Evolving Traditional Practices for Sustainable Construction in the Present
Paper presented at INTBAU International Conference 11th – 14th Jan. 2007

Abstract

In India we have entered a phase of urban growth and development which is unprecedented in its scale and impact.

As cities & towns expand and regenerate in response to the economic engines of transnational trade and finance, we see a sudden spurt in building construction. This burst of construction activity spread across a range of city activities and the socio-economic spectrum. Demand for built space for colonising new lands as well as for the upgradation and regeneration of existing built space to higher intensities of use will grow on all fronts.

This heralds a paradigm shift in the structure of the building trades, materials of construction and design practice. And, significantly, the increasing consumption of building materials such as glass , cements, metals and ceramics, which are energy intensive in their manufacture, combined with the sheer scale of construction activity, will cause an explosion of CO_2 emissions, significantly adding to the spectre of global warming.
For this process of accelerated urban development, to be socially and economically sustainable, while curtailing the impact of CO_2 emissions attributable to buildings, indicates a strategy of an evolution of traditional building practices in preference to a shift by default to ready-made global technologies and building types.

It is argued in this paper that application of the principles of industrial production to traditionally used construction materials, skills and trades, and adaptation of traditional principles would result in several benefits.

In the construction of buildings such a strategy would:

a) Include human resource of the semi-skilled and skilled personnel in the growth of the construction trade while enhancing knowledge and skill
b) Ensure a wider participation in economic processes and promote distribution of wealth.
c) Develop efficient utilisation of natural and low-process energy materials to meet contemporary demands – as an alternative to the current trend toward high process-energy materials such as glass and aluminium, thereby limiting the impact of building production on global warming.

In the design of the built-space planning & configuration a strategy of adapting climatically suitable models from traditional practices would :

a) Produce a more habitable public realm of the city
b) Produce an appropriate indoor-outdoor continuum in built space systems
c) Considerably reduce the impact of extreme weather on air-conditioning load, thereby curtailing the demand on energy on account of airconditioning.

These conclusions are derived theoretically and demonstrated by case-studies.

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Overview

The imminent acceleration of change and economic growth here in India brings us to a critical juncture in the evolution of our towns and cities. While the frenetic increase in financial investments in urban infrastructure and buildings has the potential of translating into a "better quality of life for all citizens", it has equally the potential of exacerbating, by default, our existing economic disparities and their consequent social tensions and conflicts. Important, too, though much more insidious, and therefore easily overlooked, is the impact of CO_2 emissions attributable to buildings and urban systems on climate change. The scale of construction activity compressed into a short period of time constitutes an "explosion" of CO_2 – which will undoubtedly hasten the advent of climate change.

Evidently, there is a need for strategic action on both fronts and it is in this context that I wish to discuss the potential of traditional practices of construction and design of built environments as platforms from which to construct a beneficial strategy.

Investment in Urban Development

The Jawaharlal Nehru National Urban Renewal Mission estimates investment of Rs. 120,536 crores at a rate of Rs. 17,219 crores per annum in basic infrastructure and services of 63 cities across India, spread over a seven year period. This is for the shift in the national economy toward urban services which would contribute 65% of the GDP by 2011 with 40% of the population living in cities by 2021 compared to 28% today. So we have the two overarching processes that will determine the development of our urban environments – Globalisation & Urbanisation.

CO_2 emissions explosion

If this scale of investment is predicted for urban infrastructure it may be safely assumed that at least an equivalent amount would be invested in built space in the extension of urban areas as well as in the upgradation and redeveloping the existing built space. Or else, if you consider the increase of urban population by say 30% of 2021, one can estimate the total area by built space that would be constructed to provide for it. Through either route you can convert these into quantities of aluminium, stainless steel, glass, ceramics, bricks… that would be consumed and CO_2 emissions that would result from the production of such materials. In relative terms, without going into calculations and numbers, I surmise that this phenomenon constitutes an explosive release of CO_2 into the atmosphere on account of embodied energy consumed in the production of buildings.

The strategy to limit or curtail the scale of this explosion would call, first, for efficiency in the utilisation of material resource (good engineering) and then, a preference for materials & systems that incur low processing energy, over those that are energy profligate. In other words – grasses, timbers, stones, earthen blocks, flyash blocks & ferrocement are to be preferred over stainless steel, aluminium, plate glass and ceramics. And, importantly, the technique of using the preferred materials must progressively rise to higher levels of productivity and performance efficiency.

The existing base of traditional materials and skills provides a ready platform to develop this strategy. The development of new production methods and building materials or components toward greater efficiency and performance can be achieved at relatively low capital investments, in a short time.

