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THE FORMATION OF AN EFFECTIVE CONSTRUCTION INDUSTRY SECTOR IN DEVELOPING COUNTRIES 1/

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CONTENTS

THE FORMATION OF AN EFFECTIVE CONSTRUCTION INDUSTRY SECTOR IN DEVELOPING COUNTRIES

A. General description of the socio-economic conditions in developing countries.

Before commencing any discussion concerning the establishment of an effective construction industry sector in developing countries, some consideration should be given to the background against which this process has to take place. This approach is justified by the relatively important role the construction industry plays within the economy of a country, with the capital formation in construction accounting for up to 16% of Gross Domestic Product and up to 60% of all fixed capital formation. Another motive for the initial review of the general background is given by the close interrelation existing between the level of social well-being and between the provision of one of the construction industry's most important goods, namely the housing. It is therefore obvious that the general development of a country cannot be separated from the advance of its construction industry sector and vice versa. An attempt to view first some eminent features of the whole socio-economic background in the developing countries will provide us with a better comprehension of two important points: One, the outside conditions and their influences on any possible development of the construction industry; two, the eventual consequences of the courses of action, taken within the construction sector, to the nation's economic system and social well-being.

To begin with, the most significant characteristic of an underdeveloped country, which also serves usually as a criteria to distinguish it from the developed countries, is the low level of per capita income which is usually further decreased by a high birth rate of the population. Another typical feature, often quoted in conjunction with the previous one, is the relatively large share of G.N.P. produced by the agricultural sector. However, as there are some developed countries, such as Denmark, Australia, New Zealand and Netherlands, which have also a fairly high proportion of agricultural activity, the blame for the population's insufficient income level cannot be put straightforward on the prevailing type of occupation. Rather, a common cause of these phenomena should be isolated, with all the clues directing to the qualitative inadequacy of the human resources as one of the main roots of the evil.

Adopting freely part of the ideas expressed by Prof. Yagdish Bhagwati in his "Economics of Underdeveloped Countries", this qualitative inadequacy is manifested mainly as the lack of certain attributes. Two of these, considered to be dominant, shall be mentioned here:

1. Availability of skilled operative and managerial manpower;
2. Existence of a sound public administration system.

The shortage of skilled manpower being usually only a symptom of a more general deficiency of education and the overconcentration of the active population in the agricultural sector, based on inefficient, traditional production methods, requiring only a low degree of skill, are obviously two sides of the same coin, as the conditions of rural life and work do not offer much possibilities

for the development of managerial or operative skill. Neither does the low income level of the mostly rural population allow any capital formation, necessary for a substantial development of secondary economic infrastructure, i.e., manufacturing industries, construction enterprises and basic facilities.

The shortcomings of the second type, i.e., public administration deficiencies, are also a serious impediment to the development progress. Maladministration, be it at the central, regional, or local level, may be found also in countries which already possess human resources of adequate quality. In such cases, its negative effects are even more perceptible, whereas in other developing countries they are mostly secondary to the more serious problems arising from the low educational level of the population. The most common symptoms of public administration deficiencies are economic (and at times even political) instability, proliferating bureaucracy, and corrupt practices. There is no need to explain the negative effects of these phenomena on the sound development of the various sectors of economic activity. The construction sector is, by its nature, subject to inherent fluctuations of volume, due to the seasons of the year, and to the fact that construction activities are moving from one project to another, with a decreased intensity of work at the beginning and completion of the job. It is therefore obvious that construction is particularly prone to suffer if these irregularities are joined by the instability and unpredictability of the whole economic and political environment.

Concluding this introduction, the main task of development can be defined as the concentration of all the necessary efforts to break the vicious circle of poverty-ignorance-

high birth rates by creating new employment opportunities in industrial production, construction and services and by providing the suitable climate for this process by establishing a sound and efficient public administration system. The generation of new working places obviously requires also capital investments, coming mostly from international sources, as the domestic possibilities are rather limited and in any case a great part of these investments must be made in foreign currency which tends to be scarce in many developing countries. Under these conditions, the degree of resource utilization merits supreme attention. The examples of misallocation and poor utilization of resources, witnessed in some developing countries, lead often to superflous investments that could be diverted to a more productive purpose. This is a point that is too often overlooked, and it hardly needs to be said that the construction sector is no exception to this rule.

B. Housing and other construction needs in developing countries

After having reviewed the most characteristic socio-economic features of a developing country, the next step should be in identifying the needs that are to be satisfied in this environment by the construction sector.

The most important share of construction industry's output lays without doubt in the provision of housing. This importance is not only quantitative, with the proportion of dwellings constituting up to 50% of the total construction output, (in Argentina and Israel, during some of the recent years, this share has been recorded to exceed 60%), but also qualitative, with the standard of the population's housing being one of the main components of a nation's welfare.

In many developing countries, the problem of providing adequate dwellings becomes especially complicated by the flux of the population from the poverty-stricken rural areas to the great cities, attracted by better opportunities for employment. The consequence of such population redistribution, getting out of control, is the proliferation of improvised shanty towns. It is important to mention that in many cases the newcomers have left behind them dwelling conditions that are, at least in certain respects, superior to those of the overcrowded shack quarters. This is true in particular if the population-density criteria is applied. The scarcity and high cost of land in the urban area force the people coming from outwards, without any financial means, to occupy confined pieces of ground, mostly with an inferior location. It often happens that the location conditions are so bad (e.g., areas prone to suffer by seasonal floods) that no other use of the land has been made, before the shanty town began to grow there.

In order to avoid, or at least minimize the possibility of these situations, the development scheme should contain provisions for a decentralization of the newly established industries and facilities, to prevent an overconcentration of the population in a small number of urban centers. The advantages of pursuing such a policy are manifold: First, there is a more rational use of land, sparing the scarce reserves in the densely occupied township zones. Second, with a greater part of the population remaining in its original rural environment, a higher degree of utilization of the existing stock of housing is achieved. Third, in the rural areas, where the sense of belonging to the community is much stronger, the implementation of self-aid housing schemes is much more feasible, than in the big cities, with an atmosphere of mutual alienation. All the advantages mentioned represent a considerable saving of resources and efforts that can be utilized for other purposes,

dedicated to the improvement of general welfare. The UN Committee for Development Planning underlined the importance of this approach in the following statement:

> "Improvement in housing and community facilities should be sought partly in the establishment of new townships at some distance away from the biggest centers of population, so as to halt the continuation of urban agglomeration. The new townships should at the same time be limited with planned industrial development. Low cost housing can be intensified through the exploitation of local materials and the use of labor-intensive techniques, often on a self-help basis - thereby contributing to employment as well."

The need to pursue a policy of urban decentralization becomes also obvious if the forecasts of the world population's growth and distribution for the rest of the century are considered (see Fig.1).

