Special Issue

निर्माण सारिका

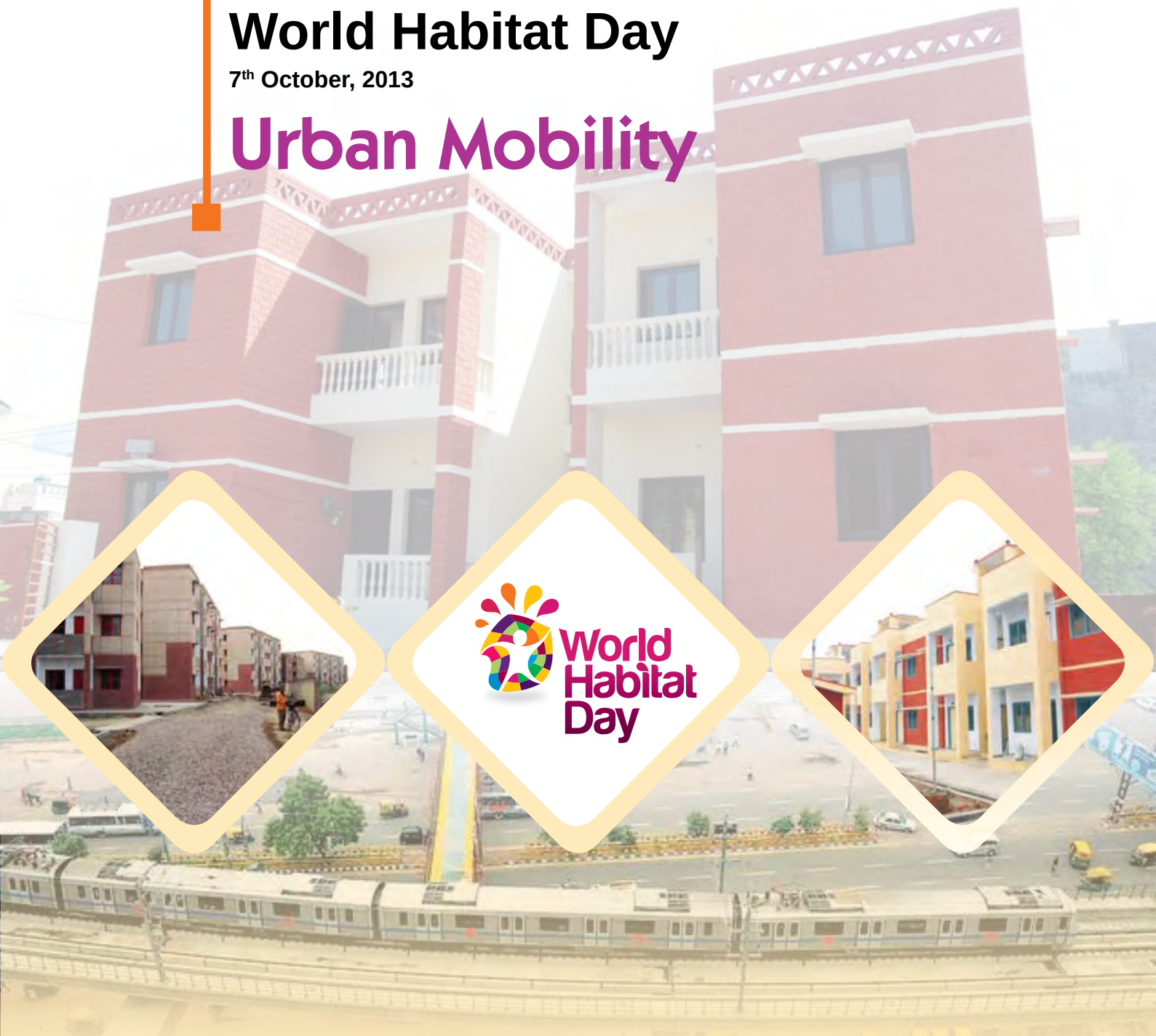
A Newsletter of BMTPC

Hkkx 2] vad 3] tqykbZ & flrEcj 2013] UkbZ fnYyh Vol.2, Issue 3, July – September 2013, New Delhi

World Habitat Day

7th October, 2013

Urban Mobility



bmtpc

निर्माण सामग्री एवं प्रौद्योगिकी संवर्द्धन परिषद्
आवास एवं शहरी गरीबी उपशमन मंत्रालय, भारत सरकार
BUILDING MATERIALS & TECHNOLOGY PROMOTION COUNCIL
Ministry of Housing & Urban Poverty Alleviation, Government of India

"Creating Enabling Environment for Affordable Housing for All"

CONTENTS

From the Desk of
Executive Director

To remind all of us regarding our collective responsibility towards our burgeoning cities, United Nations commemorates first Monday of October every year as World Habitat Day on a chosen theme. This years' theme is Urban Mobility. There could not be better theme than Urban Mobility at the time when most of world's cities in their present form are struggling to keep pace with the kind of rapid development taking place all around as far as services are concerned especially in developing countries like India.

Rapid pace of motorization, lack of road infrastructure, shifting focus from public to private transport, global climate change are some of the discernible issues pertaining to Urban Mobility. Lack of proper public transportation system is the single most cause that hampers mobility and accessibility in urban areas. This has resulted in increased energy use and thereby accentuating environmental degradation. It is estimated that 54% of transport emissions are produced by road transport. Of these, 90% are produced by private/commercial vehicles.

The increasing dependence of towns and cities on imports of fossil-fuel energy is a high risk for the future of urban transport. This risk can be mitigated by tackling supply chain through encouragement of non-motorized as well as public transport and by increasing the tax on personal vehicles. Compared to non-motorized modes, all mechanical modes are more energy-inefficient and private transport is less efficient than public transport.

Recent developments including Jawaharlal Nehru National Urban Renewal Mission (JNNURM) which supports urban renewal raises hopes for the future. The Metro revolution is catching up in India. Kolkata, Delhi and Bangalore have metro and soon Hyderabad, Chennai, Jaipur, Mumbai and Kochi will get it too.. Rapid bus transit systems & mono rail is beginning to spread across urban India. Dedicated lines for non-motorised transport are also catching up. But these efforts are restricted to major metros. It is essential to spread these to other urban centres too.

In order to tackle the issue of urban mobility in cities and towns, the problem need to be addressed holistically which includes development of comprehensive mobility plan, better urban planning and design, proper safety measures & capacity building of city engineers/town planners etc.

BMTPC's endeavour through cost-effective and emerging technological interventions in construction sector has not only been to be sustainable, eco-friendly, energy efficient but also provide an equal opportunity for the urban poor by generating small enterprise as well as employment avenues. I do hope that the agencies and organizations involved in Urban Mobility programmes and projects will utilize the services of the Council in furtherance of their objectives.

Let us create improved living and working conditions for our urban population in the cities by appropriately meeting transport needs in an economically efficient and environmentally and sustainable manner.

.

(Dr. Shailesh Kr. Agrawal)

Dr. (Ms.) Girija Vyas
Minister of Housing and Urban Poverty Alleviation
Government of India

MESSAGE

The World Habitat Day is celebrated annually by the United Nations, with the objective of, reflecting on the state of towns and cities and the basic right of all to adequate shelter and reminding the world about the responsibility to shape the future of our cities and towns.

While India's Urban Population is projected to grow to almost 600 million in 2030 and her urban sector is expected to contribute about 75% of our GDP by 2021, it has put tremendous burden on governance, civic infrastructure and built environment of her towns and cities. One of the most visible outcomes of these inadequacies are slums and homelessness. Today, we have an estimated 96 million slum dwellers, projected to increase to 104 million in 2017. The housing shortage is estimated to be around 18.78 million of which almost 95% is for the urban poor. Hence, the ethos behind the World Habitat Day resonates with the challenge that our country too faces today, of providing adequate shelter to all.

I am happy that BMTPC is bringing out this special issue of 'Nirman Sarika' coinciding with the World Habitat Day. BMTPC plays a significant role in supporting the provision of shelter to all through the promotion of innovative alternate building materials and technologies. I hope this issue will also provide further insights and knowledge of such alternate and efficient building practices that will contribute to our Governments aim of providing shelter for all.

I wish BMTPC success in this endeavour.

(Dr. Girija Vyas)

Statement on World Habitat Day 2013

by

DR. JOAN CLOS

Executive Director, UN-HABITAT

Every year on the first Monday of October we reflect on the state of our cities and towns and what we want the cities of our future to look like.

This year, the United Nations chose the theme *Urban Mobility* because mobility and access to goods and services is essential to the efficient functioning of our cities and towns as they expand.

Mobility is an important part of city design as it contributes, not only to the liveability of a city in terms of reduced congestion and pollution, but also to the economic potential, allowing the efficient movement of people and goods. Mobility is at the core of equitable access to basic goods, services and activities – such as work, education, medical care, shopping, socializing – and to enable people to participate in civic life.

Furthermore, accessible cities encourage a shift towards more sustainable modes of transportation and draw more and more travellers out of cars and onto trains, buses, bike paths, and sidewalks.

Over time, the collective costs of 'automobility' have become abundantly apparent – including urban sprawl, air and noise pollution, climate change, road traffic accidents, and the physical separation of people by class and race.

But mobility is about more than just the mode of transport we use. Urban planning and design should focus on how to bring people and places together, by creating cities that focus on accessibility, rather than simply increasing the length and capacity of urban transport infrastructure.

By optimizing urban densities and minimizing land zoning we start to make the city work for its citizens; proximity of goods and services takes advantage of the urban advantage and encourages investment and opportunity.

Compact, well-designed cities can also be cleaner and have less impact on their environment per resident than more spread out areas.

In an environment characterized by scarcity, this is not only preferable to our standard of living but vital if we are to grow our urban space in a sustainable and desirable way. We need to ensure the cities of the future are well-planned, sustainable and accessible to all.

ARUN KUMAR MISRA
Secretary
Ministry of Housing and Urban Poverty Alleviation
Government of India

MESSAGE

The United Nation has chosen "Urban Mobility" as this year's theme for World Habitat Day. This gives us an opportunity to address the issue of sustainable urban mobility in all our perspective and development plans for growing and emerging cities.

Increasingly, cities are becoming engines of economic growth for a nation, and more and more people migrating to cities is creating increasing pressures on resources such as land. Cities have responded to this challenge by sprawling further, including formerly rural and peri-urban areas at their peripheries for housing, and enveloping them within urban boundaries. This, of course, has created vicious circle of traffic growth, urban sprawl and personal motorized travel and mobility problem for its citizen and services.

Various issues affecting mobility and possibility of improvement in the developing cities include the rapid pace of motorization, condition of local demand that far exceed the capacity of facilities, the incompatibility of urban structure, a stronger transport land relationship than in developed cities and lack of adequate road maintenance.

Cities are often planned at a micro, grid, or block level, missing out the important point of connectivity and proper land use management. Land use and town planning are what shape cities' living environments and their structure. They help determine communities' mobility and energy consumption patterns, and they have an impact on the overall quality of life in cities.

It is important to have both short term and long term plans involving all stakeholders for sustainable urban mobility, which have the ability to meet the needs of the society to move freely, gain access, communicate, trade and establish relationship without sacrificing other essential human or ecological values of today or in future.

I hope the special issue of "Nirman Sarika" by BMTPC will bring out important issues related to sustainable urban mobility for the city and town planners to address, while making Master and City Development Plans of the growing and new cities.

I wish BMTPC all success in its effort.

(Arun Kumar Misra)

Date: 26.09.2013

Place: New Delhi

K.B.S. SIDHU
Joint Secretary (Housing)
Ministry of Housing and Urban Poverty Alleviation
Government of India

MESSAGE

Of late, there has been rise in the urban population attributable, in fact, to opportunities available in manufacturing and service sector in urban centres all over the globe. However, this creates growing new challenges for major cities, including that of urban mobility. Faced with pressure generated by the population growth, we must create and manage adequate public infrastructure with appropriate transportation system to facilitate the full mobility of workers and residents. Despite all its glories, there is no denying the fact that the cities today, on account of high-density living patterns, face serious challenges, such as spatial conflicts, culture collisions, social disharmony, resource shortages and environment degeneration. In view of this, the theme 'Urban Mobility' chosen by United Nations for World Habitat Day-2013 celebrations is the most appropriate and apt.

The theme in itself defines the various features of well-planned and developed cities having special emphasis on the importance of overall urban planning, better transportation, good health care, proper educational system, adequate employment opportunities, social security and better infrastructure and environment for the residents of the city. A three-part strategy can help ensure a sustainable approach to urban mobility. The first priority of this approach entails avoiding carbon-intensive mobility system, such as private-vehicle use. Shifting to multi-modal systems, such as public transport, walking, and biking, constitutes the second priority; while the third involves improving existing infrastructure, vehicle technology, and cleaner fuels.

I am aware that BMTPC is playing a major role for the development of well planned, socially secure, harmonious and sustainable cities through its participation in various housing schemes supported by the Ministry of Housing and Urban Poverty Alleviation, Government of India. Over the years, Council has played an important role realizing the dream enshrined in the National Housing and Habitat Policy 2007 for providing "Affordable Housing for All".

I am sure that the special issue of Newsletter 'NIRMAN SARIKA' of the Council, brought out on the occasion of World Habitat Day 2013, would go a long way in sharing the experiences and disseminating the knowledge to the common people.

I wish all the success to the Council in its future endeavours.

(K.B.S.Sidhu)

सत्यमेव जयते

B.K. AGARWAL
Joint Secretary (UPA)
Ministry of Housing and Urban Poverty Alleviation
Government of India

MESSAGE

In pursuance of the decision of the General Assembly of the United Nations the first Monday of October is celebrated every year as the World Habitat Day the world over. The theme of this year is "Urban Mobility".

Mobility and accessibility are declining rapidly in most of the developing world. The issues that affect levels of mobility and possibilities for its improvement includes the rapid pace of motorization, conditions of local demand that far exceed the capacity of facilities, the incompatibility of urban structure with increased motorization, a stronger transport–land use relationship. The increasing reliance on motorized mobility in the cities is unsustainable considering the fast-depleting fossil fuel resources and the associated impact on global climate change. The consequences are far more serious for India since it relies largely on imported crude oil for its mobility.

The mobility is not just about the mode of transport we use in the cities. Urban planning and design need to be focussed on how to bring people and places together, by creating cities that focus on accessibility, and optimal urban densities.

I am happy that the Building Materials & Technology Promotion Council under the aegis of this Ministry is bringing out the special issue of its Newsletter "Nirman Sarika" highlighting the theme of the World Habitat Day.

I take this opportunity to wish BMTPC every success in its efforts.

(B.K.Agarwal)

Municipal Services for Sustainable Urban Mobility

*K.K.Pandey**

Urban Mobility and Sustainable Habitat

Adequacy of urban mobility is directly linked with the promotion of sustainable habitat. Movement of goods and passengers determine the time, quality and cost implications for productivity and other economic activities, similarly vehicular movement, passage to pedestrians determine the air pollution, fuel consumption and social and economic interaction. Therefore, urban mobility is closely linked with the adequacy of shelter, services and livelihood opportunity. This reminds to whole issue of sustainable habitat. It is emphasized time and again that Global and national issues on sustainability have local solution. It is in this context that urban mobility issues become critical for municipal governance.

Role of Municipal Services

Urban infrastructure, particularly the core municipal services , play an important role to determine adequacy of urban mobility. However, this role is not duly recognized by policy makers, planners and other urban sector functionaries at different levels of governance. On the other hand, the externalities of urban mobility in terms of safe environment, productivity, quality of life, pro-poor access to transport etc. are fairly high and matter of serious concern for overall urban governance.

It is in this context, important to examine the core municipal services in terms of their contribution towards safe, smooth, sustainable, environment friendly and pro-poor urban mobility. The Table -1 brings together the core municipal services and their specific contribution towards adequacy of urban mobility.

As in evident from Table 1 municipal services have direct implicated on urban mobility and determine the efficiency of traffic and transport. Therefore upgradation and augmentation of core municipal service has to specifically give due cognizance to urban mobility. In this regards, three specific areas of service delivery namely Planning, Pricing, Financing & Resource Mobilisation and Management need special attention to concerns on urban mobility.

Planning for Core Municipal Services

City planning in India is not adequately sensitive to urban mobility particularly with regard to (i) barrier free municipal infrastructure, (ii) adequacy of road infrastructure, (iii) systematic provision of water, sewer network/system and drainage system (iv) provision of street lighting and (v) mobility friendly regulations and laws. It is particularly noticed that:

i. Physically challenged, senior citizen, children and women find it difficult to use municipal infrastructure covering public amenities on roads, public buildings and foot path etc. The basic concept of convenience to these segments of households is not applied in the planning stage itself. We can count public spaces and buildings on fingers, if there are any, having positive approach on these facilities. Similarly, it is difficult to use footpath, if one has pain in the knee or backbone or women and children find difficult to use public amenities comfortably.
ii. Road infrastructure in the cities lacks care to pedestrians and incorporation of lane discipline guidelines. Further, the amenities and modern facilities such as foot over bridge, under

* Professor, Institute of Public Administration, New Delhi.

Table-1: Core Municipal Services and Urban Mobility

Core Municipal Services	Interaction with Urban Mobility	Implications
Municipal Water Supply	Leakages (30-50%)	Traffic disruption and unsafe movements on roads
Drainage/storm water drains	Not adequately provided / maintained	Flooding and road blockade
Sewage system	Cities are not fully covered and not linked with safe disposal.	Leads to water logging through accumulation in drains
Solid water management	Almost half remains on road	Obstacles for vehicle and pedestrian movements
Steel lighting	Inadequate upkeep	Insecure movement in the night
Community policing	Almost nil	Inhuman traffic behaviour
Building regulations	Defective provision and application	Unauthorised construction resulting into inadequate space for circulation
Roads	Lack of suitable access, pavement and space	Congestion, pollution, fuel wastage, time loss, productivity loss

Source: As observed

pass, fly over, dedicated lane for buses are not earmarked in the planning itself. These are in some cases taken up in an ad-hoc manner and top-down project mode. Therefore, actual priorities on road infrastructure are not attended.

iii. Roads are also congested and suffer from the problem of encroachment. A systematic planning for road widening is by and large missing

iv. Historically water, sewerage and drainage network in the cities is fairly old and carried forward on human memory. A proper map of water mains in the city is not available. This leaves a little or no scope for timely and regular repair and maintenance. Only breakdown maintenance is taken up which is time consuming, costly and done in a gap filing manner. Therefore our roads are chocked or sometimes flooded with water causing hurdles for smooth mobility

v. Street lighting is also not planned across the roads as per requirements of the width of the road. Lighting also is not planned as per type of 'light' needed at a particular point.

vi. Solid Waste collection points in the roads are not earmarked and planned to accommodate solid waste which is just placed on one side of the road. This leaves little space for movement of vehicles and Pedestrians.

vii. Municipal regulations on circulation norms are not updated as per current requirement. The parking facilities, vehicular movement for emergency (fire etc) requirements, dividers, signage etc are not indicated in the municipal plan itself.

viii. MTRS (Mass-rapid Transport System) and Bus Rapid Transport System (BRTS) is not planned in most cities and is only gradually emerging. There is also a need to integrate land use planning with transport planning.

ix. Roads are also covered under the jurisdiction of multiple agencies. This leads to absence of integrated planning in a city.

Financing Mechanism

Financing of core municipal infrastructure does not give due attention on pricing, taxation, cost recovery and resource mobilisation to facilitate smooth urban mobility. It may be mentioned that:

i. Pricing of public transport is not integrated to have necessary cross-subsidy and funding to improve efficient flow of traffic.

ii. Congestion pricing, peak our pricing etc. are not incorporated in the licensing system which may discipline use of vehicles.

iii. Private transport is not covered under a suitable municipal pricing system. The only instrument that is applied covers 'parking' which is suffering from a well organised parallel system/mafia.

iv. Instruments to finance relatively

larger projects such as fly over, bypass, foot over bridge, relief roads etc. are not considered for suitable application. These include valorisation, Import fee, betterment levy etc.

v. Resource mobilisation through innovative methods is not in practice in most of cities. This covers the use of municipal bonds, pool financing, asset management, consortium lending, refinancing and take out finance etc.

vi. Community contrition in the form of local elasticity has vast untapped potential to develop road infrastructure (as done by some cities in Madhya Pradesh, Andhra Pradesh etc.)

Management of Municipal Infrastructure

As the planning and financing, the current practices of O&M of core municipal infrastructure do not give due importance to urban mobility. It is particularly important to note that:

i. There is a complete detachment between operations of core municipal services and urban mobility concerns.

ii. The municipal budgets do not have due provision for necessary upkeep of water, drains, sewage, street lighting and solid waste management from the angle of their role in the urban mobility. A proper O&M budget is not prepared to address mobility concern accordingly.

iii. The municipal staff deployed in core municipal services and amenities is not given due exposure on ways and means to address urban mobility concerns in the management of core municipal services.

iv. Community mobilisation and awareness an urban mobility is a function that municipal system is not using as part of their governance frame-work.

v. Innovative traffic management in most cases is not applied using lane discipline, traffic rules, one way traffic etc.

Points for Consideration

It is, therefore, evident that urban mobility' has a cross-cutting agenda for necessary support from a range of core municipal services and infrastructure. The pedestrian, passenger transport & goods transport both in the public and private sector need to be suitably supplemented by a range of corrective actions in the planning, financing and delivery of core municipal services. Some specific points that need to be attended are:

i. Urban mobility concerns pertaining to the core municipal services need to be given due cognizance by ULBs, state govts. and govt of India as part of overall policies and programme for sustainable habitat.

ii. Urban planning for water supply, sewerage and storm water drains solid water management, street lighting and regulation for building construction should accommodate respective issues on urban mobility.

iii. National policy for street vendors has special role to improve urban mobility. This need to be operationalized through town vending committee as proposed in the policy. Rickshaw pullers should be integral part of the committee.

iv. National urban sanitations policy and service level benchmarking should be modified to include the urban mobility concerns.

v. Circulation norms, building regulation/codes should be modified to incorporate concerns for physically challenged, senior citizens, women and children.

vi. Awareness programme and orientation courses should be organized to provide exposure on role of municipal service to ensure smooth urban mobility and externalities of urban mobility in from safe environment, urban productively, living standard and quality of life.

vii. Suitable material need to be developed to provide requisite exposure to various stakeholders on role of municipal services for smooth urban mobility. This may also include case studies, audio-visuals, training manuals, checklist, guidelines. In addition study visits; exchange visit and city to city cooperation should also be used for a wider role of capacity building for urban mobility.

viii. University curriculum, school education, print media, electronic media and social media should also be covered to high light urban mobility concerns and suitable corrective measures pertaining to the role of municipal services

Finally urban mobility should be recognized as an integral part of sustainable habitat. Accordingly a range of public (intergovernmental) and private (including NGO & CBSs) sector stakeholders should include the urban mobility concerns in their plan of action.

Reference

74th constitution Amendment Act – 1992
National Policy for Street Vendors
National Policy for Urban Transport
National Urban Housing and Habitat Policy 2007
Second Administrative Reforms Commission -Report
The Mckinsey Global Institute, 2010, India Urban Awakening; Building Inclusive Cities, Initiating Economic Growth
HPEC Report on Indian Urban Infrastructure and Services, GoI, 2011

URBAN MOBILITY in Indian cities

*Mukti Advani** *B.Kanagadurai***

Introduction

According to a World Bank report (1995); in most developing countries the urban sector accounts for at least 50 percent of the gross national product (GNP); in some countries that number is over 70 percent. Cities in developing countries often devote 15 to 25 percent, and sometimes much more, of their annual expenditures to their transport systems. Between 8 and 16 percent of urban household income is typically spent on transport, although this can also rise to more than 25 percent for the poorest households in very large cities. About one-third of all city infrastructure investment need is for the transport sector. Despite recent developments in private sector involvement in transport infrastructure finance, most of this investment will have to come through the city budget.

VEHICLE OWNERSHIP AND ROAD ACCIDENTS

According to Motor Transport Statistics, in 1987 there were 12.6 million vehicles. 10 years later, in 1997, this number had increased threefold to 37.2 million. Vehicle population in year 2004 reached to 73 million. Motor vehicle population has grown at a compound annual growth rate (CAGR) of 10 percent 2000-2009, during fuelled by a rising tide of motorization (Road Accidents in India, 2010).

Mohan et. al. (2009) presents the sales trend of MTWs and cars from 1972 to 2007 in India and these data are used to project future sales by using an array formula and fitting the curves to the data available. These projections are based on the past trends, do not take into account future changes in relative car or fuel prices and there is an implicit assumption that the income growth rates experienced in the past 5-8 years continue over the next decade. With these assumptions (business as usual) car sales of 2.9 million and MTW sales of 23.6 million is projected in 2015.

According to Padam and Singh (2001), the basic problem is not the number of vehicles in the country but their over-concentration in a few selected cities, particularly in metropolitan cities. If one compares the vehicle as well as car ownership rate across countries, India fares poorly vis-à-vis even most developing countries. India, where more than 15% of the world's human population lives, constitutes just 5% of the world's motor vehicle population. As far as cars are concerned, its share is even less than 1%.

Since, there is no such registration / recording of data pertaining to non-motorised mode of Bicycle, information regarding Bicycle production is the only source. (Table 1).

Apart from this, data shows that in India, in year 2007; 11.40 million units of bicycles and other non motorised cycles were produced. There is no established correlation between bicycle production trend and bicycle trips. Table 2 shows the changing modal share of trips in Delhi between 1957 and 1994. The share of trips by motorized two wheelers increased significantly from 1981 during the same period, the share of bicycle trips declined considerably.

Table 3 shows the road accident statistics of India for the year 1970-2004. It shows that while the total number of road accidents increase to almost four times from the year 1970 to 2004, the number of persons killed in them becomes approximately six times.

Table 4 shows the traffic fatalities by category of road users in Delhi (capital city of

* Scientist, Central Road Research Institute (CRRI), New Delhi
** Senior Principal Scientist, Central Road Research Institute (CRRI), New Delhi

Table 1: Bicycle Production of Selected Countries, 1990-2000

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Million units										
China	31.9	36.8	40.3	41.0	42.0	41.0	38.0	30.0	23.1	42.7	52.2
France	1.5	1.2	1.0	1.0	1.3	1.3	1.3	1.3	1.6	1.8	1.9
Germany	3.9	4.9	4.6	4.1	3.5	3.2	2.9	2.8	3.2	3.2	3.2
India	8.4	8.8	9.0	9.9	10.5	11.5	11.3	11.0	10.5	11.0	11.0
Indonesia	2.0	2.0	2.2	2.5	2.8	3.0	2.3	3.0	2.8	2.6	NA
Italy	3.5	3.6	4.1	5.2	5.8	5.3	4.0	4.0	3.0	3.3	3.2
Japan	8.0	7.5	7.3	6.9	6.7	6.6	6.1	6.0	5.9	5.6	4.7
Korea	1.5	1.5	1.3	1.1	1.2	NA	0.9	0.8	0.6	0.6	NA
Malaysia	0.3	0.4	0.6	0.7	0.8	0.8	0.5	0.8	0.7	0.8	NA
Taiwan	6.8	7.7	7.5	7.9	9.2	9.7	7.4	11.9	10.1	8.3	7.5
Thailand	0.7	0.8	1.0	1.0	1.1	1.8	1.5	1.8	1.6	1.5	NA
United Kingdom	1.3	1.2	1.2	1.1	1.2	1.2	1.2	1.3	1.2	1.3	1.2
United States	5.6	7.6	8.9	7.7	7.3	8.8	8.0	6.0	2.5	1.7	1.1

Source: International Bicycle Fund website accessed on 21st July 2013.

Table 2: Modal share of trips in Delhi between 1957 and 1994 (*Source: RITES, 1998*) *(40)*

Mode/Year	Share (%)				
	1957	1969	1981	1994	1994[a]
Cycle	36.00	28.01	17.00	6.61	4.51
Bus	22.40	39.57	59.74	62.00	42.00
Car	10.10	15.54	5.53	6.94	4.74
Scooter / Motorcycle	1.00	8.42	11.07	17.59	12.30
Three wheeled scooter taxis	7.80	3.88	0.77	2.80	1.91
Taxi	4.40	1.16	0.23	0.06	0.04
Rail	0.40	1.23	1.56	0.38	0.26
Other vehicles[b]	17.90	2.09	4.10	3.62	2.47
Walking	NA	NA	NA	NA	31.77
Total	100	100	100	100	100

[a] *includes walking trips*

[b] *includes cycle rickshaw and thelas (human powered vehicles)*

Table 3: Road Accident Statistics in India : 1970-2004

Year	Total No. of road accidents (in numbers)	Total No. of Persons killed (in numbers)	Total No. of regd. Motor vehicles (in thousands)	No. of accidents per ten thousands vehicles	No. of persons killed per ten thousands vehicles
1970	114100	14500	1401	814.42	103.50
1980	153200	24000	4521	338.86	53.09
1990	282600	54100	19152	147.56	28.25
1991	295131	56278	21374	138.08	26.33
1992	275541	60113	23507	117.22	25.57
1993	284646	60380	25505	111.60	23.67
1994	325864	64463	27660	117.81	23.31
1995	351999	70781	30295	116.19	23.36
1996	371204	74665	33786	109.87	22.10
1997	373671	76977	37332	100.09	20.62
1998	385018	79919	41368	93.07	19.32
1999	386456	81966	44875	86.12	18.27
2000	391449	78911	48857	80.12	16.15
2001	405637	80888	54991	73.76	14.71
2002	407497	84674	58924	69.16	14.37
2003	406726	85998	67007	60.70	12.83
2004	429910	92618	72718	59.12	12.74

Source: MORTH, 2010.

India). Vulnerable road users (pedestrians, bicyclists, and motorized two-wheeler riders) accounted for 84% of deaths in Delhi. The incidence of road traffic fatalities can only be controlled in the coming years if road safety policies put a special focus on the safety of vulnerable road users.

