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DEVELOPMENT OF THE SECONDARY WOOD
PROCESSING INDUSTRIES *

BELIZE

Mission Report

by

Antoine V. Bassili
UNIDO Official

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Introduction

The author, Antoine V. Bassili, Industrial Development Officer of the Agro-Industries Section (Industrial Operations Division) of UNIDO, undertook a five day mission (from 12 to 17 April 1976) to Belize at the request of the Financial Development Corporation. His terms of reference were to:

- (a) assess the present situation of the secondary wood processing industries in Belize;
- (b) identify possible new industries that could be created;
- (c) recommend the measures to be taken by the industry and the Belizean authorities to assure this development.

Present Situation

Belize's economy was founded on its forest resources. The first settlers extracted logwood for use as a dye for textiles. At a later stage, when demand for this product decreased, exports of Honduran Mahogany (Swietenia Macrophylla) and Cedar (Cedrela spp.) took over and represented the settlement's major earner of foreign currency.

It is only in recent years that the importance of forest products has decreased and that agriculture (and agro-based industries) are being encouraged.

The first export oriented sawmill was established some 40 years ago and since then exports of logs have diminished being completely banned a few years ago.

There exist in the country at the present moment several sawmills, some of which are export oriented and produce to all intents and purposes only Swietenia Macrophylla and Cedar (with some occasional lots of Santa Maria) while others, using more rudimentary equipment, fell, saw and market secondary species. The export oriented mill of the Belize Estate and Produce Co.Ltd. uses steam driven bandsaws, while the smaller mills have diesel driven circular saws. Some of the mills also have diesel driven planers.

The country's secondary wood processing industry is still at a "mechanized craftsmen" level. There are several carpenters, joiners and cabinet makers, each employing a few workers and having some basic machines, but these, even by a stretch of the imagination, cannot be called industries.

The Forestry Department has a small workshop in Belmopan employing 17 persons and producing various manufactured wood products (such as solid wood doors, crates for oranges and soft drinks, furniture, bee hives, etc.). It is equipped with four disparate industrial woodworking machines (a 4 sided planer - diesel driven, a dowel producing machine, a rip saw and a copying lathe - electrically driven). It also has other complementary woodworking machines (small 1" band, resaw, small thicknesser, small jointer, small table circular saw, etc.) These are all primarily manufactured for the "do-it-yourself" enthusiast and are under-powered and of too small a capacity for industrial production.

Kiln drying of wood is not existent at the present moment but UNDP/UNIDO are to supply a small kiln to the Forestry Department's workshop for its own use and to produce kiln dried lumber to the local craftsmen in Belize City.

At least two wood preservation cylinders exist in the country. One belongs to the Forestry Department and is located in their workshop in Belmopan, while the other belongs to the Belize Estate and Produce Co. Ltd. and is located in the Stan Creek district. None were operational at the time of the visit.

Belize possesses wood of excellent species. Honduran Mahogany and Cedar, as well as the Pines that grow mainly in the Maya Mountains are world known prime species. Some of the "secondary" species (or to put it more correctly "commercially less desirable species") would have been classified prime species of their own right had there not been available large quantities of the above mentioned three species.

Wood is the traditional building material for housing. None of the wood based panels are commonly used at present anywhere near to the extent that is common elsewhere. (This is partly due to the availability on the local market of good sawwood - not kiln dried - at "controlled" prices).

One carpenter visited was using carbide tipped tools, but he seems to be the exception rather than the rule. He was sending his tools for grinding to Miami and in spite of the trouble involved he thought this worth while because of the better quality products obtained and the longer tool life. The author shares this opinion. Had other carpenters been of the same opinion a carbide tipped tool maintenance service centre could have been established locally to cater for all of them.

Solid wood doors and furniture are normally clear varnished (using spray guns), some panel furniture is coated with melamine impregnated foils of the "Formica" type.

Possibilities for development.

As stated previously all Belize's exports of forest products at present are sawn lumber. This is graded to the US National Hardwood Lumber Association's rules and exported in two categories: normal length planks 8 feet and up and shorts. The latter, which normally should represent between 5 and 10 per cent of the output of a well run sawmill, is sold on the export market at around 50 per cent of the price of the longer planks. These shorts range from 2' to 5'6".

Two important factors help Belize in the development of its secondary woodworking industries:

- (a) The availability of high quality sawwood, of highly desired species.
- (b) Its membership of the Caribbean Common Market, since it benefits not only from duty free access to that market but also, as a lesser developed member, of some protection. Furthermore it must be realised

that among the members only Belize and Guyana are endowed with rich forest resources, all the other (island) member states being importers of primary wood products and net importers of all forest products - both semi manufactured and manufactured. On the other hand the negative factors which might impede this development to some extent are:

(i) The smallness of the local market. (The population of Belize is only 123,300 and the per capita GNP is estimated to be US\$ 600 as per 1974 figures). Industrial production should therefore be oriented for export.

(ii) The lack of adequate port facilities and frequent and regular shipping services to the Carribean and the lack of a container service to these ports.

Potential Markets.

The author feels that since there are at the present moment no secondary wood processing industries in Belize, and since industrial production and all the tasks related to it such as product development, production planning, process and quality control, tool and machine maintenance, industrial costing etc is not practised in Belize at the moment it would be preferable to attempt initially to export to the Carribean countries and not to the United States because they accept lower quality products and smaller series.

Another point which further makes this suggestion necessary is that kiln drying is at present not practised anywhere in Belize. Manufactured wooden products sold in the Carribean would be used in climates similar to those prevailing in Belize. Sawwood that has not been sufficiently dried to suit the equilibrium moisture content of the wood for use in continental United States might still be suitable for use in the Carribean.

Once the know how for mass production has been acquired the local producers will be able to enter the United States market with greater confidence of success.

The above suggestions are made for industries which will be established and operated by citizens of Belize or of other Caribbean countries. It goes without saying that in the case of export oriented joint ventures where the foreign partner brings both the know how and the market, the above does not apply.