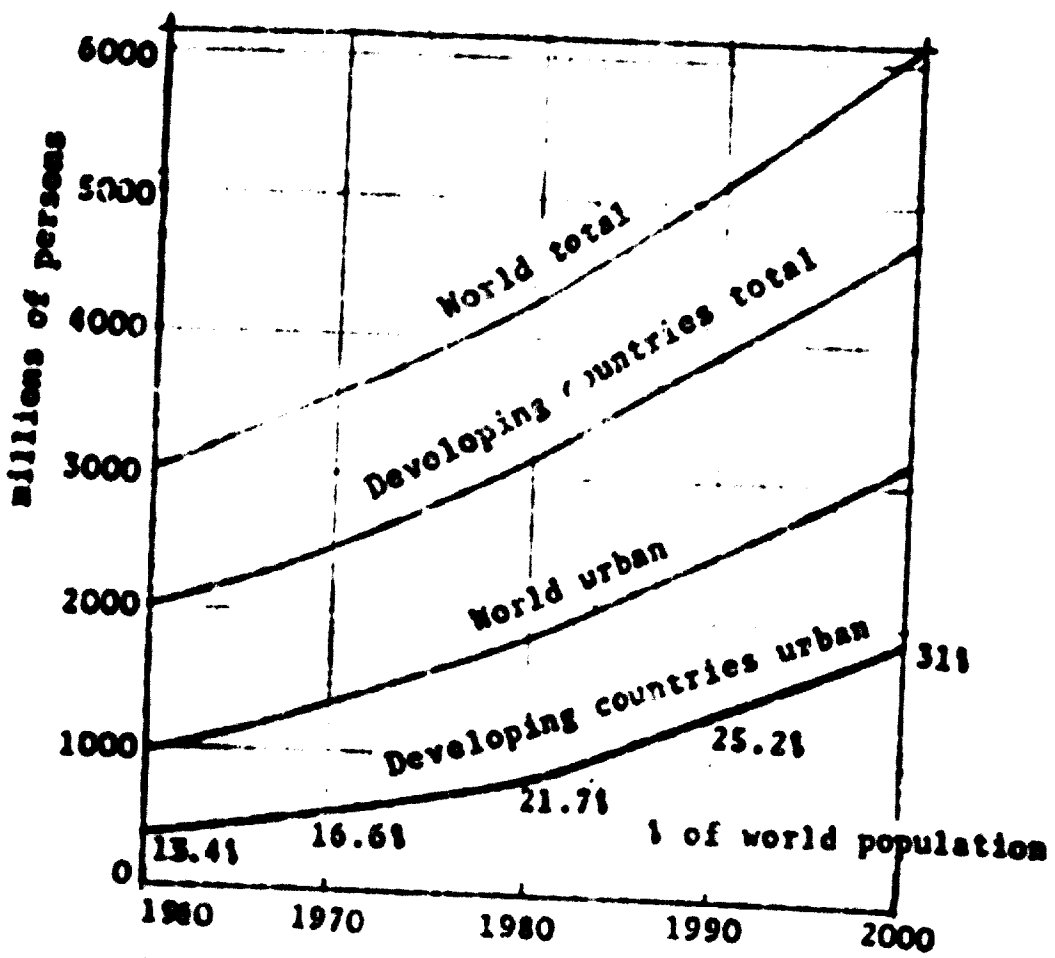


Figure 1: WORLD POPULATION 1960-2000
(UN 'Medium' projections
1963 revised 1969)

The diagram shows that the proportion of urban population in developing countries within the world total will raise to 31% towards the end of the century, nearly doubling itself during a period of three decades. Unless no adequate steps directed towards a better territorial distribution of population will be taken in these countries, such a perspective might be quite menacing, considering the misery already existent in some of the overcrowded urban areas.

A decentralization of the population and of the developing industries and facilities poses similar requirements to the construction enterprises and building materials industries.

Jointly with the setting up of new manufacturing plants, power stations and other economic projects undertaken in the various territorial locations of a developing country, provision should be made also to secure, within each region, the parallel development of a construction sector infrastructure which will be required to support all these activities. This implies a financial and administrative aid to the establishment and growth of construction enterprises and certain building materials industries on a regional scale, rather than favoring solely the evolvement of large construction industry firms operating mainly in central urban areas.

When calculating the housing needs, an account should be taken of the manifold variety of solutions that can, or rather ought to be applied, to the various types of circumstances under which the housing problem is posed. This view is expounded by the following quotation from the UN ECLA publication "Social Change and Social Development Policy in Latin America":

> "The housing programmer has at hand a wider range of optional or complementary techniques for improvement of the housing situation.....Construction of low-cost

housing for sale or rental as a public service is only one of these. Other measures include arrangements for low-cost credits....., material and technical aid for families undertaking self-help construction; rationalization of the construction and building materials industries; favourable terms for imports of building material and machinery, etc. At the same time resources can be channeled into improvements in the quality of the existing stock of housing, arresting deterioration, and even making the improvised shanty-towns more habitable."

This aspect clearly has to be taken in account also when planning the development of the nation's construction industry sector. This could mean for example the establishment of small building maintenance enterprises, the establishment of auxiliary home-industries for provision of inexpensive local materials, etc.

One further fact concerning housing which must be taken into consideration as influencing the construction sector is the necessity to provide with the housing a complementary infrastructure of basic functional services and of social and community equipment. This implies the requirement that the development of civil work enterprises capable of performing these tasks should keep pace with the development of enterprises devoted solely to housing construction.

Considering the non-housing needs for construction in a developing country, the accomplishment of the various industrial and other projects aimed at the promotion of the nation's economy poses also a problem. These projects usually possess a degree of complexity and technological refinement, requiring a level of know-how in design and execution which is not always available in the country. Hence, in some of the developing states, there is a necessity to hire the services of foreign firms to meet these tasks. This, of course, means a waste of employment opportunities for the local working force

- if they would possess the necessary skills, they would have occupied the jobs held by the foreigners, thereby decreasing the size of unemployed labor. Unless there is a possibility of obtaining the aid of international organizations, this also means a considerable expenditure of foreign currency, which is usually scarce in many developing countries, being required for a host of other purposes. Even if for a certain period the employment of foreign firms is indispensable, a provision should be made for the education and training of local personnel, for a gradual taking over of the tasks handled by the alien staff. A certain way to achieve this end is to include in the contracts of the foreign firms clauses, obliging them to provide the upbringing of a certain amount of local personnel.

Another important point deserving attention is the erection of buildings for public administration. Although nobody denies the importance of an appropriate lodging for these institutions, in some countries, the lavishness characterizing their exterior appearance borders on squandermania. Upon seeing the monumental facades covered with marble or other expensive decoration, one cannot help asking how many additional dwellings for shanty town inhabitants could have been built, or how many new permanent job opportunities could have been created with a more austere handling of the national funds.

Another important service to be rendered by the construction sector is the maintenance of the existing stock of buildings and other civil engineering structures. As the UNIDO Monograph No. 2 on Industrialisation of Developing Countries (dedicated to construction industry) points out, the share of maintenance in the total construction output, of a typical developing country, is only 13.9%, as compared to the share

of maintenance in a typical developed country, where it amounts up to 33.7%. One of the reasons for this difference is obviously the fact that the stock of existing objects requiring maintenance in the developing countries is relatively small, compared to the volume of new construction. However, as the same UNIDO Monograph mentions, there is an additional reason: "The lower standard of maintenance tolerated in developing countries for a large part of the stock also serves to diminish the proportion of work in this category." The lack of mindedness for this type of activities obviously means a waste of resources and a commitment to extra spending on repairs in the future. Any contemplations concerning the formation of an effective construction sector in developing countries should, therefore, also take in account the establishment of organizational tools for maintenance works.

Ultimately, the decision makers at the national level should bear in mind, while planning the size and composition of the construction industry's output, that a close dependency exists between the happenings within this sector and between the course of events befalling the country's economy as a whole. A relatively small but sudden decrease of the construction activity's volume may create a reset of the total economy, or, in an adverse case, the improvisation of massive housing programmes beyond the capacity of available resources may result in a serious shortage of building materials and labor, and a raise in the cost of land and construction. The construction sector should be, therefore, always viewed as a part of the whole national economic system, taking in account all the manifold relations existing between both.

C. Creating a cadre of skilled manpower.

The links existing between the low level of per-capita income in developing countries, signifying the inferior productivity of labor and between the lack of sufficiently skilled and educated manpower, have already been mentioned. Although an increment of capital investments can also effect a raise in the output per unit of labor, it is obviously better if such a raise is achieved by elevating the qualifications of the personnel. In this manner, the necessary investments - mostly in foreign currency - are reduced, not to mention the fact that the introduction of capital-intensive production methods requires, as a condition sine qua non, quite a high competency level of performance in the various operative, technical and managerial tasks within the construction sector.

