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STATE COMMITTEE ON CONSTRUCTION
AT THE COUNCIL OF MINISTERS OF THE USSR

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THE DEVELOPMENT OF THE SOVIET BUILDING INDUSTRY

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DEVELOPMENT OF THE BUILDING AND CONSTRUCTION INDUSTRY

SUMMARY

Submitted by

The Government of the Union of Soviet Socialist Republics

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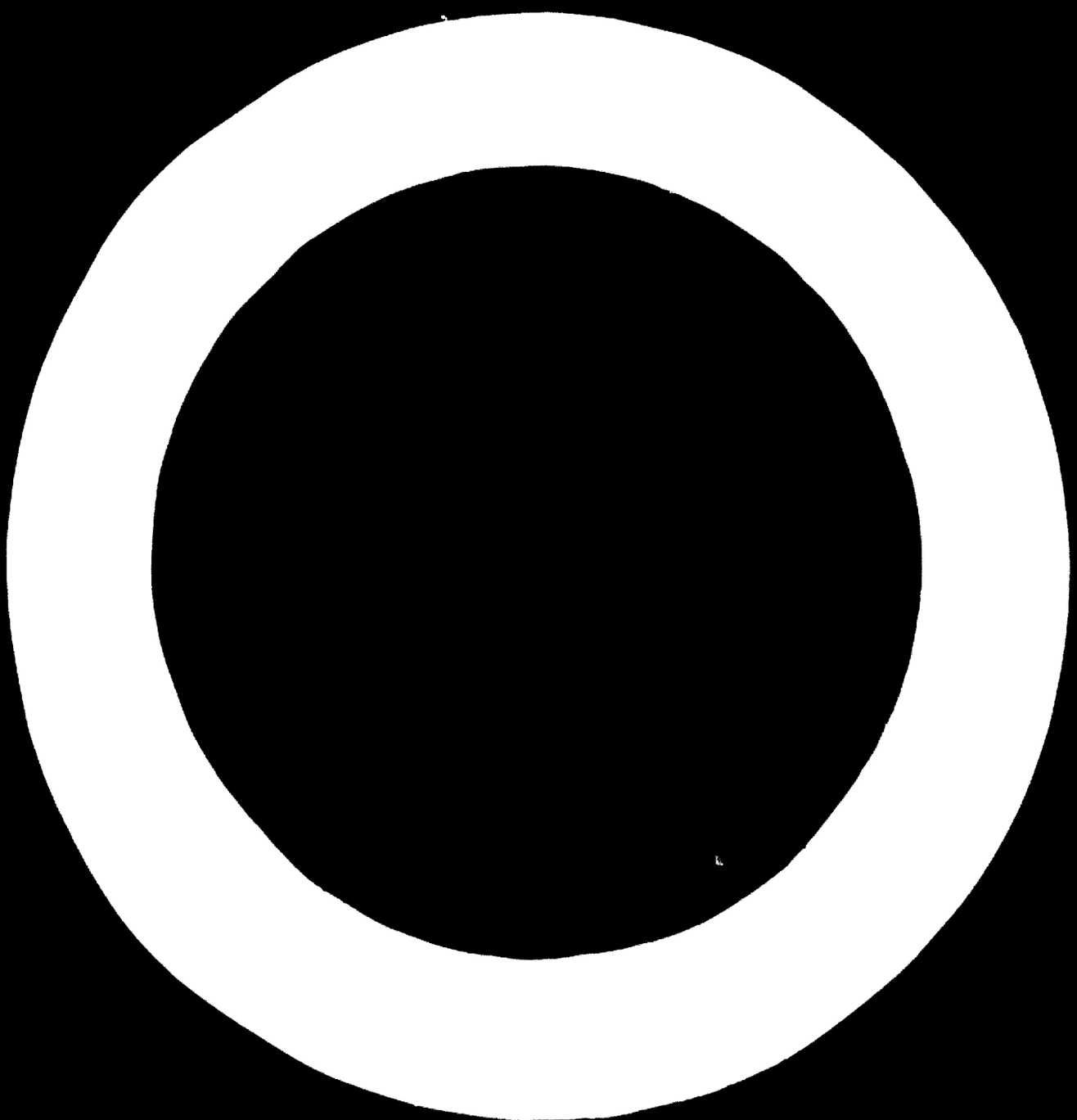

Introduction

1. The increasing volume of construction work in developing countries makes it necessary for them to set up national building industries to produce building material and hardware as well as structures. Developing countries can profit from Soviet experience. The building industry in the USSR was begun at a time when its economy was at a low level but in a short while it became a highly developed branch of the national economy.

Soviet experience in developing its building industry

2. During early stages of industrial development countries with poorly developed economies usually carry out capital construction on a small scale. Between 1918 and 1928 the average annual volume of capital construction in the USSR was only one per cent of its present figure. Building techniques were very primitive. In general, the building industry used local, traditional building materials (bricks, stone, lime, gypsum and timber). Practically all construction was done by industrial enterprises themselves rather than by specialized construction organizations functioning on a permanent basis. Unskilled manual labour was used predominantly with great expenditure of manpower.

3. As the country's economy progressed and the volume of construction increased, the building industry became an independent branch of the national economy. Permanent organizations working under contract were created to undertake construction and assembly jobs. They were supplied with large quantities of equipment. Advanced building techniques were introduced on a large scale. In addition to local building material, in-situ concrete (and later pre-fabricated reinforced concrete) was used widely. Machines and equipment of foreign manufacture were supplemented later by domestically produced equipment.

4. A unified approach to problems of planning the capacity, lay-out and design of buildings, as well as the standardization of structures, helped to promote industrial methods of construction.

