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INDUSTRIAL CONSTRUCTION IN DEVELOPING COUNTRIES BASED ON INDIAN EXPERIENCE 1/

by

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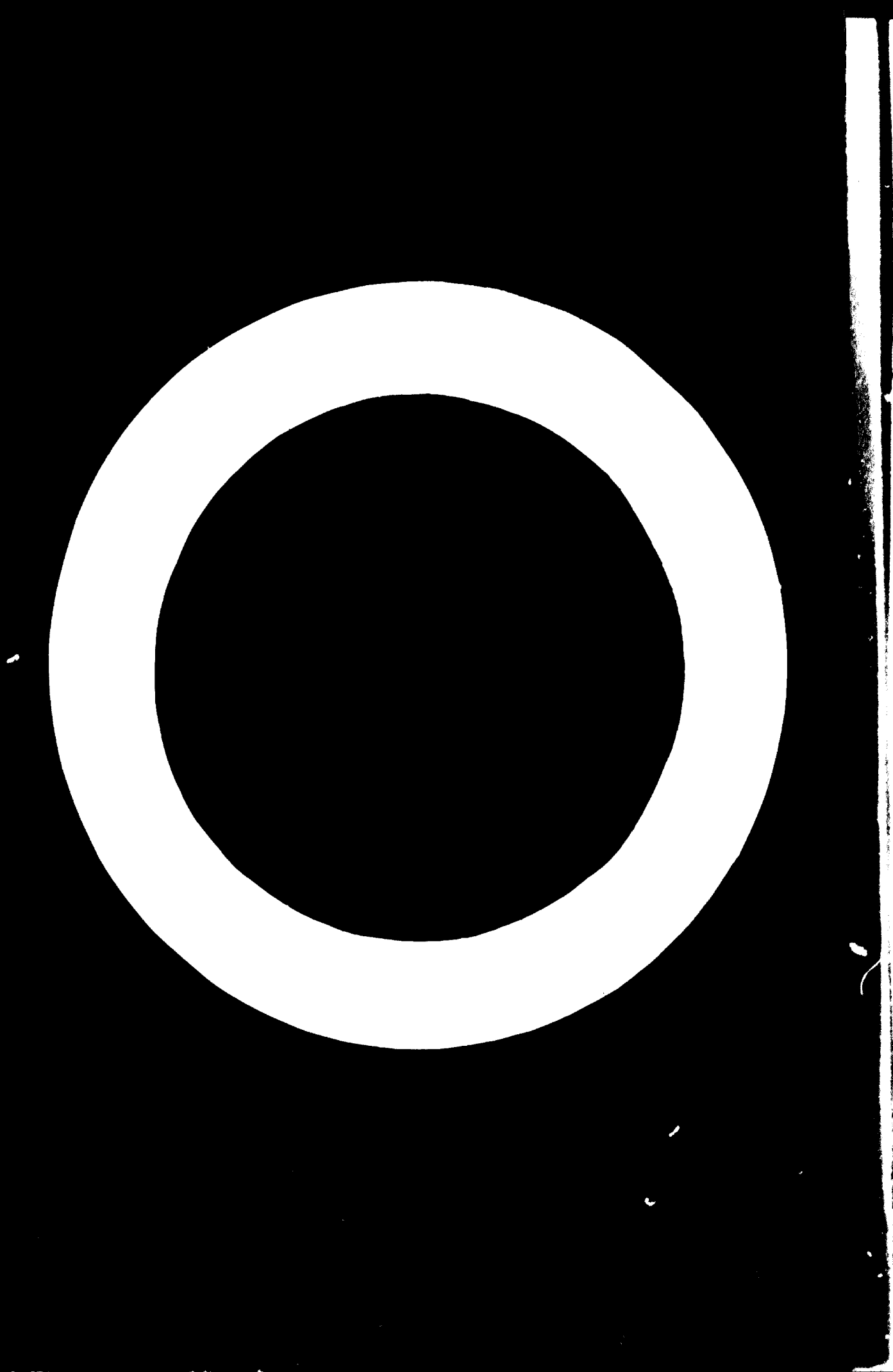


SUMMARY

The Industrial Construction Sector is a component of the overall construction activity. The problems of construction industry in developing countries were discussed in detail during the Technical Meetingon Construction Industry in Developing Countries held under the auspices of UNIDO at Vienna during October/November 1973. The basic factors to be borne in mind in the industrialization of construction are discussed.