Possible Industries which could be established

Secondary wood processing industries could be classified in the following ascending order of sophistication:

- wooden crates and pallets for packaging and/or agricultural purposes (and their elements);
- mouldings and parquet flooring;
- prefabricated wooden housing elements, precut elements and timber trusses. (This presupposes the obtaining of sound designs which not only take into account local building codes and living habits but also that the designs are done by specialized timber engineers, for "under-designed" elements will fail, leading to consumer resistance, while "over-designed" elements price themselves out of the market since they contain too much raw material. In fact, not only are they costly, but they are also wasteful).
- crates for soft drinks and beer;
- school furniture;
- solid wood and louvered doors and windows;
- office and kitchen furniture;
- miscellaneous wooden products: bowls, toys, etc;
- hotel and contract furniture;
- residential furniture;
- glued laminated timber beams (this product needs precise drying, serious quality control and knowledge of glue technology).

The pros and cons of each product are briefly discussed hereunder. (This is but an identification of possibilities and complete marketing studies and techno-economic feasibility studies should be prepared for

each potential product before an investment decision is made.)

Wooden crates and pallets

(For types, production methods and economies of scale see UNIDO publication "Wood as a packaging material for developing countries" (1).

Pros:

- Very low investment, low level of technology, highly labour intensive, quality and dimensional precisions not very important.

Cons:

- Market in Belize limited because of small agricultural sector needing crates. No market for pallets. Bulky and of low value, consequently do not stand high freight charges.

Mouldings and Parquet Flooring

Mouldings are presently being manufactured by at least one entrepreneur using air dried Mahogany and Cedar. There is no local manufacture of parquet flooring.

Pros:

- Relatively low investment, low level of technology, potential export market for mouldings if quantities produced are big enough. The market for parquet has to be determined (through a market survey).

Cons:

- Requires well maintained machines and good tool maintenance.

Prefabricated Wooden Houses and Wooden Housing Elements, including Roof Trusses.

Wood is the building material used for dwellings (both rural and urban). Wooden houses are now built "on site" by the skilled craftsmen. Although labour costs are low, factory production of elements for these

houses would assure standard (and probably higher) quality, lower costs (since through knowledge of wood technology and timber engineering less timber would be used and some of the commercially less desired species could also be used). It is imperative before such a plant starts production that the designs be obtained from a qualified timber engineer and that design and erection manuals be prepared. A sample of such instructions for high cost housing is given in the UNIDO publication "Prefabricated Wooden Houses" (2). The report of a UNIDO meeting 1969 (3) is also relevant.

Pros:

- Good local market. Possibilities for utilization of less desired species and short lengths (which are exported at a far lower price). Very low capital investment needed. Labour intensive, yet trained labour available locally. Eventual possibility of export of certain components. Local marketing channels already exist (contractors in each major town). A wide range of designs can be obtained with modular elements.

Cons:

- Need to obtain designs prepared by a competent timber engineer if full use of lesser desired species and/or short lengths is to be made. Transport and erection arrangements have to be made and adhered to. Promotion campaign needed to launch the product. Shipping might be a problem for export.

Crates for soft drinks and beer.

For description of production method, economies of scales, etc. see UNIDO publication "Wood as a packaging material for developing countries" (1).

Pros:

- A relatively large and secure local market exists. Full use can be made of very short pieces. Labour intensive methods can be used for assembly. Possibility of exporting elements (and even nailed crates) might exist for the Caribbean area.

Cons:

- Precision of components has to be high. A reasonable amount of machining is needed, but this can be done on simple machines. Market might collapse if it becomes large enough to justify the production of plastic crates.

School Furniture

This is the most common stepping stone from craft to industrial production in developing countries because the quality of the product need not be high, the local market is captive, its size can be planned (from budget figures) and in many developing countries it is the only type of furniture needed that calls for large enough series to warrant industrial production.

Pros:

- Steady captive market. Short length timber can be used. Low level of technology. Relatively labour intensive methods can be used (specially for assembling). Possibility of export to other Carribean countries. Relatively high value added.

Cons:

- Need for production planning, process and quality control to assure interchangeable parts and large serial production. Mechanization of machining necessary. Designs have to be developed for shipping in "knocked down" state if exports are to be envisaged. Wood must be perfectly air dry (preferably kiln dried). Industrial costing must be used because of large serial production.

Solid wood and louvered doors and windows

Markets for these products exist in all developing countries. Belize has the added advantage that it has excellent species for these products (Mahogany and Cedar). Exports must be envisaged. The local market is too small for industrial production.

Pros:

- Excellent species available. Full use can be made of short lengths. Investment in equipment need not be large. Considerable value added. Export markets exist in the Caribbean (and, at a later stage when series can be enlarged, quality and productivity improved, to the United States).

Cons:

- Serious quality control is necessary. Problems of shipping to overseas markets have to be solved. Wood must at least be perfectly air dry (preferably kiln dried). Tool and machine maintenance important for industrial production. Need to introduce market research, product development, new designs, production planning, process and quality control and industrial costing. Need to create new marketing channels (since importers of lumber from Belize in the Caribbean are in fact selling to similar producers in their own country and are not qualified to sell to end users and contractors).

Miscellaneous wooden products: bowls, toys, etc.

(Carvings are not included since these are normally produced only by craftsmen).

Pros:

- Utilization of very short pieces (can even be considered as utilisation of residues) with a corresponding high value added. Small capacity and small sized machines can be used. Relatively labour intensive. Suitable products for sale to local tourists and overseas (if quality is high). Appropriate hardwood species available.

Cons:

- High quality needed for export market. Relatively low value of output. Problem of packaging for export has to be studied. Tool and machine maintenance important. Important to use perfectly dry wood (preferably kiln dried).

Office and kitchen furniture.

This is already a more sophisticated product than school furniture. In spite of the availability of excellent woods, the local market is too small for industrial production and export, even to the Carribean, and calls for in-depth market surveys. Dimensional accuracy is important for interchangeable parts needed for knocked down shipment. This calls for higher investment costs in machines and relatively capital intensive production methods as well as high skills in machine setting and tool maintenance. Many inputs other than the locally available wood (e.g. melamine impregnated "Formica" sheets, hardware, fittings, surface finishing material, etc.) have to be imported. Designs for the whole range of products have to be purchased from well known designers. Marketing channels have to be developed. Not recommended for Belize at this stage of its industrial development.

Hotel and contract furniture

This product is of an even higher degree of sophistication than the office and kitchen furniture.

Not recommended for Belize for its immediate plans for the development of its secondary wood processing industries.

It should nevertheless be seriously considered at a later stage because of the large existing market in the Carribean (the local market is too small and is likely to remain so).