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5. Today the Soviet building industry uses standard designs widely. In 1965, 95 per cent of all housing, 83 per cent of buildings for cultural, use and 48 per cent of industrial premises were built on standard designs. Today 90 per cent of all construction jobs are carried out by contractors, that is by construction enterprises and organizations that function on a permanent basis. The building industry employs 7.5 million workers, engineers and other personnel.

6. Below are the figures for the average annual increase of capital investment in the national economy (per cent):

1928-1932	-	100%
1933-1937	-	227%
1951-1955	-	1064%
1961-1965	-	2901%

During the last fifteen years the average annual rate of increase of capital investment has been 10.5 per cent. Between 1918 and 1965, 40,000 large state industrial enterprises, numerous power stations, 130,000 km. of railway track, 200,000 sq. metres of housing space, schools for 26,000,000 students, and hospitals with a total of 650,000 beds were built. Today the building materials industry has more than 20,000 enterprises.

Forms of assistance to countries in developing their building industry

. Because new developing countries are pressed by a shortage of financial resources and personnel, they apply to industrialized countries for assistance. In many cases, developed countries provide assistance in the form of project documentation, research and in the organization and actual implementation of construction projects. In providing assistance the USSR and other speialist countries enlist local personnel for a large variety of jobs and, thus, give workers on-the-job training. The trainees work under the supervision of experts from developed countries, and by the time a project is completed they usually have learned their trade. This is an important aspect of assistance to developing countries because it helps them to solve the major problem of training national personnel.

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8. In many cases, all work on a project is entrusted to local construction organizations established specifically for the purpose by the Government of the developing country concerned. Under inter-governmental agreements, these organizations recieve technical and organizational assistance to tackle the complicated engineering problems of construction. By the time construction is completed, local companies have acquired experience and, thus become full-fledged modern construction enterprises.

Training of national personnel for the building industry

9. In the construction industry the ratio of specialists of university-level to workers with secondary education may be one to three, or even one to four. This ratio should be borne in mind when staffing construction jobs, because technicians with secondary education can be trained faster and at a lower cost than engineers. To train skilled machine operators and assemblymen in special schools, one-to-two-year training courses are necessary. The bulk of skilled building workers, however, can be trained at enterprises, at schools and by courses run by construction organization, or directly on construction sites.

10. Developed countries can give assistance by:

(a) Sending skilled workers to developing countries to transfer their experience or to teach;

(b) Training workers from developing countries in professional or technical schools or at construction sites;

(c) Giving aid to developing countries in the form of textbooks and curricula.

Assistance in setting up training institutions and schools is of great benefit to developing countries with Soviet technical assistance, and on the basis of Soviet experience, about 100 schools and training centres have been built, or are under construction, in Asia and Africa.

Architectural and engineering design, preparation of building manuals and building codes

11. The gradual transfer of responsibility for survey and design to national personnel has proven valuable. When enlisting local or foreign experts for design in the technological part of a project, it is advisable to bear in mind the need for specialized technological project organizations for branches of industry (or groups of branches).

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Among the prime tasks of project organizations is preparation of technical-economic reports on state policies for capital investments and trends in a country's development. These reports make it possible to estimate the volume of survey and construction work for long-term periods.

12. Highly recommended for developing countries, together with the help of experts from developed countries, are the "standard technical manuals and codes for architectural and engineering design." Also recommended are: employment of a unified modular system in building, the use of basic principles of unification and standardization and catalogues of standard constructions and standard projects for buildings and installations built on a mass scale. The experience of the USSR and other countries shows that the introduction of unified types and standards shortens construction time and reduces costs. It is advisable to develop various forms of co-operation with countries using standard design, building manuals and codes.

Housing construction

13. Normally, housing construction should be carried out as capital construction and should meet sanitation and comfort requirements. Most countries must start large-scale housing construction using traditional methods, local materials and small-scale mechanization. Later industrial methods and large factory-made structural components can be introduced. The experience of a number of countries shows that housing construction conducted by industrial methods saves time, money and labour. Structural components can be manufactured both on open sites (polygones) and at factories.

The organization of construction

14. Construction under contract, the most progressive and economical method, has won wide recognition in developed countries. Under this method, construction organizations are divided into general contractors (who undertake construction under an agreement with the customer) and sub-contractors (who perform specialized jobs under a contract with the general contractor).

15. Some developing countries also use the contract method in construction by creating national building organizations (such organizations have been established in 32 Asian and African countries).

16. Developing countries should determine the best way to take advantage of technical assistance and world experience in the organization and technique of construction and assembly jobs and their mechanization.

Development of the building materials industry

17. Many developing countries created building material industry because it is economically inexpedient to transport materials over long distances. Priority should be given to the production of buildings materials from local raw materials and surveys of resources should be made.

18. Although cement is an important building material, its production in developing countries is still very low. For the construction of walls in developing countries, light-weight local materials are recommended, and concretes based on Portland cement, combined with cheap small-piece articles such as bricks, ceramic and concrete blocks and stone.

19. Most countries have raw materials for autoclave articles, such as sand and lime. Because they can be made in large size, autoclave articles provide a fast method of construction. Even though raw materials may be available, caution should be used in deciding to create a glass industry in developing countries because the demand for glas and glass-ware is relatively small (a glassworks will operate at a profit only if its capacity is not less than 0.5 million sq. m. of sheet glass a year).

20. Many industrialized countries have a highly developed building industry in terms of technology and general organization. The developing countries should profit from the experience of these countries to raise the technological level of their own building industry.

