



TOGETHER
for a sustainable future

OCCASION

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



TOGETHER
for a sustainable future

DISCLAIMER

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

FAIR USE POLICY

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

CONTACT

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

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

RESTRICTED

DP/ID/SER.B/572
10 July 1987
ENGLISH

ASSISTANCE TO THE FURNITURE AND JOINERY INDUSTRY

SI/TON/86/873/11-01

KINGDOM OF TONGA

Terminal report *

Prepared for the Government of the Kingdom of Tonga
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Karl Fuchs, expert in furniture and joinery production

Backstopping officer: Antoine V. Bassili, Agro-based Industries Branch

United Nations Industrial Development Organization
Vienna

* This document has been reproduced without formal editing.

TABLE OF CONTENTS

	Page
INTRODUCTION	1
FINDINGS	2
COCONUT WOOD	11
ALUMINIUM JOINERY	14
RATTAN	15
ACTIVITIES	15
CONCLUSIONS AND RECOMMENDATIONS	22

ANNEXES

I Job Description (Expert in Furniture Design and Joinery Production)	24
Job Description (Expert in Furniture Design	26
II Workplan	28
III Programme of Work	34
IV Training Programme	37
V Preliminary Report	38
VI List of Manufacturers	47
VII Counterparts and Persons Met	52
VIII Work Drawings (Metal wardrobe)	53
IX Mechanical Press / Plywood	54
X Mechanical Flat Press	58
XI Work Drawings (Dining table)	59
XII Photographs of Prototypes Produced	64
XIII Production and Calculation Forms (For Serial Production Only)	66

INTRODUCTION

At the request of the Ministry of Labour, Commerce and Industries, UNIDO assigned a furniture production expert on a consultancy basis to undertake a 3 months' mission in the Kingdom of Tonga, financed from UNIDO's industrial development fund, under project SI/TON/86/873.

Karl Fuchs, UNIDO expert in furniture and joinery production (post SI/TON/86/873/11-01) began his assignment on 14 January 1987, in close cooperation with counterparts (see annex No. VI) from the Ministry of Labour, Commerce and Industries. The main purpose of his work was to give assistance to 15 furniture and joinery manufacturers and enterprises.

The objective of the mission was to up-grade the furniture and joinery industries through the use of improved designs and production facilities and to investigate the possibilities of establishing aluminium joinery and rattan furniture manufacturing and the processing and use of coconut wood.

Timo Tapiovara, UNIDO expert in furniture design, (post SI/TON/86/873/11-02,) was also assigned for a 2 month mission to the Kingdom of Tonga.

It was intended that both experts would carry out their work in close cooperation as outlined in the attached job descriptions and the overall workplan. (See Annexes No. I and II).

FINDINGS

The findings mentioned below are based on visits to 15 furniture and joinery factories, listed in annex VI in order to give ad-hoc advice and provide on-the-job-training in solving the problems of low output and the extremely poor quality of the products.

Although the job description referred to woodworking and furniture industry the nomenclature is too grandiose. Most of the establishments are in reality small scale workshops.

Visits were also made to one saw mill plant, exclusively sawing coconut wood, and to one furniture and joinery factory located in Vava'u. (Island map see annex No. IX).

The quality of furniture and joinery products is very poor. The woodworking machinery is less than basic and some of the factories merely have one simple circular saw at their disposal. This lack of adequate and efficient machinery means that most of the work has to be carried out by hand.

The most frequently used timber in these poorly equipped "factories" is imported Canadian Pine, but since this material is usually not well stored under cover, it is very often utilised wet, especially during the rainy season. It has to be pointed out that imported timber like Canadian Pine arrives in a seasoned condition in Tonga.

The result of the utilisation of wet timber can be seen following the natural seasoning process on the finished products. The joints do not fit, most of the constructions such as chairs and tables are very rickety, and profiles and surfaces appear rough and frayed out. Machine and hand sanding is more or less unknown and the rough surfaces are laquered by brushes, using only one coat.

Most of the manufactureres complained that hardwood cannot be used since their tools are not suitable for processing hardwood, let alone for coconut wood. (See pages 11-13).

The best equipped furniture factory found here is the furniture production workshop which belongs to the Commodities Board, a government-owned enterprise. This is a medium-sized factory with 27 employees. The machinery is basic in terms of function and rather old (25 to 30 years). It consists of:

- 1 Cross Cut Saw
- 1 Rip Saw
- 1 Surface Planer
- 1 Thicknesser
- 1 Spindle Moulder
- 1 Mortiser
- 1 Tenoner
- 1 Panel Saw
- 1 Belt Sander
- 1 Turning Lathe.

Machine tools are very limited and in a rather poor condition. For the spindle moulder there is only one gripping cutter head and some profile knives, together with one circular guide (ball bearing). The spindle shaft appears to be bent and the speed of the machine is just 1200 to 1500 rpm. Since the routing speed is that low and the knife angle of the worn out knives is not correctly ground, the profile surfaces show routing marks and profile edges are often frayed.

Sawdoctoring : The sawmill described on page 2 is the only place on the island where the reconditioning of carbide tipped saw blades can be carried out. Only few of the factory managers use this facility offered by the saw mill manager, and they complained about the high (in relative terms) prices charged for resharpenering of circular saws. Normally a circular saw blade with carbide tips will be used as long as it is in good condition for cutting and finally it will be replaced by a normal steel saw blade, which can be reconditioned easily with a file by the machine operators.

Workparts are assembled without sanding, and the final handsanding carried out on the already assembled piece. This does not in any way improve the quality of the product.

Since there is no trust in glueing, all the joints are fixed with nails. Therefore nailheads and hammer blows frequently appear on each edge and on the surface of a finished piece.

Material used for carcass furniture consists mostly of particle boards, since the imported plywood is rather expensive and the cutting of plywood panels to size with the poor conditioned ripping saw blades is very complicated, resulting in the edges not being straight.

The preferred material in use is particle board.

The cutting of particle board to size is also carried out with ripping saw blades, which leads to the fact that the edges show a frayed-out and rough surface. Inevitably some of the edges, which appear in the front of a finished piece are lipped and fixed with nails. Edges on shelves or drawer boxes always show an uncovered and mostly unsanded surface, and drawer boxes are rarely lacquered or even sanded.

Joints for carcass furniture such as wooden dowels or plywood hardboard tongues are never used and seem to be unknown. Thus, joints are made from glue and nails, and since the rear walls mostly consist of hardboard and never rest in a rebate and are simply just nailed, some of these finished constructions seen in the workshops and in use, are very rickety and awry.

Some of the wardrobes and wall units manufactured in the way described above are only stained with a brown-coloured oil-based stain and show a very poor workmanship overall.

Imported plastic lamination sheets, although rather expensive, are often used for table tops and carcass furniture.

Mechanical flat presses, let alone pneumatic hot presses, do not exist on the island, so the lamination is usually carried out with adhesive.

Because the carcasses are always fixed together with nails, lamination is done after assembly of the furniture piece.

The removal of the excess laminate is done with a hand-planer and file and is rather time-consuming. Again this very often leads to frayed-out edges.

Because the surface of the particleboard edges are often very rough and porous, laminate edges glued with adhesive do not remain in place for very long. It is common to find on used furniture that some of the laminate edges have fallen off. In addition the daily temperature can go up to a high level, which affects the stickiness of the adhesive, and which leads to flaws on the laminated surfaces. Daily humidity levels are also often high.

The technique of veneering is unknown and no veneer has been seen during the experts' mission.

Laminated or veneered particleboards were not available at the time of the mission partly because import prices are very high and only a limited number of Tongans could afford such high priced products.

The production of windows, frame doors and flat doors is also on a very poor level.

The material used for windows and frame doors is imported construction quality pine, which often has a blue-grey stained appearance and is also very knotty.

The use of such material leads of course to poor workmanship, since, in addition, no manufacturer pays any attention

to knots or splits. A wing or splay knot often can be seen in a completed and integral part of a construction, and this leads to malfunction in window- and door frames, particularly due to warping.

Flush doors are made from 3 mm plywood faces glued on both sides of a frame construction. Because no press is at hand, some 5 flush doors are stapled together and pressed with heavy stones until the glue has set. Often it can be seen that ultimately the plywood layer does not adhere to the frame construction due to lack of sufficient pressure and nails have to be used to solve this problem.

Dust extraction systems do not exist in Tonga and the sawdust is removed only every few days from the workshops. Especially near to thicknessers or planers the operator can hardly find a place to stand to operate the machines, because of the piles of sawdust and offcuts.

The same applies to compressed air circuits, which are available in only one factory, and even then the installation did not cover the entire factory. The simplest pneumatic devices of "low cost automation" are unknown and jigs could not be found.

Discussions with managers of most of the firms visited gave the impression that their financial situation does not allow them to invest in additional modern woodworking equipment or machines.

The Tonga Development Bank have funds available (often from overseas aid sources) for utilisation by local entrepreneurs. However, in the case of wood production, most seem to consider it as too risky to take out a loan with the Tonga Development Bank, in order to cover the costs for the purchase of some basic machines or at least for auxiliary materials such as basic woodworking tools e. g. circular saw blades, cutter heads and surface finishing materials.

The reluctance on the part of these manufacturers to improve their infrastructure can be attributed in part to a lack of confidence in the requirements or likelihood of expansion of the local market.

Factory management and especially factory organization tends to be very poor. The island lacks qualified technicians and middle managers with a knowledge of production management and overall factory organization, let alone a familiarity with serial production.

The calculation of production cost, preparation of work-forms, such as cutting lists, work drawings, production descriptions etc. the development of the production flow, the calculation of machine loading, the designing, the production and utilisation of jigs and quality control were all almost unknown and tend to be seen as of minor importance by most of the managers.

In order to give a clear picture of the usual way in which the process works from the receipt of an order until to the finished product, the following description is given:

The customer places an order for furniture and simply describes the purpose of the item needed.

An estimated price for the product will be given by the factory manager, and an approximate delivery date is mentioned.

The foreman prepares a small sketch and instructs a worker about the material to be used. It is up to the worker to select the timber to be utilised, and it often happens that due to the poor knowledge on the part of such a person in charge that in one piece of furniture two or three different timber species can be found.

Most of this timber - especially during the rainy season - is still wet while the product is being manufactured, due to the fact that timber is stored in timber yards in the open and workshop roofs are often leaky. It is quite common that before starting work in the morning workshops have to be cleaned from water, which has flooded in due to heavy downpours.

If lamination is needed the manufacturer very often uses material which is at hand and the colour or the decor of the customer's preference are of minor importance.

Some supervisors, and most of the workers, do not have in their mind the significance of the good finishing of their products. This unfortunately leads finally to the poor workmanship observed on most of the finished items.

The transportation of the completed products from factories to customers is very complicated, since only a certain number of firms have small trucks at their disposal.

In the course of several discussions with customers the expert found out that the reputation of most of the local firms seems to be very poor and preference is given to imported goods, if they can be afforded.

Considering the poor workmanship, prices are rather high. The material, the design, the colour, the quality and the delivery date seldom meet the expectations of the customers.

COCONUT WOOD

The main source of wood grown on the island is coconut wood. Products made from coconuts such as copra and coconut cream are the main export goods of Tonga.

Because of this Tongans only fell a limited number of coconut trees. Additionally the last bearing phase of the trees is not well known and replantation is costly and does not yield immediate results.

Other sources of hardwood species like cedar are very limited, therefore, this material has only secondary importance and is rarely available for wood processing.

There exists a coconut sawmill (Mataliku), which belongs to the Ministry of Agriculture, Fisheries and Forestry. This plant is rather small, but has all the basic equipment. It is well organised and managed by a sawmill expert from New Zealand.

The machinery only consists of a very standard type of a small log circular saw and a circular gang edger. The production output is 5 to 6 m³ of coconut timber per day.

The technical level achieved under the manager's guidance is good and this enterprise does not require UNIDO's training input.

Unfortunately, due to insufficient supply of coconut logs a permanent production of sawn coconut timber is not possible, therefore, material can be kept in stock only very seldom.

The natural seasoning process for freshly sawn coconut timber only needs 6 to 7 weeks, provided that it will be stored and piled in a covered timber yard, so that the prevailing wind can reduce the moisture content in a natural way.

The diameter of locally grown coconut wood logs reaches from 18 to 24 cm and the length of the logs cut is 2,50 to 3,50 m.

Most of the sawn coconut timber is used as a construction material, and the usual sizes are 1" x 4", 2" x 3", 2" x 4" and 2" X 2".

Grading of sawn timber tends to be of minor importance and piles of timber often consist of a mixture of high-density lumbers (outer part of the logs, from the skin side) and very low-density lumbers (inner part of the logs).

The expert pointed out that grading of the material should be carried out immediately after cutting on the circular saw. Selection of high- or low-density material can only be achieved on fresh saw-fallen timber. The discrepancies in colour of first grade or second grade material can only be distinguished before the seasoning process begins. ^{1/}

^{1/} The reader is referred to the following UNIDO documents by V.K. Sulk prepared for the Regional Coconut Wood training project (RAS/81/110):
a) Mechanical properties of coconut palm wood (Doc. DP/ID/Ser.A/648).
b) The grading of coconut palm wood (Doc. DP/ID/Ser.A/649).
c) Grading rules for coconut palm sawn wood (Doc. DP/ID/Ser.A/650).
d) Utilization of coconut palm sawn wood as a light framing structural material (Doc. DP/ID/Ser.A/695).

