Special Issue

निर्माण सारिका

A Newsletter of BMTPC

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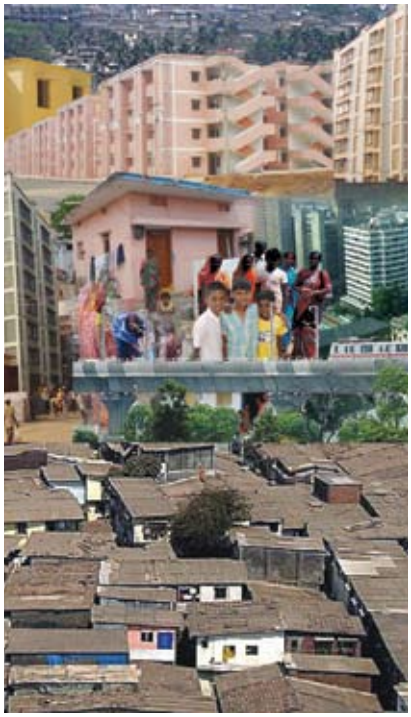
Voices from Slums

6th October, 2014

World Habitat Day

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"



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From the Desk of Executive Director

Every year the first Monday of October is celebrated as World Habitat day on a theme which is apposite in that year's context. This year, the theme is Voices from Slum which has direct bearing in Indian context as we are ushering into an era where Housing for all by 2022 is envisioned. India is grappling with huge housing shortage to the tune of around 19 million dwellings at present & which is going to swell to 30 million in another decade. The most disturbing factor in these figures is that more than 95% shortage pertain to economically weaker section (EWS) & lower income group (LIG) who largely squatter in slums. Therefore, in order to eradicate housing shortage in our country, we have to start & end with slum renewal, bearing in mind voices from slum which emerge from time to time when these prestigious programme are being taken up & executed. It is not that Govt. of India does not take into account the slum community into consultation & confidence while taking up urban renewal programme but India being large & complex country, the model which may be successful in northern state may fail entirely & squarely in eastern states. However, the prospective mission programme on housing for all is considering all these facts and the aspiration/voices of slum residents will be amalgamated while developing detailed project reports (DPRs).

Being head of BMTPC, we had the privilege and opportunity to be associated in urban renewal schemes of Ministry of Housing & Urban Poverty Alleviation as technical agency for hand holding of ULBs, state agencies & consultants for not only in preparation of DPRs but also as appraisal & monitoring agency for entire India. We have come a long way from 2005 when the scheme of Urban renewal was launched and in the process learnt the dynamics of slums & its people. It is found, sometimes there is total disconnect between the people & state/ULB administration which results into brick batting, complaints & unwillingness of people to shift to these new houses. Therefore Voices from slum need to be given due consideration or rather should be starting point for any housing scheme to be brought by state govts.

Our ministry has always been in forefront while trying out these innovative ideas of inclusion and that is why in currently ongoing scheme of urban renewal, we have made community participation mandatory. Besides, involvement of NGOs, socio-economic survey, livelihood profiles & linkages, beneficiaries' identification & their consent etc. are also included. These salient features are worth taking forward and will definitely be part of new mission on the anvil. Nevertheless, the State Govts have to take a call and embrace all these aspects into their project reports with all sobriety & sincerity.

I am indeed joyous for bringing up this special newsletter on the occasion of Habitat day and sincerely hope that we will be able to serve the society through our ministry so that the dream of Housing for all by 2022 is realized.

Join us & contribute towards faster & sustainable growth of our nation....

(Dr. Shailesh Kr. Agrawal)

सत्यमेव जयते

M. VENKAIAH NAIDU

Minister of Housing and Urban Poverty Alleviation,
Urban Development and Parliamentary Affairs
Government of India

MESSAGE

The World Habitat Day is celebrated across the Globe every year on first Monday of October to focus on state of towns and cities as well as the basic right of adequate shelters for all. It gives us an opportunity to have a closer look at the basic needs of housing for all and other related problems involved. It also reminds the World of its collective responsibility to ensure future of human habitat.

The theme of World Habitat Day-2014 is "Voices from Slums". It would recognize the right of slum dwellers; lend voices to them for suggestions to improve quality of living conditions in existing slums. It provides an excellent platform to highlight key human-settlement issues of slum dwellers so that these poor and downtrodden people living in cities can be lifted out of poverty.

The urban world is witnessing larger migration of people into towns and cities in quest for a better life. With over half of the World's population living in the cities, urban areas are the focus point of the impact of rapid urbanization and globalization. Unplanned growth of the cities leads to chaotic development and ill-managed infrastructure. It calls for efficient regional urban planning by using appropriate technologies. There is also need of effective public transportation, safe drinking water, solid waste management, sanitation, conservation of nature and energy, etc.

Building Materials & Technology Promotion Council (BMTPC) has an important role to play in providing cost effective building construction technologies not only to make them affordable but to also improve the living condition of people.

I congratulate BMTPC for bringing-out a Special Issue of their in-house Newsletter "Nirman Sarika" on the occasion of "World Habitat Day".

(M. Venkaiah Naidu)

सत्यमेव जयते

ANITA AGNIHOTRI
Secretary
Ministry of Housing & Urban Poverty Alleviation
Government of India

MESSAGE

This year's theme of "Voices from Slums" for the World Habitat Day given by the United Nation, when in our country we are framing new policies for Affordable Housing for All, reminds us to take this opportunity to understand the needs of slums dwellers living in different parts of the country with diverse climate, culture and other requirements before anything is planned and implemented.

Increased pace of urbanization has put tremendous pressure on the cities and towns leading to growth of informal / unauthorized housing in the form of slums, squatter settlement and Jhuggi - Jhopri, colonies. To tackle the issue both corrective measures in the form of slum improvement programme and preventive measures to keep provision of shelter for future migrants are necessary. Different categories of urban poor like slum dwellers, those living in non slum areas, prospective migrants and homeless & destitute need different strategies.

In all our strategies, however, Voices from Slums are important. We must consider their concerns and should provide a space to them which meets the integrated need for staying, having a roof above the head as well as having a quality of life where needs of livelihood and other services including education & health are met.

The Building Materials & Technology Promotion Council (BMTPC), has been contributing with technical input in programmes of slum improvement and housing. They are required to play even greater role, specially in the area of selection and introduction of appropriate building materials & technologies in house construction in different geographical and hazard conditions of the country.

Special Issue of Newsletter "Nirman Sarika" brought out by the Council on the occasion of World Habitat Day, I, hope, will address some of the important issues related to slum dwellers and their voices.

I wish the publication all success.

(Anita Agnihotri)

Place : New Delhi
Dated : October 7, 2014

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

MESSAGE

The Theme for this year's World Habitat Day "**VOICES FROM SLUMS**" is dedicated to the urban poor who are often forced to live in informal settlements which lack access to basic services such as housing, sanitation, potable water supply and solid waste disposal system, etc. Moreover, such settlements also lack security of tenure and hygienic environment. The slum dwellers live in fear of forced evictions and most do not have access to formal finance and loan schemes.

The various factors which catapult growth of slums, inter-alia, include shortage of developed land for housing, land prices beyond the reach of urban poor, large influx of rural migrants to cities in search of jobs, inadequate basic services and infrastructural facilities.

Building Construction being widely scattered and fragmented activity, introduction of cost-effective and emerging technologies in housing sector can help in mitigating the housing shortage. Also the availability, accessibility and acceptability of appropriate building materials at affordable prices are important dimensions in the shelter sector.

In this context, Building Materials & Technology Promotion Council (BMTPC) has been playing its role in dissemination and promotion of cost effective, environment friendly and energy-efficient building materials and safer construction technologies amongst a wide spectrum of users, entrepreneurs and construction agencies.

I am glad to know that BMTPC is bringing out a Special Issue of its newsletter "Nirman Sarika" on the occasion of World Habitat Day to highlight use of alternate and environment-friendly building materials and technologies. I do hope that the Council's efforts will gain wider acceptance and application.

I extend my best wishes to the Council in their efforts!

(K.B.S.Sidhu)

सत्यमेव जयते

SANJEEV KUMAR
Joint Secretary & Mission Director (JNNURM & RAY)
Ministry of Housing & 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. This year's theme "Voices from Slums" is very timely as the last two to three decades have witnessed a very large scale migration of the rural poor to the urban areas and significant part of such movement is settled in slum type area. Slum is a deprived human settlement which is demographically, economically and environmentally vulnerable. The rate of growth of slums has been unprecedented in the history of metropolitan areas in India because of accelerating pace of urbanization.

Most of the slums/squatter settlements spring up near factories and residential colonies and at the periphery of the towns, as they provide services to the other segment of population, i.e., vending and hawking, domestic and transport services, sanitation, plumbing and solid waste disposal services. The slum dweller plays an important and critical role in the urban economy. Lack of infrastructure and basic amenities in low income neighbourhoods and squatter settlements has not only been a major cause of environmental degradation but has also limited the growth of individuals and cities/nation.

The need of the hour is to evolve mechanism for construction for shelter in slums in a manner that permits construction within the financial capacity of the dwellers. Dissemination of information on new and emerging building materials & construction technologies should be viewed as a priority. In this context, BMTPC has been making efforts by identification, evaluation and selection of emerging technologies in the housing sector. I hope that various agencies involved in housing would take advantage of these housing technologies to improve productivity and affordability in their programmes and projects.

I am happy that the BMTPC is bringing out a Special Issue of NIRMAN SARIKA on the occasion of WORLD HABITAT DAY. I hope that this Newsletter would help in highlighting the potential for participation of different population groups in development of housing sector and will help in generating more initiative to adopt alternate and emerging technologies in housing construction.

I extend my best wises to the Council in its efforts.

Sanjiv Kum
(Sanjeev Kumar) 26/9

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

MESSAGE

Cities and towns, as the nerve centres of the economic activity, also signify the civilisation, social, cultural and scientific advancements of the community. The factors of rising population and giant strides in industrialization have contributed to large scale urbanisation. Characteristic features of our urban areas continue to be illegal constructions, undesirable land-use changes, lack of water and sanitation facilities, shortage of housing leading to fast growth of slums & squatter settlements and inadequate urban infrastructure.

In the above context, the theme for this year's World Habitat Day – "Voices from Slums" is quite meaningful and appropriate. The National Housing and Habitat Policy seeks to address a wide spectrum of shelter needs for mitigating housing shortage, both in the urban and rural areas. Pursuant to the goal of the Government as an enabler, the policy aims at strengthening the partnerships amongst various players in the area of housing and infrastructure. One of the major objectives of the policy is to improve access of the people, particularly those in the economically weaker and low income sections to critical inputs like developed lands, finance, building materials and technologies.

In the context of building materials and technologies, the BMTPC is doing an excellent work in bringing housing within affordability limits of even low income households by disseminating & promoting cost effective and emerging construction practices for housing.

I am happy that the Council is bringing out the Special Issue of "Niman Sarika" on the occasion of World Habitat Day 2014. I am sure that this publication would highlight the issues connected to the planned development of cities and ensure slum improvement and upgradation.

I wish the Council all the success in its deliberations.

(B.K.Agarwal)

Role of Civil Engineering Community

to Address the Voices from Slums – A holistic perspective

*Nagesh R. Iyer** *Saptarshi Sasmal***

Massive economic and industrial revolutions, though positively changed the lives of many, still millions of poor people throughout the world are dwelling in slums where the buildings are merely meant for shelter against adverse weather and a minimum livelihood; thus, make the buildings congested and without hygienic and sanitary conditions. The term 'slum' was initially used to identify the poorest quality housing, and the most unsanitary conditions (Iacoboaea, 2009). With time, the definition of the term "slum" is changed. Slums are defined by lack of secure tenure, non-durable housing and overcrowding. This overwhelming situation is extremely prominent in the developing and under developed countries. One out of every three people living in cities of the developing world lives in a slum (UN-Habitat, 2008). Since, the definition of 'slum' is not specific enough, it is very difficult for exact estimation of the population living in the slum areas. In the post era of industrial revolution, poverty was more specific to the rural areas, but the scenario is changing now and due to skewed socio-economic conditions, the number of urban poor exceeds the number of poor people from rural areas. The number of urban residents living in slum conditions is now estimated at some 863 million, compared to 650 million in 1990 and 760 million in 2000. Redoubled efforts will be needed to improve the lives of the urban poor in cities and metropolises across the developing world (UN-Habitat, 2013). The fact is disturbing not only for policy makers, but for the sociologists, technocrats and elite class of society, as well.

A true spirit of engineering, where engineering means the application of scientific and technical knowledge to judiciously solve issues that a society needs for its growth and prosperity, is capable of playing key role in inclusive development and poverty alleviation which are significant for not only the developing countries with emerging economics, but similar for developed countries with industry driven economy as well. Engineering plays a key role in reducing the poverty problems and produce sustainable development. Very specifically, civil engineering has the potential to address the huge lack of infrastructure and basic services which aggravate the poverty and hinders the sustainable development and it has the capability to deliver solutions, to a great extent, if not fully, to the issues of lack in basic requirements such as shelter, basic sanitation, safe drinking water etc. To achieve this, engineers must be trained to make intelligent decisions that protect and enhance the quality of life than endangering it. Engineers must remain experts in their field but must also understand the interaction between their work and the environment, culture and society, and the economy. They must provide link between scientific discoveries and their applications to human needs.

Civil engineering could provide the vital infrastructure needed for societies to develop where infrastructure, in exclusive sense, covers the facilities, structures, associated amenities, services, and arrangements that facilitate

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** Senior Scientist, CSIR - Structural Engineering Research Centre (SERC), Chennai

the dwellers. Unfortunately, may be due to under-investment, inadequate sincerity or lack of concerted efforts from the engineers, the issues have not been paid due importance. Moreover, the unplanned strategies from the policy makers and lack of holistic approach from the engineering community have serious consequences on the environment, which in long term, have detrimental effects on the socio-economic conditions of the human beings, in general, and more acute for the slum dwellers, in specific. Hence, it is clear that for providing a sustainable and feasible solution to such a complicated, mammoth and demanding problem, a thorough and in-depth understanding of the nontechnical issues such as social structure, life style, preferences, etc. of the dwellers are also crucial.

It is important to understand that people living in slum may not aspire to have the same lifestyle similar to that an engineer or a policy maker perceived for. The people in slums might be from different background and culture but they establish a very strong relationship among themselves and this community cohesion is one of the key strength to them in-spite of the weaknesses of overcrowding, unhygienic conditions, unsafe and inadequate houses etc. Slum houses are normally at ground level and they use the outside spaces for social and living purposes. This aspect is crucial for the cultures of these communities and this gives an example about how the houses that are built for slum people can have influence upon their happiness in life. Appropriate housing design for people living in slums is therefore vital for sustainability of slum housing development. Civil engineer can take the slum people's opinion before finalizing the design to avoid later conflicts raised by them. Flexible building design which gives them more control and the option to make incremental additions and extensions as their family grows will be a good way to satisfy them. In view of this, there is a need for active co-operations from- and co-ordinations among- the civil engineering community who are capable of applying scientific knowledge, technical expertise and ingenuity to provide solutions.

Innovation in science and technology can be used to uplift the standard of living of the slum dwellers. For this, the issues have to be addressed in the form of mission mode-, target oriented- and innovation driven- projects. The projects should be implemented at faster rate without compromising on quality and money, and without ignoring the sentiments of the society for whom the projects are conceived. Owing to the complex nature of slums, it is not easy to suddenly change their living condition against their established social fabric, but certainly a lot can be done to improve their living standard. For example, the existing slum houses can be repaired or provided with better physical infrastructure instead of shifting them to new houses. Most of the slums do not have toilets and bathrooms. It is very difficult to provide sanitation facilities for each household in slum due to land constraint. Construction of common washrooms depending upon the size of the slum can increase the neatness in the slum. Huts are prone to damage during floods and earthquake. People living in slums are the most suffered ones during such natural calamities. Civil Engineer can construct affordable houses with simple design which doesn't fail during such calamities for these people.

Water and electricity is not available all the time for the people in slums. They have to carry water from tanks that come once a day. It is not possible to give a metro (municipality/corporation) water connection to every household. Instead cheaper water tanks can be designed and erected near the slums and the water in those tanks will be filled regularly. This makes water regularly available for the people. Most of the slums are located along the natural drainage paths and the houses are very close to each other. Even a small rain causes water to stagnate inside the house. Construction of prefabricated compound wall around the slums and necessary storm water drains shall dramatically reduce the sufferings of the slums that they are used to witness every monsoon.

Solid waste management is not followed among the slums and they may not be aware of any such concept about it. They throw the waste outside the households. All these wastes get dumped cause diseases. Innovative, light weight, long lasting bins can be developed and installed near the slums at a convenient distance so that they can throw the wastes inside these bins and then it will be cleared regularly. Engineered roads are very rare in the slums. Construction of roads with customised paver blocks will help them easily connect to the city roads during rainy season.

Initiatives at CSIR-SERC

CSIR-Structural Engineering Research Centre (CSIR-SERC), Chennai, India is one of the national laboratories under the Council of Scientific & Industrial Research (CSIR), India. CSIR-SERC has built-up excellent facilities and expertise for the analysis, design and testing of structures and structural components. Services of CSIR-SERC are being extensively used by the Central and State Governments and public and private sector undertakings. Besides the commitment for innovations in engineering and sciences in the related fields, It is always an endeavour of the scientific community of CSIR-SERC to translate the expertise, experience and excellence to practice, viz., develop product or to demonstrate technologies/methodologies/techniques that can change the lives of millions who are underprivileged.

Cost effective engineered buildings: The concept of funicular shells has been extended for roofs using brick shells supported over reinforced concrete edge beams. Timber formwork, preferably lined by plywood over a wooden framework, is first built. Over this formwork, bricks are set in cement mortar from the edges upwards or in strips leaving gaps (to be filled later) for shrinkage compensation for large shell roofs. A concrete screed of 25 mm or more is laid over this and the top surface is waterproofed with bitumen felt or any other suitable waterproofing material. As the shell is doubly curved and extremely rigid, removal of formwork can be done at the end of 4 or 5 days after laying the screed concrete/ mortar finishing with water proofing compounds. These brick funicular shells can provide low-cost / cost-effective roofing in rural mass housing particularly, in row type of housing schemes.

Precast lightweight concrete panels for walls and floors: The technology will be useful for mass housing constructions where cost, speed and quality are the priorities, for constructions in earthquake and cyclone prone zones and in marine environment. The system essentially consists of reinforced concrete grids with foamed concrete panels. A 25 mm thick ferrocement screed at top and bottom completes the construction of the panel. The developed product is well tested at CSIR-SERC under various types of loading and adequate performance is noted. The efficiently designed wall and floor panel system economises the product.

Mould for shell

Completed building

Row of houses

Ferrocement Water Tanks and Products: Ferrocement is a highly versatile form of mesh reinforced cement mortar that possesses unique quality of strength and serviceability. This versatile construction material can be used for variety of products such as service core units (toilet/bath units), cupboards, rafters and trusses as an alternative to timber. Ferrocement water tanks of rectangular or circular type can be economically adopted for storage of drinking water in individual dwelling units or also for serving community in slum areas. Designs have been developed by CSIR-SERC for tanks of various capacities. These tanks are economical compared to the traditional brick-walled water tanks and have been successfully used in many places in India. It is estimated that about 5000 ferrocement water tanks are being produced per annum in Chennai alone in the public and private sectors, using CSIR-SERC technology.

Geopolymer concrete building/ pavers blocks: Geopolymer concretes (GPCs) are a new class of concretes based on an eco-friendly non-Portland cement based binder derived from natural geological materials such as silica and alumina by a chemical process that

Construction of precast panel

Load test on the precast panel

Circular(10000 liters) and rectangular Ferro-cement water tanks (1000 liters)

Ferro-Cement Cupboards

Service core unit (Bath & Toilet)

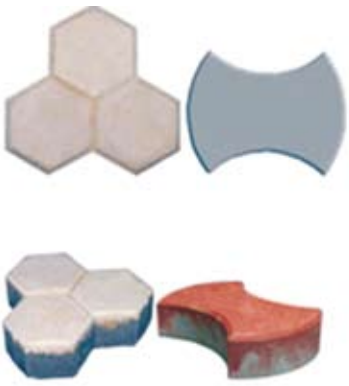
integrates minerals called as "geo-synthesis". With the enormous demand for mass applications, an unprecedented demand has been generated for bricks and building blocks. In this emerging scenario, alternate building blocks produced are being widely used. Concrete Building Block Technology developed at CSIR-SERC offers a speedier, cost effective, environmental friendly solution for mass applications. One may contact Director, CSIR-Structural Engineering Research for any further technical assistance in this regard.

Strong durable customised manhole covers: Technology has been developed at CSIR-SERC to design strong and durable manhole covers using engineered concrete. Fiber reinforced concrete is used with specific mix design based on the design strength. Application of these types of manhole covers on the covered urban drainage system would help to thousands of slum dwellers (many urban slum zones are beside the drainage system) from unbearable odor, unhygienic conditions and possible treat to physical hurt as well.

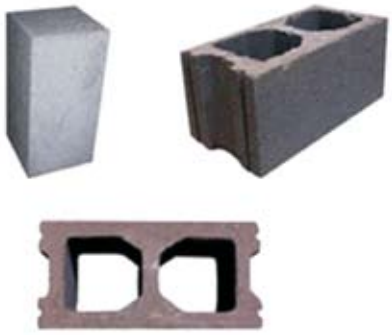
Conclusions

For sustainable and inclusive development, any slum upgrading activity must be sensitive to the

Preparation of the geoploymer Mix at CSIR-SERC



Different shape of paver blocks



Different shape of concrete blocks

situation of an individual community and culture. It would be grossly incorrect if it assumed that the residents are unhappy living in desperate poverty. Slums may be dirty, poorly serviced and overcrowded but are also places of great human energy, community spirit, kindness, hard-working, creative and happy places that many consider as home. By upholding the sentiments and preserving the comfort zones of the slum dwellers, it is a noble and social responsibility of the privileged community to make sure that the advancement in science and technology has been percolated to the bottom of the society and thus, a country as a whole can develop and progress fast without undesirable and glaring skewness in the development. In view of this, let all of us from civil engineering community take up the challenges positively; play our role and contribute, besides the professional assignments, to make the slums safer, cleaner and greener.

References:

- Iacoboaea, C. (2009), Slums in Romania, Theoretical and Empirical Researches in Urban Management, Number 1(10), pp. 101-113.
- United Nations Human Settlements Programme (UN-Habitat) (2008). Housing for all. The challenges of affordability, accessibility and sustainability. The experiences and instruments from the developing and developed worlds, Nairobi.
- United Nations Human Settlements Programme (UN-Habitat) (2014). Streets as public spaces and drivers of urban prosperity (ISBN978-92-1-132590-4).

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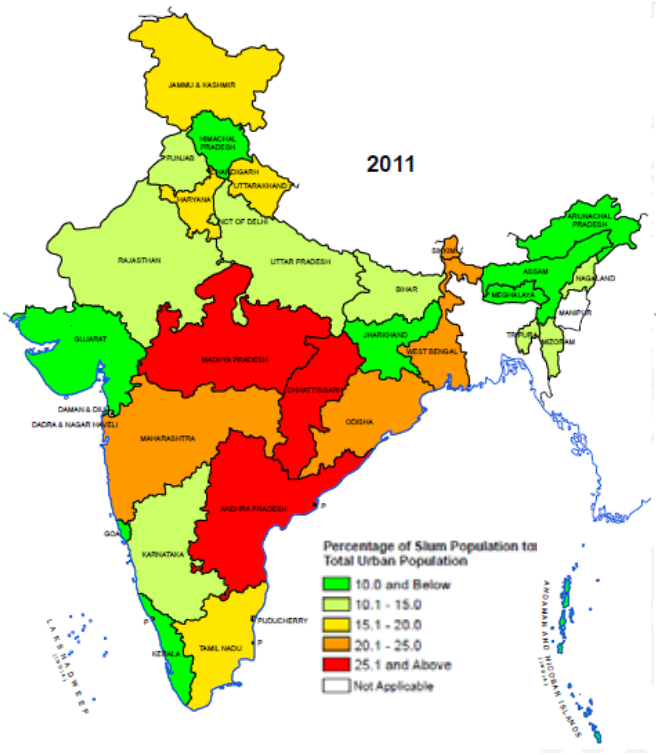
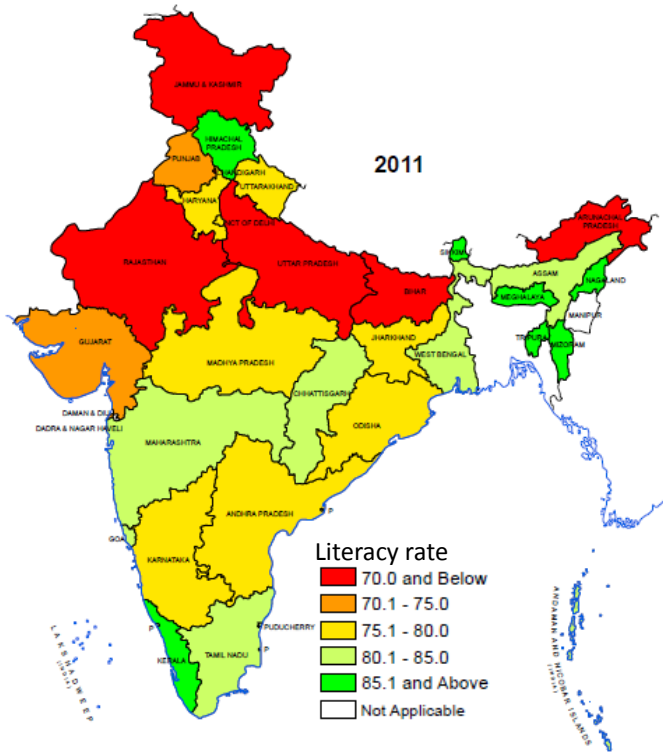
Percentage of Slum Population to Total Urban Population



Literacy Rate in Slums



Source: Primary Census Abstract for Slum, 2011
Office of the Registrar General & Census Commissioner, India

Urban (Statutory) and Slum Population -Census 2011

State/UTs	Urban Population (Statutory Towns) (in Million)	Slum Population (in Million)	% of Slum Population in Urban Population. (Statutory only)
Andhra Pradesh	24.1	10.19	42.28
Arunachal Pradesh	0.31	0.02	6.45
Assam	3.43	0.2	5.83
Bihar	11.27	1.24	11
Chhattisgarh	5.8	1.9	32.76
Goa	0.43	0.03	6.98
Gujarat	23.98	1.68	7.01
Haryana	7.93	1.66	20.93
Himachal Pradesh	0.67	0.06	8.96
Jammu & Kashmir	3.16	0.66	20.89
Jharkhand	5.35	0.37	6.92
Karnataka	22.4	3.29	14.69
Kerala	5.64	0.2	3.55
Madhya Pradesh	18.96	5.69	30.01
Maharashtra	46.8	11.85	25.32
Manipur	0.65	0	0
Meghalaya	0.38	0.06	15.79
Mizoram	0.57	0.08	14.04
Nagaland	0.51	0.08	15.69
Odisha	6.18	1.56	25.24
Punjab	9.71	1.46	15.04
Rajasthan	15.81	2.07	13.09
Sikkim	0.15	0.03	20
Tamil Nadu	29.92	5.8	19.39
Tripura	0.67	0.14	20.9
Uttar Pradesh	40.94	6.24	15.24
Uttarakhand	2.56	0.49	19.14
West Bengal	21.15	6.42	30.35
A & N Islands	0.11	0.01	9.09
Chandigarh	0.97	0.1	10.31
D & N Haveli	0.1	0	0
Daman & Diu	0.07	0	0
Lakshadweep	0	0	0
NCT Delhi	11.4	1.79	15.7
Puducherry	0.76	0.14	18.42
INDIA	**322.83**	**65.49**	**20.29**

Source: Primary Census Abstract for Slum -2011

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

*Dr. J.S. Chauhan**

The Centrality of Slums

Anna Tibaijuka, then Under-Secretary-General of the United Nations said

"make no mistake, we live at a time of unprecedented, rapid, and irreversible urbanisation. The cities growing fastest are those of the developing world, and the fastest growing neighbourhoods are the slums. ..... Urban poverty is now becoming a severe, pervasive – and largely unacknowledged – feature of modern life. Huge numbers of people in towns and cities are suffering levels of deprivation that are often worse than those experienced by the rural poor."

