houses every year, but they get less attention as they cause negligible loss of life compared to rapid collapses. Yatabe, R., and Bhandary, N. P., (2002) state that the damage due to creeping landslides in Nepal are less reported as the loss is not of abrupt nature. Many people in the mountain areas and the Nepalese government, for that matter, have been habituated to repairing their houses and roads every year. A section of the road that gets damaged by a creeping landslide is repaired one year, only to be damaged again by the landslide in the following year.

However, one of the major causes of loss of life and property in the 1993 disaster was debris flow. Every year several thousand tons of nutrient rich topsoil are eroded from agricultural fields of Nepal and are deposited in plain fields in India and Bangladesh. Many times, the debris-loaded floodwater covers agricultural field and destroys crops and houses in the tarai region of Nepal.

4. CAUSES OF SLOPE FAILURES

The causes of slope failures can be broadly classified into two groups, namely manmade and natural. Both these causes are equally important and in some cases intertwined.

4.1 *Manmade causes*

4.1.1 *Population Growth*

The basic reason for man made disaster is the uncontrolled population growth in Nepal. The current rate of population growth in Nepal is 2.25%, compared to 1.3% and 1.4% for the world and Asia, respectively. The growth pattern of population in Nepal is given in table 1.

Table 1. Population Size, Growth Rate and Doubling Time in Nepal

Census year	Total population	Growth rate %	Doubling time (yrs)
1911	5,638,749	-	-
1920	5,573,788	-0.13	-
1930	5,532,574	-0.07	-
1941	6,283,649	1.16	60
1952-54	8,256,625	2.3	31
1961	9,412,996	1.65	42
1971	11,555,983	2.07	34
1981	15,022,839	2.66	26
1991	18,491,097	2.08	33
2001	23,151,423	2.25	31

Source: Central Bureau of Statistics, Nepal

In the last four decades, there has been a mass migration from the hills to the flat low lands. However, despite this migration, the population density still continues to increase in the hills and mountains of Nepal. The increase in population density in low lands is much higher compared to that in the hills and mountains. The table 2 summarizes the change in population density in the hills and mountains of Nepal in the last four decades.

Table 2. Change in Population Density in Hills and Mountains

	Year			
Region	1971	1981	1991	2001
Mountain	22	25	28	33
Hill	99	117	137	168
Nepal	79	102	126	157

Source: Soussan, J., Shrestha, B. K., and Uprety, L. P., 1995

4.1.2 *Deforestation*

The limited land suitable for human settlement and agriculture has made the situation worse. Consequently, more and more land is being deforested for agriculture and settlement purposes. The rate of deforestation in the country was 1.7% per annum between 1978 to 1994 (SOE 2001, MOPE). Officially, the rate of deforestation is 1.3% in tarai and 2.3% in hills and mountains (HMG/DFRS, November 2001);

there are some controversies due to various figures of deforestation rate in Nepal from various sources. The table 3 lists decline in forest cover in Nepal.

Table 3. Decrease in forest cover

Year	Forest Cover (Million ha)
1964	6.5
1978	6.1
1980	5.6
1985	5.5

The deforestation causes upper soil to be more prone to erosion. Due to heavy rainfall, the erosion proceeds and forms gullies, which in turn acts as catalyst for slope soil disaster in the hilly areas.

4.1.3 *Developmental Activities in unstable hilly areas*

The settlement in unstable slopes necessitates developmental activities such as construction of roads, water supply, schools etc. in those areas. Another "developmental activity" is quarrying for producing aggregates, marbles and stone slabs. These activities normally tend to increase the existing land slope of the area. Due to limited resources, adequate measures of slope protection are not implemented when these activities are carried out. Further, the inhabitants who were producing local crops that do not require lots of water, such as buckwheat, have introduced crops requiring high water volume, such as rice. This factor exacerbates the already fragile system and increases the instability of the slope soil. Similarly, Thapa, K. B. and Khanal, N. R. (2001) have listed various cases in which failure of man made structures has caused flood and consequent landslides.

4.1.4 *Vicious Cycle*

The overall effect of all these man made causes, when aided by heavy concentrated monsoon rain results in slope soil disaster, which, in turn, reduces productivity of land and also reduces the land available for habitation and agriculture. Consequently, more forest is destroyed for agriculture and habitation. Similarly, loss of life due to disasters creates a feeling of insecurity in smaller family size, which perpetuates the rapid increase in population. This creates a vicious cycle, as increase in deforestation increases slope soil disaster, which reduces the available land and necessitates further deforestation. The figure 3 illustrates the vicious cycle of slope soil disaster resulting from human activities.

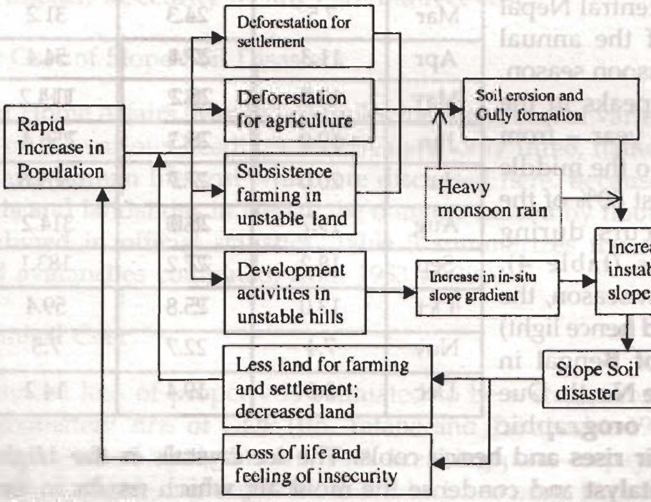

Fig. 3. The vicious cycle of manmade slope soil disaster in Nepal

4.2 *Natural causes*

4.2.1 *Geology*

As mentioned earlier, the geology of Nepal is tectonically very active, indicated by frequent earthquake events. The higher mountains and hills are young and unstable. Each earthquake triggers several major and minor landslides. Also, the Middle Mountains and the Siwalik of Nepal consists mostly of sedimentary type rocks that are easily eroded. Many of these erosion prone rocks in the Middle Mountains are exposed because of previous events of land slide or soil erosion. So, it is also a self-sustaining process.

4.2.2 *Topography*

The very steep topography of Nepal contributes its share in the slope soil disasters. The mean width of Nepal is less than 200 km. Out of that, the southern 30 to 40 km width is relatively flat land (tarai). So, the effective width of mountainous part of Nepal is only about 150 km. The difference in elevation between the highest and the lowest point is almost 9 km. Due to this extremely high slope of the land surface, Nepalese rivers in the mountain region tend to flow very fast. These fast flowing rivers erode the riverbanks easily, causing slope soil failures. Since the land slope is high, the surface runoff resulting from rainfall event also flows faster, causing formation of gully over highly erosion prone rocks. These gullies eventually aid slope soil failure.

4.2.3 *Climatology*

The rainfall pattern in Nepal is highly heterogeneous, temporally and spatially. The annual rainfall amount varies from less than 250 mm in the area north of Himalayas to around 5000 mm at Lumle, Kaski in central Nepal (figure 4). Much of the annual rain falls in the monsoon season. The monsoon rain peaks in the four months of the year – from the middle of May to the middle of September. Almost 80% of the annual rainfall occurs during these four months (table 4). During the monsoon season, the warm and moist (and hence light) air from the Bay of Bengal in India is blown to the North. Due to the Himalayan orographic barrier, the moist air rises and hence cools. The ice crystals in the Higher Himalayan Mountains act as catalyst and condense the moist air, which results in torrential rain in Nepal.

Table 4. Climatological Information of Nepal

Month	Mean Temperature °C		Mean Total Rainfall (mm)	Mean Number of Rain Days
	Daily Minimum	Daily Maximum		
Jan	2.1	18.0	14.2	2
Feb	3.8	20.2	16.7	3
Mar	7.5	24.3	31.2	4
Apr	11.3	27.4	54.4	6
May	15.5	28.2	114.2	12
Jun	19.0	28.3	256.4	17
Jul	20.0	27.7	359.6	23
Aug	19.7	28.0	314.2	22
Sep	18.2	27.2	183.1	15
Oct	13.0	25.8	59.4	4
Nov	7.4	22.7	7.5	1
Dec	3.0	19.4	14.2	1

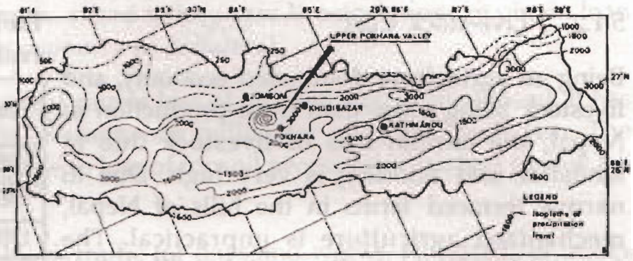

Fig. 4. Mean annual rainfall pattern of Nepal

During the rainy season, continuous rainfall lasting several days makes the upper soil layer completely saturated with water. It is a very common phenomenon in Nepal to have more than 100 mm of rainfall in a day during the monsoon season. Many times the rainfall intensity crosses the 200-mm per day mark. The 24-hour maximum rainfall intensity map of the Department of Hydrology and Meteorology shows that there are many places in Nepal that have experienced more than 350 mm rainfall in a day. This type of intense rainfall causes the nutrient rich topsoil to be eroded quickly, forming gully. The rain water gushing through these newly formed gully cuts through the hills rather quickly, turning the narrow and small gully to huge ditches within a matter of hours, thus further destabilizing the already unstable slope-soil-layer. The saturated soil layer resting on top of a rock on a sloped hill cannot withstand this added pore water pressure and results in slope soil disaster.

Further, due to erosion of nutrient rich topsoil, the land productivity decreases, which forces the farmers to deforest more lands. The average crop yields declined within the range of 5 to 30 percent during the past few decades in a number of mountain watersheds in Nepal (Chapagain, D. P. 2001). So, there is a link between the natural and man made causes of slope soil disasters in Nepal.

5. COST OF SLOPE SOIL DISASTERS IN NEPAL

Nepal pays a phenomenal price for slope soil disasters annually. The cost of slope soil disasters in Nepal can be classified into two types, direct cost and indirect cost. The easily quantifiable costs such as number of people dead are direct costs. The costs such as psychological impact, insecurity feelings are indirect cost.

5.1 Direct Cost of Slope Soil Disasters

The Ministry of Home Affairs (MoHA) compiles the direct cost of various types of disasters annually. Out of the various headings MoHA uses, only three, namely, economical cost, livestock cost and human life cost which are discussed here. Because of the intertwined nature of floods and landslides in Nepal, the damage caused by floods and landslide are generally combined in official statistics. Table 5 summarizes the direct cost by flood, landslides and avalanches combined, from 1983 to 2001.

5.1.1 Economical Cost

The average annual loss of property is estimated to be a staggering Rs. 10,000 million, which is approximately 20% of GDP (Ito, Yatabe and Takahashi, 1994). For a resource-constrained country like Nepal, this is a back-breaking price to pay. Table 5 shows that the frequency of estimated loss, the amount of which are more than 900 million annually, is increasing.

5.1.2 Live-stock Cost

Being an agriculture dominated economy, and livestock being more than meat production in Nepal, the annual loss of livestock due to landslide and flooding is very high. Due to narrow terraced farms in the hills of Nepal, mechanized agriculture is impractical. The farmers depend on the livestock for tilling their land.

5.1.3 Human Life Cost

Hundreds of people die each year in Nepal due to excess water induced disasters. The data compiled by the Centre for Research on the Epidemiology of Disasters reported that from 1975 to 2001, the number of persons killed by flood is 9908, and the number of persons affected is 268459401. According to a web source, 346 persons died in landslide related hazards in 2002 (www.scottwilson.com/nm/publish/news_18.html), the number of persons killed in that year's monsoon flooding is 237, with 45 missing. Some other sources provide different numbers of death.

Table 5. Damage by flood, landslide and avalanche in Nepal

Year	People dead	Livestock lost	Estimated Loss Million Rs.
1983	293	248	2400.00
1984	363	3114	37.00
1985	420	3058	58.10
1986	315	1886	15.85
1987	391	1434	2000.00
1988	342	873	1087.00
1989	700	297	38.61
1990	307	314	44.00
1991	93	36	21.20
1992	71	179	10.78
1993	1336	25424	4904.00
1994	49	284	59.00
1995	246	1535	1419.00
1996	262	1548	1186
1997	87	317	104
1998	273	982	969.27
1999	214	331	365
2000	173	822	932.1
2001	196	377	251.1

Source: Ministry of Home Affairs

5.2 Indirect Cost

The death and destruction of people and property that is initiated by the floods and landslides does not come in the figures of Table 5. A landslide blocks a river for a few days and causes a flood event, which, in turn, inundates a village for several days and initiates various water-borne diseases. Any deaths resulting from those diseases are not reported as deaths from landslide or flooding.

The negative psychological impact on the people affected by landslide can be long lasting. Due to lack of any psychological counseling, affected people get depressed. Many families have to resettle at a different location because their house and land no longer exist. People affected by landslide lose the feeling of safely. Many families tend to produce several children in order to cope with loss of life in future landslides. As stated earlier, this tendency fuels the vicious cycle given in figure 3.