The trades and professions active in the construction sector are manifold, ranging from the various types of craftsmen at the building site, to the engineers, architects and managers in the offices, who plan, organize and direct the whole construction process. This picture is further complicated by the fact that persons having the same background of professional training, may be active within different functional sectors of the industry (e.g., the same civil engineering graduate may be employed in structural design as well as in work inspection, or project management). Such further specialization may require supplementary skills, which are in many cases acquired solely by experience, due to the fact that the basic professional training is oriented mainly towards the fulfillment of only one function (e.g., civil engineers, whose education is mainly directed towards preparing them for work as structural designers). This might be justifiable if the quantitative requirements for

the other functions do not demand the introduction of specialized curricula for professional education. However, in many countries, especially in the developed ones, this orientation of professional education towards a limited number of ends is merely a result of frozen traditional concepts, originating from times when the other functions requiring attention were not yet fully recognized. In the developing countries, the advantage of a fresh start, unhampered by considerations belonging to the past, can be helpful in establishing a system of professional education which is better adapted to meet the manifold requirements for skills existing in the construction sector.

The setting up of a professional education system, should be based on thorough planning, taking into account the country's needs for construction, as well as all the other important factors, related to the socio-economic background of the development process. The plan itself should be painstakingly elaborated, including mainly the following details:

(a) Quantitative requirements for manpower, distributed according to profession, function and sector within the construction industry system.

(b) The areas of knowledge and skill needed by each of the categories, with an indication of the extent of training required.

(c) Proposals concerning the methods of schooling and training, with a list of suitable institutions. If necessary, suggestions for the establishment of new instruction facilities should also be included.

Due to the fact that a long time elapses between the commencement of the future employee's training, and between the stage at which his skills are fully developed, the

plans concerning professional education should extend several years - possibly even a decade - into the future. Here an objection could be voiced that a detailed long range plan might be very susceptible to the various changes occurring in the construction industry and its environment, making frequent periodical revisions and updatings indispensable. It seems, however, preferable to be prepared to meet such changes with a program that can serve at least as a base for decision making, rather than facing the possible rapid developments empty handed, having to resort to improvisations only as responses to new unforeseen situations.

One of the important functions within the whole construction industry system is the occupation of a general foreman. Whether, next in command to the site manager on bigger projects, or handling smaller jobs alone, it is he who is responsible for the translation of the design described on paper, into facts made of concrete, steel, bricks, or stone. Surprisingly enough, many countries have not yet realized the importance of methodically organized training for this occupation and thus this position is usually held by experienced skilled laborers, possessing also some leadership abilities, but practically without any formal professional education.

In Israel, the training of the foremen has been delegated since 1970 to the Institute for Training and Productivity in Building. The Institute, jointly with the Building Department of the Israeli Institute of Productivity, prepared a curriculum of a training course divided into three stages, each stage lasting one year, with lectures given twice a week, every session being three hours long. An alternative curriculum exists, divided in two stages only with a more condensed form of study, the total number of learning hours for each subject being the same.

The subjects taught in the course are detailed in the following Table 1 (according to the curriculum consisting of three stages):

Table 1: Curriculum for Foremen as proposed for the Israeli Construction Industry.

Subject Number	Subject Name	Learning Hours			Total Hours
		Stage I	Stage II	Stage III	
1	Applied arithmetic, geometry & mechanics	51	39	-	90
2	Physics (other than mechanics)	9	-	-	9
3	Slide rule	-	15	-	15
4	Theory of edifices	33	-	-	33
5	Drawings and building details	30	-	-	30
6	Site planning and organization	36	-	-	36
7	Planning and scheduling of work execution	-	36	9	45
8	Stability of structures	-	30	30	60
9	Building materials	18	21	-	39
10	Accident prevention	30	30	26	86
11	Plastering	-	6	-	6
12	Floor tiling	-	6	-	6
13	Sanitary installation	-	6	-	6
14	Electrical installation	-	6	-	6
15	Painting	-	6	-	6
16	Ironwork	-	6	-	6
17	Carpentry & joinery	-	6	-	6
18	Caulking	-	6	-	6
19	Waterproofing of roofs	-	6	-	6
20	Infrastructure development works	-	6	-	6
21	Prevention of corrosion	-	6	-	6

Table 1 continued.

Subject Number	Subject Name	Learning Hours Stage I	Stage II	Stage III	Total Hours
22	Heating and air conditioning installations	-	6	-	6
23	Elevators	-	6	-	6
24	Scaffolding	-	15	-	15
25	Equipment and tools	21	-	21	42
26	Contract documentation	-	-	21	21
27	Quantity surveying	-	-	60	60
28	Budgeting and pricing of construction works	-	-	24	24
29	Building site administration	-	-	12	12
30	Surveying on building site	-	-	39	39
31	Industrialized building	-	-	15	15
32	Personnel management	6	-	-	6
33	Human relations	6	3	-	9
34, 35)	Labor laws and social rights	9	3	-	12
36	Work study	15	-	-	15
37	Incentives application	6	-	-	6
38	First aid	-	18	-	18
39	Technical vocabulary	-	-	3	3
40	Sundries	-	-	6	6
TOTAL LEARNING HOURS		270	285	269	824

It is advisable to develop similar curricula also for the other occupations within the construction industry, striving for a coordination between all the plans concerning professional education, including possibly even syllabi which are prepared by technological colleges for the teaching of engineers and architects. In order to secure the cooperation and take into consideration the needs of all

the sectors, a public board with representatives of the groups and organizations involved should be set up for the purposes of planning and implementing the educational programme.

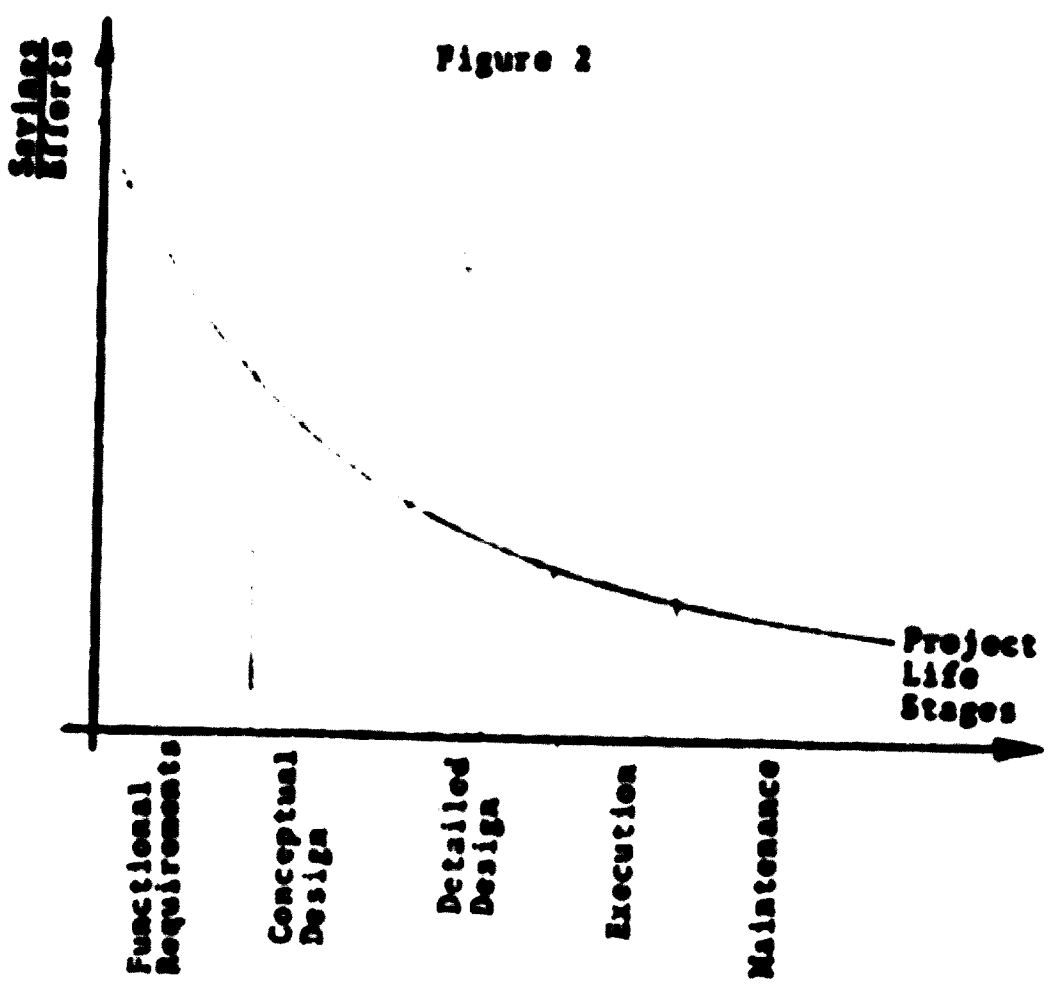
An important aspect that should not be forgotten in conjunction with the planning of professional education is the need for updating of knowledge. The well known truism stating that a man's learning should continue during his whole active lifetime holds also for the occupations existing in the construction sector. The necessity to keep pace with the frequent introduction of innovations, requires the establishment of a training system complementary to the basic one, serving as a medium for acquaintance with new materials, equipment and methods. Even in a developing country, where due to the abundance of labor and shortage of capital the appearance of new inventions is scarce, the dissemination of knowledge about innovations existing in other places is still important, because changes of condition at some future point in time may justify their introduction.