UN-HABITAT defines a slum household as a group of individuals living under the same roof in an urban area who lack one or more of the following:

1. Durable housing of a permanent nature that protects against extreme climate conditions.
2. Sufficient living space which means not more than three people sharing the same room.
3. Easy access to safe water in sufficient amounts at an affordable price.
4. Access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people.
5. Security of tenure that prevents forced evictions.

(Not everyone living in a slum area is in poverty, although most will be. And not every person in poverty lives in a slum)

The origin of Civil Engineering is of great antiquity. It is probably the oldest profession in the history of human race. Mention of construction of tanks, canals, bridges and other Civil Engineering works is made in epics, Vedas, puranas and smritis. The excavations of Harappa and Mohenzo-daro (3000–2500 B.C.) reveal that well planned dwellings with sanitary and water supply arrangements were existing even in those days. Civilization has developed more or less on the banks of rivers and canals.

Civil Engineer has a major role to play in nation building. Whatever sphere of life we may consider whether it may be construction of buildings, bridges, roads, railways, harbours, runways, marine structures or may it be irrigation works or providing drinking water to villages & towns, providing drainage and sewerage systems, the importance of Civil Engineering cannot be negated.

Civil Engineering has developed to leaps and bounds in recent times. It is no more an empherical science based on experience and judgment but it is based now on rational designs and procedures. The prospects are bright for Civil Engineers in years to come in view of the Globalization and Liberalization of our national economy. This has opened the doors for foreign investment in infrastructural development of our country, simultaneously throwing the challenges to our people to compete with the multinationals. This naturally requires lot of preparedness and training for our construction work force. This is especially so, in view of the signing of the WTO/GATS agreement which will be coming into force within a few months from now.

Construction work force is the second largest workforce after agriculture labourers in this country. As per present estimates of CIDC, there are 3.1 crore construction workers in our country out of which about 2.75 crore are working in

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unorganized sector. It shall be an eye opener for all of us that out of this total construction labour work force approximately 2.27 crore workers are unskilled. Truly speaking construction industry is surviving on this large population of unskilled workers. This is probably one of the reasons for poor quality and bad workmanship.

Another matter of surprise is that about 30% to 40% of the workers working throughout the country are from the heartland state of Madhya Pradesh. This state inspite of its vast natural resources and human resources is at the bottom of the ladder in terms of infrastructure development. Basic amenities like electricity, roads, drinking water and housing are still not available to the common man to the satisfactory extent in some areas of the state, which fact should be a cause of concern to all of us.

Construction has been recognized as the primary and most vital component in the execution of national development 5 year plans. Construction employs 31 million persons, accounts for 21% of GDP and almost 40% of the plan expenditure. In tenth five year plan (2002-2007) the planning commission has incorporated for the first time a chapter on construction, allocating a total investment of Rs. Forty lakh crore. With construction sector alone accounting for nearly 40 to 50 percent of plan expenditure, this works out Rs. Four lakh crore every year.

Training of construction workforce, upgradation of their skills, certification, rating of contractors, standardization of qualification, competency etc. should be taken up by Governmental and Non Governmental Organizations immediately in order to ensure that our workers are fully equipped to face the challenges ahead. Procedures for global bidding, contracting, Dispute resolutions, global consultancy and synergy with overseas organizations etc. should be made available to the people, keeping the fact in mind that transparency should prevail in all matters. The industry should move from the current state of rule bound, lowest-price-based contracting to a more quality-conscious, time bound, technology-driven improvement for all activities involved in construction.

A step in this direction has already been taken up by CIDC in collaboration with industry & other organizations. CIDC and IGNOU entered into an agreement in 2003 to jointly design and implement continuing and extension educational programmes for professionals and construction workers respectively. Under this agreement IGNOU has agreed to conduct all HRD activities of CIDC including certification of construction workers in different trades.

'Vocational & job oriented training for the secondary level students' was organised by Construction Industry Development Council, New Delhi, Indian Society for Trenchless Technology, New Delhi, Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal and Civil Engineering Technology Development Centre, Vidisha. 88 students (10th pass) were admitted to this training programme which lasted for six months i.e. from 20th Dec. 2004 — 19th June 2005. This is the first Building Centre in the country which the CIDC has selected for imparting training to the various trades in the construction Industry. All the trainees were later absorbed by the construction In-

Discussion with Slum dwellers regarding requirement of housing

A view of the participants and other dignitaries visiting the Building Centre

dustry. The training programme was inaugurated by Smt. Archana Chitnis, Minister for Technical Education, Employment and Training, Govt. of Madhya Pradesh and was presided over by Dr. P.R. Swarup, Director General CIDC, New Delhi, Prof. A.G.Krishnamurthy, Ex-Director was the special guest on the occasion.

Recognizing the need to boost training programmes in the country, NHAI i.e. National Highway Authority of India has made it mandatory to employ 5% trained and certified workers for its projects. Govt. of Andhra Pradesh has established National Academy of construction (NAC) with the objective of achieving the development of the construction industry and engaging in activities for the promotion of education, training research, professionalism and skill formation in the construction industry. G.O. was issued to facilitate collection of contribution from contractors to a tune of 0.25% of the gross bills towards the corpus for development and functioning of the NAC. It was agreed by the Builder's Association of India to include this as a condition in the Tender documents and agreement forms thus making such contribution mandatory. Rajasthan Urban Infrastructure Development Project (RUIDP) has introduced Grading of contractors as one of the essential conditions of Pre-qualification. Madhya Pradesh Government has also signed an MOU with CIDC for the establishment of MP Academy of construction recently. The Academy is likely to become the fountain head for this national movement in the years to come.

Catalysing five national outcomes

Concept of Equipment bank

A major chunk of construction equipment owned by companies remains unutilized for larger parts of the year. The idle equipment requires maintenance. Depreciation adds further to the unproductive costs of the company.

With total equipment stock of over Rs. 75,000 crores in the country and with additional requirements of Rs. 9000 crores every year, efficient utilization of construction equipment will result in huge savings for a capital starved economy. This concept has been mooted out by CIDC and is being implemented through some major companies.

New technologies and new trends

While developing and implementing any technology we should aim at.

- Use of locally available materials suitably improved by modern engineering techniques
- Employment generation
- People's participation
- Resource conservation
- Environmentally sustainable

development i.e. the development which conserves the resource base over a sufficiently long period into the future

- Energy conservation
- Use of non conventional energy sources like solar, wind, ocean and tidal, Geothermal, energy from Municipal and Industrial wastes, Biomass, Emerging Renewable options like Chemical sources of energy i.e. Fuel cells, Hydrogen energy etc.
- Utilization of industrial, agricultural and municipal wastes in construction industry
- Use of Cost Effective and Environment friendly (CEEF) technologies in construction
- Environmental impact assessment of each technology is to be analysed before it is implemented
- Less dependence on cement, steel, burnt clay bricks and timber by choosing alternative building materials in construction like S.S blocks, Precast stone masonry blocks, Hollow & Solid Concrete blocks, Ferrocement roofing & walling units, water tanks etc.
- Use of prefab components in construction (better quality, quick construction, less form work)
- Use of Fibre Reinforced Concrete, Ready mixed concrete, lightweight aggregate concrete, cellular concrete, high strength concrete, polymer concrete, fibre reinforced polymer composites etc.

Trenchless Technology

Trenchless technology is a set of techniques for the remote installations, rehabilitations and repair of utilities, pipe lines and small tunnels – linked by their lack of need for digging a continuous trench for the installation of new pipes or the repair of old pipes.

Some typical Trenchless construction include Micro-tunnelling, Horizontal Directional Drilling, Auger boring, Pipe Jacking, Pipe rehabilitation, Pipe replacement and Manhole reconstruction techniques.

Benefits of Trenchless Technology

Trenchless Technology reduces:

- Disruption of traffic, business etc. (Excavations only at entry and exit shafts required)
- Danger to existing underground facilities
- Easement requirements
- Environmental impacts
- Potential for settlement damage
- Potential of injuries due to open excavations
- Required time and costs

Limitations

1. This technology should be applied to a wider range of construction projects only when appropriate (Deeper installations, reduced social cost impact, higher land/lane rental/ easement cost, increasing density of underground utilities, demands of interference with future large scale underground structures, changes of utility system to accommodate new methods or demands etc.)
2. Only those contractors who are familiar with this technology should be permitted to take up the work.
3. Jobs done poorly with Trenchless technology can be even more disruptive than open cut methods.

Cost comparison between open cut and Trenchless solutions

When open cut and Trenchless solutions are both viable it is important to count the hidden costs (social and indirect costs) of both approaches so that fair comparisons are made. It is observed that the social costs are sometimes more than twice the cost of the actual replacements.

Trenchless technology is bound to be the only viable solution for repairing and augmenting the water supply and sewer lines, gas and fuel supply lines, providing electric cables and fibre optic lines, soil pollution treatment etc. in major cities. In order to prevent the disruption of traffic in metropolitan cities the government may come down with a legislation at any time banning the open excavation in busy roads as has been done in U.K. and other countries. The construction industry should be geared up to take up the challenge with full preparedness.

Earthquake resistant Buildings

While designing the buildings for earthquake resistant the following points should be given due consideration.

- The building as a whole or its various blocks should be kept symmetrical about both the axes, Unsymmetry leads to torsion during earthquakes and is dangerous.
- Simple rectangular plan behave better in earthquake than one with many projections (prefer-

ably length to width ratio not more than three in order to avoid the torsional effects of ground motion)

- Structurally it will be advisable to have separately enclosed rooms rather than a long barrack.
- Hill side slopes liable to slide down during an earthquake should be avoided
- Soils like very loose sands or sensitive clays are liable to be disturbed by the earthquake so much as to lose their original structure resulting in unequal settlement of the building.
- Such soils should be avoided in foundation and the drainage condition be improved so that no water accumulates and saturates the ground close to the footing level.
- Ductility is the most desirable quality for good earthquake performance and can be incorporated to some extent in otherwise brittle masonry construction by introduction of steel reinforcing bars at critical sections.
- The buildings should be constructed of fire resistant materials as it is likely that short circuiting of electrical fittings or gas pipe leakage etc. may take place during earthquakes.
- RCC bands are to be provided at plinth level, lintel level and roof level (minimum 75 mm thick in M-15 concrete with proper reinforcement). Vertical reinforcement corner bars are also provided in critical seismic zones.
- Avoid excessive openings in the wall by providing only the required number of doors and windows. Keep at least a minimum distance 0.6 m between the openings and from the corners.
- Limit the length of wall of each room to 6.0 m. If the length exceeds 6.0 m provide a partition wall or strengthen it by intermediate vertical buttresses.
- Flat roofs or floors shall not preferably be made of terrace of ordinary bricks supported on steel, timber or RCC joists. In case this type of construction cannot be avoided, the joists should be blocked at ends and bridged at intervals such that their spacing is not altered during an earthquake. For pitched roofs, GI or AC sheets shall be used in preference to country or Manglore tiles or other loose roofing units. All roofing materials shall be properly tied to the supporting members.

SDI Guiding principles

(what can we learn from this?)

1. An **autonomous** '**voice** *of* the urban poor' and not a voice *for* the urban poor.
2. Daily **saving** by members is a mobilising & developmental tool, creating accountability, self-reliance and financial and human resource management skills.
3. The participation of **women** and of the most marginalised members of slum communities is central.
4. Community **learning and solidarity** through horizontal exchange programmes.
5. **Incremental** human settlement **development** (identifying and building assets).
6. Grassroots-driven gathering of **information** through surveys, enumerations and settlement profiles (knowledge is power).
7. Solution-finding through **negotiations** and dialogue.
8. Community-based **shelter** training, including house modelling, community action planning and community design.
9. Small core groups of **professionals** to provide technical and financial support to federations.
10. Consistent **engagement** with local authorities through urban poor funds, enumeration data and citywide development strategies (note power relationship).
11. **International advocacy** in order to strengthen local city level initiatives.

Conclusions

Civil Engineering is a vast ocean covering many subjects. Covering the new trends and technologies in each subject of Civil Engg. like Concrete, Water Resource Management, Foundation Engineering, Cyclone resistant houses for coastal areas, new materials of construction and construction techniques Rainwater harvesting, new design concepts in structural analysis, marine structures etc. is not possible in one paper, Computer Applications in Civil Engineering has revolutionized the structural analysis and structural design. Use of computers in water resources management, Traffic and transportation Engg., Water Supply and Sanitary Engineering, construction Technology and Management has made the solutions simpler and time saving.

References

- *I.S. 1893-1984 criteria for earthquake resistant design of structures*
- *I.S. 4326-1993 code of practice for earthquake resistant design and construction of Buildings*
- *I.S. 13920-1993 code of practice for ductile detailing of structures subjected to seismic forces*
- *Payne, G. (2005) Getting ahead of the game: A twin-track approach to improving existing slums and reducing the need for future slums, Environment & Urbanization, 17, pp: 135-145.*
- *Srivastava, A. and Singh, R. C. (1996) Slums and associated problems: A case study of Bhilai, an industrial city, India, International Journal of Environmental Studies, 50, pp: 51-60.*
- *Tibaijuka, A. K. (2005) Report of the Fact-Finding Mission to Zimbabwe to Assess the Scope and Impact of Operation Murambatsvina by the UN Special Envoy on Human Settlements Issues in Zimbabwe, UN-HABITAT, Nairobi.*

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Workshop on Emerging Building Materials & Construction Technologies at Bangaluru

BMTPC together with Karnataka Slum Development Board (KSDB) organized one day workshop on Emerging Building Materials and Construction Technologies on March 07, 2014 at Bangaluru in order to disseminate knowledge on emerging technologies in Southern Region being evaluated and promoted by BMTPC. The KSDB is the premier State agency primarily entrusted with the task of slum rehabilitation in the entire State, hence, itself a promising client for such technologies. Total eight technology providers took part in the workshop to showcase their technologies & building systems and interacted with the stakeholders so as to get the feedback and understand the aspirations of the masses as regards quality housing. The participants included policy makers, engineers from various State Govt. Departments and representatives from Developers/Contracting agencies. The participants took keen interest in understanding the intricacies of the emerging technologies for possible field level application in social mass housing.

Cooperatives for Improving Living Conditions in Slums

*M.L.Khurana**

Historical Perspective and Scale of Slum Problem

When human beings were able to produce more than they consumed and had found ways of storing the surplus to provide for a large number of people, living away from the field, they settled on such areas which provided good environment, climate and soil favourable to plant and animal life, an adequate water supply, ready materials for providing shelter and easy access to other people. Concentration of population grew at the intersections of trade routes, at harbours and at the mouths of rivers with easy access to the sea. Athens, Rome was located near the sea. Mecca, Damascus and Samarkand were island cities located on caravan routes. In India all big cities were located near the banks of rivers, ports, etc. Varanasi is one of the ancient and famous cities located on the bank of river Ganges. The officials and priests lived in the main hub whereas lower classes – craft persons, artisans and labourers lived around the city republics. Gradually people from fields and small settlements started moving to city republics because of lack of farm work all time of the year and safety in cities. These city republics became powerful and tapped the surpluses and other resources. In 1800 only 2% of world population lived in towns of more than 5000 inhabitants. No more than 45 cities had population over 100,000. The 19th and 20th Century saw enormous growth of urban population and cities were not able to sustain the pressure of increased population and could not provide good environment and basic services to new entrants as they were unable to afford reasonable shelter within their means. They were therefore forced to live in slums.

The word slum which first appeared in Veux's Flash Dictionary in 1812 was derived from slumber which means a sleepy unknown back alley. Slum meant `wet mire' where working class housing was built during British Industrial revolution in order to be near the factories. These were uncontrolled settlements and lacked basic services and where only the poor lived.

According to an Expert Group of the United Nations, a slum is an area that combines to various extents the following characteristics namely; (i) inadequate access to safe water, (ii) inadequate access to sanitation and other infrastructure; (iii) poor structural quality of housing; (iv) overcrowding and (v) insecure residential status.

In India almost all urban settlements face the unpleasant scenario of 'Slums'. Often, this has remained a vaguely defined phenomenon. Various institutions and documents have attempted to define 'Slums' largely as a measure of deficiency of basic habitat services and amenities or the absence of livable environment consisting of adequate housing and infrastructure facilities.

The latest census defines a slum as "residential areas where dwellings are unfit for human habitation" because they are dilapidated, cramped, poorly ventilated, unclean, or "any combination of these factors which are detrimental to the safety and health" and covers all 4,041 statutory towns in India. Over a third of India's slum dwellers live in unrecognized slums with some researched facts:

- By 2011, over 65 million people live in slums, up from 52 million in 2001, but slum populations have grown slower than the average urban population over the last decade.
- The average household living in a slum is no larger than an av-

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erage urban Indian household, with 4.7 family members.

- The child sex ratio (0-6 years) of an average slum household is 922 girls for every 1,000 boys, compared to 905 for urban India.
- Scheduled Castes (SCs) are over-represented in slums, with 1 out of every five slums residents belonging to SC, compared to just over one out of 10 for urban India as a whole. The proportion of SCs living in slums has risen over the last decade.
- Scheduled Castes in slums have far better sex ratios than other urban communities.
- The literacy rate in slums is now up to 77.7% but still lags behind the urban average.
- Both men and women living in slums participate at a higher rate in the workforce than the urban average, even though fewer have employment through the year.

According to recent estimates, Maharashtra, Uttar Pradesh, Andhra Pradesh and Madhya Pradesh will be having largest share of slum population in India by 2017. These states are already home to a large number of slum populations which mostly lives in and around urban areas. By 2017, Maharashtra will be home to more than 20 million of slum population in India followed by Uttar Pradesh, Andhra Pradesh and Madhya Pradesh. It is estimated that by 2017, India's total Slum population will be 104 million. On the present trends, 2 billion people would be living in slums by 2030. This is because of enormous migration from rural to urban areas, new family formation and increase of population.

For the latest round, the census designated slums in three different ways - notified, recognised and identified. While the first two are designated as slums by some official authority, identified slums do not have legal status as a slum, but must consist of at least 60-70 tenements with at least 300 people.

The data shows that of the three types, identified slums have the largest sub-set of slum population, indicating that over a third of India's official slum population does not have official status as a slum, or access to legal protection and municipal services.

With over 11 million of its residents in slums, Maharashtra has the highest slum population; 4.6 million of them in 'identified' slums. Andhra Pradesh follows with over 10 million in slums, and West Bengal and Uttar Pradesh have over 6 million slum residents each. Over 1 million of Delhi's 1.7 million slum residents live in 'identified' slums.

With the new method, several states such as Haryana, Delhi, Assam, Jammu & Kashmir and Jharkhand have identified more slum dwellers in such areas than in the notified or recognized slums. In fact, the number of towns having slums has gone up from 1,743 in 2001 to 2,613 in 2011, out of a total of 4,041 towns in India.

The proportion of slum population to urban population has fallen slightly with the slum population growing at a slower pace than urban areas as a whole. There also isn't any difference in the household size of urban areas and slums any more, about 4.7, with slums showing a higher reduction in family size.

According to a study conducted by Participatory Research in Asia and Indicus Analytics, people living in urban slums contribute over 7% to the GDP of the nation.

States with the highest population in non-notified/non-recognised slums (Figures in lakhs)

States	Total slum population	Notified slums	Recognized slums	Identified slums
Maharashtra	118.5	37.1	34.9	46.5
West Bengal	64.2	0.5	37	26.7
Rajasthan	20.7	0	0	20.7
Gujarat	16.8	0	0	16.8
Haryana	16.6	0.1	0	16.5
Tamil Nadu	58	25.4	19.8	12.8
Madhya Pradesh	56.9	19.0	25.3	12.6
Bihar	12.4	0	0	12.4
NCT Delhi	17.9	7.4	0	10.5
Uttar Pradesh	16.4	5.6	46.8	10
India	**655**	**225.4**	**201.3**	**228.3**

Our country, therefore, can ill-afford to neglect the welfare of such large number of its citizens. Adequately catering to their socio-economic development needs should engage our immediate attention in larger interest of national development and national integration.

Living Conditions in Slums

Almost all the houses in slums are in bad, and sometimes dilapidated, conditions. The houses are usually inadequately ventilated. The designs are such as to afford bare shelter, leading to acute congestion. In squatter settlements, houses are constructed using materials like mud, un-burnt bricks, tin-sheets, asbestos sheets, bamboo, gunny bags, plastic sheets etc. and are usually single-room units with inadequate space standards.

Private toilets do not exist in a majority of slum areas and even common toilets are available only in a few. Where there are no toilets, people defecate in the open which, besides being an environmental nuisance, poses hardships for, especially women. Community latrines, even where available generally remain filthy and insanitary and virtually a menace to the areas in which they exist.

Most of the houses in slum areas do not have dedicated water supply. In some slum areas, public taps do exist but the number of persons using each such tap is generally very high. Many slums, especially in the outskirts of the cities, have open wells as their only source of water for drinking, bathing and cleaning. These wells are generally insanitary. No attention is paid to the maintenance of wells, or even of public taps. A considerable number of slum dwellers have to fetch water from outside the slum areas.

The drainage system in almost all the slums is very poor. With the exception of pucca buildings in old city areas, slum settlements generally do not have any drainage. Furthermore, a majority of unauthorized colonies and squatter settlements are located on low-lying lands. As a result, sewage water cannot flow away. The situation becomes particularly worse during the rainy season when storm water finds its way into these low lying settlements and get mixed-up with the sewage water, making extremely unhygienic environment.

Roads and lanes are narrow and often unpaved. Puddles and slush are common-place after every rain shower. The facility of roads and street lights is generally inadequate. This adversely affects the safety and security of residents and is generally believed to be largely responsible for high rates of night-time crimes.

There is a complex relationship between environment and health. A number of studies have shown that the unhygienic slum environments make slum dwellers more susceptible to certain types of diseases like respiratory diseases, gastro-intestinal disorders, skin diseases, malarial fever, tuberculosis, etc. Unfortunately, the economic circumstances of the slum dwellers are such as they do not allow them to improve their living conditions. A majority of the slum dwellers are employed in the unorganized or informal sector. A large proportion of them works on a daily wage basis and, therefore, has little or no job security. A significant proportion is employed in construction work. Due to low income, their standard of living is also low and they are left with little surplus income for housing after meeting their families' basic needs of food and clothing.

In brief we may say that slum dwellers are faced with insecurity of tenure, lack of basic services, especially water and sanitation, unsafe building structure, overcrowding, limited access to credit and formal job markets. Normally slums exist on polluted land. They suffer from water-borne diseases. It is also believed that slums are places of high level of crimes. This is not universally true. The poverty is the main reason for slums. At the same time slums also provide low cost accommodation to poor migrants and necessary support to city.

Organise Slum Dwellers and Urban Poor into Multi-Purpose Urban Cooperatives & Government Intervention – A Suggested Strategy

Government alone cannot effectively resolve the multi-faceted problems of the urban poor, rather people's participation is absolutely necessary in all the urban poverty alleviation programmes so that the development inputs reaches specifically to the targeted beneficiary. Therefore, the new strategy should be to organize multi-purpose urban cooperatives among the slum dwellers and urban poor in each of the slum cluster in various towns and cities. The mechanism of cooperative can be a solution because individuals come together to achieve their objectives as a collective group what they cannot achieve as individuals alone. Co-operatives can:

- Motivate people for shelter, channelize petty savings, organize and manage on democratic basis their cooperative societies and also supervise the construction of houses and post-construction maintenance of housing assets.
- Undertake various educational, cultural, economic and social activities.
- Help in income up-gradation through household micro enterprises
- Improve affordability towards housing and related services including capability for repayment of housing cooperatives.
- Motivate people to maintain the assets created (which local authorities can ill-afford as a recurring responsibility).
- Provide fresh migrants the much needed emotional security in the unfamiliar urban environment.

Suggested Action Plan and Broad Guidelines

- Organize Multi-purpose urban cooperatives among the urban poor in each slum settlement
- Land owning agencies should allot land for house construction to multi-purpose urban cooperative societies on leasehold basis at concessional rate recoverable on long term basis.
- Members would derive occupancy and ownership right which would be heritable and can be mortgaged for raising housing loans.
- Members shall be prohibited from selling their share of land or transferring it in any manner.
- When a member quits the membership of the cooperative, the land shall revert to the cooperative itself thus preventing alienation of land.
- In order to safeguard the interests of women who are the most vulnerable among the urban poor, membership will preferably be for women.
- Besides housing, multi-purpose urban cooperatives may undertake other activities like home-based industries, health and social services, rental housing, library, child care, care for elderly, distribution of building materials, publicity for the use of innovative technologies, etc.
- They can also perform thrift and credit functions among the members thereby strengthening micro credit system for urban poor.
- These additional activities will generate employment opportunities and give additional income for the members on the one hand and reduce housing costs on the other.

The Government of India has taken a number of initiatives for the development of infrastructure as well as improvement of environment in urban settlements with a view to improving the quality of life of urban poor. In this context, the Ministry of Housing and Urban Poverty Alleviation are monitoring the implementation of a few Centrally Sponsored Schemes for which, besides policy guidelines, State Governments and their development agencies are given financial support in the form of grants and loans.

The Government provides assistance to States/Union Territories (UTs) for development of urban slums through provision of physical amenities and basic services under the Basic Services to the Urban Poor (BSUP)/Integrated Housing & Slum Development Programme (IHSDP) components of Jawaharlal Nehru National Urban Renewal Mission (JNNURM). The benefits of these programmes flow equitably to members of the minority communities and to cities/slums, predominantly inhabited by minority communities. In all, 15% of the Central allocation is to be earmarked for the Minority Communities. States/UTs are required to give priority to the cities/slums, predominantly inhabited by minority communities (i.e. where minority population is 25% or more), while submitting Detailed Project Reports (DPRs) for the assistance under the BSUP)/IHSDP.

Both under BSUP and IHSDP emphasis is given for integrated development of slums through projects for providing shelter, basic services and other related civic amenities with a view to provide utilities to the urban poor. Accordingly, the approved projects include physical amenities and related infrastructure such as water supply, sewerage, storm water drain, roads, multi-purpose community centres, parks etc.

More recently, in pursuance of the Government's vision of creating a Slum-free India, 'Rajiv Awas Yojana' (RAY) has been launched. The scheme envisages providing Central support to States that are willing to assign property rights to slum dwellers for provision of decent shelter and basic civic and

social services for slum redevelopment, undertake reservation of land/Floor Area Ratio (FAR)/dwelling units for Economically Weaker Sections (EWS)/Low Income Groups (LIG), earmark 25 per cent of municipal budget for basic services to the urban poor/slum-dwellers and bring in legislative amendments and policy changes to redress land and affordable housing shortages for the urban poor. Under the RAY, 33 Pilot projects from 13 States (28 Cities) have been approved up to 31st December, 2012.

As a means of Credit Enablement of the urban poor, the Interest Subsidy Scheme for Housing the Urban Poor (ISHUP), dovetailed with RAY–provides interest subsidy of 5% on loans upto Rs.1 lakh, so as to reduce the cost of the loan taken to build/purchase house.

The Affordable Housing in Partnership Scheme (AHPS), which is intended to encourage public private partnerships for the creation of affordable housing stock is dovetailed with RAY. Under this scheme Central Assistance will be limited to least of following:-

- Rs. 50,000 per rental unit or Dwelling Unit for all dwelling units taking EWS, LIG and MIG units together which are proposed in the project, and
- 25% of the cost of all civic services (external and internal) proposed in the project.

The scheme extends to all cities covered under RAY and rental housing units as well as dormitories for new migrants are also permissible under the scheme. Under the AHPS, 11 projects from 2 States have been approved so far.

The Government of India has also approved the establishment of a Credit Risk Guarantee Fund (CRGF) Trust with an initial corpus of Rs.1000 crores. This scheme proposes to guarantee the lending agencies for loans given to EWS/LIG persons up to Rs.5 lakh without any third party guarantee or collateral security. The National Housing Bank is the identified agency for operationalising CRGF. The Trust has been registered. The CRGF Scheme has been notified in the Gazette and subsequently launched on 31st October, 2012.

Urban slums, particularly in the big cities of our country, are the picture of human misery and degradation. Urbanization is an inevitable phenomenon of modernization and economic development. Slums grow as a result of structural inequities in the development of the urban sector. Due to the high price of land and housing and low purchasing power, the urban poor are forced to join the existing slums for cheap shelter or to occupy any vacant land/areas wherever available in the city. With a view to paying particular attention to the needs of slum dwellers the programme titled Basti Sudhar monitors number of urban poor families assisted under the seven point charter viz. land tenure, housing at affordable cost, water, sanitation, health, education and social security.