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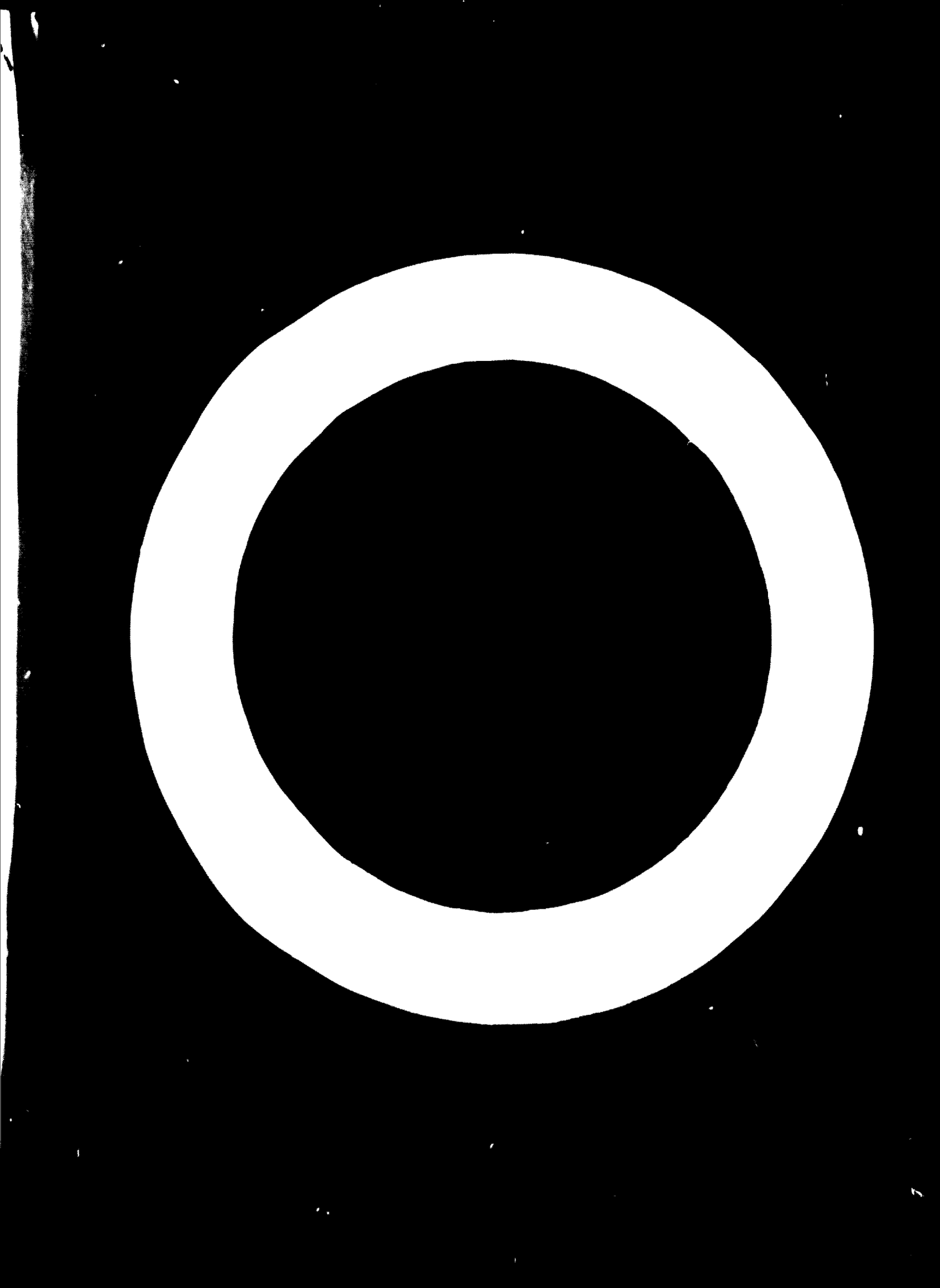

