OCCASION

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

DISCLAIMER

FAIR USE POLICY

CONTACT

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

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

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

ATELIERS D'URBANISME ET D'ARCHITECTURE

BUREAU D'ETUDES

AT.URB.A

01981

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

(U.N.I.D.O.)

UNIDO CONTRACT N° 75 / 7

PROJECT N° IS/YUG/74/023

ACTIVITY CODE 18

(R) **ASSISTANCE TO THE INDUSTRIAL CONSTRUCTION COMBINE**

G.I.K. BANAT

IN YUGOSLAVIA

FINAL REPORT

DATE : 08 . 08 . 1975

The aim of this assignment is to provide assistance to the Management of the "BANAT" combine, in working out the long-term production programme relating to materials and buildings.

Details as to the fulfilment of this assignment are set forth in clause 2.00 of the "Contract", as follows :

"a) review the existing systems and activities of "BANAT" in industrial construction with a view to identifying present technical and economical problems facing the enterprise in carrying out its functions and determining their casual factors,

"b) Formulate a long-term programme for rational development of the enterprise, covering both production and construction activities,

"c) Recommend steps that should be taken for the improvement of the present production of prefabricated elements and the new methods and design in construction material and components in order to improve construction processes,

./.

"d) Assess the possibility for the establishment of new manufac- "
" toring units in order to achieve full industrialization in cons"
" truction of industrial building and housing projects. "

It should be mentionned that the percentage of the buildings (wholly and partly) built by the "BANAT" combine using industrialized methods is comparatively low and, owing to this, the § "a" and "c" above refer mostly to non-industrialized traditional techniques.

Only the industrial and agricultural building division meets substantially the criteria of industrialized construction.

Some adjustments of the expert's mission were decided in common accord with the Management of the"BANAT"combine to take into account the prevailing situation.

To this end, three experts travelled to ZRENJANIN and the autonomous region of VOJVODINA from April 15th to 25th 1975. These three experts were :

. C. LE GOAS - Architect, a specialist for building system and prefabrication,

. P. RAZY - Engineer, a pre-fabrication specialist,

. L. SEKULIC - Architect, a specialist un architectural components.

After this initial stay the experts interviewed for two weeks the specialists and various manufacturers of precasting equipment at the Head Office during which time the most of was made by the Management and Department of the"BANAT"combine to gather the documentation required.

Two of these experts came back and stayed from the 12th to the 16th May 1975 to gather the ultimate informations needed to compare their preliminary conclusions with the Management of the"BANAT"combine.

Submission of the interim report in Vienna on 2nd June 1975 enabled to gather together the opinions of both the UNIDO industrial construction unit and of the Management of the"BANAT"industrial combine. The upshot was the need to supplement the expert's investigations through information that the"BANAT"combine committed itself to forward as promptly as possible.

This survey consists of the three following sections :

. analysis of the combine output and submission of the socio-economic context governing the production of prefabricated components.

./.

- short-term programme to improve output by optimizing the available production equipment.
- a medium- and a long-term development programme, together with the related detailed proposals.

S U M M A R Y

./.

1.2.3. - Activities abroad

1.2.4. - Production equipment

1.2.4.1. - Materials

1.2.4.2. - Construction system and technology

1.2.4.3. - Facilities
a) ZRENJANIN
b) BELA CRKVA

1.2.4.4. - Site and haulage equipment

1.2.4.5. - Building trades

1.2.4.6. - Headquarters, marketing and project

. C O N C L U S I O N

Section 2 - SHORT-TERM IMPROVMENT PROGRAM OF THE COMBINE "BANAT" PRODUCTION

2.1. - MATERIALS PRODUCTION SECTOR

2.1.1. - ZRENJANIN

2.1.2. - BELA CRKVA

2.2. - BUILDING PRODUCTION SECTOR

2.2.1. - Materials

2.2.2. - Construction system and technology

2.2.3. - Facilities

2.2.3.1. - ZRENJANIN

2.2.3.2. - BELA CRKVA

./.

./.

3.3. - PROPOSALS FOR A MEDIUM AND LONG TERM DEVELOPMENT PROGRAM

3.3.1. - Creation of an expanded clay manufacturing unit

3.3.1.1. - Use of lightweight aggregate

3.3.1.2. - Technical advantages

3.3.1.3. - Economic interest

3.3.1.4. - Needs estimates

3.3.1.5. - Manufacturing technics

3.3.1.6. - Economical data

3.3.1.7. - The manufacturing unit

3.3.2. - Creation of a prefabrication factory

3.3.2.1. - Industrialization and prefabrication

3.3.2.2. - The prefabrication factory

3.3.3. - Reconversion and extension of fixed-station shop for exceptional Units

3.3.4. - Organization and planning of transportation

3.3.5. - Instituting an open continuous prefabrication line for lightweight panels with ISOBETON base

3.3.5.1. - Materials and technology

3.3.5.2. - Description of plant

3.3.5.3. - ISOBETON and the "BANAT" Combine

3.3.6. - Constitution of Multi-Displinary "think tank"

3.4. - DEVELOPMENT STRATEGY OPTIONS

3.5. - INDUSTRIAL AND AGRICULTURAL BUILDINGS AND INCORPORATION OF TECHNOLOGY AND PRODUCTION EQUIPMENT BORROWED FROM THE HOUSING SECTOR

. C O N C L U S I O N

-0-0-0-0-0-0-0-0-0-

LIST OF APPENDIX

./.

12 - LIGHTWEIGHT AGGREGATES - LIST OF STANDARDS

13 - LIGHTWEIGHT AGGREGATES - BIBLIOGRAPHY.

14 - PREFABRICATION - INDUSTRIALISATION - BIBLIOGRAPHY.

-o-o-o-o-o-

INDUSTRIAL CONSTRUCTION COMBINE "BANAT"

G.I.K. " BANAT " ZRENJANIN

STYLE : GRADJEVINSKO - INDUSTRIJSKI KOMBINAT "BANAT" ZRENJANIN

The acronym for which is : G.I.K. "BANAT" ZRENJANIN

In English : INDUSTRIAL CONSTRUCTION COMBINE "BANAT" ZRENJANIN

ADDRESS : TRG REPUBLIKE 2

YU - 23000 - ZRENJANIN

PHONE : 023.24.830

TELEX : 15584 YU GIK

TELEGRAMS : GRADJ BANAT - ZRENJANIN

SOME HISTORICAL DETAILS :

The "BANAT" Industrial combine was established on the 1st of April 1947, its style being : "PIONIR Building Firm".

Over the years and owing to a policy in line with the economic trend, the firm has grown, widened its scope and increased its manpower.

The G.I.K. "BANAT" is in its present form since the 1st January 1973 (date of the latest regional merging), currently employs 3,000 people and represents the main force in the field of construction of the BANAT area, which is in the North-Eastern portion of the Autonomous Region of VOJVODINA (cf. appended map 2).

By virtue of the foregoing, it branches out in the said area through its subsidiaries whose head offices are respectively in NOVI BEČEJ, BELA CRKVA and VRŠAC.

The graph appended (addendum 7) shows the development of the firm since it was established and the yearly turnover achieved from 1947 to 1974, in millions of new non-constant dinars.

After an uphill period, the Complex grew at a fast rate ; its turnover increasing over the last 5 years by more than 400% (in non-constant dinars). Such growth indicates the aggresiveness and successful policy of the combine and vindicates the regional leadership it aspires to.

SCOPE OF THE COMBINE :

This currently involves the following :

. Building,

. Marketing,

. Engeneering

. Town-planning and architectural design projects,

. Erection and fitting-up of buildings,

./.

. Imports and Exports,

. Trading in and production of building materials,

. Sole agencies.

ORGANIZATION OF THE COMBINE :

The G.I.K. "BANAT" combine was set up and is operated according to both the Yugoslav law and the self-Management agreement pertaining to companies which, in this instance, is peculiar to the combine and was adopted in its current form at the General Meeting of the whole staff of the combine, on the 26th and the 27th December 1973. (Heading in the vernacular : "SAMOUPRAVNI SPORAZUM O UDRUŽIVANJU", from which is derived the abbreviation : "S.S.U.")

The first clause of this document ("S.S.U.") defines the G.I.K. "BANAT" combine as a "basic organization of united work, expressing the aims and interests of all other bodies of workers which freely integrated with it".

The co-signatories of the "S.S.U." were all the basic organization of united work (heading, in the vernacular "OSNOVNA ORGANIZACIJA UDRUŽENOG RADA", from which was derived the abbreviation "O.O.U.R." which will be referred to in this abbreviated form further on).

The appendices 6 and 5 include an itemized list of the "O.O.U.R." as well as the organization chart of the combine.

./.

AREA WITHIN THE SCOPE OF THE COMBINE :

- THE AUTONOMOUS REGION OF VOJVODINA *

. area		21,506 km2
. population		1,950,268 (in 1971)
.	approximately	2,000,000
. population density		90,7 persons/km2 (in 1971)
. total length of railway tracks		1743 km
. length in highways		7599 km
. length in waterways		1387 km

- MAIN TOWNS

. NOVI SAD		141,712 inhabitants in 1971
	approximately	200,000 in 1975
. SUBOTICA		88,787 inhabitants in 1971
	approximately	100,000 in 1975
. ZRENJANIN		59,580 inhabitants in 1971
	approximately	70,000 in 1975
. PANCEVO		54,269 inhabitants in 1971
. SOMBOR		43,791 inhabitants in 1971
. KIKINDA		37,487 inhabitants in 1971
. VRSAC		34,231 inhabitants in 1971

* *Socialist Autonomous Region of VOJVODINA*
Original title : Socijalistička Autonomna Pokrajina Vojvodina
Abbreviation : S.A.P.V.

./.

- BUILDING-MATERIALS INDUSTRY (1971 data)

. lime	48,000 metric tons
. bricks	533,000 metric tons
. rooof tiles	115,000 metric tons
. cement	819,000 metric tons

(in BEOČIN, opposite NOVI SAD, in the SREM area).

./.

Section 1 - ANALYSIS OF THE PRODUCTION AREAS OF THE "BANAT" COMBINE

In 1974,

- what is the scope of the "BANAT" combine in the production area ?
- how far should one look back to grasp the current situation and work out a short- and a long-term programme ?

These matters will be approached under the two following headings :

. the building materials sector

. the building output sector

1.1. - BUILDING MATERIALS SECTOR

There being no competition worth mentioning, either in ZRENJANIN or BELA CRKA with merchants dealing in basic building materials, the "BANAT" combine had to make available its own sources of supplies and beyond its needs market same.

1.1.1. - Aggregates

In ZRENJANIN the problem of supplying aggregates for concrete and reinforced concrete was solved by purchasing natural and aggregates dredged in the Morava river and carried in self-propelled barges.

./.

These aggregates are grab-unloaded on the bank next to the ZRENJANIN facilities where they are scree ned, graded according to requirements and stored.

They are first used for the combine requirements to a ratio of about 36%, the surplus, 64%, being sold to small firms or private individuals so as to make the plant pay its way.

These aggregates are of excellent quality, but their price is high owing to the cost of transport, screening and storage.

There is, quite close to ZRENJANIN, a sand pit using a low-capacity sand suction dredger, with neither wet cleaning nor storage plant.

This sand is very fine as the grading analisys shows :
30% of its grains are $<$0.2mm, the 70% remaining $<$ 0.4mm.

This material can only be used as either make-up sand for the fines of the concrete mix or for making rough-cast mortar according to a given mix.

There is,available to the standard-type concrete mixing plant, in the center of BELA CRKVA, a large gravel pit. This gravel comes from the recent alluvia of the Danube which flows within kilometres. The gravel is extracted to a depth af about 12 metres, the over-burden being no greater than 1.50 to 2 metres in depth.

Extraction started some years ago on a small scale and randomly, and is now proceeded with by conveyor belts mounted on floats from the river-bank where the gravel is loaded on a caterpillar loader and transferred to a dump-lorry.

The run-of-the mill aggregate is transported to a screening plant were it passes through a vibrating screen and then stored according to a particle-size distribution matching requirements.

The output of aggregates is approximately 100m3/hr, of which 12% are used for the requirements of the "BANAT" combine, the 88% remaining being sold.

./.

1.1.2. - Bricks and roof tiles

The BANAT area lies wholly in a vast alluvial plain (the ancient Pannonian Sea), the black top soil of which is about 1.50 metres deep and lies over layers of grey and brown clay 12 to 20 cm thick.

There is virtually no sand or pebble deposit, hence, the traditional building material is brick and roof tile.

In almost every village there is a more or less antiquated brick yard.

The G.I.K."BANAT"combine owns two bricks factories, one in ZRENJANIN, the other in JASENOVO (20 km from BELA CRKVA).

The ZRENJANIN factory makes solid, hollow and break-joint bricks, as well as hollow-gauged bricks for floors, and floor joists.

The factory is supplied by an adjacent clay pit, its yearly output currently amounting to 18m. building units of high quality.

The JASENOVO factory is being enlarged and fitted out with up-to-date equipment and its yearly output will amount to 24m. building units.

The output potential of these two factories far exceeds the combine's requirements which therefore markets most of its production.

./.

1.2. - BUILDING-OUTPUT SECTOR

1.2.1. - Currently, who are the combine's customers ; what are its construction methods ?

The system-building market.

The role of the combine is mainly threefold, as follows :

. as a "classical" contractor for clients who already have their plot of land and comprehensive programme of works (such as school units, hospitals and so forth).

. a "constructor" as designer for investors who also already have their plot of land and programme of work, but for whom the combine, as building contractors, provide the architectural design as well. This type of "turnkey contract" applies mostly for industrial and agricultural building.

. as a "Builder", acting as a temporary investor. Following a call for tenders, the combine purchases developed building land and ventures into a housing-development scheme, builds same and resells the latter to the public.

1.2.1.1. - Land problems

Apart from chaotic and scattered town-planning (construction of detached houses outside the built-up areas on "rural land"), a market that falls short of the combine, it behoves the municipality and town planning bodies to develop land suitable for industrial building housing and community equipment.

The town-planning policy of these land-developpers interferes directly in any of the three aforesaid instances within the scope of the work entrusted to the combine. The latter deplores such parcelling within the sphere of housing, (i.e., unduly small building sites).

./.

Conversely, there is no land problem for industrial buildings.

1.2.1.2. - Scenario of a Builder's housing scheme.

The parties to the combine's undertaking.

The municipal authorities which represent the local, economic and social bodies and supported by town-planning committees, control the building-land development fund. It calls for tenders for developed building land, including itemized specifications. 3 or 4 combines or contracting firms are approached in this way. The replies are technical and financial in nature but do not include, however, the lay out plan. The sealed envelopes are opened in public, the best offer being selected on the basis of several criteria.

The successful tenderer works out his architectural scheme and undergoes all the technical tests required by the municipal, town-planning and other authorities. The structure is built and acceptance-tests carried out (including a certification mark).

The "Builder" sells the dwellings direct on a small scale to private individuals, and the balance to firms which rent them to their personnel.

The parties to the combine's undertaking are therefore chiefly :

. the Municipality and relevant specialist committees,

. private individuals who purchase the dwellings,

. the firms that bought the dwellings.

Only collective housing units have been built according to this scenario.

A big problem is that of detached houses.

./.

1.2.1.3. - Information relating to the detached-house market

Latherly, thousands of detached houses of all types have been built, especially outside built-up areas, on "rural land". This market does meet a genuine demand as well as purchasing power and a way of life. However, it breaks away from any coherent and comprehensive town-planning policy as regards construction of dwellings whether in ZRENJANIN or throughout VOJVODINA (to gauge its significance, please refer to section 3.1.2.)

This market is extremely scattered and chaotic as regards building land and mode of application (makeshift labour, irrational construction, questionable architecture and design, and so on).

The town-planners who are subjected to such conditions have requested the local authorities to prohibit this type of building. Now the municipality cannot do this in view of its inordinate extent. Therein lies a conflict between the population's requirements, (viz., strong interest for detached houses) and those in charge of housing who consider that, in any case,

- the unearned increment of the direct cost-price of a detached house vhen compared with a collective housing unit, in conjunction with the direct cost burden borne by the Company (growth of town, and relevant consequences) warrants wilfully underestimating or ignoring detached housing in prospective town-planning schemes.

The combine is thus between the hammer and the anvil. It did not have, in the past, the opportunity to take action in this market except once, as land developer, in the financial operation known, as "Commune de Paris" in ZRENJANIN.

./.

The houses were built in the traditional manner and all of them were promptly sold at an approximate price of 137,000 dinars for a dwelling with a habitable area of 84 m2 (hence with neither cellar nor garage), or about 1,600 to 1,800 dinars per habitable sq.metre.

A somewhat mechanistic comparison of the latter with collective housing units (solely with regard to the selling price)is worthwhile although not very significant when referring to theCombine's unquestionably most successful housing venture, i.e., the 536-dwelling collective unit erected in ZRENJANIN and labelled "D.2" the average flat of which has a habitable surface of 56.10 m2 and was sold, on the average, approximately 70,000 dinars, or 1,250 dinars per habitable sq.metre.

The selling price difference amounted to, therefore, from 350 to 550 dinars/m2 ; a truly reliable comparison remains to be made by means of a comprehensive study carried out in conjunction with a significant test, and thus elicit a policy for detached houses. That is one of the ambiguities that burdens our survey of the system-building market.

1.2.1.4. - Regulation constraints

In Yugoslavia, as in most other countries, contruction of dwellings, agricultural or industrial buildings, is subject to regulations.

These relate to two different aspects, as follows :

- site lay-out, ground surface, height zoning, siting suitability and so on...

  The "BANAT" firm's engineering department is apparently very knowledgeable in this connection.

- construction provisions relating to stability, sanitation, fire prevention, thermal insulation, soundproofing, ventilation, heating, etc...

./.

These provisions refer to both constructional and engineering considerations.

As regards engineering, most of these regulations are covered by standard that evince how similar and equivalent they are with those of other countries.

The sample survey we have carried out shows that basic materials, such as steel and reinforced concrete are used in the same way as they are in France, Great Britain, Switzerland, Western Germany and other countries, where research and experimentation have been going on and followed up for a very long time.

However, we have to note a particularity : Yugoslav seismic regulations have reference to intensity degrees of VII-VIII and IX (M.C.S. scale).

Yet, there is one specific matter in which Yugoslav regulations give rise to a constraint difficult to meet ; we are referring to the heat insulation of buildings, which must be placed on the outside of structural supporting elements. Ideally, this is highly desirable. However, this actually raises in the building industry many problems which may be solved to some extent in traditional construction, but with great difficulty when using precast panels.

All countries are casting about for solutions, especially since the consumption of fuel-oil has been restricted, such solutions are available but the relevant techniques are still expensive owing to intricate constructional problems or the need of using high-cost materials.

However, we trust that the currently swift development of such research will solve this problem by the time the prefabrication factory planned herein is set up.

Fire prevention :

- the current regulations are surprisingly brief. They relate mainly to the action taken by the fire brigade when a fire breaks out and refer but very slightly to the construction itself (i.e., type of materials used, stability, fire resisting features, etc.) and of the

./.

desing lay out (i.e., horizontal and vertical passageways, distances to be covered, insulation partitioning, smoke clearing, etc...).

Such gaps for the sake of people's safety should be made good.

Refuse disposal :

- The town of ZRENJANIN has its own regulations regarding refuse disposal from the storage area to the dumping ground (situated near the entrance of the town). Provision for rubbish shoots in housing units is seldom made and there are small problems in need of technical and sanitary solution as regards the transfer of refuse from the building to the street.

  A properly designed and comprehensive system should be devised and advocated if not actually provided for. For example, provision of rubbish-shoots ductwork in the building and comprising sealed openings on landings (for instance in the ventilated cubicle for ductwork and meters) or else in the flats, including, at the bottom of the downpipe, wheeled containers so sized as to meet disposal requirements and located in the ventilated premises on the ground floor. From there, and not withstanding the lack of caretaker, the refuse-disposal concern could take care of these by providing for a rider in the main agreement.

  There are more sophisticated systems but the above-mentionned example is already advocated by Yugoslav regulations ("Journal Officiel" of the Yugoslav Republic issue 28/70).

1.2.1.5. - Financing and pricing

The purchasers' financial commitments enable the builder to launch the financial operation.

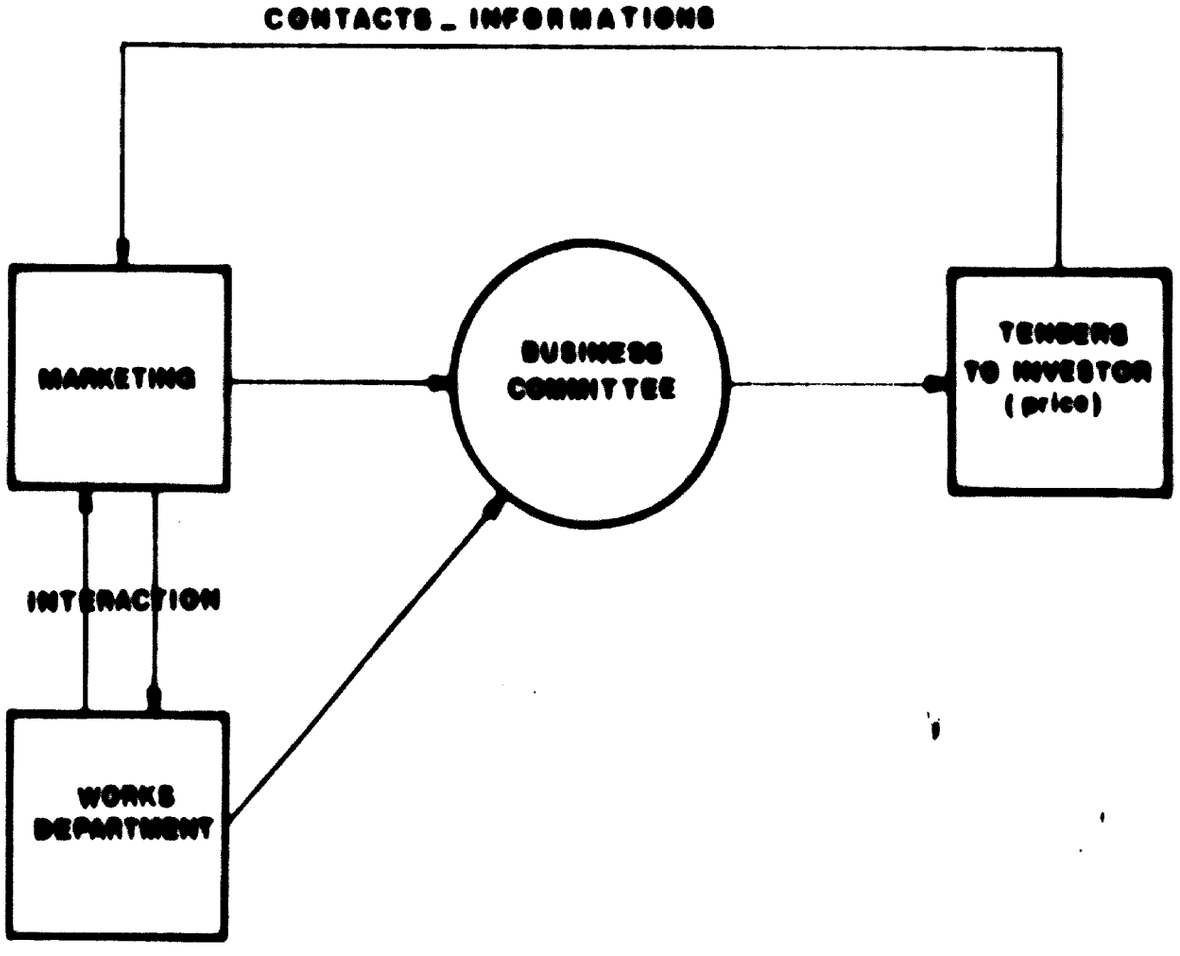
./.

The self-financing provided by the pruchasers and bank loans finance the construction of industrial and agricultural buildings, as well as housing.

A down-payment of 20% is needed for industrial investments.

No information was available in respect of housing as to a ceiling price per square metre of construction.

The pricing of the housing development comes within the scope of a free-market economy, the decision being taken within the combine, according to the following outline.



1.2.2. - Types of buildings erected

The activity of the "BANAT" industrial complex over the last two years (1973-1974) may be summarized as follows :

CATEGORY	in m2		in non-constant dinars	
	1973	1974	1973	1974
1. Public Works	27,515 26.86%	37,951 28.23%	6,826,783.75 3,68%	10,833,389.00 4.31%
2. Industrial Buildings and silos	16,295 +11,487 27,782 27.12%	33,764 + 9,453 43,217 32.16%	76,924,798.65 41.50%	82,532,003.30 32.86%
3. Housing	30,480 29.74%	41,791 31.10%	68,854,216.45 37.14%	112,930,142.95 44.96%
4. Sundry	16,678 16.28%	11,438 8.51%	32,768,819.40 17.68%	44,870,708.35 17.87%
T O T A L =	102,435 100 %	134,387 100 %	185,374,618.25 100 %	251,166,243.60 100 %

A closer breakdown is actually needed for both categories referring to main houses (public housing).

./.

1.2.2.1. - Industrial and agricultural buildings

To grasp the status of the "BANAT" industrial combine in 1975 and its dialectical development requires setting forth its background.

As early as 1950 the Firm started construction of a sugar- and starch-mill combine. The shortage of personnel and mechanized equipment gave rise to many problems. Until then, this firm was only building agricultural and a few public buildings. The aforesaid combine included 14-storey buildings, pile foundations, reinforced concrete structural shells and building frames as well as a factory stack 82 metres high.

The only executives available were several young technicians with no experience but with much ambition. The mechanized equipment had been hired. Nevertheless, the workmanship was thoroughly sound, chiefly owing to the worthiness of the formwork makers, steel fixers and masons who had already gained some experience in Yugoslavia and abroad.

Overcoming this problem was milestone in the development of the firm, which henceforth was in a condition to cooperate with large engeenering department and Institutions, thereby at the same time, promoting, training its staff.

Heartened up by this initial experience, the firm tackled other industrial combines and buildings and has become, (cf. list of its customers) a specialist in the construction of large filling stations.

This market has been kept up at a steady level owing to a sustained policy based on a market study investigated in depth and a construction system on the use of precast prestressed concrete elements.

The high level of workmanship so achieved firmly established the firm's repute.

./.

Some of its more significant accomplishments in the industrial construction are the following :

. The large warehouse combine "CENTROPROM", in SURČIN, that was designed in close co-operation with the engineering firm "PRONAPREGNUTI BETON" (prestressed concrete), in BELGRADE, which now steadily collaborates with G.I.K."BANAT".

  Once more, as a result of making use of a construction system wholly involving prestressed concrete elements, the buildings were completed within a short space of time these involving 30,000 m2 of warehouse space some of which was for cold stores, including the power and fuel facilities, with a capacity of 10,000 wagons.

. In the same line of thought should be mentioned the "MINING INSTITUTE", in ZEMUN, consisting of buildings including laboratories, factory buildings, coal-dressing shops and their equipment, the "TOZA MARKOVIĆ" buildings for making construction materials in KIKINDA where, for the first time, was large-slab roofing technique was applied. Implementation of up-to-date methods both in the construction system and a well-planned time schedule enabled the firm to complete the work within a year, including the equipment.

. Another accomplishment of the G.I.K."BANAT"in this field of activity is the new carpet factory "PROLETER", in ZRENJANIN, this consisting of a combine of fully equiped industrial buildings, since its design (work of GIK "BANAT") had provided for the use of a large number of repetitive structural elements, the most being made of prestressed concrete fabrication, such design subtantially making for lower costs and shorter time limits.

. It should be added to the foregoing a number of agricultural buildings, silos and ancillary buildings (three in ZRENJANIN, others in KIKINDA, NOVI KNEŽEVAI, etc..), and the warehouses in ZRENJANIN, SEČANJ, KIKINDA.

  The steady headway the firm has achieved within its regional sphere of activities has resulted in a list of customers that speaks for itself :

./.

INDUSTRIAL BUILDINGS

1. VEGETABLE OIL MILL "2 OKTOBAR"	- Rebuilding and construction of ancillary buildings in ZRENJANIN
2. BOILER - AND RADIATOR MAKING WORKS	- Rebuilding and construction of the workshops in ZRENJANIN
3. "SERVO MIHALJ" SUGAR MILL	- Reconstruction and construction of new buildings, in ZRENJANIN.
4. "UDARNIK" HOSIERY FACTORY	- Reconstruction and construction of new buildings, in ZRENJANIN.
5. TOBACCO FACTORY	- Fermentation and drying shop in ZRENJANIN.
6. "PROLETER" CARPET INDUSTRY	- Construction of weaving and dyeing shops (old factory, in ZRENJANIN).
7. STARCH FACTORY	- Construction of the "SERVO MIHALJ" complex, in ZRENJANIN.
8. "SVETOZAR MARKOVIC - TOZA" TANNERY	- Construction of an industrial complex, in ZRENJANIN.
9. "SERVO MIHALJ" FOODSTUFF FACTORY	- in ZRENJANIN.
10. "ŽARKO ZRENJANIN" FURNITURE FACTORY	- Reconstruction and construction of new workshops, in ZRENJANIN.
11. "STEVICA JOVANOVIĆ"	- Manufacture of returnable bottles, in ZRENJANIN.
12. "TOZA MARKOVIĆ" TILE WORKS	- in KIKINDA.

./.

13. HIGH-GRADE POTTERY FACTORY - New factory, in ZRENJANIN.

14. "PROLETER"CARPET INDUSTRY - New factory, in ZRENJANIN.

15. "SERVO MIHALJ" MARGARINE FACTORY - in ZRENJANIN.

16. "TOZA MARKOVIĆ" BRICKWORKS - Reconstruction and construction of annexe buildings, in KIKINDA.

17. IRON FOUNDRY - Construction of wagon-erecting shops, in KIKINDA.

18. THERMAL POWER STATION - for the "SERVO MIHALJ" complex, in ZRENJANIN.

19. "PROGRES" FOUNDRY FOR CAR PARTS - in ZRENJANIN.

20. "MINEL" TRANSFORMER FACTORY - in ZRENJANIN (1560 m2)

21. BRICK AND ROOF- TILE INDUSTRY, as follows :

a) "2 OKTOBAR" BRICKWORKS, in JASENOVO (BELA CRKVA) (being completed).

b) "NEIMAR" BRICKWORKS, in ZRENJANIN.

22. CAR DEALER'S PLANTS, as follows :

a) SERVICE STATION FOR "ČEPEL" cars (customer: "DINARA") in BELGRADE.

b) SERVICE STATION FOR "V.W." cars (customer: INTEREXPORT"), in BELGRADE.

c) SERVICE STATION FOR "ŠKODA" cars (customer: "BALKANIJA"),in BELGRADE.

d) SERVICE STATION FOR "PEUGEOT" cars(customer: "TEHNOSERVIS"), in BELGRADE.

./.

		e) SERVICE STATION FOR "REMONT" cars, in ZRENJANIN.
23.	TISA AND BEGEJ PUMPING STATIONS	- in BEČEJ - PERLEZ - MUŽLJA and MEDJA.
24.	"VOJVODINA-PUT" REPAIR SHOP	- in ZRENJANIN.
25.	"NAFTAGAS" REPAIR SHOP	- in ZRENJANIN.
26.	"GIK BANAT" REPAIR SHOP	- in ZRENJANIN.
27.	"ELEKTRO-VOJVODINA" REPAIR SHOP	- in ZRENJANIN.
28.	"ENTREPRISE DE TRANSPORT" REPAIR SHOP	- in BEČEJ.
29.	"NAFTAGAS" OIL-FIELD COMPLEX	- in BOKA.
30.	"NAFTAGAS" GASOLINE RECOVERY PLAN	- in ELEMIR.
31.	"BUDUĆNOST" PUBLISHING HOUSE	- in ZRENJANIN.
32.	"CENTAR" TRANSFORMER STATION	- in ZRENJANIN.
33.	TWO TRANSFORMER STATIONS	- in BEČEJ.
34.	"2 OKTOBAR" WEIGHING PLAT-FORMS FOR LORRIES	- in ZRENJANIN.
35.	FIVE WEIGHING-PLATFORMS FOR LORRIES, SUGAR MILL	- in ZRENJANIN.
36.	"ŽITOPRODUCT" TWO WEIGHING-PLATFORMS FOR LORRIES	- in ZRENJANIN.
37.	WEIGHING BRIDGES FOR THE LORRIES OF A FLOUR MILL	- in ZRENJANIN.
38.	WEIGHING BRIDGES FOR THE LORRIES OF A FLOUR MILL	- in NOVI KNEŽEVAC

./.

39.	"ČOKA" SLAUGHTER-HOUSE AND CANNING FACTORY	- in ČOKA.
40.	"PIK" SLAUGHTER-HOUSE AND COLD STORE	- in KIKINDA.
41.	"BEK" COLD STORE FOR CANNED PRODUCTS	- in ZRENJANIN.
42.	FRUIT AND VEGETABLES COLD STORE	- in ZRENJANIN.
43.	FRUIT AND VEGETABLES COLD STORE	- in ČURUG.
44.	"CENTROPROM" FRUIT AND VEGETABLE COLD STORE	- in SURČIN.
45.	"MIP" MACHINE SHOP	- 2,975 m2
46.	"BEGEJ" HAT-MAKING SHOP	- 2,730 m2
47.	"TOZA MARKOVIĆ" REPAIR SHOP AND GARAGE	- 1,553 m2
48.	NOODLE FACTORY (drying shop)	- 1,756 m2
49.	REPAIR SHOP FOR RAILCARS	-23,352 m2
50.	"ELEKTROISTOK" TRANSFORMER STATION	- 1,071 m2

AGRICULTURAL BUILDINGS AND RELATED INDUSTRIES

1.	VEGETABLE-OIL MILL	- 3000 wagons in ZRENJANIN.
2.	"ŽITOPRODUKT" GRAIN SILOS	- 600 wagons in ZRENJANIN.
3.	"ŽITOPRODUKT" SILOS	- 200 wagons in ZRENJANIN.

./.

4. SILOS FOR FLOUR MILLS	- 850 wagons in NOVI KNEŽEVAC.
5. SILOS FOR STARCH FACTORY	- 1400 wagons in ZRENJANIN.
6. SILOS FOR FLOUR MILLS	- 1000 wagons in KIKINDA.
7. "ŽITOPRODUKT" WAREHOUSES	- 800 wagons in SECANJ.
8. "ŽITOPRODUKT" WAREHOUSES	- 400 wagons in ZRENJANIN.
9. STARCH WAREHOUSES	- 2000 wagons in ZRENJANIN.
10. "SERVO MIHALJ" SUGAR-MILL WAREHOUSES	- 3000 wagons in ZRENJANIN.
11. "SERVO MIHALJ" COMPLEX, GRAIN WAREHOUSE	- 2000 wagons in ZRENJANIN.
12. "CENTROPROM" WAREHOUSE FOR FOOD PRODUCTS	- 2000 wagons in SURCIN.
13."ČOKA" FARM	- (9 production units) in ČOKA.
14. "BANAT" FARM	- (3 production units) in KIKINDA.
15. "JAKŠIĆEVO" FARM	- (1 production unit and the white-spirit plant) in SRPSKA CRNJA.
16. "MIHAJLOVO" FARM	- (2 production units), in MIHAJLOVO.
17. "ZLATICA" FARM	- in LAZAREVO.
18. "EČKA LIVADE" FARM	- in EČKA.
19. "KNIĆANIN" FARM	- (3 production units) in KNIĆANIN.
20. "BEGEJCI" FARM	- (2 production units) in SRPSKI ITEBEJ.

./.

21. "PANČEVAČKI RIT" FARM - in BELGRADE.

22. "ARADAC" FARM - (2 production units) in ARADAC.

23. MACHINERY AND TRACTOR STATION - in ZRENJANIN.

24. MACHINERY AND TRACTOR STATION - in KIKINDA.

25. MACHINERY AND TRACTOR STATION - in SRPSKA CRNJA.

26. MACHINERY AND TRACTOR STATION - in TITEL.

27. MACHINERY AND TRACTOR STATION - in ČESTEREG.

28. MACHINERY AND TRACTOR STATION - in NOVI BEČEJ.

29. IPK "SERVO MIHALJ" SILOS 1000 wagons - 3,600 m2 (1973-74)

30. "ŽITOPRODUKT" SILOS (area=52,250 m3) 2000 wagons - 8,727 m2 (1972-74)

31. "ŽITOPRODUKT" SILOS 1800 wagons - 5,945 m2 (1974).

1.2.2.2. - Residential buildings

By 1947 the initial objective of the enterprise was the construction of residential buildings, and it is still the main objective of the combine (accounting for 44.96 % of its turnover in 1974).

It is interesting to note that the growth of the combine in this area of activity was marked strongly in 1962 by the fact that it was the first in Yugoslavia to build dwellings for sale (in the capacity of "builder"), an undertaking that has become widespread since that date.

./.

The increased volume of operations resulting therefrom has enabled "BANAT" to rationalize its technology and work organization over the past ten years, and has made it a leader in industrialization.

Regarding efficiency and quantified results, we shall attempt to illustrate these by three examples picked from among recent activities of the Combinat. They relate to housing operations built in ZRENJANIN, as follows :

a) Operation D-2 (also known "4th July")
constructed 1970-71

This combine comprises :

- 6 buildings GF + 4 (+ basement) with
- 4 staircase wells each.

Foundations are made of continuous footings, basement walls of concrete (the "technical floor" is at basement level in addition to the cellars). Floors of solid slab are reinforced concrete. Above-ground walls are hollow brick masonry used as fill for reinforced concrete bracing frames ("mini-skeleton"). Roofing is non-accessible roof decks complete with built-up roofing and heat insulation.

The apartments are distributed at the rate of 5 to 6 small apartments at ground floor level + 4 apartments around a staircase on each storey, as follows.

Number of rooms	Type	Number of apartments	Habitable area	T O T A L
1	"K"	72	38.38 m2	2,763.36 m2
1	"C"	60	37.84 m2	2,270.40 m2
=		132	38.13 m2	5,033.76 m2
2		214	57.66 m2	12,339.24 m2
3		190	66.66 m2	12,665.40 m2
=		536	56.10 m2	30,038.40 m2

./.

Total area, gross..... 43,300.00 m2

Effectiveness ratio
(net-to-gross area) = 62.50 %

. BREAKDOWN PER TYPE OF APARTMENT

. 1 room	132/536 = 24.70 %	i.e. hab.area	5,033.76/30,038.40	= 16.70%
. 2 rooms	214/536 = 40.00 %	"	12,339.24/30,038.40	= 41.10%
. 3 rooms	190/536 = 35.30 %	"	12,665.40/30,038.40	= 42.20%

By way of comparison the following table shows the habitable areas of provisional standards of Nov 1973 (see 3.1.4. below) :

. 1 room	:	30 - 40 m2
. 2 rooms	:	55 - 58 m2
. 3 rooms	:	65 - 81 m2

This shows that the "D-2" operation is, at least in regard to floor areas, within the standards recommended for the state construction of dwellings.

b) Operation "WHEAT PLACE" II and III, built 1972 - 1974.