Role of NGOs

The emerging scenario of the complex socio-economic problems of slum dwellers and the somewhat isolated, piece-meal action plans and programmes drawn up so far by the Governments amply has not effectively hit the target. Thus while on the one hand the slum population is growing and the slum conditions are worsening, on the other hand, the slum programmes usually remain only partly accomplished.

What is needed is Peoples' Participation, both in policy formulation and implementation of programmes. In this regard, Non-Governmental Organizations (NGOs) with their local knowledge, skill and practical experience can play very effective role in programmes for improving living and economic conditions of slum dwellers. Various Five Year Plan documents have explicitly recognized the importance of involving NGOs in the planning and implementation of anti-poverty and minimum needs programme, which includes environmental improvement of slum areas only.

Role of Cooperatives in Slum Improvement

The essence of cooperation is that individuals come together to achieve as a collective what they cannot achieve as individuals. Inasmuch as the means, in general, and access to land, finance and other resources for housing, in particular are even more limited in the case of slum dwellers than in other sections of the society, housing cooperatives have a substantial potential role in the attainment of the shelter goals of slum dwellers.

Another major advantage of slum cooperatives is that they provide fresh migrants much needed emotional security in the unfamiliar urban environment. In furtherance of their aim of fostering a new community life for slum dwellers, slum cooperatives can undertake various educational, cultural and social activities.

Slum cooperatives can also

help in income up-gradation endeavours if, for instance, cooperative household industries in slum areas are encouraged with a view to raising incomes and, thereby affordability towards housing and related services, including capability for repayment.

An important aspect of slum improvement and up-gradation is to motivate the public to maintain the assets created. Cooperatives of slum dwellers have a major advantage in that as they can secure the much needed maintenance of assets created which local authorities can ill-afford as a responsibility. Cooperatives not only provide a forum for community action in respect of maintenance initiatives, but they also help in educating slum dwellers on the need for maintenance and thereby secure, in the long term, individual responsibility and participation.

Thus cooperatives for housing, cooperatives for water supply and sanitation, cooperatives for schools, cooperatives for health and environment etc. or a multipurpose cooperative in each slum settlement can effectively ensure the delivery of various development inputs directly and specifically to the targeted slum population in order to achieve the desired results.

The importance of cooperatives and cooperative like organizations has been acknowledged by the United Nations Human Settlements Programme (HABITAT). The paragraph 56 of HABITAT Agenda recognizes cooperatives as stake-holders at local level that compliment and supplement the governmental efforts in meeting the housing needs of the people.

The Agenda makes specific recommendations on housing cooperatives. It particularly focuses on cooperatives' role in mobilizing financial resources for providing housing for the poor. The paragraph 82 of the Agenda states as under:

To create new housing finance mechanism, as necessary, Governments at appropriate levels should:

a) Harness the potential of non-traditional financial arrangements by encouraging communities to form housing and multi-purpose community development cooperatives, specially for the provision of low-cost housing;

b) Review and strengthen the legal and regulatory frame-work and institutional base for mobilizing non-traditional lenders;

c) Encourage, in particular, by removing legal and administrative obstacles, the expansion of savings and credit cooperatives, credit unions, cooperative banks, cooperative insurance enterprises and other non-bank financial institutions and establish savings mechanisms in the informal sector, particularly for women;

d) Support partnerships between such cooperative institutions and public and other financing institutions as an effective means of mobilizing local capital and applying it to local entrepreneurial and community activity for housing and infrastructure development;

e) Facilitate the efforts of trade unions, farmers, women's and consumer organizations, organizations of people with disabilities and other associations of populations concerned to set-up their own cooperatively organized or local financial institutions and mechanisms;

f) Promote the exchange of information on innovations in housing finance;

g) Support non-government organizations and their capacity to foster the development, where appropriate, of small savings cooperatives.

The housing cooperatives across the globe have been contributing significantly towards meeting the shelter requirements of needy people. They are also instrumental in removing social evils. For instance the Cooperative Housing Foundation of Canada has dealt successfully with the problem of domestic violence by sensitizing their members and soliciting cooperation of Municipal Authorities and Women Organizations. German Housing Cooperative has organized low income families of 15 countries to restore 400 apartments for them. Turkey presents a unique cooperative example of low income people through a mass housing project undertaken by Kent Koop (Union of Batikent Housing Construction Cooperatives) in collaboration with Municipal Authority of Ankara and Workers' Unions. Now 43000 housing units of this project provide shelter for 190,000 families. In Africa too, housing cooperatives have been playing important role in solving the housing problem.

The Indian cooperative housing movement is well spread across the country and has developed over the years into a noble and popular movement and in a posi-

tion to serve the poorest of the poor living in the slums. Today there are over 100,000 primary housing cooperatives with a membership of over 75 lakhs in the country. These housing cooperatives have constructed/financed about 2.5 million housing units in various parts of the country. So far, 75% of housing units have gone to economically weaker sections and low income families.

Globalization and Slums

In the new era of globalization of national economies there is increased movement of human resources, capital and ideas. There is also an increase in uneven distribution of wealth and poverty particularly in developing countries. Slum formation is closely linked to economic cycles, trends in national income distribution and national economic development policies. There are some positive aspects of globalization. The multi-national companies have created some job opportunities in developing countries. There is also increase of financial support to NGOs and other community based organizations from international communities and organizations for undertaking some social activities for improving the living standard of poor people.

As stated above the negative aspect of the globalization is that there is concentration of wealth and poor people are the worst sufferers. The economic crises, often triggered by pressures of globalization, and interpersonal problems have emerged as major reasons for driving vulnerable people to the edge of despair in Kerala as the State tops the suicide rates in the country. The number of suicides has increased over the years. According to the State Commission for women, Kerala is now "at the receiving end of the adverse effects of globalization, commercialization and privatization" and this has in part contributed to the high rate of suicides in the State.

Conclusion And Suggestions

In the United Nations Millennium Declaration, World leaders pledged to tackle immense challenge posed by mushrooming growth of slums world-wide thereby setting the specific goal of achieving `significant improvement in the lives of at least 100 million slum dwellers by the year 2020'. This means addressing not only the needs of slum dwellers for shelter but also the broader problem of urban poverty, especially unemployment, low incomes and lack of access to basic urban services.

However surprising it may appear but indeed, even the slums offer their residents better life chances, in terms of jobs, education and income ,than they had back in the village. Census 2011 says the number of slum dwellers rose 25% over a decade to touch 6.5 crore, or about 16% of India's urban population. Experts suggest this is an underestimate, due to exclusion of small slum clusters. A more realistic number would be 11.5 crore, or 30% of the urban population. This shows miserable lack of preparedness for India's ongoing structural transformation from an agrarian economy to an industrial and post-industrial one, in which large numbers of people migrate from countryside to town.

If all of migrants have to be housed in existing towns, pressure would mount on basic infrastructure and slums and slum dwellers would proliferate further. We need to build many new towns, to avoid this degradation of human life.

This requires reform that will enable release of more land to build new towns. Zones for urbanization should be identified in advance, land in which should qualify for automatic conversion from agricultural to commercial use.

New models of town planning must be introduced to increase density, reduce commutes, optimize energy use and create open spaces for sports and community gatherings. India's new towns are run by bureaucrats and authorities, and lack institutions of self-governance.

This must change. A cluster of new cities will come up when the corridor linking Delhi to Mumbai, being done in collaboration with Japan, is complete. Similarly, another extension is being planned from Mumbai to Kolkata. Such projects should materialize the vision for new, slum-free urbanization.

The Supreme Court in a recent judgement directed authorities in Delhi to discharge their statutory obligation in keeping the city "at least reasonably clean". The Court directed the concerned authorities "to take appropriate steps for preventing any fresh encroachment or unauthorized occupation of public land for the purpose of dwelling, resulting in creation of a slum". It was further ordered that "appropriate steps be taken to improve the sanitation in the existing slums till they are removed and the land reclaimed." The Court laid down the basis for this by saying that "the density of population per square kilometer cannot be

allowed to increase beyond the sustainable limit. Creation of slums resulting in increase in density has to be prevented." The judges also added: "Rewarding an encroacher on public land with free alternate site is like giving a reward to a pickpocket".

Cooperativisation of Slums: In view of various advantages of cooperatives as outlined above, multi-purpose cooperatives of slum dwellers should be formed by motivating and educating them about the philosophy and ideology of cooperation and self-help. The local level NGO should be given the responsibility of organizing them into a cooperative. When the cooperative society becomes experienced and self-reliant and is in a position to run their affairs on their own, the concerned NGO should withdraw from the scene and let it function from its own resources. With the experience so gained and training so acquired the NGO may shift to other area that requires their assistance/guidance in the process of cooperativisation of slum dwellers.

Role of Cooperatives: This multi-purpose cooperatives should raise institutional finance for improvement or construction of dwelling units and such other activity for the benefit of members, encourage habit of thrift and to make provision for the credit to needy people within the cooperative for employment generation, run ration shops, kerosene and allied commercial activities to provide daily needs at affordable cost and at their door steps, undertake educational, hygienic and other health and community related activities, undertake repair and maintenance of common space, arrange group insurance, general insurance and other social security measures.

Security of Tenure to women: In India, women in urban slums live in dire poverty and are prone to violent crimes and limited employment opportunities and contribute substantially to the growth of the family. As such only the women should be admitted as members of the cooperatives. This will give status and respect to the women in the family and improve their contribution to the community. The title of the land should be given to the women members and selling of their right should be prohibited and if at all they want to leave they should surrender their right to the cooperative.

The U.N. Habitat campaign for `secured tenure' is very noteworthy as it is the most important element for attracting institutional and individual investment in order to improve the living conditions of slum dwellers. Hernando de Soto - a well known economist from Peru also advocates for giving formal title deeds to the poorest slum dwellers. It is legal proof of their ownership which will enable them to raise loans for improving their houses and environment and starting business. The Peruvian Government has issued one million titles to slum dwellers thereby improving their living conditions by raising loans from various sources and by contributing themselves.

Poverty Alleviation Programmes: As stated above poverty is the main cause of slum formation. The multi-purpose cooperatives should undertake activities like thrift and credit, health and social services, rental housing, library, child care, care for elderly, distribution of building materials, etc. This will generate additional income for cooperatives and employment opportunities for their members.

The Government has been implementing various schemes of poverty alleviation through DRDA, DWACRA, Indira Awas Yojana, etc. These agencies may be impressed upon to involve cooperatives in the implementation of such schemes.

Basic services: Cooperatives should sensitize slum dwellers about the constant threat posed by lack of basic services. Further the cooperatives should be entrusted for providing basic amenities like water, electricity, sanitary services for their members with the help of local bodies. These cooperatives will ultimately transform them into new communities wherein "each is for all and all are for each".

People's participation and city management: The Second HABITAT campaign is for good urban governance. It advocates transparency, responsibility, accountability, just, effective and efficient governance of towns, cities and metropolitan areas. The cities create jobs and they are strong holds of economic development and provide better quality of life to different socio-economic groups. Cities have remained the backbone of national economies and will continue to be so in future. It is, therefore, pertinent that these cities are managed properly by professionals and with people's participation. We should accept people as part of the solution and they should feel they are part of the city. In Britain, Generalist Administrators do not run local governments. The management of the cities has been given to specialists from traffic management to garbage removal. The City of

Curitiba, one of the fastest growing cities in Brazil, has set an example of innovative urban management by creating a sustainable urban environment and a strong sense of citizenship in its people. Housing provision is an integral part of urban development.

These ideas should be implemented in Indian cities to rebuild our civilization. Good governance also means involvement of residents including poor people in the decision making of the urban governance. The multi-purpose cooperatives can play a very important role in this direction.

Infrastructure Development: There is a paramount need to invest in infrastructure to enhance economically productive activities of urban centres like electricity, access to water, sanitation, roads, footpath, waste-management, etc. This will ultimately improve the quality of life in the slums. City managers, State and national Governments should earmark substantial funds for infrastructure development thereby improving the living conditions in slums.

Reversing Urbanization: There is also an emergent need to discourage migration into urban centres and reverse this trend through speedy development of rural areas and small cities in order to effectively deal with mushrooming growth of slums. Instead of encouraging people to come where infrastructure is available, the infrastructure for adequate employment opportunities, better sanitation and hygienic conditions, sufficient facilities of health and family welfare, affordable housing, access to safe drinking water, transport and communication facilities, education, etc. should be made available to the poor needy people where they live. The findings of a recent study also show that 22% of the slum dwellers want to go back to their native places. In 1997-2000 Hungary saw a slow-down trend of rural urban migration because of development of rural areas.

Rural Development schemes like National Programme for Rural industrialization with active involvement of Khadi and Village Industries Commission and involvement of Panchayats to promote local initiative in the area of primary health care units, Gram Samridhi Yojna, Employment Assurance Scheme and Swarna Jayanti Gram Swa-Rozgar Yojna will go a long way in cheering the upgradation for rural areas. All these schemes and projects need proper integration and proper implementation with the motive to develop rural areas. Some of these jobs can be entrusted to village panchayats, as they would be in a better position to monitor their implementation.

Secondly, the Indian farmers use ancient tools and farm technologies. Further the size of holdings does not afford economics of scale and the infrastructure to deliver their goods to the market is non-existent when compared to the developed World. We should bring modern technologies; remove restrictions on storage, processing and movement of farm products by the farmers or traders, liberal and cheap finance and availability of the latest planting materials and other farm inputs to farmers. This will create lot of jobs in rural areas and improve the financial position of farmers. The example of China can be quoted where agricultural reforms provided more jobs and freedom to farmers to sell their produce in open market thereby bringing prosperity to them.

Strengthening of housing activities in rural areas will not only improve living conditions of farmers, but also create employment opportunities. This is an area of huge unmet demand and also a labour intensive activity. The experience of Grameen Bank Housing Programme in Bangladesh, have set an example, in alleviating poverty in rural areas by way of making the credit a powerful instrument for socio-economic change to enable the rural poor to fight their ways out of the vicious circle of poverty and live with human dignity. These findings are based on the basis of a study conducted by the author on the working of World Habitat Award Winning Project of Grameen Bank Housing Programme in Bangladesh.

The slums are reality of today and cities are collective future of human beings. We should take collective responsibility for their future development.

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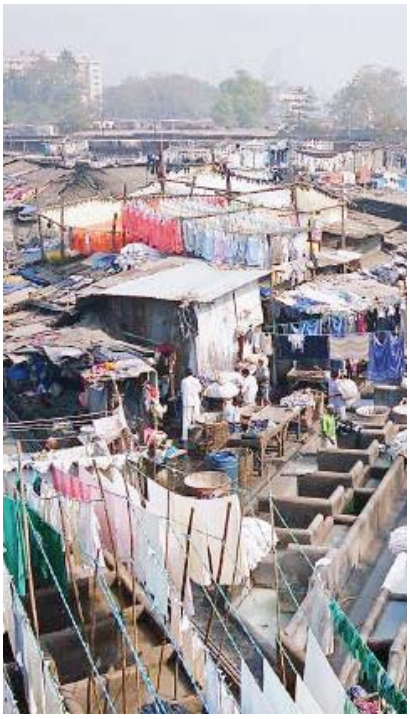

Demonstration Housing Project at Rae Bareli, U.P.

In order to demonstrate and popularise cost effective, alternate and disaster resistant technologies, the Council completed Demonstration Houses at Barwaripur, Rae Bareli using alternate technologies at the land provided by the local administration. In this Project, construction of 24 dwelling units (G+1) alogwith onsite infrastructure development were undertaken having each unit with plinth area of 32 sqm consisting of one living room, one bedroom, kitchen, one separate bath and WC with infrastructure facilities. The Demonstration Housing Project includes onsite infrastructure facilities like Pathways, Underground water tank, Boundary wall, Landscapping work, Biodigester toilets, etc. The Demonstration Housing Project was handed over to the local administration in February, 2014. The cost of construction for the project was Rs.840 per sqft. which is 10-15% less than the prevailing cost of conventional construction in the area.

Technologies/Specifications

Walling

- Burnt Clay bricks in Rat Trap Bond in place of conventional english/flemish bond to achieve energy efficiency, cost effectiveness etc.

Roof/Floor

- Reinforced Brick Concrete Slab for ground floor roof
- Filler slab with Earthen Pots for slope roofing
- Mangalore tile cladding on sloping roof.
- IPS flooring

Doors/Windows

- Pre-cast RCC door frames in place of wooden frames to achieve cost effectiveness.
- Window frames in steel sections
- Wood Substitute Flush shutters for doors
- Glazed shutters for windows

Finishing

- Exposed brick finish on external surface with pointing
- Internal plastering
- Oil bound distemper on Internal surface
- Exterior walls with water proofing cement paint
- Enamel paint on doors/windows
- Ceramic tiles in toilet and bath room
- Electrical and sanitary work

Others

- Biodigester toilets
- Pathways with concrete pavers
- Ferrocement staircases & sunshades

During the course of construction at the site of demonstration housing project, two Training Programmes were organised for Masons and a Training Programme for prospective engineers wherein 70 civil engineering students from KNIT Sultanpur were provided hands-on training on Alternate and Cost Effective Housing Technologies.

Affordable Housing - Making it Affordable, in larger Perspective

*Dipan Shah**

According to the estimate of the Technical Group constituted by MoUHPA, the urban housing shortage in the country during 12th five-year plan is estimated to be 18.78 million. The group further estimated that above 90% of shortage pertains to EWS and LIG. The number is huge and hence, one can see a major rise in policy support and also various state and central government projects on Affordable housing.

When such a huge number of projects are on going across India, it is time we work on Standards and Specification for Affordable housing. In these note, one is presenting two view points. The first one is regarding the basic Approach to Affordable housing. Let me tell you in the beginning it's a different perspective to the concern. The second part of the paper will talk about a specific case study and relevant statistics.

What is Affordable Housing ?

As an Engineering Professional, I always question myself what is affordable housing ? Did a range of homework on Google, been talking to various professionals, developers and policymakers of Affordable housing and I found each one has different perception of Affordable Housing. For some it was just a game of FSI and for others the terminology got translated into "low cost housing for the poor".

Low cost housing was a terminology widely used back in 80's, which basically meant housing at low cost i.e. cost remain at the center of the decision making process and not quality or comfort. With the passage of time, the sector evolved to "Cost Effective housing" i.e housing which is good in quality and user comfort and in which decision are taken based on cost benefit analysis. The terminology further in 2000 was evolved to Cost Effective Environment Friendly Appropriate housing. Now in these each word has its reason / meaning. First two words i.e. "Cost Effective" we have already briefed about. "Environment Friendly" was the terminology used so as to indicate that the decision taken for design and execution technology should be environment friendly i.e. should have minimum impact on Environment during construction and post occupancy. The last edition to the list was "Appropriate" i.e. the housing design and technology selection should be such that it is appropriate for the user and also for the environment. i.e. just to give an example to make the last terminology clear, a particular technology say Stabilized mud block or Hollow concrete block made using Flyash addition can be good, can be cost effective and environment friendly but may not be appropriate for a particular community or particular location because of technology non availability or non acceptance. Even appropriate was with respect to technological feasibility too i.e. available skills, scale of project, machinery required, etc.

The reason for taking this small discussion in between the discussion of Affordable housing was to now reflect that what is then Affordable Housing. Isn't it the same thing. The whole perspective of Affordable housing; the way we interpret is that a housing which is done at a scale so that a technology viability is achieved and the system is optimized in such a way to bring down the per sq m costing of the structure and at times, it is further optimized by land use. Now the land use component may need policy support or say policy framework. That is not something which one is focusing as a part of this paper.

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In these whole process somewhere the focus shifts on delivery of the housing rather than building homes. What one means is, user sensitive and maintenance free designs are two key challenges and third one will be to choose an technology which not only is environment friendly but boost the economy i.e. local economy.

Now if we take Affordability and understand various perspective of Affordable housing then

A) ***Affordability in terms of Costing :*** That is primarily for the promoter or developer of the houses which to some extent is transferred to the occupants.

B) ***Affordability for the user :*** The perspective is at two fronts one at the time of buying i.e. first level of apparent affordability. And second is long term affordability i.e. w.r.t. to maintenance and operational energy. Also in terms of mobility for daily needs of livelihood or socializing. Now it is in this second component, the choice of technology plays an important role. Many new and immerging technologies have come and they are very good as a technology, much advance and much speedy in execution with reference to conventional technology. So absolutely they are advantageous but one would like to put this with a pinch of salt and i.e. are we really as a society matured enough or as a construction industry evolved enough to get into mass delivery of all of those. What I want to put across is a technocrat view point that in most places when we do a regular slab concrete it shows signs of dampness or leakage at the end of 4 to 5 years. Conventional slab concrete we been doing since ages now but still we have not mastered the art of concreting. Just to add we are among the few countries in the world which uses plaster to protect concrete. I would like to reiterate the point again that one is not at all against the technology advancement but the fact is if we are not able to institutionalize systems and quality to back that advancement, aren't we taking our chances ? Possibility that we are may not be able to address the second component of affordability fully.

C) ***Affordability from the Environmental perspective :*** Affordable housing also means the affordability for mother earth. Global warming, climate change have been the buzz words of the century and housing is one of the sector which contributes massively to these phenomenon. We talk a lot on Operational Energy ie. OE but very few of us also know about EE i.e. Embodied Energy. Embodied Energy is the energy utilized in building or building material right from Extraction to production to transportation to installation in building. Also, depending on the need it can be represented till demolition and disposal. Now, we have on one hand very precise systems to model OE but we never calculate EE. EE can be tool to let us know, how appropriate our choice of technology is with reference to affordability at Environment front. A combine modeling using OE and EE clubbed with EIA or LCA will be a good methodology to ensure environmental affordability. It should be made compulsory.

D) ***Affordability at the Economical perspective also :*** Now here when one talks about Economy it is not about profit and loss for few but in general economical development of the region. Our simple experience of multiple projects in the past clearly reveals that if the choice of material and technology is done in such a way that major chunk of resources spend in housing are disbursed in the local or regional market, it gives a good boost the local economy. With the huge range of technological options available if decisions are taken with due stress on the above, the chunk of choices will be available.

Design Package for Western Region - Pre approved under RAY

With all the above loud thinking and expression, here one is trying to put on one of the project as a case study, where attempt was done to meet the above and work out an model package.

Background

As a part of one of the project of BMTPC i.e. Building Material and Technology promotion Council, Society for Environment Protection (SEP) and BMTPC, designed a package of 60 houses each around 25 sqm with a school and a community hall. The purpose of the project was to work on and create a model project into Affordable housing, which is not only sensitively designed but also integrates Cost effective environment friendly technologies. The purpose of the project was to help create a package which has all the required information including costing; so

Master Plan

that state government or any other agency can pick up the package and can start execution.

The Basic Philosophy of the design :

- Developing a good architectural design based on possible user needs and integrating climatic comforts.
- Select technologies which have proven track records and hence effort should be on main streaming and not developing technology display models.
- Not to treat project as a model project but to make it a feasible project for anyone and everyone.
- Keeping environmental sensitive design and the use of the local material and technology at the backdrop of all the decision making processes.
- Technology selections so as to work with available skills

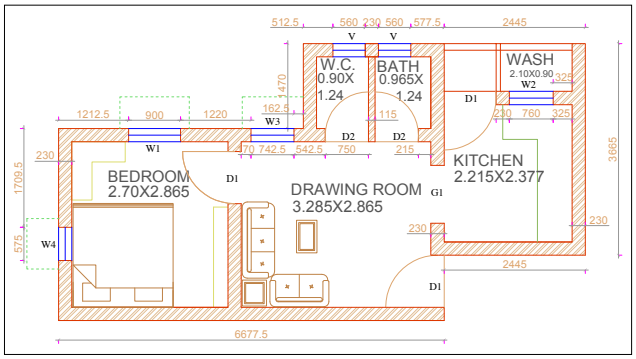
The Design of the unit was delicately worked out so as to optimize cost and user comfort.

Technology :

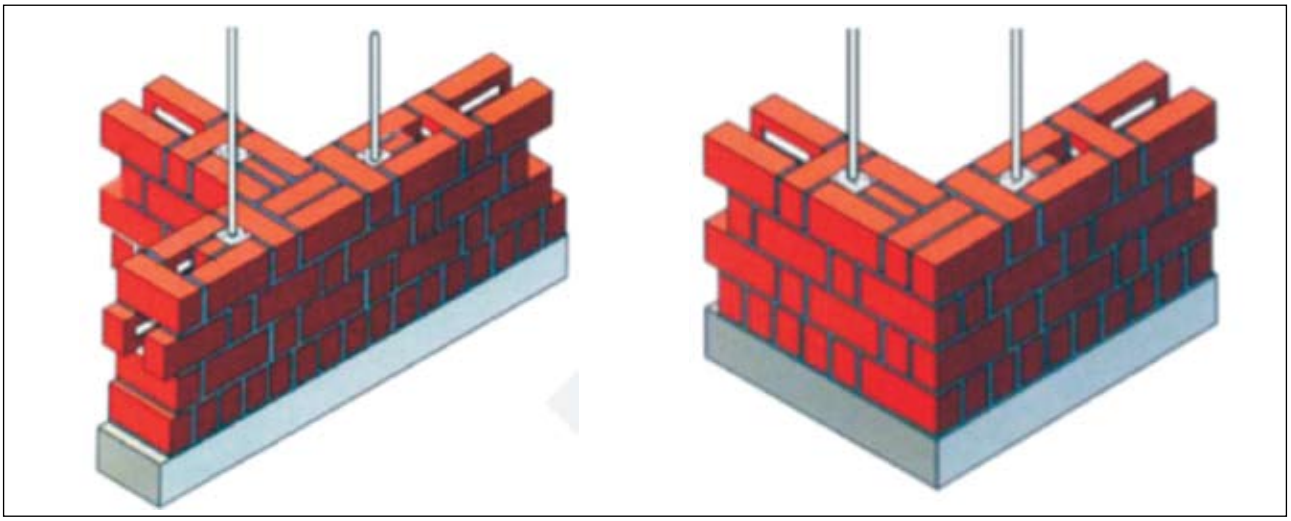
Walling : Rat Trap bond

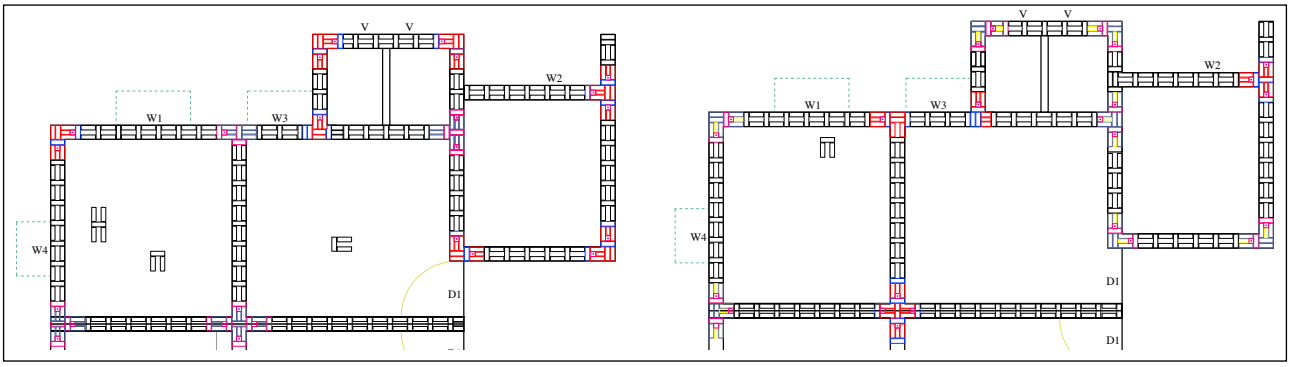
Roofing : Filler Slab

Rat Trap Bond : Rat trap bond is a simple masonry technique in which bricks are arranged on edge. It is one of the very popular technology in Kerala. It does not need any special material or equipment and can be done by mere bonding re - arrangement of conventional



Individual Unit



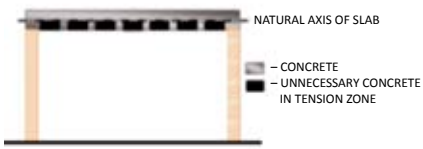


Odd and Even course plan of Rat Trap Bond

bricks. The bonding can directly save about 15% of bricks and also create cavity inside the wall which will act as sound and thermal insulator. If one is making a multi-storey structure, then the strength of brick required will be around 70kg/sqcm.

