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THE CONSTRUCTION INDUSTRY AND THE IMPLICATION
FOR ITS DEVELOPMENT - THE INDIAN EXPERIENCE*

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THE CONSTRUCTION INDUSTRY AND THE IMPLICATION FOR ITS DEVELOPMENT - THE INDIAN EXPERIENCE

1. BACKGROUND

1.0.1 The two Consultations on the Building Materials Industry in March 1985 and November 1991, recognised that improving the production and delivery of building materials alone is not enough to address the problems of housing and infrastructure works. The Second Consultation particularly laid emphasis on the need for integrating the construction industry in the national planning process in order to realise its full potential for tackling the issues confronting the developing countries in meeting the rising demand for housing and infrastructure works. The Consultation felt that by proper integration of the construction industry with other sectors of economy the governments could enhance its contribution in the national development.

1.0.2 In this background, the Director-General of UNIDO, within the frame of the Consultations Programme for the biennium 1992-93, proposed to the Industrial Development Board that the First Consultation on the Construction Industry in the Developing Countries be convened during the biennium 1992-93. The proposal was approved by the Board. Subsequently, UNIDO decided to organise the First Consultation on the Construction Industry which is scheduled to be held in Tunis, 3-7 May 1993. This study-report is a background paper for the Consultation. This paper, based on Indian experience, aims at focussing attention on important issues/areas required to be addressed by developing countries in their efforts of promoting construction industry and enhance the competitiveness of the sector.

1.0.3 Implicit in the attainment of the goals of economic development is provision of physical infrastructure like roads, railways, bridges, canals, power stations, industrial/institutional/commercial buildings, housing, utilisation systems and other civil engineering works. These all are output of the construction sector and as important components of national development stimulate, in the developing countries, an increasing realisation of the crucial role of construction industry. Though growth is inevitable for survival of all progressive industries and sectors but looking to the significant contribution construction industry can make, it is important that it blooms and not just survive. It is in this context, an attempt has been made in the present study to analyse the structure of construction industry and identify the major constraints hampering its planned growth and development in different developing situations. The analysis and conclusions drawn and presented in the study are particularly based on the experience in India. However, in keeping with the basic objectives of providing the necessary guidance to those who are in search of viable strategies and policies for organisation and development of their construction industry, effort has been made to highlight such issues which confront the overall construction industry in most developing countries (the degree of seriousness and impact of different issues may vary from country to country situation and its specificities) and devise ways and strategies to promote their respective domestic industries.

2. INDIAN SCENARIO

2.0.1 India launched a massive programme of economic development soon after achieving independence in 1947. The country has been consciously following a path of mixed economy with large investments in public sector enterprises emphasising infrastructure development as a major component of its development plans. The successive Five Year Plans (the current 8th Plan started in 1992) laid progressively increasing emphasis on developmental

planning involving large construction programmes and projects in different social and economic sectors. The Eighth Plan of the country has been drawn in the backdrop of widespread economic changes in both the international and national scenario and the liberalisation process initiated in India recently is gathering momentum offering new opportunities. It aims, inter alia, to start rolling back the Public Sector investment from those sectors of the economy where the private sector can move in and step up investment.

2.0.2 India's population has almost doubled in last 40 years and the urban population has increased four times during the same period and is expected to reach 330 million by the end of the century while the total population is estimated to be one billion. The future population projections further indicate the need and potential for large investments in infrastructure development as 35 per cent of population will be in the urban areas by the year 2001. In India construction is the largest economic activity next only to agriculture. Capital invested and man-power employed in this sector is much larger than in any other industry. Output of construction sector primarily relating to the housing, road and rail development, irrigation and power projects is still falling severely short of the needs of the country and given the present scenario increase in construction activities is inevitable in future years in the country like most other developing countries.

2.0.3 In affirmation of the commitment to the Global Shelter Strategy to the Year 2000 and recognising that Shelter and Development are mutually supportive, the National Housing Policy (NHP) was formulated in 1988 and restated in 1992 in the light of priorities and strategies in 8th Five Year Plan. It seeks to address a spectrum of shelter needs for improving housing situation. Recognising that despite considerable investment and efforts over successive Plan periods, the housing problem continues to be daunting, the NHP envisages wide ranging and innovative guidelines on how to harness the human, technological and financial resources of the state governments, local authorities, non-governmental organisations (NGOs), the formal and informal sectors and community based organisations to improve housing conditions. Rapid growth of urban population and its concentration in 300 cities with a population exceeding 0.1 million has led to increasing congestion and overcrowding in small houses, steady growth of slums and informal settlements and severe pressure on civil services, in the context of the inadequate supply of affordable housing by public and private sector and acute shortage of funds for the development of settlements and extension of city level infrastructure. This has been aggravated by institutional deficiencies of housing agencies and local bodies and insufficient attention to the shelter needs of the poor.

2.0.4 In India art and science of construction is as old as its civilisation, however, in the modern context, construction is an activity that cuts across almost all sectors of economy. The construction industry is generally considered a sector of the economy which transforms various resources into economic and social infrastructure and facilities. It embraces all phases of the process of transformation, namely planning, designing, financing, procuring, constructing, maintaining and operating. Nearly 14 million of India's working population is engaged in construction but it is not yet classified as an industry. Its products range from multi-million dollar projects to simple structures costing a few thousand rupees. Head-load carrying women and men, animals and programmable computer controlled heavy machines work side by side in perfect harmony on variety of construction sites. Some of the highest and lowest wage rates can be found in this industry in India. With its backward and forward linkages it has tremendous capacity for quantitative growth but has shown limited evidence of qualitative growth. Construction activity is a buffer to rural/agriculture workers migrating to urban/industrial occupations and by absorbing a large number of such workers it helps in generating a high potential for employment. However,

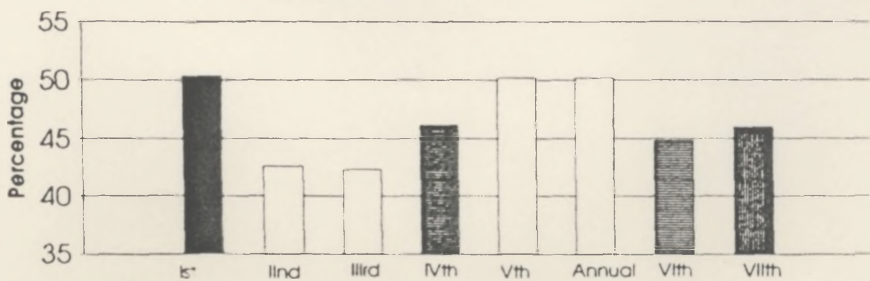
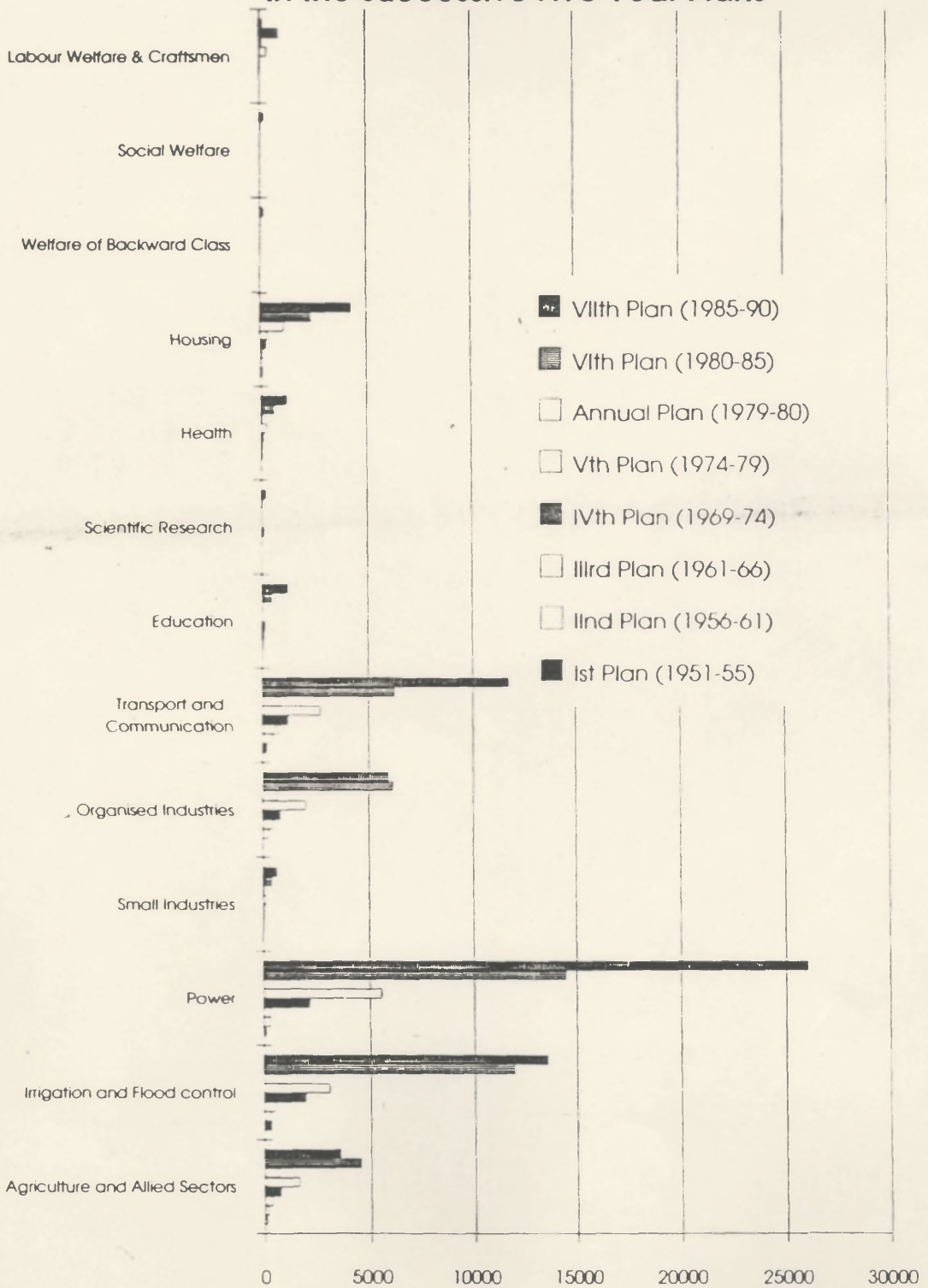
the construction scenario is changing in the background of emerging demands on the construction industry. A spin-off of the rapid expansion of the domestic construction sector during the post independence period was that the Indian contractors ventured into the execution of a large number of the construction projects abroad during 1970s and early 80s. As a result many construction contractors were exposed to new technology, advanced methods of construction and newer equipments. Also the construction industry in India witnessed a rapid transformation partly due to experience gained from variety of projects executed in various other countries and partly due to a very large pool of technically qualified manpower available in the country. But the industry suffers from wide usage of out-dated equipment and labour intensive techniques which hinders competitiveness, as the specialised construction know-how acquired from projects abroad essentially remains a monopoly with only a few large construction firms. The rapidly moving structural changes in the construction sector calls for a serious analysis of its potential, constraints and the role of policies and institutions in its development to improve productivity and efficient delivery.

2.0.5 The need for action in reducing the environmental impact of buildings and construction activity is being increasingly accepted and efforts are being made to develop and promote technology that will help in mitigating the stress on the atmosphere. Legislation, regulation, the media, advertising and specialised consultancies are all converging to focus public awareness and action on environmental concerns for ensuring sustainable development of construction industry. Recognising the need to conserve natural resources, damage caused due to excessive extraction for meeting the fast rising demand of construction sector, the macro-policies in general and National Housing Policy in particular provides thrust for promoting innovative, and energy efficient building materials technology particularly based on agricultural and industrial wastes and by-products and renewable sources of energy. Despite a number of research and development institutions in the country dealing with construction materials, methods and designs the impact of research results is hardly visible in the construction industry. Several recent policy initiatives are, however, striving to address the need to establish strengthened institutional capability to undertake and promote innovative work on science and technology inputs to housing and construction sectors.

3. SCOPE OF THE CONSTRUCTION INDUSTRY AND ITS ROLE IN THE ECONOMY

3.0.1 Construction plays a very significant role in both economic growth as well as employment creation. Construction sector contributes more to GDP and employment than most other sectors. In India, share of construction industry in the development planning can be judged from the fact that the capital outlay on construction in the successive Five Year Plans ranged from 36 to 50 per cent. Investment made in construction during the period 1951-85 was Rs.17023.9 billion which works out to be 43.2% of the total development investment. Construction component of total public sector plan outlays is indicated in Figure-I. The scope of building, civil engineering, public works industries often referred to as the construction industry comprises the work of construction, reconstruction, maintenance, repair, alternation or demolition of any one or more of buildings: railways; tramways; airports; docks; piers; highways; bridges; flood protection works; canals; dams; tunnels; sewers; drains; wells; irrigation or drainage works; telecommunication installations; pipe line water works; etc. There is hardly any sector of the economy which does not have a construction component. In fact this sector works as the 'engine of growth' and grows hand in hand with economic and social activities. According to an estimate, the economically active population engaged in construction in 1982-83 was 10.33 million. Of these 1.18 million were regularly employed in the corporate sector and with big construction contractors, 2.38 million worked for small contractors and

Construction Component in different sectors in the successive Five Year Plans



Approximate Construction Component in successive Five Year Plans (%)

Figure - I

other agencies and the balance of 6.75 million were casual employees. These figures do not include workers engaged in allied industries like brick making, sand dredging, quarrying, forestry, etc.

3.0.2 Multiplier effect of construction activity on the economy is one of the highest in magnitude after agriculture. Gross capital formation in construction industry at Rs.154450 millions accounted for 43 per cent of the gross domestic capital formation in 1981-82. It is estimated that every rupee invested in construction provides an incremental GDP to the tune of 78 paise (one rupee equivalent to 100 paise) to the economy as a whole. The corresponding figures, for agriculture, manufacturing, railways, communications, storage and warehousing are 20, 14, 8, 9 and 69 respectively. It can be seen that the activities of construction sector cuts across various sectors of economy. The percentage of construction (Table-1) in different sectors vary from 10 to 100 per cent. In per capita terms, the annual average construction expenditure has been rising over the years. It was Rs.9 in the first Plan (1951-55) and rose to Rs.18 in the second; to Rs.21 in the third; Rs.33 in the fourth and Rs.87 during the fifth Plan. It was as high as Rs.209 in the sixth Plan and is estimated to have crossed Rs.300 during the seventh Plan. The contribution of construction to national income has also been going up which was Rs.6250 million in 1960-61, Rs.18530 million in 1970-71 and Rs.67560 million in 1982-83. In the sectoral composition of Gross Value Added construction sector's contribution was 6.21% in 1984-85 and 6.16% in 1989-90. Sectorwise investment and increment in GDP during 1980-85 is indicated in Table-2 and value added from construction in Table-3.

Table-1

Approximate Construction Component of Various Sectors

1	Agriculture & Allied Activities	34%
2	Irrigation & floor control	80%
3	Power	75%
4	Small Industries	25%
5	Organised Industry	30%
6	Transport & Communications (excluding railways)	40%
7	Education	20%
8	Scientific research	10%
9	Health	37%
10	Housing	100%
11	Welfare of backward classes	12%
12	Social welfare	21%
13	Labour welfare & craftsmen training	45%

Table-2
Sectorwise Investment and Increment in GDP (1980-85)

	Investment at market prices (Rs. crores at 1979-80 prices)	Increment in GDP at factor cost (Rs. crores at 1979-80 prices)	Incremental GDP per Rs. of investment [Paise (2) as percentage of (1)]
Construction	1760	1389	78
Agriculture	32242	6404	20
Forestry & Logging	478	327	68
Mining & Quarrying	6575	1040	16
Manufacturing	45515	6500	14
Railways	4724	420	8
Transport other than Railways	11330	1025	9
Communications	2902	262	9
Trade, storage and warehousing	7299	5026	69
Banking & Insurance	260	968	370

Source: Sixth Five Year plan, 1980-85

3.0.3 The construction as a percentage of GNP in India rose from 3% in 1971-72 to 3.70% in 1984-85; 24.10% in 1985-86 and 26.01% during 1986-87. Equally impressive is the contribution of the construction industry towards the fixed capital formation in the economy. Though detailed data from various countries is difficult to obtain, the role and contribution of construction in economic development in different countries with low, middle, upper middle and high income can be seen as given in Table-4.

Table - 3

Value Added from Construction

(Rs. crores at 1980-81 Prices)

Sr. No	Item	1980 -81	1981 -82	1982 -83	1983 -84	1984 -85	1985 -86	1986 -87
1	Value of Output	16038 (16038)	16366 (19348)	15456 (21801)	15957 (24956)	16396 (28776)	17613 (34067)	17534 (13741)
1.1	New Construction	13649 (13649)	13869 (16400)	13008 (18327)	12584 (19649)	12851 (22554)	13977 (27034)	13820 (29747)
2	Gross Value-added	6114 (6114)	6446 (6988)	6148 (8079)	6576 (9421)	6761 (10906)	7110 (12789)	7344 (14709)
3	Consumption	343 (343)	374 (414)	412 (481)	445 (453)	482 (619)	513 (733)	542 (816)
4	Fixed capital Net Value of Added	5771 (5771)	6072 (6575)	5736 (7598)	6131 (8878)	6279 (10367)	6587 (12056)	6762 (13893)

Source: CSO, Department of Statistics, Ministry of Planning, National Accounts Statistics, 1980-81 to 1986-87.