Some of the major concerns regarding road traffic safety are presented by Mohan et al., (2009) are as below:

- Traffic fatality rates have been increasing in most cities. Highest increase is found in cities which are close to the newly upgraded highways or major investments have been done to improve transport facilities.
- Pedestrians, bicyclists and two wheeler riders comprise of 60-90% of the total fatalities.
- States with high income have high ownership of cars and MTW, also have high fatality rates in road traffic crashes.
- A high percentage (about 20-40%) of fatalities on highways consists of pedestrians, bicyclists, other non-motorists and occupants of slow vehicles.
- Motorcyclists represent a large portion of urban fatalities

Table 4: Traffic Fatalities by category of road users in Delhi

(Source: Mohan D., 2008)

Type of road user	Fatalities (%) (2001 – 2005)
Truck	2
Bus	5
Car	3
Three wheeled scooter taxi	3
Motorised two wheeler	21
Human and animal powered vehicle	3
Bicycle	10
Pedestrian	53
total	100

**The data are for 11 selected locations, and thus might not be representative of the entire country (tractor fatalities are not included)*

(about 25%). The expected partial shift of motorcyclists to small cars is of concern, because although small cars provide more protection to the occupants, they are expected to be more harmful than motorcycles to pedestrians, bicyclists, and other motorcyclists unless vehicle fronts are designed to be more forgiving.

- Several studies indicate that the involvement of trucks in fatal crashes is greater than would be expected based only on their exposure.
- Nighttime driving in India is substantially riskier than daytime driving. Three aspects are of relevance here: conspicuity of road users, driving under the influence of alcohol, and fatigue of truck drivers. The available data do not allow us to quantify the individual contribution of each of these aspects.
- Wrong-way drivers on divided highways. A large proportion of fatalities on divided highways are from head-on collisions. One study found that such crashes accounted for 19% of all fatalities on four-lane, divided highways.

ROAD INFRASTRUCTURE IN FAVOR OF MOTORIZED MODES

Ancient and Medieval Planners provided extensive pedestrian facilities within their cities because the primary transportation mode available then was walking. Pedestrian comfort was also accommodated through galleries, canopies and other protective features used to shield pedestrian from the sun and inclement weather. The advent of motor vehicles and afterwards increasing volumes and speeds of the traffic have culminated in a complete though undesirable reversal of these planning objectives. Pedestrians have been thrust into background as ever-increasing vehicular demand continues. The limited road space has to be shared between all road users. However, completely opposite is happening. Motor vehicles and population in the urban areas are rising, calling for a need to widen roads, construct flyovers, freeways etc., disregarding completely the needs of pedestrians. Competition on a common route by users of different type or with different purposes works to the disadvantage of the most vulnerable users i.e., pedestrians. Sidewalks are provided on a very small stretch of road system and even if it is provided a major share is encroached upon for other usage. The availability of sidewalks varies from 0 percent to 50 percent in cities. Out of total sidewalk length up to a 38 percent is encroached.

In order to facilitate the faster movement of vehicles in Delhi, road infrastructure facilities such as flyovers, signalised junctions, subways, and foot-over-bridges are being developed. With the construction of flyovers, pedestrian-crossing problems arise. To solve these problems, the construction of many pedestrian subways, i.e. underpasses and foot over-bridges, i.e. overpasses has occurred. However, the usage and effectiveness of pedestrian subways and foot over-bridges is poor.

A study regarding the examination of a pedestrian sample before and after site reconstruction produces a better understanding of the subsequent changes in pedestrian risk behaviour. In this study, strategically placed camcorders viewed pedestrians and approaching traffic. Data reduction measured the accepted time gap of each pedestrian making an unsafe crossing and the average speeds of the approaching vehicle groups. A pedestrian survey provided additional information. Sixty two percent pedestrian accepted gap less than 4 seconds (exposed to high risk) after site reconstruction compared to fifteen percent pedestrian accepting similar gap before the site reconstruction. More than 35 percent of pedestrian stage crossings had accepted gaps less than one second as compared to 6 percent of pedestrian stage crossings before reconstruction. After reconstruction, 22% of pedestrians did not use the pedestrian underpass and continued unsafe crossings at the site. Since, not all pedestrians used the pedestrian subway. It was suggested the design and location of the pedestrian subway needs modification.

CONCLUDING REMARKS

Presently, India is more sustainable than many developed countries in terms of trips made by motorized vs non-motorized modes. Non-motorised trips (NMT) in Indian cities always play major role in present sustainable part of transportation. However, this is not due to NMT based planning, policy, infrastructure, investment, management or enforcement. NMT trips survive only due to captive users. Though, in last few decades scenario has changed and is moving rapidly towards motorised way of travelling. This is demands a very careful transport planning, policy decisions, alternative road infrastructural growth, education, enforcement and engineering options.

*****

BMTPCexpo'12 on Appropriate Building Materials & Housing Technologies

BMTPC organized BMTPCexpo'12 - Exhibition-cum-Seminar on "Appropriate Building Materials & Housing Technologies" at New Delhi from 6-8 November, 2012. Three days seminar was also organized to coincide the exhibition. This exposition on building materials and construction technologies show-cased the latest, emerging and cost effective trends in the building materials & construction sector.

The BMTPCexpo'12 received over-whelming response from R&D and Academic Institutions, NGOs, Building Centres, Manufacturers, Builders, Housing & Urban Development Authorities, public and private sector departments/agencies working in the area of housing and building construction. Besides, a number of serious visitors, around 150 students from the MNIT, Jaipur, Deenbandu Chhotu Ram University of Science & Technology Sonepat, Manav Rachna University Faridabad, Jamia Milia Islamia University, IIT Bombay, NIT Nagpur, NIT Hamirpur visited the exhibition and participated in the Seminar.

The Valedictory function of three-days seminar during BMTPCexpo'12 was presided over by the Secretary, Ministry of Housing & Urban Poverty Alleviation, Government of India.

Safe, Convenient Mobility & Access Across Urban Space are the People's Necessities

*Abhijit Sarkar**

Mobility and development of habitats have been concomitants of each other. Essential for the spread and exchange of ideas and commodities as well as social bonding across terrestrial space, mobility is as old as the hills.

In terms of economics, mobility is a derived demand, which stems from people's need to commute for various activities. With cities growing at a rapid pace, both demographically and spatially, the necessity of travel for livelihood, education, shopping, medical help etc. has become a key concern of the people as users and public authorities as providers and facilitators.

The last two decades have seen a spurt in the use of personal motorised vehicles in the cities, thanks to the increase in the disposable income of people and inadequate public transport infrastructure. As flyovers. elevated roads and aspirations for higher on-road speed of personal motorised modes came to dominate the developmental vision for cities, the disconnect between the formal, people oriented mission, on the one hand and the actual design of constructed infrastructure, on the other widened. This set in motion a vicious cycle, in which a relatively disempowered mass transit mode of the affordable kind (e.g. city bus service) is typically subjected to increasing de-prioritization, accompanied by a simultaneous growth of infrastructure to accommodate more and more cars with marginal concern for the safety and convenience of pedestrians and cyclists. Expansion of infrastructure to accommodate increasing numbers of personalised motor vehicles induces more and more demand for it. Traffic, like gas, expands to fill the additional road space while easing of congestion remains the chimera that it is bound to be till it is acknowledged in actual practice that congestion is a car too many and not a road infrastructure too meagre.

In Delhi, the number of motorised vehicles registered increased from 19.23 lakh in 1991 to 60 lakh by 2008, an increase of 212% public transport's (including metro) share of commuters fell from nearly 60% to a little more than 45% Of course, the silver lining is that this jump in the number of motor vehicles is in terms of the gross number of vehicles registered, all of which are certainly not in use in Delhi and/or elsewhere. There are indications based on samples that the average age of in-use cars in Delhi is around six years.

Nonetheless, there has been a galloping growth in the numbers of private vehicles. This has caused commuting to become a nightmare for all road users side by side with negative environmental impacts of increased pollution.

The spurt in private vehicles in our cities and infrastructures designed mainly to accommodate and prioritise private motorised vehicles have adversely affected public transport users, cyclists as well as pedestrians. In order to widen carriageways to accommodate the growing number of cars, the space allotted to cyclists and pedestrians has had to be drawn upon. Footpaths either almost vanished or got reduced to tokens. Where they have survived, they are encroached upon, very substantially by cars. At some places, footpaths even serve as authorized car parks, clearly placing the need of car users over the safety and comfort of pedestrians.

* Chief - Road Transport, Delhi Integrated Multi-Modal Transit System Ltd., New Delhi

While the necessity of built measures to secure the safety and convenience of cyclists has been recognised, their implementation has been very inadequate. Of late cycle lanes have been built provided along some roads, their physical continuity is frequently interrupted and often not well lit, with inadequate protection against unauthorised use by motorised vehicles. These seriously compromise the safety of cyclists, the overwhelming majority of whom in our country, unlike cycle-commuters in prosperous countries, cycle to work on account of the limited financial means at their disposal..

Happily, there is a growing realization amongst urban planners, transport experts, governments, civic agencies and informed citizens of the need to change the development pattern of the cities to make them more public transport-, pedestrian- and NMT(non-motorised transport)-friendly. The car, despite its high score on comfort for its rider, is an inefficient mode, not only for its use of road space, but also because of the huge strain it puts on the society's resources and the environment.

Road based mass transit on the other hand, is efficient in its use of road space and natural resources as it moves a larger number of people using less space and resources. This in turn results in less pollution too.

While public transport continues to be the choice of people who cannot afford to own personal motorised vehicles, it needs to become more attractive if we are to induce private transport users to shift to public transport.

In order for road-based mass transit to be really attractive and positioned as an iconic brand, it has to be reliable, efficient, clean, safe and comfortable with priority in the right of way (along with emergency services like ambulance, fire brigade) over individual motorised modes. An efficient public transport system will have a well-oiled network of various public transport modes comprising road-based mass transit, rail-based modes, para-transit (taxis) and non-motorised modes (including pedestrian).

Buses are by far the cheapest motorised public transport mode with a large and expandable network and the flexibility to change route alignments and add new routes at very short notice to meet changing travel patterns in keeping with the growth of a city. It is not enough to have a large fleet of buses and an extensive network of routes. Bus service has to adhere to time schedules and the buses need to be clean, convenient and safe to alight, board and ride on in order for road-based mass transit to be attractive and increasingly popular.

The public transport system is not limited to a bus or a metro system. It needs to be supported by civil infrastructure that allows easy accessibility to the bus stops or stations or other modes of transport that can provide last mile connectivity. Civil infrastructure includes well designed footpaths and bus stops and stations that are also disabled friendly, well-lit streets and cycle tracks. Often the distance between a last destination of the commuter and the nearest bus stop or station can be easily covered on foot or by cycle/cycle rickshaws. These are healthy and pollution free options that need to be encouraged. However, people will be discouraged from using these options if they are not provided the right infrastructure.

In fact there is a significant stratum of society whose members can ill-afford a daily commute by bus. Their primary mode of transport continues to be walking or cycling. They form a vulnerable group and are often victims of accident-crash impacts while imposing little crash impact on other modes. It is imperative that agencies and planners create a city that takes into consideration the safety and comfort of cyclists and pedestrians to improve mobility.

As for developmental norms, strict zoning of cities should be avoided as they adversely affect the mobility, access and cost of living, especially of the economically weaker sections of society. Cities should be planned in a mixed development pattern so that people don't have to travel long distances for their livelihoods, education and entertainment.

Good footpaths combined with robust, efficient, affordable and attractive public transport system can make a city vibrant. Giving safe and comfortable access to pedestrians, bicyclists and mass transit users is essential for environmental sustainability and public health. That apart, it also makes a city more attractive for tourists. International experience suggests that visitors like cities where walking, bicycling and public transport are safe and accessible.

These factors also go on to make streets safer as more and more people will be on the streets...

Contd. on Page 22

Planning & Design of Cost-Effective & Environment-Friendly Houses in Urban Areas

*Dr. J.S. Chauhan*** *Mrs. Geetanjali Sharma**

INTRODUCTION

Any low cost housing scheme consists of three major components viz. land, Built up structure with internal services and Infrastructure which includes water supply, sanitation, roads, street lighting, energy provision and transport etc. as essential public services and shopping, education and health as community services contribution of the architect in planning and design of all these components in the background of socio-economic, cultural and environmental conditions of the people and site has been well recognized their innovative concepts are infact, not only cost reducing, but also suit the lifestyle of the people and remain viable with in available resources for execution.

Some of the major 'concepts' so far developed in low cost housing and in which architects have played a vital role include,

- cluster planning,
- group housing,
- Incremental housing,
- Skeleton housing and
- core housing

Besides evolving new concepts, architects have also been on several forefronts of creative low space and environmental standards, Minimal project design etc. Some of the important in above areas are given as below :-

– Max. distance of E.W.S. housing to selected destinations.

– Evaluation of minimal space and Environmental standards.

– Community participative approach.

– Systems of prefab construction.

– Reduction in wall masonry, length of window openings and no. of doors and windows.

– Use of frameless door and window shutters.

– Use of Brick arches and avoiding R.C.C. lintels.

– Use of low energy consuming materials.

– Use of solar and bio-gas energy.

– Orientation of buildings for comfort conditions.

– Cavity wall construction for thermal insulation and damp proofing.

Architects have also played a vital role in adopting specific regional approach based on available range of local materials and sophistication of construction techniques for planning and design of low cost housing schemes both in urban and rural sectors. For example, where soil is good it is extensively used in various forms with various techniques such as sun dried bricks/ blocks with or with out stabilizing agents & kiln built bricks for walling flooring and even roofing purposes etc. and where earth is not good, use of local stones has been extensively done. Uses of secondary timber and building materials from wastes have also been suggested in number of low cost housing schemes. Utilization of improved building technologies, as a result of extensive Research and Development works, has also been done on a large scale particularly to economies the cost and as well as materials. Some of the improved methods of construction incorporated in low cost housing schemes are listed as below:

- Under reamed piles for foundations in black cotton soils.
- Fly ash bricks, hollow cinder blocks, pre-cast stone blocks, pre-cast reinforced brick panels

* Research Scholar (Management), Samrat Ashok Technological Institute, Vidisha (M.P.), E-mail: geetanjali_sharma@rediffmail.com
** Prof. & Head, Civil Engineering Department, Samrat Ashok Technological Institute, Vidisha (M.P.), E-mail: jsccivil@rediffmail.com

and concrete panels for walls.

- Precast R.C.C. channel units, core units, cellular units, waffle units, doubly curved tiles, solid planks, L panels and ribbed slabs , bricks shells, lime & fly ash cellular slabs, A.C. sheets, cement bonded fibre sheets & paper corrugated sheets etc. for roof.
- Stabilized soil cement base, thin clay tiles, flagstones and bricks on edge etc. for flooring.
- Precast R.C.C. frames, steel moulded frames and angle iron for doors and window frames and particle boards for the shutters.
- Polyethylene, Bituminous materials and cement mortar of 1:4 with water proofing agent for D.P.C.
- Hollow beams, precast R.C.C. columns and beams, and precast staircase elements etc. for structural members.

REDUCTION IN BUILDING COST

The various aspects governing the reduction in building cost are,

Design Aspects

(a) **Load Bearing Walls**: As far as possible, the building should have load bearing walls made of bricks or stone. Reinforced cement concrete (RCC) columns and beams make construction costly. 4-1/2" thick i.e. is half brick thick wall with hoop iron reinforcement may be used as partition wall.

(b) **Doors and Window Opening**: For construction of an economical house, large openings for doors and windows should be avoided as the lintel, chajja, frame, grills for windows, shutters, fittings, glass, jalli for doors, painting and polishing make them costly.

(c) **Loft, Canopies and Sunshades**: They should be provided only where necessary and permitted under building byelaws. Their necessity may be considered from functional point of view as these add to the cost of construction.

(d) **Byelaws**: The house should be constructed as per the building byelaws of the areas and as per sanctioned plan. Any deviation from sanctioned plan and area not only increases the cost of construction but attracts penalties from sanctioning authority.

(e) **Structural Design**: Structural design should be got prepared by qualified engineer. It should be such that number of columns and beams are minimum. Good and safe structural design saves steel and cement and make construction cheap.

Material Aspects

(a) **Bricks** : The bricks should be purchased through civil supplies department, if available at controlled rates. They should not be half burnt or over burnt. Good quality bricks have regular shape, perfect corners and reddish colour. They should give metallic sound when struck with each other. Bricks should be properly soaked in water before use.

(b) **Cement** : Cement should also be purchased through civil supplies department, if available at controlled rate. Cement in drums reduces the wastage. Cement should be consumed as early as possible. More than 6 months old cement should not be used for construction.

(c) **Steel Bars** : Steel for reinforcement should be clean, free from scales of rust, oil or grease, instead of plain mild steel bars, it would be advantageous to use ribbed steel bars, which do not require end hooks and need less over lapping.

(d) **Hydrated Lime and Clay Pozzolana** : It may be used for all masonry mortars and plasters for economy. 20 to 30% quantity of cement can be saved by use of pozzolana mortars are cheaper compared to cement sand mortars and give improved workability.

(e) **Flyash** : The quantity of cement can be saved to the extent of 20% if flyash is used in conjunction with cement in mortars and plasters.

(f) **Pipes and Fittings** : Plastic pipes and fittings including electrical conduit may be used instead of G.I. or C.I. or steel pipes as these are cheaper.

(g) **Timber** : Timber to be used for construction purposes should be free from defects such as knots, wraps, splits, fungus etc. Treated and properly seasoned secondary species of timber may be used for wood-work. Exact sizes should be obtained from the market to curtail wastage. The various other alternative of timber are cement bound chip boards, rice huck boards, fibre reinforced plastics, bagasse boards, gypsum boards, ferrocement products, MDF boards, aluminum, red mud products etc.

(h) **Stone Dust** : Stone dust can be

used where good quantity is available at cheap rates, compared to local sand and stone dust should not be more than 6 to 10%.

(i) **Aggregates** : Stone aggregates can be replaced by brick aggregates in foundation concrete or filling purpose with lime where water table is not high. Stone aggregates should be clean, free from cow dung, organic and inorganic impurities. Aggregates may be round, angular or irregular in shape. It is advantageous to use various sizes for good strength.

(j) **Composite mortar** : Composite mortar 1:2:9 (1 cement:2hydrated lime:9sand) can be used for all mortars and plaster to minimize the use of cement . Coarse sand like local sand or stone dust for masonry mortar and fine sand like Narmada sand for plaster should be used . 1:2:9 is equivalent to 1:6 cement sand mortar.

(k) **Pozzolana Cement** : It is cheaper as compared to ordinary portland cement and can be used with reliability. Flyash should not be mixed with pozzolana cements it already contains pozzolana.

FOUR CONTROLLING FACTORS

The control system for achieving or maintaining thermal comfort have been described without defining limits within which comfort can be achieved without strain on the physiological control mechanisms of the body. There are four factors of thermal environment which affect the rate of heat loss from the body and therefore, thermal comfort.

1. Temperature

The air temperature is measured using a thermometer with a dry bulb and is therefore called `dry bulb temperature`. A number of measures must be taken to ensure that the thermometer is not affected by other factors such as radiation. The bulb of the thermometer contains mercury which reflects a high proportion of incident radiation. For local measurements within a building, a sling psychrometer can be used. The dry bulb thermometer is fixed in a revolving arm which is rotated rapidly by the handle. This also avoids radiation effects.

2. Humidity

The humidity of the air is measured in the Stevenson screen using a hygrograph, which records the relative humidity directly on a revolving drum. Local measurements can be made using a wet and dry bulb hydrometer or sling psycrometer. A second thermometer is located in the revolving arm alongside the dry bulb thermometer with a wet muslin cover to the bulb. The amount of cooling depends on the temperature and the humidity of the air. Since the air temperature can be found using the dry bulb, the humidity can be estimated from the wet bulb temperature (WBT).

Relative humidity is the amount of water vapour in the air expressed as a percentage of the total water vapour which can be held in the air at a given temperature.

Absolute humidity is the amount of moisture present in a given volume or mass of air and is measured in grams per kilogram, or grams per cubic metre. Humidity can also be measured by the pressure of the water vapour present in the air.

Relative humidity's less than 20% are likely to cause discomfort due to the excessive dryness of the air; this may cause lips to crack, eyes to become easily irritated and the throat to become sore. Relative humidity's above 90% feel clammy and damp.

3. Radiation

Radiation is not measured at all meteorological stations, but can be measured using a solarmeter which, as the name implies, measures the strength of the main source of radiation; the sun. Inside buildings we are more concerned with the relative balance of radiation from and to all the surfaces visible from a given point. This can be measured using a globe thermometer which consists of a thermometer whose bulb is located at the center of cooper globe painted matt black so that the globe is highly sensitive to radiation. The `mean radiant temperature` of the surfaces surroundings the globe can be calculated if the air temperature and air movement are known, but for many purposes the globe temperature alone is a useful indicator. Radiation from the sun can be measured as rate of flow of energy per unit area (Watts per square metre). Globe Temperatures (GT) and Mean Radiant Temperatures ((MRT) are measured in degrees Centigrade. If the (MRT) (or GT) is more than a few degrees above or below air temperature, discomfort may result. Discomfort may also be caused when the mean radiant temperature is similar to the air temperature but results from intense incoming solar radiation from one direction and high levels of outgoing radiation to cool surface in other directions.

Comfort is unlikely to achieved

if the globe temperature is above 28°C or below 16°C and if the difference between MRT and DBT is greater than 5°C.

4. Air Movement

Air movement is measured at meteorological stations using a cup anemometer. Inside and around buildings where the lower wind speeds are not sufficient to give an accurate reading, a kata thermometer is used. This is thermometer with only two indicators on the stem, the bulb is placed in hot water so that the mercury rises above the upper indicator. The time taken for the column of mercury to fall past the lower indicator is than measured, and the speed of air passing the bulb can be estimated once the air temperature is known. Wind speeds below 0.1 metre per second may lead to a feeling of stiffness. Wind speeds of up to 1.0 metre per second are comfortable indoors when air movement is required, but above this level discomfort and inconvenience increase. Hair is moved, papers blow away and dust is raised. Outdoors wind speeds of up to 2.0 metres per second can assist in achieving comfort hot conditions, especially when the humidity is high 5.0 metres per second is the maximum outdoor wind speed that is comfortable, but this limit is related to wind force rather than comfort.

The human body, like the thermometers is sensitive to temperature, humidity, radiation and air movement. At low temperatures no sweat is present, but as the temperature rises sweat increases and the body, like the wet bulb thermometer, becomes more sensitive to changes in relative humidity. The skin, whatever the colour, is good absorber of radiation and the body is sensitive to changes in mean radiant temperature through a wide range of air temperatures. Increases in air movement increase heat loss from the body but unlike the kata thermometer, the body becomes moist with sweat under hot conditions, and air movement increases evaporative cooling from the skin, as well as causing heat loss by convection.

Table-1: Comfort Temperature Ranges

Scale	Conditions	Humidity %	Day temperatures °C	Night temperatures °C
A	Upper range of comfort with 1 m/sec air movement	0-30	32.5-29.5	29.5-27.5
		30-50	30.5-28.5	29-26.5
		50-70	29.5-27.5	28.5-26
		70-100	29-26	28-25.5
B	Range of comfort with light summer clothes or 1 blanket at night	0-30	30-22.5	27.5-20
		30-50	28.5-22.5	26.5-20
		50-70	27.5-22.5	26-20
		70-100	27-22.5	25.5-20
C	Lower of comfort with normal warm clothes and thick bedding at night	0-30	22.5-18	20-16
		30-50	22.5-18	20-16
		50-70	22.5-18	20-16
		70-100	22.5-18	20-16

The conditions in which comfort is achieved can be defined by describing the combination of values of air temperature, humidity, radiation and air movement acting simultaneously.

CONCLUSION

As a consequence, the internal thermal storage capacity of the building, not being exposed to solar radiation, is an important means of increasing winter night temperatures and decreasing maximum temperatures during the hot season.

A high internal thermal storage capacity is essential to reduce temperature variations and to profit from an increased night ventilation.

A white outer surface or a heavily ventilated double roof construction is necessary to prevent the solar radiation penetrating the building structure, especially the roof, during the summer when the angle of the sun is high.

The ventilation rate should be kept as low as possible during the winter period. However, due to hygienic reasons, the ventilation rate must not be too low. Another problem which could occur is condensation especially in the case of structures with a relatively low internal surface temperature in combination with rooms with a high rate of added vapour such as kitchens.

During summer nights the ventilation should be increased as much as possible by catching the wind or using stack effects. In the daytime, when the outdoor temperature exceeds the indoor one, the ventilation rate should be kept to a minimum. The internal mass

thus retains the cool of the night until daytime.

A good roof insulation is recommended to protect the building from the intense direct solar radiation during summer. The effect of wall insulation is, however, negligible in the hot period, as long as the house has a significant internal storage capacity. Insulation of east and west wall can be considered.

In winter an external insulation is very efficient in raising indoor temperatures to acceptable levels. The outer walls could even be a light weight and well insulated construction if the building has a considerable mass.

No difference could be observed between MCR roofing and clay tile roofing.

At night all houses perform similarly and have a temperature about 6°C higher than the outside temperature. This is due to the relatively high thermal storage capacity.

Houses with mud-walls are clearly superior in the day time compared to brick structures because of the larger storage mass and also because they are less ventilated. The performance at night could be further improved by increased ventilation, but the inhabitants are not concerned because they sleep outdoors.

The tests show an impressive difference in the performance of the concrete structure and the mud structure. Whereas the temperature in the mud structure fluctuates by a few degrees only, in the case of the concrete structure the temperature varies between extremely high and very low. In practice, the difference may be some what less because air changes would increase the fluctuation of the temperature in the mud room. A clear difference however, would still remain.

A well-constructed conventional building performs similarly to the earth construction with a vault or jack arch. Heavy structures have almost not temperature variation between day and night. Light roofs becomes slightly warmer in the daytime, but are much cooler at night.

REFERENCES

- *Handbook on Building Economics and Productivity published by C.B.R.I. Roorkee.*
- *Low Cost Housing and Infrastructure Published by Indian National Academy of Engineering Building Materials and Technology Promotion Council, New Delhi.*
- *Guidance for house builders published by B.M.T.P.C. New Delhi*
- *CBRI, Roorkee (1988) : Proc. Workshop on Utilization of fly-ash.*
- *NBO, New Delhi (1985) : Appropriate Roof Materials for Low cost Housing.*
- *IS : 3362-1977 Code of practice for natural ventilation of residential buildings*
- *IS : 2440-1975 Guide for daylighting of buildings*
- *D. Ajitha Singh - Building Environment*
- *Martin Evans - Housing, Climate & Comfort*
- *Suresh, V (1995a) : Cost Effective Building Technologies, Technology Transfer, Dissemination and Extension, SHELTER, New Delhi, April, pp. 24-35.*

*****

Contd. from Page 17

thus contributing to the law and order ambience of the city.

The future of urban mobility is walkable streets and a city-wide mass transit network. Cities will come to a standstill if we do not consciously take concrete steps to make this change. This change has to occur at many levels, starting from policy objectives, sensitive urban planning, pro-active engagements by civic agencies and most importantly, the vision of opinion leaders. It has to be a joint effort by all the citizens to achieve a better standard of living for themselves and their children and coming generations.

**The views of the author are personal and does not reflect the views of the organisation he works for.*

*****

Integration of Land use and Public Transport

Case Study : CURITIBA (BRAZIL)

*Ramesh K Safaya** *Manju Safaya***

PREAMBLE

In recent decades, the world has witnessed rapid Urbanization and growth of large cities. Most of this growth has been getting increasingly concentrated in the urban areas. The world is now increasingly becoming more urbanized.

By 2015 the world will have 26 mega cities of which 22 will be in the developing countries. The rush to cities has been one of the great global trends of the end of the 20th century and the beginning of the 21st century. Sixty years ago, 83 cities had more than one million people. Today there are more than 500, including 13 in Brazil. "The 21st century will be the first ***urban century,*** *said Wally N'Dow of Gambia, Chairman of the Habitat-II summit with, more than half the World's population living in cities. But whether in developed countries, or developing world, we are all woefully unprepared. While Urbanization is a catalyst for economic growth, (India's Urban areas have 30% of its population and contribute nearly 60% of its GDP) their quality of life does not seem to be showing any significant improvement. The needs of a rapidly burgeoning population are placing increasing stress on the ecology and infrastructure. Planners and Environmentalists have long been warning us of an environmental crisis looming ahead, a crisis that can perhaps only be averted by* ***Sustainable and Inclusive development****.*

The need for development of the poorer countries can also not be ignored. Incomes, GDP's, life expectancies and literacy rates continue to remind us of the urgent need for progress and development in the third world. Towards such an endeavor all of us have long been looking for an example to guide us in the search for optimal development approach, the proverbial light at the end of the tunnel - found finally in the "lighthouse of knowledge- Curitiba, Brazil."

Brazil and India are both large developing countries with similar problems. Brazil, the largest country in the world is perhaps more famous for its rainforests and tourism. Both countries have an annual growth rate of approximately 1.7%. Brazil's area is almost double that of India and its population almost one sixth, yet it appears that both are losing their forest cover at a similar pace (0.7% annually). Its cities are also not very different from that of India. The cities in Brazil like India are grappling with the pressures of housing shortage, critical infrastructure shortages and major service deficiencies, urban poverty and rapidly deteriorating environment. The accomplishments of Curitiba have come despite limited means and this little-known city in

* Principal and Dean , Vastu Kala Academy of Architecture, New Delhi
** Executive director, Design and Development, Housing & Urban Development Corporation (HUDCO), New Dehi

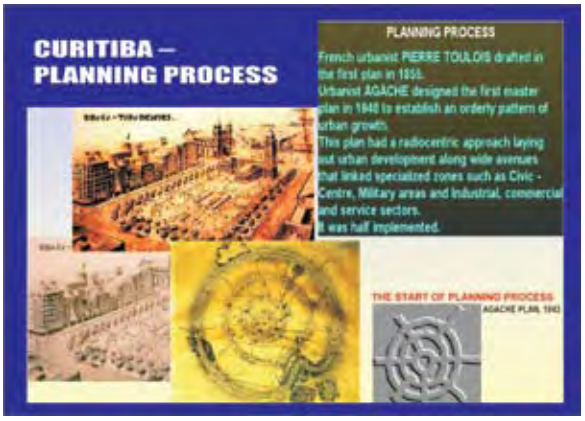
Southeast Brazil is being heralded as the place that has many of the solutions. "It is the most innovative city in the world," said Wally N'Dow. Since young maverick architects and engineers took over City Hall in the 1970s, Curitiba has tried new ways to tackle such urban ills as illiteracy, homelessness, transportation and government service shortcomings, unemployment, pollution and poverty. Curitiba is still a Third World City, with at least 10% of its 1.5 million people living in slums of corrugated tin-and-wood shanties. And its innovations from "trade villages" to schoolbooks written by the Mayor - were made gradually. But the city now stands as a model for urban planners, and mayors from around the world have visited Curitiba to learn from its experiments.