Coconut wood is known to be a very hard and tough material and manufacture can hardly be carried out without Tungsten carbide tipped tools. Therefore, in most of the factories and enterprises visited, management prohibits the use of coconut timber.

ALUMINIUM JOINERY

The window and door production using imported aluminium profiles is still on an experimental basis. At present only a division of E. M. Jones Enterprises is manufacturing a limited number of windows and doors to be used for rarely built public buildings and for churches.

Only special profiles can be utilised, since aluminium welding equipment is not at hand and the miter's faces have to be fixed with connection screws.

All the items required for a proper production of aluminium windows and doors such as:

- Aluminium Profiles
- PVC Sealings
- Glass Panes
- Fittings etc.

cannot be manufactured on the island because of the lack of raw materials as well as the respective machinery. That means, that all these products have to be imported and prices are accordingly extremely high.

The financial situation of most of the Tongans does not allow them to afford such 'luxury' items, and therefore an extension of this market cannot be anticipated in the near future.

Tongans give preference to their commonly used and locally produced small-sized wooden windows, or else to the so-called 'Louvers' (wooden frame with a couple of adjustable glass rims, resting in metal profiles).

RATTAN

Rattan as a first class material for the manufacture of furniture suitable for tropical climates, is not well known in Tonga.

There are no indigenous sources of Rattan in the Kingdom. Imported rattan furniture is, due to high transport costs, relative expensive and therefore only rarely offered.

Information on the processing of rattan was given to potential manufacturers, and catalogues of respective production equipment as well as brochures of rattan furniture designs were forwarded to them.

The advantages of rattan as a relatively cheap raw material found the interest of some entrepreneurs, and future potentialities have been highlighted.

ACTIVITIES

The expert started his work at the duty station in Nuku'alofa, island of Tongatapu, on January 21, 1987.

15 woodworking factories and enterprises were visited and the first findings were summarized in a preliminary report, which was sent to UNIDO Vienna and to UNDP in Suva (Fiji). (See Annex No. V).

In addition to this a workplan and a tentative training programme were drawn up and sent together with the preliminary report. (See annexes No. II, III and IV).

The job description has been found applicable and the duties mentioned in it could, in general, be carried out. (See annex No. I).

On-The-Job-Training / Ad-Hoc Advice

On-the-job-training was given in all of the factories and enterprises listed in annex No. VI during the time of the expert's mission.

Ad-hoc advice was given to managers, supervisors, machine operators, assemblers and surface finishers during the daily visits to different factories in order to improve factory organization and the quality of their products as well as to increase their productivity.

It has been mentioned previously that woodworking machines are just basic and the possibility of introducing modern machining methods were, because of this fact very limited. Nevertheless, the expert was able to give advice, in order to increase the capacity of the few existing machines and proper operating methods as well as jig utilisation has been introduced.

The effect of the use of unseasoned timber was demonstrated to the manufacturers and most of them indicated they have decided to stop this practice.

Joining methods such as the use of wooden dowels in carcase furniture and the utilisation of inserted tongues for solid edges has been advised.

The utilisation of simple transport devices in workshops such as wooden pallets with wheels has been advised, in order to increase production flow and to utilise manpower, fully, and has been adopted by some manufacturers.

Most of the factories do not even have handsanding machines at their disposal, and therefore the importance of handsanding could only be raised.

In view of the fact that surface finishing is carried out largely with brushes, only theoretical advice about spraying methods could be given.

Mr. Joe Talakai, who owns a welding and metal construction factory was very interested to enter the field of metal furniture manufacturing. The expert advised the owner and two of the welders on the manufacture of chairs, beds and additionally in a wardrobe (see annex No. X). The material for the wardrobe consisted of 1" x 1" square metal tubes welded together and fit on the inner side of the side frames with metal blades, acting like tongues, in order to fit into the grooves cut into the edges of the side panels, and to give support.

The basis for a serial production process for this products has therefore been prepared.

A furniture workshop equipped with only one circular saw and one handsanding machine was found, who could manufacture the necessary parts consisting of 13 mm plywood, such as side walls, top/bottom shelves, inner shelves, doors and the rear wall, in close cooperation with the metal factory.

At the end of the expert's mission a prototype of a wardrobe, a bed and a chair had been completed and displayed at the final meeting.

Seats and back rests for wood and metal chairs were seen to be made from flat plywood and improvement of the design was needed.

Therefore, the expert has prepared a construction drawing for a self-made mechanical press, in order to simplify the production of bent back rests and chair seats made from plywood. (See annex No. XI).

Advice was given on the proper lamination of surfaces. A construction drawing for a self-made mechanical press has been prepared and discussed at a Workshop by the expert, and its utilisation for laminating and flat door production has been discussed. (See Annex No. XII).

Training in Serial Production

Assistance has been given to employees of Mr. Tom Nakau, who owns a small furniture factory, which is equipped with basic woodworking machines.

The expert started a serial production of 100 coconut-timber-made chairs. All the necessary steps like planning, selection of material, machine operation, sanding, assembly, handsanding and finally surface finishing have been introduced. This has led to the development of a moderate quality product. (See annex No. XIII).

The expert insisted that only native materials should be used, for instance the chair seat was made from woven tapa strings. (Tapa / see annex No. VI).

So as to use only locally grown basic materials for production of carcass furniture made from solid hardwood frames with panels covered with printed tapa has been introduced. This product could be exported, if produced on a high quality level.

Concentrated on-the-job-training and assistance in serial production of dining tables has been given to the largest furniture factory, which belongs to the Commodities Board (mentioned on page 3). Emphasis was particularly given to factory organization, machine operation, sanding and quality control. All the necessary steps on how to run the serial production of dining tables have been taught and demonstrated.

Catalogues of modern woodworking machinery and tools have been handed over to managers and the correct utilization equipment has been described in detail.

Advice on storage of material such as timber and panels has been given and lists of different materials were prepared and introduced.

Lecturing

The expert acted as a guest lecturer on four occasions in the training centre of the Ministry of Works; teaching 12 students topics in the field of timber engineering, factory organization and theoretical advice on running serial production and measures to be taken to improve the quality standard of products.

The meaning of standardization has been explained and the importance of product design in serial production has been emphasised.

Workshops

A workshop programme was prepared and a workshop was held in order to introduce 15 managers of enterprises and factory owners to modern concepts and methods of serial production.

During this programme advice was given on overall management methods, in cost calculation and increasing productivity through improved organisational methods.

The meeting room of the Dateline Hotel in Nuku'alofa was used for this purpose.

Another five training lessons were held under this programme for managers, foremen, supervisors and others. This training took place in Mr. Tom Nakau's furniture factory, and the number of participants was 10 to 15.

Thanks are due to Mr. Nakau for his willing cooperation in this programme.

The topics and the timing of the training programme can be seen in annex No. IV.

In addition to the theoretical training modern woodworking methods were demonstrated in practice on woodworking machines.

In course of this programme the significance of the proper placement and installation of machinery in a workshop has been highlighted and demonstrated by means of a plant layout prepared by the expert.

FINAL MEETING

A final meeting took place at the meeting lounge of the Dateline Hotel in Nuku'alofa, at the 30 March 1987.

Invitation letters on behalf of the Ministry of Labour, Commerce and Industries were forwarded to owners and managers of woodworking enterprises and to key-position people from other Ministries and banks.

The number of attendants were 29 persons. The prototypes of furniture displayed consisted of 1 dining-table and 4 chairs (made by the Commodities Board) and an additional 2 chairs and 1 frame door, made of coconut timber combined with Tapa cloth (produced at Tom Nakau's factory), and found to be of great interest by the participants.

The expert pointed out applications of the technical knowledge given, in order to serve the local market with improved quality products, and to carry on in developing the field of furniture production.

The design expert showed the effect of a revised design on some of the prototypes.

A discussion was held, and questions raised concerning serial production and its commercial effects were replied to the participants.

(Prototypes displayed - see Annex No. XV).

CONCLUSIONS AND RECOMMENDATIONS

The expert recommends to the respective Ministry to undertake a marketing study in the field of the local annual requirements of furniture and wooden products.

A gathering of all entrepreneurs should be summoned, in order to give detailed information about the results of this research.

The productivity of the several local firms has to be figured out and - if necessary - to be increased according to the future needs.

Specialists of both, the Tongan National Bank and the Tongan Development Bank should give emphasis and detail information to entrepreneurs regarding requirements to obtain loans for purchase of woodworking machines and auxiliary equipment as well as for overall expansion of the enterprises.

Already at the present stage it could be a point of discussion to unite some of the firms in order to have a better position in entering the export market with their products. By means of a thus reinforced financial status on one hand, and by means of specialization in production on the other hand, this union could become a potential business challenge for competitors in the South Pacific.

Furniture and wooden products made from coconut timber decorated and / or combined with the unique locally made Tapa could eventually become a good seller on the local and export market.

Training programme: The Ministry of Works run a furniture factory including a small training centre for twelve apprentices. This training centre could be enlarged and the facilities be additionally used for advanced classes for technical trainees.

Once sufficient investments in equipment have been made, and some firms re-organized, to assign one Team Leader and three Volunteers for a period of at least one year to Tonga, in order to succeed the work done by the consultants.

Main tasks of the team leader should be the supervision of the volunteers and to act as a management advisor, production consultant and marketing expert.

However, a successful implementation of this future project may only be granted under the condition that efficient support be given and more interest for the subject in general be shown on the part of the respective Ministry.



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

June 1986

PROJECT OF THE GOVERNMENT OF TONGA

Assistance to the Furniture and Joinery Industry

JOB DESCRIPTION

SI/TON/86/073/11-01/31.7.A

Post title Expert in Furniture and Joinery Production (Team Leader)

Duration Three (3) months

Date required As soon as possible

Duty station Nuku'alofa, with possible travel in the country.

Purpose of project To up-grade the furniture and joinery industries through the use of improved designs and production facilities and to investigate the possibilities of establishing aluminium joinery and rattan furniture manufacturing industries, processing and use of coconut wood.

Duties

The expert will be assigned to the Industry Division of the Ministry of Labour, Commerce and Industry. The expert will, in close cooperation with the furniture designer and the counterpart staff, agencies, institutions and other bodies, provide assistance to the twelve units engaged in the manufacture of furniture and joinery as determined by the Ministry. Specifically he will be expected to:

1. Conduct a survey of the existing local furniture and joinery industries in terms of availability and suitability of raw materials, manpower and production facilities and product quality.
2. Identify, in light of the above, problems of the existing units in competing in the domestic market with imported products.
3. Survey the potential for introducing an aluminium joinery industry.
4. Survey the potential for the processing and use of coconut wood.
5. Give ad-hoc advice and provide on-the-job training to the existing furniture and joinery manufacturers in solving the//..

Applications and communications regarding this Job Description should be sent to:

Project Personnel Recruitment Section, Industrial Operations Division
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria

problems identified. The main areas of this assistance are anticipated to be the improvement of existing production facilities, plant layout, wood drying and surface finishing, design and use of jigs, costing and possible diversification into areas such as aluminium joinery.

The consultant will be expected to prepare a terminal report, setting out the findings of his mission and his recommendations to the Government on further action which might be taken.

Qualifications:

Wood Technologist or Engineer with long experience in operating small to medium scale furniture and joinery manufacturing at the production (shop floor) level.

Experience in developing countries and in production of rattan furniture and in the processing of coconut wood desirable.

Language:

English

**Background
Information:**

There are about twelve furniture and joinery making units in Tonga. These include an export oriented wooden toy industry and the timber joinery factory of the Commodity Board. Except for two mills which are located at Vava'u, the others are all located at Tongatapu -the main island of Tonga. Most of the existing industries are labour-intensive and engaged in the manufacture of simple type of furniture for domestic use, schools and churches. The designs and quality of the products are poor and need improvement, especially for furniture for household use. The Tongan furniture and joinery industry has not been doing well for some time. In spite of a number of industries engaged in those lines, Tonga still spends a substantial amount on imported furniture and joinery as the designs, quality and finish of the locally made furniture are not up to the mark in comparison to imported items.

The timber joinery factory of the Commodity Board was set up in the 1960's and needs improvement in production facilities if it were to manufacture furniture with export potential. Many of the existing industries badly need assistance in design improvement, better method of production, guidance for more suitable technology and equipment and training on the spot, in order to increase the domestic market share of the locally made furniture.

Moreover, the Tonga Government wishes to diversify the production of their furniture and joinery industry by introducing aluminium joinery, exploring the possibility of manufacturing Rattan Furniture processing and use of coconut wood.

UNITED NATIONS

- 26 -



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

June 1986

PROJECT OF THE GOVERNMENT OF TONGA
Assistance to the Furniture and Joinery Industry

JOB DESCRIPTION

SI/TON/86/073/11-02/31.7.A

Post title Expert in Furniture Design

Duration Two (2) months

Date required As soon as possible

Duty station Nuku'alofa, with possible travel in the country.

Purpose of project To up-grade the furniture and joinery industries through the use of improved designs and production facilities and to investigate the possibilities of establishing aluminium joinery and rattan furniture manufacturing industries and processing and use of coconut wood.

Duties

The expert will be assigned to the Industry Division of the Ministry of Labour, Commerce and Industry. The expert will, in close cooperation with the Furniture Production Expert (Team Leader) and the counterpart staff, agencies, institutions and other bodies, provide design assistance to the twelve units engaged in the manufacture of furniture and joinery as determined by the Ministry.