Four juxtaposed residential blocks clustered around vertical communications, forming a building with shopping areas which occupy a large proportion of the ground floor and first floors. The basement includes cellars, shops' stores and machine rooms.

The entire framing is reinforced concrete with hollow brick fill walls. Floors of solid RC slabs.

./.

. SHOPPING AREA :

- Gross area (GF + 1st Fl + passageway) = 4,094.08 m2

- Useful area = 3,062.57 m2

. BREAKDOWN OF APARTMENTS :

Number of rooms	Number of apartments	Habitable area	T O T A L
1	55	43.96 m2	2,417.80 m2
2	29	68.12 m2	1,975.48 m2
3	27	80.54 m2	2,174.58 m2
T O T A L	111	59.17 m2	6,567.86 m2

Total floor area, gross = 12,308.54 m2

Effectiveness ratio (net-to-gross area) = 53.50 %

. BREAKDOWN BY APARTMENTS :

. 1 room 55/111 = 49.60 % i.e. net area 2,417.80/6,567.86 = 36.80 %
. 2 rooms 29/111 = 26.20 % " " 1,975.48/6,567.86 = 30.10 %
. 3 rooms 27/111 = 24.20 % " " 2,174.58/6,567.86 = 33.10 %

Compared with the Yugoslav standards of Nov 1973 the floor areas of these apartments differ considerably, which could be explained by the location of each building with respect to the Town Centre on the one hand, and to the precise demand of the market on the other. Here in our opinion is an anomaly.

./.

c) Operation "BAGLJAŠ" - Phase 1, built 1972 - 1973

This complex of 219 apartments consists of 4 buildings resting on concrete footings and walls. There is no basement.

Walls are of hollow brick 30 cm thick reinforced by the "mini-skeleton", while floors bear on solid reinforced concrete slabs. Partitions are of 8cm thick plasterboard. Façades are plastered and faced with "Terraplaste". The sloped roof is of wood with a covering of painted Eternit sheets. There are 8 to 12 apartments per storey.

. BREAKDOWN OF APARTMENTS :

Number of rooms	Number of apartments	Habitable area	T O T A L
Bed/sitters	19	17.96 m2	341.20 m2
1	108	39.05 m2	4,217.85 m2
2	67	58.84 m2	3,942.15 m2
3	25	78.79 m2	1,969.86 m2
T O T A L	219	47.81 m2	10,471.80 m2

Total useful area, gross = 18,482.80 m2

Effectiveness ratio (net-to-gross areas) = 56.70 %

. BREAKDOWN OF APARTMENTS PER TYPE :

. Bed/sitters 19/219 = 8.68 % i.e. net area 341.20/10,471.06 = 3.26%
. 1 room 108/219 = 49.32 % " " 4,217.85/10,471.06 = 40.28%
. 2 rooms 67/219 = 30.59 % " " 3,942.15/10,471.06 = 37.65%
. 3 rooms 25/219 = 11.41 % " " 1,969.86/10,471.06 = 18.81%

./.

Breakdown by construction costs and site development (BAELJAS type apartments) and by trades :

. structural shell	33.0 %
. installations (plumbing, electrical, heating, ventilation)	14.0 %
. other trades (performed by cooperative members)	27.5 %
. design and projects	1.3 %
. development of building site	18.0 %
. mechanical equipments (lifts, garbage chutes, etc..)	6.2 %
	100.0 %

./.

BREAKDOWN BY WORK / HOURS PER M2 HABITABLE AREA

WORK BY TRADES	RATIONALIZED CONVENTIONAL CONSTRUCTION					INDUSTRIALIZED CONSTRUC.
	G.I.K. "BANAT"			YUGOSLAVIA	FEDERAL GERMANY	
	"D-2" 1970-1971	"WHEAT PLACE" 1972-1974	"BAGLJAŠ" phase 1 1972-1973	Average 1970	Average 1973	Average 1973
T O T A L =	27.6	39.4	31.8	36.5	26.3	11.3
8. Other trades	0.7	0.8	0.9		1.6	0.3
7. Paintwork - Tile-flooring	1.5	1.6	1.7		1.6	1.8
6. Heating, ventilation, electrical, plumbing	7.0	7.8	8.3		5.2	3.0
5. Doors, windows, glazing	0.6	0.8	0.9		2.8	0.6
4. Floor finishes	1.1	1.3	1.7		1.3	1.5
3. Internal and external finishes	4.2	8.0	6.5.		4.0	
2. Roofing, covering, joints, insulation	2.3	3.2	1.4		0.7	0.3
1. Staircases, floors, walls	10.2	15.9	10.4		9.1	Erection 3.8
Up to floors / Below GL — 0. Foundations Site draining, Earthwork, Site development	5.5	8.6	8.8		6.0	Foundation 2.0 Preparat. 5.2 Prefabrication 5.0
GRAND TOTAL	33.1	48.0	40.6	44.0	32.3	23.5

./.

NOTE - The effectiveness ratios for Federal Germany were submitted by I.F.B. - HANOVER.

However, there are today other and far more sophisticated industrialized construction methods (15 - 18, even 12, work/hours per m2) but such systems appear to us to border on the limits of the builders possibilities.

LIST OF RECENTLY COMPLETED (1972-1974) RESIDENTIAL BUILDINGS

1.	ZRENJANIN	- "D1 - a"	8.560 m2
2.	"	- "E-7 , E-8"	7.214 m2
3.	"	- "BAGLJAŠ" - Phase 1, - 219 apartments	18.483 m2
4.	"	- "Wheat Place"II & III	16.403 m2
5.	"	- "Naftagas"	1.984 m2
6.	"	- "GF+4 Mikronaselje"	1.915 m2
7.	"	- "GF+4 for pensioners"	3.069 m2
8.	"	- "Annexes L-2,D'-3,D-2"	1.353 m2
9.	"	- "BAGLJAŠ" - Phase 2 - 322 apartments	36.729 m2
10.	SUBOTICA	- "GF+9"	3.335 m2
11.	"	- "GF+5"	3.238 m2
12.	KIKINDA	- "GF+4"	4.255 m2
13.	"	- "GF+6"	2.801 m2
14.	"	- "GF+6"	2.779 m2
		G R A N D T O T A L =	112.118 m2

./.

RECENTLY COMPLETED (1972-74) EQUIPMENT BUILDINGS

1. HOTEL VOJVODINA, ZRENJANIN	6,876 m2
2. GENERAL HOSPITAL = PEDIATRIC CLINIC	11,069 m2
3. SCHOOL COMPLEX, NOVI BEČEJ	2,040 m2
4. SCHOOL COMPLEX, BEČEJCI	2,945 m2
5. SCHOOL COMPLEX, P.P. NJEGOŠ	4,230 m2
6. GYMNASIA FOR 1st and 2nd LYCEES	1,395 m2
7. SCHOOL CENTRE KIKINDA	2,066 m2
8. AGRICULTURAL INSTITUTE, I.P.K.	1,688 m2
9. TEHNICKA OPERATIVA NAFGAS BUILDING	1,868 m2
G R A N D T O T A L =	34,177 m2

1.2.2.3. - Site accomodation

As any contracting firm G.I.K."BANAT" came across the problem of site accomodation for the personnel who is far from home during performance of the work. Therefore, a number of trained personnel and hands have to be catered for.

Instead of building hurriedly the customary site huts, the combine has prefabricated such accomodations according to standard dimensions, and loading gauge for vehicles, and which are well adapted for comfort.

These units include the site office, rooms with beds, the sanitary installations comprising showers, wash bowls, toilets, dining rooms, kitchen, etc...

These units were carefully designed to the extent that there was a demand for them and the combine took the decision to make and market same. Currently, 200 such units are made yearly and on the Yugoslav market, they are virtually the only industrially-made site accomodation of this type currently available.

./.

1.2.3. - Activities abroad

When the combine started to expand and was casting about for new markets it should be mentioned that, as from May 1968, it co-operated direct with Firms in Western Germany such as "WAYS & FREYTAG", "DYCKERHOFF & WIDMANN" etc...

In 1969, the combine, heartened up by its initial experience, established a subsidiary in the Federal Republic of Germany, its style being :BANAT HOCH UND TIEFBAU GmbH, MUNCHEN, which has at its disposal premises in the centre of Munich and adequate construction equipment.

The combine took part in the following ;

1. Civil-engineering work of the Munich underground railway,
2. Civil-engineering work of the Olympic stadium,
3. Structural shell (brickwork and masonry) of the new head-office of the B.M.W. car manufacturers in Munich,
4. Civil-engineering work for building a hotel in Oberstaufen.

Acting as a building contractor and as from May 1st 1970, it has co-operated with the firm "OTTO GASSNER", of Starberg, and built the following :

1. A school-block in Aufkirchen,
2. warehouses for the "WIVEDA", Association of German pharmaceusists in Steinkirchen,
3. collective housing units in Söcking,
4. collective housing units, including car-parks and appurtenances "in TUTZING"

./.

In addition, to give work to the other plants of the combine for the export market (including the MIP),"BANAT"has entered into an agreement with the Swiss Firm, BROWN BOVERY which designs and builds factories in Austria, where it has a subsisiary in VIENNA.

The purpose of such "exports" was twofold :

a) earn foreign exchange for purchasing up-to-date foreign equipment,

b) improve knowledgeability and gain experience in the fields of technology and human engineering, the object being to become more competitive in the domestic market.

The economic trend in the industrialized countries of Western Europe has stopped these activities over the last two years. However, prospection on a large scale is being carried out in the countries of the Eastern Bloc and the Arab oil producing countries.

1.2.4. - Production equipment

1.2.4.1. - Materials

As set forth in § 1.1., the "Materials Production Sector" is chiefly used for the combine's own needs.

The basic materials : aggregates and ceramic products, are of excellent quality and; apart from the question of prices, are readily available.

As regards bought-out materials, the combine enters into delivery contracts for cement supplied either in bags or in bulk, for reinforcing steel supplied either as rods or in coils, steel sections for making the on -site accomodation units etc...

./.

There is no shortage on the Yugoslav market of materials such as : Heraklite, Siporex, Perlite, gypsum, ceramic products, etc...

As regards finishing materials : electrical components, sanitary ware, joinery, glaziery, paints, these are mostly made in Yugoslavia ; some materials are imported to complement supplies. We have noted that, no mild steel, such as "Tor or Tentor steel" ever is used, whereas such utilization is virtually general in most countries owing to the great savings it affords both in weight of metal and labour, there being no need to make reinforcement hooks.

It seems that the relevant steel-making process is straightforward and that Yugoslav steel mills could make it too.

The use of this steel is mandatory for prefabrication and supplying it must be considered at once.

1.2.4.2. - Construction system and technology

The sphere of action of the GIK "BANAT" is virtually fourfold, as follows :

. housing
. industry and agriculture,
. public works,
. site accomodation.

Its methods of construction are the following :

1) Housing

The method of construction is traditional, and makes use of locally available materials, viz :

- reinforced-concrete shells, columns, beams, floors (Filigramme-type slab)

- fill material consisting either of solid or hollow bricks.
(the respective sizes of which are 0.30 or 0.29 m)

- cement-mortar rendering.

./.

- backing linings with sandwich plasterboard or plaster panels, casting-in with prefabricated or semi-prefabricated components such as staircases, breast-walls, window boxes, decorative components (e.g., curved and fluted concrete shells, and the like).

The finishing components are likewise traditonal :

- Central heating by radiators,
- electrical conduits imbedded in walls or built into floors,
- wooden joinery with transom windows of any height,
- traditional installations and plumbing,
- lifts.

As a rule, no provision is made for telephone equipment or reception of radio TV broadcasts

The same applies to rubbish shoots, whether in the flat or landing.

Landings and staircases are not ventilated either by duct work or blowing ventilation, openings on the front wall being provided for this purpose.

Electricity, gas and water meters are inside the flats.

No collection line is provided but there is a fire prevention station on every storey.

2) Industry and agriculture

The combine builds industrial hangars for various uses and also agricultural equipment, such as silos, etc ...

As a rule, these structures are made with reinforced concrete, their main component such as columns, beams, trusses, are prefabricated and occasionelly include structural steel, as required.

Bricks or metal components are used for beam following.

The reinforced-concrete silos are assembled by means of sliding shutterings and prefabricated components.

None of these structures are standardized in any way, the method of construction being investigated as the work proceeds.

We have analyzed a typical example of industrial building erected by the Complex :

. From 1969 to 1972, three industrial hangars were built, respectively for dyeing, washing, weaving and spinning, including the stores and apparte-nances.

The overall area, not including outwork, is 24,749 m2.

The dyeing and washing hangars comprise two bays with a span of 20,10 and 10,20 m. respectively. The concrete columns are spaced 8 m. The overall length of the hangar is 64,30 m.; its width 30,84 m. The free headroom of the dyeing and washing sections is respectively 7,70 m. and 4,80 m. and the aera, not including outwork, 1,983 M2.

Foundations are 1,70 m. deep and lie on concrete shafts providing the reinforcement ends for the prefabricated reinforced concrete, columns.

The roofing components are made of pre-stressed concrete, while reinforced concrete is used for the purlins, common rafters and acroterion elements.

The roof consists of corrugated-steel sheets. Thermal insulation is provided with rock wool 5 cm. thick.

The boundary walls consist of hollow bricks 30 cm. thick, rendered on both sides, while the inside walls of solid bricks are likewise rendered on both sides ans distempered.

Doors and windows are made up of metal sections and glaziery.

A plain concrete slab extends over the whole area and is laid on compacted crusher material.

459.064 hours were needed to build the three aforesaid buildings, the output per square metre being :

$$\frac{459.064}{24.749} = 18,55 \text{ H/M2}$$

3) Public works

The complex builts many small civil enginnering structures for public works, including highway bridges.

The bridge abutments and decking components are usually so designed as to allow the use of shop-fabricated components which may be either made of ordinary reinforced or prestessed concrete.

4) On-site accommodation units

The M.I.P. shop makes these in ZRENJANIN, using up-to-date equipment.

The shell consistes of a welded-steel enclosure made with mouled-polyester double walls insulated with rock wool.

Depending on the intended use, all the utilities, waste drainage and ventilating systems are so designed that all these units merely require, once supplys points.

1.2.4.3. - FACILITIES

The G.I.K. "BANAT" includes two large plants, one at ZRENJANIN, the other at BELA CRKVA.

./.

a) The ZRENJANIN plants are located on a large plot of land on the bank of the river BEGEJ which is accessible via a road linking it with the BELGRADE highway.

A service road serves the following :

- Watchman's station house, dining halls and sanatary installations,

- Garage workshop for passenger cars, motor lorries and contractor's equipment. This group of buildings includes all the equipment required for maintenance and repair,

- A storage and unloading yard for the natural aggregates incoming from the MORAVA river,

This facility is rudimentary, the bank of the river being merely equipped with a wheel-type unloading showel.

- A storage plant, including a screening machine that grades the aggregates on the ground and does not include a rehandling silo ,

- A concrete mixing plant comprising two ELBA drum-type mixers, two cement silos, an ELBA aggregate-rehandling shovel. The capacity of the plant is 40 m3/hr. (appx).

- A formwork and joinery shop, equipped with all the machinery required,

- a concrete-reinforcement shop with reinforcement-straightening machines, electric bar cutters, machinery for making shutterings, and so on. The output of this shop is about 2,500 tons/yr,

- A workshop including the machinery and tool-equipment needed for batches of finishing work, such as structural steel, locksmithey, electrical appliances, and in which is to be installed shortly the plant for making joiner with plastic sections. This shop also makes on-site accommodation units.

./.

- The prefabrication area comprises rudimentary wooden platforms used solely for precasting light-weight elements, such as floors, window boxes, concrete-shells, etc... Such prefabrication is rudimentary and availed of as a makeshift, most precast structural elements being made in BELA CRKVA,

- Several ramshackle buildings, used for storing small equipment and sundry materials,

- a fairly large yard for concrete reinforcements,

- on this plot of land are also stored contractor's equipment, viz, cranes, tanks, boilers, etc... and the handling equipment which are all fairly up to to date and listed in 1.2.4.4.

b) BELA CRKVA PLANT

The Bela Crkva Plants and warehouses are quite close to town and extend over a very large plot of land located next to the gravel pit which is the chief activity of this centre.

The plant includes a prefabrication hangar extending over 2,800 m2 comprising a storage yard, premises including sanitary installations for the personnel and all the gravel-extracting equipment that includes a dredger, a belt-conveyor and a sieving plant.

These facilities are connected to the railway via a private siding which is used for dispatching the manufactured products and aggregates.

The facility, as a whole, is ill-kept, especially the access and accommodation roads.

Apparently, the concrete-mixing installation is less busy than it was and therefore not operating at full capacity. The equipment is antiquated and the overall efficiency is very low indeed.
The plants looks as if they were run without order or purpose.

./.

1.2.4.4. - SITE AND HAULAGE EQUIPMENT

The combine has at its disposal site and haulage equipment of a quite high order which, as a whole, is well kept. The following listing relating only to heavy equipment gives an idea of its scope.

a) ZRENJANIN

DESIGNATION	CAPACITY	NUMBER
CONCRETE MIXER "ELBA" I	15 m3/hr	1
CONCRETE MIXER "ELBA" III	25 m3/hr	1
CONCRETE MIXER "ELBA" II	15 m3/hr	1
CONCRETE MIXER "ITAS"	10 m3/hr	1
VIBRATING SIEVE	30 m3/hr	1
CRANE, ATMOS	60 MT	2
CRANE, X.1266.Y	80 MT	1
CRANE, POTAIN	90 MT	1
CRANE, LIPHER	90 MT	1
CRANE, LM.25 A/30	30 MT	1
CRANE, SIES	20 MT	3
CRANE, MB.80.B	80 MT	1
CRANE, GD-4	6 MT	1
ROAD ROLLER, NV 12		2
BULLDOZER, TG.90.B		2
BULLDOZER, TG.90.S.		2
BELT CONVEYOR		2
DUPM LORRY		2
SHEEP'S FOOT ROLLER		1
BOILER		1
ELECTRIC-WELDING SET		1
WASHING PUMP		2
PUP, VEDA		6
VIBRATING SCREED, WAKER		1

DESIGNATION	CAPACITY	NUMBER
MANUALLY-OPERATED SITE PUMP		4
ROLLER PAN MIXER FOR MORTAR		12
CRANE, GD-2		1
IMMERSION VIBRATORS, ISKRA		8
CONCRETE PUG MILL		1
SURFACING MACHINE		1
SITE ELECTRIC PUMP		1
LORRIES, FAP	7-11 T	17
TURN-PINS	3,5 m3	7
LORRIES, TAM	5 T	12
PLASTERING MACHINES, P,13		6
PLASTERING MACHINE, M.500		1
PUMP, B 3 D	30 m3/hr	1
SAND-SUCTION DREDGER	30 m3/hr	1
ROAD ROLLER, AVELING		1
VIBRATING RAMMER, LOS		1
VIBRATING RAMMERS, BS.100.Y		6
GENERATING SETS		2
TRACTOR 555		1
VIBRATING RAMMERS, ARAN		2
BOILERS	600 kg/hr	2
SMALL DUMP LORRIES		40
CONCRETE MIXERS	500 T	6
IMMERSION VIBRATORS, WAKER		15
IMMERSION VIBRATORS, TOMOS		2
LIGHT CRANES		8
SELF-ERECTING CRANES		4
SEMI-TRAILER	24 T	1
MOTOR-COACH, 52-SEATER		1
FORD "TRANSIT" PICK UP		1

./.

DESIGNATION	CAPACITY	NUMBER
CRANE, WARNER	36 T	1
CRANE, COLES	15 T	1
LOADER, T.120	2 m3	1
SHOVEL LOADER, A.600		1
SHOVEL LOADER, A.360		1
LOADER, MICHIGAN		1

b) BELA CRKVA

DESIGNATION	CAPACITY	NUMBER
AUTOMATIC CONCRETE-MIXER, TYPE "VAIMER"	30 m3/hr	1
MOBILE CRANE, TYPE "VULKAN", RIJEKA	5 T	4
LIFTING FORK, FOR INDOOR TRANSPORT		3
CEMENT SILO		1
GRAVEL WAGE FEEDER		1
DREDGER, TYPE "HUDROP" (HUNGARY)	75 m3/hr	1
GRAVEL BELT CONVEYOR, "ČELIK" KRIŽEVCI	length 500 M	1
MECHANICAL LOADER, TYPE 'avering" (made in ENGLAND)		1
TOWER CRANE, TYPE "SKIP" MARIBOR		2
TOWER CRANE, TYPE "RICHIER" (made in FRANCE)		1
CRANE, TYPE "TATRA"	16 T	1
CRANE, TYPE "TATRA"	6 T	1
LORRY, TYPE "FAP"	26 T	12
LORRY, TYPE "TAM"	5 T	3
LORRY, TYPE "MERCEDES"	26 T	1
LORRY, TYPE "GM"	26 T	1

./.

It follows that preserving a consistent equipment is no eesy matter in view of technical advances and the specifications required. However, we could not fail noticing how very heterogeneous is the equipment. This must pose great problems as regards maintenance, repairs and supply of spares.

The capacity of the lifting equipment is inadequate ; for instance, no tower-crane is rated at more than 90 metric tonnes, a datum hardly sufficient for traditionally-built small housing units.

The foregoing also refers to the haulage equipment which comprises, in ZRENJANIN, only one semi-trailer rated at 24 tonnes, while the highest rating of the motor lorries is no greater than 11 tonnes.

Conversely, the public-work equipment is excessive as it is only needed for the combine for appurtenances, such as approaches to buildings, roadways, conduits, green areas, etc.... Light equipment could serve this purpose quite well.

1.2.4.5. - <u>BUILDING TRADES</u>

The appurtenance work is carried out according to traditional methods as set forth in § 1.2.4.2.

The combine does perform the work of some building trades while it sub-contracts others on a permanent basis or for specific building sites.

While the work pertaining to heating, sanitation, electricity and locksmithery is mostly carried out by its own means (M.I.P.), other work, chiefly joinery, painwork and glaziery are subcontracted.

When we inspected building sites at work, we noticed that the methods used were rather artisanal and that the preparatory work was inadequate.

For instance, casting-in of some utilities was either omitted or improperly positioned, thus entailing ticklish, expensive and even hazardous rehandling work, i.e., beams or columns to be pierced.

./.

It also appears that the work is insufficiently planned, the upshot being that the building trades do not take action continuously, this greatly increasing labour costs, loss of time and fasse-proceed operations.

The hourly output imparted to us illustrates this state of affairs.

PRODUCTION UNIT	NUMBER OF HANDS	NORMALIZED HOURLY OUTPUT (HOURS ACTUALLY WORKED)		
"TERMIKA" (heating, ventilation)	54	Housing	0,8 hr/m2	GROSS AREA
		Industrial Buildings	0,8 hr/m2	"
		Equipment	1,8 hr/m2	"
"SANITARNA TEHNIKA" (sanitary engineering)	40	Housing	0,90hr/m2	"
		Industrial building	0,40hr/m2	"
		Equipment	1,30hr/m2	"
"ELEKTRIKA" (electricity)	83	Housing	1,60hr/m2	"
		Industrial building	1,20hr/m2	"
		Equipment	2,30hr/m2	"
"BRAVARI" (Locksmiths)	100	Hardware	0,40hr/Kg	
		Steel Construction	0,25hr/Kg	
"LIMARI" (sheet-iron workers)	45	sheet-iron work	0,50hr/Kg	
"KONTEJNERI" (on-site accommodation units)	40	200 units/yr		

1.2.4.6. -HEADQUARTERS, MARKETING, RESEARCH AND PROJECT DEPARTMENT

. IN ZRENJANIN :

The headquarters are in an office building with a floor area of 2400 m2. Its various departments are well co-ordinated and have at their disposal a time-sharing commercial computer mostly used by them.

The extent and agressivness of the marketing department are well worth mentioning (see organization chart in appendix 5) . It comprises 17 people, due to increase to 22, the department being subdivisided into the three following branches :

- research and planning

  This department follows closely the trend of the market which it prospects, and supervises the development plants of all the O.O.U.R.

- Sales department

  This depatment proceeds with canvassing, draws up quotations and specifications, and negotiates agreements.

- Engineering-contract branch

  This branch co-operates both within the firm or with the Belgrade design and engineering offices, is responsible for working out engineering contracts on behalf of the customers prospected by the sales department.

  Through its permanent representative in Belgrade, the marketing depatment is fully informed as to the trend of business at the federal level.

  The fact that it can avail itself of the knowledgeability and potential of the "research and development branch", (it includes 6 technicians), greatly increases its efficiency.

  In addition, the combine has integrated in ZRENJANIN, VRSAC and BELA CRKVA serveral divisions

./.

specializing in Design and Architectural groups.

The largest of them, a O.O.U.R. (cf. appendices 5 & 6), is self-reliant and known as the ZRENJANIN research and project department ; it includes 36 people of whom 7 are architects and 3 engineers.

This O.O.U.R. devotes 50 % of its time direct with the combine and also with architectural and engineering offices in Belgrade, (either for a given work or continuously) thus giving rise to some competition.

Remuneration of the combine's integrated engineering departments is based on the 1970 "UNIJA-PROJEKT" schedule with an agreed-upon 20 % rebate.

We noted that optimization cf the services and capabilities of the members of the research and project department came across the following stumbling blocks :

. Preservation of traditional and individualistic ways of designers within the purview of joint elaboration of ideas, arising from lack of understanding between the parties concerned.

. Alineating restriction of designers'responsibility at the initial-design stage, such responsibility being all too often mistaken for draughtsmanship, and also complete severance from the building site (the architect not even being answerable for the completed structure).

As for the General Management, it seemed to us - within the purview of self-management - that it faced its responsibilities diligently, endeavouring to find the right answers to strategic, tactical, operational and executive problems, a typical example of this being the care with the UNIDO assignment was planned.

./.

C O N C L U S I O N

. The aggressivness and success achieved by the combine is a major consideration.

. Yet, the extent to which the combine depends on the regional market for industrial and agricultural buildings, housing or public buildings, should be pointed out, as the few inroads made into the foreign or belgrade market are hitherto only marginal.

. The Management of "BANAT" has realized this and is aiming high to make it rise to a much higher level.

. Should also be mentioned some over-capacity of means of production from the top Management to engineering and marketing, and also of the equipment of some plants, and to which should be added some technological shortcomings (virtually no prefabrication for housing) and unsuitable location of plants in relation to raw materials and building sites.

. Slightly marginal activities, such as that of on-site accommodation units should not at all be disregarded as, from a technological standpoint, they are a source of technical progress and improved design.

. The status of "BANAT", which is both that of a manufacturer and a merchant of building materials, is ambiguous from the standpoint of its overall strategy, particularly with regard to aggregates. This point needs clearing up.

. That the combine is not present in the detached-house market is unfortunate.

. While the industrial and agricultural building sector is doing well and giving good results, it needs much attention as regards standardization.

Section 2 - SHORT-TERM IMPROVMENT PROGRAM OF THE COMBINE "BANAT" PRODUCTION

The main matter is to optimize the means of production, both intellectual and material.

Waiting for the setting and result of the suggestions of combine middle and short term development program, il is necessary to comply with market requests-considering our informations, this request will obviously be growing a short-term program is called for. Immediate decisions complementary and if possible initiatory to those explained in section 3 have to be taken.

In addition to terms of contract (a) and (b) points of article 2, these immediate decisions call for the following section.

2.1. - MATERIALS PRODUCTION SECTOR

2.1.1. - ZRENJANIN

Even if in section 3 the creation of a production unit of light aggregates is suggested, every thing won't be realized with these materials, and consequently "BANAT" will have to keep on convoying in ZRENJANIN aggregates from MORAVA, for its own needs as well as as for the sale.

That's why we think indespensable to modernize access, stocking and screening.

- to modernize access requests the construction of a quay on the river BEGEJ, either in concrete or in sheet-piles with wooden fenders, mooring posts.

- to modernize unloading and storage by the use of a shovel crane on rail, and eventually silos to avoid mechanical re-handling.

- to modernize screening by a more fitting set of the equipment and to borrow silage allowing too to avoid re-handling, for the sale of the materials as for the supply of the concrete mixing plant.

./.

2.1.2. - BELA CRKVA

The setting ofaggregates production in BELA CRKVA was not studied by "Standard Concrete" and consequently the flat price looks prohibitive.

It is very difficult to change the managment and the equipment what is linked with a trade training which is to be determined.

Effectively, "Standard Concrete" exploits the gravel pit almost exclusively for sale because its prefabrication production is very slight and it seems that new commercial markets on BELGRADE have not been studied. Consequently the gravel pit production is sold to the direct competition and in our opinion that's not a good policy.

The situation of this unit shows its remoteness for VOJVODINA and its able potentiality only towards BELGRADE. If however it has at its disposal the transportation means.

This analysis brings us to suggest the exploitation of the resources inaggregates by digging a canal between BELA CRKVA and the DANUBE, this operation will be entirely paid by the sale of dredging aggregates. It is only about 6 kms digging.

This canal should allow, firstly to supply by barges BELGRADE and ZRENJANIN inaggregates, and lastly to open a new market for all range of heavy prefabricated products in this region.

This arrangment should give the opportunity to purchase a new withdrawing equipment, the working of which should be less expensive and mainly the opportunity of rentability of the heavy prefabrication setting which is not really operational

2.2. - BUILDING PRODUCTION SECTOR

2.2.1. - MATERIALS

Generally the materials are of good quality and the diversity of the products on the market allow and ajusted use to the needs and the problems to clear up.

The only lower quality material seems to be the timber and as a consequence a fluctuation in joineries the holding of which is not perfect. Because of the climatic conditions it appears that "BANAT" should move towards either metallic joineries (iron or aluminium) or plastics sections ones.

2.2.2. - CONSTRUCTION SYSTEMS AND TECHNOLOGY

From the traditional construction, as it is presently practiced, towards the industrialized prefabrication, as we recommend in chapter III, it looks necessary even now to consider an evolution.

For the following reasons :

. The conversion from method to the other one is very difficult without a period of transition, because it is necessary to change both the architectural project conception and the working method, in workshop as well as on the site.

. The traditional construction allows some vagueness in every building-trade and even to make up these mistakes.

In prefabrication at every steps an almost absolute precision is necessary.

The allowances of the first one are utterly inappropriate to the second.

Consequently, we think that nowadays a half prefabricated construction system should not only be immediately profitable but also allow the conception and site shifts to be prepared to entire prefabrication.

That for the construction should be according to the following principle :

. The frame traditionnaly built with bearing cross walls made either of concrete shells or posts and girders systems with brick filling up or, for low buildings, of brick bearing walls.

. The front walls prefabricated and made of prefabricated sills between cross walls, the filling up between sills and upper floor being in a first period in cutted down panels or brick masonry and in a second one in prefabricated panels.

. The floor also prefabricated according to the present method of "BANAT" (Filigrane) or to the pre-flag-stone.

The gables could in a first period be traditionnaly realised and in a second one be made of either auto-bearing or clamped prefabricated panels.

Of course, all the prefabricated elements would be isothermal by incorporation of polystyrolene.

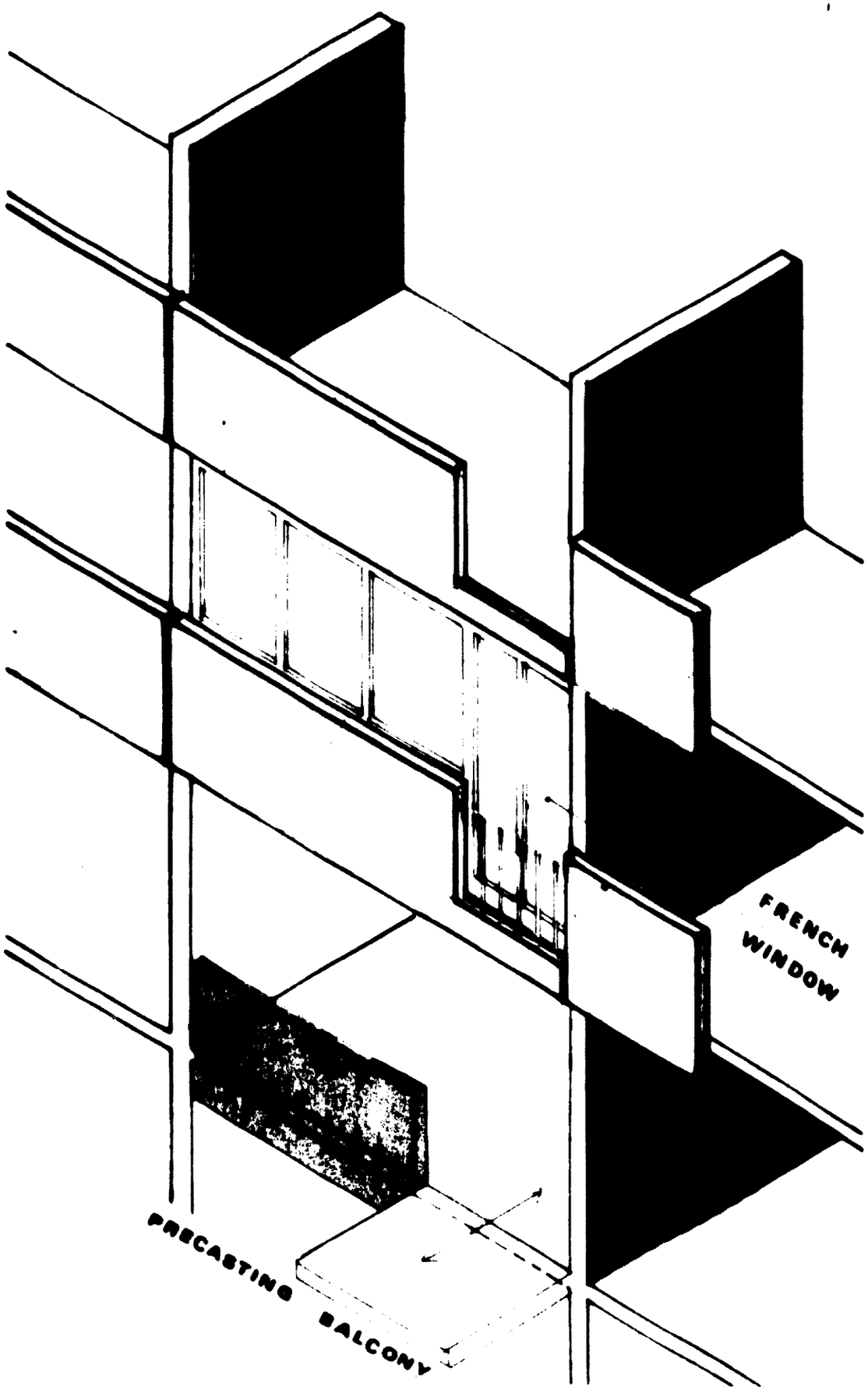
Concerning the fabrication we think that the moulds problem could easily be cleared up by"BANAT," according to simple enough technics. The moulds used according to the series and to the appearance of the requested surface will be either in timber or in metal or quite metallic timber.

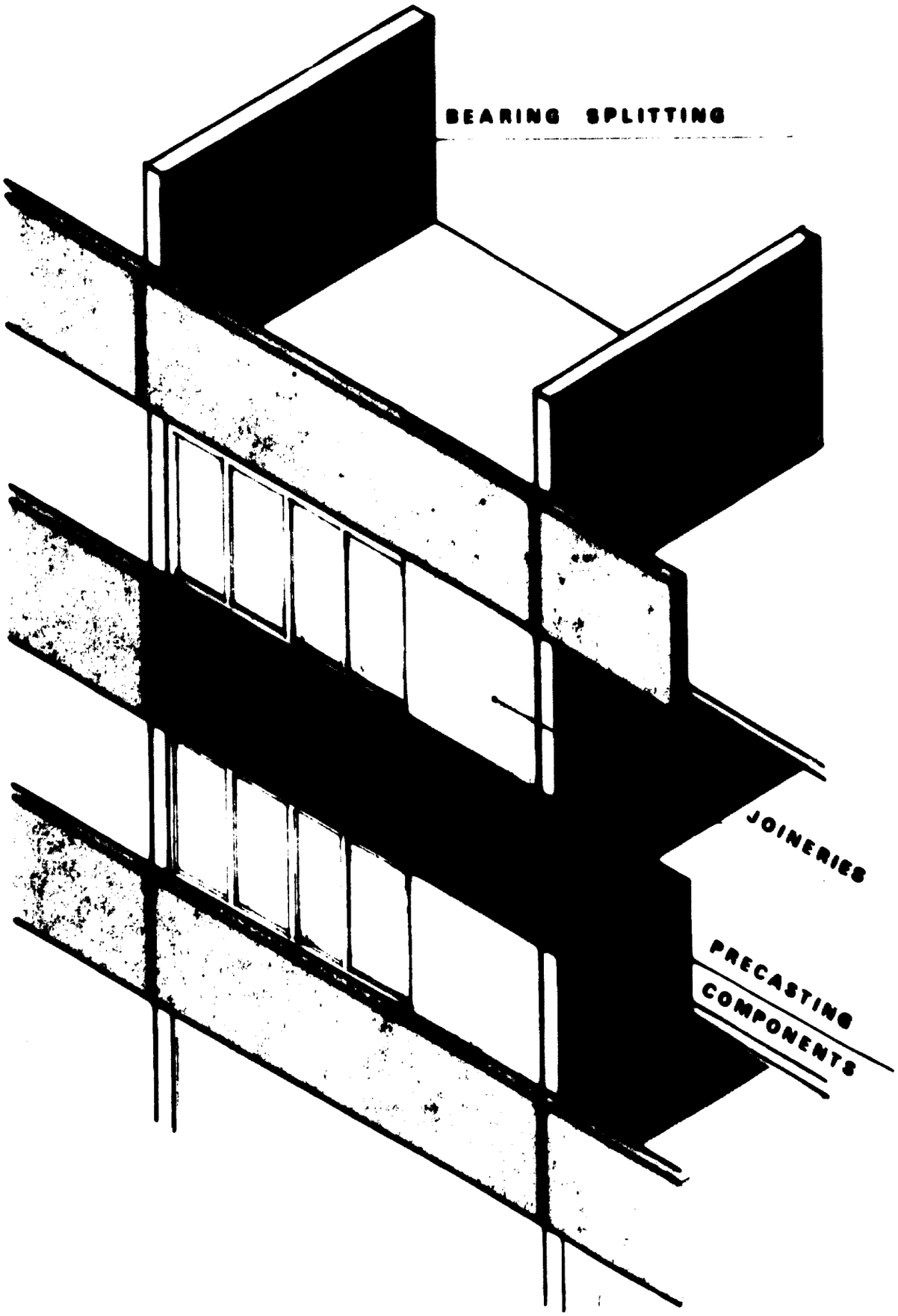
This prefabrication, may be on site, should progressively and without any important investment for equipment allow to get into its stride the whole system, including some building trades, which should have to interfere in the prefabrication for the incorporation of some networks.