The landslide causes environmental degradation and a negative impact on bio-diversity index. There is always a potential of loss of habitat of endangered species due to landslide. It takes decades to recover from the ill effects of loss of this nature.

The reduction in agricultural productivity due to loss of live-stocks used for plowing the agricultural fields does not come in the official statistics as losses due to landslides. A loss of livestock means loss of the means of land tilling. A farmer who has lost most of his/

her property in the landslide neither can afford to buy new livestock nor can obtain loan from a bank because he/she has no property as collateral.

Landslide and consequent flooding event causes loss of nutrient rich fertile topsoil. It has been estimated that Nepal looses, in average, one millimeter of topsoil each year. The reduction in agriculture productivity due to loss of topsoil necessitates farmers to look for newer areas for farming.

Landslides along highways tend to block traffic for days and weeks. Hundreds of trucks carrying goods gets halted and the economic activities get disrupted. Nepalese passengers and foreign tourists get stranded in the highway and miss national and international flights. Many scheduled activities cannot take place. The combined effects of these adds up to very big loss to the country.

6. MITIGATION EFFORTS

Realizing the effects of various disasters and the importance of disaster mitigation measures, His Majesty's Government of Nepal passed a Natural Disaster Relief Act in 1982. Since then, the government of Nepal has established various organizations to deal with disaster management and disaster mitigation. The government also allows various external organizations to work in the field of disaster mitigation. The Nepal Red Cross Society, which is an independent statutory body of HMG/N, has been dealing with the after effects of disasters since the last several decades.

6.1 *Organizations*

The following are some of the organizations working in the field of flood and landslide disaster mitigation in Nepal. Many of these organizations have recently established their web sites. A lot of valuable information can be obtained through these sites.

- Ministry of Home Affairs
- Department of Narcotics Control and Disaster Management
- Department of Water Induced Disaster Prevention (DWIDP)
- Department of Soil Conservation and Watershed Management
- Department of Hydrology and Meteorology (DHM)
- Department of Roads
- Department of Irrigation
- Ministry of Local Development
- Local Government Institutions
- Nepal Red Cross Society
- External Support Agencies
    - Japan International Cooperation Agency (JICA)
    - International Centre for Integrated Mountain Development (ICIMOD)
    - United States Agency for International Development (USAID)
    - Lutheran World Service (LWS)
    - German Technical Cooperation (GTZ)
    - OXFAM
    - Cooperation for American Relief Everywhere (CARE)
    - United Mission to Nepal (UMN)

- United Nations Development Programme
- Save the Children Fund (SCF)
- Nepal Society for Earthquake Technology
- District Level Programmes, implemented by DOI through the Irrigation and River Training Committees (IRTC)

Despite the long list of various organizations working in the field of disaster management and mitigation in Nepal, the loss of life and properties due to various scales of disasters have not reduced noticeably. The reasons for this are many, but the basic reasons are lack of concept of answerability/accountability, lack of coordination among various organizations, and poor management.

6.2 *Research and Training*

The systematic record keeping of any sort of data is still a new concept in Nepal. Information is handed down to the next generation by word of mouth. Information of landslide history and the consequent damages are no exception. Various researchers have found it very difficult, if not impossible, to find historical disaster records and systematic records of past natural disasters in Nepal (Ito, T., Yatabe, R., and Takahashi, J., 1993). In many cases one has to establish personal connections with the concerned authority for accessing the data.

Several case studies related to slope soil disasters in Nepal have been conducted. The results of these studies are normally submitted to concerned organizations and are not published unless they are presented at a seminar. These unpublished reports tend to disappear with every change in leadership of organizations. So, they are not easily accessible. This system creates unnecessary duplication of efforts as various researchers repeatedly work on similar problem. The results of some recent research and mapping activities, conducted by national and international organizations, however, are accessible through the use of Internet.

There are several organizations in Nepal that provide training on various aspects of slope soil disaster. DWIDP and the Disaster Management Support Programme conduct training on slope soil prevention using sabo and various other techniques. ICIMOD conducts training related to application of Geographical Information System and Remote Sensing for identifying disaster prone areas. Various academic, governmental and non-governmental institutions occasionally conduct national and international seminars and workshops on disaster mitigation. These training and seminars enhance technical competence of professionals working in the field of disaster mitigation. So, currently there are several highly trained professionals in Nepal who have technical expertise in disaster mitigation works.

6.3 *Engineering Solutions*

There are various engineering mitigation techniques to deal with slope soil disaster such as retaining walls at the base of critical sites, cement grouting, river training, bioengineering, lined side drains along roads, and horizontal underground drain. Many of these techniques have been used at various locations in Nepal with varying degrees of success.

6.4 *Other Solutions*

Other techniques of slope soil disaster mitigation are preparing disaster (hazard) maps, conducting integrated watershed management programs, conducting public awareness programs, installing flood forecasting (early warning) system, monitoring soil water content of slope soil at critical locations, conducting afforestation programs, controlling population growth, and planning settlement.

Various agencies in Nepal are currently involved in the execution of those techniques. DWIDP is currently in the process of preparation of a hazard map of Nepal. The landslide Hazard Zonation Mapping of Pokhara Valley has been completed (www.bgr.de). The Department of Survey is about to complete preparation of Digital Elevation Model (DEM) of Nepal, thereby making it easy to apply GIS techniques in disaster mitigation efforts. The Department of Soil Conservation and Watershed Management is conducting various integrated watershed management programs. Disaster Management Support Programme and DWIDP are actively engaged in raising public awareness related to slope soil failures, and have published brochures and manuals to educate local people. Nepal Society for Earthquake Technology is conducting various activities to increase public awareness on earthquake resistance methods. DHM has installed several hydrometric and meteorological stations specifically for flood forecasting and early warning system; a flood-forecasting project was initiated at the DHM in mid-1980s. The Nepalese government is testing various techniques, such as community forest and private forest, to increase forest cover. Nepal CRS Company is very actively promoting use of various methods to control population growth. The Kathmandu Metropolitan City is beginning to designate lands for settlement purposes. The Lalitpur Sub-municipality recently passed a regulation requiring new building permits to require structural design according to Nepal Building Code.

So, various activities that can directly or indirectly aid slope soil disaster mitigation are simultaneously going on in Nepal. But again, there is no coordination among these organizations; each organization is going on its own way. One of the reasons for this phenomenon of uncoordinated activities is uncertainty of funding for each activity. Many disaster mitigation activities in Nepal are currently being carried out through funding from various international donor agencies. Each donor agency has its own priority and its own schedule of activities. There is no integrated plan as to what are the things to be done, when those things are to be done, and which agency will do what. This lack of an integrated plan is creating confusion both to the national organizations seeking funding and to the donor agencies.

Establishment of an effective network of various organizations working in the field of pre- and post-disaster mitigation can greatly improve coordination. An integrated plan of disaster mitigation prepared with input from concerned agencies can reduce confusion among both the seekers and providers of funding for various disaster mitigation related activities. Well-managed implementation of these activities can reduce the cost of disaster.

7. SUMMARY

Due to various manmade and natural causes, Nepal experiences many types of disasters every year. Out of these, the flood and slope soil disasters are major disasters causing loss of life and property. There are various organizations, both governmental and non-governmental, working in the field of disaster mitigation. Due to the lack of proper coordination of these agencies, the mitigation measures have not been very effective. People continue to die in large numbers every year.

There are various engineering and non-engineering techniques of slope soil disaster mitigation. Many of these techniques have been applied in Nepal with varying degrees of success. By systematically applying these techniques, increasing coordination among various organizations, and raising the degree of awareness in the people living near the hazard area or near potential hazard area, significant reduction in loss of life and property can be achieved.

8. ACKNOWLEDGEMENT

The author would like to thank the various authors whose sources of information were used while preparing this paper. Information from many web sites listed under references were also used.

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LESSONS FROM THE PAST EARTHQUAKES AND MEASURES TO BE TAKEN FOR THE FUTURE

*Jishnu K. Subedi**

ABSTRACT

Because of its location in the boundary of two colliding tectonic plates – Indian plate and Eurasian plate - Nepal is prone to large magnitude earthquakes. More than six deadly earthquakes in this region during the span of three years in this millennium, further substantiate the threat. Necessary measures taken in Nepal to counter the challenge posed by earthquakes do not match the risk that is statistically imminent in the near future. Although advancement in technology has not been able to completely avoid the destructions occurring from earthquakes, observation of the damaged structures and the failure patterns reveal the fact that the causalities and loss can be reduced significantly. This study summarizes the failure patterns of many types of building structures – adobe, masonry, timber and RCC – during earthquake and recommends the necessary arrangements to be made to avoid repeating same types of failures. The recent concerns about change in ground motion characteristics in near-fault zones are also reported briefly. Suggestions are made to improve design and construction practices along with strict adherence to the codal provisions during construction. Based upon the seismological studies, it is suggested to make necessary changes in the codes to take into account the near 100 percent amplification of ground motion velocity in near-fault region.

Keywords: *Earthquakes, structural damages, near-fault effects, ground motion*

INTRODUCTION

Earthquake has become the most dreadful natural disaster claiming more than 50,000 lives in the span of three years of this new millennium. One of the most hit area by earthquake is South Asia. Out of 13 deadliest earthquakes (*See Box 1*) in this new millennium, six occurred in South Asia alone - all of these earthquakes, except Bhuj earthquake on 26 January, 2001, are along the collision margin of Indian plate with Eurasian plate. As Nepal also lies in the border of these two plates, there is always the danger of a large earthquake occurring anytime.

The process of generation of earthquake from collision can be explained in brief like this: the Indian plate is traveling towards the north at a very rapid rate – from 25 cm per year it has now decreased to 5 cm per year. In its movement towards the north, it is sliding beneath the Eurasian plate in the north. This process, which is known as plate tectonics, has led to the origin of many mountainous range in the border of Indian and Eurasian plates: Himalayan range, Hindu-Kush range and Pamir range. Because of the tectonic movement, rocks underneath the boundary get stressed, leading to storage of energy. When the energy is large enough to break any weak zone of the rock, a large amount of energy is released at once which shakes the earth.

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Box 1. Deadliest Earthquakes in the New Millennium

21 May 2003: More than 2,261 people die and more than 10,000 injured in Algiers, Algeria

24 February 2003: More than 260 people die and almost 10,000 homes are destroyed in Xinjiang region, in western China.

21 November, 2002: More than 20 people killed in the northern Pakistani district of Diamir.

31 October 2002: Italy is traumatized by the loss of an entire class of children, killed in the southern village of San Giuliano di Puglia when their school building collapsed on them.

12 April 2002: Dozens of people are killed in the third large tremor to hit northern Afghanistan in two months.

25 March 2002: Second earthquake in a month in Afghanistan. At least 800 die in the north of the country. The earthquake registers 6.0 on the Richter scale.

3 March 2002: Some 150 killed by earthquake in Afghanistan centered on Samangan province. It registers 7.2 on the Richter scale.

3 February 2002: An earthquake registering 6.0 on the Richter scale strikes western Turkey, leaving at least 43 people dead and thousands homeless.

24 June 2001: An earthquake lasting more than a minute hits southern Peru, killing at least 47 people and injuring hundreds. It measured 7.9 on the Richter scale.

13 February 2001: Nearly 300 people are killed as the second earthquake in a month hits El Salvador. The latest quake measures 6.6 on the Richter scale.

26 January 2001: An earthquake measuring 7.9 on the Richter scale devastates much of Gujarat state in northwestern India, killing an estimated 30,000 people and making more than a million homeless. Bhuj and Ahmedabad are among the towns worst hit.

13 January 2001: El Salvador is devastated by an earthquake measuring 7.6 on the Richter scale. More than 700 people die.

Source: BBC News Online (http://news.bbc.co.uk/1/hi/world/2059330.stm)

Despite the rapid advancement in technology in the last few decades, earthquake still remains one of nature's most enduring challenges for scientists and engineers. Past experience has proved that by adhering to seismic design practices in structures, loss of life and property can be reduced significantly. Observation of structural damages in the past earthquakes has revealed the fact that buildings constructed using weak materials, using poor workmanship, without taking into account seismic provisions are more vulnerable to ground shaking. Because of rapid population growth in urban areas, haphazard construction practices, lack of strict monitoring of seismic design practices in construction, use of poor technology, and lack of awareness among the public, the problem is further aggravated in Nepal. Learning from the experiences of past earthquakes in Nepal and other parts of the world, immediate actions are necessary in order to protect human life and properties.

Recent seismological studies have shown that the ground motion due to earthquake is different at forward and backward locations of fault rupture propagation. The ground motion in forward directivity region (rupture toward the site – site away from the epicenter) has characteristic large impulse velocity time history with short duration vibration in comparison to that in backward directivity region (rupture away from the site – site near the epicenter). This change in ground motion demands special provisions in earthquake codes. The failure patterns of different types of buildings, suggested measures to avoid collapse of buildings and necessary upgrading required in the code are discussed in this study.

STRUCTURAL DAMAGES FROM PAST EARTHQUAKES

Experiences from the past earthquakes can be summarized in one sentence: Earthquakes do not kill people, buildings do. Some familiar failure patterns in different earthquake for various types of structures are dealt here.