Residential Furniture

Industrial production of this type of product should not be envisaged at this stage of Belize's development. Nevertheless high quality furniture could (and should) be produced both for the small local market as well as for exports using the traditional craft methods used until now. Although the demand may be developed, series are likely to remain small and industrial production of high quality furniture calls for considerable investments.

Glued laminated timber constructions

The problems of design and quality control preclude the introduction of this industry in Belize for the near future. Furthermore, this product is normally manufactured from pines or other conifers. Belize's primary wood processing industry does not yet produce large volumes of coniferous woods to justify the establishment of this industry.

This product should not be envisaged at this stage.

Problems that have to be solved to assure a speedy and sound development of the secondary wood processing industry

1. Availability of wood

As is commonly the case in wood exporting countries, the local market plays second fiddle to the export market. In the case of Belize this is aggravated by the fact that when sawmillers sell their product on the local market they have to sell at Government controlled prices which are well below what they can obtain on the world market. (Some sawmillers claim that these imposed prices are below their production costs). Consequently, all are reluctant to sell on the local market, resulting in starving the existing carpenters and joiners of their raw material needs.

Unless this is remedied and sawn wood of the required species, grade and specification is made available at short notice and in the required quantities (even at prices well above the present control price, yet somewhat lower than the export price) it can be stated that the secondary wood processing industries will not develop in Belize as fast as they could and should. Assurances have to be given by the authorities that all the wood raw material needed by the new industry will be made available by local sawmillers (even at prices higher than the present control figures) before potential entrepreneurs will invest in equipment. This is a sine qua non condition.

2. Shipping problems

Export oriented industries have to be assured that regular (even frequent) low cost shipping is available to lift their products. Manufactured wood products are bulky, yet unless properly packaged and handled they tend to be damaged and broken during handling and transport. Shipments of components (for box shooks and furniture for example) are also liable to pilfrage.

Belize City does not yet have a wharf from where ocean going ships can load. This increases handling costs and the risk of damage, breakage and pilfrage.

The secondary wood processing industry - specially the furniture and furniture component industries - of many developing countries has benefitted from the introduction of regular container services to their ports for it has allowed for a reduction of cost of crating and packing the products and reduced pilfrage and breakage. The same applies to Belize, and it is to be hoped that, together with the improvement of port facilities, consideration will be given to the introduction of a container service to the Carribbean ports. (During his four day stay in the country, the author did not have the time to go into this matter more deeply).

3. Export tax on all wood products

The author was informed that there exists a five per cent ad valorem export tax levied on the export of all wooden products. He feels that this tax might impede the development of secondary wood processing industries since, while it provides equal treatment of producers in the region with respect to cost of wood raw materials, labour and all other inputs have to be 5 per cent lower since the tax is levied on the FOB value of the goods exported not on the cost of the wood raw material only. He suggests that, in the initial stages at least, this tax be abolished to promote exports of manufactured wooden products.

4. Availability of kiln dried timber

No kilns are at present in operation in Belize. UNDP/UNIDO is to provide the Woodworking Shop of the Forestry Department (located in Belmopan) with a small kiln to be used for pilot and demonstration purposes. Its excess capacity (over and above the Workshop's needs) will not be sufficient for any industrial production on a sustained scale, and it is recommended that all export oriented secondary wood processing industries that will be established be provided with their own kilns.

Basic information on types of kilns and criteria for their selection are given in Appendix 1.

5. Availability of qualified labour

The introduction of industrial production of manufactured wooden products calls for the introduction of new skills in fields such as: machine and tool maintenance, kiln operation, production planning, quality control (over and above the basic existing skills of carpenter, joiner, upholsterer, painter, etc. that already exist). Consideration should be given in studying each new project that the key personnel be trained in these fields before the plant produces for export.

6. Selection of appropriate woodworking equipment and machines

The author has seen in developing countries in too many cases of use of totally inadequate machines not to feel that he has to stress this point in his report. Two extremes occur: (a) where the decision of selection has been left to the equipment supplier who has sold machines that are too sophisticated for the country's state of development and needs and could have been replaced by more labour intensive methods at lower investment and production costs; and (b) where the decision was taken locally with insufficient knowledge of this highly technical subject, and it was aimed at obtaining as large a range of machines as possible within the limited funds available. In that case the machines purchased tend to be underpowered, too small and generally speaking not suited for industrial (as compared to craft) production. A good example of this case is the workshop of the forestry department in Belmopan where only 4 machines are suitable for industrial production.

The author strongly recommends that impartial expert advice be sought before investing in woodworking machines. For major investments this could be obtained as a short-term UNDP financed project to be executed by UNIDO (even through seconding a specialist from its staff). For small investments (of individual machines), advice can be obtained from UNIDO by correspondence with the author (UNIDO has acquired experience in this field having convened in 1973 a technical meeting on this very subject for which over 30 studies were prepared on specific types of equipment - list of documents in the report of this meeting (4) and of the workshop UNIDO convened in 1975 (5).

7. Availability of the normal industrial infrastructure

It is assumed that when the industrial park in Ladyville would have been completed these (water, power, roads, buildings, etc.) would be readily available to any new industrial undertaking.

Suggested secondary wood processing industries to be established in Belize

Taking into account the above considerations, the author recommends to the Development Finance Corporation that serious consideration be given to establish the following three secondary wood processing industries in Belize:

- a plant to produce solid wooden doors and louvered doors and windows;
- a plant to produce school furniture and crates for soft drinks and beer;
- a plant to produce prefabricated modular wooden housing elements.

The following is a synopsis of the available basic information and identifies the measures that will have to be taken before implementing each project:

Production of solid wooden doors and louvered doors and windows

Market: Initially the Carribean, eventually also export to the USA.

Wood Species: Mahogany and Cedar

Capacity: Would have to be determined in the light of a market survey of the region but should be large enough to fully utilize the short length lumber now being exported.

Recommended technology: As labour intensive as possible but components must be machine finished to assure interchangeable parts. Some basic information is to be found in reference Nos. 6 to 12.

Designs: The market survey should identify the designs marketable in the area.

Shipping methods: Strapped on light, non returnable pallets with protection between doors to prevent chafing. Special care must be taken to protect corners.

Preliminary studies: If a large export oriented industry is to be established a complete techno-economic feasibility study must be carried out by a specialized firm of consulting engineers. Draft terms of reference for such a study are given in Appendix 2. (It could be carried out by UNDP/UNIDO if the necessary funds - about US\$50,000 - can be secured.)

