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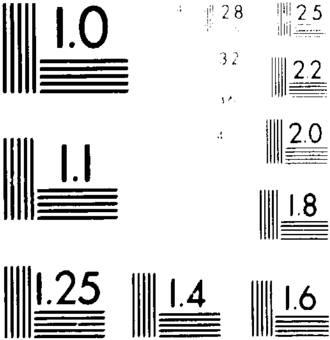

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DP/ID/SER.B/484
13 December 1984
English

Philippines.

DEMONSTRATION OF COCONUT WOOD UTILIZATION IN LOW-COST HOUSING

SI/PHI/83/801

PHILIPPINES

Terminal report *

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

Based on the work of Horatio P. Brion,
Secondary Wood Processing Expert

United Nations Industrial Development Organization
Vienna

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EXPLANATORY NOTES

The monetary unit of the Republic of the Philippines is the Peso (₱). The current official rate of exchange for the Peso is ₱14.002 = US$1.00.

The following acronyms are used in this Report :

DGLC	-	Davao Gulf Lumber Corporation, Davao City, Philippines, participant lumber processing firm in this Project.
FAO	-	Food and Agriculture Organization, United Nations
PCA	-	Philippine Coconut Authority, a Philippine Government agency responsible for the coconut industry.
PCA - ZRC	-	Philippine Coconut Authority - Zamboanga Research Center
SPDA	-	Southern Philippines Development Authority, the Project's implementing agency of the Philippine Government.
UNDP	-	United Nations Development Programme
UNIDO	-	United Nations Industrial Development Organization

A hyphen between numbers (e.g. 1-5) indicates the full range involved, including the beginning and end points.

A full stop (.) is used to indicate decimals.

A comma (,) is used to indicate thousands, millions, billions.

The following symbols and/or abbreviations are used in this Report :

US$	-	US Dollars, currency unit of the United States of America.
PH₱	-	Philippine Peso, currency unit of the Republic of the Philippines.
Sta.	-	"Santa", Spanish word for saint, usually found in the names of towns in the Philippines.
m.m.	-	millimeter, 1/1000th of a meter.

m	-	meter, metric unit of length
cu.m.	-	cubic meter, metric unit of volume.
pcs.	-	pieces, denoting unit of quantity.
No.	-	number
Hrs.	-	hours
Hp.	-	horsepower, unit of power in the English system of measurements.
Man-Hours	-	Man-hours, unit of work performed.
"	-	inch, unit of length in the English system, equivalent of 2.54 centimeters.
kms.	-	kilometers, 1000 meters
%	-	per cent, 1/100th part of a whole
kgs.	-	kilograms, metric unit of weight, 1000 grams
UP-Los Baños	-	University of the Philippines - Los Baños branch.
coco	-	coconut
°	-	degrees, a circular unit of measure of angles.
S4S	-	Surfaced on 4 sides, referring to a board whose 4 sides have been planed smooth.
T & G	-	Tongue and Groove, a system of joining wood flooring pieces.
V-Cut	-	A system of joining wooden walling boards, characterized by beveled edges to form a V-shaped groove at the joined edges.
CCA	-	Copper-Chrome-Arsenate, a wood preservative compound.
$CuSO_4$	-	Copper Sulphate, a chemical compound used to augment preservative treatment of wood.
NaPCP	-	Sodium Pentacholorophenate, an anti-fungi compound.
RL	-	Random Length, normally used to denote specified items of various lengths

TCT	-	Tungsten Carbide Tip, a hard metal alloy used to reinforce the cutting surfaces of tools
W	-	watts (unit of power, English system)
KW	-	kilowatts, metric unit of measure of power
/	-	per, meaning "for each"
HSS	-	High Speed Steel
CHB	-	Concrete Hollow Blocks
T & B	-	Toilet and Bath
CISP	-	Cast Iron Soil Pipe
Ø	-	diameter
#	-	gauge number
"	-	inch (English system of measure of length)
'	-	feet (English system of measure of length)
Reinf.	-	reinforced
C.I.	-	cast iron
G.I.	-	galvanized iron

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I. INTRODUCTION

1.1 PROJECT BACKGROUND

During the past 7-1/2 years the United Nations, through its implementing agencies --- the FAO and UNIDO, has been providing assistance to the Philippine Coconut Authority (PCA) in its efforts to promote the use of coconut (Cocos Nucifera) stem as a source of building and construction material. Research and development work on the methods and techniques of converting coconut stem into lumber and its use as a construction material was conducted principally at the PCA-Zamboanga Research Center (PCA-ZRC), Zamboanga City, Philippines.

By mid 1983, it was decided that the coconut wood processing technology developed at the PCA-ZRC was ready to be transferred to industry.

1.2 PROJECT CONCEPT AND OBJECTIVE

Based on designs for low-cost housing developed by UNIDO under Project No. RAS/81/110, Regional Coconut Wood Training Project, (Low Cost Housing Design), two models (one for urban and the other for rural areas) were chosen for possible use in this Project.

The Southern Philippines Development Authority (SPDA), based in Davao City, island of Mindanao, in pursuit of its interest in using coconut wood for the construction of low-cost houses for its employees, agreed to be the implementing agency of the Philippine Government and build coconut wood houses designed under UNIDO Project RAS/81/110.

It was further held that the coconut wood processing techniques developed at the PCA-ZRC can be applied to existing sawmilling and woodworking facilities in the country. To this end, the Davao Gulf Lumber Corporation agreed to participate in the Project and made available to the Project its sawmilling, kiln-drying and lumber surfacing/profiling facilities.

At a meeting of UNIDO and SPDA representatives held on 25 October 1983 at the SPDA Head Offices in Davao City, it was agreed to test further the versatility of the designs developed under Project No.

RAS/81/110. Thus, SPDA chose to build the duplex model of coconut wood house Type A (for urban use). It was intended that the coconut houses would be used as quarters by the members of the SPDA Board of Directors. The SPDA, as implementing agency for the Government of the Philippines, had requested UNIDO's assistance in this Project.

UNIDO engaged Mr. Horatio P. Brion, Secondary Wood Processing Expert, to assist in the adaptation of a selected commercial sawmill in Davao City for coconut wood processing, to advise the selected sawmill on coconut wood milling and sawdoctoring, and to assist the Designing Architect and SPDA in the technical execution of the construction. Mr. Brion was working on this from 25 October 1983 to 17 February 1984.

The immediate objective of the Project is summarized as follows :

> "Test and demonstrate the use of coconut wood in low-cost housing by erecting on SPDA premises two proto-type houses according to UNIDO Designs from lumber cut at a selected local commercial sawmill and to that end to :
>
> i - Advise SPDA on the adaptation of the selected sawmill for the processing of coconut wood ;
>
> ii - Train SPDA staff and/or the operators of the selected sawmill in the processing and treatment of coconut wood ; and
>
> iii - Make an economic analysis of the coconut wood processing operation and the construction of the proto-type houses."

At a meeting of UNIDO and SPDA representatives held on 25 October 1983 at the SPDA Head Offices in Davao City, it was agreed to test further the versatility of the designs developed under Project No. RAS/81/110. Thus, SPDA chose to build a duplex model of coconut wood house Type A (for urban use). The coconut house will be used as quarters for the members of the SPDA Board of Directors.

II. COCONUT STEMS LOGGING OPERATIONS

A total of 304 coconut trees were felled in two areas of Davao City : Lanang area on the eastern edge of the city and Darong area in the town of Sta. Cruz, Davao del Sur. The chainsaw method of felling and bucking were used in both areas.

2.1 LOGGING OPERATIONS AT THE LANANG AREA

Coconut log bolts were cut from 121 trees in approximately 1.10 hectare of coconut land in Lanang District, Davao City during September - October 1983. Lanang is about 5 kilometers from the city proper and is on the national highway going east to Tagum, the capital of Davao del Norte province.

Coconut trees in this area do not have harvesting steps. The felled coconut trees were 40 years or older and were located in an area being cleared for a private housing project. By special arrangements with the owners of the coconut trees, only the butt and second log bolts were bucked and transported to the construction and sawmill sites. The coconut log bolts were donated to SPDA. The coconut log bolts were bucked and transported to the construction site and the sawmill at the expense of SPDA.

The log bolt sizes are distributed as follows :

TABLE I

LOG BOLT SIZES, LANANG AREA

Log Bolt Size				
Length	Average Diameter	Estimated Volume/Log Bolt	No. of Log Bolts	Estimated Total Volume
4500 mm	29.74 mm	0.3126 cu.m.	46 pcs.	14.381 cu.m.
5000 mm	27.69 mm	0.3012 cu.m.	121 pcs.	36.448 cu.m.
5500 mm	27.08 mm	0.3169 cu.m.	75 pcs.	23.711 cu.m.
		Totals -----	242 pcs.	74.540 cu.m.

The above tabulation shows that the 4500 mm coco log bolts were butt logs, while the 5000 mm and 5500 mm coco log bolts were mostly second log bolts. The average volume of coco log bolts cut in the area is calculated at 0.3080 cu.m. per log bolt.

2.1.1 Labour and Equipment Usage

i - Labour Usage

A total of 172 man-hours were used in the felling, bucking, yarding and hauling operations in the Lanang area, distributed as follows :

TABLE II

LABOUR USAGE, LANANG LOGGING AREA

Labour	No. of Men	Hours Worked/Day	No. of Days	Total Man-Hours
Chainsaw Operators	3	8	1	24 man-hrs.
Farm Tractor Operator	1	8	3	24 man-hrs.
Helpers	2	8	4	64 man-hrs.
Truck Driver	1	8	3	24 man-hrs.
Truck Handyman	1	8	3	24 man-hrs.
Supervision	1	3	4	12 man-hrs.
			Total	172 man-hrs.

ii - Machine/Equipment Usage

Machinery and equipment usage are given in the following table :

TABLE III

MACHINE/EQUIPMENT USAGE, LANANG LOGGING AREA

Type of Machine or Equipment	No. of Units Used	Hrs./Day Used	Days Used	Total Machine Hours
Chainsaw, gasoline-driven, 24" blade model	3	8	1	24
Farm Tractor, 120 Hp	1	8	3	24
Freight Truck, 6-ton capacity	1	8	3	24

iii - Yarding, Loading and Hauling

Bucked coco logs were dragged from cutting site to truck loading point, an average skidding distance of 75 meters. Coco log bolts were loaded on the truck with the aid of a chain block hoist mounted on an A-frame. A total of 109 coco log bolts were transported from the Lanang area to the construction site, 17 kilometers away, at SPDA Head Offices in September/October 1983. The balance of coco log bolts cut in this area (133 pcs.) were transported directly to the sawmill during the first week of January 1984. 31 pieces of the log bolts at the construction site were later transported to the sawmill, a distance of approximately 10 kilometers.

2.2. LOGGING OPERATIONS AT DARONG AREA

A total of 183 coconut trees were cut in an aggregate area of 1.66 hectares in this area. All coconut trees in this area were 50 years or older and have harvesting steps with an average depth of 45 mm. The coconut trees were scheduled for replacement with hybrid species under the national coconut tree replanting program, administered by the Philippine Coconut Authority.

All log bolts were cut to 6000 mm lengths and had average diameters ranging from 230 mm (second log bolts) to 400 mm (butt logs) per log bolt. Average gross volume per log bolt was calculated at about 0.3501 cu.m. Again, only butt and second log bolts were yarded and hauled to the processing mill. (Note : It appears that the coconut plantation owners would rather retain the topmost log bolts which contain the fronds as these are in great demand locally and command a good price in the local food market.)

SPDA paid ₱25.00 (US$1.785) per tree felled, including felling and bucking. The cost of yarding and hauling to mill site were shouldered by SPDA.

Yarding from cutting site to loading point (a distance of about 2 kilometers) was done by dragging the log bolts with a 120 Hp. farm tractor. Hauling distance from Darong area to mill site is about 60 kilometers.

2.2.1 Labour and Equipment Usage

i - Labour Usage

A total of 576 man-hours were used in the yarding and hauling operations in the Darong area, distributed as follows :

TABLE IV

LABOUR USAGE, DARONG LOGGING AREA

Labour	No. of Men	Hours Worked/Day	No. of Days	Total Man-Hours
Helpers - yarding and loading	5	8	6	240 man-hrs.
Supervision	1	8	6	48 man-hrs.
Farm Tractor Operator	1	8	6	48 man-hrs.
Truck Drivers	3	8	5	120 man-hrs.
Truck Helpers	3	8	5	120 man-hrs.
			Total ---------	576 man-hrs.

Table IV shows that hauling labour made up 42%, while yarding and loading labour contributed to 50% of the total labour usage in the Darong logging operations. It should be noted that felling and bucking labour were already included in the cost of coconut trees felled and are not part of the 576 man-hours total for the Darong logging operations.

ii - Machine/Equipment Usage

The corresponding machine/equipment usage is listed below :

TABLE V

MACHINE/EQUIPMENT USAGE, DARONG LOGGING AREA

Type of Machine or Equipment	No. of Units Used	Hrs./Day Used	Days Used	Total Machine Hours
Chainsaw, gasoline-driven, 24" blade model	3	8	3	72
Freight Trucks, 6-ton capacity	2	8	5	80
Dump Truck, 10-ton capacity	1	8	5	40
Self-Loading Truck, with Hydraulic Crane (HIAB)	1	8	2	16
Farm Tractor, 120 Hp.	1	8	6	48

iii - Yarding, Loading and Hauling

The yarding technique used in this area was the same as that used in the Lanang area. During the first 4 days, coco log bolts were loaded on the freight and dump trucks by the same A-frame and chain block hoist method used in the Lanang operations. However, during the last 2 days of operations, this method was complemented with the use of a self-loading truck equipped with a 3-ton hydraulic powered crane (HIAB).

This increased the loading output and shortened the hauling turn-around time. All coco log bolts cut in this area were hauled directly to the processing mill, a distance of about 60 kilometers.

III. LUMBER MANUFACTURING OPERATIONS

Two general techniques of converting coco stems into coco lumber were used in this Project. Stakes, batten boards and form lumber were cut from coconut stems with the use of a chainsaw. All other coco lumber requirements of the Project were cut from coco stems at the sawmilling plant of Davao Gulf Lumber Corporation in Punta Dumalag, Matina-Aplaya, Davao City.

3.1 CHAINSAWING

70 coco log bolts with an aggregate gross volume of 22.73 cubic meters were sawn into coco lumber, using the method developed at PCA-ZRC. A standard gasoline-driven chainsaw with a 24-inch blade was used. An aggregate output of 9.98 cu.m. of lumber of various dimensions (as specified in the Bill of Materials, Annex I) was obtained. The resulting lumber yield rate is 43.9%.

The labour usage in these operations is distributed as follows :

TABLE VI

CHAINSAWING LABOUR

Labour	No. of Men	Hours Worked/Day	No. of Days	Total Man-Hours
Chainsaw Operator	3	7	6	126 man-hrs.
Helpers	2	7	6	84 man-hrs.
Head Laborer	1	7	6	42 man-hrs.
			Total ------	252 man-hrs.

The productivity level of this operation is calculated at 0.0396 cubic meter per man-hour.

3.2 SAWMILLING OPERATIONS

Sawmilling operations were performed in three separate plants, involving the use of three different degrees of sophistication in equipment complement. The Mahusay Box Factory, a subsidiary of DGLC, provided the most primitive set-up among the three plants. The Angala sawmill, an affiliate of DGLC, located in Banay-Banay, Davao Oriental province, about 100 kilometers east-southeast of Davao City, offered a mixed complement of imported and locally fabricated sawmilling machinery with a dead roll conveyor system connecting the various machines and work stations. The main sawmilling plant of Davao Gulf Lumber Corporation located at Punta Dumalag, Matina-Aplaya, Davao City, provided the most sophisticated sawmilling set-up among the three plants. The equipment complement of the three plants are listed in Annexes II, III and IV respectively.

A trial sawmilling run at the Angala Sawmill in Banay-Banay, Davao Oriental province (see Figures 1 to 11), was arranged by Davao Gulf Lumber Corporation with the following objectives :

i - To demonstrate the findings of the PCA-ZRC that coconut trunks can be processed into coconut lumber with the use of existing sawmilling facilities smaller but very similar to the set-up at the Davao Gulf sawmilling plant in Matina-Aplaya, Davao City, thus allaying fears and erasing doubts on the part of the local sawmilling industry (and of Davao Gulf executives) of their imagined problems and hardships in sawmilling coconut lumber ;

ii - To demonstrate the sawmilling techniques for coconut wood using bandsaws and other conventional sawmilling equipment designed to mill traditional wood species (LAUAN, TANGUILE, etc.) ; and

iii - To test check the applicability of the coco lumber milling prediction table prepared by this Consultant using technical data accumulated at the PCA-ZRC ; and improve these tables to attain more realistic forecasts of thicknesses and widths of coco lumber that may be milled from given diameters and lengths of coconut roundwood.

[illegible]

[illegible]

[illegible]

Participants in the short seminar [illegible] Technique

[illegible]


NO
SMOKING

[illegible]

[illegible] slab[illegible] on [illegible] [illegible]-saw.

Figure 16

Trim sawing end defe[illegible] on [illegible] [illegible]

The successful attainment of the trial run objectives on 17 December 1983, led to the decision for a full-scale sawmilling run at the DGLC sawmilling plant during 3-5 January 1984 (see Figures 12 to 25). A total of 516 log bolts (165.73 cu.m.) were cut during the full scale sawmilling run. The log bolt lengths varied from 4000 mm to 6000 mm. 70% of the log bolts cut were 6000 mm long. Thirty coco log bolts, each 6000 mm long, were set aside to be milled to fill up quantity deficiencies of certain board sizes cut during the full scale run.

To further test the applicability to crude sawmilling facilities of the sawmilling techniques developed during the trial and full-scale runs, DGLC agreed to cut 12.5 mm x 100 mm (Grades A and B) and 38 mm x 600 mm (Grades B and C) boards at the sawmilling facilities of its subsidiary, the Mahusay Box Factory (see Figures 26 to 28). The sawblade of the main bandsaw was stellite (No. 12) tipped and the HSS circular sawblade of the trim saw was replaced with a TCT sawblade for the purpose. 8 pieces of 6000 mm log bolts were cut to 3000 mm lengths which is the maximum log length that can be handled by the main saw carriage. The cutting pattern used in this run was basically the same as that used in the trial and full-scale runs.

3.2.1 Transfer of Sawmilling Technology

Short seminars on the techniques of converting coconut stems into lumber were held before each sawmilling run. Key plant personnel (Sawyers, Machine Operators, Saw Doctors, Graders and Sawmill Foreman and Manager) of Angala sawmill attended the seminar before the trial run on 17 December 1983 (see Figure 1). Similarly, key sawmill personnel of Davao Gulf Lumber Corporation participated in the seminar held on 27 December 1983 in preparation for the full-scale operations scheduled for 3-5 January 1984 (see Figure 12).

