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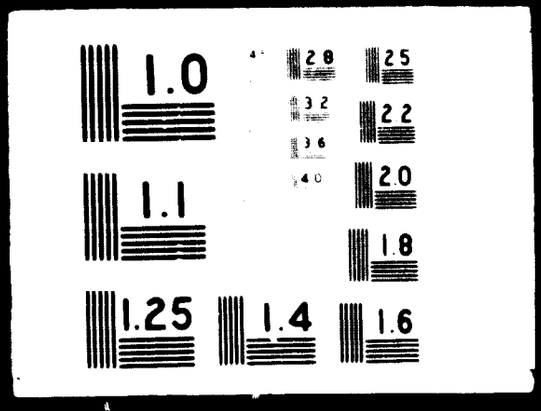

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USE OF PLASTICS IN BUILDING IN INDIA 1/

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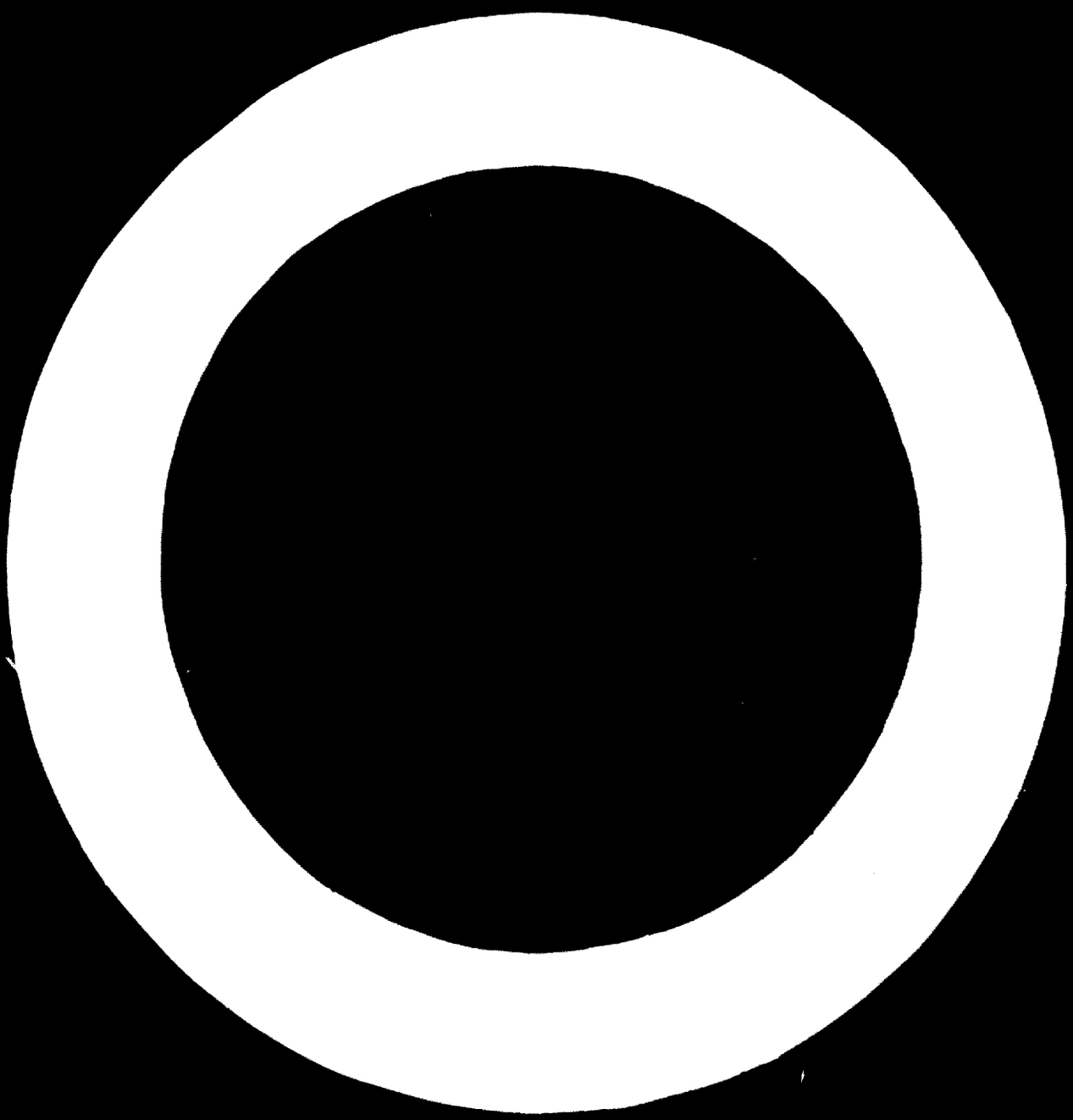

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SUMMARY

India is a vast country with varied traditions and climatic conditions. The provision of the basic needs for every family i.e. "shelter" has been given due place in the country's development plans over the last two decades. The investment on house building activities has been increasing during the last three Five Year plans. Correspondingly there has been increasing demand on development and expansion of building materials industry. Traditional building materials such as bricks, cement, timber, iron and steel, being basic materials of construction, have been going up in their cost of production, thereby affecting the over-all building cost.

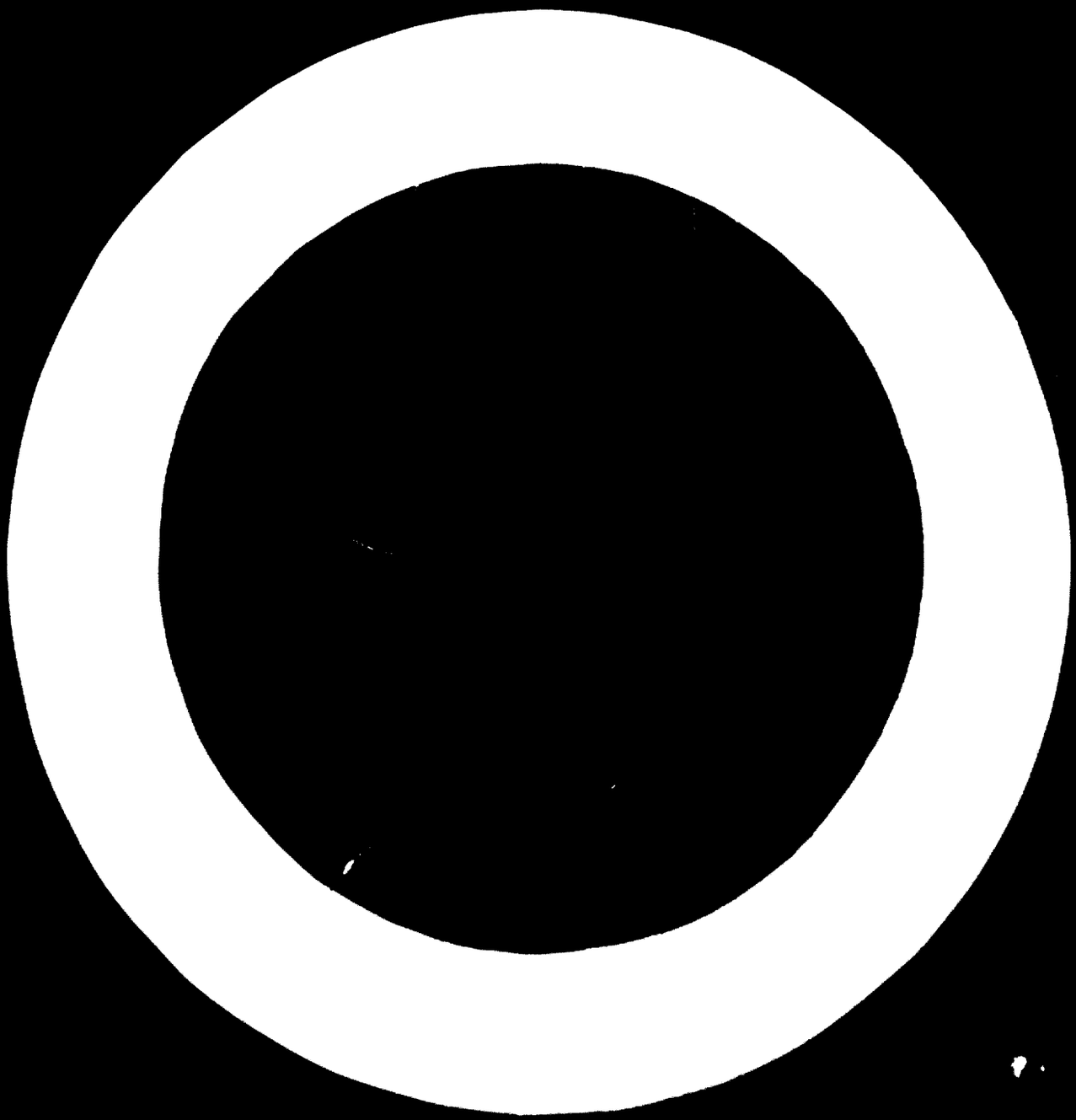
On the other hand, the shortage of traditional building materials and their successive high cost have necessitated the development and introduction of new building materials which may be economic in use as also offer certain advantages in their service performance. Among the new building materials, plastics have come to the notice of the Indian building industry only recently. The development of plastics industry has been possible with the corresponding developments in the chemical industry, and more recently the petrochemicals industry in India. The expansion of plastics industry based on petrochemicals has thus been planned. Larger quantities of plastics raw materials at cheaper rates will be available and converted into a number of products including those required in the building industry.

Already a number of plastics products for the building industry are produced and marketed in India. These include pipes and fittings, sanitary fittings, GRP rooflight sheets, electrical fittings and fixtures, building hardware, decorative laminates etc. Sufficient experience in their manufacture and use is yet to be gained under Indian climatic conditions. Also re-orientation of user habits are desired since plastics are new building materials and being organic in nature and "delicate" to handle, require proper appreciation during storage and installation on construction site. This has called for systematic education and training of the users in the building industry.

Judicial use of plastics in building demands organized study of their behaviour under Indian climatic conditions. The use of PVC piping systems for cold water services has made a beginning. This is mainly due to the fact that PVC piping system produced in India is economical to install compared to conventional metal pipes. The introduction of building hardware in plastics has promised much sought for relief on non-ferrous metals which are in short supply and at times required to be imported.

The need for suitable communication medium between plastics building product manufacturers and their users has long been felt. The National Buildings Organization has taken up this work for the building industry. This has been necessitated to provide relevant technical information on the subject to the users, formulating suitable standards and codes of practice and getting their acceptance in building codes of local authorities/construction agencies in India.

The Indian building industry has to pick and choose some of the applications of plastics in building developed in advanced countries. Applications like flushing cisterns, PVC rainwater and soil systems, PVC coated steel and aluminium sheets, and PVC window frames, raw materials for which are available indigenously are likely to be developed for the building industry in the next few years.



1. INTRODUCTION

1.1 Housing needs in India

The decade 1969-1979 will witness an unprecedented pressure on housing resources in India. Not only will it commence with backlog of 83.7 million housing units, but also add almost 10 million new families to the effective demand. Further, with the expected improvement in our food situation, the public opinion will try to assert itself, as strongly as possible, for the satisfaction of the next basic need of every family, i.e. shelter.

The urban housing shortage amounted to 2.8 million units in 1951, 5 million in 1956, 9.3 million in 1961, 11.8 million at the end of 1967, and 11.9 million by April 1969, when urban population touched 97.2 million. Another 2.5 million units are likely to be required to cover new families during the next decade. Again 1 million units of the existing housing stock of 11 million would need replacement during the next ten years. Thus in all there would be an estimated shortage of about 15.4 million units. Against this, the rate of construction has been extremely low. It works out to be 3.5 units per 1,000 persons per year, during the last three plans.