CURITIBA – BUILDING FULL CITIZENSHIP

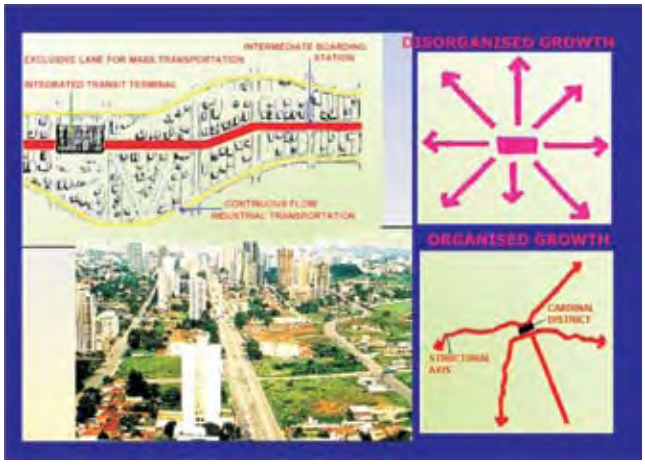
The story of Curitiba is 300 years old and its origin is intervened with gold cycle which prevailed in colonial Brazil of 17th Century. The first explorers coming from the coast arrived at this plateau to find a natural landscape of plain fields that favored the establishment of human settlements. It was an Indian and Portuguese city in the 17th Century, European city in 19th Century, with immigration of first German, then Polish and then Ukrainians. The present Curitiba is located in the wealthier southern part of Brazil and is the capital city of agricultural state of Parana. Curitiba has been involved in town planning for almost half a century. It started with 1940, which was known as original Curitiba master plan – the Agache Plan created by the French Urban Planner, Alfred

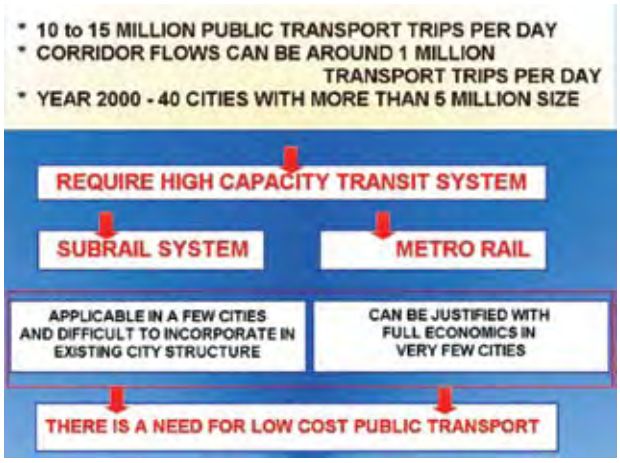
Agache set directives for the orderly physical growth of the city for 120,000 inhabitants. The plan was based on the division of the city in to specific zones (land use) with a radio centric form segregated by wide avenues. The plan wa partially implemented.

Subsequently, series of revi-



sions/modifications were incorporated which had very limited impact on the form and the growth of the city. In 1960 Brazil went through structural changes including political and economic. Urban Growth quickened with substantial rural urban migration. The demand and necessity for new organization of space was felt and subsequently a research and urban planning institution was created in 1965 to undertake the task of the formulation of plan and guide the implementation. This institute (IPPUC) which started with the multi-disciplinary staff was headed by Urbanist Jaime Lerner (who later on became Mayor of the City for three terms). The preliminary Urban Development Plan, which gave the shape to the present Curitiba, was selected in a public competition at a time when Curitiba had a population of 0.47 million growing at a rate of 5.6% annually. The plan set forth the vision for the development of the city through linear axis of increasing density along the North–South and East-West directions, supported by public transportation, the road system and land use. Zoning was used as an effective tool to rationalize land use while defining and regulating areas with specific function and operation parameters. The earlier disorganized, spontaneous growth was redirected along this axis, called structural-o-axis which provided new locations for high density housing, medium size business and services and at the same time allowed the setting up of the mass transit system which could grow with demand. The plan looked at Curitiba from global point of view instead of interfering with the traditional urban fabric and insisting on large scale urban changes. The scale, history and culture of the city were preserved, avoiding technical solutions that could have created more serious problems than solving any.





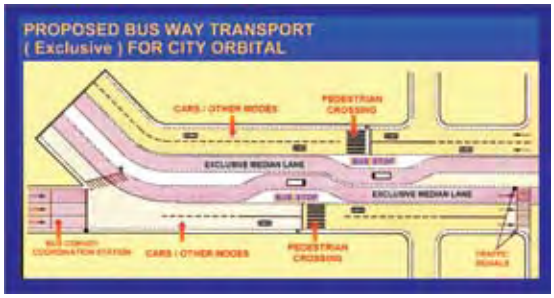
restricted to those activities which would further the cultural life of the city. The secondary goal was to transfer this area to pedestrian use, blocking normal vehicular traffic in certain sectors and changing them into paved and planted leisure areas, which provided the city with additional urban facilities. To accommodate a finance base for the urban growth, a large industrial city was developed within Curitiba city having efficient linkages with the public transport system. In addition the city was furnished with necessary urban equipments such as educational, recreational, open spaces and parks, including other social infrastructure. The master plan of Curitiba was approved by the city hall on 31st July, 1966 and became an urban law. The zoning regulations highlighting the areas of high density were gradually established thus guiding public investment and disciplining the activities of the private sector so that the objectives of the master plan could be achieved.

TRANSPORT

In the search for an effective public transport system, the possibility of optimum utilization of road based public transport and trams or improved trams (LRT) are often ignored. These traditional/ conventional modes of transportation are often associated with poor productivity, unreliability, longer journey times, and excessive over loads. Curitiba in a conscious attempt to be an inclusive city has evolved a very efficient, effective bus based public transport system. 75% of the daily journeys are made on it; fares are lower and paid prior to boarding. The performance of the system is enhanced by the reservation of travel space which removes buses from general traffic congestion. The buses travel along the bus ways with a median speed of about 20 km/h and reach the sectional speed of 60 km/h in non commercial areas.

High capacity articulated buses, specially designed to serve the system, have been introduced and headway's are as short as one minute during peak hours when the demand reaches the volume of 10 to 2000 (ever more) passengers per hour per direction.

Curitiba public transport system is used by 1.3 million passengers each day. The system gradually evolved since 1947 reinforcing and integrating every stage of development. The urban buses used are of 9 different types with different colours operating on different types of roads with strict move-



ment corridors and speed limits. There are total 1503 buses with 20 integration terminals.

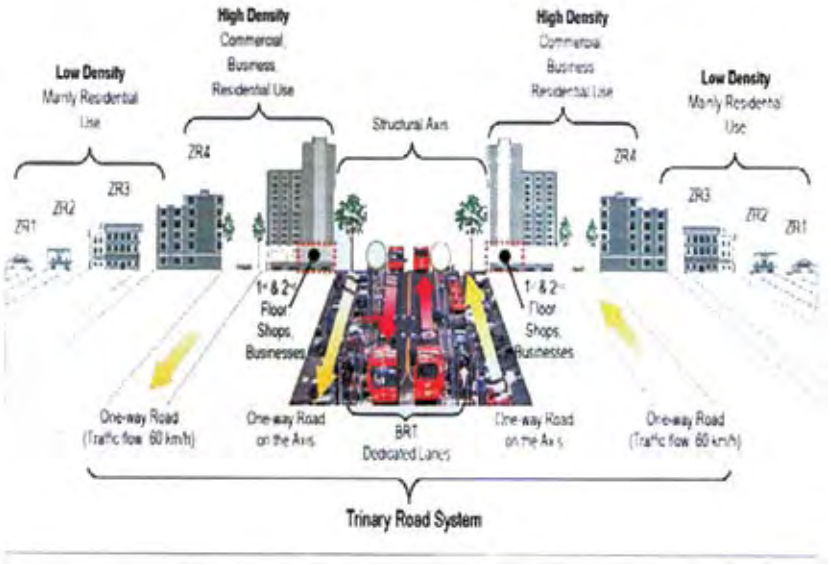
The express biarticulated, express articulated, express pardon buses with a capacity of 270, 160 and 110 passengers move on the structural axis linking various important activity areas. The inter-district routes which are circular roads connect various transfer terminals with structural axis. The feeder routes accommodate the conventional buses within the neighbourhoods. There are also other special direct or speedy routes linking various important areas including city centre. The exclusive bus lanes in the middle of the road are provided with slow car moving lanes on either side. The buses get priority at every intersection over the private automobiles. Beautifully glazed bus stops allow the passengers to embark or disembark from the buses at the same level which enable the system to reduce the travel time between two stations. The entire infrastructure is maintained by the city hall whereas the fleet of buses is maintained by the private sector. The rates are affordable. The revenue generated is equally shared by the city hall and the private operators.

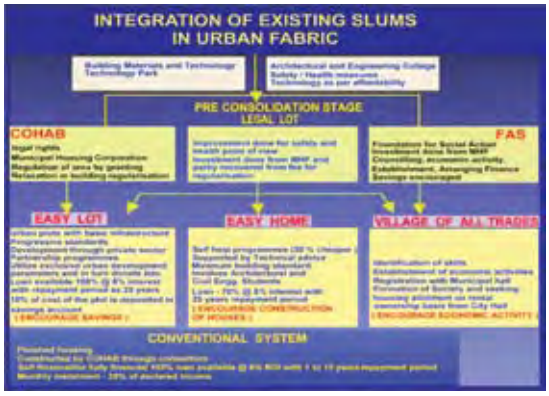
Curitiba also has the lowest rate of air pollution as the buses are of improved technology and also use biofuel. A handicapped person can leave his home and change two buses to reach his office alone and can also return back to his home safely.

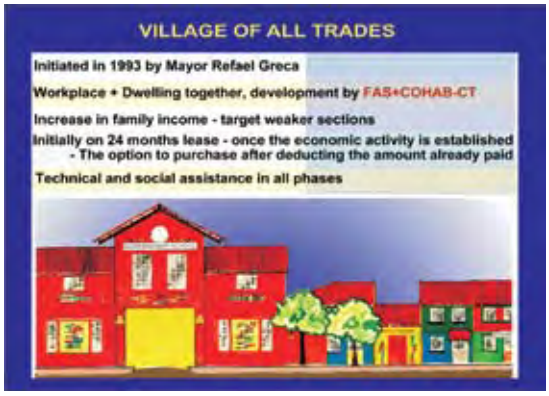
HOUSING

Municipal Housing Company is responsible for the implementation of Municipal Housing Policy in Curitiba. In line with the policy of inclusiveness, home is considered more a right for all citizens than mere shelter. In contrast with most Brazilian cities, Curitiba has over the years exhibited a sustained growth of low income housing stock. It has also enjoyed vide recognition for the quality of its interventions and for contributing to restore a sense of true citizenship to the population that receives these benefits. 10% of the population of Curitiba lives in slums. The city hall describes these recent migrants as guests and not as trespassers. A systematic, coherent programme and process exists for their integration into urban milieu of Curitiba.

In the pre-consolidation stage, improvements are done within the slum areas purely from safety and health point of view and investments are done from the fund created by the city hall for this purpose. The regulations of area by granting relaxation in building regulations and also the issue relat-







ed with the legal rights are looked after by the housing wing (COHAB) of the city hall. The issues related to counseling, identification of probable skills, generation of economic activity, encouragement of saving and arranging finance etc. is looked after by the Foundation of Social Action (FSA). The access to cost effective building materials and technologies are made available through a technology park with the active assistance from the architectural and engineering colleges. Once the community is consolidated through the above mentioned civil engineering and social engineering skills, various typologies called Easy lot; Easy home and village of all trades are made available to the weaker section. The affordable finance is also organized through various housing finance companies.

The concept of village of all trades was initiated in 1993 and involves the construction of work place cum dwelling unit together. The ground floor is used for commercial purpose whereas the first floor is used as residential unit. The house is initially given on 24 months lease basis and once the economic activities are established, the option to purchase after deducting the amount already paid, is made available to the occupier.

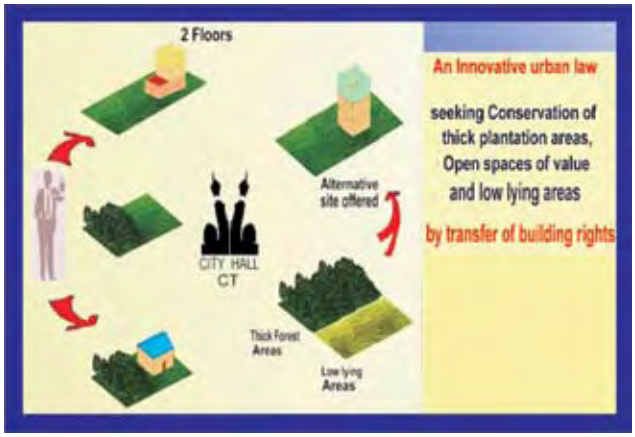
The technology park wherein the cost effective housing unit is constructed by the private sector helps in defusing the information about building materials and technologies. These demonstration houses are used as offices by the city hall and the evaluation with regard to the endurance; permeability, acoustics and thermal response are studied by the research and advisory technological institute including the research groups from engineering and architectural colleges.

An innovative urban law known as transfer of building rights (TBR) has helped in the establishment of Municipal Housing fund which is also strengthened by municipal owned real estate and to a certain extent by budget allocation. The TBR concept allows the purchase of building rights in excess of what has been established for a certain zone contributing to optimize existing infrastructure and to minimize the city housing deficit. The developer with these incentives that is higher FSI is asked to either contribute to the municipal housing fund or contribute land or construct low income housing. The locations of all the weaker section housing projects are carefully evaluated in relation to public transport and availability of jobs. These progressive and far reaching housing policies have helped in the development of Curitiba as a sustainable and inclusive city of the 21st century.

ENVIRONMENT

Curitiba has been declared as a green city having 12 Municipal Parks, including two environmental preservation areas, 10 public preservation wood lands and several small gardens.

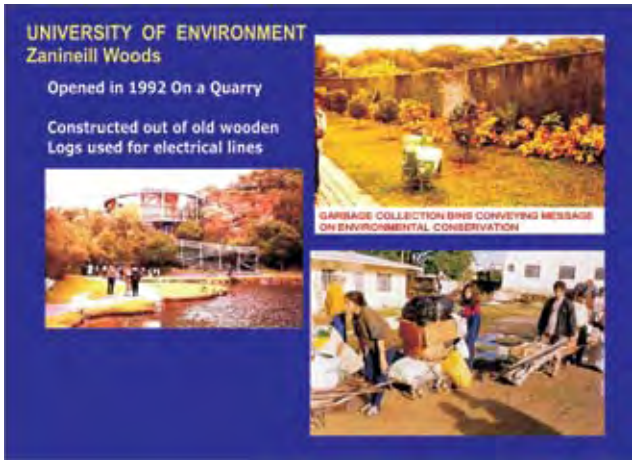
The city of Curitiba has a provision of 52 sqm of green area per person. Almost every two years, a large park is added to the city. The large park and wooded areas are effectively used for flood control, preservation of river and other water bodies,



restoration and preservation of fauna and flora and managing climatic balance. The open space system also provides for much needed leisure and recreation for the city residents. Each open space is given a distinct identity by way of locating a particular reference building for an ethnic group or a local cultural attribute within it thereby combining recreation, with socio cultural uses. In order to seek conservation of thick plantation areas, low lying areas, wooded areas and open spaces of value, transfer of building rights is used by the city hall. Through this law no individual is allowed to cut large trees/thick foliage without the permission of the city hall. In case the owner is not able to take the advantage of prescribed FAR in that situation, city hall offers an alternative site where additional FAR can be given. For preservation of low lying areas as flood absorption basins, the owners are also given the benefits of transfer of building rights. Through this process private initiatives are mobilized for preservation of the natural environment.

In 1992, the city hall established The University of Environment in one of the old quarry site which was reclaimed for this purpose. This university is used to promote environmental education research and diffusion of self-development practice in the field of environment. The building has been constructed from old wooden logs used as electrical poles in the city. All city residents have to compulsorily undergo a training programme on conservation of environment.

Curitiba has introduced an innovative way to deal with the issue of urban waste by highlighting its economic value to the residents. This was initiated in 1989 with the implementation of "Garbage i.e. not Garbage" programme which consist of segregation of recyclable materials such as metal, glass, paper and plastic from the organic waste. Along the same lines, the green exchange programme was created to serve under privileged community areas that are hard to reach with conventional garbage collection trucks. Under this programme, fruits and vegetables are swapped for garbage collected by the community. This contributes towards improving their living conditions both nutritionally and environmentally. On special days such as Christmas, the beginning of school year and Easter, the programme involves exchange of toys, fruits, cakes, school books, chocolate and other items for recyclable waste. This programme serves 55 under privileged communities



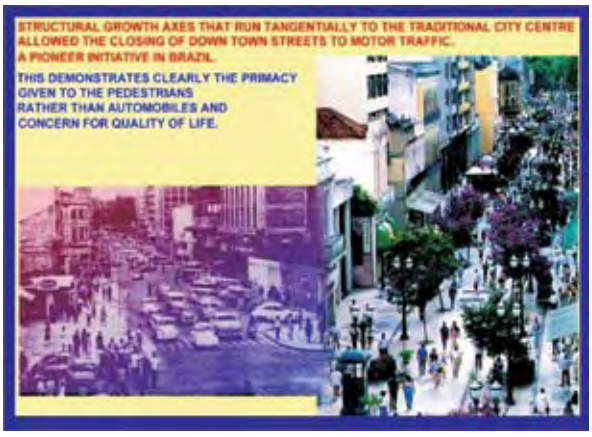
within the city. The programme was awarded a UN International Award in 1991. Another off shoot of this programme is the solidarity farm wherein in addition to swapping of fruits and other essentials for recyclable garbage, the drug addicts and alcoholics are also treated and recycled back to the society. These solidarity farms are also refurbished with a museum of garbage wherein old articles are sold to the under privileged people at cheaper rates.

Two – third of all rubbish in the city is recycled and citizens are kept continuously informed of the value of recycling. A large sign board in the central park continuously up dates the number of trees that have been saved due to recycling of waster paper. All rubbish is recycled at a plant located in the solidarity farm wherein jobs are given to the handicapped and former alcoholics who have trouble getting jobs elsewhere. Environmental awareness and education programmes are priority areas of the city government. Each school owns a stretch of drain wherein the pollution levels are monitored every month by the children with the help of experts. The message of cleanliness, basic hygiene is disseminated through school children. The school curriculum also includes the involvement of children in environmental awareness campaigns and neighbourhoods awareness programmes wherein children of 4 to 12 years are involved in the production of toys and crafts from recycled materials and those between 14 to 17 years are engaged in planting of flowers, vegetables, cleaning drains etc.

URBAN DESIGN

The city has a very unique urban design character with provision for motorways as well as pedestrians. Pedestrians are given primacy over automobiles thus reinforcing the concept of inclusiveness. The city centre which is the commercial and cultural hub of the city is completely pedestrianised to facilitate a vibrant street life without hampering movement.

The city centre square is like a live theatre wherein people meet and shop, bands plays live music, painter paints portraits/pictures and economic activity is carried out side by side without hampering pleasure or economic wheels of the city. Streetscaping and landscaping provides added life to the square. The Policy of transfer of building rights is used for preservation of buildings having cultural, historical or architectural value.



HEALTH

City hall takes care of health of the people through its municipal health care units located in 85 units. Health facilities are available for all residents. Children up to 5 years olds are looked after by the city hall. Through this process the mortality rate has been brought down from 42 to 40 per thousand, which is much lower than the country average of 54 per thousand live births.

EDUCATION

The city has 122 municipal schools and the city's literacy rate is 94.5%. The Centre for Integral Education (CIE) complements regular teaching with student follow up, sports, leisure, and culture, and multi media activities, as well as nutritional complements. For children with deficiencies or learning difficulties, there are special classes in regular schools for specialized assistance. The City Hall provides specific transportation system i.e. adapted to the needs of those users. The special books entitled "Lessons of Curitiba" have been developed to teach all school subjects from 1st to 4th grade, using the city as a starting point. It is a fundamental initiative to develop the practice of citizenship. The "Light House of Knowledge" is an innovative idea inspired by the ancient Alexandria light house and library which unites the goal of defusing

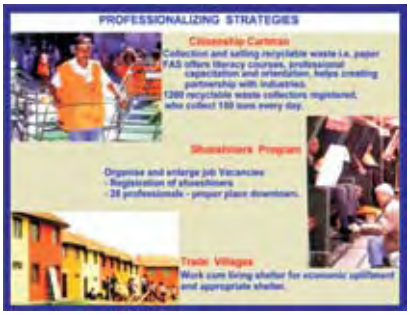
knowledge and providing safety. These lighthouse shaped buildings are neighbourhood mini libraries, usually built next to municipal school. They are open to the community and contain a reference collection of 7000 book. The tower house, a municipal guard station provides safety to the students and neighbourhood population.

SOCIAL ACTION

The integration of health, education, housing, food supply, environment and child services are co-ordinated by the Social Action Foundation (FAS). It's goal as an inclusive city is to restore full citizenship to the neediest inhabitants through programmes such as "teaching and trades line", "all clean", "citizen charter", "consolidated farms", "FAS – SOS", "SOS-Citizen – street education", "village of all trades", "house of shelter and returns", "amongst others".

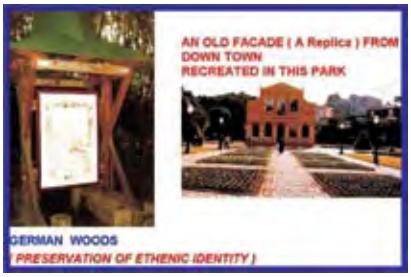
The trade lines programme promotes professional introduction courses to youths over 14 and adults, in order to facilitate their access to the labour market. About 60 courses are taught in buses that have been adapted as mobile classrooms. The all-clean programme creates temporary work team of unemployed adults or retirees. These teams are then employed to maintain public areas and to provide access to gardening and literacy courses.

The citizen charter programme is a partnership involving the municipality, shop owners and condominiums. It recognizes the contribution of rag pickers / individuals who gather discarded papers in push carts in keeping the city clean and reducing waste. The "solidarity farms" run on 100 hectares of city land helps in social and professional reintegration of alcoholics and drug addicts. . FOS-SOS provides emergency services to people living on streets/destitutes, SOS-citizen – street education programme identifies and rehabilitates homeless, alcoholic, drug addicts, beggars and also provides educational orientation for children. The street educators are identified by navy blue vests with characteristic logo and they are well received by the population because they are not coercive. This programme operates 24 hours a day. The "house of shelter and return" located in Curitiba rail and bus station is a facility that provides orientation to those who arrive in the city in search of a better life or for health treatment. The services include sheltering and return tickets to their place of origin. The significant increase in life expectancy from 65 to 70 years confirms the success story of these elaborate social action programmes



CITIZENSHIP AND CULTURE

The citizenship street, a symbol of decentralization is another example of City Halls action for and towards the people. These are adjacent to transit terminals and offer a variety of public services and commerce under the same roof to serve the citizens in their own neighbourhood. The goal is to promote cultural identity and urban references which are fundamental to improving the quality of life of its inhabitants. Hence an inactive quarry has become a theatre and cultural space "Paulo Liminski Quarry" an old farm in the vicinity of the city centre, has become the



botanical gardens. As a tribute to the migrants that have shaped the composition of Curitiba's population, important landmarks have been named after these communities such as the German wood, Portuguese Wood, the Ukrainian wood, the Polish gateway and the Italian gateway.

CURITIBA METROPOLITAN REGION

Curitiba Metropolitan region includes 23 regional towns apart from Curitiba. The Curitiba Metropolitan region has a total population of 2.5 million. The population of the Metropolitan regional towns is 1.0 million, Curitiba is 1.5 million, (60%), and Parana state has 9.0 million. The population of the towns varies from a few thousands to 0.2 million. There is a high degree of interaction between the Curitiba city and the Metropolitan Regional towns. The transportation linkage between the city and the region is responsible for this association. Towns with better accessibility within the region are growing faster than the rest. There are a number of small towns within 12 to 15 km of Curitiba all of which show growth rates double that of Curitiba. The decentralisation of population away from the main city is apparent in the case of Curitiba. The population of Curitiba within the Curitiba Metropolitan region has shown declining trends, whereas the population of Curitiba Metropolitan region within the State of Parana is showing increasing growth trends. The Curitiba Metropolitan region has a definite well laid out policy framework to enable the growth of the towns located along the structural-o-axis, whereas, the MRT systems will replace the bus way transit either fully or partly, once the assigned population for ring towns is achieved. Curitiba, has successfully demonstrated that the decentralization strategy and the improvement of the quality of life of the mother city can be implemented together as part of Metropolitan Planning Strategy.

SUM UP

Curitiba is a sustainable and inclusive city in all respects. The city treats its citizens equally irrespective of class or race. Poor destitutes are integrated in to the city main stream seamlessly. The Housing policy facilitates creation of additional housing stock for the poor annually; the public transport system provides mobility to all especially the socially disadvantaged. The Educational, Health and the Environmental policies provides for basic health and education and conservation of the environment. It is a city where the poor, destitutes are not unwanted and are welcomed and integrated in the society. "The city is built and rebuilt in each citizen; Public works become meaningful when the population appropriates them in their daily life". Says a City Hall document. The city hall functions as a facilitator for the establishment of partnerships, linkages and social practices leading to capacity building, stability and resource optimization. The city planning and the people have been wedded together. Curitiba shows creativity through simple solutions and effective actions (against large scale civil engineering transformations) which makes it possible to overcome the intrinsic challenges that cities grapple with in developing countries. The respect for the inhabitants is evident in municipal action. The progressive policies of the city has led to the establishment of relationship of reciprocity, trust and more importantly the search for a balance between the rights and duties of each individual. City hall, which boldly depicts the mural of "lighthouse of knowledge" on its front wall, is the most important friend and guide to every individual in Curitiba. The coordination between various departments of the city hall is exemplary and demonstrates the need and the effectiveness of urban management, which is distinctly different from the piece-meal and isolated interventions by planners, engineers or administrators. The projects, which receive the approval of all the line departments such as infrastructure, education, transportation, social action agency and finance, are finally designated as urban projects to be executed within a time frame. The city hall explains that "to plan is to build a bridge between the dream and possible. The Curitiba of the next generation, the one that will also belong to our children and grand children, will be the result of our present action. We must keep in a mind that the city is never finished". "Curitiba like any city in the world faces enormous challenges that may actually be understood as a single one – to ensure every day quality of life for the population. In order to achieve that goal we need to think the city, to see Curitiba in a strategic way and to work together" explains the vision document of City Hall.

The components of this vision are shared governance, matrix structure, job creation and integration with metropolitan area. Shared governance is a partnership between the public sector and the community to accomplish projects with quality and efficiency.

It involves consultation with the population community leadership meetings and public audience. The matrix structure involves the development of a new matrix based organisation structure involving all local secretariat and companies to implement the chosen strategic projects. Such structure enables strong and cooperative network, providing easy interactions among projects and contributing to the modernisation of local management. Job creation will support the various levels of actions as broad public works programmes, income generation programmes, improved housing infrastructure, and clear policy for attraction of new business, investment in the city vocations as a centre of excellence involving leading edge technology and finally creating school of talents. Integration with the metropolitan areas means the creation of solidarity network to pursue several programmes which could be multiplied in a joint effort group with the neighbouring municipalities so that a uniform standard of life in the region is established. Curitiba depends on the surrounding cities to ensure its own quality of life.

The contribution of Curitiba, to the world lies in the fact, that it has given reassurance, that: Yes we can achieve the goals of sustainable, inclusive cities. Indian cities have to do a lot, in order to come closer to what "Curitiba has done. However, the essential prerequisite shall be to bring planning and the people together through a 'community participative planning model'. This is the goal the urban management in India needs to strive for the development of sustainable and inclusive cities.

*****

Brain Storming Session
for Identification of Possible Areas of Cooperation with R&D Institutions

BMTPC has been working in the field of development and promotion of appropriate technologies from lab to field, disaster resistant technologies, capacity and skill development for more than last two decades. A number of building materials and technologies have been developed, standardized and are being used in the field with success over the years. With the field experience of use of some of the known technologies, it has been felt that there is a need to take stock of current knowledge so as to bring further improvement. Also, there is a need to identify areas of plausible Research and Development in cost effective, environment friendly & energy efficient building materials and construction technologies for sustainable housing.

With the above backdrop, one day Brain Storming Session for Identification of Possible Areas of Cooperation on Alternate and Emerging Housing Technologies with R&D Institutions was organized by the Council on 12th June, 2013 at New Delhi. About 40 participants from various academic and R&D organizations, Technology/System providers participated in the Brain Storming Session.

Explosion of Urbanization

*M.L.Khurana**

The United Nations designates first Monday in October each year as 'World Habitat Day' to reflect on the state of our cities and towns and the basic right to adequate shelter for all. It is also an effort to remind the world community of its collective responsibility for the future of human habitat. The theme of World Habitat Day this year on 7th October, 2013 is 'URBAN MOBILITY'. The theme will facilitate to draw attention of all stake holders to the problems mushrooming owing to hyper urbanization and other numerous issues like urban transport practices, pollution, urban safety, inadequate public transport services as well as traffic congestion, etc.