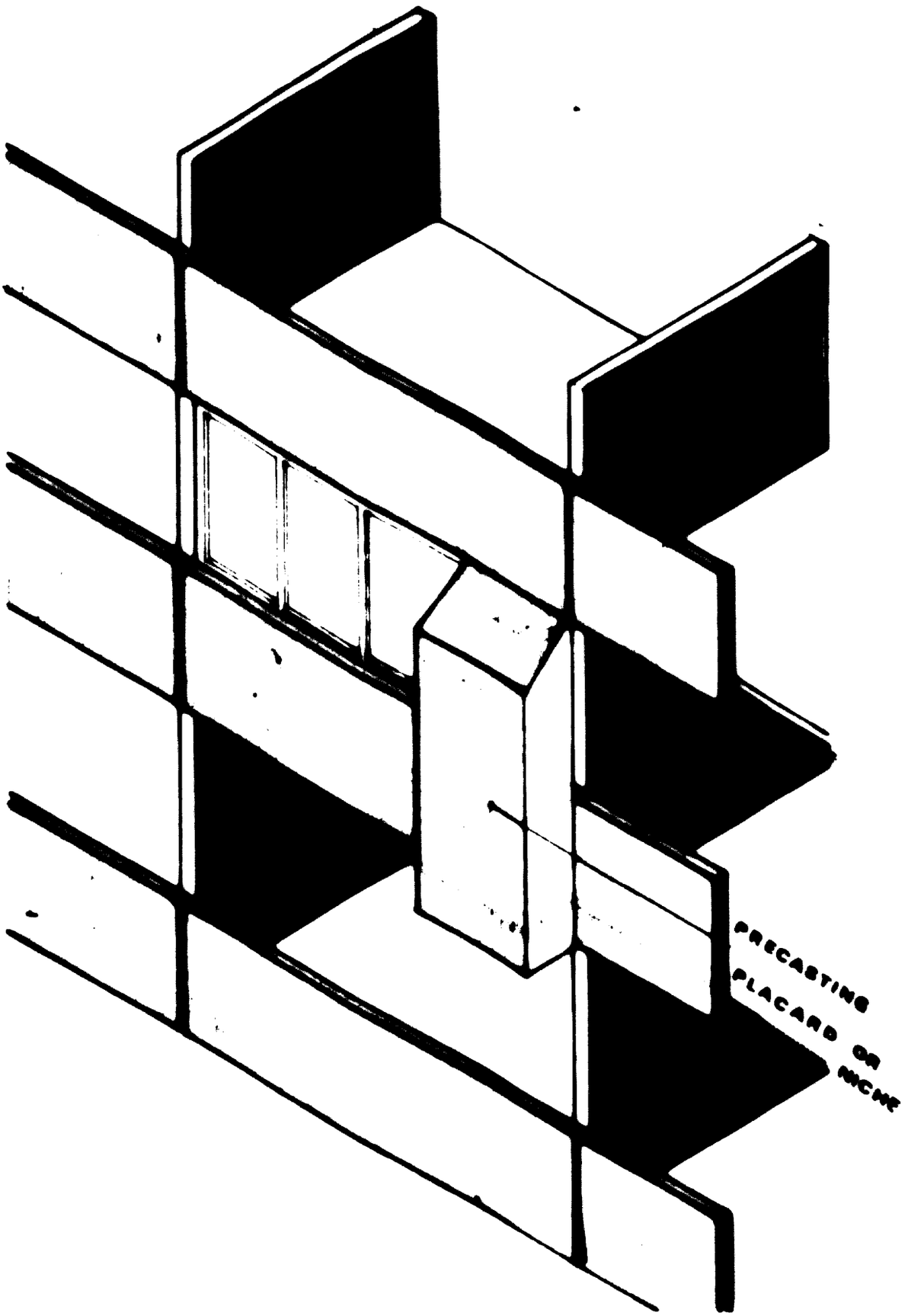
The savings in erecting equipment should divide out the costs of the moulds and of the necessary complementary setting.

At last, this method could allow to use the extant handling and erecting equipment, which is sufficient for this half-prefabrication step.

./.


FRENCH
WINDOW
PRECASTING
BALCONY


BEARING SPLITTING
JOINERIES
PRECASTING
COMPONENTS


PRECASTING
PLACARD OR
NICHE

We also think that it is possible to combine this system and the prefabrication of other elements, used in entire prefabrication, such as straight or spiral staircases, ventilation sheathings.

Except for the silos or special technical constructions it looks better to use standardized frameworks for agricultural and industrial buildings.

Standardized buildings, the trams of which allow different kinds of bonds with identical parts, generally comply with the needs, the definition of which gives a certain rope of construction.

The sketch (see annex 11) shows that it is possible to comply with almost all the requests with 18 X 24 m spans and 6 to 12 trams.

These spans and trams allow to use discountless all the roof covering and splinting materials, able to be found on the sale ; a 6 m tram in front wall also allows to realize either full concrete splintings or with incorporation of thermical insulation ones and all the wanted architectural shapes ; in a further time the prefabrication factory will be able to produce these elements but starting from now the fix post workshop we recommend is able to do it.

2.2.3. - Facilities

2.2.3.1. - ZRENJANIN

The present prefabrication areas are really sommary and do not offer the technical and economic condition requested for the realization of any component.

So we think that the prefabrication of the elements presently realized, as well as those necessary to the evolutive period suggested in 2.2.2., requests to think of an evolutive setting.

Thus, we suggest that a preafabrication workshop could take the place on the present areas. In a first time, it could be of 18/20 m and equiped with vibrating tables, travelling

./.

bridge-crane, curing system in fix plant.

Without any idea of competition with BELA CRKVA's workshop this setting should allow to realize all the connecting pieces presently crafty manufactured and used for the construction of silos, industrial and agricultural workshops, public works, ...

It should also manufacture frames, panels, ... as well as the straight or spiral staircases, ventilation ducts ... belonging to the suggested half prefabricated construction system (see 2.2.2.).

Owing to the proximity of the concrete mixing plant and of the housing prefabrication unit, this workshop could realize all these elements either in heavy or in light concrete.

At last, we consider that, to have the best profit of this setting, GIK "BANAT" could realize all the prefabrications used in public works, either for itself or for sale :

- <u>for roads</u>

  curbstones and roadways of any kind, paving, bollards...

- <u>for sanitaries</u>

  ducts in vibrated or centrifugally cast concrete, cable boxes, septic tanks, gulleys, hatches...

- <u>M.I.P. workshop</u>

  in our opinion, is sufficiently equiped to produce, beyond the site accomodations, some light site equipment such as moulds for building or industrial workshops prefabrication, metal formworks for posts and shells...

- <u>access</u>

  finally, we think that the side track from the road of BELGRADE as well as the internal have to be restored and carefully kept up ; the present state makes the running equipment suffer, involves bad conditions of work because of dust, and could occasion damages in prefabricated elements.

./.

2.2.3.2. - BELA CRKVA

The prefabrication workshop has good dimensions (2800 m2) for the present activity which can easily be increased.

However, this workshop requests a rational and modernized exploitation.

We observed an unusual congestion, because the prefabricated elements are stocked inside, instead of being removed in proportion to the outside yard.

The handlings of elements and moulds are made by two travelling bridge-cranes of 5 t., what is insufficient for the prefabrication of large elements and what presently steps down the range of products.

On a span, a bridge of at 10 t. least should be necessary.

The supply in concrete from the mixing plant is done by jubilee wagon, being re-handled by the travelling bridge-crane which so servs concrete so the moulds.

On the other hand, the concrete spreading is not automatically ordered by the travelling bridge-crane driver ; that makes necessary an expensive manual setting.

So it seems that from the concrete mixing plant, the conception of which is very modern, the transportation and spreading of concrete has to be done by an automatic bucket.

Finally we think that the prestressing bed has to be modernized, because it is dangerous in its present condition. This danger proceeds from the slackening of steel stress, which is by wire or group of wires but not in a whole. That provokes lateral efforts and consequently some strains ans risks of breaking.

The annex workshop are sufficiently equiped for present fabrications.

./.

However, if "BANAT" follows up a prefabrication policy of standardized industrial buildings, it will become necessary to provide the factory in very elaborate and precise metallic moulds, what is impossible with present means.

We think that the present workshop will be able to keep up and repair them but also that the M.I.P. workshop is sufficiently equiped to build them.

All the improvements upper explained ought to allow to comply with the combine requests in its new policy of housing half-prefabrication either to complete the settings of ZRENJANIN or for some sites in the South of VOJVODINA.

General fittings up

In our opinion, it is indispensable to seriously keep up the internal and access ways for sparing the equipment, and for avoiding every accident, taking care of the important problem of personnel working conditions.

2.2.4. - Site and handling equipment

Even if the present equipment , though dissimilar, is sufficient, it should be good for "BANAT" to think of purchasing a more specialized tranportation and erecting equipment.

For the transportation , particularly of heavy prefabricated elements, the utilization of half-trailers has to be considered because it allows to move big elements (panels, frames, girders, staircases) and to fit to the trailers the necessary arrangments (vaults, frames, gantries, ...)

For handling and erecting it is necessary to have at disposal tower-cranes of a good capacity (120 to 200 tm) because they are the only soft and precise machines.

./.

During the period of transition it is also necessary to have at disposal a light equipment flitted to the pieces to be set ; but in our opinion the construction of it can be realised in the M.I.P. workshop with elements found on the sale (spreader bars, forks, shores, etc ...)

2.2.5. - Technical and other building trades

The evolutive system of half-prefabrication, building mentionned hereinbefore, mades easier the intervention of building trades.

Effectively the front walls are finished as soon as the hard work is getting forward what allows the immediate putting of the joinery and glazing ; this air-insulation stage provides the best working conditions to the technical sector which can work continuously except during long period of freeze.

Consequently it authorized planning more precise and a better output because of the continuity and the good working conditions.

This procedure allows of having a more accurate work schedule or timetable, and more particularly to ensure improved productivity for work performed in better working conditions, and continuously.

It also spells a step forward in "concurrency" in the sequenced preparation aimed at obtaining simultaneity in operation. The final objective, clearly, is industralization of the finish work via industrlization of the structural shell. This will lead to genuine "concurrency" characterized by direct and close links between industry and the job site ; the former locking step with the latter. This presupposes the elemination of the greatest possible number of such trades -(façades joinery, glazing, plasterwork, electrical, plumbing, heating, ventilation and so on), on account of their incorporation inside of prefabricated units, thereby reducing not only the construction period but also the cost- since by definition, work that does not exist can scarcely cost anything.

The concumency of operations thus obtained will render the actual on-site work propitious for uninterupted, hence all-season, operation.

It may be added that such industrialization will be possible only to the extent that there is adequate growth of the Yugoslav industry for capital goods intended for housing.

2.2.6. - Marketing general management
Research and project department

The comparativesurplus capacity of the staff mentionned in the former section should allow it to have a good deal of the growing production of the short term program. However, it is the same staff who will have simultaneously to prepare, control and realize all the preliminary tasks for the medium and long-term program of development (section 3).

We do regret that combine "BANAT" cannot rest on the experience of a building regional institute for such an activity, what will lead it to consult international organization and research departments direcly or through the channel of UNIDO.

2.2.6.1. - Research and project department

In our opinion, the structure of this staff will have the greatest effort to do to review its whole activity. During this period of transition, in front of the improvement of the materials production and mainly of the starting of a new technology with the utilization of rationalized constructive systems (see 2.2.2.), the designer of research and project department will have to introduce changes.

The restatement of standardized projects of industrial agricultural or housing building, with the cooperation of O.O.U.R., will be the prior objective.

./.

This point of view, it means serial architectural creation (for instance : sery of housing project, standard X.Y.Z.) will demand a particular effort in conception and methodology and a progressive control of the realization on the site. The introduction of more and more numerous and various prefabricated elements will help this control effect. That is the way to have a real multidisciplinary designer staff around the architects who will have to take upon the leadership. This suggestion anticipates an imperative recommending of section 3.

2.2.6.2. - Marketing department

The sector "research and planning" will have to deepen its prospection till the elaboration of available programs which will be used by the Research department for the standardized building projects.

From the time onwards the combine is supplied in standardized projects, the activity of setting and engineering sectors will be transformed.

C O N C L U S I O N

. Beyond a new definition of the trade policy, some definitive transformations are suggested in BELA CRKVA for the aggregates exploitation and their transportation by a channel digging.

. Restatement of a half-prefabricated construction system for housing building, allowing to comply with the growing request, without any important investments, and allowing too the manpower to get in used with the prefabrication constraints.

. Voluntary systemizing of modular conception (structure and filling up) for the industrial and agricultural buildings allowing an intensive and economical use of prefabricated elements prestessed or not.

. The plants in ZRENJANIN as well as in BELA CRKVA will have to be modernized to comply with the prefabrication needs for all building types.

. The intervention of the technical and other building trades towards integration has to be rationalized by a better coordination (from the study step) and mainly by the front walls prefabrication (removal of scaffoldings) by a former intervention on closed premises.

. The creation of a multidisciplinary staff actuated by the architects (qualitative increase of research and project department) is essential to comply with the new demands : it means to give standardized projects of all kinds of buildings and to control progressively the realization.

. A program and a prior right will have to be determined to choose standardized projects taking in account the market request but also the combine internal policy.

. The importance of the standardized projects for grouped or isolated detached houses will request a deep analysis, because of the emergency of this problem

./.

Section 3 - MEDIUM AND LONG TERM DEVELOPMENT PROGRAM OF THE "BANAT" COMBINAT

The medium and long term development program is mainly concerned with finding a priority solution covering industrialized production of housing in a context of solid growth, of which an analysis is given in Part 1 of this section.

The sector of industrial and agricultural building production with an already advanced technology, will benefit from the spin-off from the industrialization of the housing sector.

Clearly, aside from the transformations, suggested in this report, of the specific activities of the "BANAT" combine, what is at stake is the entire process of production of framed construction, which is bound to evolve. The outcome will be a redistribution of responsibilities and tasks for all of the persons concerned in the act of building.

The participants in this venture, known respectively as S.I.Z., town-planners, economists, programmers, bankers, architects, building technologists, engineers, contractors an so on, will have to perform their specific jobs in the compass of programms updated to take into account the scientific and developmental progress of the productive forces of building, broken down into the three basic components of the act of building :

- sponsor
- designer
- constructor

./.

3.1. - TRANSFORMATION OF THE FRAMED BUILDINGS

The transformations taking place are profound and will upset the medium term targets of the "BANAT" combine.

On a long-term basis what is involved is the philosophy and practice of the art of building to meet social and economic requirements. That is why to understand the particular one has to start with the general --after quantitative, to assess the qualitative.

Is "BANAT" to build 2000, 4000, or ??? apartments per year, in 198... ? and what types of apartments ?

3.1.1. - Transformations at Federal Level

For objective reasons, depending on both the country's general level of development and the special attributes of its economic and organizational situation, the Federal authorities of the Yugoslav Federative Socialist Republic in 1972 started on the preparation of a deepseated transformation of the construction industry in general and of housing construction in particular.

What was intended was not only to transform, and to better adapt, the organization of the market, but also and above all, to improve and modernize construction itself. This is why in 1972 the Federal Building Council had initiated research on the theme "General Industrialization of Residential and Other Buildings in the Yugoslav F.S.R.".

Concurrently with this operation, systematic preparations have been undertaken regarding the anticipated overall industrialization by persons in the trades and by building representatives in the form of a series of studies, symposia and seminaries held at the initiative of the Building Council of the Yugoslav Economic Chamber *. Among the most

* SAVET ZA GRADJEVINARSTVO PRIVREDNE KOMORE JUGOSLAVIJE

./.

recent and most characteristic phases of these preparations, mention may be made amongst others of :

. "Provisional Building Standards in Command Construction" (in French : "construction dirigée") of Housing * topics for discussion at the extended public debate, November 1973

.OPATIJA Seminary, November 1974

. Symposium on "Social Organization of Command Construction of Housing" **
SKOPJE, 11-13 December 1974

. Permanent conference on Cities ***
ZAGREB, 13 & 14 March 1975

. Symposium on "Phase in the General Development of Industrialized Housing Construction in the Yugoslav F.S.R."
OPTIJA, 7-9 May 1975 ****

The political and social institutions also requested that, having regard to the growing and acute needs of the country, the solution to the housing problem be included among the priority items on the forthcoming agenda as a task requiring solution (cf. Resolutions of the 10th Congress of S.K.J. ***** and 7th Congress of the S.S.J. ******). They even quantified precisely the targets to be met during the forthcoming decade, namely the construction of 1.820.000 dwellings during the 1976-1985 period.

* PRIVREMENI STANDARD STANA USMERENE STAMBENE IZGRADNJE (MATERIJAL ZA ŠIRU JAVNU DISKUSIJU)
** SAVETOVANJE O DRUŠTVENOM ORGANIZOVANJU USMERENE STAMBENE IZGRADNJE
*** STALNA KONFERENCIJA GRADOVA

**** ELEMENTI RAZVOJA OPŠTE INDUSTRIJALIZACIJE STAMBENE IZGRADNJE U S.F.R. J.
***** LEAGUE OF YUGOSLAV COMMUNISTS : SAVEZ KOMUNISTA JUGOSLAVIJE hence the acronym S.K.J.
****** YUGOSLAV TRADE-UNIONS CONFEDERATION = SAVEZ SINDIKATA JUGOSLAVIJE hence the acronym S.S.J.

When it is realised that some 180 Yugoslav building contractors --with a work force of about 210,000 persons-- are currently building some 100,000 apartments per annum, it is clear that assuming the organization and technology currently prevailing in the construction industry, this target remains well out of reach.

Which is why by unanimous opinion, the solution --at least as regards production itself-- must be found in the inception of overall industrialization of housing construction.

Starting from there, the Federal Planning Institute * is working on a "Social Development Program for the intensive industrialization of housing construction in the Yugoslav F.S.R." * * The program is to be checked, discussed, supplemented and modified by professionals and responsible officials of the building trade, more specifically during the most recent events which have been listed earlier.

This complex procedure for developing the Program will ultimately lead to the intervention of representative officials at federal, regional, communal and other basic working organizations, who will take it into account during the elaboration of the forthcoming medium-term plan currently under preparation.

As regards the production of housing, what is involved is to take initial steps toward thoroughgoing rationalization with a view to emerging on overall industrialization, with the aim of building better and at less cost.

Meanwhile, the market is organizing and converting itself at the same time. Buyers and users are uniting in order to communalize their means and are forming self-managing communities of interest of habitat * * Building contractors are in the presence of indispensable counterparts who, in the capacity of clients, will enable them to work in a more coherent and continuous manner through the agency of self-management agreements. Industrial production calls for continuity and coherence. Every measure decided at federal level appears to us to have to meet this objective.

* *SAVEZNI ZAVOD ZA DRUŠTVENO PLANIRANJE*
* * *"DRUŠTVENI PROGRAM ZA INTENZIVAN RAZVOJ INDUSTRIJALIZACIJE STAMBENE IZGRADNJE U S.F.R.J."*
* * * *SAMOUPRAVNA STAMBENA INTERSNA ZAJEDNICA hence the acronym :* S.I.Z.

./.

One must however take note of the ambitious targets set forth in the matter of technological change. Indeed, at present only 20% of dwellings built are prefabricated, and this figure must reach 55% in 1980 and 80% in 1982.

3.1.2. - Transformation at regional level

In the framework of the Yugoslav socio-economic system, on the territory of the S.A.P. VOIVODINA * is the Regional Socio-Economic Institute of NOVI SAD ** which as the competent branch of the Regional Executive Council *** analyses the output and needs of the economy and of the population in that region. In a resulting synthesis, it recommends appropriate elements and potential development of the medium-term plan. It then devolves on the base (work organizations and other agencies) to study them, discuss, supplement and lastly return them to the Regional Assembly for final coordination and approval.

Thus for the period just run (1971-1975) the Institute's analysis points up the slow-down in the growth of the building industry (5.6% instead of the scheduled 8.5%). This is explainable mainly by practical problems (such as discontinuous supply, erosion of capacities, inadequate working equipment and plant) and economic problems (lack of day-to-day liquidity of enterprises and general economic measures for stabilization, especially in 1972 and 1973.

The situation is however improving in 1975, mainly due to the inception of a new credit policy.

This being the case, the program covering housing construction for that period (1971-1975) will meet only 81% of the target set.

* SOCIJALISTICKA AUTONOMNA POKRAJINA VOJVODINA hence S.A.P VOJVODIN
or in English, SOCIALIST AUTONOMOUS REGION OF VOJVODINA,
abbrev. to S.A.P. VOJVODINA
** POKRAJINSKI ZAVOD ZA DRUSTVENO PLANIRANJE
*** POKRAJINSKO IZVRSNO VECE (Regional government)

Hereto, the specific causes are ascribable to financial means (insufficient withholdings on wages and salaries allocated to housing construction, discrepancy between rents and amortizations, errors in appropriations of resources, and certain discrepancies in the financing of construction-related equipment, etc...) and in practical organization (poor technological sequencing of the various phases of construction). The lost time is to be made good in the forthcoming period 1976-1980.

Regarding the new medium-term plan, the Regional Planning Institute in its work entitled "Potential Socio-Economic Growth in the 1976-1980 Period" (NOVI SAD - Feb 1975) a; after reviewing all sectors of the regional economy and forecasting amongst others an intensive growth of the food industry and agriculture, notes concerning the construction :

" The programmed and more dynamic construction of industrial buildings (sugar refineries, oil works, silos, cold stores and the like) and of residential housing, where one expects accelerated construction in order to meet growing needs, calls for modernizing and for improved utilization of building capabilities".

To attain this, alongside an investment policy based on greater stability and longer terms, it is necessary to strengthen the organizations of united work (i.e. the enterprises) and their production capacity, by increasing their size and by promoting their business liens and working agreements amongst themselves.

In our opinion, the creation of a Regional Building Institute, in the capacity of inter-enterprise agency concerned with the development and technological and organizational improvement of the building industry, would definitely be of assistance to the existing local and regional institutions.

To bring down costs and construction times, what is required is the rationalization of conventional methods and above all the launching and generalization of industrial construction methods, no less than a more stringent orga-

a "MOGUĆNOSTI DRUŠTVENO - EKONOMSKOG RAZVOJA U PERIODU 1976-1980" NOVI SAD - FEBRUARA 1975 GODINE.

./.

nization of working procedures. This will foster a more dynamic commitment of investments. The above-mentioned text stresses the fact that "the self-management understanding ("entente auto-gestionnaire") of all the parties, as well as cooperation with the building materials industry, will contribute to the better managing of operations ; in other words, to the stabilization of economic conditions and of the cost of completed buildings.

The global approach to the problem is in our opinion seminal to the success of any ambitious program. Regarding the parties, stress is laid on the cardinal necessity for closest collaboration at every level of the act of building.

We wish again to insist on this concept of remodelling the attributes of each party in the compass of the three-fold pattern of basic components , which are :

. Sponsors

S.I.Z. :

"The financing of the construction of apartments and of utilities through the bias of communities of interests will made for the rational accumulation of facilities and of their utilization for ends which will better suit the users". Not only should the S.I.Z. be at the origin of a better directed policy for the construction of housing and of facilities, but it must also act as a connecting link between all the parties concerned, and beyond that between municipalities, producers and users (whether the latter be buyers or tenant).

Through their role and their impact, the S.I.Z. should also have a say in the new policy of the "production" of buildable sites.

TOWN-PLANNERS :

"The urbanization plan being one of the basic instruments in the policy of housing and of infrastructures", it is advisable that any prior studies should emerge on decision-making that will make for a certain amplitude and coherence --even continuity and series building-- in the production of framed construction.

./.

BANKS :

The application of a higher interest rate for releasing funds and a more suitable rent policy should make for improved programming of construction (in particular housing construction), which is one of the preconditions for the participation of commercial banks in financing".

"It is also to be expected that the banking system will involve itself more actively in the realization of the housing program, by mobilizing greater collective and private funds and by using them in more favourable credit situations".

. Designers

ARCHITECTS

The synchronizing of architects work with those of contractors is an essential condition in efficient building". In other words, the targets aimed at is well and truly a conceptual osmosis between needs (hence projects) and means (hence technology). Having regard to the anticipated technological updating and above all industrialization anticipated, a special effort is called for in training and adaptation, touching not only architects but the upper echelons of enterprises.

OTHER SPECIALIZED TECHNICIANS :

The basic documents relating to the technical and legislative aspects, which directly condition the production of buildings (geology, hydrology, traffic, etc... ; also standards, criteria and technical regulations) should be worked out as exhaustively as possible.

. Construction

(factory and job site supervision)

In addition to building contractors and the combine , it is necessary to integrate into the execution the entire sector upstream of production, namely :

./.

BUILDING MATERIALS PRODUCERS

"The dynamic growth of the building materials industry will ensure improved supplies in regard to both quality and choice of materials".

NOTE : *The above-quoted passages will illustrate the opinions of the regional institutions.*

Conclusion

For S.A.P. VOJVODINA, the growth rate for the entire building sector is planned over the 1976-1980 period to reach 7.5%, of which the social sector will account for 7.6% and the private sector 6.9%.

As regards housing, it is planned to build a total of some 61,000 apartments over the same period, of which 22,000 apartments for the collective housing sector (giving a mean annual growth rate of 7.4%), and 39,000 apartments for the individual housing sector, giving a growth rate of 4.8%.

On an average, 12,000 dwellings will be built per annum, which exceeds by about 2% the mean annual construction rate achieved during the period just completed. It is significant that the withholdings on wages and salaries allocated to the construction of apartments, which will amount to 6%, will provide a considerable stimulus for intensifying such construction. Note in this connection that in [illegible] the rate has already been raised to 7% commencing in 1975.

It is seen that the individual house will remain an important factor in framed construction.

Certain local specialists aim at having 30% of individual homes built, meaning about 12,000 for large enterprises of the VOJVODINA.

./.

To appreciate better the territorial capabilities of the VOJVODINA as a factor in its overall economic development, town-planners are due to complete a redevelopment plan for the regional territory, entitled "Master Design for Land Redevelopment with Proposals".

In view of the increased urbanization and of the housing construction program, urbanization plans will be elaborated for all the communes (with detailed urbanization plans for the conurbations) emerging on the harmonizing and updating of existing plans.

BASES AND POTENTIAL DEVELOPMENT OF F.A.R. VOJVODINA

1976 - 1980 CONSTRUCTION

. Gross National Product :

- 1975 - millions of diners	3,592	
- 1980 - millions of diners	5,146	
- Growth rate 1976 - 1980		7.4 %

. Gross capital spending on production :

- 1975 - millions of diners	129	
- 1980 - millions of diners	255	
- together 1976 - 1980	980	
- Growth rate		14,8 %

. Housing construction :	1975	1980	together 76-80
- total no. of dwelling units	10.300	13.000	61.000
- no. of socially owned	3.000	5.000	22.000 (collective buildings)
- Growth rate 1976-1980		43 %	
- No. of individually owned apartments	6,000	8,000	30,000
- Growth rate 1976-1980		26.4 %	

./.

. Breakdown by building trades

	1975	1980
- above-ground structure	33.9	34.9
- habitat	32.1	34.2
- infrastructures	20.7	20.8
- Hydraulic structures	5.9	5.5
- upkeep	7.4	5.6

An additional factor in its development is the fact that the geographical position of the region places it contiguous to the capital of BELGRADE, and that the latter's importance and dynamism will exert an evident and considerable effect on the VOJVODINA economy (agriculture, food industry, tourism etc..)

It is to be expected that the extension of the BELGRADE conurbation on the left bank of the DANUBE will offer the regional enterprises (including DANAT) an occasion they will not fail to seize on condition of course that they are ready and competitive.

3.1.3. - TRANSFORMATIONS AT LOCAL LEVEL

Without overlooking, in this survey, the towns of the BANAT geographical region, we shall concentrate our analysis on the town of ZRENJANIN.

In 1975 it is a rapidly growing industrial centre numbering some 70.000 inhabitants. Administratively the town is subdivided into 12 district units (basic communities a).

Notwithstanding this, the territory of the ZRENJANIN commune exceeds the boundaries of the town and encompasses altogether 23 territorial units which together constitute the Council of Local Communities (a a), an aggregate falling under the purview of the Communal Assembly (a a a)

Regarding the present appearance of the town, note that (insofar as this will materially affect the shapes and conditions of future growth...) it is largely made up of individual type houses, frequently with large courtyards and gardens, with a relatively specific, even original, regional architecture.

The houses are clustered together and organized into wide, orthogonal streets forming an urban "crust" a little aged and often inadequately maintained, from out of which here and there, recent structures emerge that are a part of the renovation undertaken sporadically. Due to the fact of this horizontal configuration, the town still lacks infrastructure utilities (roadways, water, sewerage, fluids etc) worthy of the name.

This situation, in addition to be high level of the ground-water table, make for heavy capital expenditure and will burden the growth of individual housing. It helps explain why the urban policy laid down by the Town Planning Plan imposes an effort at contraction, gives collective housing priority, and insists on the creation of jobs.

---

a OPŠTINSKA POLITIČKA ZAJEDNICA
a a VEĆE MESNIH ZAJEDNICA
a a a OPŠTINSKA SKUPŠTINA

./.

As set forth in the current plan for ZRENJANIN, the town's requirements are 850 apartments per annum. This figure is now under reconsideration, having regard to what was stated earlier under 3.1.1. and 3.1.2.

The creation of the S I Z (s) and the functions it already performs, taken together with the decision to raise the withholding on salaries and wages for housing to 7 %, are determinant factors in setting new targets.

A word now on the S I Z :

The federal legislation covering S I Z is recent, dating from 1974. It is stringently implemented at regional level (official journal of the SAP VOJVODINA N° 21/74), and at local level (official intercommunal journal of ZRENJANIN N° 23/74). The self-management agreement on the creation of housing S I Z (.. there are other S I Z covering health, education, culture etc ...) was signed in ZRENJANIN in december 1974 and became effective from 1 st January 1975.

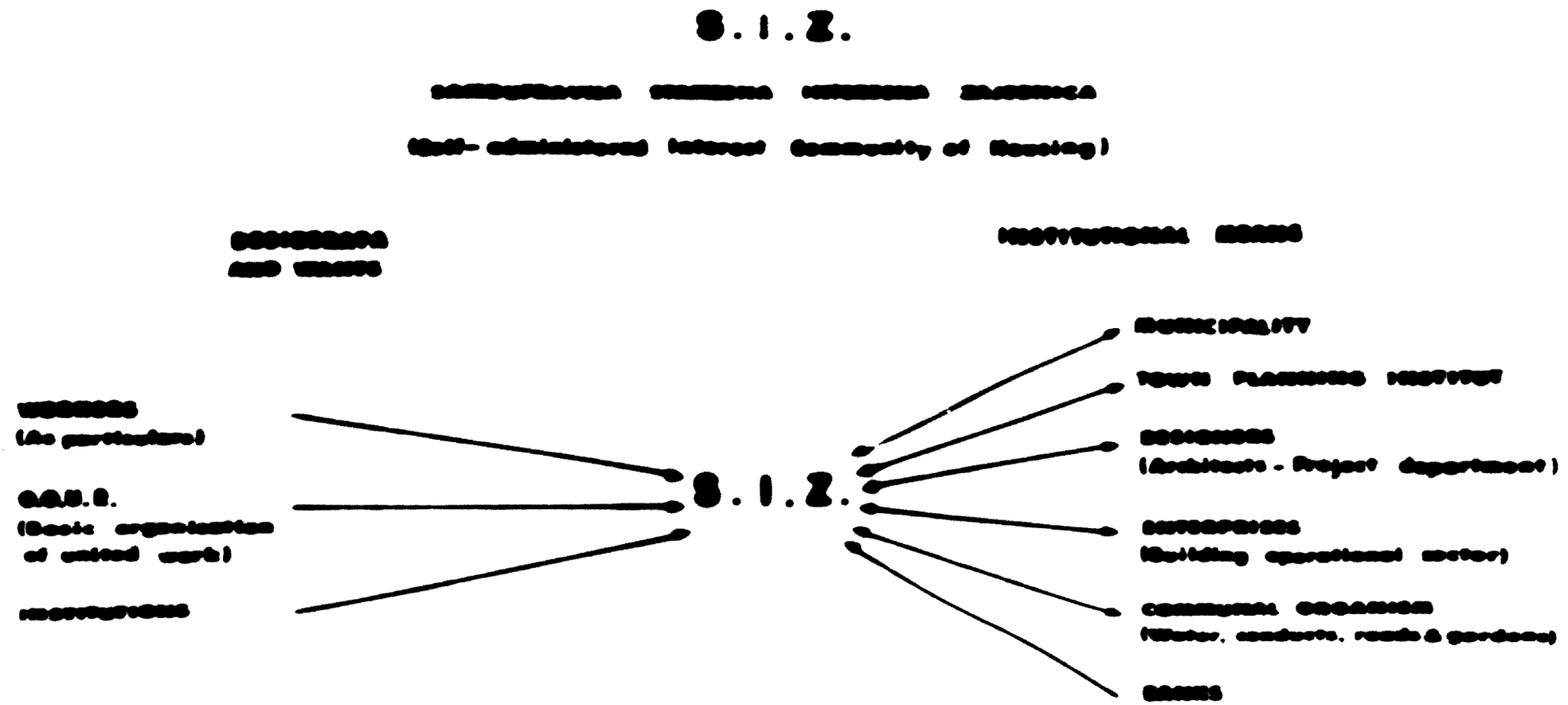
The role of the S I Z .. its very reason for existence .. is to collect, count, coordinate and harmonize and implement in one master construction plan all the elements resulting from the gifts and contributions, first, from the O.O.U.R. and from private individuals, and second, the potential and actual capabilities for construction on the other hand. It is in a sense the band leader of the programme and command construction of housing, which in turn takes over the extended functions of sponsor.

The diagram below illustrates these functions : see page 86 A.

With a great deal of drive the ZRENJANIN S I Z has taken in hand the preparation for a short and medium term plan. Thus by way of example it has already undertaken :

- SAMOUPRAVNA STAMBENA INTERESNA ZAJEDNICA (S.I.Z)

./.



ORGANIC SCHEME MANAGING HOUSING BUILDING OF ZRENJANIN TOWN SINCE THE FIRST JANUARY 1975

. A vast survey among prospective owners and users of housing, which has, amongst others, led to an operation covering 500 apartments to be built immediately, based on the following design assumptions :

No OF ROOMS	No OF APARTMENTS	HABITABLE AREA APPROX.	No OF BEDS	APPROX. COST DINARS	PERCENTAGE
1	125	38	2	215 000	25
2	250	57	3 - 4	320 000	50
2 1/2	100	66	4 - 5	370 000	20
3	25	72	5	405 000	5
TOTAL	500				

. Discussions and negotiations on multi-annual contracts binding it to its intermediaries or "instruments" (among which is the "BANAT" Combine) with which a reciprocal agreement will fix the bills of materials, prices, and the quality of the apartments. This is on the point of being signed.

This document will put a stamp of approval on a basic collaboration aiming at the establishment of a long-term economic and political housing strategy. As the objective of the S I Z is to program the production of housing in an organized and competent manner ; it must, together with the combine , lay down not only the annual volume and construction systems, with the proportion of services, but also supervise its progress.

./.

The new market rules aim at eliminating every kind of monopoly and to subordinate all actions of intermediaries to the common objectives which symbolize the S I Z. Price formation is also a matter of mutual agreement since there no longer are calls for tenders ; which however shall not prevent the S I Z, if it deems appropriate, to call in some other contractor, design consultant and/or Town Planning Institute.

In sum, what we are witnessing in the specific case of ZRENJANIN is the inception of two concurrent changes which will eventually coincide namely :

. Changes in the market and in orders placement of which the S I Z is the kingpin ; and

. Changes in manufacturing industries which are moving into industrialized construction complete with industrial approaches (prototype, pre-production runs, production line) ... which however need not spell uniformity.

There is also the evolution of a classic pattern with its three components ... sponsor, designer and contractor ... towards a dialogue between two major partners :

. The investor (S I Z) hence also expanded client/sponsor, who continuously acts as a bond between the inception activities (i.e. town planner, programmer, sociologist among others).

. The constructor who becomes a "builder" and incorporates all the activities of innovation, design etc...

As to the overall requirements of the town, they are currently estimated at about 1300 apartments/year. Regarding the financial means required for their construction, it is unquestionably here that S I Z will have a considerable work of synthesis to accomplish.

We may say that in the present state of things, the contributions of O.O.U.R. and of the institutions cover the construction of about 50 % of requirements, namely about 650 apartments. The demand of private individuals providing their own means, though evident and even very great, is far more difficult to assess ; nevertheless it may be estimated at about 300 apartments/year.

./.

To cover the balance of the requirements, the S I Z has thought up "save and build" fund : a right of subscription and the allocation and use of a new dwelling as it were.

This concept would enable people to contribute towards a new dwelling against a monthly payment within their means, say for 3 or 4 years would ensure a share of housing loans to the extent of about 20 %. Subsequently this amount could in the case of rental either be restored and used for improving the status of said dwelling, or it could be used as initial down payment in the case of a definite purchase.

This would give the S I Z sufficient means to cover the construction of about 100 apartments per annum ; or perhaps more if the right is made retroactive and involves tenants who have already benefited from the allocation of new apartments. It is a matter of solidarity.

The changing policy in rents should also help to strengthen the S I Z's financial means. Thus, apartment rentals are becoming "economic", meaning scaled according to income and incremented in order to cover not only the upkeep of the buildings but their amortizing, thus helping to construct more new dwellings. With a view to aiding the S I Z , the O.O.U.R. and the institutions owning existing buildings, agree to give up their properties, merely keeping the right to distribute those apartments among their own personnel.

There remains the market for individual houses (cf.1.2.1.3), which is both open and ambiguous. Desiring to meet the desiderata of prospective users, the S I Z would like to work out, together with its "instruments" and partners, a pilot operation covering 300 apartments.

This would be a significant test case, a first attempt at organized and command intervention on such a market, and an answer aiming to satisfy this mode of life.

In this connection it should be noted that throughout the local economic situation .. which indeed is in line with the development phase of society ... one senses the ardent wish of the population for new and comfortable dwellings, often without hesitating before the obstacles, the sacrifice even, that the realization of such a hunger implies. This is true as much for the collective dwelling as for the individual dwelling. This motor should on no account be neglected when instituting a market.

./.

3.1.4. - HOUSING STANDARDS

Having considered the quantitative aspect of the problem (namely how many dwellings to build annually), there remains to specify the quality and the standing of this mass habitat.

A directive, discussed publicly since november 1973, governs in the matter.

It is entitled "provisional standards for housing for programmed construction", drawn up by the Slovenia building centre and the I M S Center for habitat of Belgrade, at the instigation of the Yugoslav Chamber of Economics.

The satisfaction of functional, psychic and biological needs of all members of the family is the starting point of the study on "standard dwellings" of which the special, structural and dimensional design as well as the design of the equipment are integrated into a standardized system.