Production of (A) school furniture and (B) crates for drinks and beer

Market: Carribean - including local market

Wood species: (A) Local softwoods and hardwoods

(B) Pine outside, secondary hardwoods for inner grid.

Capacity: Would have to be determined by interviewing (A) education authorities in the various countries and (B) leading bottlers in the area to be covered.

Recommended technology: As labour intensive as possible but components have to be machine finished to assure their interchangeability.

Basic information on these products can be found in reference nos. 1, 4, 5, 6, 7, 11, 12, 13.

Designs: Standard designs supplied by (A) the education authorities, and (B) the bottlers.

Shipping methods: (A) Shipped knocked down for local assembly; (B) either completely nailed or sold in sets of shooks for nailing at destination. In that case they have to be strongly bound by metal bands to prevent pilferage.

Equipment needed: For (B) Circular saw(s), radial cut-off saw(s), spindle moulder(s), multiple blade table saw, horizontal boring machine, spraying guns, silk screen for embossing of publicity and trade marks, tool room equipment to maintain these tools. Kiln drying not imperative but wood must be well air dried. For (A) the following extra equipment may be needed: router(s), dove-tailing machine, horizontal belt sander, bandsaw(s), kiln.

Preliminary studies: These could be carried out by the woodworking expert to be provided by UNIDO to the Woodworking Shop of the Forestry Department in Belmopan.

Production of prefabricated modular housing elements (and trusses)

Market: Initially local, but exports to the Caribbean countries should be envisaged at an early stage.

Wood species: Pine and/or commercially lesser desirable hardwoods.

Capacity: Initially it would be small - even very small - and would grow depending on market absorption capacity.

Recommended technology: As labour intensive as possible, using machines to saw and plane the lumber. Nailing by hand.

Some basic information can be found in reference Nos: 2, 3, 5, 6, 7, 12, 14, 15.

Designs: In order to enter the market sound designs, based on types of dwellings common to the Caribbean yet designed on sound timber engineering practices would have to be obtained. An erection manual should also be supplied. Such designs should cover the whole know-how of production: the grouping of mixed species, correct design detailing, correct erection procedures, etc. Such work should not be carried out by any civil engineer or architect but by a professionally trained timber engineer.

Equipment needed: A list of equipment needed and a proposed plant layout for such a plant is given in Appendix 3. It is taken from a report prepared by TRADA (The Timber Research and Development Association in the United Kingdom) for UNIDO, as part of UNDP financed technical assistance to Laos.

Whereas no technical assistance is likely to be needed for the start up of production and erection, the author wishes to stress once again the need to obtain sound designs if this product is to be accepted on the region's market.

Over and above the recommendations made above under the various headings of this report, the author wishes to make the following general recommendations which he feels would assist the development of this whole sector of Belize's economy.

A. Addressed to the Forestry Department (and to the Government in general):

1. A serious effort should be made to promote the country's commercially less desirable species through (a) reduction of stumpage fees on them and (b) their inclusion as desired species in all government tenders. These measures will encourage demand and oblige sawmillers to keep them on stock, thus facilitating their eventual use by other potential end users. (At present, even if they want to use these species, they cannot do so because they are not being felled - for lack of demand - leading to a vicious circle).
2. A ban on exports of logs is enforced. This is a sound measure to insure local processing, but it must be realized that a small proportion of peeler quality logs (of a far higher quality than saw logs) is being wasted by converting them to lumber. The author guesses that such logs, unprocessed, would fetch more on the export market than if the lumber obtained from them were to be exported. Consequently, he recommends that consideration be given to allowing exports of logs provided that they fetch a price to be determined (which should be indexed to the price of select

grade lumber and that they pay an export fee large enough to discourage the export of all but the highest quality logs unprocessed. (The calculation of this fee will have to be based on local sawing costs, export prices, and cost of logs ex-sawmill.)

B. Addressed to the Finance Development Corporation

1. Pre-feasibility studies should be prepared by the Investment Promotion Unit to have these available for use in discussions with potential investors. The author is of the opinion that the soundest industries could be established if they were to be integrated into existing sawmill operations since raw materials will be assured and overhead costs reduced to a minimum. Failing that, he feels that the existing small carpenters and joiners would not have the entrepreneurial spirit to enter into these export oriented ventures successfully; and it is up to the FDC to interest other entrepreneurs, local or foreign.
2. Statistical and marketing information on the construction of residential dwellings in the Caribbean (floor area, costs, location, etc.) should be compiled both for the possible production of solid wood doors and of prefabricated housing components.
3. Information on the yearly value of school furniture purchased by the education authorities in the Caribbean countries should be compiled as well as - if possible - the designs of such furniture, the size of series and the cost of the various items.

Other Business

During his visit to the Forestry Department in Belmopan, the author was able to discuss with Mr. S. Flowers, Conservator of Forests, and Mr. E.D. Bradley, Principal Forestry Officer, Forestry Department, the Department's priorities and objectives for the SIS project "Forest Industry Development" (IS/BZE/75/007) which UNDP recently approved, and clarified matters relating to the purchase of equipment. It was agreed that UNIDO should purchase a small semi-automatic kiln with metal construction.

The points discussed were then communicated to Mr. Graham, Chief Planning Officer, and Mrs. Y.S. Hyde of the same Department, to keep them informed.

Criteria for the selection of kilns are given in Appendix 1.

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B I B L I O G R A P H Y

- (1) UNIDO Wood as a Packaging Material in the Developing Countries
(UNIDO Document No. ID 72)
- (2) UNIDO - Production of Prefabricated Wooden Houses
(UNIDO Document No. ID/61)
- (3) UNIDO - Production Techniques for the Use of Wood in Housing -
Report of Study Group, Vienna, 17 - 21 November 1969
(UNIDO Document ID/10 - This Document contains a list of all the
papers prepared for this meeting)
- (4) UNIDO - Selection of Woodworking Machines. Report of a technical
Meeting, Vienna (UNIDO Document No. ID/133 lists 37 other documents
prepared for this meeting)
- (5) UNIDO - Wood Processing for Developing Countries - Report of a
Workshop (UNIDO Document ID/WG.200/14. This document contains a list
of all the studies prepared for this Workshop)
- (6) UNIDO - Furniture and Joinery Industries for Developing Countries
(UNIDO Document No. ID/108 - in three parts. Part II dealing with
production technology specially relevant)
- (7) UNIDO - Guides to Sources of Information No.4: Sources of Information
for the Furniture and Joinery Industries
(UNIDO Document UNIDO/LIB/SER.D/4)
- (8) United Nations - The Prefabrication of Wooden Doors and Windows
(UN Document ST/SOA/117)
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of Alternatives
(UNIDO Document ID/WG.200/6)
- (10) TACK, C.M.: Joinery Handbook for Specifiers: London, HMSO, 1971
- (11) Building Research Establishment - Timber Drying Manual. HMSO London
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A P P E N D I X 1
BASIC INFORMATION ON CRITERIA
FOR THE SELECTION
OF
TIMBER DRYING KILNS

Introduction

There is no point to stress here the importance of Kiln drying timber before its manufacture into secondary wood products.

