



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

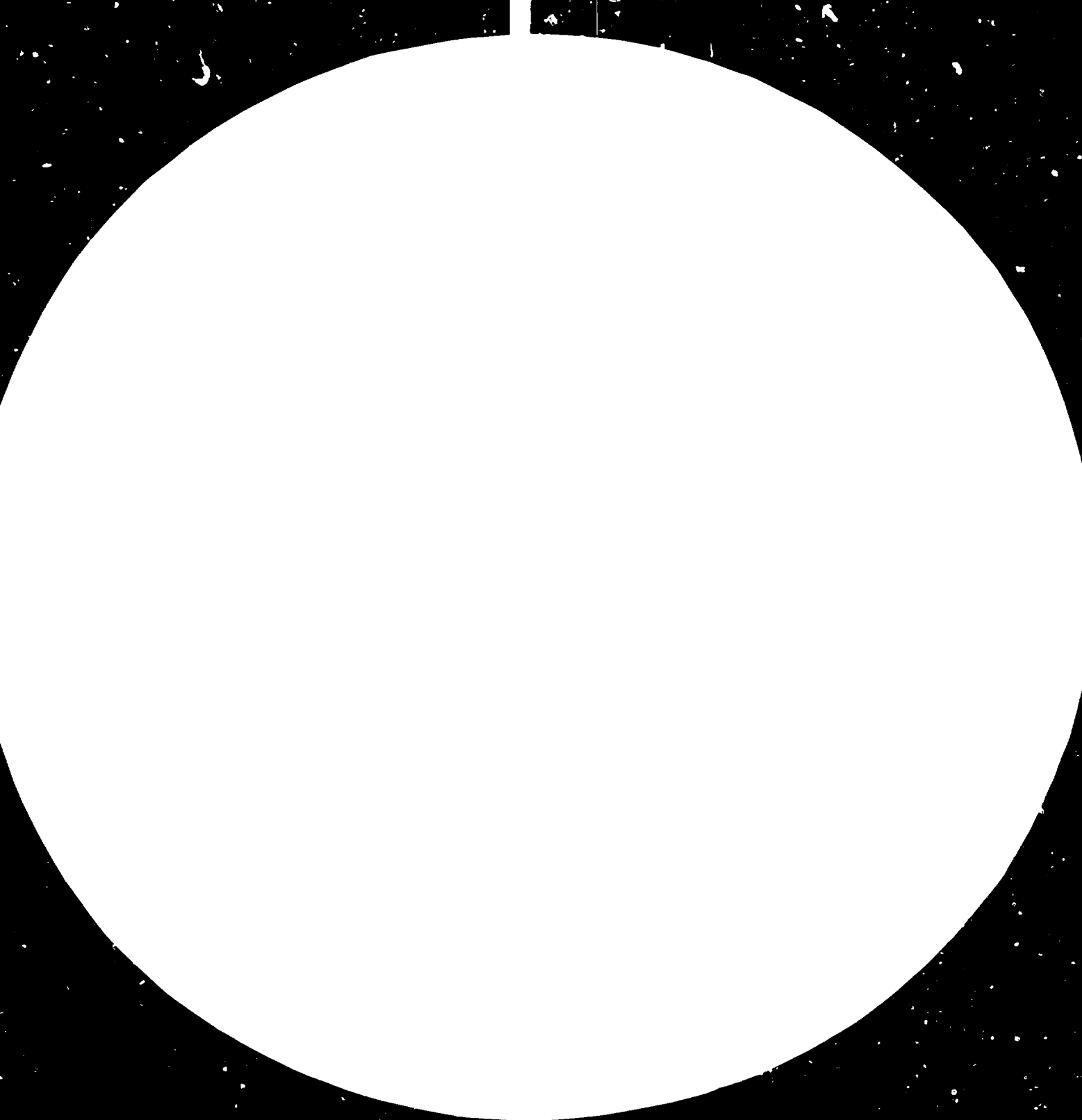
FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

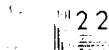
Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org





2.8 2.5



Visual acuity is the ability to resolve detail. It is measured in cycles per degree (CPD).

Resolution is the ability to distinguish between two points. It is measured in cycles per degree (CPD).

Resolution is the ability to distinguish between two points. It is measured in cycles per degree (CPD).



11506



Distr.
LIMITED

ID/WG.370/3
19 April 1982

ENGLISH

United Nations Industrial Development Organization

Workshop on Research, Utilization and Processing of
Non-Metallic Minerals with Special Focus on Building
Materials for the Construction Industry*

Belgrade (Yugoslavia), 10-16 May 1982

ACHIEVEMENTS OF THE YUGOSLAV CIVIL ENGINEERING INDUSTRY.
WITH SPECIFIC ASPECTS OF NON-METALLIC RAW MATERIAL CHANGES.
IN THE INDUSTRY OF CIVIL ENGINEERING MATERIALS**

by

M. Lancoš and R. Janjetov***

* Organized by the United Nations Industrial Development Organization (UNIDO)
in co-operation with the Government of the Socialist Republic of Yugoslavia.