The complexities of construction activity in any developing country and what could be the approach of UNIDO in identifying them are discussed.

The Industrialization of construction can cover a transition from rationalization of conventional construction techniques to a mechanical process of production and assembly. The issues involved in standardization, materials, import of plant and tools, clay products, concrete technology, timber technology are dealt with. The position in India on these aspects are dealt with briefly.

The important aspects of project survey, project engineering, specification, shortcomings in tendering, contract financing, construction management, quality control and labour relations are dealt with. The position in India in these matters are referred to.

The areas of importance that the construction agency or a firm has to look for in its development and what service the developed countries can render are dealt with. The emphasis has to be on mutual help among developing countries. The position in India in these fields are outlined.

What the role of UNIDO could be is summarized as:

1. a) To initiate in developing countries integrated projects to integrate the existing isolated institutions into a central construction industry policy-cum-technical-financial institute.

   b) To achieve the above a study group/workshop in a developing country would be organized.

2. a) As no study has been carried out on construction industry as a whole in any developing country, the UNIDO is to select three developing countries of different technological levels and undertake a comprehensive study.

   b) After the study to formulate guide lines for assistance by UNIDO and the Government of the countries.

3. a) To have an inplant training programme for the second level of developing country to be organized in a developing country with emphasis on material, small tool and plant and development of small construction firms.

   b) To organize for least developed countries programmes of technical visits and training programme

4. a) Preparation of technical manuals suitable for intermediate and least developed countries with special reference to simple hand-operated construction plant and tools. This will be an area of transfer or appropriate technology among developing countries.

   b) Similar technical manuals on construction methods and techniques.

INDUSTRIAL CONSTRUCTION IN DEVELOPING COUNTRIES BASED ON INDIAN EXPERIENCE

1. Introduction

The industrial construction sector is a part of the overall construction activity of any country. The situation, trend and short comings are problems involved or faced by the construction activity as a whole which in turn are faced by the industrial construction sector also.

These problems were discussed in detail during the "Technical Meeting on the Construction Industry in Developing Countries" which was held by UNIDO in Vienna during October/November 1973, whose conclusions and recommendations are comprehensive.

The development of the industrial construction sector is largely dependent on the general industrialization of the country or the region.

The identification of the state of industrialization and its effect on the socio-economic as well as political structure of the area needs attention.

In most of the developing and under-developed countries, agriculture forms the base. Construction activity in such countries forms almost the second biggest activity, both in terms of investment and employment.

Construction activity is a stepping stone to industrialization. It is an intermediate activity between industry and agriculture. Again, as mechanization of agriculture has its own limitations and problems, the industrialization of construction activity also has similar problems.

Agriculture is not a continous activity. It is seasonal, depends on climate, soil conditions, rains, availability of irrigation facilities, availability of labour etc. Similarly construction is a seasonal activity. As mechanisation of agriculture is economical or beneficial to the country only if continuous

operations are available, and infrastructures are developed, similarly the industrialization of construction has to face almost the same problems.

In most developing countries the Government is the major client of the construction industry and thus its policies and decisions have direct impact upon the future of construction industry.