Adobe Structures

Adobe structures along with stones are the most common type of construction in many parts of Nepal, especially among the people of poor income groups. Some of the traditional structures of cultural importance in urban cities like Kathmandu are also made of adobe. Adobe is one of the weakest building materials and the problem arising from its use in the buildings is further aggravated by loose connections – usually achieved by using mud. Although stones are strong enough individually, the structure itself is vulnerable to earthquake because of loose connections of the building materials to one another and connections of one member to another. They may act as one unit in dry areas and dry season, but during rainy seasons the connectivity and strength is lost. Observation of earthquakes in Gujarat, Iran, Afghanistan and other parts of the world revealed three typical types of failure in these structures (Fig. 1).

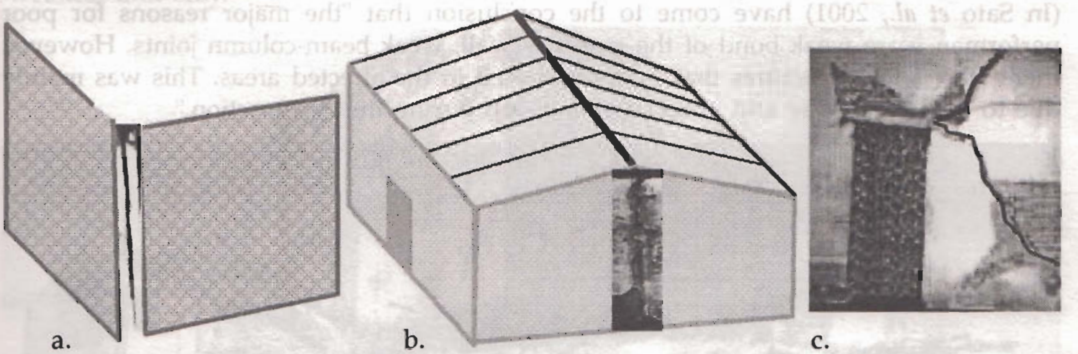

Fig. 1. Three types of failure modes in structures with Adobe and Stone materials. a. Failure of corner wall b. Failure due to out of plane flexure c. Failure around openings e.g. doors.

First type of failure arises from weak corner joints. Weak bond in the adobe wall corners lead to corner cracks and eventually to an outward failure of the walls (Fig. 1a). Second type of failure is out of plane flexural failure of walls because of direct inertial load transfer from roof to the wall (Fig. 1b). Such types of structures have wooden ceiling joists supporting roofing materials – usually clay tiles – and which in turn are connected to a main longitudinal beam centrally. The longitudinal beam rests directly on two walls. Earthquake motions generate inertial forces at the roof, which are transmitted through the top longitudinal beam directly to the transverse walls, leading to a critical out of plane flexural failure. Lack of cross bracing elements in the roof system is the main cause of the failure (EERI report on Mexico Earthquake, 1995).

Third type of failure is at the corners of opening in the walls where doors or windows are located (Fig. 1c). The large stress concentration at corners cause scalping of concrete, diagonal crack, loosening of individual blocks, and finally collapse of the wall.

Masonry Structures

Masonry buildings are those buildings built primarily with bricks, and may or may not contain beams or slabs. These types of buildings are most common in urban areas of Nepal for middle income families. Though many times better than adobe structures, they are also vulnerable to earthquakes if proper construction practices are not adopted. Non-reinforced masonry possesses little ductility and is not expected to behave elastically as is desirable during an earthquake.

Non-structural members and cantilever portions are first to fail during earthquakes obstructing passage of escape. The disassembling parts often fall upon the incumbents resulting in fatalities. Photo 1, taken after Gujarat earthquake in Anjar city, shows complete collapse of residential buildings in a newly built complex. Although the buildings look aesthetically beautiful, the constructor appears not to have considered earthquake design provisions. Many parts are hanging outside, supporting columns are small with insufficient reinforcement, and the columns are placed un-symmetrically. After an extensive field survey and measurements of different buildings after Gujarat earthquake, Meguro *et al.* (In Sato *et al.*, 2001) have come to the conclusion that "the major reasons for poor performance are weak bond of the masonry wall, weak beam-column joints. However, there were some structures that performed well in the affected areas. This was mainly due to the proper care and good workmanship during the construction."

Photo 1. Failure of architecturally beautiful looking newly built residential complex from Gujarat earthquake.

Timber Structures

Timber is a relatively ductile material. That is, it can be stretched, bent, and hammered, without loosing much of its strength. Because of large damping characteristics, they reduce the resonance and overall strain placed upon the building parts. They are lightweight, and decreased mass is an added benefit to counter earthquake force. Hence, timber structures are desirable in earthquake prone areas. In Nepal, they are used extensively throughout the country. Most of the traditional Nepalese structures are also built of timber.

However, timber is not used alone to construct buildings. It is combined with adobe, stones, and masonry for walls and floors. Addition of these materials increases vulnerability of the structure, as proper bonding cannot be achieved and mass also is increased. Decay of timber and attack from termites in timbers also reduces strength of timber members. Another drawback of timber structures is that they are fire-prone and past earthquakes in Kobe and other areas have shown that fire also contributes largely to the casualties and losses immediately after an earthquake.

RCC Structures

RCC structures are characterized by moment resisting beam-column frame structures with or without infill walls. Observations of failed building structures in the past earthquakes have revealed some important failure pattern of these buildings. Photo 2 shows collapse of a residential flat in Anjar after Gujarat earthquake. The flat had four inter-connected wings, out of which one wing collapsed completely in the earthquake. Although other wings too suffered major structural damages (shown in Photo 3), these wings remained standing. This reminds us of the fact that a structure is as strong as its weakest link only.

Photo 2. Pooja flat in Anja, Gujarat. Out of 4 wings, one wing collapsed completely and other three parts suffered structural damages. Details of structural damages in the marked area are shown in Photo 3.

Photo 3. Details of damages in three front columns in Pooja flat in Anja, Gujarat.

It can be observed from Photo 3 that the building suffered from poor construction, poor workmanship, and negligence of codal provisions. The failed portion of columns show that lateral ties are small – usually 6 mm diameter mild steel – and are placed at larger center to center distance – usually 200 mm. Depth of beam is increased at column position for aesthetic purpose, but reinforcement detailing shows that excessive shear at this juncture was not considered. Improper concrete compaction displayed poor workmanship. The concrete was not acting as one unit. Moreover, rigid continuous beams and relatively less stiff columns created an undesirable strong-beam and weak-column system (Sato *et al.*, 2001).

Another pattern of failure observed in Gujarat earthquake is that buildings with no lateral bracing at ground floor are vulnerable to earthquakes. The space is usually separated for parking and in contrast to the upper floors, where stiffness and mass increases because of addition of infill walls, they have less stiffness. This results in ground floor acting as soft story. Many large buildings suffered damage or failed completely because of this action in Ahemdabad area, 300 km from epicenter of the earthquake. In shaking a building, an earthquake ground motion will search for every structural weakness. These weaknesses are usually created by sharp changes in stiffness, strength and/or ductility, and the effects of these weaknesses are accentuated by poor distribution of reactive masses.

Occurrence of cracks, scalping of concrete, and collapse of infill walls have been observed in earthquakes. Because of large shear force, diagonal tension cracks appear in the infill members. Although infill walls are not usually designed as structural members, and their failure should not lead to collapse of structure, they can lead to casualties by obstructing escape path, by excessive dust, and by falling upon the incumbents. They can also lead to structural failure by sudden mass and stiffness re-arrangement in the structure.

One critical reason for failure of the structures in many earthquakes is because of unsymmetrical mass and stiffness distribution. Buildings that are loaded with heavy mass on top floors are prone to damage. Unsymmetrical stiffness resulted in development of excessive torsional stress in certain parts of the structures resulting in failure of that part, and ultimately resulting in collapse of the structures.

NEAR-SOURCE EFFECTS IN GROUND MOTION

The recorded velocity-time history of earthquakes in near field and far field shows different characteristics. After studying recorded motion of Hanshin-Awaji Japan earthquake, which occurred on January 17, 1995, and other earthquakes at different places, Tanimura *et al.* (2000) reported that " history profiles in the near field were obviously different from those in the far field. In the first case, the velocity at the transient stage is very strong and followed by a weak vibration; while in the last case, distinguishing feature is vibration. The records suggested that dynamic failure of structures due to the transient loading at the initial stage of earthquake should be very important." It was observed that the patterns of structural failures in the near source area were similar to those of a dynamic failure under impact loading, but different from those in the far field where the structural failure was considered to be due to the resonance.

The three factors – namely earthquake source, propagating media and local site conditions – that have important influences on ground motion characteristics are not sufficient to characterize an earthquake motion that propagates through a fault rupture. Specifically, although earthquake magnitude, distance to fault, local geologic conditions are the most important factors influencing the strength and frequency characteristics of ground motions, for near fault ground motions, fault rupture process is also important.

After studying 1999 Chi-Chi earthquake in Taiwan and many other similar earthquakes, Krawinkler *et al.* (2003) suggested that "the near-fault region (less than 10 km from the fault rupture) with forward directivity (the fault rupture propagating towards the site), the fault-normal component of ground motions is very strong and shows pulse-like characteristics." The waveform for two conditions – forward directivity and backward directivity – is shown in Fig. 2 (Somerville *et al.*, 1997). The ground motion in forward directivity region shows a dominant peak with short time history in comparison to the ground motion observed in backward directivity region. These characteristics affect structures of different resonant frequencies in a very different manner.

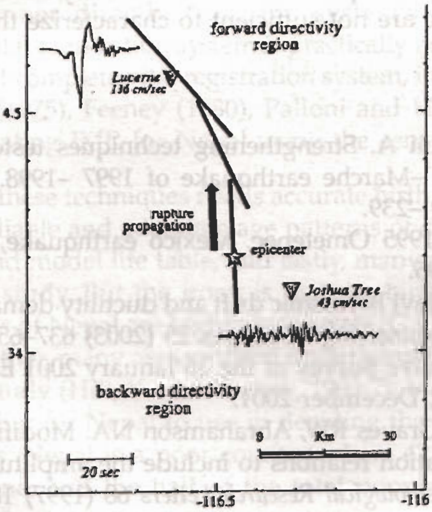

Fig. 2. Ground motion at forward directivity region and backward directivity region during an earthquake (Somerville *et al.*, 1997)

Based upon these studies, it can be concluded that ground acceleration from a seismic activity in the near-fault region can be considerably different than at a region that is far from the rupture. So far, the Nepal Building Code and Indian Standard codes focus on seismic regions divided into broad categories, ranging from zone 1 to 5. Because of the enhancing effect in ground motion due to faults, special measures for near-source zone are necessary. Studies suggest that a "near-source zone" can be defined as within 2 kilometers of a known fault zone. The maximum increase for near-source effects occurs within 2 km. The amount of increase in the seismic force used for the design decreases with distance from the fault and there is no increase at and beyond 15 km from the fault. In this "near-source zone," increase in design force requirements on structures can be as high as a 100 percent.

CONCLUSIONS

Most of the traditional structures, adobe-masonry structures, and timber structures collapse during earthquake because walls that should have been tied to floors fell outwards, removing all structural support, and bringing the roof down. Such structures can be protected by adding lateral confinements, strengthening corners and reinforcing the bonds.

Tall buildings sway in resonance with the ground vibration and vibrate with the ground below. Unsymmetrical distribution of mass and stiffness along plan and elevation of the buildings cause excessive stress concentration in some parts of the buildings, leading ultimately to collapse of the buildings. Structures with large mass at higher floors, opening in ground floors, unsymmetrical distribution of columns placement, and unsymmetrical placement of staircase have been prone to failure. Poor workmanship, poor detailing and lack of strict adherence to codal provisions also make structures vulnerable to ground shaking.

The ground motion is dependent not only on location of epicenter, medium of propagation and local site conditions, but also on fault rupture direction. The motion characteristic is significantly different towards rupture direction and away from rupture direction. Hence, the zonal divisions of code are not sufficient to characterize the earthquake motion and force.

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A METHOD FOR ESTIMATING INFANT MORTALITY RATE FOR NEPAL

*Shambhu Prasad Patel**

ABSTRACT

Timely and reliable estimates of IMR are needed for a variety of purposes. In the absence of complete vital registration system, the limited estimates of IMR so far available to Nepal were computed from the census or survey data employing costly and sophisticated indirect techniques borrowed from foreign countries. The estimation of IMR by these techniques needs accurate birth history data and age patterns of child mortality; and many assumptions to be satisfied by the population under study. But these needs do not seem to be well satisfied in Nepal's context.

Nepal needs simple model based on the realities of the country. This paper presents a simple regression model for estimating IMR for Nepal using minimum relevant parameter i.e. CDR. The validity of the model is ascertained by comparing the estimated IMRs for Nepal with the other estimates; and by computing various relevant tests of model adequacy whenever possible. The model is found to provide satisfactory estimates of IMR for Nepal for recent periods. For instance, the estimated IMR for Nepal for the year 1999 is 77.48 (per thousand live births) which may be considered consistent with IMR of 75.00 (per thousand live births) provided by the UNICEF (2001:80).

