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English

RESTRICTED

DEVELOPMENT OF THE FURNITURE
AND JOINERY INDUSTRIES AND
CREATION OF A CENTRE*

DP/YUG/73/006

YUGOSLAVIA

Technical report: Assistance to the upholstery COUR of
R. O. Vrbas, Banja Luka

Prepared for the Government of Yugoslavia
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Desmond P. Cody, expert
in industrial engineering

300.000

United Nations Industrial Development Organisation
Vienna

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Explanatory notes

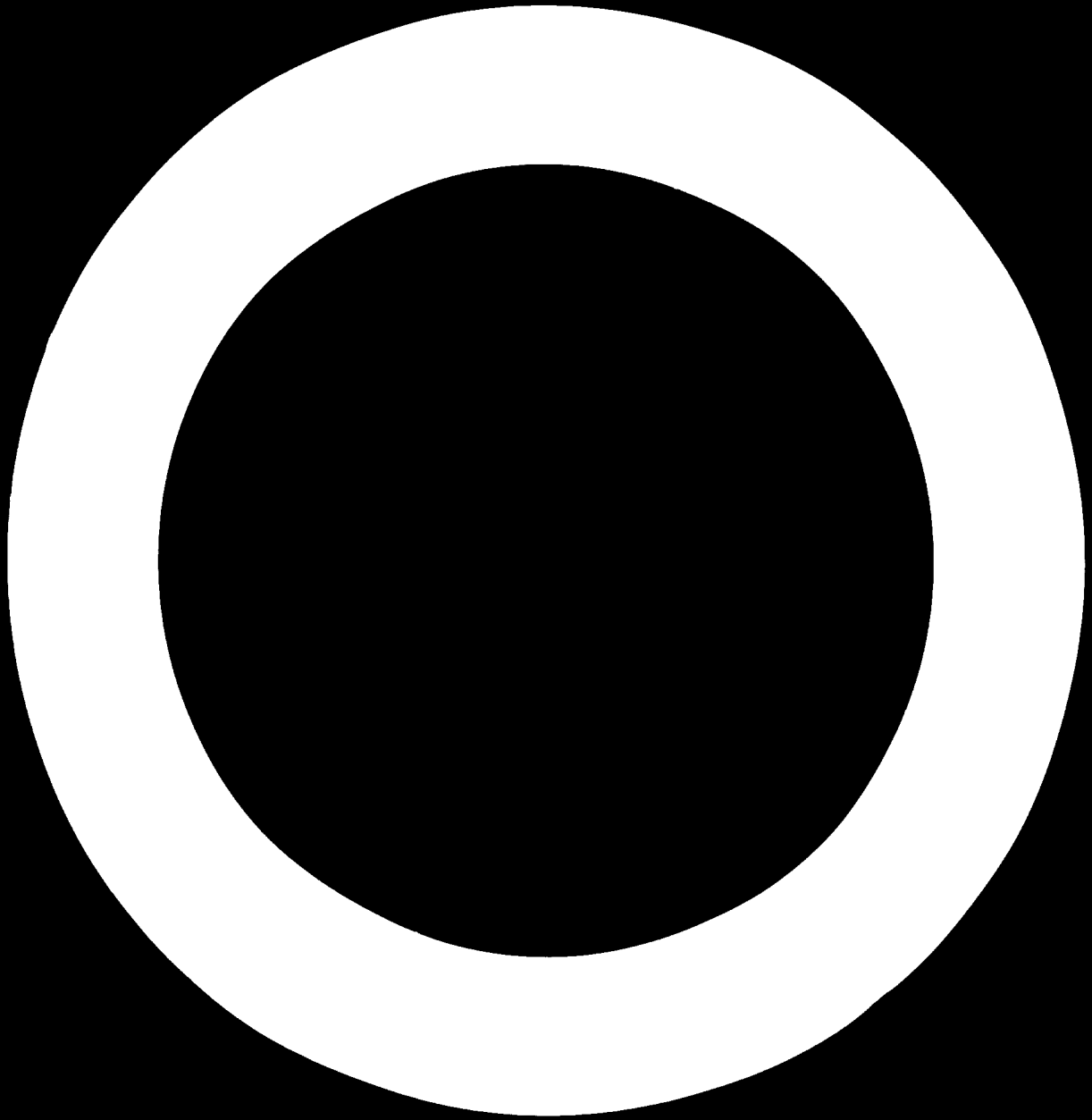
The monetary unit in Yugoslavia is the dinar (Din). During the period covered by the report, the value of the dinar in relation to the United States dollar was \$US 1 = Din 13.90.

The following abbreviations are used in this report:

EDP	Electronic data processing
FIRA	Furniture Industry Research Association
IRC	Istraživačko Razvojni Centar. This is the research and development RO of ŠIPAD
OOUR	Osnovna Organizacija Udruženog Rada. (Basic Organization of associated labour). This is a self-managed unit of an enterprise
RO	Radna Organizacija. (Working organization). This is an association of OOURs based, in ŠIPAD, on geographical proximity
VA	Value analysis

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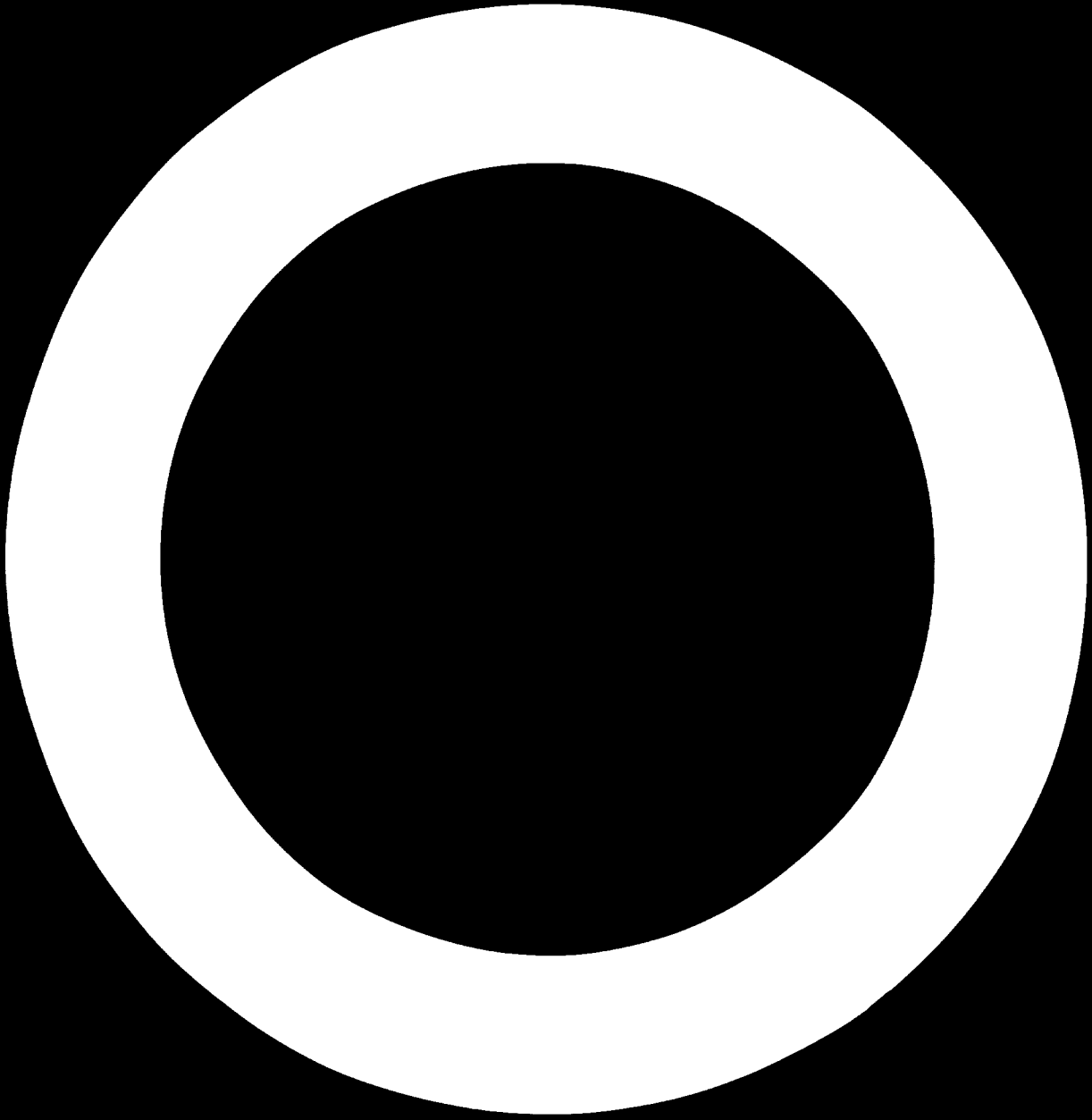
ABSTRACT

This report is based on a two-months assignment carried out by the expert in February and March 1979. The object of the assignment was to advise on the re-organization and development of the Upholstery OOUR of P. C. Vrljak, Banja Luka, Yugoslavia, particularly in terms of the introduction of new management techniques, materials and processes.

The report is therefore concerned with an assessment of the existing manufacturing situation in the upholstery OOUR and includes conclusions and recommendations regarding its improvement with particular reference to the following:

- Product design;
- Manufacturing facilities;
- Production and productivity;
- Management and labour;
- Documentation.

The report also includes details of visits to upholstery factories in the Federal Republic of Germany made by the expert and the personnel directly involved in the project. These visits were made at the commencement of the assignment.



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INTRODUCTION

The establishment of P. O. Vrbas dates back to 1918 when its first steam-powered sawmill began operations in the primary wood processing of local forests. During the second world war the plant was completely destroyed, but was immediately rebuilt as soon as war ended. Its activities were then extended to include forest management, saw-milling and rail and road transport.

From 1950 onwards further expansion took place in secondary wood processing, especially furniture, and plants were established for the production of corpus, solid wood and upholstered furniture. In 1970, a serious earthquake struck Banja Luka and again the Vrbas plants were completely destroyed. They were quickly re-built and modernised, and in 1975 Vrbas became involved in a programme, initiated at national level, of integration with other local plants also engaged in wood processing. The objectives were to maximise on the use of all available raw materials, to make better use of existing capacities, and to establish the integrated organization on home and export markets.

Since then Vrbas has been operating as a constituent Working Organization within "Ince" the complex organization of associated labour in Banja Luka. Its current activities include sawmilling, solid wood furniture, corpus furniture, upholstery, machined components for the wood industries, standard and off-standard joinery. In addition to those in Banja Luka, it includes production OOIRS in Skandar Vakuf (saw-milling and joinery), Injkonjic Grad (chair components and joinery), Kotor Varas (saw-milling) and Celinac (saw-milling and wood components) and provides marketing, design, product research and development to all production OOIRS. It also has a number of furniture retail outlets in Banja Luka and throughout Yugoslavia. Recently a joint marketing co-operative was set up for the marketing of furniture in the United States which includes Vrbas, Sipad and Krivaja.

The Vrbas manufacturing facilities are up-to-date and compare very favourably with those in countries with advanced economies. Already it has an established market for its products throughout Yugoslavia, in Eastern Europe, some

countries in Western Europe and the United States. Since it is assured of good supplies of timber such as beech and oak, which are particularly suited to furniture production, it is interested in expanding its markets for finished or semi-finished products. Statistical data on R. O. Vrbas is given in Annex I.

The Yugoslav Government formally requested the United Nations Development Programme (UNDP) in January 1979 to provide an expert in industrial engineering to advise and assist R. O. Vrbas, Banja Luka in the establishment of the principles and practices of industrial engineering in their manufacturing organization. The assignment "Industrial engineering in furniture and joinery" began on 21 January 1979 and ended on 6 April 1979. It was undertaken by Desmond P. Cody. It was part of a large-scale project, "Development of Furniture and Joinery Industries and the Creation of a Centre" (YUG/79/006), for which the United Nations Industrial Development Organization (UNIDO) was the executing agency. The government agency co-ordinating the project was the Republican Association for International Scientific-technical and Cultural-educational Co-operation. The experts job description is given in Annex II.

During a preliminary discussion which the expert had with Mr. R. Malis, Director of R. O. Vrbas, and senior members of his staff, it was agreed that, in addition to the work to be carried out in connection with the re-organization of the Upholstery OOUR, the expert would also assist in the re-assessment of certain selected items of furniture on the basis of the management engineering technique known as value analysis (see Annex III). This would be done with the assistance of teams made up of appropriate personnel who would thus become familiar with this procedure.

Annex IV contains the names of all personnel concerned with the assignment including the members of the two value analysis teams.

Annex V contains details of visits paid to upholstery factories in the Federal Republic of Germany.

I. FINDINGS

General Observations

Vrbas is a major Yugoslav producer of upholstered furniture, most of which is destined for home consumption. The enterprise is finding it increasingly difficult to remain competitive because of the nature of the Yugoslav market which shows a marked reluctance to change from traditional styling while at the same time it is becoming saturated with items of upholstery which differ only marginally from each other. Thus price, rather than design and styling is the main criterion of the potential buyer, and while what he eventually buys is by no means cheap, he has little variety from which to make a choice. Furthermore, there is no doubt that were this furniture to be sold outside Yugoslavia, it would have even less demand, particularly in Western European countries, and in consequence, valuable market opportunities are being lost while profits dwindle and disappear.

Apart from the question of design, the main problem is a lack of up-to-date technology, particularly in the availability and use of modern materials and production equipment. The management of Vrbas has become increasingly aware of this situation, and of the need to up-date its manufacturing facilities as well as to improve its upholstery design ranges. This was brought home particularly as a result of visits paid by some of its senior engineers and the expert, to upholstery factories in the Federal Republic of Germany at the commencement of the assignment. Here it was seen how the application of advanced technology in upholstery production had changed its traditional nature almost completely. For less labour intensive, no longer dependant on individual skills and judgements, and using techniques and equipment derived mainly from the textile and clothing industries, it had made considerable improvements in the nature and function of the product and had increased productivity substantially.

The work of re-organization and development described in this report represents the first stage in the future development of the Vrbas Upholstery OOUR which it is anticipated will take up to five years to complete. Eventually, a new factory will be built, but in the meantime, much can be done to improve the situation in the existing premises as regards design, technology and productivity. Not everything learned in the German factories is being implemented at this stage, but it is a careful blend of established ranges and the introduction of new designs based on up-to-date technology, materials and equipment. At the outset, top management emphasised that despite the introduction of new and improved technology with its consequent increase in productivity, employment should remain at its present level and any increase in productivity would have to be absorbed by increased marketing effort. The expert would have liked to introduce a fully automated internal transport system, since it is an integral part of the modern systematic and controlled approach to upholstery production. This was not, however, found to be feasible largely because the structure and disposition of the existing building made it impractical. Nevertheless, it was found possible to do so on a pilot basis in the cutting and sewing department and the experience gained here should prove invaluable when the new factory is being planned.

The proposals incorporated in this report are the result of the combined work of a team drawn from the various departments of the upholstery factory, the Vrbas design bureau and the expert. The Conclusions and Recommendations of the team represent an agreed view on how product design should be amended and how the manufacturing and management facilities should be adapted in order to achieve the objectives of stage I of the re-organization and development programme, namely, more up-to-date design, improved production flow, higher productivity and better quality.

Product Design

In their design and structure, products generally reflect the traditional approach to upholstering which in more technologically advanced factories has largely been supplanted by new materials and new production techniques.

The conventional upholstery frame is based on solid wood members, usually beech, with dowel, mortice and tenon and interlocking corner joint construction. It is usually constructed with over-heavy section, presumably to achieve complete reliability in performance. Now that this type of frame is becoming increasingly more expensive to produce and, in any case, since it is unwise to be totally dependant on hardwood supplies, alternative materials and new methods of construction should be investigated with a view to producing cheaper frames with a far larger range of standardised components. High on the list of alternatives are frames utilising panel materials, such as particle board and meliapan, as structural members. The nature of these materials makes them ideal for component rationalisation as they can be applied with minimum adjustment to a variety of uses. Research by F. I. K. A. carried out to apply mathematical methods of structural analysis to rationalise the construction of frames and, incidentally, to save timber has proved successful and these results could be used to advantage. For instance, the assembly of frames by means of staples with the inclusion of some form of shear panel to provide the necessary stiffness is now quite practical. The exact method of construction depends on the frames role and its performance to changing functional demands. In any event, all frames should be easily and accurately made, should use a minimum of raw material consistent with the known requirements of strength and performance in use, and should incorporate suitable surfaces for supporting upholstery and fixing points for springs castors and connectors.

A feature of practically every piece of fully upholstered furniture is the use of the coil spring unit as a suspension system for seating. In the studio couch or convertible, this spring unit is also incorporated in the back so that when it is converted into a bed, the load may be distributed evenly over the entire "bed" surface. To accommodate these units, it is necessary to enclose them in a heavy wooden box-like frame, which may also provide storage for bed linen and other bed coverings. The result is a massive and unyielding structure which is extremely heavy and difficult to move about, even when fitted with glides or castors. Almost invariably, the frames long outline the covering material.

The fully upholstered suite consists of the convertible

referred to above and two or three arm chairs manufactured in roughly the same way. Only lately has the enterprise begun to produce "show-wood" seating, i.e. with polished wood arms and legs. This should be further developed particularly since the manufacturing facilities available for this type of product are excellent, and there is virtually unlimited supplies available of good quality oak ash and beech, species particularly suited to this styling.

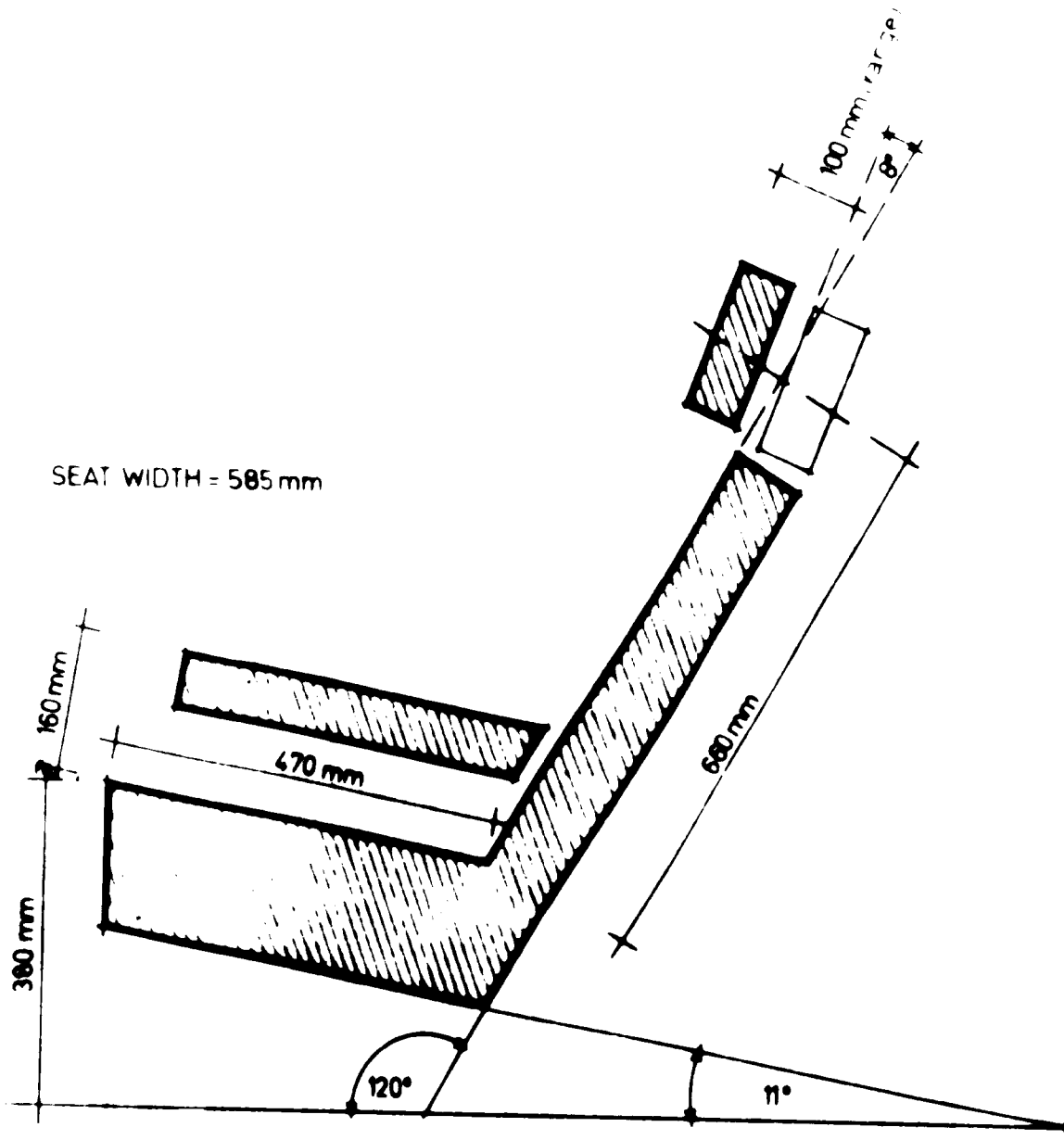
During the course of the assignment studio couches using alternative suspension systems (mainly serpentine springing and resilient webbing) and other more up-to-date substitute materials were designed and prototyped. These showed that they could be an acceptable alternative to the more traditional couch referred to, being cheaper, lighter, more mobile, more easy to produce and generally more stylish and attractive. There are difficulties with regard to the availability of certain materials, notably resilient webbing and mechanical movements for adjusting the couch to a bed but these should not prove insuperable especially since local suppliers are prepared to produce them in volume if the right demand can be established.