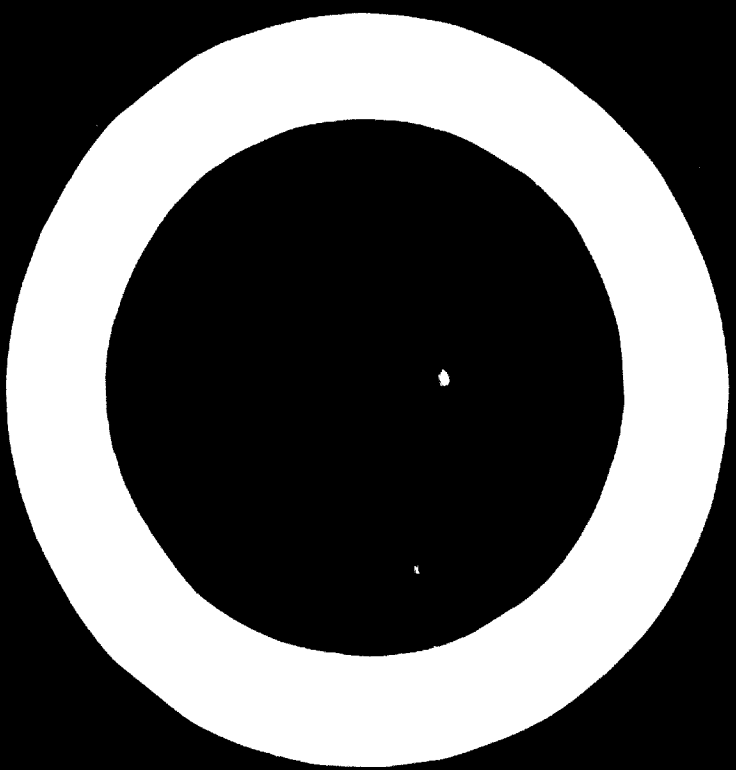

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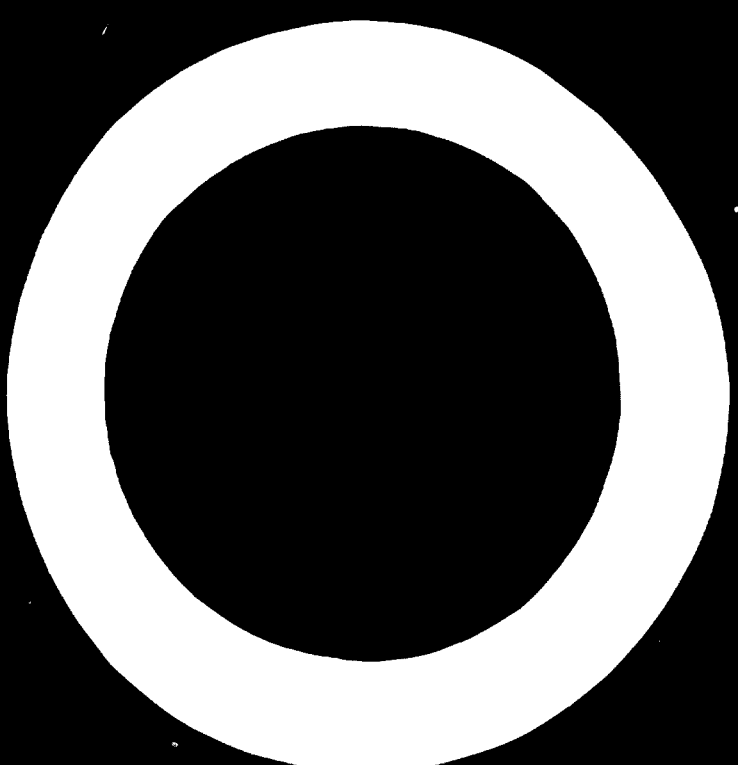
Moscow 1967



I. INTRODUCTION

1.1. At their present stage of development economically under-developed countries are paying much attention to the creation and development of a diversified national industry capable of utilizing their national wealth and labour resources to the full. The creation of their own material and technical base is directed toward overcoming the consequences of colonialism, to achieving economic independence, and toward a general raising of the standard of living and culture of the people.

1.2. The development of a national economy is inseparable from industrialization, from the construction of enterprises of the extractive and manufacturing industries and agriculture, of roads, railways, power stations, transmission lines, and irrigation systems, and from the erection of non-productive buildings to serve the needs of the population.

1.3. Successful realisation of a ris-

ing volume of capital construction requires accelerated development of the national building industry and organization of the production of building materials, components, and structural members.

1.4. Developing countries can make wide use of traditional methods of construction and simplified technical solutions for building. But their need to set up competitive enterprises with advanced technology often calls for industrial buildings with wide spans, a large assembly of columns for heavy cranes, and massive foundations for equipment. Such objects can only be built by using industrialized building methods and large-size members.

This problem can be resolved, however, and a building industry developed on a modern industrialised level by the maximum utilization of the experience of world building practice.

2. SOVIET EXPERIENCE OF DEVELOPING THE BUILDING INDUSTRY

2.1. The experience of the Soviet Union can have considerable interest for countries taking the road of developing their own building industries, the Soviet industry was originally created in condi-

tions of low economic development and was transformed into a developed branch of the economy in an historically short period of time.

2.2. Countries at a low economic level as a rule undertake capital construction on an insignificant scale in the first stage of industrial development. In the Soviet Union the average annual volume in the period 1918 to 1928 was 1 per cent of the present scale. The technical level of building was very low. Traditional local materials (brick, stone, lime, gypsum, and timber), which did not require the erection of complicated undertakings to process them, were used to erect buildings and structures. Only structural steel, which was used in very limited quantities, was fabricated in the shops of industrial enterprises. Manual labour was widely used on building sites, and the simplest forms of transport (narrow-gauge tracks, etc.). The designing of buildings and structures was undertaken by small organisations, often with the participation of teachers from technical institutes. The more complicated structures were designed and built using the experience of foreign specia-

lists, or after preliminary study of foreign building practice by Soviet engineers and technicians specially sent abroad to countries with more developed economies.

2.3. Almost all construction was carried out by subsidiary organisations, i.e., was organised and performed directly by industrial enterprises and industrial departments, and not by specialised, permanent building organisations. As the volume of building increased, there was also an increase in the production of building materials, both in quantity and range, partly as a result of reconstruction of the few existing enterprises, but mainly through the building of new ones. At the same time the network of schools was extended, where training on an abridged syllabus was organised with the aim of rapidly meeting the needs of the industry for engineers and technicians. Skilled workers were trained in the main directly on the building sites. Thus annually increasing volume of construction was able in large measure to cope with the problems of providing work. The large labour requirements of the building, which was carried out during the first

Five-year Plan with maximum use of manual labour, and the possibility of drawing on unskilled labour, not only contributed essentially to liquidating unemployment in the country but also began to create a permanent nucleus of builders from among the rural population. The developing building industry was also a veritable school training personnel for other branches of the economy. People unaccustomed to industrial work often came to the construction sites; and the building workers usually transferred to work in the factories, power stations, and other enterprises they had built, when construction was completed. A stage of development was reached later, however, when this situation began to exert a negative influence, holding up the creation of a permanent building force. Measures therefore were taken to counteract the turnover of building labour.

2.4. As the economy of the country grew, and as a result of of the changes already described, building gradually became an independent branch of industry. Permanently functioning contracting organisations were set up for building and civil engineering, and large designing institutes; research organisations were develop-

ed in the fields of construction and building materials.

2.5. The growth of national income as a result of industrial development led to a further increase of capital investment and, consequently, to a rise in the quantity of building. At the same time capital investment in the development of the building industry itself increased. Construction was improved by the enlargement and specialisation of state building organisations, and by their equipment with modern building machinery, and the employment of progressive building technology, and by raising the standard of designing work, which enabled a gradual transition to be made to industrialised methods of building. Along side the utilisation of traditional building materials, the field of monolithic concrete, reinforced concrete, and structural steel was extended. Civil engineering and highway machines began to be used in many ways, predominantly imported equipment to begin with but subsequently Soviet-made as a result of development of the engineering industries producing this kind of machinery.