INTRODUCTION

Infant mortality rate is an important indicator of development. It is widely used for assessing socio-economic and health situation in developing countries (Chandra Sekhar, S. 1972:77; Jain and Visaria, 1988). Measurement is a fundamental aspect of research in the area of infant mortality. If vital registration is complete, IMR for each year can be calculated in the conventional manner directly from the system's data (Hill, K. 1991:369). Unfortunately, complete vital registration system is practically non-existent in Nepal (Karki, Y.B. 1989). In the absence of complete vital registration system, indirect techniques proposed by Brass (1964), Trussell (1975), Feeney (1980), Palloni and Heligman (1986) and others have been used for estimating IMR for Nepal using the census or survey data.

The estimation of IMR by these techniques needs accurate birth history data to be collected from census or survey; reliable and adequate age patterns of child mortality for selecting an appropriate method and model life table; and lastly, many assumptions to be satisfied by the population under study. But the irony is that the birth and death data collected from the census or surveys of Nepal are highly inaccurate (G.C., Radhakrisha 2084/049:6-9; Pant, P.D. 1996:1-8). Further, many assumptions underlying the models are unjustifiable in the population under study (Hill, K. and Yazbek, 1993:7). Moreover, there is no reliable age distribution of mortality for Nepal to use in deciding the right family that fits (CBS, 1995:101). Apart from this, Nepal is a poor country where 42 percent of her people still live below the poverty line, and the half of the total population cannot read or write (UNDP, 2002:2).

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Keeping in view the socio-economic and demographic realities of our country, this paper presents a simple regression model for estimating IMR from the minimum relevant parameter. CDR has been selected as the minimum relevant parameter needed for estimating IMR because it represents the 'end result' of development; can be easily obtained from either suitable models or various publications; and more importantly, it is strongly correlated with the level of IMR (Arriaga, 1994). The model is applied to obtain the estimates of IMR for Nepal, and its validity is ascertained by comparing the estimated IMRs for Nepal with the other estimates available to the country; and by computing relevant tests for diagnostic checking for model adequacy.

MATERIALS AND METHODS

The proposed methodology of estimation is based on simple regression approach described elsewhere (e.g., Kumar, R. 1981; Aryal and Gautam, 2001; Singh, M.L. 2003). The methodology of estimation developed here follows the usual path of establishing the relationships between the dependent variable, which in this case is the IMR and the independent variable, herein identified as CDR. Several empirical studies show almost a linear relationship between IMR and CDR. Therefore, it was decided to fit a regression model of type:

$$Y = a + bX + e \quad \text{.........................} \quad (1)$$

Where Y = IMR (per 1000 live births); X = CDR (per 1000 population); e is a random error term; and a and b are parameters to be estimated.

The next step is to estimate the value of the parameters. For this purpose, the regression model is fitted by using the following set of data extracted from the United Nations (1999):

The table gives the following values of constants needed for estimating the parameters:

$\Sigma X = 195.90$ $\quad \Sigma Y = 1849.00$ $\quad \Sigma XY = 31598.20$

$\Sigma X^2 = 4163.81$ $\quad \Sigma Y^2 = 239821$ $\quad n = 10$

Using these data, simple regression approach gives the following estimated regression model for computing IMR for Nepal:

$$\hat{Y} = 3.01 + 7.4470\, X \quad \text{............................} \quad (2)$$

$n = 10$, $R^2 = 99.8763\%$, S.E. $(\hat{Y}) = 1.7009$

Where $\hat{Y}$ = Estimated IMR (per 1000 live births); X = CDR (per 1000 population).

DIAGNOSTIC CHECKING FOR MODEL ADEQUACY AND DISCUSSIONS

A model that fails in diagnostic checking for model adequacy will always remain suspect and little faith

Table 1. Estimates of CDR and IMR for Nepal used for Fitting the Equation (1)

Years	X (= CDR)	Y (= IMR)
1950-1955	27.9	210
1955-1960	26.7	200
1960-1965	25.0	189
1965-1970	22.8	175
1970-1975	21.1	160
1975-1980	18.4	142
1980-1985	16.2	125
1985-1990	14.1	109
1990-1995	12.8	96
1995-2000	10.9	83

Source: United Nations (1999), p. 305.

can be put in the results (Kerlinger, 1998). Therefore, it is essential that the model fitted for estimation purpose should satisfy the important tests of model adequacy. In this study, diagnostic checking for model adequacy is done by applying the model in Nepal's context; comparing the estimated IMRs for Nepal with the other estimates available to the country from different sources (e.g., Singh, M.L. 1979; CBS, 1987a, 1995; UNICEF, 2001); and by computing relevant tests for model adequacy described elsewhere. The comparison of the estimated IMRs for Nepal with the other estimates available to the country is presented by the following table and figure:

Table 2. Comparison of the Estimated IMRs for Nepal with the other Estimates

Estimates of the other sources			Present Study
Years	CDR	IMR	IMR*
1954[i]	36.70	255.00	276.05
1961[ii]	25.72	171.23	194.55
1976[iii]	22.20	134.00	168.33
1981[ii]	17.35	131.00	132.21
1991[iv]	13.30	97.00	102.02
1999[v]	10.00	75.00	77.48

Source: CBS (1987a, 1995); Singh, M.L. (1979); UNICEF (2001).

Notes:

i Refers to the estimates of Baidyanathan and Gaige (1973), PP. 278-290.

ii Refers to the estimates of Singh, M.L. (1979), P. 172.

iii Refers to the estimates of CBS (1987a), P. 99.

iv Refers to the estimates of CBS (1995), P. 96.

v Refers to the estimates of UNICEF (2001), P. 80

* Refers to the estimates of the present study.

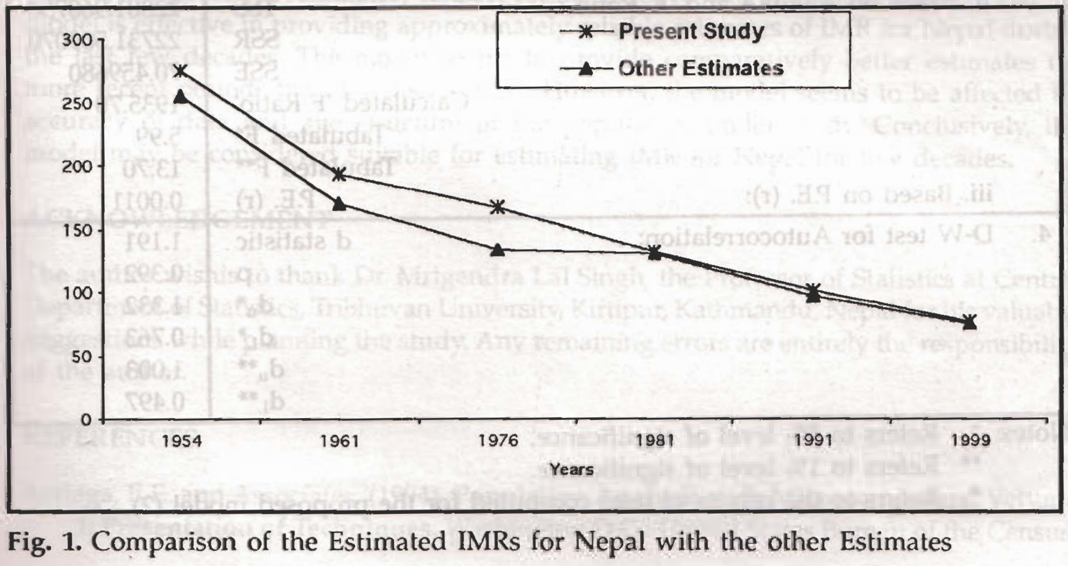

Fig. 1. Comparison of the Estimated IMRs for Nepal with the other Estimates

This figure clearly shows declining trends of IMRs over the periods as is usually expected. More importantly, it shows close agreement between the estimated IMRs and the other estimates available to the country from different sources over a wide range of periods. However, it also shows weak agreement between the estimated IMRs and other estimates especially, before 1981. This may be attributed to the limitations of data sources. In summary, the model seems to provide better estimates for more recent periods than the distant past. Diagnostic checking for model adequacy can also be done by computing major relevant tests described elsewhere.

The following table presents the results of major relevant tests computed for diagnostic checking for model adequacy:

Table 3. Tests Computed for Diagnostic Checking for Model Adequacy

Tests for Model Adequacy		Results@
1. Tests for Goodness of fit:		
i. Based on coefficient of determination:	R^2(%)	99.6900
	r	-0.9984
	n	8
2. S.E. of Estimates:	S.E. (Y⌈)	3.0188
	S.E. (a⌈)	4.4288
	S.E. (b⌈)	0.0817
3. Tests of significance:		
i. Based on 't' test:	For a⌈: |t|	205.843
	For b⌈: |t|	5808.738
	For r: |t|	43.249
	Tabulated t*	2.447
	Tabulated t**	1.943
ii. Based on ANOVA and 'F' Ratio :	TSS	22801.968750
	SSR	22731.509070
	SSE	70.459680
	Calculated 'F Ratio'	1935.70
	Tabulated F*	5.99
	Tabulated F**	13.70
iii. Based on P.E. (r):	P.E. (r)	0.0011
4. D-W test for Autocorrelation:	d statistic	1.191
	ρ	0.392
	d_u*	1.332
	d_L*	0.763
	d_u**	1.003
	d_L**	0.497

Notes: * Refers to 5% level of significance.
** Refers to 1% level of significance.
@ Refers to the results of tests computed for the proposed model (2).

The coefficient of determination (R^2) is computed for testing the goodness of fit. For the given set of data, the computed value of coefficient of determination R^2 (= 98.88%) is very high which indicates goodness of fit as 99.88% of the variation in IMR among the periods appears to be explained by the variation in the CDRs. Similarly, the smaller value of computed S.E. (Y⌈) [= 1.70] indicates the higher reliability of the model. The goodness of fit of a regression model is mostly affected by the estimated values of parameters. Similarly, the estimated parameters may be considered significant as they satisfied the 't' test. For instance, the parameter $\hat{b}$ may be considered significant as the calculated value of $|t|$ statistic for $\hat{b}$ is 103.358 which is greater than the tabulated values t^* (=1.306) and t^{**} (= 1.860) for $n - 2$ (= 8) degrees of freedom. This is also true for the other remaining parameters except for $\hat{a}$ at 5 percent level of significance. Another way to test the significance of the regression model is to compute the 'F' test. The calculated value of 'F ratio' (= 6060.69) is evidently greater than the tabulated values F^* (= 5.32) and F^{**} (= 11.30) for (1, 8) degrees of freedom and therefore, the regression model may be considered significant.

The presence of autocorrelation is a serious problem and therefore, D-W test is computed for detection of autocorrelation. The results of D-W test clearly show absence of autocorrelation in the residuals because the first order autocorrelation coefficient ρ (= 0.233) is very small, and the condition: $d_u < d < 4 - d_u$ is well satisfied. For instance, d_{u^*} (= 1.32) < d (= 1.44) < $4 - d_{u^*}$ (= 2.68); and $d_{u^{**}}$ (= 1.001) < d (= 1.44) < $4 - d_{u^{**}}$ (= 2.999) are satisfied.

CONCLUSIONS

The advantages of the indirect techniques in mortality estimation can not be over emphasized in developing countries like Nepal. The proposed model is very simple and easy to apply; does not need census or survey data and model life tables for estimation of IMR; and gives approximately reliable estimates for Nepal. The results indicate that the model is effective in providing approximately reliable estimates of IMR for Nepal during the last few decades. The model seems to provide comparatively better estimates for more recent periods than for distant past. However, the model seems to be affected by accuracy of data and age structure of the population under study. Conclusively, the model may be considered suitable for estimating IMR for Nepal for few decades.

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AN URBAN SKYLINE ANALYSIS OF NEW YORK AND HONG KONG - Impact of mixed-used mega urban waterfront development projects

*Bijaya K. Shrestha, Ph.D.**

ABSTRACT

Street network design dictating the urban fabrics and zoning and other regulations influencing building mass, bulk and height, window openings including control of sunlight, shadow, wind and view corridors define the skyline of a city. However, little work has been done so far towards the analysis of the skyline itself. This paper introduces a methodology for analysing skyline character and applies to the cases of New York and Hong Kong not only to identify the impact of ongoing mixed-used mega urban waterfront projects to the earlier skyline profiles but also to demonstrate its multiple uses.

STUDY OBJECTIVES AND METHODOLOGY

Structural change on urban waterfronts - front door, isolation from the city, deterioration and neglect and redevelopment- resulted due to mainly four factors (Sieber 1991): new means of communication and transportation including development of advanced maritime technology, enhancement of ecological value of water and conservation movement, deindustralisation and corporatisation, globalization of economy and international investment for restructuring the urban space (and the whole city), acting in different combination in different cities, is a recent phenomena taking place particularly in the advanced global cities such as New York and Hong Kong. The present ongoing mixed-used mega waterfront development projects on the reclaimed land namely Battery Park City (BPC) in New York and Central Wan Chai Reclamation Project (CWRP) in Hong Kong (Fig. 1), adjacent to the Central Business District (CBD) implemented under public-private partnership through intensive political and financial supports aim not only to fulfil the local needs of housing, commercial and entertainment facilities including open spaces (Cooper 1979, Maunsell 1993) but also to build a new built environment for the information society of the 21st century equipped with the advanced telecommunication system, a computer-literate workforce and new skyscraper of 'signature buildings', all to attract and retain the world-class financial actors.