The over-all shortage in rural areas was 56.5 million units (including those which had to be completely rebuilt or improved substantially) in 1961, 69.6 million at the end of December 1967, and 71.8 million by April 1969 when rural population was 436 million. Another 7.5 million housing units would be required to cover the anticipated increase in rural population. About 1.1 million units would be required to replace the deterioration in the existing housing stock in our villages. Thus, about 80 million new units are required to be provided in the next decade. Against this demand, the rate of construction of new houses in rural areas works out to be 0.44 units only for 1,000 persons.

The over-all rate of construction in both urban and rural areas thus works out to 2 houses per 1,000 persons annually. Against this, an expert body of the United Nations has recommended construction of 10 houses per year per 1,000 persons. It may not, however, be possible

to achieve this rate in the Fourth Five-Year Plan with the existing level of investment on housing in the private and public sectors. To meet the situation within the available resources and to minimize further deterioration, it has been recommended that the country should aim at the annual construction rate of at least 5 houses per 1000 persons in the Fourth Plan and the tempo should be stepped up to 10 houses per 1000 persons in the Fifth Plan.

1.2 Building Industry, Size and Investment during Five-Year Plans

Estimates of investment in First, Second and Third Five-Year Plans show that investment in housing and buildings represented a sizable segment of the total investment. From Table 1 it will be noticed that the quantum of housing and building investment has been increasing in every subsequent plan as compared to the preceding one, though its share in total investment of the economy has been rather declining.

Table 1 Investment on Housing and Building in India in relation to total investment in the Economy

(Rs. million)

Plan	Total investment in the Economy	Investment in Housing	Investment in other Buildg.	Total of 3 and 4	Percentage of investment in		
					Housing to total invest.	Other Buildgs. to total invest.	Housing Buildg. to total invest.
1	2	3	4	5	6	7	8
First	33600	11500	5500	17000	34	16	50
Second	67500	13000	6650	19650	19	10	29
Third	104000	15500	7750	23250	15	7	22

The housing programmes initiated during the three plans, related to specific state of population, like industrial workers, persons in low and middle income groups, slum dwellers, plantation workers, etc. These schemes have, no doubt helped in the construction of a sizable number of new housing units for the different categories of population. However, in view of the immense size of the problem which seems to be deteriorating over the years, these efforts have hardly made any dent on housing shortages. Accordingly, greater emphasis on housing to raise the allocation during the Fourth Five-Year Plan has been laid. The size of the Fourth Plan is taken to be about Rs.220000 millions. Fifty per cent of this i.e. Rs.110000 millions has been earmarked for investment in the construction sector (Rs.25000 millions for residential, Rs.85000 millions for non-residential).

1.3 Housing and Urban Development Corporation: Revolving Fund Scheme

In addition to the housing programmes envisaged in the Fourth Plan, the Government of India has formulated revolving fund scheme for housing with a capital of Rs.200 crores and the establishment of a central housing corporation. This corporation namely 'The Housing and Urban Development Finance Corporation Pvt. Ltd.' has since been established (1970), with the following objects:

(i) to finance or undertake housing and urban development programmes in the country;

(ii) to finance or undertake, wholly or partly, the setting up of new or satellite towns;

(iii) to subscribe to the debentures and bonds to be issued by the State Housing (and or urban development) Boards; Improvement Trusts, Development Authorities etc. specifically for the purpose of financing housing and urban development programmes;

(iv) to finance or undertake the setting up of building material industries; and

(v) to administer the moneys received from time to time, from the Government of India and other sources as grants, or otherwise for the purposes of financing or undertaking housing and urban development programmes in the country.

The revolving fund thus is expected to generate large-scale housing construction programmes in selected urban centres, specially the metropolitan c: For the implementation of housing programmes, it is imperative that such pro. are executed with utmost economy and speed for quicker return.

1.4 Availability of Building Materials

Availability of building materials in requisite quantities is one of the important pre-requisites for increasing the tempo of house building activities and successful execution of building programmes. During the Th rd Five-Year Plan, shor age of essential building materials created serious bottlenecks. Taking into consideration the increased investment in construction during the Fourth and Fifth Plans, advance action is to be taken for the expansion of various traditional building material industries such as steel, cement, lime, bricks, timber etc. and development and introduction of new building materials.

1.5 Building Materials Industry/Traditional Building Materials

Bricks, cement, timber, iron and steel are the basic materials of construction in India.

1.5.1 Bricks

The Fourth Plan production of bricks have been estimated to be around 100,000 million bricks. The estimated requirements of bricks for achieving the targets in the Fourth Plan is 134,000 millions (5 year period) leaving a short-fall of 34,000 million (5 year period).

The prices of bricks have increased by 40-60 per cent during the last decade.

1.5.2 Cement

Cement i the basic material in odern construction. The following are the figures of installed capacity and production of cement for 1968 to 1970 (in million tonnes).

	Installed Capacity	Production
1968	14.1	11.9
1969	15.6	13.6
1970	16.96	15.0

It is expected that by 1970-71, cement industry will have an installed capacity of 18.25 million tonnes due to commissioning of several new units. The cement production is expected to reach 18 million tonnes per year with an installed capacity of 20 million tonnes by the end of the Fourth Plan (1973-74). Taking an average production of cement at the beginning and end of the Fourth Plan, as 16 million tonnes, availability position of cement would be satisfactory and no additional capacity of cement is required to be provided.

The price of cement has risen sharply during the last decade; Rs.135.60 per tonne in 1961, to Rs.197.01 per tonne in 1970.

1.5.3 Steel

It is estimated that the production of saleable steel during the Fourth Five-Year Plan period would be 40.2 million tonnes and out of which 22.5 million tonnes is expected to be available for the construction sector. The scarcity of steel for construction is felt throughout the country as the production of steel is much below the targets. The production figures for the period 1967-69 are given below:

Table : Production (000 tonnes)

Year	Steel ingots and metal for castings	Finished steel	Semi-finished steel
1967	6361	4119	1445
1968	[illegible]	4404	N.A.
1969	4340	3120	N.A.

There has been steady increase in the price of steel during the period 1961-70. The wholesale rate of steel rods and bars which was RS.670 per tonne in 1961 rose to RS.877 per tonne in 1970. At present great scarcity of plain mild steel reinforcing bars is being experienced.

1.5.4 Timber

It is estimated that 40 per cent of the timber is used in the construction industry. On this norm, 15.5 million cu.m. of timber would be available for construction and the remainder will go for alternate uses. Fourth Plan requirement for timber has been placed at 11.0 million. Great scarcity of primary species of timber is felt in the country and the prices are soaring. To meet the shortage of primary species of timber in the construction industry, it has been recommended to use secondary species of timber, wood-based panel products, such as flush doors, etc. and particle boards and hardboards.

1.6 New Building Materials

It is evident from the foregoing paragraphs that the prices of traditional building materials have been increasing in India during the last decade. Since building materials constitute 65-70 per cent of the cost of construction, they directly contribute to high cost of building construction. Also the labour costs in the building industry have been going up and corresponding rise in labour wages has been demanded for with the rise in prices of building materials. The higher building cost is also directly related to living cost which is progressively increasing. Fig. 1 shows price rise trend in building materials and Fig. 2 gives out building cost indices in major cities in India. The National Buildings Organization have been engaged over the years to suggest ways and means for reduction in building cost. It has been recommended and agreed upon that an important route to reduction in building cost would be to promote new building materials which offer economy in use as also help conserve costly traditional materials. Accordingly the following new building materials are being promoted for use in the Indian building industry:

(i) Modern Structural Clay Products
(ii) Sand Lime Bricks
(iii) Cellular Concrete
(iv) Light Weight Aggregates
(v) Asphaltic Corrugated Sheets
(vi) Industrial and Agricultural Wastes for the production of building materials, and
(vii) Plastics Building Materials.