Whatever the material and structural considerations of seating, which will vary according to function and usage, all seating should have one thing in common, namely the provision of some degree of comfort to the sitter. The comfort afforded depends on the shape of the surface between the sitter and the chair and the dynamic characteristics of the padded surfaces.

Research carried out by F. I. R. A. into the dimensional and anthropometric aspects of comfort in seating indicates that despite the postural differences between men and women optimum values for seating that will cater for the adult population generally can be obtained. Figure I shows the dimensions of a chair expected to give the maximum comfort to most people. The dimensions allow for a seat compression of 65 mm, and the preferred angles of rake and tilt fall between 115° and 130° and between 10° and 15° respectively.

FIGURE I

DIMENSIONS OF THE OPTIMUM EASY CHAIR



Manufacturing Facilities

The most important aspect of any manufacturing organization is the product or, in the case of Vrbas, its entire range of products, which reflect not only product policy, but also the policy concerned with marketing, design and production. The nature and extent, therefore, of all the manufacturing facilities, i.e. buildings, machinery and equipment, management and operative skills are dependant upon the design, technology, raw material choice, and usage, and output volume of the product as well as the market for which it caters. It is therefore important at the outset to get the product right, because it plays a vital role in determining an acceptable level of performance, productivity and profitability.

The re-organization of the Vrbas upholstery OOUR was planned mainly around three models, "Tara", "Tisa", and "Tina" (see figures II, III and IV), which between them represent the desired level of change in terms of raw material usage and the introduction of more up-to-date levels of technology, required at this stage. Table 1 shows the existing and projected daily and annual output required:

Table 1. EXISTING AND PROJECTED DAILY AND ANNUAL OUTPUT PER PRODUCT GROUP

YEAR	GROUP I		GROUP II		GROUP III		GROUP IV	
	DAILY	YEARLY	DAILY	YEARLY	DAILY	YEARLY	DAILY	YEARLY
1978	43	11,341	29	6,152	69	17,073	38	10,355
1979	40	10,547	36	9,675	99	26,550	60	16,144
1980	44	11,863	41	10,884	111	29,869	68	18,162

- GROUP I : Studio Couch and Bed
- GROUP II : 3/Seater and 2/Seater Settees
- GROUP III: Arm Chair and Corner Unit
- GROUP IV : Arm Rest Stool Coffee Table

Table 2 summarises the total time for each of the fabric cutting and sewing work stations for each group of models in the years 1978 to 1980.

FIGURE II

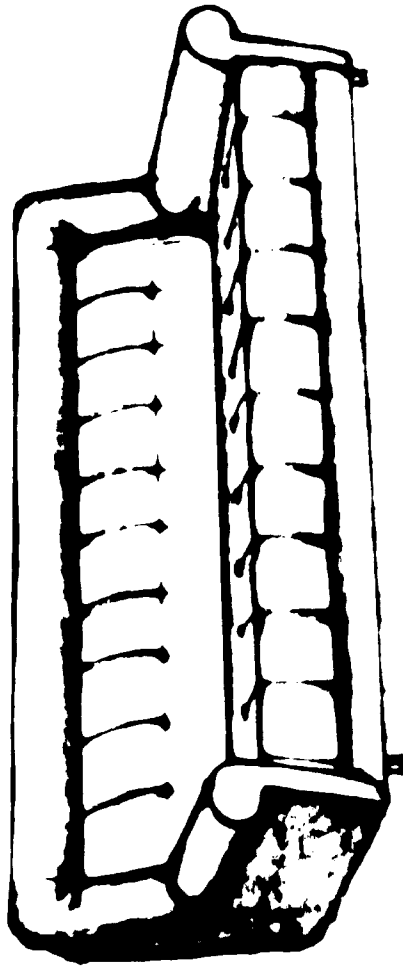
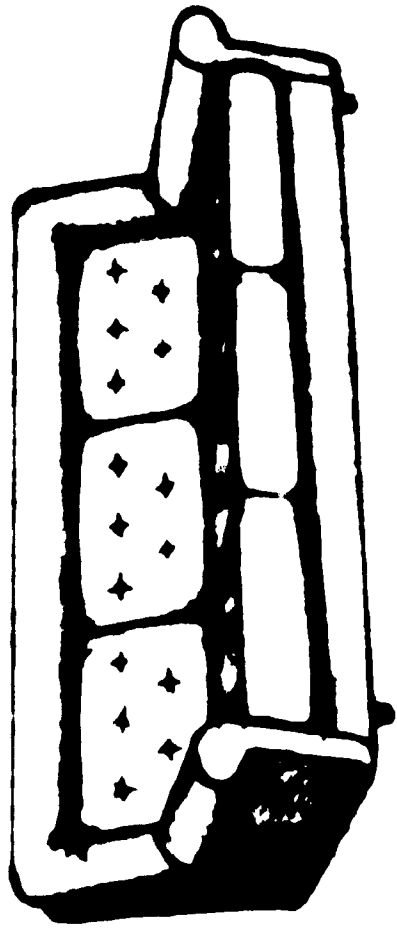


FIG. II

time

FIGURE III



tina

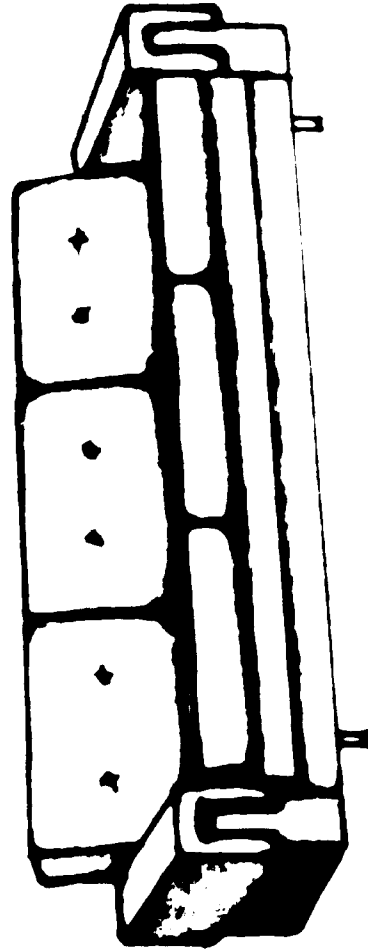


FIGURE IV

Table 2. EXISTING AND PROJECTED TIME ALLOCATION PER WORK STATION AND PRODUCT GROUP

1 Month = 23 Working Days
1 Shift = 480 Minutes

GROUP	YEAR	QUANTITY	CUTTING	SEWING	QUILTING	BUTTONING	NO. OF WORKERS
I	1978	966	11,901	25,937	23,802	4,802	17
	1979	979	10816	26276	24,122	4,591	
	1980	1,101	13,558	29,550	27129	5164	
II	1978	667	5,413	37,099	5,457	4,675	17
	1979	807	6,544	44885	6,601	5,649	
	1980	908	7,363	50,202	7427	6356	
III	1978	1,541	8,237	36,583	16,489	3875	20
	1979	22,13	11,816	52514	23,679	5,554	
	1980	2489	13,294	59,064	26632	6247	
IV	1978	851	2,085	5,497	3,361	1,123	23
	1979	971	2,378	6272	3835	1282	
	1980	1,092	2,676	7054	4313	1441	

On this and other data, the physical re-planning and equipment of the entire production area was carried out.

Buildings

The existing building is a long, low and narrow structure with a total area of 4,176 m², including storage. It has a corrugated asbestos roof supported by round section

steel roof trusses set at intervals along its length. While not entirely suitable for manufacturing purposes - the eaves height is too low at 472 cm and the roof structure is not capable of carrying heavy loads - it is, nevertheless, satisfactory for immediate purposes and an endeavour has been made to make the best possible use of existing space with a minimum of structural alterations. It has therefore mainly been concerned with the re-allocation of space determined on the basis of individual working areas requirements, intermediate storage for work-in-progress and internal transport between processes, and inter-departmental transport. Table 3 gives a break-down of the re-allocation of space in accordance with individual work station requirements.

Table 3. MANUFACTURING SPACE RE-ALLOCATION

No.	DEPARTMENT INCLUDING TRANSPORT AND STORAGE	EXISTING AREA m ³	PROPOSED AREA m ²
1	Frame preparation, Cardboard cutting, frame assembly, glueing.	687,5	512
2	Foam preparation cutting and storage	420	672
3	Collection storage distribution and control of work-in-progress	176,5	168
4	Fabric cutting, sewing and storing	560	560
5	Cover assembly and upholstery	448	437
6	Final Assembly packing storage and dispatch	448	291
	Total	2640 ----	2640 ----

Machinery and equipment

Annex VI shows a schematic re-layout of the factory in accordance with the most suitable work flow, economical use of space and provision for adequate storage for raw materials, work-in-progress and internal transport. A fully detailed layout was also prepared for the factory but is not included in this report.

The various work centres, intermediate storage areas and flow of work is as follows:

1. Storage and cutting of cardboard.
2. Daily storage and cutting of jute materials.
3. Fixing of serpentine no-sag springing and resilient webbing.
4. Fixing cardboard on frame.
5. Foam glueing.
6. Frame assembly no. 1.
7. Intermediate storage of frames (3 days supply).
8. Frame assembly no. 2.
9. Fixing jute to springs.
10. Fixing coil spring units on frames (studio couch).
11. Vertical foam cutting.
12. Horizontal foam cutting.
13. Foam profile cutting.
14. Cutting of small foam shapes.
15. Foam granulating.
16. Intermediate storage for foam elements.
17. Cushion filling and closing.
18. Intermediate storage for filled cushions.
19. Cotton storage (daily requirements).
20. Fabric storage (daily requirements).
21. Cutting cotton and cover fabrics.
22. Cover sewing.
23. Quilting.
24. Control, collection, intermediate storage and distribution area for all elements and components.
25. Arms and small components covering.
26. Covering of couches (studio type).
27. Arm-chair assembly.
28. Couches assembly.
29. Armchair packing.
30. Studio-couch packing.
31. Dispatch.

The existing range of upholstery machinery and equipment is, in general, in good condition well maintained and suited to the immediate needs of production. Some additional machines are required and provision has been made for them in the layout as follows:

1. Cutting and Sewing:

New extended laying marking and cutting table incorporating automatic mechanism for fabric spreading and tensioning and with a conveyerised section connecting each half.

Fully automatic conveyerised sewing station with provision for twenty sewing machines capable of carrying out a variety of sewing procedures.

Automatic quilting machine capable of providing an unlimited variety of quilted patterns of varying thickness on upholstery panels.

2. Fabric receipt and inspection:

Inspection table incorporating winding and measuring device.

Special tube storage for easy access in main fabric storage area.

Specially designed trolleys for daily fabric requirements.

3. Buttoning:

Fully automatic button covering and buttoning machine.

4. Cushioning:

Automatic cushion filling and closing machines.

5. Upholstery assembly:

Variety of work holders and work presses to suit various pneumatically and hydraulically operated elements, sub-assemblies and frames during cover-upholstering and final assembly.

Upholstery assembling machine.

Production

Materials Handling

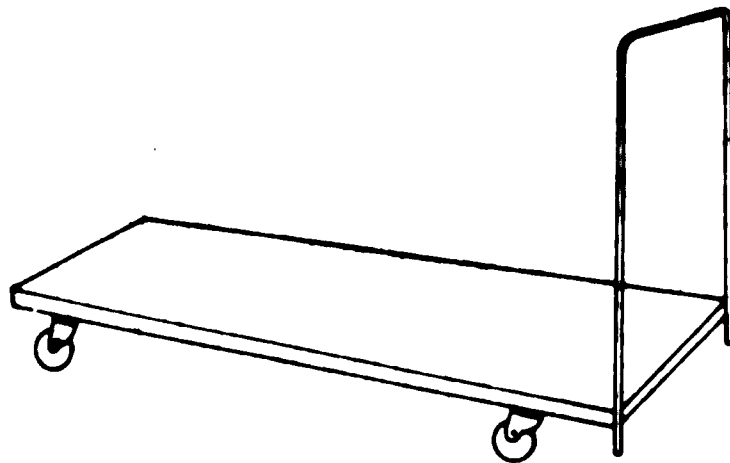
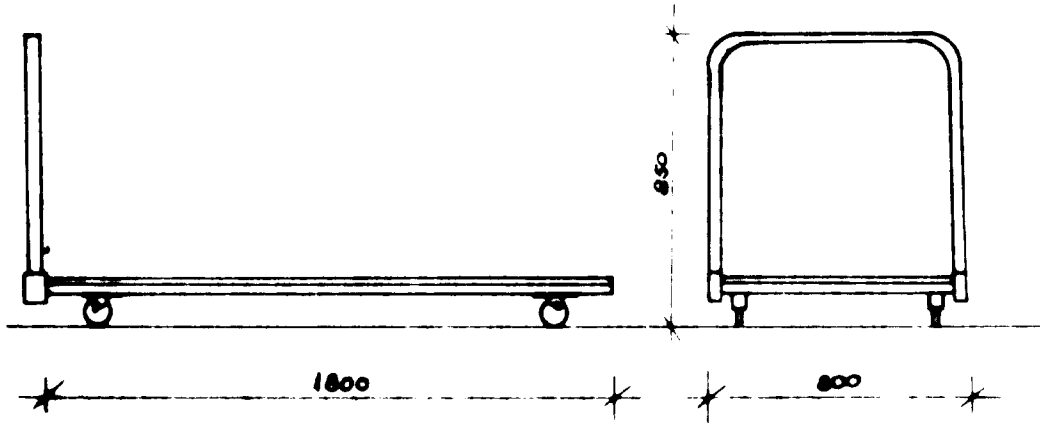
The factory has been re-designed around a concept that allows the maximum use of "bought in" components and the pre-assembly of a maximum number of parts and elements. This is accomplished at organized work stations where items are produced on a repetitive basis and thus each worker can become highly skilled in a very short time. The use of powered and manual conveyors (Figures V - VIII), specially designed for the purpose, will reduce considerably most of the lifting pushing and carrying which are a feature of the current system.

In the sewing room the transport system will be fully mechanised by means of a conveyor belt located between two rows of sewing machines which it shall service by delivering the cut fabric to each sewing station (Figure IX), and after sewing, conveying it by means of plastic boxes to the inspection and sorting area.

Fabrics currently in use (usually two days supply) will be stored on specially designed trolleys (Figures X - XI) close to the cutting tables to which they can be easily rolled and connected. The main store for fabrics is in another part of the building where they are kept until required. In order to allow ease of access to individual rolls of fabric, each will be stored in reinforced cardboard tubes. A suitable alternative would be reject or substandard plastic pipes of the correct diameter. The cutting tables will incorporate a conveyor belt section, thus enabling cutting, marking and sorting to be carried out simultaneously and thereby making maximum use of the table.

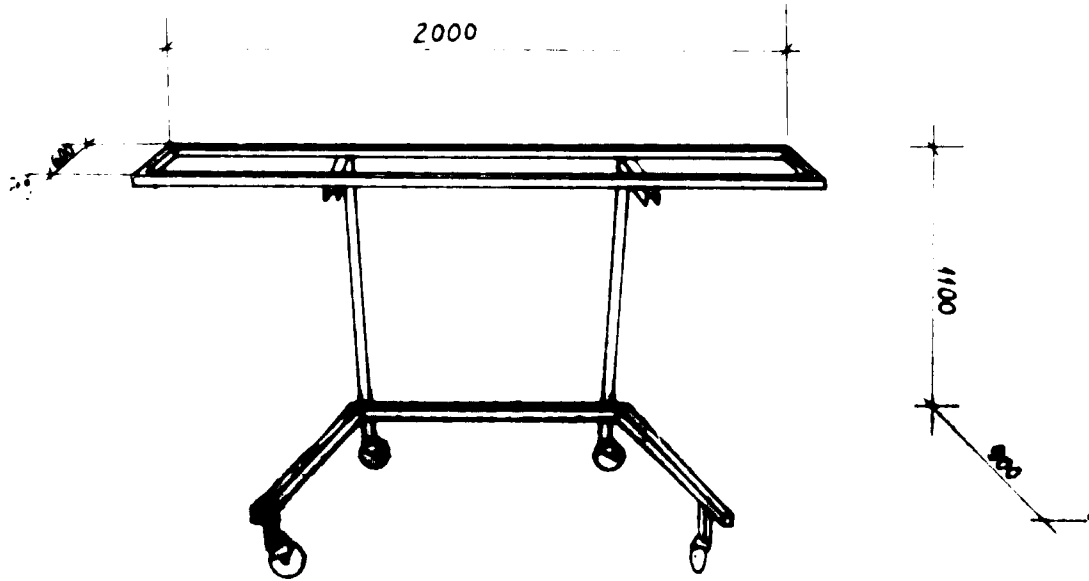
While most component and frame parts begin their cycles independently, they will eventually converge on a central collection and intermediate sorting area prior to final upholstery and assembly. There will be specially designed trolleys which will carry the prepared frame (Fig. VII), its covering material and anything else required, to the upholsterers work bench. When the work here is completed, the frame will be reloaded onto the same trolley and delivered to dispatch for final fitting and packing. Later,