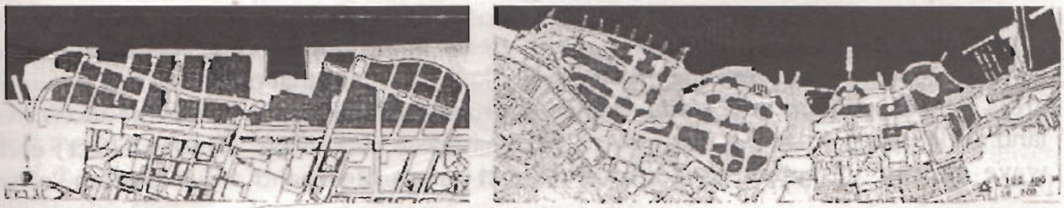

Fig. 1. (a) Battery Park City (New York) (b) Central Wan Chai Reclamation Project (Hong Kong)

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This whole (re)development process epitomises the 'conversion of industrial city into the landscape of consumption' in information oriented society; 'transition from managerial to entrepreneurial' forms of governance; 'construction of new urban imagery and new iconography for downtown'; and 'changing message of civic boosterism' which is the result of transformations of economic and political power as well as of 'rewriting' the social meaning of the city (Hubbard 1996, Paddison 1993, Short *et al.* 1993).

Tall buildings and their relationship with the other surrounding structures form image and symbolise the power of capital and hence play a crucial role in the formation of iconography of the city. However, studies of tall buildings are fewer and have focussed on the perception of the individual building, the effect of material, style and structural detailing and their function as landmarks rather than on the analysis of urban skyline formed by them. Moreover, most of the research works on city planning and urban design have been directed towards the experience of urban environment at street level rather than at skyline level. Within this context, this paper aims to introduce a methodology for urban skyline analysis and then to apply to urban skyline transformation of New York and Hong Kong which is the impact of mixed-used waterfront projects of Battery Park City and Central Wan Chai Reclamation Projects.[1] Its objectives are fourfolds. First, it reviews the land reclamation process and development control system in New York and Hong Kong, responsible for formation of urban skylines and then develops a theoretical base to analyse skyline character of a city based on 'gestalt law'. Second, it identifies the skyline character of New York and Hong Kong before and after the implementation of waterfront projects. Third, it compares and contrasts the old and new skylines in each case including cross national comparison to identify the level of impacts of the ongoing waterfront projects. Finally, it demonstrates the multiple uses of skyline analysis in the field of urban development.

URBAN SKYLINE – LAND RECLAMATION AND DEVELOPMENT CONTROL (ZONING)

Natural land constraints combined with high land value and difficulty in assembling significant amount of land near CBD have encouraged massive land reclamation from the sea in New York and Hong Kong (only 15.6% built up area and the rest inhabitable land) and shorelines in these coastal cities have been repetitively modified for port and other urban activities. However, differences in geographical location, cultural background and track of urban development coupled with different government policies have yielded different paths of waterfront transformation.

Extension of the existing 'grid iron pattern streets' and filling up of spaces between the earlier finger piers thus forming urban morphology similar to that of the existing previous areas is the general norm of land reclamation process in New York whereas the successive land reclamation in Hong Kong since 1800 has been producing 'layering effect'; each wave of land formation generated a distinct urban block and street pattern, often

1 The twin tower of the World Trade Centre located next to Battery Park City has been destroyed along with other buildings on 11th September 2001 in a terrorist attack, whereas the earlier proposed master plan of Central Wan Chai Reclamation has been modified due to public protest on huge land reclamation at Victoria harbour. Nonetheless, the date based on earlier development used in this paper to check the impact of mega waterfront projects on skyline character transformation is still significant and valid for academic purposes.

mismatching with the earlier fabrics demonstrating the socio-economic reality and political power of that time. Unlike the shorefront in New York which remained as a 'waste land' for many years (10-15 years) waterfront changes in Hong Kong is taking place on a systematic basis replacing the inner port areas by urban functions but shifting the port function to a new peripheral location thereby creating two new waterfront frontiers simultaneously.

The first zoning ordinance 1916 of New York aiming to separate the incompatible land use and to ensure minimum light, ventilation and air on the streets, combines the height, bulk and uses in one resolution requiring a building setback at a height equal to a multiple of the width of the street on which it fronted (2 or 2.5 for commercial district) and allowing to construct a tower of unlimited height covering a maximum 25% of the lot area (Weiss 1992). The 1961 zoning amendment replaced the height districts by a sky exposure plan, allowed 40% for the towering and introduced a new method for controlling density – the use of floor area ratio including 20% floor area bonus for providing a public plaza on a portion of its lot. The overall impact is the formation of distinct building typology produced by each piece of legislation – transforming earlier sleek, straight towers into the familiar pyramidal masses, ziggurats, or weeding cake and further into isolated buildings with plazas.

Despite numerous amendments of the town planning ordinance (first enacted in 1939) in 1955, 1959, 1969 (section 7 included), in 1974 (sections 16 & 17 included) and finally in 1991 including establishments of town planning unit in public works department in 1947, land use and development control in Hong Kong is mainly dictated by market forces due to government's 'lassez - faire policy. As the lease conditions often contain restrictions that specify site coverage, plot ratio, building height, and minimum floor area to be constructed- all help to calculate the potential of site development, private developers are willing to pay higher prices for the lands[2] due to 'certainty' of development (Stanley 1994). In many cases they can even modify the land use and other restrictions embedded in the lease condition after paying certain 'premium' on the land. Unlike New York where the skyline is the product of different legislations, Hong Kong's skyline is the result of dynamic market forces, often producing high rise structures along the water's edge.

THEORETICAL BASE

Basic elements

A skyline can be seen as 'figure ground' basis based on 'gestalt laws of visual organisation' with the lower portion as a 'figure' and sky as a 'ground'. The skyline analysis comprises of three basic elements - base of the building, tall building and the open sky - whereas the variables to be considered are number of tall buildings, detail contour of the buildings and their internal differentiation. As the maximum horizontal distance between the viewer and the object without losing the impression of the object is 70-110m (Lynch 1981, Gehl 1987), the skyline can be considered as a 'two dimensional pattern' for the sake of simplification though in reality one can see the depth of the buildings.

2 Almost all the lands in Hong Kong belong to the government and it is leased to private developers from time to time for a certain fixed period.

Variables

According to the 'law of proximity' elements that are closer together will be perceived as a coherent object. However, the distance between the objects should not exceed the size of the elements (Norberg-Schulz 1965). Thus all the tall buildings located closer form a group and can be taken as a single complex object which determines the sky contour. Since the base of the buildings is very complex and difficult to get the information on, it is simply defined by just projecting the line of the tall buildings downwards. Other variables such as the condition of the sky (bright or cloud), the texture and colour variations among the buildings and so on are not considered, as they are not so effective in skyline analysis. Finally, it has been suggested that generally a number 7±2 represents a bound or limit to perception as well as to short-term memory.

Selection of urban scene

Though both Battery Park City (BPC) and Central Wan Chai Reclamation Project (CWRP) are under implementation, some significant parts of the project have been completed in New York whereas few buildings are coming up in Hong Kong. The selected material of urban scenes of both the existing and new development in both cases for the skyline analysis consists of photographs taken on the site from prominent locations such as public parks, promenades and so on, postcards and photographs collected from tourist shops and drawings, model's photographs and sketches taken from the concerned offices and the published documents, as it is assumed that all these materials are prepared to capture the best urban scene. At least one or two samples from different locations are taken for each case both in longitudinal and transverse directions.

Terminology

Generally tall building within the range of 7±2 with two significant structures at both ends limits the urban scene for skyline analysis. As the bottom of the buildings is not significant, a datum line is drawn horizontally from the top of the lowest building within the range; one can not see any part of sky below this datum line (Fig. 2).

Picture area (P): Each photograph is demarcated into a 'picture area'. The profile of the skyline is determined by linking the top of the adjacent free standing buildings.

Tall building area (T): A tall building area is the surface area of the façade of a tall building bounded by its edges with the base along the datum line. The total tall building area is the sum of the tall building areas.

Void area (V): A void area is the patch of sky between the two adjacent tall buildings.

Base area (B): The total base area is the sum of the area of the low rise building mass between two tall buildings above the datum line. From the above it can be seen that the total base area (B) of the photograph is given by B = P-T-V.

SKYLINE ANALYSIS CALCULATION

Only few best photos are used for the analysis. Each photo is demarcated into picture area with skyline contour on the upper side and a datum line on the bottom, which forms different pockets of base, void and tall building areas (Fig. 2). Area for each pocket is calculated on a 'unit area' basis and added up at the end to find out the total value of T, V, and B and adding all these values gives the total picture area. Finally, ratio of total of each area with the picture area, i.e., T/P, V/P and B/P is calculated for each photo to get the 'unitless' figure, which is used to describe the character of skyline.

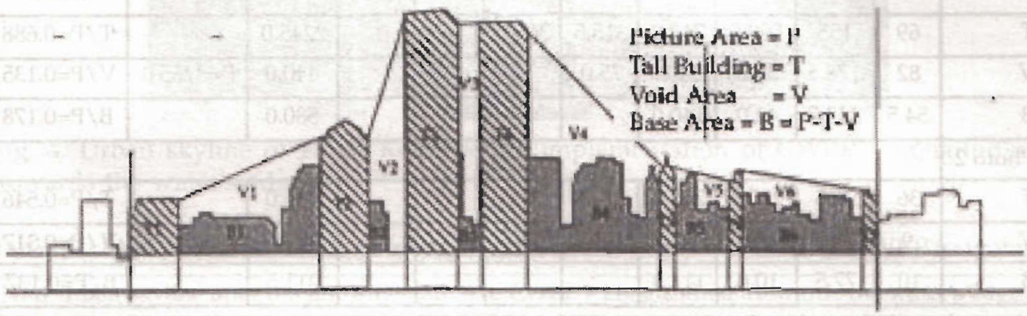


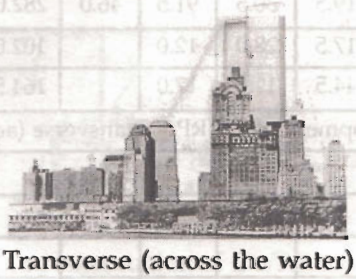
Fig. 2. Urban skyline analysis methodology

Urban skyline of New York

The skyline analysis is carried out first of the urban scenes of the existing city fabrics of New York (Table 1) and then after the implementation of the BPC both longitudinal (towards the water's edge) and transverse (across the water's edge) directions (Figure 3 & Table 2) using above mentioned method.

Table 1. Urban skyline analysis of New York (longitudinal and transverse directions)

Urban skyline before the development of BPC – Longitudinal (towards the water's edge)											
Photo 1	1	2	3	4	5	6	7	8	Total	Total P	Ratio
T	95.5	104.5	35.0	46.5	15.5	15.5	13.5	54.5	380.5		T/P=0.545
V	8.5	64.5	38.5	5.5	21.5	6.0	26.0		170.5	P=697.5	V/P=0.244
B	28.5	25.0	35.0	1	12.0	2.0	43.0		146.5		B/P=0.210
Urban skyline before the development of BPC – Transverse (across the water's edge)											
Photo 1	1	2	3	4	5	6	7	8	Total		Ratio
T	22.5	51	56	100.0	100.0	32.0	29.5	30.0	421.0		T/P=0.447
V	48.5	35	57.5	34.0	72.0	27.5	26.0		300.5	P=941.0	V/P=0.319
B	66	21	35	26.0	46	12.5	13.0		219.5		B/P=0.233



Transverse (across the water)

Fig. 3. Urban skyline of New York after implementation of BPC

Table 2. Urban skyline analysis of New York after implementation of BPC

New urban skyline after the implementation of BPC – Longitudinal (towards the water's edge)											
Photo 1	1	2	3	4	5	6			Total		Ratio
T	69	155	598.5	742.0	315.5	365.0			2245.0		T/P=0.688
V	82	178.5	50.5	54.0	75.0				440.0	P=3265.0	V/P=0.135
B	54.5	343.5	42.0	140.0					580.0		B/P=0.178
Photo 2											
T	36	92.5	280.0	296.0	140.0				844.0		T/P=0.546
V	9	106.5	26.5	348.5					490.5	P=1546.5	V/P=0.317
B	10	77.5	10.0	114.0					211.5		B/P=0.137
New urban skyline after the implementation of BPC – Transverse (across the water's edge)											
Photo 1	1	2	3	4	5	6	7	8	Total		Ratio
T	70.0	199.0	369.5	431.5	150.0	262.0	91.0	364.0	1937.0		T/P=0.638
V	48.0	244.0	30.0	25.5	31.5	31.0	38.5		448.5	P=3035.5	V/P=0.148
B	46.0	150.0	15.5	16.5	109.0	256.5	56.5		650.0		B/P=0.214
Photo 2											
T	37.5	95.0	174.0	182.0	69.0	19.5	17.5	24.5	619.0		T/P=0.486
V	70.5	76.0	67.5	67.0	20.5	26.5	18.5		346.5	P=1273.5	V/P=0.272
B	86.5	12.5	18.5	61.0	31.0	45.0	53.5		308.5		B/P=0.242

Urban skyline analysis of Hong Kong

Urban skyline for Hong Kong is also analysed as in the case of New York both in longitudinal and traverse directions before (Figure 4 & Table 3) and after the implementation of CWRP (Figure 5 & Table 4).