Figure 1

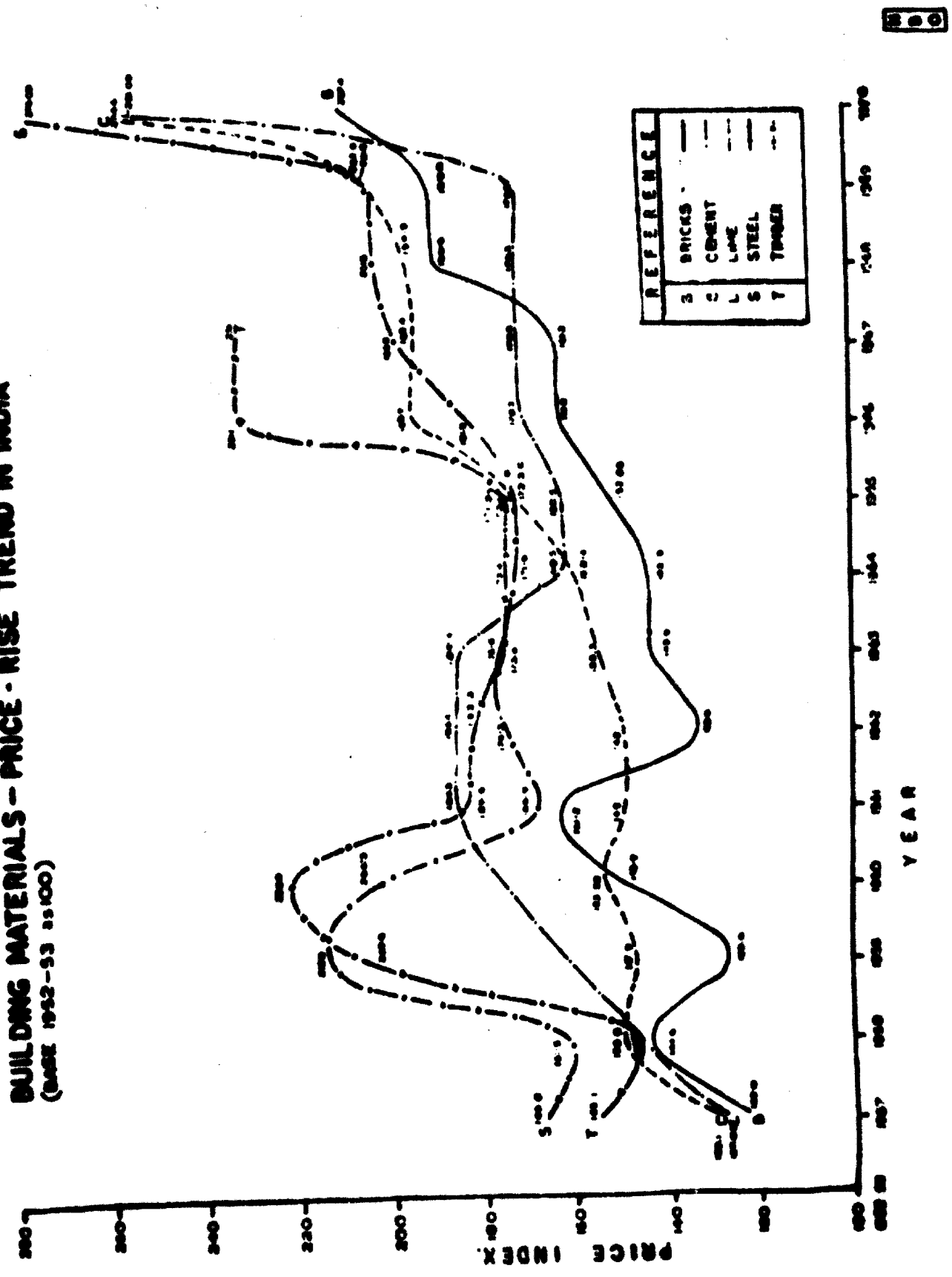
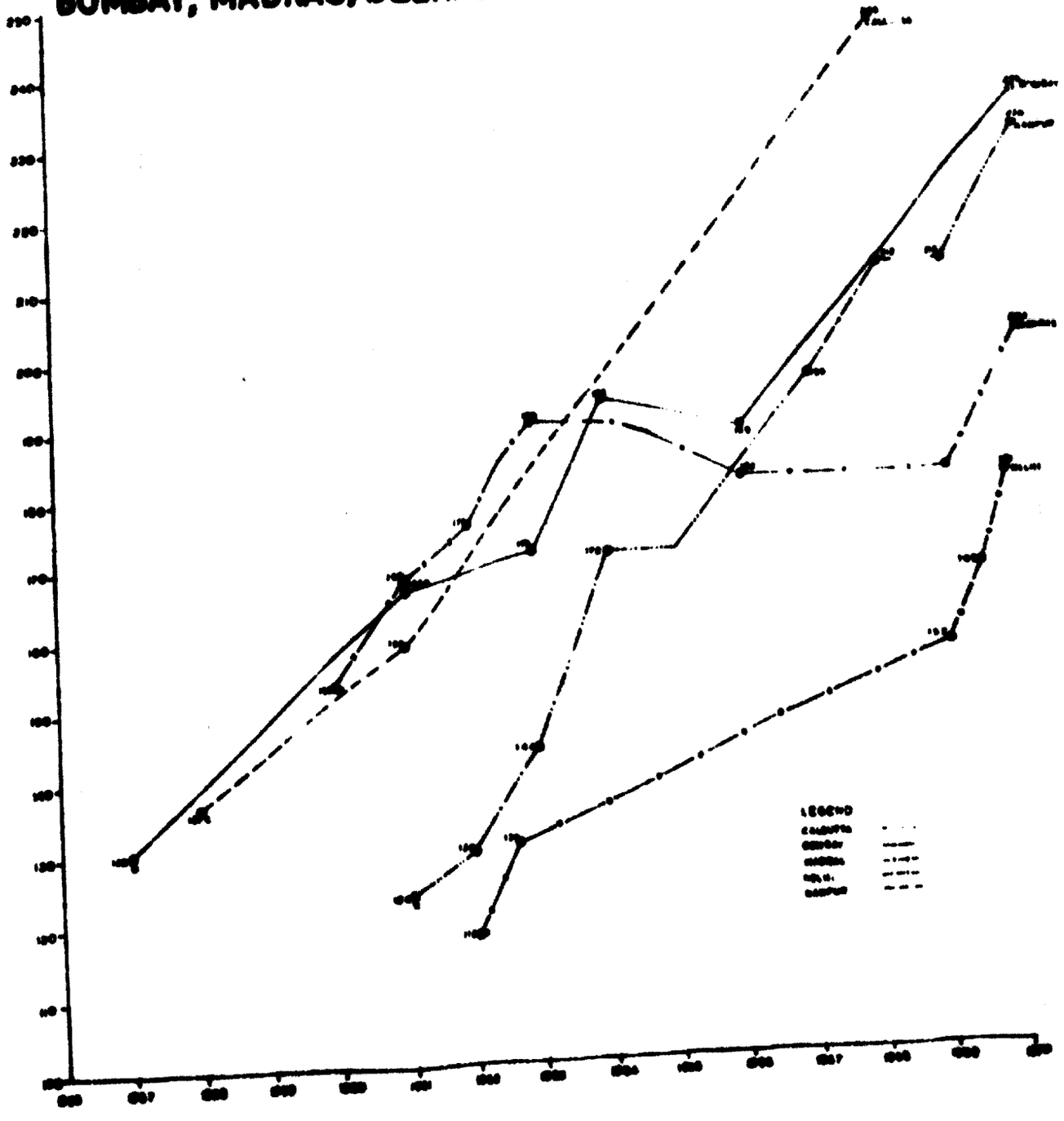

BUILDING MATERIALS – PRICE - RISE TREND IN INDIA
(BASE 1952-53 = 100)
REFERENCE
B BRICKS
C CEMENT
L LIME
S STEEL
T TIMBER
PRICE INDEX
YEAR

Figure 2

BUILDING COST INDICES - 1955 - 1970 FOR CALCUTTA, BOMBAY, MADRAS, DELHI & KANPUR



2. DEVELOPMENT OF PETROCHEMICALS BASED INDUSTRIES

The expansion of crude oil refining capacity in India has increased the potential availability of a vast range of organic and inorganic chemicals from petroleum resources. The integrated development of petrochemical industry in India was taken up at the beginning of the sixties. The programme envisaged the setting up of petrochemical complexes both in public and private sectors.

Until very recently the Indian Chemical Industry was based not on hydrocarbons of petroleum origin but on the industrial raw materials of alcohol from molasses, acetylene from calcium carbide and aromatics from coal.

2.1 Petrochemical Complexes and Targets of Production

There are two prerequisites for the development of petrochemicals based hydrocarbons. One is the availability of naphtha and the other the facility for cracking naphtha. While naphtha has been available in large quantities for many years, the facility for cracking became available from 1967 onwards. In the private sector, four petrochemical complexes have been set up. The first one, a 60,000 tonne naphtha cracker plant was commissioned in December 1966, at Trombay near Bombay (Maharashtra). At full capacity, the product mix will be as indicated in Table 3.

Table 3 Production of end-products

	Tonnes
Polyethylene	9,000
Butylalcohol	3,000
Acetic acid	1,400
Ethylacetate	600
Ethylhexanol	1,600
Dioctyl phthalate	1,600

The second integrated plant based on latest technology situated in the Thana-Belapur area (Maharashtra) was commissioned in January 1966. This unit at full capacity will be cracking 225,000 tonnes of naphtha a year to produce the following products.

Table 4

	Tonnes
Ethylene	60,000
Propylene	35,000
Benzene	14,000
Butadiene	7,200
Ethylene oxide	12,000
Polyethylene glycol	1,000
Ethylene dichloride	3,000
Vinylchloride	30,000
Polyvinyl chloride (PVC)	20,000
Iso-propanol	1,500
2-Ethylhexane	8,000

The third unit commissioned in February 1968, was the first project to make phenol, acetone and phthalic anhydride from petrochemical raw materials. The chemicals manufactured at this unit are essentially intermediates for a number of downstream products such as caprolactum (for the manufacture of nylon) phenolic and allied resins, plasticizers, acetate-rayon, solvents, PVC, etc.

The initial and subsequent production capacity of different products are:

Table 5

	Initial Capacity	Subsequent Capacity
	Tonnes	Tonnes
Phenol (from Cumene)	10,000	15,000
Cumene (from Benzene and Propylene)	14,500	22,000
Acetone (co-product in the manufacture of phenol from cumene)	6,000	9,000
Di-acetone alcohol	2,000	5,000
Phthalic anhydride	6,000	6,000
Phthalates	3,000	3,000

The Fourth unit also in Maharashtra went into production in November 1968, to produce high-density polyethylene. The major products are:

	Tonnes
High-density Polyethylene	20,000
Processed Polyethylene	5,600
Ziegler Catalysts	320

2.1.1 The petrochemicals industry is highly capital intensive and the technology is also of sophisticated type which is continuously changing. In view of this fact, the Government of India decided to set up petrochemical complexes in the public sector primarily with a view to provide assured supplies of large tonnages of raw materials to private sectors for setting up of industries for producing synthetic fibres, synthetic rubber, plastics, detergents, drugs and pharmaceuticals, pesticides, dyes, etc. In order to set up petrochemical complexes in the public sector, Government of India floated in 1969, Indian Petrochemicals Corporation Ltd. which is fully owned Central Government enterprise. Its main objective is the development of petrochemical complexes around the refineries in the public sector and its first projects are being set up at Koyali near Baroda adjacent to Gujarat Refinery. Oil refineries and petrochemical complexes existing and proposed to be set up in India are shown in Fig. 3. An estimated outlay of about Rs.4000 to Rs.5000 millions has been earmarked for Gujarat complex both in the public and private sectors. The main units of the comple - an Aromatics project and an Olefins project which are the parent projects, will be in the public sector. The down-stream units, which will use the basic raw materials made by the parent projects will be in the private sector. The aromatics unit, estimated to cost Rs.180 million, is likely to go into production by 1972. The Olefins projects is estimated to cost Rs.300 million. The Olefins project will have the largest naphtha cracker in the country of the capacity of 455,500 tonnes. Fig. 4 shows the layout of Gujarat complex and target dates of production for various petrochemicals and their end uses. Table 6 indicates anticipated capacity from naphtha cracker at Koyali.

Table 6 Anticipated capacity from Naphtha Cracker at Koyali

Ethylene	130,000
Propylene	35,000
Propylene (Comml. Grade)	43,300
Butadiene	22,000
Benzene	23,600

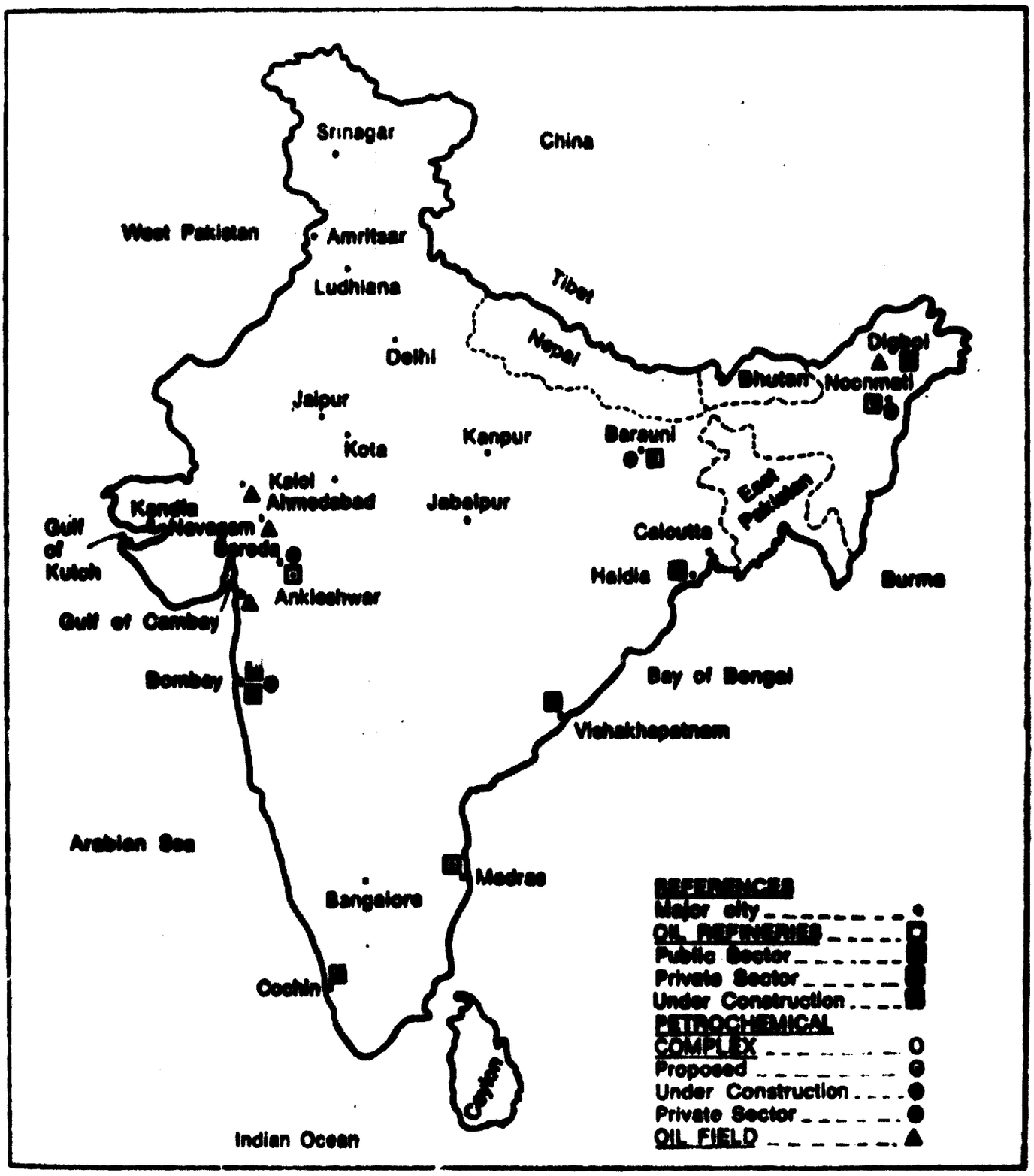
The availability of naphtha, the feedstock for petrochemicals, is very closely connected with the refining capacity within the country. Naphtha is needed both for petrochemicals and fertilizers. The present crude refining capacity in India is about 17 million tonnes. With the expansion of three public sector refineries at Barauni, Koyali and Cochin, and full production of recently commissioned 2.5 million tonne Madras refinery, the total refining capacity by 1973-74 is estimated at around 26.5 million tonnes. It is expected that the naphtha requirements of petrochemicals will be fully met.