Although the scope of this paper does not allow an enumeration of the various educational tools and forms of instruction which must be used in professional training for the construction industry, there is one important medium for the transmission of know-how, deserving special attention - namely, special building sites used for demonstration, training and experimentations. Such exemplary sites could provide excellent facilities for practical routine instruction, as well as for testing and display of new materials, machines and method under real work conditions. Needless to say, knowledge gained through perception in this manner, by direct contact with the subject, is the most effective, serving as an important complement to the other media of learning.

D. The roles of design and production.

The contribution of design to the development process of the construction sector is most significant. It is at the design stage that decisions are made as to how materials should be shaped and placed on the building site, in order to satisfy the functional requirements. The qualities of the production system within the construction sector depend, therefore, to a great extent upon the existent characteristics of the design function as a whole. A few lines on drawing or a few words in the specifications' text, requiring only several minutes to be put on the paper, may result either in a considerable saving or in a waste of reserves and means. Figure 2 shows how the ratio between savings and the efforts necessary to produce them decreases as the realization of a project approaches completion, illustrating the benefits of promoting rational design.

Figure 2



The decisions made at this stage determine also to a great extent the degree of well-being and satisfaction sensed by the user after the building is completed and handed over to him.

The necessity for a thorough knowledge of various local conditions influencing the design, emerges as an almost immediate consequence of the preceding statements. Information about the materials and the craftsmanships available, as well as facts pertaining to patterns of familiar and social life, economic conditions, climate and other factors affecting user's requirements, all provide an important contribution, leading to a more efficient design, matching the local needs and possibilities. This point of view explains also the successful results obtained at times by the right combinations of local building traditions with a sound knowledge of modern construction technology and architecture. A creation of interdisciplinary teams of specialists covering all the aspects worthy of consideration, provides a further guarantee of the suitability of the design to society's requirements.

An approach emphasizing the necessity of acquaintance with local conditions is extremely useful, even indispensable, in projects concerning self-aid housing, where a maximum satisfaction of demands must be achieved in spite of constraints dictated by shortage of means. In Argentina, the staff of Centro Experimental de la Vivienda Economica (CEVE) of the Catholic University in Cordoba, developed in 1969, under the direction of Prof. Horacio Berretta, a concept of dwelling unit that can be presented as an example for this purpose (see Figures 3 to 7). The building consists of a kitchen and dining room, three bedrooms and a bathroom with lavatory, and forms, together with a patio,

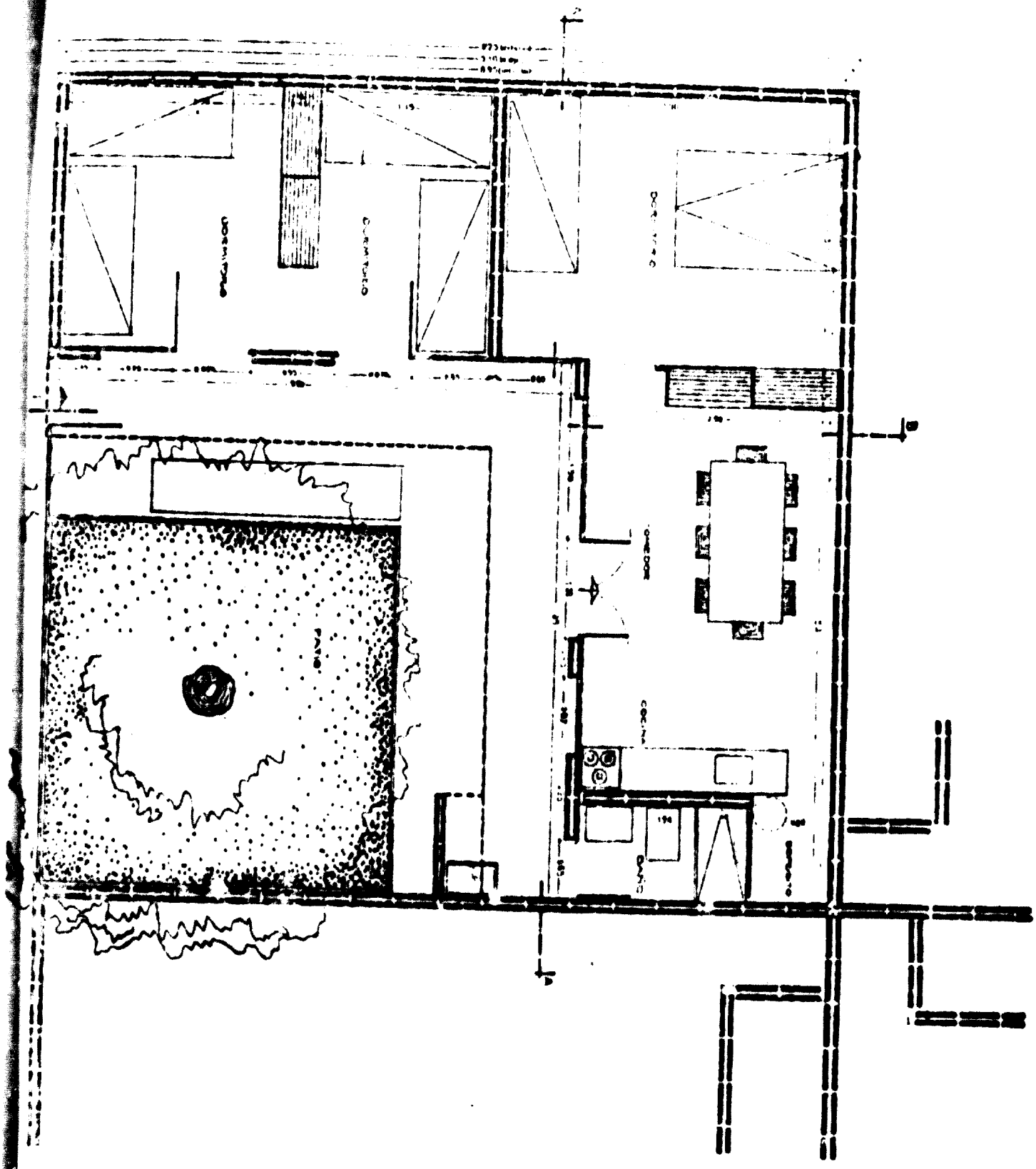


Figure 3. Plan of prototype of dwelling units developed by Centro Experimental de la Vivienda Economica (CEVE) of the Catholic University in Cordoba, Argentina.