Timber is a naturally occurring material which absorbs moisture in its cells up to the point where a level of moisture is attained and maintained in equilibrium with the ambient atmosphere moisture content. This is called the "Equilibrium Moisture Content" (EMC). Sawwood can be dried to the EMC of ambient air in the open (air-drying). This takes time, but can be achieved with no de-grade if care is taken in stacking, etc. Airdrying cannot be used if the wood is to be dried to a moisture content lower than the EMC (as for example drying wood for use in temperate climates and/or in centrally heated or air conditioned premises). In that case artificial (Kiln) drying has to be used.

Types of Kilns available

Several types of Kilns are available. These are described hereunder, and the pros and cons of each type are indicated (as they relate to conditions in Belize).

Pre-dryers:

These consist of ventilators blowing air through the stack. The rate of drying is faster than air-drying but wood can only dry to the EMC corresponding to the ambient air. Because of this and the high cost of power in Belize they are not suitable for Belize.

"Dutch" Hot Air Chambers:

These are well insulated rooms with a good sealing against air leaks at all openings. The air inside is heated by hot water. The heating elements being at the bottom of the Kiln. Air circulation is by natural convection. Drying rate is slower than in the conventional (forced ventilation) Kilns. It is claimed that mixed species and/or mixed thicknesses can be dried concurrently. Although they are becoming increasingly popular in Europe, not enough experience on their use in developing countries exists to enable the author to recommend their use in Belize.

Conventional hot air Kilns:

These consist of a chamber in which the wood pile is placed and hot air (at pre-determined and controlled relative humidity and temperature) is circulated. The parameters of the air is changed as drying proceeds. The following points should be considered:

Construction of the chamber: This is either masonry or pre-fabricated, insulated metal elements. In the case of Belize the possibility of building masonry chambers was to be preferred (because not only of comparative costs but also because of the increased cost in foreign exchange of the prefabricated Kilns). In no case should the chambers be built to the designs that have not been obtained from the Kiln suppliers. Special attention should be paid to assume good insulation and to cover problems of condensation of extractives on the walls and door on the chamber.

The doors could be produced locally in Belize, but here again the detailed drawing would have to be obtained. Insulation and sealing is most important. It is nevertheless recommended to purchase at least one such door from the Kiln manufacturers. It could then be copied locally for the other chambers.

Air circulation fans. These should be supplied by the equipment manufacturer.

Heating system. Two possibilities exist: heating by steam - this is the most common - and by hot oil. In the former case a second-hand boiler could perhaps be purchased locally, again reducing foreign exchange requirements. The boiler purchased should have excess capacity in case the battery of Kilns is to be expanded. Heating by steam has the added advantage that there is no need for humidifiers.

The most appropriate system for loading the Kiln, under conditions in Belize would be trolleys running on rails with a transfer line to enable piles to be moved not only in and out of the Kilns but also laterally.

The control system best suited to Belize would be a semi-automatic one with recording of temperatures of wet and dry bulbs (hence the relative humidity of the air). These recorders would have paper sheets, changed every day, recording the temperatures continually.

Condensation type Kilns:

These have become increasingly popular, both in developed as well as developing countries, for small capacity Kilns. Their advantages over the conventional Kilns is that they do away with the need for a boiler and the corresponding licences and maintenance problems. These operate on the dehumidification of the air by cooling in industrial sized air conditioners. Maintenance of these involves no skills which are not known in Belize.

The construction of the room, the loading mechanism and the control system is identical to the conventional hot air Kilns. Insulation of the walls of the chambers should be as good, if not better than that of the conventional chambers.

The final decision as to which type to purchase depends to a large extent on the cost of power, and the investment and operating cost of both types should be carefully compared.

APPENDIX 2

D r a f t

Terms of reference for the techno-economic feasibility study and evaluation of bids for a solid wood and louvered door and window factory to be established in Belize

I. INTRODUCTION

The United Nations Industrial Development Organization is to provide the Government of Belize (namely the Finance and Development Corporation) with technical assistance in the form of a complete techno-economic feasibility study for a plant to produce solid wood and louvered doors and windows (mainly for export) and the subsequent evaluation of offers of equipment for this plant.

The project is to be implemented in two phases, using the services of a firm of consulting engineers specialized in such work, referred to hereafter as the "Contractor".

II. DUTIES OF THE CONTRACTOR

Phase I: (Techno-economic feasibility study)

The proposed techno-economic feasibility study is to cover the following main topics:

- assessment of the raw material situation with respect to location, quantity, quality, specification, cost;
- assessment of the existing and potential demand both in Belize as well as for export to the members of the Caribbean common market initially, and the United States subsequently, for all types of solid and louvered wood doors and windows;
- assessment of the existing designs for such doors and windows, and, if necessary their modification, or the development of new designs to suit the characteristics of local hardwood species, the technical specifications imposed by the users on certain potential markets, or by the production process envisaged;
- elaboration of a specific proposal for the establishment of a plant to produce various types of solid wooden and louvered doors and windows, mainly for export.

In particular he will undertake the following tasks:

A. Raw material survey

- 1) Study the long-term availability of the better known local hardwoods suitable for the production of solid and louvered wooden doors and windows in the required specifications and qualities at various potential locations.
- 2) Make a comparative study of the properties of the lesser used species of hardwoods existing in Belize to determine which, if any, of these could be used instead of those presently commonly used, and for what purpose.
- 3) Make a comparative study of the prices and various species for various locations and specifications.