Figures in brackets are value at current prices.

3.0.4 Employment in Construction Industry:

3.0.4.1 Employment generating potential of the construction activity is also large. In India 16 per cent of the working population in the country are employed in this sector. According to Economic Survey, 1990-91 construction employment in the organised sector (both public and private) was as given in Table-5. It is estimated that every one million rupees spent on

construction generates 3000 man-days of skilled and semi-skilled and 1300 man-days of managerial and technical employment. In view of the rising population employment generation is of crucial importance in a country like India. While the rate of growth of population was about 2 per cent a year during the last decade (1980-90), the employment growth in construction industry was about 7 per cent per year.

3.0.4.2 Construction industry has some unique advantageous features, as far as employment potential is concerned, (a) it absorbs rural labour, (b) it absorbs unskilled workers (in addition to semi-skilled and skilled), (c) it permits large scale participation of women workers, (d) it supplements the workers seasonal income from farming, (e) it facilitates redistribution of income and (f) it provides a human resource development bridge from unskilled labour to highly skilled factory worker.

3.0.4.3 Construction has the beneficial aspect of backward linkage. Two-third of the construction cost is accounted for by the building materials. In this context the building materials industry plays a key role in the growth of construction sector, in terms of national product, employment and investment. Within this group, Cement claims a share of 27%, Bricks 19%, Timber 15%, Steel 13%, Sand 9.5%, Aggregated for Concrete 7% and pebble & others 9.5%. With an annual investment of Rs.280000 million in construction, a reasonable inference could be that it supports an annual industrial activity to the extent of Rs.168000 million. The total number of workers employed in the building material industry is not accurately known. Cement industry alone provided 22,000 additional jobs during the seventh plan.

4. GROWTH OF CONSTRUCTION ACTIVITIES

4.0.1 The growth of construction sector is estimated to be ranging from 8 per cent to 16 per cent in most developing countries. Asia experienced sustained construction growth during the 1980s. In most countries in the region construction accounted for approximately 5 per cent of GDP. In some countries this proportion may be even higher if the informal sector's contributions are taken into account. In India the construction industry absorbs almost 40 to 50 per cent of the public sector outlays and generates more incremental value added per unit of investment than any other industry. In Pakistan much of increased construction activity is attributed to the housing sector, certain aspects of infrastructure, sanitation and water supply. In other countries of the region construction output has increased as a result of infrastructure and industrial development (like Republic of Korea, Malaysia, Singapore, Thailand, Taiwan and China) and the development of tourism (Indonesia and Thailand). After having collapsed by over 25 per cent in 1985-86, construction output in the Philippines increased as a result of the Government's special programmes for the repair of infrastructure and for building roads, irrigation networks, schools and hospitals in rural areas.

4.0.2 Construction being an integral part of almost every sector of economy, there has been a continuing increase in the output of the construction industry during last three to four decades. The major indicators of growth are (a) aggregate growth, (b) fixed capital formation, (c) growth in construction component of plans, (d) growth in employment through construction, (e) growth in project exports and growth in construction materials. Though detailed data are not available to measure the aggregate growth of the construction sector in India, there was a growth of about 50 to 70 percent in the health establishments, about 5 per cent in education and about 10 per cent in the transport and communication infrastructure, while about 60 per cent in the residential and non-residential buildings completed during 1979-85 and about 30 per cent in those authorised. Several components like housing and urban development, railways, roads, irrigation projects are mentioned in following paragraphs.

Table - 4
CONSTRUCTION'S ROLE IN ECONOMIC DEVELOPMENT
INCOME, GROWTH AND INVESTMENT

Low-income Countries	GNP per Capita 1984 \$	Average Annual Growth Rates (percent)			
		GDP		Gross Domestic Investment	
		1965-73	1973-84	1965-73	1973-84
LOW-INCOME COUNTRIES					
Ethiopia	110	4.1	2.3	1.5	2.6
Bangladesh	130	5	5	-6.4	4.7
Tanzania	210	3.9	2.6	9.6	-
India	260	7.9	4.1	3.9	4.2
Kenya	310	7.8	4.4	15.9	1.2
China	310	0.2	6.6	12.9	8
Sudan	360	5.4	5.5	0.2	3.2
Pakistan	380	1.5	5.6	0.4	5.4
Senegal	380		2.6	8.1	-0.7
MIDDLE-INCOME COUNTRIES					
Liberia	470	5.5	0.2	5.6	1.5
Indonesia	540	8.1	6.8	17.5	11.3
Cote d'Ivoire	610	7.1	3.7	10.2	2.9
Philippines	660	5.4	4.8	4.4	4.3
Morocco	670	5.7	4.5	11	1.6
Egypt	720	3.8	8.5	-1.5	10.3
Nigeria	730	9.7	0.7	15.2	-2
Cameroon	800	4.2	7.1	8.6	10.6
Thailand	860	8.8	6.8	7.6	5.3
Jamaica	1150	5.4	-1.4	7.5	-5.8
Turkey	1160	6.5	4.1	9.7	2.3
UPPER-MIDDLE COUNTRIES					
Chile	1700	3.4	2.7	11.3	1
Brazil	1720	9.8	4.4	7.3	-
Malaysia	1980	6.7	7.3	5.1	1.4
Mexico	2040	7.9	5.1	19.7	3.3
Korea	2120	10	7.2	4.8	8.8
Yugoslavia	2120	6.1	4.2	6.7	3.9
Argentina	2230	4.3	0.4	11.1	-3.4
Venezuela	3410	5.1	1.9	22.7	-0.8
Singapore	7260	13	8.2		9.5
HIGH-INCOME COUNTRIES					
United Kingdom	8570	2.8	1	3.1	-1
France	9760	5.5	2.3	6.9	0.4
Japan	10630	9.8	4.3	14.1	3
Germany	11130	4.6	2	4.4	1.3
Australia	11740	5.6	2.4	3.7	0.7
Canada	13280	5.2	2.5	3.8	0.1
United States	15390	3.2	2.3	2.7	1.5

Source: World Bank, World Development Report 1986.

Table-5

Employment in Construction Industry

	1980	1985	1988	1989
	(Numbers in Lakhs)			
Public Sector	10.89	11.46	12.14	11.80
Private Sector	0.73	0.70	0.50	0.64
-	11.62	12.16	12.64	12.44

Lakh = 0.1 million or 100 thousand

4.0.3 As cities grew the demand of construction industry got multiplied. The growth in population and consequential increase in the area of different sizes of settlements (Table-6a.b.c.d) indicate the growing requirement of construction of housing and related infrastructure. Figure-II shows the investment in housing during the various Plan periods. During the last two decades the share of housing in national income has been around 3 to 4 per cent with marginal fluctuations. The gross capital formation in construction of residential buildings as a percentage of total gross domestic capital formation has been about 12 percent during the 7th Plan. The growth of housing stock and the estimated shortage is shown in Figure-III (a) & (b). Over Eighth Plan period it has been projected that over and above the present backlog of 31 million units (20.6 in rural and 10.4 in urban areas), the shelter requirement of upgradation and new construction would be nearly 12.22 in rural and 9.55 million in urban areas. Bulk of the housing in the country is constructed by the people themselves with their own resources and a major portion of housing in rural areas is based on biomass. National investment in housing sector has been growing in successive Five Year Plans, but the housing shortfall due to natural increase in demand gets compounded by a large stock damaged due to natural disasters like floods, cyclones, earthquakes and land slides. Building materials are an integral part of construction in any sector since two-third of the construction cost is accounted for by building materials. The consumption/requirement of building materials can therefore, be considered a good indicator for assessing the growth trend of construction industry. Requirements of building materials for other sectors are not available, but the same for housing (1991-2001) and roads sectors are estimated as given in Tables-7

Table - 6(a)

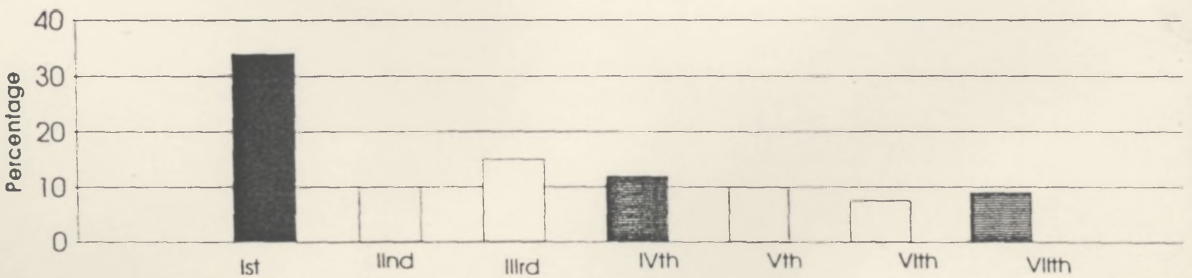
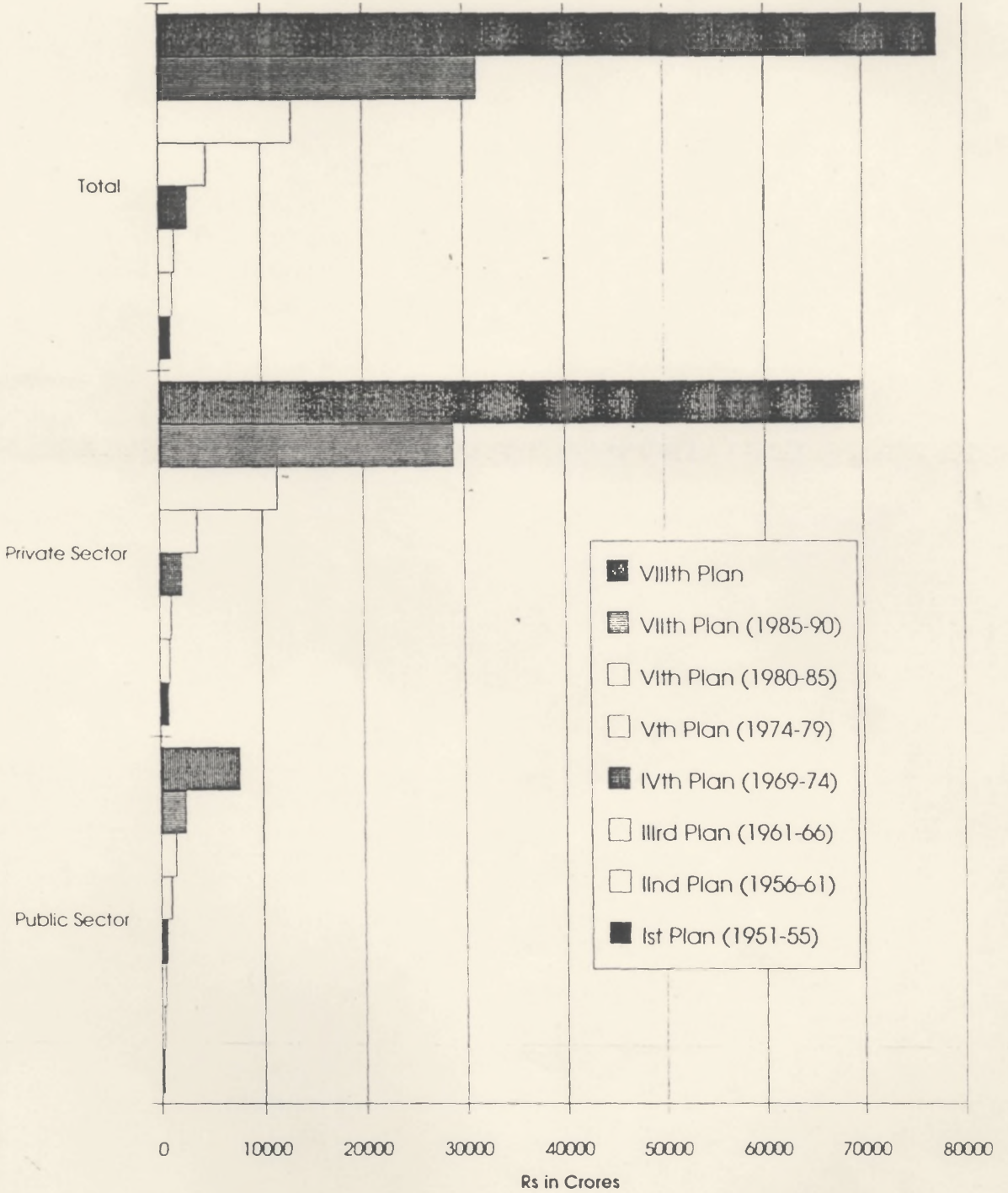
URBANISATION CHARACTERISTICS OF INDIA

Growth of Population in Different Sizes of Settlements

Category	Changes in No. of Settlements due to Population Growth		
	1961	1971	1981
	VI Below 1 lakh	115	68
V 1 to 2 lakhs	55	76	113
IV 2 to 3 lakhs	18	28	33
III 3 to 5 lakhs	14	23	28
II 5 to 10 lakhs	6	11	29
I Above 10 lakhs	8	11	13

1 lakh = 100 thousand

Investment in Housing in the successive Five Year Plans

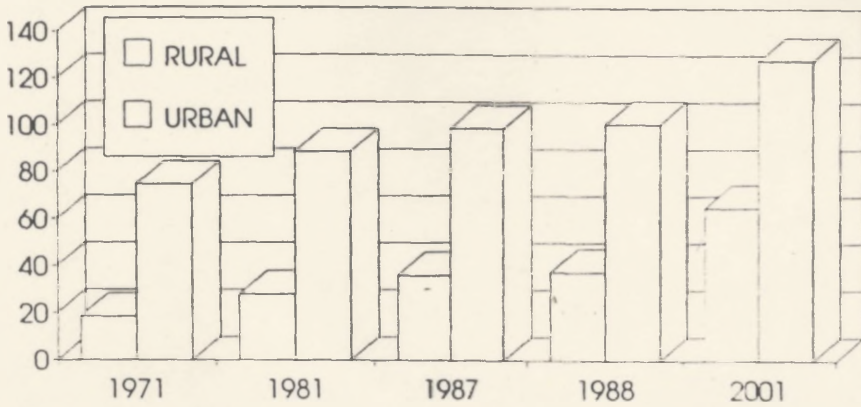


Housing Investment of Total Investment in economy in successive Five Year Plans (%)

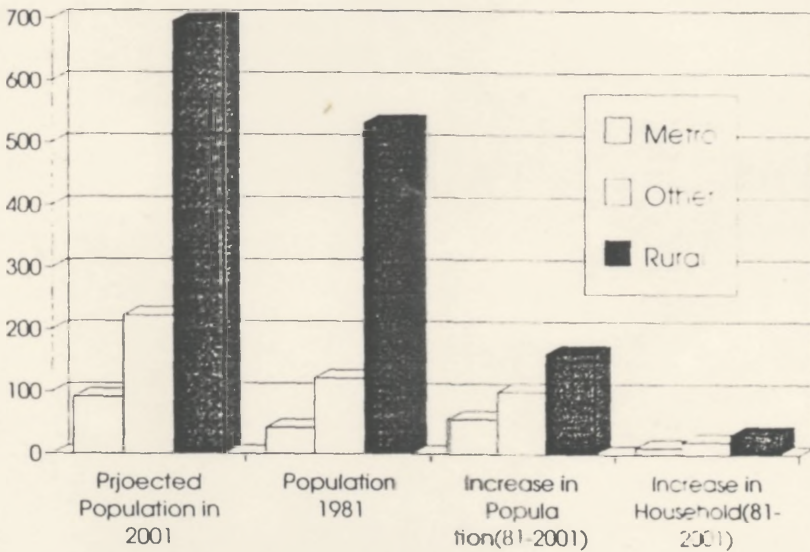
Figure - II

Growth of Housing Stock

(In million)



Increase In Households (1981-2001)



Housing Shortage

(As estimated on the basis of 77-87)

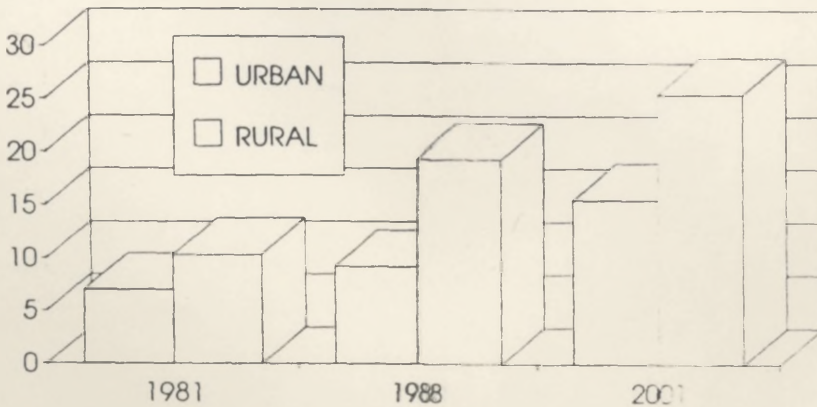


Figure - III (a)

6 (b)
Increase in Population & No. of Households (1981-2001) (in million)

	Rural	Metropolitan areas	Other Urban areas	Total areas
Projected population in 2001	696	97	223	1016
Population in 1981	533	42	122	697
Increase in population (1981-2001)	163	56	101	320
Increase in the number of households (1981-2001)	32.6	11	20.2	63.8