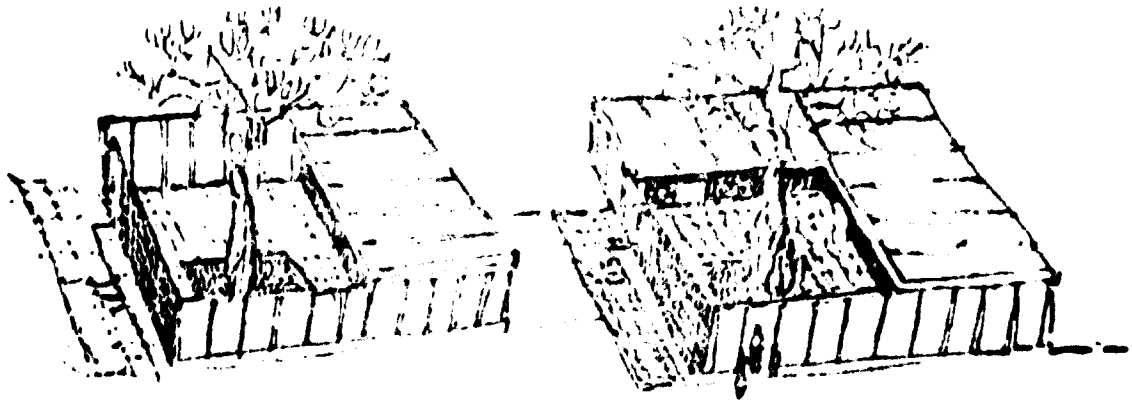


Figure 4. The stagewise completion of CEVE dwelling unit.

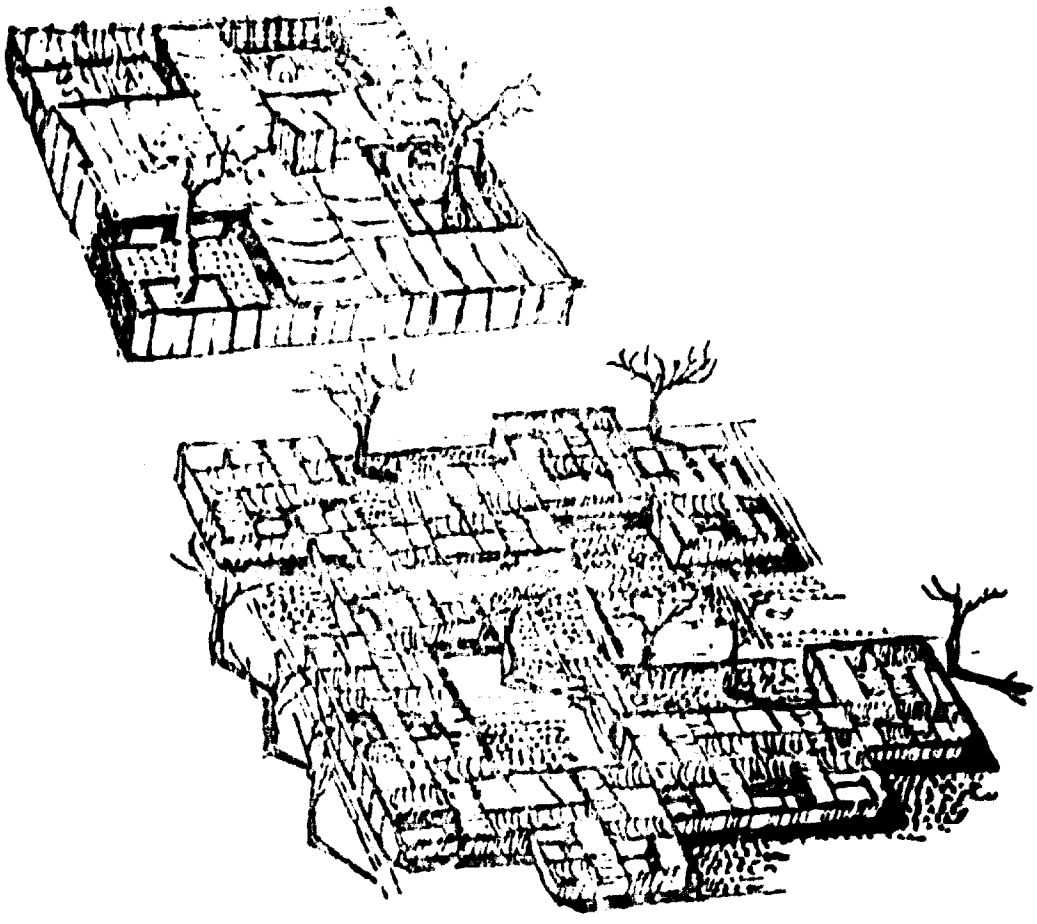


Figure 5. Typical groupings of CEVE dwelling units.

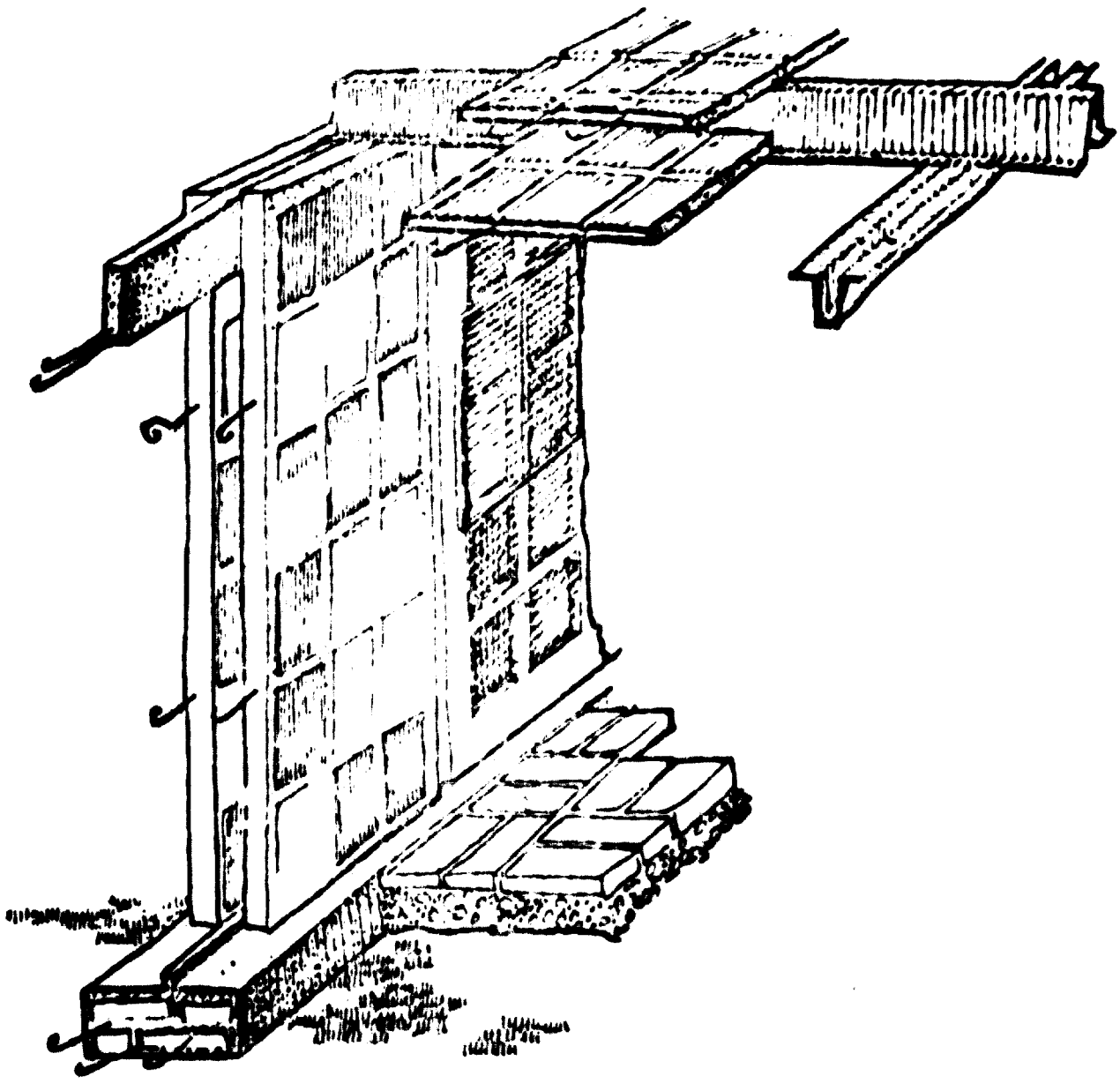


Figure 6. Structural scheme of CEVE dwelling unit.