To begin with, it is a good point to run through the reasons for people to come to larger cities. First of all, by all accounts, cities are perceived to offer a wide variety of job opportunities on the grounds that there are very different branches of businesses in cities. In as much as unemployment level is hugely high in the rural areas and the work is only about farming in contrast to countless business sectors in chief cities, more and more people choose searching for their chances in the metropolis.

Second most significant reason is better services in cities. As a matter of fact, transportation is extremely developed so as to make use of time efficiently. Medical services are supported with the latest technological improvements, there are unbelievably modern hospitals. Besides, education is taken into account seriously. There are very high-quality schools with excellent teachers, teaching with up-to-date techniques. These can be accounted for massive shortcomings in the rural areas, at this stage.

Apart from the aforesaid pull factors causing migration to big cities, there is a strong push factor stemming from absence of enough land. It would be very hard and useless to cultivate the land if it is too small to make an agricultural production. One important thing triggers this incident increasingly during the last years; namely, division of land. To explain, in the rural areas with someone's demise, the inheritance would usually be the land. Yet, the land is divided into many parts due to the fact that in the rural habitat it is common to have lots of children and they all have rights to take one part of the inherited land. Therefore, what they get are useless small lands rather than a gigantic land which is capable of making a great deal of agricultural production itself. The inability to do the only thing, farming, again brings about migration to big cities with the hopes of making money.

Cities are therefore the destinations for people escaping poverty, conflict, human rights violations, or simply those looking for a change, for something better. A city is a provider of services to its citizens, which can be measured by the quality of its services (access to telephone services, water, sewerage or electricity); the reliability of such services over time (as measured by the quality of infrastructure services) and the degree to which a city involves its citizens in decision making; is responsive to their demands, and is well governed in general.

Cities are hubs of national production and consumption, are centres of economic and social progress and generate wealth and opportunity. The UN Habitat's report 'State of the World's Cities 2006-07' says that half of world's population lives in cities. In 1950, only one third lived in cities. Fifty years later, this rose to one half and will continue to grow to two-thirds

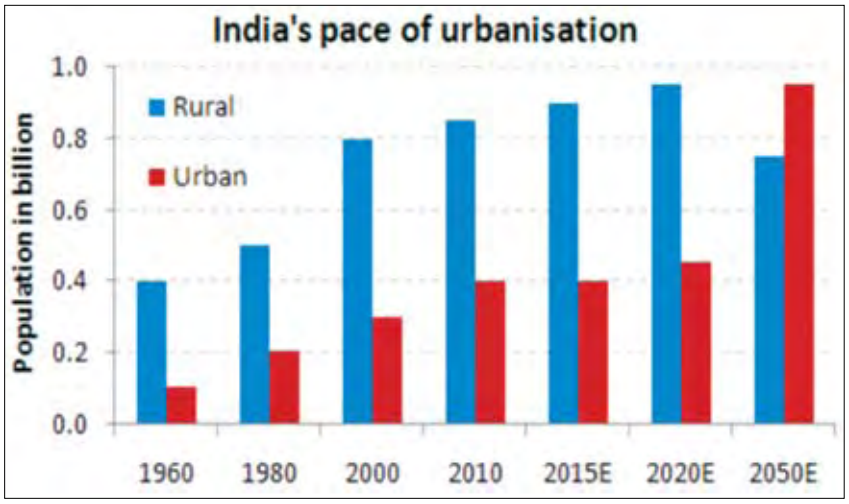
* Managing Director, National Cooperative Housing Federation of India (NCHF), New Delhi

of the global population, or some 6 billion people by 2050.

In India, industrialization has widened the gap between rural and urban areas, prompting the workforce to move to industrializing areas. In developing countries such as ours, the workforce shift has been dominated by the expansion of the informal sector. Seasonal workers are mostly absorbed into the informal sector. Studies have shown that migration is an important economic strategy for poor households in several regions of India. The National Commission of Rural Labour concluded that uneven development was the root cause of seasonal migrants. Workers could be locked into a debt-migration cycle where earnings from migration are used to repay debts at home which in turn make migration an economic necessity. In 1991, 39 million people migrated in rural-urban patterns of which 54% were female.

People come to cities with hope and expectations and a desire to earn a better life. But to what extent, do the cities or the urban centres prove to be centres of development and hope. The large influx of population that enters the city, has direct or indirect impact on the infrastructure. The progressive degeneration of urban infrastructure, questions the fundamentals of the urban development concept. The Indian Infrastructure Report 2006, by Infrastructure Development and Finance Company Ltd., which focuses on urban infrastructure says such cities as Nagpur, Surat, Vijayawada with half a million population are growing at a daunting pace. If this growth continues, large chunks of the country are going to be urbanized over the next two decades.

But the most startling feature on which several debates have been launched is that most Indian cities are manifestations of unplanned growth and are managing more number of inhabitants than they can sustain. This results in congestion, noise, traffic jams, air pollution and major shortages of key necessities. Every major city in India faces the same proliferating problems of grossly inadequate housing, transportation, sewage, electric power, water supplies, schools and hospitals. In such a situation, the migrant population adds to the burden of the cities. Migrants are exposed to large uncertainties whether it is the job or the dwelling place. The first and the foremost thing that a migrant looks for when he comes to the city are the living space and then a job. Most of them land in slums or makeshift shelters that promise no services be it the basic necessities of water or electricity or security of tenure or health service.



IMPACT OF URBANIZATION

Population Explosion

One of the most obvious or noticeable effects of urbanization is population explosion that it brings along with it. The term population explosion basically stands to signify an uncontrollable and unreasonable rise in the population of a particular area. This is exactly what urbanization is capable of bringing about. When a particular area experiences development and urbanization, it automatically becomes an attractive area and this brings in people by the thousands, ultimately exerting undue pressure on precious resources. Apart from resources, this can also result in an inequitable distribution of wealth, where the rich get richer and the poor get poorer. The major crisis arising from population explosion is unemployment rate in the cities. Imagine, that a city with a population of 5 million people with employment for all. Following the cue other citizens of the same country – especially from the rural areas – see the opportunity to have a better life and migrate to this city. Another 1 to 2 million people may be accommodated due to newly created sectors; nevertheless, if another 5 million people come to this city, the consequences will be flabbergasting. Excess unskilled labourers will certainly occupy everywhere.

Infrastructural Woes

If you just happen to live in a highly urbanized area, you may really not be a stranger to the woes of infrastructure. These woes aren't too uncommon in an urbanized world. On one hand you have transport problems to deal with and on the other you have sanitation, water and power setbacks to put up with. This uncontrollably growing kind of urbanization results in so much pressure on the infrastructure that no means of infrastructure can respond to any needs of urban life effectively. For instance, when there is a sudden rain, there would be floods all over the city, but in fact, there should not be any with the help of regular working sewers and drainage. Waste disposal is another bad aspect as well as destroyed roads and the inconsistencies of the power supplies. Electricity and natural gases have innumerable problems as a consequence of this denial of service. There do not seem to be any noticeable investments in transportation; hence, it cannot meet the needs of city residents. For the expensiveness of highly equipped private hospitals, urban crowds choose the state hospitals mostly and this leads to very long queues indeed. As a result, people cannot get a good examination in medical centres. Education is also badly hurt; because, children are made to receive education in incredibly crowded classrooms with as many as 60-80 students in one classroom. As you see, the teacher cannot show the same interest to every child and that drops the learning level sharply in this so-called educational system.This makes up for quite a wet blanket when it comes to the problems that are a direct result of urbanization. If the governments of the world can find a way to get the better of these unfortunate circumstances, then urbanization will really seem like the boon that it is.

Crime Time

An increase in crime makes for yet another unfortunate consequence of uncontrolled and biased urbanization. Why does this happen? This happens because there usually is no shortage of wealth in urban areas, and where there is wealth or the means to acquire the same, there always are criminals. Crime can range from burglary and vandalism to petty theft and sometimes even murder for gain. Unfortunately, it is not the bureaucrats or the police who face the brunt of these crimes, but the common man who does. It is advisable for highly urbanized areas to get matters of crime under control before the same reach the heights of unbearable tolerance.

Inequality and Escalating Costs

As mentioned before, in an urbanized setting, it is almost always the rich who gets richer while the poor get poorer. This only means that while the rich are finding it extremely easy to make ends meet, the poor are fighting it out for a hand to mouth existence. While at one end of the spectrum the rich roll in the lap of luxury, the poor and the not-so-fortunate bleed for a square meal, which really makes the whole scenario a very miserable one. To add to this misery is the whole issue of escalating costs which at times can even make the rich think twice before buying commodities that can be best described as essential.

Natural Regression

The extensive urban mobility leads to erosion of the environment. With rampant use of resources pollution and deforestation is everyday's scene. Factories and motor vehicles pump large quantities of carbon dioxide and other waste gases into the air. More vehicles mean more pollution. For example, the poisonous gases coming from the vehicles result in acid rain that damages trees, buildings and are killing fishes in lakes and rivers. Rivers are also polluted by industrial waste from factories. Deforestation, on the other hand, is very widespread in recent years; large areas have been destroyed, as the trees are cut own for wood or burned to give way to concrete buildings of several kinds. It is not wrong to say that this unplanned urban growth influences accommodation in the form of illegal buildings by ruining the nature and natural bounties. Further, excessive use of energy, chemical and other natural resources in the cities has resulted in air, water and soil pollution leading to environmental crisis causing major issue of global concern. The global warming, depletion of ozone layer, desertification, acid rains, deforestation, air-water soil pollutions are some of the threats. The world is undoubtedly warming, thanks to the emissions of carbon dioxide and other greenhouse gases from human activities. During the twentieth century, the earth's surface warmed by about 1.4 °F. There are a variety of potential causes for global climate change, including natural and human-induced mechanisms. Scientists world over have shown great concern and have determined the potential

causes responsible for the climate change, providing strong evidence that greenhouse gases released to the atmosphere by human activities are the main cause of contemporary global warming. India is the world's fourth largest economy and fifth largest greenhouse gas (GHG) emitter, accounting for about 5% of global emissions. India's emissions increased 65% between 1990 and 2005 and are projected to grow another 70% by 2020. On a per capita basis, India's emissions are 70% below the world average and 93% below those of the United States.

Housing Shortage

In India alone, the housing shortfall is estimated to be between 25 and 30 million units. This translates into 200 million+ people who'd like a home of their own but do not have one. A very large majority of this unmet demand is in urban areas and 99% in the 'affordable segment', which can be defined as housing priced between Rs 200,000 and Rs 1 million. This shortfall is expected to go up by nearly 2.5 million units per year over the next 20 years creating an additional requirement of nearly 50 million dwelling units. The majority of India's workforce earns between Rs.5000 and 15,000 per month; a house that costs less than Rs 500,000 is affordable to them. With the country's agriculture sector having a limited absorption capacity, majority of the growth in urbanization is expected to be a consequence of rural-to-urban migration. Post economic liberalization, India's manufacturing and services sector has seen an influx in employment from the rural youth. With the country expected to witness rapid industrialization, the trend of migration from rural to urban areas is likely to continue. Growing concentration of people in urban areas has resulted in an increase in the number of people living in slums and squatter settlements. Skyrocketing prices of land and real estate in urban areas have induced the poor and the economically weaker sections of the society to occupy the marginal lands typified by poor housing stock, congestion and obsolescence. It is apparent that substantial housing shortage looms in Urban India and a wide gap exists between the demand and supply of housing, both in terms of quantity and quality. According to a report submitted by a technical committee to the Ministry of Housing and Urban Poverty Alleviation (MHUPA), India's urban housing shortage is estimated at nearly 18.78 million units in 2012. Besides those living in obsolescent houses, 80 percent of these households are living in congested houses and are in requirement of new houses. The report also highlights that nearly one million households are living in non-serviceable katcha houses, while over half a million households are in homeless conditions. This is a segment that has been completely overlooked. Genuine constraints that are faced by the developers are:

- Unavailability of urban land
- Rising construction costs
- Lack of skilled manpower
- Delay in approvals from local authorities
- Financing constraints for low income groups
- Limited financial avenues
- Certain government laws and unclear guidelines
- Disputable Tax regime

THE WAY FORWARD

There is a need for balanced and sustainable development of both urban and rural areas. Given the strong inter-dependence of cities and rural areas, there is a strong need for improving rural-urban linkages. It is now widely recognized that there exists, an economic, social and environment interdependence, and need for a balanced and mutually supportive approach to development of both ends of the continuum.

Ensure decentralized development of small towns and rural areas by creating micro level village enterprises with a supporting strong Management Information System enabling transparency and prudence at the grass root level.

Infrastructure development in rural areas and intermediate towns is essential for balanced regional development. Improving infrastructure network increases rural production, giving people in rural areas better access to markets, information and jobs. Cities act as magnets for rural trade, and gateway to national and international markets. The better road connectivity between cities and their hinterlands ensures faster economic development of rural areas. Private sector would also need to play an important role in development of infrastructure facilities such as roads, electricity, health and education facilities.

Reversing Urbanization: A major problem in India is the fact that secondary and tertiary towns are underdeveloped. Economic Development in small towns can have a positive impact on the surrounding rural economies through a greater demand for rural pro-

duce from urban residents who normally have a higher purchasing power. Well-developed intermediate towns provide natural destinations for rural migrants. They also help cushion the impact of major migration flows towards large cities. Therefore the only way to reverse the trend of urbanization is arresting the migration of rural people to urban area by creating better infrastructure facilities and job opportunities in rural areas.

Improving rural urban linkages: These should be fully developed and in this process community participation through NGO's, CBO's village panchayats and private sector should be sought. The Government could play a more effective role with policy support. Community involvement in planning, design and maintenance of physical infrastructure is crucial particularly when majority of people are low income earners. The District Planning Committees, which were supposed to be constituted by the State Government for each districts as per the 74th Constitutional amendment are some of the agencies that can play a very important role in governance at the local level, while preparing development plans for both rural and urban areas, since they have been mandated to prepare regional development plans for balanced sustainable development of region, within its jurisdiction.

Restructured Policy Governance: Our policy makers have encouraged investment and growth in few mega-cities despite contrary advice. In 1961, the authorities in Delhi were told to stop new offices and relocate existing ones. But no one listened. On the other hand, enormous amount of investments have been made in subsidies to infrastructure. People come from such a long distance for treatment Just because there are no hospitals in their areas. If money is pumped only into Delhi, there will be no hospitals in other regions. Therefore, people will come to the cities. The same applies to employment opportunities. Majority of immigrants are poor and they come in search of jobs. The directions of development and financial planning have not responded to these issues adequately. That is one of the reasons why cities are expanding physically, and physical expansion invariably results in this kind of problem. Urban management in India is shockingly poor. The government is allocating more and more money to megacity projects. The beneficiaries will be only 10 per cent. But the real beneficiaries will be only two per cent, who are rich, due to which other regions are neglected. This kind of financial mismanagement results in poor urban management. The criteria for allocating funds need to be re-examined. Money is going into the larger towns while other areas are suffering.

Housing Solution: The Housing Cooperatives have taken up its bit of responsibility to face global challenge by contributing in a humble way in improving the environment of the dwelling place of an individual. There are about 100000 housing cooperatives which have constructed 25 lakh houses along with providing safe drinking water, conservation of energy, controlling pollution and making surroundings environment friendly. The Indian Farm Forestry Development Cooperative Limited (IFFDC) project has been initiated in 1995 with the mandate "To develop farm forestry on wastelands through promotion of village level Primary Farm Forestry Cooperatives (PFFCS) for socio-economic development of the landless, marginal, small farmer's and women in particular with people's participation," in the states of Rajasthan, Madhya Pradesh and Uttar Pradesh. The function of the 26 state-level federations of NCHF is in playing a significant role in the pursuance of cooperative strategy. It not only provides financial assistance to housing cooperatives in their respective jurisdiction but they also provide guidance on technical matters and assist them in the general co-ordination and supervision of activities, such as assisting them in obtaining building materials. As an example, the Pondicherry Cooperative Housing Federation has set up a Pondicherry Cooperative Building Centre whose main objectives are to "set up manufacturing units of building materials, purchasing bulk quantity of materials for construction of buildings and sell them off to members and public at fair and reasonable price". An idea to promote the use of certified low cost materials helps them to bring a more cost-effective methodology to the construction process. The centre has received several awards for its work.

Apart from serving the basic cause of housing cooperatives, its contribution toward human development lies in creating one million jobs every year in India. The job opportunities in housing cooperatives are related to:

i. Organizational management and administration;
ii. Planning, designing and con-

Contd. on Page 50

Demonstration Housing Project at Barwaripur, Rae Bareli, Uttar Pradesh

BMTPC, in continuation of its efforts to demonstrate cost effective, alternate and disaster resistant technologies, is constructing Demonstration Houses in Uttar Pradesh. The State Government has identified the land for construction of demonstration houses at Barwaripur, Rae Bareli. Under the Demonstration Housing Project, construction of 24 dwelling units (G+1) is being undertaken. Each Unit having plinth area of 32 sqm will consist of one living room, one bedroom, kitchen, one separate bath and WC. The Demonstration Housing Project will include onsite infrastructure facilities like internal water supply, sanitation, electrical, pathways, septic tank, underground tank, street lighting, etc.

The Foundation Stone for the project was laid by Smt. Sonia Gandhi, Hon'ble Chairperson, UPA in the gracious presence of Shri Ajay Maken, the then Hon'ble Minister of Housing & Urban Poverty Alleviation on 7th November, 2012. An exhibition on Alternate Building Materials & Construction Technologies was also organised during the Foundation Stone laying ceremony. The project is being undertaken with the aim to popularize cost effective building materials and technologies in the area as part of BMTPC's mandate to disseminate sustainable technologies. The basic structure of the all the blocks have been completed and the finishing work is under progress.

Sustainable Transport Strategies for Dehradun City

*Pooja Singh** *M.Parida***
*P.S.Chani****

ABSTRACT

Rapidly growing urban population and changing morphologies of the urban settlements coupled with higher expectations of the global economy are placing unprecedented stress on the urban transportation system. Realization of issues and challenges of urban transportation and counter measures for them will increasingly rely on the development and deployment of new technologies and cutting edge solution Dehradun has grown manifold after being declared as capital of Uttarakhand state in 2000. The municipal corporation area had population of 4.26 lakhs as per Census 2001 and has grown to 5.66 lakhs in 2011. Considerable growth of population and registered vehicles coupled with a marginal increase in the transport infrastructure apart from Bus and Truck Terminals has been observed since inception of a new capital. Due to rapid ribbon development, along various corridors and concentration of activities in the core area, traffic problem has increased tremendously and become critical. Increase in city's traffic due to unprecedented growth in number of registered vehicles and influx of vehicles on city roads from surrounding areas. Lack of adequate road infrastructure facilities like footpaths, traffic signs, FOBs, street lights etc. put safety of road users at stake. Thus, the city needs a sustainable urban transport plan with focus on the mobility of people rather than vehicles by improvement in public transport and better integration in land use development and transport planning proposals.

INTRODUCTION

Although circumstances differ across cities in India, certain basic trends which determine transport demand (such as substantial increase in urban population, household incomes, and industrial and commercial activities) are the same. These changes have fuelled the demand for transport – a demand that most Indian cities have been unable to meet. The prevailing imbalance in modal split besides inadequate transport infrastructure and its sub optimal use. Public transport systems have not been able to keep pace with the rapid and substantial increases in demand over the past few decades. Bus services in particular have deteriorated and their relative output has been further reduced as passengers have turned to personalized modes and intermediate public transport (such as three-wheelers and taxis), adding to traffic congestion which has had its impact on bus operations.

URBANIZATION IN INDIA

India is world's second largest urban system. Its urban population has grown by about six times during last six decades'1951-2011. (Ref.fig-1)There has been 3-fold increase in the % of urban population to total population over the century. The vitality of urban settlement is evident from the fact that 31.15% live in town & cities in 2011 compared to 17.29% in 1951.

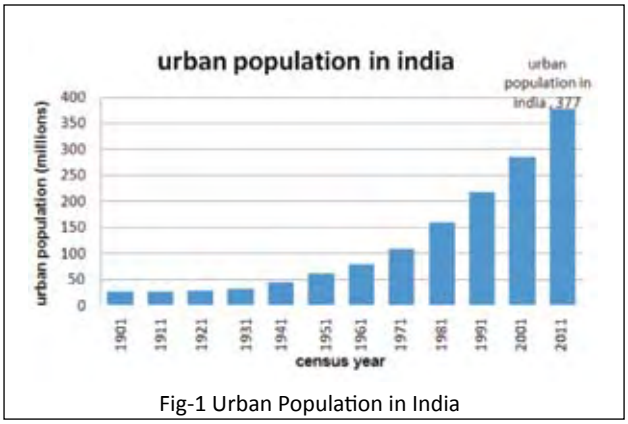


Fig-1 Urban Population in India

* Research Scholar, Department of Architecture and Planning, Indian Institute of Technology Roorkee; poozza26@gmail.com
** Professor, Department of Civil Engineering, Indian Institute of Technology Roorkee, mparida@gmail.com
***Assistant Professor, Department of Architecture and Planning, Indian Institute of Technology Roorkee; prabhjot.chani1@gmail.com

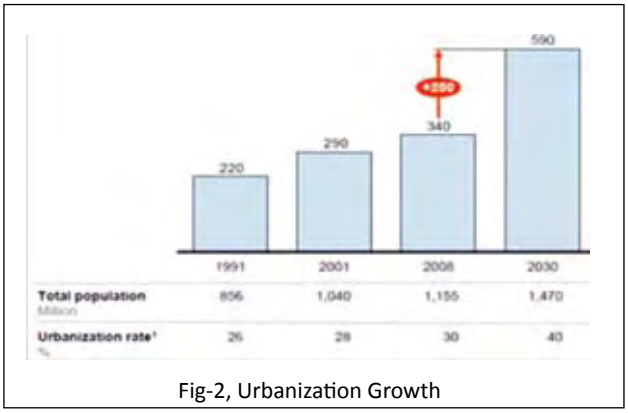


Fig-2, Urbanization Growth

India's urban system is skewed towards bigger cities. Concentration of population in bigger cities reveals imbalance in the Indian urban system. Cities likely to House 40% Of India's Population by 2030, (Ref.fig-2)

NEED OF SUSTAINABLE URBAN TRANSPORT

A sustainable transport is one that is safe, economically viable, and socially acceptable access to people, places, goods and services & meets the objectives for health and environmental quality. With the growth of population and urbanization, more natural resources and energy is consumed, which results in increased environmental pollution .Growth of urban transport along a sustainable path in cities is the foremost need of the hour; local pollution is a health hazard and Green House Gas (GHG) emissions are a global issue.

Dehradun, the capital of Uttaranchal state, houses many government and prestigious educational institutions of high repute across the country. Dehradun has grown manifold after being declared as capital of Uttarakhand state in 2000. The municipal corporation area had population of 4.26 lakhs as per Census 2001 and has grown to 5.66 lakhs in 2011.Due to rise in population and unprecedented increase in vehicular growth has resulted in traffic congestion, delays, rise in accidents and pollution levels, etc. which pose potential threat to the economic vitality and productive efficiency of the city. Thus, the city needs a sustainable transport planning with focus on the mobility of people rather than vehicles by improvement in public transport and better integration in land use development and transport planning proposals.

URBAN TRANSPORT ISSUES AND CHALLENGES

Dehradun is a dense populated city of 5,66,053 (Census 2011) over the area of 87.4 sq. km. the density of dehradun wards ranges from 2500 to 70,000 people/sqkm. kalika mandir is most populated ward.

The tourist inflow is also increasing @ 24.70%.(Refer-table-1)

Dehradun city comprises of 493 kms of road network of which 363 km are maintained by Municipal Corporation and 130 kms are maintained by PWD.

The traffic carrying capacities are low due to limited widths, intense land use and encroachments.

Vehicular Growth of Dehradun

- Two Wheeler : 10% per annum and has grown 2.5 times in the last 10 years.
- Cars: 17% per annum has grown 5 times in the last 10 years.
- No significant increase in Public Transport/ IPT.
- Annual Growth of 11% has been observed in last ten years.

Inadequate Public Transport System

The existing intracity public transport system is being operated by private operator through bus and tempo. The private buses are running on 10 routes having a fleet of about 100 busses. About 10 main tempo routes are operating in the city with about 1300 tempos on the roads which is not catering the need of present travel demand. Due to inadequacy of public transport 60-70 % of travel need are met by IPT mode. Vikram is the main mode of public transport in the city and operated from the road side, utilizing the road ROW as terminal and causing the delay of other vehicles plying on the road. (Ref.fig-3)

Unpredictable and Unreliable Public Transport System

- Due to unscientific route planning and location of depot the amount of dead mileage is quiet high leading to energy and financial losses.

Table -1: Tourist inflow in Dehradun city

Year	Indians	Foreigners	Total	% Increase
2009	11,23,715	17,051	11,40,766	---
2010	14,01,942	20,699	14,22,641	24.70

Source : CMP 2011

- Due to less passenger ridership in busses, their performance index is on lower side.
- No provision for physically challenged people.
- Lack of cleanliness and unreliability of mass public transport system results in shift to private transport modes to cater the travel need of the passenger

Lack of Inter Modal Integration

Lack of integration of public transport system which results in loss of productive time and energy on the one hand and fuel and environment inefficiency on the other hand like vikram and buses are running in competetion of each other rather than complement each other.(Ref.fig-3)

Fig-3 Inadequacy of PT and no proper integration of public transport

Fig-4 On street parking in CBD, Paltan Bazar

Fig-5 Encroachment by hawkers, Lalpul

Poor Parking Facilities

Due to rise in private vehicles Parking has become a chronic problem.

Lack of organized parking has resulted in traffic choking near commercial areas and on major arterial roads.

Inadequate availability of parking spaces near major commercial area leads to parking spill over. This spill over creates bottleneck for the smooth flow of traffic (Ref. fig-4,5).

Poor Mobility

Hardly any serious effort is made to make provision for elderly, physically challenged, children and females.

Inefficient Transport System Management

The transport system management is mostly absent and awfully in bad condition. Figure -6-12 showing some of the problem are. Loading and unloading during peak hours, poor road condition and geometry and no pedestrian facilities, poor signal operation ,resulting frequent traffic jam, chaotic scene, accidents, delay and loss of energy and productive time. Traffic Signals are not provided at major intersections like Clock Tower, Saharanpur Chowk.

Manual system often increases the cycle time of the junction and increases the delays. The manually operated junctions also impact the other adjacent junctions.

Deteriorating Environment Condition

The deterioration of the environment due to traffic has been causing serious concern. Some environmental issues of traffic are:

Safety of road users has been seriously endangered by the motor vehicles. An inevitable result of growth of traffic has been the increase in road accident which takes a great toll of human life

Fig-6 Loading/ unloading during peak hours

Fig-7 Signal non operative Aragarh chowk

Fig-8 Poor intersection design

Fig-9 Poor Road Condition

Fig-10 No pedestrian facilities

Fig-11 Improper geometrics of junction,Saharanpur chowk

every year. in many of the accident pedestrian are the sufferers. Children and aged is another group that receives severe punishment. Pedestrian, cyclist and slow moving vehicles account for 60-70% of fatalities.

Noise in the street and adjoining areas has been growing up to intolerable levels. It can cause discomfort, annoyance, interference in sleep, speech and general task and can cause physiological effect like deafness. Pramendra(2011), elucidates the levels of noise pollution in different zones in Dehradun city, which indicate that the noise level are exceed the standard limit in every zone.

Air pollution in atmosphere is fumes and gases emitted from vehicles create unpleasant environment and cause effect on health.

Lack of Inter Agency Coordination

Planning, development and

enforcement works on different aspect are performed by numbers of agencies in the urban settlement. Many agencies are working in different area of Traffic and Transportation, be it transport system,roads,rail,terminals or traffic control and regulation. But all these agencies work independently and hardly any coordination is visible amongst them. Lack of coordination amongst different agencies is responsible for absence of an integrated approach to urban transportation planning and development.

Inadequate Funding and Financing Option

Lack of finance is one of the most significant causes for slow progress in improving the urban transportation scenario. Funding and financing of urban transportation is still in an ambiguous state of affairs. Though some efforts have started in bigger cities but a longer path is yet to be travelled.

SUSTAINABLE TRANSPORT STRATEGIES

Transit Oriented Development (TOD)

TOD is walkable mixed use form of development along the transit. Concentration of high density along transit station encourage ridership. Decentralization of work places will reduce the travel demand remarkably as it reduce trip no. trip length. Locate major centers like restaurant, shopping, mall, plazas etc. along transit to reduce the no of trip.

Higher density development around BRTS. So that transportation system is convenient and economically efficient. The distance that a person is willing to walk to take the transit defines the primary area within which transit will occurs. Distance should roughly a 5 minute walk approx.400-600 m.

Improving Public Transport

Introducing world class transportation system like LRT, MRT and BRT in the cities to make it attractive for the private vehicle users. Providing a high quality public transport system that satisfies the transport need of all sections of commuters and offer an attractive alternative to motor car is the need of the hour in most of the urban settlement. Such a shift will reduce the energy requirement and vehicular emission to a great extent.

Instead of competition, different public transport should complement each other.

- Bus priority lanes and junctions should be planned to make it more attractive and faster alternative of cars.
- Intelligent traffic lights should be erected to detect approaching buses and turn green automatically at the junction. Make use of GPS system to locate the buses.
- Prioritization of bus traffic at signalized intersection will supplement the efforts made for dedicated bus lanes, which will tempt the passenger to use such vehicles in place of operation in the city.