6 (c)
Growth in Area of Different Sized Settlements

Category	Changes in No. of Settlements Due to Area Growth		
	1961	1971	1981
VI Less than 10 Sq.km	32	22	16
V 10 to 20 Sq.km	53	44	32
IV 20 to 50 Sq.km	74	78	80
III 50 to 100 Sq.km	39	42	48
II 100 to 500 Sq.km	16	29	37
I Above 500 Sq.km	2	2	3

6 (d)
Decadal Increase in Area

Category	1961-71 (No.)	1971-81 (No.)
VI Below 0%	25	20
V 0-30%	139	148
IV 30-50%	15	21
III 50-100%	18	13
II 100-200%	11	14
I Above 200%	17	10

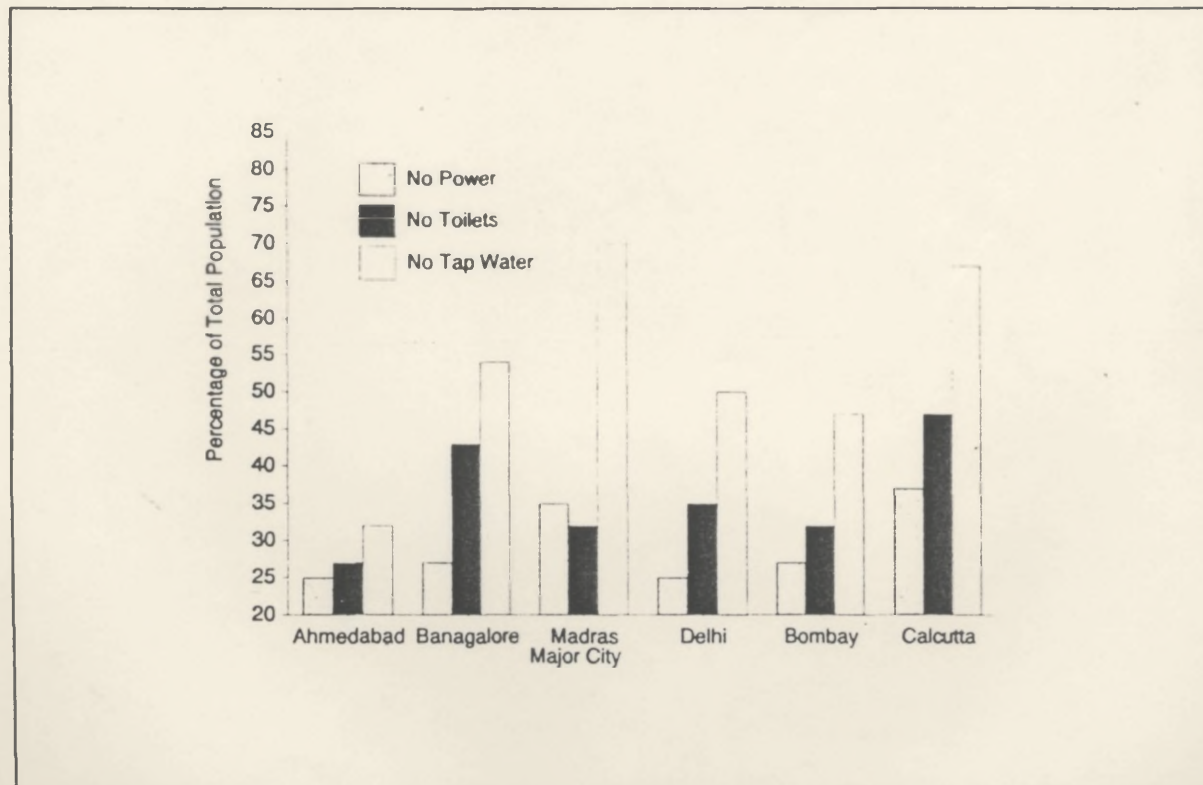


Figure - III (b)

Table -7

ESTIMATED QUANTITY OF MATERIALS REQUIRED FOR HOUSING 1991-2001

Item of Input	Unit	Rural	Urban	Total
Stone blocks	Million cu. m	121	320	441
Stone slabs	Million cu. m	71	174	245
Stone chips	Million cu. m	52	128	180
Total	Million cu. m	244	622	866
Bricks (burnt)	100 Million	2324	2294	4618
Bricks (unburnt)	100 Million	674	238	912
Total	100 Million	2998	2532	5530
Sand	Million cu. m	138	1252	1390
Cement	Million Tonnes	14	64	78
Lime	Million Tonnes	10	570	580
Bitumen	1000 Tonnes	151	9	160
Tiles for roof	Million Nos	17218	7495	24713
Mosaic tiles	Million Nos	105	1234	1339
Other floor tiles	Million Nos	637	539	1176
Asbestos sheets	Million Sq.M.	16	73	89
Corrugated iron sheets	Million Sq.M.	32	128	160
Iron and Steel	Million Tonnes	2	5	8

4.0.4 There has been a four-fold increase in the total road length in the country since 1951 (Figure-IV) and still a third of the villages remain unconnected and about two-thirds without an all weather road. Significant improvements such as surfacing and addition would be necessary in the immediate future besides creating road network in hilly and remote areas of the country such as North-Eastern region and Himalayan region in Himachal, Uttar Pradesh, etc.

GROWTH OF ROADS IN INDIA (IN '000kms)

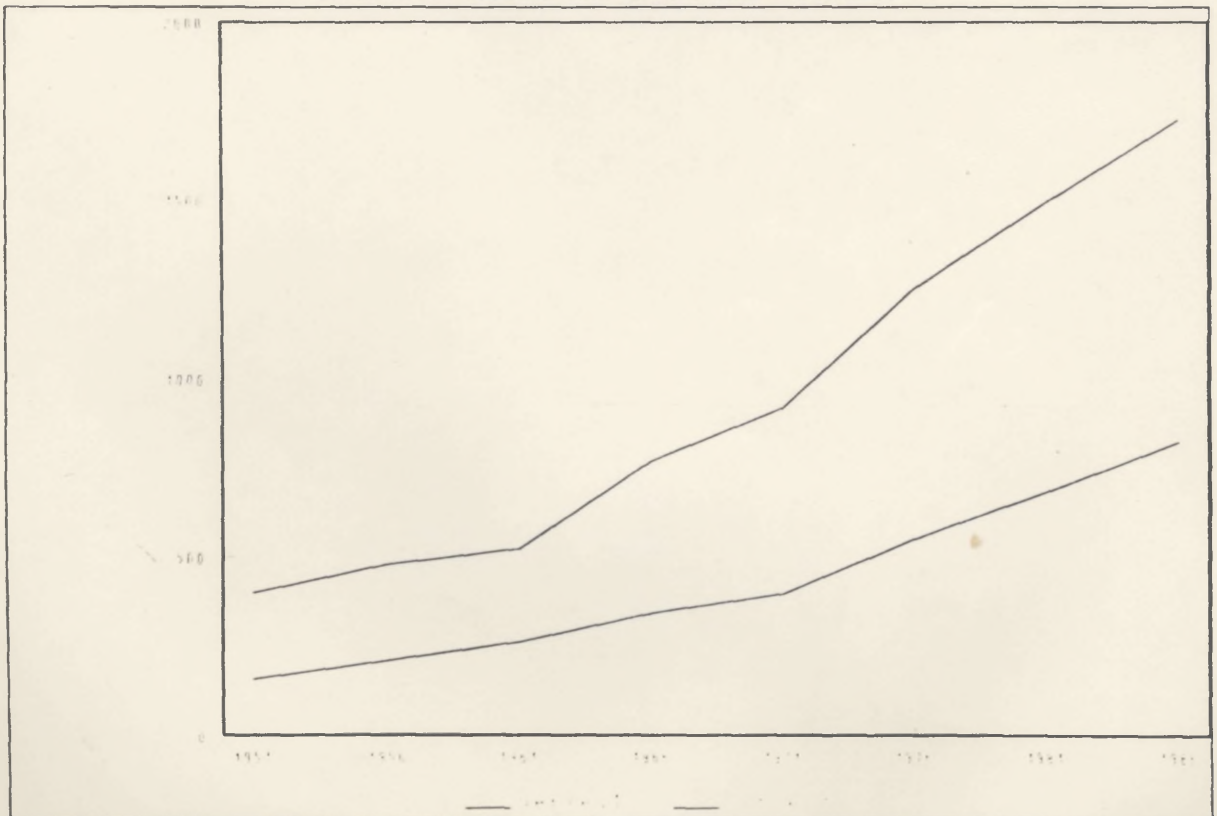


Figure-IV

4.0.5 India had a well developed rail network at the time of independence. The network consisted of tracks of multiple gauges. In the second and third plan period when significant emphasis was laid on the development of infrastructure tracks and sidings were increased. However, these marginal increases have had very little to relate to the rapidly growing necessity of greater passenger movement. It is only in the last decade a realisation of the need to increase the track length has been emphasized and the shift to uni-gauge tracks have been initiated. The Figure-V indicates the growth in construction activities in railway sector during 1950-51 to 1985-86.

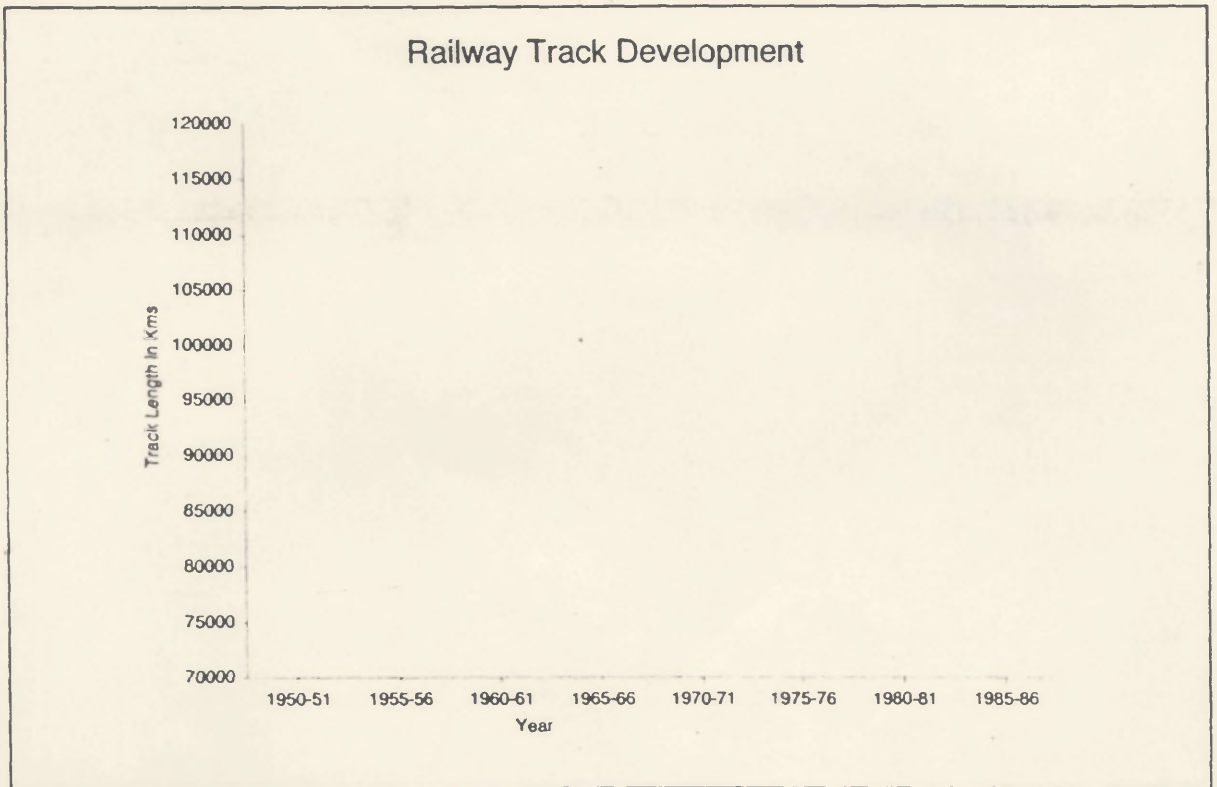


Figure - V

4.0.6 Similarly, irrigation sector is another sector where large scale construction activity takes place. The ultimate irrigation potential is estimated to be 113.3 million hectares, of which 58.5 million is considered to be possible by major and medium irrigation schemes which call for a high input of construction activity. Currently, the contribution of major and medium irrigation systems is only 8.6 million hectares. This has been achieved by the construction of over 1000 major and medium dams since independence (Figure-VI). Since most of the better suited sites have been exhausted, these projects are likely to come up in more complex environments, which may not only require more complicated construction methods and higher volume of building materials but may have critical impact on the surrounding environment.

4.0.7 Development of power sector has also been one of the major areas where construction activities grew at a very fast rate. The fast addition in generating capacity through successive plans generated substantial demands on the construction industry. The additional installed capacity envisaged during the 8th and 9th Five Year Plans would be 38000 MWs and construction component will be nearly 40 to 50 percent of the total outlay of power sector.

4.0.8 Despite the above mentioned trends of rising demand on construction sector by expansion in housing and infrastructure components, prosperity of the construction industry in majority of countries, is more vulnerable to fluctuations in government policies than is that of other economic sectors. This industry is highly exposed to cyclic nature of the economic performance in many economies and its development in such circumstances depends on the degree of resilience and capacity to absorb innovation. Such policies may influence, for example: in periods of high interest rates a decreased demand for housing; in periods of manufacturing downturn - a decreased demand for industrial buildings and infrastructure; and in periods of constraints on public expenditure - a decreased demand for social infrastructure and public utilities.

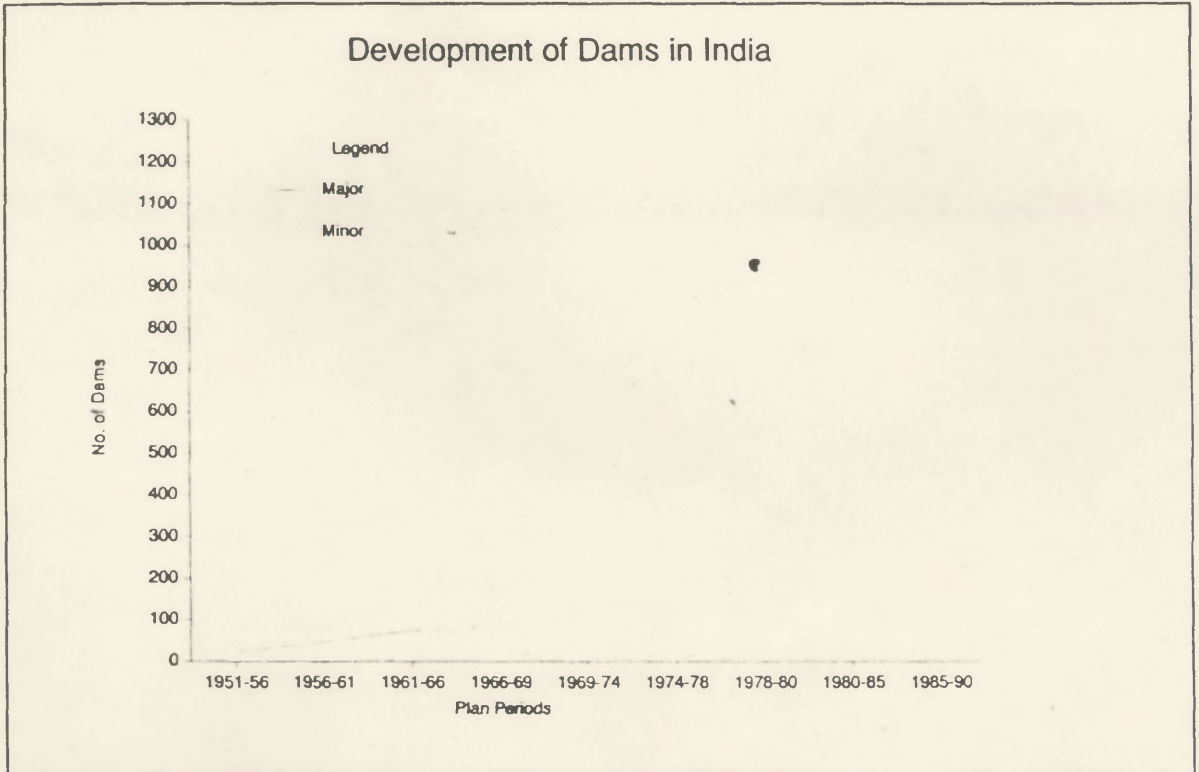


Figure - VI

5. LINKAGES AT INTERNATIONAL LEVEL

5.0.1 Construction industry, depending upon its development at domestic level, has very good scope for international participation. As mentioned earlier, the post-independence period provided the Indian construction sector a fillip with massive projects coming up all around the country. Per force the contractors have acquired expertise in many challenging fields of construction. The oil-boom during 70s in the middle east provided momentum to the domestic sector through project exports and several Indian construction companies ventured into the execution of a variety of construction projects in other countries. Construction industry has also contributed towards the foreign exchange earnings through export. According to Exim Bank estimate about 30% of the value of the projects executed abroad was repatriated into the country in the form of foreign exchange. Through this route it has contributed nearly Rs.22000 million of foreign exchange. During the boom phase in 1970s India's performance in construction project exports exceeded Rs.50000 million i.e. an annual average performance of Rs.10000 millions. During the period 1975-89 Indian project exporters executed 415 projects which included variety of construction projects like townships, housing, water supply, sewerage systems, Airport Construction, Railway lines, bridges,

flyovers, dams, pile foundations, diaphragms, caissons etc. During the process the Indian construction industry involved itself with different forms of technology transfer and technology upgradation. Several large construction companies executed different types of construction projects as sub-contractors of construction companies from developed countries as the contracts were mainly bagged by the world's leading contractors. However, in the process benefits received by the Indian construction companies included training of Indian technicians and engineers in advance construction methods; general technology upgradation in the construction sector; foreign exchange earnings; large scale employment of skilled, unskilled and managerial personnel and to some extent export of building materials (which was 6 per cent of the project value).

