Construction of Earth Quake Resistance Rural Housing in Bihar: Role of Technical Institutions

Abstract

This paper deals with the **Technology for constructing** rural housing to sustain natural onslaught due to incidence of seismic disturbances. Bihar has a wide range of variation in climatic and geographical conditions. A large part of Bihar is susceptible to seismic disturbances. Though a range of technologies are available for tackling the seismic onslaught, these have not reached the people for whom they are developed due to lack of awareness, lack of resources to access technology, poor communication among generators and users, and lack of extension services, etc. The technology transfer in the rural housing sector may be achievable only by participation of Technical Institutions in Bihar and Jharkhand (Erstwhile Bihar). A framework for technology transfer Mechanism with the help of Technical Institutions in Erstwhile Bihar has been proposed for effective transfer of technology from the Technical Institutions to the user.

Keywords : Rural Housing, Technology, Artisans, Technical Institutions, Information Communication Technology (ICT), Extension.

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Introduction

Majority of the houses in rural Bihar are constructed with traditional materials such as grass, thatch, bamboo, wood and mud, etc. Houses in villages are self-built (or self-managed) with locally available materials by the help of skilled as also unskilled labour. Rural housing construction is primarily a “people’s process”. A number of factors influence production processes and product quality in rural housing such as declining access to bio-mass materials, increasing alienation from traditional construction materials and practices, limited exposure and access to new building materials and technology, underdeveloped housing credit system and institutions, exodus of skilled labour to cities, scarce professional services, financially and administratively weak panchayats (Shah, 2000).

There are many determinants of housing construction, i.e., policies and programmes of government, socio-economic conditions of households, geo-climatic conditions, cost effective materials and technology, skilled manpower, institutional mechanism, etc. There is clear division between urban and rural areas in construction of safe houses to resist seismic incident/ earthquake. These are listed in Table-1 below:

Table 1: Urban-Rural Divide

Sl. No.	Parameter	Urban area	Rural area
	Information flow	Rapid	Very slow
2	Channels of information	Many such as electronic media, internet, etc.	NGO, government sources
3	Literacy level	Moderate to high	Low,visual Communication more effective but interpretation unpredictable
4	Basis of housing construction	Past experience, research, information inflow	Past experience, local knowledge from ancestors
5	House builder	Developer,contractor	People with local artisans or just people and their personal labour.
6	Technical assistance	Architect,Engineer, Universities etc.	None
7	Skill availability	From any part of the country	Mostly local with little non-local.
8	Materials	Mostly non-local, few local	Predominantly locally available materials from immediate surrounding

9	Transportation of materials	Available and affordable	Major cost burden, in remote areas, it is the biggest constraint, adversely affects the pace of construction.
10	Funds	Institutional finance, loans from employer, personal savings,	Earning from a crop, loan from loan-shark, loan from friends and relatives, personal savings,
11	Infrastructure availability	Adequate	Grossly inadequate electricity, transportation, water etc.
12	Priorities	Housing is high up on priority list.	Survival is first priority-i.e. Food-often hand to mouth.

Source: (Desai, 2001; Shah, 2000; Dutt, 2002; Choudhary, 2000; Sihag, 2000).

Housing and Environmental Factors

Housing and households are actually parts of two systems: a social system and an environmental system (Glaeser, 1995). Mostly, rural people build their houses generally out of earth or mud and cover them with thatched roofs, their dwellings are constantly under threat from powerful environmental forces such as cyclones, earthquakes, heavy rains and floods as well as fire, damage from sun rays, creeping dampness and termites (Popposwamy, 1983).

India, particularly Bihar has a wide range of variation in climatic and geographical conditions. A large part of Bihar is vulnerable to seismic disturbances. As per the seismic zone map of India contained in IS (1893-2002) of the Bureau of Indian Standards (BIS) Code, the country is divided into four seismic zones, namely zones II, III, IV and V, where zone V (with magnitude 9 or more on the Richter scale) is a very risky zone. Zone IV can experience an intensity of 8 to 9 while zone III is in between 6 and 8 on the Richter scale. Based on this zoning, about 60 percent of India's land area is under moderate seismic threat or more, i.e., under seismic zone III or above.

In the past, from time to time, major earthquakes have jolted the country. Many great earthquakes of Richter magnitudes 6 to 8 occurred in India in the last 50 years, thereby resulting in the injury or death of several people and in the collapse of many buildings. For example, notable earthquakes are like the Uttarkashi earthquake of 1991, the Latur earthquake of 1993, the Jabalpur earthquake of 1997, and the Chamoli earthquake of 1999. These were followed by the Bhuj earthquake of January 26, 2001 and the Jammu & Kashmir earthquake of October 8, 2005. All these major earthquakes have established that the casualties were caused primarily due to the collapse of buildings. It was mainly due to faulty construction practices and lack of technical inputs for earthquake resistant building (NDMG, 2007).