Rat Trap bond will give maximum advantage if the wall length are designed in modules of RTB. To optimize the project further, the odd and even course plan were made for the structure.

Filler Slab : Filler slab is also one of the commonly used technology. It is simple technique were concrete below the neutral axis of slab, which is not required in taking tension, is replaced by appropriate material which is low on cost and also add to thermal insulation property of slab.



As per IS 456 : 2000, it is known as voided slab.

Both Filler slab and RTB are well known technologies and have been used in Government housing in Kerala. They don't require any high end skills, consumes less material and are more environment friendly both as material requirement and also from the user perspective since both have thermal insulation properties.

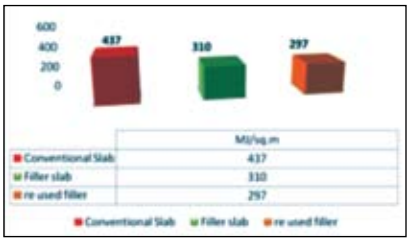
Also, since they use local material and technology they help boost local economy of the region. Simple the money is spend but large chunk of resources stays in the region and hence help local economy. Speed and quality is not a concern since they are not a new range of product but the same old known technologies, used differently. Just a simple one day training program makes person equipped enough to use them.

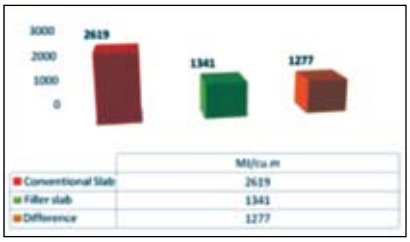
Cost Comparison

For comparing the cost, Rate anlaysis, Ahmedabad SoR and two quotations from actual contractors were taken. With all of them, the comparison was done. It was very apparent that on an overall project cost one was able to save about 10 to 15 % for sure. This is a conservative figure and not an optimistic calculation. The savings are bound to increase if the scale of the project is bigger and once the labour gang and contractor get used to the technology.

Embodied Energy Calculations

Embodied energy(EE) is the energy calculated which is stored in the building right from raw material extraction to the installation of the building component. The EE depending on the boundary condition of consideration can be till demolition and waste disposal of the construction product. For





the above project EE was also calculated as one of the parameters for quantifying sustainability.

Just by a sensitive design and correct choice of material, the project could manage to save 16,39,873 MJ of Embodied energy i.e. about 130 tonnes of CO_2 emissions. This is over and above the non tangible benefits of user comfort and boosting of local economy due to use of local material.

Based on the design package the technology and systems were adopted for IHSDP Lonar Project in Maharashtra.

Conclusions

Affordable housing is one of the upcoming sector. With lot of policy framework and incentives being worked out to give the boost to the sector, one should also focus on "Sustainability" and technologies which can be validated holistically and link sustainability as a requirement for eligibility of any incentive. The above is just an illustration, as mention range of conventional and advance/emerging technologies are available and best would be to work on a policy framework which sets in benchmarking criteria's for evaluation of project including "Sustainability" perspective and have multi-disciplinary body to evaluate/validate the same.

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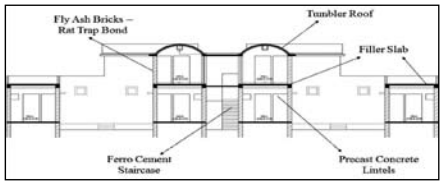


Construction of Demonstration House for Promotion of Alternate Housing Technologies

To popularise the cost effective, alternate and disaster resistant technologies for general public, BMTPC constructed a demonstration house for display at HUDCO BuidTech 2013 during India International Trade Fair at Pragati Maidan from 14-27 November, 2013. The Demonstration Unit having plinth area of 33.15 sqm. consisted of two habitable rooms, kitchen, combined bath & toilet and front and rear court yard.

The various cost effective and alternate technologies demonstrated were:

- Rat-Trap Bond in Flyash Bricks
- Cellular Light-weight Concrete Blocks
- Hollow Concrete Blocks
- Fly Ash Interlocking Blocks
- RB slab with Bricks
- Filler slab with earthen Pots and Bricks
- MCR Tile Roofing
- Precast RC Planks and Joists
- Bamboo Mat Corrugated Roofing Sheets
- Bamboo mat door
- Ferrocement Shelves
- Ferrocement Sunshades
- Ferrocement Kitchen Slab, etc.

The demonstration house also showcased the Earthquake/Cyclone Resistant features.

Urban Renewal through Slum Rehabilitation – JNNURM Experience

*C.N.Jha **
*Pankaj Gupta ***
*Dr. Shailesh Kr.Agrawal ****

Introduction

India is fast urbanizing, the trend which is common to most of the developed & industrialized countries of the world. This unprecedented high growth in the urban sector, has led to large scale migration from rural area which intern has adversely impacted the civic infrastructure & resulted in slum proliferation particularly in bigger cities. It was felt imperative to draw up coherent urbanization policy/ strategy to cope with massive problems that emerged as a result of rapid urban growth and to make the growth of the cities sustainable. It is in this context, Jawahar Lal Nehru Urban Renewal Mission, one of the flagship programmes of Govt. of India., was launched on December 03, 2005. The Mission was launched initially for a Mission Period of 7 years upto March, 2012, which was further extended by three years upto March 2015 to complete ongoing sanctioned projects. The present year is the final year of Mission period. Housing & basic services to urban poor is one of the two components of the Mission, being dealt by Ministry of Housing and Urban Poverty Alleviation.

Components and Implementation Aspects

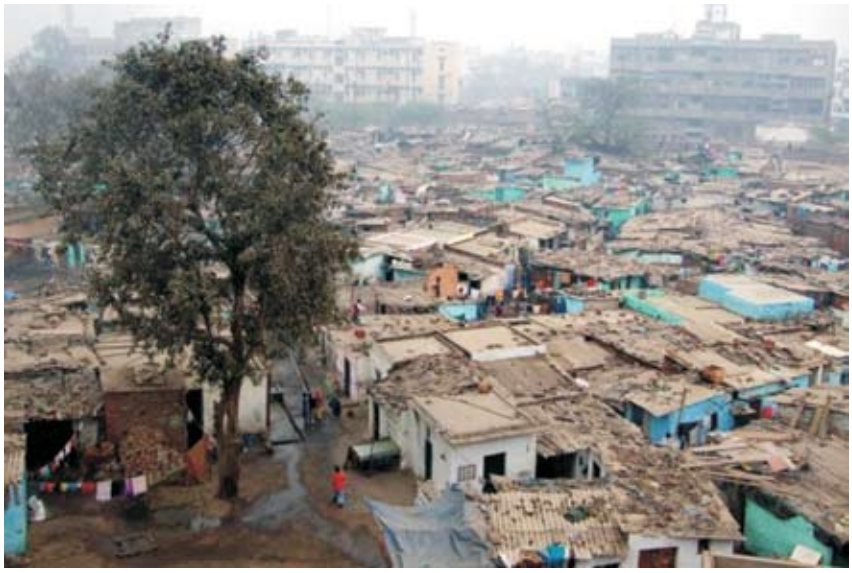
The Mission has been implemented mainly in 65 (initially 63) selected large cities and cities of historical/religious importance, designated as Mission Cities. There are two sub-components of this mission, namely Urban Infrastructure & Governance (UIG) and Basic Services to Urban Poor (BSUP). Under UIG, admissible components were City level infrastructure items such as transportation network, roads and flyovers, conservation of water bodies, augmentation of water supply, improving coverage of sewer network, etc. While BSUP sub component primarily covered Slum improvement and rehabilitation projects with provision of 7 point charter to slum dwellers consisting of security of tenure, housing at affordable cost, water supply, sewer network, road network, health, education and social security. The trunk infrastructure in terms of water supply, sewer line etc. to the slum locations,

The 65 Mission Cities under BSUP comprises of:

A	Cities with 4 million plus population as per 2001 census population	07
B	Cities with 1 million plus but less than 4 million population	28
C	Selected Cities (of religious/historic and tourist importance)	30*

** The Category C cities were initially 28 in numbers but later on two more cities namely Porbander, Gujarat & Tirupati, Andhra Pradesh were added.*

* Dy Chief (S&PD), BMTPC; ** Dy Chief (I&D), BMTPC;
***Executive Director, Building Materials & Technology Promotion Council (BMTPC)



Slums in Delhi

were also considered as part of the project.

In order to develop smaller cities and towns other than 65 Mission Cities, Urban Infrastructure Development for Small and Medium Cities (UIDSSMT) and Integrated Housing and Slum Development Programme (IHSDP) having similar components as of UIG and BSUP respectively are also under implementation.

Financing Pattern

Under BSUP, Financing of projects is in the ratio of 50:50 by Govt. of India and State share (State Grant, ULB share & beneficiary share) for Category A & Category B cities as above. The same is 90:10 & 80:20 for North Eastern States & Category C cities respectively.

Under IHSDP, the Ceiling Cost for Dwelling Unit was Rs.80,000 for the projects sanctioned upto March 31, 2008, however during 2008-09 onwards this was enhanced to Rs 1,00,000 for the purpose of determining Central share, with States/ UTs/ Urban Local Bodies (ULBs) having the freedom to fix higher unit cost for housing meeting the additional cost by themselves.

The sharing of funds is in the ratio of 80:20 between Central Government & State Government/ ULB/Parastatal. States/Implementing Agencies are allowed to raise their contribution from their own resources or from beneficiary contribution/ financial institutions. However, for special category States, the funding pattern between Centre and the States is in the ratio of 90:10.

Nodal Agency of State Govt.

The scheme has been implemented through a State Level Nodal Agency designated by the State Government. The SLNA acts as State interface for Central Govt. & it's responsibilities include; appraisal of projects submitted by ULBs/Para-statal agencies, Obtaining sanction of State Level Steering Committee for seeking assistance from Central Government under JNNURM, Management of grants received from Central and State Government & release of funds to ULBs/Para-statal agencies, Monitoring physical and financial progress of sanctioned projects, monitor implementation of reforms as committed in the MoA etc.

Various Models of Slum Rehabilitation for Slum Households

- ***In-situ development:*** In-situ development of selected slum are preferred to ensure that development does not lead to loss of livelihood linkages or additional commuting hours

Insitu-redevelopment site at Indore, Madhya Pradesh

Community centre in insitu Up-Gradation site at Rajasthan

Relocation site at Visakhapatnam, Andhra Pradesh

Relocation site under PPP Model at Nagpur, Maharshtra

leading to loss of income. Interventions in selected slums are on the following lines:

- ***Redevelopment:*** development of entire slum by providing adequate housing and infrastructure (civic and social) to the slum dwellers after demolition of the existing built structures.
- ***Upgradation:*** 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:*** Slum relocation is an option of slum-redevelopment for untenable slums. However in such case, emphasis needs be laid on providing mobility and recreating livelihood linkages. Such interventions are also expected to include adequate connected infrastructure (civic and social) on alternate site selected for slum relocation.

The role of BMTPC under BSUP and IHSDP of JNNURM

The Council has been extensively involved under various activities of BSUP and IHSDP sub component of JNNURM as appraisal, monitoring agency and resource institution. The opportunity provided BMTPC to deeply look into the urban renewal aspects and share its experience alongwith certain suggestions for improvement.

Appraisal of DPRs

BMTPC is one of the Appraisal Agencies for Detailed Project Reports. It has so far appraised 203 numbers of DPRs under BSUP and 134 number of DPRs under IHSDP received from States/UT agencies worth crores. DPRs envisages con-

struction of dwelling units along with all necessary basic physical as well as social infrastructure. The appraisal activity also included framing of Administrative & Technical Check lists, DPR Preparation formats etc

Issues at DPR stage under Appraisal

In many cases, at the prima facie, the DPRs were found technically deficient, lacking on various parameters of Guidelines & decisions of the sanctioning committee from time to time. The technical issues generally related to carpet area & unit plan vis-à-vis provisions in National Building Code, overall layout of the project, drawings, estimates etc.

It was further observed that the DPRs prepared by State agencies generally covered the estimates part comprehensively, however lacked in social details. While the DPRs prepared by Consultants lacked in sufficient inputs & involvement of ULB & State Govt. representatives.

DPR improvement measures during Appraisal

BMTPC contributed in publishing of the standardized designs of the Booklet by JNNURM Directorate namely "Habitat for Urban Poor: the Design Perspective – Inclusive Planning & Architecture" which included good Internal house design, Layout of cluster housing, Neighborhood colony layouts, designs of community facilities etc. along with HUDCO and MoHUPA. The standardized designs of the booklet have later been used extensively by State Agencies while formulating new DPRs. Various Capacity Building Programmes were also organized by the Council for preparation of DPRs for State & Municipal Officials.

Monitoring of the Projects under BSUP & IHSDP

The Council has also been designated as one of the monitoring agencies by Mission Directorate for undertaking monitoring of projects under BSUP and IHSDP. The scope of the monitoring under field visits primarily includes physical & financial progress of the projects, deviation from the sanctioned project component parameters, quality aspects, cost & time overrun. BMTPC has so far monitored 206 BSUP projects in 79 Mission Cities & 146 IHSDP projects in 133 towns/cities from 29 States/UTs so far. An e-Tracking system has been developed by the Ministry for on line monitoring of physical as well as financial progress of BSUP & IHSDP projects. Based on monitoring experiences, the implementation issues as presented by State Govts during various review meeting & review of Third Party Reports of project inspection, various implementation issues encountered by ULBs, the following may be enumerated;

i. In many DPRs of initial phases of JNNURM from State Govt. like Madhya Pradesh, Andhra Pradesh, Maharashtra etc, a provision of housing cost as close to Rs. 1 lakh/DU was somehow made (may be due to some confusion with cap of Rs 80,000 per DU under IHSDP) & ULB/ State Govt. suffered huge cost escalation while implementing the project. Along with this, huge time overrun also took place because of repeated retendering. The tendering & work award process needs serious review & reform by bringing in accountability & putting up a time frame for entire process.

ii. In many cases factors as transfer of State Govt. /Other deptt. land to ULB, land initially proposed was observed under litigation/ dispute & alternate site identification made substantial delay in start of the project.

iii. The delay in MoEF clearance for project site attracting such provision, some kind of bushes/ plantations on project site also needing MoEF clearance, resulted in considerable delay of some projects.

iv. In many projects the construction activities got stopped for considerable phase of time due to no supply of sand & aggregate on account of ban on sand mining & stone querying in a particular area. This is the time to go for alternate materials & technologies.

v. During the phase of 2008-09, due to abrupt rise in prices of steel & cement, the contractors stopped the construction work affecting the overall progress of projects.

vi. The large scale delays have taken place in completion of majority of projects due to various reasons as above & also partly on account of lack of commitment, accountability & swiftness in action at decision making level. A still higher level of flexibility, decision making & clear policy is required under PPP model in doing due diligence of the proposals from private partner by public body. One not so successful project sanctioned under JNNURM under PPP model is an example.

vii. Based on monitoring experience we are of the view that the decision on in-situ Upgradation model needs to taken after careful consideration of constraints in existing, slum as intervention in same case may not lead to planned development at all.

viii. Some of the completed projects & with DUs occupied by beneficiaries showed deterioration in terms of leakage from sanitary pipes on buildings giving it shabby look.

The various issues need to be seriously reviewed as we are planning to aim housing for all by year 2022

Lessons learnt from the experiences of JNNURM as incorporated under presently of scheme of RAY

i. The State Govts, by & large have learnt from the JNNURM mistakes & started updating the SOR more expeditiously to arrive at realistic cost estimates. The quality of overall project layout, unit plan carpet area & design also got improved with experiences gained from JNNURM.

ii. The provision of post construction O&M amount to an extent of 4% of project cost has been made, to address the future operation & maintenance requirement of the project.

iii. Under JNNURM, the temporary transit units were not considered for approval & permanent transit & rental units were also not encouraged, which acted as deterrent for success of in-situ redevelopment projects. Now under RAY, all three components are admissible & in-situ redevelopment model is preferred mode of development.

However, despite this policy level support for this in-situ redevelopment model, even now some projects under this model are not smoothly taking off because of reasons as vested interest of slum lords, local politicians, lack of initiative of ULB etc. This issue needs to be dealt with effectively & efficiently by all the stakeholders for the success of the projects & the scheme.

iv. Lack of beneficiaries consultation at the time of formulation of DPRs proved to be one of the bottlenecks for project implementation under JNNURM & the same has been given much emphasis at the stage of project formulation under RAY.

v. The four stages equal GoI installments under BSUP has been changed to three installments with major share of 80% going as first two installments, with an objective to improve the fund flow to the projects under execution.

The present Status of JNNURM as on June 30, 2014

- A total 479 projects under BSUP & 1036 projects under IHSDP are under implementation (with some of it completed) from 35 States/UTs.
- Total project cost of the sanctioned projects is Rs. 37,479.94 Cr with Central share as Rs 20,174.58 Cr.
- The total originally sanctioned DUs were 17,44,198 out of which 3,02,011 have been curtailed making the revised sanction figure as 14,42,187
- Out of 14,42,187 DUs, 8,15,786 DUs have been completed & 5,91,761 DUs have been occupied.

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Definition and types of slums – Census 2011 — INDIA

(i) All notified areas in a town or city notified as 'Slum' by State, Union territories Administration or Local Government under any Act including a 'Slum Act' may be considered as ***Notified slums***

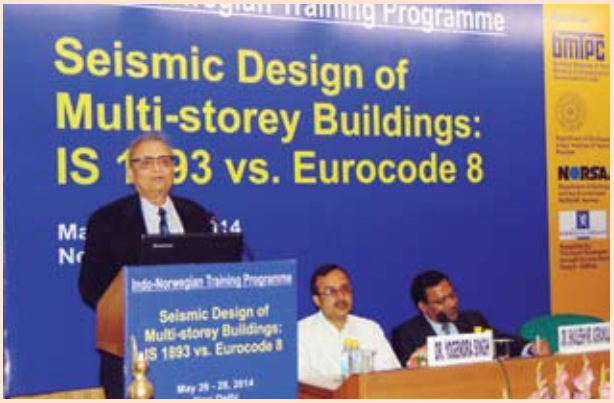
(ii) All areas recognised as 'Slum' by State, Union territories Administration or Local Government, Housing and Slum Boards, which may have not been formally notified as slum under any act may be considered as ***Recognized slums***

(iii) A compact area of at least 300 population or about 60-70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities. Such areas should be identified personally by the Charge Officer and also inspected by an officer nominated by Directorate of Census Operations. This fact must be duly recorded in the charge register. Such areas may be considered as ***Identified slums***

Source: Primary Census Abstract for Slum, 2011
Office of the Registrar General & Census Commissioner, India

Indo-Norwegian Training Programme on Seismic Design of Multi-Storey Buildings: IS 1893 vs. Eurocode 8 at New Delhi

A three-days Indo-Norwegian Training Programme on Seismic Design of Multi-storey Buildings: IS 1893 vs. Eurocode 8 from May 26 to 28, 2014 at New Delhi was organized by Building Materials & Technology Promotion Council (BMTPC) jointly with Indian Institute of Technology, Roorkee (IIT Roorkee) and NORSAR, Norway. BMTPC, Ministry of Housing & Urban Poverty Alleviation, Govt.of India has been playing a proactive role in the area of disaster mitigation and management. IIT Roorkee is one of the premier organization having excelled in the area of earthquake resistant design and construction and NORSAR, Norway is an independent research foundation specialized in seismological research and engineering services relevant for the society and their efforts have over the past years included seismic hazard and risk projects in many earthquake exposed countries, including Guatemala, Nicaragua, El Salvador, Pakistan, India, or entire Central Asia. The Training Programme was supported by the Norwegian Embassy to India, New Delhi through the Indo-Norwegian Collaboration Project EQRisk.



The three days Training Programme was inaugurated by "Padma Shri" Shri B. Bhattacharjee, Hon'ble Member, National Disaster Management Authority and Former Director, Bhabha Atomic Research Centre and Member, Atomic Energy Commission. During the Inaugural Session the participants were addressed by Dr. Shailesh Kr. Agrawal, Executive Director, BMTPC, Dr. Dominik H. Lang, Senior Research Engineer, NORSAR, Norway, H.E. Mr. Eivind S. Homme, Ambassador, Royal Norwegian Embassy, New Delhi, Dr. Yogendra Singh, Professor, Department of Earthquake Engineering, IIT Roorkee. The programme was attended by around 100 participants from various parts of the country as well as from Nepal. Although initially it was planned to accommodate 45 participants but due to overwhelming response to this Course, the number of seats had to be increased twice. The course was specifically targeted to Structural & Geotechnical Engineers and Designers in public and private sectors with emphasis on real-life problems and tackling them through hands-on training.

Sustainable URBANIZATION

Pawan Jain *

The Urban Population of India is increasing at great speed. It is both due to growth of families in the urban areas, and the migration from towns and rural areas.

Planners forever have to expand the cities at the boundaries to accommodate more and more houses. Cities are becoming too large to manage. Besides the cities are net consumers of resources, they need clean water, food, fuel, sewage disposal, garbage disposal and electricity, besides a host of other products. There are many cities in India which have 15 million people or more.

We cannot control the migration of people until the situation of education, health-care, employment etc improves in the villages. But what we can do is to cater to this unending need for affordable housing in the cities. Even if there is no migration, according to some surveys up to 50% population lives in subhuman conditions in the cities. India has to take care of its poor and the under privileged and for this it has to constantly construct planned affordable and sustainable houses.

This is by far the largest problem being faced by our country and a viable solution is order of the day.

The Present Scenario

Land is at a premium in the cities. Land prices in the cities of India are often higher than equivalent land in some developed countries where the per capita income is many times higher.

Land prices are growing. Buying land for individual houses is out of the question for a salary earner in a city now. Buying a floor or part of a floor till some years ago was affordable, but now buying any kind of a legal house with land rights and services is out of the reach of the middle class.

The role of government has been of facilitator and therefore, responsibility of providing housing mainly lies with developers and private builders. The private builders feel that the only way to go is vertically up and High Rise housing has become the norm. Once the high rise buildings are built, the surrounding land is used up for gardens and parking areas. Densities of up to 200 dwelling units/hectare are made in these developments where most of the houses are between 700 and 2500 sft each. Built areas are up to 2.4 times the area of the land. All builders are vying with each other to build fancier and more luxurious houses than the other. The needs of the city to provide cheap housing are largely forgotten. Builders are making a killing but the maximum share goes to government in term of various taxes (upto 27%) in the cost that the end-consumer pays. There is tax on:

1. Registration of land
2. Cement and steel both excise and sale tax
3. Royalty on aggregates
4. Service tax on all professionals involved
5. Sales tax on contractors
6. Service tax on contractors
7. Stamp duty on sale
8. Tax on all building materials
9. Service tax on consultants
10. Tax on vehicles and fuel

In the present, the maximum allowable densities in most cities are approximately 165 dwelling units per hectare. If anybody makes this, it is achieved by doing 35% coverage of the ground and the remaining land is used in roads, paving and gardens. Essentially multi-storey apartments have to be done to accommodate these dwellings. These multi stories consume about 3500 kgs of steel, 200 bags of cement, 20000 bricks, 1500 cu ft of sand and aggregates apart from a lot of other materials which are brought from all across the country. The lifetime costs of the building are also high because of the need to constantly

* Practicing Architect, Dehradun

pump water, run lifts, and provide climate control and power for illumination.

In the present, any land which is earmarked for urbanization is lost completely from growing vegetables or other crops or any other thing. It is assumed that there will be some trees but most soil under other areas will be buried under buildings, or under roads and maybe some gardens, but never for production.

In the present scenario, the average middle class worker cannot afford a house, and that's it. He cannot afford to buy any house of any kind in the large and small cities. The governments are doing some bit for the poorest of the poor, but the middle class is totally left out. If a man makes Rs.15000 in a month, he can put away Rs.3000 a month for housing, but not more. The minimum price of a house in any small town is Rs.12 to 15 lakhs. On a twenty year repayment plan, the man will pay 100% of his income for the installment. There is nothing available for even say Rs.8000 - 10000 per month. All these people are forced to live in illegally built housing, slums and sometimes as tenants in legal houses. Sanitary conditions are poor, transport is a struggle and the living conditions are cramped and unhealthy. Fights about water, parking, and use of common toilets are very common. There is a growing number of people living in inhuman conditions in the slums

In the present scenario, there is no control on the prices of housing and house tax is uniform if you have second and third houses. A large number of people invest in houses for speculation. Compounded by the real shortage and artificial shortage fuelled by people owning two and three houses, the cost of houses is going higher and higher. Presently there is no control on the business of building and selling houses and a lot of builders routinely cheat the desperate consumers by providing them poor quality, and badly serviced houses. People even manage to get a subsidized housing loan for a second house in a family

The Desired State

It is desired that plenty of affordable houses should be available for buying and renting in the cities. It is desired that the real users get these houses. It is desired that these houses don't have to depend on a lot of energy to function and maintenance. It is also desired that it should have all the minimum basic services like water and electricity supply, sewerage etc.

Looking at possibilities within urban areas, it is possible to grow some vegetables and fruits in the neighbourhood. It should be possible to collect some rain water, treat the sewage, produce some manure. It is now possible to generate some electricity with Photovoltaic on the roof tops. It should be possible to run a public bus with the biogas produced from the sewage treatment/ dairy plant.

There is also crying need for reform and regulation. House tax on second homes should be higher. Design life of plumbing/services should be 25 years; design life of everything else should be 50 years. Solar geysers should be mandatory. Harvesting of roof rainwater should be made mandatory. Mean practices in the allotment of land, change of land-use and granting of permission to build, occupation permissions etc. makes it very tough for cooperative house building societies to actually build. This has to be corrected.

It is desired that governments should get out of this vicious cycle of having to regularize Slums/ bastis/illegal colonies. Instead it should be possible to resettle them somewhere and reuse that land for creating a proper organized housing for the people to buy or rent.

Solutions

It is possible to design a settlement with a density of about 165 units per hectare, each unit of 550 sq feet with three small rooms. It is possible to make a housing organism/apparatus/juggernaut which will actually be a food forest, which will produce vegetables and fruit, produce some electricity and gas, and even be green and have a small carbon footprint.

Here is a model which has all the components. None of the technologies are new or un-tested. The combination needs to be built once. Even if large tract of agricultural land is acquired for the purpose of such urbanization, it will not be lost for good. At least 50% of the land will absorb rain water, will grow fruits and vegetables, even grain. The settlement will not be food or energy autonomous, but it will produce 35 to 40% of its needs of water and electricity and food.

Our middle classes are hard working. Some labour for the production of the crops and for management of the dairy, the biogas plant and the biogas bus can be found from within the community on basis of remuneration.

We will need professionals to implement and monitor this whole

settlement like the launch of a PSLV because calibration alone can make this succeed.

At present prices, it should be possible for any government to provide this housing at 1/6th the cost of a similar house in the private sector. Taxes will also have to change for middle class houses.

A New type of land-use will have to be invented for this type of urbanized areas. It could be called Agri-Resi-Servi because it will combine food production, residential accommodation, dairy and energy production.

The Construction Proposal Itself

1. The construction itself shall be partly prefab and partly in-situ. Design life of everything shall be 50 years and services 25 years.
2. The foundation shall be a series of rain water harvesting tanks.
3. The houses will be+ amidst food production areas which produce fruits, vegetables and spices.
4. For every 352 houses, there shall be a sewage treatment plant and a biogas plant.
5. A density of 150 dwelling units per hectare shall be achieved in the housing pockets
6. A biogas bus shall be run to go to the city centre. The gas shall be provided by the biogas plant
7. 1/6th of all water requirement shall be met from the stored water
8. The roofs of all houses shall be used for generation of electricity with photovoltaic.
9. There will be a cap on the use of water and electricity in the houses.
10. 50% of the area of the land shall be used for growing fruit trees and vegetables which will be surplus for the settlement.
11. Manure for the fields shall be supplied from the biogas plants. Manure shall also be a net export.
12. There will be grid supply of electricity and a municipal supply of water also. One out of seven blocks will be four storied and the water tanks will be located on that block.
13. The services shall be maintained by a service provider who will employ from within the community to provide the services.
14. There will be a cap on the number of people who live in one flat.
15. There will be a net export of vegetables and fruits from the settlement.
16. The biogas bus will have a 20 cum bag on top (equal to 14 litres of diesel) for each trip .
17. There will be a cooperative store and a cold storage for the people.