Although economic and social changes in developing countries depend primarily on the actions of their people and thoir Governments, the co-operation from the developed countries especially through financial and technical assistance and multi-lateral and bilateral aid programmes is vital. It is clear that financial assistance in support of one big project like a power plant, irrigation dam or a factory will not contribute to the development programme of the country as it may utilise all its limited resources. It is generally agreed that the role of international programme should be directed more towards institution development in these countries rather than to one single spectacular project. It is of utmost importance to bear in mind the socio-economic environment of the country in implementing plans for assistance to industrial construction sector. Even though the technology adopted and industrial construction programme in a country receiving assistance may look beneficial immediately, in long term it is likely to have adverse consequences, specially on the growth of indigenous skill, technology, materials and plants and balance of payments have to be carefully weighed before making out a case for industrial construction programme. It also requires a thorough understanding of the economic and social structure of developing nations and an awareness of the expansive changes required in human value and attitudes including education, communications, acceptability of new ideas, administrative effectiveness, business enterprise and political leadership.

Any industrial construction technology initiated without understanding of the above problems will remain only an imitative process and foreign to the cultural, social and progress of the developing country.

In framing recommendations to improve the quality and output of indigenous construction industries in developing countries, attention must first be given to the levels of resources available. This of course varies from country to country but finance appears to be an almost universal constraint.

The availability of materials also varies. No attempts are made sometimes to capitalize on the country's natural resources and there is a tendency to import expensive foreign substitutes at considerable harm to the balance of payments position which further debars an opportunity for gainful utilization of indigenous building materials industry concerned. In general, plant requirements are seldom a real constraint on the modernizing of a construction industry in a developing country unless one depicts it as a carbon copy of typical industrial construction method of a developed country. The priority should be to fit the structure and nature of the industry within the framework of social and economic needs of the country.

Any import of foreign machinery in a developing or partially underdeveloped country means import of foreign labour which keeps out the local labour employment potential. In most cases, in terms of value, added labour intensive techniques provide higher returns, in terms of the cost of not employing available local labour is taken into account.

Industrial construction, involving construction material production and mechanized construction methods, is based on a relatively higher technology, better technical knowledge, sophisticated equipment and plant and also high capital outlay. These are insufficient in most of of the developing countries. Even if the country is developed enough, what kind of assistance or promotion is required needs careful attention. Is it in terms of technical knowledge, new construction materials, new plant and equipment, experienced personnel, expertize, co-operative activity or joint activity? Whatever it may be, it should help the country to develop its own resources in men, materials, methods and industry rather than be only a financial or trading activity.

It may be worthwhile considering if developing countries themselves help each other in exchange of this knowledge of industrial construction that has been tried out in their respective countries. This will be more advantageous rather than the developed country implanting same industrial construction activity in two similar developing countries. This will help also in better understanding and integration of developing countries.

The developing countries having different political outlook should consider this as co-operative on economical and financial basis for mutual benefit, interest and sharing of risks, and build up of know-how instead of each going on its own or parallel and overlapping developments

The recent development of joint planning commission or common platforms for planning and development by India-Russia, India-Hungary, India-Bangladesh is a step in right direction which is bound to benefit both the countries.

2. Development of the Industrial Construction Sector in Industrialization of Construction Process

For any organization that has to formulate a policy for implementing the development of this sector has to appreciate and analyse the complexities of construction activity in formulating long term as well as short term strategies and planning:

a) Construction covers such a vast area, as almost all activities of society have some bearing on construction. Construction does not only cover the building of dwellings but also roads, dams, irrigation and power works, air-fields, ports, harbours, large industrial and residential projects and works connected with defence. It also covers the maintenance and repairs of previous works.

b) Construction agencies range from self-employed workers who build their own dwellings, to the large construction firm or Government agency carrying out national projects.

c) Construction materials range from ordinary soil to the most sophisticated man-made materials.

d) Construction labour covers the ordinary unskilled workers employed in ordinary road making right up to a highly skilled equipment operator or serviceman on earth moving or concrete placement equipment.

e) Construction management ranges from a "gang-man" managing works on a village road, to a well-established construction firm dealing with management of a major project.

f) Construction design ranges from self-designed dwellings to a consulting engineering firm dealing with intricate civil engineering designs of nuclear power stations.