5.0.2 Indian exporters executed projects in Asia, Africa and Europe. In all export bids were successful in 32 countries which included 20 in Asia, 7 in Africa, 2 in Western Europe and 3 in Eastern Europe. Middle east accounted for 77.8 per cent of the projects in terms of value during the first phase. Its share declined subsequently due to decline in the oil revenue of the region and Iran-Iraq war. Major contracts in second phase were in Malaysia, Thailand, Bangladesh, Turkey, Malta, Sudan and Maldives.

5.0.3 Construction industry today is heading towards globalisation. The global market for construction, expressed in terms of contracts awarded to the world's top 250 contractors, exceeded \$ 120 billion in 1990. Over 90 per cent of these contracts went to contractors from advanced industrialised countries. A considerable proportion of these construction projects are funded by international development banks and agencies though many of these are implemented in developing countries. But in World Bank funded projects, mechanisms have been introduced to enhance the participation of developing countries through supply of equipment to mostly developed countries, the home countries of the construction firms.

6. EMERGING DEMANDS ON THE CONSTRUCTION INDUSTRY

6.0.1 The core strategy of Eighth Plan of India under different sectoral development programmes heightens the future demand for construction services and products in the country. In the housing and human settlements sector the emphasis is laid on expansion in the provision of basic infrastructure facilities in rural and urban areas in order to improve the overall environment of habitat and access to housing.

6.0.2 Accurate forecasts are not available but the volume of construction in India during the eighth plan period (1992-97) is likely to be around Rs.31,000 million. Urgent steps are required for the construction industry to respond to this demand. The state of economy further demands that extreme care has to be exercised to ensure that all construction is carried out speedily, efficiently and economically. The industry has to also respond to subtle politico-economic changes being ushered in by the Government. Decentralisation of economic development, increased outlay (50%) to the rural sector, impetus to employment amongst rural youth etc. are declared objectives of the Government. The industry must respond to these changes.

6.0.3 A spurt of activity in the construction of schools, health centres, roads, minor irrigation projects in rural areas. Clients will be of a different type. There will have to be a large number of contractors of smaller size who are willing to go and can adapt themselves to work in rural and remote areas. They will have small organisations, perhaps with some local moorings. Technology is vital to the realisation of the full potential of rural construction. Their methods and construction techniques will have to be appropriate to the rural environment. More of labour-intensive work, often

seasonal working to mesh with the employment of the same labour on agriculture, more of local materials, etc.

6.0.4 On the other hand, many of the large power projects also may be located in remote areas. These will require marshalling of resources for large scale projects. Besides the specific objectives of the projects, such mega projects should also be utilised to bring about a general upgrading of the regions economy and local industry by the creation of ancillary industries, training institutes, schools, hospitals, parks and by gestures like "adopting" a few villages etc.

6.0.5 The New Industrial Policy (1992) of India and the whole package of economic reforms being currently introduced are bound to promote rapid and industrial development in the country and would foster a dynamic process of inter-dependence among the developing economies of ASEAN, SAARC and Middle-Eastern regions. With the abundant labour, capacity to absorb technology and large market the country could easily attract large investment from foreign countries and Non-Resident Indians (NRIs) which is likely to provide a fillip to Indian construction industry. In some ways, India is at the second take-off point in its long journey to become a fully developed nation. Construction industry will have to play its part by improving its capacity both quantitatively and qualitatively.

7. MAJOR CONSTRAINTS IN THE DEVELOPMENT OF CONSTRUCTION INDUSTRY

7.0.1 The development of construction industry by its vary nature and multifaceted linkages with other sectors of economy is prone to be affected by a disproportionately large number of factors related both to demand and supply side aspects. Consequently, several components of macro-economic policies as well as specific policies of different sectors directly or indirectly affect the nature and development of construction industry in any developing country. Over the last 40 years developments and improvements in building materials, construction methods, transportation systems, machinery and equipment have taken place everywhere and such developments and innovations have helped in the progress of the construction activities under various sectors like construction of highways, railways, airports, irrigation works, industrial structures, airports, etc. However such developments have hardly impacted the methods and materials of construction in the building and housing sectors which continue to employ conventional labour intensive methods. The construction industry in most developing countries is confronted with large number of constraints which hinder its long-term development. Though a lot of progress has been possible in several countries due to policy interventions, yet a number of bottlenecks continue to retard the desired pace of development of their construction industry. To understand the nature of constraints, it is essential to analyse the environmental parameters which impact the growth of construction sector. The construction enterprises generally have to operate under different environmental factors (as given below) which affect their capacity development and operational efficiency.

- i) Social environment: includes factors like population growth (influencing demand), occupational distribution, literacy, social customs (influencing choice of products), state of urbanization (influencing available infrastructure), housing conditions (influencing marketability), relationships in formal and informal construction activities.
- ii) Economic environment: includes factors such as natural and locally available resources, per capita income, consumption pattern of population, governmental policies & regulatory mechanisms, budgetary allocations for target sectors (where output of the enterprises is to

be absorbed), fiscal incentives, industrial production, local and regional demand, pricing trend, transportation infrastructure, domestic and foreign linkages, communication, etc.

- iii) Technical environment: includes scientific and technological developments, technology transfer mechanisms, innovative processes and new products, new machinery and tools, appropriate technologies, status of standardisation, educational and training programmes, quality improvement strategies.
- iv) Managerial environment: includes factors like management tools and techniques, marketing strategies and potential, consultancy services, advertising and publicity, labour relations.

7.0.2 Thus it can be seen from the above that construction enterprises operate in a multi-linkage environment which necessitates availability of a strong data base and system of information within the industry. This would not only help the different size of construction enterprises to plan their activities for an efficient delivery of services and products but would also enable the decision-makers and policy analysts to deepen their understanding of the sector which supplies substantial inputs to all other sectors of economy.

7.0.3 Despite its massive contribution to nation building activities, construction in India like many other developing countries is not treated as an industry and this created more hurdles in the progress of sector as construction is not treated amongst the nodal functions of any one central authority or department. Standardisation and dimensional coordination has scarcely begun in most developing countries. Each project or product is essentially treated as a 'custom made' and as a result the advantages of serial production or mass production are largely not taken care of even in building and housing programmes. Construction in fact is treated as an activity or combination of several activities performed by a wide variety of people not particularly connected or governed by certain set norms as in other productive sectors. Some of the major constraints in the development of construction industry emanate from the fact that in most developing countries there is a general lack of understanding and comprehensive overview of all the activities which constitute construction industry thereby leading to an uncoordinated growth. The major constituents of the construction industry are; (a) building materials, (b) planning, design and consultations and (c) contracting and implementation. It is, therefore imperative that an indepth analysis of the factors hindering the development in all these three areas is made by different developing countries in order to evolve their own strategies for developing the domestic construction industry.

7.0.4 The World Bank report entitled "A Review of Bank Assistance to the Construction Industry in Developing Countries" while reviewing the impact of its strategies and operations aimed at the development of the construction industry in developing countries noted that despite a sound policy, comprehensive guidelines, numerous operations and almost a decade-and-a half of operational experience the Bank's goal of promoting the construction industry in developing countries was still elusive. The report analyses that the domestic construction industries in developing countries are plagued by inefficient policies and practices, weak institutions and adverse business environments. The industry in most developing countries lack in the effective capacity and efficiency in terms of quality, economy and timely completion of projects. Consequently delays in project completion have become endemic and the resulting economic losses are high.

7.0.5 Incompatible Technologies and Lack of Technology Upgradation Efforts

7.0.5.1 India like other developing countries requires to modernise its infrastructure along with creation of additional facilities. But Finance and Technology are prime constraints in developing the construction industry for desired level of output. India has the fifth largest professional manpower pool in the world. But poor quality and lack of initiatives for technological upgradation particularly in building sector still persists in India like most developing countries where State-owned-Enterprises are responsible for construction projects. Despite massive investments in science and technical education such enterprises and consequently the whole construction sector tend to be very poor technological innovators and most construction agencies operate below existing technology frontiers. It is generally felt that use of outdated technology is one of the reasons for most of the cost and time overruns. With reference to large size civil engineering construction projects it has been analysed that in India component of plan outlays being spent on cost overruns alone can go upto 20 per cent and if coupled with the cost of time overruns the percentage could be much higher. In case of several other countries higher costs of many such projects were due to imported modern construction techniques under "packages" of foreign made materials, sophisticated equipment which could not be sustained due to inadequate back-up of training and spare parts etc. Thus it will be seen that while in some countries the continuing dependence on outdated traditional technology is a serious constraint to the development of the construction industry, in case of others use of 'sophisticated' 'modern' techniques imported from industrialised developed countries became road block in the progress of the local construction industry. It is, therefore, important in such cases where foreign technology or companies are to be imported for any construction project "technology packages" should be formulated comprehensively to include adequate provisions for technology absorption by local technicians/managers backed by engineering know-how, training on implementation, repair, maintenance, etc. and technical-back up services that will enable the maximum use of the imported know-how and equipment for subsequent projects.

7.0.5.2 It is frequently seen that technology adopted in various construction projects is not always what is desired. One of the main reasons for backwardness of construction industry in most developing countries is that pace and scale of technology upgrading are not commensurate with rising needs and variety of construction works that are required to be executed with defined time and cost targets. No doubt, that technology upgrading, in construction sector has to be of differential nature in different countries and in different sub-sectors of the same country because of high diversification in the construction sector's activities. For example, in the subsector of housing, a financially sound programme in a metropolitan situation (like Calcutta, Delhi, Bombay, etc.) or any large urban agglomeration may necessitate industrialised construction methods/technologies while for small and medium towns and rural centres only locally available traditional materials and construction practices may serve - though there is a need to modify these techniques in such situations also as most conventional techniques are material wasteful and do not conform to desired performance levels. Thus it has to be realised that Today's expectations can not be met by Yesterday's methods and tools. But this aspect is not appreciated in every developing country and in consequence the productivity levels of construction industry stagnate.

7.0.5.3 Lagging development of the municipal utility systems of sewerage disposal, water supply, electricity distribution is another area where technology continues to be mostly conventional and the construction industry fails to meet the challenge of fast expanding urban centres. In most

metropolitan cities particularly in inner city and highly congested areas these utility systems are on the verge of break down. These can not be efficiently maintained or repaired. Unless innovative approaches like "trenchless sewers" or rehabilitation of congested inner city areas, through prefabricated techniques of construction are adopted by construction industry such situations will continue to pose danger. In new housing developments also it is a common occurrence in big cities that houses lie unoccupied for long periods for non-completion of utility networks in time targeted manner. Such situations mostly occur due to lack of adequate advance planning and poor coordination between different agencies and conventional time consuming construction methods.

7.0.5.4 Methodological changes in the organisation and execution of the building process from design to construction and operation is another major area where industry in most developing countries lags behind. Existence of new technologies, whether pertaining to materials, equipment & machinery, construction methods, skill upgrading or management play an important role in determining the level and development rate of productivity of construction sector. Studies undertaken by several international funding and development agencies have more than often highlighted that productivity of construction industry in majority of developing countries has a very poor growth rate due to industry's failure to induct new technologies and practices which can reduce costs, time and material consumption, and/or increase quality.

7.0.6 Lack of Recognition as an Industry and Risk Confronting the Construction Enterprises

7.0.6.1 The most common factors responsible for low growth rate of construction industry are noted to be, over-reliance on public enterprises for handling construction projects, wrong technological choice, structural deficiencies in the sector and non recognition of construction activity as an industry. Since it is not given the status of industry, benefits normally allowed to industrial enterprises under other productive sectors like financial assistance from banks and financial institutions, supply of important raw materials at industrial rates are not available. Though denied the status of industry, the construction sector in India like many other countries is subjected to all regulatory Laws and Acts as applicable to other industries for example labour laws and sales tax laws etc. Main operators of construction sector are different types of small, medium and large contractors who need adequate financial support from banks, financial institutions since construction contracts are highly capital intensive. Generally large contracting firms have better access to specialised banking or credit institutions, but small contractors/enterprises are subjected to unpredictable risky conditions as their access to credit is limited and they have to face highly fluctuating demand of construction market.

7.0.6.2 Another important factor affecting the development of construction industry in most developing countries is continuance of outdated contracting systems evolved during colonial period. Similarly, system of construction contracts in India is based on or derived from the British system and a large number of terms and conditions still exist which are responsible for number of inequities in obtaining these contracts. It has been analysed that in existing contract systems some of the most troublesome clauses pertain to areas such as; (a) Construction changes; (b) Design changes; (c) Design rework; (d) supporting documents; (e) workmanship variation; (f) work scope definition; (g) Definition of costs; (h) Cost reporting and control; (i) Schedule reporting and control. The need to bring-in such necessary changes in the contract which will avoid most of the inequitable clauses and facilitate induction of upgraded technologies in system is clear from the fact that many of the projects financed by international funding agencies incorporating compulsory clauses for using upgraded technologies were executed with far more satisfying results.

7.0.7 Inadequate Regulatory Mechanisms

7.0.7.1 Despite a close link of construction activities with the socio-economic sectors the existing regulatory documents and mechanisms in most developing countries are quite inadequate and their enforcement is poor. As mentioned earlier the demand on construction sector gets multiplied with the growth of population and consequential rise in the size and areas of urban settlements (Table 6a,b,c,d). Expansion of urban centres exerts pressure for more buildable land thereby leading to pressure on infrastructure and escalation in land values and prices and it also gives rise to speculative tendencies. Obviously land-use transformations of forest, agricultural and rural lands become essential. Unless sufficient public regulatory documents like Master/Development plans, land-use and zoning regulations with proper legal back-up exist in a country the growth of housing and building activity is likely to be unauthorised, uncontrolled, haphazard and unsafe. Such documents and the expected inbuilt guidance to designers, users are of great importance for regulating settlements growth particularly of urban ones and are appropriate tools to encourage structurally sound architectural solutions and forms, as well as development of infrastructure compatible to available technology and skills. The issue relating to house/building designs in disaster-prone areas is one of significant contribution of construction activity as large regions in both industrialised and developing countries are often affected by natural disasters such as cyclones, floods, hurricanes, earthquakes etc. The disparity in construction technology between the industrialised countries and the developing ones is perhaps most vividly illustrated in the great difference between levels of human casualties and loss of property (by numbers) in such events and their aftermath. An earthquake (7) which hit sparsely - populated areas in the northern part of the Islamic Republic of Iran killed over 40,000 people, whereas an equally intensive one in the San Francisco area (1991) resulted in less than 100 deaths. The higher levels of death and physical damage in developing countries is due to the poor levels of provision of structurally-sound buildings and infrastructure which in turn are consequence of higher costs of existing technologies and failure to develop and effectively enforce more affordable alternatives. In India, it is estimated that nearly 1.2 million houses (this excludes other types of buildings) are damaged partially or fully per year due to different types of disasters (cyclones, floods, land-slides, hurricanes, earthquake). Similarly there are large number of squatter settlements and slums where frequent fires damage large number of houses due to poorly built constructions by people themselves on urban lands. What is lacking in most developing countries is formulation and enforcement of appropriate regulations and codes to promote good construction practices especially in disaster prone areas.

7.0.7.2 Non-existence of properly conceived policies to plan and guide the urbanisation trends and sufficient regulatory mechanisms like urban regulations relating to building design and construction, infrastructure provisions in many countries coupled with poor enforcement machinery affects the habitability and quality of built-environment, performance of civil engineering works, durability of the output of construction and result in misuse of land-use and loss of scarce financial resources spent on unsafe buildings and infrastructure. This is a paradox that scarcity of resources skills and non-existence or poor enforcement machinery are some of the factors that affect performance and durability while poor performance and durability of construction output is also the outcome of scarcity of resources and skills. These are one of the major impediments in the development of construction industry and have to be addressed seriously by the developing countries to achieve optimum utilisation of land which is a fixed commodity and in order to improve the quality of life in human settlements.