Figure V



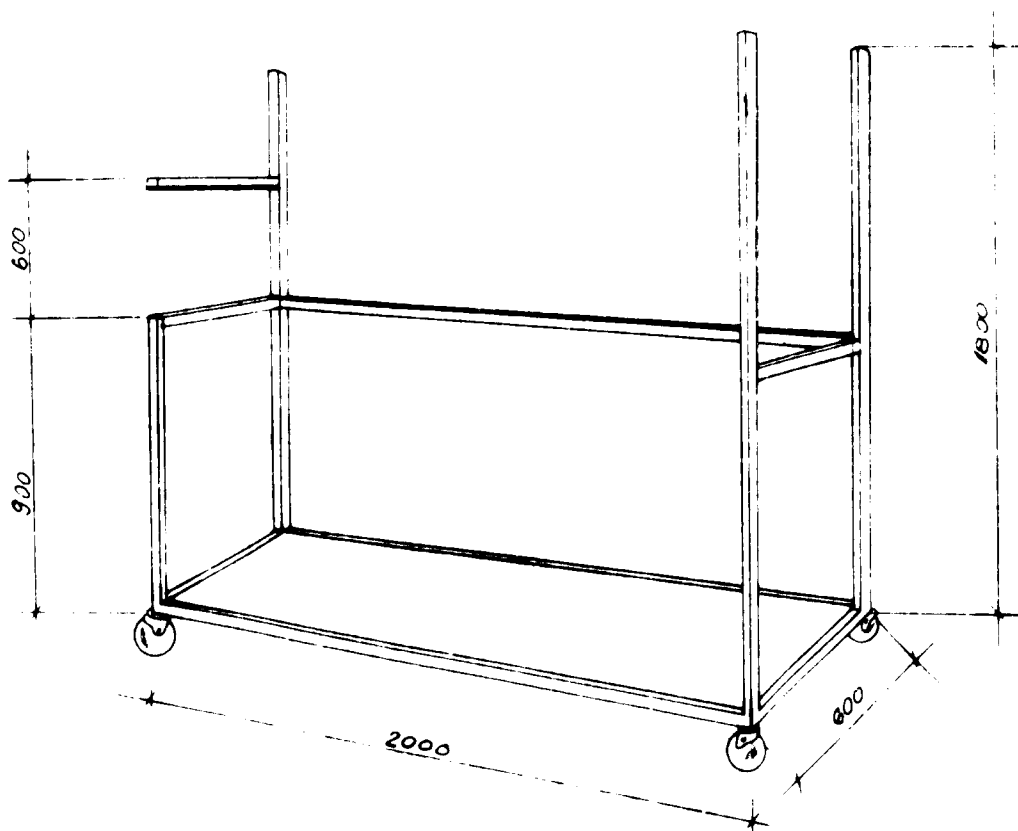
**TRANSPORT
WAGON**

Figure VI



TRANSPORT WAGON
FOR UPHOLSTERED SUITES

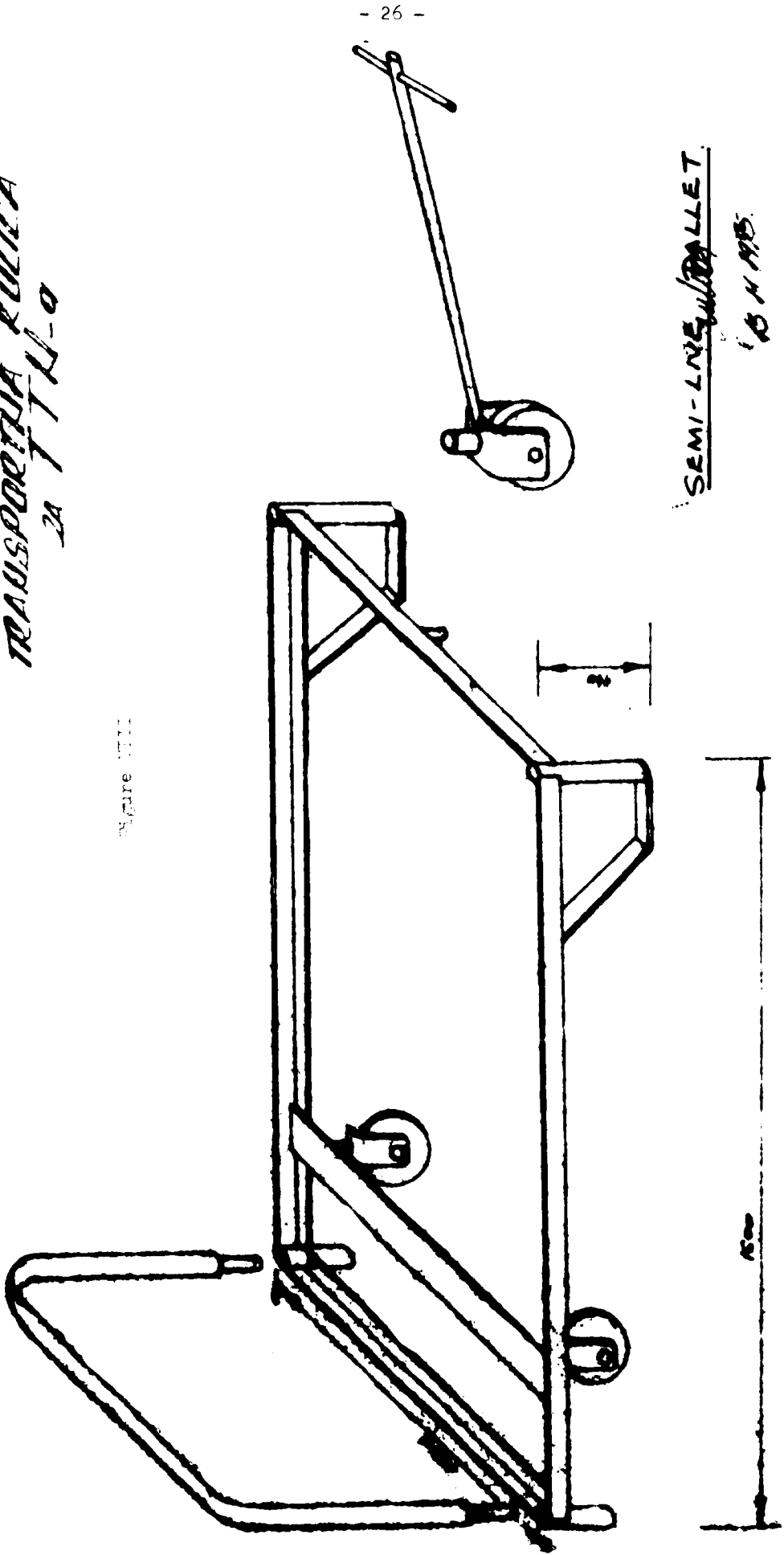
Figure VII



**TRANSPORT WAGON
FOR FRAMES**

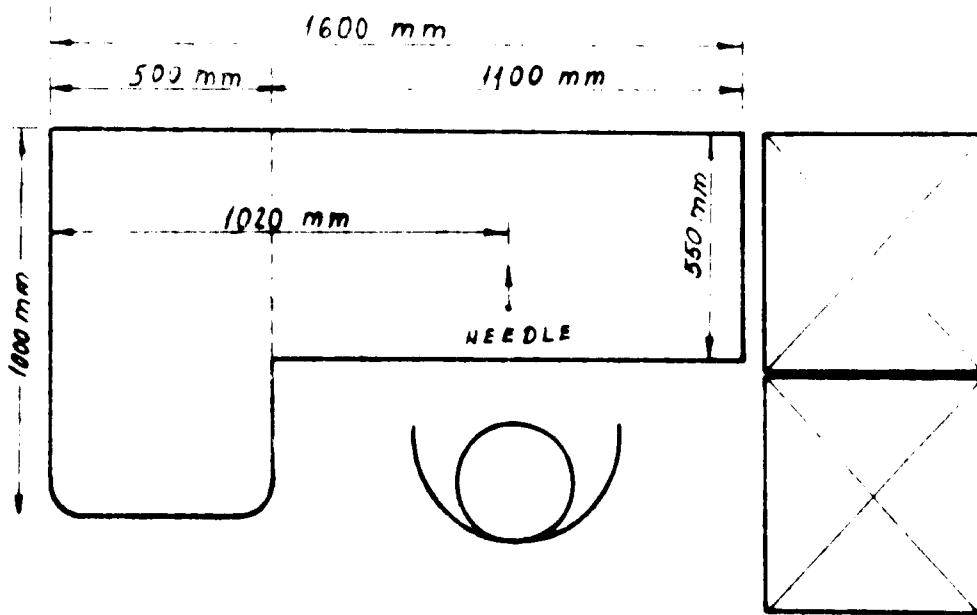
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Figure 1711



SEMI-LINE BALLETT
134 MM.

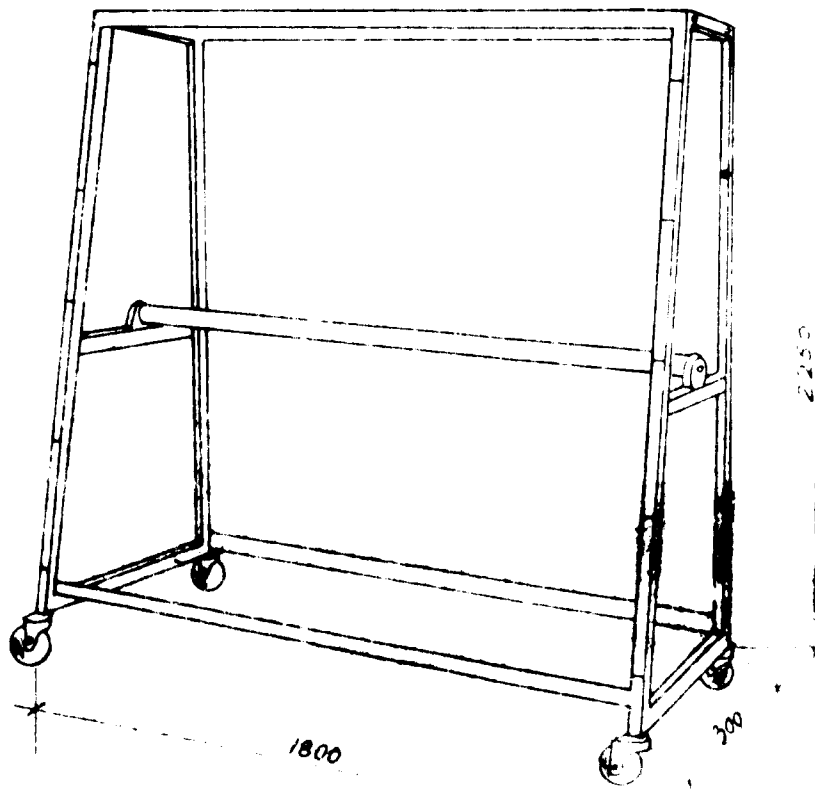
Figure 13



CONVEYOR BELT

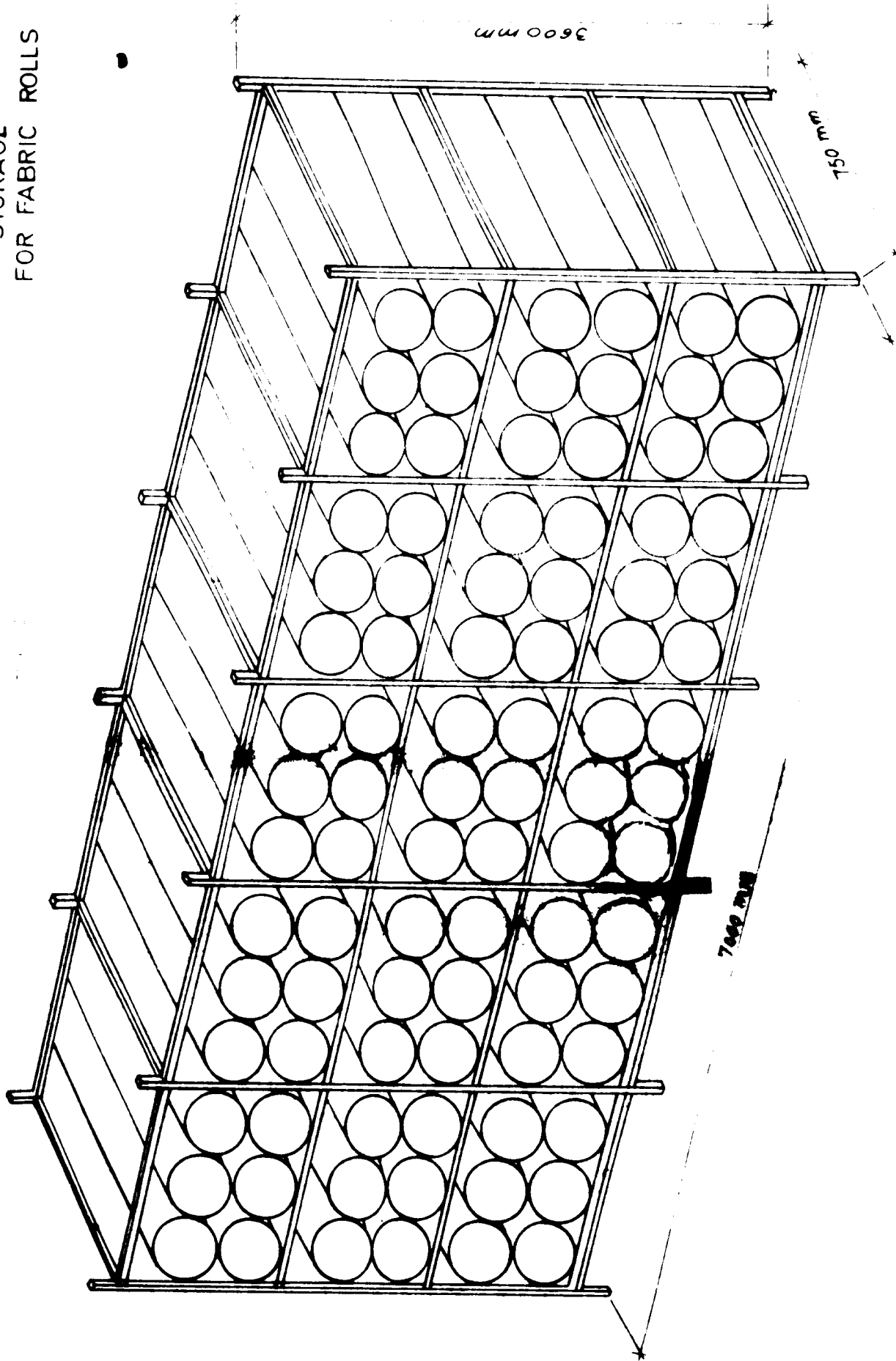
SINGLE SEWING STATION

Figure 3



TRANSPORT WAGON
FOR FABRIC ROLLS

STORAGE
FOR FABRIC ROLLS



it is hoped to replace the castorised trolleys with a fully automated system of overhead conveyerisation, but this must await a new building and more drastic changes in product design than those envisaged at present.

Cutting and sewing

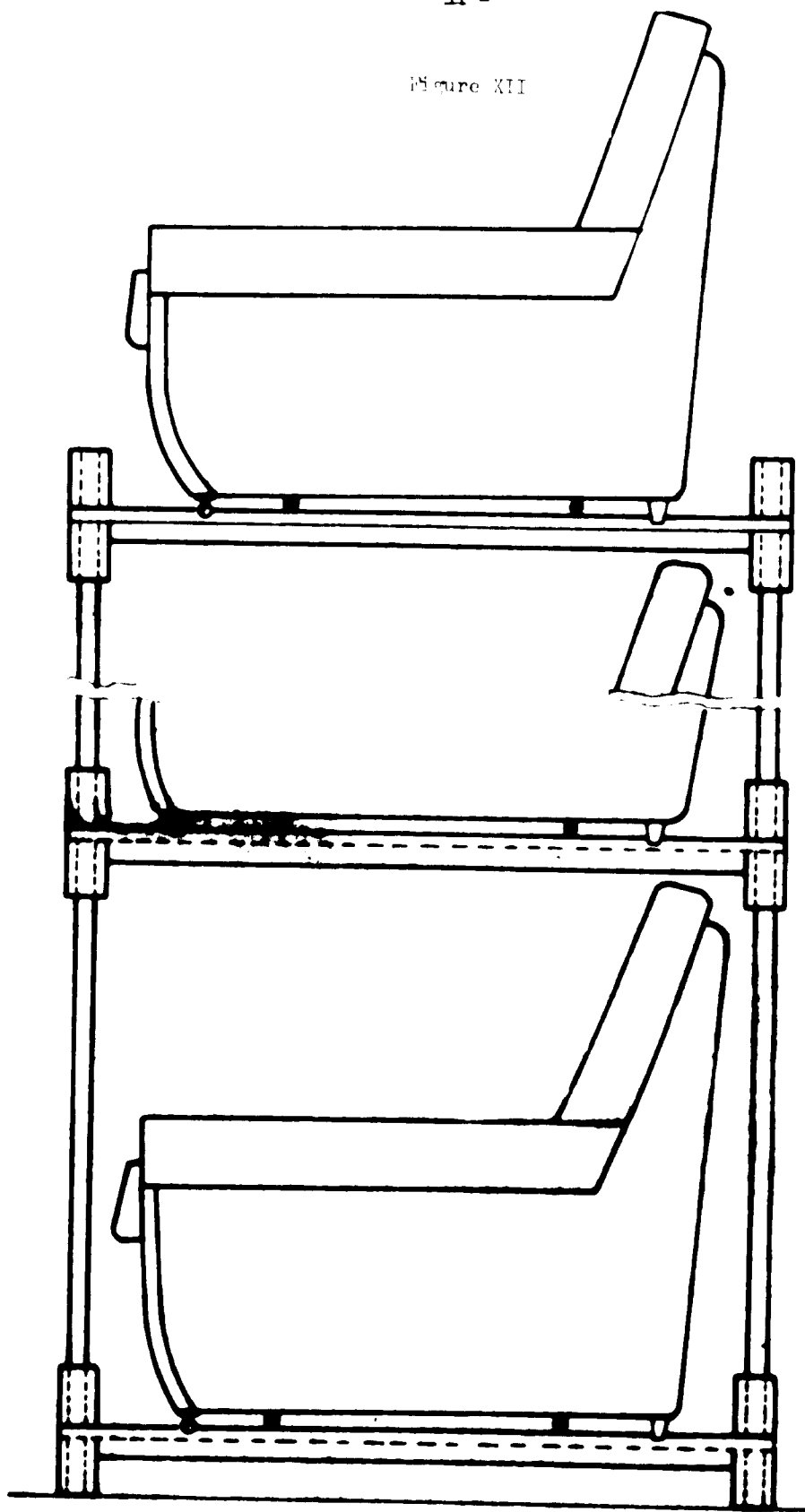
After inspection and measuring of the fabrics required for a given work period, they are conveyed by fork lift to the fabric trolleys already referred to and eventually to the cutting tables. One cutting table is devoted to cutting secondary materials or barrier cloths (linen, muslin, hessian) in multiple lays, and these and covering fabrics are cut by reciprocating knives operating from overhead spring loaded power cable. The cutting tables incorporate an overhead electrically operated gantry for accurate spreading of the fabric and equal stretch per lay, and there are special holding devices to ensure correct marking and cutting. In order to avoid variation in shade of fabric on the same model each layer of fabric is numbered on the back after cutting and the same number is then used for each cover part of the same model.

After cutting, materials are taken by manual conveyor to a fabric sorting or classification centre, where they are sorted. Non sewing parts go to mobile storage racks (Figures XII - XVI), where they are lined up in accordance with production programming. Work tickets, already prepared, state on which production line and in which production period the cut fabric is to be used.

Sewing centres are classified according to the nature of the sewing activity required. There is therefore provision for straight sewing and seaming, cushion boxing and ruffling, sip insertion, welting, leather and vinyl sewing and piping. Appropriate pieces go to the relevant sewing station with the small flatwork being done by less experienced sewers. Button-making and quilting are also located in this area.