2.6. The development of industrialized building methods was aided by wide unification of the dimensional layouts and

design solutions of buildings and structures, standardisation of the types and dimensions of structural members, transfer of their fabrication to factory conditions, and the mechanisation of assembly and building work.

2.7. The modern building industry widely uses standard designs, and highly industrialised methods of production. Thus 95 per cent of all the housing built in the Soviet Union in 1965 in accordance with the state plan, 83 per cent of the social and communal buildings, and 48 per cent of the industrial construction were built to standard designs. The remaining objects, as a rule, were also built using standard structural members. At present a high proportion of buildings is done with prefabricated load-bearing members and cladding and 90 per cent of all Soviet building work is done on contract by permanent building and erecting organisations. The industry employs at present 7.5 million persons - workers, engineers, technicians and administrative staff.

2.8. The setting up of a building industry as such and the development of industrial production of building materials

enabled the USSR to increase capital investment at a rapid rate, as the following data makes clear:

Annual Capital Investment in the Soviet Economy, %

1928-1932	1933-1937	
100	227	
	1951-1955	1961-1965
	1064	2901

In the last 15 years (1951-1965) the annual average growth rate for Soviet investment has been 10.5 per cent.

2.9. A colossal building programme has been carried out, and is continuing. In the years between 1918 and 1965 around 40,000 large state industrial enterprises were built or reconstructed and brought into production; a large number of power stations, including the largest hydroelectric stations in the world; more than 130,000 kilometres of new railway line and 70,000 kilometres of trunk pipeles; housing with a total area of about 1,200 million square metres; general schools for 26 million pupils; hospitals and polyclinics with 650,000 beds. And more than 700 new towns have been built during the years of Soviet power.

2.10. The success of capital construction in the Soviet Union is closely linked with the development of the building materials industry, which has made possible a steady rise in the tempo of construction and played a most important role in industrialising building. As a large-scale independent branch of the economy the production of building materials was essentially organised from scratch in Soviet times. Today it comprises more than 20,000 enterprises, employing around two million workers. Pre-revolutionary Russia imported many building materials, but home production now completely meets the rising consumption. In 1928 Soviet output of cement was under 6 per cent of American; by 1962, however, the USSR had already surpassed the USA in production of this important material. It now also occupies first place in the world in the production of asbestos-cement sheets and pipes, window glass, building lime, and a number of other building materials. This experience confirms the importance for any developing country of creating its own national building industry, even at a very low level of development of the productive forces.

3. FORMS OF AID FOR DEVELOPING BUILDING

3.1. Young independent states taking the path of progressive development experience a marked shortage of means for capital construction, and often require technical aid and long-term credits for the creation of building bases and research and designing organisations, and to train specialists and skilled workers.

3.2. Experience shows that they tend to turn to organisations and firms in the industrially developed countries in the first stage of their development with requests to carry out geological and engineering surveys, and establish the economic feasibility of building certain objects; to determine their optimum capacity, prepare designs, plans and technical documentation, prepare and install the technological equipment of new enterprises, and to give technical assistance with their construction. Economic and technical cooperation has the greatest effect where the specific economic conditions in the different states are taken into consideration, and their interest in creating an independent economy, training local national cadres, and acquiring experience in

designing and building is appreciated.

3.3. The practice exists, however, of foreign firms handing over completed plans and documentation to the developing countries without disclosing the methods and techniques used in the calculations, research, surveys and designing. The building of separate objects is also often undertaken without using local engineers and local building workers for the more skilled work. With such an organisation of construction the developing countries have very limited possibilities of giving their national cadres experience in the field of designing and building, or of acquiring engineering, technical and economic information, which holds them back in the long run, and in any case does not encourage the development of a national building industry.

3.4. In this connection the experience of several socialist countries in building in developing countries deserves attention. These countries (the Soviet Union, Czechoslovakia, the German Democratic Republic, Poland, etc.), have striven to draw national cadres to the maximum into the fulfilment of all work and at all stages of construction when giving technical assistance.

With this organisation of technical aid national cadres are trained during construction and acquire the experience of the advanced countries. For example, local people are widely employed, as a rule, in making engineering surveys. The designing of objects is sometimes undertaken on the spot with national personnel, in co-operation with, and under the guidance of, specialists from the industrially developed countries. The carrying out of all complex work in the construction of various objects, including the largest and most complicated, is also often undertaken with local building organisations specially set up by the governments of the developing countries. In accordance with inter-governmental agreements these local organisations are given the necessary technical and organisational assistance to enable them to cope successfully with the complex engineering problems involved. On the completion of such objects the developing countries, as a rule, have at their disposal their own building organisations, trained workers, the necessary intermediate technical personnel, and the technical equipment for building. The training of workers and technicians in

these organisations is done directly on the building sites, without a break from production, through joint fulfilment of building and civil engineering work with specialists from the countries rendering technical aid.

3.5. The practical experience of the national building organisations of a number of developing countries in constructing large industrial and civil buildings and structures with the assistance of Soviet specialists has considerable interest. From the start of these undertakings all work was carried out by groups of national building workers under the direction of instructors skilled in advanced working methods. The engineering work (geodesic, research, the drawing up of work plans and work schedules, etc.) was done by Soviet engineers in direct collaboration with national specialists who outnumber them by two or three to one. The leadership of building sectors was undertaken by national specialists jointly with Soviet engineers experienced in the organisation of construction work. The Soviet instructors, engineers and other specialists helped the national cadres of workers to learn how to use mechanised building instruments

building machines and mechanisms, and the national specialists to acquire the necessary knowledge, experience and skills in organizing and carrying out large-scale construction. This process of training building workers of various trades and passing on engineering experience took place more quickly and successfully, the more conditions were created to establish mutual understanding and friendliness between the specialists rendering the aid and those receiving it. This new, very effective form of carrying out construction is more complicated for the countries rendering the aid than using only their own resources, skilled labour, and engineers for the whole job; but it is more effective since it helps solve in minimum time the problem of creating a national building industry with the necessary national personnel.