g) Construction equipment itself ranges from simple hand tools and baskets to the most sophisticated concrete mixing and batching plant and cableways.

h) Construction financing embraces at the two ends of a scale an owner's self financing for his own dwelling to the complicated financial arrangements for a national project.

i) Construction methods again range from fully labour intensive to fully mechanized.

j) Construction tendering and contracting is another area of conflicting interests and is of a complicated nature as many parties are involved with different interests and approaches.

k) The standards and specifications for construction materials, tools, plant and equipment, and for different items of work vary with the agency handling constructions.

l) The construction activity has to depend on the other sectors and industry for its development, so the status of those sectors has a bearing on construction.

m) Construction labour laws have to bear in mind the complications of the construction industry, its seasonal nature, its varying work volume, the closure of labour activity as soon as the structure is finished, the mobility of labour, the system of task work, and the system of contracting.

n) The organization or methods required for new construction works are different from maintenance and repairs of old structures.

o) Construction activity is often carried out in a country by many agencies, private and public, many government departments, municipal bodies etc. with their own vested interests, standards and methods having its play.

Keeping these complexities of construction in view, it may be worth consideration to form a team of experts who whould be assigned to analyze and establish a policy consistent with the socio-economic and other constructions prevalent in the country which is taken up for development on the following lines:

1. Identify the present status and prospects of development of construction industry.

2. Identify the material inputs with special reference to local production and also with reference to the import.

3. Identify the building techniques adopted and the construction plants, tools and machinery being used and whether any industrialization or mechanization of these operations could be done to improve the quality. This has to be consistent with the technology available for local production and also the balance of payments take care of imports.

4. Identify the technical skill and the power existing and what will be needed in future for industrialization. Then formulate the training programmes.

5. Identify the areas which need improvements, in the regions that are considered for industrial construction in terms of road transport, auxiliary services etc.

As stated earlier, construction is the second biggest activity next to agriculture, which has the rural base. Any industrialization has to go hand in hand with the mechanization or rationalization of agriculture.

The types of plants and tools to be introduced should be common for both the sectors.

Another important primary necessity of the developing countries is housing. The industrialization of construction process in the rural housing and urban housing which require only low cost systems has to be given priority.

The plant and tools which are common to both agricultural and construction should be given a priority. Agriculture machinery like tractors, pumps, burrows etc. can be very well utilized on construction also. Even digging of canals, small cross-overs etc. could all be adopted to industrial construction along with agriculture.

In short the industrial construction and mechanization of agriculture go hand in hand in most of the developing countries, particularly in rural areas.

3. Industrial Construction Design and Technology

Conventional construction today is concerned primarily with the organization of the supply of conventional materials and their assembly in traditional methods to achieve a given design. Industrialization of construction means a transition from the rationalization of conventional construction techniques to a mechanized process of production assembly.

Any industrialization has a prerequisite of standardization as only standardized items can be mechanically provided or assembled in an economical manner. The dimensional co-ordination or modular co-ordination is a prerequisite. A number of national and international organizations are dealing with standardization of construction materials, design criteria and other aspects of construction. Probably the standardization could be achieved only by legislation by the Government concerned. Adoption of standards not only speeds up industrialisation but ensures production of acceptable quality.

The next priority could be given to mechanization of building materials. This is an area where even rationalisation and improvements in methods, use of small tool and plant can be of great help in improving the quality and cost of building materials.

The study of soil, the basic construction materials, needs attention. Brick, clay product, sand-lime and soil cement blocks, light weight aggregates are all based on soil. Even road construction, earthen [illegible] construction which are so common in any developing country need a study of the soil.

The improvement in tools and plants used for excavation, sorting out, mixing, transport, spreading and consolidation will be of immense value. Such trends are not only beneficial to construction but also in agriculture.

In India the agriculture tractor has been developed with different attachments like a crane, back-hoe, trailer, road roller etc. which could be of great use in both sectors.