Specifically he is expected to:

1. Conduct a survey of the existing local furniture and joinery industries' existing designs and range of products, existing and available raw materials, hardware and other inputs.
2. Develop, based on the above, improved designs appropriate to existing capabilities with a view to replacing imports and entering into regional export markets.
3. Prepare material specifications for these new designs bearing in mind also the availability of coconut wood.

Applications and communications regarding this Job Description should be sent to:
Project Personnel Recruitment Section, Industrial Operations Division
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria

4. Assist the local furniture producers in the production of the prototypes of these new designs, train the staff on the job, and give ad-hoc advice to improve existing designs and design practices.

The consultant will also be expected to prepare a technical report setting out the findings of his mission and his recommendations to the Government on further action to be taken by itself, the industry and/or international organizations.

Qualifications:

Furniture designer with long experience in the development of a wide range of designs suitable for labour intensive and simple production techniques. (Knowledge of designs, quality level and product finish of the furniture in developed countries desirable). Experience in conditions prevailing in the smaller developing countries desirable.

Language:

English

Background

There are about twelve furniture and joinery making units in Tonga. These include an export oriented wooden toy industry and the timber joinery factory of the Commodity Board. Except for two mills which are located at Vava'u, the others are all located at Tongatapu - the main island of Tonga. Most of the existing industries are labour-intensive and engaged in the manufacture of simple type of furniture for domestic use, schools and churches. The designs and quality of the products are poor and need improvement, especially for furniture for household use. The Tongan furniture and joinery industry has not been doing well for some time. In spite of a number of industries engaged in those lines, Tonga still spends a substantial amount on imported furniture and joinery as the designs, quality and finish of the locally made furniture are not up to the mark in comparison to imported items.

The timber joinery factory of the Commodity Board was set up in the 1960's and needs improvement in production facilities if it were to manufacture furniture with export potential. Many of the existing industries badly need assistance in design improvement, better method of production, guidance for more suitable technology and equipment and training on the spot, in order to increase the domestic market share of the locally made furniture.

Moreover, the Tonga Government wishes to diversify the production of their furniture and joinery industry by introducing aluminium joinery, exploring the possibility of manufacturing Rattan Furniture processing and use of coconut wood.

ANNEX II

W O R K P L A N

FEBRUARY TO EARLY APRIL, 1987

1. Survey of existing local furniture, joinery, sawmill factories in terms of their production and organisation levels.
2. Preparation of plant layouts for one medium-scale furniture production factory (government owned) and one small-scale furniture production factory (privately-owned).
3. Preparation of a Workshop program to be given to General Managers of Government Enterprises and private owners of factories.
4. Presentation of workshop program
5. Preparation of a training program (1) to be given to workshop managers, supervisors and foremen.
6. Presentation of training program (1)
7. Preparation of a training program (2) to be given to supervisors, foremen, machine operators, assemblers, surface finishers.
8. Presentation of training program (2)
9. Preparation of final Report

(See expanded notes on this Plan overleaf).

WORK PLAN SI/TON/86/073 PREPARED BY KARL FUGHS PRODUCTION TECHNICIAN

ACTIVITIES	1987												
	JANUARY		FEBRUARY				MARCH				APRIL		
UNIDO briefing and travel to duty station (Tonga).	■												
Introduction to proper Ministry, Departments and authorities		■											
Visit to 10 woodworking factories sawmill's and production plants		■	■	■									
Production Management				■									
Furniture and Joinery Technology				■	■	■	■	■	■				
Cutting tools, re-conditioning and machine maintenance practices.						■	■	■	■				
Effective utilisation of woodworking equipment, preparation and utilisation of jigs.				■	■	■	■	■	■				
Production design and development.						■	■						
Preparation of Reports								■	■	■			
Travel to Vienne debriefing at UNIDO.												■	

PRELIMINARY REPORT

1. The survey of the local furniture/joinery/sawmill factories has been commenced by the expert, together with his counterpart, Mr Tevita K. Fout, Assistant Industrial Promotion Officer, Ministry of Labour, Commerce and Industries. His first findings are given in this Preliminary Report.

2. Preparation of Plant Layouts:

The furniture and joinery factory located at Haveluloto belongs to the Construction Division of the Tongan Government's Commodities Board.

It has been decided that this factory can be used as one of the Technical Training Centre during the expert's stay in Tonga. A medium-scale production factory, it is the largest factory in Tonga. It is demonstrably the leading public-owned enterprise. It will provide a suitable base for a training workshop for government employees.

In addition to the assistance given to this factory through the improvement of the floor layout, it is felt that it would be wise to also give assistance to a privately-owned small-scale furniture/joinery factory. This enterprise is located on the Small Industries industrial estate in Nuku'alofa. It will also provide the base for a training centre for private enterprise employees.

The expert intends to run two separate training courses, one at each venue, to enable the course numbers to be limited to 15-20 people.

The owner of this enterprise, Mr Tom Nakao, has indicated he would appreciate the use of his factory as a training centre.

Hence, a plant layout for both of these factories has to be prepared, so that all the existing equipment may be situated correctly, to enable a proper production flow and the creation of a rational production system.

WORKSHOP PROGRAM FOR MANAGEMENT

In the expert's opinion it seems essential to have a sustained discussion/seminar with managers of enterprises and with factory owners.

The overall aim is to convey basic concepts of good management, including planning ahead, allocation of workloads, good communication between management and workers, and the importance of thorough organisation in each department and section.

Although the fields of timber processing and furniture production are currently somewhat moribund, it will be pointed out that both these areas have great development potential, albeit on a limited scale. In particular, a continued and increasing use of locally grown timber will be encouraged. It will be pointed out that this could be a good business proposition, with profit-making potential.

In addition, an emphasis will be given to the need to improve the work practices and production processes already in existence. Again this should afford an improvement in turnover and profits.

Since factory organisation seems to be on a very poor level this will be a particular point of concentration in this training program. The expert will prepare working papers, such as production forms, working drawings, material lists, etc, and also calculation sheets, account forms, budget forms etc.

Emphasis in this training program will be on the need for care in handling of materials and the finished products, the observance of safety precautions, proper application of laminates and paint/lacquer finishes, and better working methods.

The main source of indigenous timber is coconut wood. It is extremely difficult to obtain precise figures on the size of coconut stands, but there is hardly an api uta (a land grant measuring 8 acres) which is not almost fully occupied by coconut palms, spaced about 5 metres apart. These spaces are usually planted with a variety of food crops, including yams, cassava (manioc), bananas, sweet potato, etc.

Discussions will be undertaken with officials and field workers of the Ministry of Agriculture, Fisheries and Forestry regarding current research on the coconut tree in the Kingdom. These discussions will be a two way exchange of information, in that the expert will particularly emphasize the need to encourage farmers to plan ahead, in order to be prepared for the replanting, as well as the felling of coconut trees which have reached their last bearing phase.

In addition it will be emphasized that if no such education program exists, it should be undertaken, together with instruction on the need for speedy harvesting of cyclone-damaged trees, rather than allowing these to stand and deteriorate. This will admittedly be difficult, as many farms are owned by absentee farmers who may be resident outside Australia.

TENTATIVE WORK PROGRAMME

1. Production Management:
 - Concepts and scope of production management
 - Production planning and control overall factory organisation.
 - Materials management and control.
 - Production systems

2. Furniture and Joinery Technology:
 - Mode of Production
 - Arrangements of phases of work in machining, assembling and surface finishing.
 - Furniture and joinery standards properties of timber used in the furniture and joinery industries.
 - Quality standards of sawntimber for furnitures and joinery industries.
 - Factors affecting properties of wood substance
 - Hardwood and softwood, coconut timber
 - Effect of moisture on wood.
 - The drying process and drying systems
 - Drying problems
 - Natural seasoning
 - Technical requirements , and use of Panels by the furniture industry
 - Particleboards, plywood and blockboards used in furniture production

- Glueing methods
- Factors that affect glueing
- Glueing of wood
- Glueing of laminates
- Types of glues
- The glueing process
- The surface preparation for finishing
- Surface sanding
- Painting equipment
- Stains, staining
- Lacquers and lacquering
- Spraying techniques
- Promotion of safety
- Safety procedures on woodworking machines

3. Cutting Tools, Re-conditioning and machine maintenance practices:

- Types of machine tools for woodworking
- Tungsten carbide tipped saws
- Bandsaw blades
- Planer and moulder knives
- Planer heads
- Grinding techniques
- Proper installation of machines
- Organisation of maintenance activities
- Preventive maintenance
- Stocks for maintenance
- Maintenance of bearings

4. Effective utilisation of
woodworking equipment:

- Machining methods in serial production
- The need for waste and dust extraction systems
- Centralised extraction systems
- Preparation of jigs and their effective use in serial production
- Technical standards for woodworking machines

5. Production design and
Development:

- The need for furniture designers in developing countries
- The need for technical product design
- Properties required for serial production
- Factors affecting production design
- The role of work drawings and production forms
- Preparation of work drawings
- Preparation of production forms
- Stock taking
- Cost accounting principles
- Value analysis and cost reduction.

TRAINING PROGRAMME

TRAINING COURSE IN MODERN MANUFACTURING TECHNIQUES AND PRODUCTION
MANAGEMENT ACTIVITIES IN FURNITURE AND JOINERY FACTORIES.

Development Objectives:

- To introduce modern concepts and methods of serial production in the furniture and joinery industry.
- To familiarise and re-orient the thinking of managers, foremen and supervisors on the concepts of modern manufacturing management techniques and serial production methods.

Proposed Training Programme:

1. Production Management
2. Furniture and Joinery Technology
3. Cutting Tools, Re-conditioning and Machine maintenance practices
4. Effective Utilisation of woodworking equipment preparation and utilisation of jigs
5. Product design and Development

Activities:

The training course will be organised by the UNIDO Expert.
The Ministry of Labour, Commerce and Industries will act as Host Agency.
The course will be conducted in English.

RESTRICTED

5 February 1987
English

ASSISTANCE TO THE FURNITURE AND JOINERY INDUSTRY

SI/TON/86/873/11-01

KINGDOM OF TONGA

PRELIMINARY REPORT

Prepared by Karl Fuchs, Expert in Furniture and Joinery

Production

United Nation Industrial Development Organisation

SITUATION REPORT

I arrived at the duty station in Nuku'alofa Tonga on January 21 1987. Most of the findings outlined below are based on information obtained during visits to ten wood-working factories and enterprises. These establishments ranged in size from 1 to 26 employees. Their output included household furniture, school furniture, door and window frames and a variety of wooden structures.

Production levels and Design

The production of finished timber items is at a low level. Furniture design tends to be extremely utilitarian, with little utilisation of quality finishes. In addition, there seems to be little appreciation at present of the possibilities inherent in wood manufacturing.

It should be noted that at this present point in time Tongans make and retain their traditional house furnishings. Many of the population still sleep on pandanus mats on the floor, and also eat sitting on the floor. On the other hand, there is a great desire for modernity throughout all levels of Tongan society.

Increased levels of family prosperity due to the receipt of remittances from migrant relatives living in the U.S.A. (including Hawaii), New Zealand and Australia has stimulated new house and church building. Not infrequently house furnishings are directly imported through the agency of overseas relatives.

The currently used furniture designs tend to be poor. There does not appear to be a highly developed sense of aesthetics vis a vis the design or appearance of household furnishings on the part of the manufacturer or the customer. This is probably due in part to the lack of exposure to a variety of modern designs. Television viewing is in its infancy (although video movies are very popular.) The

main source of information is the government-owned radio station, and a small 8 page weekly newspaper. Hence the design of kitchen and lounge chairs, for example, would date from perhaps the 1930's or 1950's.

In the case of a dining chair the large size of the wood pieces used in the construction give it an almost "Gothic" appearance. (The size may well be influenced by the fact that the average Tongan weighs 100 kg).

There are no official design standards; no design norm for height and size of furnishings appears to be acknowledged.

Imported pine wood is the most commonly used material for furniture construction. Imported plywood and particle boards are also used. However, because very few of the wood workers appear to have a "feel" for their materials, much of the furniture produced is rustic in appearance. For instance, it is not uncommon to find on a finished surface that the teeth marks of a circular saw still appear, as well as indentations from hammer blows. The use of sanding techniques does not appear to be advanced.

The surface treatment involves the use of brushes. Spraying equipment for the application of surface lacquers (including nitro-cellulose lacquer) and varnishes is not used. This fact also contributes to the poor appearance of the finished product.

The producers of wood products in Tonga do not appear to fully take advantage of the fact that they have a virtually "captive market". At least one manufacturer complained of the lack of orders. This man readily admitted that his low level of orders could be attributed to customer expectations of poor workmanship and failure to meet order deadlines.

The majority of the workers, and even the self-employed entrepreneurs are self-trained. Few have proper trade qualifications in carpentry and wood-working. Trade training was only available overseas until recently. Potential trade teachers are currently being trained at the Fiji Institute of Technology. Woodwork classes are also offered in most High Schools.

Most of the managers complained of a loss of skilled and semi-skilled workers due to their emigration from Tonga, particularly to Australia and New Zealand. To give some idea of the scale of this exodus it has been estimated that at least 10,000 Tongans have left the country since early December, 1986, due to an easing of New Zealand's entry rules. It is considered that some will return, either having fulfilled short-term earning goals or having been unable to obtain employment.

The per capita income is estimated at T\$650.^{1/} The average daily wage of a skilled worker ranges between T\$6-10, depending on the benevolence of the employer. A graduate civil servant may receive T\$11.00 per diem. Establishments in the recently established Small Industries Centre offer some security of employment, as do some entrepreneurs. However, many workers are often employed on a casual, daily basis.