7.0.8 Existence of Outdated Building Bye-laws, Standards and Codes of Practice

7.0.8.1 Bye-laws are fundamental regulatory documents used by municipal authorities in all countries which describe in general terms certain targeted functions of housing, buildings and other developments in human settlements. In most of the developing countries the bye-laws formulated in colonial periods still exist without having been revised and updated. These antiquated regulatory documents on one hand do not permit any innovation in planning, design and construction of buildings thereby causing substantial waste of space, costly building materials and other resources, while on the other hand cause delays because of the inbuilt rigidity. Many developing countries lack capability for formulation of national standards and codes of practice which are supposed to be the most basic technical regulatory documents and serve as the tools for implementation of the essential requirements to be met by the products of the construction and civil engineering works. Unlike many developing countries, India and several other Asian countries where a strong pool of qualified manpower and professionals and R&D institutions exist, substantial progress has been achieved in formulating national standards and codes of practice encompassing all aspects of civil engineering such as, a multitude of building materials & products, elements of building construction, techniques of construction for roads, railways, irrigation works etc. There is National Building Code which defines in detail essential requirements of performance of building elements, built enclosures and host of other aspects covering planning, design and construction. Research, development and standardisation in different sectors of economy have flourished as nationally recognised activities in post-independence period (after 1947) and there are large number of national laboratories, educational institutions and Bureau of Indian Standards who have contributed to the formulation and development of national standards and codes of practice. But the unfortunate part is that all these standards and codes of practice are recommendatory and not mandatory and are not followed seriously partly due to negligence of enforcement authorities and partly due to non-availability of adequate technical manpower in the enforcement and regulatory agencies. In number of areas essential certification system has also been introduced. Recently for eco-friendly products (where building materials and products are also covered) ECO-MARK scheme has been initiated which would help in promoting environment friendly building materials for sustainable development of industry. Thus the importance of standards is broadly recognised, however, extensive national efforts are needed for formulation, drafting and enforcement of standards as non-existence of standards or existence of borrowed standards from other developed countries (which is true for large number of developing countries in various regions of the world) which are mostly non-functional and non-enforceable in developing countries create lot of hindrances in the progress of construction sector's growth and adversely impact the quality and quantity of the output of the construction industry.

7.0.9 Existence of Large Size of Informal Sector and Its Limitations

7.0.9.1 The precise definition of the informal sector has been the subject of considerable debate at many fora but it has been described by different people in different ways that sufficiently distinguishes it from the formal sector of economy. The characteristic features used for defining informal sector include, size of operations, number of people engaged, levels of technology used, capital base, quality and nature of management etc. In construction, the size of informal sector and its operations is rather big in most developing countries and its operations account for substantial contribution in terms of variety of inputs essential for productivity of construction sector. The informal sector in many countries is a major force in shelter delivery and for supply of large quantities of basic building materials and variety of skills and services. Though informal sector in

construction industry supplies majority of its products and services to the activities of formal or recognised sector still it has its inherent limitations in terms of low quality, instability and incapacity for progress and innovation. Since the output of informal sector is a major input to the construction industry, the sector's basic limitations also serve as major bottlenecks in the development of industry. However, its growth and continuing dependence of industry on it are the outcome of the unstable working conditions, unpredictable market demand of construction and high potential for employment of unskilled and semi-skilled workers.

7.0.10 Lack of Modern Management Practices and Contracting System

7.0.10.1 Management practices obtaining in developing countries including India and other South Asian countries are outdated and most of the construction projects suffer due to lack of adequate management manpower and continuing dependence on old methods and tools of management.

7.0.10.2 There are several serious bottlenecks to sound development of the construction industry, some relate to inadequacies of contractors while others pertain to unsound policies, inefficient systems, weak institutions and undeveloped or underdeveloped industrial environment. The most pervasive barriers according to the World Bank Report (mentioned earlier) are; inequitable contracting practices, failure of employers to meet their obligations under the contract, and the adverse conditions of the industry's business environment. The Report further mentions that discussions with contractors associations in selected countries (including an Opinion Survey conducted in Pakistan) confirmed that the most serious problems affecting construction industry are;

- lack of efficient pre-qualification standards,
- inequitable contract documents
- delays in payments,
- lack of credit facilities,
- problems in importing equipment
- lack of standardisation of local building and spare-parts, materials and high transportation costs.

7.0.10.3 The lack of development and management of suitable technologies seen as a combination of building materials, methods, equipment, manpower, skills, financing mechanisms are the real roadblocks in the progressive development of construction industry. Construction activity is no doubt rightly considered as having high potential for employment but on the other hand it requires a higher percentage of skilled labour.

7.0.10.4 Summarising the various factors mentioned already, it can thus be seen that the following major impediments exists which hinder progress of the construction sector and improvement in its productivity in most developing countries;

- i) The fragmented nature of construction industry and uncertainty in demand makes it difficult and expensive for the construction enterprises to deliver their services and products at desired pace.
- ii) Lack of desired operative interface between the various participants of the construction sector, the decision makers, contractors, professionals, building material manufacturers & suppliers, equipment manufacturers, R&D and standardisation organisations.
- iii) General shortages of financial resources and lack of access of the small and medium construction firms to institutional finance.

ECO-MARK

The Government of India has instituted a scheme for labelling of environment friendly products as optional requirements. The scheme will operate on a national basis and provide accreditation and labelling for household and other consumer products which meet certain environmental criteria alongwith quality requirements of the Indian Standards for that product. The label shall be known as "ECO Mark".

The definition of environment friendly product shall be:

'Any product which is made, used or disposed of in a way that significantly reduces the harm it would otherwise cause the environment, could be considered as environment friendly product.'

The objectives of the scheme are as follows:

- a) To provide incentive for manufacturers and importers to reduce adverse environmental impact;
- b) To reward genuine initiatives by companies to reduce adverse environmental impact;
- c) To assist consumers to become environmentally responsible in their daily lives by providing information enabling them to take account of environmental factors in their purchase decision;
- d) To encourage citizens to purchase products which have less harmful environmental impacts;
- e) To improve the quality of environment; and
- f) To encourage sustainable management of resources.

The Government has recently notified labelling wood substitute (which meet the following criteria) as ENVIRONMENT FRIENDLY PRODUCTS.

PRODUCT SPECIFICATION:

- i) Wood Substitutes for Fuels:
 - (a) Briquettes shall be made from agricultural and domestic wastes without synthetic binders, for industrial and domestic use as wood substitute for fuel.
 - (b) Biogas LPG and Natural Gases are eligible for ECOMARK as wood substitutes for fuel.
- ii) Wood substitutes for Building Material:
 - (a) Building boards generally used in partitioning flooring panelling, cladding and false-ceiling material shall be made from agricultural or industrial wastes (such as phosphogypsum, red mud baggase, cotton stalks, rice husk coir fibre, jute fibre seasile fibre, saw dust (agro or wood wastes etc.) or non-conventional timber.
 - (b) Frames and shutters used as building hardware shall be made from agricultural wastes or industrial wastes or ferrocement or environment friendly wood substitute and plastics.
- iii) Wood Substitutes in Furniture:-The furniture (Tables Chairs and stools etc.) shall be manufactured by using 100 per cent non-wood raw materials like agricultural wastes or industrial wastes or metals or environmental friendly plastics or non-conventional timbers.

BIS may formulate incorporate optional standards for environment friendly characteristics.

- iv) Lack of an integrated approach to technology transfer, innovation and upgradation of building materials, their production processes and delivery systems and transfer of research output from lab to land.
- v) Persisting dependence on energy intensive and material wasteful methods of construction.
- vi) Slow progress in improving the regulatory mechanisms and legislative control on land use.
- vii) Lack of extensive national effort required for strict adherence and enforcement to national standards on building materials, products, installations and construction techniques.
- viii) Lack of quality consciousness and non-existence of performance certification on products and processes.
- ix) Labour laws and governmental regulations stand in the way as significant institutional forces restraining the development of construction activities since the construction is still not recognised as industry in majority of countries.
- x) Declining quality of skills, lack of training programmes and low perspectives of salary gains through specialisation at all levels.
- xi) Effectiveness and quality of construction management, lack of institutional arrangements for upgradation of skills and human resource development.
- xii) Inadequacy in fiscal and other incentives at central and provincial levels for the construction industry.
- xiii) Lack of policies and promotional efforts for enhancing production and application of innovative alternate building materials particularly based on recycling of wastes which are renewable raw material resources.
- xiv) The general policy of all related sectors for contracting services or buying of materials is based on lowest price concept and not on quality and the concept disregard the life-cycle costs.
- xv) Lack of concerted national effort in improving the efficiency and output of the construction sector.
- xvi) Lack of continuing interaction between R&D & field organisations; professionals & decision makers; and specifiers & suppliers of materials.

8. INFRASTRUCTURE MECHANISM REQUIRED TO ENCOURAGE DEVELOPMENT OF CONSTRUCTION INDUSTRY

8.0.1 Thrust Areas in National Development Plan - dictates the priorities for development of Construction Industry

8.0.1.1 In most developing countries future demand for effective output from the construction industry is far greater today than ever before. While increasing realisation of the role of construction in achieving the socio-economic goals in developing societies is affecting the macro policies for its improvement on one hand the competitive and fragmented nature of the industry and construction being a project based activity makes the long-term

development and improvement very difficult on the other. Since the aims of development of the construction industry may differ from country to country depending upon the national situations and priorities essential components or parameters for its development strategy will have to be identified individually by different countries. Still several components are such which would be equally applicable and desirable for most developing countries. Following are some of the thrust areas which need to be addressed by practically all developing countries, though the action plans may be different for newly industrialising economies from the other developing ones,

- augmenting the financial support systems for construction industry;
- improving the methods and technologies of construction;
- training of manpower and skill upgradation;
- strengthening the capability of construction industry to develop, absorb and practice innovative and cost-effective technologies;
- conservation of national construction resources, increasing the use of renewable resources and preservation of natural environment;
- development and improved availability of alternative construction materials;
- strengthening the capacities of contracting enterprises to face competitive and market forces;
- improvement in professional approach in consultancy and design services;
- establishment of new if non-existent or strengthening the existing institutional framework for efficient development of construction industry.
- establishing promotional and enabling policies and strategies, financial support mechanisms and providing fiscal incentives;
- creation of information and distribution systems for improving the delivery of products and services.

8.0.2 Facilitating Policies and Strengthening of Institutional Structure for Technology Transfer

8.0.2.1 The development of any sector necessitates the presence of strong and viable institutional structure and an appropriate enabling policy framework. Policy initiatives can not be sustained in the atmosphere of slackening implementation and it is in this context it is imperative for all developing countries to identify and establish such infrastructural mechanisms and support systems those would encourage development of domestic construction industry both in long-term and short-term goals. The Brazilian Programme PRONATH (National Technology Programme for Housing), for example was developed and put into operation in early 1991. This programme is linked to the Brazilian Programme for Quality and Productivity (PBQP). The short-term objective of this programme was to have a clear diagnosis of the situation of the building industry in order to identify the bottlenecks in its technological and management development. The long range targets, however, are to upgrade the quality and productivity levels of the building industry in order to reduce costs and increase the general levels of competitiveness. Under this programme several initiatives have been planned and taken both with support from public agencies and private enterprises. The conclusion that they came to - to quote the coordinator himself - "although the public agents

play is an important role in getting things started, unless the private sector is deeply involved and motivated to supply infrastructure and funds, none of the desired goals, which ultimately benefit all the actors involved, will be achieved".

8.0.2.2 Recognising the need for appropriate institutional structure, a number of development institutions for the construction industry were established in different developing countries during the 1980s. The experience gained from the initiatives in India, the Philippines, Singapore and Sri Lanka has been documented by Miles and Neale in an ILO publication. In India, the National Institute of Construction Management & Research (NICMAR) was established by a group of major construction firms. The Government of India established the Building Materials & Technology Promotion Council (BMTPC) to provide an interministerial apex institution for speedy technology transfer in housing, building materials and construction sector. The Council undertakes to coordinate the activities of the various participants in the construction sector in order to improve delivery of services, output and productivity of construction enterprises. In Singapore, the Construction Industry Development Board (CIDB) was set up as a statutory body under the Ministry of National Development to coordinate, spearhead, promote, develop and monitor the industrialisation programme of the construction industry. In the programmes initiated by CIDB, it is hoped that the thrust of technology would reduce the labour requirements with a view to reduce dependence upon foreign workers. Similarly, the Institute for Construction Training and Development (ICTAD) established by the Government of Sri Lanka has a very broad mandate to promote the development of the construction industry generally. The need for setting up such an institution was recognised when certain serious problems were encountered in the country while planning to develop infrastructure at a fairly fast rate was initiated by the government. For example, it became evident that the organisational, economic and practical problems of the traditional clients/designers/contractors/sub-contractors/ materials and equipment suppliers/manpower chain of construction procurement were seriously inhibiting the development of the industry.

8.0.2.3 As mentioned earlier, the Indian construction industry generally has inducted new and emerging technologies, new equipment, modern construction methods, in various infrastructure sectors like roads, highways, bridges, railways, irrigation and power projects being associated with large projects funded by World Bank and other international and bilateral programmes both in India and abroad. But such technology upgradation has not taken place in housing and building sector and particularly in building materials industry. In view of this, there have been number of initiatives in the country to strengthen technology upgradation of housing industry by strengthening institutional infrastructure for promoting innovative technology. Some of these initiatives to improve technology delivery in the building industry are given below.

8.0.2.4 Institutional Mechanism for Technology Diffusion

The importance of technology diffusion for modernisation and promotion of building materials industry and development of construction enterprises for improving their delivery system is well reflected in the small sector new industrial policy of India which envisages following facilitatory strategies:

The National Renewal Fund (NRF) would also be used from now onwards to modernise upgrade the technology of small scale sector to enable enterprises to face competition and prevent sickness and closure. It is also proposed to set up an Industry Modernisation Fund for the SSI sector with a total outlay of Rs.1000 million to be made during the 8th Plan.

- **A Technology Development Cell** is proposed to be set up in the Small Industries Development Organisation (SIDO) which would provide technology inputs to improve productivity and competitiveness of the small scale enterprises including those engaged in building materials sector.

- To ensure adequacy and equitable distribution of indigenous and imported raw material to the small enterprises, a policy is under active consideration to prevent enterprises militating against each other.

- In order to facilitate modernisation and technology upgradation aimed at improving productivity, efficiency and cost-effectiveness in the small scale sector, the new policy envisages to encourage and support Industry Associations which will particularly look into the aspects of (a) quality counselling (b) common testing facilities (c) technology information to provide updated knowledge on technology and markets.

- **National Research Development Corporation (NRDC)**: By working closely with all major government funded R&D agencies, the CSIR, Defence Research Laboratories, the IITs etc. and reputed engineering companies NRDC provides an important link in the innovation change for effective transfer of technology. Some of the technologies promoted during recent years include:

- *Insulating bricks from rice husk ash*
- *Manufacture of lime*
- *Water filter candles*
- *Mini cement plants*
- *Flyash sand lime bricks*
- *Bricks by semi-mechanised process*
- *High-draught kiln*
- *Manufacture of hydrated lime by newly developed lime hydrator*

- **Building Materials & Technology Promotion Council (BMTPC)**: Set up in 1990 under the aegis of Ministry of Urban Development, the Council strives to bridge the gap between laboratory development and large scale field application of innovative building materials, construction techniques by facilitating production on commercial scale and persuading the construction agencies both in public and private sector to incorporate the new technologies in their schedules and building practices. BMTPC has developed an integrated system for technology transfer and delivery which enables it to coordinate its activities with central and state decision-making machinery on one hand and with the R&D, standardisation organisations, construction agencies, housing finance and industrial promotion agencies (central and state level), corporate sector and professionals on the other. Evaluation, validation and documentation of new technologies particularly based on agro-industrial wastes, identification and promotion of wood substitutes, formulation of Indian Standards and specifications (in concert with BIS), interaction with construction agencies, and professionals to adopt new technologies in their construction practices and encouraging the entrepreneurs for setting up production units in different regions are some of the current activities engaging the attention of BMTPC. The Council also identifies appropriate technologies from other countries and explore the possibility of technology transfer by encouraging joint ventures (either under bilateral programmes or directly), entrepreneurial interaction etc. The Council has also been developing jointly with HUDCO technology packages for rehabilitation and repair programmes being executed by State Governments by wide spread damage to housing stock due to cyclones in several Southern States and due to earthquake (October, 1991) in Garhwal, Himalayan region in North. Several new technologies developed by R&D organisations in India have also been identified for exploring their

market in other developing countries and the Council is interacting with the Technology Promotion Division of UNIDO to explore the possibilities of transfer of technology from India to other developing countries.

Housing & Urban Development Corporation (HUDCO): Functioning for over two decades as the national housing finance organisation in the country, HUDCO has taken lead in promoting cost-effective new building materials and construction techniques in large number of housing schemes put-up in different regions of the country. While utilising their financial leverage attempts are made for integrating appropriate technology options in the financial package to the state housing agencies who are the main borrowers of HUDCO. To promote investment in the commercial production of new building materials mainly from agro-industrial wastes, HUDCO has been extending financial assistance as term loan and equity participation for setting up such industries. Nearly 30 industries in different parts of the country has so far been successfully promoted by the financial support and technical guidance extended by HUDCO. The other major area where HUDCO has been instrumental in promoting cost-effective building materials and appropriate technologies is through the centrally sponsored national programmes of building centres. A Building Material Technology Exposition has been set at Madras which attract a very large number of entrepreneurs, professionals, students and house holders to know about potential and possibility of using cost-effective new building materials, components and techniques. Such more centre and few 'mobile expositions' are also being planned for information dissemination and demonstration at wide spread level. It is also operating a R&D support scheme where grants and soft loans are made available for development of new technologies by voluntary organisations, NGOs, building centres, etc.