2.2 The Plastics Industry

2.2.1 Raw Materials

The Indian plastics industry got its start during the fifties (before that it was based on imported raw materials and processing machinery) when relatively small PVC, polystyrene and polyethylene plants were established. The only base materials (indigenously available) were alcohol obtained from molasses, acetylene from calcium carbide and benzene from coke ovens in steel industry. Naphtha cracker units had not been planned then - use of raw materials that were indigenously available was logical. When downstream units were established (after 1966), petroleum ethylene became available at much lower cost and switch-over from alcohol to ethylene became inevitable. At present all the major plastics raw materials are produced in India. Among the thermoplastics are included, PVC (resins and compounds), polyethylene - both low-, and high-density, polystyrene (both general-purpose and high-impact) and cellulose acetate. The thermosets include phenol-formaldehyde urea-formaldehyde, and melamine formaldehyde (resins and moulding powders), polyesters, and epoxy resins. Of the four units engaged in the production of PVC resin, two are based on carbide process, one on alcohol, and one on

Figure 3



INDIAN PETROCHEMICALS CORPORATION LTD.

(A Government of India Undertaking)

Figure 4

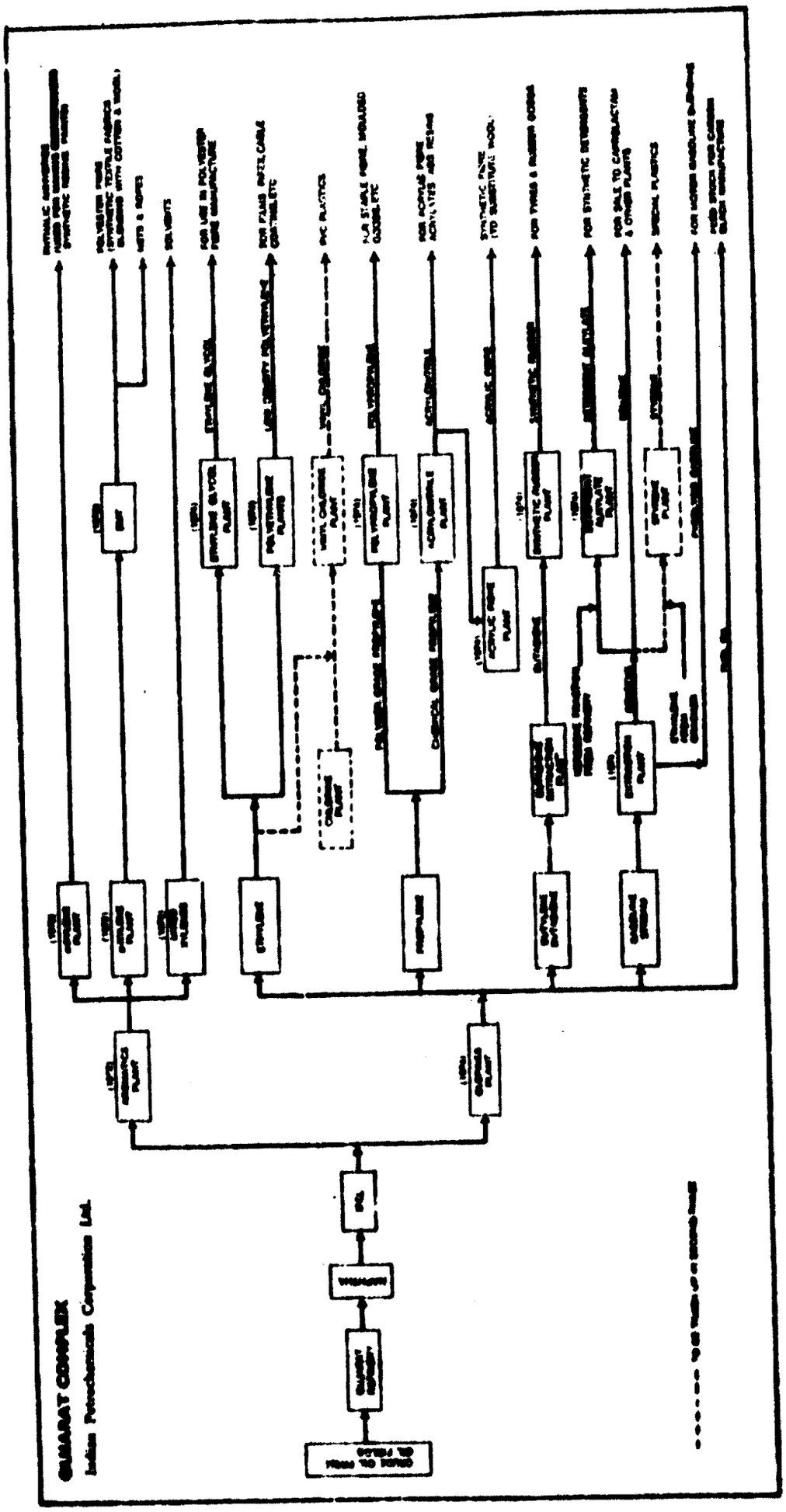


Table 7 Production of Major Plastics Raw Materials in India

(Tonnes)

Year	Phenol formaldehyde moulding powder	Urea formaldehyde moulding powder	Polystyrene	Polyethylene (Low-density)	Polyvinyl chloride (Resin)
1958	1,314	162	1,906	...	...
1959	1,810	321	3,314	2,084	...
1960	2,101	360	3,618	4,147	...
1961	2,111	433	3,484	5,800	917
1962	2,424	679	3,887	8,058	2,580
1963	2,895	1,030	5,515	7,923	2,964
1964	3,225	1,220	5,383	9,059	9,217
1965	3,360	1,225	5,643	13,508	12,179
1966	3,823	1,127	5,791	14,129	10,796
1967	3,750	1,342	5,591	9,751	13,611
1968	4,619	1,573	6,735	15,660	17,640
1969	2,643	1,540	9,384	7,975 (HD) 18,710 (LD) 17,338 (HD)	34,388
1970	3,200	1,600	9,400	22,000 (LD) 18,000 (HD)	38,000

petroleum ethylene. Among two low-density polyethylene plants, one is based on alcohol, and another one on petrochemical ethylene. The high-density polyethylene unit commenced production based originally on petrochemical ethylene. In the course of the next few years, all PVC and polyethylene units will change over to petrochemicals. Table 7 gives production figures for various plastics raw materials since 1958. During the decade of the sixties the production index (1961: 14,000 tonnes: 1970: 100,000 tonnes) rose to sevenfold, and the consumption index (1961: 37,000 tonnes; 1970: 120,000 tonnes) to about 3.2 times. The estimated requirements of various plastics by 1973-74 and by 1978-79 are as follows:

Table 8

Materials	Present Capacity (1970-71)	1973-74	1978-79
Thermoplastics	112,500	222,000	474,000
Thermosets	8,000	11,000	18,000
Others	13,200	27,150	50,700
	133,700	260,150	542,700

This calls for the present capacity to be doubled by 1973-74. With the infra-structure that already exists in the country, and with the implementation of Koyali Petrochemical complex at Gujarat, including its downstream units as per schedule, it appears certain that the capacity of 260,000 tonnes for plastics production will be established by 1974. Installed production capacities for thermo-plastics are given in Table 9.

Table 9 Installed Production Capacity for Thermoplastics

Thermoplastics	Tonnes/annum	No. of Mfg. Units
Polystyrene	17,500	2
High density Polyethylene	24,000	1
Low density Polyethylene	16,000	2
Polyvinylchloride	45,000	4
	102,500	9

The Plastics Panel of the Development Council for Organic Chemical Industries (Directorate General of Technical Development, Government of India) have prepared the following estimates for thermoplastics requirements for the Fourth and Fifth Five Year Plan periods. Compared with the established capacities, these forecasts imply rapid growth as will be evident from the Table 10. Table 11 indicates, estimates of demand for plastics in India.

Table 10 Future Requirements of Thermoplastics

	(Estimates)	(Tonnes/annum)
Material	1973/74	1978/79
Polystyrene	35,000	70,000
Low-density Polyethylene	72,000	150,000
High-density Polyethylene	30,000	45,000
Polyvinylchloride	80,000	175,000
Polypropylene	7,000	15,000
	224,000	455,000

Table 1) Estimates of Demand for Plastics in India

No.	Materials	Tonnes per annum 1968-69	1973-74
1.	PF Moulding Powder	4,000	7,000
2.	UF Moulding Powder	1,800	4,000
3.	UF Resins	5,500	8,000
4.	Phenolic resins (incl. laminates)	4,000	8,500
5.	Polyester resins	300	1,200
6.	Melamine Moulding Powder	150	500
7.	Melamine Resins	350	1,200
8.	LD Polyethylene	25,000	65,000
9.	HD Polyethylene	5,000	20,000
10.	Polystyrene	8,000	25,000
11.	Foam Polystyrene	700	2,500
12.	ABS Moulding Powder	50	2,000
13.	SAN Moulding Powder	50	1,000
14.	PVC resin	20,000	60,000
15.	C.A. Moulding Powder	1,000	3,000
16.	C.A.B. Moulding Powder	600	1,000
17.	Nylon Moulding Powder	200	750
18.	Epoxy resin	250	750
19.	Polyurethane Foam	500	2,500
20.	Polyvinyl acetate	3,000	5,000
21.	Polypropylene	1,500	7,000
22.	Acrylics (Monomer/moulding powder/sheets)	2,500	5,000
23.	Cellulose Nitrate Sheets	750	1,500
24.	Cellulose Waste films	500	1,000
25.	Others	400	800
	Total	86,000	234,200

2.2.2 Plastic Processing Machinery

With the increasing availability of raw materials, plastics processing industry has correspondingly developed in India. The converting capacity of the industry through compression moulding has gone up from 11,200 tonnes in 1955 to 48,000 tonnes in 1968. The corresponding figure for injection moulding has increased from 550 Oz., to 8,600 Oz. The number of extruders for the industry has risen from 55 to 460. Four injection moulding machines of 2 kg. capacity, and 1 of 4 kg. are in operation in India.

The indigenous manufacture of machinery has been established. Injection moulding, and blow moulding machines, and extruders of various sizes are now manufactured in India. Injection moulding machines covering a range of 2 to 49 Oz. shot capacity are being manufactured.