** The views expressed in this paper are those of the authors and do not necessarily
reflect the views of the secretariat of UNIDO. This document has been reproduced
without formal editing.

*** M. Lancoš, Yugoslav Center for Civil Engineering, Belgrade
R. Janjetiv, Institute for Civil Engineering of SAP Vojvodina, Subotica
V.82-24773

1. Introduction

Yugoslavia is one of the European countries which during the Second World War were greatly destroyed, and had considerable losses in material and population.

When the Second World War ended, the communication networks were destroyed, towns and villages burnt and there were very few industrial objects undamaged or without a considerable damage.

Among the others, the following data on destruction was recorded:

- 655,408 apartments or 20.7% out of the total housing fund. Besides the mentioned, 190,000 housing buildings were also damaged;
- 85.2% of social - and medical buildings;
- 77.3% of cultural - educational buildings;
- 65.0% of the industrial objects were either destroyed or damaged;
- 6,140 km of railway tracks (manouering tracks and other station infra-structure are not included) which is 45% out of the overall railway communications;
- besides the above mentioned, the following was destroyed on the entire communication network: 930 bridges in a total length of 51,546 meters or 60% out of the total number, 92 tunnels, 162 water stations, 5,302 buildings and a lot more of other buildings and plants.

As far as the road network is concerned, the size of distruction is clearly illustrated by the data on 47,000 meters of destroyed bridges.

Bearing in mind the degree of destruction, lack of material reserves, lack of covering background of the national currency and with enormous manpower losses, the national economy facing such a situation at the time of liberation was completely paralysed, and the first task was to re-build the destroyed objects.

However, the first task - reconstruction of the destroyed country, was successfully carried out with the participation of the entire population of the country in less than 2 years, in 1945 and 1946.

Even during 1946, construction of some new objects was commenced, to be continued with the erection of new energetic, industrial, communication and housing objects in 1947.

So, for example from the liberation until 1980 the following new objects were constructed:

- 1,120 km of railway tracks
- 55,200 km modern roads
- 3 million flats
- 52,000 hospital beds in medical buildings,

while the energetic and industrial objects were almost completely constructed in the post-war period.

The intensity of the development of the civil engineering industry can be seen also through the data that before the Second World War 73,000 workers were employed in the civil engineering out of which 58,000 were seasonal workers, while today more than 750,000 workers including those in the industry of civil engineering materials, are employed in the civil engineering industry.

Together with the civil engineering industry, the industry of civil engineering materials has also been developed. The development of this industry can be seen from the illustration of the growth of production for some of basic kinds of civil engineering materials:

<u>Material</u>	<u>Measuring unit</u>	<u>1940</u>	<u>1980</u>
1. Bricks (normal size)	pcs 1,000,00	380	4,346
2. Tiles	pcs 1,000,000	228	383
3. Stone blocks & decorative stone	m ² 1,000	44	1,944
4. Lime	t 1,000	180	2,384
5. Cement	t 1,000	800	9,315
6. Gravel & sand	m ³ 1,000	1,214	27,026
7. Asbestos - cement products	t 1,000	28	420
8. Roofing felt	t 1,000	17	218
9. Primary wood processing	m ³ 1,000	3,000	4,700
10. Production of wood plates	m ³ 1,000	40	157
11. Civil engineering joinery	pcs 1,000	30	4,724
12. Prefabricated wooden houses	m ³ 1,000	40	157
13. Wooden floors	m ³ 1,000	24	81
14. Light civil engineering plates	m ² 1,000	1,254	7,818

Besides the development of the production of these civil engineering materials and products, the production of completely new products was also developed, as follows:

- ceramsite
- perlite
- facade mortar
- paints and coatings for interior and exterior wall treatment
- modern insulation materials
- additives for concrete
- concrete pre-fabricated elements
- pre-fabricated elements for: pre-fabricated houses, administrative and industrial buildings and prefabricated bridges.

As the industry for civil engineering materials was very much under-developed before the Second World War, including a primitive technology for production, we had to rely on developed countries in the development of this industry and at the beginning we had to buy licences and know-how. With the development of this industry, our own original new technologies have been developed. The Yugoslav machine building industry began to develop and produce equipment and mechanisation for some technologies of production of civil engineering materials, pre-fabricates and products.

Two essential elements were kept in mind in the development of the industry of civil engineering materials:

- to erect plants which will use local and domestic raw materials,
- to select such production technologies which will employ the optimum number of workers, especially in under-developed regions of the country.