Table 3. Urban skyline analysis of Hong Kong (Central and Wan Chai districts)

Urban skyline before the development of CWRP-Longitudinal (towards the water's edge)											
Photo 1	1	2	3	4	5	6	7	8	Total		Ratio
T	17.5	46.0	31.0	19.5	30.5	91.5	46.0	282.0	421.0		T/P=0.514
V	22.0	6.5	16.0	17.5	28.0	12.0		102.0	300.5	P=548.5	V/P=0.186
B	2.0	15.0	75.0	44.5	11.0	17.0		164.5	219.5		B/P=0.30
Urban skyline before the development of CWRP – Transverse (across the water's edge)											
Photo 1											
T	95.0	29.5	19.5						144.0		T/P=0.454
V	68.0	36.5							104.5	P=317.0	V/P=0.330
B	29.5	39.0							68.5		B/P=0.216

Fig. 4. Urban skyline of Hong Kong before implementation of CWRP – Longitudinal (towards the water's edge)

Table 4. Urban skyline analysis of Hong Kong after the implementation of CWRP (ongoing)

New urban skyline after the implementation of CWRP - Longitudinal (towards the water's edge)							
Photo 1	1	2	3	4	Total		Ratio
T	131.0	28.0	56.0	75.5	290.5		T/P=0.197
V	115.5	133.0	435.5		684.0	P=1477.00	V/P=0.463
B	200.0	122.5	180.0		502.5		B/P=0.340
Photo 2							
T	28.5	72.0	169.0	77.0	346.5		T/P=0.215
V	109.0	451.0	298.0		858.0	P=1607.75	V/P=0.534
B	32.5	217.0	153.75		403.25		B/P=0.251
New urban skyline after the implementation of CWRP - Transverse (across the water's edge)							
Photo 1							
T	182.5	89.0	12.0	13.5	297.0		T/P=0.213
V	335.0	93.5	39.0		467.5	P=1393.0	V/P=0.336
B	448.5	140.5	39.5		628.5		B/P=0.451
Photo 2							
T	32.0	107.5	7.15		211.0		T/P=0.209
V	119.0	257.5			376.5	P=1007.5	V/P=0.374
B	122.5	297.5			420.5		B/P=0.417

Fig. 5. Urban skyline after the implementation of CWRP-longitudinal (towards the water's edge)

URBAN SKYLINES COMPARISON – NEW & OLD AS WELL AS CROSS NATIONAL COMPARISON

Comparative study of different ratios before and after the implementation of the waterfront projects in both cases provides crucial information on the impact of the waterfront projects on skyline transformation. In the case of New York, the bigger value of T with descending order of values of V and B (and their ratios with P) in longitudinal and transverse directions supports the fact that distinct tall buildings are clearly visible with voids between them; no matter if one sees the skyline either towards the water's edge or across it (Table 5). The grid iron pattern of street network also contributes to some extent for such character of skyline. New development of housing and office blocks of Battery Park City has minimum impact on the existing skyline character as the values of T, V and B and their ratios with P remain in descending order as in earlier case. In other words, the differences between the values of different ratio for both directions are very small indicating that the urban skyline character remains largely unchanged. Such skyline character can be linked into the land reclamation process, in which the existing street patterns are simply extended with formation of urban blocks of similar characters of the existing fabrics.

However, the case of Hong Kong is totally different (Table 6). First, the higher value of B (and B/P=0.300) compares to the void area in the analysis of the existing urban skyline (longitudinal direction) means existence of bulky building with little void area between the tall buildings along the water's edge. Second, the skyline character of Hong Kong looking in transverse direction resembles similar to that of New York, as the values of T, V and B and their ratios with P are in descending order indicating that tall buildings with clear voids between them are clearly visible. Third, the proposed new development of CWRP will have great impact on the character of earlier skylines in both directions. In the longitudinal direction along the water's edge, the higher values of void area and its ratio

Table 5. Comparison of skylines of new and old in New York

Comparison of existing and new skyline in New York							
Longitudinal (towards the water's edge)				Transverse (across the water's edge)			
Ratio	Existing	New	Difference	Ratio	Existing	New	Difference
T/P	0.545	0.617	0.072	T/P	0.447	0.562	0.115
V/P	0.244	0.226	0.018	V/P	0.319	0.210	-0.109
B/P	0.210	0.157	0.053	B/P	0.233	0.228	-0.005

Table 6. Comparison of skylines of new and old in Hong Kong

Comparison of existing and new skyline in Hong Kong							
Longitudinal (towards the water's edge)				Transverse (across the water's edge)			
Ratio	Existing	New	Difference	Ratio	Existing	New	Difference
T/P	0.514	0.206	-0.308	T/P	0.454	0.211	-0.243
V/P	0.186	0.498	0.312	V/P	0.330	0.355	0.025
B/P	0.300	0.295	-0.005	B/P	0.216	0.434	0.218

with P (V/P=0.498) with smaller value of tall building area (T/P=0.206) after the implementation of CWRP reveal that there will be few tall buildings with greater voids between them filled up by masses of bulky buildings. The higher value of difference between the values of T/P before and after the implementation of the waterfront project means dramatic change in skyline character. Similarly, while looking across the water's edge, one can see bulky buildings with minimum tall building area. Such skyline character is partly contributed by the proposal of massive buildings on the reclaimed land covering the whole street blocks but blocking the water's view from the existing street networks.

From the cross national comparison, it can be stated that the urban skyline character in New York and Hong Kong before the implementation of waterfront projects is comparable as in both cases the values of T, V and B and their ratios with P are in descending orders indicating that the tall buildings are clearly visible with sufficient void areas in between for both directions. However, the mega urban waterfront project of Hong Kong will definitely transform the earlier skyline character dramatically reversing the case. In new skyline of Hong Kong, the effect of tall building will be the least visible dominating the skyline with masses of bulky buildings.

CONCLUSIONS AND MULTIPLE USES OF SKYLINE ANALYSIS

Land reclamation process and development control such as zoning (and other legislations) influencing building bulk and height, building material selection, window openings and their organisation including control of sunlight, shadow, wind and view corridors has a crucial role in skyline formation. However, the study on skyline analysis itself is lacking. This paper of urban skyline analysis method with demonstration in the cases of New York and Hong Kong reduces the wide research gap. Moreover, this method has multiple uses:

(a) Morphological analysis and study of pedestrian activity checks the integration of urban fabrics and street level activity between the new urban development areas and the existing surrounding areas whereas the skyline analysis contributes new evidence by assessing the integration at sky level.

(b) This method helps both private developers applying for 'request for proposal' or 'bidding for a project' as well as municipal architects or urban designers while issuing building permit and planning permission.

(c) It helps to define the unique character of the city thereby strengthening the image of the city and the power of capital landscape.

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KINEMATICAL APPROACH IN SLOPE STABILITY ANALYSIS

*Kishor Kumar Bhattarai**

ABSTRACT

This paper is brief review of Kinematical approach in Slope Stability analysis. Large dilation as predicted by perfect plasticity associated with associated flow rule condition is centre of dispute in application of this method. But nevertheless this method gives solution comparable to any other methods of slope stability analysis.

1. INTRODUCTION

Stability analysis history dates back to 1773 when Coulomb first solved the stability problem of the vertical cuts. Owing to the works by Prandtl in plasticity and Fellenius in the method of slices much progress in this domain was achieved in the 1920s. In 1937, Taylor used the logarithmic spiral method to determine the stability of earth slopes. The development of stability analysis and the theory of limit analysis were accelerated from 1950s because of complete establishment of plasticity theory and the later advent of computers. Different methods, limit equilibrium method, limit analysis method, slip line method, finite element method, rigid finite element method to name few, have come up each claiming advantage over the others. Some methods incorporate ideas from others to solve the problem in a different way. The application of the variational calculus in soil mechanics has made it possible to combine the upper-bound limit analysis method with the conventional limit equilibrium method and to lead to the development of a realistic and practical method for the solution of class of stability problems in non-linear soil mechanics.

Limit equilibrium methods with slice technique (Bishops method, Janbu's method, Morgestan and price method, Ordinary slice method, Lowe and Karafiaths method etc.) are most widely used methods of slope stability analysis. But they do not satisfy the overall equilibrium conditions; consequently several assumptions regarding the inter-slice forces must be made for the problem to be solvable. There are 5n-2 number of unknowns (forces and locations) and 3n numbers of equations available to solve these unknowns (n is the number of slices). Location of side forces and normal forces on slip line is actually unknown. If the problem is to become statically determinate, exactly 2n-2 assumptions must be made. All limit equilibrium slope stability analysis procedures based on the method of slice require assumptions regarding the forces

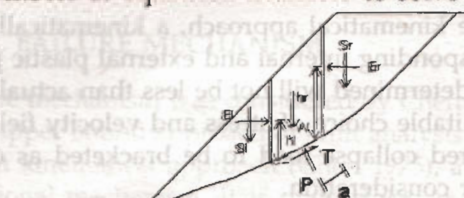

Fig. 1. Forces acting on Slice

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between slices. The assumption made about the side forces is one of the main characteristics that distinguishes one limit equilibrium method from another, and is itself an entirely artificial distinction. Generally the effect of the side force assumptions is small provided that static equilibrium of both forces and moments is satisfied; variations of no more than about 5% in the factor of safety are typically expected when the static equilibrium is fully satisfied (Fredlund and Krahn 1977; Duncan and Wright 1980). As reported by Zornberg *et al.* based on their model test the ordinary method of slices (Fellenius 1936) which only satisfies moment equilibrium, underestimates the factor of safety by almost 20%. Similarly Lowe and Karafiaths method, which satisfies both horizontal and vertical force equilibrium but does not satisfy moment equilibrium, overpredicts the factor of safety by nearly more than 10%. The "simplified Janbu" procedure, which satisfies only force equilibrium (Janbu's method satisfies all equilibrium conditions except for the moment equilibrium of one slice) often gives factor of safety that are significantly less than those calculated by Spencers procedure. (Gilbert *et al.* 1998). The Morgenstern and Price procedure is more flexible than Spencer's procedure concerning side force assumptions. Except Finite element method all other methods need initial assumption regarding shape of the probable slip surface (For Bishops's and Fellenius' method it is cylindrical while for Janbu's (1957), Morgenstern & Price (1965) and Spencer (1967) it can be either circular or non-circular).

The value of safety factor computed thereby will, of course, depend on the reasonableness of the assumptions that have been made. Perhaps the most striking feature of this approach i.e. slice technique, is that no matter how complex the geometry of a problem or loading condition is, it is always possible to obtain some approximate but realistic solution.

2. LIMIT ANALYSIS AND KINEMATICAL APPROACH

Limit analysis is based on plasticity theory which is a general theory of mechanics. In limit analysis the general procedure is to assume a kinematically admissible failure mechanism or statically admissible stress field and then to optimize the objective function with respect to a very limited number of variable parameters. There are two approaches: static and kinematics. Static approach gives lower bound (load) while kinematics approach gives upper bound.

In the static approach, we determine whether there exists an equilibrium stress field, which is in equilibrium with the applied load and with which the plastic yield condition is nowhere violated in the structure. If such a stress field exists, it can be ascertained that the applied load is less than the limit load and no plastic failure occurs. This gives lower bound solution.

In the kinematical approach, a kinematically admissible velocity field is searched; and corresponding internal and external plastic power dissipations are calculated. The loads thus determined will not be less than actual collapse load thus giving the upper bound. By suitable choice of stress and velocity fields, the above two theorems thus enable the required collapse load to be bracketed as closely as seems necessary for the problem under consideration.

In limit analysis, it is necessary to assume soil as a material exhibiting perfectly plastic behavior which is not true in the real sense. Actually soil demonstrates work or strain softening or hardening nature. The choice of the level of the constant stress is not an absolute one, but is determined by the most significant features of the problem to be solved. So the first obstacle for proper utilization of limit analysis method is selection of appropriate average stress level for this idealized perfectly plastic region. Secondly, the required limit analysis assumption on normality condition leads to a much too larger dilation for frictional (ϕ=0) soils during plastic flow than can be explained experimentally. The normality assumption is therefore the center of dispute on the validity of limit analysis in application to cohesionless soils.

While in conventional limit equilibrium methods stress strain relations of soil is neglected, it is taken into consideration in an idealized manner termed as normality or flow rule in limit analysis method. In limit analysis, the objective is generally to determine the collapse load, whereas the factor of safety is calculated in methods of slices. In the limit analysis method there is no theoretical restriction that the assumed stress field or velocity field need have some similarity to the actual state, although generally speaking, the closer the assumed state is to the actual state, the more realistic the resulting answer will be (Chen & Liu, 1992).

3. KINEMATICAL APPROACH OF SLOPE STABILITY ANALYSIS

The calculation is based on the kinematic theorem of limit analysis. This theorem states that *the rate of work done by traction and body forces is less than or equal to the rate of energy dissipation in any kinematically admissible failure mechanism.*

$$\int_v \sigma_{ij}^*(\in_{ij}^*)dv \geq \int_{sv} T_iV_ids_v + \int_{si} T_iV_idst + \int_v X_iV_i^*dv \quad \text{............................ (1)}$$

Where $\in_{ij}^*$ is the strain rate in a kinematically admissible velocity field, σ_{ij}^* is the stress tensor associated with $\in_{ij}^*$, velocity $v^*_i = v_i$ on boundary S (given Kinematical boundary condition), X_i is the vector of body forces (unit weight and the distributed quasi static intertial force), S and v are the loaded boundary and the volume, respectively.