Fig-12 BRT in Beijing

- Special care should be taken while planning and providing facilities for elderly, physically challenged, children and woman at the terminal to make them more mobile.(Refer-fig-12)

Transport System Management (TSM)

TSM techniques offer low cost solution to urban transport problems are:

a) Road Widening/Traffic Free Zones and TDR: Wherever feasible take up road widening by acquiring land but it is difficult in cities. So the novel solution is TDR (transferable development rights) wherein owner of the property on either side of the road to be widened have to compulsory relinquish the required extent of land needed to widen the street free of charges in lieu of increased FARs. The TDR can also be sold like share.

b) Traffic Signals Management: Computer controlled traffic signals management system provides flexible time traffic signaling, depending upon the volume of traffic and area-wise traffic signal coordination. Priority can be accorded to Public transport vehicles at traffic crossing.

c) Parking Policy: Parking policy should be critical consideration which should be evolved keeping in view the following:

- Review of parking norms for various land uses
- Optimizing parking spaces.
- Multilevel parking provision at the venues of public concentration in commercial areas/metro station.
- Minimizing the need for use of private transport.
- Review mixed land use policy
- On street parking should be

strictly banned on all arms of major intersections.

- Intersections identified for ban of on-street parking : Clock Tower, Saharanpur Road, ISBT Chowk, Prince Chowk, Darshanlal Chowk, Brindalpul Chowk.

d) Car Pooling: Car pooling can reduce vehicle emission drastically. Off peak our and weak end car schemes to allow more car primarily during off timing resulting less congestion and reducing energy requirement.

e) Peak Hour Congestion: Use of trucks and private cars should be banned on all major roads in mega cities during peak hours. Where individual still wish to ply their vehicles during peak hours, they should be required to obtain a permit on payment of a fee.

Staggering of office hours is a simple and effective way to spread the duration of the peak hour and lessen the pressure on the road space. School hour can be very conveniently planned to be sufficiently away from the office hours. Even the office and industrial working hours can be staggered.

The system of "minimum occupancy vehicles" can be introduced during rush hours in all millions plus cities along specified roads to reduce congestion in peak hours

f) Cordon Pricing: With a view To reduce the traffic congestion in Central Business District (CBD),a "Cordon Pricing System" for cars , heavy trucks and other such vehicles should be introduced. This would imply charging of an entry fee for the cars, trucks and other vehicles into notified CBD during specified hours.

g) Padestrianisation : Complete banning of the motor vehicles from certain areas and declaring the same as pedestrian precincts has a salutary effect on the traffic situation. It increases the safety of the pedestrians .it gives them the freedom to move about and shop leisurely. It frees the area from noise, fumes and smell .it may affect he shopping turnover also.

h) Better Traffic Monitoring and Information : The information includes; motorist location, prevailing traffic condition, road works, parking facility etc. even the optimal route. To allow every motorist to access a wide variety of information while travelling

i) Proper Road Signage's: Immediate need is to provide all kind of signages on all major roads.

Travel Demand Management (TDM)

TDM aims to maximize the efficiency of urban transport system by discouraging the inefficient private transport and encourage environment friendly public transport. Travel demand can be managed by controlling vehicle ownership and usage.

- Control of vehicle population has been achieved through two main measures: car ownership restraints and car usage restriction measures.
- Restrict vehicle usage by road pricing and parking fee and registration fee & fuel tax.etc, as practiced in Singapore.eg; Charging the drivers for using congested road and Imposing heavy parking charges. and banning inner city parking
- Vehicle Quota System (VQS) is to Controls vehicle population, where number of new vehicles are predetermined, Owners bid for Certificates of Entitlement (COEs) to own a car.
- Giving priority to buses and car pool and employer should encourage their employees to prefer public transport by giving them allowance for choosing public transport.

Provisions of Non Motorized Transport and Bicycles

- It is non- polluting and environment friendly. It is time saving, flexible. It is accessible in narrow streets, undulating terrain and difficult areas.
- Planning and development of dedicated bikeways, NMV streets and Lanes. Which should be adequate direct, shortest, safe and attractive. (ref fig-13,14).
- Develop underpass on major roads and signal control lock system as prevalent in west countries.

Pedestrian Facilities

- Footpaths are provided along major roads (NH-72, NH-72A) but missing on other arterial roads or have been encroached by hawkers.

Fig-13 Nanded District, Maharashtra, India

Fig-14 Bicycle Tracks in Germany

- So pedestrians are forced to use road space for walking. Footpaths are necessary to provide safe walking to the pedestrian.
- Pedestrian guard rails along footpaths

Improvement in Vehicle Design and Fuel Technology

- Improvement in engine design technology in two wheeler i.e changing the 2 stroke engines with 4 strokes will make the automobile environmentally clearer and energy efficient as well.
- Use of catalytic converters should be made mandatory in the petrol driven vehicles. As it can reduce CO2 and HC levels by more than 70%.
- Alternative fuel like electricity, solar energy CNG, LPG ,synthetic liquid fuels derived from hydrogenation of coal, synthetic liquid, which has been proved to be less air polluting and energy efficient.

Environmental Concern Measures:

Some techniques and measures to reduce the environmental impact like noise pollution, air pollution, and traffic induced vibration and visual intrusion are as follows:

- Change in design of vehicles, in tiers or road surfaces and Elimination of nosier vehicles & create barrier to reduce noise pollution.
- Modification in traffic operation
- Use small car instead of big cars & alternative fuels
- Controlling idling engines
- Construction of bypass and ring road to reduce traffic in mid town.
- Provision of wider roads & Enforcing a certain minimum distance between adjacent buildings to reduce vibration
- Suitable off street parking and enforcing measures for on street parking
- Control unsightly bill boards by suitable regulatory measures" IRC policy on Control of Road side Advertisement act"
- Access control & Provision of Service road

Nodal Authority

A single transportation agency (Nodal Authority) should be established in cities which will act as coordinator to all other agencies responsible for planning development and maintenance of urban transportation facilities. No plan of any agency should be implemented without the recommendation of this nodal authority.

CONCLUSION

The future transportation scene is bringing alarming challenges in the decades to come. A comprehensive vision is required to be developed to attain sustainable urban transport system for future. Rapid urbanization is a driving force to increased transport demand. Inadequacy of mass public transport system, inappropriate transport system management measures, inappropriate vehicle and fuel technologies, lack of inter agency coordination etc. have been making the urban transportation system unsustainable and inefficient. Mobility, safety, environment, energy, reliability, convenience etc. are the major issues striking the urban settlement in the current urban system in India. Corrective measures like Transit Oriented Development, Transport System Management and Transport Demand Management, Improved Public Transport Planning and Operation, Pedestrian facilities and Fuel Technology Capacity Building Practices will minimize the above said issues to the large extent and make the urban travel seamless.

REFERENCES

- Kadiyali, L.R.,(2012), "Traffic Engineering and Transport Planning" published by Publisher Khanna, New Delhi.
- Ministry of Urban Development, (May 2008), "Study on Traffic and Transportation Policies and Strategies in Urban Areas in India", Government of India, New Delhi.
- Mckinsey Global Institute, (April, 2010) "India's Urban Awakening, Building Inclusive Cities; Sustaining Economic Growth, India.
- Jain. A.K.(2009), "Low Carbon City-Policy ,Planning and Practice", New Delhi.
- Luthra Ashwani (2002), "Sustainable Transport Policy for Small and Medium Sized Cities of India", paper presented in National Conference on Transportation System, IIT Delhi,24-26 April.
- Luthra Ashwani (2011), "Planning and Development Strategies for Urban Transportation-2020", paper presented in 60th NTCP, Mysore.
- Chua Yew Peng (2010), "Towards Environmentally Sustainable Transportation Singapore", Singapore.
- Comprehensive Mobility Plan for Dehradun city, (2012), Transport department, Government of india.
- Dev Pramendra, (2011); "Environmental Noise Pollution Monitoring and Impacts On Human Health in Dehradun City, Uttarakhand, India", Civil and Environmental Research, Vol 1, No.1.
- Todd Litman, (2007,) "Developing Indicators for Comprehensive and Sustainable Transport Planning , Transportation Research Record 2017, Transportation Research Board (www.trb.org).

*****

Construction of Bamboo Houses with Balcooa

*Kamesh Salam**

A typical construction of a modern and improved Bamboo house would mean the up gradation of some traditional systems to improve its performance. It would essential mean the use of a combination of materials like metal, cement plaster etc in conjunction with whole Bamboo and other forms of Bamboo to provide longevity, safety and better living standards. Its basic features would be

- Improved design to respond to rain and weathering.
- Better response to earthquake forces.
- Improved framing methods for structural safety.
- A pucca plinth made of brick and mortar instead of a Mud base.
- Use of mature and treated balcooa only in super structure
- Use of M.S.Plate and bolt joinery instead of organic ropes etc.
- Typical cement plastered walls over variety of woven bamboo panels in place of Mud plaster.
- Choice of flooring and finishing.

The construction of a typical modern bamboo house would involve the following pre construction steps :

- Selection of mature and straight and mature and straight bamboo pieces.
- The natural preservation and additional chemical treatment of bamboo.
- Designing of structures with features to protect from rain and weaturing.
- Planning a rigid frame structure with safe joinery details.

FRAMING FEATURES

Bamboo can be used to provide many structural solutions and a typical two-way lean-to roof is much favoured. The framing of such a structure would involve the use of few isolated columns and partition walls connecting smaller columns at regular intervals. This type of framing is dependent on the height and size of the structure. The important design consideration for framing is as follows:

- The construction of a rigid and lightweight framework out of bamboo which responds to dynamic loads and is protected against any buckling.
- Use of correct joinery and structural design to respond to earthquake and other impact loads.
- Framing also has to take into

Fig 1. Demonstration house

* Founder and Executive Director, South Asia Bamboo Foundation, (SABF), Guwahati and Expert Member of National Bamboo Mission (NBM), Ministry of Agriculture and Coop, Government of India

Fig 2. Veranda and Overhang in Demonstration House

Fig 3. A Bamboo truss being erected

account the need for large overhangs to protect from rain and weathering.

- Optimum column spacing to accommodate bamboo weave panels for walls.

STRUCTURAL FEATURES

Owing to the lightweight nature of Bamboo structures the columns are less susceptible to failure due to constant dead load, but its primary objective is to remain stable under any lateral stress and impact. For such it is ideal to work with closely spaced columns with bamboo reinforced walls, which acts as stiff diaphragms. This provides rigidity to the structure. For isolated columns it is sometimes essential to work with bundle columns of different types to respond to additional weight and prevent any buckling. In case of beams a combination of single and double bamboo arrangement can be considered to respond to additional weight.

A typical Bamboo structure is a combination of the following structural characters:

- The roof structure is out of lightweight Bamboo members and is supported on the ridge and edge beams. With proper joinery a variety of trusses can also be used.
- The beams transfer the load to the plinth with a closely spaced column arrangement.
- The stiffness and rigidity of the structure is provided by the lateral connecting members and the bamboo panel-mortar walls which act as diaphragms. The Bamboo panel walls can be combination of various Bamboo weaves with wire mesh and Cement Plaster of 1:3 ratio.

JOINERY

One of the most important aspects of a modern Bamboo House would be its joinery. Traditionally, a combination of ties and lashings has been used. A better alternative to this is the use of metal plates and clamps fixed together with bolts. This makes for a rigid and safer alternative and there is no concern for recurring maintenance. The M.S plates used for this purpose is 40mm wide and with a thickness of 3-4 mm. A typical metal clamp join would be at the ridge and at the edge beams. Depending on the specific detail a variety of profiles can be fashioned out of the metal plates and joined together with bolts. It is important to protect the bamboo against crushing and specific joineries have to be designed to distribute large point loads.

While working in these joints, it is necessary to keep in mind the following issues:

- The M.S plates and bolts have to coat in primer.
- Joints should be close to the internodes to avoid splitting of bamboo.
- Limit the number of bolts in a

Fig 4. M.S plate joinery for ridge

Fig 5. M.S plate joinery for edge beam

particular section of the Bamboo.

- Use hand drill or electric drill only for insertions.
- Grout mortar into critical joints for additional strength.

CONSTRUCTION OF WALLS

A modern bamboo house in the North East of India would have Bambusa Balcooa as its main structural member. For walls a variety of readily available bamboo weaves can be used to provide mortar finished wall panels. Traditionally the walls of many old buildings in the region are made out of elephant grass and bamboo weave combined with mud plaster and cement mortar. Among the many possibilities of bamboo weave and cement mortar walls the most versatile is the Open weave panel with 40mm strips at 100 mm apart which is overlaid with wire mesh and plastered. The Bamboo mat weave is also useful to provide such mortar walls but the epidermal layer of bamboo has to be avoided as it does not adhere well with the mortar, hence they can be put to good use to provide semi enclosed spaces only. Another option is the Split Bamboo mat where the Bamboos are split and opened up to expose its inside; this along with a wire mesh over lay can be plastered consequently.

SEQUENCE OF CONSTRUCTION

Step1: Selection and Treatment of Bamboo

A prerequisite for any good bamboo construction is the selection of mature and de-starched bamboo. The mature Balcooa in 3-4 years old and a dry bamboo means the starch content is considerably decreased when the felled bamboo are kept under water. A good source of such bamboo is the riverside market where the bamboos have been transported along the waterway. This sets a natural preservation process in motion whereby the bamboo becomes less prone to borer attack.

The Bamboos selected for construction would be the one without any major deformations. Once the pre-selection is done a range of chemical treatment can be done to preserve the bamboo. The most favoured ones would be

- Dipping in boron solution
- Dipping or injection with diesel and creosote solution.
- Subjecting the bamboo to light smoking in controlled chambers.

Step 2: Planning the Substructure

To respond to site, weather and earthquakes etc. it is best to erect the bamboo structure on a brick and concrete base. The advantages of such a substructure are:

- The combination of short RCC columns and the plinth beams provide protection during earthquakes etc.
- The raised plinth keeps the rain splashing and moisture from reaching the bamboo structure.
- The plinth is used to lay out the plumbing and electrical connection as per design and latest specification.
- The plinth is to be designed keeping in mind the exact position of the Bamboo columns

Fig 6. Creosote-Diesel Injection in Bamboo

and framing so as to correctly place the Bamboo over the strip columns.

Step 3: Erecting the Bamboo Structure

- The bamboo column is cut and sized to their required length.
- The bamboo columns are placed over the strip columns in the plinth with the help of a reinforced detail.
- Depending on the position and importance of the columns a combination of single and bundle columns are used.
- Once the columns are fixed, it is left to cure for a week to ten days to attain its strength

Step 4: Framing Sequence

After the columns are set, it is safe to proceed with the framing of the superstructure.

- With attention to precision the edge beams and the ridge beam are put in place and temporarily fixed
- The ridge beams have to be placed with a minor rise in the middle of the structure to negate the perspective effect.
- The rafter and purling are to be fixed next as per design. They have to be selected on the basis of their lightweight nature and straightness.
- The woven Bamboo panels are fixed in place and attached to the columns with Iron bars at regular intervals
- The Door and Window frames are put in place and fixed with either the Bamboo wall panels or the Columns as per the location.

Fig 7. Bambusa Balcooa

- A wire mesh is then overlaid over the woven Bamboo panels. A combination of jute mesh and Bamboo weave can also be used.

Step 5: Joinery

As the skeletal frame of the structure is ready, all the joints are now fixed and sealed before starting the finishing works. While doing so the following have to be kept in mind.

- The joints are to be close to the internodes such that the bolts are within the last internode
- The open ends of the Bamboo pieces are to be sealed with mortar.
- For the critical joints, mortar car be grouted into the hollow of the Bamboo for better safety.
- The joints with bolts used for tightening should be done carefully such that the Bamboo is not crushed and the use of large washers is a must. Excessive tightening of the bolts could result in splitting.

Step 6: Finishing with Cement Plaster

As a final step in the construction, the Bamboo weave panels have to be plastered to act as partition walls and also to provide stiffness and resilience to the structure.

- Cement plaster in the ratio of 1:3 is applied over the Bamboo weave panels.
- The iron bars connecting the Panels to the Columns and The Door-Window frames etc are now embedded in the Plaster.
- The use of the wire mesh and metal bars embedded in the plaster gives much needed resilience to the structure
- The walls have to cured with water for a week to attain its strength.
- The exposed Bamboos are now thoroughly cleaned and finished with any typical wood finish for protection from moisture and to add to aesthetics as well.

CONSTRUCTION PLANNING

Design:

- Architect / Engineer to plan and detail
- Architect / Engineer to provide estimated work plan

Skilled workers:

- Skilled workers with bamboo working skills and tools.
- Carpenter to supervise framing and joinery
- Skilled masons

Material:

- Mature bamboo
- Treatment chemicals.
- Power drills
- Civil construction materials.

TREATMENT AND PRESERVATION

Natural Method of preservation:

Water seasoning is the best natural way of preservation without any fear of pollution. in this process the bamboos are dipped in flowing water immediately after felling and are kept in that condition for about three months. After removal from water they are kept under shade for ten days to about 3 months to bring the moisture content to safe and stable level.

Dip Diffusion with boron solution:

In this process boric acid and borax is added to water in the ratio of 1:1.5. The bamboos are then dipped into it. Boiling is required only if the bamboos are dry, but the temperature should not be allowed to exceed 60 degree Celsius, else the chemical will evaporate with the steam. The duration of dipping is 2 to 3 hours. Both whole and split bamboos can be used in this process. The bamboos are then kept in the shade for 3 to 4 days for drying.

Internodal injection with creosote oil:

In this process creosote oil is poured inside the bamboos through the drilled holes and then the holes are close by using putty or wax. The bamboos are then allowed to dry in shade for three to four days so that the bamboos absorb the oil. The bamboos treated by this process can be used for both internal and external use.

COST ESTIMATE

Cost of a typical Bamboo House is @200rs/sqft.

- Bamboo works @ 25% of total value of work.
- Foundation/ plinth @ 35% of total value of work.
- Floor/roofing/plaster @ 25% of total value of work.
- Door-Window/ electrical/ Plumbing @15% of total value of work

BIBLIOGRAPHY

1. Das, Bipul k. 2001, bamboo in the field of construction in north east India. Cane and bamboo technology centre, Guwahati
2. Jayanetti, Lionel and Follet, Paul. 1998. Bamboo in construction. Published by TRADA and INBAR for Department of international development.(DFID).
3. Stamm, Jorg. 2001,Guadua Para la, construccion de pueten en guadua, GTZ,Cooperacion alemana al desrrollo.
4. Leisse, Walter. 2003.
5. Kaley,Vinoo.2000. Venu Bharati Aproop Nirman, Maharashtra, India
6. Ubidia, Jorge Moran. 2001. Building with bamboo, special edition for workshop in aizawal by CBTC – UNIDO. Guwahati.India

*****

Contd. from Page 37

-struction of housing units;

iii. Post construction management of services and maintenance of houses and community assets;
iv. Production, transport, storage and delivering of building materials;
v. Real estate business related activities.

In India, the Government has taken some serious steps towards successful 'urban mobility'. At the National level, the Hon'ble Prime Minister of India released the National Action Plan on Climate change on 30th June, 2008. The plan comprises missions such as the National Solar Mission, the National Water Mission, and the National Mission for Enhanced Energy Efficiency, etc. One of the eight missions is The National Mission for Sustainable Habitat which seeks to promote sustainability of habitats through improvements such as energy efficiency in building, urban planning, improved management of solid and liquid waste including recycling and power generation, model shift towards public transport and conservation.

REFERENCES

- http://www.buowl.boun.edu.tr/teachers/sample%20student%20essays/urbanization/urban1.htm
- http://lifestyle.iloveindia.com/lounge/urbanization-effects-12295.html
- http://www.isb.edu/cems/focus-areas/urbanisation-and-affordable-housing
- http://www.kpmg.com/IN/en/IssuesAndInsights/ArticlesPublications/Documents/Urban-housing-shortage-in-India.pdf

*****

Training of Trainers (TOT) Programme
on Earthquake Resistant Design & Construction for State Engineers and Architects

The Bihar Institute of Public Administration and Rural Development (BIPARD), Government of Bihar at the behest of the Bihar State Disaster Management Authority requested BMTPC's assistance in conducting Training of Trainers (TOTs) on Earthquake Resistant Design and Construction.

In order to impart training, standardised Resource material for Training of Engineers, Architects and Contractors & Builders in earthquake resistant design and construction has been prepared in association with Deptt. of Earthquake Engineering, IIT Roorkee. Under this project, BMTPC is organising training programmes for Training of Trainers (16 batches for engineers and 10 batches for architects).

The series of Training of Trainers (TOTs) Programme was kick-started by organisation of Sensitization Programme on "Earthquake Resistant Design and Construction" jointly with IIT Roorkee on 15th January, 2013 at Patna.

So far seven batches of the TOTs have been organized. The resource persons are from IIT Roorkee, IIT Mumbai, NIT Patna, BMTPC including other experts in the field. At the end of training of each batch, evaluation of trainees has also been conducted through examination.

Sustainability in Preparation of Master Plan of Urban Areas

*Deepak Bansal**

Global warming due to Greenhouse Gases is a serious concern all over the world. The urbanization is increasing resulting in more energy demand thus GHG are increasing. It is assumed that building contributes to about 40 % of Greenhouse Gases and consumes about 30% of fresh water. India with a population over 120 billion as per Census of Year 2011, is the second most populous country in the world. Presently India has about 30 % population in urban areas, but this is increasing rapidly because of heavy migration from rural areas to urban areas and also due to natural growth of population in India. The huge population in urban areas requires massive energy for Housing, Transport, Industry, Communication, Recreation etc. India needs a strategic planning system to develop urban centres/cities in such a way that all the required people can be accommodated in these cities with the reduced impact on the environment. This can be done by incorporating sustainability in Master Plans of the cities.

Currently many cities are being developed (along the Delhi Mumbai corridors, Jharkhand, Chhattisgarh etc.) and Master Plans of the many old cities are being revised (like Delhi etc.) to accommodate more people in the cities. For this purpose Floor Area Ration/ Dwelling Density/Height Limits etc., are being increased and green areas/ river/forest/agricultural areas are converted into residential/industrial usages, without thinking the impact of this on the environment and infrastructural services like water supply, sewerage, electricity, transport, rain water recharging, biodiversity, flora and fauna and Disasters like Floods, Earthquakes and on Emergency services like Hospitals, communications and emergency response time . The increase in height of the existing buildings may result in weak buildings as the increase in no of floor on the existing building has its impact on structural members of the lower floors (Columns & Beams) and on foundations. Many of the buildings are already weak and are unauthorized, will play havoc, in case of any failure not only to self but to other nearby properties also. The only purpose of this present development is to accommodate more and more person in the same geographical area without augmenting facilities. This is a sure sign of a disaster in making.

The master plan is a vision document of a city, which defines the human activities on a given piece of land and in a typical master plan Residential area occupies about 20-40 % land area, Business/ Industrial/Institutional area about 20-30%, Transport about 10-20 % and rest areas are green/forest/ water bodies/agriculture/misc. areas. Typically in a master plan green areas are about 10-20 % only. The distribution of areas varies depending upon the planner's creativity. However the distribution of the areas is not done as per sustainability criterion but on economic and aesthetics considerations.

If one has to calculate the sustainability of a city, then the best way is to calculate the carbon footprint of the development at the Master Plan level. This can be done based on total area under Built up Area, area under Transport activities, area under Manufacturing, area under Utilities and energy consumption of the town like usages of electricity & petroleum product. Every Sector has a defined carbon footprint and this can be obtained from the reference available. The carbon foot print of the built up area can be easily done based on area and FAR al-

* Deputy General Manager (Projects), Housing & Urban Development Corporation Limited (HUDCO), New Delhi 110003, India. Email: dbansal1969@gmail.com

lowed. Suppose the total built up area of affordable housing at the master plan level, comes out to be 1000 Sqm, then as per the average carbon content of the building materials @ 4GJ/Sqm (This is total Embodied Energy for Load Bearing affordable Housing, and besides these houses will further require energy for operation, which may be calculated as per actual electrical/fuel consumption) will be 4000 GJ. Similarly the carbon foot print of the other buildings/Industry/ Transport etc. can be calculated. This way the carbon footprint of the city can be calculated. This will give a complete picture of the carbon content of the city at macro level. The towns can then be defined on a sustainability yardstick based on carbon content of the Master Plan.

Now the carbon content of the city can be reduced by trees and greens and usages of New & renewable energy. The carbon is sequested (consumed) by Trees and plants, and on an average a Deciduous tree sequest about 12Kg of carbon per year i. e. about 134 MJ energy equivalent per year. The average life of a Tree is about 20 years, (although trees life is more, but this has been taken as 20 Years to take the benefit of Forestry Products) hence a tree will sequest 2680 MJ of energy equivalent in its life time (20 years). Hence for 4000 GJ, about 1500 Nos of trees are required. An average Tree takes about 2-5 Sqm of land area, hence about 4500 sqm of forest area will nullify total carbon foot print of the embodied energy of 1000 sqm of built up area in 20 Years. If the allowed FAR is 2, the ground coverage of 1000 sqm area will be 500 sqm, for this area forest area of 4500 sqm is almost 9 times, hence would be difficult to provide. In such situations some trade-off has to be achieved. Similarly the carbon content of other activities like Transport, Industry etc. may also be calculated and equalized by Trees either fully or partially. This approach is missing in the preparation of master plans or in the revision in the master plans.

The hierarchy of spaces can be designed in such a way, so that all the daily needs are available within a distance of 1-1.5 km through a well shaded pedestrian or cycle track (Deciduous Trees can shed its leaves in winter allowing sun to reach in cold season). Public transport should be designed in such a way to use minimum fossil fuel by using minimum road lengths per sq km of developed area. CNG is a good fuel but has a disadvantage of emitting much more micro particles in air, which are aserious health hazard, hence either solar or Electrical/Battery operated vehicle may be encouraged in the Master Plan.

Similarly the water requirements, sullage water recycling can also be integrated along with the rain water harvesting proposal in the Master Plan. It is observed that 80 % water demand can be fulfilled by sullage water treatment, hence fresh water demand can be reduced and loads on STPs can also be reduced by reusing sullage water. Rain water can be harvested and monitored which may result in self-sufficiency on water front at master plan level. The monitoring of these activities are very much required, as it is observed that Rain water Harvesting structures are not actually collecting/Recharging ground water at the correct Aquifer level, and there is no development of ground water Table. There should be Piezometers to record the fluctuation of the water tables at the control locations.

There should be more emphasis on the renewable energy like solar and wind in the master plan and this should be mandatory in the master plan, so that dependence on fossil fuel based power can be reduced. At least 10 % of the power requirement of the public facilities may be achieved through renewable energy in the beginning of the development and gradually increased to 100 %.

All these steps are achievable, quantifiable and will result in major saving in energy thus in carbon content and do not require much capital expenditure. When CFL (Compact Florescent Lamp) were introduced about 10 year back, there was a great apprehension in the mind of public that this is very costly i. e, about Rs 300/ unit of 12 W compared to Rs 10/ for an Incandescent Bulb, and public was generally could not visualise the future of CFL at that point of time. Now in Delhi, CFL is a great success and cost has also come time i. e about Rs 100/Unit and changed the mind set of people as they themselves have seen the reduction in energy bill. Similarly, now Fans, Refrigerators, TV, ACs, Washing Machines, Bikes, etc., are rated based on their energy efficiencies. CFC (Chlorofluorocarbon) based refrigerants have been completely banned in most of the countries.

The Master Plan is a very important legal document and the...

Contd. on Page 61

Prefabricated Housing Options for Migrant Workers



*S.K. Nath** *Jagadish Vengala*** *Amitava Sil****

Urban mobility is essentially linked to pre-fabricated housing in many countries, as the economical and practical housing for migrant workers is much related with the prefabricated housing. The shortcomings in the housing facilities provided to the highway and urban infrastructure workforce is becoming a serious concern. To improve the better living conditions of the workforce, pre-fabricated housing may give the better answer. Safety and hygiene living of the workforce can be taken care by creating proper housing facilities.

Following are the two types of pre-fabricated bamboo based houses developed/constructed at IPIRTI.

- Timber Prefabricated Bamboo House(TPBH) and
- Steel Pre-fabricated Bamboo House(SPBH)

Considering the importance of Bamboo, IPIRTI, during the last two decades has developed cost effective technologies for manufacture of bamboo composites which have been commercialized. Use of bamboo composites reduces the pressure on nonrenewable building materials, reduce pollution thus leading to substantial energy conservation. The institute has brought out specification for all the three bamboo composites developed i.e. IS: 13958 Bamboo Mat Board for General Purpose, IS: 14588 Bamboo Mat Veneer Composite for General Purpose and IS: 15476 Bamboo Mat Corrugated Sheet as roofing material. These products are well accepted in the market and there is a great demand for the same.

Composites bestowed with unique advantages such as lightweight, high strength to weight ratio, drew attention from the developed world for novel applications and are replacing the conventional materials like metals, woods etc. Bamboo composite materials offer some significant advantages over heavier metals in many structural applications due to the flexibility of selecting various fiber reinforcement (bamboo slivers) and resin matrix. The reinforcing slivers are the primary load carriers of composite materials with the matrix component transferring the load from sliver to slivers. It has been observed that a weight saving of over 20% is attainable in most of the structures. These are due to lower density of composites and in addition to their inherent properties provide performance benefits over other conventional materials.

Keeping in view the importance of Bamboo and its tensile strength, IPIRTI, during the last two decades has been working on building bamboo based houses using bamboo and bamboo composites.

TIMBER PREFABRICATED BAMBOO HOUSE

Bamboo construction technique is also amenable to prefabrication either in the form of precut or prefabricated components like trusses, frames, columns, wall panels and beams (BMB and wood glued components) or as fully prefabricated units which can be transported.