The other clay products like bricks, tiles for roofs and floors are other items which can be improved. Even if standard sizes and quality can be made to improve by better mixing tools, moulds, burning methods, it will be a step towards industrialization. In India, manufacture of wire-cut bricks, mechanized brick kilns, etc. have started but there is much to be done yet.

Another area that could be considered for industrialization is concrete technology. The manufacture of aggregates, cement, cement products, design of concrete mixes, use of simple gadgets for mixing placing and consolidating concrete, proper form work etc. are stepping stones to further industrial.zation. Number of cement and concrete laboratories in India are doing very valuable work in this field.

Seasoning of timber and use of panels is an area of importance. The Indian Forest Research Institute has done valuable work on this subject.

Many developing countries like India, have construction techniques, equipment, expertize and know-how comparable to many developed countries. But here finances come in the way of further development and wide utilization.

Construction man-power development has to go hand-in-hand with improvement in techniques of construction, practical and theoretical training on-site. The occupational institutes, Industrial training institutes set up in most parts of India are doing good work in this

direction. Of course it is necessary that construction engineering and construction management are given a more important place in the faculty of engineering.

Even though new construction form a major quantum, the up-keep and maintenance of already constructed structures is a very important matter in the over-all economy and development of a country. The maintenance techniques, the materials used for maintenance are many a time quite different from those in normal construction. The maintenance personnel have to be all-rounders to understand the implications and make the maintenance work economical and effective. The training of personnel, methods employed, material used, scheduling and programming maintenances all need great planning and training. The experience of various countries in such special cases of repairs will be of great value.

In most countries industrialization of construction or mechanization of construction comes about through introduction of imported equipment. The same happened in India also. There are, as a matter of fact, any number of different makes and capacities of plants which were introduced to India by different countries through aid or loan. Each make or type being of different technological development needs different spare parts, lubricants etc. The availability and utilization of equipment is thus very poor. Even now equipment is seen idling for want of imported spares involving heavy foreign exchange. Of late, India has become self-sufficient in construction equipment except for may be some sophisticated and special equipments which are cheaper to import than manufacture locally. Any developing country, which intends to manufacture its own construction equipment progressively should select only such type and size of equipment that can be fully utilized or for which there is a ready outside market and for which technology could be easily developed. Many developed countries which may have undergone this exercise will mutually benefit by exchanging their experiences. The developing country could evolve the most suited plant and exchange it with a neighbouring country in the region. This would help build up expertise and make production in large numbers possible thus economical and worthwhile.

In any geographical area, methods of construction would be similar due to common resources, materials, manpower, environment, socio-economic conditions, setting up of zonal industrial construction service dealing with design, plant and techniques will be very beneficial. In India, the Central Water and Power Commission is doing a great service in collecting information from various irrigation and power projects in the country on matters of survey, design, plant, construction, construction plant and construction techniques and operation data and passing it on to those in need.

Similarly the National Building Organization, a "clearing house" on building materials and building techniques, and the Indian Road Congress on the road engineering. The Institution of Engineers, Architects, Surveyors, Contractors and Builders' Association are others who collect and distribute information. There are many other central organizations in different fields rendering valuable service all over the country.

Such organizational set-ups may be a model for other developing countries.

4. Implementation and Construction of Industrial Projects

Under this topic, the technical and managing aspects of individual construction are considered.

The socio-economic and financial aspects of any industrial project have to be studied in all its ambits. Many times this is not done thoroughly as to their effect on people and ecology but decisions taken are often politically based.

Project engineering is detailed at all stages of the project: Its design, objectives and co-ordination between different elements. It is not unusual that enough time is not spent on this study and when work gets under way, there are many changes. The estimates are often exceeded, giving rise to a lot of financial problems. There is great reluctance in Government circles to make use of expertize available on such matters from non-government bodies or from other departments.

A clear and non-ambiguous specification is very necessary. It is much better to have standard specifications or incorporate the national standard specifications. For this purpose, it becomes necessary to have national standards. The Indian Standard Institute is a good example of this.