The ideological and technological bases of a unified housing market are recommended for discussion (on principle there is no segragation).

The standard size of the apartments in keeping with the number of inhabitants (number of beds) is comparable to shades in the mode of life, recommendations and/or regulations obtaining in Europe.

Note that the observance of such standards will cause certain anomalies to disappear which were observed earlier, and which falsified the economic analysis of production costs (see 1.2.2.2).

The directive on the provisional standards covers in detail the problems of the immediate environment of the dwellings, thus instituting an urbanistic dimension (though it is regrettable that insufficient qualitative guidelines and standards are set forth regarding residential parking lots).

A call for "complex rationalization" ... (no downgreding of dwellings but a seeking after qualitative savings over the entire porduction process) ... aims to sustain the ratio "cost price per average dwelling/GNP per inhabitant" "to an optimum level. The "standard dwelling" to be built by the thousand units will be a quality item, rationally and humanly devised. It will be built by industrialized means.

./.

3.1.5. - [redacted]

In the previous sections, we considered the needs determined by the social and economic context, as well as the definition of the product liable to meet such needs (necessarily with certain local adjustments).

It emerges from the above that the potential market open to "[redacted]", especially when it is considered that, in addition to [redacted], the combine is already well set up in other towns of the [redacted] region ([redacted], Vrlac, Bedaj etc) yields a realistic target of [redacted] apartments per annum [redacted]

This figure is equivalent to about 120 000 m2 floor area of apartments and related equipment.

In the long term, the "[redacted]" Combine, in view of the projected trends of the market at the scale of the [redacted] area, and having regard to the reorganization of forces taking place among existing enterprises, aims to reach a capacity of [redacted] apartments/year in the 1990s

The overall context of the Yugoslav economy, characterized by intense striving in the area of housing as well as by the penetration of the individual housing market by enterprises of the "[redacted]" type, and without considering the eventual extension of the geographic action zone in the Belgrade area (left bank of the Danube), are major factors shoring up the credibility of this target.

3.2. - CHANGES REQUIRED OF THE "BANAT" COMBINE

The traditional methods of construction of the Combine (building system and technology), even if rationalized and improved in keeping with the recommendations of Section 2 above, are unable to cope with the demands of the new construction market. Moreover, the need to lower construction costs and especially the number of work/hours per sq.metre of built floor area, are beyond the possibilities of traditional procedures.

A three-fold change is essential.

3.2.1. - Conceptual reconsideration of the role of the Combine in the overall production process of framed construction

It must become essentially a "builder", selling the largest possible number of "turnkey" operations covering architecture through to ultimate technology

Due to its preferential and continuous relations with the S I Z, the Combine will have to expand its capabilities and the spectrum of its responsibilities. Its participation (in the capacity of organic consultant of the S I Z, as it was) in the decision-making far upstream of the housing construction programs, which at the end of a coherent process will be the subject of a negotiated contract covering construction at specified prices and periods, will fundamentally transform the concept of marketing.

The new type of marketing can exist only if it covers a wide and innovative spectrum of fully finished products, i.e. typical projects for various buildings with an assortment of erection means and adaptation to sites, which we propose to designate by the term "model"

Having regard to prefabrication and to industrial processes covered under items 3.2.2 and 3.2.3 above, the development of such models inside the Combine will call for the melding of design, construction and building supervisory activities.

This melding should make for the primacy of a coherent architectural concept in the industrialization process (covering the order to factory and of prefabrication equipment) then in the operation of the "industrial tool" (phase covering series production of diversified and innovative "models").

The brand image, and above all the social finality of the Combine at the end of this change, will be that of a "constructor" anticipating creatively and realistically the needs of society in regard to framed construction.

3.2.2. - Technological change :

. The era of brick masonry is on its way out,

. The era of concrete and lightweight concrete is in.

Starting with the wealth of the subsoil (clay) and of cheap energy (natural gas), it is necessary to create production plants for expanded clay units.

This lightweight aggregate is used, not only in the factory building of building components (floors, façades, wall units etc..) but of a great many poured-in-situ structures. It is very competitive, due to the lightness, heat insulation, manhandling, etc...

Above all, in the case of mass housing,

. the era of on-site construction is ending,

. the era of erecting increasingly finish-equipped building units is starting

The invention of modular construction building systems using self-supporting panels with and without fill panels will permit the use of all kinds of prefabrication systems (heavy expanded panels, lightweight insulation panels, etc... - see items 3.3.2. and 3.3.5. below).

The primacy of factory building (or system building) must be intensified, not only for the structural shell, but for all second trades, leading to more sophisticated finish of units and optimum incorporation of mechanical fittings.

The necessary regard for problems of energy and of heat insulation, and the striving to control the interchange between built-up space and environment (view, sun, noise, etc) likewise leads to a technological mutation of which the driving motor is of a quantitative and economic nature.

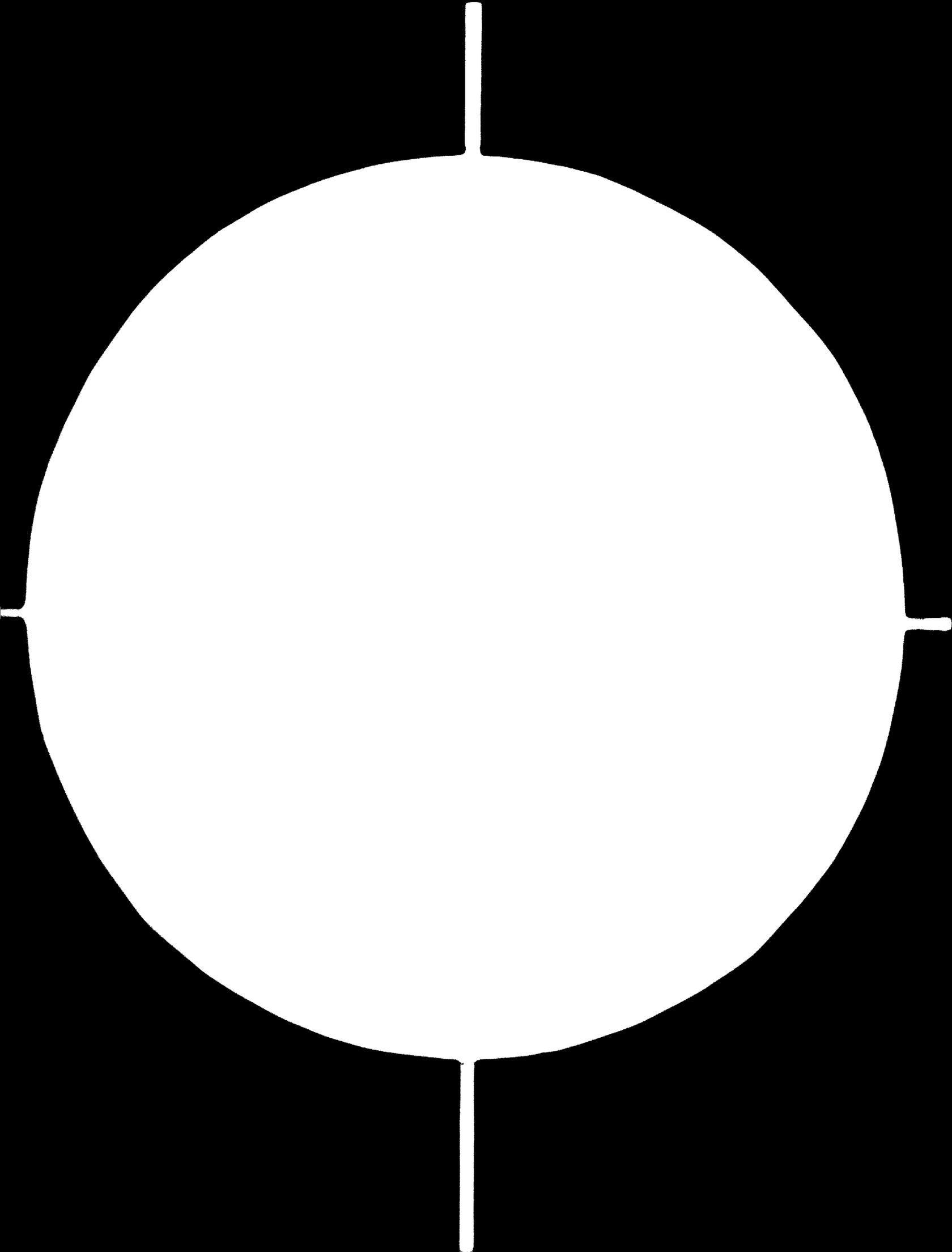
3.2.3. - Changes in production methods

The change we are witnessing is the transition from the itinerant worker (the traditional building site, even when rationalized) to industry production or system building : primacy of work in factory, modernizing and systemizing the erection reduced on site modification and/or finish.

This calls for resolutely adopting the industrial production of housing.

B-563

81.08.28



Modern industry makes for diversity : it is unthinkable that ther be only one "model" made industrially.

The observance of the industrial cycle is imperative :

. prototype phase,
. pre-production run
. production run.

The industrialization of building will have to be content with relatively short runs.

Prefabrication offers a solution for this requirement with the creation of a components industry.

It is necessary to consider three components subassemblies of which the growth rates and renewal rates differ. They are, in terms of automobile industry :

. frame subassembly : floor, frame, staircase wells,
. engine block subassembly : kitchen, bathroom/WC complex,
. body subassembly : outside walls.

Through the interplay of combinations (some thought must be given in time to the feasibility of a data processing aid for the design and management of the various parts of such a puzzle) it should be possible to ensure the following simultaneously :

. continuity in the components market (amortizing investment)
. diversity of the overall product (the "models") in function and appearance.

3.3. - PROPOSALS FOR A MEDIUM AND LONG TERM DEVELOPMENT PROGRAM

In keeping with the foregoing considerations, we now propose an aggregate of measures having an evident internal coherence, but which are dealt with neither chronologically in their application, nor hierarchically as regards their targets :

. 2 000 apartments in 1977, and
. 4 000 apartments in 198..

3.3.1. - Creation of an expanded clay manufacturing unit.

Because aggregates are completely inexistent in ZRENJANIN and close neighbourhood, and because there is a fairly inexhaustible amount of good-quality clay and an important

natural gas spring, we believe that setting up a lightweight aggregate plant-expanded clay-would be the indispensable complement to the prefabrication unit which we proposed earlier on.

We estimate it better for the unit plant to be rather located near the ZRENJANIN brick-works, as it would be able then to benefit from the exploitation of existing clay, gas supply and qualified technical supervision in the field of ceramic production.

3.3.1.1. - Use of lightweight aggregate

Here is a brief reminder note on the possible use of light-weight aggregate :

. a/ first of all, it may be mainly used for lightweight concrete. Lightweight concrete can almost always replace heavy aggregate concrete in traditional building as well as public works ; it can simply be reinforced or prestressed.

Its use in the prefabrication field is particularly interesting for its irrelevant weight, and enables to work out lightweight components such as full or hollow concrete parpens, smoke or ventilation shafts, refuse pipe work, flowers stands, etc... as well as any heavy ones, such as facing, floor, and cross-wall panels, industrial shifting, poles and girders, and so forth.

. b/ such material is also used to insulate terraces against heat, for filters in water-processing, for the anti-pollution layer of some coatings, etc...

3.3.1.2. - Technical advantages

The advantages of lightweight concrete are that it keeps some technical characteristics of ordinary concrete, it is ahead as regards others, and sets forth particular economic interest.

Actually, after comparing the two sorts of concrete, we come to the conclusion that :

. both are equally resistant to compression and tensil strength

. it is more fire-proof, being a weaker heat-conductor,

. it is more sound-proof,

. it is more resistant to seismic movements,

. technologically, as for its composition, mix, vibration, and setting up, it is slightly different from ordinary concrete, but does not show any particular difficulty.

3.3.1.3. - Economic interest

To our mind, the economic interest plays an extremely important part.

According to technical and economic comparisons made by several other countries, even if lightweight aggregate is more expensive than heavy aggregate (with same production and transport conditions) other economic parameters make for it.

We have noticed in particular :

. a profit on foundations (30 %),

. a profit on quantity of concrete (especially on bearing components) (15 %),

. a profit on reinforcement posts and floors (20 %),

. a profit on transport,

. a profit on means of site hoisting and handling.

3.3.1.4. - Needs estimates

To estimate the GIK "BANAT" program of construction needs for lightweight aggregates, we imagine the fabrication of structures concrete for a useful apparent volumetric mass of 1 750 kg/cubic meters.

Such concrete consists of :

. 10/20 granulates	800 l.
. river sand	500 l.
. C.P.A. 325	350 kgs

Besides, average ratios show that to build 1 m2 fit for habitation, 3,40 m2 of precast panels (floor, facing and cross-wall panels) have to be used.

The standard 3-roomed apartment with 65 m2 fit for habitation

needs therefore :

65 x 3,40 = 221 m2 of panels.

The enterprise program ranging from 2 000 to 4 000 apartments, the components prefabrication will then require from :

2 000 x 221 = 442 000 m2

to :

4 000 x 221 = 884 000 m2

If we did choose an average maximum 0,25 thickness for all types of panels, needs would thus range from :

442 000 m2 x 0,25 x 0,800 = 88 400 m2

to :

884 000 m2 x 0,25 x 0,800 = 176 800 m2

of lightweight aggregates.

To such quantities, we must not forget to add all other annex manufactures (such as pipes, ventilation shafts, refuse pipes, and so forth ...) and use for industrial and agricultural buildings, the construction of individual dwellings.

Therefore, we think that a basic output capacity of 200 000 m2/year should be considered.

This unit would permit to BANAT to grant its autonomy in its main field of activity from the basic aggregates to the end product, and on the other hand, it would add a new product to its material-trading activity.

3.3.1.5. - Manufacturing technics

The expanded clay manufacturing technics have been quite perfected nowadays, and we believe that some French units that are still being set up, are technologically ahead in this sector.

We shall briefly remind what expanded clay consists in, and its related, main manufacturing processes and economic data.

Some kinds of clay have the property of swelling after internal gas release at high temperatures. Simultaneously,

the heat provokes the creation of an exterior skin by vitrification of material. A cellular ceramic product shielded by a closed skin has thus been created.

Expansion is obtained by gas release coming from specific chemical reactions at high temperature ; those gas essentially consist of : carbonic gas, carbon monoxide, sulphur dioxide and sulphuric anhydride.

Because of their specific chemical composition, some kinds of clay cannot produce gas release ; expansion adjuvants are therefore required.

Lightweight aggregate manufacturing can be achieved through quite a lot of ways, but only two of them are used :

. 1/ the dry way,

. 2/ the wet way.

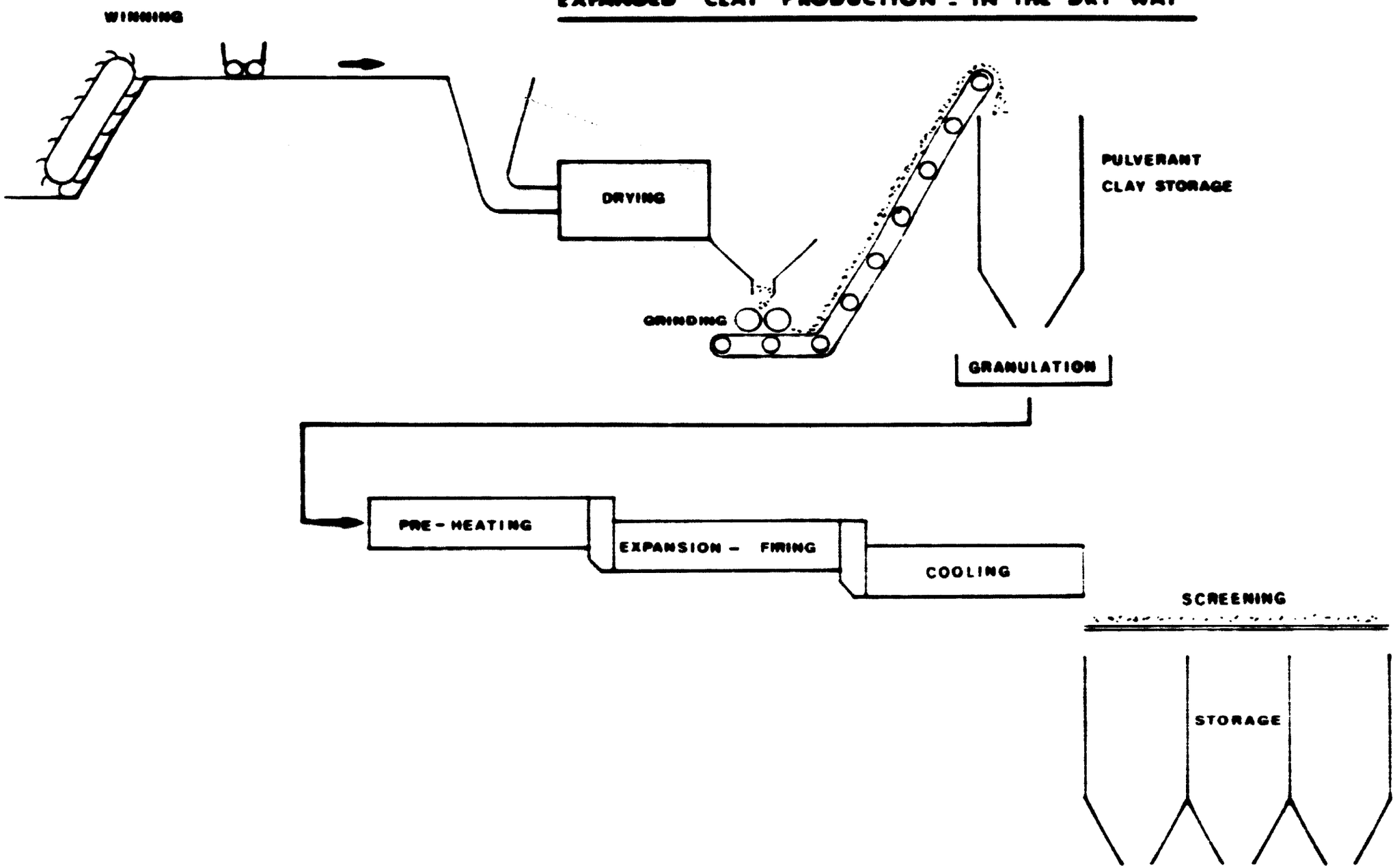
. 1/ In the dry way (see diagram n° 1), the extracted clay is first ground and worked, then dried. The dried components are then ground to powder texture ; if necessary, expansion adjuvants are added to the mix ; powder is changed into granulates of appropriate size, and they are then expanded, fired and cooled. The final phase of processing deals with screening and ensileging.

. 2/ In the wet way (see diagram n° 2), the extracted clay does not need to be left to dry. It is directly ground and worked, and goes through a system producing tap-shaped-modules which are then dried, and put into kilns to be expanded fired and cooled.

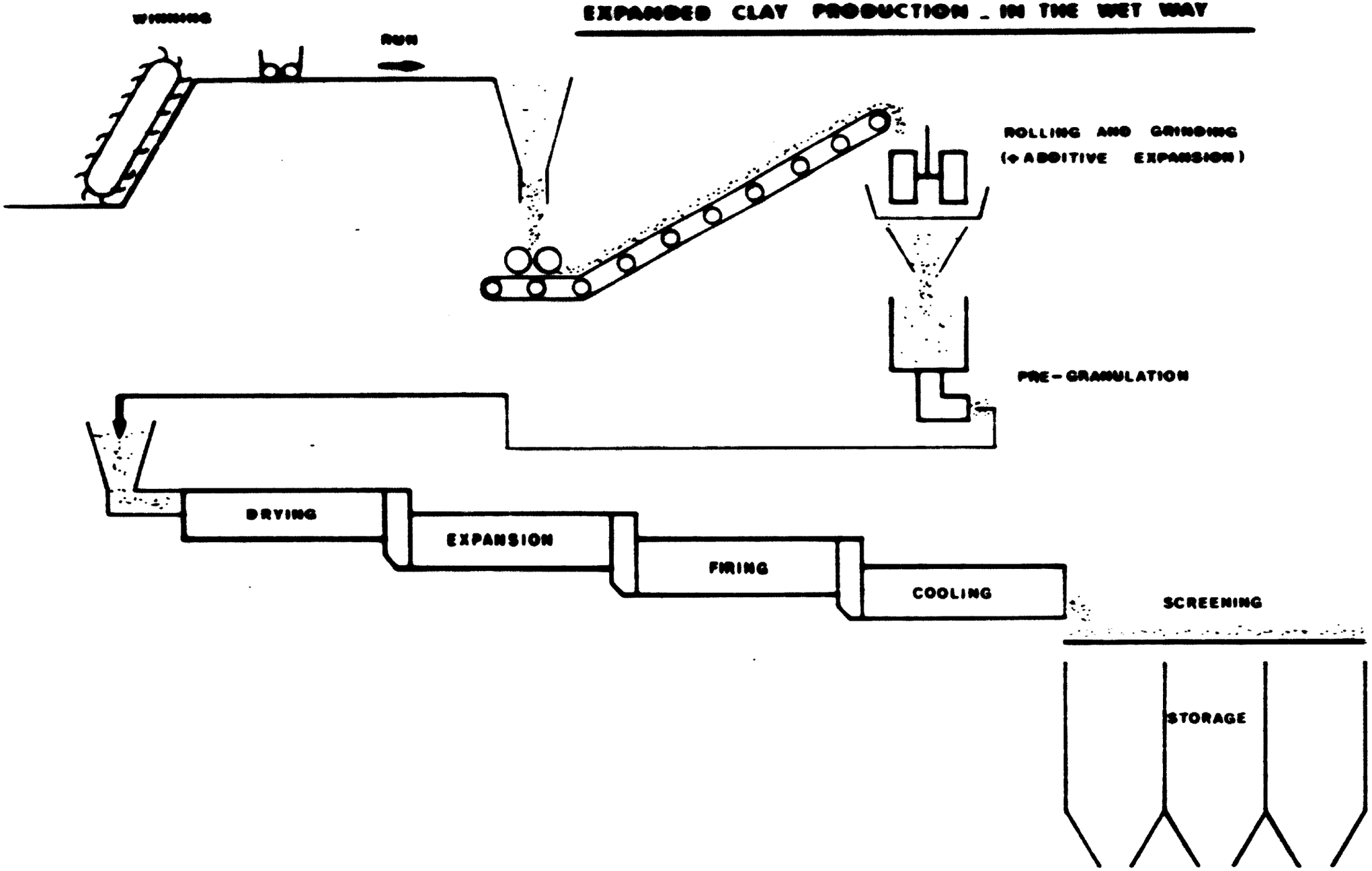
There are quite numerous types of kilns, but recent technics seem to prefer the system of kilns in series it allows a better temperature control at the various stages of processing an efficient heat recuperation and then on, an important economy of energy.

To produce a kilogram of lightweight aggregate, it is necessary to consume about a little less than 1 000 k/cal.

EXPANDED CLAY PRODUCTION - IN THE DRY WAY



EXPANDED CLAY PRODUCTION _ IN THE WET WAY



3.3.1.6. - Economical data

It is not easy to fix the cost price of expanded clay aggregates on their leaving the factory, because of different economic backgrounds.

Some economic parameters are perfectly known, but others have to be subjected to a GIK "BANAT" accurate survey ; this , in particular, if the unit will be set up on the ZRENJANIN brick-works site, where supervision, extraction, setting up, and energy (gas and power) problems, and so on ...can be common to both manufactures, and where at a first stage, new investments to be paid off are not to be worried about.

A survey that has been conducted on several expanded clay manufactors leads to the conclusion that the cost price can be divided as follows :

. extraction	20 %
. productive manpower	20 %
. fuel	25 %
. power	5 %
. consumable materials	5 %
. maintenance	10 %
. general costs and others ..	15 %
	100 %

We do know fuel, power and manpower costs in ZRENJANIN, but it would be illusive to state an accurate price.

Upon rough analysis, the cost price of a cubic meter of aggregates can be estimated at about 200 dinars, supposing the unit be paid in 7 years.

It would be as well to compare the price of a 350 kg cubic meter of implemented, heavy aggregate concrete with that of lightweight aggregate concrete of same prize.

The material prices provided by "BANAT" let show that :

. 1 m3 of 350 kg PC 450 implemented concrete costs ..... 1 350 dinars

It is composed of :

. the Morava aggregates ..... 1 300 l.
. P.C.H. 450 cement ..... 350 kgs

Those material cost :

. aggregates 99 din/m3
. cement ..... 968 din/kg

The Morava aggregates price indications are those of unsorted material back to ZRENJANIN, they must be reprocessed screened and stocked.

After processing its price is estimated at :

99 x 1,30 = 129 dinars/m3

Materials incidence being therefore of :

. aggregates .. 1 300 x 129 = 168 dinars
. cement ..... 350 x 0,68 = 238 dinars

406 dinars

The rest, that is :

1 350 - 406 = 944 dinars

represents transport and handling, setting-up manpower costs, general costs and profits.

In the case of lightweight aggregates, material incidence would be :

. granulate ..... 0,800 x 200 = 160 dinars
. sand ..... 0,500 x 129 = 65 "
. cement ..... 350 x 0,68 = 238 "

463 dinars

Supposing we used the Morava sand, whereas it seems probable we would use Mužlja sand which only costs 27 dinars,

We can then notice that the price of a cubic meter of lightweight aggregates concrete is higher up to :

463 - 406 = 57 dinars

which means, it increased by :

$$\frac{57}{1\ 350} = 4{,}22\ \%$$

As previously said, this difference will be greatly compensated by accomplished savings (see § 3.3.1.3.) as our final balance shows a general saving of about 4,50 % to 5 %.

3.3.1.7. - The manufacturing unit

The technology of the manufacturing unit has evidently to be determined according to desired output, exact quality of clay to be processed, resources of eventual adjuvants and start and successive investments that can be made.

We believe that the basis of daily factory output should be 1 000 m3 for investments profits to be satisfactory.

As there are 250 working days in Yugoslavia, we can schedule that the unit will actually operate over 200 days, the other 50 working days being dedicated to maintenance, repairs and various breakdowns.

Annual output would then reach 200 000 m3, thus corresponding to estimated needs, as in § 3.3.1.4.

GIK "BANAT" let us know of the chemical analysis of clays from the "NEIMAR" brick-works and the MIHAJLOVO road extractions.

Here are their respective compositions :

. Al_2O_3	NEIMAR	15,89 %	MIHAJLOVO	22,57 %
. SiO_2	"	55,92 %	"	57,89 %
. Fe_2O_3	"	7,56 %	"	4,39 %
. Ca O	"	6,05 %	"	5,83 %
. Mg O	"	3,26 %	"	2,43 %
. SO_3	"	0,41 %	"	0,37 %

. Si	.....	NEIMAR	0,02 %	MIHAJLOVO	-
. K_2O	.....	"	-	"	3,22 %
. Na_2 O	.....	"	-	"	2,00 %
. Mu O	.....	"	-	"	0,05 %
. Fe O	.....	"	-	"	1,72 %
. Ti O_2	.....	"	-	"	0,59 %
C O_2	.....	"	-	"	2,97 %

Those analyses should be completed by mineralogical and granulometrical ones.

To such extent, the qualities of analysed clay seem to suit expanded clay manufacturing, eventhough in both samples the lime percentage is a little high (5,83 % to 6,05 %) the superior limit generally admitted being from 4 % to 5 %.

It is our suggestion that a hand-working unit should be scheduled to start off with, and then provided with automation systems, all this because the necessary tests and running in, while perfecting it, can only operate by hand and because of more reduced basic investment.

In a second phase then, automatic manufacturing would be accomplished with the necessary dispositions to such purpose yet scheduled from the start.

Scheduled investments, site, system of roads, construction engineering and gas, power and water supplies excepted, can be estimated during the first phase at about 40 000 000 dinars.
When starting with equipment and machinery manufacturing, the second evolution phase will range from 400 000 dinars to 1 000 000 dinars according to the degree of desired automation.

3.3.2. - Creation of a prefabrication factory

(continuous assembly line of concrete components with open system)

3.3.2.1. - Industrialization and prefabrication

Our determination in this chapter is not to describe the history of construction nor to explain by which ways the technics, always progressing, have made the industrial methodes applied for housing.

It's no more to expose the many processes of industrialization and prefabrication, but to keep in good attention on advantages and disadvantages and also on the creative meaning which has to be the main care as well in the research as in the realization, and take in charge all the obligations belonging to an industrial process.

A - INDUSTRIALIZATION

If a lot of industries have been successfull in great progress, particularly those last years, construction was not able to follow the development it researchs, because it has to take in charge of natural paramaters, differents kinds of needs, various psychological facts and the research in architectural creation.

Industrialization of building meant that a determinal product is made in a factory without knowing who will buy it, where and why it will be used.

If this tendency may be agreed for some products such as industrial buildings, rural plants, elements for bridges, etc...., it might not be for framed construction.

It's why we think that in construction, industrialization is more to use machines for almost all the operations, and realize components, either in factory or on the work, and it's what we call prefabrication.

B - PREFABRICATION

If it is impossible for abvious reasons, to industrialize

./.

whole a construction, it is able to do it for the elements composing a building ; this industrialization is called prefabrication.

That own can be realised either on the site or in factory.

The own principle of the prefabrication is to divide the building project in a certain number of elements, to realise them, to transport them and to put them together ; therefore it's quite necessary to normalize, to product series, the only technical and economic base of an industrial production.

The dividing in elements can be operated by differents ways :

- By dividing the traditional construction in usual components, piles, beams, floors, breasts, etc...., valuable for industrial buildings.

- By dividing each primary unit - bed-room, kitchen, bath-room, etc...., that is the tridimensional prefabrication.

- By dividing in flat and large size elements, the constructions built by self supporting shells, or tables or tunnels ; it's prefabrication in heavy pannels.

Now, it is this last process which is the best corresponding to industrial technics, economical imperatives and architectural research.

In this system, a lot of processes exist in the world, and those can be organized in two classes :

- the first one is to produce a few number of fixed dimension elements, just giving a narrow architectural choice ; it is the "closed prefabrication".

- the second one is to use a plant allowing, with the same machines, to get large enough variations in dimensions and architectural appearance ; it is the "open prefabrication".

But, of course, all these processes are limited by the ways of production, according materials, transportation and lifting possibilities on the site.

./.

Without any anticipation on the further points, we will analyse advantages and inconvenients of the heavy prefabrication, technical and architectural problems.

a)Advantages and inconvenients

There are several kinds of advantages for heavy prefabrication :

- saving in qualified manpower by succession in a factory of primary simple and repetitives operations.
- better working conditions, almost all the work being realized in a factory far from weatherings.
- saving in materials and easier use of isolation or coating materials which are too expensive in traditional building.
- easy and precise incorporation of completion equipments.
- saving in site engines (especially staging) and saving unecessary expenses (casting wood, steels, etc.....).
- completion at time by the able planified production in a factory.

The main inconvenients are :

- The important investments to seattle the factory and to adjust the organization of the combine with new methods.
- The technical difficulties regarding occuracy of manufacturing, working organization, perfection of lightworks (joints, coating, incorporations, etc...).
- The difficulties of transportation and lifting of finished components, heavy and weak at the same time, with all the problems of repairs on the site.

b) Technical problems

The problems of fabrication are all of the same kind, whatever the curried process, and have to be studied not only deeply at first, but also be purchased according

./.

entrance on the market of new materials and whole the progress required by the ease.

The main problems are regarding :

- the heat insulation and consequently elaboration of differents kinds of walls :

  - plain
  - many layers
  - with hollow bricks
  - with air matress
  - sandwichs

  etc....

- the air and water lightness, consequently the problem of joints.

- the condensation on the external walls, issued either from surplus of mixing water, or from the atmosphere of wet rooms (kitchens, bath-rooms).

- the protection against fire regulation of which is respecting to the fire-barrier, the stability of works and material inflammability.

- the idea of acoustic confort which has to resolve the problems of transmission of the aerial and impact noises either from external, or neighbours, or lightwork instalments.

- the integration of completions :

  - heating
  - electricity
  - plumbery
  - joinery
  - cup-boards

  etc...

- the stability of the constructions, the study of which seems complex because of the interdependance of the diverse components, but the experience of which shows that the account simplifications allow to surround the problem precisely.

- the durability of the construction and the facilities of maintenance.

- then, the realization as well in a factory as on the

./.

site. This question requires the study of materials, system of fabrication and transportation and erection.

Concerning the materials, we have seen that G.I.K."BANAT" has almost all the necessary lightwork materials, but is really dependant on extraction and transportation of aggregats, the main base of a precasting plant which has to be in the center of its activities, it means ZRENJANIN.

That's why we think that a production of lightweight aggregates (expanded clay) could be, in any point of view, the adequate solution.

A prefabrication in lightweight aggregates would resolve the problem of transportation and erection, regarding the regular load per axle in Yugoslavia (10 T.) and the existing liftingpossibilities. We must remember that the lightweight concrete weighs 30 % less than the traditional concrete.

We will inquire about this important question in a following chapter.

c) Architectural problems

Architectural creation connected to shop-fabricated components sets a certain amount of very complex problems as far as design is concerned.

We must say that historically, the first persons to produce pre-cast components have been enthusiastic, innovating manufacturers, but who didn't have the least worry about architecture itself ; (to their mind, shape being the "pure consequence" of the technique or decoration that is plastered later).

Consituted bodies in architecture have been sulky with prefabrication for years (despised and refused it).

The prefabricated-housing markets and prefabrication manufacturers to have lived in some conceptual self-sufficiency to the detriment of the sense of synthesis and architecture.

The excesses of some partisans of inward-looking systems of prefabrication, for whom profit-making and economic

./.

criteria were the only factors of appreciation, provoked a healthy reaction from users and professionnal people involved.

Nowadays, architecture in housing estates, built from outward-looking prefabricated systems of construction is going through an uneasy adolescence since not very long ago.

The conceptual effort and creativeness involved by some people should bear fruit. Pluridisciplinary teamwork becomes compulsory. It's up to the architect thence to assert his personality within it !!

Imagination, the technological survey of the components' shape, a very open combinatory with the help of collective effort should enable to progress in such direction.

To our mind, main efforts should be concentrated for now on the richness of the combinatory, which would thus leave it free to create very varied interior (cell) and exterior (urban landscape) architectural spaces on the one hand, and on the morphology of front-walls' components both on ordinary and ground-floor on the other.

3.3.2.2. - The prefabrication factory

A - TYPE

We have analysed G.I.K. "BANAT" prospects as regards both collective housing units and detached houses under the angles of both quantity and output.

To meet these changing needs, we recommend setting up a prefabrication unit comprising a continuous production line. This type of factory is well-proven and gives entire satisfaction from the standpoint of quality of the products and minimum requirements in materials and manpower.

We will now set forth its operation, performance, possible extensions and the capital investment needed.

./.

B - OPERATION

Operation of such a factory is based on conventional industrial production chains, viz., the element being processed moves forward in front of the various working stations, action being taken by operatives in the proper manufacturing sequence.

This production chain is a circular platform conveyor, the successive operations carried out on the platforms being as follows :

a) One team prepares the moulds which are made up of sides and cross-members (the profiles of which match the joint surfaces both horizontally and vertically) and a multiple-cavity undermould.

   After checking and applying mould-release oil to the mould, the travelling platform starts moving...

b) The platform comes in front of the team whose task is to cast-in major items, i.e., door frames, window, ironwork, front-wall facing and thin concrete slabs.

c) At the next working station, the heat-insulant, welded meshwork and connection ends of concrete reinforcements are positioned.

d) .... whereupon the team whose duty is to cast-in secondary items, such as duct systems, possibly an electrical heating lattice, service mains, inverted moulds and so on, comes into action.

e) The next working station is that of the final concreting, vibrating and smoothing operations.

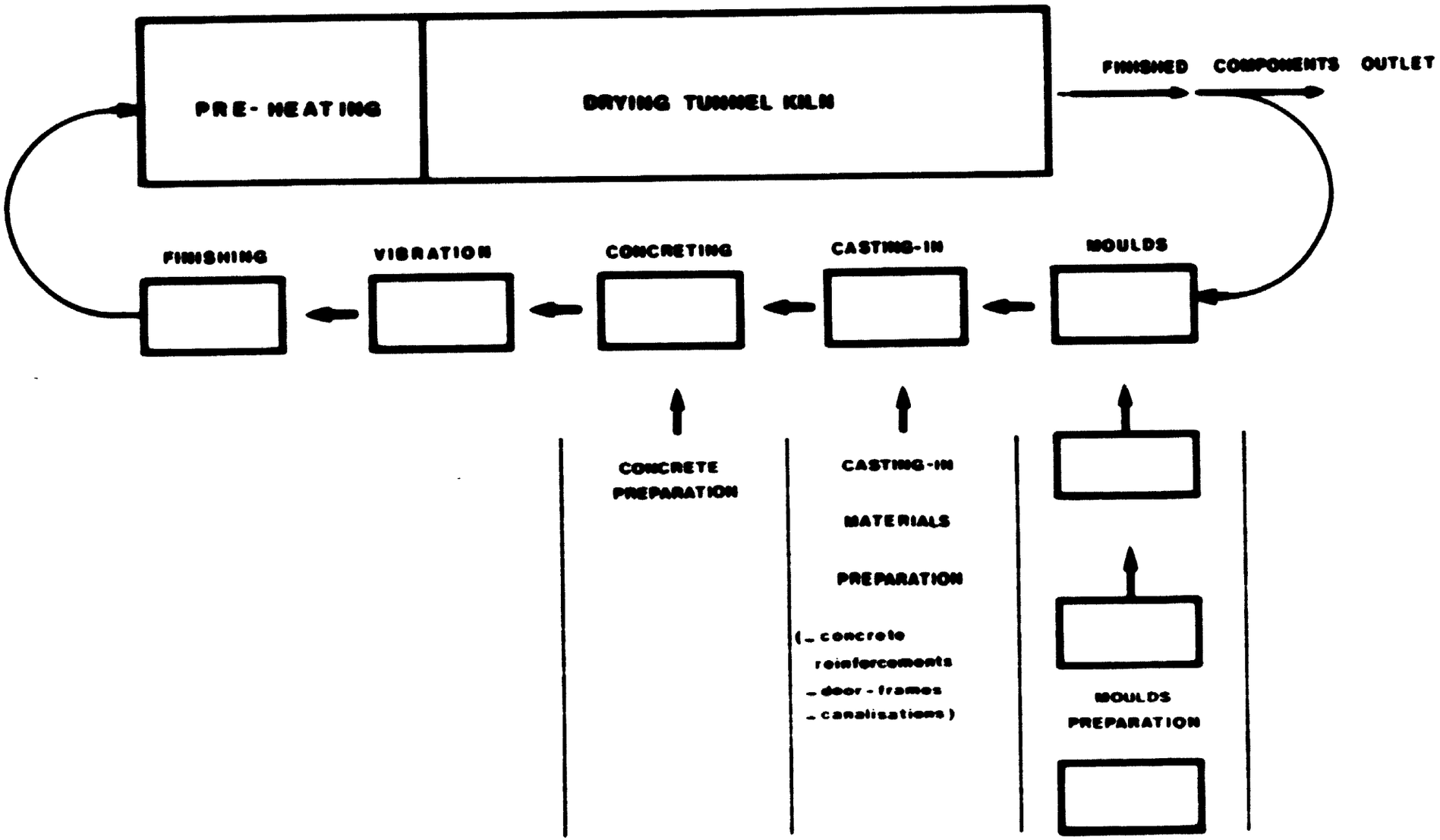
f) The platform then passes through a prewarming tunnel-oven in which most of the excess water is eliminated.

g) Next, the element passes through a steam-curing tunnel-kiln to give it the mechanical strength needed for releasing it from the mould by tipping it upright, and transporting it either to the building site or storage yard.