4. TRAINING NATIONAL BUILDING FORCE

4.1. The basis for training national engineering and technical cadres for building, of course, is a very widely developed system of education and technical training, and other measures. As that is not the subject of the present report,

it would be out of place here to do more than make the following recommendations on training. Specialists with higher education are absolutely necessary for those sectors of building where decisions are taken on various complex problems of an administrative, scientific, technical or economic nature. When there is a shortage of engineers, other responsibilities can be undertaken by corresponding specialists with secondary technical education. The ratio between them on sites can be 1:3 or even 1:4. Taking this into consideration eases the task of providing specialists, since the training of technicians with secondary education requires less time and is much cheaper than the training of those with higher education.

4.2. The training of skilled workers, considering the scale of the problem, is a very difficult task. The most skilled - operators of building machines, fitters for assembling and installing technological equipment and repairing building machinery, and other trades - are best trained in special schools with a period of education of one to two years. Their proportion among building workers, however, is relatively low in the first phase

of development. Soviet experience is that the bulk of skilled workers (plasterers, bricklayers, painters, etc.) can be trained in groups or individually directly on the job, or in schools and special courses run by the building organisation on the site to train workers and improve their skill.

4.3. Developed countries can render aid of this kind in the following ways:

- by sending skilled workers to the developing country to pass on experience and teach in schools and training courses;
- by training workers from the developing country in its trade and technical schools or directly on building sites;
- by sending teaching material to the developing country, e.g. training programmes, textbooks, teaching aids, etc.

4.4 Aid in the setting up of schools is extraordinarily useful. Nearly 100 schools and education centres have been or are being built with Soviet economic and technical assistance in a large group of countries in Asia and Africa. India has received the equipment for a technological institute in Bombay as a gift from the Soviet Union, Cambodia a higher technical school, Ethiopia a trade train-

ing school, Algeria a network of trade schools, an institute and a secondary technical school.

5. BUILDING PLANS AND THE DRAFTING OF BUILDING STANDARDS

5.1. A most important question in developing building is the rational organisation of designing and surveying. The organisational form of a national body for this work, the ways and means it adopts, and the programme and character of the aid required from the U.N. and industrially developed countries, must undoubtedly be related in each individual case to the concrete needs and conditions of the country. The various developed countries, and the Soviet Union in particular, have accumulated experience of definite interest, in this field. Thus a mixed designing organisation composed of Egyptian and Soviet specialists was formed on the site of the Aswan Dam. It carried out directly on the building site all the work of designing repair shops for machinery and motor transport, compressor and oxygen shops, etc., approach roads, warehouses and numerous other auxiliary structures, on the building site. A group of Indian specialists was sent to

designing organisations in the USSR to take part in work on designing the Bhilai steel works. This direct participation enabled the Indian specialists to acquire experience and gave the possibility of setting up an Indian designing organisation during the building of the works. This organisation subsequently designed blast furnace No.6 and a number of other objects built at the works.

5.2. The experience of carrying out this type of work while gradually transferring it to national cadres has justified itself. It is also advisable to draw national specialists from enterprises working in the country or from abroad into the designing of technological sectors, with a view to the setting up later of specialised technological designing bureaus for one or more branches of industry, depending on the scale of the work.

5.3. Among the priority tasks of such bureaus and mixed designing organisations could be the preparation (through engineering, technical and economic planning surveys, investigations and special research) of technical and economic reports on state policy in the fields of capital investment and the direction of industrial

development. These reports would help to determine the required capacities and best districts for the building of industrial enterprises and objects of the building industry (factories, workshops, warehouses and other production units belonging to building organisations), and prepare an outline plan for the development of transport, water supply, communications, and power, as well as dealing with questions of the re-settlement of the workers needed on the site and in the various production units. Technical and economic reports of this kind would give the competent organs of the developing country the possibility to determine the long-term volume of designing, preparatory and building work, and to establish the volume of the work that can be carried out with its own forces given the necessary cadres, means and institutions.

5.4. To raise the standard of designs and plans it is advisable for developing countries to work out "Standard Technical Specifications for Designing" with specialists from developed countries, taking the local conditions and technical possibilities into consideration. Similar specifications could also be drawn up for a group of neighbouring countries. Close atten-

tion should be given to the experience of developed countries in drawing up and introducing the following:

- a single modular system for building, i.e. a code of rules for co-ordinating the dimensional layouts and elements of buildings and structures on the basis of an accepted module. This code will promote unification of members and standardisation in designing;

- standards governing the basic prescriptions for the unification and standardisation of structural members;

- a catalogue of standard structural members;

- standard designs and plans of buildings and structures for mass erection.

5.5. The introduction of unification and standardization, as the experience of the Soviet Union and other countries has shown, even at the initial stage promotes reduction of the time and cost of construction, since the number of types of buildings erected is reduced, as well as their parameters (spans, height, etc.). The number of types and sizes of members is also reduced and, consequently, the period and cost of their fabrication. In this connection it could be very useful

to have a systematic exchange of experience between industrial and developing countries, with coordination of research on various problems, and joint work on individual questions. It is also desirable to develop various forms of cooperation in the field of standard designs and in the preparation of recommendations on basic questions of building standards and regulations. This applies above all to the handing over for use according to agreements between the parties concerned of a number of scientific, designing and standard documents.

6. HOUSING

6.1. The creation and extension of industry in developing countries involves important problems of housing construction linked with the re-settlement of workers at enterprises.