The Construction Agency engaged in construction industry has voiced some valid points for considerations:

a) Tender papers are not prepared with due care and diligence.

b) The conditions incorporated in the tender document are all one sided safeguarding the interest of the owner against shortcomings.

c) The soil conditions, sub-soil data, natural resources position etc. are not properly investigated and no reliable data is furnished.

d) No guarantee of proper supplies of materials, power, drawings etc. to be supplied by the owner.

e) Many times the financial conditions and conditions pertaining to foreign exchange are included which do not have prior sanctions from competent authorities.

f) The earnest money, security, performance bonds etc. need rationalization.

g) Detailed construction drawings are not included. The drawings are usually very sketchy and unreliable.

h) Under present inflationary conditions escalation clauses to cover cost-rise necessary.

The acceptance of the lowest bidder without giving any weightage for expertize, equipment etc. is a rule and thus contract becomes a gamble rather than a calculated risk.

Contract financing is a great problem for any construction agency. There are no regular institutes to finance construction contracts, unlike in other industries. How best contract financing can be achieved by owners leading a helping hand and financial institutions entering construction financing need a study. This is particularly so when in developing countries new entrants start on contracting and get into problems of cash flows, credit inability and other aspects, as 10 % to 15 % of the contract amount remains with the owner in terms of security,

bonds, insurance etc. even after 6 to 15 months after work is over.

In industrial construction it may be that the margin is only in terms of plant and equipment the construction agency has bought and this leads again to financial bankruptcy.

The construction management involves a follow up from the time the bid is accepted to finishing and putting into production the industrial unit.

In present day other matters become minor and can be easily tackled but not the material resources, financial resources which are bigger constraints that have to be planned in advance.

Quality control and adherence to specification can only be possible if there is properly trained personnel to supervise and the construction agency personnel also aim to good workmanship. Any bad work is costly both in terms of cost, money and reputation. This aspect needs to be stressed to the supervisory and construction men involved.

The construction industry, because of its complex nature, has inherent vast problems on labour relations. The developed countries and some of the more developing countries have had the experience of these. The formation and development of Unions and how to deal with them need proper training in human relationship. The labour laws, the safety rules, the insurances are other areas where any developing country should be given guide lines so that the industrial construction is founded and developed on sound principles.

In India, the Planning Commission has made out a draft contract. The commission has studied all aspects of construction and made recommendation on contracting, tendering, financing etc.

Works of large magnitude carried out in India are either labour intensive or fully mechanized, their needs in terms of tender, specification of contract, construction management etc. for all types of works have been developed. Huge projects are now completely managed by Indian construction agencies both public and private from the initial stage of survey to operation without any outside help.

Even on the labour legislation, India is far advanced. Hence experience of India which has undergone all phases of development and

experimentation should be a good example for any developing country in the same region or in the starting stage of development.

5. Transfer of Construction know-how

In many developing countries there are no construction firms or contractors who have the capability of industrial construction. Many firms or contractors are mostly real estate speculators rather than contractors. Most of them are family owned or one man shows. There are no organizational set-ups. No technical personnel is employed or encouraged. The smaller firms in developing countries need the know-how on construction techniques and management.

The guidelines for transfer of know-how could be, how to develop a proper attitude in industrial construction towards aim of business, how to get business, how to shape the future, how to have good relationship with sub-contractors, clients, owner, government labour, financial institutes etc.

Construction is mostly a business that has to be won by proper bidding. So, bidding for a work needs careful study in terms of contract, site investigation, quantity survey, pricing, work planning, man-power, plant and equipment organization, their turn-out efficiencies, productivity, financing etc.

Since construction is a work executed through written contracts, the type of contracts, its implications, general conditions, special conditions, obligations on the part of owners and contractors, arbitrations and other connected clauses, escalation, etc. needs careful attention. Since most of the developed countries have passed through different stages of contracting and contract conditions and have arrived at current practice after great experience and legal battles, the developing countries should be given knowledge and guidance so that the drill may not be repeated and good time wasted.