This process is already underway, as evidenced by the small & medium scale industrial operation for production of masonary blocks, cladding stones, timber boards & prefab-doors & windows. The most significant advantage of this approach is that it achieves progress without displacing or dispossessing employment, skills and knowledge. On the contrary, it would ensure a wider distribution of wealth while adding value to skill & knowledge of the building crafts.

All needs of construction for small span structures of upto 4 storeys can be met in these ways – if the professions of architecture and engineering actively promote them.

Even for tall or large-span structures which may necessarily require RCC frame construction, there are innovative possibilities to reduce the embodied energy of the structural system. And, in any case for infill & finishes – both internal and external, which would typically constitute 30% of the total embodied energy of the building – I would argue that techniques that utilise stone/timber, mud block etc. cannot serve as effective substitutes for the current preference for "modern" methods of aluminium & curtain glazing. There is a potential, to be creatively tapped for innovations by local industries, to meet the new needs of quicker construction and higher thermal performance of the building envelope. In addition fiscal incentives to promote these materials and innovation are urgently needed.

If the making of buildings for the urbanising & growing economy causes an explosion of CO_2 emissions, then a veritable bush fire ensues due to the energy demands for the operation of buildings. Here, I wish to focus on the single most energy profligate operational requirement of modern urban life – air-conditioning. In commercial buildings 60 to 70% of the energy bill is on account of air-conditioning. As this “need” becomes a wide-spread norm it will be the most significant contributor to CO_2 emissions in the operation of buildings.

With an increase in disposable incomes and availability of “cheap” systems, air-conditioned comfort is becoming the norm for middle class life. This is creeping over the existing building stock, and will be expected in almost all new buildings.

In Delhi’s climate, for example, where once we managed with the ceiling fans & the evaporative coolers, the transition to air-conditioning causes an eight to ten fold increase in the demand for electricity for an equivalent level of comfort. In the new commercial buildings 60 to 80% of the electricity consumption is attributable to airconditioning. New state-of-the-art and hugely expensive “western” technologies for comfort conditioning, though relevant, are not being looked at here. What is pertinent is the design of the built structures themselves to reduce the impact of extreme climates, and thereby effect a reduction in air-conditioning loads.

At the scale of the urban fabric this calls for a pattern of building that is derived from traditional practice. Speaking of this part of the country, for example, this means low-rise, high-density low-rise patterns producing a sheltered external space. From the traditional form of the desert city one would evolve to a modified form that integrates vegetation as a climate modifier, and finds the balance of open to built-space to obtain daylighting & ventilation, while achieving a sheltered open space. Models have been tried for various functions and at different scales based on this principle. This practice needs deliberate promotion in city planning, urban design & in framing building bye-laws. Many of the current city-planning systems and building bye-laws foreclose this potential and therefore need urgent revision. Studies show that by careful design of the external envelope of building – preferring small apertures and shading – as was traditional common sense – makes a difference of 15% in air-conditioning load.

And by design of appropriate buildings envelopes that incorporate insulation it is seen that air-conditioning loads can be reduced by 30% compared to a “business as usual”. It is possible, at little additional costs to design the building fabric to give a service of 25 sq.mt. of conditioned area served by ITR of air-conditioning as compared to the industry norm of 15 sq.mt. per ITR.

This potential must be seen in opposition to the current dangerous practice gaining ground – buildings that reach out for the sun as monuments to “design”, first constructed as a solar cookers and then modified at enormous energy and financial costs into a refrigerators! Intelligent evolution of traditional design principles for shelter from climatic extremes for building envelopes and spatial design extended the scale of the urban fabric needs to be the first strategy toward reducing CO_2 emissions on account of air-conditioning.

In summary,

The threat of global warming is real. It will grow dramatically with urbanistaion and globalisation of the Indian economy.

The evolution of traditional building construction & design practices offers a platform that can help mitigate this threat.

This evolutionary strategy has two fronts:

In the construction of buildings:

It

a) Develops efficient utilisation of traditionally understood natural and low-process energy materials to meet contemporary demands – as an alternative to the current trend toward high process-energy materials such as glass and aluminium - thereby limiting the impact of building production on global warming.
b) Includes existing human resource of the skilled personnel in the construction trade, enhancing their knowledge, skill, productivity.
c) Ensures participation with higher economic status of the building crafts and trades in economic processes of construction leading to a wider distribution of wealth.

In the design of built-space:

It

a) Adapts principles of climatically appropriate building & urban fabric design to reduce the impact of climatic extremes on the built-space.
b) Produces a more habitable and continuum of indoor-outdoor continuum.
c) Reduces the demand on dependence on air-conditioning – a leading cause of the CO_2 bushfire.