6.2. The choice of direction for housing development depends on natural and climatic conditions, the raw materials available for a building materials industry, the technical standard of building, and the skill of the labour force, etc. It will, however, have to be capital construction, and must meet the necessary standards of hygiene and comfort. In

the majority of countries it will obviously be provided by traditional means in the initial stage with broad utilisation of local materials (bricks, wood, etc.) and power tools.

6.3. With further development and the higher rate of completion of housing it will become necessary, a transition to industrialised methods of erecting houses and communal buildings will be required. Depending on the possibilities available it will be advisable to go over from the use of small-unit materials, and the preparation of roofs, floors and other members in situ, to the utilisation of large-size prefabricated elements.

6.4. The experience of a number of countries has shown that industrialized methods are more economic and less labour intensive, and enable houses to be built in a shorter period. The fabrication of large-size elements at special factories and their erection at the site requires only a fraction of the skilled specialists needed to do all the work for similar houses directly in situ. This explains the lively and warrantable interest shown by developing countries in setting up modern house-building enterprises that could help

them overcome their pressing shortage of modern housing. Those countries with a higher level of economic development, and disposing of a cement industry, might therefore be well advised to develop fully prefabricated methods.

6.5. The level of production for prefabrication enterprises may differ according to the output required, the initial capital investment, and other factors. Structural elements can be fabricated at open casting yards or in factories. Definite proposals on the types of industrial buildings, their layout and design,, materials and means of production can only be worked out after study of the raw material and industrial base of each country, taking into account its specific economic conditions, etc.

7. ORGANISATION OF BUILDING

7.1. The most progressive and economically effective way to organize building is to execute the construction and assembly work by contract (agreement). According to the contractual relation involved, building organisations can be divided into general contractors, carrying out the construction or reconstruction of an enterprise in agreement with the em-

ploying body, and specialised sub-contractors performing special work under contract for the general contractor. Contracting is widely used in the developed countries. It enables building and civil engineering organisations to be set up with permanent staffs of qualified personnel, and to undertake specialisation, develop a production base, and constantly accumulate production know-how.

7.2. Contracting is being adopted for industrialised building in individual developing countries by the setting up of national building organisations. Such organisations, or national building corporations, using modern techniques, have already been formed in 32 countries in Asia and Africa. The work of the Soviet-Guinea building organisation deserves attention in this connection. Founded by inter-governmental agreement, it has built many large industrial and civil structures. It has the structure of a modern industrialised building organisation and exercises all the necessary functions: it orders and accepts technical plans and specifications; receives, stores, and ensures the correct application and utilization of building materials and equipment, and fabricates the necessary components

at its own industrial base; operates and repairs motor vehicles, building machinery and mechanisms; organises and executes building and assembly work of high standard, etc. Its whole activity is based on maximum use of local resources: raw materials, building materials, and labour. All work is carried out by local builders on a contract basis. To this end the respective Soviet and Guinean sides have established a standard unitary valuation of work to be done, on which contracts are concluded. The Guinean side has organised building co-operatives by definite trades (each co-operative consists of 20-30 men, but may increase this number by decision of its members) which tender for one project or another. The structures erected by the joint organisation have a better standard of work and a much higher tempo of building than those built where similar bodies have not been founded.

7.3. It is expedient at the same time to define the direction to be taken by technical aid and the transfer to developing countries of the accumulated experience of world building practice in organisation, technology and mechanisation. In this respect it should not be

thought that the existance of a surplus of labour in developing countries makes their optimum level of mechanisation lower than that in industrial countries. In the immediate future it will obviously be more rational to use expensive machinery only to mechanise work that cannot be done without it (the assembly of heavy constructional elements and equipment, earth shifting in large volume, etc.). For other work it is often sufficient to use simple apparatus and mechanisms to lighten the labour of the workers. Preference should be given in the majority of cases to mobile machines (mobile cranes, lorries, etc.) and to universal, multi-purpose machines with a variety of changeable working tools and attachments.

7.4. Construction experience in developed countries indicates that it is necessary, in order to reach a high standard of industrialisation in industrial building, to have production bases of the building organisations in regions of large-scale building. These bases may include the following undertakings:

- concrete, mortar and asphalt-concrete factories and installations;
- workshops for the fabrication and

partial assembly of technological elements and pipes, electrical and sanitary fittings, etc.;

- parks of building machines and mechanisms;
- woodworking enterprises;
- machine shops and repair facilities;
- transport and storage facilities.

8. THE DEVELOPMENT OF A BUILDING MATERIALS INDUSTRY

8.1. It is to be expected that many developing countries will create their own building materials industry, since it is economically inexpedient to transport relatively inexpensive products for long distances. Production of building materials needs to be developed in quantity and variety to a level ensuring full satisfaction of the requirements of a rising volume of capital construction. Production of the building materials in greatest demand from local raw material will obviously take first place in development. Study of the reserves of local material, and of the possibility of using industrial residues and by-products for building, also has real significance in developing countries.

8.2. Cement is one of the fundamental building materials. Its production in developing countries has been growing rapidly in post-war years and at present almost every country has, or is building, a cement factory. Nevertheless the production of cement is still at a low level. Considering the shortage of water and fuel in some developing countries, it is advisable to recommend the building of cement factories using dry processes. Where small new states have limited possibilities of utilizing cement locally in large quantities it may be advisable in specific cases to pose the question of building a single, more powerful cement factory for several countries. Such concentration would fully justify itself.

8.3. With due consideration of the peculiarities of climate, the majority of countries should be recommended to use light local materials and concrete made from Portland cement for walls. Production of the bulk of wall material should obviously be oriented at present toward cheap small-unit items - bricks, including economy bricks (hollow tiles, etc.), ceramic blocks, concrete blocks, natural stone, etc. Most countries have the mate-

rials to organise production of steamcured materials (sand, lime), bearing in mind that steam-cured components are the road to rapid industrialisation of building, since they can be prepared in large sizes.