B. Market survey

- 1) Assess the local demand for solid and louvered wooden doors and windows produced on an industrial scale, and identify the major centres of consumption in the Caribbean Common Market.
- 2) Forecast the growth potential for such doors in this market and assess the price elasticity for this product.
- 3) Compile information on present prices for solid and louvered wooden doors and windows produced presently on a craft basis.
- 4) Study the existing designs of solid wooden and louvered doors and windows and determine their suitability for industrial production; making the necessary modifications.
- 5) Carry out similar market surveys, as enumerated in points 1 to 4 above to assess the markets for solid wooden doors in the United States.
- 6) In addition to the above, compile information on tariffs and tariff barriers affecting the potential export of solid wooden doors from Belize to the United States.
- 7) Similarly, compile information on shipping regulations and freight rates for this products for shipment to the various islands of the Caribbean Common Market and the United States and on frequency of service to the potential markets.

- 8) Enumerate the local customs in specifying solid and louvered wooden doors and windows in construction, and make a comparative table of the main parameters of these standards.

C. Product development

Based on the raw material and market surveys, and on the assessment of the suitability of the available designs, the contractor may have to undertake the following task:

1. Design a range of solid and louvered wood doors and windows of various types (suitable for the markets identified above) which could be produced industrially in Belize in the plant he will recommend in the feasibility study he will prepare.
2. Supervise the production in Belize of prototypes of these doors and their eventual testing in a research laboratory if this proves to be necessary. (The cost of production of prototypes and testing shall not be included in the contract of the contractor with UNIDO but shall be borne by the authorities of Belize)
3. Prepare detailed drawings, cutting lists and specifications for all the products designed.

D. Techno-economic feasibility study

Based on the information compiled in the raw material and market surveys and on the product development work carried out, the Contractor shall prepare a complete techno-economic feasibility study for a plant to produce industrially solid and louvered wooden doors and windows mainly for export. In this study he shall:

1. Recommend, based on the market survey, the capacity of the proposed plant; and based on the market and raw material surveys, its location.
2. Recommend, based on the market survey and product development work the product range and specifications of the doors and windows to be manufactured.
3. In selecting the site for the proposed plant, the Contractor shall take into account the following factors: (a) location with respect to raw material supplies and markets (both present and future), and to the availability of skilled carvers if carved solid wooden doors are to be produced.

- (b) cost of land
 - (c) area required
 - (d) existing infrastructure (roads, power, water, sewers, etc.)
 - (e) cost of fuel, power and water
 - (f) labour market (both quantitative and qualitative assessment)
 - (g) Township facilities.
4. Draw up the technical specifications of the equipment needed. (This should be detailed enough to serve as a basis for a call for tenders.)
 5. Define the characteristics of the buildings required (area, height of ceilings, floor loading, etc.).
 6. Prepare a plant layout for the overall dispositions and equipment.
 7. Evaluate the manpower requirements, and, based on the skills available, draw up a training programme for key personnel.
 8. Estimate the capital requirements (both in local and in foreign currencies) for the proposed plant.
 9. On the basis of the above, determine the project's profitability and its impact on the national economy.
 10. Undertake a simple sensitivity analysis for such parameters as: cost of equipment, interest rate, cost of raw materials, cost of labour, selling price.
 11. Recommend the measures that will have to be taken by the management of the plant to be erected, the Finance Development Corporation, the Forestry Department, other local bodies, the Government as well as eventually by the international organizations to ensure the speedy implementation of the project.

Phase II: (Evaluation of offers)

A. Field work in Belize

1. Obtain information from the owners of the proposed plant, the Finance Development Corporation, and other interested parties on any modifications that they have decided to introduce to the proposal made by the Contractor in Phase I.
2. Meet with the civil engineer, architect and Contractor retained for the project to clarify all details and discuss all points.
3. Make a preliminary assessment of the offers received and discuss it with the interested parties listed under 1 above, indicating to them the methodology which he (the Contractor) proposes to use, and identify those offers which need clarification and/or completion.

B. Work done at the Contractor's Head Office

1. Approach those bidders who have submitted incomplete and/or unclear offers and obtain all the necessary information.
2. Make an in-depth study of the offers received for each piece of equipment and/or each line and/or each turnkey proposal (if appropriate); indicating the technical advantages and disadvantages of each machine selected as they relate to conditions in Belize and justify his choice.
3. Select for each machine the appropriate accessories and spare parts which must be purchased.
4. Update the feasibility study prepared in Phase I of the contract to conform to the actual costs and labor requirements of the plant that will actually be erected.

III. PROPOSED IMPLEMENTATION

Phase I:

The Contractor is to delegate a team of qualified specialists to Belize within one month of the submission of the contract for signature by UNIDO for the implementation of Phase I.

This team will comprise (but not be limited to) specialists in the following fields: wood technology, testing of joinery products, production of solid and louvered wood doors and windows, marketing of these doors and windows, industrial engineering, economics. The team leader and key members of the team shall visit UNIDO in Vienna on their way to and from Belize for briefing and exchange of views.

The draft report of Phase I is to be submitted to UNIDO in five copies in English within six weeks of the return of the team from Belize. Thirty copies of the final report of Phase I, in English, are to be submitted to UNIDO within one month of receipt of UNIDO's comments on the draft report.

Phase II

After its submission the report on Phase I and its study by the interested parties in Belize they may decide to proceed with the implementation of the project. In that case they will issue a call for tenders to supply the equipment for the proposed plant. This could either call for supply on a turnkey basis, for the whole plant, or certain lines, or through purchasing individual machines - or a combination of both alternatives.

In its contract with the Contractor UNIDO reserves the right to implement only Phase I. It shall notify the Contractor within a maximum of three months of its intention, or not, to proceed with the implementation of Phase II, and if so indicate a tentative date for the start of the field work.

In case Phase II is implemented, the Contractor shall make available at the date set by UNIDO a team comprising specialists in the production of solid and louvered wood doors and windows, mechanical and electrical engineering and procurement to evaluate the bids received.

The team leader, and key members of the team shall visit UNIDO on their way to and from Belize for briefing and exchange of views within two weeks of the date set by UNIDO.

They shall submit a draft report, in five copies in English, within six weeks of their return from Belize, and a final report, in fifteen copies in English, within two weeks of receipt of UNIDO's comments.

IV. BACKGROUND INFORMATION

Note: The text hereunder will have to be expanded by the Finance Development Corporation (by including statistical data on production and exports of sawn lumber, etc.) before it can be used in the contract with the Contractor.

Belize has over million acres of hardwood forests and acres of pine forests.

The vast majority of its primary wood processing industries produce Mahogany and Cedar sawnwood.