National Housing Bank (NHB): The Bank which was set up as an apex Housing Finance Organisation under NHB Act, 1987 has also taken interest in promotion of new technologies for housing by extending equity participation to the entrepreneur desirous of setting up manufacturing units of building materials based on innovative technologies. Another scheme for Equipment Refinance in the construction sector is also under consideration of the Bank. Under the proposed scheme availability of finance would benefit the housing and building sector for improving the quality and productivity as new machinery and equipment is essentially required for application of modern technologies.

Bureau of Indian Standards (BIS): Recognising the standardisation as an important instrument of technology transfer the Bureau has been playing a very significant and effective role in extending R&D results for the benefit of the housing and building agencies by formulating Indian standard specifications, Codes of practice, Hand books, and other documents which it has been bringing out from time to time. The main objective of the BIS is to promote development of standardisation and related activities in the country. The BIS has also started several Certification Marks Schemes for various types of products including some of the products in the building material sector. The recently initiated ECO-mark scheme by the Department of Environment, is also being implemented by BIS. Under the 'certification programme' the BIS has been periodically bringing out buyers' guides for the benefits of end users.

8.1 Policy to promote Recycling of Agro-industrial Wastes

8.1.1 As a result of rapid industrialisation, the generation of wastes has increased several fold during the last few years. The measures required for proper utilisation or disposal of these wastes have lagged far behind in comparison to the quantum of waste produced with the result that these wastes have contributed substantially towards environmental pollution. Some of the

INTEGRATED TECHNOLOGY TRANSFER MECHANISM

To overcome the limitations of the conventional approach a broad based comprehensively conceived technology transfer mechanism that ensures growth of building materials production to achieve sustainable housing activities has been evolved in India. A dedicated national level set-up (Building Materials & Technology Promotion Council - BMTPC) has been created to coordinate the activities of the concerned organisations, departments, agencies concerned with R&D, standardisation, industrial promotion, production, regulatory mechanism, construction of housing and buildings, with a view to diffuse and promote new technologies in the building materials and housing construction sectors. In past, the technology transfer activities failed to stimulate the production of innovative building materials and promoting the new construction techniques in an integrated manner. The new approach enables promotion of new technologies through entrepreneurial activity by designing and operating schemes for credit facilitation supported by policy measures in terms of fiscal and non-fiscal incentives and thus making available to the end users results of research and development. So far, the efforts for transfer of technology have been sporadic which did not have any appreciable impact in the construction sector. However, under the new approach, it has been possible to undertake following steps:

- i) Working with selective approach formulation of 'technology guides' and 'interest exploration profiles' providing details of selected technologies developed by various Organisations/Institutions and those have potential for commercialisation.
- ii) Dissemination of the technology informations to the entrepreneurs, users and other technology institutions through publication, advertisement, seminar, symposia, exposition etc by closely coordinating with R&D institutions and Building Centres.
- iii) Setting up technology evaluation and validating services for emerging technologies.
- iv) Demonstration of new materials and techniques in the field to convince the entrepreneurs as well as the users about their viability by encouraging construction of demonstration projects at various places in different geo-climatic regions in the country.
- v) Identification of the entrepreneurs for setting up new production units on commercial scale through its Business Promotion Cells.
- vi) Identification of the projects where these techniques/materials could be utilised.
- vii) Facilitating availability of credit, financial incentives and other supports to the entrepreneurs for setting up industries of building materials based on new process technologies and promoting the new construction technologies.
- viii) Training: To make special efforts/arrangements for training in new technologies at different levels for the construction related workforce especially for production and utilisation of these new materials/techniques in the construction.
- viii) Identification of agencies/contractors for undertaking large scale housing projects utilising these new materials and construction techniques.

The strength of integrated approach for technology transfer developed by BMTPC can be attributed to the linkages that it has established and currently fosters with variety of institutions, organisations, bodies, committees governmental, semi-governmental, private, NGOs and the approach adopted in its technology transfer functions (Figure - VIII). The following issues are primarily addressed by BMTPC..

- i) Developing and implementing technological system for development, promotion, adaptation and effective use of selected technologies.
- ii) Promotion of productivity improvements in the building materials sector from macro level to micro(enterprise) level.
- iii) Promotion of technological upgradation and restructuring programmes to strengthen intra-industry and inter-industry linkages by integrating inherent characteristics of building materials industry with complementarity and specialisation parameters/features with respect to situations obtaining in India and other countries in the Region.
- iv) Promotion of international links and cooperation to strengthen technology transfer, R&D, training and technical assistance.

developmental projects aimed at ushering overall prosperity for the local population have also become harbinger of environmental degradation and source of serious health risks. There are several areas in India where extensive air, land and water pollution has been caused due to unscientific and haphazard disposal of industrial waste generated by such projects. Research and development efforts carried out in India and abroad have revealed that number of industrial solid wastes can be reused and recycled particularly in case of fly ash (from Thermal Power Stations), phosphogypsum (from Fertiliser Industry), red mud (from Aluminum Plants), blast furnace slags, lime sludge etc. Resource optimisation along with reuse, recycling of the wastes generated can go a long way in achieving sustainable development of building materials and construction industry. In India, BMTPC has mounted special thrust on promotion of building material production technologies using variety of wastes. Government has provided several incentives (excise duty, custom duty exemptions) for materials produced from different kinds of wastes.

8.2 Fiscal Incentives for Housing Sector

8.2.1 Fiscal incentives are being devised to induce employers in the organised sector, including industry, to provide housing for their employees and workers.

8.2.2 Incidence of direct and in-direct taxes on building materials and components are being reviewed with a view to bring down the cost of construction especially to the households who derive no direct concession from investment in housing.

8.2.3 Incentives have been given to promote the manufacture of new building materials and components produced by using agricultural, industrial and other wastes and those which substitute or reduce the use of scarce materials like wood and energy-intensive materials like iron, steel and cement.

8.2.4 In order to encourage building material industries in the country the housing finance institutions such as HUDCO and NHB are considering to form a consortium with other national and state level financial institutions to extend loan and equity participation to the entrepreneurs. The existing system of taxes, levies on production of building components and systems has been rationalised and changes made in the new industrial policy.

8.2.5 Following exemptions and concessions have been given in 1991-92 and 1992-93 Central Govt's budgets to encourage production of prefabricated buildings and waste-based building materials and wood substitutes etc.

- a) Exemption of Excise Duty on the production of low cost building materials and components being produced at various Building Centres.
- b) Exemption of Excise Duty on the production of building materials using flyash or phospho-gypsum in 25 per cent or more quantities as raw materials.
- c) Exemption of Excise Duty on bricks and tiles manufactured using red-mud (25% or more as raw material) and light weight hollow/solid blocks and other components.
- d) Exemption of the Custom Duty on the import of equipment, machinery and capital goods required for the production of building materials using flyash, phosphogypsum such as bricks, light weight aggregates, light weight concrete elements etc.

- e) Reduction in the Excise Duty from 15% to 5% on the pre-fab components required for housing.
- f) Exemption of excise duty on doors and windows using plastics and steel panel doors (this would encourage use of various wood substitutes to be used in door shutters).

8.3 Modernisation of Brick & Tile Industry

8.3.1 Recognising the energy intensity of clay brick-making industry and the increasing environmental considerations for saving top soil, the BMTPC and the National Federation of Brick & Tile Industry have evolved an Action Plan for modernisation of brick industry which is a very wide spread and rural-based industry. In order to concretise the action plan the brick manufacturers have recently taken an initiative by sponsoring a study with the Central Building Research Institute (CBRI) for developing pollution control methods, energy efficient kiln designs and improving the productivity of the conventional kilns.

9. INTERACTION BETWEEN THE PUBLIC AND PRIVATE ECONOMIC SECTORS AND THE ROLE OF MAJOR PARTICIPANTS

9.1 The need for greater involvement of the private sector in construction projects is now evident in many countries. In the industrialised countries projects and mechanisms already exist which makes provision for an active private sector involvement. The aim for involving private sector is to improve the financial resource base and also encourage technology based programmes for improving quality, productivity and resource management in the industry. In order to develop a strong construction industry the case for a trained, well looked after and responsive manpower can not be over-emphasised. In most developing countries many civil and mechanical engineering schools, polytechniques and other institutions exist but there is a great paucity of training schools for construction management and construction skills. Here is a strong case for national action to promote training institutions which will make the manpower presently deployed in the industry more effective. Formalised institutions and certification systems will help to attract new comers into taking up profession in the construction industry where trained manpower is in short supply.

9.2 Another significant area that needs to be addressed for creating infrastructure mechanism is the low capacity of the contractors in developing countries to purchase equipment for which institutional finance is not easily available. The national governments should encourage setting up of programmes or institutions for providing equipment to domestic contracting enterprises. Besides there is a need to encourage credit institutions to improve access of the small and medium contractors to credit on reasonable terms. The Government may evolve policies to protect credit institutions/mechanisms against undue risks in lending to the contractors.

9.3 Venturing into construction projects abroad by the Indian contractors particularly during 1970s & early 1980s had its beneficial effects as they were exposed to new technologies and newer equipments. With the expertise gained from the projects executed in other countries many of these contractors could apply the experience in local projects demanding sophisticated technologies. The lessons from such project exports could be to encourage domestic contractors by developing countries to collaborate with experienced foreign contractors on a long-term basis, which will ensure technology transfer and strengthening the capabilities of domestic construction industry for technology absorption. In India, for example, the Government has supported formation of the Overseas Construction Council of

India (OCCI) which has a number of large contracting firms on its membership. The OCCI facilitates the Indian Construction companies to participate in the global tenders in other countries. Similarly, on the domestic front there could be appropriate mechanisms evolved to encourage and promote sub-contracting to provide opportunities to small contractors both for getting employment and gaining experience by working with the more experienced large contractors. Such activities can be undertaken by assisting contracting enterprises to form associations and societies which will also undertake to promote high professional and ethical standards besides taking care of other interests of the member contractors.

9.4 The construction industry has certain special features which distinguish it from other industries particularly in developing countries where most construction demand is in public sector. Almost all construction products are custom-made and location-specific to meet particular needs of projects/clients. As mentioned earlier the industry is highly vulnerable to fluctuations in governmental policies which have a direct impact on relationships between public and private economic sectors. It is generally seen that construction and building sector is quite heterogenous in character and relationship between public and private sectors is somewhat arbitrary. The agencies operating in public construction sector more than often receive their inputs from informal or unorganised private sector to save costs and obtain products for which no substitutes exist in the formal sector.

9.5 In order to meet the rising demand on quantity and quality of output of the construction sector the existing relationships and roles of the key participants are required to be reoriented particularly in developing economies. Construction industry is a sector of economy which transforms variety of resources into economic and social infrastructure and utilities. Ownership of nations' natural resources generally rests with the national and provincial governments in most developing countries. In order to regulate the utilisation of available resources for better productivity while ensuring its even distribution in the society most governments in past did not allow private sector's participation in a large number of sectors of economy where a large component is contributed by construction sector. In keeping with this policy in past, government was the major client and state-owned enterprises were mainly used in implementing most housing, building and civil engineering work programmes. However, with economies in most countries opening out in recent years the relationships between public and private sectors in almost all or may economic sectors are fast changing and more flexible policy initiatives have either been taken in many countries or are in offing in others, with the objective of bringing in additional resources for implementing the development programmes.

9.6 The National Housing Policy of India envisages the role of government and public agencies as facilitators of housing and not builders of housing. Like many other countries in India too, economic policies are fast moving towards privatisation of many activities which were earlier reserved only for public sector enterprises, for example, roadways, railways, energy-generation, municipal services, and several other sectors responsible for providing infrastructure. Thus shift from central planning to market economy in many countries and for privatisation of several core sectors of economy in others focus on two basic issues of financial and technology resources and available capabilities. These policy changes will call for new orientation of relationships and interaction between public and private economic sectors and the role of key decision-makers, professionals and contractors. There are mainly four types of actors who impact the policies and activities of construction industry:

- those supplying knowledge and information such as R&D, standardisation and educational institutions, data bases, mass media;
- those applying knowledge and information to decisions, plans and

programmes such as authorities, associations, entrepreneurs, planners, designers and programmes, etc.;

- *those applying decisions, plans and programmes for the production of goods and services for delivery such as processors, producers and implementers;*
- *those supplying goods and services for consumption and usage and maintaining the delivered goods and services, such as administrators, controlling distribution policies, servicers and renovators.*

9.7 One major recommendation that emerged at the Second Consultation on the Building Materials industry (Athens, November 1991) need to be looked into in this fast changing market oriented scenario. To quote the recommendations, "Entrepreneurs are the central actors in and the driving force behind the growth of the sector. A national strategy should, therefore, strive to involve the entrepreneurs in all decision-making processes."

9.8 There is an urgent need to integrate or coordinate the activities of different actors to improve the productivity and quality of construction output consistent with the income and affordability of each country. This calls for concerted action at the national, local and enterprise level to create a conducive policy environment for the industry and to improve the construction sector's access to finance, physical resources and technologies. Such initiatives should reflect the specific needs of different sub-sectors of the construction industry including building materials producers, suppliers, small, medium and large construction enterprises, specialised sub-contractors, public and private enterprises, and the informal sector as well as different components of the construction activities such as housing, infrastructure, maintenance and rehabilitation works. In order to achieve this a comprehensive view of the construction industry is needed and the industry should be considered as a system. A system consists of a number of participants, contexts in terms of inputs, an institutional framework and a body of rules and regulations which govern interaction amongst its participants and their performance. A graphical representation of the construction Industry's total system (Figure-VII) as recommended in India by the Working Group constituted by Planning Commission (October, 1989). The task given to the Working Group was to study the existing construction methodologies and technologies and to suggest improvements which could be implemented for improving efficiency, speed and quality of construction in the country. The system is to be further looked into to include the requirements of the participants of the industry, societal gains and other outcome of the industry, institutional framework. The main recommendation of the Group was that the desired development of the construction sector can be better ensured if it is restructured to act as a comprehensive system.

9.9 It is observed that the construction sector in its present state does not have the capacity - organisationally, quantitatively or qualitatively - to play its full role in nation-building. If the construction industry is to meet the challenges facing it and to fulfill the expectations of the people, the urgency for change for improvement has to be realized at all levels and the total system has to be revamped. New technologies, materials and methods have been and will continue to be evolved. At best a new directional thrust would be needed towards economy and towards rural development. But, most important, the participants of the system will have to change their organisation and style of functioning. The industry must develop qualitatively to perform more than merely executing works at the site under departmental supervision. The government organisations, their structure, culture and style also need a radical change because implementation of any change depends maximum on the government and its organisations. They must lead the change by regulations as well as by adopting the new technologies in their own construction works.

9.10 In view of the foregoing discussions it is clear that a flexible construction industry set-up would evolve in due course where different sizes of enterprises will operate at decentralised level and their scale and nature

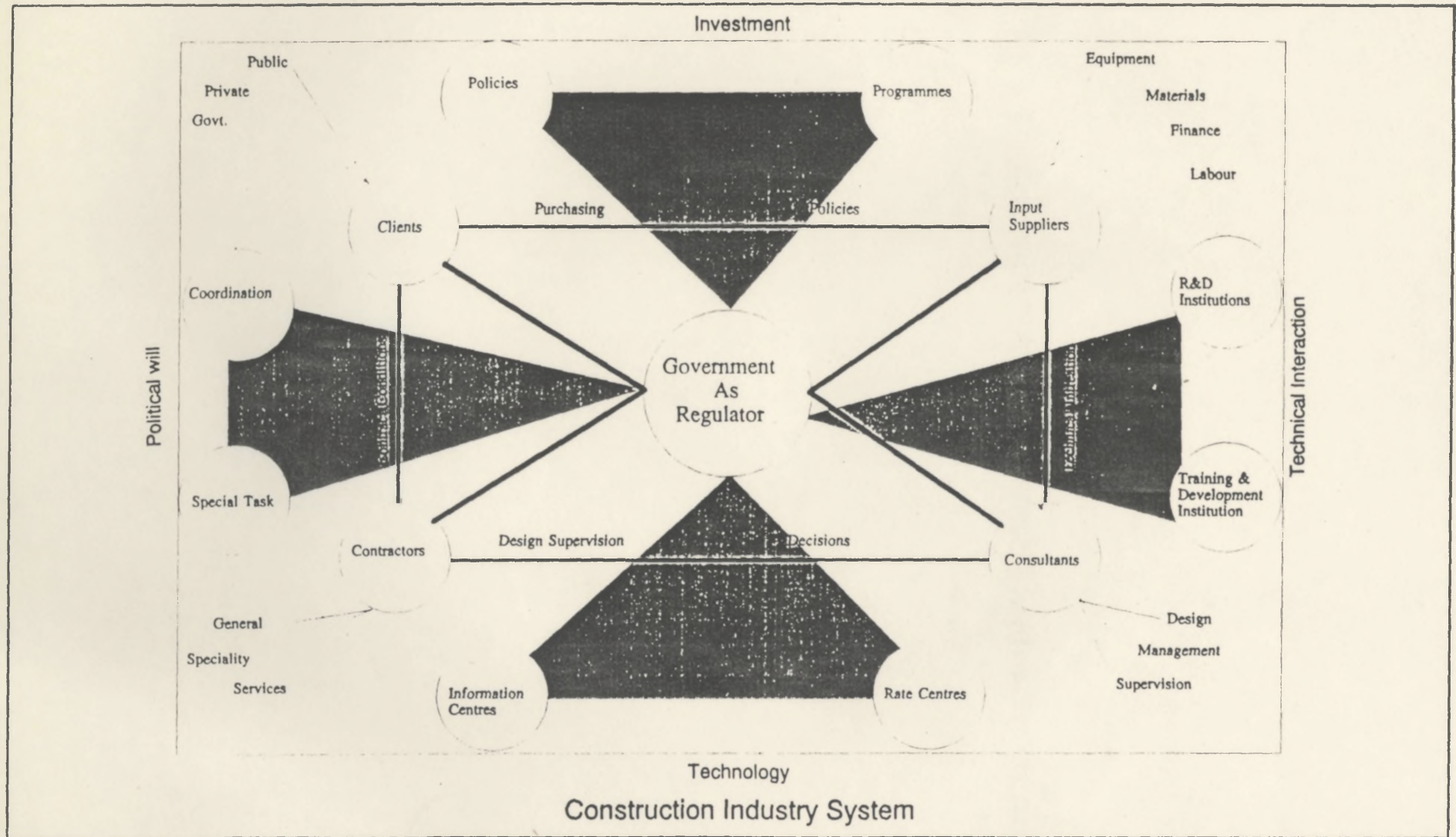


Figure - VII

of operations will be demand and market driven. To be responsive to these changes the construction industry in developing countries will have to strengthen the enterprises particularly small and medium size contracting firms their vertical and horizontal linkages in the sector, their resource base, technology modernisation capabilities through enhanced training at different levels of workers, supervisors and managers.