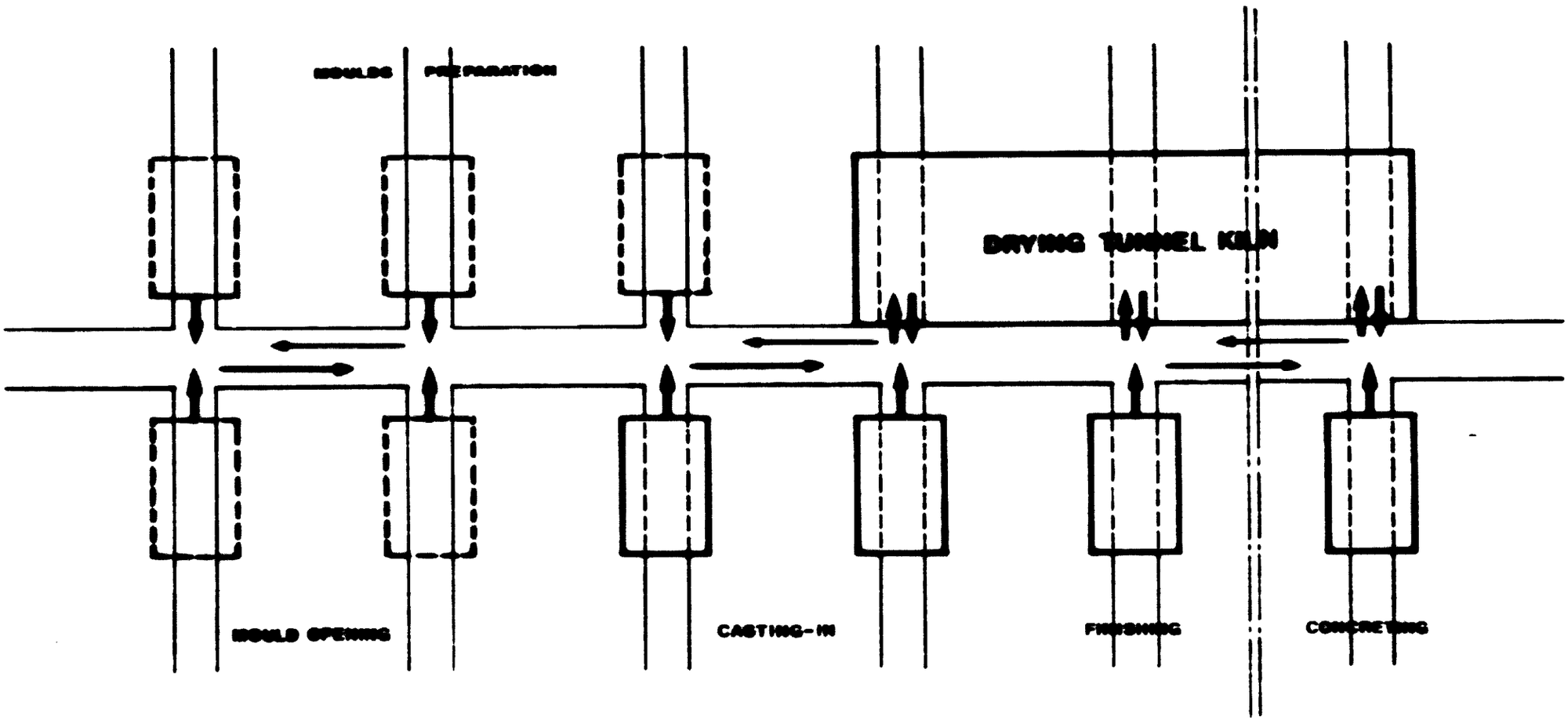
h) Though apparently different in conception, the continuous and angled assembly lines have the same fondamental principle, all the operations are running in the same order ; just the platforms handling

./.

CLOSED CONTINUOUS ASSEMBLY LINE PLANT



CONTINUOUS ANGLED ASSEMBLY LINE PLANT



system is different but anyway it's able to consider some modification.

Operation of the production line is shown on diagram 2.

Of course, all these manufacturing cycles are programmed and automated to avoid any chance of manual mishandling.

C - PERFORMANCE

Performance of this type of production line depends on several parameters (according to the type of element manufactured), e.g., facing, cross-wall or floor, and on their inherent complexity.

As a rule, the facing panel is the longest to prepare owing to the number of operations it requires : surface finishing, thermal insulation, casting-in of utilities, door frames, electrical components, concrete reinforcements and so on., and also to the need to proceed with concreting in several stages.

However, we will tentatively quote average ratios for a production line making either facing panels, floors or thin-concrete cross-walls.

Analysis of an up-to-date factory, operated by a practised staff, brings out the following data :

On the basis of a 3-room dwelling, with an effective area of 66 m2, the covered area being 7.20x3.60 metres such an analysis shows that the all-round mean effective area of the panels is 16.60 m2 and that the ratio :

panel surface $\frac{\cdot}{\cdot}$ effective area = 3.40 metres.

The panel area required is therefore :

3.40 x 66 = 224 m2,

their number being : 224 $\frac{\cdot}{\cdot}$ 16.6 = 13.5

With 27 travelling platforms, the output per 8-hour shift is : twenty-seven 16.6 m2 panels, that is 450 m2, or 2 dwellings.

Working with 3 shifts, this would be :

3 x 450 m2 = 1.350 m2/day. ./.

Assuming, on this aforesaid basis, 250 working days, the yearly output would be :

250 x 1.350 = 337,500 m2.

This is a minimum, as actually the factory operates over 250 days yearly. Furthermore, more than one panel can be made at once on each platform within the limits of its area.

It seems therefore that an average of 350,000 m2 should be considered, that is :

$$350.000 \cdot \frac{\cdot}{\cdot} \; 224 = 1{,}562 \text{ dwellings/year.}$$

The chart hereunder shows that, working with 3 shifts, (3x8hr), the distribution of manpower and of the total number of hours worked, those worked per square metre of panel and per average 16.60 m2 panel.

OPERATION	MANPOWER	NUMBER HOURS	HOURS M2/ PANELS	HOURS PER PANELS
Prefabrication	69	553	0.41	6.83
Workshop reinforcement	22	176	0.13	2.17
Services	8	64	0.05	0.79
S/ T O T A L	99	792	0.59	9.77
Stokage and loading	6	48	0.04	0.59
Repairs	7	56	0.04	0.69
Electric installation	5	40	0.03	0.49
Transportation (average 40 km)	11	88	0.06	1.08
S/ T O T A L	29	232	0.17	2.85
T O T A L	128	1024	0.76	12.62

Furthermore, the manpower for maintenance of the plant requires 10 hands 8 hours a day, that is, 80 hours, the distribution of which, proportionately to the product, amounts to :

. 0.06 hr/m2, that is, 1 hour/panel. ./.

D. EXTENSIONS

Therefore the capacity of a factory of this type could approximate to 1500 dwellings per year ; it would be feasible to increase its dimensions for a basic output of 2,000 dwellings by means of a greater number of platforms and of work shifts and, also, by lengthening the steam-curing tunnel-oven, the throughput time of which is a fixed term.

However we do not think this would be the best way to solve the problem as a fairly large additional capital investment would be called for and, anyway, would not allow implementing a long-term program of 4,000 dwellings.

Another answer to this problem would consist in doubling or trebling the production line but this would entail a similarly increased capital investment and, apparently, setting up these lines on the present ZRENJANIN site, with all the present conveniences derived from the existing plant, would not be feasible.

Therefore, we submit a more evolutionary and economical solution based on the following considerations :

. the precast elements for dwellings are of the three following main types :

- facing slabs,
- cross-wall slabs,
- floor slabs.

We will not mention functional elements such as staircases, duct systems and so on, which, anyway, are to be prefabricated in a separate shop.

In relation with these slabs, a dwelling usually consists of :

- 1/3 for front walls,
- 1/3 for cross walls,
- 1/3 for floors.

The "choice" elements being those for front walls, require, owing to appearance considerations, an exacting surface finish and various items to be cast-in and which can only be shop-fabricated.

./.

Conversely, cross-wall and floor elements can be precast separately in the shop or on site.

Cross-wall slabs only require casting-in of door frames and some ductwork (for utilities and waste drainage) since their surface finish is carried out on-site after erection.

It seems, therefore, that the "casting bed" system will be capable in a first stage, to increase the factory's output. Should only cross-wall slabs be fabricated in these casting beds, the productive capacity would increase by 50 %, that is 2250 dwellings per year.

If, on the other hand, floor slabs are pre-cast either in the shop or in casting beds, the basic capacity is then increased threefold, i.e. 4 500 dwellings/year.

This datum is slightly overestimated as the above-mentionned outputs are average, and it follows that the output rate depends on the facing slabs, the preparation of which is the longest.

Yet, 4 000 dwellings per year can reasonably be considered. We will now go into the fabricating method of cross-walls and floors.

a) Cross-walls

These can be made in "casting beds" in which they are cast vertically.

Depending on their type, these casting beds can make either 2 or several elements (folded-plate system).

In many instances, it may be best to manufacture these components on site, and, therefore, we recommend using two elements casting beds for they are fairly easily transportable and their number may be made to match the output required.

Furthermore, in this way, the labour turnover permits of carrying on, with no break, the work relating to concrete reinforcement, concreting and mould release.

In addition, capital expenditure can be gradual and suited to meet increasing requirements.

b) Floors

As regards fabrication of floor components, we recommend the two following systems ;

The first would consist, as for cross-wall components, in making use of "casting beds" providing the same range of use, either in the shop, or on-site and entailing the same expenditure.

The other, quite conventional, would consist in prefabricating components in the shop on stationary platforms. However, this process is more expensive owing to the cost of the tipping platforms and the drying equipment these require.

In no case, should such floors be made of either lightweight or high-density prestressed concrete as the camber of the slabs is not compatible with the accuracy required for horizontal joints.

E - HAULAGE EQUIPMENT

The shop- fabricated components must be taken away asthey are made and carried either to the storage yard, or directly on site.

The weight, size and brittleness of the edges and coatings of components require that the haulage equipment be devised for the purpose.

The commonly-used method consists of using containers made up with a U-shaped double-frame accommodating 2 or 3 components. This unit is carried by a special type semi-trailer which provides shockless transport either to the storage yard or on-site and at the rate required.

The components are pre-handled singly, either with a travelling bridge or a jib crane, to be either stored or assembled.

F - ASSEMBLING EQUIPMENT

The components are assembled on-site with a tower crane.

./.

The rating of the latter, including a margin of safety, must be adequate in order to serve the whole building-site area.

The weight of the heavier components is in the region of 10 or 7 tons when, respectively, made of heavy and light-weight concrete.

We consider that the minimum rating of the crane should be 160 metric tons, but 200 metric tons would be best to allow for the layout of buildings and retraction space needed in some instances.

Apart from this basic equipment, the assembling process only requires small items such as adjustable oblique-angled stays, stabilizing stands, and so forth.

G - CAPITAL EXPENDITURE AND COST-EFFECTIVENESS

Stating the capital investment required for such a prefabrication production line is not an easy matter as it depends on the program to be achieved, quality of products, and degree of automation required.

To take a decision, a comprehensive analysis of all the parameters involved is necessary.

We believe that prefabrication of dwellings can only be considered with a production-unit with a yearly rated capacity of 1,000 dwellings. The break-even point, compared with traditional buildings being, in this instance, 800 dwellings.

Under present economic conditions it may be estimated that a production-line with a capacity of 1500 dwellings/year, not including the cost of civil-engineering work, concrete-mixing plant, haulage and assembling equipment, would cost from 35,000,000 to 60,000,000 dinars ex-works.

To form a correct estimate of cost-effectiveness, should be added to the cost of labour for prefabrication and transport, set forth in 505, the mean time spent on both assembling and finishing the structural shell, i.e., the latter being ready for the finishing building-trades to come into action.

./.

A team of 13 hands can, within 8 hours, assemble and finish 500 m2 of panels.

The breakdown of the overall time thus spent is as follows ; taking in consideration an overvaluing ratio of theoretical notions in § "C" for "miscellaneous and unexpected" :

- prefabrication and transport :.... 0.95
- assembling and finishing :..... 0.95

1.90hr/m2 of panels

say, 2.00hr/m2 ;

i.e., for a dwelling with an effective area of 66m2, requiring a panel area of 224 m2 :

. 224 X 2 = 448 hours/dwelling

i.e.,

. 448 66 = 6.8 hr (appx)/m2 effective area

H - TRAINED PERSONNEL

Shop-prefabrication is somewhat peculiar in many aspects, and therefore we consider it essential that the supervisory staff of the factory should be trained prior to launching into production.

In a factory of the type selected, this personnel should be trained over a period of 4 to 5 months and would include mainly :

-1. The Manager,
-2. The chief-mechanic,
-3. The foreman electrician,
-4. Two or three shift foremen,
-5. One casting-in electrician,
-6. One steel-fixing foreman.

It will also be necessary that this personnel be present and partake with erection and, in turn, be supported by the trained personnel of the head-erector for several months after the factory is commissioned.

Training of the design engineering staff (architects and engineers) is dealt with elsewhere in this survey.

./.

I - IMPLANTATION

One of the suggested hypothesis considers the implantation of the new heavy prefabrication unit on the site.

The site, schemed on the map in annex, looked as the rest, because it could allow :

- storage and supply of light aggregates by trucks
- storage of elements and inclusive equipment prepared in the various close workshops (reinforcement, formworks, light work, ...)
- the easy conveyance of complementary heavy aggregate concrete from the existing plant.
- storage along the river BEGEJ of the panels and components able to be loaded by trucks or barges.

3.3.3. - Reconversion and extension of fixed-station prefabrication Shop for exceptional Units

In our description of the prefabrication plant (3.3.2) it was stated that the latter would not be capable of producing exceptional units, namely :

. Straight and winding staircases

. Ducts and staircase wells

. Miscellane ous vents,

. Balconies, loggias, window boxes and the like.

In 2.2.3 we recommended the installation of a prefabrication hall in ZRENJANIN, to replace the present bare areas, in order to meet the requirement for a semi-prefabricated construction system (see 2.2.2.)

The concurrent reorganization of the facilities at BELA CRKVA strengthened this recommendation.

As soon as the prefabrication plant described under 3.3.2. comes into operation, these facilities will no longer have to produce parts of dwarf walls, façade panels and so on, hence "BANAT" will then have available the required areas for prefabricating exceptional components (e.g. staircases, ventilation ducts etc ...) for the residential buildings at the required rate.

There should be no problem in effecting this reconversion, provided it has been programmed ahead.

It would be more reasonable to suggest that, depending on the activity in other areas(industry, office buildings, public works, etc...) "BANAT" decides on enlarging these halls. As regards their structure, we have already suggested (see 2.2.2) a modular type of building.

The production of architectonic facade panels, at fixed stations and in small runs of exceptional parts, should not be neglected and will provide an additional source of amortization of the fixed plant facilities.

There remains the question of where to develop the prefabrication of exceptional parts : to give priority to ZRENJANIN or to BELA CRKVA ?

The proposed cutting of a canal connecting the Danube with the installations at BELA CRKVA, allowing for conveying the prefabricated products of every kind by internal waterway, would undoubtedly reshuffle all the conditions of the problem.

./.

3.3.4. - Organization and planning of transportation

This section also covers the erection of the infrastructures, finish of buildings and their approaches.

In conventional building the works supervisor, assisted by the project manager, is liable for the entire operation from site work to foundations, the buildings themselves, connection to public utilities, and the installation of the approaches.

To do this he has available the contractor's personnel, that of the subcontractors or co-contractors, the equipment placed at his disposal by the machine pool chief, and materials for which he places orders with the purchasing department.

For a structure of prefabricated components, the situation cannot be the same since the sequencing of the operations begins at the factory or factories, where the building trades will already come into the picture, and will stop only after erection on the site.

It is essential therefore that the factory manager takes over the management of the sites, assisted of course by the site supervisor and a staff overseeing production planning, transports, erection and finish work.

However, adapting to local soil conditions, the traditional foundations and structures, installing the mechanical systems, connections, and construction of approaches will have to be performed by specialist teams, whether of the contractor of the subcontractors, but all under the authority of the works supervisor of the prefabrication site.

Concerned here are either traditional works such as general grading of the site, foundations, paving, etc... or second-work finishes (see 2.2.5) site development etc... of which the execution is site-related but of which the precision of preparation is necessarily that of prefabrication.

Since one advantage of prefabrication is to be able to plan the works ahead (as described under 3.3.2.) it is necessary that the entire operation be likewise planned ; and this requires that a single management shall oversee that sequencing of the operations and that such services as transport, handling, resupply, finish etc... shall abide by the master timetable.

It is mandatory therfore to create an organization and planning team under the sole responsibility of the works manager, this being the only method of achieving the optimized sequencing of the operation.

The research and programming Section of the Marketing Division, which was in charge of the load plan of the O.O.U.R. will have to be merged with the special section of the division liable for that purpose.

3.3.5. - Instituting an open continuous prefabrication line for lightweight panels with ISOBETON Base

The technological updating imposed on the "BANAT" Combine (cf 3.2.2), alongside with the necessity to diversify its current and future output, emerges on the obligation to manufacture lightweight panels of high thermal efficiency. BANAT'S modest experiment with its containers paves the way for prospecting for novel materials in the way of lightweight fill panels which by their intrinsic quality and advanced technology will meet the problem in hand. In the spectrum of prices covered by the assortment of existing prefabrication systems, we believe that ISOBETON is clearly ahead by its competitiveness and reliability, and on this account justifies the proposal set forth below.

3.3.5.1. - Materials and technology

ISOBETON is a composite material consisting of rigid polyurethane with an aggregate fill. As against concrete (made of aggregate + cement), in this case the aggregate is replaced by expanded balls and the binder is replaced by a synthetic foam with an isocyanate base, hence its name.

. Composition : . Filler aggregate consisting of either :
- expanded glass, or
- expanded silicate, or
- expanded clay

Grain size	Specific weight
10 - 30	120 - 140 Kg/m3

. Polyurethane resin binder :
60 - 65 Kg/m3 ISOBETON

. **Physical characteristics** :

1 - Specific weight		200 Kg/m3
2 - Heat insulation		λ = 0.47 kcal/h/m2/°C
3 - Compressive strength		8 - 10 kg/cm2
4 - Bending modulus	$\simeq$	abt. 1300 kg/cm2
5 - Permeability to water vapour		.006 g/m2/h/mm HG
6 - Impermeability		Nil capillarity

. **Basic data on prefabrication of ISOBETON-based external walls**

INDUSTRIALIZATION PROCESS :

- Large panels 280 x 680 cm (storey height , max. width 7 m. without joint)	Stringent tolerance during manufacture
- 100% factory finished	Mounting rig
- Packed in shrunk polyethylene film	

CHARACTERISTICS

- Solid, rigid units - Dimensional stability - Intimate bonding of components obtained by injection	no sealing cracks

- Cladding integral during fabrication - optionally, external cladding reinforced with glass fibre for direct coating on all facing materials.

- lightness reduced thickness	reduced transport costs (e.g. one 100 m2 house on a single truck)

- External cladding may be of various ticknesses 7 - 25 cm.

. **Physical properties of panels**

For one external housing panel, typically :

- Thickness 8 cm : - 7 cm ISOBETON
  - 1 cm Placoplatre
- Heat insulation coefficient : K = 0,55 kcal/h/m2/°C
- Fire performance :
  1) Resistance to fire - Stable for 1/2 h., which be improved by admixture of asbestos-cement.
  2) Reaction to fire - Internal facing non-flammable
     - External facing moderate-flammable, conforming with criteria for 1 and 2 family housing standards

(note : above standards comply with french regulations on fire protection)

. bearing capacity ISOBETON walls may be considered bearing walls over one storey (individual house GF+ 1 and containers).

. Typical applications of ISOBETON in housing and industry

EXTERNAL BUILDING WALLS	Curtain walls	- Collective buildings - Factory sidings
	Panel walls	- Collective buildings - Individual houses - Offices - Bungalows, villas
ROOFING	Insulating panels for flat deck roofs or sloped roofs	- Factories - warehouses - Residential - Housing - Office

MISCELLANEOUS FACINGS : Asbestos-cement-wood - lacquered sheeting - gypsum - waterproof film - film coated stone - plastic film - laminateds -

COLD STORES	- Insulating walls of cold rooms - Refrigerated truck walls - Refrigerated wagon walls
MISCELLANEOUS	- Caravan walls and floors - Containers

./.

MISCELLANEOUS FACING : *Laminateds - stoneware-lacquered sheeting*

3.3.5.2. - DESCRIPTION of PLANT.

A simple awning of about 5500 m2 covered area (increasing to 7700 m2 if an extension is made for a second press), comprising four main zones of activity as follows (see plant plan and section, below).

1. preparation of parts to be fabricated
2. pressing and injection
3. mould striking, finishing and packaging the units
4. Storage of raw materials used for panels (if plant makes individual houses, this operation covers centralization and dispatching of all constituents used in the building, except of course foundations, floor slabs constructed in situ).

After packing, the components are dispatched straight to the job sites, or are stored in the open.

1. PREPARATION ZONE

The components of the panels to be fabricated are assembled on trays 7m. x 3 m., which is the size of the press. Steel corner strips and anchoring frames are used to make them to the desired dimensions.

On these trays the plasterboard facings are laid out, together with the wood or metal frames, doors, windows and pipe and wiring ducts, if any. ISOBETON panels are then filled with glass balls, expanded silicate or expanded clay.

2. PRESS AND INJECTION ZONE

The heart of the plant consists of three machines of which the dimensions condition the capacity.

- an elevator, known as "stacker/destacker", is installed in a deep pit which feeds panels to be filled and removes panels after filling.

- a traverser (rehandling conveyor) handles two stacks moving at the same time by means of self-propelled lift trucks from the press to the elevator.

- a shaping press size 7 x 3 metres, 11 panels high, keeps the stack in place and clamps it together. The clamping must resist the pressure of injection occurring in the moulds during injection and up to polymerization of the polyurethane foam ; it also ensures flatness of the panels.

In an adjoining room, the two basic constituents are stored, namely polyol and isocyanate.

Throughout this zone the room temperature should be slightly over 20° C.

3. FINISH OF PANELS

On leaving the destacker the panels have their moulds struck, are deburred and rehandled vertically over a transfer rail track. They next pass in front of the various working stations (for installing doors, glazing, electrical fixtures and wiring, painting, wallpapering, etc...) At the end, once completely equipped with all fixtures and fittings, they enter an autoclave, for receiving a wrapping shrunk-on of polyethylene film to protect the panels against impact and weathering.

If intended for individual houses, transport to the job site is done in containers. These consist of fully standardized assemblies of walls and framing, complete with "technical" panel units.

Inside each oblong container mesuring about 8 m. long by 2,50 m. wide x 3 m. high, the panels are stacked including façades, partitions, ceilings and all the other components and fixtures (sanitary, boilers, etc).

4. STORES AND OFFICES ZONE

Together these account for 20% of the entire plant's floor area.

- Plant capacity

The capacity depends on the press cycle which is 1' 30" (i.e. 1 hour press pass + injection 15 " and transfer 15"). The press operates 5 to 6 times per shift of 8 hours (in actual fact the cycle corresponds to 5 pressings of 7' 30" and 6 pressings per 9 hours'work). Hence the minimum output per 8 hours/shift comes to :

5 pressings x 11 = 55 panels/hour

or in the production of individual houses :

$$\frac{55}{18,25} = 3 \text{ average houses of 4-5 rooms}$$

(in which the average number of panels per average house = 18,25),

or, annually :

55 x 220 = 12 100 panels/year.

The number of work/days per annum given above, namely 220, is a minimum assuming a high coefficient of contingencies. In fact, the figure generally exceeds 250 work/days annually.

From which we get :

12 100 large-size panels,

or 3 x 220 = 660 houses/year.

If the work is done in two shifts, one of 8 hours and the other of, say, 8 1/2 hours, the output is improved as follows :

5 + 6 = 11 pressings/day

11 pressings at 11 panels = 121 panels/day

i.e. $\frac{121}{18,25} = 6,63$ houses/day.

On a yearly basis, this comes to :

121 x 220 = 26 620 panels/year

or say 6,63 x 220 = approximatively 1 460 houses/year.

In the event of an extension to the plant, which is possible and relatively low-cost, by the addition of another press, what will then be determinant on output is the cycle of the stacker/destacker, which by itself will be service the two presses.

Since it processes 1 stack (or 11 panels) per hour, the output per shift comes to

8 x 11 = 88 panels/day

$$\frac{88}{18,25} = 4,82 \text{ average houses/day}$$

or, annually :

88 x 220 = 19 360 large-size panels/year

or, house-wise :

4,82 x 220 = 1 060 houses/year.

Assuming two 8 hours shifts daily, we get :

16 x 11 = 176 panels/day

or 9,64 houses/day

or, annually :

176 x 220 = 38 720 large size panels/year

9,64 x 220 = 2 120 houses/year.

The plant's capacity may also be expressed in square meters of panels per annum, which may have an absolutely universal application, i.e. walls, "containers" curtain walls, building façades, offices and other building walls, industrial and agricultural buildings, etc...

With an average panel of 15 m2, the plant capacity will be as follows :

. 1 press (1 shift gives 12 100 x 15 = 181 500 m2
) 2 shifts give 26 620 x 15 = 399 300 m2

. 2 presses(1 shift gives 19 360 x 15 = 290 400 m2
) 2 shifts give 38 720 x 15 = 580 800 m2

Estimated number of operatives per shift :

Fabrication shop + preparation :	38,5	persons
Finish shop + stores	28,5	"
Loading and dispatching	10	"
	77	operatives

. Transport

In the production of individual houses, transport accounts for 1 to 1,5 % of the overall cost per house.

. In-situ erection

This is done by a crew of 5 all-purpose workers per house.

In France, the ratio of work/hours in the plant and on the site is 15 : 25 francs.

Per individual house, the on-site labour required is one month, during which a crane is used only one day (delivery day) to ensure the erection.

. Capital outlay

At present-day costs this will amount to about 60 000 000 diners.

Not included in the above price are :

. plant buildings,
. civil engineering
. roadways
. storage area
. parking lots
. and offices.

. Construction period

About 18 months after placing the order.

3.3.5.3. - ISOBETON and the "BANAT" Combine

This proposal regarding isobeton is necessarily subsidiary to the preceding ones, namely that regarding the basic output of the Combine, i.e. concrete and lightweight concrete.

The exceptional interest of Isobeton lies in its complementarity with respect to this output ; as well as, of course, its complementarity in, say, the construction of individual dwellings and the fabrication of "containers".

By way of example, Isobeton panels could supplement and reinforce, even diversify, the product range :

. Collective housing (façades in general and specifically panels at backs of loggias, dwarf walls, curtain walls,etc ....)

. Ancillary members e.g. façades, heat insulation of offices, school complexes, hospitals, etc ...

. Industrial and agricultural structures (sidings, roof covering, insulating partitions of cold stores etc ...)

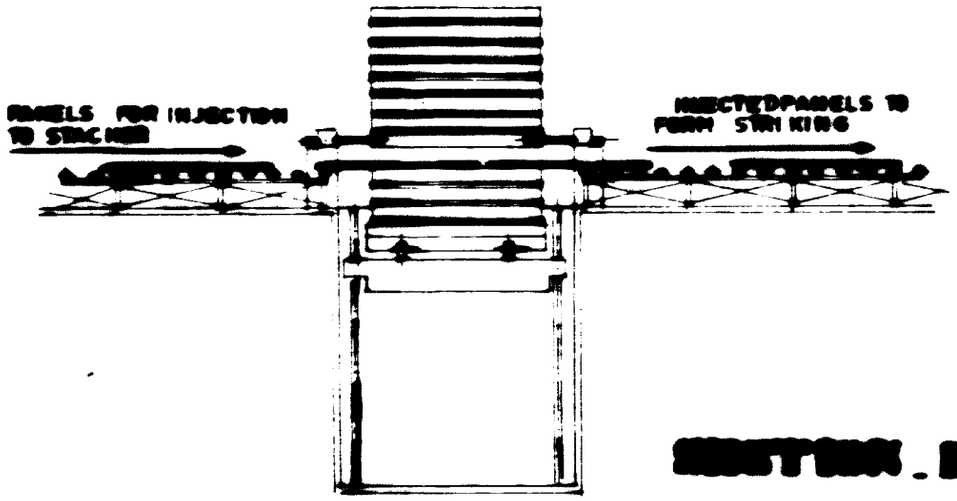
. Individual housing, in which the generalized or partial application of Isobeton could be judicious and profitable ; provided of course that typical projects are worked out beforehand including design and alternative proposals covering basic individual houses with GL + 0 and GF + 1.

. Bungalows : see week-end homes

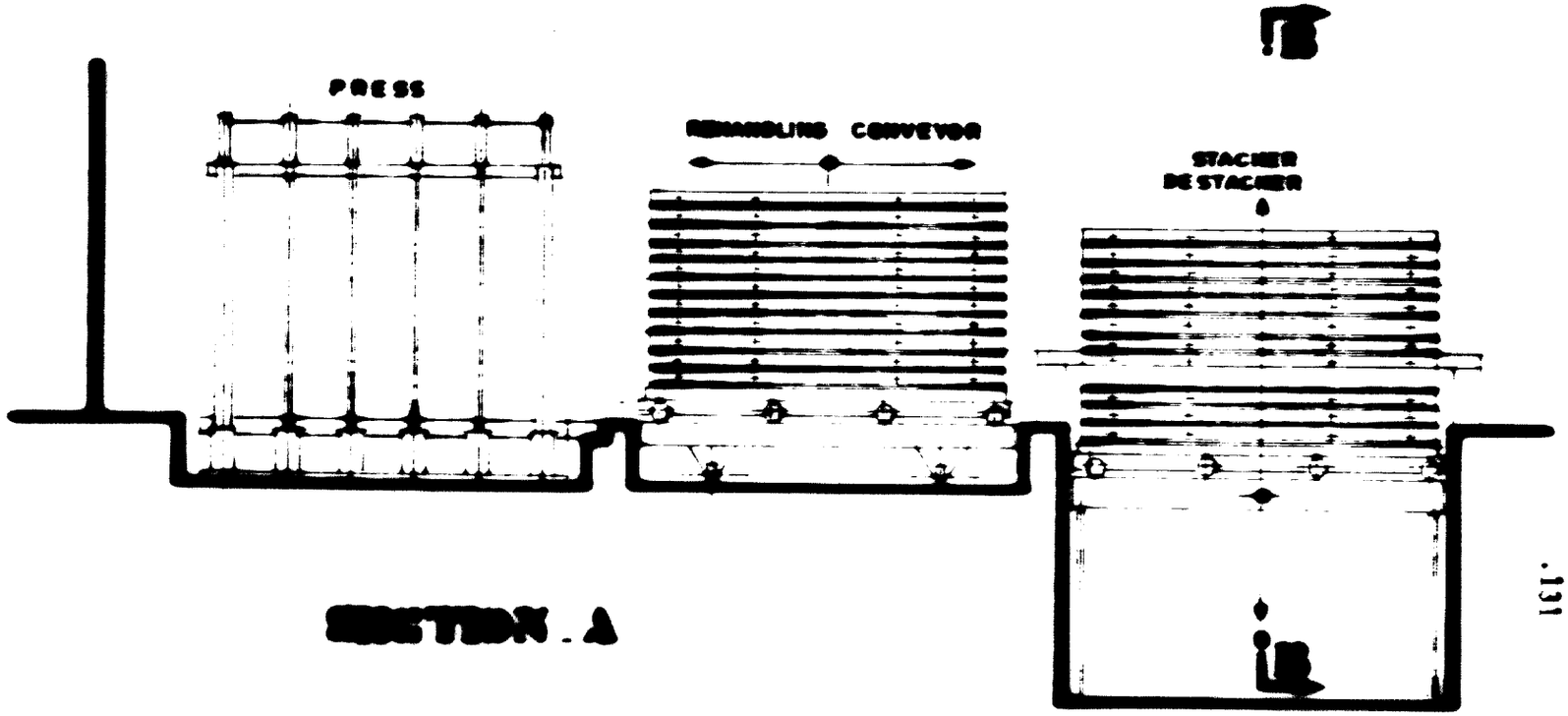
. Jobsite sheds or modules for operators (ℝ). These are already fabricated (together with other materials, see 1.2.2.3), as part of "BANAT's" output at the current rate of 200 per year. It is intended in the first place to meet the Combine's own needs ; but it appears to be the sole producer of such modules in Yugoslavia at the moment.

(ℝ) It appears that these sheds are known, by their makers, quite improperly, as "containers". It is not proposed to use this designation here, in preference to which the term "modules" is used (translator).

./.



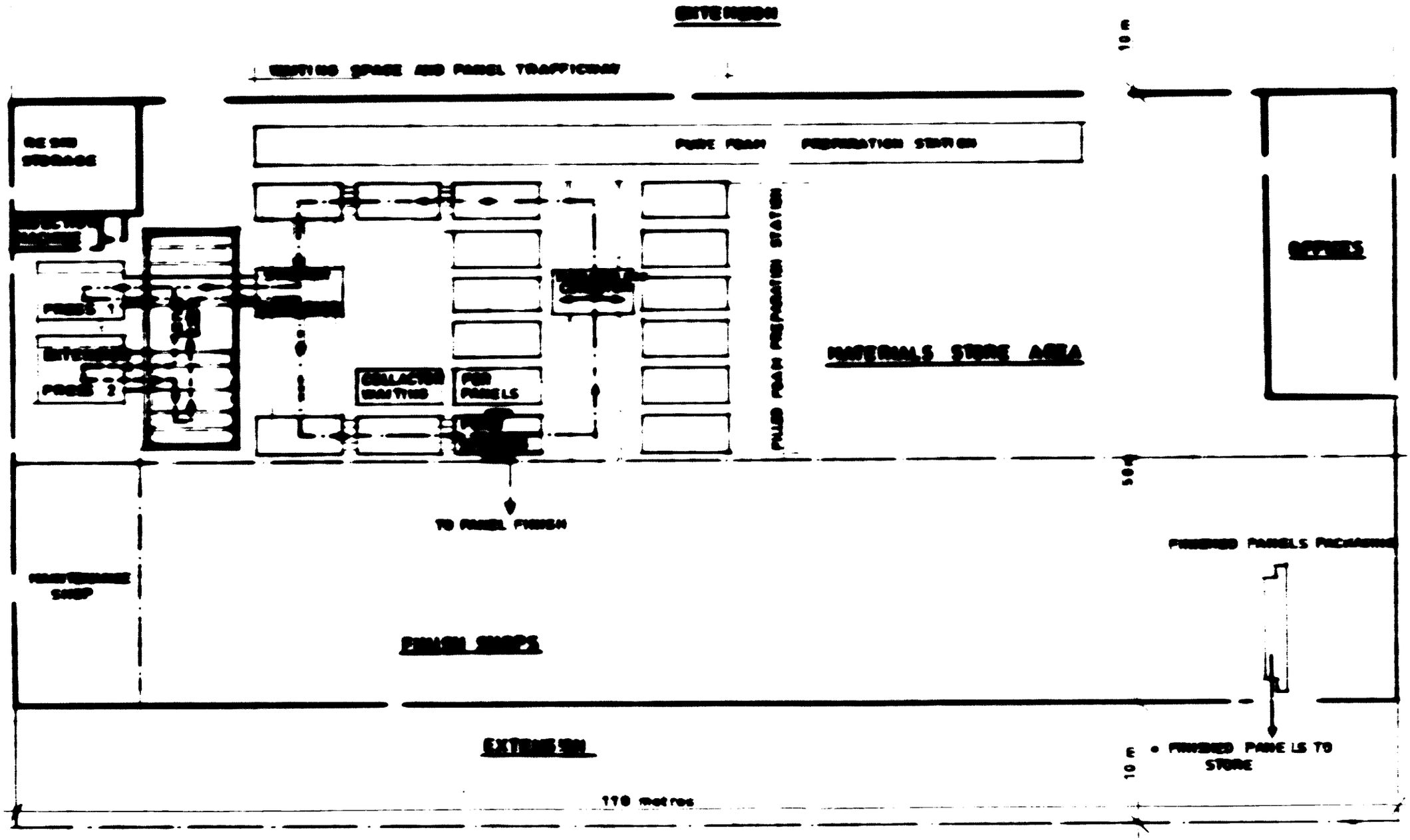
SECTION - B



SECTION - A

PROTOTYPE D.B.F. FRANCE

PLAN



Thus "BANAT" could seek to cover the needs of the national market, which solely for the building trade, numbers some 25,000 workers (about 12 % of the total labour force) working on job sites away from their domicile ; and quite apart from jobsite office sheds etc ...

Plant location :

Logically, the Isobeton plant should be located in the ZRENJANIN area.

3.3.6..- Constitution of Multi-Displinary "think tank"

Given the changes called for in "BANAT" on account of the transformation taking place in the market, and the proposals made here involving the material facilities required for the industrial production of housing, it is evidently necessary to forge an intellectual tool capable of directing such an operation. Its scope would cover a very wide field :

. Architectural research and design

. Technology of construction systems

. Technology of the production of :

- components
- in-built fittings
- erection
- finish work
- attachments

. Concrete specification of building programs to be modelized

. Potential for framed construction

The scope of such a "think tank" would have to cover the development of prototypes up to decision-making on production cycles in the plant.

It is important to stress the multi disciplinary nature of such a headquarters staff ... which may if necessary co-opt external counselling ... that stretches, all the way from architectural conception and design, to all the criteria and potential of the industrial facilities.

./.

Coherence in the process of elaboration calls for collective working. The synthesis, group dynamics and direction of such a unit must be imparted by the management, which will have the extremely complex task of planning at long term its own creative activities.

One needs to be fully aware of the vital importance, for the entire Combine, of the quality of the "product" turned out by this "think tank". It encompasses the problem of "good components" and "good models".

The system production of framed construction focusses the responsibility on certain operatives only in contrast to traditional building construction, which dilutes the effects over a number of operatives.

This is why, if the Combine intends entering the field of industrialization, its primary decision must be to create such a multi-disciplinary "think tank".

3.4. - DEVELOPMENT STRATEGY OPTIONS

The proposals made above, which included considerations on the location of the plant, are predicated on meeting the overall demand for 2000 to 4000 dwelling units per annum.