The following topics were discussed during the seminars :

i - Project Background

- the Philippine Coconut Replanting Program
- possible economic utilization of coconut stems

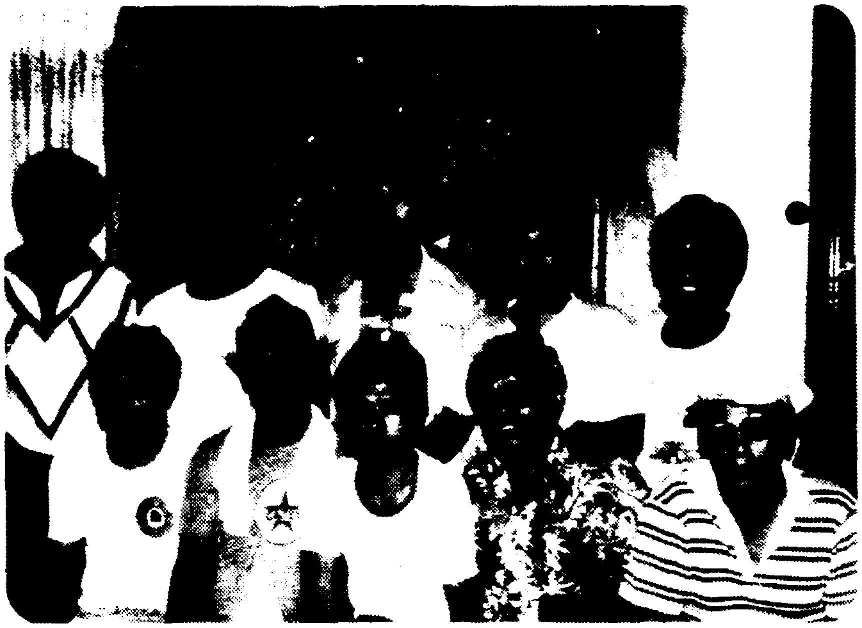


Figure [illegible]

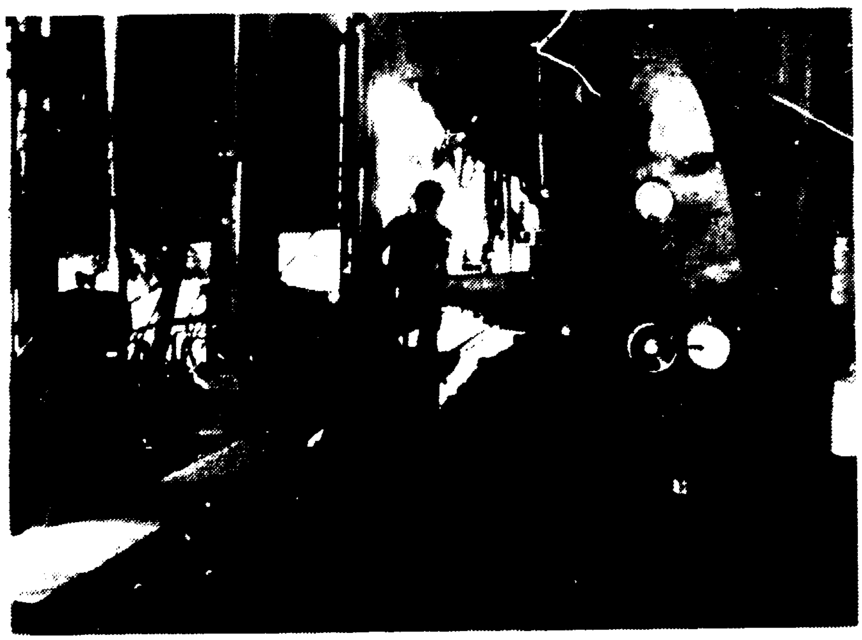
Participants [illegible] seminar [illegible]

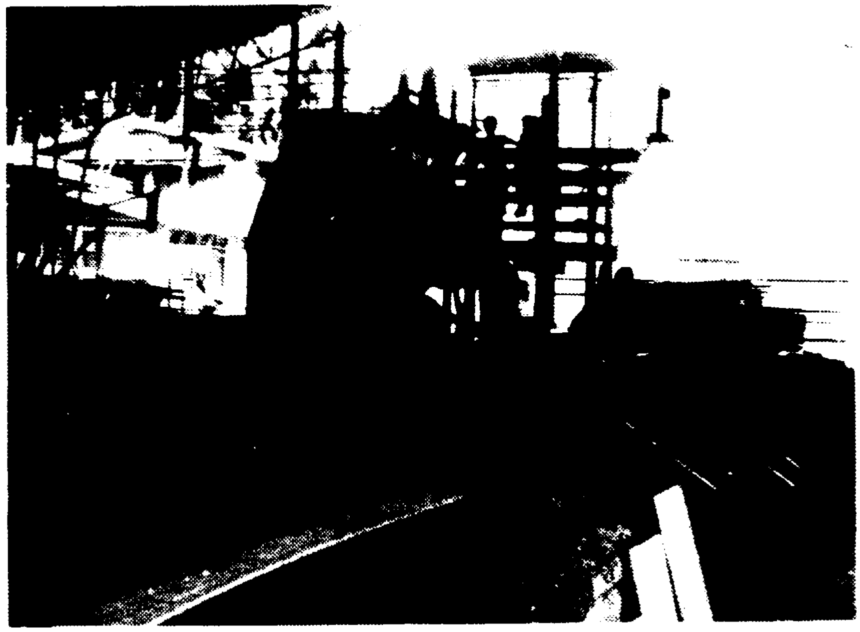
Figure [illegible]

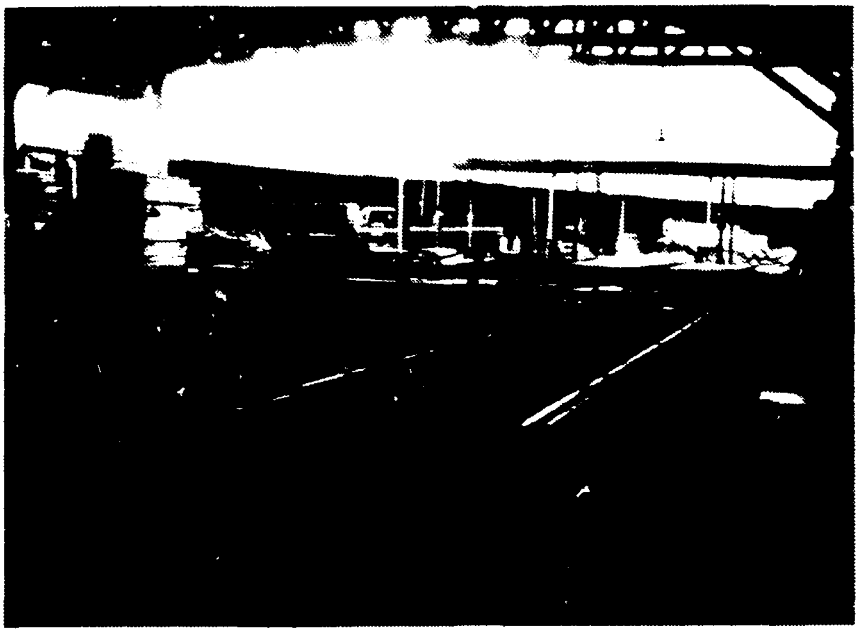
Unloading [illegible] log bolts [illegible] temporary [illegible]

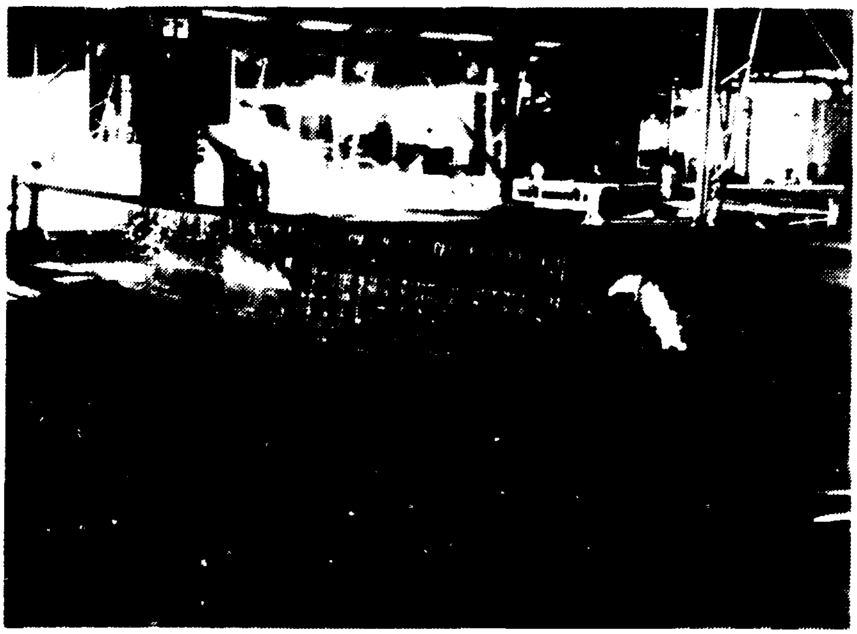
Figure [illegible]

Coco log bolt [illegible] conveyor [illegible]









[illegible]

Figure [illegible]

[illegible] checking [illegible] ness of [illegible] on the one-man [illegible] powered rail [illegible] saw and carr[illegible]

Figure [illegible]

Lubricating saw-blade of main bandsaw.

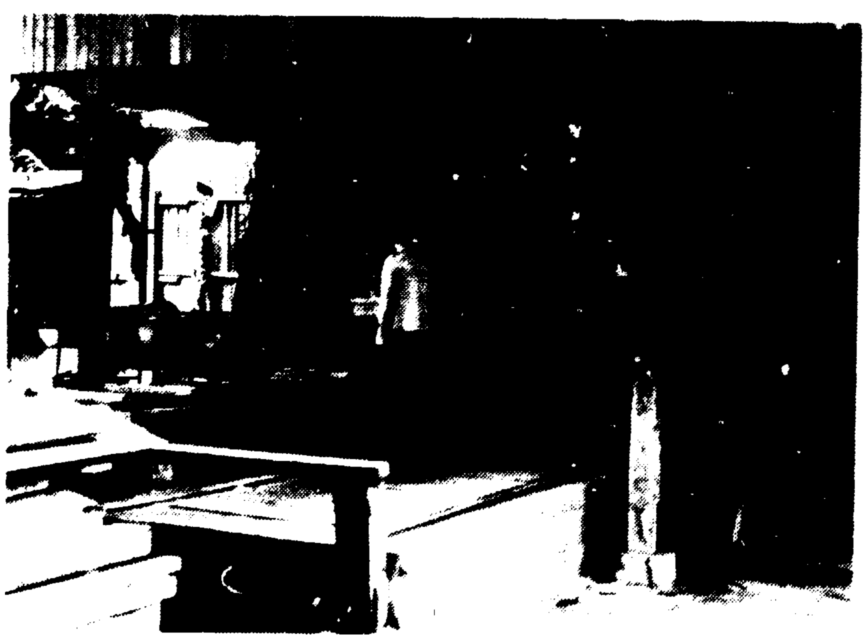


Figure [illegible]

Changing [illegible] on main band[illegible]

- processing facilities for coconut lumber

ii - <u>Sawmilling Coconut Lumber</u>

- characteristics of coco wood
- properties of coco lumber obtained from various density zones of the coconut stem (see Annex V)
- other characteristics of coconut stems (harvesting steps, crooks, hardness variations with height of tree)

iii - <u>Sawmilling Pattern for Coco Wood</u>

- cross-sectional distribution of density zones (see Annex VI)
- cutting pattern for normally straight and tapered log bolts (see Annex VII)
- effects of harvesting steps on output and lumber sizes (see Annex VIII)
- effects of bends or crooks of coconut stem on lumber output (see Annex IX)
- the use of tapering device on main saw and pony rig carriages (see Annex X)

iv - <u>Feed Speeds vs. Log Bolt Diameter and Part of Coconut Tree Origin</u> (see Annex XI)

- first slab cut
- first board cut (thickness vs. number of boards)
- cutting for specific sizes

v - <u>Edging Operations</u>

- maximum cutting widths
- edging boards width taper and re-processing of cants
- feed speeds (see Annex XI)

vi - Re-sawing

- initial shrinkage allowance
- feed speeds (see Annex XI)

vii - Trimming

- end defects
- excessive wanes

viii - Coco Lumber Grading

- stress grading vs. density of coco lumber
- deflection chart and grading fixture (see Figure 3)
- physical appearance of coco lumber and visual grading

ix - Recommended Cutting Schedule for Fully Conveyorized Sawmilling Operations (see Annex XII)

x - Projects Coco Lumber Requirements

- cutting thickness vs. log bolt average diameter (see Annexes XIII and XIV)
- required volumes and sizes each Grade of coco lumber (see Annexes XV and XVI.)

Annexes XIII and XIV are basically prediction tables which indicate the board size and quantities of each board size that can be cut from a log bolt with known average diameter.

The seminar participants' immediate comprehension of the above sawmilling concepts and techniques was obtained through a discussion of the physical characteristics and milling properties of coco wood as compared to traditional species of better known hard, medium and soft wood species whose sawmilling techniques are already familiar to the participants. Special emphasis was given to the role played by sawyers operating the main saw and pony rigs.

The results could be described as very satisfactory, for the sawyers were able to cut the first slab and first board without guidance from the UNIDO Consultant after the first 3 log bolts. In fact, during the full-scale sawmilling operations at DGLC, the sawyers' skills were developed to a point that they could do their jobs satisfactorily without referring to the cutting tables (see Annexes XIII and XIV).

3.2.2 Special Cutting Techniques Developed During the Trial and Full-Scale Sawmilling Runs

Some cutting techniques were developed and perfected during the full-scale sawmilling operations, as facilitated by the quantity, sizes and grades of coco lumber required in the Bill of Materials (see Annex I).

i - 50 mm x 50 mm (Grades A and B)

Coco wood requirements for nailers and studdings (50 mm x 50 mm, Grade B) and purlins (50 mm x 50 mm, Grade A) were produced with the use of a special cutting technique developed during full-scale sawmilling operations. After cutting the first slab on the main bandsaw, two 50 mm boards were cut such that there was still about 50 to 75 mm uncut material between the two boards. The twin 50 mm boards is then passed on to the Pony Rig, which cuts the two boards simultaneously into 50 mm wide pieces (see Figure 17). This technique led to high output rates when cutting 50 mm x 50 mm coco boards. The first board yield were Grade "A" purlins while the second board gave Grade "B" nailers and studdings. The technique was given the name "CHOPPING", by the DGLC Sawyers.

ii - 12.5 mm x 100 mm Sidings and Double Wall Boards, Grades A and B

The log bolt is opened up by cutting the first slab to get a minimum face width of 100 mm. Using this face as reference, the log bolt is turned 180°, and the cutting procedure is repeated to get an open face parallel to the first open face. The remaining flitch is then sliced to give 100 mm thick flitches, which are then passed on to the Pony Rig. Thus, 12.5 mm x 100 mm boards (Grades A and B) were cut on the Pony Rig until the Grade "B" zone is completely cut from one face of the flitch. The remaining flitch is then turned 180° and the cutting procedure for 12.5 mm board is repeated. The remaining material (Grade C) is then passed through the re-saw to get 38 mm x 100 mm boards which are used as material for roofing shingles. This procedure was dubbed "PEELING" by the DGLC Sawyers.

iii - Cutting 25 mm x 50 mm, 25 mm x 75 mm and 50 mm x 75 mm Laths on the Edger Saw

The cutting load on the band re-saws became heavy as a result of efforts to re-process slabs and cants into narrow laths. The Edger Saw provided available machine time to cut narrow boards and help take away some of the heavy re-processing load off the band re-saws. However, the minimum cutting width on the edger is 100 mm, which normally would prevent ripping of 50 mm and 75 mm laths. A 75 mm wide fence was clamped on the fixed sawblade side of the Edger in-feed table. This enabled cutting of 75 mm, 50 mm and even 25 mm wide slats by setting the movable sawblade at 150 mm, 125 mm and 100 mm cutting marks, respectively. Thus, all edgings with 3 square faces produced at the Pony Rig were processed into narrow slats on the edger saw with the aid of the temporary ripping fence. This technique helped ease the load on the band re-saws.

3.3 SAWMILLING OUTPUTS, LUMBER YIELD RATES AND PRODUCTIVITY

The following tabulations summarize the performance level of the three sawmilling runs conducted under this Project.

TABLE VII

RESULTS OF COCO SAWMILLING RUNS

Type of Operations and Location	Log Input Volume cu.m.	Lumber Output Volume cu.m.	Lumber Yield Rates %	Actual Production Man-Hours	Productivity cu.m. per Man-Hour
1. Trial Run, Angala Sawmill	4.559	2.012	44.13 %	20.85	0.0965
2. Full-Scale Operations, DGLC Sawmill	165.730	84.150	50.78 %	836.35	0.1006
3. Balancing Operations :					
a) Mahusay Box Factory	2.8	1.314	46.93 %	120.00	0.0101
b) DGLC Sawmill	7.7	3.938	51.14 %	88.00	0.0447
Overall Performance ---	180.789 cu.m.	91.414 cu.m.	50.56 %	1,065.20 man-hours	0.0858 cu.m. per man-hour

The highest lumber yield rates were obtained at the DGLC mill (51%) while the trial run at the Angala sawmill gave the lowest lumber yield rate (44.13%). This leads to the conclusion that the use of a tapering device on the main saw carriage helped increase significantly the quantity of coco lumber cut per unit volume of coco log bolt, noting that among the three mills used in this Project only the DGLC mill is equipped with a tapering device on the main saw carriage.

However, it is felt that the lumber yield rates could have been higher were it not for the fact that the sawmilling runs were oriented to cutting coco lumber of specific dimensions as required in the Bill of Materials, instead of maximizing lumber yields as is normally practiced in sawmilling operations. Nevertheless, the resulting lumber yield rates are comparable to those obtained when milling under-sized (average diameters less than 500 mm) traditional species, such as LAUAN, APITONG and TANGUILE (all classified as Philippine Mahogany).