Plate 1 Timber prefabricated Bamboo House

* Joint Director, Indian Plywood Industries Research & Training Institute (IPIRTI), Bangalore
** Scientist-D, Indian Plywood Industries Research & Training Institute (IPIRTI), Bangalore, E-mail: jdvengala@ipirti.gov.in
***Scientist-C, Indian Plywood Industries Research & Training Institute (IPIRTI), Bangalore

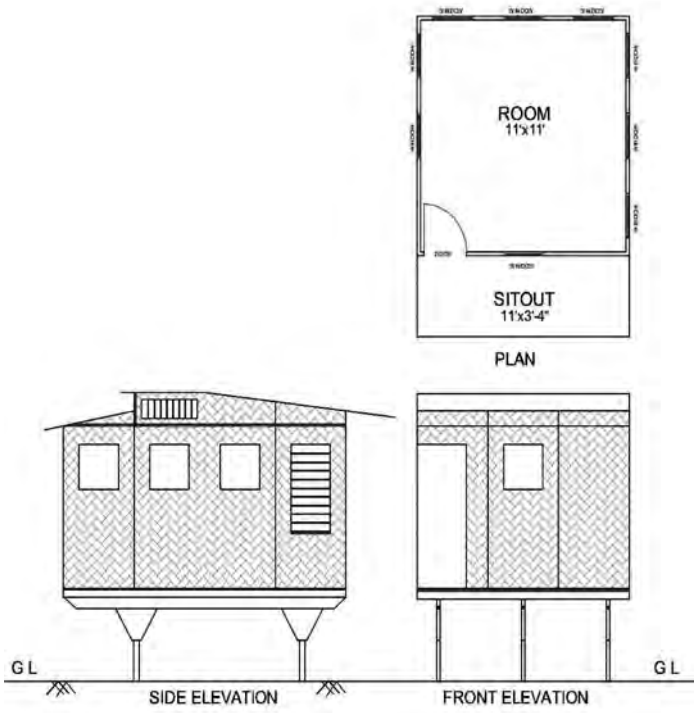


Fig. 1 Plan and elevations of Timber prefabricated Bamboo House

Fig.1 shows the plan, front and side elevation of the Timber prefabricated Bamboo House. Treated wood sections of 3.5"x3.5" was used as columns to raise the structure from the ground level. These timber columns were set in concrete footings to transfer the loads from the structure to the ground. BMB was used to create the box beams to support the structure. Wall panels are composed of 8'x 4', 6mm thick bamboo mat board. Treated timber battens of 2.5"x1.5" cross section has been used to construct the basic wall frame. Panels were nailed and glued over the battens on both sides of the wall. Wood –BMB composite box beams were also used as roof beams at key places to carry out the load from the roof. 2" x 3" treated sawn timber sections were used as purlins and supporting beams over the roof other than the box beams.

Bamboo Mat Corrugated Sheets (BMCS) were used for the house and placed over 2"x 3" sections of timber using standard J-bolts. For doors and windows, frames were made of 75 x 60 mm sawn plantation timber like silver oak and shutters consists of single skinned BMB infill panels stiffened with silver oak rails and styles. Door and window frames were tied to the grids through nails driven into the outer perimeter of door and window frames as fixing points. Plate 1 shows the Timber prefabricated Bamboo House (TPBH).

STEEL – PREFABRICATED BAMBOO HOUSE (SPBH)

The design specifications of single walled prototype house with attached bath having size 10ft x 12ft x 8 ft are as shown in Fig 2.

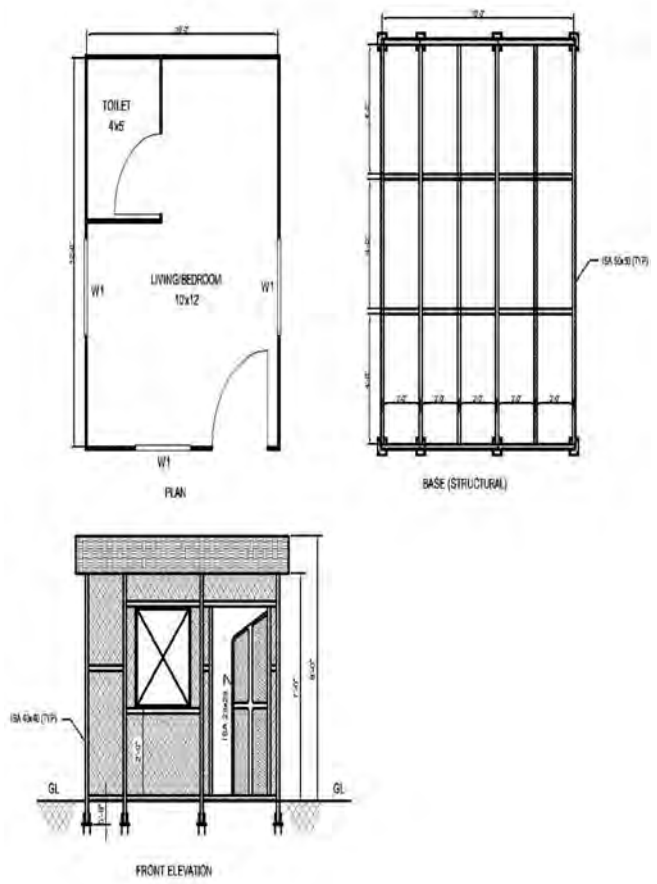


Fig 2 : Plan and Elevation Prefabricated Single Walled Modular House

Construction Methodology :

Bamboo composite material such as Bamboo Mat boards are fastened on rolled steel framed angle ISA sections allowing provisions for doors and windows and then erected quickly at site. The steel angles are erected through proper grouting, bolting and welding to get proper shelter dimensions along with steel purlins on the top to support the roofing sheets (BMCS). The doors are made out of bamboo mat boards of 6mm thick fixed on door frames and windows are of glass panes fixed to steel window frames. The whole structure rests on cement concrete floor through grouting. Generally, the dimensions (length and breadth) of the floor are built slightly larger than the inside dimensions of the shelter to protect the foundations of supporting steel structures.

Structural :

All structural components are composed of rolled steel sections conforming to IS:808 (Part-V). The angles are of equal angle sections subjecting to withstand wind load and dead load in both directions. This provides excellent structural integrity.

Base:

The base consists of grid steel framed structure ISA 50 x 50, 3mm angle running in both directions. Spacing of bottom runner is 0.6m c/c which is placed in inverted position. Elevation from ground level is 0.66m.

Wall Panels:

Wall panels are composed of 8'x 4', 6mm thick bamboo mat board. The panels are attached to the structural steel frame by screw rivets on the building interior. The wall panels are water and heat resistant and conform to IS: 13958.

Connection:

All structural components are interconnected by 12mm dia nuts and bolts to create a unitized framework to make it completely dismantable type.

Floor:

Flooring consists of 8'x 4', 16mm thick bamboo mat board and conforms to IS: 13958. A coating of Rhino prime is given on the top surface to avoid any abrasion. The panels are kept above steel grid frame and then nut bolted on top.

Ceiling:

The ceiling consists of 8'x 4', 6mm thick bamboo mat board placed on the steel grid frame with purlins and rafters of ISA 35 x 35, 3mm thick. The edge joints are sealed with GE silicon sealant on top surface to avoid any water seepage. **Doors and windows:**

Standard outfitted window having char glass panes and ISA 25 x 25, 3mm thick as frames were fixed. The door frames are also of ISA 25 x 25, 3mm thick having 8'x 4', 6mm thick bamboo mat board as door panels which are lockable from both sides.

Toilet:

It is of size 4'x 4', having partition wall with 8'x 4', 6mm thick bamboo mat board attached to structural frame which is completely dismountable type with a provision of EWC.

Plate. 2 gives the view of single prefabricated bamboo house and Plate 3 gives the typical floor view inside the SPBH.

The main advantage of development of modular houses is that they can be pre-fabricated in

Plate 2 Steel Prefabricated Bamboo House

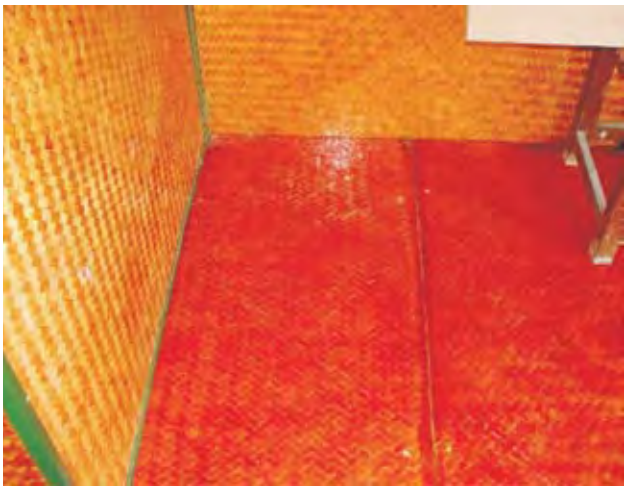


Plate 3 Typical floor view inside the House

large quantities and can be easily transported to construction sites. IPIRTI's bamboo composite panel based pre-fabricated houses can be transported efficiently in "one pack" and assembled quickly. Such technology will be highly useful particularly for relief agencies for disaster management. Bamboo based panels have properties similar to the wooden panels. The potential market for using bamboo based composites in construction for pre-fabricated housing is very promising.

Besides the benefits of a quick supply of houses in large quantities, the design and development of a bamboo based modular housing production chain will also directly benefit the bamboo growers, harvesters and employees of the building industries by generating direct and indirect employment and linking them with industries in pre-processing and processing of panel components. This will lead to the development of long term rural-urban market linkages.

This prefabricated bamboo housing can be best used for accommodating the workforce in highway and urban infrastructure. These houses can create the healthy and safe environment for the workforce and can be shifted from one place to another place easily.

*****

Road Show on
Emerging Fast Track Technologies for Mass Housing

A Roadshow/Exhibition-cum-Seminar on 'Emerging Fast Track Technologies for Mass Housing' at Chennai was organised jointly with Indian Concrete Institute at Convention Centre, Tamil Nadu Trade Promotion Organisation, Chennai from 18-19 December, 2012. This was the first of its kind road show organized in Southern Region with the aim that the construction industry will learn the new ways of construction and adapt them in field so that the dream of adequate and affordable housing for all is fulfilled.

During the Road Show, 22 companies participated and displayed their products and technologies in the area of mass housing. More than 300 participants from R&D, Academic Institutions, NGOs, Building Centres, Manufacturers, Builders, Housing & Urban Development Authorities, public and private sector departments/agencies working in the area of housing and building construction participated in the Road Show.

भवनों का भूकंपीय पुनर्वास

डॉ. शैलेश कु. अग्रवाल*

Lkkjk'k

भूकंप के दौरान मानव निर्मित अभियांत्रिक एवं गैर अभियांत्रिक भवनों के ढहने से सर्वाधिक जान–माल की क्षति एवं चोटें आदि होती हैं। वल्नरेबिलिटी एटलस आफ इंडिया के अनुसार देश का लगभग 57 प्रतिशत क्षेत्र सामान्य से गंभीर भूकंप के दायरे में है । भारत, जो एक भूकंप प्रबल देश है, में ज्यादातर मकान ऐसे हैं, जिनमें कोई विशेष भूकंप रोधी उपाय नहीं किये जाते है तथा अवांछित जोखिम के दायरे में हैं। इसलिए, सबसे बड़ी चुनौती यह है कि इन नाजुक भवनों का पुनर्वास (पुनर्स्थापन) किया जाए ताकि महत्वपूर्ण रूप से जान–माल की क्षति को कम किया जा सके।

संरचना (स्ट्रक्चर) अभियांत्रिकी बंधुओं के सामने एक सवांधिक चुनौतीपूर्ण कार्य विद्यमान भूकंप भेद्य भवनों के पुनर्वास का है। जैसा कि भवनों की संहिताओं का अद्यतित किया जाता है तो इनमें से विद्यमान बहुत सारी इमारतें वर्तमान मानकों को पूरा कर पाने में पीछे रह सकती हैं यद्यपि हो सकता है इन्हें पूर्ववर्ती संहिताओं के मापदंड के अनुसार डिजायन एवं निर्मित किया गया हो। बहुत सारी संरचनाएं (विनिर्माण), संभवतः अपर्याप्त हो सकती है और भविष्य के भूकंपों के लिए गंभीर खतरा साबित हो सकती हैं पुनर्वास उपायों से इन इमारतों की क्षमता को उन्नत निष्पादित किया जा सकता है और इस लेख का यह मुख्य विषय है।

यह सर्वविदित है कि प्रारंभ में ही भूकंप अवरोधन को समाहित कर भवन बनाना अपेक्षाकृत अधिक सस्ता होता है अपेक्षाकृत बाद में मरम्मत और सुदृढ़ीकरण कार्य करने के। भूकंप अवरोधन की विशिष्टताओं को समाहित करके बनाई जाने वाली इमारत में लगभग 2–5% की अधिक लागत आती है, अपेक्षाकृत बिना उपायों का शामिल किए जाने वाली इमारत के। हालांकि बाद में इमारत में किए जानेवाले मरम्मत एवं सुदृढ़ीकरण के कार्य में, शुरूआती लागत से 4 से 8 गुना तक लागत आती है। इन तथ्यों के बावजूद, भवनों का निर्माण भूकंप–रोधन विशिष्टताओं के साथ नहीं किया जाता। पूर्व में आने वाले भूकंपों के दौरान इन आरसीसी संरचनाओं की असफलता एक प्रमाण के रूप में सामने हैं।

Hkwdai h; iquokl

'भूकंपीय पुनर्वास' एक व्यापक शब्द के रूप में प्रयुक्त होता है जिसके अंतर्गत मरम्मत, उन्नयन, रेट्रोफिटिंग (सज्जीकरण) एवं सुदृढ़ीकरण की अवधारणा सम्मिलित होती है जोकि भवन की भूकंपी नाजुकता को कम करने का काम करती है। विश्व भर में भूकंप प्रभावित क्षेत्र में विद्यमान भारी संख्या में इमारतों को अनेक कारणों एवं प्रेरकताओं से भूकंपीय पुनर्वास की जरूरत है जैसे कि कोडल नवीनीकरण या भूकंप क्षति। भूकंप से क्षतिग्रस्त इमारत को पुनः इस्तेमाल के लिए सुदृढ़ीकरण के साथ–साथ क्षति ग्रस्त भागों की मरम्मत (भूकंप पश्चात पुनर्वास) की आवश्यकता हो सकती है। सामान्यतः इनका पुनर्वास किया जाता है ताकि भविष्य में धरातलीय गति से उनकी बेहतर भूकंपी निष्पादकता प्राप्त की जा सके। प्रायः विद्यमान बहुमंजिला इमारतों की रेट्रोफिटिंग इसलिए अनिवार्य बन जाती है जब ऐसी इमारतों की अपेक्षित क्षमता वर्तमान भूकंपी संहिताओं (कोड्स) की अपेक्षाओं को पूरा करने में संरचनात्मक (बनाकर) रूप कमतर पाई जाती हैं। भूकंपीय कमजोर इमारतों, जिनकी डिजायन वर्तमान कोडल (संहिता) प्रावधान को पूरा नहीं करतीं, को भी पुनर्वास (भूकंप से पूर्व पुनर्वास) की आवश्यकता हो सकती है। भूकंप के पश्चात विद्यमान इमारतों की रेट्रोफिटिंग करना संरचना (स्ट्रक्चरल) इंजीनियरों के लिए एक सबसे बड़ी चुनौती वाला काम होता है। यह कार्य उन स्ट्रक्चरल इंजीनियरों के लिए अक्सर चुनौतियां एवं बाधाएं खड़ी करता है जो अवधारणात्मक रेट्रोफिट योजना का इस्तेमाल करते हुए एक इमारत की रेट्रोफिट करते है।

iquokl j.kuhfr ,oa rduhfd;k

iquokl j.kuhfr

किसी भी भूकंपी पुनर्वास का उद्देश्य होता है (क) कि मूल संरचनात्मक निष्पादन को प्राप्त किया जाए (ख) भूकंपी प्रतिक्रिया का कम किया जाए, ताकि इमारत की भूकंपी नाजुकता को घटाया जाए। मूल संरचनात्मक निष्पादकता की प्राप्ति हेतु, एक इमारत के क्षतिग्रस्त या नष्ट प्राय हिस्से को औचित्यपूर्ण निर्माण सामग्री से मरम्मत करनी पड़ सकती है या फिर नई सामग्री या घटक (एलीमेंट) को स्थानापन्न करना पड़ सकता

* कार्यकारी निदेशक, निर्माण सामग्री एवं प्रौद्योगिकी संवर्द्धन परिषद्, नई दिल्ली

है। संरचनात्मक निष्पादकता के उन्नयन हेतु संरचना को कसना (स्टिफनिंग) सामान्य उपागम है ताकि ड्रिफ्ट (निश्क्रियता) को नियंत्रित किया जाए और नए संरचनात्मक तत्वों को जोड़कर संरचना (स्ट्रक्चर) को सुदृढ़ीकरण किया जाए। इसके साथ ही, यह भी आवश्यकता होती है कि स्टिफनेस (कसावट) की अनियमितता या असंगति/अनिरंतरता को या सुदृढ़ता वितरण को बेहतर बनाया जाए, अन्यथा यह बातें एक इमारत के उस विशेष हिस्से के लिए असफलता या वृहद विध्वंस की परिणिति बन सकती हैं। इसे संरचनात्मक विन्यास (आकृति) को बदलकर पाया जाता है। यह संपूरक ऊर्जा छितराव (सपलीमेंट इनर्जी डिसीपैटिंग) डिवाइस (साधन) के स्ट्रक्चर में लगाने से प्रभावी होता है जो भूकंप ऊर्जा को छितराने की सक्षमता को बढ़ा देती है और इसके परिणाम स्वरूप भूकंपी प्रतिक्रिया में कमी आती है। भूकंपी प्रतिक्रिया को कम करने की एक अन्य अवधारणा है विद्यमान संरचना को धरातल से (भूकंपी अलगाव) अलग करने के साथ–साथ इमारत के भार में कमी लाना। महत्वपूर्ण भवनों हेतु, जिन्हें भूकंप के बाद भी निश्चित रूप से इस्तेमाल किया जाना है या फिर जो बहुत ही मंहगी एवं महत्वपूर्ण (अनमोल) वस्तुओं को संरक्षित किए हैं, वस्तुतः इनके लिए यह प्रभावशाली उपागम है।

etcrh ;k lqn<+hdj.k rduhd

विद्यमान संरचनाओं (स्ट्रक्चर्स) को सुदृढ़ीकरण करने के लिए व्यवहार में लाए जा रहे एवं विश्व भर में जिनका अध्ययन किया गया, ऐसा साहित्य उपागमों एवं तकनीकों से परिपूर्ण है। इनमें से कुछ विद्यमान संरचनाओं को कसने (स्टिफिन) सहित तथा या फिर मकान की कसावट (स्टिफनेस) को या मजबूती के वितरण की अनियमितता या असंगति को बेहतर बनाना शामिल है। भूकंपी सुदृढ़ीकरण की अवधारणा को यहां संक्षेप में वर्णित किया गया है।

Hkdih jksfQV dh fy, vo/kkj.kk,a

यह सर्व विदित एवं स्वीकृत है कि भवन पार्श्विक (क्षैतिज) सुदृढ़ता (मजबूती) तथा तन्यता (डकटिल्टी) अत्यंत अनिवार्य घटक हैं जो एक इमारत की भूकंपी निष्पादकता को विनियंत्रित करते हैं। इसलिए खराब या कमजोर भूकंपी क्षमता वाली इमारतों के लिए भूकंपी स्ट्रोफिंटिंग की तीन अवधारणाएं संस्तुत की गई हैं। इन अवधारणाओं की रेखा चित्र–1 में योजनाबद्ध तरीके से प्रदर्शित किया गया है:–

(क) संपूर्ण स्ट्रक्चर की मूल भूत सुदृढ़ता को बढ़ाना

(ख) विकृत (डिफोर्मेश्न) क्षमता, जैसे कि तन्यता को बेहतर बनाना

(ग) (क) एवं (ख) का समन्वयन

योजना (क) मूल की अपेक्षा अधिक सुदृढ़ता प्रदान करती है और चूंकि भूकंपी प्रतिक्रिया उसकी विरूपित या विकृत क्षमता से छोटी हो सकती है उदाहरणार्थ नई आरसीसी दीवार या एक विद्यमान फ्रेम में स्ट्रील विनिमित बंधनी (ब्रास)।

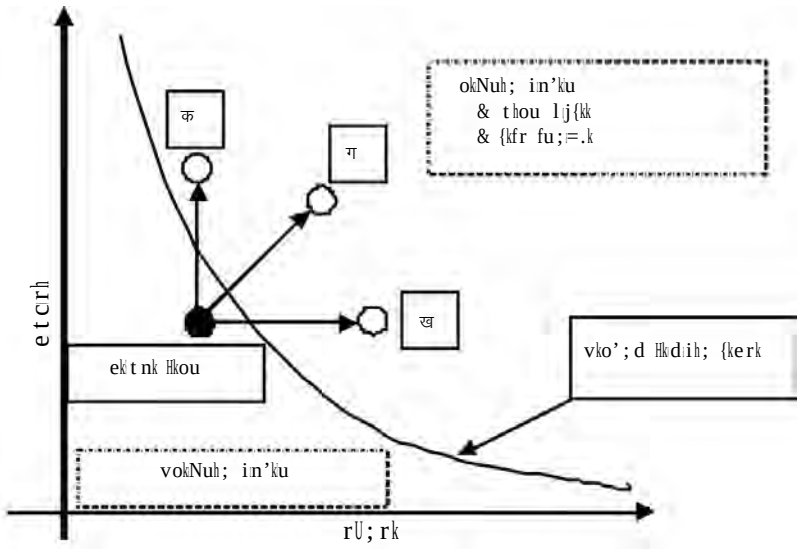
योजना (क) व्यापक विरूपण क्षमता (तन्यता) प्रदान करती है और चूंकि विरूपण क्षमता से संरचनात्मक प्रतिक्रिया छोटी हो सकती है। स्टील खंडों या संपूरक रेनफोर्स (प्रबलित) क्रंकीट खंडों से कालम को जैकेटिंग (कवच) करना, योजना (ख) के लिए एक प्राथमिक तकनीक हो सकती है। योजना (ग) उपरोक्त दोनों योजनाओं (क और ख) का समन्वित (संपाक) रूप है। दोनों से उच्चतर सुदृढ़ता एवं विरूपण क्षमता अपेक्षित होती है।

अपेक्षित निष्पादकता को सुदृढ़ता (मजबूती) एवं/अथवा तन्यता के रूप में मूल्यांकित किया जाता है। सुदृढ़ता एवं तन्यता का समन्वित या संपाक स्वरूप में सुदृढ़ता एवं कसावट (स्टिफनेस) के बीच उचित संतुलन समाहित होता है।

यह साधारण से मध्यम ऊंचाई की इमारतों को बढ़ी हुई मजबूती प्रदान करने वाली सर्वाधिक विश्वसनीय उपागम है। यहां तक कि यदि पर्याप्त तन्यता एवं उपयुक्त मजबूती उपलब्ध कराई जाए तो खिंचाव पूर्ण विस्थापन को घटाने में सहायक होती है।

Ýe ¼pk[kV½ lqn<+hdj.k rduhd

सामान्यतया, विद्यमान चौखटों (फ्रेम) को बढ़ी हुई मजबूती जैसे कि दीवारें (साइड वाल्स), पुश्तों या बांधनी (टेक) आदि के लिए नए विन्यासों को जोड़ा जाता है। विद्यमान फ्रेमिंग विन्यासों को लोचपूर्ण क्षमता वृद्धि और/अथवा तन्यता को बेहतर बनाने हेतु



चित्र–1 – भूकंपी स्ट्रोफिटिंग हेतु प्राथमिक अवधारणा

प्रबलित भी किया जाता है। भराऊ दीवारें एवं साइड की दीवारों को यथा स्थान ढाला या फिर फ्रेम (चौखटे) या बीम में पूर्व निर्मित (ढलवां) दीवार विन्यास से जोड़ा जाता है। सामान्यतः दीवारों को यथा स्थान पर विद्यमान खाली फ्रेम में कंक्रीट भर कर निर्मित किया जाता है। यह आवश्यक है संपूर्ण परिधि को परस्पर संयोजन (जोड़) प्रदान किया जाए, जहां पर मोनोलिथिक दीवारों की यथापेक्षित सुदृढ़ता जरूरी हो। प्रायः मेख/गुटका (डॉबेल) संयोजन का उपयोग इनफिल दीवारों एवं साइड वाल्स के लिए किया जाता है। गुजरात में आए भूकंप के पश्चात अपेक्षित भूकंपी निष्पादकता पाने के लिए सॉफ्ट स्टोरी (नरम निर्माण) में शीयरवॉल (अपरूपण दीवार) का जोड़ना एक सामान्य प्रविधि हो गई।

'kh;j okYl

विद्यमान इमारत की सुदृढ़ता एवं कसावट के लिए शीयर वाल्स की शुरूआत एक अत्यंत प्रभावी प्रविधि है। शीयर वाल प्रणाली प्रायः सस्ती एवं अधिकतर विद्यमान कंक्रीट ढांचों के लिए जल्द उपलब्धता की क्षमता वाली है। हालांकि विद्यमान ढांचे में शीयर वाल का जोड़ना कुछ विपरीत प्रभाव डाल सकता है। जैसे कि भारी मात्रा की शीयर वाल जोड़ने के परिणाम स्वरूप इमारत की सुदृढ़ता में वृद्धि हो सकती है और इस प्रकार भूकंपी बल एवं सुदृढ़ता की आवश्यकता में वृद्धि हो सकती है। अक्सर शीयर वाल्स के परिणाम स्वरूप महत्वपूर्ण रूप से वास्तुशिल्पीय प्रभाव दिख सकता है क्योंकि खिड़कियों का खत्म होना एवं भूतल में बाधाओं का पैदा होना तथा उनके आधार पर व्यापक प्रतिवलित बलों का उत्पन्न होना, जिसके लिए अतिरिक्त संपूरक नींव/आधार कार्य की जरूरत हो सकती है जोकि प्रायः काफी खर्चीला होता है। अधिकतर भूतल में खुले आरसी फ्रेम की इमारतों को भुज, गुजरात के भूकंप के पश्चात आरसी शीयर वाल्स के साथ चयनित पैनल लगाकर खुले भूतल में पार्किंग या सेवाओं को बिना बाधित किए सुदृढ़ीकरत किया गया।

c/kuh ¼ckl½ Ýse ;k <kp

एक विद्यमान इमारत की पार्श्विक (क्षैतिज) कसावपन (स्टिफनेस) एवं सुदृढ़ता को संवर्धित करने के लिए बंधनीयुक्त स्टीफ फ्रेम (ढांचे) एक आम प्रविधि है। हालांकि, भारत में यह लोकप्रिय नहीं है चूंकि विद्यमान आरसी फ्रेम/ढांचों में बंधनीकश्त फ्रेमों को प्रभावी ढंग से जोड़ना बहुत मुश्किल है। विशिष्ट रूप से, ब्रास्ड (बंधकी) फ्रेम निचले स्तर की कसावट एवं सुदृढ़ता प्रदान करते ही जिससे सेवाओं को कम बाधित किए बिना शीयर वाल को जोड़ा जा सकता है और ये कम आयतन लेते है। इनसे प्रकाश में कम अवरोध होता है और भवन के परिसर में आवागमन को भी कम प्रभावित करते हैं।

ecj juQkflx ¼?kVd icRuu½ rduhd

नवीन अनुलंबीय एवं संपार्श्विक (क्षैतिज) प्रबलीकरण के साथ कंक्रीट या स्टील कवच (जैकेटिंग) प्रदान करके फ्रेमों (ढांचों) की नमन क्षमता को संवर्धित किया जा सकता है। तन्यता व्यवहार की प्राप्ति हेतु यह महत्वपूर्ण है कि पर्याप्त रूप से संपार्श्विक प्रबलीकरण व्यवस्थित किया जाए। स्टील घटक के साथ बीम से कालम के लिए परिरोधन हेतु संयोजन की जरूरत हो सकती है, यद्यपि निर्माण आसान नहीं होता है।

ifjjk/ku ¼dUQkbueV½ tkMuk

गैर–तन्य कंक्रीट कॉलम की विरूपण क्षमता को बाहरी परिरोधन कवच (जैकेटिंग) के प्रावधान के माध्यम से संवर्धित किया जा सकता है। कॉलम को कवचपूर्ण (जैकेटिंग) का सरलतम तरीका है, विद्यमान कालम के सबसे कमजोर हिस्से को प्रबलीकरण हेतु विगोपित करके परिरोधित प्रबलीकरण प्रदान करना तथा नवीन एवं विद्यमान प्रबलीकरण के बीच पर्याप्त बोंड (बंधनीयता) प्रदान करना। ठीक इसी दौरान, नवीन अनुलंबीय प्रबलीकरण बीम कालम जोड़ को पर्याप्त रूप से जोड़ा जाना चाहिए और विशेष रूप से कालम के शीर्ष पर मधुमक्खी जैसे छत्ते के विनिर्माण से बचे जाने पर ध्यान दिया जाना चाहिए। बीम और कॉलम के संयोजन को सुदृढ़ीकृत करने के लिए आवश्यक है कि भूकंप के दौरान व्यापक गतिविधि (हलचल) के पैदा होने को अवरोधित किया जाए। अनुलंबीय प्रबलीकरण को पाद स्तर तक जारी रखा जाए और विद्यमान एवं नवीन कंक्रीट के बीच पर्याप्त संरचनात्मक समिश्रीकरण को पाद (फुटिंग) के दायरे तक कवचपूर्ण किया जाना चाहिए। चूंकि निर्माण के नजरिए से बीम को कवचित करना एक मुश्किल भरा काम है अतः यह अधिमान्य है कि अतिरिक्त आरसी बीम/स्टील खंड उपलब्ध कराया जाए। जहां भी अपेक्षित हो या अनुकूल स्थानों पर अतिरिक्त कॉलम प्रदान किया जाए ताकि लंबे स्पैन विस्तारीय वृहद कांटीलीवरेज (प्रास) हट जाए।