Possibilities

This kind of settlement is more easily possible in years to come because...

1. The manufacturing cost of some things has come down drastically, such as photovoltaic cells. Systems for management of energy from two sources are more easily available.
2. There is advancement in the sewage treatment technology.
3. There is more awareness about energy conservation, more efficient gadgets and bulbs available now.
4. The desperation for shelter has become more acute now. The value of organically produced fruits and vegetables has risen considerably.
5. Effects of things such as global warming, increased levels of CO_2, extremities of weather, side effects of pollution are beginning to show in real life

Plea

It is my plea to all organizations, corporate houses, industrial houses, aware developers, industrial houses, housing corporations, individuals, ashrams, cooperative housing societies, groups of individuals, old age homes, slum redevelopment boards, city councils and to governments to adopt this or similar models to build houses. This will reverse the present trend of declaring war on land and burying it irreversibly under the urban sprawl. This is a win-win formula. Quite literally it is like picking up dollar bills lying on the side walk

I have not invented any of this except the linkages between the various technologies. In fact the readers of paper may think that this is just repeating common knowledge. Actually, I am just stating it again in a different, easy to understand way and in the process demystifying it. For the same of paucity of space the drawings and detailed information may be sought from the author. In fact I will be happy to provide any other information to make developments like this easy for the readers.

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National Seminar on Green Building Materials & Construction Technologies at New Delhi

BMTPC organized a one day National Seminar on Green Building Materials & Construction Technologies on August 29, 2014 at New Delhi to deliberate on the various issues in the area of green building materials and technologies, its applications in mass housing including emerging trends. The use of green building materials and products promotes conservation of non-renewable resources and helps in reducing the environmental impacts associated with the installation, reuse, recycling, disposal etc. of the building materials. Most importantly, energy efficient products and systems used in construction with sustainable building reduce maintenance and operating costs to large extent and it is noted that green buildings generally use less energy than conventional construction. There are number of green building products in vogue which may contribute towards green or sustainable habitat.

It has been observed in recent times that awareness of concepts, importance and implementation of Green Initiatives for new construction of various buildings is rising; a lot still needs to be done. The Seminar also provided an opportunity to comprehend the new developments taking place in the construction sector as regards emerging materials and construction system and raised issued related to mainstreaming the Green Building Materials & Construction Technologies.

The Seminar was inaugurated by Ms. Anita Agnihotri, Secretary, Ministry of Housing & Urban Poverty Alleviation, Government and Shri K.B.S.Sidhu, Joint Secretary (Housing), Ministry of Housing & UrbanPoverty Alleviation also addressed the august gathering. On the occasion, the Chief Guest also released a publication brought out by BMTPC entitled “Prospective Construction System for Mass Housing” containing Technology Profiles of Emerging Technologies. Besides the experts in the field, Technologists and Scientists working in the area of green building materials and construction technologies, Technology providers for building products, Academicians from various engineering and architectural colleges and students, Product manufactures of building components and Builders, real estate developers, etc. participated in the Seminar.

हरित भवनः
प्रवृत्तियां, अवसर एवं चुनौतियां

डॉ.शैलेश कु. अग्रवाल *
एस.के. गुप्ता **
दलीप कुमार ***

हरित भवन वह है जो एक पारंपरिक भवन की तुलना में कम पानी का उपयोग करता है, ऊर्जा दक्षता का अनुकूलन करता है, प्राकृतिक स्रोतों का संरक्षण करता है, कम अपशिष्ट पदार्थ पैदा करता है और भवन में रहने वाले लोगों को स्वास्थ्यवर्धक स्थान उपलब्ध करता है। यह भवन के ढांचे के निर्माण और उन प्रक्रियाओं का क्रियान्वयन है जो डिजाइन से लेकर निर्माण, परिचालन, अनुरक्षण, नवीकरण और विखंडन तक एक भवन के संपूर्ण जीवन–चक्र में पर्यावरणीय तौर पर उत्तरदायी और संसाधन–निपुण है। यह कार्य आर्थिकता, उपयोगिता, स्थायीत्व, और आराम के पारंपरिक भवन डिजाइन मुद्दों को विस्तृत और अनुपूरण करता है। यह हरित भवन अवधारणा मुख्यतः बुनियादी सुविधा उद्योग के विकास में योगदान देती है जो भारतीय संदर्भ में तीव्र गति से विकसित हो रहा है। हरित भवन निर्माण का मुख्य उद्देश्य निम्न के द्वारा मानव स्वास्थ्य और प्राकृतिक वातावरण पर कृत्रिम वातावरण का समग्र प्रभाव कम करना हैः

- ऊर्जा, जल और अन्य स्रोतों का कुशलतापूर्वक उपयोग
- निवासियों के स्वास्थ्य की सुरक्षा और कर्मचारियों की उत्पादकता में सुधार
- अपशिष्ट पदार्थ, प्रदूषण और पर्यावरण का क्षरण कम करना

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भारत के भवनों में ऊर्जा उपयोग और वायु प्रदूषण महत्त्वपूर्ण मुद्दे हैं, इस तथ्य की पहचान करने पर, भारत सरकार ने ऊर्जा संरक्षण अधिनियम (ईसीए 2001) को अधिनियमित किया, जो ऊर्जा दक्षता एवं संरक्षण को बढ़ावा देता है। ईसीए ने ऊर्जा दक्षता ब्यूरो (बीईई) का गठन अधिदिष्ट किया, बीईई को एक ऊर्जा संरक्षण निर्माण कोड (ईसीबीसी) स्थापित करने हेतु प्राधिकृत किया। ऊर्जा दक्षता के मामले कुछ हद तक भारत के राष्ट्रीय निर्माण कोड (एनबीसी) के तहत भी सुलझाये जाते हैं। हालांकि ऊर्जा मंत्रालय और बीईई ने वर्ष 2007 में ईसीबीसी जारी किया। यह भारत में प्रथम स्वसंपूर्ण राष्ट्रीय निर्माण ऊर्जा कोड है। अभी जबकि यह स्वैच्छिक है, बिल्डिंग ऐन्वलप, लाइटिंग, हीटिंग, वेंटिलेशन और एयर कंडिशनिंग (एचवीएसी), इलैक्ट्रिकल सिस्टम, वाटर हीटिंग और पम्पिंग सिस्टम्स के लिये ईसीबीसी न्यूनतम ऊर्जा दक्षता अपेक्षाएं निर्धारित करता है।

भारत सरकार विभिन्न संगठनों जैसे बीएमटीपीसी, हडको आदि और गैर–लाभकारी संगठनों जैसे भारतीय हरित भवन परिषद् (आईजीबीटी), ऊर्जा एवं संसाधन संस्थान के माध्यम से भारत में सक्रिय तौर पर हरित भवनों को बढ़ावा दे रही है। निम्नलिखित पांच क्षेत्रों में निष्पादन पर ध्यान देकर स्थायीत्व प्राप्त करने के लिये समस्त–भवन दृष्टिकोण को बढ़ावा देना अनिवार्य हैः

- धारणीय स्थल विकास
- जल की बचत
- ऊर्जा दक्षता
- सामग्री चयन
- इनडोर पर्यावरणीय गुणवत्ता

इसके अतिरिक्त, एलईईडी भारत ने भवन निर्माण हेतु कई बेंचमार्क अपनाये हैं। रेटिंग स्तर ''प्लेटिनम'', ''गोल्ड'', ''सिल्वर'', और ''प्रमाणित'' वह सीमा इंगित करते हैं जिस तक एक भवन राष्ट्रीय कोड की अपेक्षाएं पूर्ण करता है। पिछले कुछ वर्षों में, आईटी और आईटीईएस 'हरित बनें'(गो ग्रीन) के दर्शन की स्वीकृति और विकास में प्राथमिक योगदानकर्ता हैं। इस मामले में एक मिसाल पैयानुर, चेन्नै में टर्बो ऐनर्जी लिमिटेड (टीईएल) आर एंड डी एवं प्रशासन ब्लॉक है जो एलईईडी द्वारा भारत में सर्वोत्तम हरित भवन के तौर पर प्रमाणित किया गया है और विश्व में दूसरे स्थान पर हरित है। अन्य प्रमुख हरित परियोजनाओं में आईटीसी ग्रीन सेंटर (गुड़गांव), आईजीपी कार्यालय परिसर (बैंगलुरू), कल्पतरू स्क्वायर (मुंबई) और सीआईआई–गोदरेज ग्रीन बिजनेस सेंटर (हैदराबाद) शामिल किये गये, यद्यपि अभी भी अवधारणा को व्यापक आधार पर लागू करना बाकी है। भारत के सबसे बड़े बैंक एसबीआई द्वारा भी महत्त्वपूर्ण सहायक की भूमिका भी निभाई जा रही है। यह

* कार्यकारी निदेशक, निर्माण सामग्री एवं प्रौद्योगिकी संवर्द्धन परिषद्, नई दिल्ली
** उप–प्रमुख (टी.डी.ई. एडं आई.सी.), निर्माण सामग्री एवं प्रौद्योगिकी संवर्द्धन परिषद्, नई दिल्ली
***वरिष्ठ क्षेत्राधिकारी (डी.सी.एडं ई.), निर्माण सामग्री एवं प्रौद्योगिकी संवर्द्धन परिषद्, नई दिल्ली

हरित निर्माण विकास पर रियायत प्रस्तुत कर रहा है जो संपूर्ण उद्योग में ऐसी ही प्रवृत्ति प्रारंभ कर सकता है।

पर्यावरण एवं वन मंत्रालय ने एक निश्चित आकार एवं लागत से बड़ी सभी निर्माण परियोजनाओं के लिए पर्यावरणीय मंजूरी को अनिवार्य कर दिया है। इसमें परियोजनाओं को पर्यावरण अनुकूल उपाय एवं तकनीक अपनाने में इस मंजूरी के दायरे में लाने की आवश्यकता होती है। यह पर्यावरण प्रभाव आकलन (ईआईए) नई परियोजना पर किसी भी प्रकार के निर्माण कार्य प्रारंभ करने से पूर्व केन्द्र सरकार से टाउनशिप, औद्योगिक टाउनशिप, बस्ती कॉलोनियां वाणिज्यिक परिसर, होटल परिसर, अस्पताल, औद्योगिक क्षेत्र एवं कार्यालय परिसरों के निर्माण से संबंधित नई परियोजनाओं को एक निश्चित आकार से ऊपर पूर्व पर्यावरण मंजूरी लेने को अनिवार्य बनाता है। पर्यावरण प्रभाव आकलन (ईआईए) प्रक्रिया वैध सार्वजनिक भागीदारी एवं संसाधन उपभोग का सर्वोत्कृष्ट प्रक्रियाओं के साथ नये निर्माण परियोजनाओं में पर्यावरण संबंधी चिंताओं का एकीकरण सुनिश्चित करता है।

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आज के परिदृश्य में, पिछले कुछ वर्षो में हरित भवन को दुनिया भर में स्वीकार किया गया है लेकिन अभी भी एक बड़ा वर्ग या तो टिकाऊ डिजाइन अवधारणा से अनभिज्ञ हैं, इसके प्रति उदासीन हैं या इसके फायदों के प्रति आश्वस्त नहीं है। टिकाऊ डिजाइनों के फायदों के बारे में भू–स्वामियों, भवन निर्माताओं एवं डिजाइनरों (अथवा अन्य पणधारकों) को समझाने के लिए यह नितांत आवश्यक है कि उन्हें हरित भवन की अवधारणा के अनेक फायदों को समझाया जाए। ऐसा करने के लिए यह अत्यंत आवश्यक है कि प्रत्येक समूह के उनके बिक्री अंक के आधार पर विचार को समझना।

एक भू स्वामी के लिए सबसे अहम वित्तीय हो सकता है। एक वास्तुकार के लिए यह पर्यावरण संबंधी हो सकता है एवं एक इंजीनियर के लिए यह प्रदर्शन दिखाने का हो सकता है। हरित भवन बनाने के अनेक कारण हैं जो टिकाऊ डिजाइन प्रदान करेंगे, वास्तुकारों को विशेष दर्शकों के लिए उपयुक्त प्रासंगिक तर्क प्रदान करने में दक्ष होना चाहिए। पर्यावरणीय, आर्थिक क्षेत्रों के अन्तर्गत टिकाऊ डिजाइन के निम्नलिखित लाभ हैं।

Åtk dh [kir e deh

टिकाऊ आवास का एक प्रमुख लक्ष्य निर्माण सामग्री के उत्पादन, भवनों के निर्माण एवं अपने भवनों को ठंडा, गर्म व प्रकाशयुक्त रखने में आवश्यक ऊर्जा की मात्रा को कम करना है। निर्माण उद्योग में दैनिक उपभोग के लिए अधिकांश ऊर्जा में आजकल जीवाश्म ईंधन, गैर बारहमासी स्रोतों एवं नाशवान संसाधनों का उपयोग किया जा रहा है। टिकाऊपन को सुनिश्चित करने के लिए यह आवश्यक है कि हमारे ऊर्जा की आवश्यकताओं की पूर्ति नवीकरणीय स्रोतों के अतिरिक्त नवोन्मेषी तकनीकों के माध्यम से ऊर्जा की सर्वोत्कृष्ट उपभोग से हो। अप्रतिरोधी रणनीति जैसे डे लाईट थर्मल मास एवं शेड अथवा उच्च प्रदर्शन वाली प्रणालियों का उपयोग करके हम काफी हद तक हमारी यांत्रिक प्रणालियों की ऊर्जा की मांग को कम कर सकते हैं। यह घटते जीवाश्म ईंधनों समाधान करने एवं बिजली संयत्र परिचालन करने में कम आवश्यकता में परिवर्तित होता है।

ikuh dh [kir e deh

पानी संबंधी दक्षता के साथ हरित भवन, गैर उपभोग के उपयोगों के लिए अपेक्षित जल की मात्रा में कमी लाता है। एक कुशल परिदृश्य एवं छत का डिजाइन भी जल भराव में कमी लाता है जिससे हमारे वर्षा एवं सीवर प्रणालियों पर कम बोझ पड़ता है। यह प्रदूषण में कमी लाकर एवं प्राकृतिक जलाशयों की सहायता करके स्थानीय क्षेत्रीय एवं वैश्विक जलमार्ग को सकारात्मक रूप से प्रभावित करेगा।

ok;q izn"k.k e deh

प्रदूषण के अनेक अप्रत्यक्ष स्रोत हैं जैसे भवन सामग्री की ढुलाई करने वाले वाहनों एवं भवन सामग्री के निमार्ण से प्रदूषण। वायु प्रदूषण के प्रत्यक्ष प्रदूषक स्रोत भी हैं जैसे एचवीएसी रेफ्रीजरेंट्स एवं हमारी समाप्ति से विषाक्त उत्सर्जन। ये सभी ग्लोबल वार्मिंग, ओजोन रिक्तीकरण एवं वायु प्रदूषण पर प्रभाव डालते हैं।

lkexh dh n{krk c<+kuk

खनन, परिवहन एवं निर्माण प्रक्रियाओं के कारण, हमारे भवनों में स्थानीय एवं प्राकृतिक सामग्रियों के उपयोग से उपरोक्त तीनों रणनीतियों पर सीधा लाभ होता है। इसके अतिरिक्त, पुनर्नवीकृत, भूमि पुनरूद्ध ार अथवा कबाड़ सामग्रियों का प्रयोग करते हुए क्षेपण (डंपिंग) की आवश्यकता में कमी लाकर हमारे भू भराव स्थलों के बोझ को कम किया जा सकता है।

vYi vof/k dh ykHk

हरित भवन उपयोगिता लागत के क्षेत्र में तत्काल बचत करते हैं। चाहे वह बिजली एवं पानी की कमी से हो अथवा वर्षा जल शमन के बुनियादी ढांचे की लागत में कमी से हो। हरित भवन से तेजी से बढ़ने वाले उपयोगिता बिलों की लागत में कमी आने के अवसर होते हैं। इसके अतिरिक्त, दक्ष नक्शे के भवन, भवन सामग्री की लागत एवं निर्माण के कचरे में कमी ला सकते हैं। यदि एक भवन में छोटे उपकरणों का उपयोग होता है एवं गर्मी एवं ठंड के लिए अप्रतिरोधी रणनीतियों पर अधिक भरोसा किया जाता है तो उपकरण की पहली लागत कम हो सकती है। टिकाऊ डिजाइन की रणनीतियों का उपयोग भवनों के लिए स्थानीय उपयोगिता कंपनियों से वित्तीय प्रोत्साहन भी मिलता है।

nh?kZ vof/k d{k ykHk

लंबे समय से उपयोगिता लागत की बचत से अग्रिम लागत वृद्धि की संभावनाएं पैदा करती हैं। यद्यपि फोटोवोल्टिक पैनल जैसे मदों पर पैसे लौटाने की अवधि बहस का मुद्दा है लेकिन कुछ अन्य उपाय त्वरित भुगतान का साधन बन सकते हैं। अप्रतिरोधी प्रणालियों को चालू रखरखाव की बहुत कम आवश्यकता होती है इसलिए भवन मालिक, भवन प्रचालन बजट पर बचत कर सकता है। यह हमारे परिदृश्य डिजाइन को भी परिवर्तित करता है। प्राकृतिक परिदृश्य को आमतौर पर पारंपरिक वाले परिदृश्यों से कम रखरखाव की आवश्यकता होती है। लचीने नक्शों से तैयार भवन पुनर्विन्यासन की लागत में कमी लाते हैं।

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अधिकांश मालिक आजकल बिक्री के बिंदु के तौर पर 'हरित डिजाइन' का उपयोग कर रहे हैं। संपत्ति के पट्टे अथवा पुनः बिक्री के लिए टिकाऊ भवन नये लोगों एवं नये बाजार को आकर्षित कर सकते हैं। यह इसे तेजी से बिक्री एवं अधिक किराये में परिवर्तित कर सकता है। इसके अतिरिक्त नये कर्मचारियों की भरती (एवं उन्हें रखकर) आकर्षक एवं स्वास्थ्य सुविधाओं पेश करने में मदद कर सकती हैं जिसमें कार्य करना है। अध्ययन दर्शाते हैं कि एक स्वस्थ वातावरण में कार्य करने वाले कर्मचारी अधिक उत्पादकता से काम करते हैं, कम बीमार पड़ते हैं एवं कंपनी के साथ वफादार रहते हैं।

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हरित भवन के सबसे आम नुकसानों में अतरिक्त व्यय के प्रति आलोचना है। इस बात पर विचार करना अत्यंत महत्वपूर्ण है चूंकि यद्यपि अतिरिक्त लागत आमतौर पर ऊर्जा की बचत से संतुलित हो जाती है एवं यह अतिरिक्त पैसा होता है जो ग्राहकों की जेब से जाता है। इसलिए इस आलोचना को जायज माना जाता है। इस आलोचना के लिए अच्छी खबर यह है कि हरित बाजार में हाल की वृद्धि एक प्रतिस्पर्धी बाजार बनता जा रहा है अतः यह संभवतः निकट भविष्य में महत्वपूर्ण स्तर पर भवन की अतिरिक्त लागत में कमी ला सकता है। दरअसल यह पहले से विकसित हो रहा है एवं प्रतिस्पर्धा कीमतों को नीचे ला रही है। यह स्थानीय आवासीय भवन के समक्ष बहुत लंबा नहीं होगा। सुपर स्टोर के पास हरित भवन खंड होगा जहां ये उत्पाद प्रतिस्पर्धी कीमत पर आसानी से उपलब्ध होंगे। लेकिन हरित भवन के सबसे बड़े नुकसानों में से एक इसका मुख्य फोकस पर्यावरण पर केन्द्रित होना है। यह एक अजीब विवरण हो सकता है क्योंकि हरित भवनों द्वारा पर्यावरण के लिए अनेक लाभ प्रदान किए। उदाहरण के लिए, हाल के वर्षों में अमेरिका के घरों में अधिक से अधिक ऊर्जा दक्ष हो गये हैं जिसे घर के अंदर (इंडोर) वायु गुणवत्ता की समस्या के लिए लगाया गया है। ग्राहक के घर इस तरह से बंद हो जाते हैं जिससे वे इंडोर प्रदूषण से प्रभावित होते हैं। यद्यपि हरित भवन इंडोर वायु गुणवत्ता के समस्याओं का समाधान करती हैं मुख्य तौर पर भवन एवं भवन प्रक्रिया में पर्यावरण के समग्र प्रभाव पर केन्द्रित होती हैं एवं वहां रहने वालों के स्वास्थ्य को अपनी प्राथमिकता में नहीं रखती हैं ताकि समय पर इसे इंडोर वायु गुणवत्ता की कीमत पर केन्द्रित किया जा सके एवं अंततः यह स्वास्थ्य संबंधी समस्या को बढ़ावा देते हैं। हरित भवन निर्माता सभी बल्बों को ऊर्जा दक्ष फ्लोरोसेंट लाईटों से बदल सकता है जो अधिक विकिरण उत्सर्जन के लिए जाने जाते हैं। शोध अध्ययन दर्शाते हैं कि इस विकिरण से स्वास्थ्य संबंधी समस्याओं की अधिक संभावना रहती हैं।

gfjr Hkou d{k dk;kZUo;u e¡ pqukSfr;k¡

निजी एवं सरकारी पणधारकों द्वारा प्रारंभ किए गये हाल की मुहिम से भारत में हरित भवन के विकास की गति पकड़ने की उम्मीद है। लेकिन इस अवधारणा के कार्यान्वयन में अनेक बाधाएं हैं जो निम्नलिखित हैं।

dk;kZUo;u

ईसीबीसी का कार्यान्वयन करना पहली एवं सबसे महत्वपूर्ण आवश्यकता है । अभी ईसीबीसी वर्तमान में स्वैच्छिक है लेकिन भविष्य में या तो केन्द्रीय या राज्य सरकार द्वारा इसे अनिवार्य मानक के तौर पर अपनाया जा सकता है। अभी तक किसी भी राज्य ने इसे नहीं अपनाया है। बीईई, ईसीबीसी को बढ़ावा देने के लिए राष्ट्रीय एवं राज्य स्तर की सरकारी एजेंसियों के साथ मिलकर काम कर रही है। एक बार जब ईसीबीसी या तो केन्द्रीय अथवा राज्य स्तर पर अनिवार्य बन जाता है तो कोई भी मान सकता है कि कार्यान्वयन एवं प्रवर्तन दृष्टिकोण समान होगा जो अन्य भवन कोड के लिए नियोजित है।

xHkhjrk ,oa urRo dk vHkko

सरकार द्वारा संरक्षण उपायों के दिशा में लिए गये सभी प्रयास लंबी अवधि की ऊर्जा नीति के पूरक के तौर पर बने हुए हैं। सभी उपाय जो किए गये थे वे कुछ घटनाओं के लिए प्रक्रियाशील थे प्रकृति की सक्रियता के लिए नहीं। मार्च 2002 में बीईई की स्थापना जोहनसवर्ग में आरआईओ+10 शिखर सम्मेलन के साथ हुई। इसके अतिरिक्त इसके गठन के बाद, बीईई का परिचालन लगभग बंद रहा। शासन की तरफ से और अधिक गतिशीलता की आवश्यकता है ताकि यर्थाथवादी आधार पर ऊर्जा दक्ष के रूप में भारत के दीर्घ कालिक लक्ष्य, विकसित आर्थिक शक्ति का पता लगाया जा सके यहां तक कि हमने इसके लिए कम समय प्रदान किया है।

of'od foi.ku dh vko';drkvksa d{k fy, tkx:drk

ऊर्जा की तीव्रता के आंकड़ों में सुधार

के संकेत केवल पिछले डेढ दशकों में अर्थव्यवस्था के खोलने के साथ देखे गये। देश एवं विदेश में बढ़ी प्रतिस्पर्धा ने व्यापार जगत को ऊर्जा की लागत बचाने में एक वैकल्पिक विचारों पर विचार करने के लिए इकट्ठा किया। इस सदी में अधिकांश उद्योग निर्यात को बढ़ावा देने के लिए कमर कस रहे थे तो उन्होंने महसूस किया कि ऊर्जा की लागत आंतरिक बाजार में उनकी प्रतिस्पर्धा में बढ़त बना रहे थे। भारत में बिजली की लागत में पिछले दस वर्षों में तीन गुना बढ़ोत्तरी हुई है। इससे शायद बेहतर व्याख्या हो सकती है कि क्यों हरित भवनों से 40 प्रतिशत तक ऊर्जा की लागत कम होने का अनुमान किया जा रहा है जिसकी वैश्विक बाजारों में मुकाबला होने की संभावना है।

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यह उल्लिखित किया गया है कि, ''पर्यावरणीय प्रभाव को परिमाण के महत्त्वपूर्ण क्रम द्वारा न्यूनतम करने के लिये यह अपेक्षित है कि अच्छी आर्थिक व्यवस्था के साथ अच्छी अभियांत्रिकी और इसके साथ ही उपभोक्ता की बदलती हुई पसदों को मिश्रित किया जाए।'' वर्तमान अनुभव एक मूल्यवान सबक प्रस्तुत करता है कि ''हरित भवन अल्प दृष्टि'' के साधारण खतरे से कैसे बचा जाए। जबकि महान हैं, फिर भी अवधारणा के लाभों का प्रभाव उपभोक्ताओं के केवल सबसे गहन हरित स्तर पर पड़ा है। उपभोक्ताओं का विशाल समूह, हालांकि, यही पूछेगा, ''यदि मैं 'हरित' भवन अवधारणा का उपयोग करता हूं, इसमें मेरे लिये क्या है?'' व्यवहार में, उपभोक्ताओं के विशेष पक्ष को हरित प्रभाव आकर्षित नहीं कर पा रहे हैं जब तक कि लागत बचत अथवा संशोधित उत्पाद निष्पादन जैसे वांछित लाभ भी प्रस्तुत न करे।

Tkf[ke vkj vfuf'prrk

यद्यपि हरित भवन में निवेश और हित तीव्रता से बढ़ रहे हैं, कई जटिल और विविध कारणों से, हरित भवन हेतु वित्तीय मामले ने भूसंपदा और विकास समुदाय में अभी तक मजबूती से पकड़ नहीं बनाई है। कई जोखिम हैं जो हरित भवन के संबंध में भूसंपदा समुदाय में विद्यमान हैं। ये निम्नानुसार हैं:

- हरित भवन प्रौद्योगिकी की विश्वसनीयता पर अनिश्चितता
- हरित भूसंपदा के विकास की लागत पर अनिश्चितता
- हरित भूसंपदा के आर्थिक लाभों के बारे में अनिश्चितता
- समय बीतने के साथ हरित भवन निष्पादन के बारे में अनिश्चितता

vuHkoh dk;cy dh deh

एक अन्य मुख्य समस्या जो भारत द्वारा हरित भवन की अवधारणा को उपभोक्ताओं की स्वीकृति दिलाने में और इसके क्रियान्वयन में झेली जाती है, वह है अनुभवी कार्यबल की कमी। भारत में हरित भवन के क्षेत्र में कई अनुभवी परामर्शदाताओं की कमी है जो तीव्र विकसित होते हुए उद्योग में साहित्य और अनुसंधान की बेहतर पड़ताल करें। इस उद्योग में विस्तार अनुभवी कार्यबल की कमी द्वारा संकट में है। इससे अनुभवहीन और अप्रशिक्षित सेवा प्रदाताओं के हरित भवन बाजार में अपनी सेवाओं पर लाभ की खोज में प्रवेश करने का जोखिम और अधिक बढ़ जाता है।

fu"d"k

हरित भवन तीव्रता से विकासशील बुनियादी संरचना उद्योग में एक उभरती हुई अवधारणा है। यह जलवायु परिवर्तन और ग्लोबल वार्मिंग के लिये एक समाधान है जो मुख्यतः विश्व स्तर पर कार्बन उत्सर्जन के कारण होते हैं। सभी विकसित और विकासशील देश अपने कार्बन उत्सर्जन को लेकर बहुत गंभीर हैं। परिवहन और निर्माण उद्योग से भी प्रमुख कार्बन निकलता है। हरित भवन एक टिकाऊ भवन है जो पारंपरिक भवन में उपयोग की गई ऊर्जा का 40% कम उपयोग करती है और भवन में रहने वालों को स्वस्थ स्थान भी उपलब्ध कराती है। इसीलिये इस अवधारणा ने कई देशों को आकर्षित किया है और वर्ष 2000 के प्रारंभ में ही कई विकसित देशों में पहले ही लागू हो चुकी है। लेकिन भारत में, यह अवधारणा अभी भी शुरूआती स्वीकरण स्तर पर है, जिसके पीछे कई क्रियान्वयन के मुद्दे हैं जिन पर पहले चर्चा की जा चुकी है। भारत सरकार को इस अवधारणा को राष्ट्रीय और सभी राज्य सरकारों के स्तर पर स्वीकृत कराने के लिये महत्त्वपूर्ण उपाय करने होंगे। भारत के कार्बन चिन्ह कम करने के लिये और ग्लोबल वार्मिंग व जलवायु परिवर्तन के प्रभाव को कम करने के लिये इस अवधारणा को लागू करने के लिये एक परिषद् और समिति बनाने की आवश्यकता है। मजबूत नेतृत्व, स्वच्छ दृष्टि और नीतियों व कार्यों के सही मिश्रण सहित, भारत में सभी नये और विद्यमान भवनों के लिये हरित भवन मानक आचार बनाये जा सकते हैं। आज, एक समर्थित हरित भवन मजबूत संवेग है। हमें इस संवेग का फायदा उठाना चाहिये।

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Quality and Inspection Manual for Housing Projects

*Dr. Shailesh Kr. Agrawal **
*Sunil Bhardwaj ***

Introduction

In order to have good, durable & resilient structures, it is mandatory to ensure good quality construction which can be ascertained through well laid down principles of quality control, assurance, regular supervision and inspection of the project work under consideration. Quality was not paid the due attention until 26th January 2001 Bhuj, Gujarat earthquake where in Ahmedabad, a place more than 300 km from epicenter, there have been total collapse of RCC framed structures leading to irreparable losses to lives and properties. The main reasons attributed were bad workmanship, poor quality of materials, utter disregard to codal provisions, and insistence on thumb rules type design. This all made the engineering fraternity to rethink as it was found that even the basic principles of civil engineering was ignored and had there been any technical framework to bring in checks and balances right from the inception of the project, the losses could have been circumvented. It is on this pretext that most of the state governments introduced third party quality assurance and monitoring apart from bringing their own quality control and quality assurance plan. It is nowadays commonplace to have project management consultants who with the help of quality control guidelines and quality assurance plan warrant the good quality construction. Bureau of India standard (BIS) is also coming out with series of codes on project management encompassing quality management aspects (IS: 15883 (Part 1) - 2009, Construction Project Management – Guidelines).