3.4 COCO LUMBER GRADING

For purposes of this Project, the coco lumber grading scheme developed at the PCA-ZRC was modified and adapted to suit the needs of existing commercial sawmills in the following manner :

TABLE VIII

COCO LUMBER GRADING SCHEME

Assigned Commercial Grade	PCA-ZRC Qualitative Description	Density Grouping	
		Qualitative	kgs./cu.m.
A	Hard	High Density	600 and above
B	Medium	Medium Density	400 to 599
C	Soft	Low Density	200 to 399

Deflection values for each thickness and grade obtained during experiments at the PCA-ZRC cover only 3000 mm, 4000 mm and 5000 mm long coco boards. These values were plotted on cross-section paper (10 divisions to the centimeter) and corresponding values for 3500 mm and 4500 mm long coco boards were interpolated. Similarly, values for 5500 mm and 6000 mm long boards were extrapolated from the plotted curves (which appeared to be a family of parabolic curves with asymptotes parallel to the x- and y-axes). Table IX below gives the deflection data for 25 mm, 38 mm and 50 mm thick boards, thus obtained.

TABLE IX

COCO LUMBER DEFLECTION CHART

Board Length (m.m.)	Board Thickness (m.m.)	Deflection (m.m.) at Mid - Length of "GREEN" Coco Board		
		Grade "A"	Grade "B"	Grade "C"
6000	50	0 - 135	136 - 193	Above 193
	38	0 - 196	197 - 262	Above 262
	25	0 - 346	347 - 960	Above 960
5500	50	0 - 76	77 - 109	Above 109
	38	0 - 111	112 - 148	Above 148
	25	0 - 262	263 - 469	Above 469
5000	50	0 - 42	43 - 60	Above 60
	38	0 - 60	60 - 80	Above 80
	25	0 - 185	186 - 252	Above 252

Board Length (m.m.)	Board Thickness (m.m.)	Deflection (m.m.) at Mid - Length of "GREEN" Coco Board		
		Grade "A"	Grade "B"	Grade "C"
4500	50	0 - 27	27 - 38	Above 38
	38	0 - 42	43 - 57	Above 57
	25	0 - 134	135 - 182	Above 182
4000	50	0 - 12	13 - 16	Above 16
	38	0 - 25	26 - 34	Above 34
	25	0 - 82	83 - 112	Above 112
3500	50	0 - 7	8 - 10	Above 10
	38	0 - 16	17 - 22	Above 22
	25	0 - 52	53 - 71	Above 71
3000	50	0 - 3	3 - 4	Above 4
	38	0 - 7	8 - 10	Above 10
	25	0 - 22	23 - 30	Above 30

A grading fixture made of coconut lumber (see Figure 11) fitted with deflection scales based on the values given in Table IX was used during the trial and full-scale sawmilling runs.

IV. COCO LUMBER PRESERVATION AND SEASONING

4.1 COCO LUMBER TREATMENT AND PRESERVATION

During the familiarization and orientation activities of this Consultant at the PCA-ZRC, the various treatment and preservation methods for coco lumber were discussed with the Laboratory Chemist, Wood Treatment and Preservation Section. Taking note of the constraints (availability of preservative chemicals and treatment facilities) in Davao City, a schedule of Treatment and Preservation Procedures was drawn up specifically for the Project (see Annex XVII).

Two units of open troughs were fabricated by cutting up the drum sides 1/4 down the diameter and welding, end-to-end, 6 pieces of 200-liter steel drums for each dipping trough (see Figure 29). One trough was used to boil plain water, while the other trough was half-filled with 3% CCA solution.

As of 17 February 1984, a total of 2300 pieces of coco wood roofing shingles (approximately 1.74 cu.m.) and 50 pieces of 50 mm coco

COCONUT LUMBER PRESERVING AND SEASONING OPERATIONS

Figure 29

Coco board which will be exposed to the elements
as installed in the coco wood house
are dipped in 3% CCA Solution
after 2 hours in boiling water.

boards with varied widths and lengths (approximately 0.628 cu.m.) have been dipped in 3% CCA solution. The deposition rate was calculated at 1.18745 kilograms of CCA per cubic meter of treated coco wood. The average CCA treating output was 500 pieces of shingles (0.3782 cu.m.) per day and 0.314 cu.m. of 50 mm boards per day. Labour usage was 16 man-hours per day.

All coco wood surfaces (and the corresponding concrete surfaces) in contact with concrete were brush coated with SOLIGNUM (a commercial brand of creosote-borne NaPCP), as prescribed in Annex XVII. Similar treatment method was used on interior surfaces of 100mm x 100 mm coco wood posts built up from 50 mm x 100 mm coco boards. Material usage was 0.31 liter of Solignum per square meter with the use of man-hours of labour per square meter of coated surface.

4.2 KILN-DRYING OPERATIONS

Based on the work done by Kininmonth 1/ and kiln-drying data from PCA-ZRC and the Forest Products Industry Development Institute, U.P. - Los Baños, 2/ separate kiln-drying schedules were drawn up for 50 mm coco boards and 25 mm (and thinner) coco boards A slight modification was introduced on Kininmonth's recommended drying schedule for 50 mm coco boards to provide for a stage designed to accelerate drying of the boards to 30% moisture content. The resulting kiln-drying schedules are presented in Annex XVIII.

Oven-drying tests were conducted on the coco sample boards at the IFMC (SPDA) Laboratory (see Figures 30 and 31), as this was not available at DGLC. Correspondingly, the sample boards size was designed to fit the capacities of the IFMC oven and triple rod weighing balance. The procedure for the preparation, handling and disposition of the coco sample boards are given in Annex XIX.

1/ "CURRENT STATE OF KNOWLEDGE OF DRYING COCONUT WOOD", J. A. Kininmonth, Forest Research Institute, Rotorua, New Zealand, 1983.

2/ "AIR- AND KILN-DRYING OF COCO WOOD", L. J. Peñamora, CWUT 310, PCA-Zamboanga Research Center, Zamboanga City, 1983.

"SEASONING CHARACTERISTICS OF COCONUT LUMBER AND POLES", Casin, R. F. and F. N. Tamolang. Paper presented at the Coconut Stem Utilisation Seminar, Tonga, October 1976.

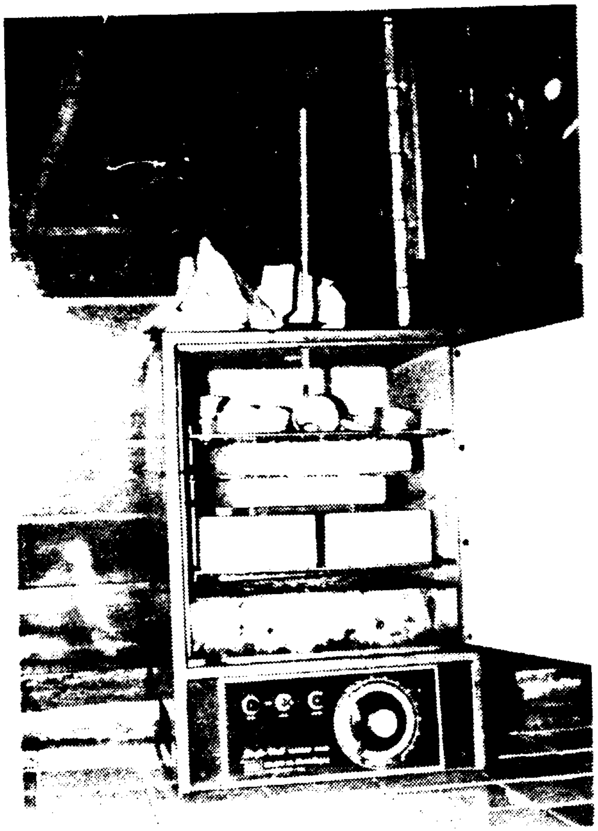


Figure 30

[illegible]

Figure 31

We[illegible]ing oven - dried core [illegible]
sample boards at the S[illegible] laboratory.

The first kiln charge (see Figures 32 and 33) consisted of approximately 13.6 cu.m. of 50 mm coco boards; while the second load was a mixture of 9.4 cu.m. of 25 mm, 19 mm and 12.5 mm boards. The kiln chamber was then filled with corresponding thicknesses of "LAUAN" lumber to obtain full kiln loads.

Actual kiln-drying time for the 50 mm boards starting from an average moisture content of 44% MC was 288 hours, while that for thin boards (mixed load of 25 mm, 19 mm and 12.5 mm boards) starting from an average moisture content of 30%, was 144 hours, to obtain a final MC of 15% to 16% in both kiln loads. Kiln-drying degrades were negligible - mostly surface checks and slight cupping of the top layer boards of both kiln loads.

V. WOODWORKS OPERATIONS

5.1 SURFACING AND PROFILING

An old planer-matcher (presumably pre-World War II model), see Figures 34 and 35, was rehabilitated to good working condition. The technical specifications of the machine, as best as could be determined, are given in Annex IV.

All cutterhead knives were re-ground at a grinding angle of 40° to obtain a cutting angle of 35°. The machine normally requires only 3 workers to operate when milling traditional species lumber. However, in view of the heavier weights of coco lumber (particularly the 50 mm thick boards) 5 men were required to surface/profile coco boards on the machine (2 men feeding, 2 men catching and 1 operator). The machine was operated at a low feed speed of 12 meters per minute to obtain satisfactory surface smoothness.

S4S operations were successful with the use of plain HSS knives ground to 35°cutting angle. However, plain HSS knives proved to be too soft for profiling operations (to produce T & G and V-cut boards). As it was not possible to import TCT knives in view of the existing economic constraints in the country, an alternative solution was developed. The cutting faces of the profiling knives

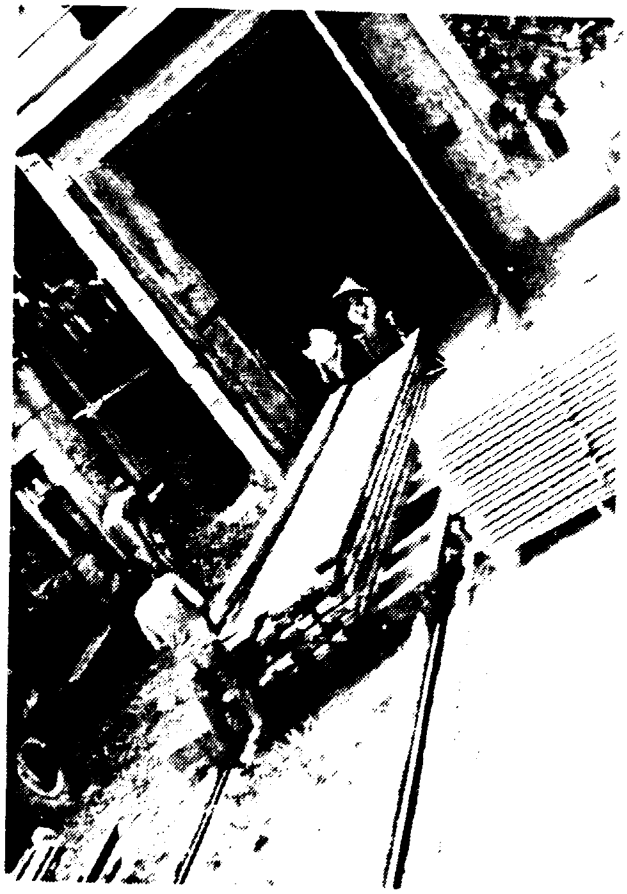
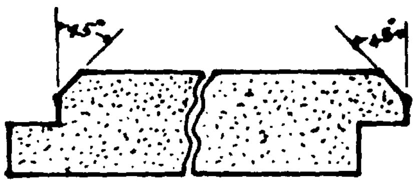


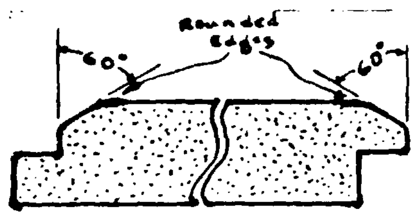
Figure 23

In-feed doors of 95 cu.m. kiln-drying chamber, BCLC.

were ground and coated with a 2.5 mm x 9.5 mm layer of Stellite No. 12, using as much as 1.5 times the heat applied to stellite tipping on bandsaw blades. The stellite-tipped knives were then re-ground to obtain the desired 35°cutting angle. The stellite-tipped knives had to be re-sharpenend (honed) after every 2,000 meters of profiling run. Further improvement of the stellite tipping technique is indicated by the conditions of the stellite-tipped knives after the final profiling run (see Figures 35-A to 35-C). A heavier and wider deposit of stellite is indicated in the burnt (dark) areas shown in Figures 35-A and 35-B. Furthermore, it appears that better profiling cuts on coconut lumber can be attained by decreasing the profile sharpness, i.e., avoiding 90° profiles, if possible, as shown in the sketch below :



Original Cross-section
V-Cut Board



Revised Cross-section
V-Cut Board

The cost of stellite tipping the HSS profiling knives was negligible, ₱500.00 ($30.00) for an estimated knife life of 100,000 meters of profiling run, or ₱0.005 ($0.00036) per meter of profiled boards.

The following machine set-up and knife maintenance data were obtained during a surfacing and profiling run with an output of approximately 1200 meters of S4S and about 400 meters of T & G stock :

TABLE X

OPERATIONS DATA - SURFACING AND PROFILING

1. Materials Input - Coconut Lumber, 2 weeks air-dried
2. Feed Speed Used :

   i - Low : 10 meters per minute

   ii - High : 17 meters per minute

Figure [illegible]

In-feed end of Planer-Matcher [illegible]
[illegible] operations of 50 x 150 mm [illegible]

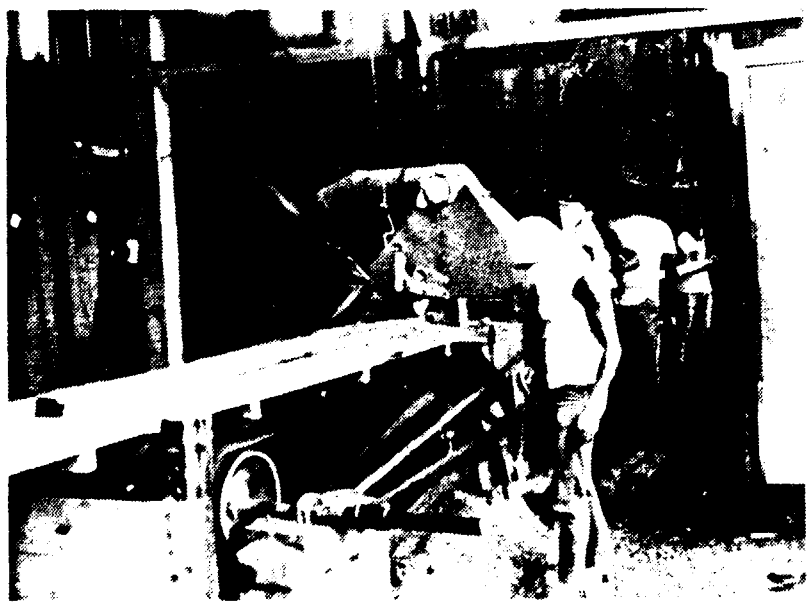


Figure [illegible]

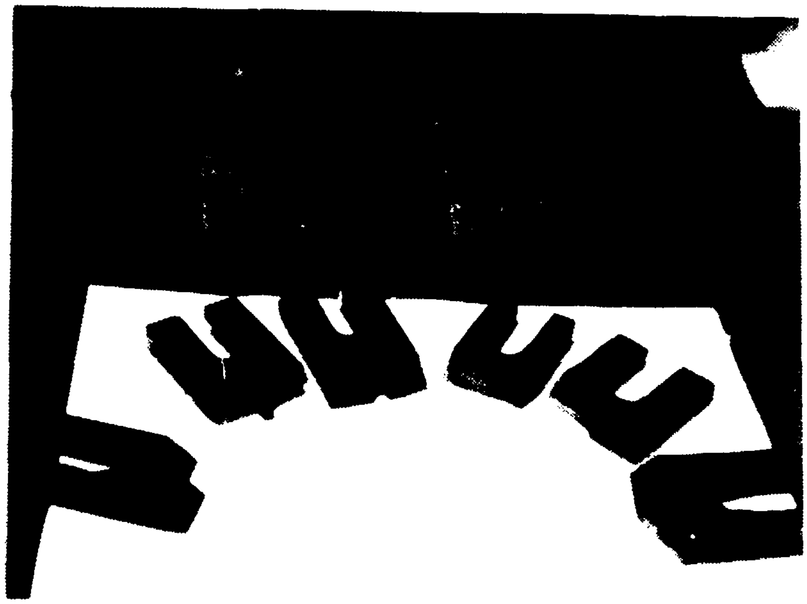
[illegible] of Planer-Matcher [illegible]
[illegible]

Figure 35-A

Stellite-tipped profiling knife for V-cut boards. (Note burnt areas on right side of knife indicating need for heavier deposit of stellite tipping material at those points of the knife edge.)

Figure 35-B

On the left foreground are 3 plain HSS profiling knives, while on the right foreground are 3 HSS profiling knives with stellite tips. On the background, V-cut board sections profiled with plain HSS knives (left) and stellite-tipped knives (right).



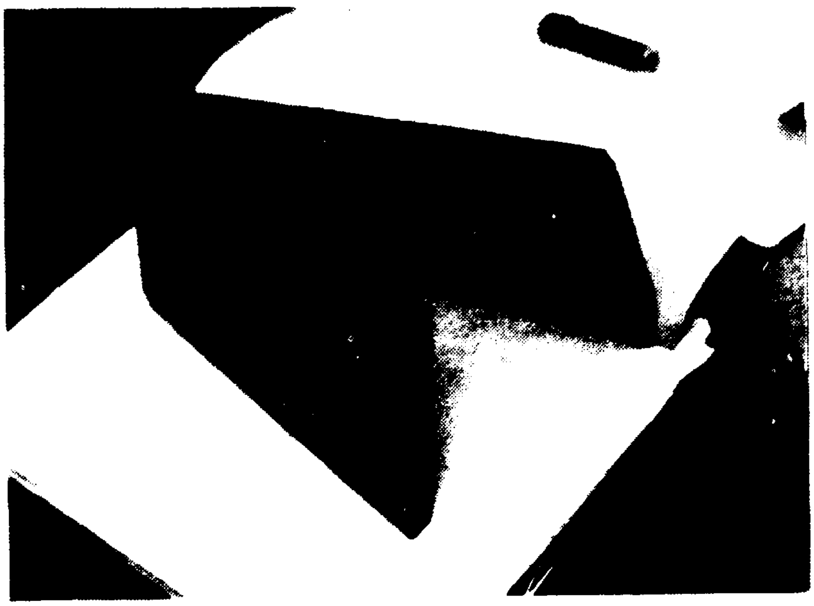


Figure 35-C

Close-up view of V-cut board sections indicating milling defects resulting from use of plain HSS knives (foreground) and the improved profile achieved with the use of stellite-tipped HSS profiling knives.