The application of such a policy in erection of new factories, and later on modernisation and reconstruction of existing factories, besides employment for the workers enabled their professional education and training, and thus gave space for gradual introduction of modern and fully automatised technology of production. The Yugoslav civil engineering industry has also been intensively developing and equipping during the last 35 years. A series of significant objects have been erected in the country representing a world wide achievement: the hydro power station "Djerdap" (Iron Gate), hydro power station "Mratinje" with its highest arc shaped dam in Europe, the mainland-island Krk bridge with its reinforced concrete arc which is the biggest of such kind in the world, the "Sava" congress center in Beograd, the Beograd-Bar railway line, the Danube-Tisa-Danube hydro system, a series of big industrial objects, new hospitals, hotels, sports centers and big dwelling settlements. Our systems of pre-fabricated construction of housing and administrative buildings can be of a special interest.

Since 1953 the Yugoslav civil engineering organisations have been engaged in constructions in 45 countries in Europe, Africa, Asia and South America. The Yugoslav civil engineering organisations have been constructing in these countries capital investment objects and acquired excellent references.

The annual gross product in 1981 for works abroad amounted more than US \$ 1,500,000,000.-

2. Basic Civil Engineering Materials Based on Non-Metallic Raw Materials

2.1. Cement

Cement is the basic civil engineering material for all kinds of construction, starting with road construction, hydro constructions, building construction and up to concrete pre-fabricates (tubes, columns, communal fancy goods, asbestos-cement products).

Yugoslavia is rich in raw materials for cement production and due to this fact 15 cement mills have been erected which are located in all republics and autonomous provinces.

All cement mills operate with update technology. The total product of all Yugoslav cement mills in 1981 amounts 9,613,729 tons of cement.

The domestic machine building industry is increasingly included into the equipping of cement mills and at present it is in the position to deliver 70% of the required equipment. The producers of this equipment are: "MAG", "Djuro Djaković" and "Energoinvest".

The Yugoslav experts are in the position to carry out all laboratory researches, studies of applicability of raw materials, selection of technologies, projecting and staff training. Detailed informations and techno-economical

data are available with the business association for cement - "Jucema".

2.2. Lime

One of the basic civil engineering materials is lime for the production of which Yugoslavia has the necessary raw material - lime stone.

During the post war period 26 new production plants have been constructed for the production of the so called alive or hydrated lime.

The total production figure in 1981 was 1,644,000 tons of alive lime and 950,000 tons of hydrated lime.

The Yugoslav machine building industry is in the position to offer complete equipment for primary or final gypsum processing in cooperation with foreign partners.

Detailed informations for consulting and engineering services for erection of factories for lime production are available with Jugoslovenski građevinski centar (Yugoslav Center of Civil Engineering) and PZ "Kamergran".

The Yugoslav manufacturers of equipment are the following:

- SOUR Mašinogradnje "MAG", Beograd
- "Djuro Djaković", Slavonski Brod.

2.3. Brick and tile production

Owing to the wide spread availability of good quality raw material, brick and tile production is very much developed.

These products are manufactured in 140 plants and the overall production in 1981 was as follows:

5,029,764 x 10³ units normal size wall, facade and loft material and
376,227 x 10³ tiles.

In such a mass production the assortment is very wide especially with wall and facade material that includes normal size bricks and all other up to blocks of 6 units of normal size, and tiles from drawn ones, channel type up to various types of pressed tiles.

The wide assortment is clear to understand since bricks and tiles are in the full sense of the word the most important local civil engineering material with a great participation in the construction of dwelling buildings especially with family houses. The individual housing construction in Yugoslavia amounts 70% out of the total housing construction.

The existing plants are on various technical levels with various capacities. Some of them are with primitive technology and have a seasonal character, other are the most update plants with automatised continuous production running throughout the year. The existing plants have a capacity between 15 to 50 million normal size units per year.

All kinds of energy materials are used (gas, oil and coal). Due to the energy crisis in the world significant efforts are being made to introduce the domestic coal as energy source for modern technologies.

Manufacturers of the equipment are in the position to equip such plants completely and their achievements can be compared with those of developed countries (Italy, West Germany). Yugoslav equipment is installed in many countries worldwide (Hungary, Poland, Czechoslovakia and some countries in Africa).

Manufacturers of the equipment are as follows: "Ivo Lola Ribar", "Dalit", "Cer" and "Miloš Dimanić".

Complete consulting services comprising research works, elaboration of raw material applicability studies, laboratory and semi-industrial researches,

projecting, training and start-up can be offered by the Yugoslav Center of Civil Engineering.

Detailed information is available with the producers of the equipment, projecting organisations "Biro za gradjevinarstvo" - Beograd, "Kera-Projet" - Zagreb and "Konstrukcioni biro" - Zagreb.

2.4. Ceramsite

Good quality raw material for the production of ceramsite - expanded clay, is also available in Yugoslavia.