Internal rationale ... meaning technological optimization ... leads quite naturally to recommend the adoption of the following development strategy :

- p h a s e 1 -

Gradual setting up of a multi-disciplinary conceptual headquarters ("think tank") around a basic core unit.

- p h a s e 2 -

Concurrent and joint installation of an expanded clay production plant and the prefabrication plant at ZRENJANIN plus :
1 fixed-station shop for exceptional components in either ZRENJANIN or BELA CRKVA ;

./.

Total capacity of both plants to be based on the production of 2000 dwelling units per annum.

- p h a s e 3 -

To cover the growing capacity of the Combine and of the diversification of its products :

. Installation of pre-production line for light weight panels of Isobeton (1 press), in ZRENJANIN.

- p h a s e 4 -

Extension of heavy panels prefabrication plant, and extension of fixed-station shop for exceptional components/

- p h a s e 5 -

Extension of Isobeton lightweight panels prefabrication line (2 nd line)

Arising out of this strategy, the problem then is where to locate the fixed-station shop for exceptional components : should it be in ZRENJANIN or BELA CRKVA ; or in both, in a proportion to be determined later ?

The decision will involve taking into consideration the political striving after the possible dynamic growth ... or not ... of BELA CRKVA, despite its eccentric nature; and in this connection, too, the proposed construction of the Danube canal will play a part.

But another potential strategy may be followed, in order to cut down capital spending on phase 2, (the costliest phase) by extending it in time.

In this case, the prefabrication plant would be installed first, turning out conventional aggregate units, pending the construction of the expanded clay fabrication plant.

In such a case, there will be an additional item of investment for an extra set of side cheeks for the panels, amounting to about dinars 4.000.000 ; plus of course the necessity for additional transport and materials-handling facilities, which will amount to 30 % more than for handling expanded clay panels.

./.

The fixed-station shop for exceptional components would be constructed simultaneously.

3.5. - INDUSTRIAL AND AGRICULTURAL BUILDING AND INCORPORATION OF TECHNOLOGY AND PRODUCTION EQUIPMENT BORROWED FROM THE HOUSING SECTOR

All the proposals made above relate essentially to the operation residential building sector. Clearly, a similar intensive operation could be conducted in the sector of industrial and agricultural building in the following specific areas :

. Use of the "Think Tank" approach in the design of "models" of specialized building ;

. Intensive and systematic application of basic components i.e. :

- normal concrete
- expanded clay concrete
- Isobeton.

. Use of excess plant capacity for the advance prefabrication and in reserve storage of common parts, components and units (possible "communalizing" of certain units).

. Use of advanced know-how developed for housing for optimum rationalization of industrial and agricultural building production, thereby enabling "BANAT" to tackle the national market in the most favourable conditions.

./.

C O N C L U S I O N

. To keep in step with the profound transformations taking place in the market for framed construction ... (mass housing and all its appurtenances) ... the "BANAT" Combine must set itself an ambitious target : 2000 dwelling units per annum in 1977 and 4000 for the 80s.

. It is an obligation for the Combine to undertake changes in the concept of its role, in the technology of its operations, and in its production processes. It should aim to become a high-technology industrial "constructor".

. The medium and long term development strategy for "BANAT" for which housing will become the major area of activity, rests essentialy on three production facilities to be constructed :

- An expanded clay fabrication plant ; base material utilizing the local riches of the soil (clay + natural gas),

- A plant and a shop for fabricating concrete components (e.g. panels, beams, columns etc ...) which, then assembled together, will form complete buildings,

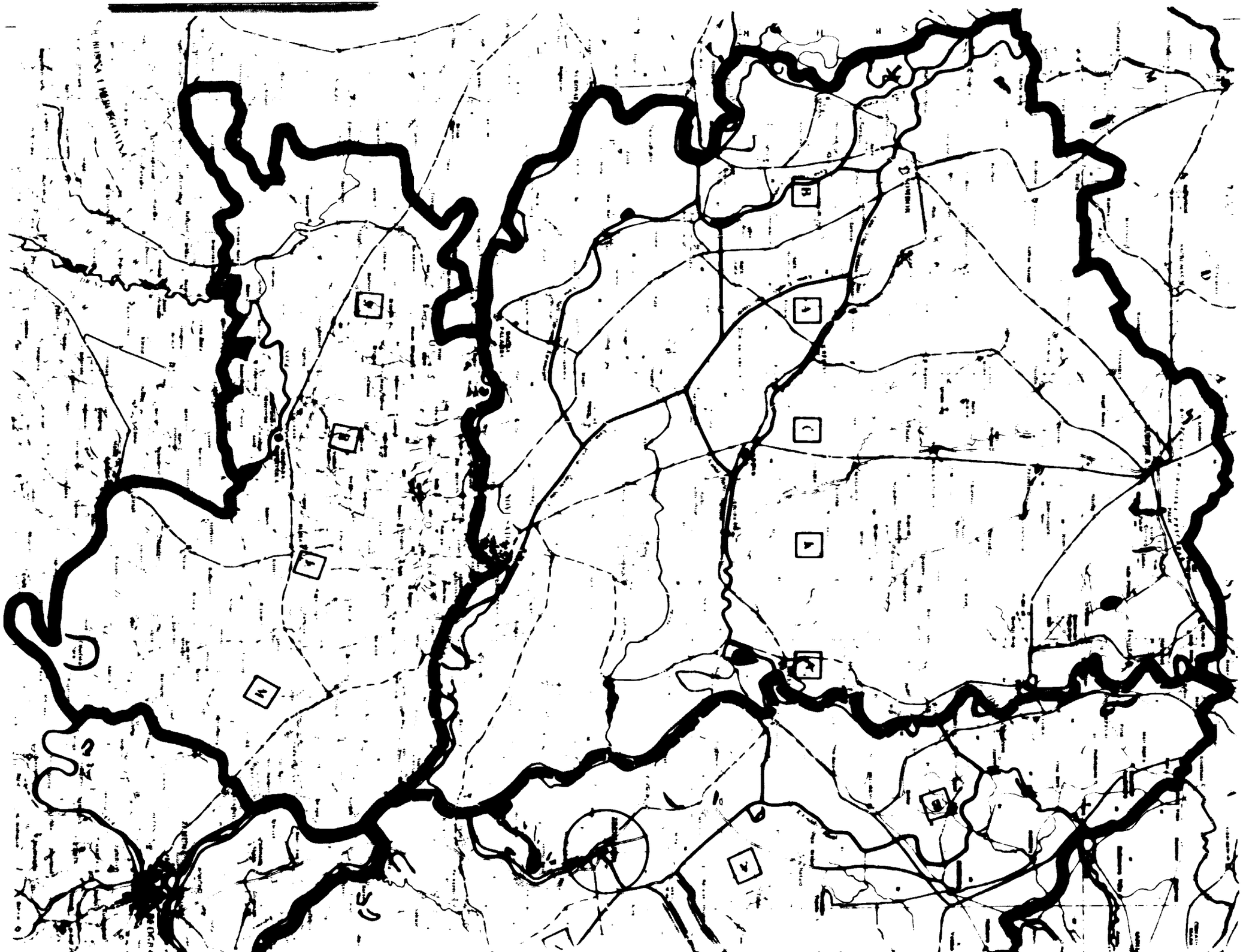
- A lightweight panels prefabrication plant (with high heat insulating properties) based on Isobeton, an allpurpose construction material.

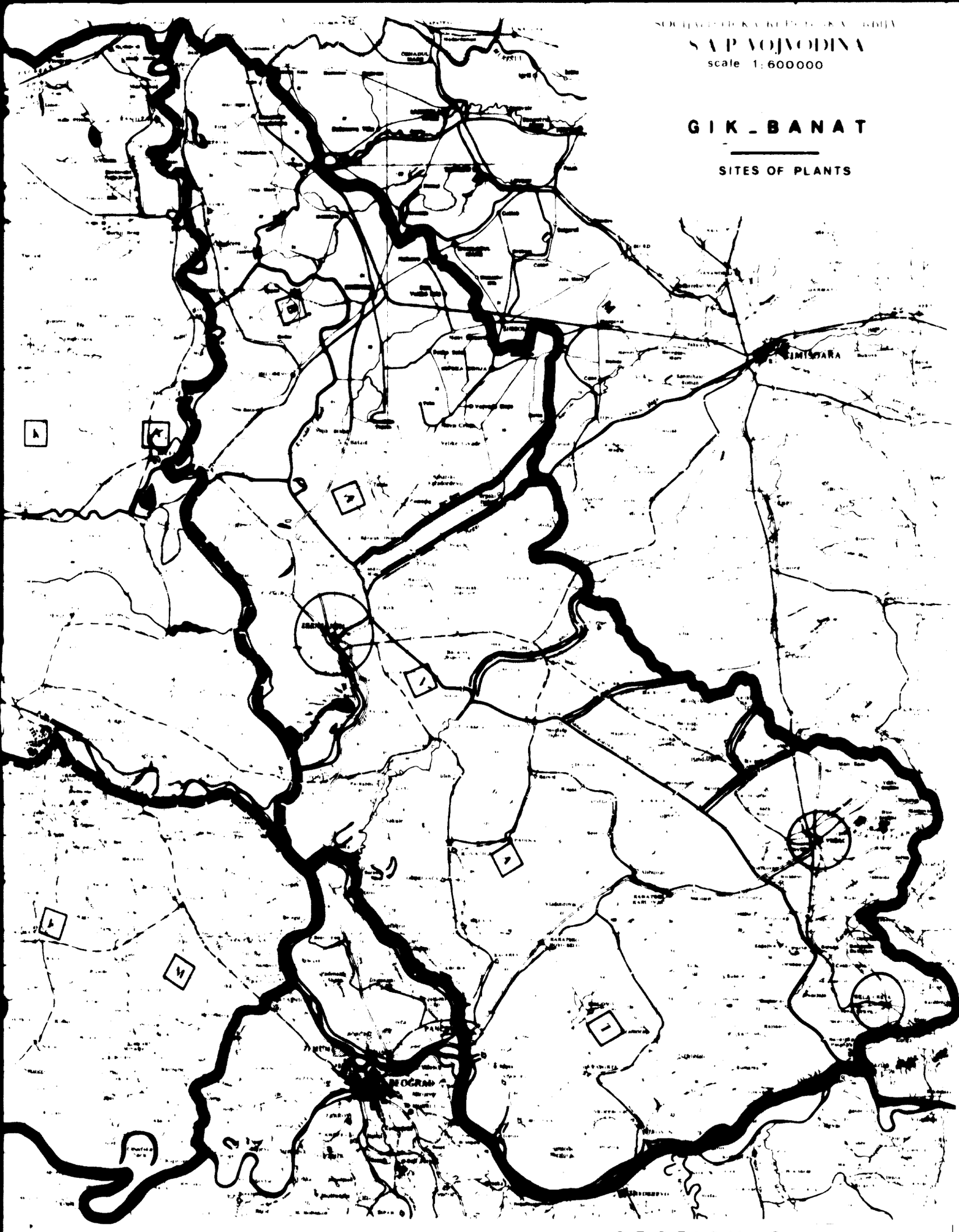
. To conceive, manage and animate the industrial production of residential buildings, it will be necessary for the "BANAT" Combine to undergo organic mutations (among others, the creation of a multi-discipline "think tank").

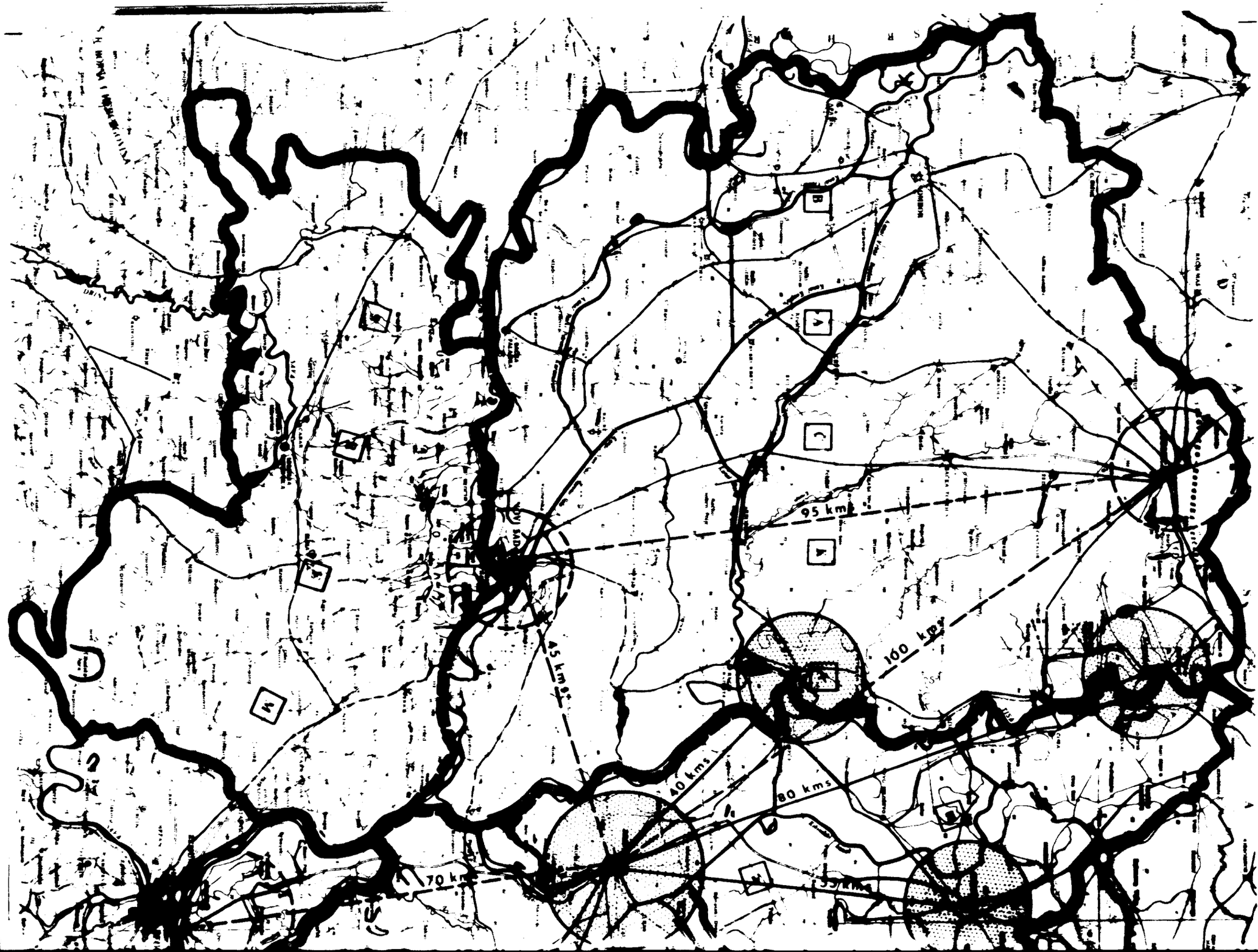
. The production of agricultural and industrial buildings will benefit from the spin-off generated by the industrialization of the housing sector and will open up new vistas ; the same also holds for the potential foreign markets.

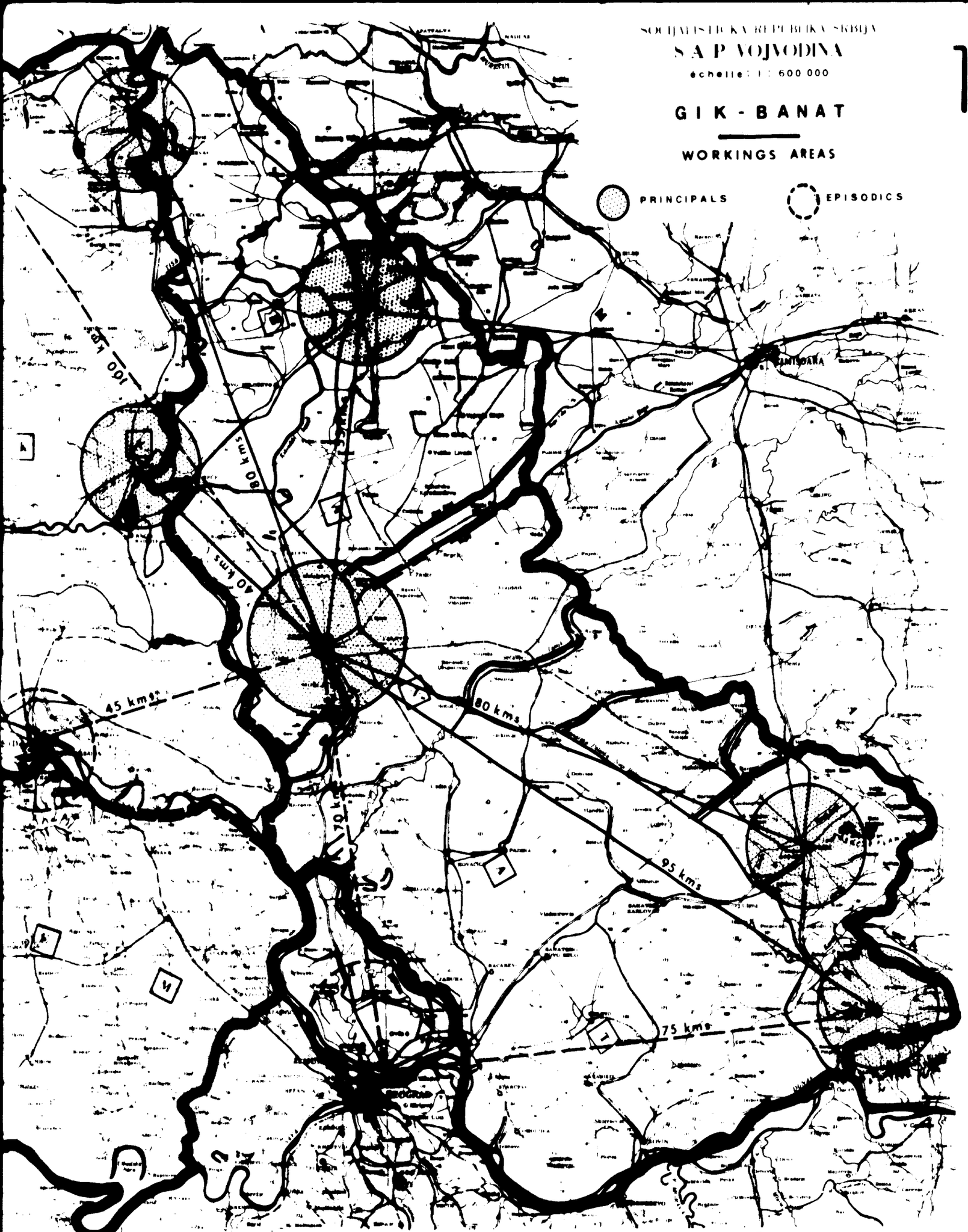
. The preparation of a development program scaled to the dimensions of "BANAT" will call for a vast international and regional cooperation. Its implementation will mobilize material and intellectual means that should on no account be under-estimated.

. Lastly, compatibility with the daily operations of "BANAT" and its current short-term program will be a constant preoccupation. The qualitative approach thereto will be made via the inception of modest increments in all fields of building.




SAP VOJVODINA
scale 1:600000
GIK_BANAT
SITES OF PLANTS

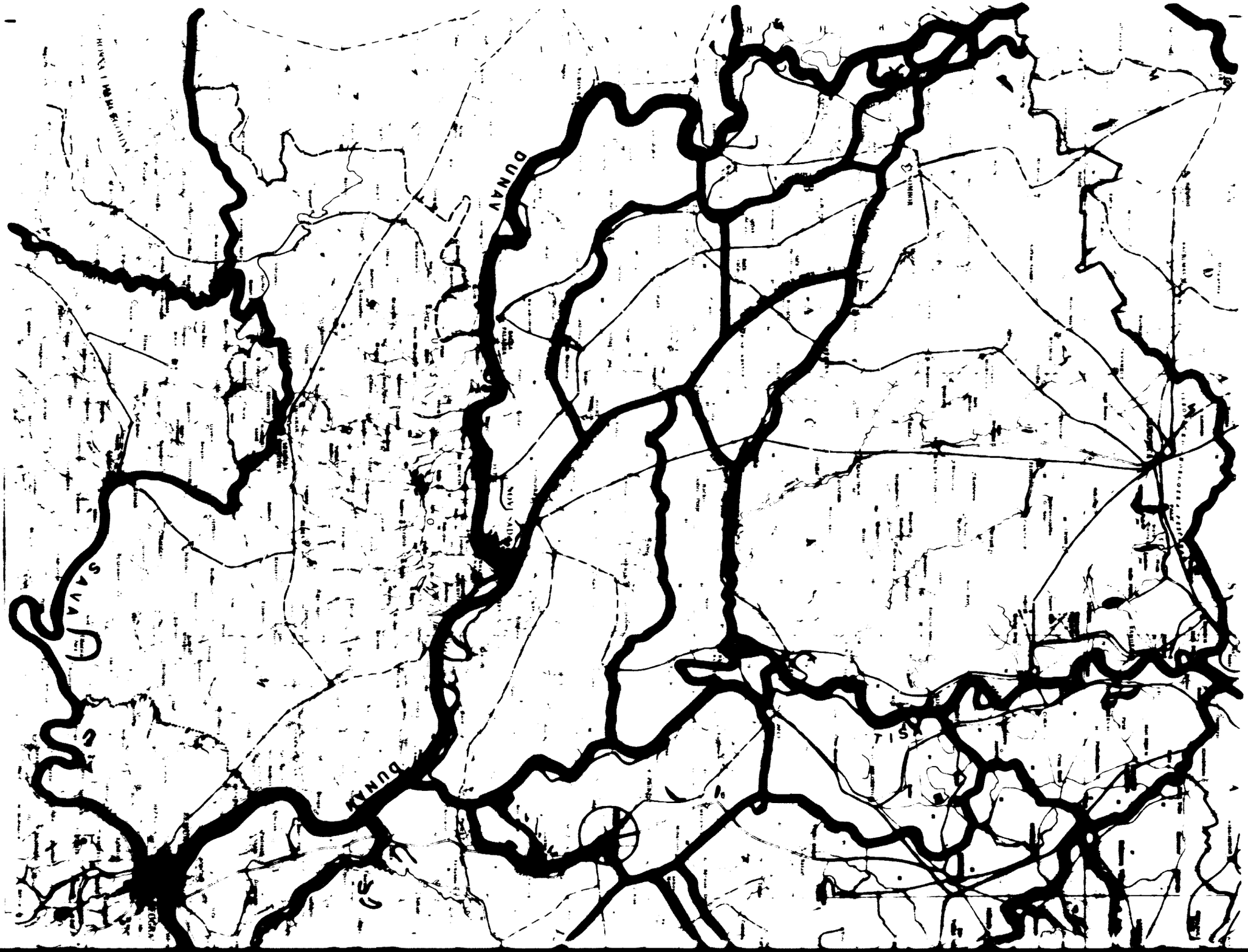

95 kms
100 kms
45 kms
40 kms
80 kms
70 kms


SOCIJALISTIČKA REPUBLIKA SRBIJA
SAP VOJVODINA
échelle : 1 : 600 000
GIK - BANAT
WORKINGS AREAS
PRINCIPALS
EPISODICS
100 kms
80 kms
40 kms
45 kms
80 kms
95 kms
75 kms
SAMOŠKA
BEOGRAD

SECTION 2

APPENDIX 3

ЗРЕЊАНИН


DUNAV
SAVA
DUNAV
TISA

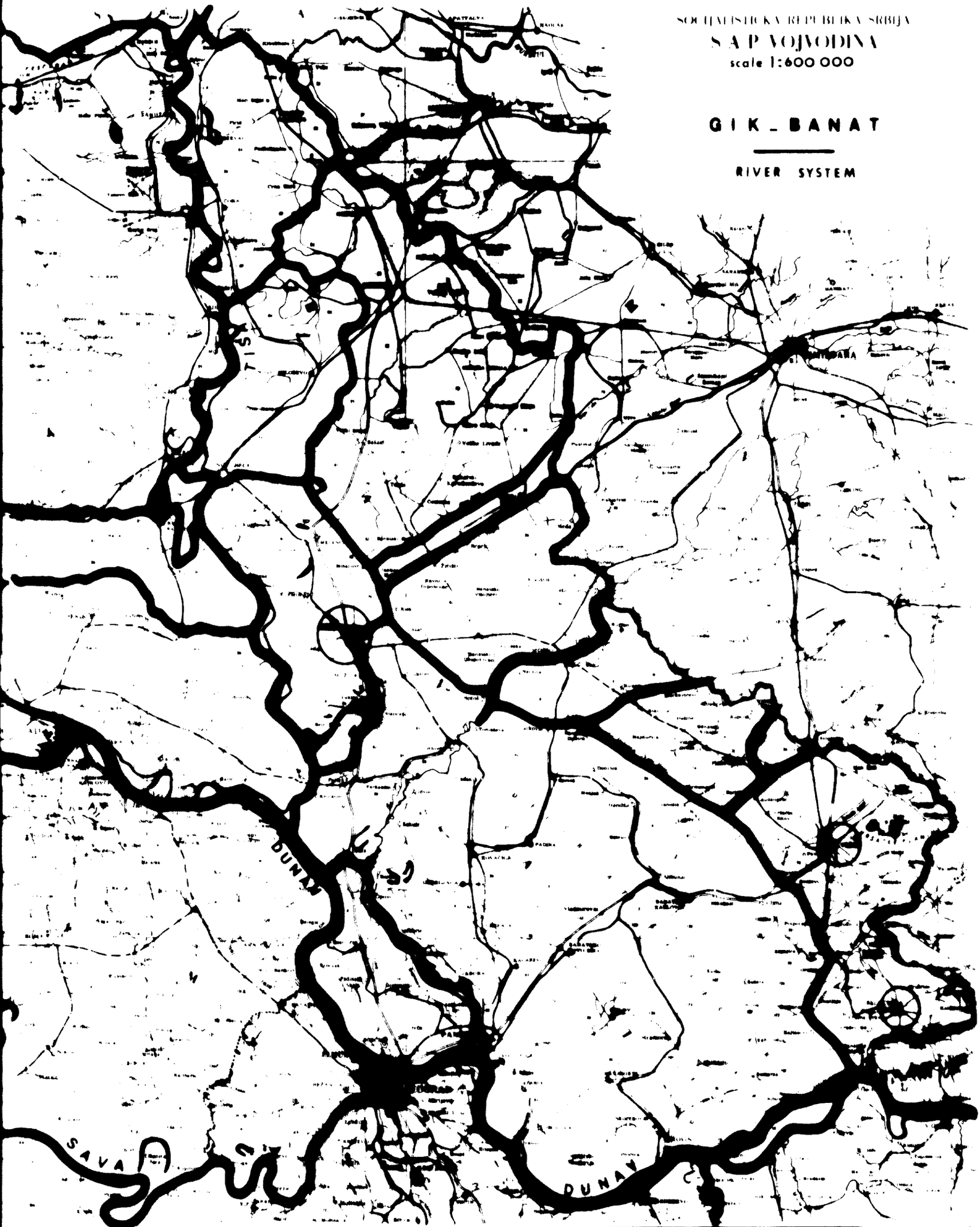
SOCIJALISTIČKA REPUBLIKA SRBIJA

SAP VOJVODINA

scale 1:600 000

GIK - BANAT

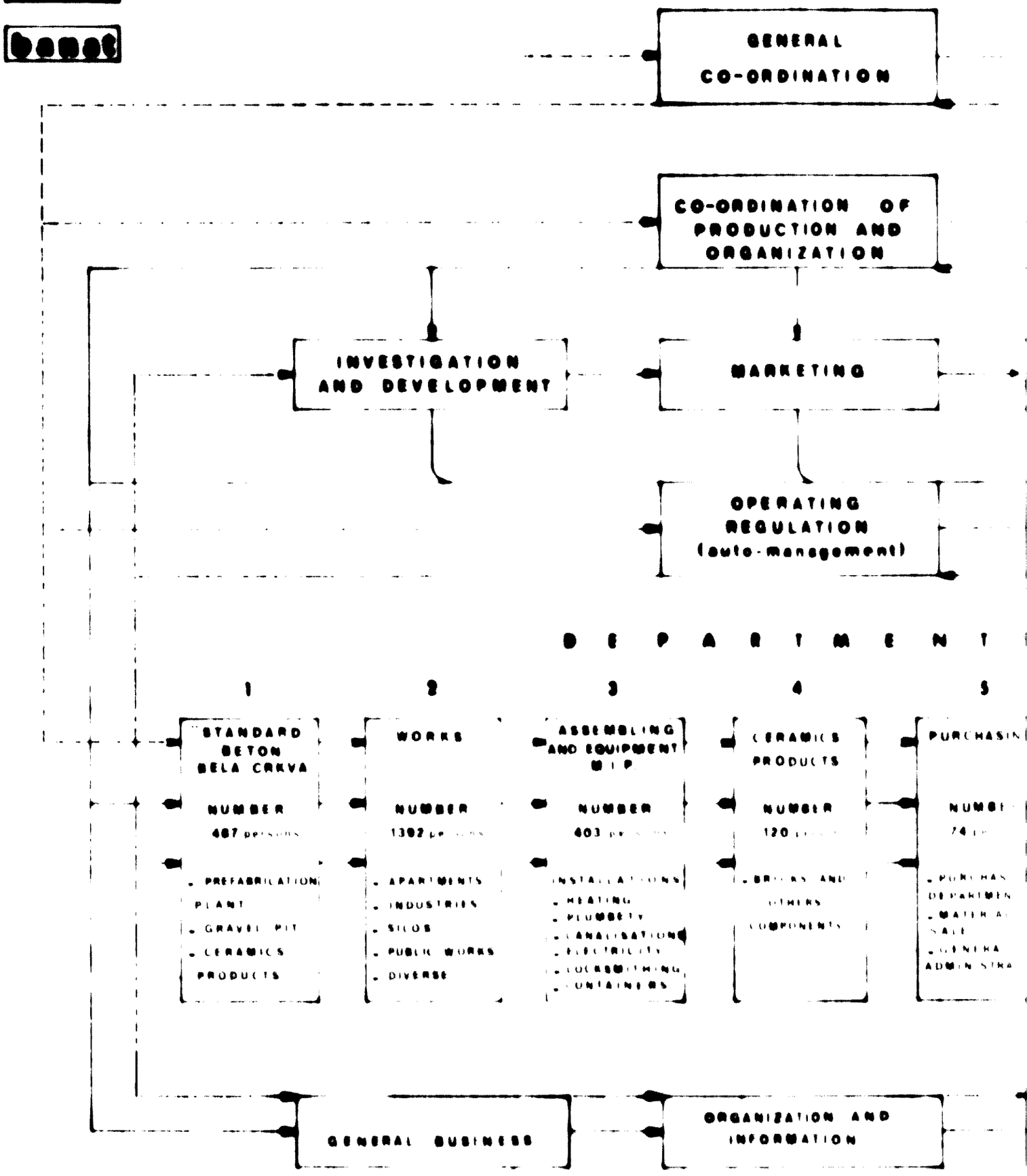
RIVER SYSTEM



SECTION 2

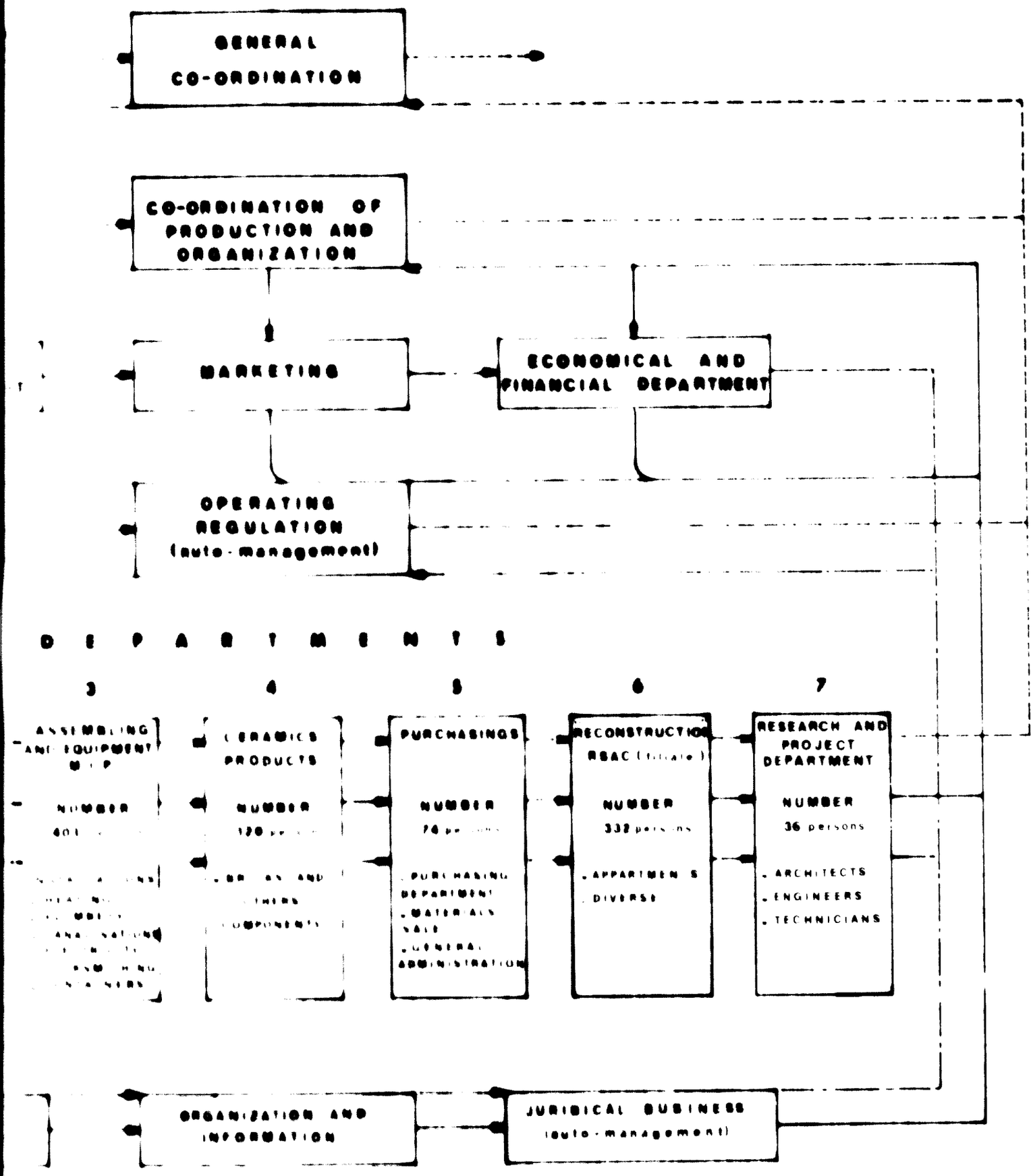
APPENDIX 5

ORGANIGRAMM



SECTION 1

ORGANIGRAMME



APPENDIX 6

" O.O.U.R "

The "BANAT" Combine is composed of the following O.O.U.R.[a]

1. - OOUR "GRADJENJE" ZRENJANIN ("Works" - *word sites, heavy works*)

2. - OOUR "NEIMAR" ZRENJANIN ("Builder" - *ceramic products*)

3. - OOUR "M.I.P." ZRENJANIN ("Assembly, fixings and equipment")

4. - OOUR "TRGOVINA" ZRENJANIN ("Commerce" - *purchasing center, but also sales of materials and general administration*)

5. - OOUR "PROJEKTNI BIRO" ZRENJANIN ("Research and Planning Department")

6. - OOUR "ZAJEDNIČKI POSLOVI" ZRENJANIN ("Common affairs" - *including research and development, market studies, economic and financial services, general business, organization and information, legal and self-government matters*)

7. - OOUR "BETONJERKA" BELA CRKVA ("Concrete mixer" - *prefabrication and implementation*)

8. - OOUR "ŠLJUNKARA" BELA CRKVA ("Gravel pit" - *aggregate exploitation*)

9. - OOUR "RAD" BELA CRKVA ("Work" - "*classic*" *contractor*)

10.- OOUR "2 OKTOBAR" BELA CRKVA - JASENOVO ("2 October" - *ceramic products*)

11.- OOUR "URBANIZAM" BELA CRKVA ("Urbanism" - *but also development for construction sites, the V.R.D. and administration of residential buildings*)

[a] *Basic organizational grouping of associated labor*
Original title : "OSNOVNA ORGANIZACIJA UDRUŽENOG RADA"
from which is derived the abbreviation "O.O.U.R."

./.