3. Operations Time :

Loading - 5 seconds per 500 mm long workpiece
Average Run Per Workpiece - 12.5 meters per minute
Unloading - 3 seconds per 500 mm long workpiece

4. Cutterheads Set-up Time :

i - All 4 knives, plain	- 20 minutes
ii - Two Vertical Head Knives, plain	- 8 minutes
iii - T & G Knives, Vertical Heads	- 30 minutes
iv - V-Cut Knives, Vertical Heads	- 30 minutes
v - Two knives, each for two horizontal heads	- 15 minutes

5. Knife Grinding Time :

i - Plain Knife, 150 mm long	- 6 minutes per piece
ii - Plain Knife, 200 mm long	- 10 minutes per piece
iii - T & G Knives	- 15 minutes per pair
iv - V-Cut Knives	- 15 minutes per pair

Note : a) Knives are re-ground after each 3000 meters run.

b) Grinding times for T & G and V-Cut knives were supplied by the machine operator.

5.2 ROOFING SHINGLES PRODUCTION

Blanks for roofing shingles were cut from 38 mm x 100 mm boards, Grade B and C, and from trimmings of 50 mm x 100 mm Grade A boards. The coco lumber grade distribution of roofing shingles blanks is roughly : 5% Grade "A", 15% Grade "B" and 80% Grade "C", and are 38 mm x 100 mm x 400 mm. Two shingles were cut from each blank with the use of a simple cutting jig (see Figures 36, 27, 28, 29 and 40). Roofing shingles were fabricated at the Mahusay Box Factory, a subsidiary of DGLC.

The sequence of operations for cutting roofing shingles is as follows :

i - Trim boards to 400 mm lengths on trimmer saw.

ii - Re-saw thickness of blanks to 40 mm on table bandsaw.

iii - Slant re-saw blanks on band re-saw with the use of cutting jig, to obtain two shingles from each blank

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[illegible]

[illegible]

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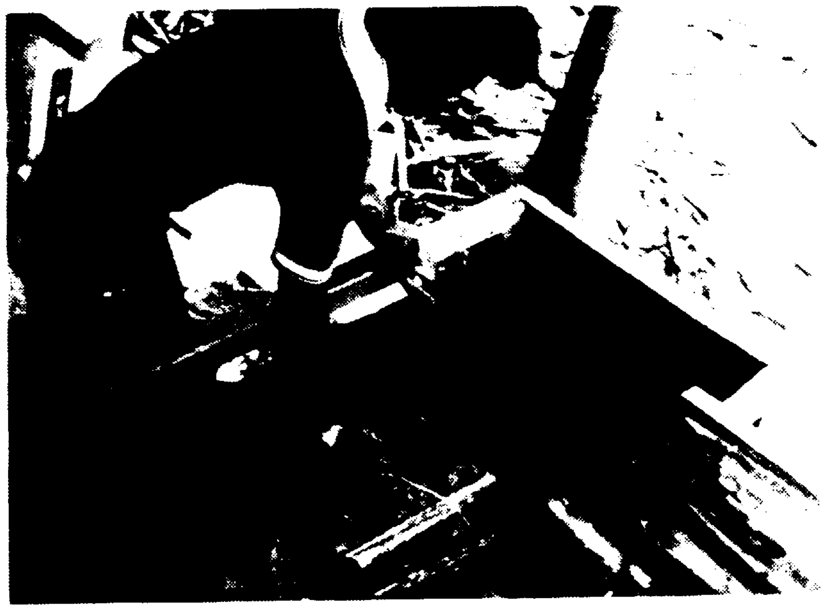


Figure [illegible]

Dipping newly cut [illegible] wood [illegible] in NaPCP Solution.

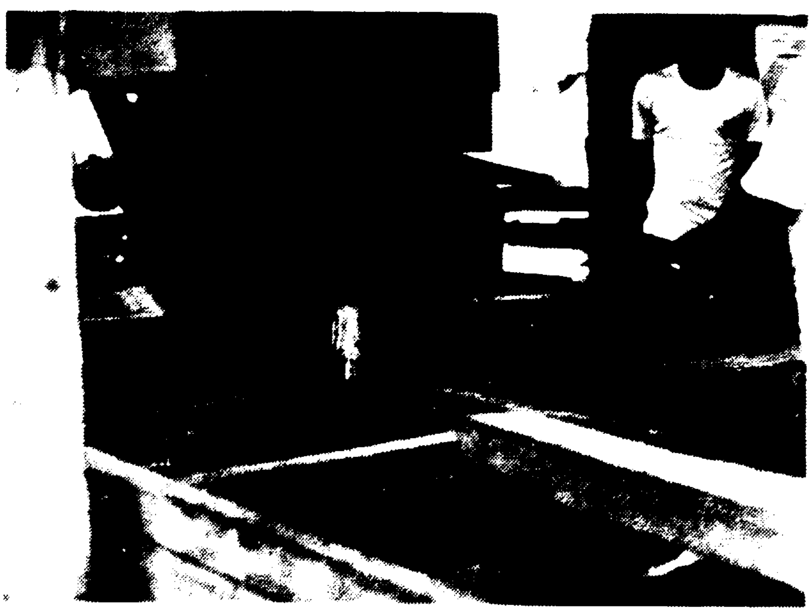


Figure [illegible]

[illegible] air [illegible] drying for [illegible] iv - Dip shingles in anti-fungus (1.5% NaPCP) solution.

v - Stack treated shingles to facilitate air-drying.

The following production data were obtained :

TABLE XI

OPERATIONS DATA - ROOFING SHINGLES FABRICATION

1. Manpower Used :

   Trim Saw :

   Machine Operator - 1 man
   Out-Feed Helpers - 3 men

   Bandsaw :

   Machine Operator - 1 man
   Helpers - 2 men

2. Materials Input - 38 x 100 x 6000 mm Grade "B" and "C" Coconut Lumber

3. Product Output - 19 x 100 x 400 mm roofing shingles

4. Sawblades Grinding/Filing times : change blades every 3 hours run.

5. Outputs :

   i - Cutting 6000 mm coco boards to 400 mm lengths - 1500 pieces per hour

   ii - Re-sawing 38 x 100 x 400 mm blanks into 19 x 100 x 400 mm shingles - 1500 pieces per hour

5.3 RIDGE ROLL AND EAVES FLUSHING

Coco wood Ridge Roll and Eaves Flushing were specially designed and fabricated for the demonstration coco house. 125 x 125 mm x RL coco material were specially cut at the DGLC sawmill. Ridge Rolls with 25 mm thick legs and 126° internal angle, and Eaves Flushing with 25 mm thick legs and 90° internal angle were fabricated at the Mahusay Box Factory. The pendulum type trim saw was set-up to cut the 125 x 125 mm coco material, 25 mm away from two edges, as shown in Figure 41. The legs of the resulting angular pieces were then re-sawn to 100 mm widths, to make up for width variations caused by severe wanes on the apex of the angle formed. There were nine (9) pieces ridge roll fabricated with an aggregate length of 17 meters;

while 14 pieces (with an approximate total length of 31 meters) made up the required length of Eaves Flushing, including the canopy requirement.

The production data thus obtained are as follows :

TABLE XII

OPERATIONS DATA - RIDGE ROLL AND EAVES FLUSHING FABRICATION

Operation	Equipment	No. of Man-Hour Used
Bucking to 3000 lengths	600 mm Chainsaw	0.75 man-hour
Ripping on Special Trim Saw Set-up	500 mm TCT, Circular Sawblade, with 0.75 KW Electric Motor	15.00 man-hours

Saw Set-up Times (2 Men) :

(a) Eaves Flushing - 1.25 man-hours
(b) Ridge Roll - 2.50 man-hours

Both the Ridge Roll and Eaves Flushing were treated with CCA using the same method as that for roofing shingles.

VI. COCO LUMBER COST

6.1 GENERAL APPROACH IN COSTING SCHEME

Implementation of the Project was started late September 1983, before the effects of the latest devaluation of the Philippine Peso could stabilize. Thus, materials and labour costs increased by leaps and bounds during the last quarter of 1983 and January 1984. Prices of construction materials are still increasing at this writing.

Furthermore, the increase of unit labour cost in government pay scale lagged behind unit labour pay increases in the private sector. Thus a marked difference in actual cost structure was evident in the cost of coconut logs cut in the Lanang Area (September-

October 1983 operations) and the cost of logs cut in the Darang Area (December 1983 to January 1984 operations).

The fast-increasing cost picture also greatly affected the sawmilling charges. The original DGLC commitment was ₱678.40 (US$48.45) per cu.m. or ₱1.60 per board feet, for November - December 1983 sawmilling run. This was increased to ₱448.00 (US$60.56) per cubic meter, or ₱2.00 per board feet, when actual sawmilling operations could be done in early January 1984. It is even doubtful if DGLC would agree to the same charges for sawmilling runs later in 1984 or thereafter.

In order to arrive at a more realistic cost picture of the Project, new costs were calculated based on the following considerations :

i - Prevailing industry labour pay rates and equipment/machine rental schedules ; and

ii - Actual labour and equipment usage figures.

6.2 COCO LOG COSTS

Assuming that coco logs'cut in the Lanang Area were also paid for at the same cost as those produced in the Darong Area (₱25.00 per tree, including felling and bucking), the re-calculated logs costs are as shown below :

6.2.1 Cost of Coconut Tree, including Felling and Bucking

TABLE XIII

COST OF COCO TREE, FELLING AND BUCKING

Logging Area	No. of Trees Felled	Vol. of Log Bolts Produced, cu.m.	Total Cost of Tree, Felling and Bucking	Cost/ cu.m.
Lanang	121	74.54	₱3,025.00	₱40.58
Darong	183	128.14	4,575.00	35.70
Total --	304	202.68	₱7,600.00	₱37.50

It should be noted that only about 2/3 of the coconut tree trunks was actually sold to and used by SPDA (see Section 2.1, paragraph 2, and Section 2.2, paragraph 2).

6.2.2 Yarding (Skidding) Costs

The re-calculated yarding costs from cutting site to loading point are as follows :

TABLE XIV

YARDING (SKIDDING) COSTS

A. Labour Cost :

Logging Area	Type of Labour	Man-Hours Used	Unit Labour Cost ₱/Man-Hour	Total Labour Cost
Lanang	Skilled	24	₱3.75	₱ 90.00
	Unskilled	32	2.50	80.00
Darong	Skilled	48	3.75	180.00
	Unskilled	120	2.50	300.00
	Totals -----	224 Man-Hours		₱650.00

B. Equipment Usage :

Logging Area	Type of Equipment	No. of Hours Used	Cost of Use/Hour	Total Cost
Lanang	120 Hp. Farm Tractor	24 hours	₱40.00	₱ 960.00
Darong	120 Hp. Farm Tractor	48 hours	50.00	2,400.00
	Totals ----	72 hours		₱3,360.00

(Note : Cost of equipment use includes cost of fuel and lubricants, but does not include operator's wage.)

C. <u>Site Yarding Costs</u> :

Logging Area	Labour Cost	Cost of Equipment Use	Total Yarding Cost
Lanang	₱170.00	₱ 960.00	₱1,130.00
Darong	480.00	2,400.00	2,880.00
Total	₱650.00	₱3,360.00	₱4,010.00

D. <u>Project Unit Yarding Cost</u> :

$$\frac{₱4{,}010.00}{202.68 \text{ cu.m.}} = ₱19.78 \text{ per cu.m. of coco roundwood}$$

6.2.3 <u>Project Loading, Hauling and Unloading</u>

The labour cost of loading at each logging area and unloading at destination site are re-calculated as follows :

TABLE XV

LOADING AND UNLOADING COSTS

A. <u>Loading Costs</u> :

Site	Volume Loaded	Man-Hours Used	Unit Labour Cost	Total Labour Cost
Lanang	74.64 cu.m.	56 man-hours	₱2.50	₱140.00
Darong	128.14 cu.m.	120 man-hours	2.50	300.00
Total --	202.68 cu.m.	176 man-hours		₱440.00

B. <u>Unloading Costs</u> :

Site	Volume Unloaded	Man-Hours Used	Unit Labour Cost	Total Labour Cost
SPDA Construction Site	25.19 cu.m.	20 man-hours	₱2.50	₱ 50.00
DGLC Sawmill	177.49 cu.m.	120 man-hours	2.50	300.00
Totals -----	202.68 cu.m.	140 man-hours		₱350.00

(Note : Use of forklift/front loader at mill site is not included in above costs, as this cost is part of milling fees, as agreed with DGLC.)

C. Summary of Loading and Unloading Costs :

Loading Costs	₱440.00
Unloading Costs	350.00
Total Loading and Unloading Costs	₱790.00

D. Project Unit Loading and Unloading Costs :

$$\frac{₱790.00}{202.68 \text{ cu.m.}} = ₱3.90 \text{ per cu.m. of coco roundwood}$$

The actual hauling costs were low and are deemed unrealistic as government-owned trucks were used. The following hauling costs are based on prevailing truck hiring rates (which include cost of fuel, lubricants and the wages of the driver and one helper.)

TABLE XVI

COCO LOG HAULING COSTS

Origin	Destination	Hauling Distance	Vol. of Logs Hauled (cu.m.)	Unit Hauling Cost	Total Hauling Cost
Lanang Area	SPDA Construction Site	17 kms.	25.19 cu.m.	₱7.50*	₱ 3,084.22
Lanang Area	Sawmill Site	14 kms.	49.35 cu.m.	7.50*	5,181.75
Darong Area	Sawmill Site	60 kms.	128.14 cu.m.	7.50*	57,663.00
		Total	202.68 cu.m.		₱65,928.97

Project Unit Hauling Cost :

$$\frac{₱65,928.97}{202.68 \text{ cu.m.}} = ₱325.29 \text{ per cu.m. of coco roundwood}$$

(Note : Unit hauling charges marked * are prevailing hauling fees in Davao area.)

6.2.4 Summary of Unit Log Costs

The cost of logs (25.19 cu.m.) delivered to SPDA construction site, of which 22.73 cu.m. were chainsawn into coco boards (for use as stakes, batten boards and scaffolding) is calculated as follows :

Cost Item	Ave. Cost cu.m.	% of Total Unit Cost
Cost of Coco Log Bolts	₱ 40.58*	22.3 %
Cost of Yarding	15.16*	8.3 %
Cost of Loading and Unloading	3.90	2.1 %
Cost of Hauling	122.44*	67.3 %
Total Unit Cost	₱182.08	100.0 %

(Note : Cost items marked * indicate costs of log bolts coming from Lanang logging area.)

The cost of coco log bolts (177.49 cu.m.) processed into coco lumber at the DGLC sawmill is calculated as follows :

Cost Item	Cost per cu.m.	% of Total Unit Cost
Cost of Coco Log Bolts	₱ 35.70	8.6 %
Cost of Yarding	22.47	5.4 %
Cost of Loading and Unloading	4.03	1.0 %
Cost of Hauling	354.07	85.0 %
Total Unit Cost	₱416.27	100.0 %

The over-all Project cost of coco log bolts are as follows :

Cost Item	Cost per cu.m.	% of Total Unit Cost
Cost of Coco Log Bolts	₱ 37.50	9.7 %
Cost of Yarding	19.78	5.1 %
Cost of Loading and Unloading	3.90	1.0 %
Cost of Hauling	325.29	84.2 %
Total Unit Cost	₱386.47	100.0 %

The log cost structures for the three categories listed above show the predominant influence of hauling costs on the total unit log costs. Thus, any efforts to bring down the cost of coco logs in future projects should be directed to shortening hauling distances from logging area to mill site.

6.3 COST OF CONVERTING COCO LOG BOLTS TO COCO LUMBER

Two methods of converting coco log bolts to coco lumber were used in this Project : (a) chainsawing and (b) bandsaw milling. Both methods were contracted to private contractors and payment was made on the basis of output volume.

The corresponding lumber costs for both methods are presented in the following paragraphs.

6.3.1 Chainsawn Lumber Cost

The cost of chainsawn lumber is as follows :

Cost of log bolts (at 44% lumber yield) delivered to SPDA construction site --------	₱ 433.52/cu.m.
Cost of chainsawing (₱1.45/Bd.ft. output) ----	614.80
Total Cost -------	₱1,048.32/cu.m.

6.3.2 Cost of Bandsawn Coco Lumber

The cost of lumber processed at the DGLC bandsaw mills is as follows :

Cost of log bolts (at 51% lumber yield) delivered to bandsaw mill ------------------	₱ 816.11/cu.m.
Cost of milling (₱2.00/Bd.ft. output) --------	848.00
Total Cost -------	₱1,664.22/cu.m.

(Note : The volume of coco log bolts milled at the Angala sawmill and the Mahusay Box Factory is so small compared to the volume milled at DGLC. Hence, assuming that all log bolts were milled at DGLC will not significantly affect the final cost of coco lumber.)

6.4 ADDITIONAL COCO LUMBER PROCESSING COSTS

Further processing charges, such as kiln-drying, surfacing, profiling and/or woodworks milling, on various coco wood components of the demonstration house were contracted to DGLC on the basis of input volume in the case of kiln-drying, by the input length in the case of profiling/surfacing and by the piece in the case of roofing shingles. These additional processing charges added to the cost of coco lumber as milled give the total cost of each group of coco wood components of the demonstration house. The costs given in the following paragraphs are ex-factory.

Transportation cost from mill site to SPDA construction site should be added to the listed costs to obtain the cost of each lumber item delivered to construction site.