As a civil engineering material, ceramsite is convenient for application in housing and industrial building construction because of its physical and technical properties - low specific gravity and good thermo-insulating properties.

The annual production of ceramsite in Yugoslavia in 1981 was 35,000 m³ and the manufacturer is K.G.P. "Polet", Bečej.

The producer of the equipment is "Djuro Djaković", Slavonski Brod.

All detailed information are available with KGM "Polet" Novi Bečej and Jugoslovenski gradjevinski centar - Beograd (Yugoslav Center for Civil Engineering, Beograd).

2.5. Gypsum and gypsum products

Yugoslavia is rich in good quality raw material for gypsum production and has nineteen existing production plants.

The production of gypsum in 1981 was as follows:

- raw gypsum	669,000 tons
- baked gypsum	123,000 t
- gypsum plates	3,631 x 10 ⁶ m ²

The existing plants for the production of baked gypsum and gypsum based prefabricates have a modern technology for the time being relying on foreign experience.

The Yugoslav machine building industry started with the production of equipment for the gypsum industry which complies with the interest and the needs of domestic and foreign partners.

Detailed information on gypsum production and on the Yugoslav capacities are available with:

- Jugoslovenski gradjevinski centar - Beograd
- Poslovna zajednica "Kamergran" - Beograd
- SOUR Mašinogradnje "MAG", Beograd

2.6. Gravel and sand

Gravel and sand are basic natural civil engineering materials in the full sense of the world.

Yugoslavia is rich in these materials and exploitation plants are located in all republics and autonomous provinces.

Production of these materials in 1981 was as follows:

- gravel 22,565,000 m³
- natural sand 4,024,000 m³

The Yugoslav professional institutions are qualified to carry out all laboratory researches for these materials, to make applicability studies, projects and train the relevant staff.

Producers of the equipment are as follows:

- STT Trbovlje,
- Slovenija Ceste

Detailed information on all matters referred to researches of raw materials, exploitation and applicability are available with the Jugoslovenski gradjevinski centar, Beograd.

2.7. Natural stone (decorative stone)

The application of natural stone in civil engineering is practised in the following three forms:

- as technical stone
- as architectural stone
- as stone for the means of industrial application.

In this information only the application of technical and architectural stone in civil engineering in Yugoslavia will be considered.

The annual production in 1981 of technical stone was 34 million tons.

The annual production of architectural stone in 1981 was as follows:

- stone blocks 87,000 m³
- stone plates 2 million m² approximately.

Yugoslav producers of the equipment for primary processing of technical stone are the following:

- SOUR Mašinogradnja "MAG" Beograd
- STT Trbovlje
- Slovenija Ceste, Ljubijana

Detailed informations are available with PZ "Kamergran" Beograd.

2.8. Insulation materials

Following the trend of the development of scientific thought and techno-economical requirements to provide proper application of adequate civil engineering materials, it is necessary to construct good quality objects that will besides their basic function meet the optimum requirements of civil engineering physics from the point of good quality constructed objects bearing in mind the values of applicability and exploitation expenses, energy savings, stability of durability

of objects, the chemical industry of Yugoslavia developed and achieved a high degree of good quality products as follows:

- protective coatings, paints, varnishes, mortars for external and internal wall treatment and for protection of built-in jointry,
- various kinds of insulation materials for hydro-sound insulation and thermo insulation of objects
- various kinds of additives for quality increase of physical - technical properties of concrete especially in objects of special application.

As an example, it can be mentioned that in 1981 the following quantities of insulation materials were produced:

- hydro insulation tape "Condor" type	28 million m ²
- special tape for welding systems	20 million m ²
- aluminium and silicium foil tape with insert	8 million m ²
- coatings for special application	60,000 tons

Detailed information on insulation material production as well as consulting, engineering and projecting services are available with Jugoslovenski gradjevinski centar and PZ "Izma" Beograd, as well as with producers of thermo-insulation materials and protective coatings:

- PZ "Izma" - Beograd
- RO "Duga" - Beograd
- RO "Grmeč" - Beograd
- SOUR "Chromos" - Zagreb
- RO "Samoborka" - Zagreb
- KTK - Karlovac
- Izolirka - Ljubljana
- "Termika" - Ljubljana
- TIM - Laško
- "Kovinoplastika"
- SOUR "Bitas" - Sarajevo
- Inžinjeri" - Skoplje

2.9. Wood industry

As a country relatively rich in forests which were used before the Second World War primarily for primary processing and exports of raw material, after the liberation of the country semi-final, later on final production took place both of various kinds of plates, joinery, furniture, prefabricated houses - all made of wood as basic raw material.

As an example, it can be mentioned that the production of hardboard and plywood plates has been acquired and there is a considerable export of these products which are resistant to special climatic conditions - moisture, insects etc.