The wage levels are obviously based on the premise that workers will have other sources of support, notably access to land for food crop production or family resources. This is not always the case, as the capital has attracted many emigrants from the other islands in the Kingdom. Increasing inflation, a new Government imposed consumption tax, landlessness and lack of employment are all causing hardship to sectors of the population, and are precipitating factors in the emigration of many.

1/ US\$ 1 = 1.40 T\$ (Pa'anga)

Machinery and the production process

Most of the machinery is very basic and is rather old in terms of function and design. Since there appears to be minimal maintenance undertaken, machinery malfunction and breakdowns are common. About fifty per cent of the wood working machineries were out of order in the establishments which I visited.

Factory layout is poor. No proper production flow is possible because of the poor layout of machinery. Pieces of sawn timber are quite frequently piled between the machines.

Parts of an item being manufactured are moved manually between machines. No wooden pallets or lift trucks are utilised, and these appear to be unknown.

No dust extraction equipment is used, and the factory/workshop floors are invariably cluttered with offcuts and piles of sawdust. In addition, basic safety standards are not observed. This is due in part to the fact that the workers do not appear to have been instructed in meeting safety requirements and the proper use of safeguards.

Coconut Sawmill, Mataliku

One of the most efficient and interesting establishments which I visited was the sawmill operated by the Ministry of Agriculture, Fisheries and Forestry. The sawmill manager is an expatriate from New Zealand.

The sawmill is small, but clean and well-organised. It consists of:

- 1) The sawmill plant, equipped with a heavy circular saw and a re-saw, mainly used for sawing coconut wood. The present output is 5 - 6m³ a day;

- 2) A moulder plant, equipped with one edger, one surface planer, one thicknesser, one spindle moulder, one recut saw. This section is partly serviced by a dust extraction system, and is mainly used for the production of coconut wood parquet floor tiles. These have a most attractive appearance and this product has good local and export sales potential if production could be maintained at a consistent level;
- 3) A roof shingle production department, equipped with one heavy circular saw for the cutting of the shingles. The inner and softer wood of the coconut is used for these. Treated chemically they should last for 20 years. There are problems regarding local sales since the product is expensive and the method of fixing the shingles not known to construction workers (who are most usually owner-builders); (see comments on this below).
- 4) A wood treatment plant, comprising a pressure cylinder and a compressor system. This is mainly used for treatment of fence posts, and construction timber, but is also used for the preservation treatment of the roof shingles;
- 5) A sawdoctoring shop, equipped with grinders and welding equipment. This section is run by two skilled saw-doctors, who service, sharpen and re-condition the above mentioned equipment.

General comments on the sawmill

The technical level which its workers have achieved under the manager's guidance is good. This enterprise will not require training input. This factory also has an expatriate expert in the sawing of coconut timber.

However, due to a lack in the supply of coconut logs and to a lack of orders no production activities were observed during my visits to this establishment.

In regard to the sale of floor tiles and roof shingles, one urgent problem is the lack of workers experienced in shingling or in laying wooden floor tiles. In my opinion, a nucleus of a few workers, trained in these techniques, would be sufficient to demonstrate the use of these materials, both to potential customers and other workers. The shingles in particular offer a particularly attractive alternative to galvanised iron roofing materials, and would be appropriately utilised in the construction of modern adaptations of the Tongan fale. This building is being rapidly displaced by mundane rectangular houses, built of concrete blocks or weatherboards, and invariably roofed with galvanised iron.

A higher production output could possibly reduce the local price, and the encouragement of Government architects and local designers to incorporate more local products in new buildings might ensure their wider utilisation.

Metal working production

I also observed the work of one enterprise (a division of E.M. Jones Ltd) which manufactures aluminium window frames, galvanised iron roofing sheets, metal fence posts and concrete bricks.

They have also commenced to manufacture furniture such as side tables, china cabinets and small cupboards from aluminium frames and glass. This is on a trial basis, and these products have not yet gained a market.

This company also had a wood working section, equipped with a circular saw, a spindle moulder and a work bench. Four skilled furniture makers had worked there until recently, manufacturing tables, wardrobes, and kitchen cabinets. However, all four workers have left their employment to go to New Zealand.

The proprietor was appreciative of the concept of a workshop which would demonstrate the proper working and utilisation of wood-working machinery, factory organisation, and the care of materials and products, as well as offering information to potential and existing management on management skills.

Possible Introduction of Rattan

There are no indigenous sources of rattan. If manufacturers wishes to utilise this material import prices would make it prohibitive. Some rattan furniture is imported, but the transport costs are high.

Rattan is a premier material for the manufacture of furniture suitable for tropical climates.

It would be possible for me to convey information on the processing of rattan up to its use in furniture production during my current stay in Tonga. This could give potential producers, as well as manufacturers some idea of the possibilities of this material.

T O N G A

S E L E C T E D D A T A

1. Population 100,000 estimated (Mini-census Nov. 1984 - 96,592) plus overseas resident population of 40-50,000; (including foreign born children).
2. 70% live on Tongatapu
3. Population under 20 years: 54% (Nov. 1984)
4. Government revenue (1982/83 - About T\$ 18 million
5. Government expenditure 1982-83 - T\$ 16,905,292
6. Exports (1984) T\$ 10,439,094
Imports (1984) T\$ 46,614,129
7. Major exports: Coconut products, agriculture produce
(eg. bannanas, watermelon)
8. Major imports: Foodstuffs, petroleum and other fuels
9. Principal export trading partners: New Zealand, Australia,
Sweden
10. Principal import trading partners: New Zealand, Australia,
Japan, Singapore, USA
and Fiji
11. Area 747 sq. km.

WOODWORKING FACTORIES IN TONGATAPU

Pacific Construction

Production of household furniture

Number of employees: 4

Equipment: 1 circular saw, 1 band saw, 1 thicknesser
(.hobby size)

Lazy Lil Company

Production of upholstered furniture

Number of employees: 2

Equipment: 1 circular saw, 1 band saw, 1 surface planer,
1 compressor (.hobby size)

Oceanic Industrial Enterprises

Production of wood and metal furniture and joinery products

No of employees: 7

Equipment: 1 circular saw, some electrical power driven hand tools

Tu'ivai Enterprises

Production of furniture and joinery products

No of employees: 3

Equipment: 1 circular saw, 1 thicknesser, some electrical power
driven hand tools

Talakai Tu'ipolotu Enterprises (Welding Factory)

Production of furniture, wood and metal combined

No of employees: 3

Equipment: 1 metal re-cut saw, 1 welding equipment,
1 compressor, some electrical power driven hand tools

Lipoi Tuou and Sons Company

Production of furniture and joinery products

No of employees: 4

Equipment: 1 circular saw, 1 thicknesser and planer,
some electrical power driven hand tools

O. G. Sanft Industries

Production of furniture and upholstered furniture
(wood and metal)

No of employees: 8

Equipment: 1 combined circular saw/spindle moulder
1 turning lathe
1 combined thicknesser/planer/mortiser
1 self-made belt sander, 1 welding equipment
1 compressor, some electrical power driven hand tools

Lolohea Enterprises

Production of furniture and joinery products

No of employees: 1

Equipment: 1 circular saw, some electrical power driven hand tools

Jones Industries Ltd

Production of furniture and joinery products

No of employees: 2

Equipment: 1 circular sar, 1 spindle moulder, 1 drill
stand, some electrical power driven hand tools

Production of aluminium windows and doors

No of employees: 2

Equipment: 1 metal cut saw, some electrical power driven hand tools

Mattheus and Associates (Tom Nakau)

Former export oriented wooden toy industry

Production of furniture, serial production of chairs

No of employees: 3

Equipment: 1 circular saw, 1 thicknesser, 1 cross cut saw,
1 compressor,

Amateur size equipment: 1 tenoner, 1 surface planer

2 mortisers, 1 router, some electrical
power driven hand tools

Vailea Enterprises

Production of furniture and joinery products

No of employees: 2

Equipment: 1 combined circular saw/spindle moulder/
thicknesser/planer/mortiser, some electrical power
driven hand tools

Ministry of Works - Workshop

Production of furniture and joinery products

No of employees: 8

No of apprentices: 12

Equipment: 1 circular saw, 1 cross cut saw, 1 band saw,
1 surface planer, 1 thicknesser, 1 belt sander,
some electrical power driven hand tools

T and T Builders Company

Production has not yet been started

Intended no of employees: 5

Equipment: 1 circular saw, 1 thicknesser/planer
1 spindle moulder, some electrical power driven
hand tools

Commodities Board - Workshop

Production of furniture and joinery products

No of employees: 27

Equipment: 1 cross cut saw, 1 rip saw, 1 surface planer,
1 thicknesser, 1 spindle moulder, 1 mortiser,
1 tenoner, 1 panel saw, 1 belt sander, 1 turning
lathe

Saw Mill Mataliku (MAFF)

Saw mill department: cutting of coconut timber

No of employees: 7

Equipment: 1 heavy circular saw with inserted teeth and carriage, 1
circular edger with roller feed, 1 forklift truck

Floor-tile production department: Production of coconut wood
parquet floor tiles

No of employees: 5

Equipment: 1 rip saw, 1 cross cut saw, 1 surface planer,
1 thicknesser, 1 spindle moulder.

This section is partly serviced by a dust
extraction system.

Roof shingle production department: Production of coconut wood
roof shingles

No of employees: 2

Equipment: 1 heavy rip saw

Wood treatment plant: Chemical preservation of roof shingles
and construction timber

No of employees: 2

Equipment: Pressure cylinder (3.5 m³ loading capacity)
air compressor plant

Saw Mill Mataliku (MAFF) / continuation

Saw doctor shop: Reconditioning of machine tools for the entire factory, and tool maintenance service for the general public

No of employees: 2

Equipment: 2 saw grinding machines, 1 knife grinder,
1 welding equipment

WOODWORKING FACTORY IN VAVA'U

V. J. N. and Sons, Industrial Joinery Ltd

Production of furniture and joinery products

No of employees: 4

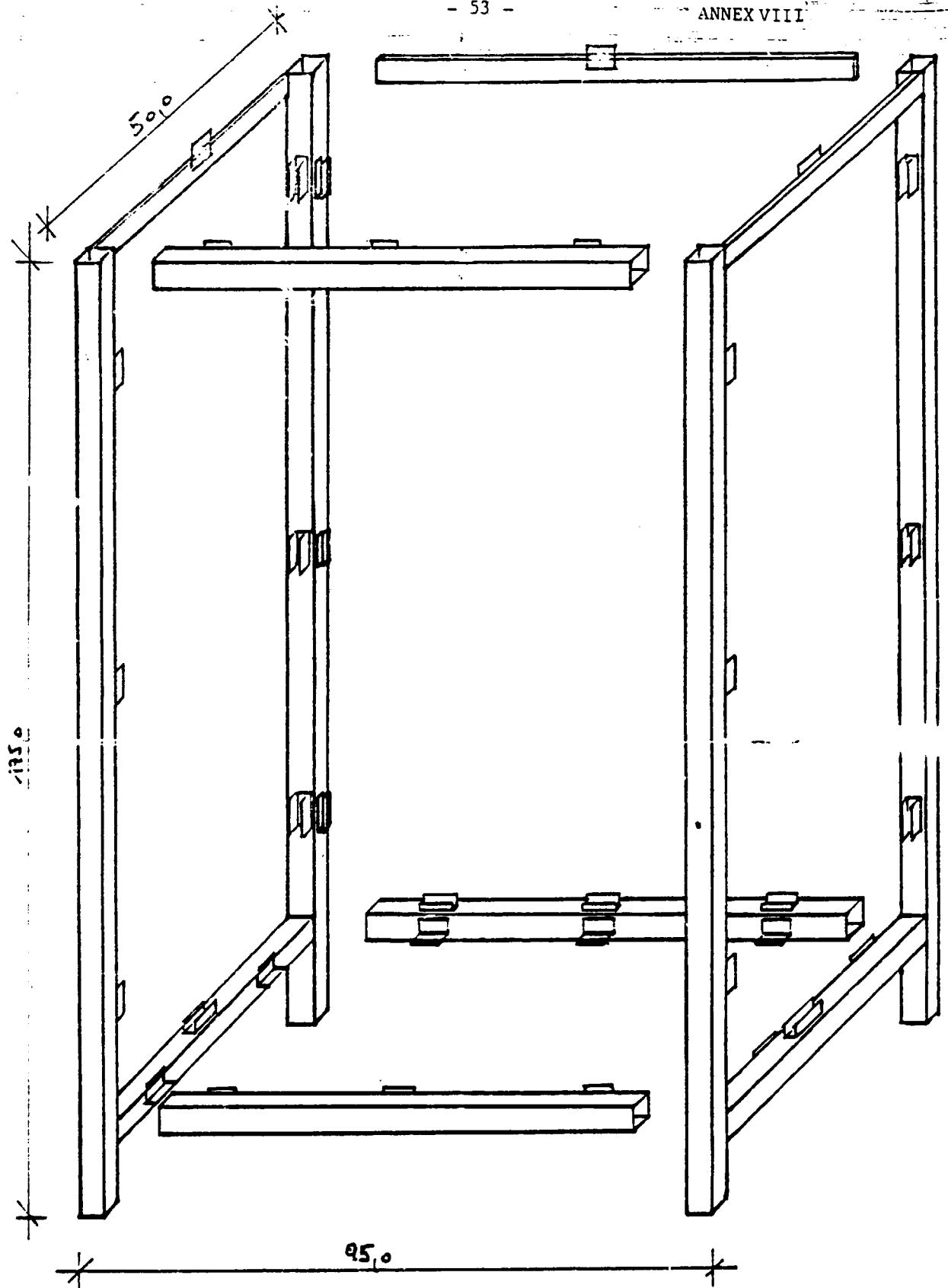
Equipment: (all "hobby" type): 1 circular saw, 1 cross cut saw,
1 band saw, 1 planer, 1 thicknesser, 1 compressor,
some electric power driven hand tools