Bihar falls in the seismic zones IV and V with possible earthquakes of maximum magnitude up to 9 on the Richter scale[1]. Northern part of the state is adjacent to Nepal, a Himalayan Kingdom that lies in the highest risk zone-V (http://earthquake.usgs.gov/hazards/). The state also has a history of moderate to severe earthquake occurrences in 1833 (magnitude 7.0-7.5) and 1934 (magnitude 8.4)[2], which caused a colossal loss of life and property (*Times of India*, January 1, 2005; Richter, 1958). The seismic zone map is given in Figure 1 below:

Source: http://earthquake.usgs.gov/hazards/

Figure 1: Seismic Zone Map of India (The seismic zone map has been revised with now only four zones so that the erstwhile zone I has been merged with zone II)

Natural Onslaught and Technology

Throughout history, it is with the help of technology that man has transformed resources available to him into use values (Drucker, 1970; Fisher and Pry, 1972). Technology is said to be basically an integrative phenomenon and as such the same is to be expected in housing development also (Giriappa, 1992).

India is well endowed with both technology and human resources. A number of environment-friendly, energy-efficient, cost-effective building materials and components have been developed in India (India: National Report, 2001). Several research institutions in India have developed variety of technologies and materials for resisting natural onslaught, but they are not deployed for rural housing Construction. The primary reason traced for this is the lack of effective institutional framework. The Council of Scientific & Industrial Research (CSIR) Laboratories, particularly the Central Building Research Institute (CBRI), have devised a wide range of technologies and innovative building materials, components and systems (CBRI, 1997). The Centre for Application of Science and Technology to Rural Areas (ASTRA), Indian Institute of Science, Bangalore and Kanpur are also promoting Technology for sustaining the seismic disturbances. The CSIR laboratories have developed several innovative construction materials, components and systems (CSIR, 2004). As a result, an extensive technological knowledge has been developed centered around research and development laboratories and institutions. In spite of remarkable achievement in developing technological base in research institutions, there remains quite a large reality check deficiency. Research institutions are, after all, only the generators of technologies and technology solutions, not diffusers of technologies. As a result, these technological innovations are not percolating down to grass root users in India.

Technological intervention for housing construction in rural areas is almost negligible. Generally, local artisans construct houses without building plan, bye-laws, guidelines, etc. These houses constructed by local artisans are not treated as an engineering structure. The services of trained professionals; engineers, development authority and housing developers are not available in rural villages (Kumar *et al*., 2004a). There is neither any master plan nor any bye-law to govern the individual housing construction and also there is no institutional structure available for this purpose in rural areas (Sihag, 2000). The mode of construction in the rural areas is now changing from mud and thatch to brick and concrete without any technical inputs. This is leading towards more vulnerability and rural people are not aware about it; they are unsafe to live, particularly from the seismic point of view.

Though a range of technologies has been developed for the benefit of the people, these have not reached the people for whom they are developed due to lack of awareness, lack of resources to access technology, poor communication among generators and users, lack of trained people, lack of extension services, etc. (Kunnumkal *et al*, 2004; Revi, 1992; Kumar *et al*., 2004b). At present, no effective organizational structure/institutional framework exits at the local level or state level or national level for framing the model bye-laws to enforce *Techno-legal Regime*[3] and provide necessary technical inputs for constructing earthquake resistance rural housing in India. The Ministry of Home Affairs (MHA), Government of India has formulated guidelines for amending building bye-laws to incorporate the Bureau of Indian Standards (BIS) seismic codes for construction. The National Disaster Management Authority (NDMA) has made it compulsory for all new constructions to be earthquake-resistant (NDMG, 2007).

Role of Technical Institutions

The scenario of technology transfer at the user end as discussed above, all reinforce the seminal proposition that technology transfer for rural housing development cannot happen in the absence of an effective participation of Technical Institution[4] in Bihar or Jharkand (Erstwhile Bihar).

Involving Technical Institutions, the delivery mechanism for technology would be setup and it ensure delivery of technology, plan and designs for rural houses, up-gradation of skills of local artisans, value addition of local materials, guidance, extension, linkages and coordination. Besides, it would also help to develop vocabulary of building materials, technologies, components of building, building system which permits local artisans and households to build functionally efficient houses in response to local needs, affordability, and vulnerability to natural calamities. In this way the Technical Institution of erstwhile Bihar would provide appropriate technology, which is economically viable, and socially acceptable in area specific mode to sustain natural forces like earthquake.