The Yugoslav producers can offer a complete consulting, engineering and projecting service as well as training of staff for the development of this industry. Detailed information can be obtained at:

- SOUR "Šipad", Sarajevo
- SOUR "Slovenijales", Ljubljana
- SOUR "Novi dom", Beograd.

3. DEVELOPMENT OF THE BUILDING SYSTEM AND HOUSING ERECTION

The expansion of the development of civil engineering activities in the post-war years was conditioned on the first place by the destructions of the War, followed by a sudden growth of population and its considerable concentration into the towns. All the above mentioned found its reflection through the problems faced by the civil engineering trade in certain periods through numerous building activities, mostly in the field of housing erection and accompanying objects for housing areas - objects for the production of fulfilling the needs of contemporary living - as a category of construction of buildings in civil engineering.

The permanently large requirements in apartments absorbed a considerable portion of the activity of the civil engineering activity, imposing at the same time numerous questions connected with the quality and standard of flats, like:

- whether the user is offered a corresponding flat for the present time and for the near future,
- whether building is rational for the individual and the society in total,
- whether the natural and technical possibilities are utilised and
- whether all achievements of the update science have been applied.

The data showing that in Yugoslavia for the last ten years there were 140,000 flats built yearly, that approximately 500 civil engineering work organisations are engaged exclusively with objects of "building construction" within which 70% of the total erection covers building of housing objects, indicates the degree of development of civil engineering production in erection/building activity. This specially refers to the portion of construction of objects, as the fitting and finishing works have a lower degree of efficiency.

The technology of erection - the constructional part of objects, has been modernised considerable through industrially prefabricated elements and component parts. In Yugoslavia there are more different systems of prefabrication and assembling. Some of these industrialized systems are based on licences but the majority of them is the result of the research work of Yugoslav institutions, individual experts, civil engineering operational staff, the industry of civil engineering materials and other accompanying industries.

Industrialisation of the erection work is in fact specialisation of work organisations for the production of certain components of the buildings and specialisation in assembling the objects. This method of production (prefabrication of components) and assembling of objects, interconnected with projection forms a unique business system which can offer to the interested parties a complete service - i.e. projection, production (prefabrication), assembling and finalisation of a

larger assortment of housing objects. The largest number of multi storey apartment buildings in Yugoslav towns is built in one of the industrialised systems. All these systems use for the production of the relevant elements and components natural and processed materials of non-metallic origin (gravel, sand, stone, cement, clay, lime etc.) with a smaller addition of iron and other metals.

The largest number of construction systems utilises concrete - conventional and reinforced - for the prefabricated elements, but there are also systems with which the basic material is baked clay - blocks, expanded clay, ceramsite concrete, pyporex - foamy concrete, "Durisol" - wood chips bound with cement, wood.

As far as the shape of prefabricated elements are concerned, there are two basic types of systems: scaffolding and panel type. The system of tunnel plates has to be added hereto, as a rational system in which the construction of the object is made on the spot in a portable typical plate pattern.

4. YUGOSLAV INDUSTRIALISED SYSTEMS IN THE ERECTION OF HOUSING OBJECTS

4.1. Scaffolding systems

The scaffolding systems represent the systems for multi-storey reinforced concrete buildings with which the basic vertical constructional prefabricated element is - the column. The expansion of longitudinal and lateral construction is practically the same and has no consequence whatsoever on the constructional prefabricated elements.

Through various combinations and shaping of the prefabricated elements - column, beam (support) and ceiling, typical assemblies (groups) of the multi storey scaffolding system are obtained.

4.1.1. IMS Žeželj system

The Institute for Material Testing of SR Serbia (Institut za ispitivanje materijala SR Srbije) has the oldest Yugoslav industrialised scaffolding system of erection (1955) and is, at the same time, the most widely spread over the country with 60,000 completed apartments so far. The highest possible building is ground-floor plus 25.

It is possible to carry out complete assembling construction up to the completion of the carrying construction set with the non-carrying partition walls, sanitary cabins, including the finally processed outside walls.

The system is an open one and gives free hand to the projecting people for the internal shaping of space within the objects.

The base of the assembly is a continuous modular project net of the M-60/60 modul, which is in alignment with the axial lines of columns and is used most commonly in spans of 480 cm, 420 cm, 360 cm respectively 480/360 cm, while it is made in spans of 660 cm.

The assembly consists of columns /30/30 - 38/38 cm/ of 2 or 3 floors length, ceiling elements in the field (cassette type), console and edge carriers.

The columns and ceilings are interconnected with stretching cables for reinforcing in two directions, by which action the basic construction of object becomes monolithic.

The problem of seismic stability is overcome with additional concrete plates for stiffening which secures a seismic safety of up to 9° MCS.