10. RESEARCH AND DEVELOPMENT CAPABILITIES

10.0.1 In India research and development in housing and building construction has much of its background in the goals and instruments of Science and Technology (S&T) nationally established in mid-forties. The strategy for application of S&T in all sectors of economic development was first resolved under Scientific Policy Resolution (SPR) of 1958 and later in Technology Policy Statement (TPS) of 1983 consequently R&D in building and construction, like various other sectors flourished as a nationally recognised activity at several centres of research and teaching. Some of the major areas in which significant R&D achievements have been made by these institutions include;

- Characterisation of building materials based on assessment of their properties.
- Upgrading of performance of traditional building materials and construction techniques.
- Development of energy efficient and cost-effective process technologies for economical manufacture of building materials.
- Structural design criteria for load categorisation and for foundations, walls & roofs; seismic designs, designs against high wind forces and cyclones, floods, land slides, etc.
- Improved foundation engineering techniques and practices.
- Economy through improved construction techniques by promoting simple onsite industrialised methods.
- Improved productivity through better construction equipment and operations.
- Design criteria for environmental/comfort requirements with reference to lighting (natural and artificial), ventilation and thermal comfort in buildings.
- Low-cost sanitation, plumbing methods, sewerage disposal systems.
- Fire safety measures in buildings and performance assessment of materials and building elements under fire.
- Building regulations space and landuse standards based on physical, functional and comfort of users.
- Energy efficient design of buildings and use of alternative sources of energy for building requirements.

10.0.2 Standardisation

10.0.2.1 In India, significance of standardisation for improving appropriate, intermediate, cost-effective building materials, technologies and technology dissemination in the field of building industry and housing was recognised quite some time back since building materials are responsible for nearly 2/3 of construction cost. The process of standardisation particularly for innovative building materials and components

was started during early 70s to create acceptability for the newly developed building materials and to promote their large scale application. A large body of standards on building materials, components, cost-effective construction techniques has been generated by amalgamating the information, experience and research results. The aims of standardisation in India and the areas covered are indicated below:

AIMS

- Conservation of building materials
- Overcome shortage of building materials
- Increased availability of building materials
- Promote use of locally available materials
- Utilisation of Agro/Industrial waste
- Environmental protection
- Energy conservation
- Import substitution
- Economy in construction
- Speed of construction
- Technology upgradation
- Consumer protection
- Low income housing

AREAS

- o Cements and concretes;
- o Various building materials and elements of building;
- o Structural engineering & structural safety;
- o Wind engineering;
- o Fire fighting and fire safety;
- o Soils and soil engineering;
- o Geosynthetics;
- o Water supply and sanitation;
- o Construction management;
- o Earthquake engineering;
- o Special structures;
- o Public health engineering;
- o Foundation engineering;
- o Safety in construction;
- o Ports and harbours;
- o Rock mechanics;
- o Offshore installation.

10.0.2.2 The extent to which lack of standards, specification and codes of practice has been instrumental in hindering the adoption of home grown innovative building materials and technologies has long been a matter of concern for the Government. Since non-listing of these new technologies in Indian standards and codes has been generally quoted, by public sector housing agencies, for non-adoption of new technologies in the building practice, the Bureau of Indian Standards (BIS) has been constantly striving new technologies within the fold of a standardisation. Many new materials and techniques have attracted the attention of building industry and housing agencies and have also been gradually identified in codes of practice and are getting incorporated in the schedules of specifications of organisations like Central and State Public Works Departments and other large construction organisations in public and private sectors. The gaps in adoption of BIS codes are addressed by the national Govt. and BMTPC and is also leveraged by housing finance being related to use of cost-effective technology. The Bureau of Indian Standards which is the statutory national body for formulating national standards in all areas has one full divisional council for civil engineering and building industry. Over 1600 Indian standards have been so far designated and formulated.

10.0.2.3 Quality control of construction operations through standard construction practices inspection and testing is another area which is attracting the attention of architects, engineers and other professionals engaged in the housing and building construction. The quality consciousness has been recently increasing particularly in view of the new industrial policy and other measures taken by Government of India for liberalising the economy with a view to bringing competitiveness in the Indian industry. The aspects of quality control at site for materials and components are much more important for the promotion of innovative building materials and techniques and construction of large scale housing projects.

10.0.3 Energy Conservation in Construction Activities

10.0.3.1 Until recently, energy planning in India like most other developing countries was done with little concern for environmental implications of energy production, conversion, transportation, and utilisation. However, the implications of one or more of these steps in the energy chain could be particularly severe in the areas of concentrated population and of human settlements activity. With the rapidly rising demand of energy from various sectors, energy planners are increasingly becoming aware of the impact of construction practices and urbanisation pattern on the quantity and types of energy required in construction works or by the users of the buildings. Different forms of energy are spent in various stages of building which include the site layout, design, construction, subsequent performance and maintenance. Thus energy consumption in buildings occur mainly at three stages viz. (a) production of building materials and components, (b) construction process, and (c) design, operation and maintenance in the long run. The design decisions at planning stage, selection of sub-systems and related equipment, efficiency ratings of such equipments, fixtures and fittings are all important for overall energy requirement and consumption levels.

10.0.3.2 On the one hand the design and fabric of a building in a given geographical and climatic setting influences significantly the overall energy requirement and on the other the energy requirements in production of building materials are affected by the nature of raw materials, processes and technologies employed for their production and post-production conversion methods for making them ready for specific applications in the buildings and other construction works. The energy profile for residential buildings assuming an average area of 1000 sq.ft. (90 sq.mt.) in urban area and 500 sq.ft. (45 sq.mt.) for rural area works out to be as given below:

	Urban House (in kcal)	Rural House (in kcal)
Materials	1.38×10^{15}	1.52×10^{15}
Construction	3.90×10^{12}	4.28×10^{12}
Maintenance	3.58×10^{13}	3.93×10^{13}

10.0.3.3 Construction industry at present does not take into consideration energy conservation practices except in certain cases where professional architects, engineers and energy experts are associated with the planning, design and construction in large projects. Reduction of cost being the main consideration in the construction industry mainly dominated by private sector, generally neglects energy conservation aspects. Conventional construction practices themselves are energy intensive, improved construction techniques like pre-fabricated building components, cavity walls, light-weight concrete products, fly ash bricks, several other alternate new materials etc. are being adopted to reduce the energy requirement of buildings but use of such innovative construction technologies is presently confined to very few buildings.

10.0.3.4 Production of building materials particularly in the manufacture of cement, steel, brick, lime, plastics, etc. consumes substantial quantity of energy mainly through non-renewable sources. Energy requirements in the manufacture of some of the important materials are given in Table-8. This is the average energy spent in the production of these materials in the form of fuel, manpower etc. To-date, the use of alternative energy sources in the building materials industry has been very little. Total energy inputs needed for projected quantity of some building materials for housing requirements during the period 1991-2001 are given in Table-9.

Table-8
ENERGY COSTS OF VARIOUS BUILDING MATERIALS IN INDIA.

Materials	Basis	Energy (K.Cal)
Cement	kg.	1.93x10 ³
Burnt Clay Bricks	1000 Nos.	1020.6x10 ³
Surkhi	kg.	0.330x10 ³
Quick Lime	kg.	1.51x10 ³
Mild Steel	kg.	6.3x10 ³
PVC	kg.	27.75x10 ³
Sheet Glass	m ²	63.8x10 ³
L.D.Polyethylene	kg.	5.2x10 ³
Burnt Clay Roofing Tiles	1000 Nos.	1060.0x10 ³
Sand-lime Bricks	1000 Nos.	665.0x10 ³
Wood Particle Board	kg.	0.74x10 ³
Linoleum	m ²	39.8x10 ³
Sanitary wares	kg.	7.80x10 ³
Stoneware pipes	kg.	5.07x10 ³
Aluminum	kg.	34.3x10 ³
Clay-Flay Ash Bricks	1000 Nos.	553.0x10 ³
Bloated Clay Aggregate	kg.	1.27x10 ³
Gypsum (Calcined)	kg.	0.3613x10 ³
Crushed aggregate	kg.	0.0516x10 ³

Table - 9
ENERGY INPUTS IN PRODUCTION OF MAJOR BUILDING MATERIALS
FOR HOUSING 1991-2001 (INDIA)

Item of Input	Unit	Total Quantity	Energy (x10 ⁶ KCAL)	Oil Equivalent (Million Tonnes)
Bricks	100 Million	4618	47129.98	4.80726E+11
Cement	Million Tonnes	78	150760000	1.53775E+15
Lime	Million Tonnes	580	876070000	8.93591E+15
Bitumen	1000 Tonnes	160	831.74	8483748000
Tile for roof	Million Nos	24713	26195.52	2.67194E+11
Iron and Steel	Million Tonnes	14	87135.55	8.88783E+11
				1.0475311e+16
MTOE for 1991-2001				10.4753111865
MTOE for a year (1 Million Tonnes = 10.2 x 10 ¹² K cal)				6.8466086186

10.0.4 Human Resource Development

10.0.4.1 During the past four decades there has been a phenomenal expansion of technical education in the country. As such there are over 200 recognised technical education institutions at the first degree level and more than 560 polytechnics at the diploma level with annual admission capacity of 40,000 and 80,000 students respectively. Nearly 140 institutions offer facilities for post-graduate studies and research in several specialised area. In the engineering and technology sector there are nearly 20 institutions like Indian Institute of Science, Bangalore, five Indian Institutes of Technology (IIT), which functions as centres of excellence and nearly 1600 graduates and post-graduates come out of these institutions annually. With such a large number of academic institutions in engineering and technology, it is but natural that the country has a vast pool of highly qualified manpower. The post-graduate institutions in general and IITs in particular engage themselves in technology development through innovation and its transfer to industry. The Government has been facilitating interaction and collaboration of such institutions with industry and other user organisations in order to promote technology development and upgradation. In keeping with the new industrial policy the Eighth Five Year Plan envisages

further action for improving interaction with industry and extending technical support to engineering entrepreneurs for further development of products and processes.

10.0.4.2 While adequate emphasis has been laid on education and training of technical personnel through a hierarchy of teaching institutions, skill upgrading and human resource development at the level of construction workers and technicians in different trades have been largely neglected.

11. INFORMATION DISSEMINATION AND TECHNOLOGY TRANSFER

11.0.1 Though there are no restrictions on the dissemination of information pertaining to the outcome of R&D and technological innovations taking place within or outside the country, the policies in many developing countries do not provide for a strong technology transfer mechanism and as such adequate funds are not available as no specific institution is ever made responsible for technology transfer activities in construction sector. Difficulties in dissemination of R&D results in a country of India's size are compounded due to some of the following major bottlenecks:

- For wide spectrum of problems confronting the construction industry due to the geo-climatic spread of the country the R&D investment itself is quite low and it cannot absorb any expenditure on extension and technology transfer activity;
- Inadequate access of the general population as well as the professional groups to the technologies being developed by various R&D institutions;
- Lack of adequate documentation in the form that can be understood by the people who have to use it;
- Lack of policy commitment and administrative backup inhibiting adoption of innovative technologies (building, housing and other construction projects being controlled by interdisciplinary teams tend to ignore the recommendations coming out of research institutions);and
- Lack of innovative strategies and strong technology transfer institutions at regional level.

11.0.2 Poor Interface Between Concerned Agencies & Information Dissemination

11.0.2.1 In the backdrop of the mounting housing shortage and widening gap between demand and supply of building materials most developing countries have no soft option but to adopt on large-scale, the locally available cost-effective building materials and appropriate technology. Inadequate interface between the various participants in the housing process, hinders availability of information in the required format for the prospective entrepreneurs and results in lack of user awareness and credibility gap for the newly developed materials and construction technologies. There are no listings of technology sources available with small industry development organisations in many of the developing countries.

11.0.2.2 Extensive research results are available in institutes and other bodies both in developed and developing countries but this knowledge has not been effectively disseminated at the construction enterprise level in the developing countries, necessitating the urgency for appropriate co-operation programmes within the country and between the different countries. Information on innovative materials and construction techniques is lacking even on proven technologies and on the sources from where such technologies can be obtained. The data on raw material resources for production of building materials is scanty and not easily available to entrepreneurs. Professionals and agencies operating in the field do not receive regular

information about the new developments nor they are involved in the development processes of materials products and construction methods. Many enterprises for production of alternate building materials fail because the availability of raw materials in quantitative terms and on continuing basis was not known at the time of starting the production unit. Similarly, the data projected on annual availability of different types of wastes from agricultural, industrial or mining industries at various points is neither readily available nor in the form required by entrepreneurs to plan details of investment and for setting up of new manufacturing units based on such wastes as raw-material.

11.1 Resistance to induct innovative technologies in schedules of specifications/tenders documents of public construction agencies

11.1.0.1 The housing and building construction agencies in the public sector have yet to incorporate majority of new materials and techniques of construction in their schedules of specifications & rates and tender-documents. Application of new technology, has been mostly in the construction schemes of semi-governmental housing agencies but not in ones undertaken by Govt. agencies like as Public Works Deptt, Railways, P&T, MES (Military Engineering Services) etc. It is being increasingly felt that the links between research institutes and such governmental agencies are not well established thereby hindering application of new technologies in governmental works. This trend discourages the exiting enterprises to diversify their production or new entrepreneurs to start manufacturing or trading of innovative products.

11.1.0.2 It takes a long time before relevant standards, codes of practice are formulated on new materials and technologies which inhibit their wider application. In India, a very large number of standards exist on variety of building materials, construction techniques/systems and building related products. Since standards are not mandatory but recommendatory, there is no sound mechanism for their enforcement and conformity, thereby leading to a situation where existing enterprises can keep on ignoring them. The pre-standardisation certification or performance based certification systems are generally non-existent in most developing countries.

11.1.1 Lack of evaluation and absorption capacity of Small Enterprises engaged in Building Materials Production or Construction

11.1.1.1 Another major draw back of existing technology transfer systems comes from lack of appreciation and evaluation capacity of existing small and medium contracting firms and enterprises engaged in building materials production. These enterprises are often unaware of the technological options or their implications. Partly, this can be attributed to the deficiencies in the institutional network for technology extension services, their inability to supply the information either at a cost affordable by the enterprises or in packages that can be readily understood and utilised. For most small scale production units adjustments in the level of technology are called for as a part of modernisation to raise productivity or to improve the quality of products or to reduce the consumption of costly inputs like energy or raw material. Since the technology transfer institutions do not provide necessary advice and back-up services for evaluation of available options and finally selecting the appropriate technology on industry to industry basis, it has not been possible to modernise traditional industries. The lime and clay brick and tile producing industry, for example, have a long tradition in most countries of Asia, whose sizes of production units and qualities of end products vary widely. These are industries with considerable scope for modernisation by inducting standardisation and new production processes. Several new production processes and efficient kiln designs have been developed by R&D organisations in India, for production of lime and clay

bricks and tiles. Their adaptation by large number of existing units (though a large number of new units are coming up) has not been possible mainly because of poor capacity for evaluation of new technologies on the part of industry and also due to inadequacies in functioning of the existing technology transfer institutions and their approaches which do not go beyond supporting pilot scale trials and demonstrations at few selected locations.

11.1.1.2 There are a large number of cases where dependence of a developing country on transfer of packaged building materials technology from developed countries have led to problems. Experience has shown that, in many cases, technologies so transferred or acquired fail to meet expectations due to inappropriate choices and at conditions not suited to local industrial environment having inadequate capacity to absorb a fully packaged imported technology. Unlike commodity transfers, where market prices are fairly well known, the cost and terms of technology transfers are not suitably evaluated. Most of the entrepreneurs from developing countries find themselves in weak position when acquiring or negotiating with technology suppliers, particularly, if the source is a large international company. Naturally, this is a failure of a institutional arrangement concerned with technology transfer for not having an adequate strengthened technology base for facilitating technology flow from developed to developing country. The UNIDO has been arranging workshops and training programmes to help developing countries in improving capabilities of the entrepreneurs to negotiate technology transfer agreements and it is suggested that the developing countries should take benefit by participating in such workshops or requesting UNIDO/UNCHS to arrange for specific workshops for different countries on regional basis.