Work for cushions flows through zipper sewing, cushion boxing, and after these and backs have been sewn, are transported to an inspection and sorting centre on castorised trolleys. From here they are dispatched to cushion and back filling stations respectively. After closing regulating,

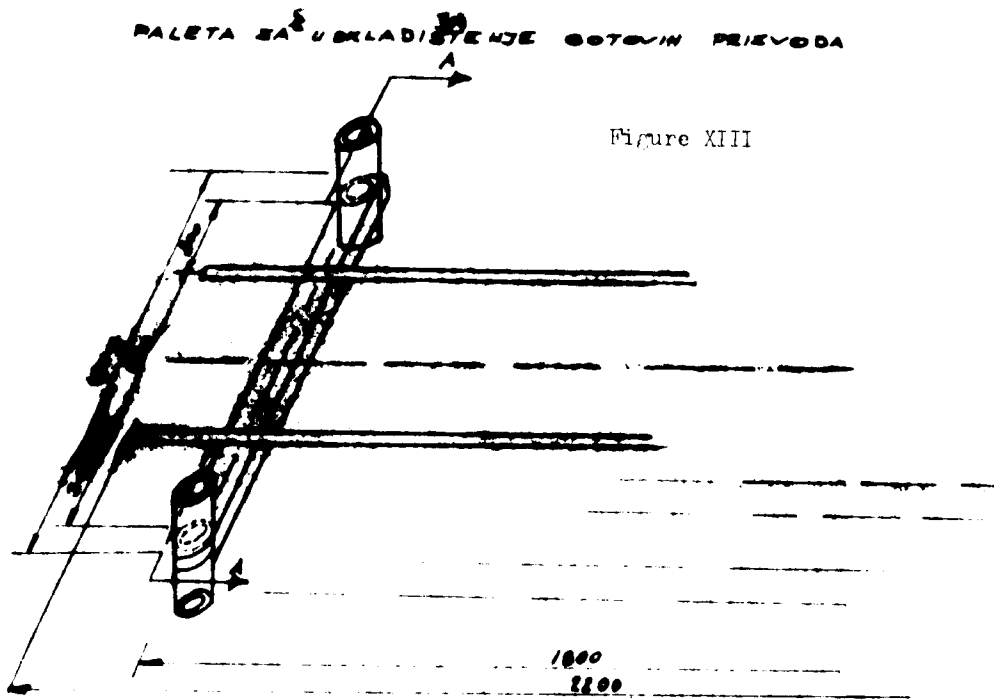
Figure XII



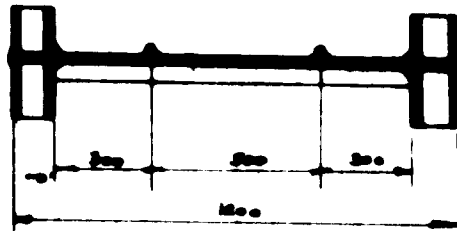
MULTIPLE STORAGE RACKS

PALETA SA UBLADISTENJE GOTOVIN PREGVODA

Figure XIII

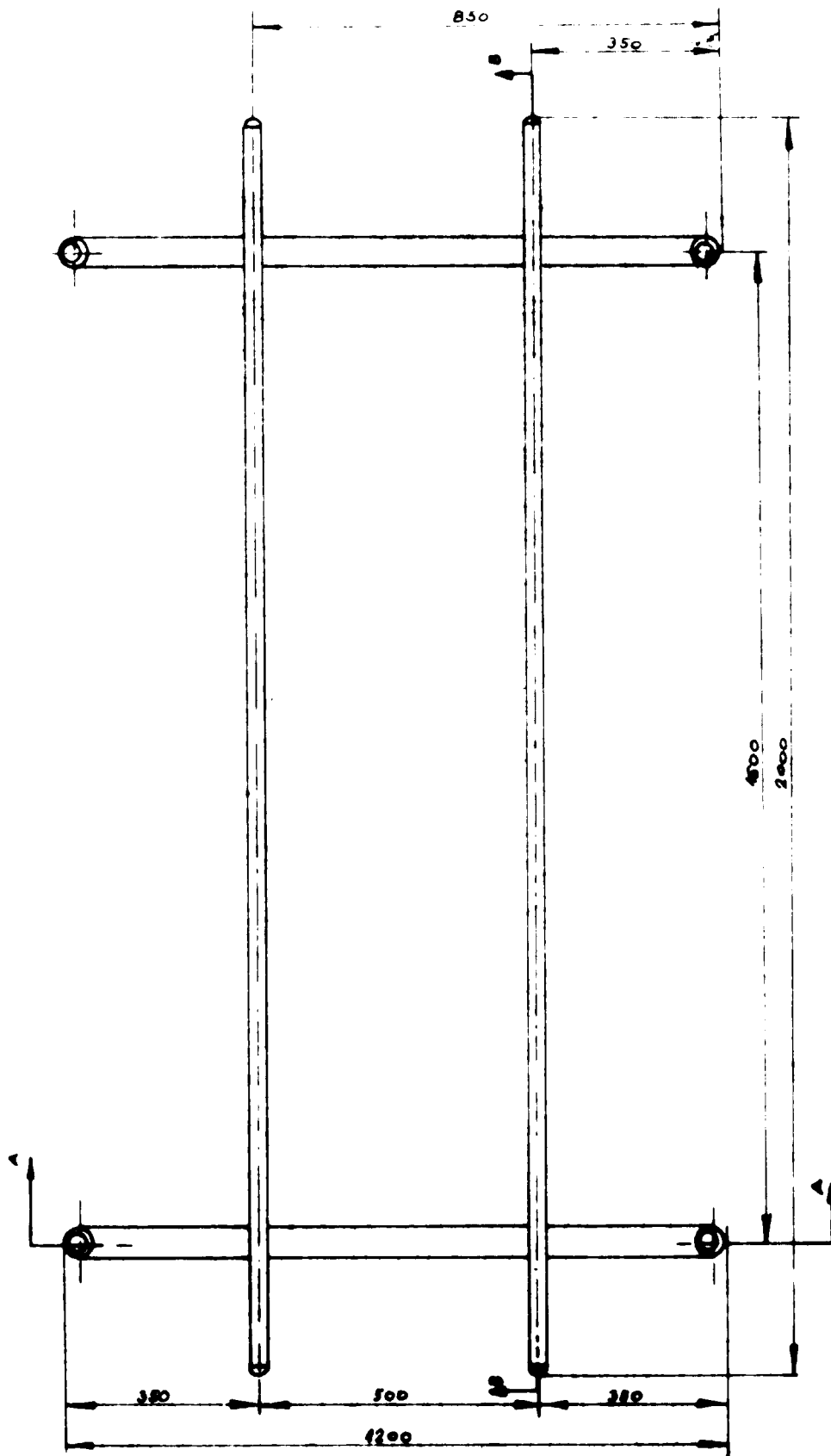


SECTION
PREMA A-A



Constructional Details For Figure IX

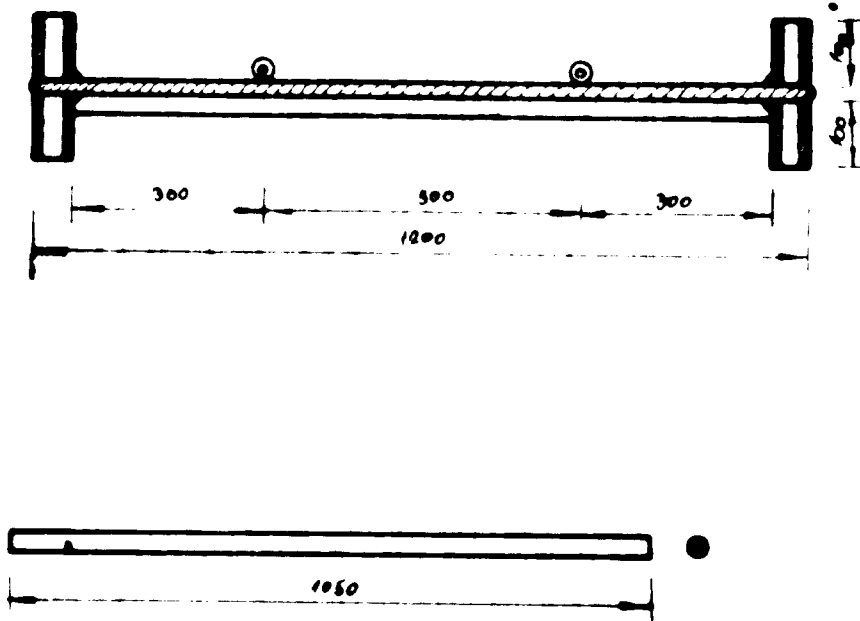
Figure XI



Constructional Details for Figure IX

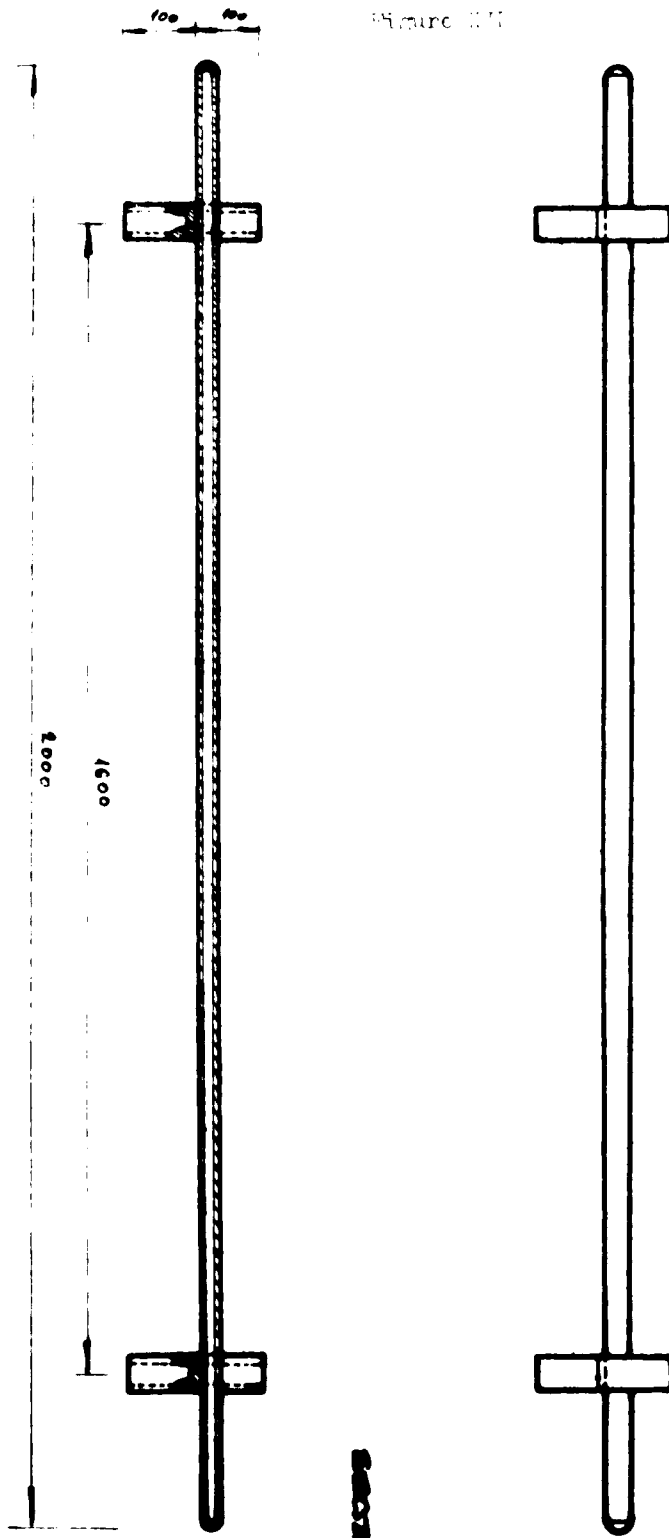
Figure IX

SECTION A-A'



Constructional Details For Figure IX

Figure III



SECTION, S-S

Constructional Details for Figure IX

button installation, etc, they are removed to the central intermediate storage and collection area.

Frame preparation

This includes both fully assembled frames and sub-assemblies such as arms, seats and backs. Depending upon the springing system to be used (i.e. coil-spring unit, serpentine no-rag, resilient webbing or platform) each frame will be "sprung up" and cardboard profiles or infills fixed where necessary to the frame. It then proceeds to the padding area where a thin sheet of polyurethane foam is glued to the outer surface again by means of a spray adhesive. Heavier cushioning is fixed to armrests seats and backs and the various types of frames which are now ready for cover assembly are transported to the central storage and collection area.

Foam cushioning preparation

Foam is delivered to the factory in block or slabstock form. In the foam preparation department it is cut into various surface dimensions and thicknesses according to requirements by means of slitting knives and band knives. Depending on usage, some cushions will be of the same foam density throughout, while others will be made up of a variety of densities being softer on the outside, and harder on the inside. Waste foam is reconstituted in the form of crumb or spaghetti by means of a special shredding machine and is used as an additional form of cushion infill in channel case cushioning which is subsequently covered with low hardness polyether sheeting. A fairly high percentage of cushioning will be made up from a combination of polyester fibre with a core of urethane foam. Solid foam cushioning may be further shaped and profiled according to design requirements. Cut foam and the other types of cushioning referred to will be transported on specially constructed bogey-type cushion trolleys to the cushion filling and closing machines which are located close to the central collection and intermediate storage area.

Work-in-progress

All components, sub-assemblies fully assembled frames, finished cushions, sewn covers and all other materials required for final assembly converge on the centrally located

collection and storage area. Complete sets for each chair or settee are attached to the appropriate frame according to the line up instructions on the work-ticket documentation, and then the whole is placed on a castorised trolley for delivery to the appropriate cover assembly line. Each trolley accommodates either a settee or two arm chairs and these are lined up in readiness for final assembly. Provision is made in the assembly area itself for a line up of loaded trolleys so that the cover assembly lines are never without work. When the upholsterer or cover assembler has finished his work, the completed frame is loaded onto the same trolley and conveyed to final assembly and packing. At this stage casters, wheels and in the case of studio couches mechanical movements are fitted to the frames. Each upholstered frame complete with cushions is then stored wrapped in polythene before transport.

Data processing

The Vrba's data processing centre already caters for the production programming needs of the corpus factory. This service will now be extended to cater also for the needs of the upholstery COOR providing management with information on sales trends of fabrics, the style of frame, colour and pattern of fabric, both sold and produced, raw materials inventory for each model, production by department, unit check list, programming check for one week and production plan for two weeks.

Production control

From data supplied by EDP with the production order, a work ticket for each unit is prepared. This sheet contains a number of perforated sections containing all the information necessary to produce the item. There are tickets for cutting, sewing, springing, frame, finish, cover assembly, fittings and packing. As each process is completed, the relevant ticket is pulled and returned to control until all processes have been completed.

Every three days a production order is issued, which for planning and control purposes is divided into six four hour periods. Each period is given an identification letter, A B C D E or F. The letter is printed on each production ticket for easy identification. Each department or work centre is then given a schedule stating when each

letter should be completed by that department. In this way progress, or lack of it, can be monitored. A numeral is also added to the ticket which indicates on which production line it is to be run. For example, 4-D means that the item is planned to be worked on production line 4 during period D.

The numbered and lettered tickets are also colour-coded for easy identification and they also assist those responsible for placement of items in the intermediate storage and central collection area. They also provide an easy method of matching and sorting items in the cutting and sewing department.

Management and Labour

Management

This report is largely concerned with the technical aspects of upholstery production and it is in this context that the present management is viewed. In Yugoslavia, there is no formal training in this subject in any of the schools or technical colleges and knowledge of it is generally confined to whatever experience has been gained in actual production. Furthermore, most of the management personnel have a wood engineering background and since the upholstery technician category of supervisory staff does not exist, it may be seen how limited are the opportunities for appropriate management development.

This is reflected in the quality of the current level of technical and supervisory staff which, while undoubtedly interested and anxious to improve, is limited by the traditional nature of the present system of production with its heavy dependence on materials and techniques, which are outmoded and expensive. Thus the current project provided a timely opportunity to investigate and apply new techniques, both in the means of production and in the end product itself.

Despite the progress made, there is still a large deficit in management knowledge of the basic technology of modern upholstery production particularly in relation to textiles, upholstery frame design and mechanics, sewing,

tailoring, and other filling materials. Management should therefore be given the opportunity to study those developments at first hand by having frequent meetings with the technical representatives of supplier firms, by availing of the information in trade literature devoted to the technologies of textiles, foams and upholstery itself. They should also attend the many trade fairs concerned with these materials and techniques and, in particular should attend Interzum Köln (16-20 May 1979) and the Milan Trade Fair.

Upholstery technicians are urgently needed not only in Vrbas, but in most of the other upholstery factories visited by the expert in Bosnia and Herzegovina. This could provide an opportunity for joint action by all the enterprises in order to fulfill a much wanted need. In any event, this category of management which fits into the gap between the engineer and operative usually has a craft background. After appropriate experience as a skilled upholsterer, he would then attend a special upholstery technician course which would include the following:

Upholstery plant layout and design:

Problems in industrial plant design as applied to upholstery manufacturing.

Building structures, equipment, location, space utilization, power utilization, light, heat, ventilation and safety.

Materials handling

Maintenance.

Upholstery equipment:

Equipment for fabric inspection, laying up, marking and cutting, sewing, buttoning and quilting, foam cutting, jointing and profiling, cushion filling and closing, springing up, assembly, packaging.

Capabilities and limitations of machines.

Theory and practice of cutting and sewing.

Low-cost mechanization, pneumatics, electrics and hydraulics.

Upholstery processes:

Processes for cutting fabrics, matching, sewing, springing, finishing, reconstituting foam and other filling materials.

Engineering economy:

Criteria and techniques for management decisions in relation to economy of design, selection and operation, effects of depreciation policies and machine replacement.

Upholstery manufacturing and processing:

Production methods in upholstery, including procedures for all operations from receipt of raw materials through packaging and dispatch.

Raw materials technology:

Basic raw materials, including textiles and natural and imitation leathers and polyvinyl chlorides.

Cushioning materials, including latex and polyurethane foams.

Resilient webbing and other seating support materials.

Quilting and buttoning materials.

Needles and threads for various sewing techniques.

Springing materials.

Stapling, nailing and fixing.

Manufacturing controls:

Development of principles and procedures for control of materials, manpower, and costs with special attention to production and inventory control, equipment utilization, earnings classification and cost reduction programmes.

Quality controls:

Economic balance between cost and value of quality.

Statistical theory as applied to sampling, control charts, tolerance determination, acceptance procedures and control of production.

Labour

The expert has formed a good impression of labour which is hardworking, resourceful and skilled. If, at present, it is neither as productive nor as quality conscious as it might be, it is less its own fault than the absence of experienced direction and good training. Both can be remedied without undue difficulty and in the case of training should be done, as for management on a formal and planned basis. This is particularly important for those who are joining the workforce for the first time, when care should be taken to integrate them into full production on a staged basis of accumulating skills and experience. This means that a section of the factory should be set aside for training only. It should be supervised by a skilled upholsterer and should have the basic production requirements. Training programmes should be devised on the basis of developing good production skills and the special needs of the factory. Learners should work for a period in each department of the factory in order to obtain a good overall knowledge of the upholstery industry and they should be encouraged and supported to attend technical colleges and evening courses.

Future UNIDO assistance

The expert recommends that future UNIDO assistance in industrial engineering be continued along the lines recommended in this report.

Particular emphasis should be placed on the following:

1. The preparation of detailed standard specifications for the design and production of corpus, solid wood and upholstered furniture for both the domestic and contract markets.

2. The improvement of quality control systems at individual factory level.
3. The provision of advice and assistance in the re-organization and development of the solid wood (chair, frame and table) factory.
4. The introduction and establishment of in-plant training programmes for all levels of personnel.
5. The training of counterparts in such management techniques as the physical and administrative organization of production, work study, (especially in the corpus and solid wood factory), machine loading and factory programming, machine adaptation, jig and fixture design and value analysis.
6. The provision of advice and assistance in inter-factory integration, component standardisation and product rationalisation.

The programme should best be carried out during a series of two months assignments held at intervals in order to give time to the personnel involved to fully implement the experts recommendations.

II. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. R. O. Vrbas is very well established in the upholstery sector of the furniture industry in Yugoslavia.
2. The design of upholstery products is largely traditional and does not reflect the advances in the industry which have taken place elsewhere.
3. Despite limitations in the availability of certain raw materials and production equipment, much can be done to bring the enterprise up-to-date both in design and production techniques.
4. The existing building is adequate at least for the immediate future, but would need to be replaced should a more automated system of production be introduced or if output is to be increased substantially.
5. Production equipment is good and well maintained but requires to be augmented especially in relation to cutting, sewing, upholstery assembly and internal transport.
6. Management is inexperienced in modern production technology, but this can be easily remedied by more attention to training and a better system of technical information.
7. Production techniques are not sufficiently developed, particularly in production planning and work programming, method study, design of production aids design of work stations, materials inspection, quality control, materials handling and transport.

8. Levels of skill are generally good, and with increased mechanisation and better over-all planning, productivity could be almost doubled.
9. Training of technicians and operatives is not satisfactory and needs to be dealt with on a more formal basis.
10. The raw material content of individual designs could be reduced substantially to their advantage both from appearance and functional points of view.
11. This is essential because generally upholstered models are too expensive.
12. The future for Vibra upholstery appears to lie in the production of better than average furniture, particularly for exports.
13. There should be special emphasis on the production of high quality reproduction or period furniture for which available raw materials and skills are particularly suited.
14. The investment required at this stage to bring the enterprise up-to-date and achieve an acceptable level of productivity is relatively small, and no more than a fraction of that required for wood or panel processing.