COUNTERPARTS

Mr. Kupu Falekava	Assistant Secretary, Ministry of Labour, Commerce and Industries
Mr. Tevita Kitu	Industrial Promotion Officer, Ministry of Labour, Commerce and Industries

LIST OF OFFICIAL PERSONS MET

Mr. James W. Harris	Asst. Secretary	Ministry of Labour, Commerce and Industries
Capt. Maulupekotola Tuita	Acting Secretary	Min. of Foreign Affairs
Mr. Tevita Havili	General Manager	Tonga Commodities Board
Mr. Sioceli Matoto	Estate Manager	Small Industries Centre
Mr. Sahae Desh	Planning Officer	Ministry of Labour, Commerce and Industries
Mr. David Abbot	Planning Officer	Tonga Commodities Board
Mr. Ivan Kippenberger	Chief Forestry Officer	Ministry Agriculture, Fisheries & Forestries
Mr. Bryan Miller	Sawmill Manager	Mataliku Sawmill



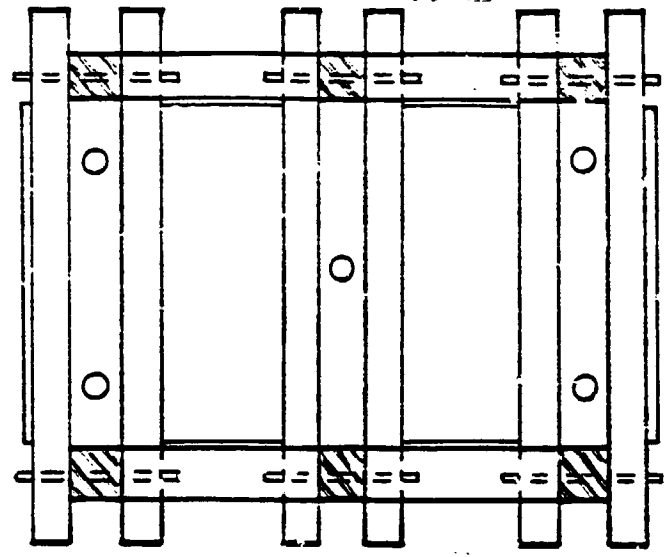
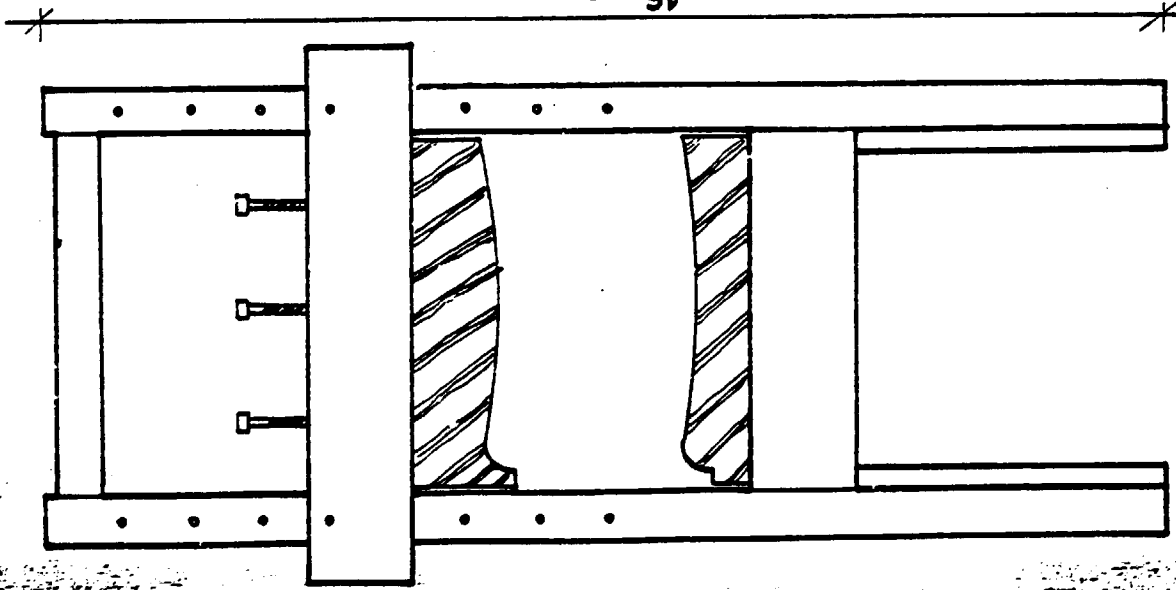
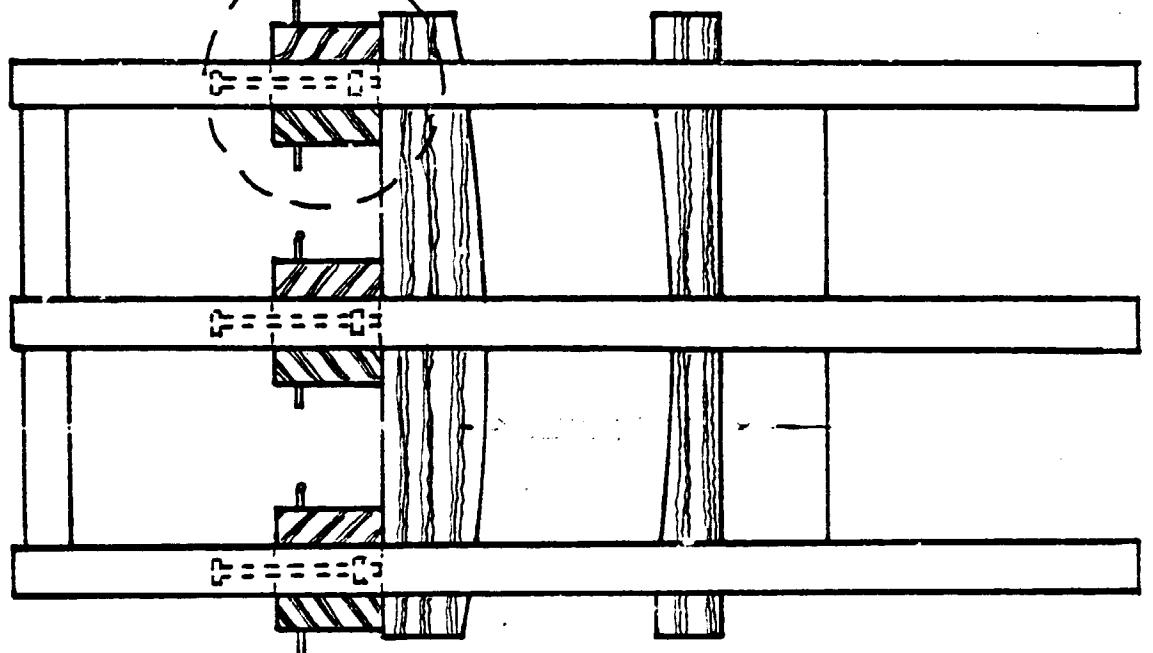
MECHANICAL PRESS
FOR CHAIR SEAT (PLYWOOD)
SCALE 1:10

75.0

65.0

160.0

A

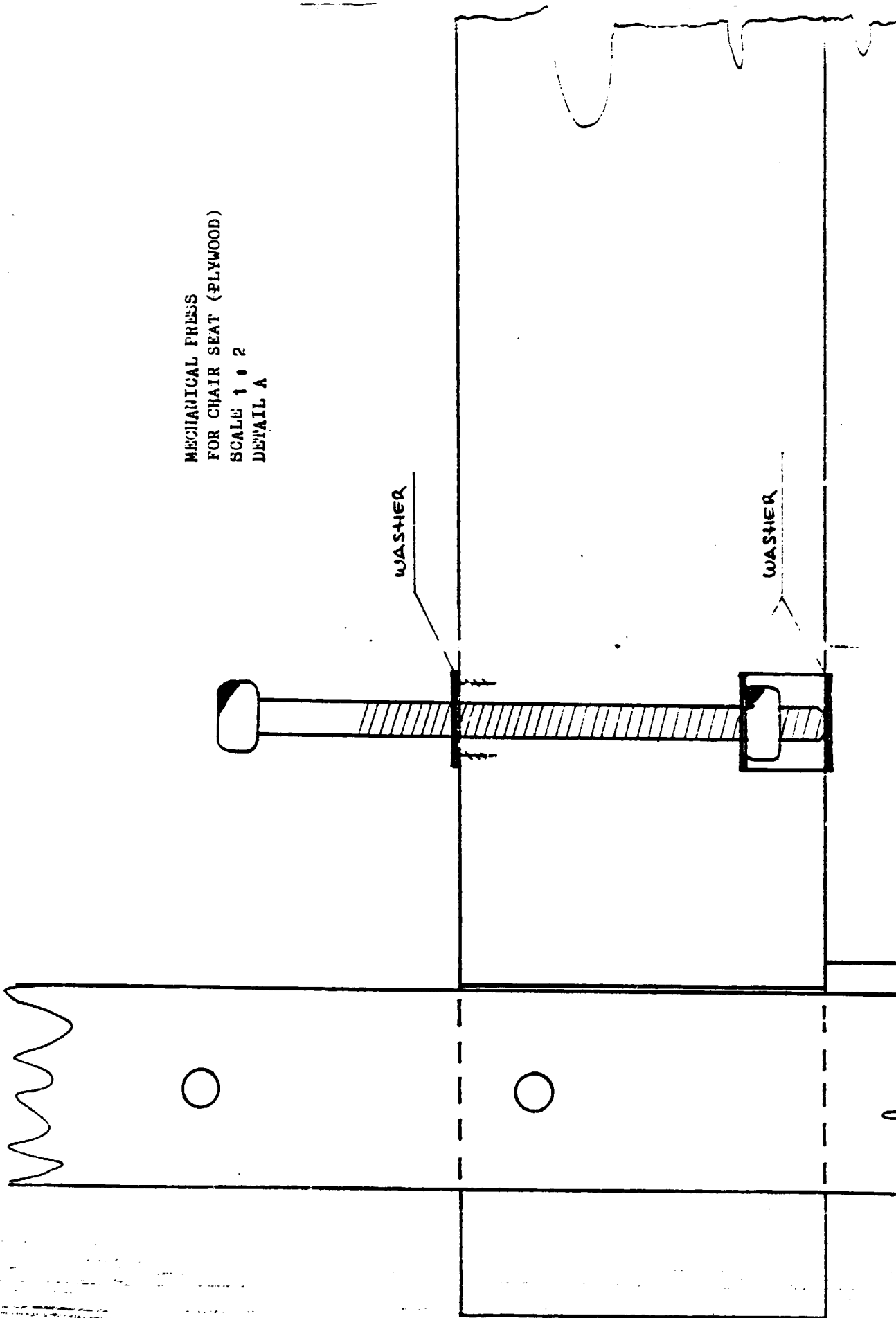


TOP VIEW

FRONT VIEW

SIDE VIEW

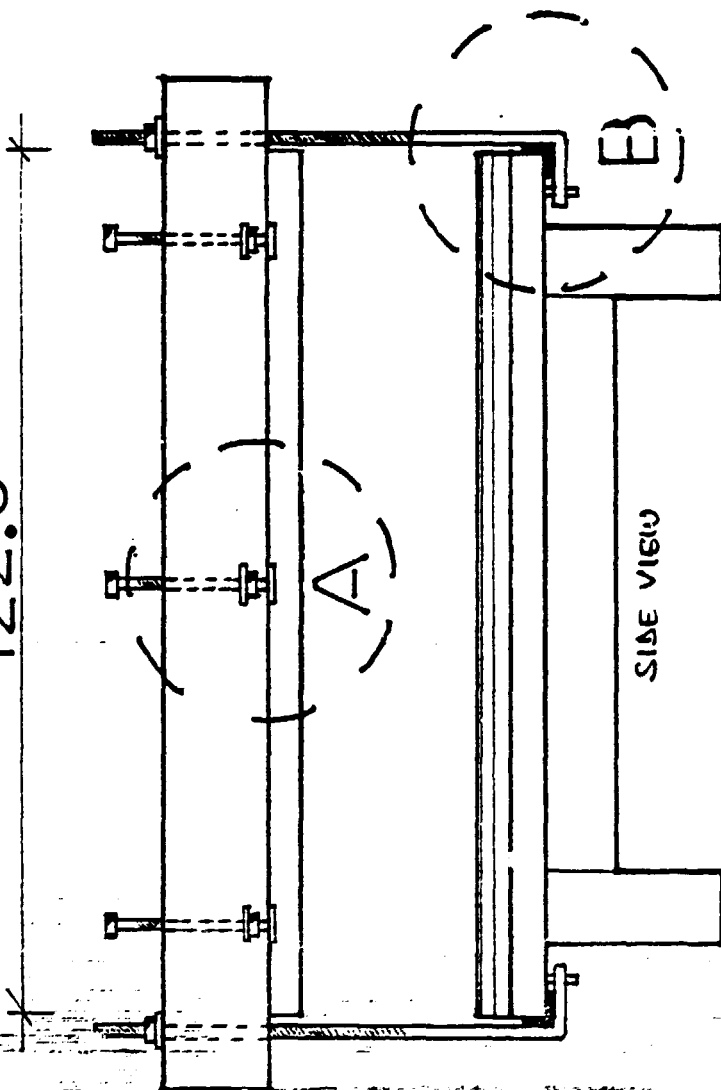
MECHANICAL PRESS
FOR CHAIR SEAT (PLYWOOD)
SCALE 1 : 2
DETAIL A