In kinematical approach of limit analysis it is assumed that soil obeys the flow rule associated with the Mohr-Coulomb yield condition. In simple words velocity jump vector along discontinuity surface makes angle ϕ with slip surface. Analysis can be done for slip surface of any shape provided the velocity field is kinematically admissible. In slice technique soil mass is divided into blocks and it is assumed that the energy is dissipated not only along the failure surface but also within the sliding mass, i.e. along the vertical interfaces.

4. ROTATIONAL AND TRANSLATIONAL FAILURE MECHANISM

Stability of slopes based on a rotational failure mechanism was considered by Chen *et al.* (1969) and Chen and Giger (1971) using the upper bound approach of limit analysis. The rotational mechanism is the most efficient in kinematical approach (Chen 1975), and it leads to lower critical heights than translational mechanism. It is often stated that an analysis based on the rotational mechanism has two disadvantages: it becomes cumbersome when the soil is non-homogeneous, and no influence of the pore pressure is included (although an attempt for a specific case is presented by Miller and Hamilton, 1989).

Upper bound approach states that rate of work done by external forces (surface traction and material weight) is less than or equal to the rate of energy dissipation in any kinematically admissible velocity field. The issue of the kinematical admissibility of the failure patterns selected here is not even raised in slice method, as slice methods do not make use of the stress strain rate relation.

The analysis based on the translational mechanism always satisfies the equations of equilibrium of forces. And as the failure mechanism does not include rotation, couples do no work during the failure process; consequently, moments become irrelevant in the analysis. In this sense the result is equivalent to one that could be obtained from a limit equilibrium approach.

The rate of energy dissipation per unit area in the case of material obeying Mohr-Coulomb yield criterion and flow rule (associative flow rule) is given by

$$d = \sigma_{ij} n_j [V]_i = c[V]\cos\phi \qquad \text{.............................. (2)}$$

Where n_j is the unit vector perpendicular to the rupture surface, $[V]_i$ is the velocity jump vector and $[V]$ is its magnitude.

And the rate of work done by external forces and body forces are given by right hand side of the equation 1. Equating rate of energy dissipation with work done (by internal and external forces) will lead to a solution where equilibrium of forces are satisfied.

5. KINEMATICAL APPROACH AND SLICE TECHNIQUE

Kinematical approach of stability analysis can be coupled with general slice technique of slope stability analysis also. One of the main advantage of this approach is there is no need for any kind of extra assumption to solve the problem. Of course there are some implicit assumptions associated with Mohr-Coloumb failure criteria, plasticity theory and flow rules.

In figure 2 and 3 below V and [V] are velocity jump across slip surface and vertical sides of each slice. As shown in the figure these velocity jumps makes angle ϕ with slip surface.

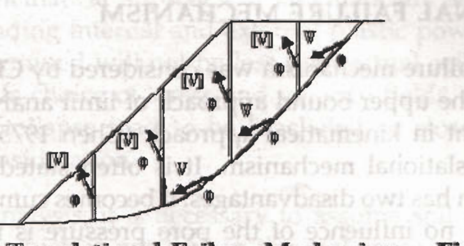

Fig. 2. Translational Failure Mechanism

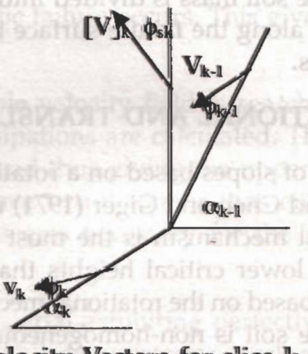

Fig. 3. Velocity Vectors for slice k-1 and k

In this mechanism energy is dissipated along the failure line and also within the sliding mass, along the vertical interfaces. The velocity of the first block is $V_1=V_0/\sin(\alpha_1-\phi_1)$, where V_0 is the vertical component of the velocity of the first block (boundary condition). The respective velocities of other blocks V_K and the interfacial velocity jumps are given by

$$V_k = V_{k-1}\frac{\cos(\alpha_{k-1}-\phi_{k-1}-\phi_{sk})}{\cos(\phi_k+\phi_{sk}-\alpha_k)}$$

$$[V]_k = V_k\frac{\sin(\phi_k-\phi_{k-1}-\alpha_k+\alpha_{k-1})}{\cos(\alpha_{k-1}-\phi_{k-1}-\phi_{sk})} \qquad \text{.............................. (3)}$$

For the mechanism shown above the rate of energy dissipation is

$$\dot{d} = \sum_{i=1}^{n} l*c*V\cos\phi + \sum_{i=1}^{n} l_k *c*[V]\cos\phi \qquad \text{.............................. (4)}$$

and the rate of work done is

$$\dot{W} = \sum_{i=1}^{n}(W+Q)*V\sin(\alpha-\phi) \qquad \text{.............................. (5)}$$

Equating Rate of Work done with rate of energy dissipation and defining factor of safety as

$$F = \frac{c}{c_d} = \frac{\tan\phi}{\tan\phi_d} \qquad \text{.............................. (6)}$$

will give the factor of safety of the shown failure mechanism as

$$F = \frac{\sum_{i=1}^{n} C*l_k*V_k\cos\phi_{dk} + \sum_{i=1}^{n}\overline{C}*t_k*[V]_k*\cos\phi_{dk}^{*}}{\sum_{i=1}^{n}(W+Q)*V_k*\sin(\alpha-\phi_{dk})} \qquad \text{.............................. (7)}$$

where W = weight of the slice, t = ht. of vertical interface of slice, $\overline{c}$ = c value of vertical interface, Q is superimposed load, ϕ_d and $\phi^*_d = \tan^{-1}(\tan\phi/F)$ for slip surface and vertical section respectively. While calculating velocity also we have to replace ϕ by ϕ_d and ϕ^*_d in equation 3.

Hence the stability problem can be solved without any assumptions regarding side forces. When energy loss in vertical interfaces are neglected the solution thus obtained will be identical to the solution obtained from limit equilibrium method.

In Fig. 4 and Fig. 5 critical slip surface obtained by Janbus simplified method and limit analysis log –spiral method are plotted along with those by kinematical approach combined with slice techniques.

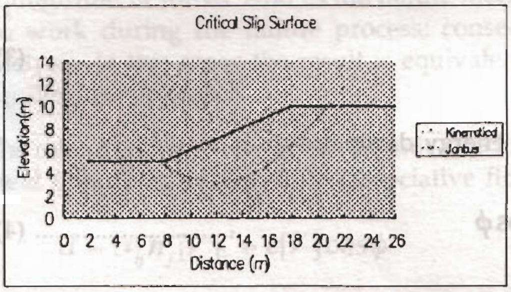

Fig. 4. Critical slip surface by Janbus Simplified method and Kinematical Approach

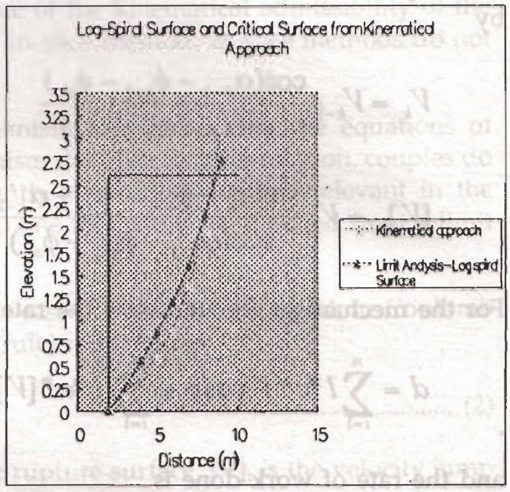

Fig. 5. Critical Surface Log-Spiral and Kinematical Approach

CONCLUSION

For slope stability analysis Kinematical approach is very useful and comparatively easy method with no assumptions involved. This method can be easily extended to solve the various kinds of slope stabilizing methods. But method is still not complete in a sense that it is restricted till now to homogenous soil mass.

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TECHNICAL AUDIT AND APPROACH TO VALUE ENGINEERING

*Bharat Sharma**

In a nutshell the sole objective of Technical Audit exclusively in the public sector is to verify whether products of acceptable value and quality are achieved within the stipulated time in return for HMGN expenditure on design, planning or construction project.

In Nepal, to start with, the proposed technical audit is confined to "infrastructure projects" carried out by the Ministry of Physical Planning and Works of His Majesty's Government (HMGN), the main reason being that huge amounts of money is spent in the area.

When audited the infrastructure projects could be in one of the following distinct stages:

i) Planning and design stage

ii) Procurement stage

iii) Implementation stage

iv) Post implementation stage

In the context of value engineering technical audit is obviously just a tool for scrutinizing projects at a particular stage and particular time.

Recently, with the help of IBRD, Nepal is trying to initiate technical audit in the context of value engineering. The main objective of the IBRD project is the development of technical audit capacity of HMGN. The basic role of this proposed technical audit is to prescribe a technical audit system and recommend the introduction of a systematic, independent and well documented process for obtaining "Evidence" and evaluating them very objectively to ascertain the extent to which "Expectations" are fulfilled. For this the main guiding principal criteria are:

a. Quality

b. Value

c. Time

Quality incorporates the ability of a set of inherent features to fulfill the expectations of "target users". While value is "worth" of the project in the context of benefit as opposed to costs. Hence value has cost effectiveness element in it, which is "proper balance between functionality and lifecycle cost".

Time is yet another crucial criterion. It has to be scrutinized in the context of the project's schedule. Hence for each technical audit it is pertinent to establish the status of the followings:

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a. Project's Budget
b. Quality of Works
c. Value of Works
d. Project's Schedule.

Value, cost overrun and time-overrun have to be well monitored and assessed.

As of now the existing HMGN Financial Administration Regulations, Public Works Directives, pertinent contract documents and guidelines of funding agencies provide the basis for the proposed audit.

The recently prepared "Public Works Directives" are intended to strengthen project implementation practices which in the Nepalese experience generally are not technically consistent and systematic. In fact these directives will help to establish the followings:

i. Procedural requirements
ii. Decision making process
iii. Legal process
iv. Project prerequisites
v. Procurement process

These will complement the technical audit process. Hence compliance to public works directive will be checked during the audit. These directives would provide terms of reference against which government projects can be audited technically.

The prime objective of technical audit is to compare and contrast the conditions found during audit with those expected to be found prior to carrying out the audit. Thus the expectations have to be compared with "evidences".

BRIEF BACKGROUND IN NEPALESE CONTEXT

In retrospect the first recorded suggestion about "quality and value" audit dates to the 1970s. There was concern for quality of construction work and it was felt that appropriate value was hardly achieved for money spent. The report of the Administrative Reform Commission further validated this shortcoming. As a consequence the Asian Development Bank funded technical assistance for organization and management improvement.

A Quality Branch was established to carry out technical audit with specific role of "quality assurance and inspection section".

Further, the dire need for office of Chief Technical Examination was felt to do technical audit specifically and professionally. Prior to this the Auditor General's office used to carry out mainly financial and sometimes performance audit which in effect was audit for money spent only and not so much on technical aspects.

The vital and distinct phases of the project such as planning/design, procurement, implementation and post implementation, hardly got specific scrutiny.

INFRASTRUCTURES & NEED OF TECHNICAL AUDIT

It would be pertinent to point out that technical audit for infrastructure projects has to be conducted by a third party for it to be impartial.

Nepal spends huge amount of money annually on infrastructure development, with very limited concern for meticulous package of well deliberated phases of project consisting of design/planning phase, procurement phase, implementation phase and post implementation phase.

Each phase merits serious and factional inputs. Very often all the above mentioned phases are taken lightly with the consequence of loss of cost effectiveness, time overrun, cost overrun and definite set back for value engineering. Invariably there is alarming gap between "Expectations" and "Evidences". The monitoring tool and mechanism is very often weak. The effective tool of the S-Curve which is a control device to interrelate (a) planned expenditure (b) actual expenditure and the (c) earned value is hardly maintained. Very often there is misleading picture of the actual progress of the project. The project often experiences budget and time overruns.

To control all of the above and to run the project on system analysis basis to meet the goal of cost effectiveness, technical audit is a MUST and the need of the hour in Nepal.

All the prerequisites of the project have to be well worked out to eliminate any technical, legal or financial flaws. Complacency in any phase means flaws, which should be totally avoided. Technical audit is very effective in monitoring and checking these flaws.

Technical audit follows a set of format for collecting "Evidences" (what was actually, found) and "Expectations" (what was expected) through meticulously drawn "Criteria" and "Questionnaire". Audit tools for (i) Time control (ii) Cost control and (iii) Quality Control are used to safeguard the goals of the project.