Therefore, it is important for any civil engineer or an architect to understand the basics of quality control, monitoring, its associated terminologies and how to put them into practice. It becomes more pertinent for the people who are working in areas which are hazard prone as it is learnt from past damages that even the well-designed structures can be subjected to life threatening collapses, if the execution is not done properly i.e. as per specifications maintaining good workmanship.

The chapter is written with the view to introduce the general guidelines on quality control, inspection and assurance especially for RCC structures and make the readers understand the intricacies of the quality management.

2. Quality and its associated terms

Quality

In the building construction industry, quality can be defined as meeting the requirements of the owner, architect, designer, contractor, building officials and regulatory agencies.

Quality Control

Quality control in construction typically involves ensuring compliance with minimum standards and workmanship by proper testing and acceptance criteria. The minimum standards are provided in the specifications. QC activities encompass all the phases of the project including design, construction and testing.

Quality Assurance

Quality Assurance means bridging gap between what is conceived & designed and what is finally achieved. It covers the planned and systematic actions necessary to ensure that the building conforms to the project requirements and will perform satisfactorily in future.

Quality Audit

It is the systematic and independent examination to determine

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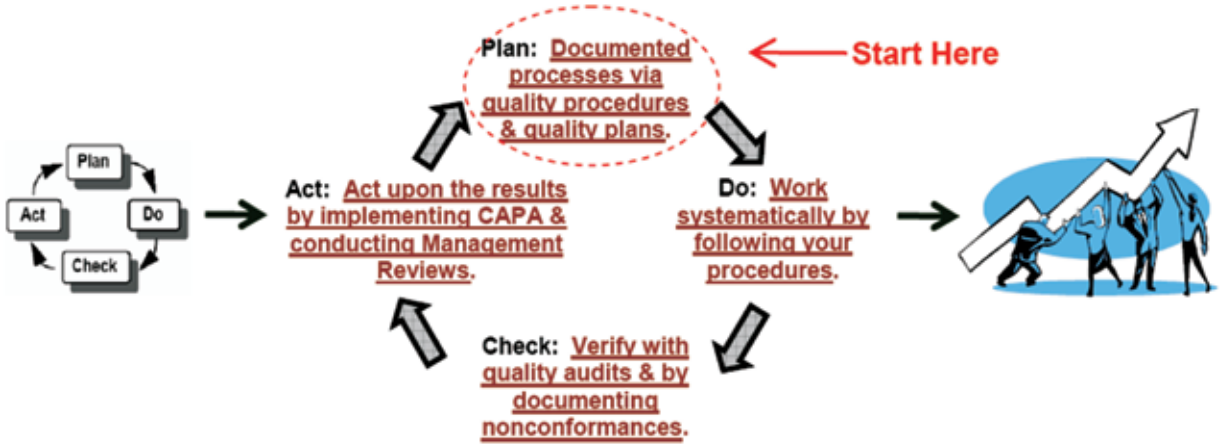

whether the quality activities and related results comply with the requirements.

Quality assurance can be easily defined by a famous Plan, Do, Check, Act" (PDCA) Cycle which is shown below. It is nothing but systematic operations and activities that are conducted to instill confidence so that the final service/ product will satisfy the requirements of stated quality. For it to be effective, constant and continuous evaluation of factors that affects the adequacy of design, specifications, materials, workmanship, and construction techniques needs to be carried out to ensure that performance on these factors is being executed as per the laid down standards.

All planned and systematic strategies and actions necessary to generate adequate confidence that input and output product will satisfy given requirements of quality and all the components of works perform satisfactory during life period of service, adequate quality checks as analyzed during construction is a record which speaks of "Quality Assurance". It comprises planning and policies, education and training standards and specifications, contracts and agreements, and quality control. Quality assurance is to assume that the materials as per standards and as per requirements have gone into the production of concrete, earth, masonry work etc. This is achieved by evaluating the quality of materials, checks/inspection during construction and post construction tests in the structures.

3. Quality Assurance Measures

In order that the properties of the completed structure to be consistent with the requirements and assumptions made during the planning and design, adequate quality assurance measures shall have to be taken. The construction should result in desired strength, serviceability and long term durability so as to lower the overall life-cycle cost. Quality assurance in construction activity relates to proper design, use of adequate materials and components to be supplied by the manufacturers, proper workmanship during the execution of works by the contractor.

Quality assurance measures are both technical and organizational and can be defined as follows:

Technical measures

Fixing out key elements necessary to provide fitness to the structure and the means by which they are provided and measured; with the overall purpose of establishing confidence that realised project will work satisfactorily in service fulfilling intended needs. Quality audit of inputs and outputs is therefore essential.

Organizational measures

Task and responsibilities of the persons involved, adequate control and checking procedure, preparation and maintenance of adequate documentation of building process and its results. It includes

- Test reports and manufacturers certificates for materials
- Concrete mix design details
- Concrete pour cards
- Records for site inspection of workmanship
- Records of field tests
- Non-conformity reports
- Change orders
- Quality control charts in case of continuous production at large projects
- Statistical analysis

The job of quality control and quality assurance would involve

quality audit of both the inputs as well as the outputs. Inputs are in the form of materials for concrete; workmanship in all stages of batching, mixing, transportation, placing, compaction and curing; and the related plant, machinery and equipment; resulting in the output in the form of concrete in place. To ensure good quality control/assurance for RCC structures, testing of all the ingredients of concrete and testing of steel reinforcement must be followed with detailed inspection at every step during the construction to ensure proper degree of workmanship.

3.1 Workmanship

In civil construction works, standards for workmanship are difficult to describe. Therefore, it is best to make some check points during execution, so that acceptable degree of workmanship can be achieved. This part would describe the checks to be made during inspection to maintain good workmanship:

3.1.1 Excavation

1. Check the centerline and dimensions of the trenches/ foundations with the respective drawing.
2. Masonry pillars shall be erected at suitable points (permanent structure) in the area to serve as benchmarks/reference marks during construction.
3. Take proper care to check RL of bottom (depth) of pit/foundation.
4. Ensure removal of all loose earth, roots of plants/trees etc.
5. Check the dimensions at bottom of foundation pit before laying PCC bed.
6. Provide sufficient working space for workman when to be executed from outside. For deep excavation depths, adequate side stop/berms must be provided to retain the sides.
7. Take care to dump the excavated earth away from the edge of excavation.
8. Proper barricading, shoring, shuttering must be provided for safety whenever required.
9. Ensure technical safety by maintaining proper slope of cut depending upon the soil characteristics.
10. Any kind of water flooding near the pit is to be avoided.
11. Incase of extra digging, depth is adjusted by filling back of excavated earth followed by proper compaction and leveling.

3.1.2 Laying of Plain Cement Concrete (PCC) Bed in Foundation

1. Excavation dimensions must be checked before laying PCC bed and necessary shuttering must be done, if required.
2. Remove all loose earth/debris from the foundation pits.
3. Sprinkle water; carry out ramming in the foundation pit and leveling of the surface.
4. Level marks “Thiyas” are to be put at a distance of 1.50m c/c before laying of PCC.
5. Ensure that proportioning and mixing of concrete is being carried out as per tender specifications.
6. Transport and placing of concrete is to be done by such a method that it should not segregate.
7. Laying, compaction and finishing of concrete should be carried out to get smooth even surface.
8. Curing of concrete must be carried out for 14 days.

3.1.3 Formwork/Shuttering

1. Use formwork, which is rigid and closely fitted, with sufficient strength to support the wet concrete.
2. Ensure that centering plates, planks or plywood are even and properly cleaned.
3. Apply suitable form release agent after proper cleaning of formwork and before placing the reinforcement.
4. Ensure proper check for dimensions, alignment, leveling and plumb before starting concreting activities.
5. It is important to check the shuttering system for proper rigidity.
6. Pockets, conduits, junction boxes etc. are to be carefully placed and checked before concreting.
7. Removal of formwork is only to be allowed as per the guidelines given in IS 456:2000.
8. Care should be taken to avoid the damages of corners & edges during removal of formwork.
9. Form work should be cleaned & stacked properly for further repetition/use.

3.1.4 Reinforcement

1. Ensure that reinforcement/ steel/rebars are clean from grease, oil, paint, rust, dust & any other objectionable foreign materials.
2. Ensure that straightening of

bars is done without damaging the configuration. Cutting, bending shall be as per bar bending schedule.

3. Ensure that vertical distance between the successive layers of bars is maintained by providing steel spacer at required interval.
4. Check reinforcement for size, spacing, location, numbers, splicing as per drawing and bar bending schedules.
5. Ensure that rebar should be kept in position by chairs of proper size.
6. Ensure proper and adequate placement of cover blocks, embedded inserts and cutout, if any.
7. Ensure that walkways are placed in adequate numbers resting on the shutting, to avoid the displacement of reinforcement due to movement of workers.
8. Do not permit any movements of personnel and placing of equipments directly over reinforcement.
9. Cement slurry should be spread over reinforcement for proper bond with concrete.

3.1.5 Reinforced Cement Concrete

1. Ensure that cement is of approved quality and is not set. Routine testing is to be carried out as per existing Indian standards (IS).
2. Cement bags are to be stored in a completely water proof storage accommodation and number of bags just sufficient for 30 days of consumption.
3. Ensure that entire stacks are covered by tarpaulin or polythene sheet, with an adequate overlap. This is to be adopted specially during cloudy and rainy season.
4. Ensure the aggregates to be used are of approved quality. Routine testing is to be carried out as per IS for fine aggregates and coarse aggregates.
5. Ensure that adequate quantities of aggregates are available before start of work.
6. Necessary correction for bulking of sand is to be done on day to day basis.
7. Ensure that portable water from approver source is available for construction and curing. In case of doubt, testing is to be carried out as per IS.
8. Proportioning of materials is to be carried out by weigh batching only. Do not overload a batch.
9. Ensure that water cement ratio as per mix design is maintained for each batch after necessary correction for bulkage of aggregates.
10. Routine checks are important for checking of sensitivity of balance and weights.
11. Mixing is to be carried out using concrete mixer or computerized mixing & batching plant.
12. In case of concrete mixer checks for RPM of mixer, hardened material, number of blades inside the drums, working of chute and hopper, leveling, raising, emptying and release of hopper are to be carried out.
13. Ensure that minimum mixing time required (1.5 - 2 minute or as per manufacture instructions) is followed for each batch.
14. Keep suitable thickness of cover blocks (>M35) as per requirements of structural drawings at maximum spacing of 1.0 m c/c.
15. Ensure that concrete should be transported and placed in position before initial setting time and without any segregation.
16. Concrete should be placed to the position of construction joint with proper care to avoid the displacement of inserts, pockets etc.
17. Proper and stable walkways are to be provided to avoid the displacement of reinforcement etc.
18. Concrete should be laid in suitable layers without break in continuity and uniform thickness of layers.
19. Use suitable type of immersion vibrators for compaction of concrete and avoid over vibration.
20. Insert immersion vibrator minimum 100 mm away from the shuttering face vertically to the full depth; do not drag, withdraw vertically and slowly. Do not allow the needle to touch the reinforcement.
21. Stand by vibrators and needles should be available at the site.
22. Finishing is carried out after a little stiffening of concrete has occurred with suitable tools.
23. Provide green cuts immediately after finishing a particular layer of concrete by suitable means and clean it thoroughly.
24. In case of proceeding concrete, surface being old cheeping

must be done upto 10 to 15 mm depth and should be thoroughly clean using air or water jets before placing the subsequent layers of concrete.

25. All RCC work should be cured adequately with suitable methods for minimum 07 days.

26. All the equipment to be used in concreting work such as weigh batcher, mixer, vibrator, tippers etc shall be checked and insured in functional condition a day before planning of concreting.

3.1.6 Back Filling of Trenches

1. Earth used for filling shall be of approved quality and free from salts, organic or other deleterious matters.
2. execute back filling or filling in trenches in layers of 30 cm to 45 cm
3. Each layer is to be properly spread, watered and compacted using suitable equipment.
4. Ensure that the consolidated top layer is dressed to the required slope and label.
5. Back filled soil should not be allowed to fall on the concrete work. However, once it falls than should be washed thoroughly.

3.1.7 Brick Masonry

1. Before commencing any brick work, it is to be conferred that all pipes, conduits, drains, sleeves, bolts, hangers or any other materials necessary to be installed in the brick work are in place.
2. The mortar for brick work consists of cement and sand and is made in small quantities so as to be consumed within 30 minutes.
3. The cement and sand of the required proportion is first mixed dry thoroughly and water added and mixed.
4. The cement mortar must be preferably made below temporary roof in shade. The size of brick should conform to the standards.
5. Bricks are soaked in water before use, for a period, for the water to just penetrate the whole depth of the bricks.
6. Alternatively bricks may be adequately soaked in stacks by profusely spraying with clean water at regular intervals for a period not less than six hours.
7. When the bricks are soaked, they are removed from the tank sufficiently early so that at the time of laying, they are skin-dry.
8. Bricks are laid in English Bond unless otherwise specified.
9. For brick work in half brick wall, bricks are laid in stretcher bond.
10. Half or cut brick are not used except as closer where necessary to complete the bond.
11. Closers in such cases, are cut to the required size and used near the ends of the wall.
12. All loose materials, dirt and set lumps of mortar which may be lying over the surface on which brick work is to be freshly started, are removed with a wire brush and surface wetted.
13. Brickwork should be cured for at least 7 days and at least 3 days before starting of plastering work.

3.1.8 Cement Plastering

1. The cement plaster is of 10mm, 12mm, 15mm, and 20mm thickness or as specified in the item drawing.
2. The mortar of the specified mix using the type of sand and cement as described in the item is used.
3. All plaster work is executed in a workman like manner and as per the dimensions on the drawing, and is ensured to be in the true plane without imperfections and square with adjoining work.
4. Masonry and concrete surface to which plaster is to be applied is clear, free from efflorescence, damp and sufficiently rough and hacked, washed and well watered before plaster is applied.
5. Long straight edge is freely used to ensure a proper bond.
6. All the surfaces are thoroughly washed and well watered before plaster is applied and bonding agent is to be applied just before commencing of plastering work or as directed by quality staff.
7. All chasing, installation of conduits, boxes etc., are ensured before any plastering is commenced on a surface.
8. Chasing or cutting of plaster is as far as possible avoided.
9. All corners are finished sharp, edges of windows, chajjas should in single plumb or line from top to bottom of the building.
10. Curing is started as soon as the plaster has hardened suffi-

ciently not to be damaged when watered.

11. The plastered surface is kept continuously damp for proper curing for at least 7 days.

3.1.9 Quality Control Elements

To ensure good quality and continue progress of construction at site, it is important to comprehend; what is going wrong & How to correct it. Table-1 gives the quality control elements and the related works which may be wrong along with the corrective measures to be adopted.

3.2 Testing of Raw Materials

To get desired degree of quality in reinforced cement concrete construction, it is imperative to use the material of prescribed quality. It is required to do frequent testing of materials i.e. cement, aggregates, water, reinforcement etc. to check their acceptance according to the relevant standards. The materials going to be generally used for the typical construction works are as follows:

1) Cement
2) Fine Aggregates
3) Coarse Aggregates
4) Admixtures
5) Water
6) Reinforcement Bars
7) Binding Bar

3.2.1 Tests required

The tests required for each material to be used in the construction are as given below:

1) Cement
   - i) Fineness (Dry Sieving)
   - ii) Standard Consistency and Setting Times
   - iii) Soundness (Lechatelier's Method)
   - iv) Compressive Strength
2) Fine Aggregates
   - i) Particle Size Distribution and Fineness Modulus
   - ii) Material finer than 75 Micron
   - iii) Organic Impurities
   - iv) Specific Gravity and Water Absorption
   - v) Bulking
   - vi) Silt Content
   - vii) Surface Moisture Content
3) Coarse Aggregates
   - i) Particle Size Distribution and Fineness Modulus
   - ii) Flakiness and Elongation Indices
   - iii) Specific Gravity and Water Absorption
   - iv) Surface Moisture Content
   - v) Crushing Value
   - vi) Impact Value
4) Admixtures (If used)
   - i) Bleeding
   - ii) Relative strength
   - iii) Setting time
5) Water (As per IS 3025)
   - i) pH value
   - ii Organic Solids
   - ii) Inorganic Solids
   - iii) Sulphates (SO3)
   - iv) Chlorides (Cl)
   - v) Suspended Matter
6) Reinforcement Bars (Confirming to IS 1786)
   - i) Tensile testing
     - a) Tensile Strength
     - b) Elongation
     - c) Proof Stress
   - ii) Mass
   - iii) Bend
   - iv) Rebend
7) Binding Wire (Confirming to IS 432)
   - i) Tensile testing
     - a) Tensile Strength
     - b) Elongation
     - c) Proof Stress

3.2.2 Frequency of testing and allowable limits

The frequency of testing of raw materials for each test with the relevant standards and allowable limits are given in Table-2.

4. Sampling and Testing of Concrete

To ascertain that the concrete going to be poured in the structural components have desired durability and strength properties, it is required to carry out quality control tests for consistency, workability and strength of concrete. Fresh concrete is used to carry out consistency and workability testing while compressive strength tests are conducted on hardened cubes as per relevant standards.

4.1 Testing of Fresh Concrete

Slump cone test is performed to know the consistency of concrete and compaction factor test is the most widely test to keep a check on the workability of fresh concrete mix at site. Both slump cone and compaction factor tests are carried out for each shift of concreting at frequent intervals as per IS 1199 and compared with mix design requirements.

4.2 Testing Hardened Concrete

Compressive strength test on hardened concrete cubes for each grade is mandatory to be carried out as per minimum frequency

Table-1 : Quality Control Elements and Corrective Measures

Sl. No.	Control Element	What is going wrong	How & when came to know	Corrective measure
1.	Excavation in Foundation	a) Excavation more or less than specified dimensions b) Undergrowth and root etc. encountered not removed	On inspection by a representative	Order rectification as per drawing
2.	Fine Aggregates	a) Silt more than permissible b) Bulkage more than specified c) Grading not within specified limit	After testing of sample	Ask the contractor for sample from other source, test and approve
3.	Coarse Aggregates	a) Not from the specified source b) Grading not within specified limit	a) Production of sample b) After testing of sample	Ask the contractor for sample from other source, test and approve
4.	Cement	a) Grade not as specified b) Initial and final setting and strength not as specified c) Purchase vouchers for each lot not specified	After testing of sample and during receipt of cement lots	a) Field test for initial and final setting be done b) Cement strength of every lot to be checked/ tested c) Verify vouchers of manufactures of every lot
5.	Steel	a) Steel not procured from authorized source b) Steel not confirming to IS:432(Part-II) and IS: 1786 c) Purchase vouchers of each consignment not produced d) Bars not bent as per drawing e) Chairs not provided f) Laps not as per IS codes and drawings g) Test certificate of manufacturer not produced by contractor	a) Visual inspection b) Verification of source of procurement, purchase voucher, test certificate with each lot not produced	Approve reinforcement before concreting based on necessary tests
6.	Concreting	*Proportioning* a) Not as per specified in the concrete mix design b) Volumetric batching instead of weigh batching c) Correction for bulking fine aggregates is not provided	Visual during execution of work	a) Ensure and ask the contractor to follow mix design b) Do not allow only stick to weigh batching c) Ask to apply correction for bulkage of fine aggregates
		Mixing a) Mixing not through mechanical method b) Mixing is not for specified time	a) Visual inspection b) Observed during execution	a) Ask the contractor to do mixing through mixers only b) Not allow placing of concrete if not mixed for specified time

Sl. No.	Control Element	What is going wrong	How & when came to know	Corrective measure
		Transportation a) Depending upon the lead from the mixing and placing points transportation method is not appropriate	a) Notice during execution	a) Appropriate method is to be suggested and ask to adopt the same
		Placing a) Construction joints are not prepared properly and spraying of cement slurry/water not carried out before pouring of concrete b) Drop height of concrete is such that it is causing segregation of concrete, displacement of reinforcement and impact load on formwork c) Storing of concrete at one place in the form of heap on formwork then spreading/ laying	a) Observed just before placing of concrete b) Observed during execution c) Notice during laying of concrete	a) Ensure that Construction joints are prepared and sufficient quality of cement slurry/ water has sprayed before pouring of concrete b) Ensure that the drop height should not be more that 1.0m c) Should not be placed at any point on formwork in the form of heap, if it is required at site then proper strengthening of formwork in the area is to be carried out
		Compaction a) Proper mechanical vibrators/ tamping and rodding not done b) concreting done on power failure and absence of vibrators c) In Corners, embedded fixtures, dense reinforcement areas concrete not fully poured and vibrated	During execution of work	a) Use immersion vibrators as per IS 2505 and IS 3558 b) Stop work if power fails or vibrators not available c) Ensure in inaccessible places concrete is poured and vibrated properly
		Finishing Concrete not sprayed and finished evenly	During execution of work	Pour concrete slightly more than desired finished depth
		Removal of Formwork Formwork removed before specified period	During execution of work	Ensure that IS code guidelines are strictly followed for removal of formwork. Note: The period specified in IS code may be increased or decreased by competent authority if there is any specific requirement.

Table-2 : Frequency, Standard and Allowable Limits for Raw Materials

Test	Frequency	IS	Allowable Limits
Cement			
a) Chemical i) Alkalies ii) Minor, major oxides by Calorimetry iii) Chloride	For each consignment	i) 269 ii)1489 iii)4032	i) OPC < 0.60% ii) PPC < 0.70% iii) PPC/OPC < 0.05%
b) Physical i) Fineness ii) Soundness iii) Consistency iv) Setting times v) Compressive Strength	For each Consignment	i) 269 ii) 1489 iii) 4031 iv) 4031 v) 4032	i) > 2250 cm^2/gm ii) < 10 mm iii) 5-7mm from base iv) Initial > 30 min Final < 600 min v) As per grade of cement
Fine Aggregates			
i) Particle Size Distribution and Fineness Modulus	One test for every 150 m^3 of sand used in concrete	2386 Part-I	2.2 to 3.2 (Fineness Modulus)
ii) Material finer than 75 micron	-do-	2386 Part-I	3.0% for uncrushed and 15% for crushed stone
iii) Organic Impurities (Mica Content)	-do-	2386 Part II	
iv) Specific Gravity and Water absorption	-do-	2386 Part III	
v) Bulking	-As above- (also once in a shift or for every consignment)	2386 Part III	Maximum 20%
vi) Silt Content	One test for every 150 cum of sand used in concrete	2386 Part II	Not greater than 2% for crushed and 5% for uncrushed aggregates
vii) Soundness	-do-	2386 Part V	Loss Not > 10% after 5 cycles of immersion in $Na_2 So_4$ OR Loss Not > 15% after 5 cycles of immersion in $MgSO_4$
Coarse Aggregates			
i) Particle Size and Shape	One test for every 150 m3 or less	2386 Part I	
ii) Specific Gravity and Water Absorption	-do-	2386 Part III	Not > 2.6 Not more than 5% by weight
iii) Soundness test (Sodium Sulphate method)	-do-	2386 Part V	Loss Not > 12% after 5 cycles of immersion in $Na_2 SO_4$
iv) Crushing Value	-do-	2386 Part IV	Wearing Surfaces: Loss Not > 30% Non Wearing Surface Not > 45%
vi) Impact Value	-do-	2386 Part IV	Wearing Surfaces: Loss Not > 30% Non Wearing Surface Not > 45%
v) Organic Impurities (Mica content)	-do-	2386 Part II	Less than 1%

Test	Frequency	IS	Allowable Limits
Water			
i) pH value ii) Organic Solids iii) Inorganic Solids iv) Sulphates (SO_3) v) Chlorides (CI) vi) Suspended Matter	Two samples for each source	 3025 Part 18 3025 Part 18 3025 Part 24 3025 Part 32 3025 Part 17	Not less than 6 Not greater than 200mg/lit Not greater than 3000mg/lit Not greater than 400mg/lit PCC 2000mg/lit & RCC 1000 mg/lit Not greater than 2000mg/lit
Reinforcement			
Mass	i) > 10mm dia. -1 sample from each 40 Tonne ii) 10-16mm dia.-1 sample from 45 Tonne iii) <16mm dia. 1 sample from 50 Tonne	1786	i) Up to and including 10mm dia. ± 7% ii) Over 10 up to and including 16mm dia ± 5 % iii) Over 16 mm dia. ± 3%
0.2% Proof Stress/Yield Stress, Min.	-do-	1786 1608	For Fe 415 – 415 N/mm^2 For Fe 500 – 500 N/mm^2 For Fe 550 – 550 N/mm^2
Elongation, %, Min on Gauge Length 5.65√A, where A is the C/S area of the test piece	-do-	1786 1608	For Fe 415 – 14.5 For Fe 500 – 12.0 For Fe 550 – 8.0
Tensile Strength, Min	-do-	1786 1608	For Fe 415, 10% more than the actual 0.2% proof stress but not less than 485 N/mm^2 For Fe 500, 8% more than the actual 0.2% proof stress but not less than 545 N/mm^2 For Fe 500, 6% more than the actual 0.2% proof stress but not less than 585 N/mm^2

Note: The actual frequencies shall be determined by the engineer-in-chief to suit the nature and variability of material placed and the rate of fill placement with the objective of ensuring best quality control and quality construction.

given in the Table-3. A random sampling procedure shall have to be adopted to ensure that each concrete batch shall have a reasonable chance of being tested. Samples from fresh concrete shall be taken as per IS 1199 and cubes (15 cm) shall be made, cured and tested at 28 days in accordance with IS 516.

Three test specimens shall be made for each sample for testing at 28 days. The test results of the sample shall be the average of the strength of three specimens. The individual variation should not be more than ±15% of the average. If more, the test results of the sample are invalid.