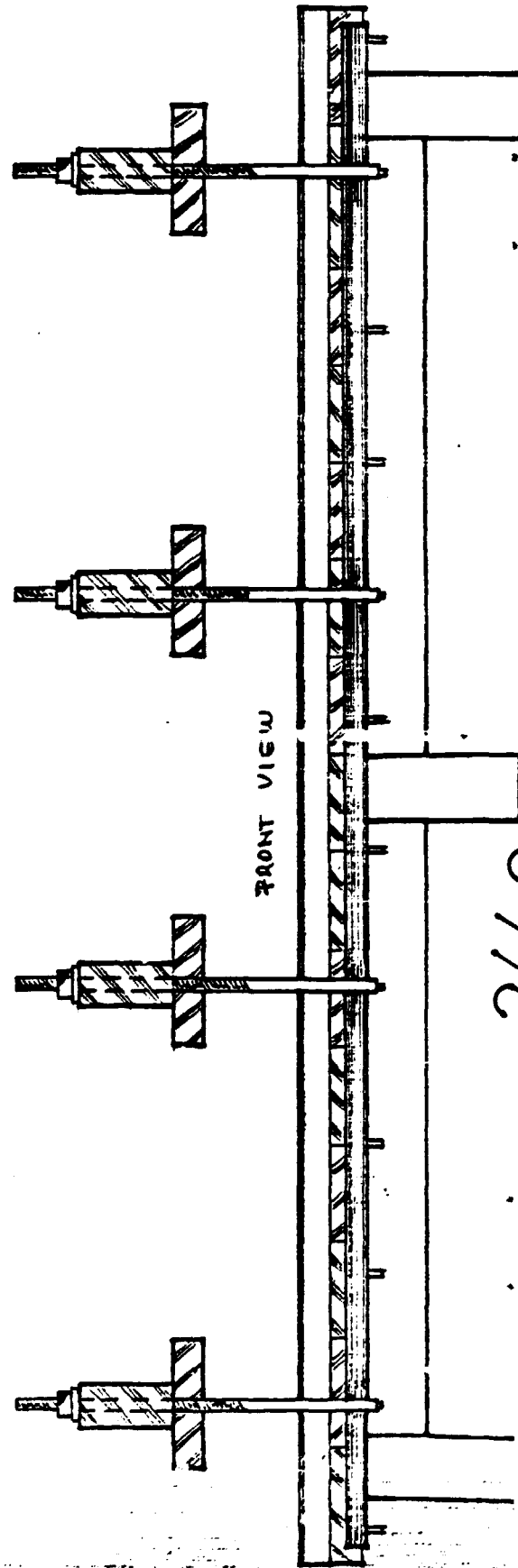
MECHANICAL PRESS

SCALE 1 : 10

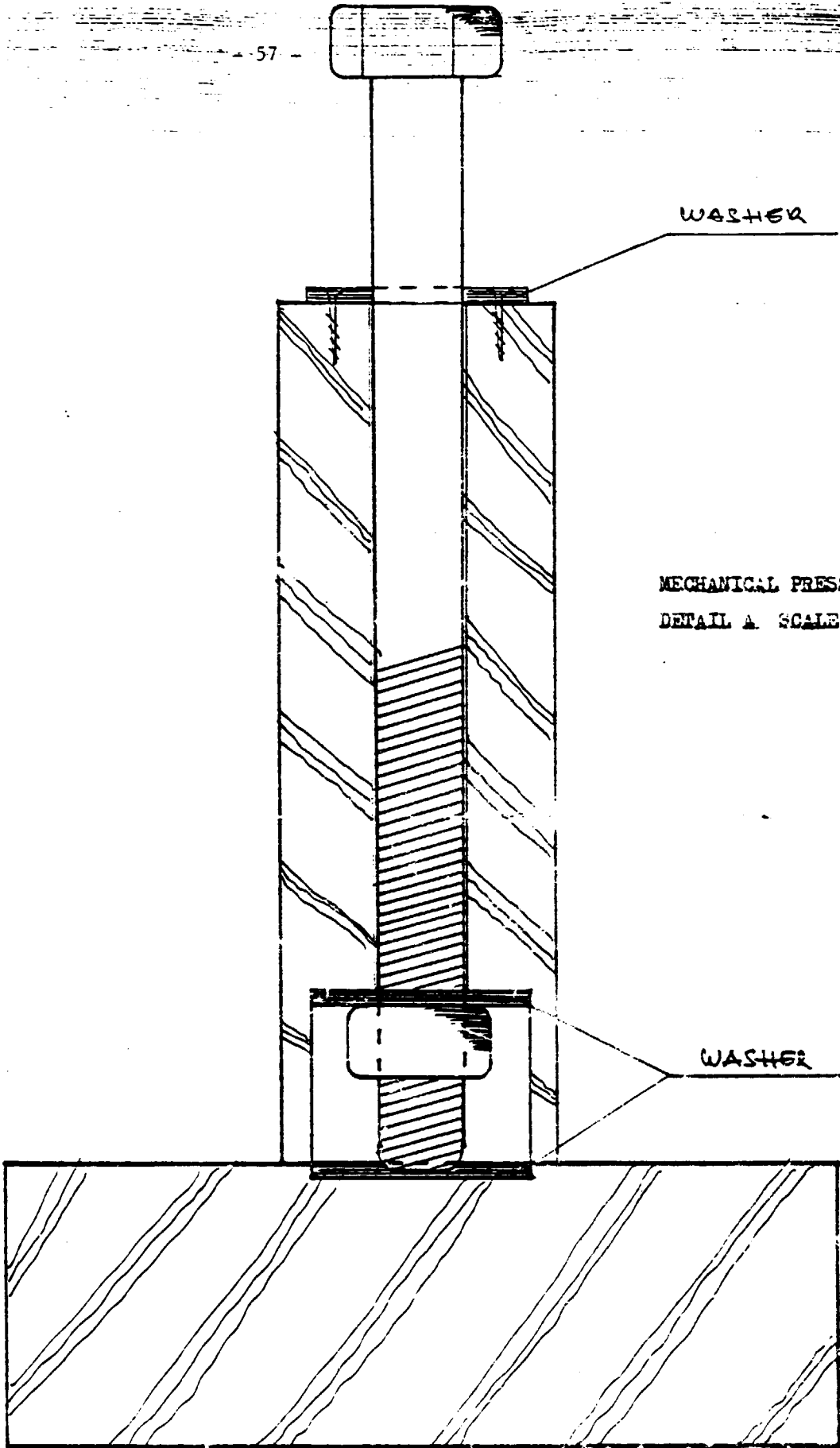
122.0



SIDE VIEW



FRONT VIEW

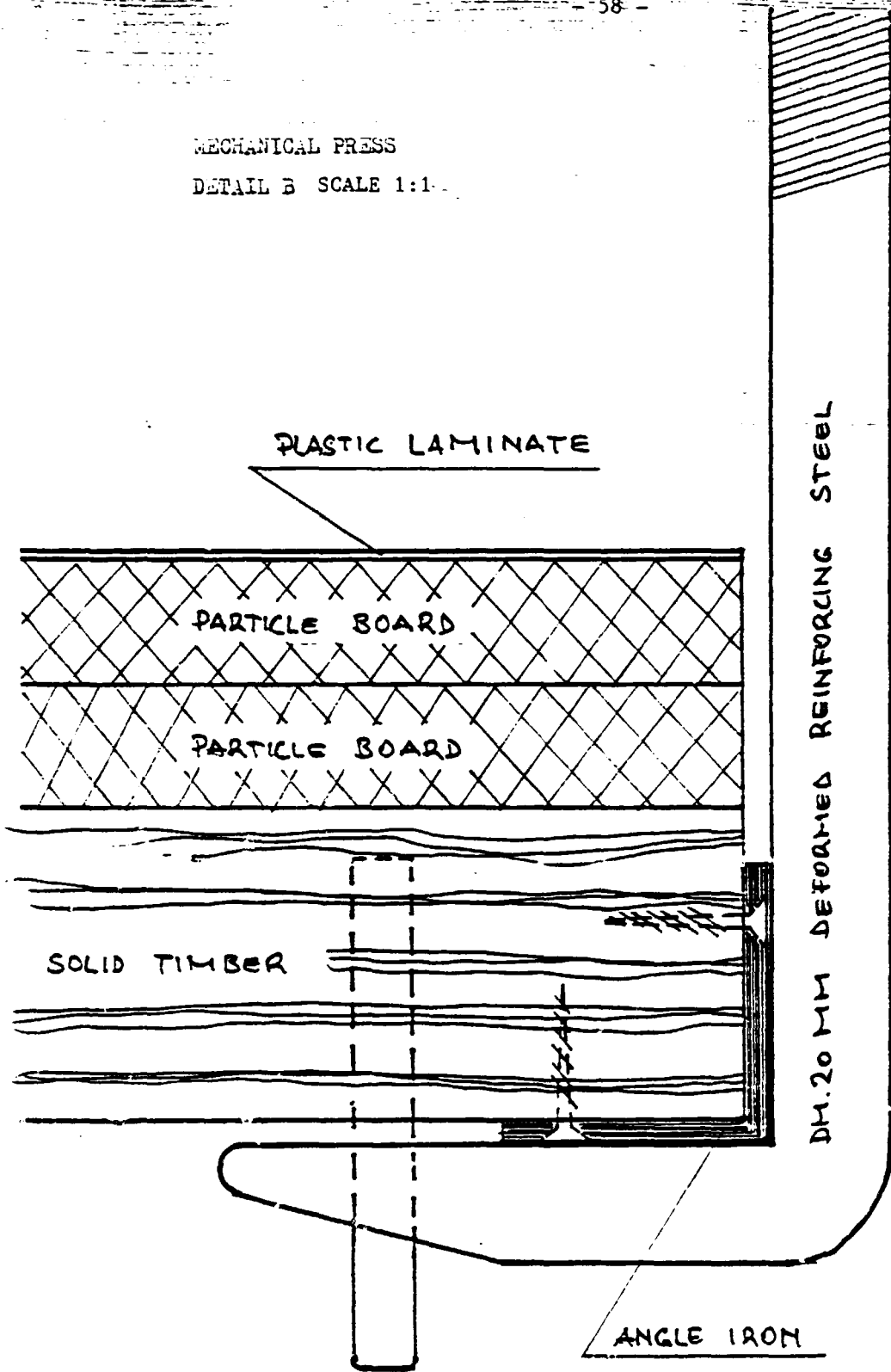


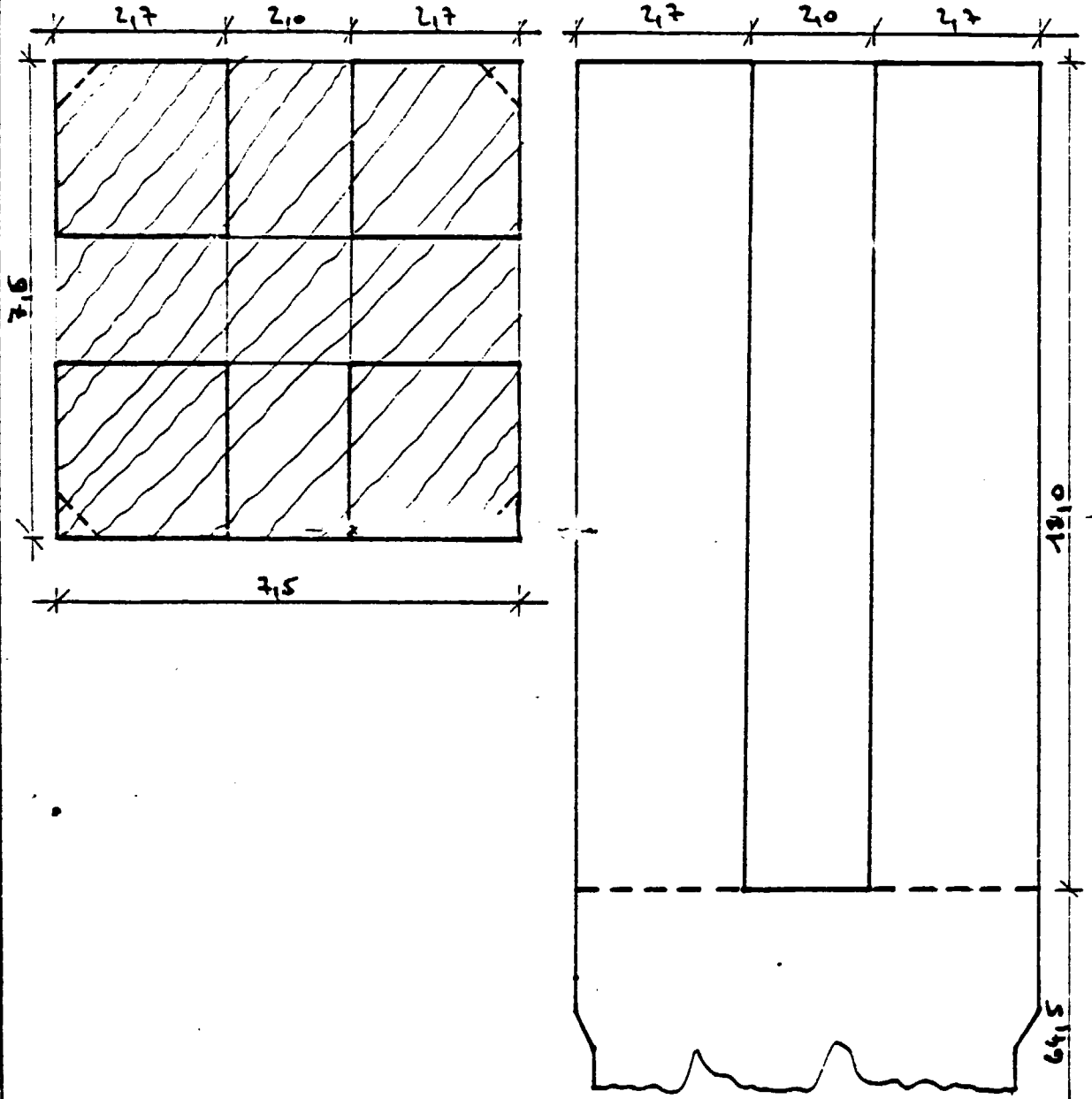
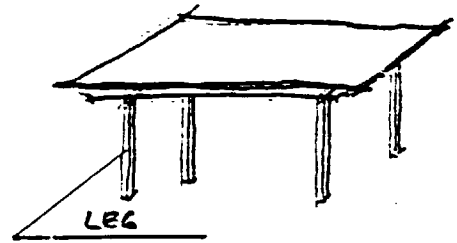
WASHER