The mould and die manufacture is also established in India on a reasonable scale and the requirements of a wide variety of moulds are now met indigenously. The complete range of machinery for the manufacture of injection moulded articles up to 1,400 gms. capacity, such as buckets, bowls, PVC footwear, household and industrial items and complete extrusion plants for the manufacture of tubular film, pipes, monofilaments, pelletizing, heavy duty sacks etc. is manufactures in India. It is relevant to stress that the quality and productivity of all these equipment meet the high standard of performance that is required of the machines.

Keeping in view the expansion of the plastics industry and the corresponding requirements of processing machinery, the need to train operators for mould making, mould designing, machine setting etc., and manufacture of moulds and dies on an organized scale has long been felt by the Government of India. Accordingly, (during 1968), a Central Institute of Plastics, Engineering and Tools (CIPET) has been established in Madras (Tamil Nadu) by the Government under the Ministry of Petroleum and Chemicals, assisted by the United Nations Development Programme, with the International Labour Organisation as the Executing Agency. The first

mould making course commenced at this Institute on 29 January 1969. The first design course was started six months later. The United Nations Development Programme besides sending experts for staff of the Institute, has supplied specialized machines for the tool-room and few moulding machines. Training at the Institute (CIPET) is industry oriented and aims at training personnel for the sponsoring industries.

2.2.3 Investment and Employment

At the beginning of the Fourth Five Year Plan, the plastics industry provided gainful employment to about 100,000 persons apart from a large number of self-employed persons in the trade. Of the total investment of about Rs.1,050 millions in the plastics industry, approximately Rs.800 million is in the raw materials manufacture sector and Rs.250 million in the processing sector. The raw materials sector is capital intensive and provided only limited employment opportunities. The processing sector is constituted of mainly small-scale units. Of about 4,000 plastics processing units in India today, more than 3,800 are in the small-scale sector.

2.2.4 Plastics Products

A range of plastic products using both indigenous plastics raw materials as also imported materials (such as polypropylene, ABS, Acetal resin etc.) are produced in India. These include both consumer and industrial products like houseware, toys, novelties, stationery items, electrical fittings and fixtures, refrigerator liners, air-conditioner grills, decorative and industrial laminates, film for packaging, chairs, pipes and fittings, bath-tubs, sanitary fittings, building hardware etc. Glass-fibre reinforced polyester resin also finds extensive applications in the manufacture of a number of items like, rooflight sheets, bath-tubs, false-ceiling panels, concrete formers, glazing and partition panels.

3. PLASTICS BUILDING MATERIALS

3.1 Development and introduction

It will be observed from the foregoing pages that there has been frequent rise in prices of traditional building materials in India thus the corresponding costs of building construction, during the last decade. Moreover, the traditional materials have been in short supply from time to time. Though traditional materials like bricks, cement, timber, iron and steel are the basic materials for building construction and these are time tested and offer necessary structural performance and environmental comforts when used in construction, the need to economize their use due to high cost and to substitute these, wherever possible with new materials which may be economic in use and offer certain advantages in performance, has long been felt in India. Plastics are among the new building materials which have lately come to the notice of Indian building industry and efforts are being made to systematically develop and introduce them in India.

The development of plastic building products in India has been mostly based on corresponding developments in other advanced countries. With the planned expansion of the Indian plastics industry based on petrochemicals, and availability of plastics raw materials at cheaper rates, their conversion into a range of products including those for use in the building industry has been planned in advance, since building industry being the major consumer of plastics.

It was around 1960 that the first plastics building product was introduced in India. The product was low-density polyethylene pipes for water services. It was marketed under various trade names. Its application picked up gradually for village water supplies, and water supplies in hilly regions where flexibility of polyethylene pipes and their availability in longer lengths were taken advantage of. Gradually with the availability of plastics raw materials indigenously during sixties, other products like, PVC handrail, glass-fibre-reinforced polyester resin products, PVC floor tiles, PVC pipes and

fittings etc. were developed. The introduction of plastics building products as substitutes, or in preferential use for conventional products, had its own problems with the builders/engineers/architects. Questions like, durability, life and economics of plastics products were frequently asked by the users. Furthermore their use by Government construction agencies/local authorities would not be approved of unless these were included in official specifications/Building Codes. This would mean furnishing of convincing proof by the plastics building product manufacturers to the users in respect of durability, life, and economics and quality, that is, satisfactory service performance, compared to standard traditional materials. Moreover, plastics as a group of new organic materials are marketed into products under various proprietary names and when offered, to the builders/architects/engineers for use, are confusing in terminology, unless of course the facts are explained in their true perspective. Building industry is termed as 'Conservative' in its adoption of new materials and techniques, and Indian building industry is no exception in this respect.

3.2 Climatic Conditions and User Habits

These two important aspects must be taken into consideration while introducing new materials to the building industry. More particularly so in case of 'Plastics', which are organic in nature and their technology is sophisticated and fast changing both in manufacture and product applications. India is a tropical country. There are regions in India where minimum temperature touches sub-zero and there are others where it reaches as high as 50°C during certain periods of the year. Rainfall is concentrated in certain regions and there are regions which are dry, while others are hot and humid. There are hilly regions, plains and deserts. There are coastal regions and their corrosive atmosphere would reduce the life of several traditional materials. So we have varied climatic conditions in India. While specifying use of plastics in building in a particular region in India, one has to study these aspects in relation to the type of plastics sugrested for a particular application, and whether it is for external or internal use. The two plastics materials which find extensive

applications in the building industry are polyethylene and PVC. Being thermoplastics in nature, advantages apart, these have limitations on either side of the temperature scale. It is apparent, therefore, that while considering development and introduction of plastics as building materials in India, it is essential to study performance characteristics of these materials in relation to climatic conditions as a whole, and in the region concerned in particular.

'User habits' in the building industry are yet another aspect which needs due consideration while suggesting adoption of new materials. Plastics are basically 'delicate' materials to handle, though in their service, performance they may excel in certain characteristics over traditional building materials. Handling of plastics materials on building site, their storage and installation by suitably trained workmen has called for reorientation of users' habits in the building industry. The situation has also called for systematic education of users in India in the proper adoption of plastics as building materials.

3.3 Plastic Products

A wide range of plastics raw materials produced and marketed in India are converted into products of use in the building industry.

Among the plastic products currently produced and marketed for the building industry in India are:

(i) Surface coatings-paints and varnishes;

(ii) A range of electrical fittings and fixtures, in phenol and ureaformaldehyde, polystyrene and acrylics;

(iii) Electrical conduits in PVC, and polyethylene;

(iv) Decorative laminates for surfacing wooden furniture;

(v) PVC handrails, curtain rails, and staircase nosings;

(vi) PVC floor tiles; (incl: PVC-asbestos floor tiles);

(vii) Epoxy resin based floor toppings for industrial floors;

(viii) Roof-lights sheets in glass-fibre reinforced polyester resin (GRP);

(ix) Glazing and partition panels - plain and decorative in GRP;

(x) Polyethylene film for water-proofing and DPC;

(xi) WC seats in phenol-, and urea-formaldehyde;

(xii) Pipes and fittings in polyethylene, low-, and high-density, and rigid (unplasticized) PVC (including showers, sink-wastes, water taps, waste traps, floats and syphons (for cisterns) in polyethylene);

(xiii) Bath-tubs in GRP;

(xiv) Thermal and sound insulation materials, expanded polystyrene and polyurethane foam-rigid;

(xv) Concrete formers in GRP;

(xvi) Chairs in GRP and polypropylene;

(xvii) PVC (including foam-PVC) leather cloth, and rigid PVC sheet - plain and decorative;

(xviii) Window catch and handles in polypropylene;

(xix) Water stops (water bars) in PVC;

(xx) False ceiling panels in GRP, high impact, and expanded polystyrene etc.

3.3.1 Decorative Laminates

These are quite popular for surfacing wooden furniture, door-panelling, and counter-tops, in residential and commercial buildings, restaurants, hotels, and showrooms. These are essentially phenolic impregnated paper based laminates with top printed laminate impregnated in melamine resin. These are presently produced and marketed under different proprietary names, by five units, and are available in a range of colourful patterns and shades, and convenient sizes and thickness.

3.3.2 Pipes and fittings

Plastics for cold water services has gradually gained acceptance with the building industry. Over a dozen units are engaged in the production of these products using indigenous polyethylene and PVC. Plastic pipes from 15mm to 250mm sizes are produced and marketed in India. The production of rigid PVC pipes and fittings during 1970 was 1000 tonnes and during 1971 it is likely to be around 2000 tonnes.

The corresponding production of polyethylene pipes was only about 500 tonnes. Sanitary fittings such as the taps, sink-wastes, showers, waste-traps, floats and syphons, all in polyethylene are currently produced and have been accepted by the building industry. The organized usage of plastic pipes and sanitary fittings by the building industry in India is gradually picking up, as their prices are comparative with the non-ferrous counterparts. Plastic pipes at present produced and marketed in India are economical to use for water supplies. For instance, 15mm to 40mm size UPVC pipes are 40 to 60 per cent cheaper than G.I. pipes; 50mm and 65mm sizes are 30 to 40 per cent cheaper than G.I., 50mm to 150mm sizes are 10 to 15 per cent cheaper than AC pressure pipes and 15 to 20 per cent cheaper than CI pipes.

3.3.3 GRP Products

Glass-fibre reinforced polyester resin (GRP) products in general and a number of them for the building industry in particular, have now established themselves in India. GRP corrugated sheets are extensively used as roof-light sheets in industrial sheds and factories. These sheets are strong, shatter proof, permit light transmission up to 70 per cent and are light in weight and thus offer great advantage for long distance transportation besides these are favourably priced. GRP bath-tubs have been introduced in India. These are quite popular in hotels as they are economical and offer satisfactory service performance. Porcelain enamelled cast iron and enamelled pressed steel are the common materials that have been used in the manufacture of bath-tubs. Until recently for good quality bath-tubs, standard hotels in India have been depending on their imports. With the introduction of GRP bath-tubs, hotels are gradually switching over to their use. More than six units are engaged in the manufacture of GRP bath-tubs.

Other GRP products that have been moulded and are marketed include: chairs, false-ceiling panels, concrete formers decorative glazing and partition panels, and kitchen sinks. In fact the GRP moulders in India are well equipped to take up any specific job according to the requirements of the users.

3.3.4 Flooring

Flooring in plastics, PVC floor tiles, and PVC-asbestos floor tiles are produced in India in varied colour designs and patterns. Plastics flooring is popular in commercial buildings such as the showrooms, hotels, because of its easy to lay advantages, and also that it can be conveniently laid in any desired pattern. PVC flooring is available in different sizes cut into tiles, or in sheet length depending upon the requirements of the users.

For industrial floors, such as in chemical plants, manufacturing fertilizers, pharmaceuticals, acids, solvents etc., dairies, garages, service stations, etc. use of epoxy resin based floor toppings have been formulated. These are available in India and have been actually installed satisfactorily in a number of industrial undertakings.

3.3.5 Acrylic Plastic Products

Though acrylic plastics are not produced in India, they find extensive applications in moulding lighting fixtures and false-ceiling panels (for diffused lighting) commonly seen in theatres, and commercial establishments showrooms, restaurants etc. At present acrylic plastics are imported from the U.K. and Japan.

3.3.6 Building Hardware

A number of items of hardware in plastics have been introduced. Plastics hardware have a long life and this is particularly advantageous in the maintenance of buildings. Curtain rails, hand rails, and staircase nosings in PVC, and window stays in polypropylene are produced and marketed in India. These have been found to be satisfactory in service performance and are economical compared to their metallic counterparts.