Recommendations

Design

1. Design standards in upholstery should be raised.
2. Individual models should reflect the advances which have taken place in materials and production technology.
3. Greater attention should be paid to anthropometric and ergonomic considerations in the design of seating. Dimensioning and comfort should conform much more to user needs.

5. Designers should appreciate more fully the importance of the covering fabric and considerable attention should be given to its design not only from an appearance point of view, but also in relation to ease of production.
6. A major user of upholstery fabrics such as Vrbas should have its own exclusive range of covering fabrics.
7. Designers should attend all the major European furniture fairs and the Köln Interzum fair for materials and accessories used in furniture production.
8. Vrbas should, from time to time, commission designs from outside consultant designers to augment internal design programmes. This is particularly important with regard to exports.

Raw materials

9. Vrbas should encourage foam manufacturers to supply a greater variety of urethane foams.
10. There should be greater use made of polyester fibres in conjunction with urethane foams in the production of cushioning systems.
11. Cushions should, as far as possible, be reversible and should incorporate zip fasteners for closing.
12. Upholstery frames should be standardised and individual elements should make greater use of panel materials such as particle board and flakeboard.
13. There should be greater use made of serpentine "no-sag" springing and resilient webbing.

Their use would greatly improve the design and performance of the seating.
14. The mechanical movement connector which is currently used in the production of the "kip" (sleeping) convertible couch should be replaced by a more simplified version, such as the "siso" movement, which may have to be imported.

Production

15. Greater attention should be paid to work planning, individual work station layout, job analysis, production control, quality control, materials storage and handling.
16. Management should realise that the modern concept of upholstery production is based on "bought in" or processed components and that whenever possible the former should be the case especially for upholstery frames.
17. Materials handling and transport account for a high proportion of production time and therefore should be given appropriate planning attention.
18. All fabrics should be inspected immediately on arrival at the factory and rejects should be immediately returned to the suppliers.
19. Many improvements can be made in fabric storage, laying, marking and cutting. New sewing machines and sewing techniques in line with up-to-date sewing technology need to be introduced.
20. New automatic and semi-automatic systems of buttoning and quilting should be introduced.
21. A greater variety of cushioning systems is needed in conjunction with cushion filling and closing machines.
22. Improved upholstery assembly techniques and the use of mechanised work holders and work presses are required.
23. A new system of internal transport for work-in-progress should be introduced. This should be designed to suit individual materials, components, and elements.
24. Transport in the sewing department should be by automated and programmed conveyerisation.
25. This conveyerisation should be extended to cover the entire factory at a later date or when it moves to a new premises.

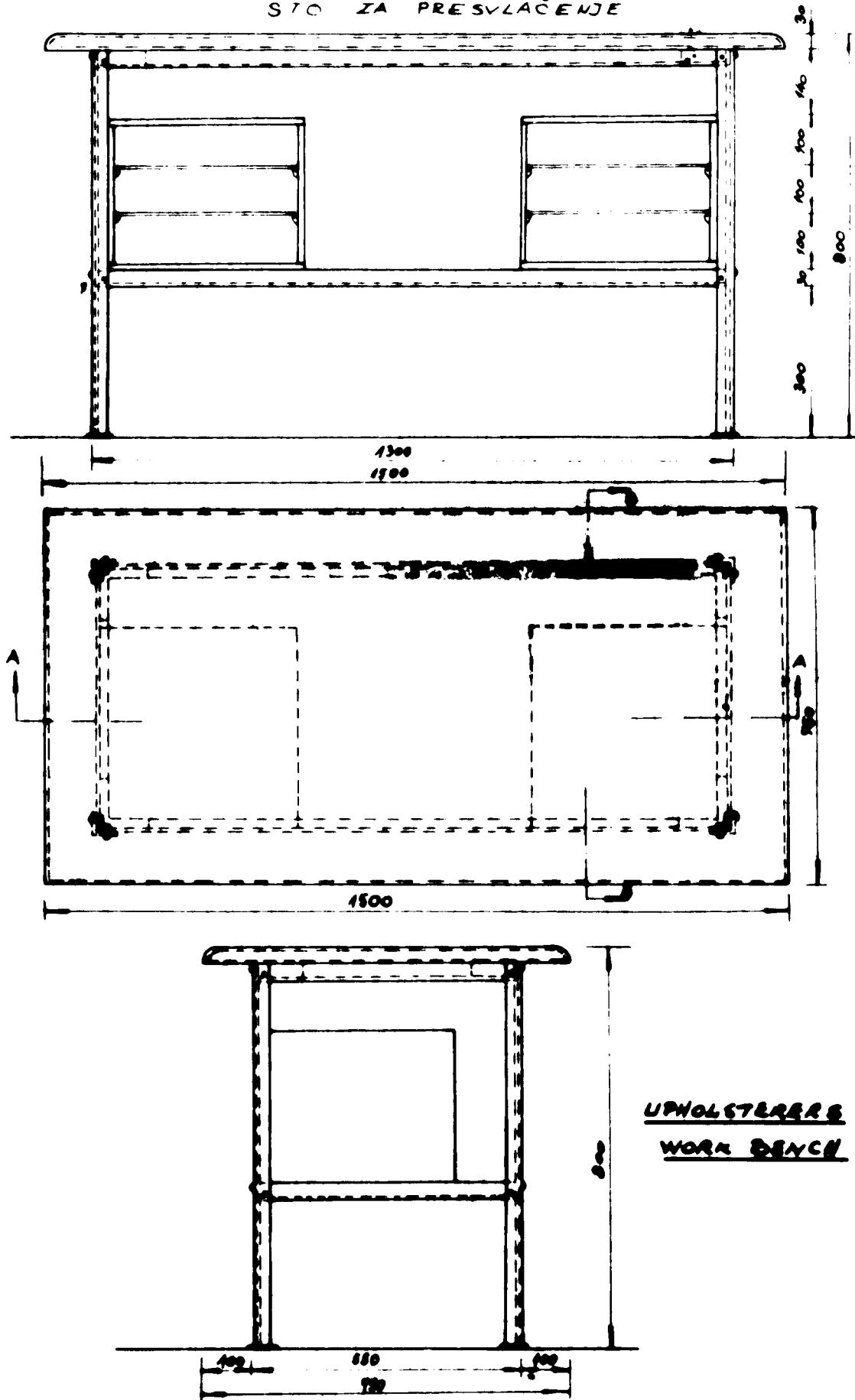
26. Work programming should be on the basis of production documentation which sets and maintains standards of performance, quality and productivity.
27. The putting into production of new designs should be speeded up. The period from the design concept to full production should not exceed four months.
28. The prototype workshop should be equipped with such basic woodworking machines as a circular saw, bandsaw, surfacer/thicknesser spindle moulder, router, boring machine and sander.
29. Production planning engineers should devote more of their time to the physical aspects of work planning, i.e. jig and fixture design, machine adaptation, design of individual work stations, design of specialised transport systems and materials handling equipment.
30. The ratio of sewing machinists to cover or assembly upholsterers should be 1 : 1.
31. The assembly area should have three separate upholstery lines for studio couches, settees and armchairs.
32. All existing upholstery benches should be replaced by that shown in the accompanying diagram. (Figure XVII)

Management and Labour

33. Job specifications and responsibility levels should be clearly defined for all management, supervisory and operative levels.
34. There should be an additional supervisory category namely the upholstery technician. He/She should have an upholstery craft background with additional training in the science/engineering aspects of upholstering.
35. All production supervisory personnel should be trained in textile, foam and sewing technologies.
36. Research and Development (IRÇ) should have one engineer specialising in upholstery technology and providing appropriate technical information to the design bureau and to production personnel.

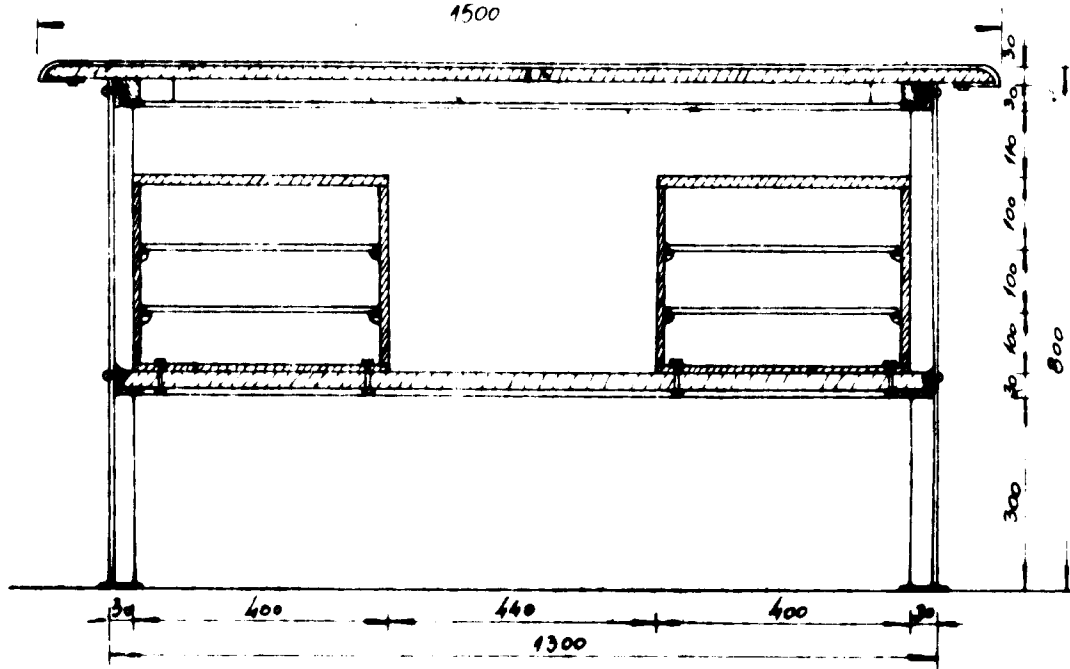
Figure 1277

STO ZA PRESVLAČENJE

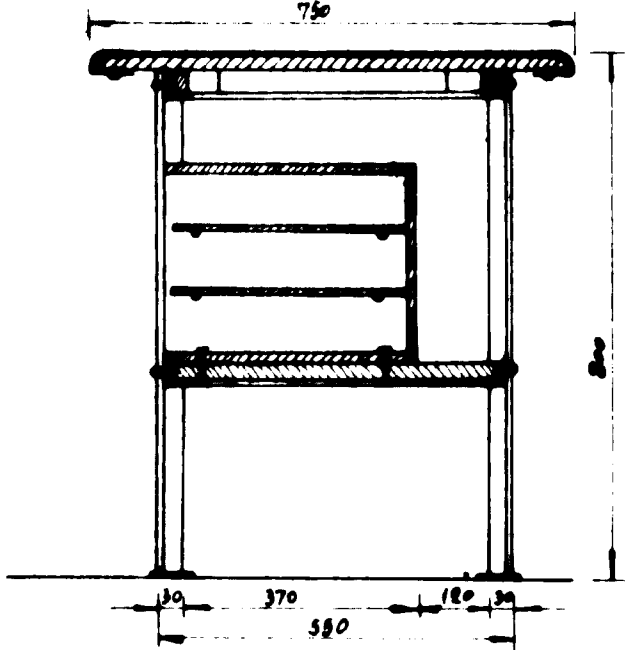


IN ARCHITECT

SECTION A-A'



SECTION B-B'



DETAILS OF UPHOLSTERERS WORK BENCH

37. Before taking up a particular management appointment all personnel should undergo a period of induction and training. In the case of inexperienced production engineers this should include periods in the other Vrba factories so that they can better understand the relationship and need for co-operation between the factories.
38. Engineers should understand and apply such management techniques as works study, value analysis, technical production planning and control, machine and work station loading, and systematic waste reduction.
39. Supervisors and engineers should realise that there is no substitute for direct and personal supervision. They should therefore spend much of their time on the factory floor.
40. A particularly important aspect of their work is progress chasing, and this emphasises the need for a highly efficient internal transport system.
41. The level of operative skills should be continually upgraded by the application of strict supervision and quality control.
42. Satisfactory quality control is a collective responsibility and should be exercised by all levels of personnel.

Training

43. In-plant training programmes for all grades of management and production should be established by all levels of personnel.
44. There should be a full-time instructor appointed to take complete charge of all aspects of production.
45. In the training of production workers, particular emphasis should be placed on the achievement of a high level of skill and craftsmanship. A section of the plant should be set aside for this purpose.

Annex I

DATA ON R.O. VRBAS

Total factories (number):

Furniture	4
Joinery	2
Saw-milling	6

Service organizations:

VRBAS Komerc	1
Technical R + D	1
Finance and Administration	1
Design and product development	1
Computer and data processing	1

Total employment (no. of persons):

Corpus production	257
Solid-wood production	466
Upholstery production	218
Saw-milling production	1,281
Joinery	276
Other	895

Value of production (million Dinars):

	N.D.
1970	100,847
1977	874,330
1980 (estimate)	1,624,140

Type of production in 1978 (%):

Corpus	19
Solid-wood	14
Upholstery	33
Saw-milling	12
Joinery	22

Productivity in 1978 (Dinars/Person):

Furniture average	305,163
Corpus production	408,177
Solid wood production	167,098
Upholstery production	478,830
Joinery production	96,220
Sawmilling production	177,117

Exports, %:

% Volume	
To centrally planned economies	18.5
Market economies	81.0

Annex II

JOB DESCRIPTION
(DP/YUG/73/006/11-03/w)

Post Title: Expert in Industrial Engineering
(Furniture Industry)

Duration: Two months

Date required: 1 February 1979

Duty Station: Banja Luka (Bosnia)

Purpose of the Project: To assist in the development of the furniture and joinery industries of Bosnia and Herzegovina, and the creation of a Centre.

Duties: The expert will be attached to the R. O. Vrbas Furniture plant in Banja Luka. The expert will implement the plan for the introduction of modern industrial engineering procedures (recommended during his previous assignments to the project) in the plants of Vrbas in Banja Luka. Specifically, the expert will be expected to:

1. Survey present level of industrial engineering in R. O. Vrbas in Banja Luka.
2. Advise on its further development with specific reference to the Vrbas Upholstery OOUR and in relation to the following:
 - product design and development;
 - introduction of modern upholstery technology;
 - factory planning;
 - organization of production;
 - productivity;
 - standard specifications and quality control;
 - research and development;
 - industrial training;
 - marketing.
3. Preparation of technical report.

Qualifications: Industrial engineer with experience in consulting to a large range of industries. Experience in the furniture and joinery industries desirable.

Languages: English, French an asset.

Background information: The furniture and joinery industries of the country contribute about eight per cent to the Republic's gross national product, and represent over four per cent of its exports. An ambitious five-year development plan is being implemented to double the production of furniture which attained about Din. 1.500 million in 1976, the work force was 7.400 persons in 1976. This plan calls for an investment of Din. 800 million. Joinery production represented in 1976 approximately Din 800 million; over 3000 persons being employed in this sector. The work force will attain 4.500 persons. Investment of Din 950 million are foreseen for joinery plants (US\$ 1 = Din. 18.3).

Assistance is to be provided to a large furniture complex, R. O. Vrbas in Banja Luka as part of the large scale UNDP/UNIDO project of Assistance to the Furniture Industry of the Bosnia Herzegovina.

Annex III

VRBAS PERSONNEL CONCERNED WITH THE ASSIGNMENT

Name	Qualifications	Function	Years of experience in the furniture industry
1. Vignjević Djuro	Wood Engineer	Manager Upholstery plant	9
2. Milašinović Novak	- " -	Technical Manager	3
3. Sučić Ivka	- " -	Technologist	2
4. Jaksić Dragor	- " -	Technical Manager	5
5. Čadjo Slavica	Architect	Designer	4
6. Trifković Ankica	Economist	Accountant	5
7. Mijatović Savo	Wood Engineer	Market Research	3
8. Tomas Rikardo	- " -	Manager Product Development	12
9. Golubovski Ljubo	- " -	Technical Manager	15
10. Babić Branka	- " -	Technologist	5
11. Selimović Majo	- " -	Technician Manager	15
12. Ilić Gojko	Economist	Manager Marketing	11
13. Milutinović Marija	Economist	Accountant	8

Name	Qualifications	Function	Years of experience in the furniture industry
14. Klindić Desa	Architect	Designer	7
15. Gujić Leonard	Wood Engineer	Technical Manager	13
16. Strejček Anton	- " -	Technologist	24
17. Andrić Mijo	Wood Technician	Technician	
18. Gujić Ruža	Architect	Designer	8
19. Bandić Slobodan	Wood Technician	Production Supervisor	8
20. Jovanović Slobodan	Wood Engineer	Production Development Manager	15

Annex IV

REPORT ON VISITS TO UPHOLSTERY FACTORIES IN THE
FEDERAL REPUBLIC OF GERMANY

1. General

On 5 February 1979, five production engineers from the R. O. Vrbas Upholstery OOUR accompanied the expert on visits to upholstery factories in the Federal Republic of Germany.

The object of the visits was to study at first hand the latest trends and developments in upholstery production, to examine the most up-to-date equipment available and to make use of the information thus acquired in relation to the re-organization and development of the Vrbas factory.

2. Findings

2.1. Design

- (i) All factories visited employ professional designers, some on a full-time basis, others on a part-time basis.
- (ii) Design programmes were highly rationalised, parts were standardised and there was much interchangeability of components.
- (iii) The over-all level of design was very high.
- (iv) The period between completion of working drawings, prototyping and integration into full production is never more than four weeks.
- (v) The prototype workshops were well equipped with suitable machinery and equipment.

2.2. Production Technology

- (vi) None of the factories manufactured their own upholstery frames and these, like most other components, were "bought in" from outside suppliers.

- (vii) Despite very large turnovers requiring large series production, the factories operated extremely efficiently and productivity appeared to be very high.
- (viii) Internal transport was by means of conveyerisation which collected and distributed the work-in progress at the various work centres throughout the factories.
- (ix) Work organization in the cutting and sewing departments was particularly impressive where every activity was as mechanised as possible.
- (x) There were special arrangements for the inspection and measurement of all covering fabrics on arrival at the factory.
- (xi) Storage of fabrics was by means of specially designed trolleys each capable of holding eight rolls of fabric.
- (xii) Cutting tables incorporated conveyerisation so that cutting and sorting could be done simultaneously.
- (xiii) All sewing stations were linked by a conveyor belt which distributed and collected the work automatically.
- (xiv) A special part of each factory was used for marshalling all components including sewn covers, padded and sprung units and any other component requirements.
- (xv) These were then distributed to the upholstery assemblers by means of over-head conveyerisation.
- (xvi) A notable feature of the upholstery frames was their light weight and consequent ease in handling.
- (xvii) Most frames were made from particle board and incorporated design features enabling them to be used in a variety of seating.

- (xviii) The ratio between sewers and upholsterers was one to one. This meant that the latter's time spent on each frame had been reduced considerably.
- (xix) After assembly, the frame was transported by the same means to final fitting and dispatch.
- (xx) There was very considerable emphasis on the use of loose cushioning for all upholstery systems.
- (xxi) The quality of urethane foam available was very high for all cushioning and there were special grades for arms, seats, and backs.
- (xxii) All seat and back cushions were filled with polyester fibre wrapped around a core of urethane foam which accounted for about 25% of the cushions total volume.
- (xxiii) Springing systems even for studio couches were confined to "no-sag" serpentine springing and resilient webbing.
- (xxiv) All frames were sectionalised enabling faster process times and easier handling.
- (xxv) Many assembly processes were fully mechanised, including button-covering and buttoning, quilting and other decorative work.
- (xxvi) Sewing machines capable of sewing a variety of seams and special stitches such as ruffling were very much in evidence.
- (xxvii) All cushions incorporated zip fasteners for ease of filling and subsequent cleaning of the fabric.
- (xxviii) In order to avoid the problem of differences in colour shading between two rolls of the same fabric, each layer is numbered on the back after cutting, so that the same roll parts reach the same frame.
- (xxix) Production control was by means of a group of work tickets which gave all the necessary information to make each item. This included cutting, sewing, springing, padding of frame, cover assembly, final assembly and packing. As each process is completed and inspected, the relevant ticket is removed and returned to Control. One factory worked from data supplied by EDP.

