A basis for the évolution of strategy
for a futuristic development of building materials

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PREAMBLE

Building materials account for a substantial part of the national expenditure in most countries of the world and more so in developing countries. The outlay on construction in the successive Five Year Plans of India have been in the range of 40 to 45% of the national outlay and about two-thirds of this expenditure on construction is on building materials (fig. 1).

The situation in many other developing countries is similar where almost 30 to 35% of the total national outlay account for building materials.

Whenever the question of making available the required building materials of the right quality and right cost at the right time is considered, the following four main aspects come into the picture:

(i) the natural resources available on which the building materials can be based;
(ii) the considerations of environmental balance in extracting the resources from nature and partly getting

Fig. 1. — Construction content as percentage of total developmental plan outlays — the Indian scenario (source: The Economic Times, New Delhi, July 24 1985).
over this problem by utilizing industrial, agricultural, rural and urban wastes for conversion into building materials;

(iii) the technological and economic considerations for the manufacture of building materials; and

(iv) the technological and economic aspects of the utilization or application of the building materials in actual construction.

RELATION WITH NATURAL RESOURCES

There are varieties of building materials. The basic question which every construction agency has to ask is: are we adopting in our construction activities the building materials which are likely to be the right answer in the given situation? Any material which is not in harmony with nature is not likely to succeed as a means of meeting this massive need. Since 90% of the earth’s crust and human environment is made of the natural elements comprising oxygen O₂, silicon Si, aluminium Al, iron Fe, and calcium Ca, the major building materials and specifically the most widely used building materials have to be based essentially on these natural elements. Even in this, the spectrum available is a very large one — from natural earth, stone and timber at one end of this spectrum — through materials processed to different degrees — one could have at the other end of the spectrum the most modern polymer impregnated prestressed precast concrete. The relative consumer costs of these at a given location, the relative performance-cost ratio, the expected life cycle cost will determine how low cost the material is and determine the choice of the building materials in a given situation.

ENVIRONMENTAL CONSIDERATIONS

Environment is an integral element of nature; whenever nature is disturbed, environment does get disturbed to a smaller or a bigger degree. One engages in agricultural or industrial process with the hope the result of these processes would contribute to improvement in the “quality of life” of the members of the society, but in the process of obtaining the results, one disturbs nature, on the one hand during the process of exploiting nature’s raw materials and, on the other in producing wastes or byproducts during the processes. For example, in order to provide one tonne of cement for the use of the society, about one and a half tonnes of limestone has to be utilized; this means disturbing about one and a half to two tonnes of limestone from the natural deposit on earth. On the other hand, in producing one tonne of paper, the paper plant produces about 0.5 t of lime sludge, the disposal of which is a problem. The problem of the latter could become the resource of the former if the two are made to match, and science and technology come to the aid in matching these. In fact not only from paper industry but the waste products from many industries like carbide (acetylne), sugar, and water treatment plants based on lime neutralization contain CaCO₃ or Ca (OH)₂ as major components of the sludge wastes. These wastes, either alone or in combination with limestone, can successfully be used for the manufacture of such building materials which are lime-based. Another distinct consideration is the impact of polluted environment of the durability of building materials. If environmental degradation due to industrialization cannot be controlled, it has to be endured by choosing appropriate materials of construction.

WEALTH FROM WASTE

Man and his activities produce a lot of wastes. At the same time man consumes many things. Amongst the various things man consumes, building materials happen to be the largest in terms of weight — being about 5 t per capita per year — next only perhaps to water. Environmental problems created by wastes are becoming more and more acute day after day and finding ways and means whereby the wastes are so utilized that the environment is kept free from as much of waste load as possible is of great importance. Utilization of wastes by converting them into building materials, appears prima facie the most logical answer and should create the least difficulty from the point of view of the overall dimensions of waste disposal and utilization problems.

The so-called wastes are indeed resources at unwanted places just like sound which is unwanted becomes noise and wastes which are not wanted become nuisance; these resources can become precious when they get positioned in wanted places. How this is done in a technologically feasible, economically viable and socially desirable manner constitute what may be called “Waste Management”. The science and art of wastes management has today become an exciting and challenging field. Scientists, technologists, environmentalists, engineers, economists and a host of others have all to play their due roles in such management of wastes.

The wastes that come to be in our environment are (a) agricultural wastes, (b) industrial wastes, and (c) urban and rural wastes including animal wastes.

Exact estimates of the agricultural wastes, such as wheat straw, paddy straw, jute stalk, sorghum sticks, rice husk, cashew apples and so on, produced today, are not available as there are no organized data, but estimates made about their total availability in India indicate about 1450 million tons every year.

Industrial and mineral wastes, such as fly ash, blast furnace slag, lime sludge, red mud and so on are generally from more organized sectors and the data available indicate that about 50 million tons of these wastes are available every year in our country.

In regard to urban and rural wastes, such as sweepings, garbage, kitchen wastes, night soil, animal wastes, even though it is known that man is the largest