MECHANICAL PRESS
DETAIL A SCALE 3:1

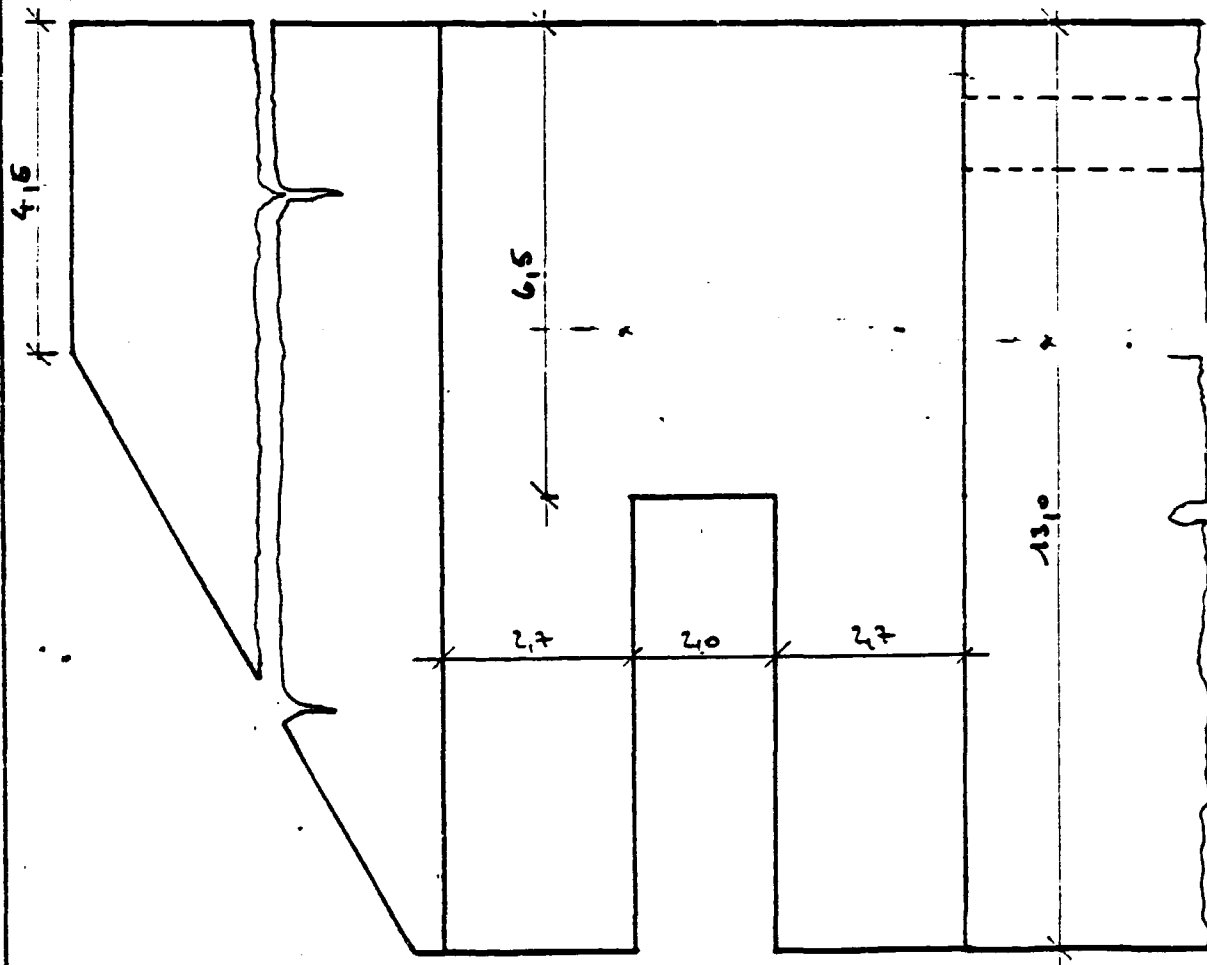
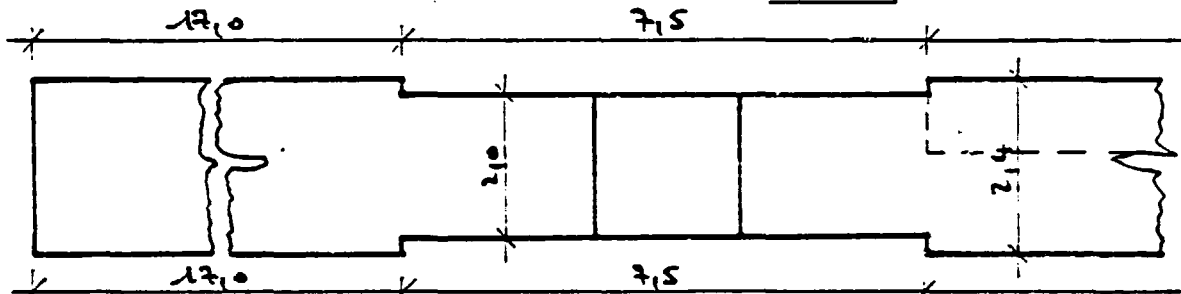
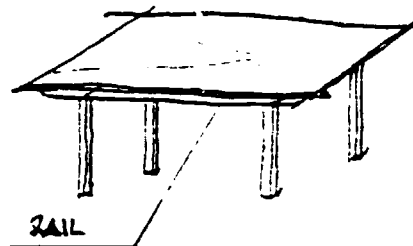
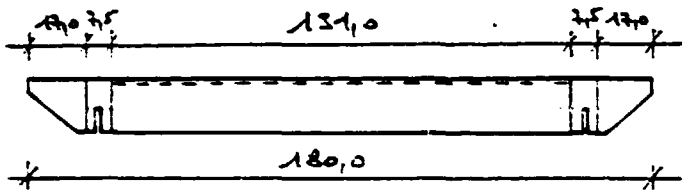
WASHER

MECHANICAL PRESS
DETAIL B SCALE 1:1

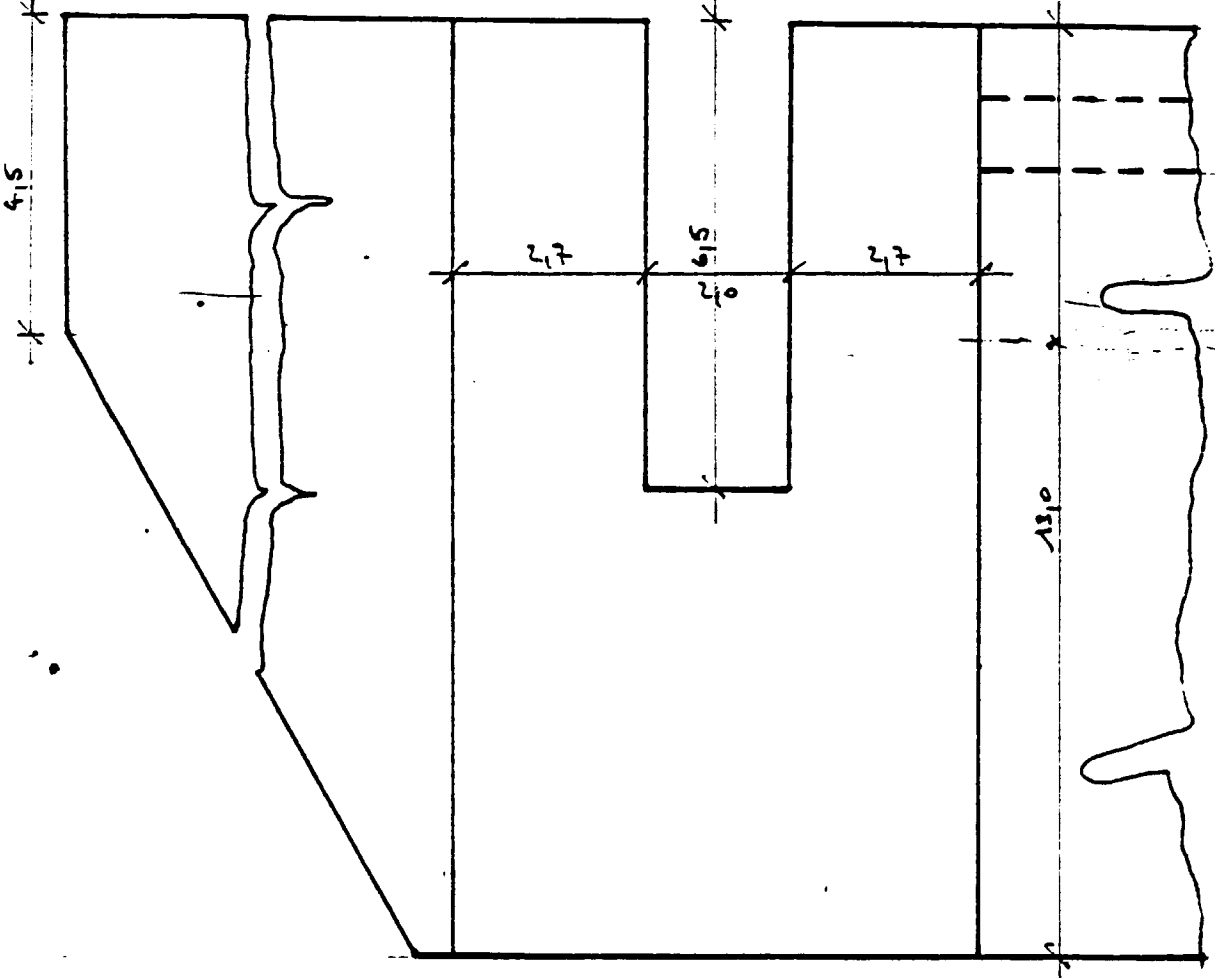
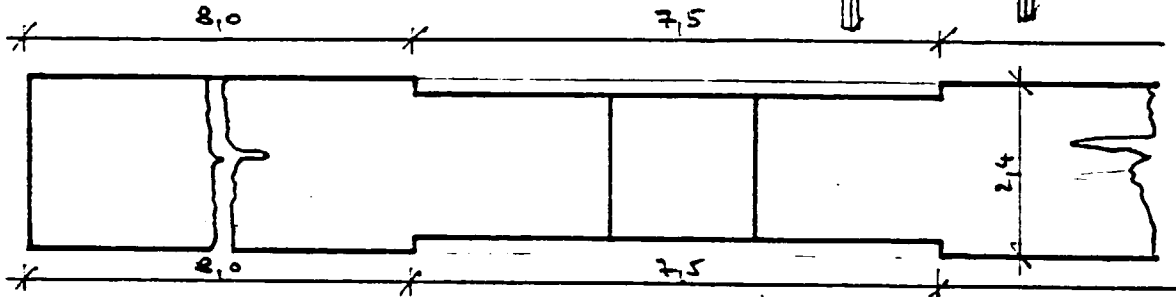
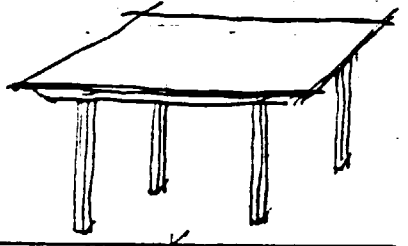
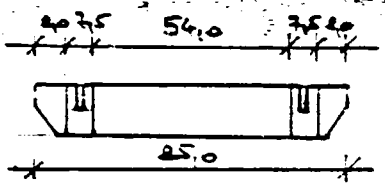