3. Factories visited:

- 3.1. Schillig, Willi
Polstermoebelwerke,
Frohlach
Federal Republic of Germany
- 3.2. Koinor G.m.b.H.
Polstermoebelwerke,
Michelsau
Coburg
Federal Republic of Germany
- 3.3. Kirchner G.m.b.H.
Polstermoebelwerk
Frohlach
Federal Republic of Germany
- 3.4. psb - Pfalzstahlbau G.m.b.H.
Pirmasens
Federal Republic of Germany

4. Participants:

Vignjevic, Djuro	Plant Manager, Vrbas Upholstery
Milašinović, Novak	Technical Manager Vrbas "
Suđić, Inka	Technologist " "
Jovanovic, Slobodan	Product Development Manager
Malis, Radmillo	General Manager Vrbas
D.P.Cody	UNIDO Consultant

Annex V

VALUE ANALYSIS

Understanding what value analysis is

Value analysis is a systematic review of a product and its components in order to ensure that the necessary quality and reliability are being achieved at the lowest cost.

Objective of value analysis

To improve performance or reduce cost by providing all the required functions of the product system at the lowest cost.

How value analysis is carried out

Value analysis operates through a team of usually 4 - 6 people who represent various functions of the organization. It would therefore include:

Marketing/Sales
Design
Production
Costing
Purchasing
Work study.

V. A. is used to develop original ideas and solutions superior to those developed previously.

Job Plan

It is necessary for the team to follow a job plan which

will provide the guidelines within which the team can operate and should consist of the following stages:

1. Select project.
2. Determine functions or objectives.
3. Obtain and analyse the information.
4. Speculate and stimulate ideas.
5. Evaluate the ideas.
6. Develop and test selected ideas.
7. Implement the best ideas.

This plan will allow the team to define functions or objectives; specify how and at what cost these are achieved at present; list a series of alternative ideas; select those that provide the functions at lowest cost and; develop these into practical alternatives.

Methodology

Basically, value analysis (V.A.) consists of a critical questioning of present practice or design and achievement. It questions:

What is it?	:	Select
What does it do?	}	: Determine function
What must it do?		
What does it cost?	:	Information
What else will it do?	}	: Speculation
How else can it be done?		
What does it cost?	:	Evaluation

It is important to recognise that V.A. is more than a cost reduction exercise since it includes a detailed review of the function of each component in a process or assembly. In developing alternatives, the same functional performance is retained at a lower cost without reducing quality, reliability, performance or appearance.

Advantages of V. A.

Apart from the direct benefits of improved performance and reduced costs V.A. carries other advantages:

1. It ensures a continuous appraisal of product quality and reliability;
2. It provides a means of continually seeking out and evaluating new materials and processes likely to be of benefit;
3. It improves communication;
4. It develops teamwork;
5. It continually appraises product functions and updates them;
6. It provides an effective means of stimulating innovation;
7. It develops effective cost awareness amongst managements and supervisors.

Selecting the product for analysis

The selection of the product and the identification of the high cost areas within the product is critical. Areas showing most potential must be identified, ideas generated which improve the value of the product and quality and reliability must be maintained or improved.

The basis for selection of a product should include the following considerations:

1. High turnover - the best-sellers;
2. A reasonable life to ensure adequate return on the cost of improvements;
3. Containing components or sub-assemblies (elements) used in a significant number of other products;
4. Containing a material or item which is purchased in significant quantities.

At this stage, it is advantageous to list a selection of products for analysis and put them in order of priority.

Value Analysis

Product Assessment Form - Upholstery

MODEL: _____ DATE: _____ SIGNATURE: _____

	CHARACTERISTICS	Satisf.	Req. Impr.	Req. Alt.	Un-satisf.	OBSERVATIONS
I						
Market	1. Market Analysis				x	No information available
	2. Design brief.				x	- ditto -
	3. Market share.				x	- ditto -
	4. Consumer reaction				x	- ditto -
	5. Competitiveness				x	- ditto -
II	<u>Design characteristics</u>					
The Product	1. Function	x				
	2. Suitability (fitness for purpose)	x				
	3. Form and styling		x			Shape of arm rests and sewing, buttons collar. Poor detail.
	4. Fabric colour and pattern				x	
	5. Fabric wearability	x				
	6. Tactile beauty				x	Eliminate buttoning, increase quilting.
	7. Decoration		x			
	8. Comfort		x			
	9. Overall size		x			
	10. Dimensional Conformity		x			
	11. Weight/Handling				x	
	12. Mobility				x	
	13. Performance		x			
	14. Market life cycle					No information
	15. User life cycle				x	Over-made
	16. Design integration with other models				x	Model does not fit in anywhere
	<u>Raw Materials</u>					
	17. Frame: seat elements	x				Because it is used in common with others
	18. " back elements				x	
	19. " arm elements				x	
	20. " component					
	Sectional dimensions				x	
	21. Springing: seat elements				x	
	22. " back elements				x	
	23. " arm elements				x	
	24. Cushioning: seat elements				x	
	25. " back elements				x	
	26. " arm elements				x	
	27. " thickness		x			Arm rests too thin (can feel frame)
	28. " density		x			
	29. Covering fabric: colour	x				
	30. " " pattern				x	
	31. " " texture				x	
	32. Convertible mechanism				x	
	33. Castors/Glides				x	

Value Analysis

Product Assessment Form - Upholstery

MODEL: _____ DATE: _____ SIGNATURE: _____

CHARACTERISTICS:	Satisf.	Req. Impr.	Req. Alt.	Un-satisf.	OBSERVATIONS:
III Production					
1. Frames: High level of mechanisation	x				To be made by factory.
2. Frames: Inter-changeable components			x		
3. Frames: Joint construction	x				Except for nailed joints.
4. Frames: Low material waste factor			x		
5. Frames: Use of panel materials	x				Over-used.
6. Frames: Ease of Assembly			x		
7. Frames: Suitability for upholstery			x		
8. Frames: Weight				x	
9. Frame: Labour content					
Fabrics:					
10. Selection				x	
11. Cutting				x	
12. Waste factor				x	
Sewing:					
13. Utilization				x	
14. Welting				x	
15. Seaming				x	More quilting
16. Buttoning				x	
17. Zipping				x	None
18. Profiling (Blind Seam)				x	
19. Ratio to upholstery (1 - 1)				x	
Cushioning:					
20. Frame padding				x	
21. Shaping				x	Back collar.
22. Profiling				x	
23. Filling					Does not apply
24. Closing					- ditto -
25. Reversible					- ditto -
26. Loose					- ditto -
27. Fixed				x	
Assembly:					
28. Sectionalised approach				x	
29. max. sewing, min. tacking				x	
30. Ease of handling				x	
31. Ease of assembly				x	
32. Ease of transport				x	
Productivity					
33. Mechanisation				x	
34. Low manual input				x	
35. High output volume				x	
Costing:					
36. Raw materials input				x	
37. Labour input				x	
38. Overhead charges				x	
39. Profitability				x	
40. Quality control				x	

Value Analysis

Product assessment form - Corpus Furniture

MODEL: _____ DATE: _____ SIGNATURE: _____

CHARACTERISTIC	Satisf.	Req. Impr.	Req. Alt.	Un-satisf.	OBSERVATIONS:
I					
Market					
1. Market analysis		x			Not enough detail from
2. Design brief.		x			More precise information on details.
3. Market share		x			Reservation about production performance.
4. Consumer reaction		x			Improved sales training.
5. Competitiveness:					
Design	x				
Price	x				

II					
Product	<u>Design Characteristics:</u>				
1. Function				x	Not completeness of line
2. Suitability (fitness for purpose)				x	because of 1.
3. Form and styling	x				
4. Storage capacity: cupboards	x				Except for bar which should be outfitted.
5. Storage capacity: shelving	x				
6. Storage capacity: drawers				x	Provide for double depth, and special storage
7. Storage capacity: hanging	x				See no. 2
8. Veneering/Folio				x	Better selection related to requirements (review policy). Patchyness
9. Colouring				x	Quality
10. Surface coating				x	Greater attention and detail.
11. Tactile beauty				x	Improvement in quality.
12. Fittings: Hinges				x	To be provided with other locks especially for fall.
13. Fittings: locks				x	Look for standardisation and exclusivity, increase diam of cut-outs.
14. Fittings: Handles				x	Fitting not affective.
15. Fittings: Stays				x	But additional process involved which is unnecessary.
16. Fittings: S/Supports	x				Colour must be changed.
16A. Assembly	x				--
17. Drawer-front treatment	x				--
18. Door-front treatment	x				--
19. Vertical division treatment	x				--
20. Decoration	x				--
21. Over-all size	x				--
22. Dimensional conformity	x				--
23. Weight/Handling	x				--
24. Performance	x				--
25. Market life cycle	x				--
26. Uper life cycle	x				--
27. Component interchangeability				x	Additional elements required.
28. Design integration	x				
29. Ease of assembly	x				
30. Uniformity	x				
<u>Raw materials</u>					
31. Carcasses	x				See no. 8
32. Veneers/Foils					Species satisfactory. Care in selection and quality.
33. Fronts (drawers + doors)	x				Best quality lacquer to be used (see 10)
34. Finishes				x	See 12 - 16A.
35. Fittings				x	

Value Analysis

Value Analysis

Product Assessment form - Corpus Furniture

MODEL: _____ DATE: _____ SIGNATURE: _____

CHARACTERISTICS	Satisf.	Req. Impr.	Req. Alt.	Un-satisf.	OBSERVATIONS:
III Production					
Solid Wood:					
1. Species (Janen)					
'ASH'			x		Suppliers are unsure (i.e. of ash
2. Quality		x			
3. Availability				x	
Veneers:					
4. Species	x				
5. Quality	x				
6. Availability	x				
7. High level of mechanisation			x		Additional equipment required.
8. Interchangeable components	x				
9. Joint construction	x				
10. Low material waste factor			x		
11. Minimum panel thickness			x		16mm should be satisfactory if quality OK.
12. Machining accuracy			x		Especially boring; folio machine.
13. Damage protection			x		Introduce urethane protective pads.
14. Ease of assembly			x		Review fittings arrangements.
15. Low manual labour content			x		Review m/c requirements.
Drawer fronts:					
16. Minimum thickness	x				
17. Low waste factor	x				
18. Machining accuracy				x	Better production planning + control.
19. Ease of fixing			x		Better engineering.
19/A. Edge treatment			x		Better machining and pre-planning.
Door Fronts:					
20. Minimum thickness					
21. Low waste factor			x		Standardised sectional dimensions.
22. Machining accuracy				x	Better production planning and control.
23. Ease of fixing			x		
24. Edge treatment			x		
25. Ease of assembly (frame)	x				Awaiting appropriate equipment.
26. Low manual labour content			x		Add. equipment required.
V. Connecting elements:					
27. Accurate machining			x		
28. Ease of assembly	x				
29. Low waste factor	x				
30. Minimum thickness	x				
Productivity:					
31. Mechanisation					
32. Low manual handling					
33. High output volume					
Costing:					
34. Raw materials input					
35. Labour input					
36. Overhead charges					
37. Profitability					
Quality:					
38. Raw materials					
39. Machining					
40. Surface coating.					
41. Final assembly.					

Annex VI

NEW FACTORY LAYOUT AND WORK FLOW

Key to factory layout:

- 1.00 Preproduction preparation.
- 1.01. Cardboard cutting
- 1.02. Cutting of jute
- 1.03. Frame assembly (No. 1) springing and webbing
- 1.04. Fixing coil springs to frame.
- 1.05. Frame assembly (No. 2). Fixing jute to springs.
- 1.06. Fixing no-sag serpentine springing to frame.
- 1.07. Fixing cardboard to outside of frames.
- 1.08. Conveyor belt.
- 1.09. Inspection and control.

- 2.00 Foam preparation.
- 2.01. Vertical foam cutting
- 2.02. Horizontal foam cutting.
- 2.03. Cutting of small foam elements.
- 2.04. Foam granulating.
- 2.05. Foam gluing-arms etc.
- 2.06. Cushion cutting
- 2.07. Cushion profiling
- 2.08. Storage of cut foam.

- 3.00 Cushion filling area.
- 3.01. Cushion closing.
- 3.02. Cushion press
- 3.03. Button fixing
- 3.04. Cushion filling
- 3.05. Button making.
- 3.06. Storage of finished cushions.

- 4.00 Collection and storage of elements and components.
- 4.01. Sorting and distributing of work to final assembly.

- 5.00 Cutting and sewing.
- 5.01. Daily fabric requirements stored on trolleys.
- 5.02. Fabric unwinding and spreading machine.
- 5.03. Cutting table.
- 5.04. Sorting table.
- 5.05. Sewing stations with conveyerised delivery and retrieval

- 5.06. Computerised conveyor belt.
- 5.07. Pre-selection of cut materials before delivery to sewing stations.
- 5.08. Storage of pre-cut materials.
- 5.09. Mammut quilting machine.
- 5.10. Matromatic automatic quilting machine.
- 5.11. Corner sewing machine.
- 5.12. Storage of waste fabric.

- 6.00 Upholstery assembly.
- 6.01. Couch covering with fabric
- 6.02. Couch assembly.
- 6.03. Arm covering.

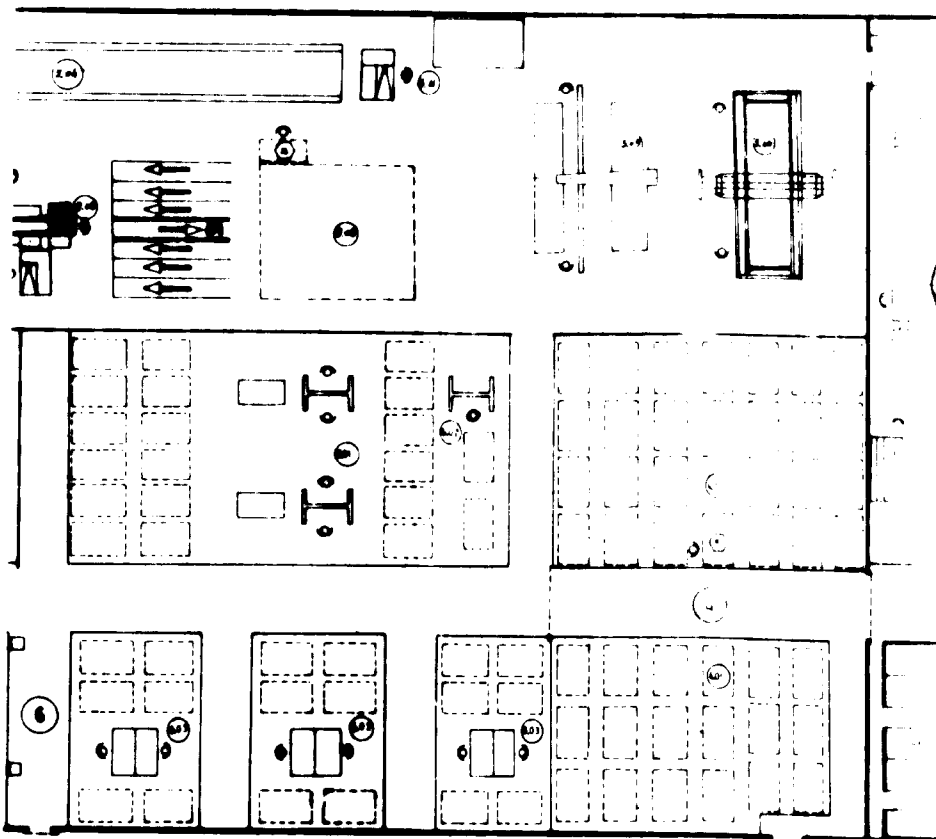
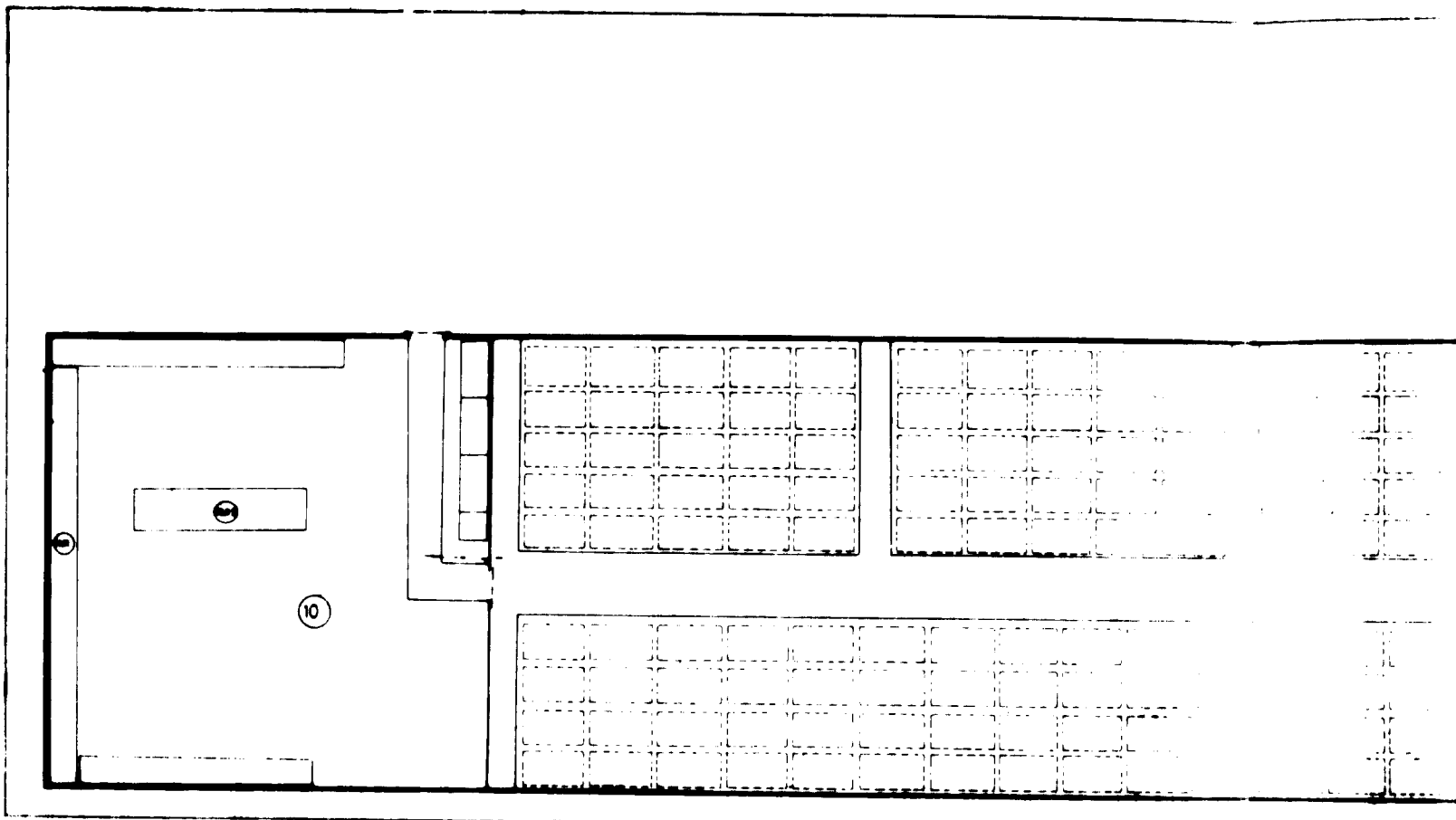
- 7.00 Final assembly
- 7.01. Arm chair assembly
- 7.02. Couches and two-seater assembly
- 7.03. Packing and control.
- 7.04. Transport