The following organisations are incorporated into the IMS production community:

- GP "Naimar" - Novi Sad
- GP "Gradjevinar" - Niš
- GP "Konstruktor" - Pančevo
- GP "Kozara" - Banja Luka
- GP "Gradnja" - Osijek

- GP "Kazimir Veljković" - Kragujevac
- GP "Graditelj" - Leskovac
- GP "Napred" - Beograd
- "Invest-import-metalna" - Beograd
- "Šipad" - Sarajevo - Inženjering - Zvornik
- IMS - Institut za ispitivanje materijala SRS Beograd.

The record figure of this system is one month in the construction of a 12-storey building with fitted facade and sanitary cabins.

On the basis of this system, on a licence basis, flats are constructed in Hungary, Austria, Italy, Cuba and there are initial applications in the USSR and in the People's Republic of China. Other countries showed interest for this system also.

The Institute of Technical Sciences of the Serbian Academy of Science and Art, Beograd (Institut tehničkih nauka Srpske akademije nauka i umetnosti, Beograd) in cooperation with professor eng. Branko Žeželj extended the possibilities of this system by introducing "System 50", by which even bigger achievements resulted with this system.

Detailed information about the IMS System can be obtained with the Institute for Material Testing of SR Serbia, Beograd (Institut za ispitivanje materijala SR Srbije, Beograd).

4.2. Panel systems

The largest number of prefabricated housing objects is built in the panel system of erection. The basic elements of this system are prefabricated carrying wall panels of one floor height and prefabricated elements for the inter-floor construction.

From the constructional point of view, the objects can be with transversal carrying walls, longitudinal carrying walls or intercrossed carrying walls.

The filling out elements of the object: facade, walls under the windows, internal partitions, sanitary blocks and sanitary cabins, chimney and ventilation channels, are with the majority of the systems uniform and are prefabricated.

The systems differ from each other according to the size of wall panels and the inter-floor construction, as well as by the difference in the inter-connecting system between individual construction elements.

In order to increase the seismic stability of the object, some of the systems utilise stretched cables in the level of inter-floor constructions, while the panel system of KMG "Trudbenik", Beograd utilises also vertical cable stretching of the carrying wall panels.

A modular step of 60 cm is applied with all panel systems, and in the majority the following spans are used: 3,60 m, 4,20 m, 4,8 m and 5,40 m².

Prefabricated wall panels and ceilings with bigger panel systems are produced from reinforced concrete, but also systems with prefabricated elements produced from ceramic concrete, gas-concrete, "Durisol" thin layered clay elements - special hollow bricks and wood are also in application.

Buildings up to the height of ground floor plus 25 storied can be constructed in panel systems.

Detailed information on panel systems based on reinforced concrete can be obtained from the following organisations:

- PZ "Jingrap" - Beograd
- PZ "Inpros" - Beograd
- PZ "Panonijaingrap" - Novi Sad
- "Jugomont" - Zagreb
- "Karpoš" - Skoplje
- Obnova - Ljubljana
- "Adrijamont" - Rijeka
- "Vranica" - Sarajevo.

Detailed information on panel systems based on clay blocks can be obtained from the enterprise "Prvi maj", Bačka Topola.

Detailed information on panel systems for the construction of family houses and apartment buildings up to the height of ground floor plus one, on the basis of ceramsite concrete can be obtained from "Neimar", Novi Sad.

Detailed information on panel system on the basis of gas-concrete can be obtained from PZ "Parobeton", Pula.

Detailed information on prefabricated dwelling buildings based on wood, can be obtained from:

- ŠPIK "Ivanjica" - Ivanjica
- "Velimir Jakić" - Pljevlja
- SOUR "Šipad" - Sarajevo
- "Krivaja" - Zavidovići
- "Marles" - Maribor
- "Jelovica" - Škofja Loka.

In the brief review of the development of basic civil engineering material industry based on non-metallic raw materials and their application in modern technologies and systems of construction in Yugoslavia, an effort was made to outline the character - istics and significant Yugoslav possibilities and achievements in this field.

Convergency of material production, components and elements in civil engineering systems are present in numerous positive examples of complex construction. Within these the efforts of civil engineering material industry based on clay is worth of mentioning in the sense of transformation of production for a more sophisticated finalisation of products as a contribution to the industrialisation of construction. This, first of all refers mostly to the greatest Yugoslav producer of elements based on clay, IGM "Toza Markovic", Kikinda, which together with

the Institute of Civil Engineering of the Socialist Autonomous Province Vojvodina from Subotica (Institut za gradjevinarstvo SAP Vojvodine, Subotica) works on the development of a panel system based on porous brick; it also refers to IGM "Polet", Novi Bečej which develops a system for a wider application of "ceramsite" - a modern civil engineering material from expanded clay.