3.4 Quality Control and Standardization

Plastics products are new to the building industry. Sufficient experience in their manufacture and use has yet to be gained in India. In the building industry it is not an accepted practice to specify new

materials unless these are made and certified as per standard specifications. In the absence of sufficient experience available for plastics as building materials, Indian manufacturers had been taking advantage of standard specifications from advanced countries. British standard specifications for the plastic products have been accepted in India. Keeping in view the expansion and diversification of Indian plastics industry, the Indian Standards Institution (ISI) has been lately engaged in formulating a series of standards for plastics building products produced and marketed in India. Indian Standard Specifications will greatly facilitate adoption of plastics products in the building industry and help maintain their quality. Indian Standard Specifications on the following subjects have so far been formulated and issued.

(i) WC seats in phenol-, and urea-formaldehyde IS:2548-1967

(ii) Polystyrene wall tiles IS:3463-1966

(iii) Flexible PVC floor tiles IS:3462-1966

(iv) PVC asbestos floor tiles IS:3461-1966

(v) Methods of tests for plastics flooring and wall tiles IS:3464-1966

(vi) Code of practice for laying epoxy-resin floor toppings IS:4631-1968

(vii) Low-density polyethylene pipes for potable water supplies IS:3076-1968

(viii) High-density polyethylene pipes for potable water supplies IS:4984-1968 and

(ix) Rigid (unplasticized) PVC pipes for potable water supplies IS:4985-1968

The major plastics building products which demand stringent quality control during manufacture, are plastic pipes and fittings. At present plastics pipes manufactured in India are as per relevant Indian Standard Specifications. In the formulation of Indian Standards, both manufacturer and user interests, as available and required in India, coupled with relevant experience in the field gathered from advanced countries, are taken care of.

3.5 Import Substitution

Non-ferrous metals and their alloys find wide applications in the manufacture of a number of building components which are used extensively in the construction industry. These include building hardware, sanitary fittings, G.I. pipes and sheets and other miscellaneous components, such as water-bars/water stops. Zinc and copper are the common non-ferrous metals which have found applications in the manufacture of the said components. Both zinc and copper are in short supply in India, and a major quantity of these is imported which means a drain on the country's foreign exchange reserves. Brass which is an alloy of zinc and copper goes into the manufacture of a number of building hardware items, such as window stays and fasteners, door handles, and sanitary fittings such as water taps, stopcocks, sink-wastes, etc.

The Government of India's present policy of discouraging the use of brass and other non-ferrous metals for building components calls for import substitution measures and the use of other materials which are readily available in India, or, are likely to be available in the near future. Aluminium which is indigenously available, has been used to some extent in place of brass in the manufacture of a few hardware items, but the problem still remains for substitution plastics to come under the 'other class of materials' which have found extensive applications in the manufacture of building components.

3.5.1 Building hardware

Developments in the use of plastics for building hardware in India have been quite promising. Curtain-rails, handrails and staircase nosings in PVC have already been successfully produced and marketed in the country.

The introduction of polypropylene window stays has been welcomed by architects and builders. They have been shown to be very economical on cost-to-cost basis. The conventional brass 'window stays' costs about Rs.5.50, whereas a polypropylene stay only about Rs.1.50.

The latter has the additional advantages such as availability in the desired colours, good rigidity combined with flexibility, corrosion resistance and freedom from maintenance. There is no likelihood of any 'theft' of plastic fittings as it is common with brass fittings, in public buildings. With the growing trend to construct multi-storeyed buildings in India, steel windows and window stays/ fasteners will be used in large number and the use of polypropylene window-stays in their place could contribute much to economy and also substitute brass.

Door handles and knobs for cupboards and drawers in polystyrene, acrylics and polyester have also been well received.

Polypropylene used in the manufacture of window-stays and fasteners is at present imported. But on weight-to-weight basis one kilogram of polypropylene will give more number of window-stays as compared to that of brass, which is also imported. However, the import content of polypropylene both in respect of weight and cost is much less than that of brass as is evident in Table 12, and thus the cost of the finished product as shown in Table 13. Though this may not be a case of direct import substitution but considering the weight and cost of import content involved there is certainly a substantial saving of foreign exchange.

Table 12 - Brass Versus Plastics Materials for Building Products

Sl. No.	Product	Material Commonly Used	Material Cost	Material suggested for substitution (quantity required)		Material Cost
1	2	3	4	5		6
				Plastics		
1.	Window stay 300 mm size	Brass	200 gms Rs.3 (@ Rs.15 per Kg.)	Polypropylene	25 gms	10 paise (@ Rs.4 per Kg.)
2.	Window fastener	Brass	135 gms Rs.2	Polyethylene	20 gms	7 paise
3.	Tap (water) ½" size	Brass	250 gms Rs.3.75	Polyethylene	125 gms	63 paise @ Rs.5 per Kg.)
4.	Waste trap	Brass C.P.		"	200 gms	Rs.1
5.	Sink waste	Brass C.P.		"	40 gms	20 paise
6.	Basin waste	Brass C.P.		"	50 gms	25 paise

Table 13 - Comparative Market Prices of Brass and Plastics Building Products in India

Sl. No.	Product	Brass (Rs.)	Plastics (Rs.)
1	2	3	4
1.	Window Stay (1")	5.50 per piece	1.50 per piece
2.	Window fastener	5.50 per piece	1.50 per piece
3.	Water tap ($\frac{1}{2}$")	6.50 per piece	4.50 per piece
4.	Waste trap	12.00 per piece	10.00 per piece
5.	Sink waste ($1\frac{1}{2}$")	4.00 per piece	1.50 per piece
6.	Basin waste ($1\frac{1}{4}$")	4.00 per piece	1.50 per piece
7.	Bath shower (3")	3.00 per piece	2.00 per piece
8.	Bath shower (5")	5.00 per piece	3.00 per piece
9.	Stop cock ($\frac{1}{2}$")	7.00 per piece	5.00 per piece
10.	Float control valve	4.00 per piece	2.00 per piece

3.5.2 Sanitary Fittings

Non-ferrous metals and their alloys are most commonly used in the manufacture of a number of sanitary fittings, which include, water tap, waste trap, sink waste, basin waste, bath showers, stop cocks, and float control valve. These items have now been successfully produced in plastics, (polyethylene, both low-, and high-density). Switching over to plastics in the manufacture of these items not only offers inherent advantages and longer service performance but also helps conserve and substitute non-ferrous metals and alloys. Plastics sanitary fittings are economical and prevent frequent replacements which are common with their metallic counterparts. Table 13 gives comparative costs of plastics and brass sanitary fittings.

3.5.3 Pipes and fittings

G.I. pipes and fittings are commonly used in plumbing services in the building industry. Now plastics (polyethylene and PVC) pipes and fittings have been introduced which offer advantages and are economical.

3.5.4 Roofing sheets

Asbestos-cement, and G.I. corrugated sheets are accepted roofing materials in the construction industry. In the former case, the asbestos fibre required is imported, while in the latter, zinc constitutes the import content. Polyvinylchloride (PVC) corrugated sheets have been successfully produced in other countries, particularly in Japan. PVC corrugated sheets, serve a good substitute to G.I. and A.C. roofing sheets. Also PVC corrugated sheets could be used for temporary sidings for which G.I. sheets are used commonly. PVC corrugated sheets are light in weight, yet strong, possess built-in-colour (thus no frequent paning required). PVC corrugated sheets, because of their light weight, could be found very useful as roofing sheets in hilly regions and at high altitudes, where transportation of heavy conventional roofing sheets pose problems.

Though PVC corrugated sheets are not yet in commercial production in India, there is good scope for their development by the plastics industry, and introduction into the building industry, in the near future.

3.6 Research and Development

No systematic research work on the development and introduction, as also to study in-field service performance of plastics as building materials in India has been initiated. It is partly due to the late introduction of plastics in the Indian building industry, and partly due to the fact that the plastics raw materials manufacturers in India have collaborative arrangements with their principals in U.K., U.S.A., Japan and West Germany. The work carried out by the respective collaborators is communicated to manufacturers in India. In the case of building industry, research and development problems are much different keeping in view the Indian requirements such as that of climatic conditions, user habits and economics. The need is now felt of initiating research and development work in respect of the use of plastics in building in India. The plastics raw materials manufacturers do maintain their 'Technical Service Laboratories' to study and solve day-to-day problems referred to them by their respective customers.

Only recently some weathering studies on the use of plastics in building were initiated at the Central Building Research Institute, Roorkee. These related to (i) Use of polyethylene films for water-proofing and damp-proof course, (ii) polymethyl methyacrylate sheets, as skylights and glazing (iii) polyester resin sheets (glass-fibre reinforced). It has been observed that polyethylene films used in buried situation for 7-8 years were found to be comparable with newly manufactured films in their tensile strength and elongation value. Study on outdoor behaviour of new films both of natural and black variety was also taken up. Natural films failed earlier than black films, the elongation value came down to below 10 per cent at the end of three months' exposure in the case of natural films, whereas value

remained nearly 200 per cent in case of black films. The original elongation value was 400 per cent in both cases. Natural film samples were completely damaged due to weathering effect in six months. Black film samples were in sound condition but showed a further reduction of elongation value to 150 per cent.

Indian cast sheets of polymethylmethacrylate were exposed to outdoor weathering for three months. Weight measurement, visual observation, gloss retention, light transmission and tensile strength were adopted as the test methods for assessing weathering effect on these sheets. Data collected so far have not shown any appreciable failure in the sheets.

Weathering studies carried out on glass-fibre reinforced polyester sheets of different commercial brands showed considerable discoloration, and fibre prominence in one-year outdoor exposure.

The Central Public Health Engineering Research (CPHERI), Nagpur, has conducted extensive investigations to compare the material quality of water passing through and stagnant in polyethylene and unplasticized PVC pipes with those under similar conditions in C.I., G.I. and AC pipes. The experiments conducted at the Institute have clearly demonstrated that these pipes are safe from bacteriological point of view for potable water supplies and that they are in no way inferior to the conventionally used pipes; further neither the plastic pipes harbour larger number of bacteria on the internal surfaces as compared with the conventionally used pipes nor they pose any problem for disinfection. In the light of these findings, and the suggestions made by the Ministry of Health, and National Buildings Organization recommending the use of plastics pipes, it has been concluded that polyethylene and unplasticized PVC pipes are quite safe for potable water supplies in India.

Investigations on the lead content in UPVC pipes for potable water supplies are under progress at CPHERI, with a view to evolve a proper method of analysis of lead for incorporation in the relevant Indian Standard.

There is great scope for initiating research work in India on developing suitable portable structures incorporating plastics components, for use in hilly regions and field areas, as also required for emergency caused by natural calamities. With the trend in multi-storeyed building construction in India, there is also a need to design and develop suitable plastics foam-core sandwich panel construction.

3.7 Case-histories

In the absence of any organized usage of plastics in building in India, it has not been possible to collect and correlate information on case-histories. The only usage which has been talked of much and propagated in the building industry during the last 10 years has been the use of plastics pipes for cold water services. First, it started with low-density polyethylene pipes for village water supplies, as also in hilly regions. Problems experienced were chiefly related to improper installation techniques and unsatisfactory jointing. And because, polyethylene being flexible and soft enough to be damaged by any sharp tool, complaints such as that pipes had been damaged by "rodents" or cut by mischief-mongers, were frequently entertained by the manufacturers. User departments would naturally get cautious in accepting plastic pipes. Gradually they were convinced that "rodents" had no specific liking for polyethylene.