The other sphere is the job planning and organization, once the bid is accepted, and work secured. In this area, the job planning, moving in, organizing different stages of construction, sub-contracting,

labour recruiting, whether to buy a machine or hire it etc., needs examination. The reporting, costing, financing, relationship with owners supervision etc. are other areas where past experience will be of great help in the proper execution and profits.

It may be that the foreign firms from the developed countries which have entrenched themselves in developing and under developed countries are trying their best in these fields but it is not enough. They may not be able to understand the overall attitudes, socio-economic conditions of that country as well as any other developing country could understand. The developing countries which have already progressed on these matters have a better understanding of the aspirations of the people of developing and underdeveloped countries.

In India, there are a number of well established construction firms which have a standing of more than 40 to 50 years. These are well equipped with construction skills, construction management techniques. They employ qualified engineers, overseers and skilled workers. In India, there are also government owned construction firms who undertake heavy civil engineering works, works of buildings, irrigation structures etc. These are generally managed by technocrats. The construction firms are within central sector as well as state sectors. Over and above, there are a number of well equioped laboratories, research institutes which render very valuable service to construction industry.

India now produces most of its construction equipment and has a well established training and service organization.

So, India is in a very favourable position to render service to other developing and under-developed countries.

UNIDO can very well act as a catalyst in bringing forth more and more co-operation and promotional activities among developing countries. The under developed countries and developing countries will feel more confident and eager to absorb the know-how when once they know that their counterparts in other developing countries have learnt it on their own and would be more free in their approach and understanding.

India is in an advantageous position to offer the know-how at any stage of development as all levels of technological development and know-howare available from India.

6. Conclusions and Recommendations

The overall aspects of development and other considerations have to be kept in view, while formulating policies for industrial construction sector.

The main attention should be given to rationalization and improvement in production of indigenous building and construction materials, plant and equipment. Housing Sector is the one that needs priority as shelter is a basic human need.

Construction firms in developing countries must get a better institutionalized training in all fields of construction activity. The experience of developed countries and some developing countries and co-operation among developing countries themselves in institutional and technological change rather than importing some sophisticated equipment or technique, has to be reckoned.

As no comprehensive study has been made in construction activity or industrial construction work in any country, UNIDO can undertake a survey, covering all aspects, in any one developing country and evolve an effective and comprehensive approach to achieve the results in industrial construction and thus lay down guide lines for other developing countries.

The programmes that can be recommended for initiation under the auspices of UNIDO for the next five years could be:

1. a) To initiate integrated projects - strengthening and expansion of existing isolated organizations or centres or institutes in selected developing countries of higher technological levels and transferring the same into integrated central construction industry policy-cum-technical-cum-financial institutes.

   b) To achieve the above an immediate study group/workshop to be organized in a developing country with three participants from each of the selected developing countries.

2. a) As no study has been made of construction industry as a whole in any developing country, UNIDO can select three countries of different technological levels and undertake a comprehensive study with multi-disciplinary expertize including financial.