6.4.1 Cost of Air-Dried, S4S, Coco Lumber

The cost (ex-factory) of air-dried, S4S, coco lumber per meter of dressed surface is calculated as follows :

TABLE XVII

COST OF AIR-DRIED, S4S, LUMBER (EX-FACTORY)

Cross Section	Input Volume per Meter Length	Cost of Coco Lumber/ Meter Length	S4S Charges/ Meter Length	Total Cost/ Meter Length Output
50 mm x 50 mm	0.00250 cu.m.	₱ 4.161	₱0.30	₱ 4.461
50 mm x 75 mm	0.00375 cu.m.	6.241	0.30	6.541
50 mm x 100 mm	0.00500 cu.m.	8.321	0.30	8.621
50 mm x 125 mm	0.00625 cu.m.	10.401	0.30	10.701
50 mm x 150 mm	0.00750 cu.m.	12.482	0.30	12.782
50 mm x 200 mm	0.01000 cu.m.	16.642	0.30	16.942
25 mm x 50 mm	0.00125 cu.m.	2.080	0.30	2.380
25 mm x 75 mm	0.001875 cu.m.	3.120	0.30	3.420
25 mm x 100 mm	0.00250 cu.m.	4.161	0.30	4.461

6.4.2 Cost of Kiln-Dried, S4S, Coco Lumber

The cost (ex-factory) of kiln-dried, S4S, coco lumber per meter of dressed surface is as follows :

TABLE XVIII

COST OF KILN-DRIED, S4S, COCO LUMBER (EX-FACTORY)

Cross Section	Input Volume per Meter Length	Cost of Coco Lumber/ Meter Length	Kiln-Drying Charges per Meter	S4S Charges per Meter	Total Cost/ Meter Length Output
50 mm x 50 mm	0.00250 cu.m.	₱ 4.161	₱1.272	₱0.30	₱ 5.733
50 mm x 75 mm	0.00375 cu.m.	6.241	1.908	0.30	8.449
50 mm x 100 mm	0.00500 cu.m.	8.321	2.544	0.30	11.165
50 mm x 125 mm	0.00625 cu.m.	10.401	3.180	0.30	13.881
50 mm x 150 mm	0.00750 cu.m.	12.482	3.816	0.30	16.598
50 mm x 200 mm	0.01000 cu.m.	16.642	5.088	0.30	22.030
25 mm x 50 mm	0.00125 cu.m.	2.080	0.636	0.30	3.016
25 mm x 75 mm	0.001875 cu.m.	3.120	0.954	0.30	4.374
25 mm x 100 mm	0.00250 cu.m.	4.161	1.272	0.30	5.733

6.4.3 Cost of Kiln-Dried, Profiled Lumber Items

The cost (ex-factory) of T & G and V-Cut coco boards are calculated as follows :

TABLE XIX

COST OF T&G AND V-CUT COCO BOARDS PER METER LENGTH (EX-FACTORY)

Cross Section	Input Volume per Meter Length	Cost of Coco Lumber/ Meter Length	Kiln-Drying Charges per Meter	Profiling Charges	Total Cost/ Meter Length Output
25 mm x 100 mm	0.002500 cu.m.	₱4.161	₱1.272	₱0.30	₱5.733
25 mm x 75 mm	0.001875 cu.m.	3.120	0.954	0.30	4.374
19 mm x 100 mm	0.001900 cu.m.	3.162	0.954	0.30	4.416
12.5 mm x 100 mm	0.001250 cu.m.	2.080	0.636	0.30	3.016

6.4.4 Cost of Components Treated with CCA

Current quoted price for CCA is ₱60.00 per kilogram, and ₱176.67 per kilogram for copper sulphate ($CuSO_4$). Thus, the material cost when dipping in 3% CCA solution is ₱60.00 per kilogram of deposit , while that for dipping in 3% copper sulphate solution will cost ₱176.67 per kilogram of deposit, assuming that the cost of water is negligible.

In view of the unavailability and high cost of $CuSO_4$, it was decided to use the diffusion method of CCA treatment. Coco lumber is dipped first in boiling water until the wood temperature is raised to 100°C, then the hot coco lumber is immediately soaked for a specified period of time (soaking time directly proportional to coco lumber thickness) in the cold CCA solution (see Annex XVII).

Thus, the cost of preserving coco wood by the CCA diffusion method is calculated as follows (assuming costs of water and firewood are negligible) :

Material (CCA)	: ₱60. x 1.18745 kg./cu.m.	= ₱ 71.247/cu.m.
Labour	: 2 men x 6 hours x ₱2.50	= 30.00 /cu.m.
	Total Cost ------	₱101.247/cu.m.

6.4.5 Cost of Roofing Shingles

Fabrication of coco wood roofing shingles was contracted to DGLC at ₱0.32 per piece, including cost of dipping in anti-fungus solution. The total cost of roofing shingles, treated with CCA, ready for installation, is calculated as follows :

Cost of Coco Wood Input --------------------	₱1,664.220/cu.m.
Cost of Shingles Fabrication ---------------	516.160/cu.m.
Cost of CCA Preservation ------------------	101.247/cu.m.
Total Cost ---------	₱2,281.627/cu.m.

Since there are 1,613 pieces of coco wood roofing shingles in one cubic meter, then the cost per piece of shingle is :

$$\frac{₱2,281.627}{1,613.00} = ₱1.415 \text{ per piece}$$

6.4.6 Coco Board Surfaces Treated with Creosote-borne NaPCP

The cost of protecting coco wood components (applied by brushing) from termite infestation is calculated as follows :

Cost of Materials Used :

0.39 liters/sq.m. x ₱47.79/liter = ₱18.64/sq.m.

Cost of Labour :

$$\frac{\text{₱2.50/man x 2 man-hours}}{\text{12.36 square meters}} = 0.40$$

Total Cost ----------- ₱19.04 per square meter of coated surface

Note : For coco wood components in contact with masonry works, the cost of applying the preservative on the corresponding concrete area should also be added to the cost of coating the coco wood surface, to obtain a more realistic cost picture.

VII. ECONOMIC ASPECTS OF COCO LUMBER AS A CONSTRUCTION MATERIAL

7.1 COCO LUMBER AS A SUBSTITUTE FOR TRADITIONAL WOOD SPECIES

Wide acceptance of coco lumber as a construction material substitute for traditional wood species (e.g., LAUAN, TANGUILE, APITONG, etc.) will be greatly dependent on its price advantage. Prevailing cost of White Lauan lumber is ₱1,865.60 (US$133.24) per cu.m. which is the lowest among the three species mentioned above. The corresponding cost of coco lumber as evolved in this Project is ₱1,664.22 (US$118.86) per cu.m. It is still doubtful whether the cost advantage of ₱201.00 (US$14.38) per cu.m. in favor of coco lumber, is attractive enough to overcome the initial customer's resistance to using a new wood specie, in addition to the fact that coco wood is harder to work than traditional wood species. Further technical studies coupled with market surveys, should give an indication of the price advantage required of coco lumber in order for it to be readily accepted as a substitute for Lauan, Tanguile or Apitong.

To that end, therefore, it is needed to look deeper into the cost structure of coco lumber and identify areas which provide potential cost reduction for the product. Among the more obvious areas indicated in this exercise, the following are worthy of further investigation :

i - Ways and means of reducing coco log hauling costs ;

ii - Further refinement of available sawmilling techniques

iii - Development of techniques to utilize 25 mm x 25 mm, 25 mm x 50 mm, and smaller laths which are usually obtained when re-processing slabs, cants, edgings and trimmings, especially the short pieces resulting from cutting logs with harvesting steps.

These and other cost reduction schemes which may be developed by looking at coco lumber processing as a complimentary activity to the processing of traditional species will help further increase the cost difference (in favor of coco lumber) to a level which will make coco lumber widely accepted as a construction material.

According to PCA estimates 1/ there will be available annually 5,400,000 coconut stems when the current coconut tree replacement program is in full swing. At an average usable roundwood volume of 0.90 cu.m. per coconut stem, and a lumber yield of 50%, this means 2,430,000 cubic meters of coconut lumber that can replace a corresponding volume of Lauan, Tanguile, Apitong, etc. for local consumption. In turn, this volume of traditional species lumber (or their more advanced wood products) can be exported. Based on current export price of Philippine Mahogany lumber (air-dried Lauan, Tanguile, etc.) at about US$1,000 per MBF (US$424 per cu.m.), the potential impact on the Philippine economy, in terms of foreign currency generation may be valued at about US$1,030,320,000 annually.

There is therefore that much of an incentive to exert all efforts to make coco lumber a widely accepted construction material, without even considering the possibility of exporting coco lumber (or its more advance manufacture) itself.

1/ MADRAZO, R.M. and JUSON, R.A. "THE PRODUCTION OF COCONUT LUMBER, SAWING AND SAWING FACILITIES", CWUT 103, PCA-Zamboanga Research Center, Zamboanga City, 1983.

7.2 MORE ADVANCED FORMS OF COCO LUMBER PRODUCTS

Current industry experience shows that more advanced forms of lumber products (doors, window frames, furniture, etc.) give at least a 200% value added to basic lumber cost. Bearing this in mind, and assuming that only 25% of the expected coco lumber production (at full development of the coco lumber processing industry) is converted to more advanced forms of coco lumber product, the impact on the national economy would be in terms of economic benefits to be derived from an additional gross products output of the order of ₱1,000,000,000 (US$71,418,360) annually from the advanced forms of coco lumber products alone.

However, there is still so much work to be done in order to make this a reality. Among others, the following aspects of the coco lumber processing industry need further study and/or immediate experimentation :

i - Development of more efficient kiln-drying techniques and schedules, both for local and export purposes ; and

ii - Accumulation of more technical information on the following aspects of woodworking :

- (a) choice of proper type and method of application of adhesives on coco lumber products ;
- (b) choice of proper type and method of use of industrial abrasives on coco lumber products ;
- (c) choice of proper system of finishing materials and their method of application on coco lumber products ;
- (d) adaptation of currently available cutting tools to facilitate woodworking operations using coco lumber ; and
- (e) development of product designs making use of coco lumber as the basic material.

So far, the results of this Project have indicated that the costs entailed by the special machining requirements of coco lumber using stellite tipped saws and carbide tipped blades in woodworking operations may be overcome through mass production of coco lumber products.

This is also indicated in the case of using coco lumber for housing and construction : production of pre-fabricated coco houses could be the solution to the problem of special machining requirements for coco lumber housing and building components.

VIII. THE DEMONSTRATION COCO HOUSE

8.1 CONSTRUCTION ACTIVITIES

Ground-breaking activities for the demonstration coco house were started in mid-November 1983. Excavations for concrete stilt footings and septic vault were completed by the first week of December 1983. Chainsawing coco stems to provide stakes, batten boards and scaffolding materials was also completed during the same week. Further progress in construction activities was slowed down as construction materials became scarce, electric power cut-offs and labour strikes temporarily closed the milling facilities of DGLC. The coco wood demonstration house was finally completed by 15 May 1984. Construction work progress is better seen in Figures 42 to 110.

8.2 SPECIAL CONSTRUCTION FEATURES

The principal objective in the design and construction of the demonstration coco house is to assure its acceptability as a bankable project. This entails structural design to assure adequate strength of the coco house to resist such natural calamities as typhoons, earthquake and heavy rains. Furthermore, all design features are expected to keep the house in good service conditions for at least 25 years under stresses of normal living activities.

The salient design features to make the coco house meet the above requirements are described in the following paragraphs.

8.2.1 Reinforced Concrete Stilts

Figures 51 to 53, show the reinforced concrete stilts on which the coco wood posts are mounted. Adequate footings for the stilts were also poured to assure stability of the structural framework and the house, as built.

[illegible]

[illegible]

Framework [illegible]
[illegible]
flooring completed.

[illegible]

4 Fe[illegible]

[illegible]

Figure 4?

4 February 1?

Scaffolding ... Structural ... was started.

Figure 46

7 February 1984

Scaffolding for Roof Structural members completed.

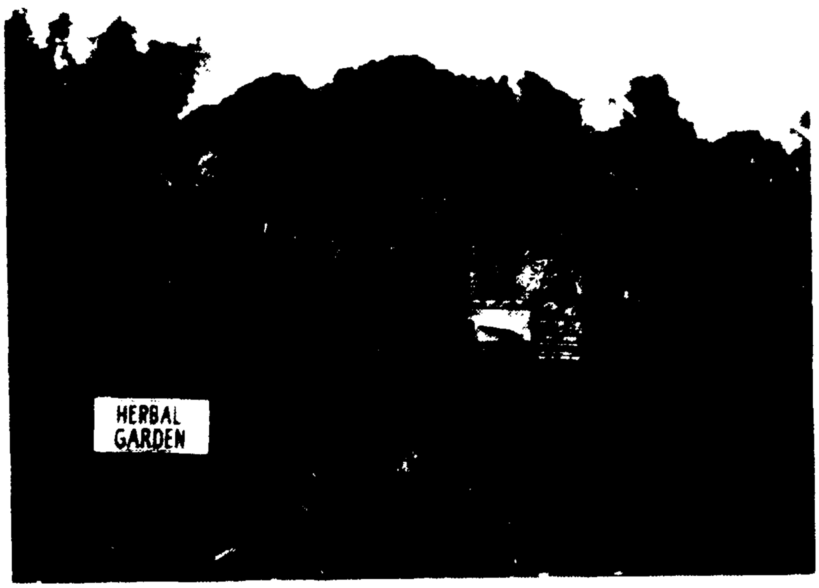


Figure ?

9 February 19?

Roof Girts ... started.

Figure 48

14 February 1984

Rafters installation started.

Figure 49

16 February 1984

Roof girts and rafters are completely installed.

Figure 50

17 February 1984

Floor girts and [illegible] completely install[illegible]

[illegible]

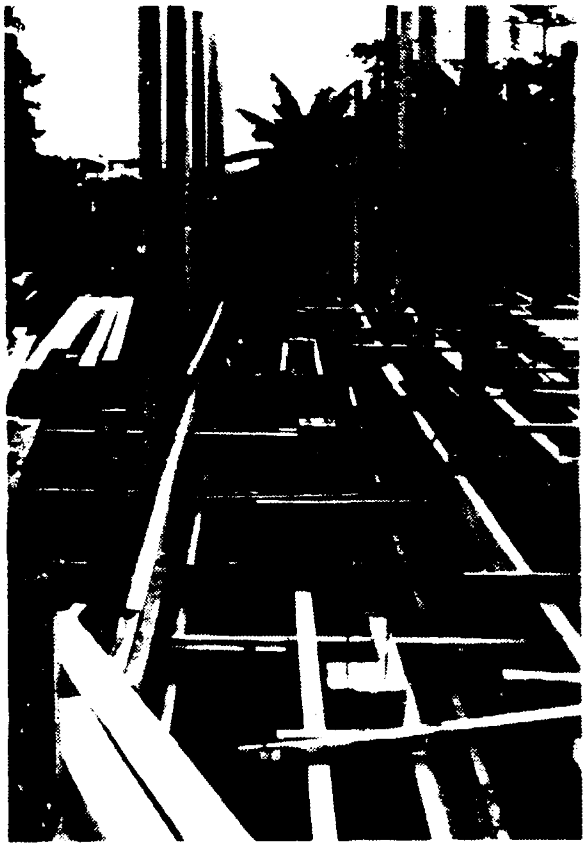


Figure 51

Concrete stilts ready for mounting of wood [illegible]

Note: All concrete [illegible] formwork and scaff[illegible]

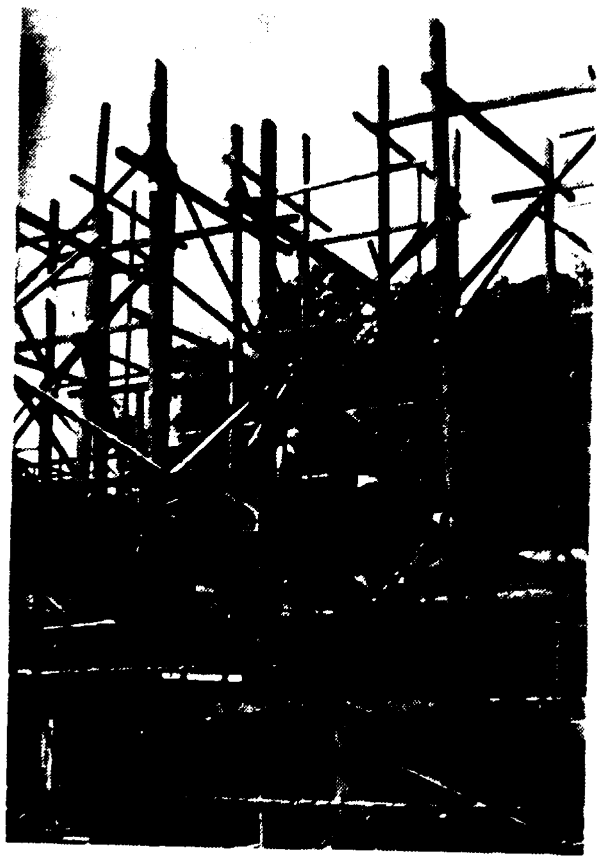


Figure 52

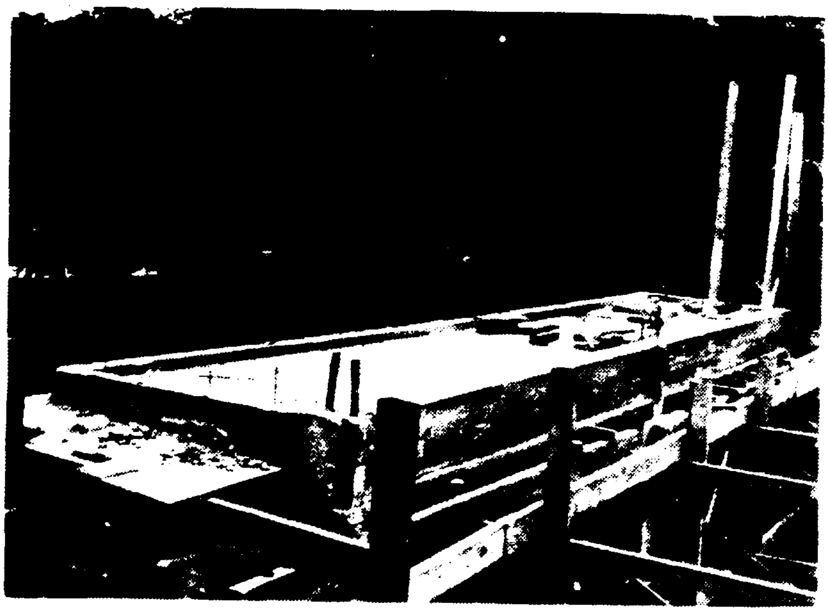
Scaffolding installation for Roof Curve and Purlins.

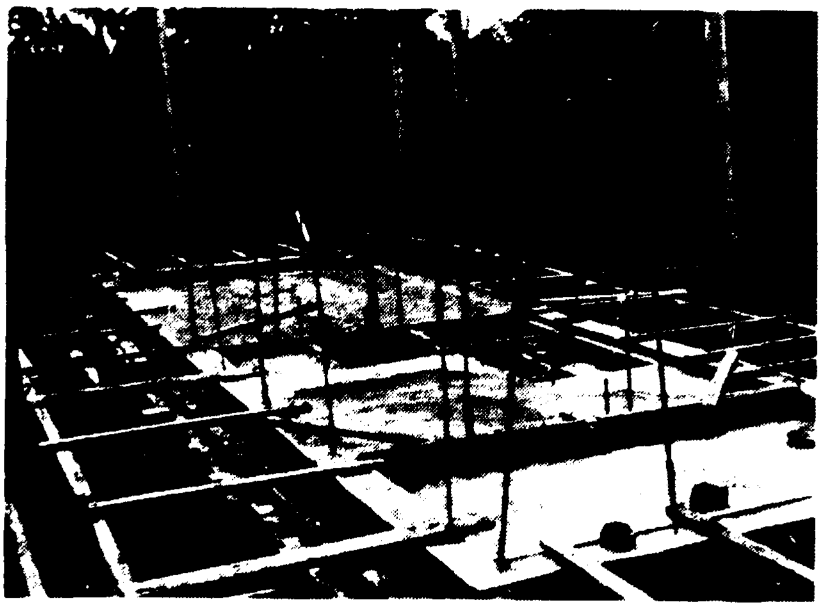
<u>Figure 53</u>

Ground Floor Masonry Works.