The audit of infrastructures should be carried out both generically and sector specifically to cover all the aspects in a holistic way. Although ISO 9000 has fixed a definite procedure, it is more related to the manufacturing sector. In our context it should be concentrated on the followings:

(i) Use of public works directives (PWD)
(ii) Cost effectiveness and efficiencies
(iii) Quality (value for money)
(iv) Cost and earned value analysis
(v) Time and earned value analysis

While PWD deal with organizational directives, procedural directives and bidding documents, others take care of "Value Engineering aspects". Thus the audit becomes comprehensive and fruitful. It helps to establish standard professional practice with elements of ethics too. Very clear cut terms of reference (TOR) and accountability of concerned persons are established in the process.

CONCLUDING REMARKS

Though work is in progress to establish the office of the Chief Technical Examiner (CTE) with autonomy and specific statutory provision, there seems to be quite a way to be covered. Until and unless the office of CTE is legally established with necessary latitudes, technical audit could not be made mandatory and is likely to become questionable. The institutional provision has to be categorically cleared so that CTE could smoothly function without any hurdle. Perhaps a separate constitutional institution like the Office of the Auditor General could serve the purpose better. It is paramount to establish a system with correct procedure, as institutionalization is essential.

As very strong stakeholders, Nepal Engineer's Association and Council of Engineers (NEA) could play very effective roles to usher in "Value Engineering dimension" for the interest of the profession and the country. It is no secret that in the social context the image of the engineering profession in project implementation is somewhat questionable. Hence to reinforce professional ethics and to enhance the image of the engineering profession it may be imperative to create a transparent situation which will serve the nation and society better. It is a soul-searching exercise too.

LMTD - A CONCEPT OF TEAM BUILDING

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ABSTRACT

Nowadays, start up and closure of many organizations is almost an everyday event. No organization is free from problems and internal conflicts. The success of an organization depends upon its proper regulation, operation and management of men, money, materials and machines respectively. There is not a single formula, which can be used to run an organization successfully. Various models and techniques have been worked out and tried to run the organization smoothly to achieve its targets. In this paper, a simple model called an LMTD- a concept of team building has been described wherein like-minded people cooperate to work jointly to achieve common objectives. It is expected that the model will be helpful in resolving many inherent problems of an organization and help to run it smoothly to achieve its goals.

1. INTRODUCTION

No organization is free from problems, be it small or big. When one problem ends, it is very likely that another will crop up. The magnitude of the problem depends upon the size of the organization. As the organization becomes bigger and bigger so does the dimension of the problems. If the growing problems are not checked and solved in a timely manner, it will affect the organization very badly. However, the main problem is related with managing man in any organization. This is because the nature and attitude of human beings are very difficult to forecast correctly. Studies have shown that most common way of getting rid of problem is building a team. The team will function efficiently if it is formed of like minded, like thinking and like doing people (LMTD).

2. CLASSICAL TEAM BUILDING STEPS

Classical Team building is viewed as a natural sequence that can be divided into five stages (FSNPA) as follow:

1. Forming
2. Storming
3. Norming
4. Performing
5. Adjourning

1. *Forming*: In this case the manager and the group focus more on tasks than on teamwork. They organize the team's structure, set goals, clarify values and develop an overall vision of the team's purpose.

2. *Storming*: This stage is less structured than the first stage. The focus is given on accomplishing tasks and building relationships. Social needs of the group are given more important. The emphasis is given to interpersonal interactions, active listening, assertiveness, conflict management, flexibility, creativity, and kaleidoscopic thinking.

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3. *Norming*: In this stage, the process is more relationship-based than task oriented. Recognition and esteem of group members are given more importance. The manager relies on communication, feedback, affirmation, playfulness, humor, entrepreneurship, and networking of the team. Group members achieve a feeling of involvement and support.
4. *Performing*: At this stage, the team operates on its own. As the team members are motivated by achievement and self-actualization, management style is neither task nor relationship-oriented. Manager's role is to serve as mentor/coach to take a long-range view of the needs.
5. *Adjourning*: In this stage, management is concerned with low task and high relationship. The manager focuses on evaluation, reviewing and closure. Team members continue to have the feeling of achievement and self-actualization.

Some of the concrete examples, which transfer group into team, are as follows:

- Set a Good Example: The manager who trusts the subordinates and delegates authority to carry out the task and expects others to emulate that style. Open give ands take approach fosters similar behavior in the team. The team member's best behavior is called to the forefront.
- Coach team Members: Coaching requires schooling. Each individual reacts differently to standardized "shotgun" approach. Hence, "different-stroke-for different folks" philosophy is applied. Coaching session can be as simple as a chat with subordinate who made a mistake about why something happened and what can be done to avoid it from reoccurring. It can be tailored-made approach. Or it can be formal appraisal session type.
- Train team members: It can be in the form of lectures, round-table discussions, and seminars or workshops. Lectures are large amount of information put in a short time frame. Round-table discussion is open forum debates on pertinent subjects. They give the participants a chance to air their views and present their opinions and ideas frankly. In Seminar/workshops information is dispensed in smaller doses interspersed with group discussions and debates.
- **Effective Interpersonal relations: key to successful Teamwork**

  Teamwork depends heavily on the interpersonal skills of all the members. For effective interpersonal relations, skills needed by the members are: listening, technique to deal with interpersonal conflicts, negotiating and influencing.
- Listening: Communication. No matter how clear and concise the message, it is wasted unless some one listens actively. Here is the attitude that represents good listening:

  "I am interested in what you are saying and want to understand, although I may not agree to everything you say. You are important as a person and I respect you and what you have to say. I am sure your message is worth listening to, so I am giving you my full attention".

A good listener requires to focus on both the communicators content and feeling and then to extract the essential message being conveyed.

❖ Dealing with Interpersonal Conflict:

It is an inevitable part of team dynamics. There are five ways of dealing with interpersonal conflict namely;

(i) *Withdrawing*: Use this when you can't win, the stakes are low, to gain time, to preserve reputation or when you win by delay.

(ii) *Smoothing*: Use this to reach over-arching, to create an obligation for trade-off, to maintain harmony or to create goodwill.

(iii) *Bargaining*: Use this when "win-win" situation occurs for the both parties, when others are as strong as you are, when you are not sure you are right or when you get nothing if you do not make a deal.

(iv) *Collaborating*: Use this when you both get at least what you want and may be more, to create a common power base, when knowledge and skills are complementary, or when there is trust.

(v) *Forcing*: Use this when "do or die" situation exists, when important principles are at stake, when you are stronger (*never start a battle you can't win*), to gain status or power or when relationship is unimportant.

❖ *Negotiating*: Team members will deal with third party and in-house situations that will require major negotiation skills. The notion is to invent options for mutual gain calling for a creative search for best alternatives.

❖ *Influencing*: This is the ability of members to influence one another for the good of the common cause. This includes the following principles;

➢ play to the benefit,
➢ stay clear of Machiavelli (avoid manipulation)
➢ go beyond I think, I can,
➢ put an umbrella over your moves,
➢ tune into what others say,
➢ size up your plans for congruency,
➢ remember different strokes for different folks, and
➢ watch your language

2. BACKGROUND

The idea of LMTD came to my mind when I found one of my colleagues named Yogesh and two of his friends who have been regularly publishing a small magazine called Pasuka since the last 5 years. I observed, it was their commitment and notion of LMTD which kept the said activity going. I explained this happening to two of my friends named Bhulai and Shivnarayan in terms of LMTD. They were very much impressed and asked me to prepare a write up about the same. Nearly two months later, this is a small attempt in that direction. Literally, LMTD means Like Minded, Like Thinking and Like Doing. In totality, this is much more than that. This includes all kinds of people doing work that calls for joint activity with whole-hearted effort. It is, in fact, never possible to get all kinds of people to agree on all sorts of thinking and doing. However, three is always a point where they can have exactly the same thinking and doing for a particular business or work. And this could be the starting point for a joint business or activity. This is nothing but a team building of the like minded people having like thinking and like doing who would hesitate to put his/her prestige on the line if the work was not performed as intended for the benefit of the organization. In this case, the productivity is increased through synergy: the magic that appears when team members generate new ways to get things done and that special spirit to make them happen.

3. BENEFITS OF LMTD-TEAM BUILDING

Team building through the LMTD model offers a number of benefits as follows:

- *Success is enhanced*: Helps members to excel in what is being done and boosts the chances of "Winning".
- *Promotes Creativity*: Stimulates innovation and finds new approaches to problems
- *Builds Synergy*: Mathematical absurdity "3+3=7" becomes possible
- *Promotes Trade-offs and solves problems*: Creates problem solving atmosphere and facilitates decisions to be taken on schedule, cost and performance.
- *Fun*: Creates spirit to think and work together, reduces tension and conflicts
- *Suitable for Large and small organization*
- *Responds to challenges to change*

4. PITFALLS TO WATCH OUT FOR

There are certain pitfalls to this model. They are:

- Negative Synergy: When the work is not performed according to the LMTD model, the synergy becomes negative. The equation becomes "a+a = 2a+k", where k is a synergy constant greater than unity with negative sign
- Excessive Independence: Ill-guided or poorly formed LMTD team wanders off track and start doing things which obstruct efforts to meet the overall goals
- Time is needed: If the organization culture is not properly imbibed, a lot of time is needed to create the team spirit
- Slow Decision: Getting group consensus is a time consuming task. Also depends on the size of the group.

5. LMTD-UMBRELLA TO HELP TEAM BUILDING PROCESS

The process of team building can be accelerated using the following steps under the umbrella of LMTD as follows:

☞ Identify what factor(s) drive your team

☞ Get your own act together: polish your skills and show your teamwork talents

☞ Understand the game: each business game is different and rules need to be rethought

☞ Evaluate the competition of the real market

☞ Pick up players and adjust your team: choose qualified players and make sure players are in the right spots

☞ Identify and develop inner group leaders: delegating, mentoring and coaching must be part and parcel

- Get the team in shape: for this start with active listening, communicating and negotiating
- Motivate players: discover what individuals need and relate those desires
- Develop plans: members must be involved in the planning process so that they can say with conviction, "This is our plan".
- Control, evaluate and improve

6. CARE-SHARE AND DARE- A LEVER ARM OF LMTD

No organization is free from problems whether it is started by an individual or by a group of people. No matter how old it is, how it started or ran, irrespective of size or market position it will always have some problems. These problems may be due to internal management, internal conflict, or external market competition. To cope with the problems, it is necessary that the owner(s) of organization should have the feeling of CARE, SHARE and DARE and exercise them in reality.

(a) CARE: Organization is like an offspring, as one cares for his/her offsprings and nurtures them to his/her best ability. The organization requires similar Care and direct involvement. This Care and involvement generate the culture of nurture and feeling of ownership. And once the sense of ownership and culture of nurture are developed, a sense of commitment and environment of continuity are generated for the well being of the organization. So long as there are sincere and honest caretakers, the organization will run smoothly in a competitive way.

(b) SHARE: An organization runs best due to improved management skills, communication and interpersonal skills of stake holder(s), manager and workers. It is to be noted that the problems grow bigger and bigger as the size of the organization becomes larger and larger. In this case, more and more sharing of ideas and opinions is demanded for the smooth operation of the organization. Both horizontal and vertical communication should be well balanced to run the organization smoothly. For larger organizations, vertical communications require more attention than the horizontal ones. The sharing of ideas and wisdom of people in a team planning and management stimulates innovation and encourages new approaches to problems. Additionally, it is essential to share responsibility, work load, money and time, if one of the partners slacks down or quits the organization. To build up synergy, it is very necessary to share the ideas, opinions, skills, capability and wisdom of all concerned. For example, the success of the Japanese management style (KIZEN) stresses the involvement of employees in all phases of the work.

(c) DARE: This goes much more beyond the CARE and SHARE to contribute to the organization. DARE in this case, means to provide the organization more than the capacity of the individual in terms of wealth, knowledge, skill, idea and time. Strictly speaking, managing organization means managing men, money, and materials and machines respectively. Of these, managing men has always been the hard nut to crack. This is because the human behavior can not be predicted accurately. In many organizations, especially in developing countries like ours, the entry of persons without defined role and task (RaT) in many cases is unavoidable.

DARE to deal against anti-RaT people

People without RaT usually become members of an organization because either an agreement is made between the two institutes or the parent (main) organization sends such persons or if an influential authority or partner forces to employ them. Such people will unnecessarily visit other staff in the office only to pass their idle time and consume the productive time of other people having RaT. These people, to exhibit their existence in the organization, will unnecessarily trouble the subordinates. They also unnecessarily occupy the facilities/services of the organization. Furthermore, such people will become the permanent source of problems for the organization. Organization will have not only difficulty in managing them but also in removing them. The real DARING, will require guts to avoid the entry of such persons and handle them judiciously. Thus, the DARING will create the most ideal environment and situation for any organization to meet all kinds of challenges in days to come. It will further create synergy, as people will work together with LMTD notion to meet common goals in an organization. And this will definitely ensure the organization to run and flourish as expected.

7. CONCLUSION

After all these discussions, the question now arises, "Why is Team building more important at present than it was in the past?" One obvious reason is the change in economy, society, environment, technology, polity and globalization that is taking place at an accelerating speed. Nepal will become a member of WTO (World Trade Organization) by 2005. Globalization will have profound effect on Nepalese business and economy than on anything else. In some cases, it may exert a radical change as well. And the change is having a dramatic effect not only on the individuals but also on the organizations. Under this scenario, LMTD team enables the organizations to be more coherent, nimbler, flexible and respond swiftly and creatively and meet the challenges of competitive business environment effectively.

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