5. UNIDO AND INDUSTRIALISATION OF CIVIL CONSTRUCTIONS
IN THE SOCIALIST AUTONOMOUS PROVINCE OF VOJVODINA
AND IN SFR OF YUGOSLAVIA

The presented systems of civil constructions in Yugoslavia, even though different among themselves to a good extent are a good proof that with proper organisation good results can be achieved which are not beyond other achievementsⁱⁿ the world. In order to decrease the differences between the systems it is necessary to increase the composibility of elements and their assemblies which requires introduction of uniformity of elements which universally can be used in a greater number of systems, i.e. in more constructive and other assemblies. In order to introduce uniformity of elements and components, it is necessary to set-up standards. It might be advisable to compare the present situation with a certain period of the development of the automobile industry, when the major technical problems were solved but when that automobile reminded us of a carriage. Standardisation and uniformity influenced the technological development and relatively rapidly launched a serial product of a good quality upon acceptable price for a greater number of buyers.

In order to find a solution for convergent drawing near of the existing systems in Vojvodina a request was formulated and assistance was asked from UNIDO, thus to capacitate our civil construction for more rational erection of a greater number of flats. The programme was accepted by UNIDO and UNDP and a project was made under the title "Industrialisation of Civil Engineering in the SAP of Vojvodina DP /YUG/76/001/.

Tasks of the Project were as follows:

- a) on the basis of analyses of foreign and domestic systems with respect to Yugoslav regulations to elaborate a model that would comprise the following:
- modular coordination of measures
 - standardisation of forms, methods and principles and uniformity of elements and components in order to provide composibility,
 - to provide possibilities for industrialisation of installations and finishing works.

This task also comprised training of a certain number of staff members for projecting in such a system and for production of such elements.

- b) Training of a certain number of experts by means of specialisations for research work -research of adequate forms of materials for modern ways of production and construction as well as researches of new materials.
- c) Establishment and equipping of a modern laboratory for realisation of the above mentioned tasks.

The tasks of the project were carried out. The model and the project were made - the operative title of the project is "Banat 80" (according to the title of one of the executives of the project - GIK "Banat" from Zrenjanin) which was realised with assistance of UNIDO, i.e. an expert company ATURBA - Paris and a group of individual experts. The anticipated provisions were achieved - composibility of elements was made possible, element joints of the system were attested and conditions for standardisation were created, which do not provide composibility only, but also meet seismic security requirements. The constructive subsystem enables flexibility in projecting, architecture and function. Thirty models were tested out of which 12 are

included into the catalog. The study has shown spans of 6,00 m, 4,80 m, and 3,00 m which mostly match the standards of an apartment and also offer possible economical solutions in function and production. Modularity has already been recognized in Yugoslav civil engineering industry -- n x 60 cm.

The other two tasks of the project have also been finalised by the Institute of Civil Engineering of the Socialist Autonomous Province of Vojvodina from Subotica (Institut za gradjevinarstvo SAP Vojvodine, Subotica) with assistance of individual UNIDO experts and specialised local experts. A basis has been made for further research work and a laboratory was equipped for specific researches and material testing. For further development of the system and civil engineering in general, a professional team consisting of more than 25 experts - research workers was established. These experts are also affiliated with various institutions through which they can influence the further development through direct participation or indirectly by preparation of future experts (faculties) for improvement of civil engineering.

The project DP/Yug/76/001 - Industrialisation of Civil Engineering of SAP Vojvodina initiated the issuance of regulations: "Uniform conditions for projecting and construction of housing buildings in SAF Vojvodina". Through the association "Panonija - INCRP" a Programme of Industrialisation of Installations and Finishing Works was prepared and accepted which will be realised in the forthcoming period. This programme incorporates the interested engineering organisations, the industry of civil engineering materials of SAP Vojvodina, KMG "Trudbenik", Beograd and the Yugoslav Association of Industrial Civil Construction "JINGRAP" (Jugoslovenska zajednica industrijske gradnje "JINGRAP" Beograd).

The general association of civil engineering and industry of civil engineering materials of Yugoslavia through its committee for industrialisation of construction has been channelling for a good number of years the activities of development of

civil engineering for the establishment of standards for projecting, production and construction. The Federal Government of Yugoslavia has entrusted this task to the Federal Administration for Standardisation. The first phase of these standards has already been made and published and the second phase will be finished in the coming year of 1983.

6. POSSIBLE FORMS OF COOPERATION WITH THE INTERESTED PARTIES FOR YUGOSLAV EXPERIENCES IN CIVIL ENGINEERING AND THE INDUSTRY OF CIVIL ENGINEERING MATERIALS

The variety and the broadness of professional experience in the development of numerous systems of production of civil engineering materials and their application in the Yugoslav civil engineering, offer a wide basis for cooperation with the interested countries for transferring these positive experiences and other achievements in this field.