Unplasticized PVC pipes came in the field later, and their first organized application for village water supplies commenced during 1963, when 4,000 ft. of PVC pipes (sizes 2" to 5") were donated by a PVC pipe manufacturer from Holland, for installation in a village near Delhi. The same have been giving satisfactory performance since then. These pipes are mostly buried in the ground. Recently (April 1971) a portion of the pipe was cut and removed for observations and testing for mechanical and hydraulic properties. Visually, the pipe did not show any damage, or scale formation and appeared to be in its original shape and form. This is the oldest history (8 year) available in India in respect of use of PVC pipes. Lately, PVC pipes have been recommended by Public Health Engineering Departments and local authorities and construction agencies

for water supplies in different regions of India, in sizes varying from 15 mm to 250 mm. In respect of PVC pipes usage, users in India needed to be convinced in relation to economics and satisfactory service performance besides durability of the material compared to conventional metal pipes.

Other plastic products which have been recommended and used in building, include PVC handrails, rooflight sheets, PVC floor tiles, decorative laminates, and polypropylene window stays. Use of PVC handrails has not posed much difficulty except that for external use, only black colour has been suggested, since other colours are prone to fading by exposure in the open. Rooflight sheets in GRP have indicated fibre prominence by outside exposure. The indiscriminate use of PVC floor tiles has not proved favourable. The introduction of PVC-asbestos floor tiles recently may prove to be more popular with the building industry in India. The use of decorative laminates for surfacing/panelling externally has posed weathering problems whereas their indiscriminate use for surfacing counters in banks, restaurants, cafes, has brought out problems like that of unsatisfactory abrasion and wear resistance, where printed designs of laminates have been used. Also delamination of the laminate has been noticed on laboratory table tops especially near the sinks, when proper adhesive has not been recommended.

3.8 Promotional Development Activities Role of National Buildings Organization

During 1966, the National Buildings Organization initiated a systematic programme of promotional development work relating to plastics building materials produced in India. A section on "plastics in building" was established and this has been looked after by the author since then. This involved systematic programming of work of the section, such as collection and collation of technical information on the subject from various sources within the country and abroad, preparation of list of plastics building materials manufacturers in India, arrange lectures/exhibitions/film shows bringing out facts and figures relating to use of plastics in building, and answer all the technical enquiries on the subject received from various construction agencies/local authorities in the countr

Until the section in NBO was established, the communication sources between plastics building product manufacturers and the prospective users had been in a much confusing state of affairs. Plastics materials terminology and their proprietary names were chaotic to the engineers/architects/builders. For them, all plastics were either "PVC" or "polyethylene". The promotion of plastic products by the manufacturers was not from material - properties point of view but purely on trade promotion aspects. The building industry on the other hand could not catch up with plastics and the confusing terminology. The need for promoting plastics in the Indian building industry, by an impartial agency, with no commercial bias but with technical orientation, was felt. Since the National Buildings Organization is a national co-ordinating agency for the Indian building industry in respect of building materials and construction techniques, the work on the use of plastics in building was taken up by NBO. This was well in tune with the developments taking place in other countries and the corresponding expansion of the Indian plastics industry.

Plastics-in-building-information service is at present maintained in the National Buildings Organization. Information sheets/bulletins are prepared from time to time on selected aspects of plastics in building and issued to various construction agencies and user departments in the country. So far the following information sheets/bulletins have been prepared and issued. These have been found very useful and informative by the user departments:

(i) List of important manufacturers of plastics building materials manufacturers in India;

(ii) Plastics in Plumbing - Pipes and related products; (NBO Project Note)

(iii) Plastics as Building Materials (NBO Technical Information Series Bulletin);

(iv) Materials for damp-proofing, water-proofing and roofing; (NBO Project Note);

(v) Building Hardware in Plastics (NBO Project Note);

(vi) Prefabrication Trends in Building Industry - Role of Plastics (NBO Project Note);

(vii) Flooring in Plastics (NBO Technical Information Series Bulletin)

In addition, the Journal of National Buildings Organization (half-yearly) has been bringing out supplements under "Plastics in Building" wherein useful information and activities on the subject are covered from time to time. The activities on the use of plastics in building in India are given wide coverage in technical journals and local newspapers (ref: Photo-copy of a news-item)

3.8.1 Seminar on Plastics in Building

The first Seminar on Plastics in Building was organized during 9-10 March 1967, at New Delhi, by the National Buildings Organization in co-operation with the Indian Section of the Plastics Institute. The main objective of the Seminar was to create an awareness among the prospective users of plastics building materials regarding their potentialities and advantages, as also the limitations of these materials in the light of developments taking place in the advanced countries and corresponding developments in India. That this objective was successfully achieved was evident from the prompt response of the manufacturers, engineers, architects and others in the building trade, who participated in the Seminar; altogether 250 persons from all over India representing different user departments including those from research institutes, and plastics product manufacturers participated in the Seminar. Sixteen papers covering various aspects of applications of plastics in the building industry and also reviewing the developments in other countries were presented and discussed.

The usefulness of the Seminar was enhanced by the "PLASTICS DEVELOPMENT HOUSE", which was planned and erected by the Plastics Institute in co-operation with the National Buildings Organization and plastics product manufacturers, to demonstrate the actual usage of various plastics building materials produced and marketed in India. The Development House was kept open to the public for over two months and attracted more than 8,000 visitors and received wide coverage in local newspapers.

Recommendations: The Seminar had adopted several recommendations for promoting the use of plastics in building in the country. These are given in the Annex to this paper.

Economic Times
Bombay
- 8 FEB 1958

Use of plastics in building: NBO body set up

From Our New Delhi Bureau

NEW DELHI, February 7.

The Union Ministry of Works, Housing and Supply has constituted a central body in the National Buildings Organisation, to formulate and co-ordinate developmental work on plastics with a view to promoting their use as building materials in the country.

Creation of a central body was one of the major recommendations made at the seminar on "Plastics in Building," recently organised jointly by the NBO and the Indian Section of the Plastics Institute.

TASK

The members of the Central Body include the Directorate-General of Technical Development Ministry of Industrial Development and Company Affairs, Central Public Health Engineering Research Institute, Central Building Research Institute, the Indian Standards Institution, the Indian Section of the Plastics Institute and the National Buildings Organisation.

The Central Body has been given the task to find ways to promote the use of plastics as building materials and act as a liaison between the manufacturers and users. It will also undertake research projects with a view to studying the behaviour of known plastics products under Indian climatic conditions and lay down recommendations for the proper use of plastics building materials, produced and marketed, in India. The development of new products indigenously will also be considered, as the basic raw materials, required for the purpose, would be available in larger quantities.

The central body has also been entrusted with the work of laying down codes of practices in regard to the use of plastics products in order to facilitate construction departments adopt them in their works. It would also assist the Indian Standards Institution in the formulation of Standard Specifications for plastics building products and their uses.

Of 40,000 tonnes annual production of plastics raw materials in India, a portion is used by the building industry in the shape of electrical fittings and fixtures, decorative laminates, floor tiles, corrugated and roof light sheets, sanitary ware, thermal and sound insulation material and pipes and fittings. The consumption of plastics in advanced countries the ISI is estimated over 25 per cent. of the total production.

3.8.2 Committee for Promotion of Plstics in Building

The Central Body, namely, "Committee for promotion of Plastics in Building", (as recommended by the Seminar above) has since (1968) been constituted in N.B.O., by the Government of India, Ministry of Works, Housing and Urban Development with the following terms of reference:

(i) To suggest course of action for the implementation of the of the recommendations of the Seminar on "Plastics in Building";

(ii) To take up work relating to the subject of plastics as buildings materials, as and when called upon by the prospective users and plastic building materials manufacturers, such as:

(a) Assisting the Indian Standards Institution in the formulation of standard specifications of plastics building materials;

(b) Laying down codes of Practice for Plastics Building Materials and their inclusion in the respective Building Codes to facilitate their adoption by Municipal Corporations/ Committees, Central State P.W.Ds., and

(iii) To take up research projects, if and when required, with a view to studying the building characteristics, of known products under Indian climatic conditions, and also in the light of availability of increased quantities of basic raw materials and development of new products indigenously.

Both manufacturer and user interests are represented on this Committee. The National Buildings Organization holds the Secretariat.

The Committee has since met twice (March 1968, and February 1969) and had prepared and discussed the following proposals:

(i) Plastics-in-Building Information Service;

(ii) Need to demonstrate the use of Plastics for cold water plumbing on country-wide scale;

(iii) Training programme for plumbers/sanitary engineers, in respect of use of plastics in plumbing;

(iv) Standardization of plastics building materials;

(v) Planning and designing of plastics development houses;

(vi) Bringing out an illustrated guide on plastics in plumbing;

(vii) Prefabrication trends with plastics in building industry - scope for development and introduction of plastics foam-core sandwich panel construction in India;

(viii) Development and promotion of building hardware in plastics;

(ix) Development and introduction of plastics cisterns (cold water storage and flushing);

(x) Introduction of asphalt impregnated plyurethane foam as joint sealane filler.

3.8.3 Plastics in Plumbing get-togethers/Demonstrations/ Training Courses

Plumbing is a necessity for every house planned for construction, it does not make any distinction between the sophisticated and unsophisticated. With the accepted use of plastics in plumbing and water services in other countries, and the developments taking place in India in this direction, plumbing and water services offer a major outlet for use of plastics in building. In India it is mainly the cold water services and plumbing, and thus the plastics piping systems which are thermoplastics in nature with obvious limitations for use for cold water services, offer unprecedented growth in India, if organised systematically.

One of the recommendations of the Committee for promotion of plastics in building was to promote the use of plastics for cold water plumbing and services on country-wide scale. For this purpose it was decided to organize a series of get-togethers/demonstrations on the subject in different regions of India, in co-operation with the plastics piping systems manufacturers and construction agencies. During the last three years such get-togethers have been organized in three different regions. These get-togethers have created a fair amount of awareness and appreciation among engineers/architects/builders in respect of usefulness of plastics piping systems available in India. Also, construction agencies and local

authorities have got themselves convinced for taking into their respective buildings Codes/Specification of works, use of plastics piping system for cold water services. Training courses for the benefit of plumbers and sanitary engineers have been successfully organized.

3.8.3.1 Demand for Pipes in India

The demand of G.I. pipes, 15 mm to 32 mm, for the building industry during 1969-74 has been estimated to be 62 million metres whereas that for 110 mm heavy C.I. pipes it is placed at 17 million metres. Even if, half of this requirement of pipes is met out of plastics pipes - mostly UPVC, which is the only one for the building applications, the consumption of PVC for pipes alone would work out to be over 30,000 tonnes.

3.8.4 Evaluation of Service Performance

One of the significant approaches to successful promotional development work is to formulate a procedure to evaluate satisfactory service performance of new building materials and for that matter plastics as building materials while in actual usage. This would facilitate organized growth and proper adoption of plastics building products. As a result, the National Buildings Organization has taken up "experimental projects" to evaluate service performance of plastics (PVC) piping systems and building hardware in plastics (polypropylene window stays*). These products have been installed in a number of buildings (residential/office) with a view to experiencing their satisfactory performance in use. Over the last two years since the products were installed, their satisfactory performance has been reported. This sort of procedure has been necessitated due to the fact that the information supplied by the plastics building product manufacturers on this aspect has been invariably questionable by the building industry and at times misleading.

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* Surface crazing has been observed on grey-colour window stays exposed in Delhi weather.