Table-3: Frequency of Cube Testing

Sr. No.	Quantity of concrete (m^3)	No. of Samples
1	1 – 5	1
2	6 – 15	2
3	16 – 30	3
4	31 – 50	4
5	51 and above	4 + one additional for each additional 50m^3 or part thereof

4.2.1 Acceptance Criteria for Compressive Strength of Concrete

The concrete shall be deemed to comply with the strength requirements when both the following conditions are met:

a) The mean strength determined from any group of four consecutive tests, the results complies with the appropriate limits in column 2 of Table-4.

b) Any individual test result complied with the appropriate limits in last column of Table-4.

Table-4: Acceptance Criteria of Concrete

Specified grade	Mean of the group of 4 non-overlaping consecutive test results in N/mm2	Individual test results in N/mm²
M15	≥ f_{ck} + 0.825 x established standard deviation (rounded off to nearest 0.5 N/mm²) or ≥ f_{ck} + 3 N/mm² whichever is greater	≥ f_{ck} - 3 N/mm²
M20 or above	≥ fck + 0.825 x established standard deviation (roun ded off to nearest 0.5 N/mm²) or ≥ f_{ck} + 4 N/mm² whichever is greater	≥ f_{ck} - 4 N/mm²

Note: *In the absence of established value of standard deviation (2.5 for M15 and 6.3 for M35) may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.*

5. Inspection and Testing of Concrete in Structures

Immediately after stripping the formwork, all concrete shall be carefully inspected and any defective work or small defects either removed or made good before concrete has thoroughly hardened. In case of doubt regarding the compressive strength of concrete, either due to poor workmanship or based on results of cube strength tests, testing of concrete in structure is to be carried out. There are two types of testing of hardened concrete in structure which can be carried out to know the strength/ quality of concrete in structure.

i) Concrete Core Testing
ii) Non Destructive Testing

5.1 Concrete Core Testing

Cylindrical cores of required sizes are to be cut and tested as per IS standards. The point from where cores are to be taken and the number of cores required shall be at the discretion of the inspecting engineer and shall be representative of the whole of concrete concerned. In no case, however, shall fewer than three cores be tested.

Concrete in the member represented by a core test shall be considered acceptable if the average equivalent cube strength of the cores is equal to at least 85 percent of the cube strength of the grade of concrete specified for the corresponding age and no individual core has strength less than 75 percent.

5.2 Non Destructive Testing

Non destructive testing of concrete members may also be carried out to reduce number of cores to be cut and ascertain quality of concrete, position of reinforcement & concrete cover using rebound, ultrasonic and rebar locator techniques.

6. Team Co-ordination

The staff responsible for construction and quality control staff must act in tandem to achieve good quality of the finished product and construction as per the contract specifications.

Construction staff should make it a point to inform the quality control staff, the date of starting of any activities or component of the work well in advance so as the enable the quality control staff to schedule their work plan and attend the particular work on the particular date.

In turn, quality control staff should schedule their programme, so as to attend to the work on the dates required by the construction staff and ensure that, the progress of work is not hampered.

The defects, if any, noticed by the quality control staff during their course of inspection shall be brought to the notice of the construction staff then and there. It is the primary responsibility of the quality control & inspections staff to draw the attention of the construction staff, whenever defective work is noticed during the course of inspection. It is duty of the construction staff to attend to the rectification and maintain proper specifications as pointed out by quality control staff. Work should immediately be suspended and not allowed to resume until the defects pointed out by quality control and inspection staff are rectified.

Quality control staff should monitor that tests required as per agreement/I.S. codes are carried out by the field staff on regular basis. The field staff should also conduct the required tests as routine and maintain record of each and every activity at the site related to quality control. Quality control staff may co-ordinate with any other national laboratory/ academic institute for testing of any material/concrete.

All observations regarding sub-standard or below specification work will be duly recorded by quality control representative and all such substandard or below specification works should be got stopped/ dismantled immediately by execution unit. The defects pointed out by quality control team will be communicated to the competent authority and contractor for compliance immediately. The compliance report should be sent by quality control representative or contractor within a week to competent authority.

The competent authority cannot supervise the placement of concrete on a mix to mix basis continuously. They can only conduct random testing/check of input materials, mixing time, placement of concrete, compaction, cube testing etc. Therefore, it is the primary responsibility of the quality control team and contractor's staff to ensure adequate supervision of placement of concrete.

The quality control staff shall not interfere in any way, with the executive powers vested with the competent authority. Also, their primarily responsibility is to assure quality of all works and to carry out the works as per the technical specifications.

In case of difference of opinion between quality control staff and construction staff, it should be sorted out by way of discussions in cordial atmosphere and mutual trust. In case of any problem related to design features/aspects, design office should be duly consulted and the advice given to the construction staff has to be accepted.

In case of difference of opinion between quality control staff and contractor staff, decision of competent authority shall be final and binding on all. In case there is any dispute related to quality control, competent authority in consultation with engineer-in-chief may appoint third party for quality checking/inspection.

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Consultation Meet on Standards & Specifications for Affordable Housing at Ahmedabad

With the aims of "Housing to All by 2022" and housing shortage to the tune of 18.78 million (2012), there is need for faster planning and construction of dwelling units. With varying geo-climatic conditions hazard scenario and availability of building materials, it is required to develop regions specific Standard & Specification of dwelling units with different alternate technologies, which may serve as useful guidelines for designers while planning the dwelling units. BMTPC has initiated the exercise, in consultation with State Governments to develop such guidelines. This also aims to standardize basis module of spare dimension for different type of building material component and system. In this regard, a Consultation Meet on Standards & Specifications for Affordable Housing (Western Region) was organised by BMTPC on 26 March 2014 at Ahmedabad. Around 75 participants participated in the Consultation meet including technology providers.

Simple Tips for Safe & Cost Effective House Construction

Deepak Bansal *

Background

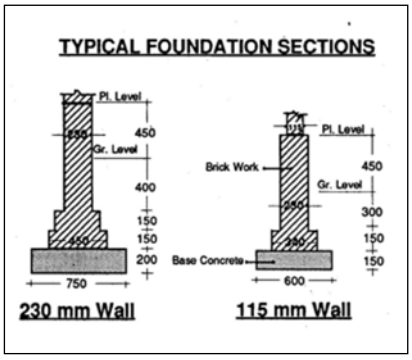
The House construction is a big nightmare for almost all the person, as Design Finalization, Material Planning and finding the right professional is a difficult Task. Although the Tips are available for safe and cost effective housing are available here and there but the comprehensive data are missing. When one starts this/her House construction, these information's are not readily available and the person are left with the mercy of contractors and mason.

The simple tips are given here for laymen to target the gray areas in house construction.

The general consideration for choosing a cost effective house plan are:

The building plan must be suitable to the residents, modifiable, structurally sound and cost effective.

Layout: As far as possible the layout should be simple and symmetric. The Proper orientation of the building on a pit ensures the wasteful expenditure on mitigation of vagaries of the nature. There should not be Irregularity in either Plan or in Elevation of the building.



Load Bearing or Framed Construction: Normally all the houses can be easily designed as load bearing up to a typical room span of about 5 m. The whole of the North India except some part of Gujarat and Himalayan region are quite safe to go for brick masonry construction. However, the brick masonry needs horizontal RCC Bands at Plinth and lintel levels in many cases. But, if the symmetry of lower and upper floors is different then either masonry has to be reinforced or go for full or partly framed structures.

Load Bearing Construction: The Load Bearing Construction should be carried out with all structural features as:

a) **The foundation:** Observing the old houses in the locality and enquiries about types of foundations used for the same type of buildings will help in choosing the right foundations. Any visible cracks in masonry at floor levels and settlements in skirting, in the same type of old houses indicates that either soil is weak or foundation design is improper. In this case investigate the soil thoroughly to decide type of suitable foundations otherwise choose the same foundation at same depth where there are no cracks.

b) **Bondings/Toothings and Bands in walls:** The joints of bricks should be properly filled and cross wall should be jointed with proper toothing, some of the typical bondings in brick work are English, Flemish, Stretcher, Rat-Trap etc.

c) **RCC Plinth/Lintel Bands:** As per the requirements of the Indian standards these bands are required in all the load bearing Buildings. Table-1 gives the details regarding the Structural Requirement of Steel in the bands.

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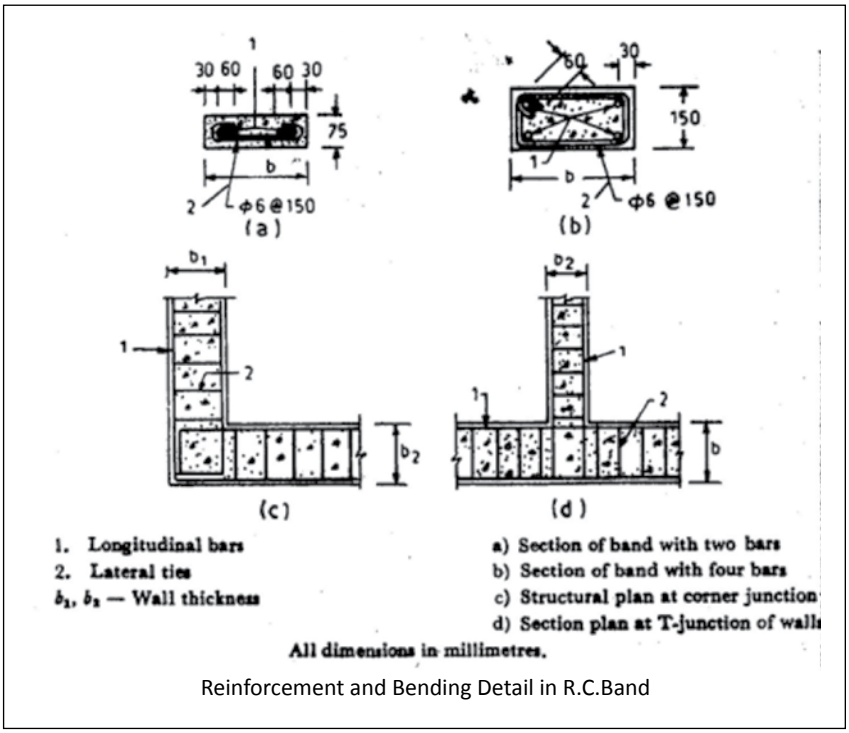


Reinforcement and Bending Detail in R.C.Band

Table-1: The details regarding Structural Requirement of Steel in the Bands

Recommended Longitudinal Steel in RCC Bands

SPAN	Building Category B		Building Category C		Building Category D		Building Category E	
Metre	Nos of Bars	Dia (mm)	Nos of Bars	Dia mm)	Nos of Bars	Dia (mm)	Nos of Bars	Dia (mm)
5 or less	2	8	2	8	2	8	2	10
6	2	8	2	8	2	10	2	12
7	2	8	2	10	2	12	4	10
8	2	10	2	12	4	10	4	12

Building Category:

Importance Factor	SEISMIC ZONE			
	II	III	IV	V
1	B	C	D	E
1.5	C	D	E	E

All the Residential Buildings have Importance Factor as 1.

Vertical Steel Reinforcement in Masonry walls with rectangular Masonry Units

Nos. of Storey	Storey	Diameter of HSD Single Bar in mm at each critical section			
		Category B	Category C	Category D	Category E
One		Nil	Nil	10	12
Two	Top	Nil	Nil	10	12
	Bottom	Nil	Nil	12	16
Three	Top	Nil	10	10	12
	Middle	Nil	10	12	16
	Bottom	Nil	12	12	16
Four	Top	10	10	10	Four Storey building not permitted
	Third	10	10	12	
	Second	10	12	16	
	Bottom	12	12	20	

Recommended Mortar Mixes

Building Category	Cement coarse sand Mortar
A, B & C	1:6
D & E	1:4

d) Positions of opening: The positions of openings in brick masonry are very crucial as this should not be close to the corners and very large opening without proper structural design should be avoided.

Framed Structures: In Column Beam Structures the Most important Feature is the Column Beam connections and Splicing of Reinforcement Bars.

Column Beam Connection should be monolithic and Beam bars should go in column bars to make this joint works as monolithic.

Splicing of bars should be done as:

Column: All bars should be spliced in middle two Third Lengths of Column and not more than 50% bars should be spliced at on location.

Beams: Bottom bars should be spliced near supports and Top Bars should be spliced in Middle lengths.

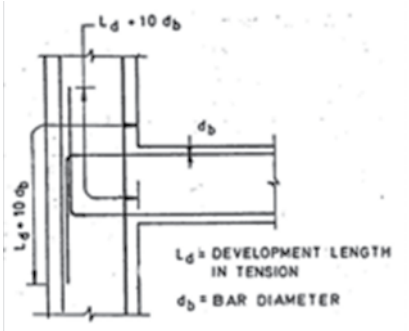
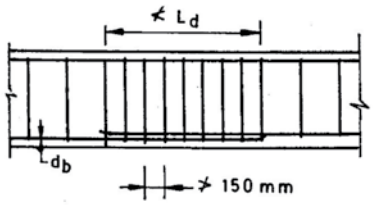


FIG. 1 ANCHORAGE OF BEAM BARS IN AN EXTERNAL JOINT



At Splicing Joints the rings should be provided not more than 150 mm center to center.

Roofing: Typically a RCC slab of about 100 mm to 115 mm thick is good enough for a general room span of 2.7 m to 3.5 m with 10 mm dia TMT reinforcement (10 kg/sqm). However, RCC is a matter of concern as generally the quality of RCC in houses is very poor.

In my opinion, as far as possible, use skilled masons and supervisors for the construction as skill makes a lot of difference. The life of brick masonry is much longer compared to RCC due to inheritance weakness in RCC like weathering, sulphate attacks, corrosion in steels, peeling of cover etc., whereas brick masonry needs much less attention.

Materials

Bricks: Use good quality of burnt clay bricks, as the bricks are the main support. If first quality bricks are not available then cement concrete blocks (Solid/Hollow), Fal-G bricks/ blocks, Stabilized earth blocks, calcium silicate bricks etc. can be used. Their cost comparisons should be done in terms of cubic content as the thickness of some of these product is 200 mm compared to 230 mm of Burnt clay Bricks, hence for the same house the cubic content will be about 8% less and carpet area will be 2-5% more, secondly they are generally stronger than Burnt clay bricks, hence provide much strength to the house.

Cement: Different types of cement are available like OPC, PPC, blended cement and in different grades as 43, 53 MPA etc. Choose any reliable brand of cement with 43 grades as this releases less heat, which will take care of some error in curing.

Steel: Steel should be from branded manufacturers and should be TMT (Thermo mechanically treated) & HCR (High corrosion resistant) as this decrease the chances of corrosion.

Sand/Stone Aggregate: These are unbranded materials and available in sundry shops, makes it difficult to choose rights one. Hence, always take a sieve of about 2 mm sizes for sand and 10 mm for coarse aggregate and sieve it for about 2 minutes. Compare the weight when sieve full and after sieving for 2 minutes. The Percentage retaining on the sieve should be in the range of about 50%.

The other test of sand / aggregate like impurities, strength, bulking cannot be easily done, hence should be done by experienced mason / supervisors.

Water: The water used in construction must be potable.

Mortar/concrete: Normally mortar is mixed manually in house construction sites. This needs careful monitoring and supervision. In mortar, water content should be about 50% by weight of cement. The mixed mortar must be consumed within 1 hour of mixing.

The concrete should be mixed only in mixer and not manually. The ratio of different ingredients should be checked in every lot. The mixing time of each lot should be same and neither concrete should be too dry nor too wet. The consumption of concrete should be done within half hour of mixing.

Curing: The curing of the construction should be done dutifully as this makes construction strong. There is no substitute for curing. The curing should be done at least for 7 days at least two times a day and mortar/concrete should be damp throughout seven days.

Bar Bending: The steel bars should be straightened first and then cut. The spacing of bars should be maintained as per design. The steel bars should be provided in Bottom of the slab but extra bars should be placed within L/8 distance from the edge of the slab at top also (L is the distance between two support). The extra bars at top at continuous edges of the slab are absolutely essentials.

However, in cantilevered slab, the main steel is at top and its anchorage with edge beam / edge slab is very crucial.

Special Features

Levels: This is another important aspect in house design, as during planning of sewers, ramps and staircase often this becomes a problem area. The plinth level of the house should be min 300 mm high from the road level to get better light, ventilation and to safeguard house from every year increase in road level. This also prevents flooding back flow of water from street to inside of the house.

The sewers lines also frequently get chocked and overflow, which makes it difficult to discharge the flow from the house to sewers and results in back flow.

The ramps slope has to be very gentle hence unnecessary increase in plinth height of the house will require long ramp, which will eat away a lots of space.

The Staircase should be planned in a proper way otherwise to achieve the required heights lots of winders/spirals have to be introduced in the staircases, which are not desirable.

Concealed Fittings: Although the concealed fittings for water, sewers and electrical lines is a very good idea, but when they mal- function they create a big nuisance. The life of GI pipe is about 15 years and to replace them one has to dig all the walls and floors. The cPVC and uPVC options are quite good as the life is long and scaling is also less besides good thermal insulations.

The Electrical conduiting is simpler than water supply or sewerage lines but this has to be meticulously done because If MS pipes are used then they get rusted after some time and replacing/repairing the cables becomes difficult.

Earthings for Electrical: The earthing should be properly done even though it has been taken from the supply point. As the supply point cannot be relied upon all the times.

Water Proofing: The water seepage in house either from walls, floors or roof plays havoc and is the most difficult to check later on.

The common source of water seepage is:

a) Roofs: The cracks in roof, open parapets, improper flow of water on roof, faulty rain water Khurras, Faulty Golas may results in water seepage from roof. The roof casting should be done in one go and slope in roof should be 1:50 to 1:70 towards each khurra. The average roof area per khurra should be 150sqft. The junction between roof and parapet should be provided with cement concrete Gola in such a way that Gola on wall side should be below the wall plaster. The parapet should be provided with the drip course and should be plastered at top with rich cement sand mortar.

b) Adjacent Property: The adjacent property walls transfers all the water on it to the neighboring wall through physical contact.

Hence, when the source of the water is from outside, then it is really difficult to check. However applying bitumen felt/ polythene sheet, silicon paint on the wall to the adjacent property during construction can help this problem to some extent.

c) Leakage in water and Sanitary lines: If they are leaking than find the source of leakage and seal it. The efforts should be made to get the proper plumbing done at the first place through a trained plumber.

d) Rise of moisture from ground through floors and walls: Proper DPC and floor concrete can prevent this seepage. Proper care must be taken to see continuity of the DPC on all the walls and continuity of flooring concrete below it.

Termite Proofing: This is also difficult to check later on. Hence termite treatment should be given in foundations, floorings and on wood works. However in the areas where this problem is not presents since decades then this treatments can be avoided.

Structural and Earthquake Features:

The mason can guide the owner on how to construct the house and often boast that they had constructed lots of houses and if one do not listen them, then there is no responsibility on their shoulders. Do they provide any insurance to the property or do they give any undertaking of any sort for the safety? No.

The people usually follow them in absence of proper guidance.

But there are lots of areas where attention is required like foundations, masonry, beams, columns, slabs, as what should be the optimum requirements and are we going for over design due to these advices from unscrupulous people?

Can we save some money and at the same time construct a stronger house.

The tips are simple to complex as have been discussed in the article.

Hence Apart from Vastu, functional requirements, interiors, type of construction, The materials and Technologies are the major deciding factor in house construction, which plays in decide the cost economics, as generally, person neither go to soil investigation report nor to a competent structural engineer/Architect and continue to shuttle here and there for wants of specifications and guidance.

In the light of these factors one should not hesitate to take expert opinion in case of any doubt, as this will not only help him to construct a safe house but a cost effective house.

Cost Comparison of Different Building Materials

Estimated Cost Saving on using Innovative Building Materials:

	Cost-Effective Technologies	In place of Conventional options	% of Saving
I.	**FOUNDATIONS**		
1.	Pile foundation (under reamed)	Traditional stone/bricks	15
2.	Brick Arch foundations	Footings	25
II.	**WALLING (SUPER STRUCTURE)**		
1.	230 mm Thick wall in lower floors	330 mm brick walls	5
2.	180 mm Thick wall in bricks	230 mm brick walls	13
3.	115 mm thick recessed walls	230 mm brick walls	20
4.	150/200 mm Stone block masonry	Random rubble masonry Ashlar masonry	30 20
5.	Stabilized mud blocks	Burnt brick walls	20
6.	FaL-G Block masonry	Clay brick walls	20
7.	Fly ash brick walls	Clay brick walls	25
8.	Rat trap bond walls	English/Flemish bond	25
9.	Hollow blocks walls	Solid masonry	20
III.	**ROOFING**		
1.	85 mm thick sloping RCC	110 mm RCC	30
2.	Tiles over RCC rafters	Tiles over timber rafters	25
3.	Brick panel with joists	RCC	20-25
4.	Cuddapah slabs over RCC rafters	CS over timber rafters	20
5.	L-panel sloping roofing	RCC	10
6	.RCC planks over RCC joists	RCC	10
7.	Ferrocement shell roofing	RCC	40
8.	Filler slab roofing	RCC	22
9.	Waffle roofing	RCC	15
10.	RCC channel units	RCC	12
11.	Jack arch brick roofing	RCC	15
122.	Funicular shell roofing	RCC	18
13.	Brick funicular shell roofing	RCC	30
14.	Precast blocks over inverted T-beams	RCC	25
15.	Micro-concrete roofing tiles	Clay tile roofing AC sheet roofing	20 15
IV.	**MISCELLANEOUS ITEMS**		
1.	RCC door frames	Timber Frames	30
2.	Frameless doors (only inserts)	Frames and shutters	50
3.	Ferrocement door shutters	Timber shutters (second class timber)	30
4.	RCC window frames	Timber frames	30
5.	RCC jallies	Timber windows/ventilators	50
6.	Precast thin lintels	RCC lintels	25
7.	Precast sunshades	Cast sunshades	30
8.	Ferrocment sun shades-cum-lintel	RCC lintel-cum-sunshades	50
9.	Brick on edge lintels	RCC lintels	50
10.	Corbelling for lintels	RCC lintels	40
11.	Brick arch for lintels	RCC lintels	30
12.	Precast RCC shelves units	Timber/concrete	20-35

Conclusion

This article deals in basics of design and construction of a house so that all planning related measures can be taken to achieve less maintenance cost and to have fair idea about cost efficiency.

The design Efficiency can be calculated by calculation of plinth area rates and ration of carpet area and plinth area in a given design. The plinth rates given by different authorities are very general, as they do not disclose the materials requirements and specifications involved like depth and width of foundations, total length of wall etc, without this the plinth rates defines only the budget for the particular specifications. The individual variation in specifications and rates of the materials renders the plinth area rates redundant.

An attempt is made in this article to evaluate the design on the basis of running length of the wall with respect to covered area, for any given specifications. The length of masonry determines the foundation cost, masonry cost and plasters cost, and for the given thickness the carpet area also, hence is a important parameter. If the length of the wall is more the carpet area will be less and cost will be high.

These are the View of the author and Hudco need not subscribe to these Views.

References:

- IS-1893-2002 " Criteria for Earthquake Resistant Design of Structures" BIS
- IS 1905- 1987 " Code of Practice of Structural use of Unreinforced Masonry"BIS
- NIRMAN Bharti, Volume 1, No 1 October 1994, HUDCO
- Dr A S Arya " Brick and Masonry Design " Nem Chand Publication, Roorkee
- Vulnerability Atlas of India " BMTPC"
- IS 13920-1993 "Ductile Detailing of RCC Subjected to seismic Loading" BIS
- IS 13828-1993" Improving earthquake Resistance of Low Strength Masonry Building "BIS
- IS 13835-1993" Repair and Seismic strengthening of Building" BIS
- Guidelines "Improving Earthquake Resistance of Houses" BMTPC
- IS 456-2000 " Plain And Reinforced Concrete – Code of Practice" BIS
- Author's Article in Construction Journal of India
- Author's Article in Construction World
- IS-4326-2003 "Earthquake Resistant Design and Construction of Building" BIS

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Emerging Technologies for Housing & Building Construction

BMTPC has been promoting cost-effective, environment-friendly, energy-efficient and disaster resistant technologies developed in India. With fast depleting natural resources; need for environment protection to protect greenhouse gas effect; need for bringing more speed, durability and quality in construction; it is prudent to widen the horizon to look for alternate cost effective technologies within and outside the country.

A variety of technologies are knocking the door of construction industry. BMTPC through a Technical Committee is evaluating for possible use in housing in Indian conditions.

The various parameters considered for evolution include:

- Material specification and their durability
- Suitability to Indian Climatic & Hazard condition
- Structural stability under all loading conditions including seismic and wind forces
- Fire resistance
- Behaviour of joints and connection, specially for prefabrication system
- Adoptability of service connection & electrical, plumbing
- Speed of construction & quality
- Thermal & Acoustic behaviour
- Ease of working
- Expected life span of the structure
- Maintenance requirements.
- Environment friendliness and sustainability.

The various Technologies evaluated are:

i) Advanced Building Panel System using Steel Mesh, Polystyrene Core and Chipping Concrete

ii) Factory Made Fast Track Modular Building System using Concrete, Steel structure and Polystyrene Core

iii) GFRG/ Rapidwall Building System Technology

iv) Monolithic Concrete Construction technology using Plastic/ Aluminium Formwork

iv) Light Gauge Steel Framed Structure using Cold Formed Steel Sections

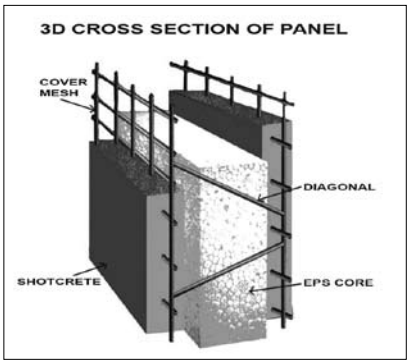
v) Speed Floor using a Roll Formed Steel Joist and Steel Composite Floor

The details of few technologies are as under:

Advanced Building Panel System using Steel Mesh, Polystyrene Core and Chipping Concrete

Profile

Advanced Building Panel System is a factory made system based on expanded polystyrene panels (corrugated) reinforced with double mesh of galvanized cold steel wires, interconnected to each other. To form the walls, the mesh is covered with a coat of shortcrete (1:4) applied under pressure using a pneumatic system. The support walls of a building are constructed by horizontally connecting the panels overlapping the mesh part; the walls are vertically connected to the concrete structure and to the floor of the upper level by means of deformed steel dowels. The panels used to form the ceiling are similar to the ones used for the walls, except with thicker wire forming the links. In framed structures the panels are used as infill walls. Once the panels are installed, they are



anchored and finished with the application of light concrete on both of their sides. Thus, buildings with load bearing walls consisting of two reinforced concrete plates are made integral by a thick network of connectors, with an insulating core. As load bearing element, the double panel and the floors are finished during the installation with concrete of suitable grade placed into the slab ribs as well.

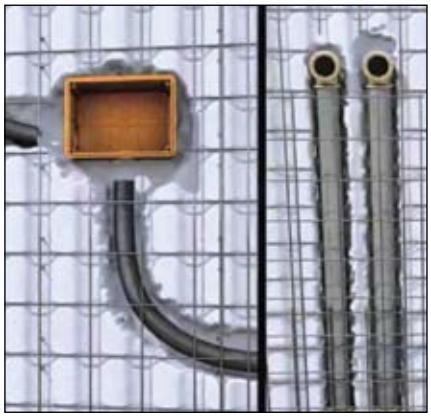
Manufacturing Process

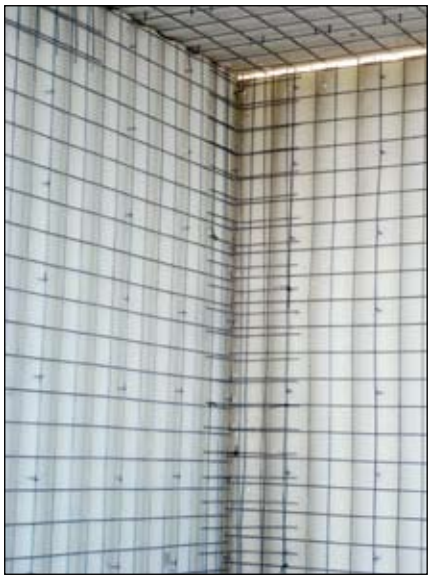
The panels are made up of two electro-welded galvanized steel meshes positioned adjacent to the faces of a central block in wave-shape expanded polystyrene. High resistance steel meshes composed of bars having dia. 2.5 to 5 mm. are made in factory. The automatic industrial production assures the consistent quality of the product. The mesh is also realized automatically and continuously by the machines. The parameters that influence welding are set in the machines. The density of the panel polystyrene block is variable from 15-35 kg/m^3 as is the thickness of the block from 40-320 mm. The two meshes are connected by means of metal connectors positioned across the nodes. The panels produced are characterized by a standard width of 1.2m and a variable length depending on the engineering requirements.