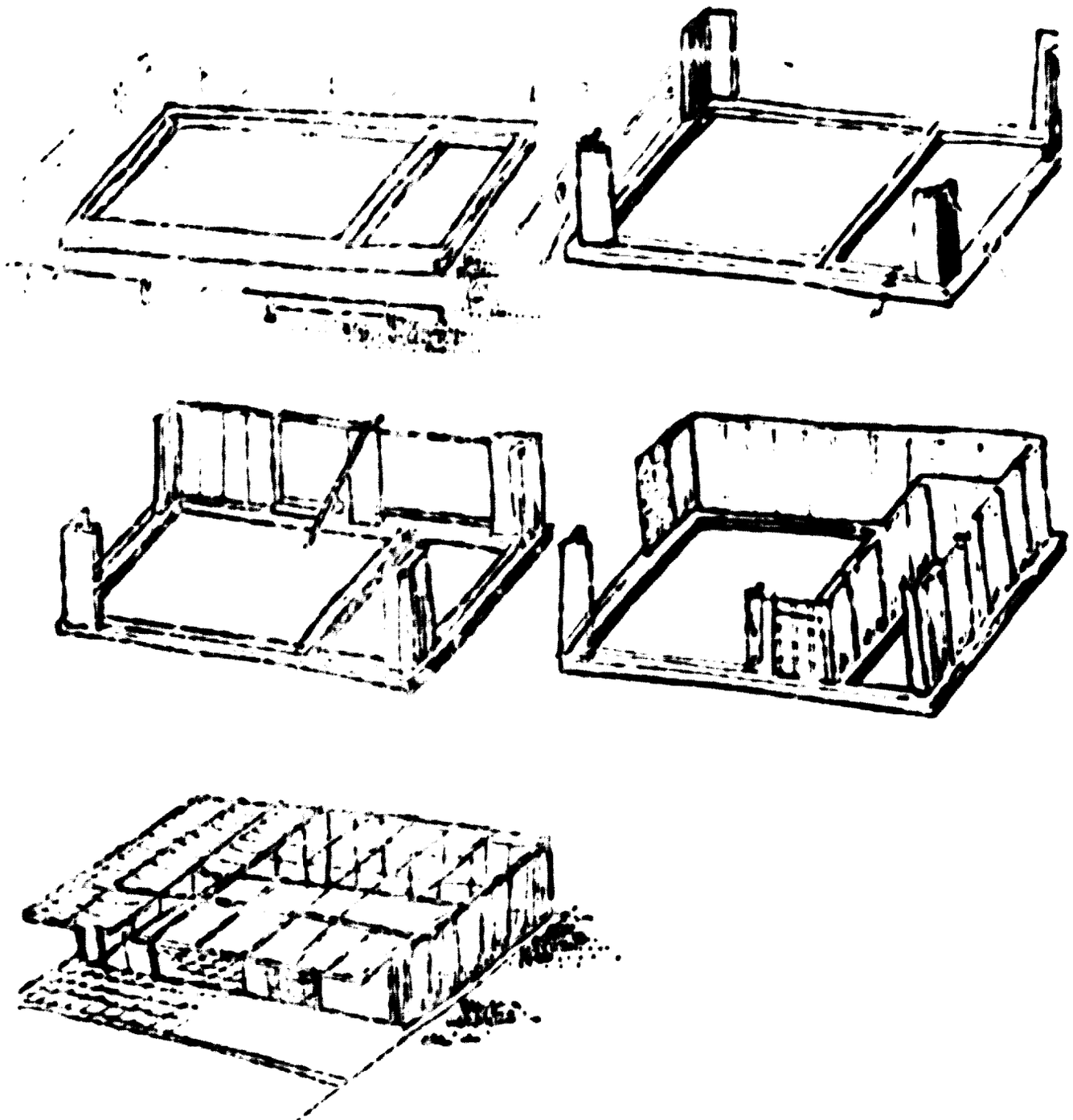


Figure 7. Steps in the erection process of CEVE dwelling unit.

an enclosed square covering an area of approximately 81 square meters. More than a third of the area is left for the space of the patio, which also has a part covered by a projection of the roof, providing the necessary shadow. A possibility exists to erect the house in two stages, constructing first the dining room, kitchen, one bedroom, and the bathroom with lavatory, and adding the remaining two bedrooms later. This construction is relatively simple and economical, based on precast wall panels that can be made locally from bricks and a small quantity of concrete with a few bars of reinforcement. The panels are placed pairwise with a void for insulation between them. On top of the structure, bent steel profiles are used, to bear the roof, covered by panels similar to those used for the walls. Work consumption required by this type of house amounts to about 160 mandays, making it possible for two adult persons to erect the building within a span of ten months, provided that about two hours are worked daily and seven hours on weekends. Thanks to the closed unit formed by the dwelling part and the patio, the houses can be arranged into various clusters, while still allowing a considerable amount of privacy for the individual buildings within the group.

Any discussion concerning the functions of design and production would not be complete without mentioning the division existing between both functions in the construction industry. The fact that the execution of the works and the planning of the product are often entrusted each to a separate body has been rightly considered as a hindrance to the development of more effective ways for building. This state of affairs, which is practically a traditional continuation of the distribution of tasks existing in Europe for centuries, requires some modifications be made, especially in the developing countries. The commissioning of projects

for execution inclusive of design might mean a considerable improvement, if the scheme is correctly applied. This approach obviously requires the elaboration of detailed specifications for functional demands, the setting up of criteria, to measure the design's extent of meeting these demands, and a careful evaluation of the submitted proposals. It appears, moreover, that the efforts made in this direction are worthwhile. In Argentina, for example, the "Project and Price Competition with Price Ceilings", initiated by the Ministry of Social Welfare through the State Secretariat of Housing and Banco Hipotecario Nacional, enabled an effective linkage of urbanistic and architectural design with contractors' considerations of execution and production. Under this scheme, contractors are invited to compete in the submission of a proposal for the design and construction of dwellings, which will include the complete infrastructure of services, with expenditures not exceeding a set, limited sum. In Israel, a similar course of action has been undertaken by the Ministry of Housing. The Ministry issued invitations for tenders to construct several projects, each comprising about 300 to 600 dwelling units. The points of competition were the price of construction and the maintenance of an acceptable quality of design. It has been observed, in both countries, that such an approach gives rise to the promotion of more efficient building methods.

Standardization and dimensional coordination are also factors belonging to the subjects related to connections between design and production. There is no doubt nowadays that there is indeed economic benefit to be derived by applying these principles in construction. Unfortunately, their application may be hindered by the fact that the designers, on the one hand, will not specify standardized components, if they are not available on the market, while,

on the other hand, the manufacturers will not produce something for which there is no continuous demand. Such demand, however, can be created only by continuous appearance of the product in the design of various projects. This vicious circle may be broken by the introduction of laws and other administrative measures, ensuring the mandatory use of dimensional norms, to promote the production of standardized building components. Such a process might be facilitated in the developing countries by virtue of the fact that the building materials industries have not yet fully evolved, and, in view of the absence of institutionalized precedents in processing, one can more readily introduce dimensional coordination and standardization than in the already established manufacturing enterprises, where changes require more toil. It is advisable, therefore, to exert all efforts towards the inculcation of standardization and dimensional coordination as soon as possible, with a broad base encompassing even the design of self-aid housing and other types of construction which might still be far from the industrialized way of building.