Hkdih iuokl gr uoxkeh mikxe

भूकंप के तुरंत बाद, परम्परागत मरम्मत बनाम सुदृढ़ीकरण योजनाओं – जैसे कि भूतलीय कालमों का कवचीकरण (जैकेटिंग), शीयर वाल्स को संयोजित करने आदि के द्वारा इमारतों के सर्वाधिक नाजुक जगहों पर रेट्रो फिटिंग की ओर ध्यान केन्द्रित हुआ जोकि मुख्यतः समाज आर्थिक विचारों से विनियंत्रित थी। हालांकि, इन भूकंपी रेट्रोफिट योजनाओं को इसलिए नहीं प्रयुक्त किया जा सकता, चूंकि निम्नलिखित परिस्थितियों में उपलब्ध रेट्रोफिट योजनाओं में अमूमन उच्च प्राथमिकताएं निर्णायक हो सकती हैं।

- निर्माण स्थल, अवधि एवं समय की सीमितता
- काम के साथ शोर, कंपन एवं धूल आदि
- वास्तु शिल्पी एवं/अथवा संरचनात्मक डिजायन का संरक्षण
- संरचनात्मक निष्पादकता के साथ–साथ क्रियात्मक निष्पादकता

- निर्माण के दौरान सेवा देयता

अनेक नई प्रौद्योगिकीय विकल्पों जैसे कि भूकंपी विलगाव, संपूरक ऊर्जा छितराव, सक्रिय नियंत्रण, रेट्रोफिटिंग के लिए उपलब्ध उच्च निष्पादक सामग्री तथा भारतीय संदर्भ में लागत सातत्यता इन प्रौद्योगिकियों के उपयोग को विनियंत्रित करती है।

भुज में आए भूकंप के पश्चात, मंहगी लागत को ध्यान में रखने के बावजूद अनेकों बहुमंजिला इमारतों में सफलतापूर्वक कार्बन फाइबर रैपिंग आफ स्ट्रक्चरल मेंबर (सरंचनात्मक मेंबरस (पट्टा) का कार्बन फाइबर) क्रियान्वित किया गया। इसकी कार्यान्वयन एवं टिकाऊपन की गति परम्परागत मरम्मत तकनीक से बेहतरी एवं अच्छेपन में आगे रहती है। यह प्रौद्योगिकता के साथ–साथ विष्लेशणात्मक रूप से सत्यापित हुआ है कि कमजोर कालम एवं बीम के आस–पास कार्बन की रैपिंग कन्फाइवमेंट को बढ़ाती है और इस तरह से फिक्सर, शीयर एवं तन्यता के प्रति मजबूती को बेहतर बनाता है।

vkjlh dkye dk dkcu Qkbcj dop yxkuk ¼tdfVx½

फाइबर रैपिंग प्रणाली अत्यंत मजबूत समिश्र (हाईब्रिड) बुना हुआ कपड़ा/इपोक्सी है जो इपोक्सी रेजिन में सांद कर ई–ग्लास तथा केलवार/अरामाइड फाइवर्स से संघटित होता है। यह योजना मूलतः विद्यमान आरसी कॉलमों की तन्यता को बेहतर बनाती है जो भूकंप के दौरान टूट कर गिर सकते हैं। कार्बन फाइबर कवच के उपयोग का लाभ अपेक्षाकृत आसानी से उपयोग में लाना तथा त्वरित गति से क्रियान्वयन, भार की तुलना उच्च मजबूती, पर्यावरण निम्नीकरण तथा क्षरण से अच्छा प्रतिरोधन, किसी भी आकार में कंक्रीट तत्वों के साथ रूपाकृति पाने की उपादेयता होती है। यद्यपि, सामान्य प्रविधि में, डिजाइन सिद्धांतों तथा फाइबर रैप के उपयोग हेतु कुछ जांच परिणामों के बारे में साहित्य उपलब्ध है।

vk/kkj iFkDdj.k ¼cl vkblkyu½

इस उपागम में, एकल स्तरीय भवनों में अनुलंब (वर्टिकल) भार वहन प्रणाली, विशिष्ट रूप से आधार के पास अनुपालनकर्ता (कंप्लाइंट) बियरिंग प्रविष्ट कराने की जरूरत होती है। इन बियरिंग को इस तरह विन्यासित किया जाता है जिनमें अपेक्षाकृत निम्न सख्तीपन (स्टिफनेस), विस्तीर्ण संपार्श्विक विरूपण क्षमता और सर्वोत्तम ऊर्जा विस्तारण विशिष्टताएं भी हो सकती हैं। एक आइसोलेशन सिस्टम के अधिष्ठापन के परिणाम स्वरूप भवन के आधारभूत प्रतिक्रिया अवधि में तात्विक वृद्धि तथा आद्रता हेतु सक्षमता से प्रतिरोध प्रभावी होता है। चूंकि संरचना के स्व संपार्श्विक अनुपालनीयता से आइसोलेशन बियरिंग में अपेक्षाकृत आधिक्य होता है फलतः भूकंप के दौरान बियरिंग का कंक्रीट स्वतः ही संपार्श्विक विरूपण की मांग को प्रोद्भूत करता है। इन दोनों के एक साथ मिलने के परिणाम स्वरूप आइसोलेशन बियरिंग के ऊपर स्थित भवन के हिस्से की संपार्श्विक मांग व्यापक रूप से घट जाती है। हालांकि, भारत में भूकंप के पश्चात भूकंप पुनर्वास में इस तकनीक को उपयोग में नहीं लाया गया है।

fu"d"k

यह लेख उन विभिन्न रेट्रोफिटिंग योजनाओं को प्रस्तुत करता है जिन्हें पुनर्वास के दौरान अपनाया गया है। संक्षेप में, लेखक इस बात पर जोर देना चाहता है कि किसी भी पुनर्वास तकनीकि का प्रभावीपन/निष्पादकता विद्यमान मेंबर्स (पट्टा या स्तंभादि) हेतु रेट्रोफिट तत्व की सहज संवितरण प्रक्रिया पर निर्भर करता है और यह इस महत्व को उजागर करता है कि भूकंप के दौरान ठोस भूकंपी निष्पादकता हेतु अनुकूल कारीगरी (शिल्प) के माध्यम से संरचनात्मक उपयुक्त डिजायन के जोड़ ब्यौरे तथा निर्माण कार्य की महत्ता क्या है।

*****

Contd. from Page 53

sustainability should be the main criterion of it along with the economics and physical development. The forest and human co-exist with each other and cities should be designed and planned to make them co-exist in the Master Plan also. Now National Building Code of India has incorporated a chapter on Sustainability in it, which has given emphasis on Architectural Planning and Building Materials on achieving Sustainability in Built Environment. Some Cities has already planned based on these Principals but the Carbon Calculations is not been done to rate them on Sustainability. Since Buildings and electrical appliances are getting rated for their energy efficiencies, Master Plans also need to be evaluated based on sustainability principles.

** These are the views expressed by author, and HUDCO may or may not agree with these.*

*****

Detailed Project Reports for Slum Rehabilitation Projects in Urban Areas

*C. N. Jha**
*Pankaj Gupta***

Building Materials and Technology Promotion Council (BMTPC) is designated as one of the Appraisal Agency by Ministry of Housing & Urban Poverty Alleviation, Government of India for appraisal of projects under BSUP (Basic Services to Urban Poor) and IHSDP (Integrated Housing and Slum Development Programme) under JNNURM. Around 350 projects were appraised by BMTPC received from various states from all over the country.

In pursuance of the vision of Hon'ble Prime Minister of "Slum free India" in his address on 15th August 2009, Rajiv Awas Yojana (RAY) was launched in June 2011 in two phases; the preparatory phase for a period of two years which ended in June 2013 and implementation phase. Central Government has approved the implementation phase for the period of 2013-2022. RAY envisages two-step implementation strategy i.e. preparation of Slum free City Plan of Action (SFCPoA) and preparation of projects for selected slums.

Rajiv Awas Yojana (RAY) envisages a "Slum Free India" with inclusive and equitable cities in which every citizen has access to basic civic and social services and decent shelter.

The Mission statement of RAY reads to "Encourage States/Union Territories (UTs) to tackle slums in a definitive manner, by focusing on:

i) Bringing all existing slums, notified or non-notified (including recognized and identified) within the formal system and enabling them to avail the basic amenities that is available for the rest of the city/UA;

ii) Redressing the failures of the formal system that lie behind the creation of slums by planning for affordable housing stock for the urban poor and initiating crucial policy changes required for facilitating the same.

For implementation of RAY, two step strategy would be adopted i.e. preparation of Slum-free City Plans of Action (SFCPoAs) on 'whole city' basis and Detailed Project Reports (DPRs) on 'whole slum' basis for selected slums. The SFCPoA will be an overall action plan of the ULB with investment requirements projected and prioritized for improving/developing the existing slums

* Dy.Chief (SP&D), ** Dy.Chief (I&D) – Building Materials & Technology Promotion Council, Ministry of Housing & Urban Poverty Alleviation, Government of India, New Delhi

and providing houses including basic civic infrastructure and social amenities for the urban poor for the next 10-15 years.

On the basis of prioritization of slums in SFCPoAs, cities would be required to prepare Detailed Project Reports (DPRs) following a 'whole slum' approach. In each selected slum, an integrated approach would be adopted with the provision of housing, basic civic infrastructure and social amenities. DPRs should include details of arrangements for convergence of inputs of health, education, social security, livelihoods and connectivity to city civic infrastructure from existing schemes and programmes of State/ULB/Centre.

While considering a slum rehabilitation project, broadly three types of interventions come into picture:

i) In-situ Redevelopment
ii) In-situ Upgradation
iii) Relocation of slum

In-situ Redevelopment means development of entire slum by providing adequate housing and infrastructure (civic and social) to the slum dwellers after demolition of the existing built structures.

In-situ Upgradation means development of the entire slum by filling gaps in housing and infrastructure (civic and social) to the slum dwellers without complete demolition of the existing structures.

Slum relocation should preferably be selected as a method of slum-redevelopment for untenable slums and in such case, emphasis should be laid on providing mobility and recreating livelihood linkages. Such interventions would include adequate connected infrastructure (civic and social) on alternate site selected for such slum relocation.

With the above background and experience of appraisal of DPRs under JNNURM & RAY, the framework for preparation of a Detailed Project Report of a Slum Rehabilitation Project is being presented herewith.

i) **Executive Summary** of the project with cost abstract.

ii) **Introduction**: General introduction of the city and list of slums and slum map of whole city Scope and status of ongoing & under pipeline projects of state/Central Govt related to housing & Infrastructure. It may further include progress made in various Central / State funded projects in slums like JNNURM (BSUP , IHSDP), ILCS ,SJSRY etc. Land is the foremost and most crucial component for the project formulation. Land should be in possession of the implementing agency and free from any encumbrances and litigation. The land use of the project should be residential. In case land use change is required, it should be done before sanction of the project so that execution of the project is not delayed after sanction.

iii) **Project Concept and Scope**: This should include the following: Introduction of slum(s): General description of slum(s) , Age of slum(s), Area of slum(s), Demographic profile, Social infrastructure etc. as per finding from slum survey. Location of slum, with map showing surrounding areas and trunk infrastructure available for the integration with proposed infrastructure of the slum. Tenural Status, Land use and Land Possession status in proposed project area. Existing basic infrastructure i.e. water supply; sewerage, roads, drains, solid waste management, electrification, available and its coverage. Strategy adopted for the slum improvement / development i.e. In-situ up-gradation, In-situ Redevelopment, and relocation (only in unavoidable cases). Brief of proposed components (Housing and Infrastructure).

iv) **Survey and Mapping of Slum** : it is required to create detailed plan by carrying out Total Station Survey for the slum(s) showing physical boundary of slum house type, (such as kutcha, semi pucca, pucca, dilapidated etc.), existing infrastructure, Surrounding area up to a reasonable distance, say 100 m to depict adjoining road / property and Contour Map.

v) **Assessment of Deficiencies in Slum(s)**: Deficiencies in housing, basic urban and social infrastructure and social economic conditions are to be assessed. Slum Profile and Household Survey would establish the existing deficiencies for all these three parameters.

vi) **Community participation for slum improvement**: Community consultation is very crucial in success of any slum rehabilitation project. Ideally Community involvement should be done from planning stage to allotment and further in operation & Maintenance of the assets created. Beneficiaries consent should be taken for relocation project, accepting DUs on upper floors in multistoried building and financial contribution. In case of in-situ redevelopment, transit housing / arrangement

for the slum dwellers during the construction period needs to be ensured.

vii) **Assessment of Demand / Gap and Preparation of Detailed Designs**: Based on the assessment made during deficiency analysis, provision of housing and infrastructure (Physical & Social) needs to be made conforming to the National Building Code and other relevant Bureau of Indian Standards Codes.

viii) **Integration of Social Infrastructure**: The DPR should aim at integrating water supply, sanitation and ensuring convergence of education, health and social security alongwith affordable housing with security of tenure. Convergence of these components may be ensured with other on-going schemes of the Departments of Health, Education like Sarva Shiksha Abhiyaan (SSA) and Social Welfare like SJSRY and other upcoming schemes.

ix) **Linkages with City-wide infrastructure Network**: Proposed in-slum infrastructure requires to be linked with city-wide infrastructure – Roads, Electricity network, Water Supply network, Sewerage network, Storm Water Drainage and Solid Waste Management System.

x) **Environmental Sustainability**: The location of slums should be examined from the viewpoints of environmental sustainability. The purpose is to ensure that its existence and continuance at a given location does not pose a threat to environment; neither should it pose a threat to its residents in terms of safety and hazard. The location of slums vis-à-vis environmental sustainability can be checked whether the slum is located in/within:

1. Industrial Land-use and/or close to Hazardous Industries
2. Cultural or religious sites / structures / locations / zones
3. Héritage sites / structures / locations / zones
4. Coastal Regulation Zones / Areas
5. Urban forestry / Reserve forest areas / Forest land
6. Waterway of Natural Drainage Courses, Floodways
7. Conserved structures / lakes / rock formations / steep slopes
8. River beds or of the stream / river and Tank Beds
9. Any other environmentally sensitive location that may fall in restricted area/prohibited area, such as near landfill sites, within high tide line, etc.

If the existing slum is located in any of the above-mentioned areas, it is imperative that these would be required to be relocated at an appropriate location either in full or in part, depending on the admissibility of location as per existing rule. The sites of new development or of relocated slums shall be examined accordingly. Requirement of clearance from Ministry of Environment & Forest may be ensured at the time of formulation of the project.

xi) **Provision for Safety against Hazards/Disasters**: The project report should include hazard resistant planning and design, taking into account proper site selection as well as housing and infrastructure to be constructed so as to avoid loss of or threat to lives and minimize economic losses. "Guidelines on Multi-Hazard Resistant Construction of EWS Housing Projects", developed by the Building Materials & Technology Promotion Council (BMTPC), Ministry of Housing & Urban Poverty Alleviation, Government of India may be referred to for housing design and construction apart from NBC and Indian Standards.

xii) **Estimation of Project Cost**: Cost estimates should be worked out on the basis of detailed bill of quantities (with detailed measurements of Length, Breadth, and Depth/ Height for each item), using current Schedule of Rates of the State Government. If the applicable Schedule of Rates relates to a year which is one or more years prior to 'current' year, appropriate cost index may be applied to update such rates, as approved by the State Government so as to get the realistic project cost.

xiii) **Project Implementation and Management Framework**: The DPR should clearly bring out the implementation and management framework of the project, dealing with administrative structure, implementing agencies against various components of the project. If more than one agency is involved, a clear description of method to achieve co-ordination among them should be described. The DPR should provide a time-bound Action Plan including Tendering, Appointment of Contractors, Construction Schedule and Post-construction activities including Project Delivery. The

Action Plan should include, inter alia, (i) Project Schedule in the form of Gantt chart, showing monthly target (ii) Quarterly Fund requirement to match the project schedule and (iii) Schedule of slum-wise Project Delivery.

xiv) **Operation and Maintenance plan of proposed assets**: In Public Works, Operation and Maintenance of assets created has always been a problem area to varying extent. Usually, operation and maintenance becomes the responsibility of the project owner, e.g., the ULB, State PWD, State PHED etc. Many centrally-sponsored programmes have not been successful primarily due to lack of maintenance; the underlying cause is often the lack of resources available to project owners to carry out maintenance. Although the annual budget requirement for maintenance is miniscule compared to the project cost, huge investments have simply suffered due to negligence in continued budget allocation. In the DPR, the component wise details of annual operation and maintenance plan for five years indicating expenditure incurred vis-à-vis revenue generated summarizing all these aspects – administrative, financial and operational, should be clearly spelt out.

The major portion of the article is derived from the following references:

i) Rajiv Awas Yojana – Scheme Guidelines

ii) Toolkit For Preparation of Detailed Project Report under Rajiv Awas Yojana (Draft).

*****

Monitoring
of BSUP & IHSDP Project under JNNURM

National Seminar on Performance Appraisal Certification Scheme (PACS)

The then Ministry of Urban Development & Poverty Alleviation, (now Ministry of Housing & Urban Poverty Alleviation), Government of India, vide Gazette Notification No.16011/5/99-H-II in the Gazette of India No.49 dated the 4th December 1999 has authorized the "Building Materials and Technology Promotion Council" (BMTPC) to issue Performance Appraisal Certificates (PAC) giving independent opinion of the fitness of new building materials, components, products, elements, construction system and assemblies for intended use, not yet covered by Indian Standard. This scheme provides for a third party certification for certifying the performance of the product and in the process it generates sufficient data needed for formulation of Indian Standard at later date.

The above scheme has been framed to fill the gap between development of new products and formulation of Indian Standards. PAC on the product/system contains all the details about the technical aspects including its performance characteristics and suitability for varying uses which is quite helpful in exploring wider market potential. It also helps in building greater confidence in user's mind and developing ultimately a national Standard on the subject.

BMTPC has so far issued Performance Appraisal certificates (PAC) for 24 products/systems/machines covering various items viz. Wooden/FRP/ PVC/PUF Doors & Windows, Block Making Machine, Pan Mixer, Recron Fibre, Gypcrete Wall Panel, Brick Kiln Technology, Plastocrete/Insulated/ Sandwich/ Gypsum Panels, Underground Water Storage/ Septic Tanks, FRP Manhole, Monolithic Formwork and Marble Slurry Binder.

In order to create awareness and disseminate the benefits of the Performance Appraisal Certification Scheme amongst manufacturers/ developers/ suppliers of new building materials and construction system, BMTPC organized National Seminar on PACS on 23rd August, 2013 at New Delhi. Dr. (Ms.) Girija Vyas, Hon'ble Minister of Housing & Urban Poverty Alleviation was the Chief Guest at the Seminar. She also gave a key note address emphasizing the use of local materials and emerging technologies. She pointed out that in Rajasthan, marble slurry waste is available in abundance and efforts may be made to use such local materials so as to reduce the material and transportation costs which will be comparatively less as compared to the materials brought from other places.

On the occasion, two publications of BMTPC namely "Performance Appraisal Certification Scheme - A Tool to Propagate Innovative and New Building Materials & Technologies" and 'Major Activities in Pursuit' were released by the Chief Guest. Among others dignitaries who attended the Seminar were Sh. Arun Kumar Misra, Secretary, MHUPA, Sh. KBS Sidhu, JS (Housing), MHUPA and Dr. Vimal Kumar, Honorary Adviser, Fly Ash Unit, Deptt. of Science & Technology.Dr. Shailesh Kr. Agrawal, Executive Director, BMTPC gave the welcome address mentioning the guidelines of Performance Appraisal Certification Scheme which is a systemic way to study the characteristics and performance of emerging building materials and technologies for wider acceptance by the construction Industries for mass applications.

About 40 participants from different fields and various Govt. Organizations, Institutions, reputed private companies, architects and consultants etc. have participated in the Seminar. Among the key speakers were Ex. ADG, BIS, Bangalore; Shriram Institute of Industrial Research, New Delhi; NABCB, Quality Council of India, New Delhi; IPIRTI, Bangalore; Central Institute of Coir Technology, Coir Board, Bengalore; B G Shirke Construction Technology Pvt. Ltd., Pune; CSIR – North East Institute of Science & Tech., Jorhat; FACT-RCF, Kochin; JB FAB India, Jindal Steel & Power Ltd, Gurgaon; STP Ltd, New Delhi; NICMAR, Pune; Emmedue/ B K Chemtech Engg. Pvt. Ltd., Bangalore; Kitec Industries, Silvasa;

Tata Steel Ltd. and Synergy Thrislington, Mohali who gave lectures on Standards, Evaluation Testing & Certification and Alternative & Emerging Technologies and need for Performance Certification.

A few presentations on new products & systems by private firms were also made as under:

1. Glass Fiber Reinforced Gypsum (GFRG) Panel, manufactured by M/s FACT-RCF, Cochin, is a building panel product, made of calcined gypsum, plaster, reinforced with glass fibers, for mass housing.
2. M2 (Emmedue) Advanced Building System, manufactured by M/s B K Chemtech Engineering Pvt. Ltd. Bangalore. The system consists of panels manufactured to form a three dimensional truss type welded wire space frame integrated with self extinguishing type EPS.
3. Instacom/Instahome manufactured by M/s Synergy Thrislington, Mohali. These are factory made modular building construction systems manufactured in a controlled factory environment and shipped to a prepared building site for installation.
4. Light Gauge Steel Structure, manufactured by M/s JB FABINFRA Pvt. Ltd., Raigarh (CG). These are fully integrated light weight steel gauge computerized construction systems which does not require heavy concrete foundation.
5. '3-S' Prefab System for High Rise Buildings manufactured by M/s B. G. Shirke Construction Technology Pvt. Ltd. The '3-S' prefab system comprises of all structural building components which are manufactured in factories/ on-site casting yard.

Demonstration of Cost-effective Alternate Technologies

BMTPC organised BMTP-Cexpo'12 - Exhibition-cum-Seminar on "Appropriate Building Materials & Housing Technologies" at New Delhi from 6-8 November, 2012. In order to demonstrate various alternate housing technologies during the BMTPCexpo'12, a demonstration house was constructed using proven cost effective, environment friendly, energy efficient and disaster resistant technologies having plinth area of 36.10 Sqm. with living room, bedroom, kitchen alcove, bath-cum W.C. and balcony was showcased.

The Demo House attracted a number of professionals including general visitors. Many of the visitors requested BMTPC to provide technical assistance for construction of such type of houses in their respective region.

The Specifications of the house constructed for demonstration are given hereunder:

Space Norms:

- Plinth Area of 36.10 Sqm. and Carpet area of 25.11 Sqm.
- Two Habitable Independent Rooms
- Kitchen Alcove
- Combined Bath & Toilet
- Court Yard/Balcony

Building Materials/ Construction Technologies:

Walls:

- One wall with Clay Bricks in 1:4 Cement Coarse sand mortar, in Rat-Trap Bond
- One wall with Fly ash Bricks in 1:4 Cement Coarse sand mortar, in Rat-Trap Bond
- One Wall in Cellular Lightweight Concrete Blocks
- One Wall with Fly Ash Interlocking Blocks

Roofing:

- RCC Filler slab with Bricks and earthen Pots as infill
- MCR Tile Roofing
- Bamboo Mat Roofing Sheets

Openings:

- Arch opening
- Inbuilt Brick Jallies
- Brick on Edge Lintels
- RCC Door Frames
- Steel section glazed window
- Brick Corbelling
- Bamboo mat door
- Ferro cement Shelves, Sunshades, Kitchen Slab

Flooring:

- Precast concrete tile flooring

Finishing:

- Cement Pointing

Others:

- RCC Plinth Bands, Lintel Bands, Roof Band and Vertical Steel Reinforcement at corners & Junctions
- Cement Coarse Sand Mortar of 1:4
- Designed as per NBC, BIS Specifications

Sustainability:

- Thermal efficiency due to cavity in Rat-Trap Bond Masonry
- Reduction in bricks and mortar quantity due to Cavity in Masonry
- Concrete quantity reduces due to Filler slab, without compromising structural Strength
- RCC Door/Window Frames reduces demand for Timber/ Steel
- Brick Jallies eliminates requirements of windows frames and shutters
- Ferro Cement shelves reduces Stone/RCC slab
- No Plastering is required
- Locally available building materials may be used as per availability and Costing,
- Locally available materials are low Embodied Energy materials.
- Embodied Energy of the house can be decreased by about 30 % without increase in cost.

Costing:

- Cost is dependent on geographical area, volume/scale of work and time, however cost of construction with these technologies is about 10% - 15% less than the cost as per standard specifications of CPWD/ States PWDs/ Housing Boards/ Development Authorities.
- No Complicated construction Techniques.
- No Proprietary Items of works as all are covered in BIS.

The demonstration house was handed over to NSIC by the Secretary, Ministry of Housing & Urban Poverty Alleviation, Government of India on 6th November, 2012.






Security Risks Assessment in Urban Built Environment

*Prof.(Dr.) Virendra Kumar Paul** *Ms. Garima Singh***

INTRODUCTION

Security is defined as "A form of protection where a separation is created between the assets and the threat". This includes but is not limited to the elimination of either the asset or the threat. Risk assessment aims to determine probability of occurrence of risks, in this case related to safety, and its impact based on its severity. From times immemorial, security has been an indispensable part of our society for ensuring growth and development. In the modern times, security has aided in ensuring uninterrupted operation of functions in built environment. Recognizing the concern for acts of terrorism, natural disasters, fires etc, in urban areas, a multi-dimensional approach for potential hazards and vulnerabilities is essential. Planning and designing process in urban context requires a proactive approach that anticipates and protects the building's occupants, resources, structure as well as urban infrastructure functions, and ensures the continuity of their operations. According to India Risk 2012 survey, conducted by FICCI, terrorism, fire and crime are perceived amongst the top five risk categories (refer to Fig.1). Further, infrastructure sector stakeholders perceive natural hazards, fire, crime, political instability and accidents amongst top five risk categories.

Memories of 26/11, 9/11, Upahar tragedy, Parliament attack are reminders of vulnerability of urban infrastructure and built assets. This calls for Security Planning and Design as an approach for master planning that integrates the formulation of organisational, procedural and physical security measures for the protection of the organization and premises against various threats and risks. At the core of 'security planning and design' is the risk assessment which considers evaluation criteria based on risk perception and provides the basis for prioritization of risk mitigation measures. This paper highlights the risk assessment methodology for urban built environment that provides rational to planning and design process.

SECURITY CONCERN IN BUILT ENVIRONMENT

Security is the assurance of safety. Absolute security for an individual would require total isolation from a normal environment and other people. Absolute secu-

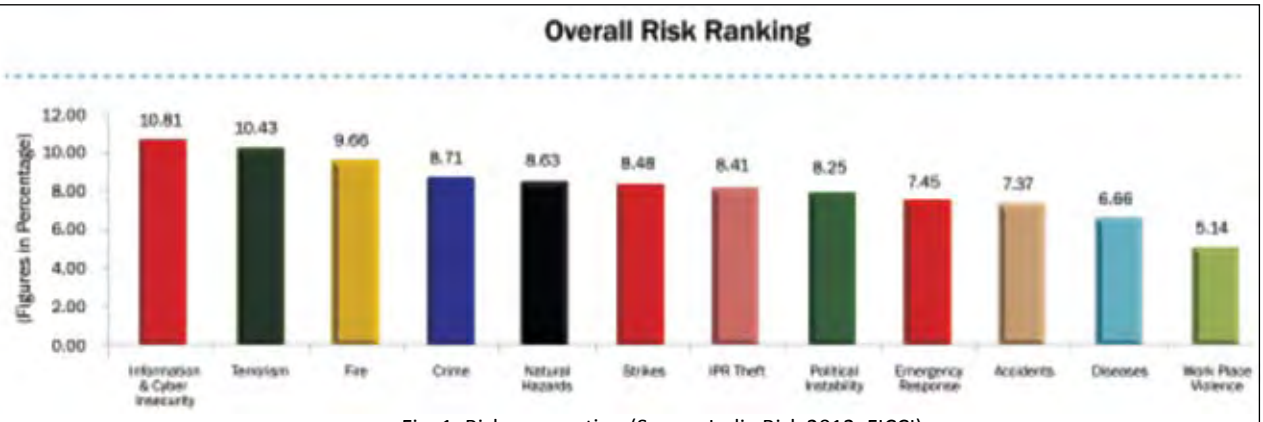


Fig. 1: Risks perception (Source India Risk 2012, FICCI)

* Professor, School of Planning and Architecture, New Delhi.
** Former Master's Degree Student, School of Planning and Architecture, New Delhi.

rity for a tangible asset or object would require that it be completely isolated from access. The complete isolation of a person or asset is not practicable and is rarely possible. Providing safety and security is a balancing act between access and isolation. The concept of Crime Prevention through Environment Design (CPTED) has been in practice for a while in some western countries but is yet to be recognized as a comprehensive methodology for planning in India. Physical security, most commonly resorted in India, in the wake of security threats is one of the components working on the approach of 'detect, delay and respond' methodology. Integrated security planning includes: physical, electronic and operational. It is important to understand that the technology plays a major role is enhancing capabilities and technological advances constantly necessitate review of planning process so that advantages of advances are realized.

CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPETD)

Crime Prevention is defined as the anticipation, recognition and appraisal of a crime risk and the initiation of some action to remove or reduce it. The concept of CPTED takes crime prevention a step further. It involves studying the site design principles and practices and working with the members of community in an attempt to implement safer design practices in new and existing developments. CPTED, is based on the idea that the proper design and effective use of the built environment can lead to a reduction in the incidence and fear of crime, and an improvement in the quality of life. In other words, if a site / built environment is designed well, the likelihood of it being targeted for a crime may be reduced. The four most fundamental built environment design strategies in CPTED are:

- Natural surveillance: directed primarily at keeping intruders under observation
- Natural access control: directed at decreasing crime opportunity.
- Territorial reinforcement: realizes that physical design can create or extend a sphere of influence so that users develop a sense of proprietorship or territoriality.
- Maintenance and management

A well integrated CPTED approach for deterrence against security risks has the benefits as:

- Provides the residents, opportunities to play meaningful roles in community crime deterrence and prevention
- Lower crime rates in neighbourhoods and business areas, less victimization of residents
- Improved perception of safety and liveability in public areas and neighbourhoods
- Improved quality of life through reduced fear of crime
- Enhanced consideration of public safety in planning, development, and redevelopment projects
- Safer locations available for business owners that are more attractive to customers and employees
- Planners/architects have a greater role in designing the environment; a holistic approach to the development and planning process
- Beyond being effective in lowering the incidence of crime, CPTED typically reduces the overall costs of preventing crime. Cost of designing according to CPTED principles are often lower than with traditional approaches
- Increased use of parks, recreation and other public facilities by residents

URBAN RISK ANALYSIS FOR BUILT ENVIRONMENT

Security Risk analysis can be defined as "A detailed examination including risk assessment, risk evaluation, and risk management alternatives, performed to understand the nature of unwanted, negative consequences to human life, health, property, or the environment; an analytical process to provide information regarding undesirable events; the process of quantification of the probabilities and expected consequences for identified risks." Security Risk Assessment is the process of assessing security-related risks from internal and external threats to an entity, its assets, or personnel.