- 8.00 Intermediate storage

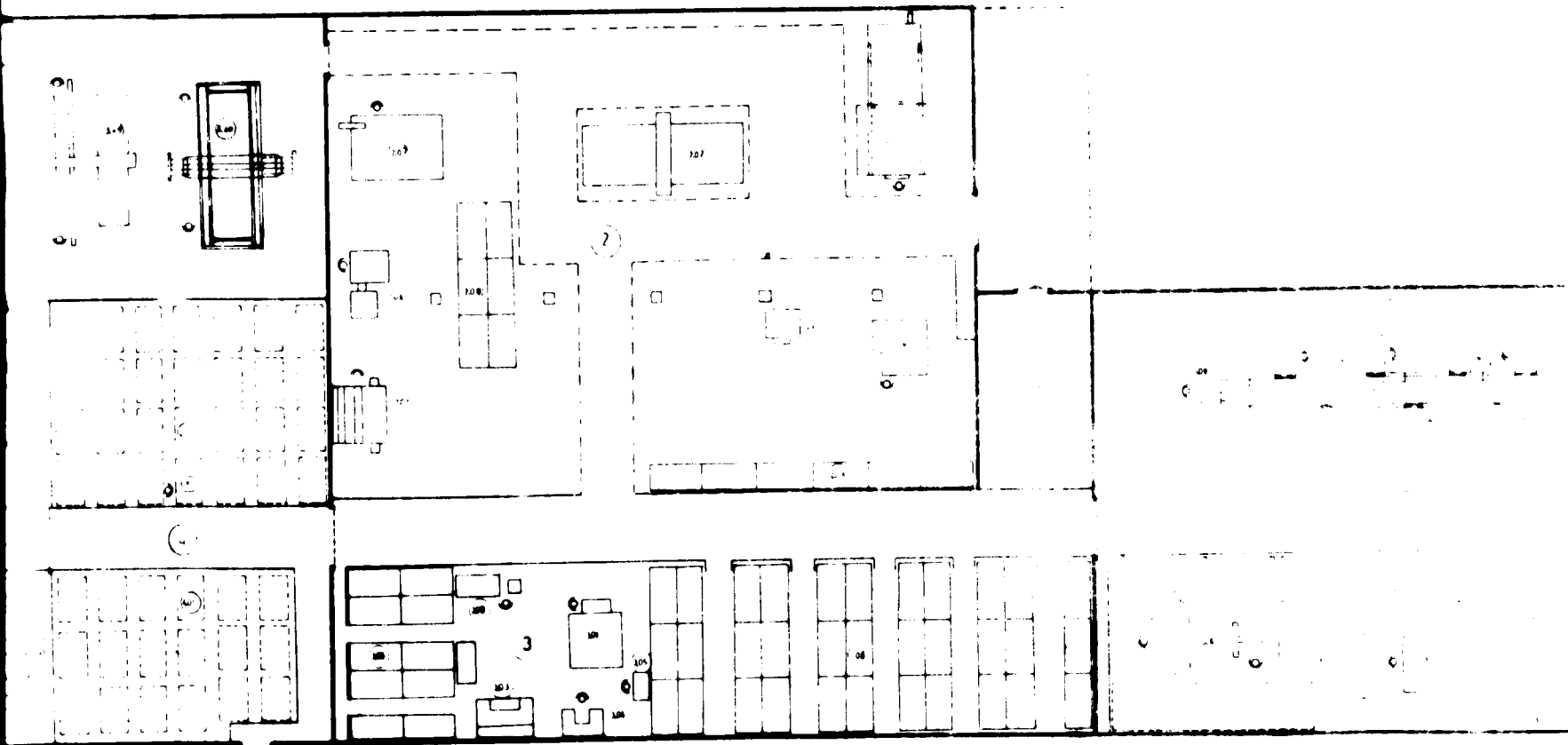
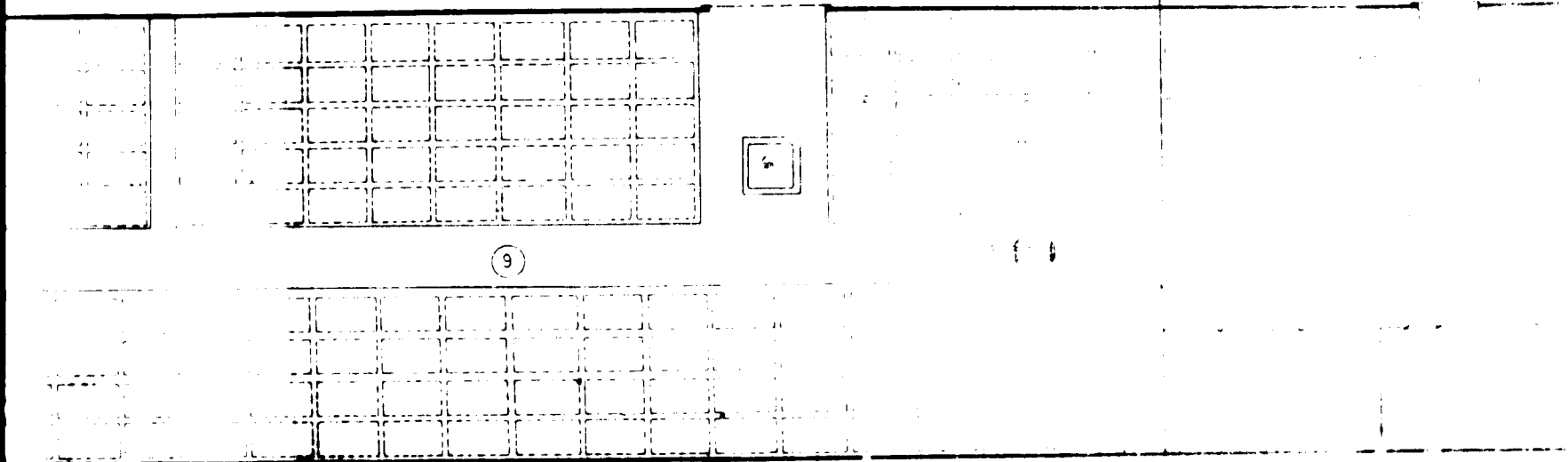
- 9.00 Final storage.

- 10.00 Prototyping room
- 10.01 Work table.
- 10.02 Assembly bench.

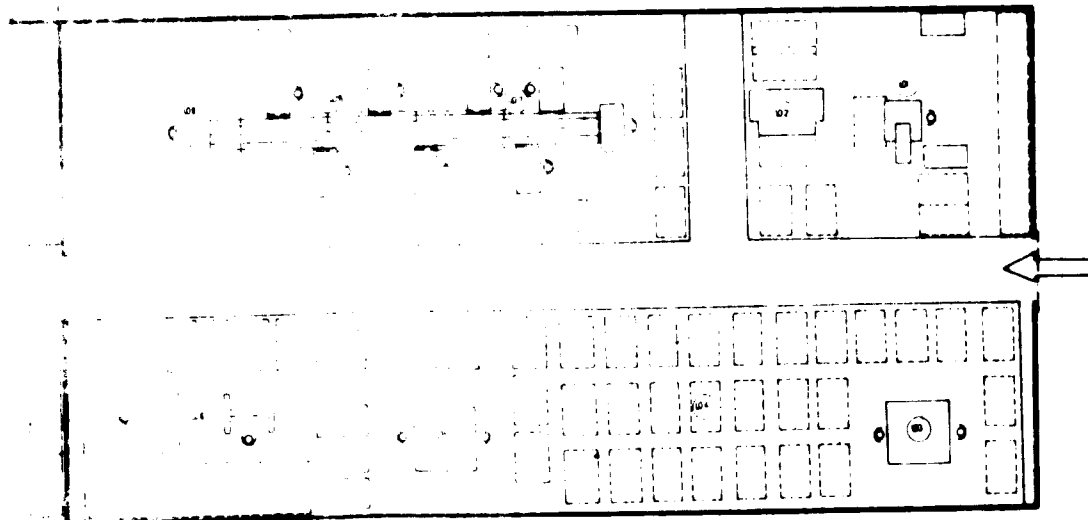
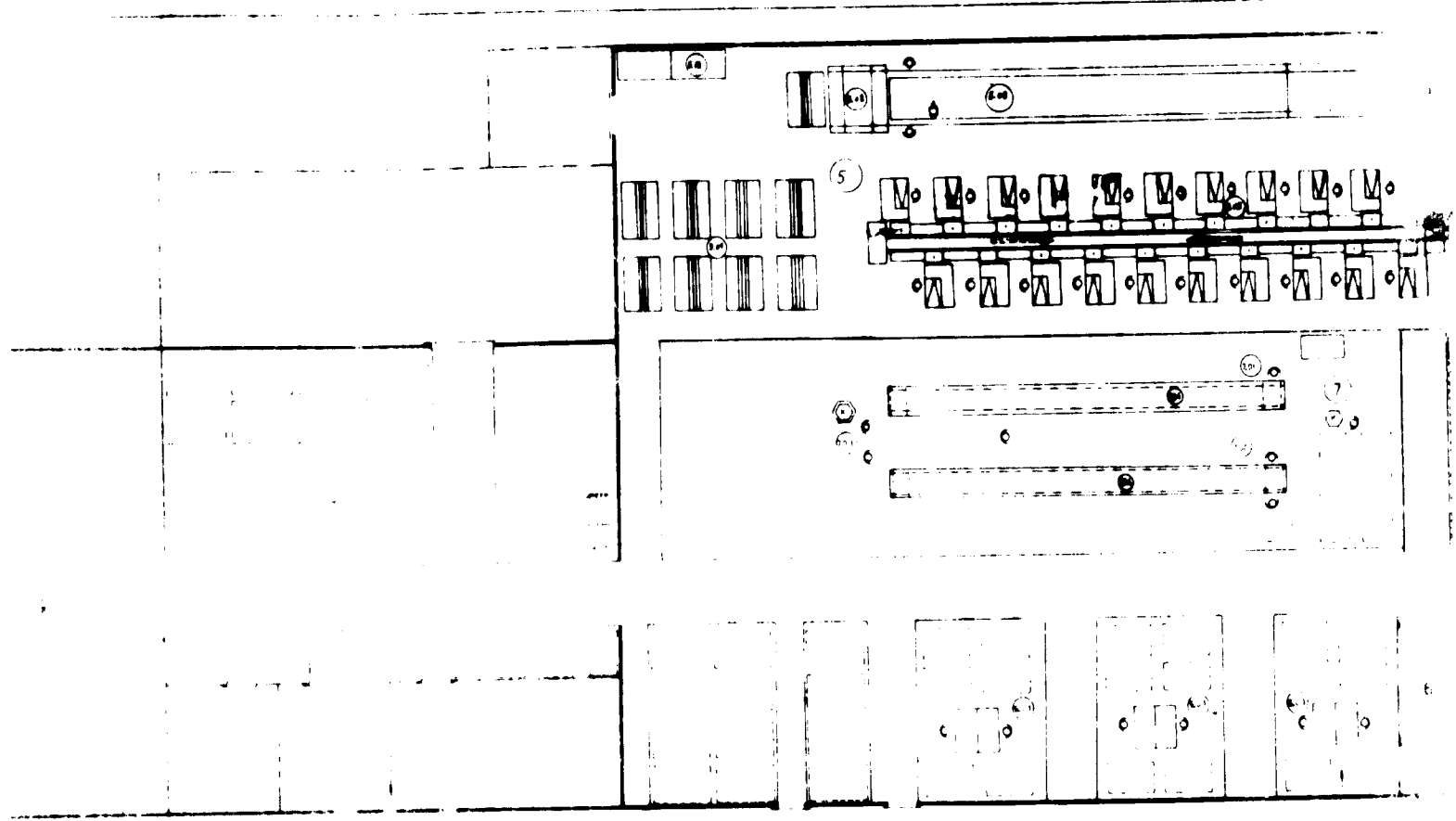
- 11.00 Materials storage (glue etc.)



SECTION 1

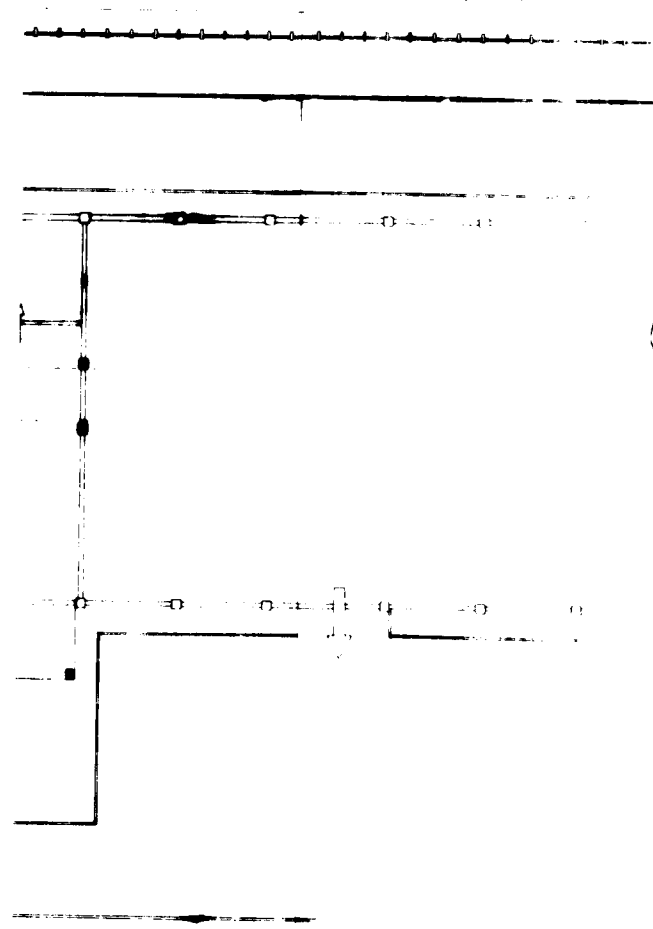
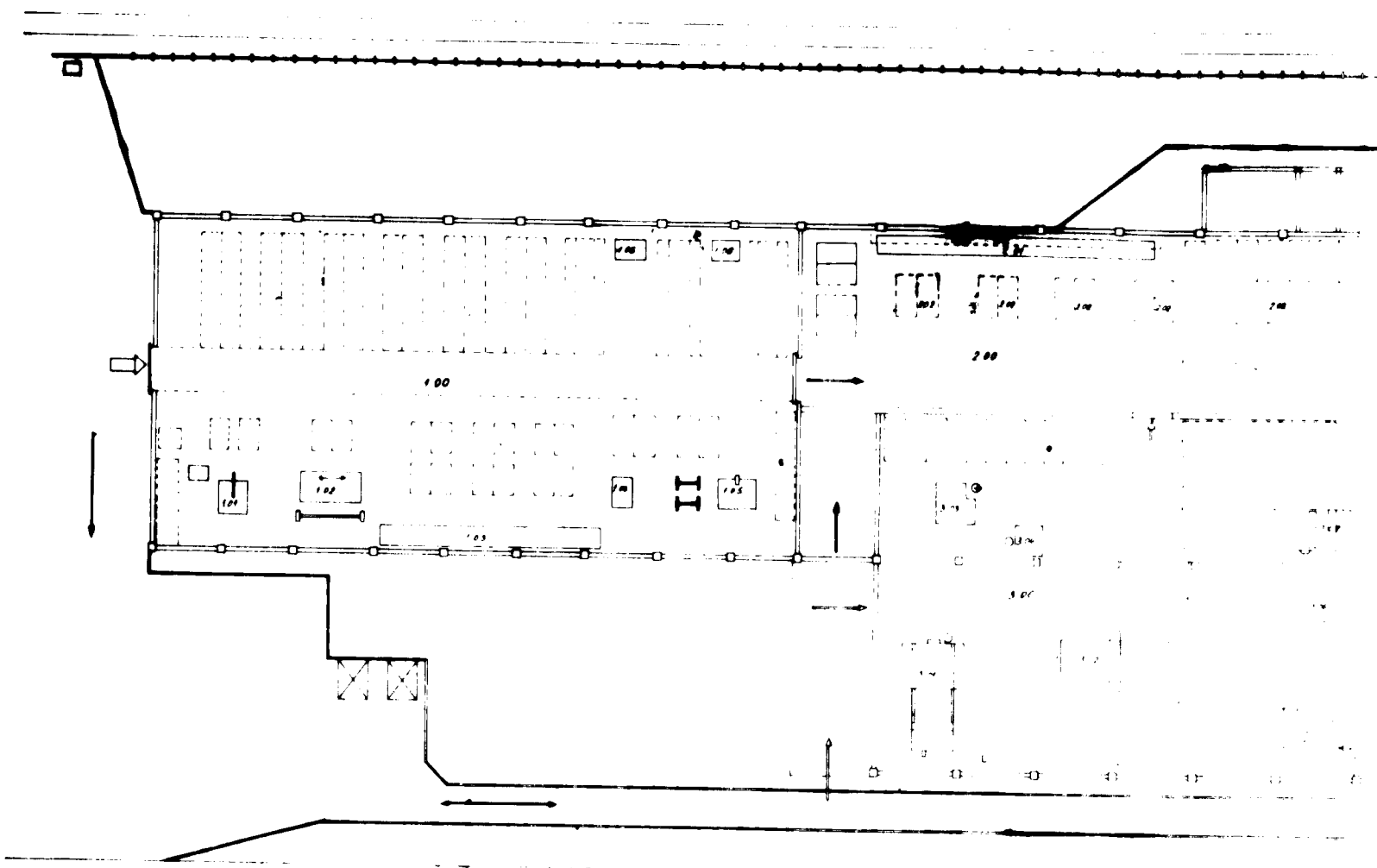