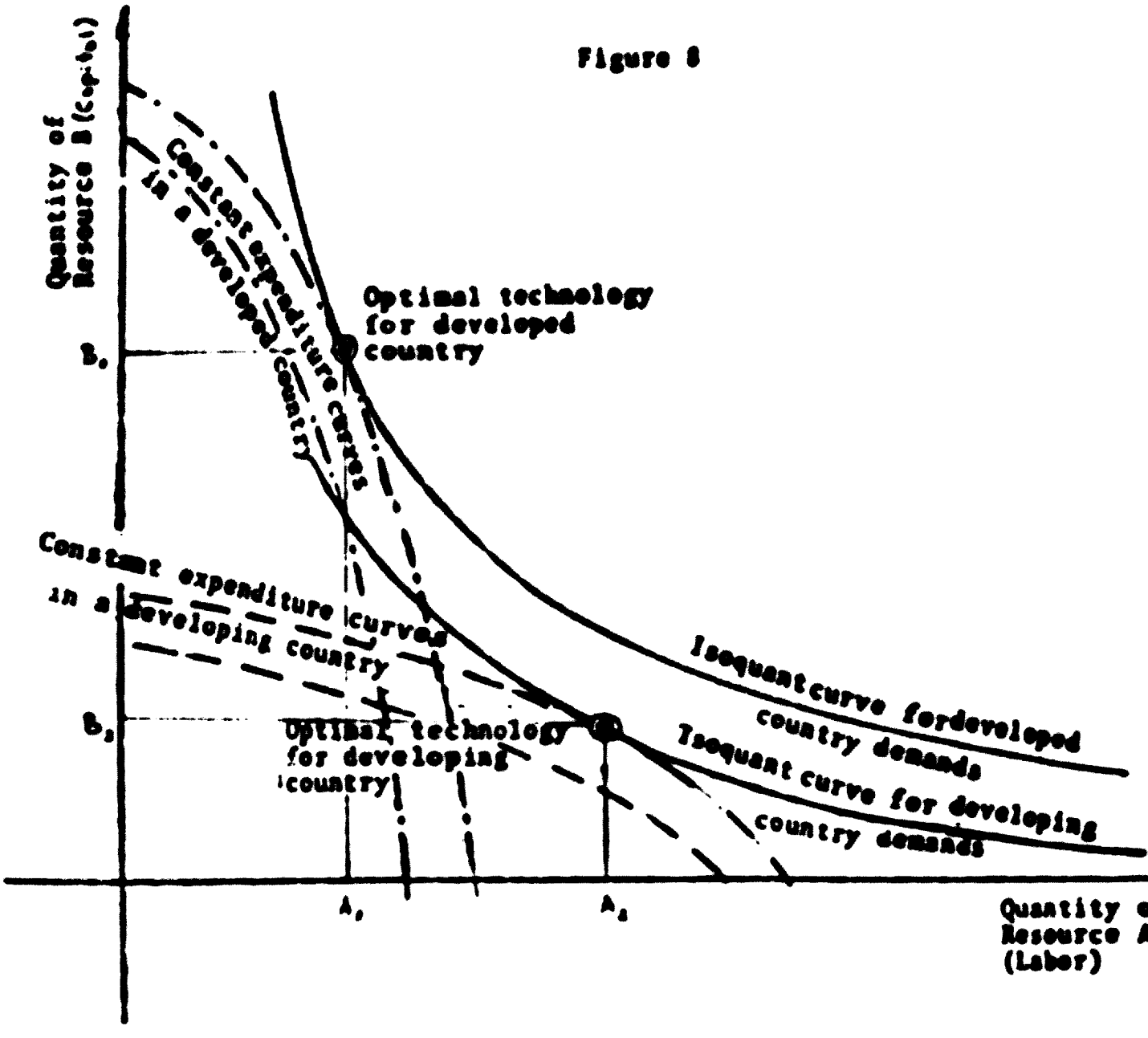
E. Progressing towards developed status.

This section attempts to follow the evolvement of the construction sector within a developing economy by describing the most salient characteristics of this process, namely the transit from a labor intensive to a more capital intensive production and by outlining some considerations concerning this progress.

There is obviously a multitude of possible technological methods that can be used in order to satisfy a certain amount of demands confronting the construction sector in a

country. However, in spite of the fact that all of them may lead to the satisfaction of the same need, each method requires different quantities of various resources. Figure 8 graphically represents the previous statement, with the curve joining all the points representing the various possible quantitative combinations between resource A and resource B, necessary to produce a constant amount of a given utility. A curve of this type is named isoquant, due to its aforesaid property.

Figure 8



Substituting labor for resource A and capital investments (for machinery, equipment and other labor saving expenditures) for resource B, the position of the methods used by the construction sector in a developing country will clearly lay to the right of the isoquant curve. The question to be answered now is, when and how should the position be shifted to the left side of the curve representing the domain of capital intensive technologies.

To answer this question, another concept shall be introduced. As there exists a certain price for the utilization of each type of resource, a group of parallel curves can be drawn joining all the points representing the various possible quantitative combinations between resource A and resource B and resulting in the same amount of expenditure. The tangent point between one of these curves and the isoquant corresponds to the optimum technology, assuming that each quantitative combination of resources can be associated with a certain production method. Any other point on the isoquant will obviously lay on a curve corresponding to a higher constant expenditure.

As the socio-economic background changes with the progress of development, the position of this optimum also changes. The gradual absorption of manpower by other economic activities, resulting in an increase of the relative price of labor, changes the form of the constant expenditure curve, shifting the optimum to the left thus forcing the construction sector to adapt more capital intensive methods. As a parallel process, the raise of the income level may create demands for an increased quantity and higher standard of construction. Such new demands require obviously more resources, and the points representing the quantitative combination of these resources will yield a new isoquant

situated above the previous one.

However, at times situations occur, marked by a trend of intensive mechanization and equipment investments, in spite of occupational conditions that might be far from full employment. Although an encounter with such situations is quite rare, their development should be by all means avoided. At this point, it should be remembered that the proportion between the price of labor and the price of capital investments can and shall be regulated to a great extent by the administration so as to guard the economic welfare of the society. An introduction of capital intensive production methods to construction - including some types of prefabrication - therefore should proceed jointly only with the creation of additional working opportunities. These working opportunities may be even available in other sectors due to the fact that the "construction traditionally serves as a transitional stage between unskilled, rural agricultural employment and skilled, urban industrial occupations" (UNIDO Monograph on Industrial Development, No.2, Construction Industry). An exception to the above rule might exist in cases, where a speedy completion of vitally important projects requires the use of advanced technological means (e.g., the extensive utilization of equipment on the construction of a factory building could, on the one hand, jeopardize the employment of a score of construction laborers, but, on the other hand, it could mean the creation of a thousand working places one year sooner).

There are some further conditions that must be satisfied, every time, before steps are taken in the direction of further capital investments, such as reliable prognoses indicating a raise or at least stability of demands for the goods that are to be produced by the purchased equipment,

the availability of sufficiently skilled manpower, to operate and maintain the equipment, and last but not least the ability to bear the financial commitments (which is an often underestimated aspect).

A clear distinction should be made between the introduction of more capital-intensive methods and the increase of productivity, as the latter usually means improvement without any significatn additional investment. Any step leading to such achievements should be therefore always accepted. By no means should the unemployment problem be solved by sticking to wasteful production methods and malorganization, which are both serious impediments to progress and development. It is worthwhile, at this point, to consider a wider introduction to the construction of approaches and techniques, used for the promotion of productivity in the manufacturing industry, such as work study, value engineering, operations research, etc. The results obtained so far have been promising - at least in those cases in which these methods have been applied in a correct way. Any comparison between the labor requirements per square meter of two projects, differing only by the quality of site organization, will provide a convincing evidence about the extent of benefits that can be achieved.

Another significant contribution to the introduction of improvements may come from building reserve stations, advisory services, information centers, and exemplary building sites, serving as facilities for the generation and dissemination of knowledge aimed at the promotion of construction sector development.