The security risk assessment for any building type is carried out to evaluate the vulnerability of the project to different types of threats and the anticipated impact of the risk. The severity of impact of the threat may be analyzed based on the criticality of the business operations being carried out in a building. Another aspect is the vulnerability of the occupants of the buildings. The more susceptible the occupants are to a threat, more is the risk associated with the building. Buildings housing high

value assets and critical high value operations and processes should also be designed carefully for security threats. Objectives of security risk analysis includes:

a. Continuance of business operation
b. Security of vulnerable occupants
c. Security and safety of high value assets
d. Security and safety of high value processes and operations

Following are the risk can be identified which are associated with the built environment for the purpose of risk analysis:

i. Fire
ii. Assault
iii. Robbery and theft
iv. Vandalism
v. Tresspassing and unauthorized entry
vi. Terrorism
vii. Natural hazards
viii. Shoplifting (specific to commercial buildings)
ix. Medical and epidemiological

METHODOLOGY FOR RISK ASSESSMENT

Each of the risks are assessed by considering loss event criticality and loss event probability based on surveys of similar situations or studying situations statistically. Fig. 2 shows the risk matrix that can be created for each of the risk typologies identified above and depicts a flowchart for risk assessment process.

Based on assessment risks process, generic risk identification for various building types was carried out and a ranking was prepared. Fig. 3 presents a generic risk ranking for various building typologies. Risk ranking is generic and is based on the perception of authors but

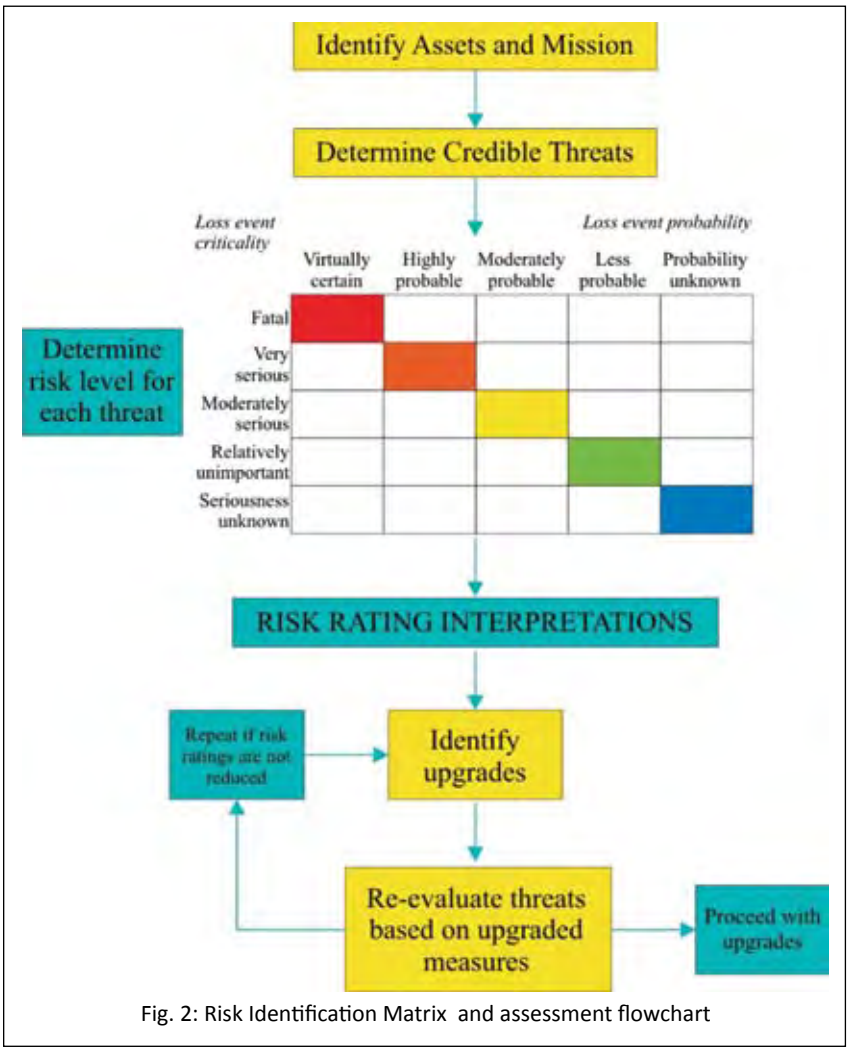


Fig. 2: Risk Identification Matrix and assessment flowchart

the same can be developed for specific buildings and their situation / locational context for identifying the risk mitigation strategies. The purpose of the raking is determine priorities for mitigation and focus attention on specifics to the extent of their destructive potential.

RISK MITIGATION STRATEGIES

In a case study for academic purpose, an actual commercial building was assessed and mitigation measures were proposed for enhancing the security status. The limitation of the exercise was that the design was considered to be fixed and alterations were not undertaken. Following are the proposals (generally within the operational domain) made which were considered valid form the owner's perspective.

- Perimeter of the entire site
  - o Perimeter boundary
  - o Physical barrier
  - o Electronic surveillance
  - o Security guards
  - o Vehicle forced intrusion obstacles
- Perimeter of the complex
  - o Physical barrier
  - o Electronic vehicle access control
  - o Electronic surveillance
  - o Security guards
  - o Basic to detail checks
- Building entrance
  - o Electronic access control
  - o Electronic surveillance
  - o Security guards
  - o There may be three segre-

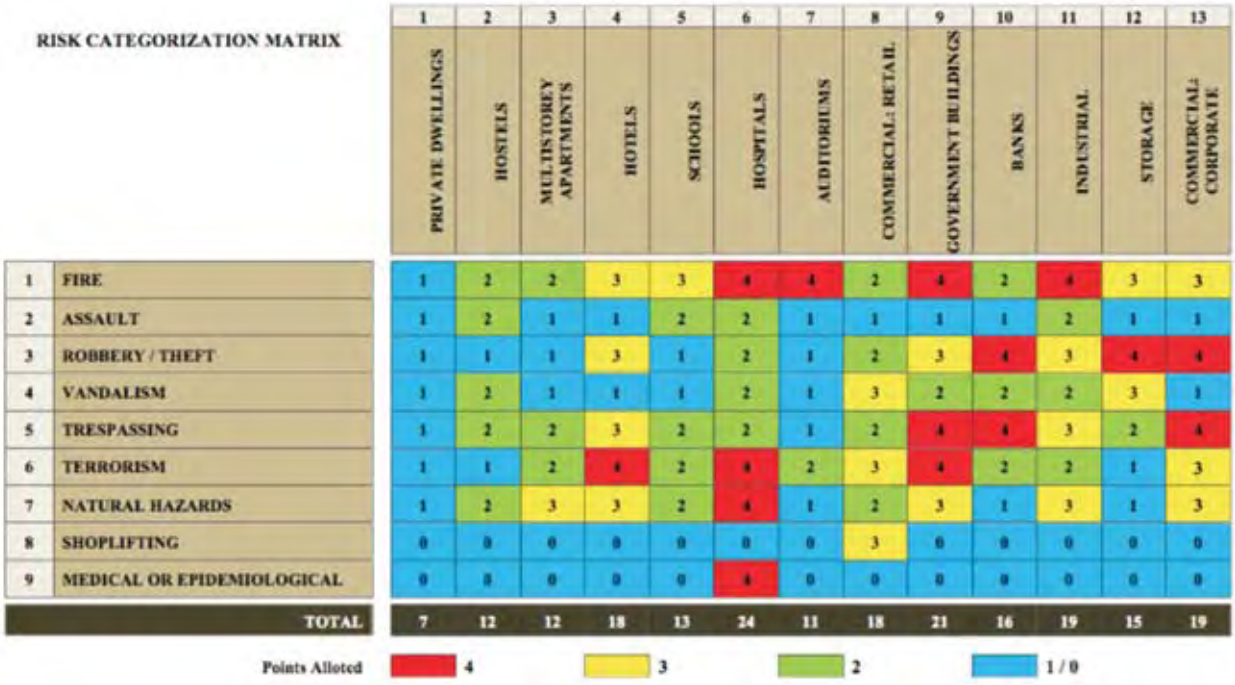


Fig. 3: Generic Risk Ranking

gated entrances within a building

- Office premises (Occupants' responsibility)

The objective of the case example undertaken was to relate risk assessment with the mitigation. Although the exercise was academic but the experience is supportive of basic premise of enhancing security through risk assessment and integrating the same with planning and design measures.

CONCLUSIONS

Risk analysis methodology is an important component to create a safe and secure built environment. Recognizing the concern for various threats posed to the continuity of a business, a multi-dimensional approach for addressing the potential hazards and vulnerabilities is essential. In the absence of formal security design standards, it is essential to develop a framework that that gives an overview of the functioning of the process of planning and designing for security and presents a proactive approach, representing the minimum requirements for all new and existing developments.

The methodology presented in this paper builds on subjective criteria and establishes a specific rationale for developmental strategies. As one understands, some building typologies are highly vulnerable but there is need for creating access. This is especiallly true for all public buildings and assests. In such cases, it is imperative that CPTED planning approach is undertaken with a focus defined by the risk assessment methodology. In further work, case example are proposed to be undertaken to demonstrate efficacy of proposed risk analysis apprach in a given context.

REFERENCES / BIBLIOGRAPHY

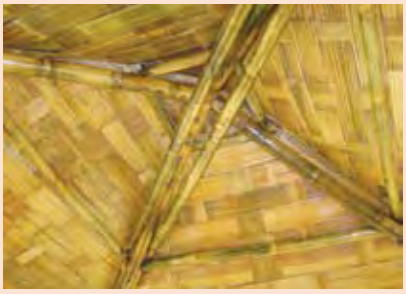
1. Wikipedia, http://en.wikipedia.org/wiki/Security, viewed 17th February 2012
2. Wikipedia, http://en.wikipedia.org/wiki/Security_management, viewed 19th February 2012
3. "General Security Risk Assessment: An ASIS International Guideline", ASIS International Guidelines Commission, 2003.
4. "Crime Prevention through Environmental Design: General Guidelines for Designing Safer "Communities", Municipal Center, Virginia Beach, viewed 18th Feb, 2012, http://www.humanics-es.com/cpted.pdf
5. "Designing out Crime Planning Guidelines", Western Australian Planning Commission, Perth, Western Australia, Published June 2006, Viewed 18th Feb, 2012, http://www.planning.wa.gov.au/dop_pub_pdf/docguidelines.pdf.
6. "Crime Prevention through Environmental Design Guidebook", National Crime Prevention Council, Singapore, Viewed

18th Feb 2012, http://www.ncpc.gov.sg/pdf/CPTED%20Guidebook.pdf

7. A. Nadel,Barbara, "Building secutrity: Handbook for Architectural Planning and Design".
8. http://www.godrejsecurityequipment.com/godrej/SecuritySolutions/Virtualsite/SiteProtect.html, viewed 5th April, 2012
9. Department of Army, United States of America, "Field Manual No. 3 – 19.30: Physical Security", viewed 4th April, 2012, http://www.wbdg.org/ccb/ARMYCOE/FIELDMAN/fm31930.pdf
10. Information Assurance Technology Analysis Center (IATAC); Department of DefenSe (DoD,USA) and Defence Technical Information Center, "Intrusion Detection Systems", Information Assurance Tools Report, viewed 6th April 2012, http://iac.dtic.mil/iatac/download/intrusion_detection.pdf
11. FEMA P-424, Risk Management Series: Design Guide for Improving School Safety in Earthquakes, Floods, and High Winds, December 2010.
12. FEMA 426, Risk Management Series: Reference Manual to Mitigate Potential Terrorist Attacks against Buildings, December 2003.
13. FEMA 427, Risk Management Series: Premier for Design of Commercial Buildings to Mitigate Terrorist Attack, December 2003.
14. FEMA 428, Risk Management Series: Premier for Design Safe School Projects in Case of Terrorist Attacks December 2003.
15. FEMA 452, Risk Management Series, Risk Assessment: A how to Guide to Mitigate Potential Terrorist Attacks Against Buildings, January 2005.
16. FEMA 459, Risk Management Series, Incremental Protection for Existing Commercial Buildings from Terrorist Attacks, April 2008.
17. FEMA 543, Risk Management Series, Design Guide for Improving Critical Facility Safety in Earthquakes, Floods and High Winds, January 2007
18. FEMA 577, Risk Management Series, Design Guide for Improving Hospital Safety in Earthquakes, Floods and High Winds, January 2007
19. Challenger, Dennis, "From the Ground Up: Security for Tall Buildings", An ASIS Foundation Research Council CRISP (Connecting Research in Security to Practice) Report, Viewed 1st March, 2012, http://www,asisonline.org/foundation/noframe/research/crisp.html
20. "Guide to Preventing Violence, Robbery & Theft", Retail Council of Canada, Toronto, Ontario, viewed 25th March 2012, http://www.gov.ns.ca/lae/healthandsafety/docs/ohsguidspreventingviolencerobberytheft.pdf

Training Programme on Building with Bamboo at Imphal, Manipur

The Council organised a Training Programme on Building with Bamboo at Impal, Manipur from 26 - 29 June 2013 jointly with Manipur State Bamboo Mission, Forest Department, Government of Manipur and South Asia Bamboo Foundation (SABF). During the Training Programme, a Bamboo Gazebo was constructed by the participants under the guidance of master crafts mason at Kangla fort, Imphal for practical training. The Gazebo was handed over to Deptt. of Arts & Culture, Government of Manipur, Imphal.



Visit of Technical Team for Post-flood Reconstruction and Rehabilitation Work in Uttarakhand

A Team comprising of the officials of Ministry of Housing & Urban Poverty Alleviation along with technical officials of HUDCO, BMTPC & HPL led by Shri D.S. Negi, PS to Hon'ble Minister HUPA, OSD - JNNURM & RAY and Director - NBO, visited Dehradun on 6th and 7th July 2013 to extend help and support for rehabilitation and restoration activities being undertaken by Uttarakhand Government. The team also met the Chief Minister, Government of Uttarakhand in Dehradun in the wake of flash floods occurred in the region. As per preliminary assessment report, 238 villages has been severely affected and more than 5000 houses have been damaged during the disaster. The Ministry of HUPA has decided to provide financial help to Uttarakhand Government to the maximum extent possible and also technical support for reconstruction and rehabilitation work in disaster affected areas of the State through construction of demonstration houses and imparting training to the artisans and capacity building of Engineers/Architects of the Urban Local Bodies.

After the detailed deliberations following were emerged for rehabilitation and reconstruction in the region:

1. The land for the construction of a neighbourhood of 24 houses at three locations would be provided by the ULBs/state government/ beneficiaries. Three locations proposed by the Government of Uttrakhand at Barkot, Chamoli and Dharchula for construction of Demonstration houses are located in three different sub-regions of the state. Barkot is in the noth-west, Chamoli in the north and geographically centrally located, and Dharchula is in the north-eastern part of the state. Barkot and Chamoli have predominantly hilly terrain, and Dharchulla is located in the valley and is largely having relatively flat terrain.
2. All the logistics support for construction of houses and infrastructural facilities like water supply, sewerage, community building, approach roads and schools/hospitals would be provided by the State Govt.
3. The layout plans would be prepared taking into considerations of site-specific factor- access from main road, topography, availability of services (water, electricity, sanitation) and characteristics of the existing settlement patterns. Appropriate green spaces and space for community activities shall be provided.
4. The dwelling unit will be envisioned as a core house consisting of a multi-purpose room, a bed room, a kitchen, a bath room and a verandah with a plinth area in the range of 300-350 square feet. The toilet will be outside the house. The design would have provision for incremental expansion/up-gradation, which could be undertaken by the beneficiary/user as and when their finances permit them to do so.
5. The unit designs will be based on the requirements of beneficiaries, sensitivity of the people and their social and living pattern and will be finalised in consultation with the state Govt. authorities for long term adaptability and sustainability of the project/ designs etc.
6. Keeping in view the terrain of the region, climatic conditions, hazard proneness of the state, scarcity of conventional building materials in the region after the floods and urgency to construct the houses in a shortest possible time following fast track prefabricated buildig technologies/ systems may be explored:
   a. EPS sandwitched panels with steel sheets system
   b. EPS panels with shortcreting system
   c. Light gauge steel with EPS sandwitched Panels system
   d. PUF Injected insulation panels system
7. The second approach is to use a mix of conventional building and alternate/cost-effective technologies being promoted through Building Centres which have been supported by HUDCO/ BMTPC.
8. HUDCO/BMTPC may consider conducting training programmes for the building artisans of the area where these demonstration houses are to be constructed. This would enable building capacities of the local building artisans (masons etc.) to use the technologies as above.

Identification, Evaluation and Dissemination of Emerging Housing Technologies

BMTPC earlier invited Global Expression of Interest (EOI) from Construction System/ Technology Developers/Providers for introducing emerging and alternate cost effective housing technologies suitable to Indian geo-climatic and hazard conditions. The Technology Advisory Group (TAG) constituted by the Ministry identified eight technologies for further evaluation. Out of this two technologies namely, Monolithic Construction Technology with Plastic/Aluminium Formwork and Glass Fibre Reinforced Gypsum Panels/Rapidwall Panel System were evaluated under PACS. The remaining six technologies are under evaluation.

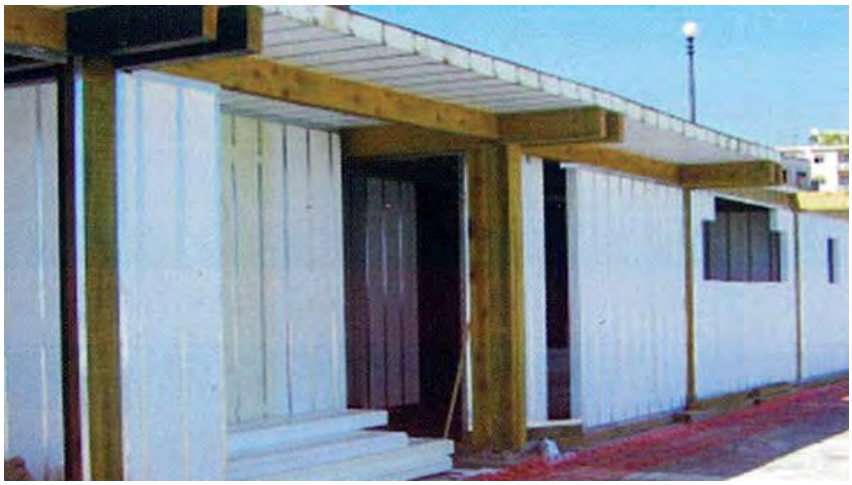
Meanwhile the Council has further identified following four more technologies which are also under evaluation:

Light-weight Wall Panel Framing System

- Steel reinforced partition wall panels are manufactured using the insulating capabilities of modified EPS and steel inserts.
- These are pre-engineered, pre-labled and pre-fabricated lightweight insulated panels.
- Panels provide rapid assembly, integral insulation for energy efficiency and sound dampening and are used in curtain walls, interior and exterior non-load bearing wall applications.
- Patented process: Self supporting, steel beams and furring strips
- Fast, flexible and safe method to build concrete floor or roof.

Light Gauge Steel Frame Construction System (NEST-IN)

- Frame is made of cold rolled high strength steel sections.
- Structure is erected by joining these sections, using patented 'Dipple Klick' technology which reduces number of nuts and bolts.
- Roof is made of GI roofing sheets placed upon equi-distant purlins in the truss.
- Walls are made of cement bonded particle boards with polymer plaster on both sides and insulated with mineral wool.
- Eco-friendly and earthquake & fire resistant technology
- Single house can be built in 9 days.



Light Gauge Structure System

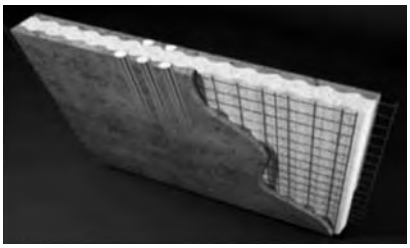
- Frame is made of cold rolled high strength steel sections and EPS panels for walling.
- Internal walls covered with gypsum and cementitious board. Exterior wall Sprayed with cementitious material directly onto the studs.
- Faster construction by prefabricated panels. All structural components are precisely pre-

manufactured and simply assembled on site.

- Enhanced Thermal & Acoustic insulation with Boarding/ Expanded Polystyrene (EPS) / Rockwool/Vapour Barrier.
- Eco friendly structure. Superior and sustainable performance. Minimum Impact on natural resources.

Smart Modular Steel Building - InstaHome

- Steel tubular pillars made up of square tube using fasteners with nut and bolts.
- MS Steel prefabricated modules of Hot rolled U sections including plates used for aligning the pillars.
- Walls of EPS Panels made up of 60 mm thick with 3 dimensional wire mesh and 35 mm thick concrete / form work both side.
- Light Weight Panels generate minimal inertia force & therefore contributes to greater stability. Unique Tongue & Groove System permits local adjustments for shock absorption.
- Eco-friendly and faster construction.



In order to disseminate the emerging technologies at the State level, the Council is organizing a series of Workshops to sensitize the various stakeholders. In this series, the first workshop was organised at Ahmedabad on August 31, 2013 with Ahmedabad Municipal Corporation wherein approx. 400 professionals from State participated.

Apart from the above, the Council has initiated a process for inclusion of already evaluated emerging technologies in the CPWD Schedule of Rates. In this direction, presentations from the Technology Providers of Monolithic Concrete Construction using Aluminium/Plastic formwork was organised on September 20, 2013 before CPWD senior engineers and architects.

Skill Development and Capacity Building
in the area of Alternate and Cost Effective Building Materials & Construction Technologies

The Council has organized following Capacity Building Programmes in the recent past:

- Three months Training Programme for Field and Lab Technicians jointly with Indian Concrete Institute (ICI) at Nagpur started on 16 February, 2013.
- Training programme for Masons on Cost Effective Construction Technologies in Rural Areas at Amirgarh, Gujarat during March 7-9, 2013. Thirty participants participated in the training programme.
- Training Programme and Exhibition for Supervisors on Low Cost Building Materials & Construction Techniques during March 13-14, 2013 at Building Centre, SATI, Vidisha, MP. Twenty participants participated in the training programme.
- Training programme for Supervisors on Low Cost Building Materials & Construction Techniques during March 18-19, 2013 at IIHRD, Vidisha, Madhya Pradesh. Twenty participants participated in the training programme.
- Training Programme for Supervisor on Effective Supervision of Workers and Improve the Construction Supervisor's Ability during March 20-21, 2013 at RADS Tehri Garhwal, Uttarakhand. Twenty five participants participated in the training programme.
- Training Programme of Masons for Rural Areas on the Manufacturing Process for the Fly Ash based Building Products during March 23-24, 2013 at Adityapur, Jamshedpur. Thirty participants participated in the two days training programme.
- Two days Hands on Mason's Training Programme on 'Quality and Disaster Resistant Construction Practices' from March 23-24, 2013 at Building Centre, Kerala GIDC, Bavla, Gujarat. Twenty participants attended the training programme.
- Short term Training Programme on Design and Construction of GFRG/Rapidwall Building Systems organised jointly with IIT Madras on March 25, 2013 at Chennai.
- Training Programme for Engineers and Supervisors on Green Building Technologies from March 28-29, 2013 at Rural Building Center Kanyakumari, Tamilnadu. Twenty five participants attended the training programme.
- Training Programme for Masons on Cost Effective Housing Technologies at Rae Bareli, U.P. on Cost Effective Housing Technologies on April 21-22, 2013. 22 local Masons were trained during the programme.

Priced Publications of BMTPC

DIRECTORY OF INDIAN BUILDING MATERIALS & PRODUCTS (with information on Nepal, Bhutan & Pakistan) 2009
550 pages, Rs. 1000 + 200 postage

BUILDING MATERIALS IN INDIA : 50 YEARS - 560 pages, Rs.1500 + 200 postage

HOUSING AND KEY BUILDING MATERIALS IN INDIA - A LONG TERM PERSPECTIVE - 98 pages, Rs. 700 + 75 postage

INSTRUCTION MANUAL FOR APPROPRIATE BUILDING SYSTEMS
64 pages, Rs. 150 + 75 postage

BUILDING WITH COMPRESSED EARTH BLOCKS
28 pages, Rs. 60 + 30 postage

STANDARDS AND SPECIFICATIONS FOR COST EFFECTIVE INNOVATIVE BUILDING MATERIALS AND TECHNIQUES INCLUDING RATE ANALYSIS (SECOND EDITION)
200 pages, Rs. 250 + 75 postage

DIRECTORY OF CONSTRUCTION EQUIPMENT AND MACHINERY MANUFACTURED IN INDIA - 684 pages, Rs. 1500 + 200 postage

USER'S MANUAL on Production of Cost-Effective, Environment-Friendly and Energy-Efficient Building Components -
116 Pages, Rs. 250 + 50 postage

MANUAL ON BASICS OF DUCTILE DETAILING -
27 pages, Rs. 100+50 postage

VULNERABILITY ATLAS OF INDIA (First Revision – 2006) - Earthquake, Windstorm and Flood Hazard Maps and Damage Risk to Housing - 900 pages, Rs. 5000 + 200 postage

LANDSLIDE HAZARD ZONATION ATLAS OF INDIA - Landslide Hazard Maps and Cases Studies - 125 pages, Rs.2500 + 200 postage

BUILDING A HAZARD- RESISTANT HOUSE:
A COMMON MAN'S GUIDE-
88pages, Rs. 350+75 postage

MANUAL FOR RESTORATION AND RETROFITTING OF BUILDINGS IN UTTRAKHAND AND HIMACHAL PRADESH -
134 pages, Rs.250+ 75 postage

GUIDELINES FOR IMPROVING EARTHQUAKE RESISTANCE OF HOUSING -
84 pages, Rs. 350 + 75 postage

GUIDELINES FOR IMPROVING FLOOD RESISTANCE OF HOUSING -
36 pages, Rs. 200 + 50 postage

GUIDELINES FOR IMPROVING WIND/CYCLONE RESISTANCE OF HOUSING - 50 pages, Rs. 350 + 75 postage

EARTHQUAKE TIPS – LEARNING EARTHQUAKE DESIGN & CONSTRUCTION
58 pages, Rs.200 + 50 postage

Publications/Video Films may be obtained by sending Demand Draft, drawn in favour of BMTPC payable at New Delhi

Promotional Publications of BMTPC

1. Corporate Brochure - in English and Hindi
2. BMTPC Newsletters
3. Environment Friendly Building Materials & Construction Technologies
4. Grah Nirman Mein Vishesh Savdhaniyan
5. Reconstruction of Earthquake Resistant Houses in Garhwal Region - Guidelines in Hindi
6. Retrofitting of Stone Houses in Marathwada Area of Maharashtra
7. Saste Makan: Vibhinn Vikalp Avam Suvidhain - in Hindi
8. Useful tips for House Builders
9. Local Vegetable Fibres + Industrial & Mineral Waste for Composite materials
10. Machines developed by BMTPC
11. An Introduction to the Vulnerability Atlas of India
12. Performance Appraisal Certification Scheme
13. Green Houses for ITBP at Leh
14. Bamboo - A Material for cost-effective and disaster resistant housing
15. Retrofitting of Hospital in Kupwara, Kashmir, J&K for Safety Against Earthquakes
16. Simple Ways to Earthquake Safety for Jammu & Kashmir - in English and Urdu
17. Bamboo in Housing & Building Construction - Initiatives of BMTPC
18. Aam Aadmi Series - House Building Digest (Series 1 to 12)
19. Seismic Retrofitting of MCD School Buildings in New Delhi
20. Guidelines for Multi-Hazard Resistant Construction for EWS Housing Projects
21. Guidelines on "Aapda Pratirodhi Bhawan Nirman : Sampurn Bharat ke liye Margdarshika
22. Design & Construction of Earthquake Resistant Structures : A Practical Treatise for Engineers & Architects
23. Design Packages using Alternate Building Materials & Technologies for Western and Souther Regions.
24. Major Activities in Pursuit
25. Criteria for Production Control of Ready Mix Concrete for RMC Capability Certification
26. Explanatory Handbook on Performance Appraisal Certification Scheme (PACS)

Published by:
BMTPC, New Delhi
For Further Details write or contact:
The Executive Director
Building Materials & Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation
Core-5A, First Floor, India Habitat Centre,
Lodhi Road, New Delhi - 110 003
Tel.: 91-11-2463 8096, Fax: 91-11-2464 2849
E-mail: bmtpc@del2.vsnl.net.in; info@bmtpc.org; Website: www.bmtpc.org

World Habitat Day

The Building Materials & Technology Promotion Council (BMTPC) was setup in 1990 as an inter-ministerial organisation under the Ministry of Housing & Urban Poverty Alleviation to bridge the gap between laboratory research and field level application.

Vision

"BMTPC to be world class knowledge and demonstration hub for providing solutions to all with special focus on common man in the area of sustainable building materials, appropriate construction technologies & systems including disaster resistant construction."

Mission

"To work towards a comprehensive and integrated approach for promotion and transfer of potential, cost-effective, environment-friendly, disaster resistant building materials and technologies including locally available materials from lab to land for sustainable development of housing."

bmtpc