12.- OOUR "TRANSPORT" BELA CRKVA ("Transport and mechanical devices")

13.- OOUR "ZAJEDNIČKE SLUŽBE" BELA CRKVA ("Joint services")

14.- OOUR "OBNOVA" VRŠAC ("Reconstruction" - "classic" contractor with research and planning office)

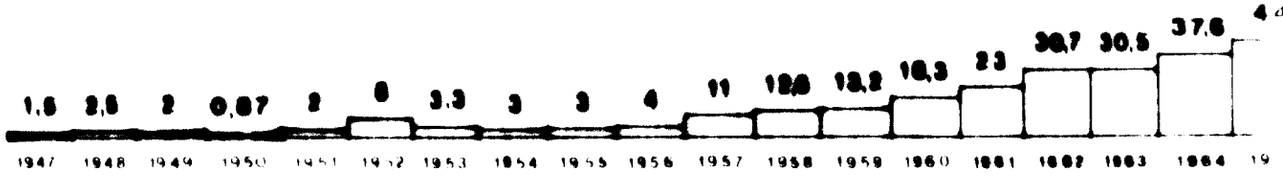
-o-o-o-o-o-

APPENDIX 7

G.I.K. BANAT

T U R N O V E R

('000.000 dinars)

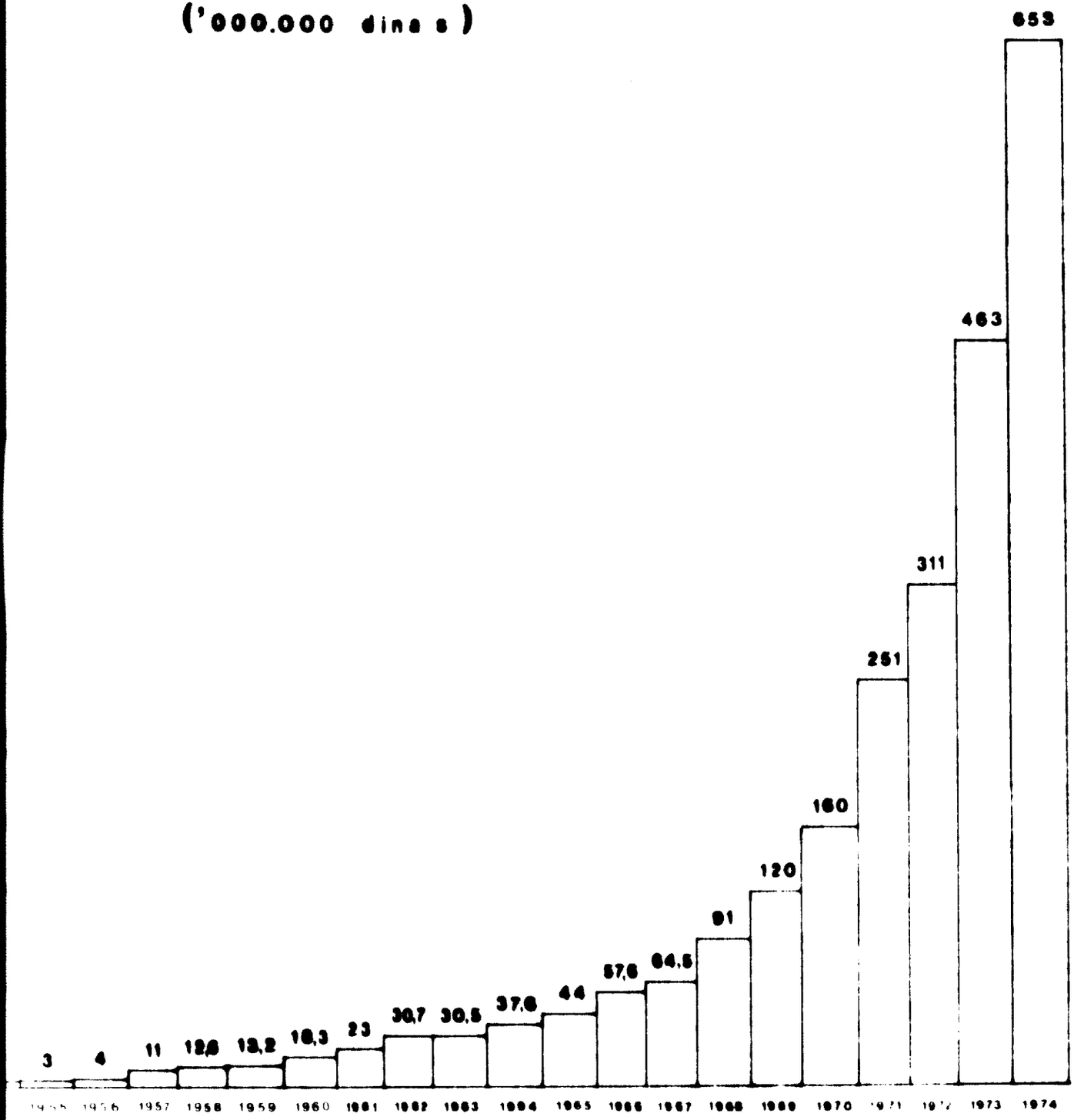


SECTION 1

G.I.K. BANAT

TURNOVER

('000.000 dinars)



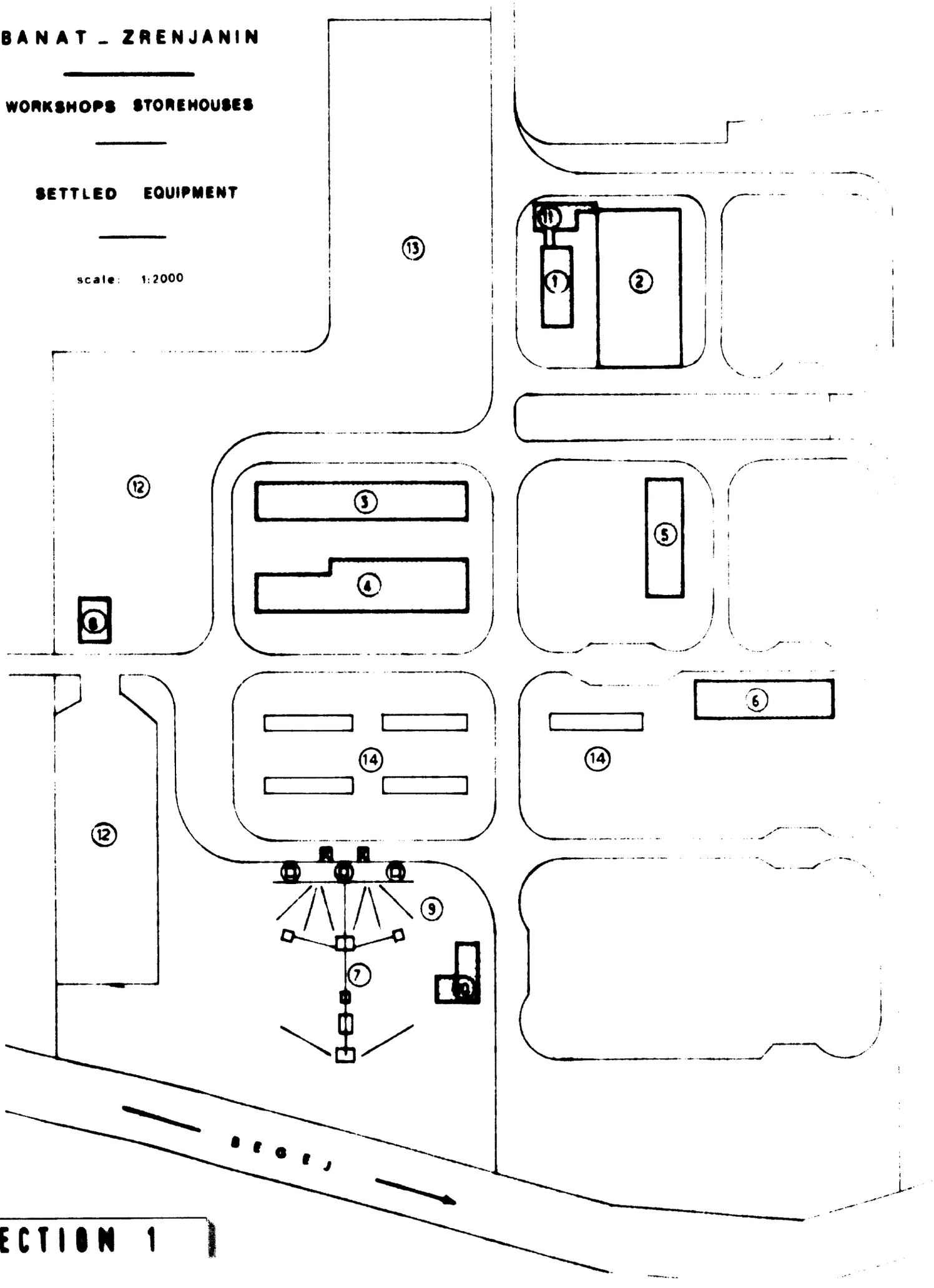
APPENDIX 8

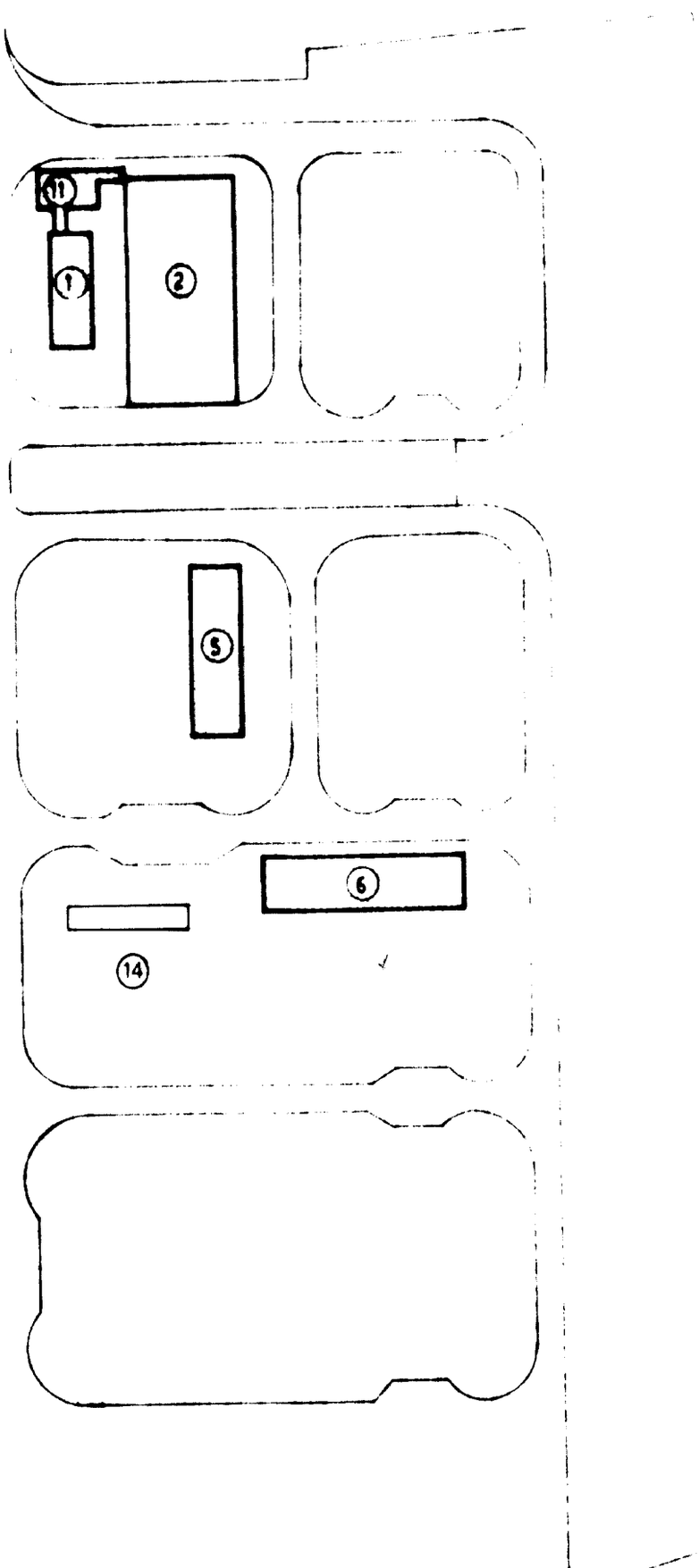
BANAT - ZRENJANIN

WORKSHOPS STOREHOUSES

SETTLED EQUIPMENT

scale: 1:2000





LEGEND

1 - MANAGEMENT
2 LIGHT-WORK WORKSHOP
3 GARAGE VEHICLE REPAIR WORKSHOP
4 BUILDING MACHINE REPAIR WORKSHOP
5 JOINERY
6 CONCRETE-REINFORCEMENT WORKSHOP
7 AGGREGATES SCREENING
8 WATCHMAN
9 CONCRETE MIXING PLANT
10 CONCRETE LABORATORY
11 SANITARY
12 CAR PARKS
13 EQUIPMENT STORAGE-YARD
14 PRECASTING AREAS

SECTION 2

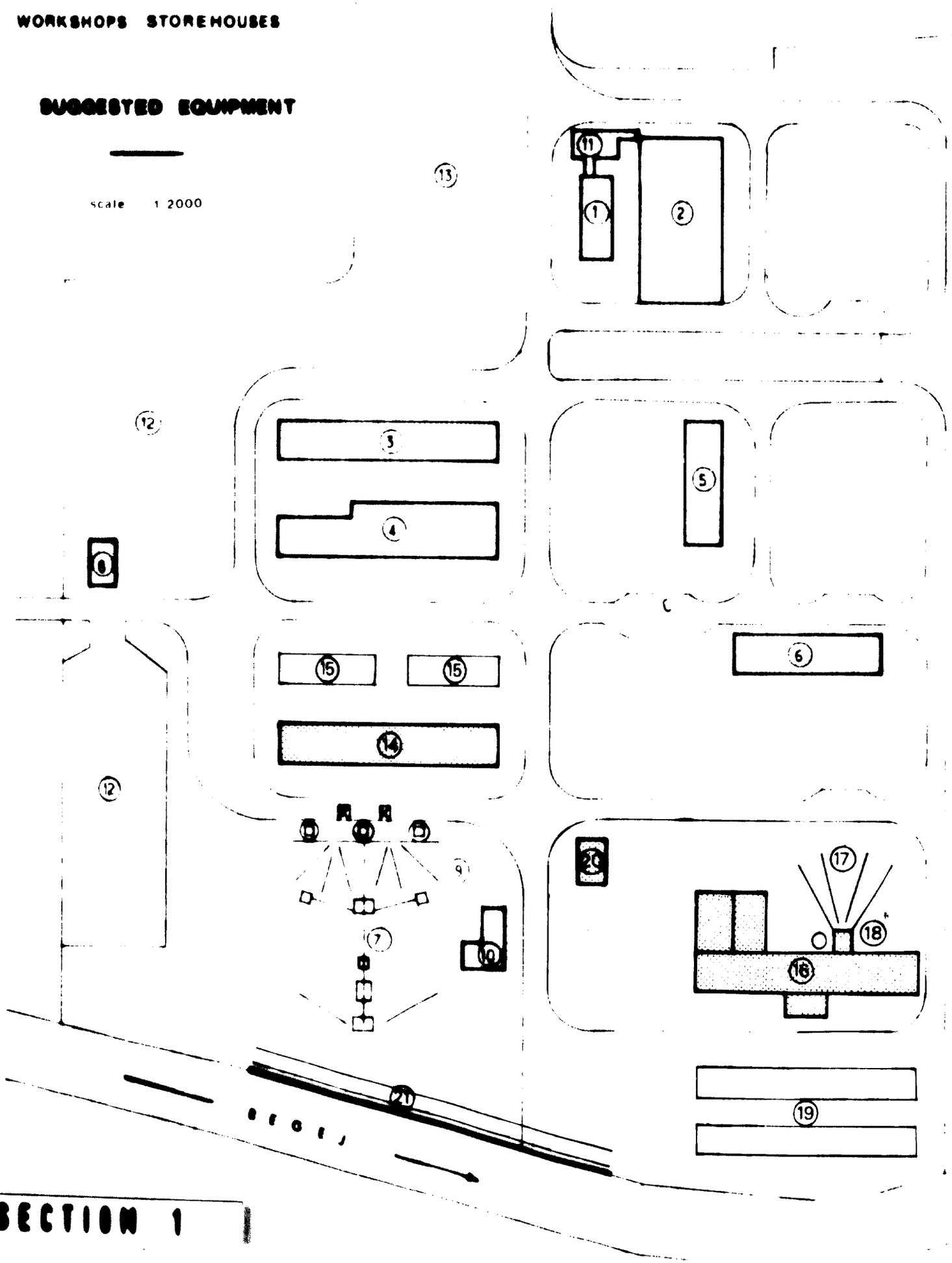
APPENDIX 9

BANAT - ZRENJANIN

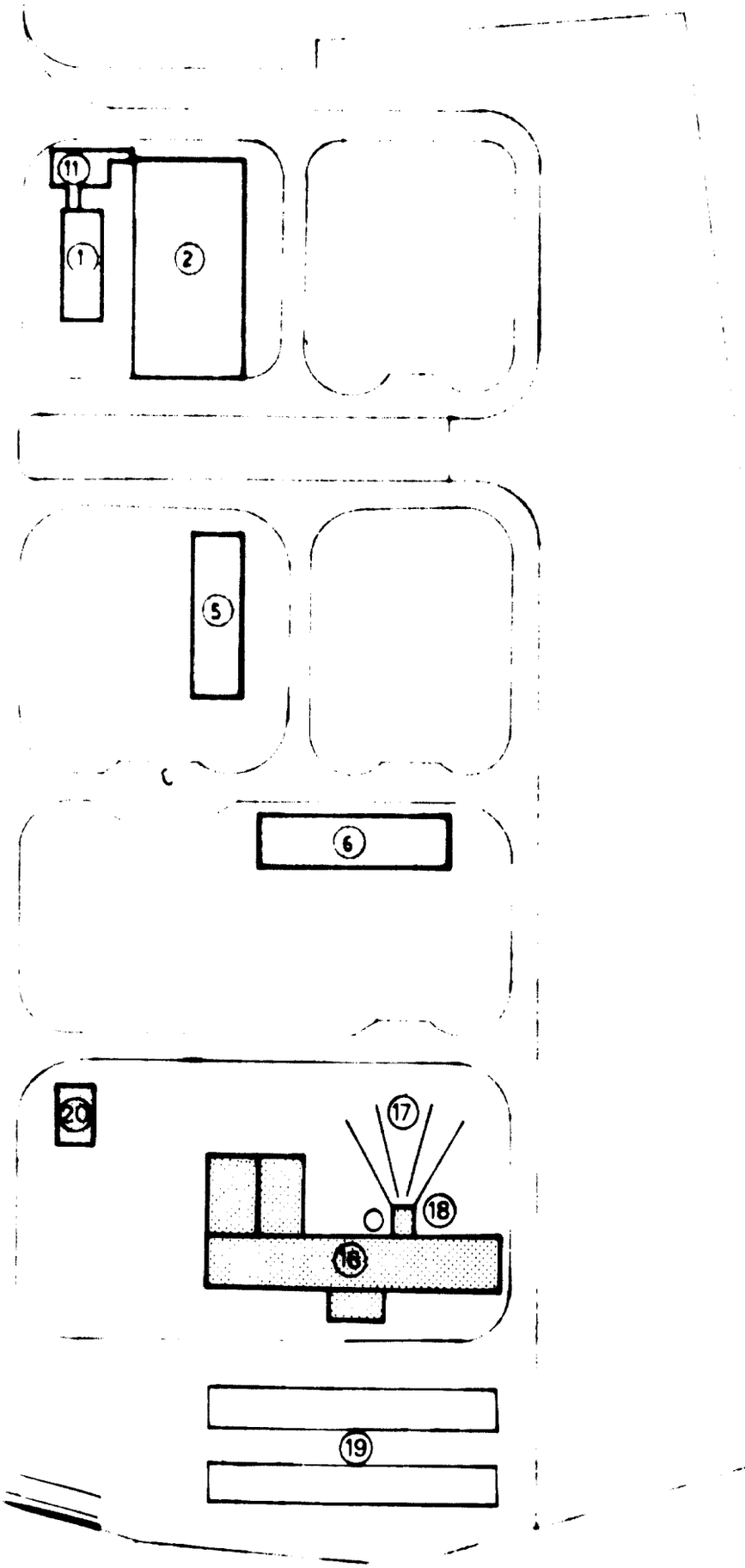
WORKSHOPS STOREHOUSES

SUGGESTED EQUIPMENT

scale 1 2000



SECTION 1



LEGEND

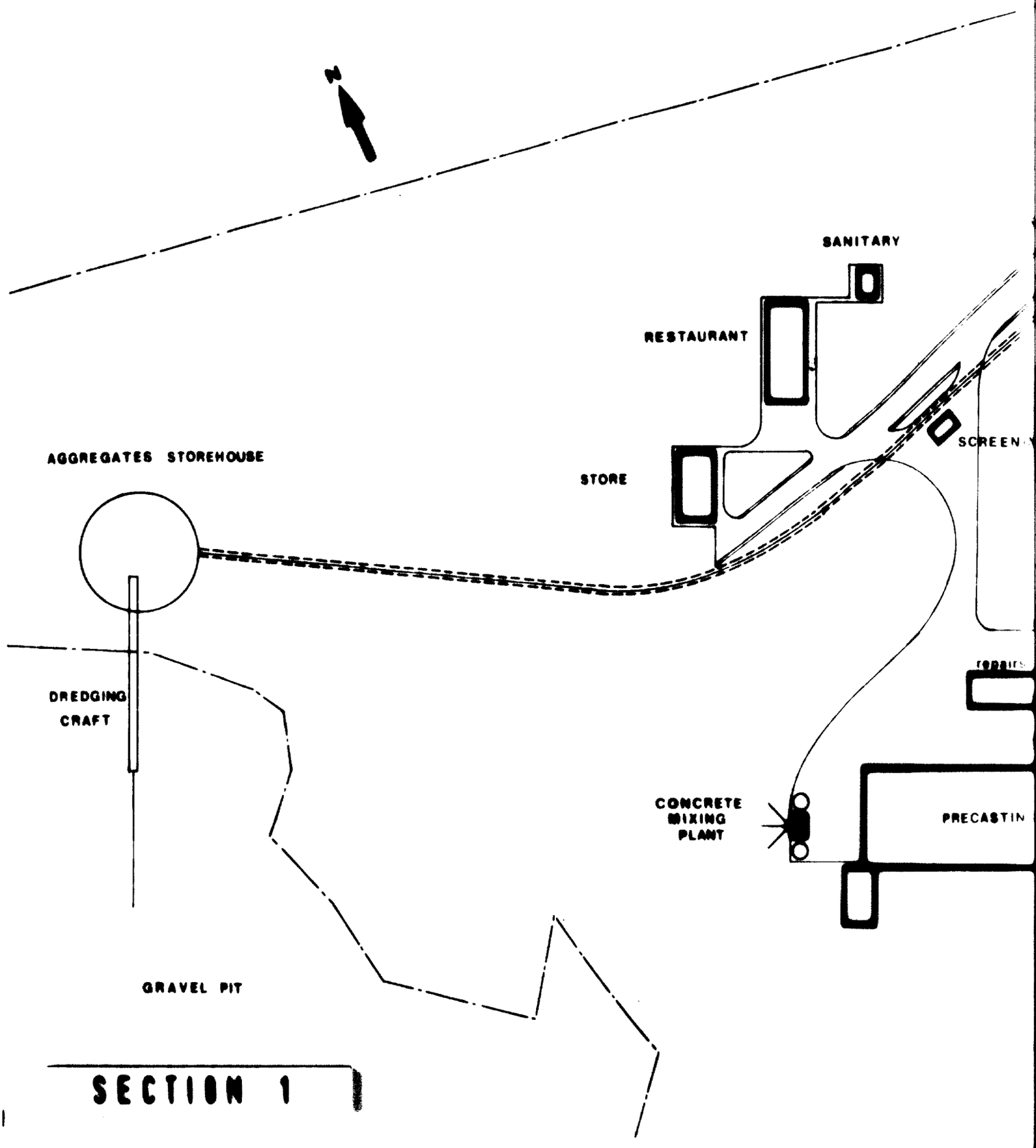
1 MANAGEMENT
2 LIGHT-WORK WORKSHOP
3 GARAGE VEHICLE REPAIR WORKSHOP
4 BUILDING MACHINE REPAIR WORKSHOP
5 JOINERY
6 CONCRETE - REINFORCEMENT WORKSHOP
7 AGGREGATES SCREENING
8 WATCHMAN
9 CONCRETE MIXING PLANT
10 CONCRETE LABORATORY
11 SANITARY
12 CAR PARKS
13 EQUIPMENT STORAGE - YARD
14 PRECASTING AREAS
15 STORAGE
16 PRECASTING HEAVY ELEMENT PLANT
17 LIGHTWEIGHT AGGREGATES STORING
18 LIGHTWEIGHT CONCRETE MIXING PLANT
19 PRECAST ELEMENT STORAGE
20 PLANT MANAGEMENT
21 LOADING AND UNLOADING PLATFORM

APPENDIX 10

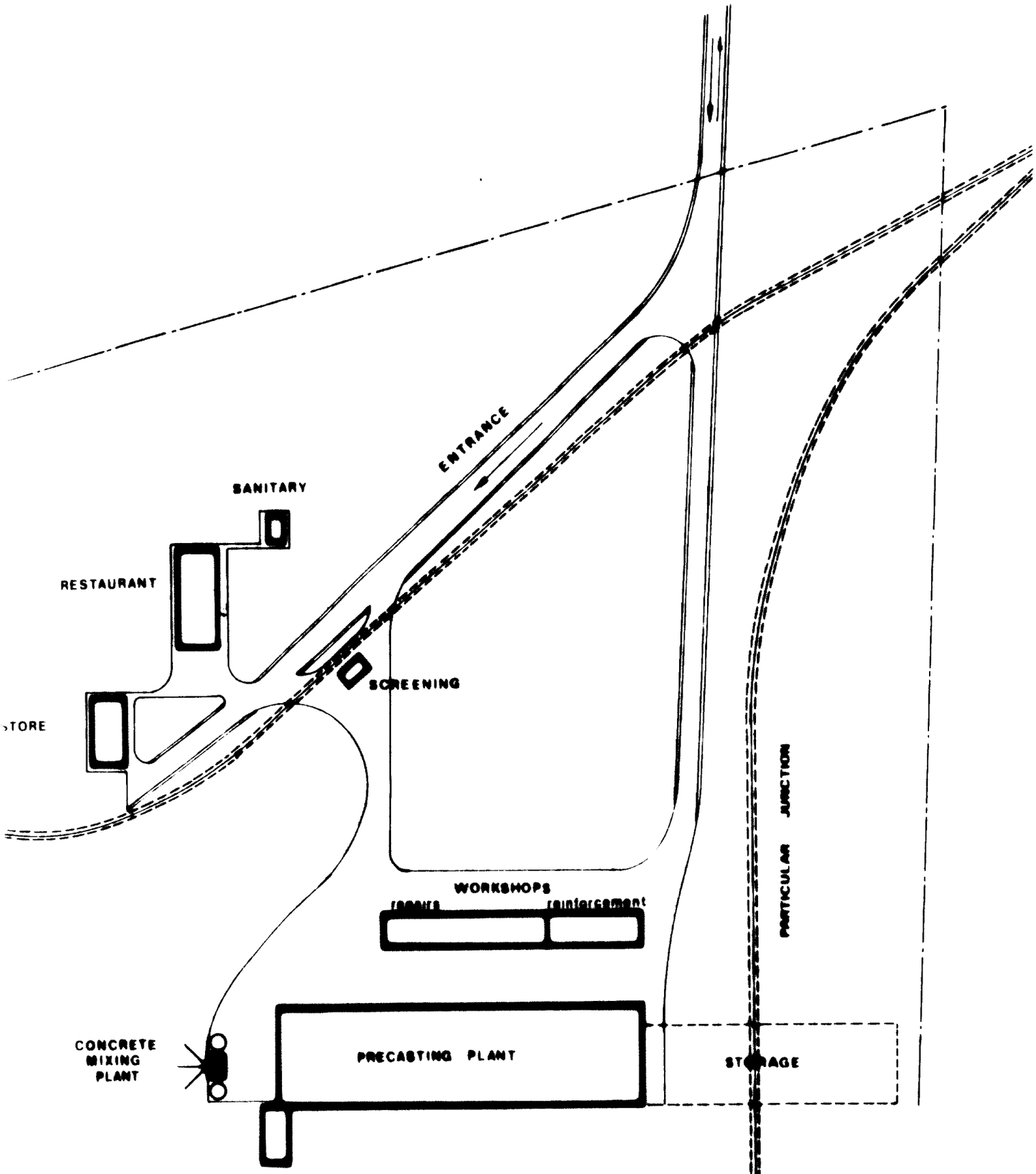
STANDARD BETON

BELA CRKVA

SETTLED EQUIPEMENT



SECTION 1

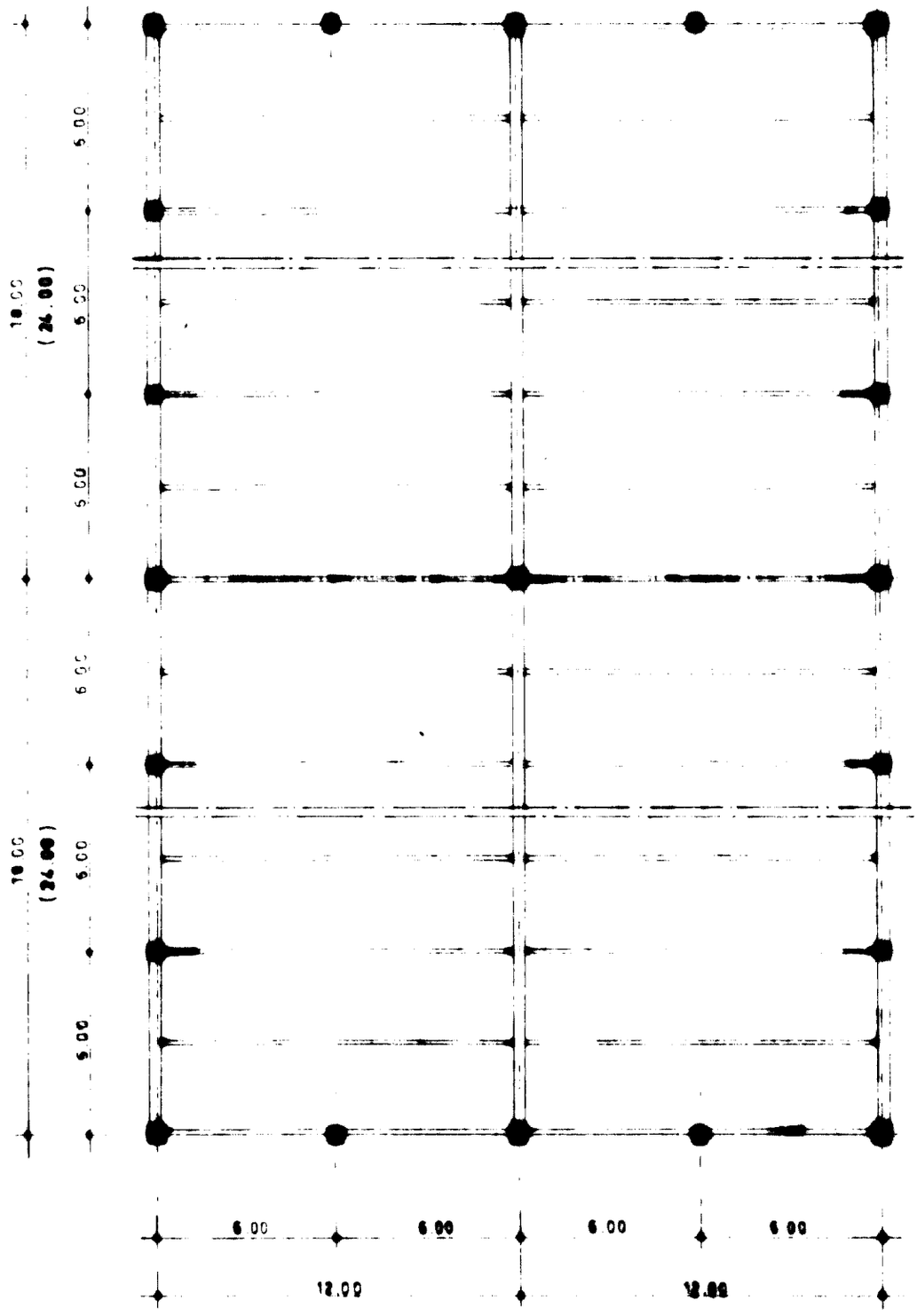

ENTRANCE
SANITARY
RESTAURANT
SCREENING
STORE
WORKSHOPS
reinforcement
PARTICULAR JUNCTION
CONCRETE MIXING PLANT
PRECASTING PLANT
STORAGE

SECTION 2

APPENDIX 11

TYPICAL LAYOUT OF AN INDUSTRIAL OR AGRICULTURAL HANGAR

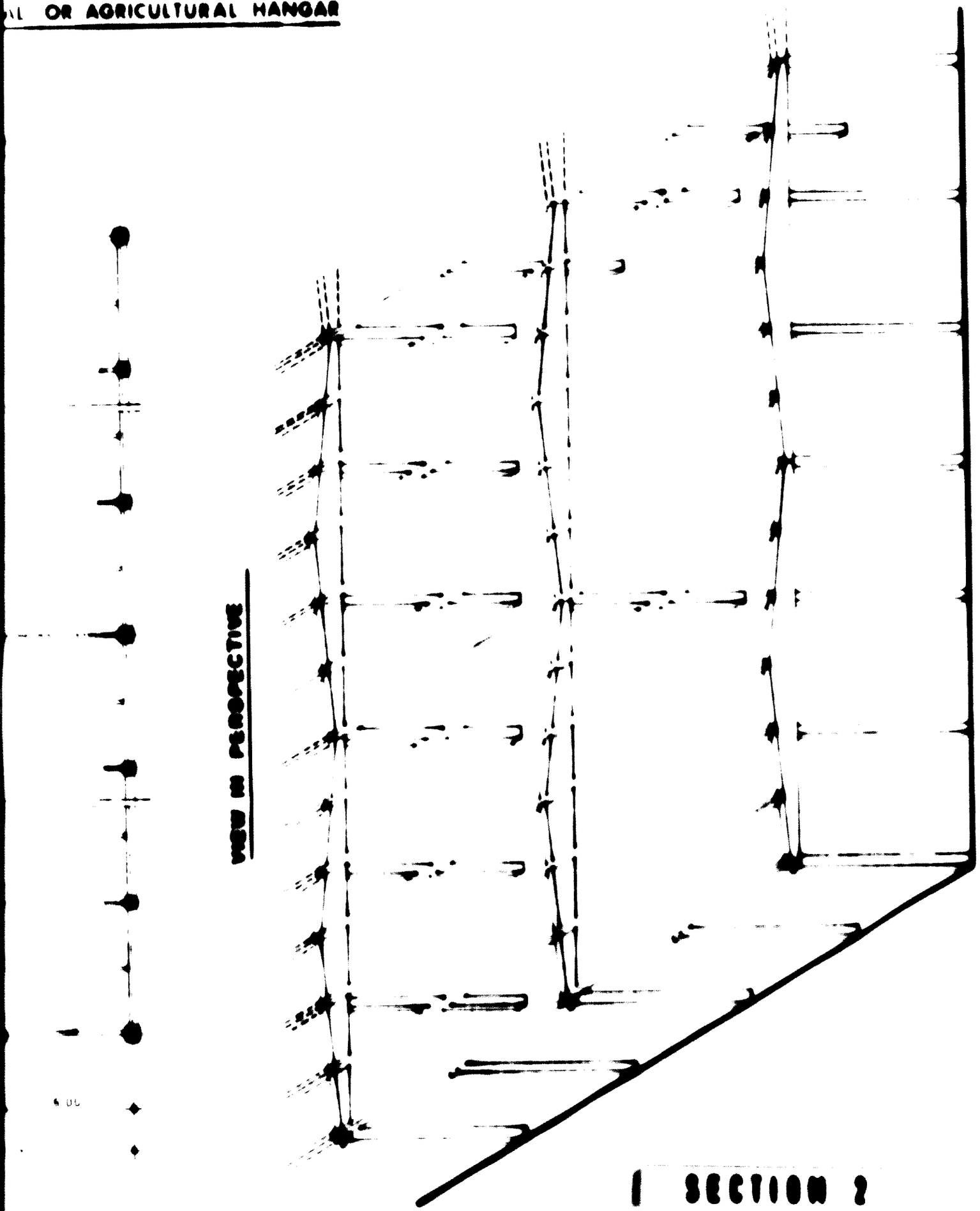
TOP VIEW



SECTION 1

VIEW IN PERSPECTIVE

...L OR AGRICULTURAL HANGAR



VIEW IN PERSPECTIVE

SECTION 2

APPENDIX 12

[redacted]

[redacted]

NORMES FRANCAISES A.F.N.O.R. - REGLES D.T.U.

NORMES A.F.N.O.R.

NF P 14 301	Blocs pleins ou creux en béton de granulats lourds pour murs et cloisons - 1971.
NF P 14 303	Blocs creux en béton de mâchefer pour murs et cloisons - décembre 1966.
NF P 14 304	Blocs pleins ou creux en béton de granulats légers pour murs et cloisons - 1971.
NF P 14 402	Blocs en béton pour murs et cloisons : dimensions - 1971.
NF P 17 302	Laitier expansé - septembre 1965.
NF P 18 309	Bétons de construction : granulats d'argile expansée fabriqués en four rotatif.

D.T.U.

D.T.U. n°20	Cahier des charges applicable aux travaux de maçonnerie, béton armé, plâtrerie - Cahier C.S.T.B., livraison 87, cahier 767 - janvier 1961.
D.T.U. n°23.2	Cahier des charges applicable aux travaux effectués en béton caverneux à granulats lourds sans éléments fins - Cahier C.S.T.B., livraison 33, cahier 272 - septembre 1960.
D.T.U. n°23.3	Cahier des charges applicable aux travaux effectués en béton caverneux à granulats lourds avec éléments fins - Cahier C.S.T.B., livraison 40, cahier 322 - octobre 1959.
D.T.U. n°23.6	Cahier des charges applicable aux travaux de béton caverneux de laitier expansé ou de pouzzolane avec ou sans éléments fins - Cahier C.S.T.B., livraison 84, cahier 482 février 1962.
D.T.U. n°26.1	Enduits aux mortiers de liants hydrauliques - Cahier C.S.T.B., livraison 79, cahier 000 - avril 1960.

..//..

D.T.U. n° 43 — *Etanchéité des toitures terrasses et des toitures inclinées* - Cahier C.S.T.B., livraison 68, cahier 576 juin 1964 - Additif 1 (systèmes semi-indépendants). Cahier C.S.T.B., livraison 91 d'avril 1968 - Additif 2 (formes de pente sur panneaux isolants). Cahier C.S.T.B. livraison 95 de décembre 1968.

D.T.U. Thermique — *Règles de calcul des caractéristiques thermiques utiles des parois de construction et des déperditions de base des bâtiments* - Cahier C.S.T.B., livraison 62, cahier 513 - juin 1963. 1re mise à jour : cahier C.S.T.B., livraison 78, cahier 675 de février 1966. 2e mise à jour: cahier C.S.T.B., livraison 89, supplément, de décembre 1967. 3e mise à jour : cahier C.S.T.B., livraison 121, cahier 1053 de juillet-août 1971.

Structures en bétons légers. 11e session plénière - Bruxelles, octobre 1966. Bulletin du Comité européen du Béton n°59 de janvier 1967.

Structures en bétons légers. Compte rendu de la 9e session plénière - Ankara, le 23 septembre 1964. Bulletin du Comité européen du Béton n°51 de septembre 1966.

Recommandations internationales pour le calcul et l'exécution des ouvrages en béton. Comité européen du Béton. Fédération internationale de la Précontrainte - juin 1970.

NORMES AMERICAINES A.S.T.M. - A.C.I. STANDARD

NORMES A.S.T.M.

C 33 - 67	Specifications for concrete aggregates.
C 294 - 60	Descriptive nomenclature of constituents of natural mineral aggregates.
C 330 - 60	Specifications for lightweight aggregates for structural concrete.
C 331 - 60	Specifications for lightweight aggregates for concrete masonry units.
C 332 - 66	Specifications for lightweight aggregates for insulating concrete.
C 495 - 60	Test for compressive strength of lightweight insulating concrete.
C 513 - 60	Sampling, preparing and testing specimens from hardened lightweight insulating concrete for compressive strength.
C 567 - 60	Test for unit weight of structural lightweight concrete.
C 601 - 60 T	Test for staining materials in lightweight concrete aggregates.

A.C.I. STANDARD

A.C.I. 613.A - 59	Recommended practice for selecting proportions for structural lightweight concrete.
A.C.I. Committee 213	Guide for structural lightweight aggregate concrete.
A.C.I. 318 - 63	Building code requirements for reinforced concrete.

[illegible] B.S. - BRITISH STANDARD CODES OF PRACTICE

[illegible] B.S.