The Yugoslav enterprises and institutions are searching for and are offering a long-term cooperation with all interested enterprises and institutions which could be realised through one of the following forms of cooperations:

- researches of raw material deposits, elaboration of studies on applicability of raw materials on laboratory and semi-industrial testings,
- elaboration of feasibility studies, projects and realisation of factories for the production of civil engineering materials,
- consulting services for the construction of factories for production of civil engineering materials, and construction of housing objects,
- transfer of technology and know-how in the production of civil engineering materials, prefabricates and civil engineering systems,
- services of experts: institutional or individual in finding out solutions for problems in production and construction,
- training in Yugoslav educational institutions,

- training in Yugoslav productional plants,
- training in the country of the user of the cooperation,
- specialisations in research institutions in Yugoslavia,
- consulting services in projecting, construction and organisation of work of the Civil Engineering Center,
- technical assistance through UNIDO
- any other defined or specific needs of professional cooperation in this field.

NOTE:

Below we are giving the addresses of the work organisations and Yugoslav institutions in the sequence of order as they appear in this paper.

For detailed information please refer to:

- Jugoslovenski gradjevinski centar, Beograd
Bulevar revolucije 84

Phone - 011/436-122 and 011/436-229

Telex: 12007 YU JGC

- Institut za gradjevinarstvo SAP Vojvodine
Subotica, Put Moše Pijade 86

Phone - 024/41-011 and 024/43-213

Telex: 15218 IGV SU

- SOUR "MAŠINOGRADNJA" (MAG) 11000 Beograd, Nemanjina 4/XI
- SOUR "DJURO DJAKOVIĆ" 35000 Slavonski Brod, Njegoševa 1
- "ENERGOINVEST" 71000 Sarajevo, Tvornička 3
- PZ "JUCEMA" 41000 Zagreb, Prilaz JNA 30/1
- "DALIT" 43500 Daruvar, Radičeva 46
- PZ "KAMERGRAN" 11000 Beograd, Bulevar revolucije 84
- Industrija mašina "IVO LOLA RIBAR", 11250 Beograd-Železnik, Tome Buše 1
- "CER" 32000 Čačak, Dr Dragiša Mišovića 169
- "MILOŠ DIMANIĆ" 16210 Vlasotince
- Biro za gradjevinarstvo, 11000 Beograd, Dalmatinska 47
- RO "KERAPROJEKT" 41000 Zagreb, Petrova 112
- Konstrukcioni biro, 41000 Zagreb, Prilaz JNA 30
- Jugoslovenski gradjevinski centar, 11000 Beograd, Bulevar revolucije 84
- Slovenija Ceste, 61000 Ljubljana, Titova 38
- Institut za gradjevinarstvo, 24000 Subotica, Put Moše Pijade 86
- RO "NEIMAR-NOVI SAD" 21000 Novi Sad, Stevana Branovačkog 3
- RO "INVEST-IMPORT" 11000 Beograd, Terazije 5
- "ŠIPAD" Sarajevo, RO "INŽENJERING", 75400 Zvornik, Filipa Kljajića 6
- Institut za ispitivanje materijala SR Srbije, 11000 Beograd, Bulevar
Vojvode Mišića 43
- Institut tehničkih nauka SANU, 11000 Beograd, Knez Mihajlova 35
- "JUGOMONT" 41000 Zagreb, Horvaćanska cesta 11
- KMG "TRUDBENIK" 11000 Beograd, Bulevar revolucije 79
- GIP "OBNOVA" 61000 Ljubljana, Titova 39
- "ADRIJAMONT" 51000 Rijeka, Antuna Barca 3
- GP "VRANICA", 71000 Sarajevo, JNA 9

- GIK "1 MAJ" 24300 Bačka Topola, Bečejski put bb
- Fakultet tehničkih nauka - Institut za industrijsku gradnju,
21000 Novi Sad, Veljka Vlahovića 3
- PZ Jugoslovenskih proizvođača plina i pjenobetona, 51000 Pula, J.Dobrile 6
- "MARLES" 62000 MARIBOR
- Industrijski kombinat "KRIVAJA", 72220 Zavidovići, Radnička 2
- IGM "TOZA MARKOVIĆ" 23300 Kikinda, Bašaidski drum 62
- PZ "JINGRAP", 11000 Beograd, Bulevar revolucije 84
- PZ "INPROS" 11000 Beograd, Bulevar revolucije 84
- PZ "PANONIJA-INGRAP" 21000 Novi Sad, Trifkovićev trg 4
- SOUR "ŠIPAD", 71000 Sarajevo, M.Tita 15
- ŠPIK "IVANJICA", 32250 Ivanjica, Venijemina Marinkovića bb
- ŠIK "VELIMIR JAKIĆ", 84210 Pljevlja, Stržica 11
- Lesna industrija "JELOVICA", 64420 Škofja Loka, Kidričeva 58
- RO "POLET" 23272 Novi Bečej, Železnička 13
- Opšte udruženje gradjevinarstva i IGM Jugoslavije,
11000 Beograd, Bulevar Revolucije 84