Technical Intuitions with core competent team of professionals may be able to access knowledge, knowledge sharing and knowledge capturing. Information collection, information handling, and information processing related to Earthquake technology would be possible by establishing such arrangements. Further, skill up-gradation and training of masons, artisans, carpenters, and other building related workforce including professionals like architects, and engineers depend upon the sound human resource base of the Technical Institutions. Design of extension network with trained manpower for delivering technology as an input into housing construction is need of the present time.

There is a repertoire of technologies available in different research institutions and all Indian Institute of Technology (IITs) for seismic turbulence. They may be captured, acquired and documented with the help of a core competent team of faculty members to make them more accessible and usable with the help of ICT (Information and Communication Technologies) support system. Now it is possible to ensure a free flow of all the information related with Earthquake technology, thanks to the advancements in ICT[5].

Extension programme may be designed including Technical Institutions, Panchayati Raj Institutions (PRIs)[6]for broad based planning in region specific mode, people centering participatory and bottom up and top down to meet local needs for technology. With support of extension services and appropriate technology, the rural people would be able to use their own income, assets, knowledge and own labour in a more efficient way for constructing their abode.

Skill Improvement of Local Artisans

Training of masons, construction workers and building professionals not only develops their skills but also empowers them for livelihood generation and provides effective ways to disseminate technology (GoI, 2002-07; Singh and Das, 2000). As a result, costs of dwelling units can reduce thereby making housing more affordable to rural people. In addition to training of artisans, the least educated youth from the rural areas are required to be trained as well in construction activities for not only solving their unemployment problem but also enabling them to significantly solve the rural housing problems. The vulnerability of rural houses to natural onslaughts may be prevented only if local skills of artisans, construction workers and educated youth are developed for safe construction with the help of Technical Instutions.

Value Addition of Local Materials

The upgradation or value addition of local materials is only possible by appropriate technology inputs and knowledge as substitutes for costly materials like cement, steel and stones. The realistic solution would be to judiciously combine more local materials with less imported materials, use of skilled artisans, people's own labouring capacity and technical inputs provided by the Technical institution through extension network. The value addition of materials would be achieved by knowledge and technology as shown in Figure 2.

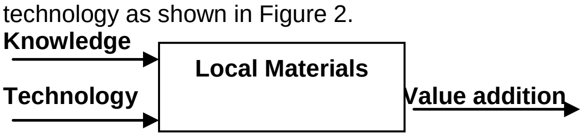

Figure 2: Value Addition of Local Materials

The rural households as per their economic ability may construct the house, if necessary advice or guidance on the right choice of technology is offered to them by the Technical Institutions of Bihar.

Conclusion

At present there is no institutional mechanism available for technology dissemination. Therefore, there is a need to set up unit in all Technical Institutions of Erstwhile Bihar with adequate financial resources, ICT infrastructure for acquisition and collection of all technological knowledge from various sources for mitigation and preventing the harshness of Earthquake damages.

Finally, utilization of local resources, human talents, individual resources of rural households and the linking of technology with rural households through extension network backed by Technical institutions would be able to transfer technology at the user end for constructing safe rural housing for sustaining the natural onslaughts in rural areas of Erstwhile Bihar.

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Foot Notes

1. It is a scale to measure the magnitude of an earthquake, introduced in 1935 by the seismologists Beno Gutenberg and Charles Francis Richter. The scale was originally devised to measure the magnitude of local earthquakes in southern California as recorded by a certain kind of seismograph.
2. An earthquake of magnitude greater than 8 on the Richter scale will destroy houses, buildings

and other structures which are not built with proper design and standard. Man-made structures built on soft ground and hill slopes may collapse due to elevation, depression, tilting or violent shaking of the ground. The land may be degraded making it unsuitable for habitation and the rivers may change their courses.

3. Building regulation /Byelaws for regulating building activity from planning, design to completion of construction (www.ndmindia.nic.in).
4. All Engineering Colleges and Polytechnics in Erstwhile Bihar.
5. ICT is the technology of communication of information, sharing of information, the speed of information flow, volume of information process capabilities, etc. (Emma, 1994).
6. The 73rd Constitutional Amendment Act, 1992 of the Government of India has empowered the PRIs to perform the duty of rural housing development and related infrastructure like drinking water supply, sanitation, waste management, electricity supply, etc. The Act has undergone amendments to turn villages into local self-governments (GoI, 1993).