<u>Figure 54</u>

Concrete flooring for Balcony.





<u>Figure 55</u>

Concrete flooring for utility and bathroom areas. Note change of service stairs landing from [illegible] wood to concrete flooring.

8.2.2 Concrete Balcony Flooring

A concrete flooring was provided for the cantilevered balcony. Although the balcony is an optional construction feature, it was decided to construct it to obtain more data on the service life of coco wood railings and handrails which will enclose the balcony. Although the balcony flooring could have been of coco wood, it was held that available data on the structural strength of coco wood in service exposed to the weather elements and the expected load stress on the balcony floor do not favor the use of coco wood as balcony flooring. Figure 54 shows the reinforced concrete balcony flooring.

8.2.3 Concrete Flooring and Concrete-Hollow-Block Walls for Kitchen, Bathroom and Service Stairs Area

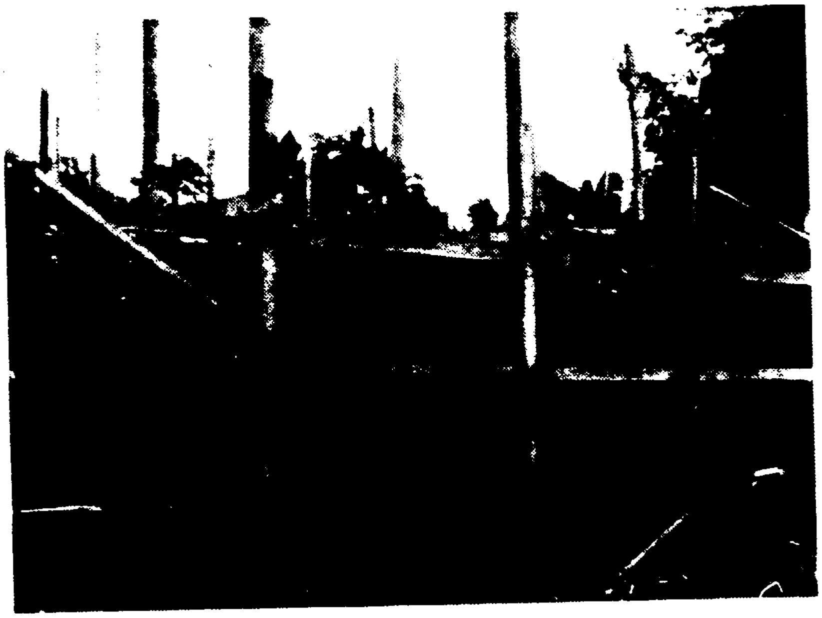
Figure 55 shows the reinforced concrete flooring for the kitchen, bathroom and service stairs area, while Figures 56 and 57 show the progress of work on laying concrete-hollow-block walls to separate the kitchen from the bathroom.

8.2.4 Coco Wood Posts

Structural requirements call for Grade "A", 100 mm x 100 mm coco wood posts. However, in view of the small diameters of coconut stems, it is impossible to cut 100 mm thick Grade "A" material from one coconut stem. Thus, it was decided to build up two pieces of 50 mm x 100 mm coco boards to make one unit of 100 mm x 100 mm wood post. Figures 58 and 59 show how this was done, including the measures taken to protect the built up coco wood post from termite infestation. Figures 60 to 64 show the method of erecting coco wood posts on the concrete stilts.

8.2.5 Steel Straps as Rafter Anchors

6 mm x 50 mm twisted steel straps and machine bolts were used to anchor rafter ends to the lower roof girts ; while the other rafter ends were bolted to the apex roof girts by means of 6 mm x 50 mm Y-steel straps. Figures 65 to 72 illustrate the use of twisted and Y-steel straps.



[illegible]

Figure [illegible]

[illegible]

Figure 58

Brushing Preservative (SOLIGNUM, a commercial brand [illegible] creosote) [illegible] on faces of coco wood posts [illegible] in contact upon assembly.

Figure 59

[illegible] together two 50 x 100 mm coco boards [illegible] 100 x 100 mm coco wood posts.

Figure 62

Temporary bracings are nailed on floor girts after coco wood post is aligned on steel straps. (Note suspension type of mounting floor girts, right background.

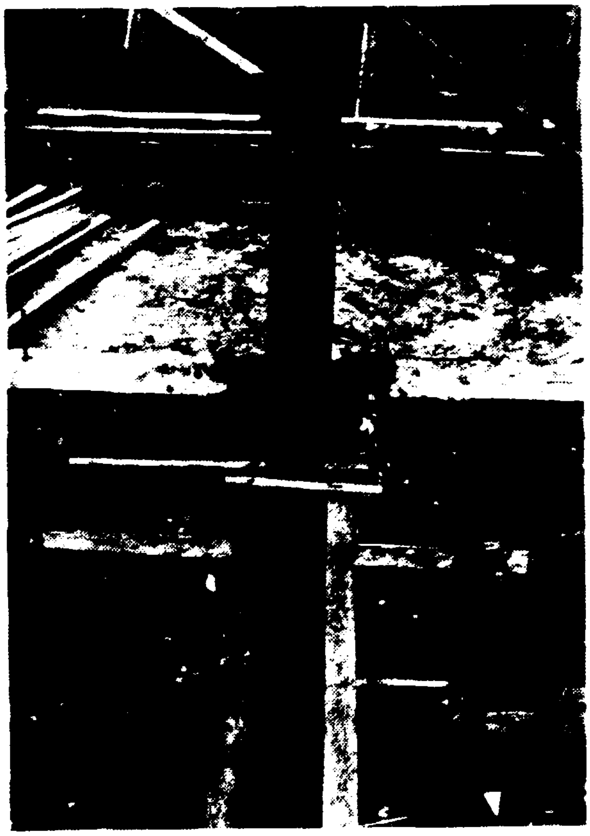


Figure 63

Coco wood post mounted on inside edge of concrete balcony floor. (Note two bolts embedded in concrete floor to mount steel straps for suspension type of installation floor joist girts abutting masonry works.)

Figure [illegible]

[illegible] machine bolts to [illegible] steel strap [illegible]

ROOF GIRTS AND RAFTERS INSTALLATION

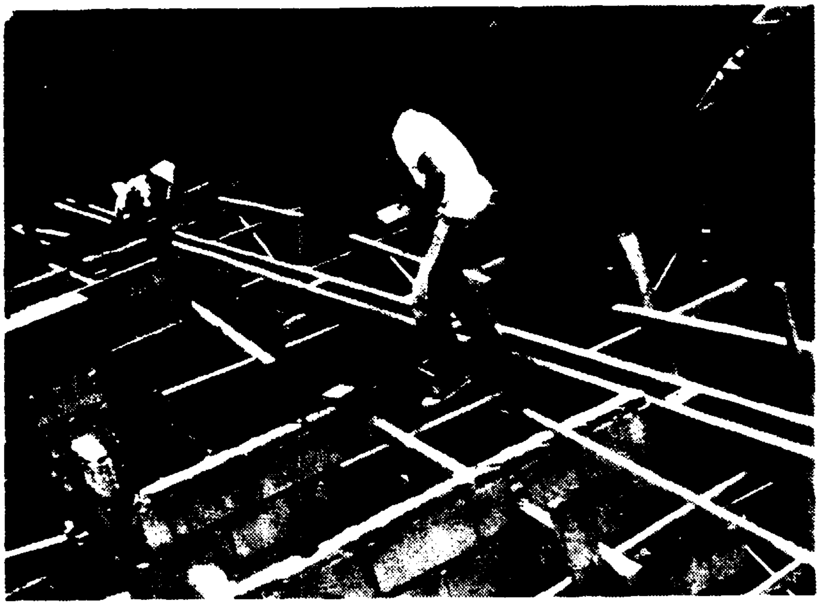


Figure 65

Installing roof girts over service stair, toilet and bath after masonry works.

Figure 66

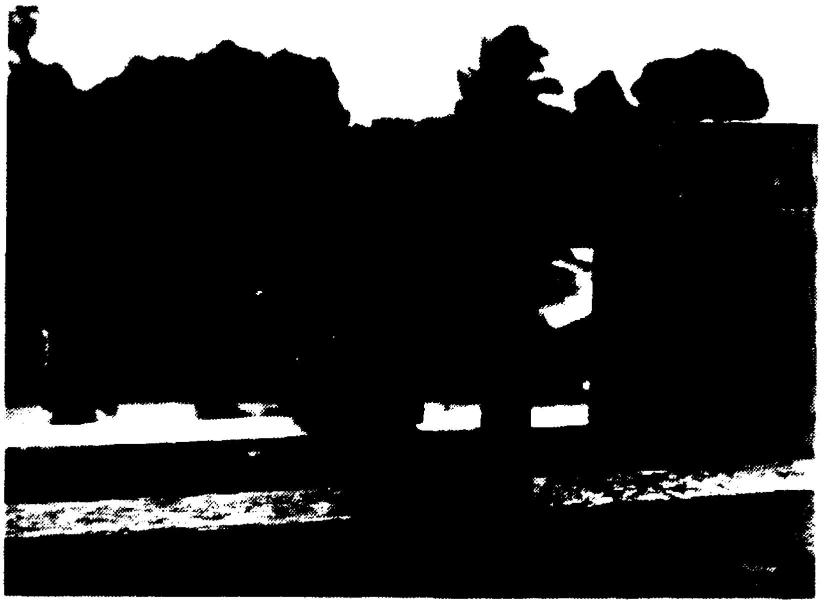
Boring holes for rafter steel mountings.

Figure 67

Twisted steel strap keeps rafter in place on roof girt mounting.

Figure [illegible]

Rafters installed in pl[illegible] [illegible]rts.



[illegible]

[illegible]

Figure 70

Y-Type steel straps ready to receive rafters on apex roof girts.

Figure 71

Close-up view of roof girt splicing and rafter joint at roof apex.

Figure 72

Another view of rafter joints at roof apex.

8.2.6 Suspended Connection of Floor Girt Ends

Floor girts whose ends abut concrete works were anchored to the concrete works by means of 6 mm x 50 mm twisted steel straps. Floor girts are anchored to the coco wood posts by machine bolts. Figures 73 to 75 illustrate the technique of anchoring floor girts to coco wood posts and concrete works including the application of anti-termite chemicals to both concrete and coco wood surfaces which come in contact upon installation.

8.2.7 Pilot Holes for Nails

The physical composition of coco wood makes it prone to splitting upon application of wedge type stresses through the thickness of the wood piece. Experience at PCA-ZRC showed that splitting of coco wood can be avoided if pilot holes were drilled before driving nails into coco wood. Figures 76 and 77 illustrate the application of this technique on the assembly of bridging blocks to adjacent floor joists, while Figure 78 shows the completed job.

Pilot holes had diameters equal to one size smaller than the nail shank diameters, and were drilled through the board being nailed to penetrate the next (anchor) board to a depth of at most 1/2 of the nail length penetrating into the anchor board. In case there were more than two boards being nailed together (as in the installation of roofing shingles), the first and intermediate boards were drilled through-and-through, while the anchor board was drilled to a depth of at most 1/2 of the nail length penetrating it. This technique was facilitated by attaching stoppers at the proper location on the drill bit.

Figures 79 and 80 show pre-drilling techniques being used in the installation of ridge rolls and roofing shingles, respectively. The pictures also show the completed assembly of studdings and nailers on both ends of the demonstration coco wood house. Pre-drilling also helped attain good alignment and positioning of the components fastened with nails.

FLOOR GIRTS, JOISTS AND BRIDGING INSTALLATION

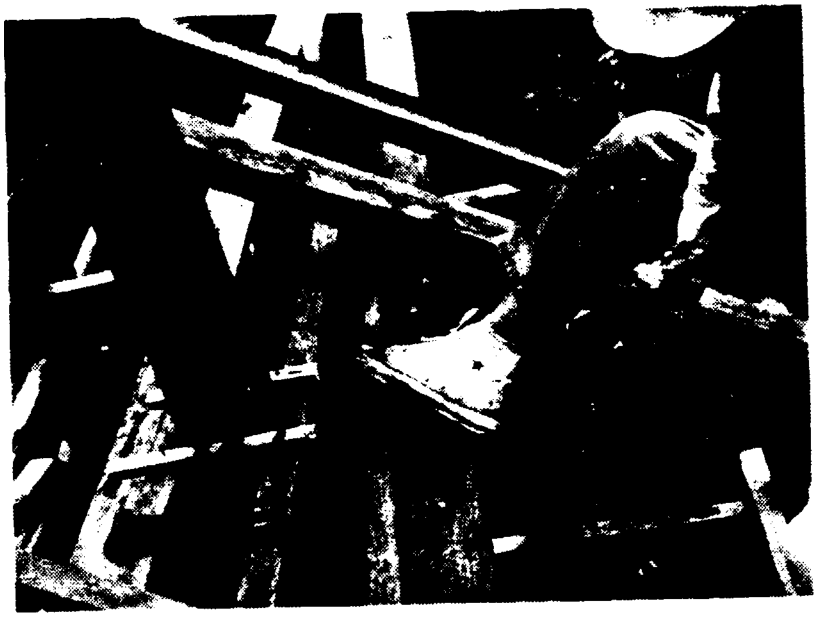


Figure 73

Boring holes for floor girt assembly to coco wood posts.

Figure 74

Brushing Solignum (creosote base paint) on [illegible] in contact with [illegible].

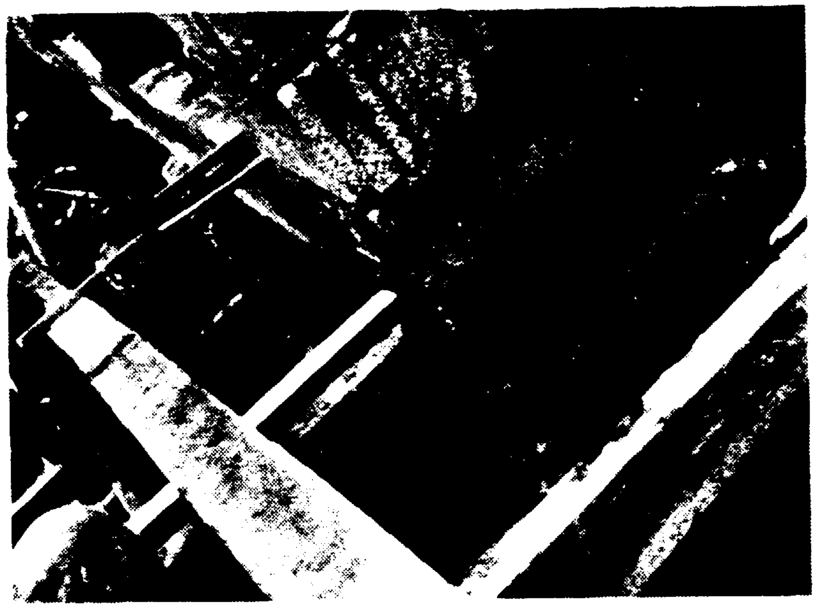


Figure 75

Suspension type of mounting floor joists on masonry walls.

Figure 76

Drilling pilot holes for nailing bridgings to floor joists.

Figure 77

Nailing bridging to floor joists.

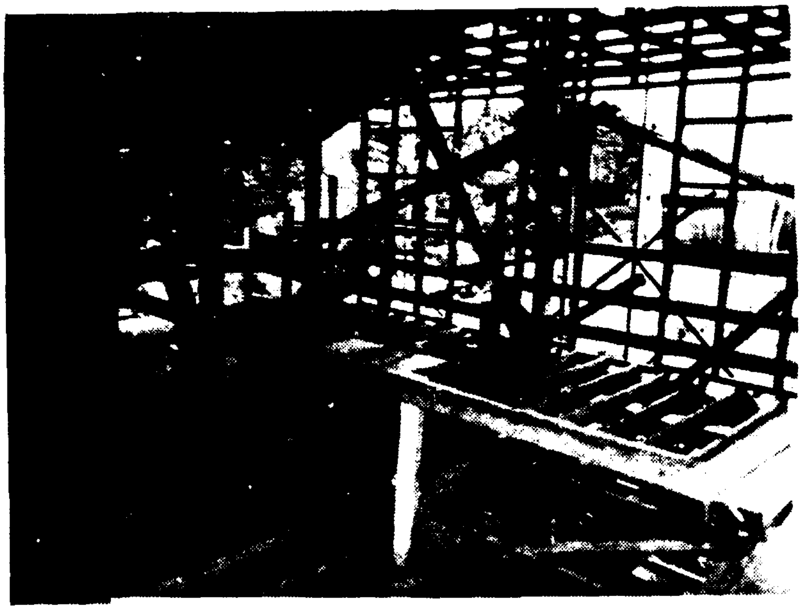


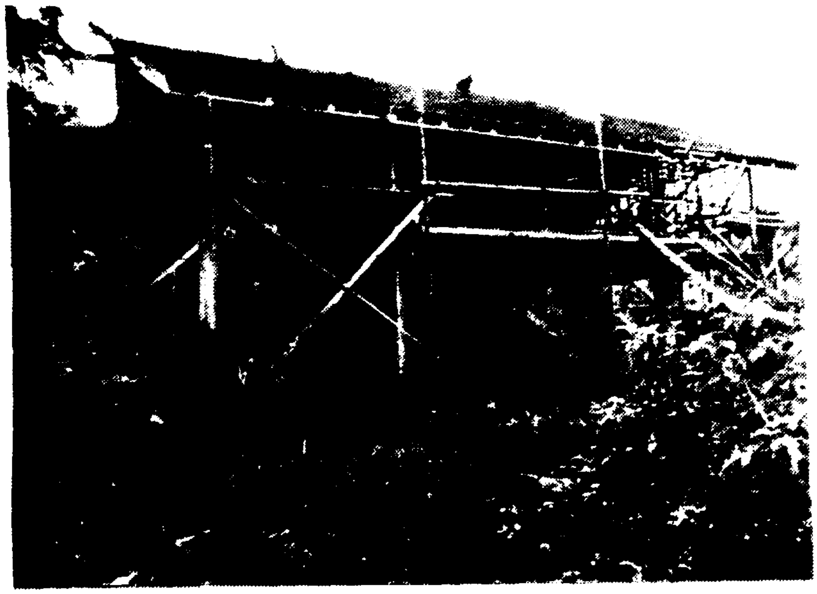
Figure 78

Nailers and studdings for interior walls and sidings under installation on north end of coco house, after completion of ceiling nailer frames and floor joist bridgings.

Figure 79

1st week of March

Front view of coco house under construction, with studs and nailers completely installed, on south face (left side of photo) and nailers on north face (right side of photo) being installed. Installation of ridge rolls on roof apex in progress.