11.1.2 Lack of technology service capabilities

11.1.2.1 Engineering design and consultancy services are the part of the infrastructure that facilitates modernisation through upgradation of technologies at enterprise level by mobilising indigenous manpower, skills and experience to work on construction projects. Such services by technology transfer agencies can play a significant role in ensuring better use of local resources by employing appropriate technologies. Lack of such technological support services as project preparation, feasibility studies, engineering design and consultancy, are often responsible for hindering the modernisation of the construction industry in most developing countries.

11.1.2.2 It is thus clearly seen that the technology transfer mechanisms, which should perform as the coordinator and turnstile between investment and production activities and facilitate flow of information on technological possibilities, in most cases suffer from their inability to provide engineering design and consultancy services and fail to offer comprehensive service to the entrepreneurs on feasibility and viability of production methods for producing new and durable building materials and to meet the total need for enabling them to set up enterprises.

11.1.3 Innovative modes of technology transfer

11.1.3.1 The success of a technology transfer system largely depends on the intimate study and recognition of the structure of construction sector in a given country-specific situation, and the roles and linkages between the various actors in the sector. In a developing country such relationships generally revolve around a large number of factors like existing capital-labour ratios; raw materials locally available or transported from outside the region; nature and volume of local demand; production processes employed; nature and cost of inputs; design of products/outputs; organisational pattern; links between enterprises within same type and with others in same or other sectors; to and fro information flow on technological aspects; available

technical skills and capability within enterprise (capacity to innovate or absorb innovation); available technology support from other enterprises, governmental institutions and from private consultants; financial capacity of the enterprise, availability of affordable financial support, policy support, incentives, available infrastructure services and supports. In the efforts of majority of organisations dealing with extension of technology it is seen that their emphasis is on giving information on new technologies to help building and setting up of an industry or rehabilitating an existing one. A clear distinction must be made between such services to enterprises for building up industrial capacity and to the sector for building up technological capability. It is in this context only that the nature of technology transfer mechanism has to be evolved after a thorough understanding of the construction sector and its forward and backward linkages in the country-specific environment. An innovative 'mode of technology transfer' has to offer services beyond dissemination and extension of technologies in order to direct the technological upgrading of the building materials and construction sector and provide a basic technological infrastructure in the country. Recognising the need for setting up of such a comprehensive system Govt. of India established the Building Materials & Technology Promotion Council (BMTPC) as an apex institution to provide inter disciplinary and inter-ministerial platform and to develop an integrated mode of technology transfer in housing, building materials and construction sectors.

11.1.3.2 The reasons for success in reaching the new technologies to the prospective entrepreneurs and facilitating creation of a technology environment in a short span of time in India emanate from its integrated approach and the structure of the BMTPC itself which is inter ministerial, inter agency, inter state, inter-institutional and inter disciplinary. Further the operative linkages being developed and fostered makes it possible to achieve visible results. The structure and operative linkages with various institutions are reflected in Figure-VIII. It will be seen that the Council in its efforts seeks to facilitate transfer of technology with the support of central/provincial government policies, regulations, fiscal incentives, executive support of decision making at agency level, S&T and standardisation support from concerned institutions and above all taking action to cover both the supply side and demand side aspects of building materials involving both the manufacturers/entrepreneurs on one side and the users, construction agencies and professionals on the other. The Council is operating through its Business Promotion Cells and networking with industrial promotion agencies in various regions of the country and trying to reach various target groups with appropriate "technology-packages" and entrepreneurial programmes.

12. COST-EFFECTIVE OPERATIONS AND PERFORMANCE OF THE CONSTRUCTION INDUSTRY

12.0.1 Methodological changes in the organisation and execution of construction projects is a major area that needs to be addressed by the developing countries in order to improve efficiency and productivity of the construction industry. Availability of adequate managerial capabilities in the construction sector in a developing country are of great importance for cost-effective operations, optimum utilisation of resources, efficient productivity and completion of construction projects in estimated time and cost and of requisite quality. In view of the contribution of construction industry in achievement of various sectors of economy accounting for nearly 50 per cent of total investment in development plans makes it imperative that required level of project management skills are developed and adopted in practice to improve cost-efficiency and performance of the construction industry.

12.0.2 It is a common observation that many large construction projects become economically unviable due to time and cost over-runs. Analysis of

GOVERNMENT
Ministry of Urban Development
Planning Commission,
Indus. Dev., Finance, Deptt. of Small Scale Indus.,
Power, Rural Development, Environment

R&D
CBRI,
SERCs,
RRLs, NCB
CBRI, IITs

- Technology absorption of Imported techno.
- Identification Development & Evaluation
- Standardisation
- Techno-Feasibility
- Quantitative performance standards
- Technical advice for special area problems

BIS,
NRDC
TESTING
INSTITUTIONS

- Standards
- Performance & Evaluation of new technologies
- Pre-feasibility studies
- Licensing
- Entrepreneurial awareness

DST(TIFAC)
NBO, GSI
NCAER,
NEERI
DOEn, CPRI

- Technology planning
- Identify opportunities & threats for selected tech.
- Social acceptance of Techno.
- Technology monitoring
- Regionwise resource Survey
- Environmental surveillance
- Contextual Mapping

RESOURCE INSTITUTIONS

Fiscal Concessions
 Pricing policy
 Financial Support
 Policy support
 Long range policy options

Building Materials and Technology Promotion Council

HUDCO
HSMI
Building Centres

NHB
IDBI
IFCI
ICICI

State level Industrial Development Agencies

CPWD & other major Construction agencies

- Technology extension in Pub. & Pvt. agencies professionals, household sector
- Feedback on Innovative technologies
- Demonstration projects
- Training
- Mats. estates
- Venture Capital
- Equity & loan support

- Equity & loan support
- Import of techno. and equipment
- Entrepreneurial feasibility
- Technology development support

- Economic analysis of alternate technologies
- Technology transfer to construction deptt. MES, P&T, Rlys, State PWDs,
- Market support by tying up with Building Centres
- Pre-standardisation certification

BENEFICIARIES

- Construction Agencies (Public & Private)
- Manufacture of Building Materials
- Financial & Industrial Development Agencies
- Dept of Power, NTPC
- Govt. & Private undertakings generating wastes
- Prospective Entrepreneurs
- Workers, Craftmen, artisans.
- House holds

Figure - VIII

various projects which had serious time and cost over-runs indicate that main responsible factors are;

- (a) Inadequate project formulation
- (b) Poor planning for implementation
- (c) Lack of proper contract planning and management
- (d) Poor project management during execution stages.

12.0.3 Most of the planning, design, engineering and project management functions of construction projects in India and other developing countries are being handled by Government departments and agencies who are the major clients for all construction and civil engineering works. This has led to marginalisation of the managerial capabilities in the construction industry which has been largely relegated the role of supplier of work force for carrying out different tasks and material and products required for completion of works. Such a practice has weakened the construction industry considerably as accountability for cost-effective operations and for overall performance of the sector does not lie with non-governmental participants of the industry that is contractors. Since contractors (who are not the designers but are simply expected to build as per given design & specifications) are not involved in planning and design or formulation of projects they have no opportunity to contribute or give any benefit of their experience and expertise.

12.0.4 Research and development (R&D) activities connected with construction do cover aspects like design, materials, structures, and site works but aspects of project formulation management, monitoring, development of appropriate institutional mechanisms are generally not covered by R&D studies. Research studies in developing countries have also not addressed the areas like improvement in working conditions, safety and health of workers. For instance, in Japan increasing concern at the high rates of accidents in certain concreting operations on high-rise buildings led to the development of automated concrete placing using robots. Technologies introduced into the construction industry due to closer participation of contracting firms have improved productivity, for example, Austrian/French Tunnel Form system and some of those technologies which have offered opportunities for recycling materials and raising productivity, for example, scarifiers of pavement black top. There are also cases where large construction projects are held up due to action of environmentalist and social activists because of a worse environmental impact of such projects. Due to increasing concerns for environmental and ecological aspect of sustainable construction activities, in India now Environmental Impact Assessment of large construction projects (river valley, irrigation structures, and power stations etc) has been made mandatory for approval project. These examples emphasise the need to incorporate decisions about technological choice in the early phases of the project design. This approach can help in improving productivity and working conditions simultaneously. High performance industries are, with increasing success, adopting an approach of combining quality, ergonomics and value analysis - the three important requirements of performance. Success of this approach depends on efficient communications between the participants and its adoption has proved useful in improving working conditions, productivity and product quality and it is argued that the approach can be meaningful adopted by the construction industry.

12.0.5 Poor technology levels and Lack of management capabilities responsible for Lack of Cost-effective Operations of the Construction Industry

12.0.5.1 From the existing scenario in the construction industry, the confronting constraints and analysis of the requirements for further development of the construction industry in India particularly and developing

countries generally presented in the foregoing chapters, it is to be seen that the potential of the construction industry for improving efficiency of investments in development programmes and enhancing the pace of development is substantial. The fast moving economic liberalisation and changing industrial environment in India and other developing countries offer great opportunity for the construction industry to develop its potential. Construction is becoming more of an international activity in terms of the services that the construction enterprises can provide today.

12.0.5.2 The Indian construction industry despite the advantages of low labour costs, large number of different sizes of construction enterprises and the experiences learnt from project exports of 1970s and early 80s as well as their association with the execution of projects being funded by international development agencies like World Bank etc. fail to respond to the changing pressures of demand and competition. India has the rare distinction among developing countries of having all domestic construction projects executed by local contractors. However, technology and management continue to be stagnant owing to failure on the part of most contracting companies, public contractors to induct modern construction equipment, methods and technologies. Some isolated efforts have been put in to modernise this industry but without much impact either in terms of increased output or higher level of productivity.

12.0.5.3 The study of successful case studies of construction industry from some countries indicate that Government plays an effective role in controlling and directing the growth of the construction industry and it is a combination of enabling policies, efficient regulatory mechanism and effective dissemination of information technology and other industry related aspects which are required for proper development of the sector. In the absence of an effective coordinating mechanism at the apex level the construction activity being inherently fragmented continue to be subjected to controls, checks and interferences at all levels. This has a bearing on the development of the construction industry within the country and adversely impacts the overseas participation by domestic industry.

12.0.5.4 The lack of adequate capacity for cost-effective performance in the domestic construction industry in India is mainly due to following factors;

- o Lack of financial support for construction industry - The industry suffers from poor capacity to mobilise financial resources at entrepreneurial level because it has not been accorded the status of an industry.
- o Lack of finance, awareness and slow speed of introducing improvements in the methods and technology of construction and management practices.
- o Poor performance and efficiency of public sector enterprises operating in construction and housing sector.
- o Lack of adequate attention to manpower training and skill formation in tradesmen, supervisors, small-contractors and project managers.
- o Inadequate availability of newly developed alternative construction materials and incentives for enhanced utilisation of new materials and methods.
- o Poor contract management framework.
- o Lack of facilities and long procedures involved in acquiring equipments for the construction industry.

- o Lack of policy support and regulatory mechanism for strengthening contracting firms.
- o Poor environment for improvement of consultancy, design and management services.
- o Dwindling export market and lack of competitive capacity of construction enterprises.
- o Lack of initiative on the part of construction enterprises for technology transfer from other countries.

12.0.5.5 In view of the fast expanding requirements of housing, buildings and infrastructure, the Governments in most countries are increasingly turning to the private sector as a partner in the funding of construction and civil engineering works. Simultaneously the private sector is making greater demands upon construction enterprises to deliver services and products within strict limits of cost, time and quality.

12.0.5.6 The two major partners in the construction industry in a country like India are contractors and the construction workers but both of them suffer due to lack of adequate regulatory mechanisms for their sustenance and growth. For example, there is no systematic licensing system for contractors but only a registration system prevails that too based on the criteria which is inconsistent with the needs of construction activity and performance. Even the membership of the Builder's Association of India is not compulsory and there is no other code of ethics to govern the activities of the contractors. Thus the growth and development of the construction sector is not regulated. The construction workers do not enjoy a regular employment status that would give them the basic rights to employment and social security. Temporary and contract labour including migrant labour accounts for the largest share of construction workforce. It is due to this widespread practice that the necessary technological developments are difficult to be undertaken.

12.0.5.7 The standard working week in India as well as in many countries has become shorter whereas the actual time of work often remains high (even the maximum statutory overtime limits are crossed). Studies undertaken in United States suggest that consistently high levels of overtime reduce productivity.

12.0.5.8 Continuing demands of housing, buildings, civil engineering and public works confront the construction industry with a number of pressures for change. The high technological standards in other spheres and environmental concerns are imposing more stringent demands and restrictions on the construction activity particularly in terms of time, cost and quality criteria. It is, therefore, essential to create policy supports and set up facilitatory measures under a well considered action plan to develop technological, organisational and financial capabilities in the construction industry in all developing countries. New management structures, modes of operation and coordination between the various participants and greater integration of the project phases are required to be considered as effective means for development of construction industry.

13. RECOMMENDATIONS

13.0.1 The size of public and private investments in housing, building, infrastructure and public utilities and the fast increasing demands call for structural changes in the construction industry in most developing countries. The existing structure of the industry is characterised by the slow speed of technological innovation leading to low productivity levels and poor manpower quality and management are the main factors hindering the desired level of development of the construction industry and its cost-effective performance

in majority of countries. Following recommendations are offered for further discussion, consideration and adoption:

13.0.2 For National Governments

13.0.2.1 Technology Development

- Strengthening existing institutional framework and creating new (if non-existent) to develop, disseminate, demonstrate and promote innovative cost-effective construction materials and technologies.
- Develop Technology Management Nuclii at national level to train professionals in Demand Management through technology upgradation in the construction sector.
- Establish Technology Management and Industrial Information Centres at regional (within the country) levels to help technology upgradation at enterprise level.

13.0.2.2 Manpower Development

- Create institutional framework to promote, sustain, network and supervise programmes in construction related trades/tasks for skill formation, upgrading, standardisation, testing and certification at decentralised level and scale compatible to the spread of construction sector's activities.
- Training and skill development of supervisors, contractors and project managers.

13.0.2.3 Industry Development

- i) Enabling strategies, policy framework and facilitatory measures should be established to improve the business environment of the construction industry by improving access of the contractors to credit on reasonable terms.
- ii) Efficiency and competitiveness of public sector construction agencies should be improved and these need to be treated equally with the private construction firms.
- iii) Development, production and application of local materials or innovative alternate materials should be promoted. The promotional efforts should have policy backup in terms of fiscal and non-fiscal incentives.
- iv) Strengthening of existing institutions engaged in upgrading the managerial capabilities, entrepreneurship and export potential, and promotion of new building materials and technologies of construction industry.
- v) Dissemination of information on availability of cost-effective building materials and appropriate construction techniques from within and outside the country should be given high priority.
- vi) All developing countries should urgently formulate national policies, strategies, regulatory mechanisms and technology options appropriate for optimisation of energy needs and sustainable developments of the construction industry.
- vii) An appropriate legislation and licensing system for the contractors should be established. The needs for training and human resource development should be assessed and

appropriate institutional mechanisms be established for training, certification and development of professional competence.

- viii) Research and development efforts should be directed to develop ways and means to improve the capacity and efficiency of construction industry in terms of cost-effective operations, quality of work and timely completion of projects. More R&D studies should be undertaken to cover areas such as policy research, technology upgradation needs, capacity improvement, managerial options and strategies to improve operational methods.

13.0.3 For International Action

- i) Case studies of construction industries in developing countries having varied circumstances should be undertaken to assess trends in construction productivity, cost-effectiveness and impact of the existing policy framework. The cooperation in terms of joint ventures and technology transfer among the developing countries and between developed countries should be encouraged in order to provide impetus for development of the construction industry in developing countries.
- ii) Sharing of experiences and documentation of successful projects and undertaking of demonstration projects in the area of improving the construction techniques for house construction in disaster prone regions.
- iii) UNIDO and UNCHS should support few well structured programmes aimed at capacity-building in construction industry of selected situations where cooperation on transfer of technologies amongst developing countries can also be promoted as a part of proposed programme.
- iv) UNIDO should support workshops and International Entrepreneurial Meets in different regions involving few neighbouring developing countries to provide opportunities to meet and discuss with entrepreneurs from industrialised countries for developing joint-venture proposals or to promote direct buying and selling of technology between different countries.

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GLOSSARY

BIS	Bureau of Indian Standards
BMTPC	Building Materials & Technology Promotion Council
CIDB	Construction Industry Development Board
CSIR	Council of Scientific and Industrial Research
HUDCO	Housing and Urban Development Corporation
ICTAB	Institute for Construction Training & Development
IIT	Indian Institute of Technology
ILO	International Labour Organisation
MES	Military Engineering Service
NGO	Non Government Organisation
NHB	National Housing Bank
NHP	National Housing Policy
NICMAR	National Institute of Construction Management & Research
NRDC	National Research Development Corporation
NRI	Non Resident Indian
OCCI	Overseas Construction Corporation of India
P&T	Post & Telegraphs
R&D	Research and Development
S&T	Science and Technology
SAARC	South Asian Association for Regional Cooperation
SIDO	Small Industries Development Organisation
SPR	Scientific Policy Resolution
TPS	Technology Policy Statement
UNCHS	United Nations Centre for Human Settlement
UNIDO	United Nations Industrial Development Organisation