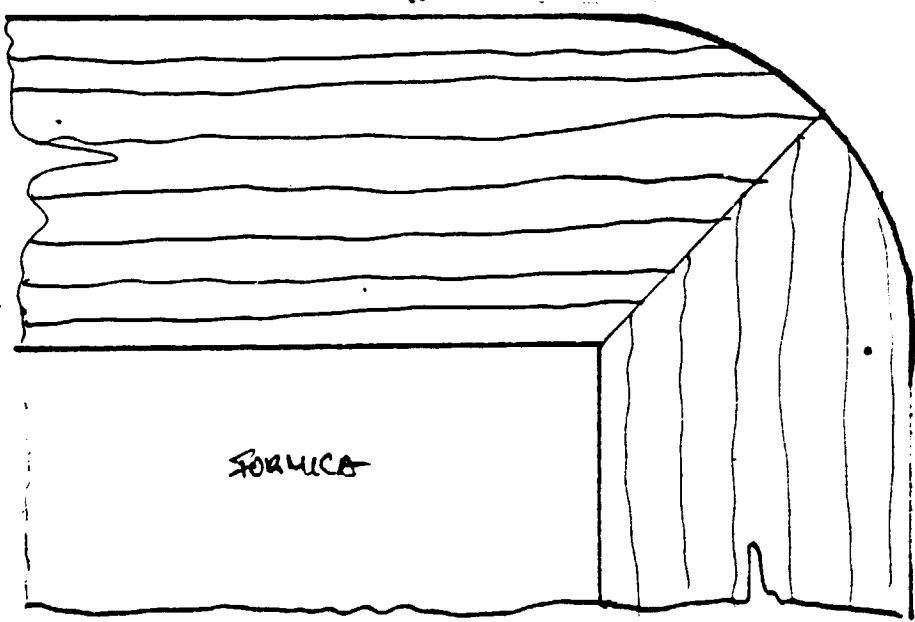
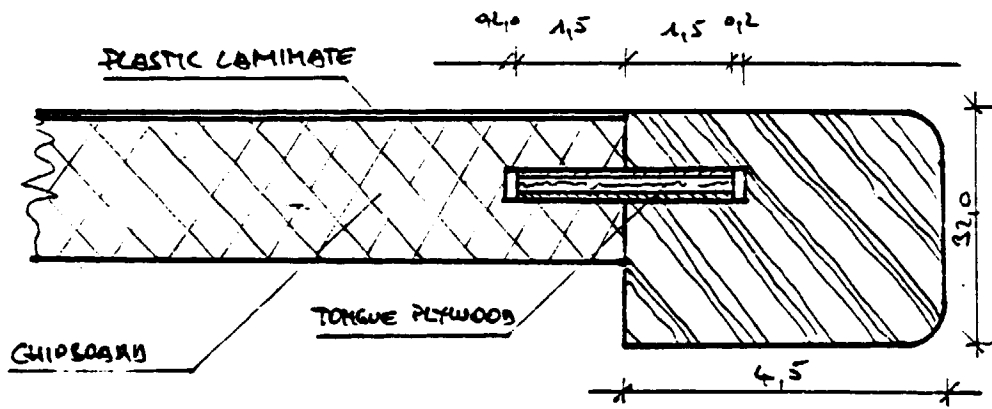
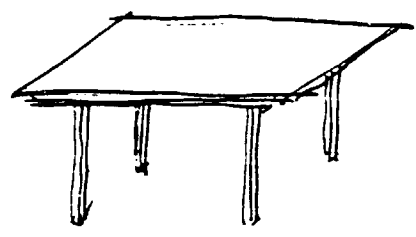
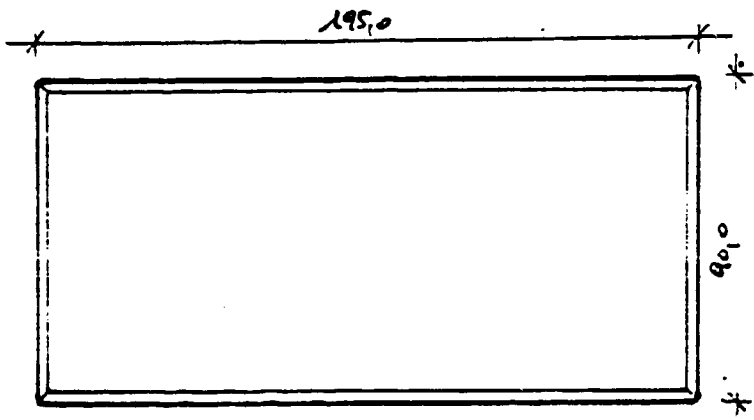
PRODUCT - DINING TABLE I		PART - LEG - LEFT / RIGHT	SCALE. 1:1
DESCRIPTION -	LEG CAN BE USED FOR LEFT AND RIGHT SIDE		DRAWING NO. 1
			DRAWN.
			CHECK.



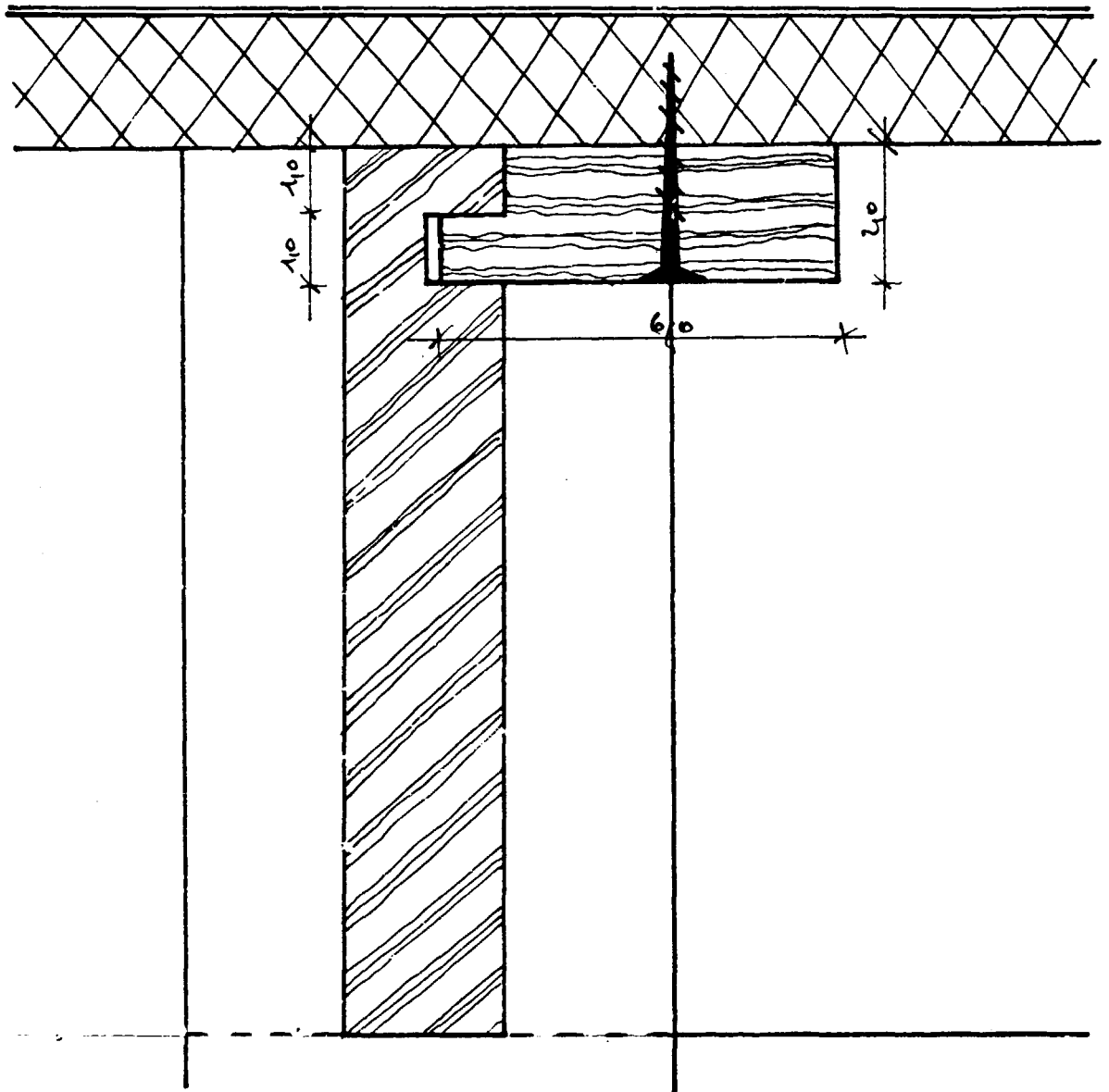
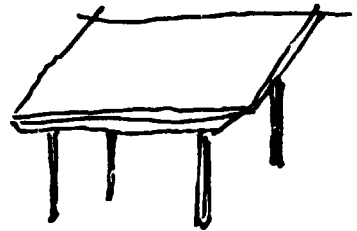
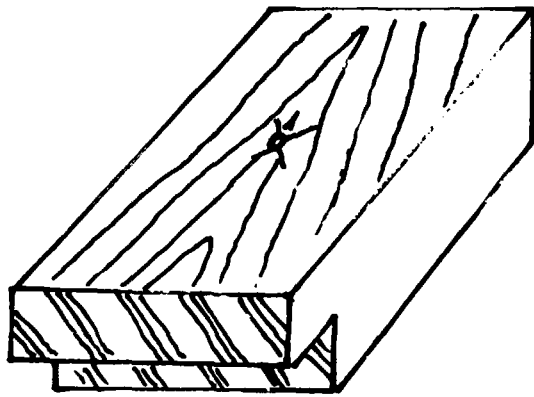
PRODUCT - DINING TABLE I	PART - RAIL - FRONT/BACK	SCALE. 1:1
DESCRIPTION -		DRAWING NO. 2
		DRAWN.
		CHEC.



PRODUCT — DINING TABLE I		PART — SIDE RAIL	SCALE. 1/11/1:20
DESCRIPTION —			DRAWING NO. 3
			DRAWN.
			CHECK.
			CHANGE.



PRODUCT — DINING TABLE I	PART — TABLE TOP	SCALE. 1:1 1:6
DESCRIPTION —		DRAWING NO. 4
		DRAWN.
		CHECK.
		CHANGE.

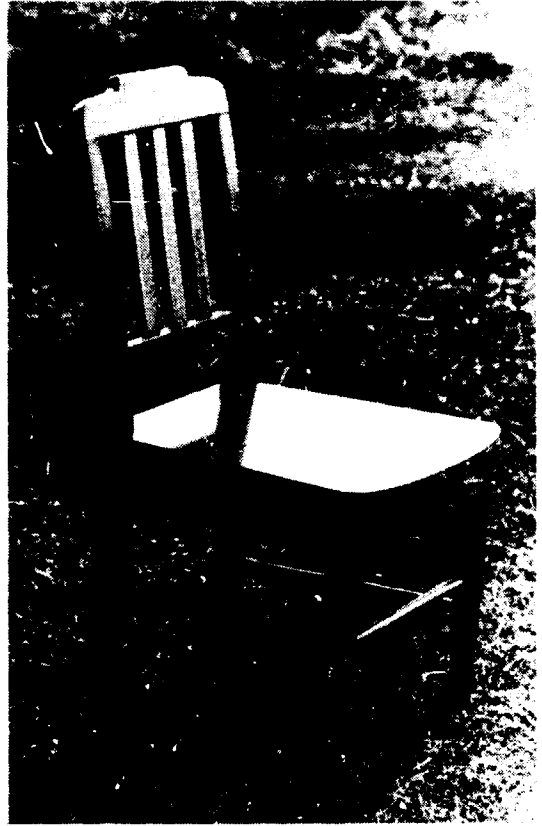


PRODUCT — DINING TABLE I	PART — ASSEMBLY BLOCK	SCALE. 1:1
DESCRIPTION —		DRAWING NO. 5
		DRAWN.
		CHECK.
		CHANGE.



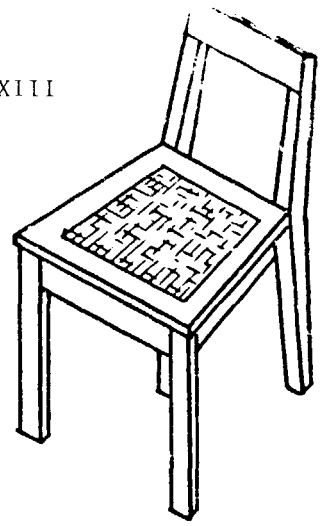
PHOTOGRAPHS OF PRODUCED PROTOTYPES





PHOTOGRAPHS OF PRODUCED PROTOTYPES





PRODUCT ▷ chair a1 teak	PART ▷	SCALE ▷
DESCRIPTION ▷		DRAWING NO,
		DRAWN ▷
		CHECK ▷
		CHANGE ▷
SI/TOM/86/873 UNIDO 87 K, FUCHS		

production end date:			break down: - 67 -			production start:				
production order no:			issued by:		batch no:	part family:				
no.off.	part no.	finished size			part good	part waste		rough size		jig
		long	wide	thickn.			long	wide	thickn.	no. [long

mach. no.	material:									time used
	operation and instruction									

FOR SERIAL PRODUCTION ONLY

PRODUCTION COSTS CALCULATION

POS	OPERATION	MATERIAL	ROUGH SIZE			FINISHED SIZE			PIECE r m m 2 m 3 m 4	QTY	TE	TR	T	N#	TOTAL	RATE	RATE	COSTS
			L	W	TH	L	W	TH			TIME	SETTING	MINUTES	OF	TIME	PER	PER	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
LEGENDE : 11 X 12 + 13 X 15 X 18 ⇒ COSTS																CARRYOVER		
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		
21																		

FOR SERIAL PRODUCTION ONLY

issued by _____ date _____ Modification N° _____

issued by _____ date _____

CARRYOVER OR TOTAL COSTS _____