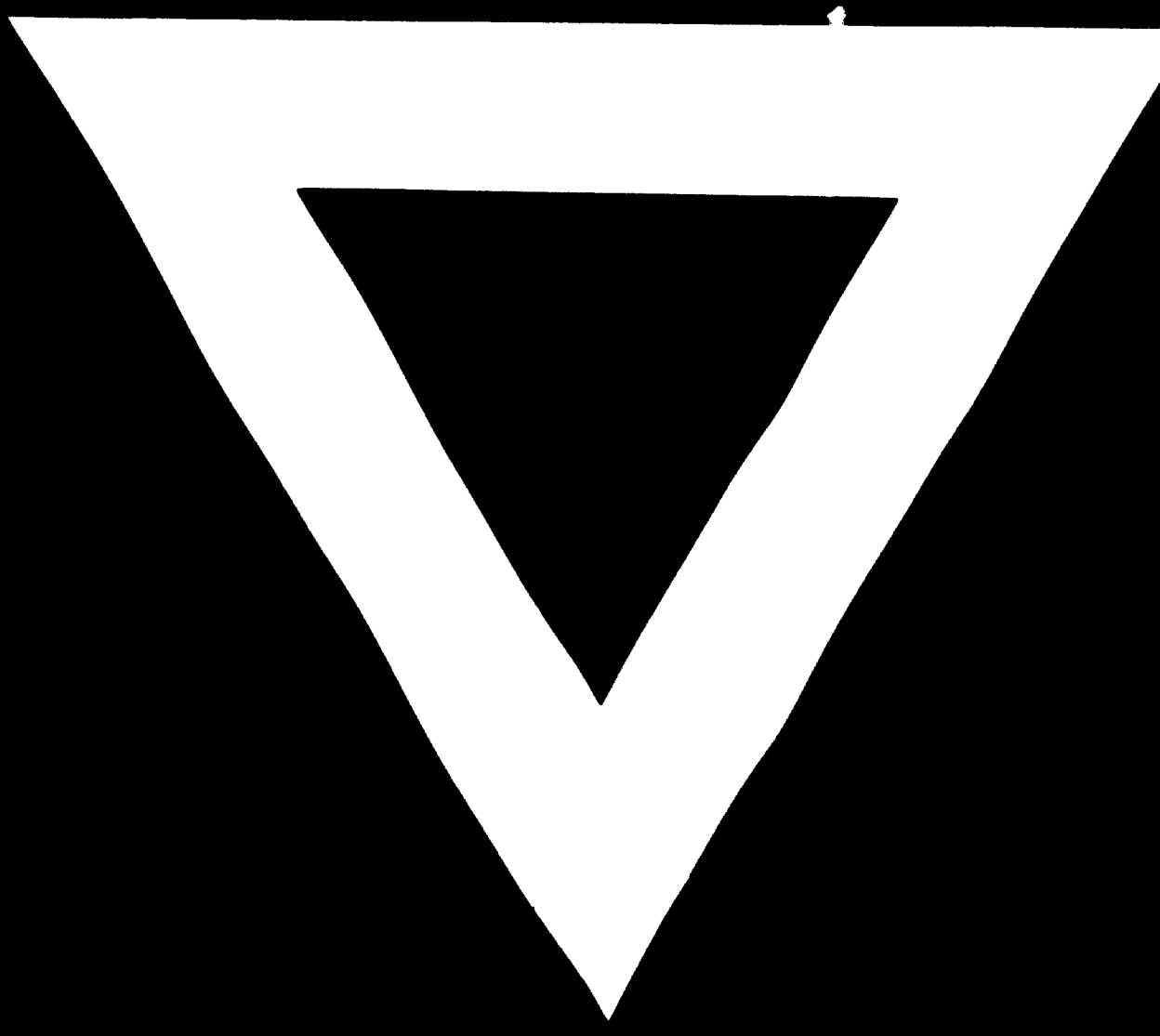
   b) After the above study, formulate the guide-lines for different levels of construction for assistance by UNIDO and the Governments of the countries on the ways and means of development of this sector.

3. a) A comprehensive in plant training programme for second level of developing countries to be organized in a developing country with emphasis on material selection, construction methods and small tool and plant and development of small construction companies.

   b) For the least developed countries a special programme under co-operation among developed countries in terms of promotions of technical visits, assistance and training programmes.

4. a) With special reference to intermediate and least developed countries, a technical manual with specifications, photographs and other details on hand tools, manually operated simple construction machinery, and other construction equipment, including items such as wheel barrows, hoists, hand operated mixers, trailers, should be prepared. This may highlight available products and technical know-how from other developing countries and will promote transfer of appropriate technology among developing countries.

   b) Similar technical manual can be made on construction methods and techniques.



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