4. FUTURE PROGRAMME

The basic materials of construction in India being traditional, some of the building components in plastics which have been successfully developed in advanced countries, have great scope for their introduction in the Indian building industry. During 1970, the author was deputed for six months to visit the United Kingdom and a number of countries in Europe with a view to study developments in the applications of plastics in building. He had the opportunity of studying the developments from the point of view of Indian building industry requirements. We in India have to pick and choose some of the applications to suit the Indian requirements, such as that of climatic conditions and user habits. Since plastics raw materials will be available in larger quantities in the next few years, the development and introduction of the following new products for the Indian building industry hold out a promising future:

(i) Flushing cisterns in high-impact polystyrene;
(ii) Overhead water storage tanks in polyethylene;
(iii) PVC rainwater system;
(iv) PVC soil pipe system;
(v) PVC coated steel/aluminium sheets, and
(vi) PVC window frames.

Flushing cisterns in India are made in cast iron and ceramics, and have their own problems such as they are liable to leak and crack, besides being heavy in weight. Already float balls, syphon etc. moulded in plastics are available in India. The shell of the cistern could be moulded in high-impact polystyrene. The practice of using overhead water storage tanks in G.I. metal sheet is very familiar in India. The tank is invariably exposed to the atmosphere on the roof of a house. In course of time the tank gets worn out and badly corroded, and this is more common in coastal regions where the atmosphere is corrosive and affects the G.I. metal components, easily. Substitution of metal by suitable plastics materials such as plyethylene could prove to be quite economical and favourable with the building industry.

The conventional rainwater, and soil pipe systems in India are in cast iron. Here again in coastal regions in particular, corrosion and frequent replacements are problems. The PVC systems, if designed to Indian requirements could prove to be quite popular with the building industry.

For putting up industrial structures, and roofing, G.I. and A.C. sheets are used. The PVC coated steel/aluminium sheets could be developed, since the raw materials are available in India. The weathering characteristics of PVC coating would be required to be carefully studied under Indian climatic conditions since this is an application for external purpose.

Window frames in steel, aluminium, and wood are popular with the building industry. With the trend in the construction of multi-storeyed buildings, steel and aluminium window frames are invariably favoured. While steel frames pose a grave problem of corrosion (more so in coastal regions) and thus calls for frequent maintenance and replacements in certain cases, aluminium frames are fairly costly. Designing of suitable PVC window frames for Indian requirements could be useful for the building industry since favourable developments have taken place in this direction in advanced countries.

The National Buildings Organization has already taken up these new products for developments and introduction into the building industry. The Organization has been encouraging the Indian plastics industry to develop and introduce suitable products for the building industry, by supplying relevant information as to the material and design requirements, and providing technical/trade literature and samples procured from different countries.

5. CONCLUSION

It will be observed from the foregoing pages that the use of plastics in building in India is still in infancy, compared to developments taking place in advanced countries. The plastics industry made its appearance in India fairly late, so was the plastics product technology. The development of Indian plastics industry has been based mainly on borrowed technology both in respect of materials manufacture, and product applications

The Indian building industry, being traditional, the introduction of innovations like new materials and techniques, with a view to reduce construction cost has been taking place gradually. The economics of the use of new materials, their durability, and satisfactory service performance are the three main factors that are to be looked into carefully while recommending the use of plastics in building in India. In addition, varied climatic conditions and user habits in the building industry which vary from region to region also call for careful study. The trend in the use of plastics in building in India is towards the introduction of building components - mainly those which are likely to be accepted by all types of building construction activity, rather than restricting to specific type of construction. The semi-structural and structural components in plastics for the building industry are not likely to make any headway in the near future because of economics and their uncertain performance in use under Indian climatic conditions.

Plastics piping systems for cold water services hold out promising future in India. Already plastics (mostly PVC) for internal plumbing and water supplies have made successful appearance in the building industry. Substitution of non-ferrous metals in the manufacture of sanitary fitting and building hardware is another application which is likely to expand in India. The promotional development work initiated by the National Buildings Organisation has helped the building industry understand and appreciate better various aspects of the use of plastics in building. The size of the Indian building industry being large, offers wide scope for introduction of plastic products in situations where conventional building materials do not offer satisfactory performance. The expansion of plastics industry based on petrochemicals has been planned. It will give impetus to the plastics industry to develop and introduce new products for the building industry. Re-orientation of the user habits in the building industry in respect of use of plastics products and their inclusion in the building codes, through systematic education of the users has been taken care of by the National Buildings Organization.

New plastic products like flushing cisterns, rainwater and soil piping systems and window frames will be developed and introduced in the course of the next few years since these will contribute to economy in cost of building construction, by way of prevention of corrosion, and frequent replacements most common with conventional metal counterparts.

ANNEX

RECOMMENDATIONS OF SEMINAR ON PLASTICS IN BUILDING, HELD IN NEW DELHI DURING 9-10 MARCH 1967

(i) Although a number of plastics building materials are now available in India, they have not been time tested in use. Their long term behaviour in buildings is not, therefore, known. Laboratory and performance tests, in other countries, however, hold out promise for these materials. The Seminar felt that more developmental work on plastics building materials and testing under Indian conditions are necessary. To this end, the plastics industry should set apart funds for market research, practical investigations, demonstration and displays. In this connection, a suitable programme should be evolved by the Plastics Institute (Indian Section) in collaboration with the National Buildings Organization.

(ii) It was recommended that National Buildings Organization in consultation with the Plastics Institute should take up with the Ministry of Labour (Directorate of Employment and Training) the question of drawing up a programme of training of skilled workers in the proper use of plastics in the building industry. The manufacturers of plastic components will provide practical training.

(iii) Indian Standards and Codes of Practice in respect of plastics building materials should be formulated on the basis of experience in other countries, wherever results of investigations under Indian conditions are not available. This would facilitate expeditious adoption of plastics materials in building practice.

(iv) The use of melamine decorative laminates for surfacing furniture, and as wall-panelling material, and flexible PVC and polyethylene cables for internal lighting and power have already found acceptance in India. PVC and polyethylene electrical conduits possess advantages, such as ease of installation, and are, therefore, generally good substitutes for steel conduits. A range of electrical accessories in urea and phenolics, light fittings in polystyrene and acrylics have already found wide acceptance

in the building industry. PVC tiles are gradually gaining acceptance in flooring of buildings. The use of polyethylene film for damp-proofing holds out promise, although the material requires careful handling by skilled labour. The use of foamed or expanded polystyrene as impact sound and thermal insulation material is well-known. Its use in better class buildings requiring insulation needs encouragement. Surface coatings based on polyvinyl acetate/acrylic emulsions have been accepted as high class finish for walls. Synthetic enamels with an alkyd base are already in use for protecting and decorating wood work and steel work in buildings. It was considered desirable to follow the codes of practice laid down by the I.S.I.

(v) The suitability of the use of polyethylene and PVC pipes and fittings for cold water services was recommended. But to ensure safety to health it was agreed that manufacturers should ensure freedom from toxic effects, and in due course, Indian Standards Institution should give certification marks, after formulation of the relevant standards.

(vi) There is good scope for promoting the use of flushing cisterns, wash basins, sinks and bath-tubs in fibre glass reinforced polyester, and overhead water tanks in polyethylene, as also a number of plumbing fittings in plastics. The use of PVC for the production of water stops or water bars, for expansion joints as well as for concrete shuttering, needs due encouragement.

(vii) Special flooring materials, such as for heavy duty floors are required in many industrial buildings. Formulations of polyester and epoxy-based compounds can provide such materials. Epoxies are imported and expensive and their indigenous production should be expedited.

(viii) The high price factor for the different plastics building materials in India, dominated the discussion during the Seminar, though prices of traditional building materials are steadily rising. It was agreed that widespread usage of plastics materials could be exploited, if they are available to the building trade at competitive prices. With

the availability of large quantities of raw materials, derived from the petrochemical complexes, during the fourth plan period, the costs of finished plastics products are expected to come down.

(ix) The Seminar recommended the formation of a Central Body composed of the National Buildings Organization, the Plastics Institute (Indian Section), Indian Standards Institution, Directorate-General of Technical Development, Central Building Research Institute, with a view to formulating detailed lines of action for the promotional development of plastics for the building industry in India.,

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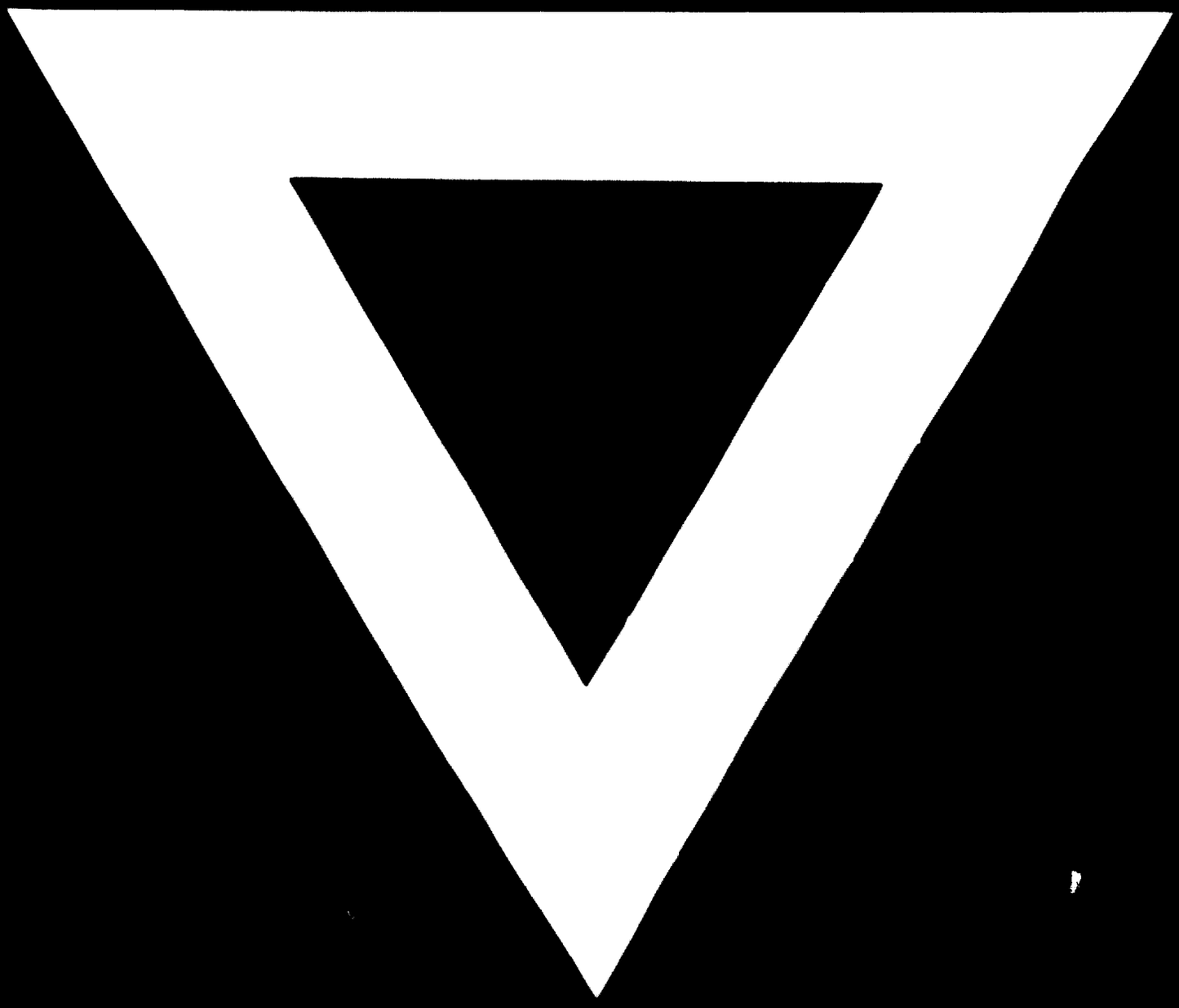

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