B.S. 877 (1987) Formed on expanded blastfurnace slag lightweight aggregate for concrete.

B.S. 882-1201 (1983) Aggregates from natural sources for concrete - including granolithic.

B.S.1165 (1985) Clinker aggregate for concrete.

B.S.2028-1364 (1968) Precast concrete blocks.

B.S.3797 (1990) Methods for the sampling and testing of lightweight aggregates for concrete.

B.S.3797 (1990) Lightweight aggregates for concrete (exfoliated vermiculite, expanded perlite, expanded clay, expanded shale, sintered pulverised-fuel ash and pumice.

B.S.3892 (1982) Pulverised fuel ash for use in concrete.

[illegible] STANDARD CODES OF PRACTICE

C.P. 114 (1957) Structural use of reinforced concrete in buildings.

C.P. 116 (1965) The structural use of precast concrete.

Greater London Council by Laws Amendment relating to lightweight concrete precast (London, 1986).

NORMES ALLEMANDES D.I.N.

D.I.N. 4 108 (mai 1969)	Wärmeschutz im Hochbau.
D.I.N. 4 158 (avril 1969)	Deckenhohlkörper aus Leichtbeton für Stahlbetonrippendecken.
D.I.N. 4 164 (octobre 1981)	Gas-und Schaumbeton ; Herstellung, Verwendung und Prüfung, Richtlinien.
D.I.N. 4 165 (février 1980)	Vollbausteine aus dampfgehärtetem Gas-und Schaumbeton.
D.I.N. 4 223 (juillet 1980)	Bewehrte Dach- und Deckenplatten aus dampfgehärtetem Gas- und Schaumbeton.
D.I.N. 4 226 (janvier 1971)	Zuschlag für beton ; Zuschlag mit dichtem oder porigem Gefüge.
D.I.N. 4 232 (octobre 1966)	Geschützte Leichtbauvorwände für Wohn- und andere Aufenthaltsräume ; Richtlinien für die Ausführung.
D.I.N. 10 102 (janvier 1964)	Hausschornsteine ; Formstücke aus Leichtbeton m. Querschnitten bis 900 cm² .
D.I.N. 10 161 (septembre 1982)	Hohlblocksteine aus Leichtbeton.
D.I.N. 10 162 (septembre 1982)	Vollsteine aus Leichtbeton.
D.I.N. 10 102 (mai 1964)	Wandbauplatten aus Leichtbeton, unbewehrt.

NORMES SOVIETIQUES GOST

GOST 11050 - 64	Bétons de granulats légers. Méthodes de détermination des résistances et des masses volumiques.
GOST 11051 - 64	Bétons de granulats légers. Méthodes de détermination des compositions de béton.
GOST 9757 - 61	Granulats minéraux légers pour bétons légers. Classification.
GOST 9758 - 68	Granulats minéraux légers pour bétons légers. Méthodes d'essais (24 caractéristiques).
GOST 9759 - 65	Granulats d'argile expansée (four rotatif).
GOST 9760 - 61	Granulats de laitier expansé.

APPENDIX 13

LIGHTWEIGHT AGGREGATE

BIBLIOGRAPHY

AURICH M. : *Kleine Leichtbetonkunde* - Bauverlag - WIESBADEN (1971).

PORTMANN J. : *Leichtbeton in den U.S.A. - Bericht einer Studienreise - Herstellung von leichten Zuschlagstoffen* - Betonsteinzeitung 32 (1966) n° 2, pp. 93-100.

RUDNAI G. : *Leichtbeton-Baukonstruktionen* - Akadémiai Kiado - BUDAPEST - 1966.

Lightweight concrete review - Part 2 : *Production of low density aggregates* - Concrete 2 (1966) n° 5, pp. 190-196.

Proceedings of the First International Congress on Lightweight Concrete - Vol. 1 et 2 - Cement and Concrete Association - LONDRES - 1968.

An introduction to lightweight concrete - 4ème édition revue - Cement and Concrete Association - LONDRES - 1970.

BLOCH C. et ARLE G. : *La fabrication et les utilisations de l'argile expansée* - Revue Arts et Manufactures, n° 181 (1967).

CHABREL L. : *Le laitier expansé* - Cahier du C.S.T.B. n° 208 (23).

CUBAUD J.C. et MURAT M. : *Fabrication industrielle de l'argile expansée* - Silicates Industriels n° 5 (1968).

JARRIGE A. : *Les cendres volantes* - EYROLLES (1971)

LEVY J. : *Les bétons légers* - EYROLLES (1965)

RIESSAUW F.G. : *Le béton léger structural* - Revue C.S.T.B. n° 3 (1968)

SCHUMACHER J., CHAIZE A. et DEICELLIER P. : *Les bétons légers* - Cahiers du C.S.T.B. n° 90 fas. 780 (1968) et n° 114 fas. 996 (1970)

VERNAT M. : *Bétons légers et bétons à base de granulats légers* - Travaux Communaux - Décembre 1971.

Les bétons spéciaux - Edité par la Fédération de l'Industrie Cimentière (BRUXELLES).

American Concrete Institute (A.C.I.) - Committee 213 : *Guide for structural lightweight aggregate concrete* - Traduction française éditée par la Société Diffusion des Techniques du Bâtiment et des Travaux Publics - PARIS (1970).

DOMJEVITCH S.A. : *Bétons légers de granulats poreux* - Lit. de la Construction, MOSCOU (1970).

Comité Européen du Béton (C.E.B.) - Fédération Internationale de la Précontrainte (F.I.P.) : *Recommandations internationales pour le calcul et la réalisation d'ouvrages en béton* 20ème Edition - Cement and Concrete Association - LONDRES 197

../..

Richtlinien für leichtbeton und stahlleichtbeton mit geschlossenem gefüge - Edition Juin 1973 - Deutscher Ausschuss für Stahlbeton - Beuth-Vertrieb - Berlin-Cologne (1973).

Verein Deutscher Zementwerke : *Vorläufiges Merkblatt II für Stahlleichtbeton - Zusammensetzung und Eignungsprüfung* - Edition 1972 - Beton-Verlag - Düsseldorf.

Verein Deutscher Zementwerke : *Vorläufiges Merkblatt III für Stahlleichtbeton - Herstellen und Verarbeiten* - Edition 1972 - Beton-Verlag - Düsseldorf.

HEUFERS H. : *Stahlleichtbeton - Spannleichtbeton* - Zement-Taschenbuch 1972/73 - Bauverlag - Wiesbaden - 1972.

WEIGLER H. et KARL S. : *Stahlleichtbeton - Herstellung - Eigenschaften - Ausführung* - Bauverlag - Wiesbaden - 1972.

REINSDORF S. : *Leichtbeton - Bd. I - Leichtbetone aus porigen Zuschlagstoffen* - VEB-Verlag für das Bauwesen - Berlin - 1961.

Deutscher Ausschuss für Stahlbeton : *DIN 1045 - Beton und Stahlbetonbau - Bemessu und Ausführung* - Edition Janvier 1972.

WEIGLER H. et KARL S. : *Kriechen von Konstruktionsleichtbeton bei frühzeitiger Belastung* - Betonstein-Zeitung 35 n° 10, pp. 584-592 (1969)

Forschungsinstitut der Zementindustrie, Düsseldorf - *Schwind und Kriechversuche an leichtbetonen aus Leichtzuschlägen "Liapor"* - Programme d'essais B.789.

ROSTASY F.S., TEICHEN K.Th. et ALDA W. : *Über das Schwinden und Kriechen von leichtbeton bei unterschiedlicher Korneigenfeuchtigkeit* - Procès-verbal d'essai de l'Institut OTTO-GRAF de l'Université de Stuttgart - 1972.

HEUFERS H. : *Über langfristige Schwind- und Kriechuntersuchungen an leichtbetonen höherer Festigkeit und vergleichbaren Normalbetonen* - Communications techniques et scientifiques de Dyckerhoff-Zementwerke AG, Wiesbaden - Amöheburg n° 5 - Mars 1970.

MARTIN H. et JANOVIC K. : *Verbundwirkung von Betonstahlhaken in Leichtbeton* - Part. I et II - Lehrstuhl für Massivbau der TH MUNCHEN - Rapports n° 6279/Ja/K et n° 2399/ja/K.

MARTIN H. et JANOVIC K. : *Verbundwirkung von Betonstahlschlaufen in Leichtbeton* - Lehrstuhl für Massivbau der TH München - Rapport n° 6328/Ja/K.

WESCHE K. : *Regulations for reinforced and prestressed lightweight aggregate concrete in various countries* - Rapports du Premier Congrès International du Béton léger - Londres - Mai 1968 - Volume I - Rapports Cement and Concrete Association - Londres 1970, pp. 225.233

..//..

Draft British Standard Code of Pratice for the Structural Use of Concrete - Devant remplacer : CP114 : the structural use of reinforced concrete in Buildings - CP115 : the structural use of prestressed concrete in Buildings - CP116 : the structural use of precast concrete - British Standards Institution - LONDRES - 1970.

Recommandations concernant les additions aux réglementations relatives au béton, en vue d'étendre leur applicabilité au béton d'aggrégats légers de structure, y compris l'argile expansée - Promulgué en Février 1971 par la Commission de la Fédération Nordique du Béton pour l'étude des recommandations - Nordiska Betongförbundet - Publi cation n° 4 (1972).

ABELES P.W. : Partial Prestressing and its suitability for limit state design - The Structural Engineer, 49 (1971) n° 2, pp. 67-86.

Commentary on Building Code Requirements for Reinforced Concrete - ACI 318-71 - American Concrete Institute - Détroit - Michigan - 1971.

BOBROWSKI J. et BARDHAN-ROY B.K. : A method of calculating the ultimate strength of reinforced and prestressed concrete beams in combined flexure and shear - The Structural Engineer 47 (1969) n° 5, pp. 197-209.

BOBROWSKI J. et BARDHAN-ROY B.K. : Structural assessement of lightweight aggregate concrete - Concrete 5 (1971) n° 7, pp. 229-234.

U.T.I. : Comparaison technico-économique entre béton traditionnel et béton léger - Revue BATIR n° 22 - Mai 1973.

U.T.I. : Les bétons de granulats légers - Revue BATIR n° 15 - Septembre 1972.

CORMON : Bétons légers d'aujourd'hui - Edition EYROLLES.

HEUFERS H. : Wirtschaftlichkeit von Fertigteilen aus Konstruktionsleichtbeton - Betonstein-Zeitung 35 (1969) n° 12, pp. 733-737.

AURICH H. : bautechnische Fragen zur Herstellung von Konstruktionsleichtbeton - Zement und Beton n° 44-45 - Mai et Juin 1960.

AURICH H. : Konstruktionsleichtbeton aus künstlich Zuschlagstoffen - Die Bauwirtschaft Heft 24/25. 17/6/1967.

BACHE H.H. : Résistance du béton léger de structure - Congrès R.I.L.E.M. 1969. Troisième séance d'études. 1969.

BESSEY G.E. : The world development and economic significance of the aerated concrete industry - Congrès I.C.L.C. - Londres - Cession C. Mai 1968.

BLAIRON A. : La préparation du schiste cuit - Revue des Matériaux de Construction et des Travaux Publics - Août, Septembre 1963.

BLAKEY F.A. & LEWIS R.K. : A review of elastic deflection, creep and shrinkage of expansed shale concrete - Constructional Review - Juillet 1964 - Vol. 37, n° 7.

BRETTLE H.J. : Structural aspects of prestressed lightweight aggregate concrete - Constructional Review - Mai 1962 - Vol. 35, n° 5.

BROECKHOVEN J.F.A. : Proeven met Berwilit, Korlin en Hollith - Cement XXI n° 6 (Hollande) 1969.

BUISSON M. & BRIANCOURT M. : Les essais non destructifs des bétons caverneux légers de laitier expansé - Laitiers et Tarmacadam n° 16 - Décembre 1961.

CHARREL L. : Les bétons légers - Cahiers du CSTB n° 64 - Cahier 530 - 1963.

CHEFDEVILLE : Les bétons légers - Cahier CSTB. Janvier 1949.

COBA F. : Perlite concrete roof decks - Concrete Products n° 8 - Août 1969.

Enquête CATED : L'emploi et la mise en oeuvre du béton léger - Le Bâtiment Mensuel n° 5 - Mai 1969.

COMMUN P., enquête CATED : Les bétons de schiste expansé "Berwilit" en Allemagne - Le Bâtiment hebdomadaire n° 8, 22/2/1969.

COMMUN P., enquête CATED : Les bétons légers de polystyrène expansé "Styropor" en Allemagne - Le Bâtiment Mensuel n° 9 - Septembre 1969.

COMMUN P., enquête CATED : Les bétons légers de structure en Angleterre - Le Bâtiment Mensuel n° 10 - Octobre 1969.

DELAHAYE R. : L'agrégat léger d'argile expansée - Etudes et Réalisations n° 90 - Décembre 1964.

DEMOULDER M. : L'argile expansée - Ses propriétés - Son traitement Ses emplois - B.R.G.M. (Bureau de Recherches Géologiques et minières) Août 1969.

DENGERT H.V. : Herstellung von Bläh-ton nach dem Zerbulation-Strömungsverfahren Die Ziegelindustrie n° 22 - Novembre 1966.

DUBROVKIN A. & MALINOWSKI R. : Volume changes of lightweight concrete by repeated wetting and drying - Rilem Symposium (Helsinki) 1966.

EVANS R.H. & BRADBURN C.O. : The use of P.C. structures of lightweight aggregate (Leca) concrete - Civil Engineering, Janvier 1966.

GRIMER F.J. : Tests on lightweight concrete columns - Structural Concrete 11.12.1965.

GROW J.B. & VANDERBILT M.D. : Shear strength of prestressed lightweight aggregate concrete flat plates - P.C.I. Journal - Août 1967.

HANSON N. : Technique américaine de dosage des bétons d'argile expansée - Congrès I.C.L.C. - Londres - Session A - Mai 1968.

HEUFERS H. : Le béton léger de structure et ses aspects économiques - Congrès B.I.B.M. 1969 - Troisième séance d'études.

HEUFERS H. & AURICH H. : Beitrag zur Entwicklung des Konstruktiven Leichtbetons in Deutschland - Betonstein Zeitung - Mai 1966.

HEUFERS H. : Über die ersten Ingenieurbauwerke aus Leichtbeton in Deutschland - Beton Herstellung Verwendung n° 17 - 1967.

HOMMILLER F. & KOHLING K. : Sytropor Leichtbeton - Betonstein Zeitung 1968.

IVEY DON. L. & BUTH E. : Shear capacity of lightweight concrete beams - A.C.I. Journal - Octobre 1967.

JINDAL B.R. : Properties of structural lightweight concrete using sintered fly ash aggregate - Indian Concrete Journal - November 1964.

KRÜGEL F. : Kurz- und Langfristige Deformation von Leichtzuschlagbetonen - Zement und Beton n° 44-45 - Mai et Juin 1969.

KUNZEL H. & HEROLD T. : Essais sur les conditions d'humidité dans les murs extérieurs en béton cellulaire autoclavé - Betonstein Zeitung (traduction C.S.T.B. 77 364 n° 781) - Août 1969.

LEWIS R.K. : The steam curing of lightweight concrete after initial moist curing - Construction Review - Octobre 1965.

LONDON A.G., STACY L.E. & MALHOTRA M.L. : The thermal and acoustic properties of lightweight concrete - Fire resistance - Buildin Research Structural Concrete Vol. 3 - Mars-Avril 1966.

LYLON-MICE F.D. : Le problème de l'absorption de l'eau par les granulats légers (University of wales institute of science and technology) - Magazine of concrete Research Vol. 21 n° 68 (traduction C.E.S. 77306) Septembre 1969.

NILSOII J.K. : Structural lightweight aggregate concrete - Concrete Publications Limited - Londres - 1966.

../..

GRISTED M. : Creep of prestressed lightweight concrete - P.C.I. Journal Vol. II, n° 6 - Decembre 1966.

PARKER T.M. & RYDER J.F. : Le retrait et le comportement des bétons légers en fonction des changements de leur teneur en eau - Silicates Industriels - Mars 1969.

PEARSON A.S. : Granulats légers fabriqués à partir des cendres volantes - Civil Engineering n° 9 - Septembre 1964.

PFEFFERMANN O. : Réflexions sur l'application du béton de ponte comme isolant thermique des toitures - Chaleurs et Climats n° 392 - Août 1968.

PORTMANN H.J. : Leuchten für Betonfertigteile - Betonstein Zeitung - Novembre 1965.

ROESSLER R. : Erfahrungen mit betonfertigen Leichtbeton in den Vereinigten Staaten von Amerika - Betonstein Zeitung - Novembre 1965.

ROESSLER R. : Leichtbeton in den U.S.A. - Betonstein Zeitung - Mai 1966.

RUSSELMEYER H. : Zuschlagstoffe nach Maß - ein Beitrag zum Thema "schöneres Sichtbeton" - Aufbereitungs-Technik n° 4 - 1966.

SCHLEPACHER J. & DELCELLIER P. : Les bétons légers - Cahiers du C.S.T.B. Livraison n° 90 - Cahier 780 - Février 1966.

SEIGNEURET : Retrait du béton cellulaire - Revue des Matériaux de construction - Novembre 1964.

STEINBRICHE K.H. : Betonfertigteilen aus Leichtzuschlagstoffen - Betonstein Zeitung - Septembre 1964.

TRAUBERT J. : Überlegungen zum Leichtbeton technologie und ihre Bedeutung für Leichtbeton - Betonstein Zeitung - Avril 1970.

TEVLINENE B.C. : Structural concrete made with lightweight aggregates - Concrete, Vol. I - Avril 1967.

VERGNAUD L. & MOLINAGUE J.C. : Bétons d'argile expansée - Etude des différents bétons des poudres d'argile et de béton d'argile expansée - Annales I.T.B.T.P. n° 231-232 - Mars-Avril 1967.

VERGNAUD L. & THIERRY-LEVITSKY G. : Etudes de granulats légers de diverses provenances - Etudes d'un béton léger pour structures en béton armé - Compte-rendu de recherche du C.E.B.T.P. - Essais effectués en 1968.

MEHLER H. & REICHERT R. : Untersuchungen an Konstruktions Leichtbetonen - Betonstein Zeitung - Novembre 1966.

MEHLER H. & KARL S. : Frost und Tausalzwiderstand und Verschleissverhalten von Konstruktionsleichtbetonen - Betonstein Zeitung - Mai 1968.

WICKE E. Agrégats légers pour le béton armé et le béton précontraint - Betonstein Zeitung - Novembre 1966.

WISCHERS G. : Versuch des genau de compression sur le béton ordinaire et le béton léger - Betontechnische Berichte - Düsseldorf n° 221-68 - 1967.

Schleuderbetonrohren vorläufiges Richtlinien für Ausführung und Prüfung (Hessen) - Betonstein Zeitung - Décembre 1967.

Lightweight aggregate concretes. 3 Structural Applications - Building Research Station Digest n° 31 - Février 1963 (révisé en novembre 1968).

Bulletin du C.S.T.B. concernant des bétons légers Building Research Station 1962 et 1963 (nouvelle édition novembre 1970).

Les bétons légers à base de granulats d'argile expansé Chronique du Laboratoire C.E.B.T.P. Septembre 1966.

L'emploi dans le bâtiment des bétons de granulats légers préfabriqués - (Compte-rendu sommaire du troisième colloque franco-polonais - Paris Mars Avril 1966) - Cahiers du C.S.T.B. Livraison n° 1012 - Cahier 892 - Septembre 1966.

La préparation du béton d'argile expansé Equipement mécanique - Carrières et Matériaux n° 86 - Juin-Juillet 1966.

Les bétons spéciaux : Les bétons légers Bulletin d'informations de la Fédération de l'Industrie cimentière belge.

Prestressed lightweight concrete - Indian Concrete Journal Vol. 42 n° 12 - Décembre 1968.

Properties of plain lightweight concrete Journal of American Concrete Institute - Octobre 1966.

APPENDIX 14

[redacted] -- [redacted]

BIBLIOGRAPHY

L'Industrialisation de la Construction (1968) - Préfabrication en usine et foraine - Analyse de quelques systèmes - LE MONITEUR.

MOREZ : Traité de la Préfabrication (1971) - Procédés - Installations.

SCHMIDT : Constructions Modulaires (1969) - Systèmes de préfabrication - ARTEMIS à ZURICH.

Les Cahiers du C.I.S.B.A. (Comprehensive Industrialised Building) - Systèmes de constructions industrialisées - HERRAN à LONDRES.

Mécanisation et automatisation des fabrications dans le bâtiment - Production de composants lourds et préfabrication automatisée - Cahier du C.S.T.B. n° 151 (1974)

Cahiers "BUILD", n° 2 - Mécanisation préfabriquée (1970)

C.I.B. (LONDRES) - Bâtiment International (1971) n° 1 - Constructions par grands panneaux - Système de bâtissage en hauteur - Transport et montage de matériels préfabriqués

Conception, production et utilisation d'éléments industrialisés - Cahier du C.S.T.B. n° 103 (1964)

Coefficients d'assemblage - Tolérances et ajustements - Annales de l'I.T.B.T.P. n° 30 (1971)

RICHARDSON - La préfabrication en usine de construction en béton (1970) - Buts, avantages, méthodes, aspects des éléments, personnel employé, etc - CECA à LONDRES.

PERRET - Méthodes industrialisées de construction (1971) - Inventaire des procédés connus avec fiches par procédé, par pays, par nom du procédé - PERRET

LUBET - Préfabrication lourde en panneaux (1971) - Etude générale de la préfabrication - Editions EYROLLES

Dispositions communes pour l'agrément des procédés de construction par grands panneaux lourds préfabriqués - Cahier du C.S.T.B. n° 888.

CROSNIER M. - L'hygrothermique dans le bâtiment - Editions EYROLLES (1972)

BERTHIER J. - La condensation dans le mur - Editions EYROLLES (1971)

Règles de calcul des caractéristiques thermiques utiles des parois de construction et des déperditions de base des bâtiments - Editions C.S.T.B. et CSTIC.

.../...

BERTHIER J. : Les points faibles thermiques ou ponts thermiques. Cahier du C.S.T.B. n° 334.

BIETRY J. : Étanchéité et planéité des joints.

LEWICKI B. : Bâtiments d'habitations préfabriqués en éléments de grandes dimensions. Éditions EYROLLES (1965).

[illegible] R. et [illegible] G. : L'étanchéité des joints de façade. Annales de l'I.T.B.T.P. - Janvier 1969.

Prescriptions pour l'exécution de panneaux chauffants à tubes métalliques enrobés dans le béton. Cahier du C.S.T.B. n° [illegible].

D.T.U. Recommandations pour la prévision par le calcul du comportement au feu des structures en béton. Cahier du C.S.T.B. n° 1.103 (1977).

BERTHIER J. et ANQUEZ J.C. : Températures maximales atteintes au soleil par des parois de construction. Cahier du C.S.T.B. n° [illegible].

[illegible] L. et THIERRY-LEMPEREUR G. : Essais de comportement de murs au choc thermique. Annales de l'I.T.B.T.P. n° 267-268.

SIESTRUNK R., [illegible] P., [illegible] C. et ALVISET L. : Action de l'humidité sur la céramique, envisagée dans le cadre de l'association béton céramique. Symposium R.I.L.E.M.-C.I.B. - HELSINKI 1965.

LUGEZ J. et SCHUMACHER J. : Observations sur la tenue des revêtements scellés sur murs préfabriqués en béton d'argile expansée. Cahier du C.S.T.B. n° 1.087.

Recommandations internationales unifiées pour le calcul et l'exécution des structures en panneaux assemblés de grand format. C.I.B. C.E.B. U.E.A.tc. Édité par l'Associazione Italiana Tecnico Economica del Cemento - AITEC - 1969.

[illegible] W. et LUGEZ J. : Résistance des murs en béton non armé soumis à des charges verticales. Cahier du C.S.T.B. n° [illegible] (1966).

LUGEZ J. et ZARZYCKI A. : Influence des joints horizontaux sur la résistance des éléments préfabriqués de murs porteurs. Cahier du C.S.T.B. n° [illegible] et 971 (1969-1970).

ALBIGES M. et GOULET J. : Contreventement des bâtiments. Annales de l'I.T.B.T.P. n° 149 (1960).

DESPEYROUX J. : Analyse statique et dynamique des contreventements pour consoles élémentaires solidarisées par des milieux élastiques. Cahier de l'Association Française du Béton, n° 5 (1972).

GUILLOT V. : Influence des ouvertures dans la stabilité des bâtiments de grande hauteur. Refends à files d'ouvertures. Cahier de l'Association Française du Béton, n° [illegible] (197[illegible]).

BURGESS P.A. : Aspects et applications pratiques du contrôle dimensionnel dans la préfabrication de grands éléments en béton. Thème I, livre II du V° Congrès du C.I.B. - Editions C.S.T.B. (197[illegible])

DEUTSCHMANN E. : Influence de la technologie sur la précision dimensionnelle des murs réalisés en panneaux préfabriqués. Cahier du C.S.T.B. n° [illegible] (196[illegible]).

Recommandations pour le calcul et l'exécution des constructions industrialisées en béton. C.S.I.C. - BRUXELLES - (1970)

MIRONOV S.A. : Le bétonnage en hiver. Théories et méthodes. Editions DUNOD (1960).

[illegible] M. et [illegible] J. : Un nouveau dispositif pour mesurer l'ouvrabilité du béton. Annales de l'I.T.B.T.P. (1971).

[illegible] J. et [illegible] I. : Contribution à l'étude des méthodes d'accélération du durcissement des bétons par la chaleur ; accélération par chauffage des constituants. Cahier du C.S.T.B. n° [illegible] (196[illegible])

[illegible] J. et CHAIZE A. : Contribution à l'étude des méthodes d'accélération du durcissement des bétons par la chaleur : le traitement en moules chauffants. Cahier du C.S.T.B. n° [illegible] (19[illegible])

[illegible] M. : L'étuvage des produits en béton. BETON INDUSTRIEL (196[illegible])

[illegible] J. : L'étuvage du béton. Application de la vibration dans l'industrie du béton manufacturé. Construction n° 9 PARIS (1971)

Cahier de la Recherche n° 25 : Durcissement accéléré du béton manufacturé. Colloque R.I.L.E.M. MOSCOU 1964 - Editions EYROLLES

[illegible] M. : Aspect du béton. Technique. Réalisation. Pathologie. Collection de l'I.T.B.T.P. (1971).

POUPES C. : La prévention des chutes de hauteur en préfabrication. Les boucles servant au levage des panneaux préfabriqués. La fabrication et le stockage des éléments préfabriqués lourds. Cahier de notes documentaires. Institut National de Recherche et de Sécurité - PARIS.

HALASZ R. : [illegible] aus Stahlbetonfertigteilen. Betonsteinjahrbuch 19[illegible]

HENTSCH O. : [illegible] decken aus [illegible] - Betonsteinjahrbuch 1957.

[illegible] T. : über die [illegible] von mehrgeschossigen Industriebauten mit [illegible] Die Bautechnik (37) - 1960.

[illegible] S. & LAMBERT F. : Une application de la précontrainte [illegible] de [illegible] dans un grand magasin parisien Annales de l'I.T.B.T.P. n° 75-76 - Mars-Avril 1954

[illegible] I. , Erfahrungen mit [illegible] und Möglichkeiten ihrer Anwendung Betonsteinzeitung (25) 1959.

[illegible] H. : Die Herstellung statisch unbestimmter Systeme durch nachträgliche Verstärkung und Verbindung von Stahlbetonfertigteilen Beton und Stahlbetonbau (50) 1956 - Berlin.

[illegible] H. , Über die Berechnung von Scheiben aus [illegible] Bau und Bauindustrie (13) 1960.

[illegible] G. , [illegible] mit Stahlbetonfertigteilen Betonsteinzeitung 1957.

[illegible] G. , [illegible] F.I.P. - AMSTERDAM 1955.

[illegible] S. [illegible] Forschung zur Gestaltung von Fertigteilen [illegible] mit Stahlbetonfertigteilen im Industrie- und Wohnungsbau Bauverlag 1960.

[illegible] A. , Die Montagebauweise im Industriebau Separatdruck aus [illegible] für das Bauwesen Verlag Stocker Schmid - Dietikon - ZURICH.

[illegible] F. Hallen aus vorgefertigten und zusammengespannten Stahlbetonteilen - B. und St. 1959.

[illegible] I. , Verbindung von Stahlbetonfertigteilen - Die Montagebauweise mit Stahlbetonfertigteilen und ihre aktuellen Probleme VEB Verlag Technik 3 Auflage 1960.

[illegible] H. , Das Problem der [illegible] infolge [illegible] und Schwinden bei aus Stahlbetonfertigteilen hergestellten Konstruktionen und seine praktische Bedeutung - Vorbericht des 6 Kongress der I.V.B.H. in Stockholm - Verlag Lehmann - ZURICH

[illegible] P. : Stabilité élastique des poutres en béton précontraint à l'égard du déversement latéral Annales de l'I.T.B.T.P. 1959.

DASLER E. : Allgemeine Merkmale der Vorfabrikation, Technische Forschungs- und Beratungsstelle der schweizerischen Zementindustrie - Wildegg 1963.

HASLASZ R. : Die neuere entwicklung der konstruktiven systeme bei hoch- und industriebauten aus fertigteilen - Betonsteinjahrbuch 1958.

CASADO C.F. : Couvertures en sheds préfabriqués pour bâtiments industriels (Espagne) - Mitteilungen der I.V.B.H. n° 15.

TRITTLER G. : Herstellung und montage vorgespannter betonfertigteile für förderbrücken - Betonsteinzeitung (25) 1959.

DEININGER K. : Im spannbett hergestellte fertigteile - Betonsteinzeitung (22) 1956.

KONCZ T. : Die hallenkonstruktionen der graugiesserei der autofabrik csepel aus stahlbetonfertigteilen - Baupl. und Bautechnik 1957.

FRANZ G. : Versuche über die querkraftaufnahme in fugen von spannbetonträgern aus fertigteilen - B. und St. 1959.

CSONKA P. : Die standsicherheit der aufgehängten fertigbauteile - Baupl. und Bautechnik 10 (1956).

MÄKELT H. : Ein hallenbau mit grossen fertigteil - Fachwerkbindern - B. und St. 57 (1962).

DOGANOFF J., HOFFMANN C. und RÜHLE H. : Schalen und faltwerkdächer aus vorgefertigten, zusammengespannten stahlbetonelementen - Bauplanung und Bautechnik 13 (1959).

NERVI P.L. : Precast concrete offers new possibilities for design of shell structures - Journal of A.C.I. Février 1962.

RAUER M. und JAIN N.C. : beitrag zur berechnung und konstruktion vorgespannter hohlkörper im industriebau - Der Bauingenieur 39 (1964).

DOGANOFF J. : Das entwerfen und die ausführung vorgefertiger schalen und faltwerke unter berücksichtigung der wirtschaftlichkeit - Bau und Bauindustrie (1963).

ANGELESCU S. und BAICULESCU E. : Unüberdachte kranbahn mit vorgefertigten stützen und trägern aus spannbeton - Bauplanung und Bautechnik 13 (1959).

Technische abteilung des entwurfsbüro für industriebau : Entwurf mehrgeschossiger industriebauten mit stahlbetonfertigteilen (Ungarish) - Ipari Epitészeti Szemle.

KRELL K.H. : Massabweichungen bei stahlbetonfertigteilen und ihre kontrolle bei vieferungen und in der produktion - Betonsteinzeitung 24 (1958).

..//..

WEISZ J. : Industrialisierung der montagebauweise mit stahlbetonfertigteilen Bauverlag Wiesbaden 1959.

BREGOU G. : Système de préfabrication pour garages souterrains - Bâtir S. 35 Bis 40.

BECK H. : Vas bauen mit beton und stahlbetonfertigteilen - Betonkalender 1967.

BAY H. : Konstruktive möglichkeiten der verwendung von betonfertigteilen im hochhausbau - Beton 12 (1962).

BEHNISCH G. : Vorfertigung von schul- und universitätsbauten aus der sicht des architekten - Betonsteinzeitung (1965).

BLACHERE G. : Industrialisation du Bâtiment en France - Technique et Architecture 25 (1965).

DEBOMY P.L. : Les écoles et lycées industrialisés - Construction (1965).

LE MEUR G. : L'industrialisation de la construction scolaire - Technique et Architecture (1965).

BARETS J. : La préfabrication lourde - Annales de l'I.T.B.T.P. 1955.

BECK H. : Vie grosstafelbauweise bemerkungen zur statischen berechnung und konstruktiven durchbildung - Der Bauingenieure 36 (1961).

BERNDT K. : Vie montagebauarten des wohnungsbaues in der bundesrepublik - Bauverlag Wiesbaden 1967.

CAMUS R. : Fabrication industrielle de huit logements par jour dans la région parisienne - Annales de l'I.T.B.T.P. - Mai 1956.

FOUGEA E. : L'industrialisation de la construction de bâtiment Exemple concret du chantier d'Evreux - Annales de l'I.T.B.T.P. - Mai 1953.

GILBANE F.T. : Precast concrete panel multistory construction - Journal of A.C.I. - May 1950.

GOFFIN H. : Vie bautechnische prüfung und begutachtung vorgefertiter wohnungsbauelemente unter berücksichtigung der neuen bauordnung für NRW - Bauindustrie 19[illegible]

HAMPE K.H. : Montagebauten aus raumgrossen betonfertigteilen (Prefabricated construction with room-size concrete units) - Deutsche Bauzeitschrift n° 5 - 1962.

Industrialisation, réalisation d'un programme en préfabrication lourde 1.000 logements à MEAUX - Annales de l'I.T.B.T.P. 14 - Juin 1961.

[illegible] R. : Das erste wohnhochhaus in grosstafelbauweise, system betonwerk [illegible] - Betonstrasse Zeitung 27 (1961).

[illegible] H. : Anwendung der plattenbauweise in der deutschen demokratischen republik - Bauplanung und Bautechnik 13 (1959).

[illegible] W.J. and **BISHOP** D. : Construction of multi storey flats - The economics of large panel methods - The Builder - vol. 202 - n° 6206 - April 1962.

[illegible] R. : Beitrag zur statischen berechnung waagerecht belasteter querwände bei hochbauten - Der Bauingenieur 36 (1960).

[illegible] R. : Tafelwände als aussteifende systeme bei hochbauten - Der Bauingenieur 42 (1967).

[illegible] R. : Approximate analysis of shear walls subject to lateral loads - A.C.I. Journal - Proceedings V. 61 (1964).

[illegible] H. und **[illegible]** D. : Aktuelle baumethoden und baukonstruktionen im [illegible] - Die Montagebauweise im Industrie und Wohnungsbau - Bauverlag Wiesbaden 1969.

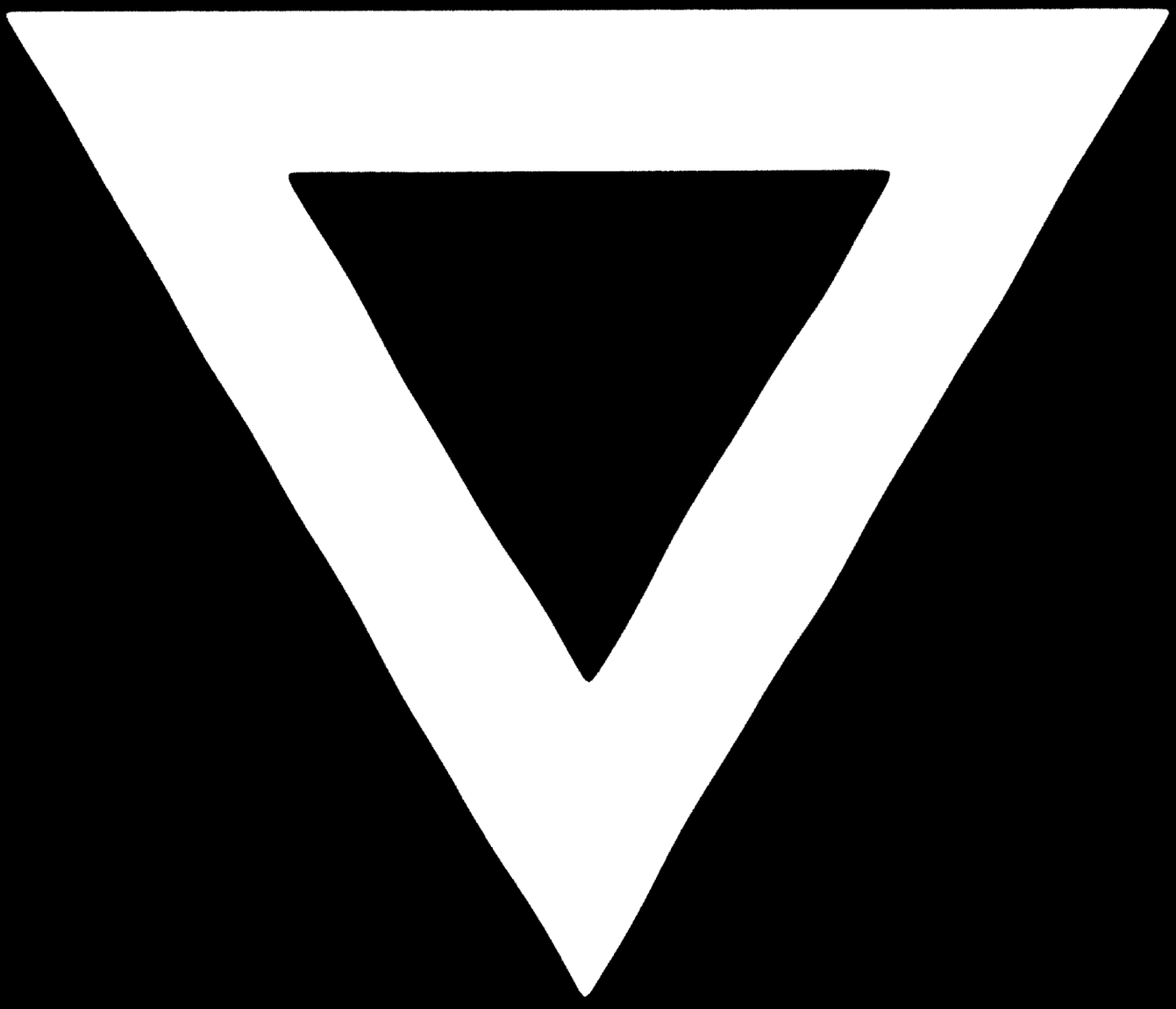
[illegible] W.R. : Der [illegible] wohnungsbau - Bauplanung und Bautechnik 13 (1959).

[illegible] E.I. : Viergeschossige wohnblocks aus vorgefertigten bauelementen in [illegible] - Betonstrasse Zeitung 25 (1959).

The [illegible] wall frame system - A new british system of prefabrication - Concrete [illegible] 1967

[illegible] H. : Stabilité au vent des bâtiments élevés - Cas des bâtiments à noyaux [illegible] porteurs - La Technique Modern Construction (1956).

B-563



81.08.28