Secondary wood processing industries are, to all intents and purposes, still at the craft stage.

The Government of Belize has requested UNDP/UNIDO assistance for the development of its secondary wood processing industries. One field in which assistance is to be given is for the preparation of this study for local production of solid and louvered wood doors and windows for export.

APPENDIX 3

Plant layout and equipment for the production of modular prefabricated wooden housing elements ^{1/}

A suggested layout for a factory to produce the components for the building system is shown in Fig.1. The machines are drawn with distinguishing types of line to show three degrees of sophistication which might become three stages of development if a factory starts with the simplest equipment and acquires the more advanced machinery later.

Stage 1

The minimal set of equipment comprises

1. Radial arm cross-cut saw with pivoting arm and 360° saw carriage rotation, 14" blade (US\$1000 approx., floor space 6' x 3'6").
2. Portable 3/4" drill and drill stand (US\$ 125 approx).

The above list of equipment assumes that timber is obtained ready planed to size and the area shown for the stage 3 machine is available for stacking this timber prior to cross-cutting.

Stage 2

The following general woodworking items could be added for convenient production of low-volume parts which cannot be made with the Stage 1 machines or would interfere with their high-volume operations. Examples are ripping standard boards to smaller widths, making occasional joinery items when there is a shortage or interruption in normal deliveries, and making components for panel variants requiring a small amount of non standard machining.

1/ Based on information contained in a report by TRADA (Timber Research and Development Association) Hughenden Valley, High Wycombe, Great Britain for UNIDO as part of a contract to provide designs and erection supervision for a technical assistance project carried out for UNIDO in a developing country.

1. Combined surface planer and thicknesser, capacity 30" x 9" (US\$4,500, floor space 7' x 6').
2. Dimension/rip bench. For cheapness, a simple machine could be obtained and would be much more convenient for cutting plywood sheets to make truss gussets etc. instead of using the portable saw and handsaws. If the extra cost is not too great, a machine with a rolling table would be a great advantage, especially with an outrigger table for large sheets. (US\$800, floor space 5' x 8')
3. Chain and chisel mortiser. For timber sections up to 12" x 9" and chisels up to 1" square (US\$3,200, floor space 4' x 3'6").

This completes a modest outlay for a second stage although if panels of more advanced construction are added to the system later, further machines would be needed. For example to make a louvre unit with the louver blades fitted in grooves, a low cost louvring machine would be desirable to avoid interference with the cross-cut saw.

Stage 3

The four-side planing machine shown in the layout is a very important item for a complete factory. Planing in the factory instead of purchasing ready-planed material gives great advantages in ensuring the correct sizes are produced as well as establishing control over sawn timber stocks to enable them to be properly planned and stored to meet future requirements.

A "four-cutter" or four-side planing and moulding machine is often used for high production work but would be a very expensive machine, especially because for the best operation of the factory and system a size capable of planing the largest floor beams would be desirable and this would mean using a heavy duty 4" x 12" machine.

The alternative would be a heavy duty panel planer with side heads. This is still expensive but not nearly so expensive as the 4-cutter. It is a lower production machine but is more versatile and the greater width of components that may be planed might well be found advantageous in further development of the system.

(Such a machine, planing sections of 16" x 4 1/4", would cost US\$12,500 and require floor space of 7'6" x 4')

The prices quoted are recent indicational prices in the U.K. and should be increased by the percentage usually adopted in Belize for including transport charges etc.

Design of jigs

The design of the jigs for the panel and truss tables shown in Figure 1 will have to be finalized after the designs of the elements to be assembled or them have been decided upon.

Labour requirements

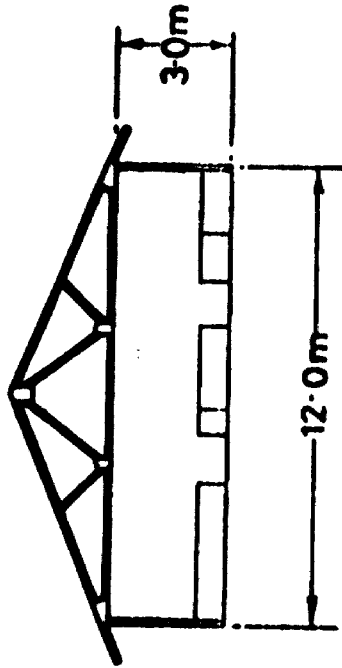
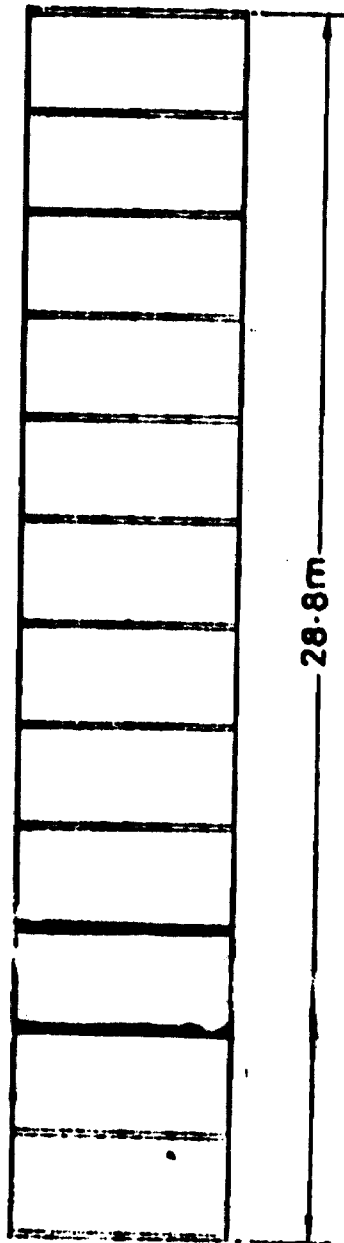
In a typical building of 24' x 36' there are 36 wall panels and 10 trusses, or roughly four panels to each truss. Assuming the panel jigs produce two panels per hour and the truss jig produces one truss per hour, two panel jigs will be required to match the output of one truss jig. This has been assumed in the factory layout drawing, Fig.1.

The following manpower provision is suggested.