8.4. Despite the fact that many developing countries have deposits of the main materials needed for the production of glass, care should be exercised in deciding whether to set up glass industries, considering their relatively small consumption of glass and glass articles. It should further be noted that the average annual demand for sheet glass to ensure minimum profitability for a works needs to be not less than 500,000 square metres. When reviewing this question, window glass consumption should be determined in each specific case, not only in terms of the country itself, but also on the possibility of marketing production in neighbouring countries.

9. CONCLUSIONS

9.1. The majority of industrially developed countries have achieved a high technical, economic and organisational level in industrial and civil building. By using this experience, developing

countries could set up building industries and develop the industrial production of building materials by progressive methods. The U.N. organisation for industrial development is playing a growing role in this connection by selecting and transferring to under-developed countries broad information on the experience of world practice any on the latest technical advances in building, and by organising the assistance needed with the following important problems:

(a) The working out of lines of state policy for the industrial development of countries and the determination of optimum directions for capital investment.

(b) The organisation of technical and economic research and the preparation of reports on long-term industrial development with well-founded schemes for the main lines of developing power, transport, communications, water supply, and housing, the resettlement and employment of the population, and economically justified areas and objects for construction.

(c) The drawing up of economically sound directions for technical policy in the field of building and for the choice of types of buildings and structures best suited to local conditions and circumstances.

(d) The working out of a technically and economically warranted development and extension of the national technical and supply base for building, bearing in mind the development of a building materials industry based on local raw materials.

9.2. It is also extremely important to ascertain and establish the economic optimum capacity and region for enterprises to produce cement, glass and metal and wooden structural elements to meet the demand in several neighbouring small countries.

9.3. Great attention must also be given to organizing assistance with the training of a national building force - engineers, technicians and skilled workers - in developing countries, to the provision for this purpose of teaching material (curricula and syllabuses, teaching aids, etc.) and textbooks, and to sending instructors and teachers to train qualified specialists and help with the organization and decision of technical problems of construction.

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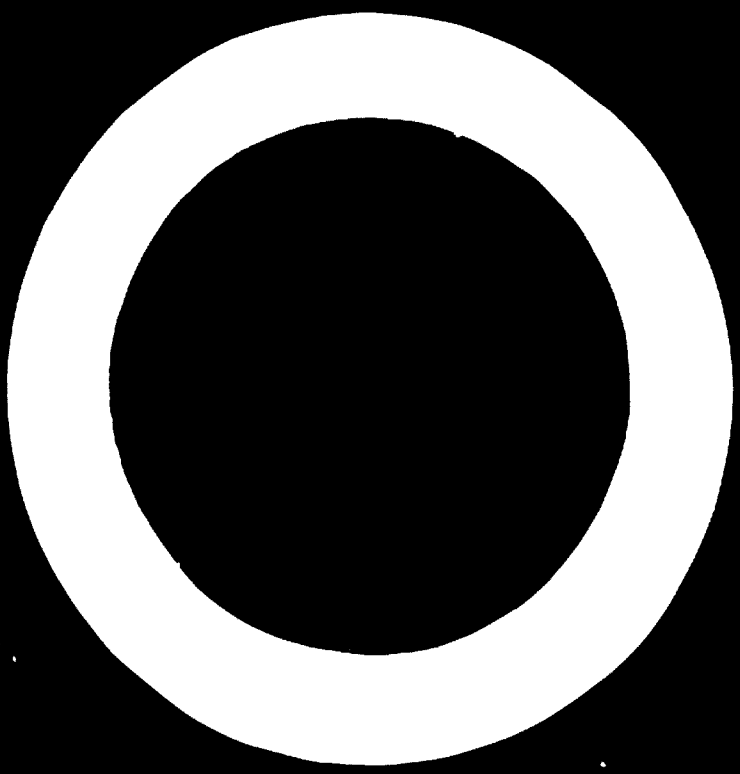

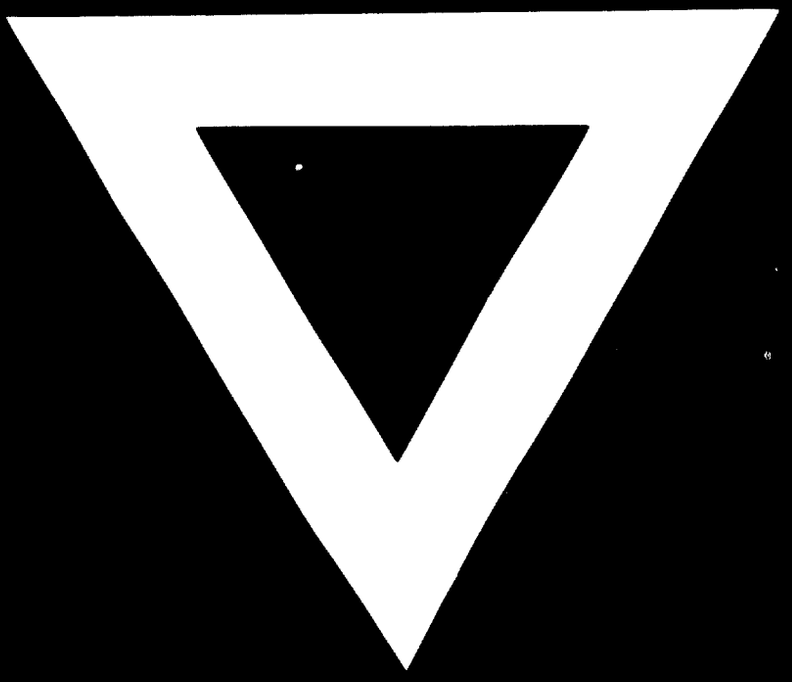

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