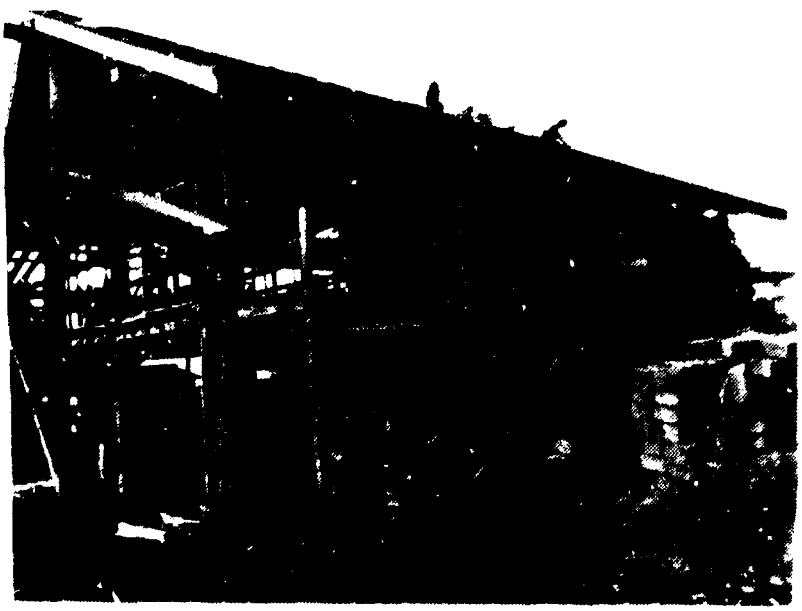


Figure 80

1st week of March

Corresponding rear view of coco house under construction. Piles of concrete hollow blocks await laying of septic vault walls.

8.2.8 Coco Wood Roofing Shingles

The coco wood shingles used in this Project were appreciably thicker than conventional wood shingles. The final milled dimensions of the coco wood shingles were 12 mm-21 mm x 100 mm x 400 mm. The increased dimensions are expected to make the shingles more resistant to the variable weather conditions in the locality (28°C to 30°C during the day and rain in the late afternoons and early evenings).

Marine Plywood (Type I, phenol formaldehyde adhesive) was used as sheathing between the purlins and the coco wood roofing shingles, to replace tar paper which was not available.

Figures 81 to 84 show the roofing system used in the demonstration coco wood house.

During the eight-week period between completion of the coco wood shingles roof and the installation of the coco wood ceiling, no leaks were observed on days of heavy rains. At this writing, 16 weeks from complete installation, the coco wood roofing shingles have withstood the local variable diurnal weather conditions (dry and wet within 24 hours) characteristic of Catalunan Pequeño, Davao City, as shown in Figures 81 to 84.

8.2.9 Gutters and Downspouts

Gutters and downspouts were not provided in the design of the demonstration coco wood house, the primary reasons being :

i - The demonstration coco wood house is a single isolated housing unit, and the rules for mass housing construction requiring the installation of gutters and downspouts do not apply ; and

ii - Exclusion of gutter and downspouts in the coco wood house design helped keep costs at low levels.

Figure 81

3rd week of March

Coco wood roof completed. View of shingles roofing looking north.

Figure 82

Installed ridge rolls specially fabricated from coconut trunk. Note use of galvanized iron nails and wire strapping material.

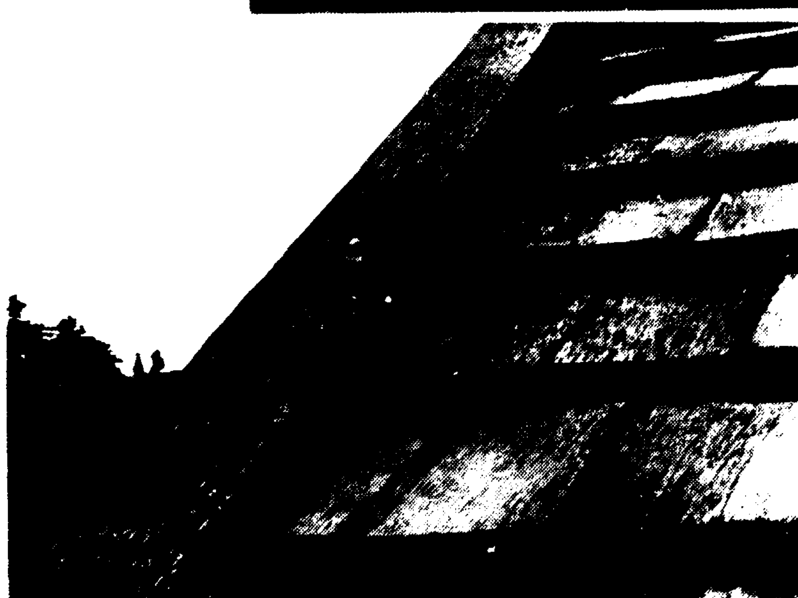


Figure 83

Coco wood eaves flushing installed with the use of galvanized iron nails and wire strapping material.

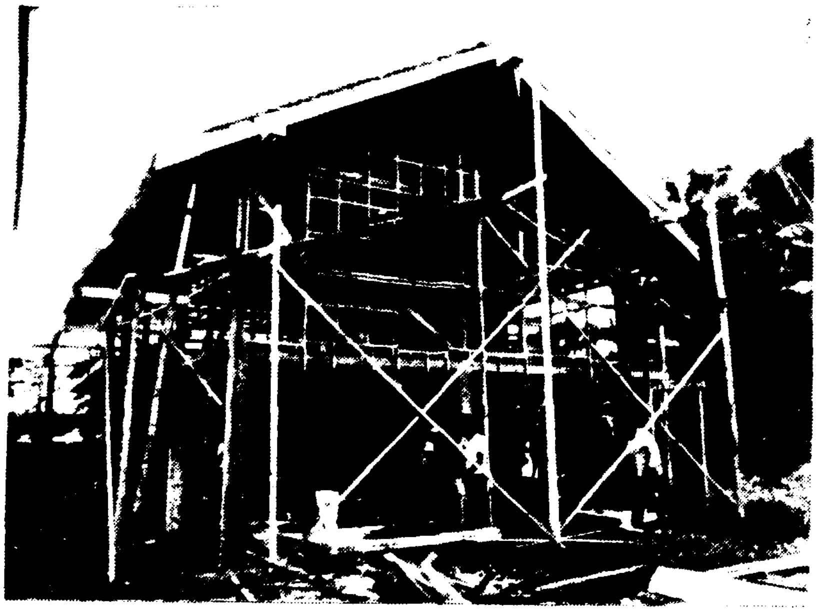
Figure 84

Ridge roll intersection with eaves flushing on both sides of roof apex.

Figure 85

4th week of March

Nailers and studs almost completely installed on north end of coco house.



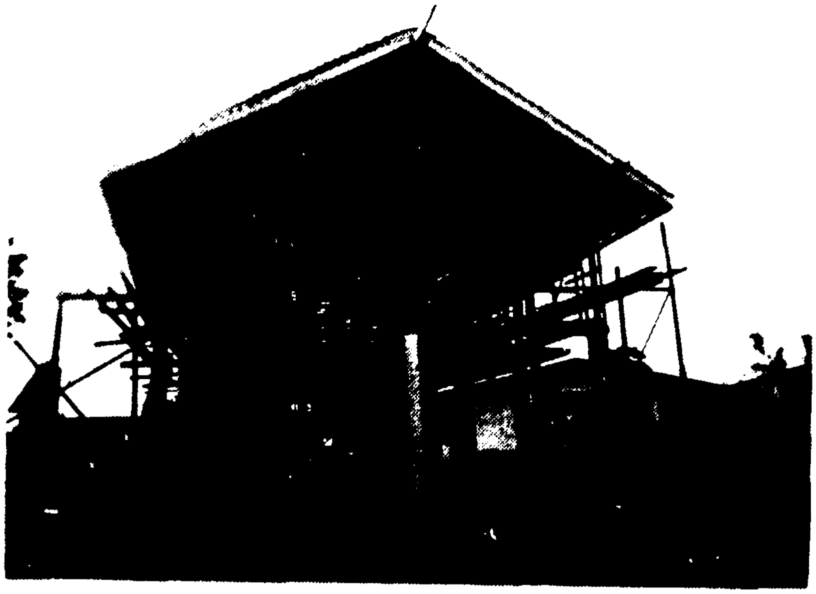


Figure 86

4th week of March

Nailers and studs completely installed on south end of coco house. Installation of nailers and studdings on front and rear sides of coco house in progress.

However, in projects involving a number of housing units, gutters and downspouts are necessary to provide better control of rain water effluent and to comply with city or municipality regulations on the matter.

8.2.10 Canopies

Windows directly below the roof apex (see Figures 92 and 93) may not be adequately protected by the roof overhang, in view of the steep apex angle, particularly in localities where gusts of wind blow the raindrops at a slant to the vertical.

Thus, coco wood canopies were provided over the windows directly under the roof apex (see Figure 93).

8.2.11 Fixed Louvres

Fixed louvres (see Figures 89, 90, 91, 92, 93, 104, 106 and 107) were provided below the movable louvre windows in order to provide a continuous means of ventilation inside the coco wood house. This construction feature will not be a problem even during heavy and continuous rains as Davao City is not visited by typhoons or strong winds the whole year round.

However, fixed louvres are not recommended for houses in typhoon areas or in localities affected by strong gusts of winds during the rainy part of the year.

8.2.12 Exterior Doors and Window Screens

The windows and doors of the demonstration coco wood house will eventually be screened to keep out mosquitoes and other undesirable insects. The screen frame will be installed on the interior face of windows and exterior faces of the main and service doors of the coco wood house. The window screens will either be of the swing or detachable type to allow easy maintenance of the windows. The screens covering the movable louvre windows should have an access swinging section to allow easy closing and opening of the louvres.

Figure [illegible]

1st week [illegible]

Install[illegible] [illegible]

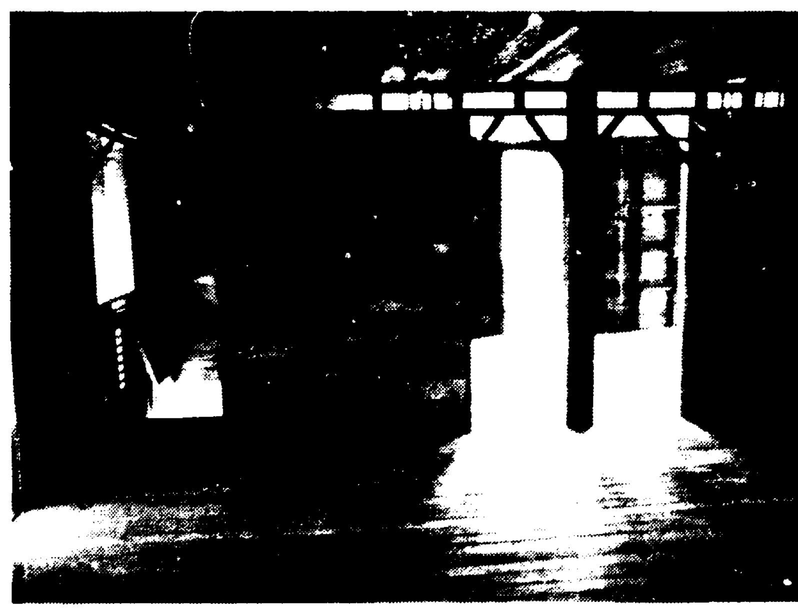


Figure [illegible]

[illegible] week [illegible] April

Exterior siding [illegible] installed. Interior walling partially complete. [illegible]

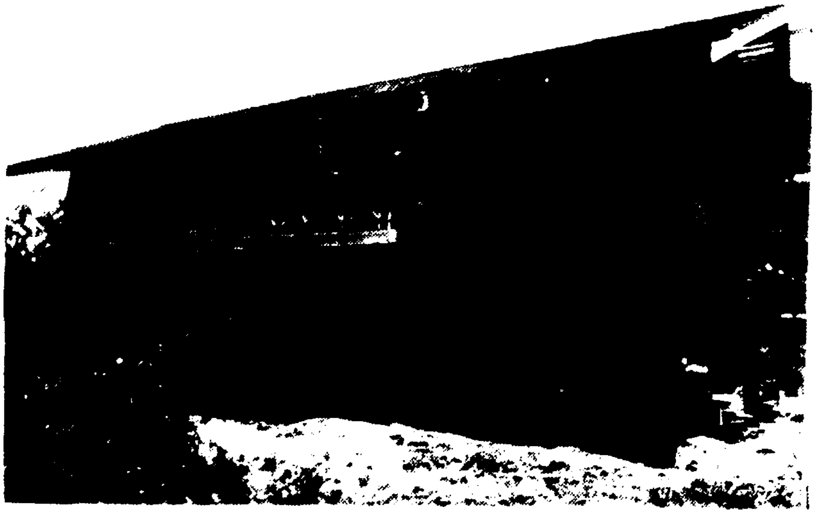
Figure [illegible]

3rd week [illegible] April

Front [illegible] complete[illegible] installation [illegible] ceiling [illegible] [illegible].

Figure 90

3rd week of April
Northeast corner of coco house.



Figu e 91

Front view of coco house, showing balcony,
t o main stairways and shingies roofing.

Figure 92

2nd week of May

South side of completely-built coco house, with construction of coco wood kiosk in progress, foreground.

Figure 93

Close-up view of coco wood canopy on north side of coco house.

Figure 94

Main stairs to south wing of duplex coco house.

Figure 95

Looking down the stairs from second floor landing.

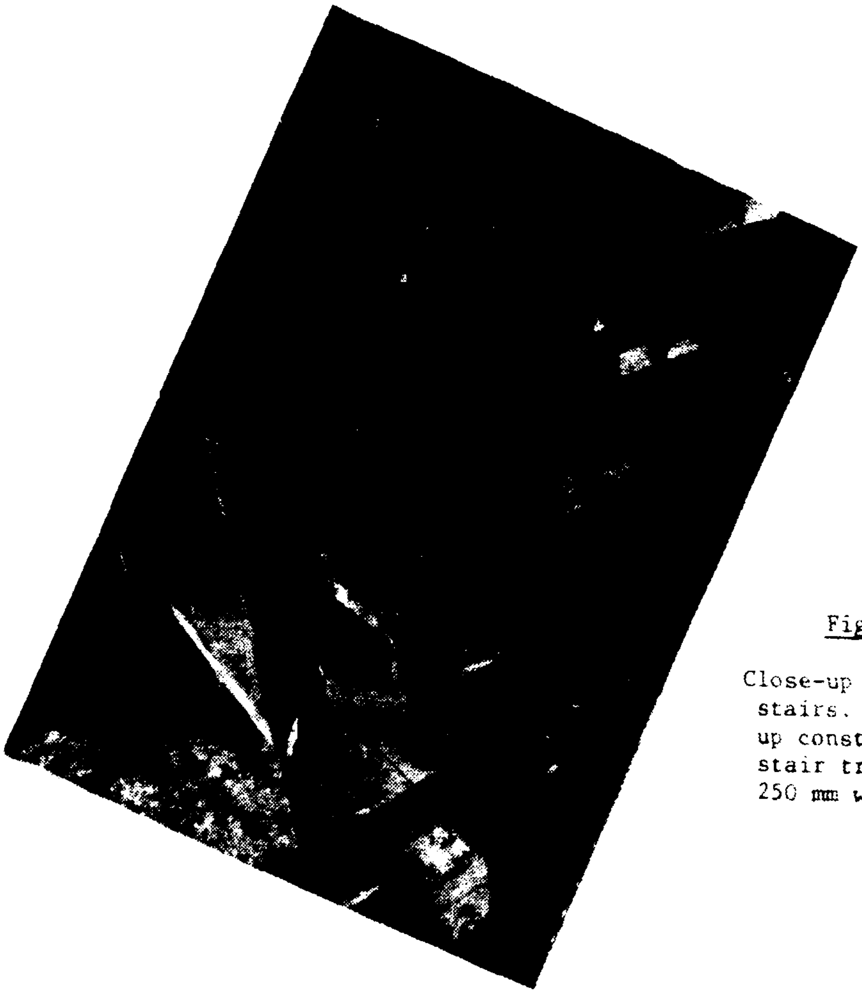


Figure 96

Close-up view of main stairs. Note built-up construction of stair treads to obtain 250 mm wide treads.

Figure 97

Ceiling above living room.

Figure 98

Close-up view of main door opening to main stairs on southeast corner of coco house.

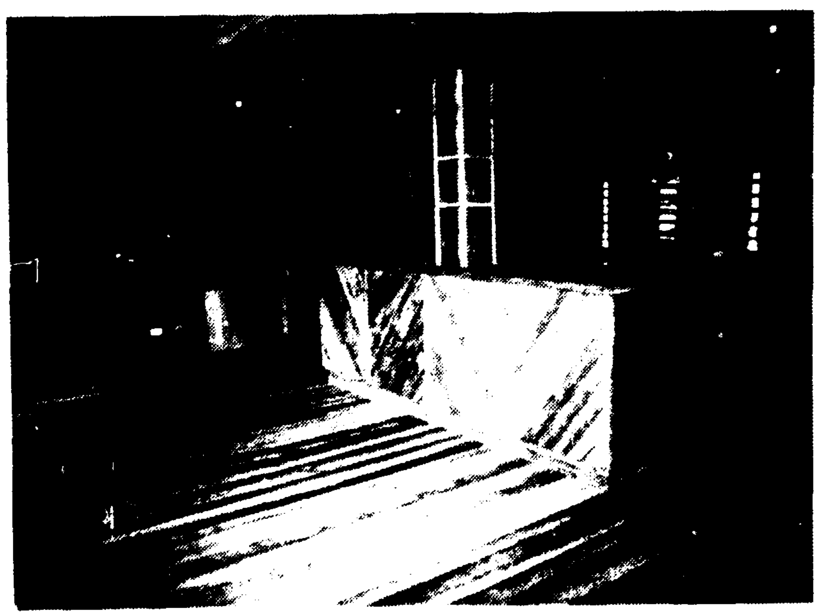


Figure 99

Coco wood bar and counter in living room of coco house.

Figure 100

Kitchen sink cabinet, auxillary cabinet and bar counter (clockwise all made of coco wood.

Figure 101

Built-in closet door (left side), interior partition and door (open, right side of photo) of bedroom on northwest corner of north unit of duplex model coco house.