<u>Duties</u>	<u>Manpower</u>	<u>Type</u>
Truss assembly - 1 jig (including spandrel panels)	2	semi-skilled
Wall panels - 2 jigs	4	" "
Supervisor	1	skilled
Cross-cut saw	1	semi-skilled
	1	unskilled
Four-side planer	1	skilled
	2	unskilled
General labour for timber, handling, loading, maintenance etc.	2	unskilled
Foreman of whole factory	1	skilled
Manager	1	-
Clerical stores	1	-
Total	17	

Building

The building shown to a small scale in Fig.1 envisages the use of a 40' truss at a spacing of 8'. The building is clad along the sides but there is access at both ends, preferably through large sliding doors which can be closed when necessary to prevent driving rain entering the factory.



12m SPAN ROOF TRUSSES

2.4m BAY SPACING

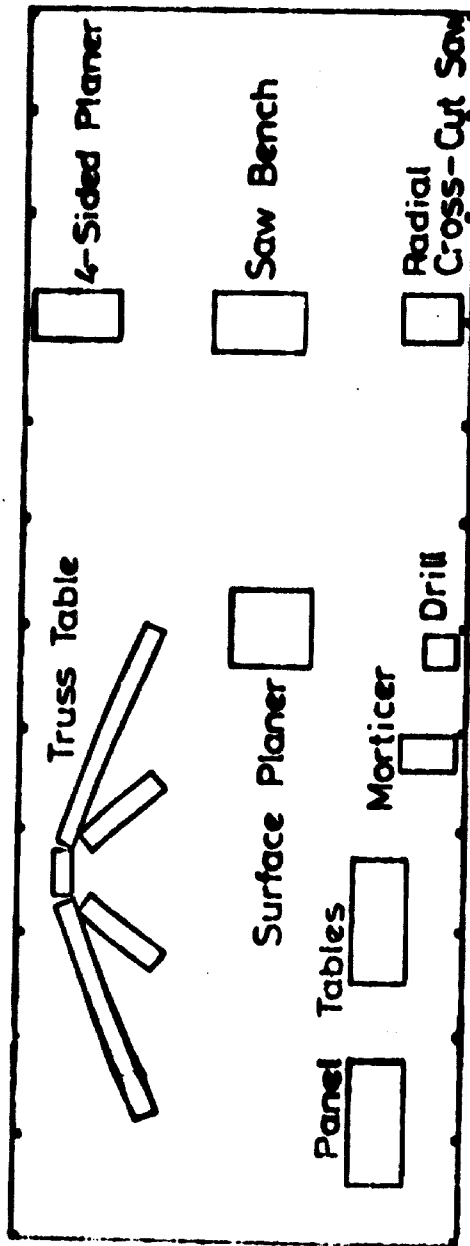
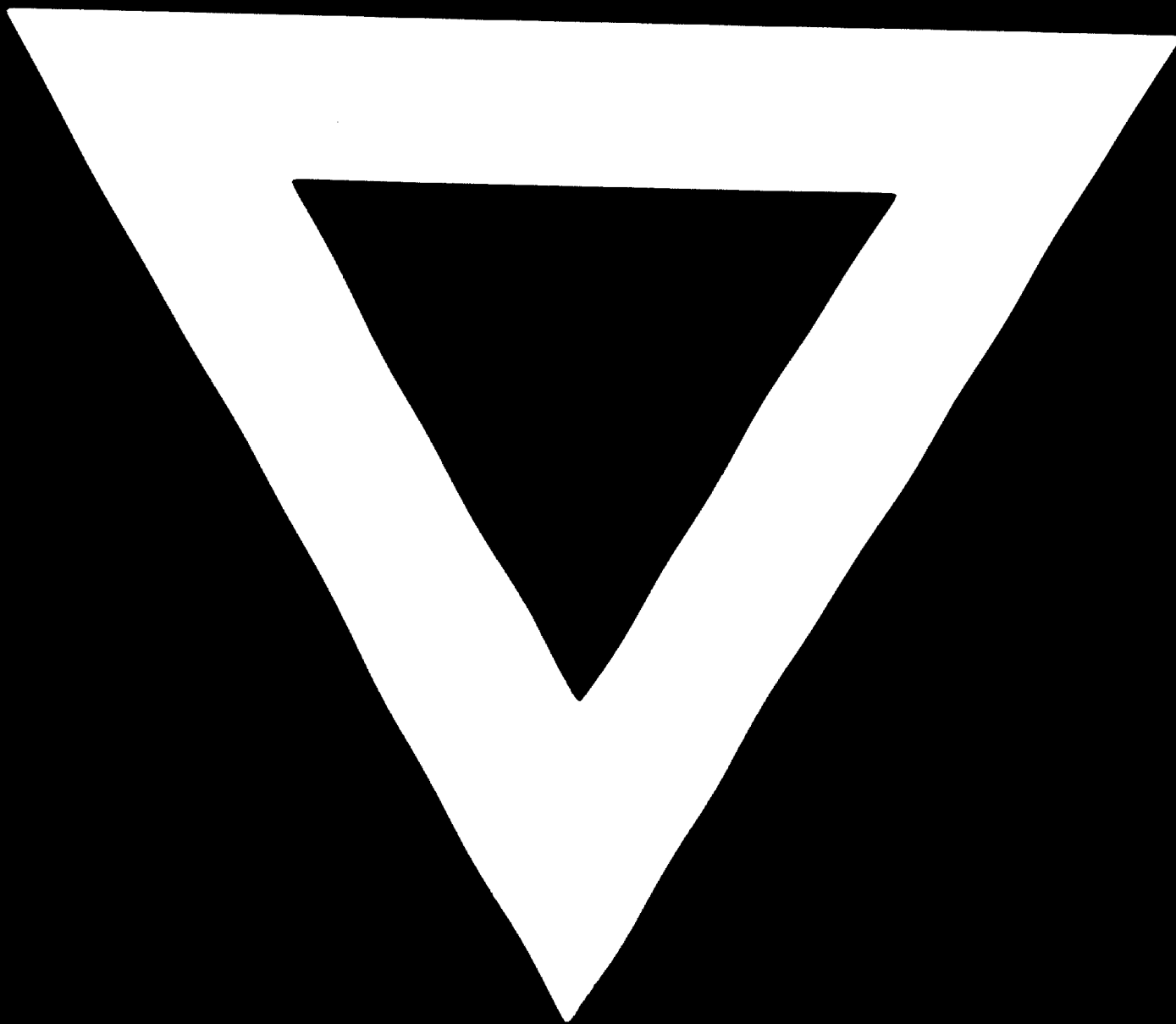


Figure 1: LAYOUT OF EQUIPMENT

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