SECTION 2



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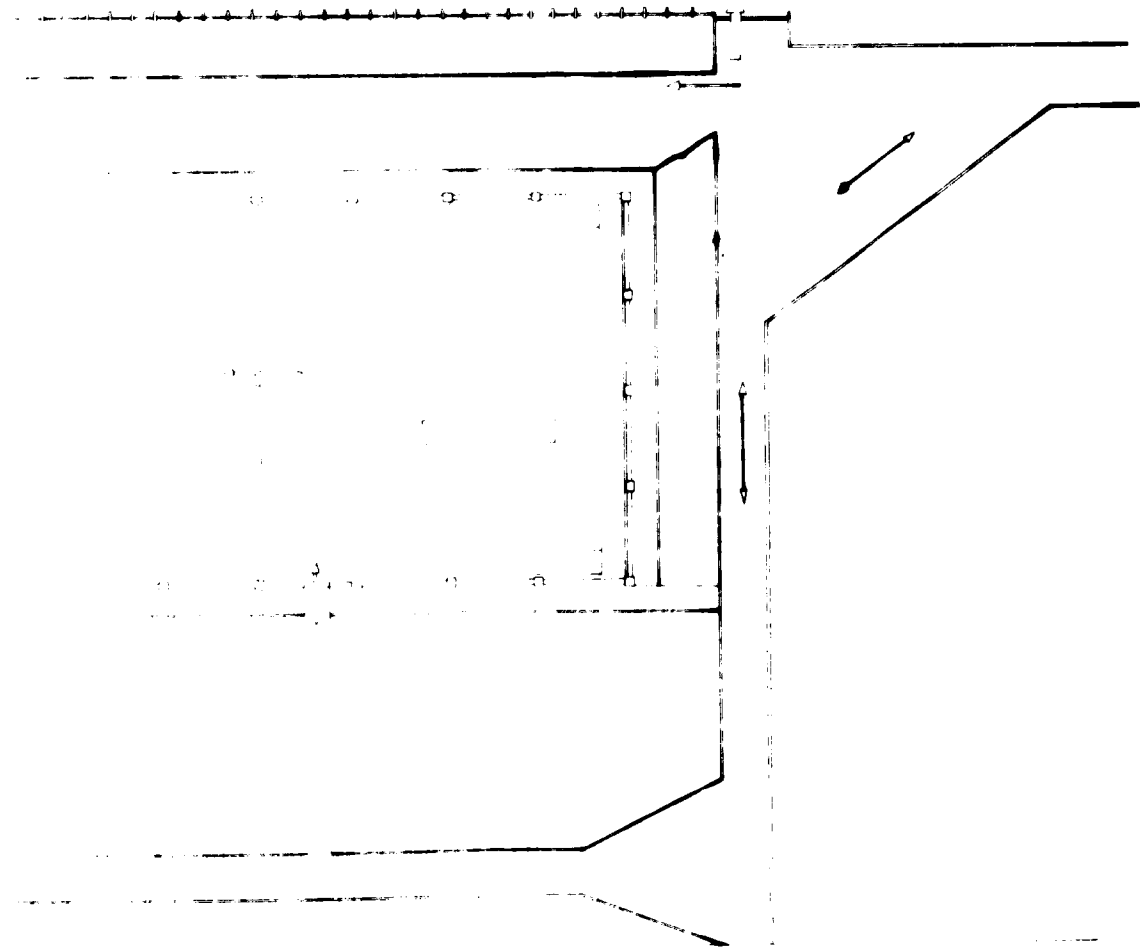
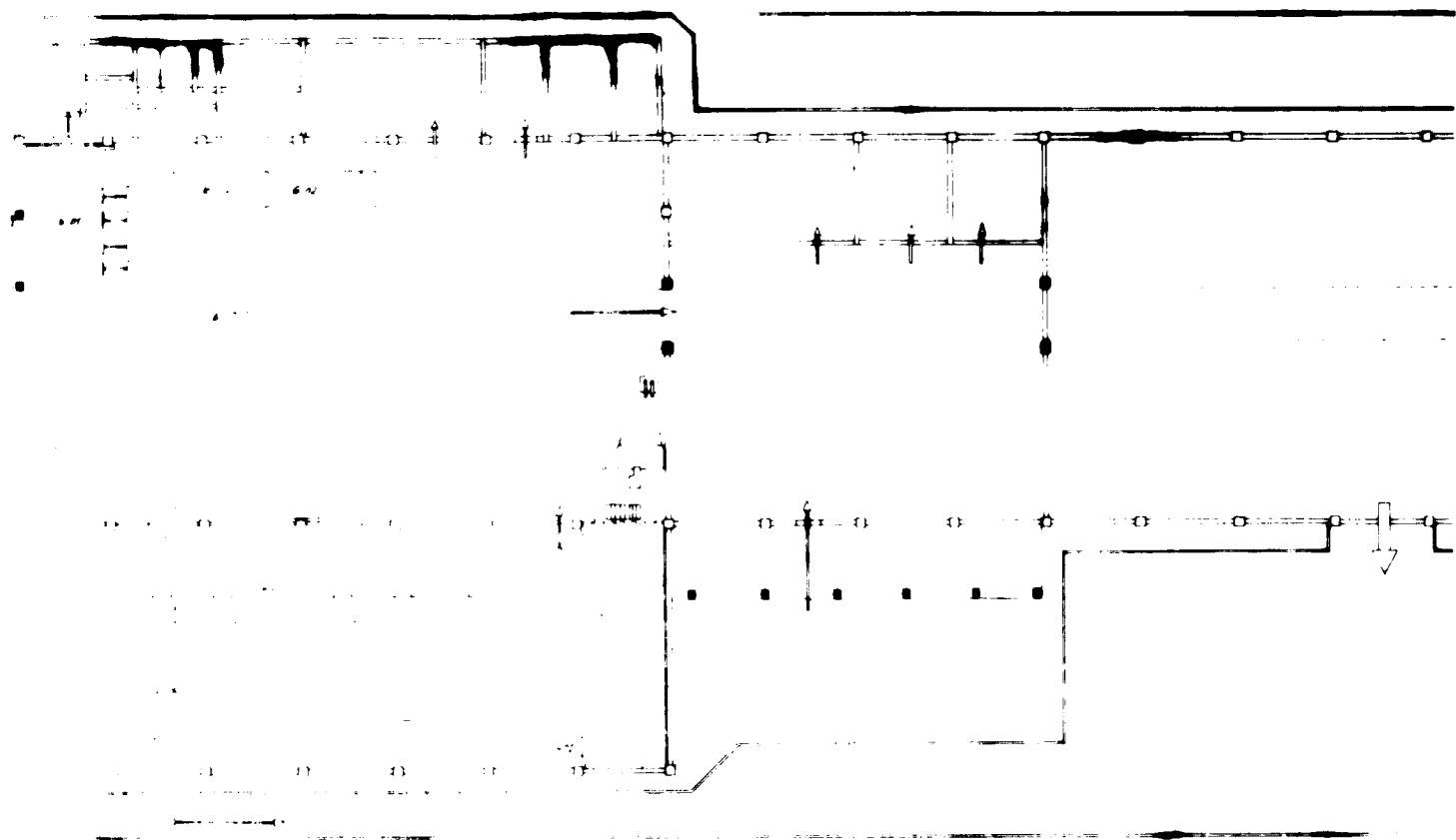
SECTION 3



SECTION 1

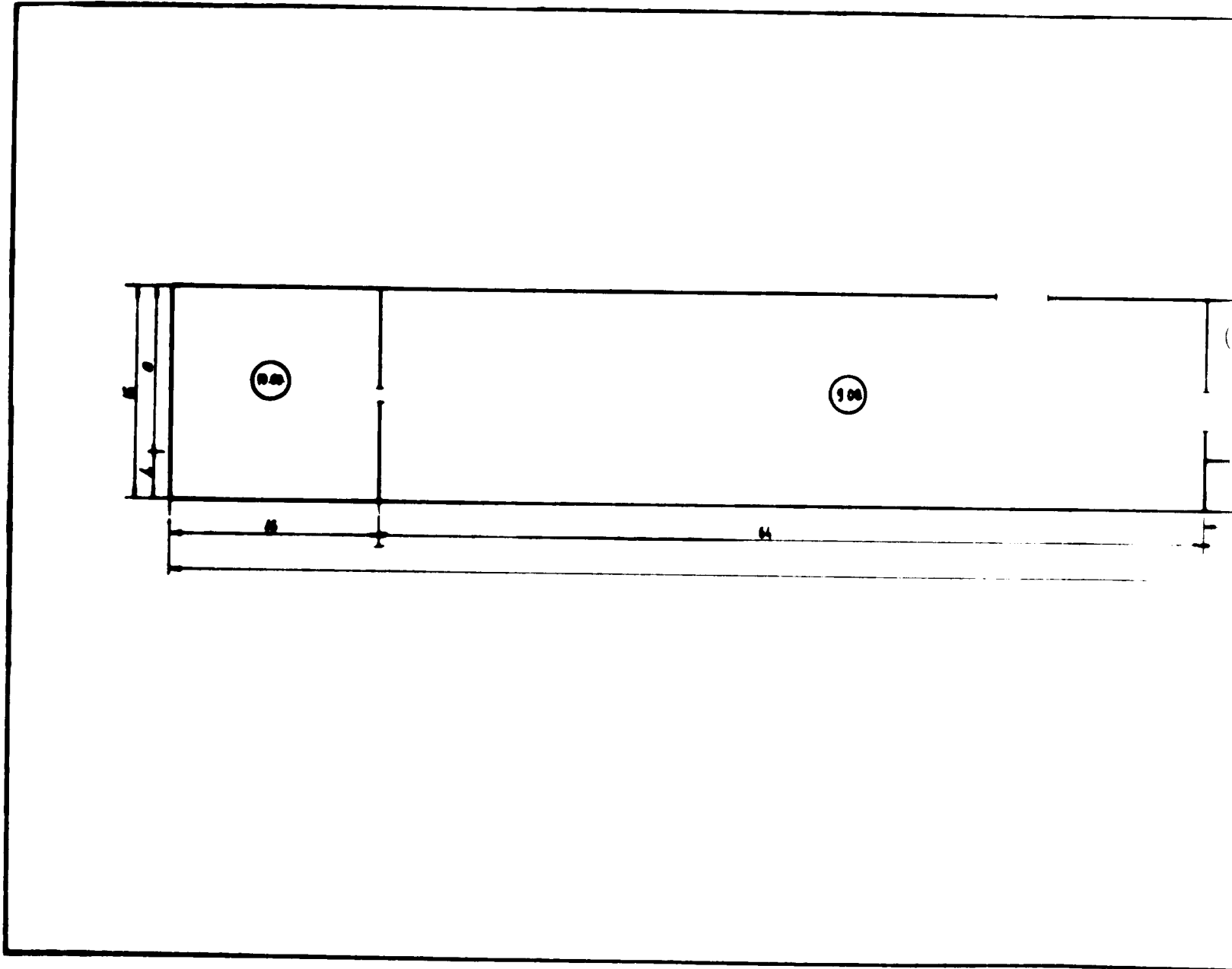


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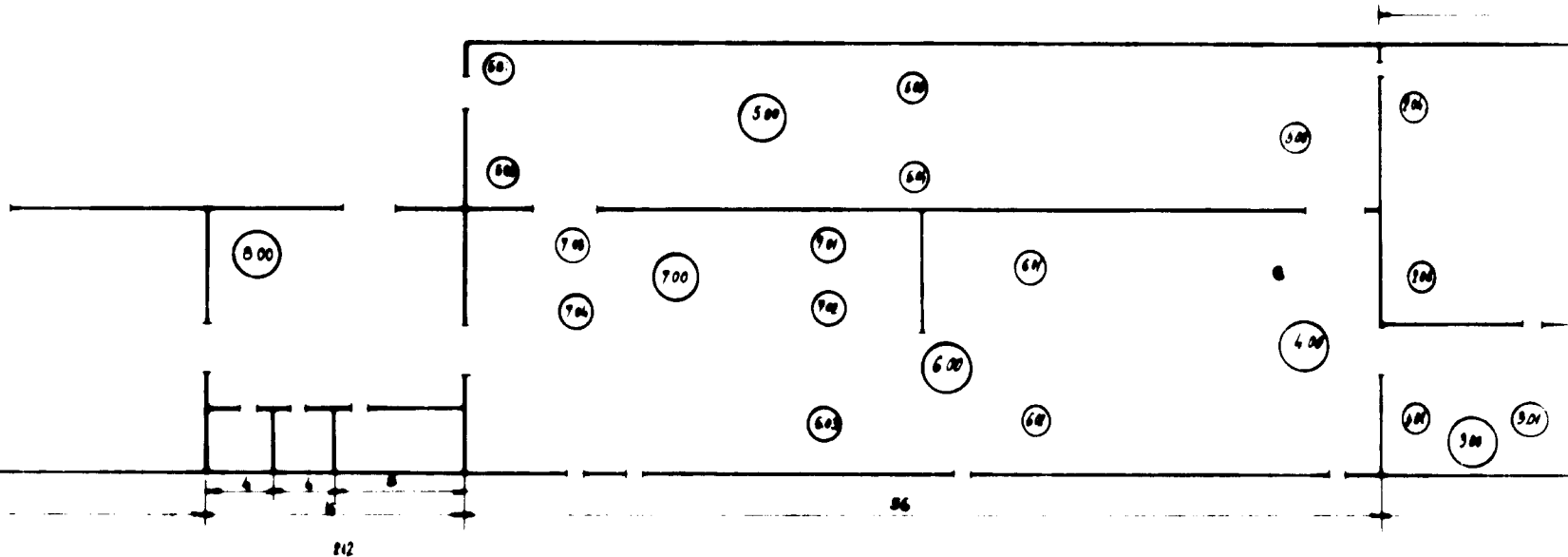


SECTION 3

OLD FACTORY LAYOUT



SECTION 1

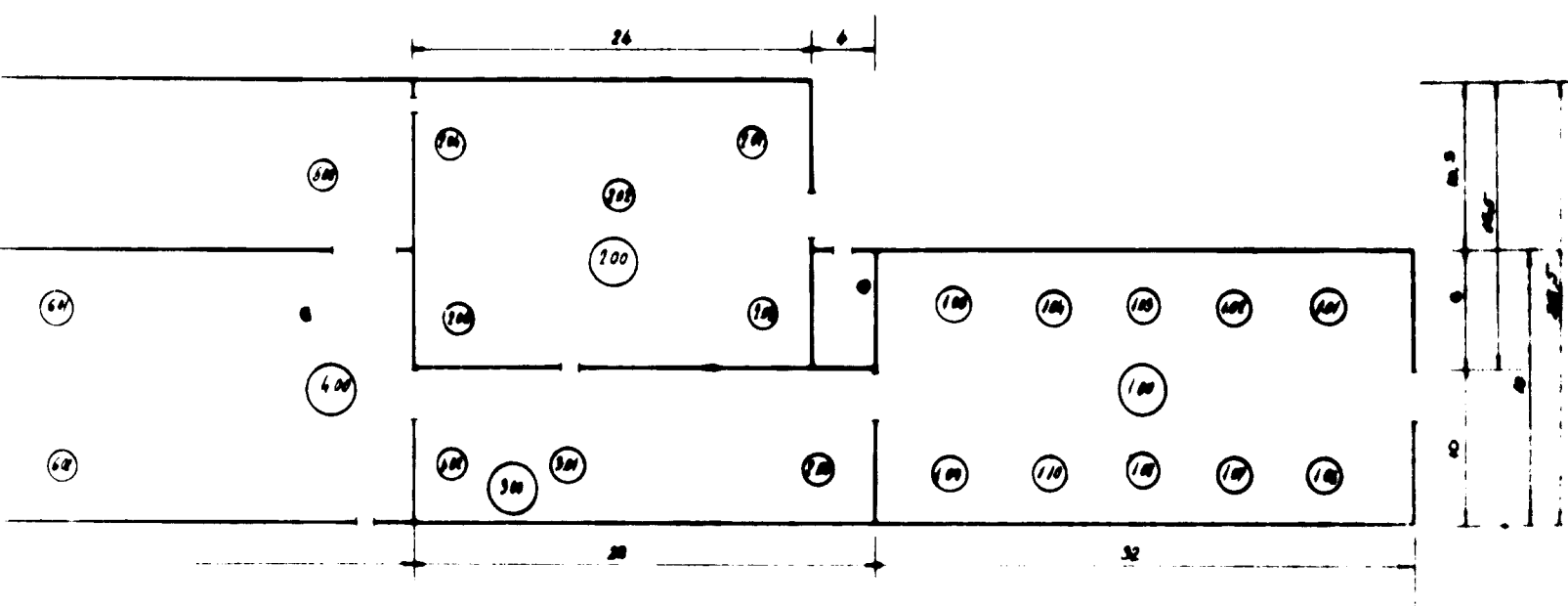


1000	DISPATCH
900	STORAGE SUITES

800	COUCH AND ARMCHAIR ASSEMBLY
704	ARMCHAIR PACKING
703	COUCH PACKING
702	ARMCHAIR ASSEMBLY
701	COUCH ASSEMBLY
700	FINAL ASSEMBLY AND PACKING
803	ARMS AND SMALL COMPONENTS COVERING
802	COVERING OF ARMCHAIR
801	COVERING OF COUCHES
800	COVERING

505	QUILTING
904	COVER SEWING
503	CUTTING COTTON AND COVER
502	FABRIC STORAGE (DAILY)
501	COTTON STORAGE (DAILY)
500	FABRIC CUTTING
400	COLLECTION INTERMEDIATE CONTROL AND DISTRIBUTION
302	INTERMEDIATE STORAGE FOR FILLED CUSHIONS
301	CUSHION FILLING AND CLOSING
300	CUSHION FILLING

SECTION 2



ARMCHAIR ASSEMBLY
FINISHING
PACKING
ASSEMBLY
FINISHING
FINISHING AND PACKING
INSTALL COMPONENTS
FINISHING
ARMCHAIR
COUCHES

505	QUILTING
504	COVER SEWING
503	CUTTING COTTON AND COVER FABRICS
502	FABRIC STORAGE (DAILY)
501	COTTON STORAGE (DAILY)
500	FABRIC CUTTING
400	COLLECTION INTERMEDIATE STORAGE CONTROL AND DISTRIBUTION
302	INTERMEDIATE STORAGE FOR FILLED CUSHIONS
301	CUSHION FILLING AND CLOSING
300	CUSHION FILLING

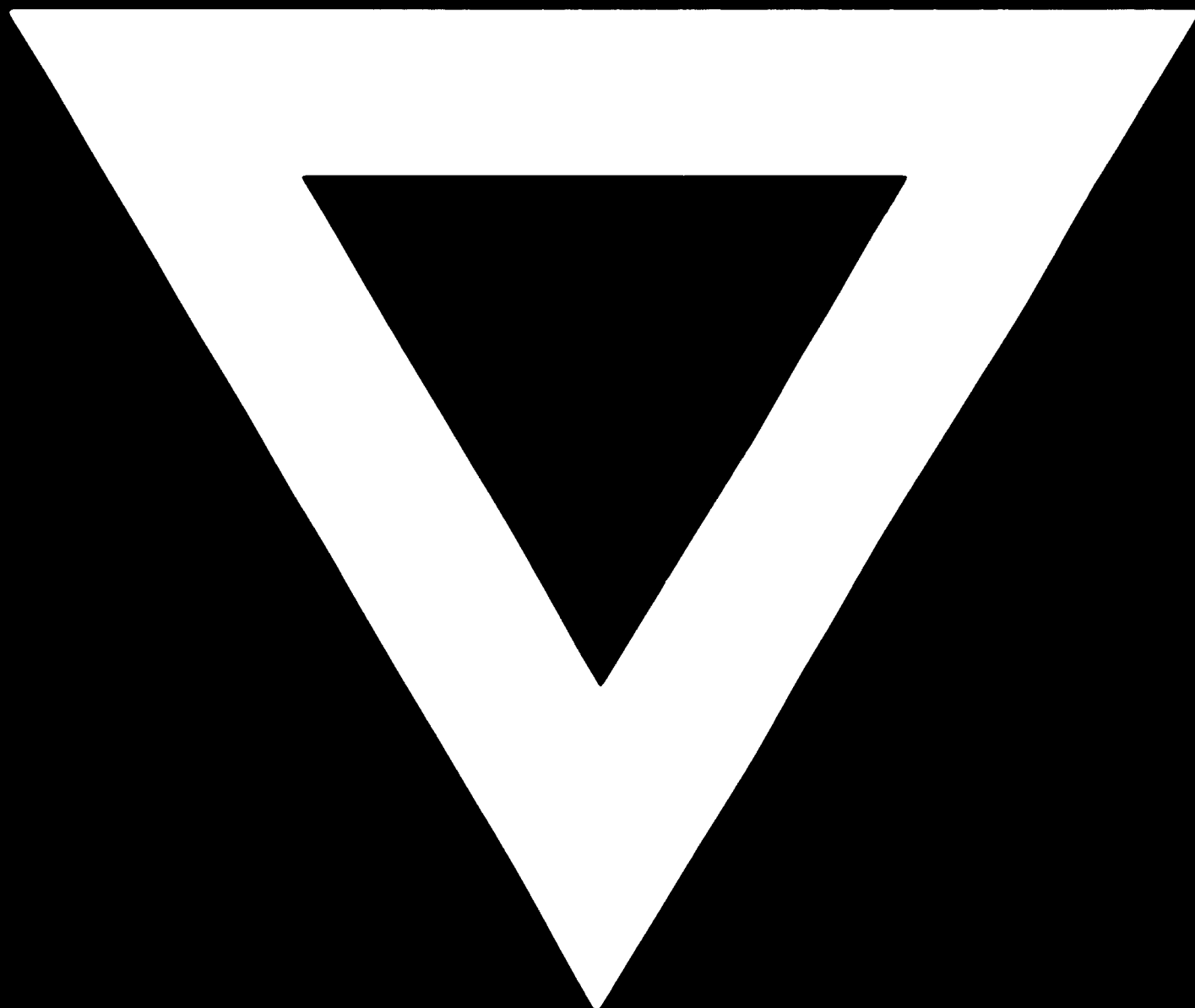
206	INTERMEDIATE STORAGE FOR FOAM ELEMENTS
205	FOAM GRANULATING
204	CUTTING OF SMALL FOAM SHAPES
203	FOAM PROFILE CUTTING
202	HORIZONTAL FOAM CUTTING
201	VERTICAL FOAM CUTTING
200	FOAM CUTTING
110	FIXING SPRUNG UNITS ON FRAMES
100	FIXING JUTE TO SPRINGS
100	FRAME ASSEMBLY NO. 2

109	INTERMEDIATE FRAME STORAGE	
108	FRAME ASSEMBLY NO. 1	
105	FOAM GLUEING	
104	FIXING CARDBOARD ON FRAME	
103	SERPENTINE SPRINGING AND RESILIENT WEAVING	
102	DAILY STORAGE AND CUTTING OF JUTE	
101	STORAGE AND CUTTING OF CARDBOARD	
100	FRAME PREPARATION	
DRAWING NO. 1	WORK CENTRES AND WORK FLOW	SCALE 1/20

SECTION 3



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