Finally, it should be remembered that the successful guidance of an economic sector through subsequent stages of

development requires a steady supply of reliable data reflecting the status of the construction industry itself as well as of the relevant social and economic environment. For this purpose, the establishment of an efficient statistical information system, appears to be essential. This important tool for decision-making is often neglected, due to the prevalent misinterpretation of its purpose, considering it solely as a means to satisfy scholastic curiosity.

F. Summary

For conclusion, the following main recommendations have been recapitulated:

1. The general development of a country cannot be separated from the advance of its construction industry sector and vice versa. Therefore, it is important to view the construction as a part of the whole national economic system and as an important factor, contributing to the social well-being of the population.

2. A climate of political and economic stability is an indispensable condition for the sound development of construction industry, which is usually more vulnerable during inconstant situations than many other sectors of the economy.

3. Considering the numerous needs that must be satisfied by the construction industry in developing countries, especially in the provision of housing, it is imperative to preclude any unnecessary waste of resources. Some of the steps to be taken for this reason are:

a) A wider regional distribution of the development efforts in order to avoid an overconcentration in certain urban areas. This means a better utilization of existing housing stock in the rural communities, and a saving of expensive land reserves in the big cities.

b) The construction of ostentatious-looking, expensive public buildings should be avoided, diverting the means that can be saved by building simpler structures to more worthwhile demands.

c) Due attention should be given to the maintenance of the existing stock of buildings. Negligence of this requirement will lead to a rapid deterioration of what has been built by great efforts, meaning an unjustifiable waste of resources.

d) The planning of solutions to the housing problem should take in account the wide variety of potential ways to approach this task, which offers, besides the provision of low cost dwellings, also the possibilities of self-aid housing, amplification and arresting deterioration of existing housing stock, etc. Thus a selection of an appropriate combination between these solutions can also lead to a considerable saving of resources.

4. The sound development of the construction sector requires the establishment and growth of all the auxiliary enterprises and services, belonging to the infrastructural base, necessary for the smooth functioning of the construction industry, (e.g. various subcontracting firms, building material manufacturers, trading companies, etc.). This process, together with the evolvement of construction and builders' enterprises,

should be also directed towards a certain degree of regional decentralisation, in accordance with the general policy of regional development.

5. Manpower, especially in a developing country, is the most important resource of the construction industry, with the level of productivity being directly dependent on the extent and quality of available skills. Therefore, the education and training of manpower provide a most significant contribution to the progress of the construction sector, and the efforts of promoting the efficiency should concentrate in this field, rather than in purchase of expensive machinery and equipment.

6. For the purpose of gradually raising the level of skills and know-how a detailed long range plan with elaborated curricula for professional education and training should be established, encompassing all the various professions, trades, and functions active within the construction industry, providing also for knowledge updating to trained personnel. The preparation of such a plan should be entrusted preferably to the hands of a public board, representing the various groups and organisations concerned with the subject.

7. Special attention should be given to the training of general foremen. This post, carrying out one of the important functions within the construction sector is often occupied by personnel whose contribution could be considerably increased by providing them with

an adequate professional education.

8. The establishment of a special building site for demonstration, training and experimentations is highly recommended as an efficient medium for the generation and transmission of professional experience. Due care should be given also to other institutions, vital to the sound development of the construction industry, such as building research stations, testing laboratories, advisory services, information centers, etc.

9. It is imperative that the desingers should be aware of the great share they can contribute to the increase of efficiency in construction. In this context the importance of thorough acquaintance with various local factors influencing the design should be emphasized. Another concept that may lead to an improvement of construction efficiency is the striving for a better integration between the design and production functions.

10. The introduction of standardization and dimensional coordination should be started as soon as possible, in order to take advantage of the fact that they necessitate less changes at an early stage of development.

11. During the transition from the developing to developed status in the construction industry, great care should be taken at the introduction of capital intensive production methods, considering their impact on employment, economic benefits, availability of skilled operators, possible shortening of project execution times, etc. The change from a labor intensive to a more capital intensive form of production, including the introduction of some prefabricated methods should take place only

gradually, considering carefully all the factors mentioned at each stage of development.

12. A good functioning system for the collection, processing and supply of relevant statistical information is an important tool in the hands of planners and decision-makers responsible for the development of the construction industry. The establishment of such system, providing reliable data is therefore a matter of necessity in spite of being often neglected.

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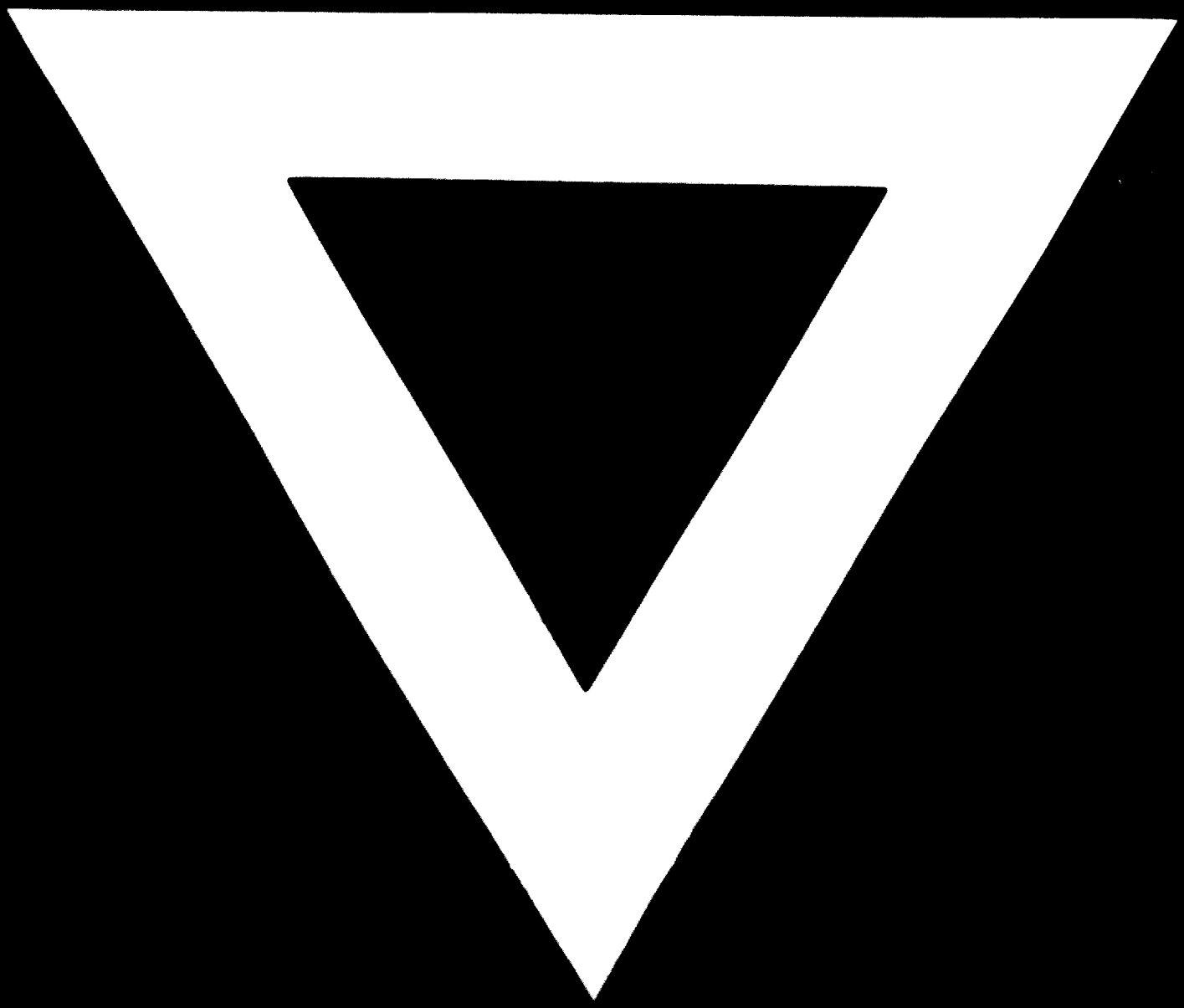

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