The steel used for the meshes is drawn with hot galvanization, whose average resistance to pull results higher than 600 MPa. The typical insulation of a polystyrene for a finished panel of 100 mm thickness with 50 mm polystyrene core corresponds to the insulation properties of an ordinary brick wall of 650 mm thick. The self-extinguishing foam polystyrene suitably shaped can be used both as a disposable form and as an insulating layer. The EPS is made of carbon, hydrogen and for 98% air. Thickness, shape and density of the polystyrene core may change according to specific requirements.

The technology developed about 30 years back is now in use successfully in many other countries like Morocco, Algeria, South Africa, Kenya, Austria, Malaysia, Romania & Australia etc. with involvement of different agencies and brand names.

The various types of panels manufactured are:





1. Single Panel for load-bearing walls, partition & in-fill walls and for floors

2. Double Panel for load bearing walls

3. Floor Panel

4. Staircase Panel

Raw Materials

i) Zinc coated drawn steel wire having high resistance steel bars of dia. 2.5 – 5mm and zinc coating galvanizing of 60 gm/m^2

ii) Self–extinguishing Polystyrene core (min. density 15 kg/m^3),

iii) Chipping Concrete having min. characteristic strength of 30 Mpa

Use of the System

The panel may be used generally in the following ways:

i) As load bearing walling in buildings

ii) As high capacity vertical and shear load bearing structural walling in multi-storey construction.

iii) Non Load bearing wall panels

iv) As partition infill wall in multi-storey framed building:

v) As floor/ roof slabs

vi) As cladding for industrial building

vii) As staircase panel

Advantages

- Versatility in construction, lightweight but strong
- Diversity of panels to accommodate differential architecture and design features
- Structural capacity and resistance to earthquakes and hurricanes/tornado forces including blast explosion of 30 tons/m^2
- Lower foundation costs compared with traditional systems
- Cost effective building system utilizing local raw materials and labour force
- Speed of construction (30% less than conventional construction system)
- Good heat and sound insulation properties
- Environment friendly being CFC free and non-toxic & energy efficient
- Panel can resist fire for 150 minutes with respect to load bearing capacity, integrity and insulation
- The panel has got good acoustic behavior
- The thickness and density of the panel can be customized to deliver specific thermal insulation requirements

Factory Made Fast Track Modular Building System using Concrete, Steel Structure and Polystyrene Core

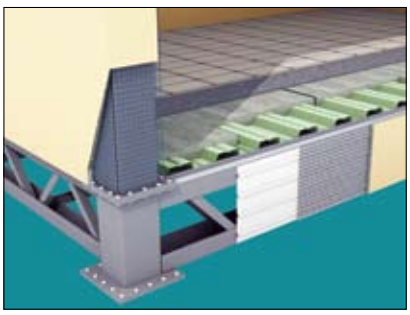
Profile

Factory Made Fast Track Modular Building construction is a fast building solution manufactured and fabricated in a controlled factory environment and shipped to a prepared building site for installation. The system based on steel structure with different walling components is designed according to relevant Indian / International standards to withstand various forces. About 70% of the work is done in the factory with minimal usage of concrete which enables it to deliver the building within a few days of work at site.

Manufacturing Process

The steel-modules pre-fitted with flooring, ceiling tiles, electrical and plumbing fittings are transported to the site for installation. Once all the components are assembled and erected at site, concreting is done on the factory made 3-D Expanded Polystyrene (EPS) panel walls making it a monolithic structure.

The buildings and houses can be designed to suit any geographical position or environment and can withstand wind speed in excess of 285km/hr. The system does not impose any design restrictions and can be used for any kind of architectural and aesthetic design as these panels are custom designed and manufactured. The panels have smooth surfaces. However, any kind of texture can be added on to the panel surface. Due to cohesive structural design, the sys-



tem requires only strip foundation for most buildings.

Components of the building structure are:

i) Foundation

ii) Steel structure

iii) Steel staircase

iv) Flooring

v) Walling

vi) Door & window

vii) Utilities

Raw Materials

i) Steel structure consist of H R steel strip, M S plate, M S tube and hexagon bolts & nuts

ii) Expanded Sintered Polystyrene of self-extinguishing type having min. density of 15 kg/m^3

iii) Zinc coated cold drawn steel wire of 2.5 to 3.0 mm dia and zinc coating galvanizing of 60 gm/m^2

iv) Cement, aggregates, sand with additives

Use of the System

The system shall be used as framed steel structure.

Advantages

- *Ultra-fast construction:* Since more than 70% of the work is carried out in the factory, the complete building can be delivered within few days of work at site.
- *Cost savings:* Faster construction mode saves time, minimal material waste and increased asset value
- *Savings in Exterior Painting & Finishing:* All exterior surfaces can be provided with aggregate or other such colored finishes which require no additional painting over the life time of the building. Alternatively the walls are made with a very smooth mirror like finish saving in plastering costs.
- *Resistant to earthquakes:* Combined with well-designed lightweight structure and unique bracing system, these buildings are capable of withstanding higher intensity of earthquakes as compared to conventional buildings of same size.
- *Eco-friendly:* Steel is sustainable, non-toxic & recyclable. Since more than 70% of the work is carried out in the factory, with minimal usage of concrete which reduces carbon footprint and the reverse impact on green spaces at or around the job site.
- *Minimized construction waste and pollution:* With total quality control at plant and 30% work at site, there are minimal emissions, flying dust and polluted water at site. Construction waste reduces to 1% of the total material involved.
- Safety of construction: Since the structure is manufactured under safer conditions at the factory, the building is much safer.

GFRG/ Rapidwall Building System Technology Usuing Phosphogypsum, Glass Roving and Concrete

Profile

Glass Fibre Reinforced Gypsum (GFRG)/ Rapidwall is a building panel product, made essentially of gypsum plaster, reinforced with glass fibres. This product, suitable for rapid mass-scale buildings construction, was originally developed and used since 1990 in Australia. The product is not only eco-friendly or green, but also resistant to water and fire. GFRG panels are presently

manufactured to a thickness of 124 mm under carefully controlled conditions to a length of 12 m and a height of 3 m. The panel can be cut to required size. Although its main application is in the construction of walls, it can also be used in floor and roof slabs in combination with reinforced concrete.

Manufacturing Process

The panel contains cavities that may be filled with concrete and reinforced with steel bars to impart additional strength and provide ductility. The panels may be unfilled, partially filled or fully filled with reinforced concrete as per the structural requirement. Experimental studies and research have shown that GFRG panels, suitably filled with plain reinforced concrete, possess substantial strength to act not only as load-bearing elements, but also as shear walls, capable of resisting lateral loads due to earthquake and wind. It is possible to design such buildings up to ten storeys in low seismic zones (and to lesser height in high seismic zones). Manufacture of GFRG panels with increased thickness (150 mm, 200 mm) with suitable flange thickness can facilitate construction of taller building.

GFRG panels can be unfilled when used as partition walls, but when used as external walls, need to be suitably designed (with reinforced concrete filling) in order to resist the design wind pressures. For single storey construction (suitable for mass low-cost housing), unfilled GFRG panels can be used for walls as well as roof (which may be pitched suitably), with local reinforced concrete filling at the joints between walls and between the roof and walls. It is mandatory to provide embedded RCC horizontal tie beam over all the walls below the floor slab/roof slab.

Raw Materials

(i) Phosphogypsum – Shall be > 90% purity as $CaSO_4$

(ii) Glass Roving – E glass shall be > 98% purity

(iii) Ammonium Carbonate – Shall be of 99.14% purity as $NH4-CO_3$

Use of the Panel and its limitations

The panel may be used generally in the following ways:

i. As lightweight load bearing walling in building upto two storey construction: the panel may be used with or without non-structural core filling such as insulation, sand polyurethane or lightweight concrete.

ii) As high capacity vertical and shear load bearing structural walling in multi-storey construction: the panel core shall be filled with reinforced concrete suitably designed to resist the combined effect of lateral and gravity loading.

iii) As partition infill wall in multi-storey framed building: Panel may also be filled suitably.

iv) As Horizontal floor/ roof slabs with reinforced concrete micro beams and screed (T-beam action)

v) As pitched (sloped) roofing

vi) As cladding for industrial

vii) As compound wall

Limitation of Use

i) Can not be used for wall with circular or higher curvature

ii) Clear span shall be limited to 5m for residential buildings

Advantages

- Substantial reduction in the structural weight of the building
- No plastering requirement for walls and ceiling
- Increased speed of construction with less manpower
- Saving of cement, steel, river

sand, burnt clay bricks/concrete blocks and hence saving of energy and reduced CO_2 emissions, contributing to environment protection and mitigate climate change

- Use of reprocessed/recycled industrial by product, waste gypsum, to manufacture GFRG panel, helping to abate pollution and protect the environment.
- Panels being only 124mm thick, the built up area is much less than the conventional buildings for the same carpet area
- Using the system, the construction of a building can be very fast compared to the conventional buildings
- Panels can be used not only as walls but also as floors, roofs and staircase.

Light Gauge Steel Framed Structure Using Cold Formed Steel Sections

Profile

Light Gauge Steel Framed Structure is based on factory made galvanized light gauge steel components produced by the cold forming method assembled as panels at site forming structural steel framework of a building of varying sizes of wall and floor. The basic building elements of light gauge steel framing are cold formed sections which can be prefabricated on site using various methods of construction. Cold formed sections are widely used in construction including residential floors, industrial and commercial buildings, hotels and are gaining greater acceptance in the residential sector. Light Gauge Steel Framed Structure is already well established in North America,

Australia and Japan and is gaining ground in India. Light Gauge Steel Framed Structure is typically ideal for one to three storey high buildings, especially in residential homes, apartments and commercial buildings.

Light Gauge Steel Framed Structure can be combined with composite steel/concrete deck resting on light steel framing stud walls. Apart from having potential for mass housing, modular buildings can be used for long term temporary or permanent structures such as schools, military and civil housing needs, post disaster relief structures and industrial buildings.

Construction and Assembly

Construction phases of steel buildings resemble the phases of conventional reinforced concrete buildings. The building is designed and details of sections are worked out. Then the steel frame construction starts. The production takes place in the factory as floor, wall and roof etc. components of the building are manufactured as galvanized steel profiles in appropriate sizes. These profiles are sent to the construction site without loss, either as profiles or as panelized parts, considering the distance of the construction site and transportation conditions. Profiles are assembled by expert assembling

teams at the construction site in line with the architectural plan. Only special studs are used during the assembly, no welding is done. When the assembly is done, the frame is filled with insulation materials (fiberglass, rock wool etc.). Walls are covered with standard boards or similar materials.

The panels are assembled on site with screws and bolts to form the internal and separating walls and inner leaf of the external walls of a building and floors & ceiling. The building is completed by the installation of an external layer of insulation material and outer leaf of CP Board or dry mix shotcrete.

The system can incorporate all types of architectural features like coving, boxes, cantilevers, projections, infill walls, mezzanine floors etc. This system can also incorporate all types of services viz. electrical, gas and plumbing etc. The design and engineering of the structures is executed by following the norms & guidelines stipulated in relevant Indian Standards.

Components of the System are:

i) Main section are studs and track

ii) Wall frame

iii) Wall cladding

iv) Bracing

v) Floor frame

vi) Roof frame

vii) Roof truss

Raw Materials

i. Stud & track profiles are manufactured from pre-galvanized high tensile steel having Yield stress of min.350 MPa & Tensile stress of min. 380 MPa and coating of min. Z 275. Track is formed in a U-shaped configuration, having a depth compatible with that of the studs of the same nominal size. Bracing and bridging shall have configuration and steel thickness to provide secondary support for the studs in accordance with the relevant specifications.

ii. MS plate

iii. Heavy duty CP Board

iv. Gypsum board

v. Wire mesh – made of 4mm dia wire of UTS 480 MPa of spacing 150x150mm or 1.4mm dia of spacing 40x40mm

vi. Rockwool slab having density 100 kg/m^3

vii. Rockwool roll with Aluminium foil having density 36 kg/m^3

viii) Shotcrete when used is of min. grade of M 25.

Use of the System

The system is used as framed steel structure.

Limitation of Use

i. System may be used only upto G+3 level without any composition

ii. System may be used in G+3 and above with composition of hot rolled structures

iii. System is not to be used for buildings with vibrations

iv. Advisable span for the buildings is up to 6.5m.

Advantages

- Fully integrated computerized system with CNC machine provide very high accuracy upto 1mm.
- High strength to weight ratio. Earthquake force generation is less due to light weight. Chance of progressive collapse are marginal due to highly ductile and load carrying nature of closely spaced studs /joists.

- Construction speed is very high. A typical four storey building can be constructed within one month.
- Structural elements can be transported to any place including hilly places to remote places easily and structure can be erected fast.
- Structure can be shifted from one location to another without wastage of materials.
- Environment friendly – Steel can be recycled when required.

Speed Floor

Profile

Speed floor is a suspended concrete flooring system using a roll formed steel joist as an integral part of the final concrete and steel composite floor. The Speed Floor system essentially is a hybrid concrete/steel tee-beam in one direction and an integrated continuous one-way slab in other direction. The joists of different depths are manufactured from pre-galvanized high tensile steel in a one pass roll former, where it is roll formed, punched, pressed and slotted in a fully computerized machine manufactured in New Zealand. The joist depth and the concrete thickness are varied depending on the span, imposed loads and other functional considerations. The Speed Floor composite floor system is suitable for use in all types of construction. The Speed Floor joists are custom manufactured to suit particular job conditions.

Manufacturing Process

The joists are manufactured from pre-galvanized high tensile steel in a one pass roll reformer, where it is roll formed, punched, pressed and slotted at a fast production rate. The ends are bolted to the joists which are then ready for shipping to site. The individually marked joists are placed on the support medium where the Speedfloor shuttering system locks the joist into the exact position. The Speedfloor joist's modular spacing can be adjusted to suit varying conditions.

Components of the System

i. The joist is manufactured from G 350 Z275 pre-galvanized steel.

ii) The lockbar support the temporary plywood formwork between the joists during construction.

iii) Temporary plywood formwork-- High density paper overlaid 12mm shuttering plywood is used as formwork to produce a good finish to the underside of the slab.

iv) Reinforcing mesh made of 8mm dia, bars

v) Concrete-- Minimum grade of concrete used is M25.

vi) Accessories

a) Edge angles

b) Jointers

c) Lockbar Hanger Angles

Raw materials

i) Speedfloor joists are roll formed from zinc coated steel conforming to IS 277:1992. The min mass coating of galvanizing is 275g/m^2.

ii) HR plate

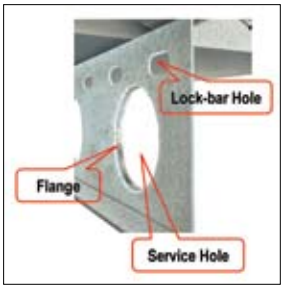
iii) G.I. coil: 16mm thick for Edge angle and Hanging angle.

Use of the System

The Speed floor composite flooring system is suitable for use in all types of construction including

a) Steel frame structures

b) RCC frame buildings



c) Poured in-situ or precast concrete frames

d) Light gauge steel frames

e) Conventional brick wall construction

Limitation of Use

Maximum length of joist which can be used is 10m.

Advantages

- Generally the system uses a 75mm or 90mm topping. A general weight saving can be made throughout the structural components of the building.
- The joists are lightweight, requiring less craneage than other concrete flooring systems.
- The joists are custom manufactured to suit particular job conditions. The joist modular spacing can be adjusted to suit varying conditions.
- During construction, the system provides a rigid working platform.
- Shallower floor depths can be achieved because of the increased rigidity of the system.
- Services can be passed through the holes pre-punched in the joist.
- The bottom of the joist can support a suspended fire rated ceiling directly fixed to the joist.
- The lockbars and plywood sheets are reusable.

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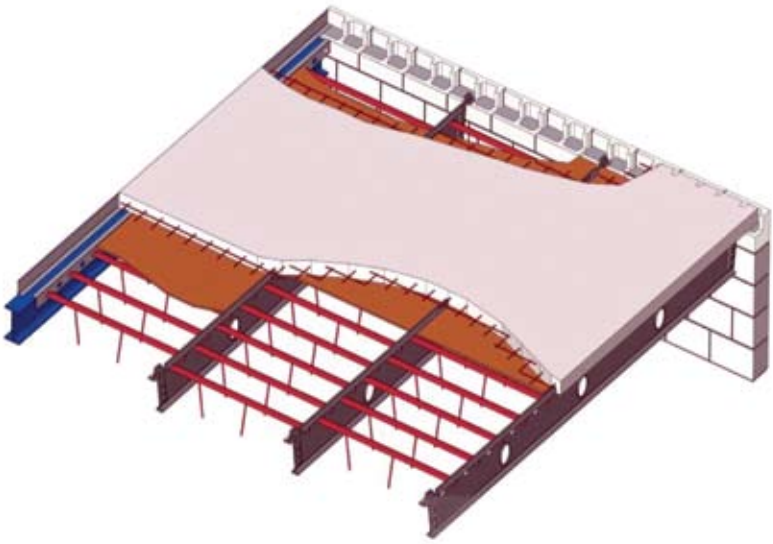

Brain Storming Session on Understanding the Bottlenecks in use of Emerging & Alternate Housing Technologies at New Delhi

The Council organized a Brain Storming Session on Understanding the Bottlenecks in use of Emerging & Alternate Housing Technologies in Housing Schemes for providing Housing for All on 17th September, 2014 at New Delhi.

The Brain Storming Session was chaired by Ms. Anita Agnihotri, Secretary, Ministry of Housing & Urban Poverty Alleviation in the gracious presence of Shri Sanjeev Kumar, Joint Secretary & Mission Director (JNNURM & RAY). The Brain Storming Session was attended by 34 participants from various R&D institutions, State Housing Deptts./Boards, Academicians, Technology Providers and Experts in the field.

The major recommendations of the Brain Storming Session are as under:

- Preparation of a Concept Note for setting up a Technology Sub-Mission on new emerging building technologies in Ministry with BMTPC.
- Finalization of Matrix for selection of technologies.
- Preparation of model tender for technology neutral construction.
- Preparation of Directory of technologies, technologies providers, Engineers, Architects involved in emerging technologies.
- Creating a portal, where technology providers can place information on new emerging technologies.
- Documentation of success stories of emerging technologies.
- Working on a proposal on fiscal and policy intervention to bring level playing field between emerging new technologies and conventional system.
- Hand holding of professional engineers, architects and skill up gradation of artisan.

Community Centre at Ambala

(A first of its kind demonstration project where multiple alternate technologies have been showcased)

BMTPC's Project Awarded 5th CIDC Vishwakarma Awards 2013 - Achievement award for Best Construction Projects (Code F) Buildings (Residential/Commercial)

Concept Note

The project, Community Centre, was envisaged as a 'demonstration project' at Village Naggal-Khojikipur in Ambala.

In India, unfortunately the promotion, adaptation and use of proven low-cost technologies have been extremely slow. Across India, it is clear that innovative technologies need to be used on a broader scale. Not only will innovative approaches make construction more affordable, but also they can have a significant impact on the environment.

We believe that filling this gap presents a huge opportunity. Demonstration projects such as this one are aimed for this purpose.

Selected for its central location, the site chosen by BMPTC sits in the middle of two villages, Naggal and Khojkipur. It is surrounded by individual houses and is easily accessible from the main roads of the region.

The community centre showcases a variety of cost effective and environment friendly techniques while providing the village with a new hub for community gatherings. By creating a space to 'touch and feel' something new, we hoped to spark interest and generate awareness of alternative building methods in the area.

COMMUNITY CENTRE AT AMBALA

Project:	Community Centre at Naggal-Khojkipur, Ambala
Purpose:	Technology Demonstration project
Owner:	Building Materials & Technology Promotion Council (BMTPC)
Architect:	Mr Promod Adlakha, Adlakha Associates P. Ltd, New Delhi
Year of Start:	2010
Year of Completion:	2011
Covered Area:	6830 sq feet (635 sq meters)
No. of storeys:	2

About The Project

The two story building has been implemented over a covered area of approximately 6830 sq feet (635 sq m). It has been designed as a multipurpose building, suited to fulfil various needs of the villagers.

The ground floor contains a large hall for social functions with an appropriate stage as well as separate toilets for men and women. A crèche room with a separate entry door, play area and toilet specially designed for children are incorporated into the design. The community centre also includes a library-cum-reading room and an office room.

Two separate multi-purpose rooms (one for men and the other for women) have been created for community activities on the first floor. There is also space for a colony health centre with areas for waiting patients, male doctors, and female doctors, as well as for compounders to dress injuries and distribute medicines.

"These techniques require less money, but more intelligence. It requires a lot of effort and practice, but change is happening slowly. People are very interested to learn"

– MD Kalib, Master Mason, Ambala project

Objective of the Project

1. There is an imperative need to find ways by which housing can be made affordable. Within the socio economic context there is a need for an effective methodology to develop, promote, produce, standardize and apply in large-scale cost effective innovative building materials and construction technologies in housing and building sector.
2. Building sector can play a major role in reducing greenhouse gas emission simply through application of appropriate low cost technologies aimed at optimum use of building materials.
3. Demonstration buildings offer a chance for the community to learn new technologies and understand methodologies involved in systematic manner. The demonstration buildings also help promote the development, production, standardization and large scale application of innovative cost effective building materials and construction technologies.

Innovative Technologies Used in the Project

Walls:

The technologies adopted for walls are:

- Mechanized Fly-ash bricks 230/115 mm
- Mechanized clay brick 230/115 mm
- Mechanized modular Claybrick 200/100 mm
- Conventional clay brick wall in Rat trap bond (Row lock bond) 230mm
- Perforated bricks
- Wire cut bricks
- Hydraform interlocking blocks
- Stretcher bond 190 mm
- Modular brick wall

Roofing:

The technologies adopted for roofing are:

- Precast RC plank & Joists
- Precast RB panel
- Precast RB curved panel
- Precast Doubly Curved Shells
- Filler Slabs
- Micro Concrete roofing tiles
- Hollow slabs with 'kulars'

Other technologies:

Other technologies are:

- Precast Ferro-cement staircase
- Flat Arch Lintels

- Concrete door window frames
- Precast sunshades

Salient Features of the Project:

Disaster resistance:

Apart from the various cost effective technologies used in the project, the community centre is a standing good example of disaster resistant techniques incorporated in any construction. These include: High Plinth, Strong Brick Arch foundation, Lintel and Plinth Beams, Corner reinforcements.

Energy efficiency:

Cost effective construction technologies lower the use of energy consuming materials, bringing down the embodied energy level associated with producing building materials.

The materials and technologies chosen for this project also fulfil this criterion:

- Non endangering bio-reserves and non-polluting
- Self-sustaining and promote self-reliance
- Recycle polluting waste into usable materials
- Utilize locally available materials
- Utilize local skills, manpower and management systems
- Benefit local economy by helping income generation
- Utilize renewable energy sources
- Be accessible to the people
- Be low in monetary cost

Social Impact of the Project:

Involvement of the community, village elders, community repre-

sentatives and Masons:

- Through the course of construction, BMPTC has attempted to actively promote the alternate technologies. Over 20 local masons were trained on these construction techniques.
- Students from the polytechnic institute were invited to observe the community centre and the methods used.
- The neighbourhood community was aware of the construction of the community centre. During construction the work area was free for the community members to visit.
- At the end of construction, an open invitation was issued for the community to visit the community centre and look at the technologies used.

Partner's Contribution:

BMTPC constructed this structure to demonstrate cost-effective, alternate and disaster resistant technologies. M/S Adlakha Associates Pvt. Ltd. was engaged Architectural & Technology Consultants. The inputs included the concept plans primarily to adopt loadbearing concept with various alternative walling and roofing technologies. The contribution of M/S Adlakha Associates Pvt. Ltd. also included the training to site supervisors & workmen. During the construction, a workshop & awareness programme was also organized by BMTPC which was well attended by faculty & students of Ambala Polytechnic and Chottu Ram University of Science & Technology, Murthal.

Learnings from the Project:

- There is a need to implement a large number of technology demonstration projects in the region to truly institute change in the minds of the community about cost effective construction technologies. One project may instigate change of thoughts, but certainly would not be able to challenge established conventional construction technologies to the extent of changing the same. More such projects are needed to bring that change.
- Bouquet of technologies approach to be repeated: It is recommended that the technology demonstration projects in future shall continue showcasing multiple technologies in one building as in case of Ambala. This approach is equivalent to building Standing Exhibition of Construction Technology in the heart of the community that shall stay forever.
- More effort for clearing misconceptions of the community: While community consultation was carried out through the Panchayat, active community involvement needs to be increased. Currently, among the villagers, the general feeling is that the appearance of the centre is very nice. Yet there is still a resistance for using these technologies because they feel it is 'new' and they feel wary of changing the old and the known. Hands on involvement and trainings during the construction phase can help mitigate these worries.
- It is suggested that demonstration buildings should act as the information hub to the community. The information hub should provide to the community the sources from where the interested families can get the cost effective materials as well as technical support.

Conclusion:

The Community Centre has been a good demonstration of multiple technologies in a single building. It has succeeded in showcasing the architectural, environmental and benefits of various construction methodologies directly to the end user. The incorporation of community needs and the active support of local government have been other points of pride in this process.

Implementation of
Performance Appraisal Certification Scheme (PACS)

BMTPC is implementing Performance Appraisal Certification Scheme (PACS) 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. During the period from January to September, 2014, following activities of Performance Appraisal Certification Scheme have been carried out:

- Performance Appraisal Certificates for the products/systems namely Advanced Building System (Emmedue) and Fluorogypsum based Anhydrite Binder approved by the Technology Advisory Group (TAC) in the 6th Meeting were issued to the respective manufacturers in January, 2014.
- Feedback for reviewing the whole process of PACS was sought from the PAC holders in January, 2014. Most of the PAC holders have submitted the feedback about their products/systems stating that the PAC has helped them a lot in convincing their clients as a third party assurance from a Govt. body like BMTPC.
- For carrying out surveillance inspection as per the guidelines stipulated for renewal of PAC for Glass Fibre Reinforced Gypsum Panel (Gypwall) System, visit to the production unit of FACT-RCF (FRBL), Cochin was made on 29th & 30th May, 2014 for inspection and taking samples of the product for getting these tested for performance characteristics at its lab and from Structural Engineering Division, IIT Madras. Results of the tests done in the FRBL lab and IIT Madras were found to be satisfactory.
- Many agencies involved in manufacturing/ developing/marketing of new materials/systems to be used in construction have been approached to apply for PAC for their new emerging product/ system.
- Draft PAC for the system Quickbuild 3D Panels of M/s Beardsel Ltd., Chennai has been prepared while for the system Concrewall Panels of M/s Schnell Wire System, Italy is pending for want of the tests to be got done by the manufacturer.
- Initiated actions to hold 2nd BMTPC Board of Agreement (BMBA) Meeting scheduled to be held in October, 2014 for appraisal of Performance Appraisal Certification Scheme (PACS) .
- Based on the applications received for issue of PACs, Detailed Application Form (DAF) for the products namely Tunnel Forms (Formwork/Shuttering) of M/s Outinord Intl. Ltd., Pune, Composite Plumbing Pipe along with fittings of M/s KiTEC Industries (I) Ltd., Mumbai and Bamboowood Flooring of M/s Mutha Industries Pvt. Ltd. Mumbai have been sent to the firms for submission along with test reports and other documents for processing the applications further.

- PACs for the systems Speed Floor and Light Gauge Framed Steel Structure manufactured by the firms M/s Jindal Steel & Power Ltd., Raigarh and M/s J B Fabinfra Pvt. Ltd., Raigarh respectively and renewal of PAC for Glass Fibre Reinforced Gypsum Panel (Gypwall) System, have been approved by the TAC in its 7th Meeting held on 19th September, 2014 at Raigarh.

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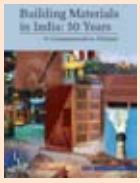

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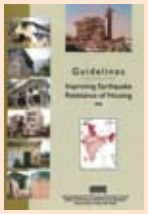

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World Habitat Day

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."

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