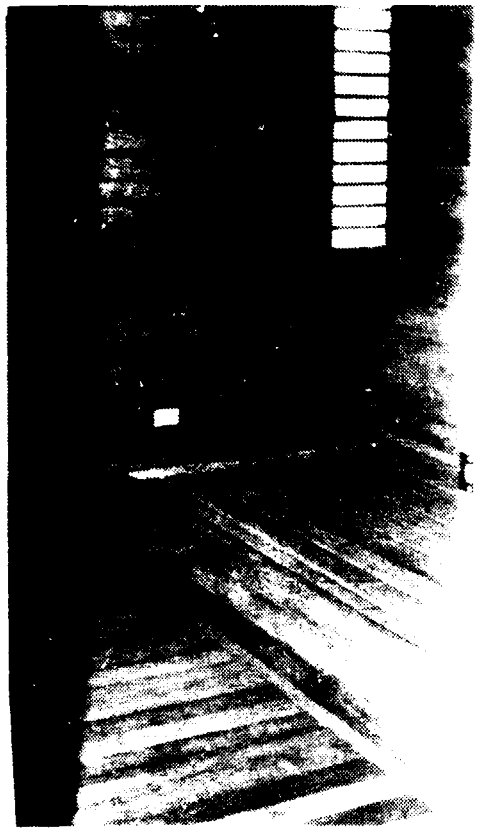


Figure 102

Entry to northeast bedroom of duplex model coco house. (Note bed made of coco wood.)

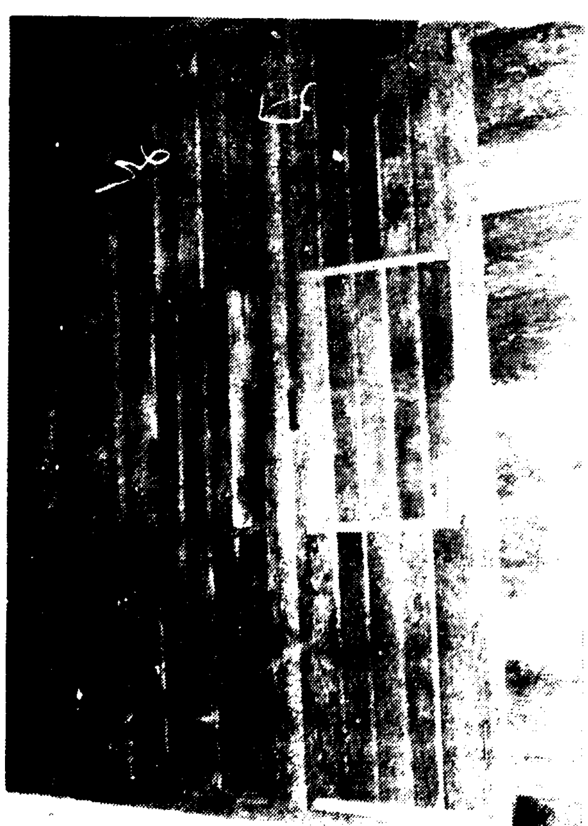


Figure 103

Built-in closet door in northeast bedroom.

85.05.22
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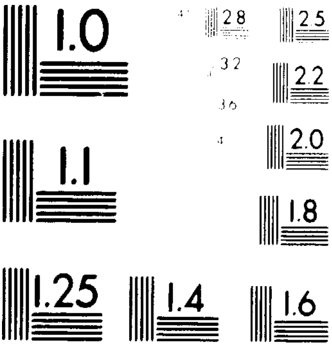


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

Figure 104

View of northwest room.
Fixed and movable louvre windows
assure ample ventilation.
Note bed (lower left corner) made of coco wood.

Figure 105

Toilet and bath on the south wing of the duplex coco house.

Figure 106

Sliding doors to the balcony, viewed from the living room.

Figure 107

Balcony, with concrete floor and coco wood railings, on the east side of the coco wood house.

8.3 RECOMMENDED MODIFICATIONS IN DESIGN AND SPECIFICATIONS FOR FUTURE COCO WOOD HOUSES

The following modifications in design and specifications are recommended (see Terminal Report: The Design, Supervision and Certification Aspects of the Demonstration Coco Wood House Project, by Gregorio G. Sta. Maria, Project Architect) :

8.3.1 Roofing System

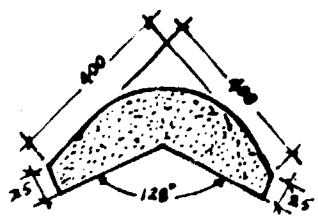
i - Coco wood shingles with longer lengths (600 mm, maximum) ;

ii - 250 mm distances between purlins for 600 mm long shingles ;

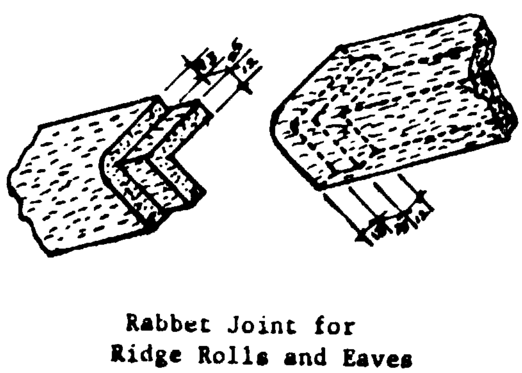
iii - Unless specified by existing building codes, plywood or tar paper sheathing between the shingles and purlins may be eliminated, provided the thicknesses of shingles used in this Project are adopted ;

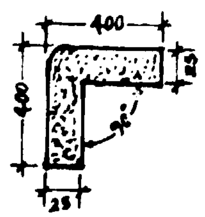
iv - The last courses of shingles on both sides of the roof apex should be single courses if coco wood ridge rolls are to be used, otherwise the last shingles courses should be installed in double courses as shown in Sheet $\frac{S-2}{2}$, Architectural Plans, submitted under UNIDO Project No. RAS-81-110.

v - Ridge rolls and eaves flushings, with cross-sections and joint system shown below, are recommended for aesthetic and cost considerations :



Ridge Roll Cross-section


Rabbet Joint for Ridge Rolls and Eaves Flushing



Eaves Flushing Cross-section

vi - Because of milling constraints on the production of wide boards, fascia boards may be fabricated from the same profiled 12 mm x 100 mm boards used as V-cut sidings (see Figures 90, 91, 92 and 93) ; and

vii - The roof girts may be extended, see Figures 80, 85, 91 92 and 93, and wrapped with V-cut boards, to give a "Malay" motif to the roof design.

8.3.2 Rafters

Because of milling constraints dictated by the small end diameters of coconut trunks which limited the quanitity of 50 mm x 150 mm x 5100 mm long boards that could be produced, 50 mm x 150 mm x 4200 mm boards may be used as rafters. Overhang is attained by splicing rafters at roof girts section.

8.3.3 Roof Girts

For rafter type roof framing, 100 mm x 100 mm x 300 mm coco wood blocks (built up from 50 mm x 100 mm boards) should be installed between each pair of girt members at 1200 mm distances, in addition to the triangular corbels inserted between the rafters and inner girt members, in order to attain a more even load distribution on both lower roof girts.

8.3.4 Construction Joints in Roof Framing

All major construction joints (girts to posts, rafters to girts, etc.) should be bolted.

8.3.5 End Rafters

End rafters should be located to coincide (flush) with corner posts so that vertical nailer studs will help carry roofing load and contribute to a more rigid construction frame (see $\frac{C}{S-1}$, Sheet $\frac{S-1}{3}$, Architectural Plans, Annex I-A, separate cover, "Terminal Report: The Design, Supervision and Certification Aspects of the Demonstration Coco Wood House", by G. Sta. Maria).

8.3.6 Ceiling

Ceiling is required for rafter type roof; and optional when trusses are used.

8.3.7 Door Jambs

Door jambs cross-sections should be as simple as possible in housing projects involving small number of units to avoid heavy cost of profiled TCT knives. (Refer to $\frac{E}{A-7}$ and $\frac{F}{A-7}$, Sheet $\frac{A-7}{7}$, Annex I-A, separate cover, "Terminal Report : The Design, Supervision and Certification Aspects of the Demonstration Coco Wood House Project", by G. Sta. Maria).

8.3.8 Nailer Studs

Door and window jambs should be installed simultaneously with all vertical and horizontal nailers and studdings for sidings on the four sides of the house. This technique will help attain more rigid framing and hasten installation activities.

8.3.9 Sidings (Exterior)

Exterior sidings should be installed horizontally (rather than vertically) to attain better leak-proof properties of the construction. This also complements the ceiling V-cut boards orientation, thus presenting a better harmony of V-lines between the sidings and the exterior ceiling, (see Figures 91, 93 and 110).

8.3.10 Double Walling (Interior)

Interior walling of V-cut boards should be installed horizontally (rather than vertically) for better aesthetic considerations (see Figures 97 and 99).

8.3.11 Studs for Double Walling

Studdings for double walls should extend from floor to ceiling only. This will help cut lumber costs without interfering with the structural properties of the house.

8.3.12 Studs for Sidings

Studs for exterior sidings should extend from floor joists to roof framing. This allows installation of exterior sidings before the floor and ceiling.

8.3.13 V-Cut Boards Profile

The edge angle that forms the "V" on the V-cut boards may be less acute (shallower) than conventional V-cut boards to facilitate profiling operations (see Figures 35-A and 35-B).

8.3.14 T & G Boards

T & G boards are absolutely required for flooring purposes. The L-cut (plain rabbeted) boards used for flooring in the demonstration coco wood house could not be nailed on the edges without splitting the rabbet. Thus, the L-cut boards had to be nailed on the faces, which makes the floorworks look less nicer than if the boards were nailed to the floor joists through the edges, as is normally done with T & G flooring.

8.3.15 Ceiling Boards

V-cut boards may be used as ceiling boards if T & G boards are not available.

8.3.16 Stair Stringers

Original plans on the stairs construction should be followed in case 50 mm x 200 mm boards are not available.

8.3.17 Stair Braces

Availability of 50 mm x 200 mm coco boards for stair stringers strengthened the stair construction and made unnecessary the use of braces (located on the front edges under the treads) connecting the stringers (see Figures 94, 95 and 96). However, in situations where stringers are built-up from 2 pcs. of 50 mm boards, triangular blocks will be required to receive the treads, and the braces are thus made absolutely necessary (see $\frac{F}{A-5}$, Sheet $\frac{A-5}{7}$, Architectural Plans, Annex I-A, separate cover, "Terminal Report: The Design, Supervision and Certification Aspects of the Demonstration Coco Wood House Project", by G. Sta. Maria).

Figure 108

Looking down the service stairwell
at the back of the coco wood house.

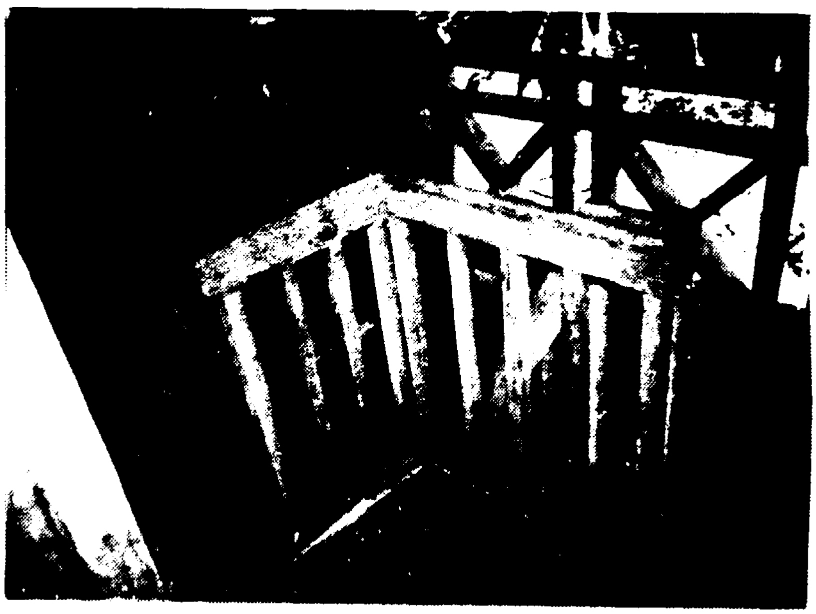


Figure 109

Hand rails, balusters and railings
in the service stair area of the coco wood house.

Figure 110

The COCO WOOD HOUSE, Model A, Duplex Type

8.4 THE ACTUAL COST OF THE DEMONSTRATION COCO HOUSE

The cost data used in the following calculations for the actual cost of the demonstration coco wood house were supplied by the Project Officer, SPDA, Davao City (see Annexes XX, XXI, XXII). All non-coco wood materials were purchased during the period when the prevailing foreign currency rate of exchange was PHP14.00 = US$1.00.

T A B L E XX

ACTUAL COST OF MATERIALS USED FOR THE COCO WOOD DEMONSTRATION HOUSE

Project Aspect	Actual Cost (₱)		Actual Cost ($)	
1. Concrete and Masonry :				
a) Footings and Columns	₱ 6,171.00		$ 440.75	
b) Beams and Slabs, Balcony	1,766.50		126.18	
c) Toilet and Bath Slabs and Ground Floor CHB Walls	3,897.75		278.41	
d) Rear Stairwell and Kitchen Slab and CHB Walls	3,131.50		223.68	
e) Septic Vault	1,760.75		125.77	
Sub-Total		₱ 16,727.50		$ 1,194.82
2. Hardware and Fasteners	₱ 11,029.15		$ 787.80	
3. Plumbing Supplies and Fixtures	22,947.35		1,639.10	
4. Tileworks	2,475.05		176.79	
5. Plywood				
a) Roof Sheating	6,880.00		491.43	
b) Cabinet Lining	792.00		56.57	
6. Coconut Lumber	110,180,20		7,870.01	
7. Electrical Fixtures and Supplies	10,977.60		784.11	
Sub-Total		₱165,281.35		$11,805.81
Grand Total		₱182,008.85		$13,000.63

Note : Item (1) above does not include Item III-C-2, Annex XXI, for the construction of an office and storage room on the ground floor is not specified in the original design plans.

The corresponding cost of labour used is summarized below, and is based on prevailing labour pay rates in the area.

TABLE XXI

ACTUAL COST OF LABOUR USED FOR THE DEMONSTRATION COCO WOOD HOUSE

Project Aspect	Man-Hours Used: Highly Skilled	Skilled	Semi-Skilled	Unskilled	Totals
A. Construction Labour :					
1. Masonry and Concrete Works, including site preparation and earthworks	---	858	79	1,478	2,415
2. Building Frameworks	---	261	---	84	345
3. Sidings and Wallings	---	1,143	---	173	1,316
4. Flooring	---	366	---	187	553
5. Ceiling	---	251	---	76	327
6. Roofing and Canopies	---	1,546	---	786	2,332
7. Joinery	---	1,590	---	512	2,102
8. Cabinetry	---	356	---	32	388
9. Plumbing and Water Supply System	95	---	65	---	160
10. Electrical Works	89	---	92	---	181
11. Others	---	12	---	---	12
Totals :	184 MHrs.	6,383 MHrs.	236 MHrs.	3,328 MHrs.	10,131 MHrs.
Prevailing Pay Rate :	₱5.00/MHr.	₱3.75/MHr.	₱3.00/MHr.	₱2.50/MHr.	
Total Costs - PH₱ :	₱920.00	₱23,936.25	₱708.00	₱8,395.00	₱33,959.25
Total Costs - US$:	($ 65.71)	($ 1,709.73)	($ 50.57)	($ 599.65)	($ 2,425.66)

B. Supervision and Administration :	Man-Hours	Cost
1. Project Engineers	242 Man-hours	₱ 3,025.00
2. Foreman	1,008 Man-hours	7,560.00
3. Timekeeper/Recorder	160 Man-hours	800.00
4. Toolkeeper/Storekeeper	132 Man-hours	561.00
Totals -------	1,542 Man-hours	₱11,946.00
		($ 853.29)

The total Project cost amounted to ₱227,913,50 (US$16,729.58) and is summarized as follows :

Cost Item	Cost	
Construction Labour	₱ 33,959.25	$ 2,425.66
Coco Wood Materials*	110,180.20	7,870.01
Non-Coco Wood Materials	71,828.05	5,130.62
Supervision and Administration	11,946.00	853.29
Grand Total	₱227,913.50	$16,279.58

(Note : *Cost of coco wood materials include cost of preservation.)

The following Project ratios are obtained from the foregoing tabulations :

Unit Cost ------------- ₱ 2,198.27 ($157.02) per m of floor area.
Labour : Materials ---------------------------------- 19 %
Labour : Total Cost --------------------------------- 15 %
Materials : Total Cost ------------------------------ 80 %
Supervision and Administration : Total Project Cost ----- 5 %
Coco Wood : Total Project Cost ----------------------- 48 %
Coco Wood : Total Materials Cost ---------------------- 60 %

The above ratios are comparable tc those obtained in house construction projects using traditional wood species instead of coconut lumber.

IX. THE ECONOMICS OF COCO WOOD MILLING AND HOUSE CONSTRUCTION

9.1 GENERAL OBSERVATIONS

The coconut stem logging operations and the coconut lumber milling techniques developed in this Project are mainly applicable to production operations at commercial and industrial scales. This is principally due to the high volume capaciti-s of the logging equipment and wood processing facilities made available to the Project. Thus, it is deemed relevant to determine the limits within which these techniques may be economically applied to any future project involving coconut stem logging and mass housing construction using coconut wood.

Since it has been shown that existing wood processing facilities can be used to produce lumber and housing components out of coconut stems, it is also important to know the limits within which such milling/ processing operations could still be economically viable.

Furthermore, it would be of great interest to wood processors, as well as architects and construction engineers, to have available indicators as to whether it will be economically viable to use coconut wood as the principal house construction material or only as pre-fabricated components for house construction, to replace similar products made from traditional wood species.

The discussions in the following sections of this Chapter are all based on the consideration that there will be adequate quantities of coconut trees available (as predicted by the PCA) for conversion into lumber and other wood products on a commercial scale.

9.2 MAXIMUM HAULING DISTANCE FOR COCONUT STEMS

It is indicated in Section 6.4.2 of this Report that hauling cost is the principal component of the coconut log cost --- amounting to about 67%, when the hauling distance was about 17 kms. and increasing to as much as 85% of the log cost when the hauling distance was 60 kms. Hauling distance, therefore, is a primary concern in the economics of the utilization of coconut tree trunks as a source of materials for housing components.

During the stage when acceptability of coco lumber is still being sought in the local market, the initial limiting factor would be its cost as compared to those of traditional wood species it is intended to replace, like Lauan, Tanguile, Apitong, Yakal, etc. On this basis, the viability of coconut lumber production will be dependent upon the acceptability of its price in the local market. For purposes of this exercise, and in the absence of any study indicating the prices at which coconut lumber will be acceptable in the local market, it will be assumed that the acceptable price for coconut lumber will be at least equal to the prices of commercially available traditional wood species it is expected to replace as a construction material. These prices are shown in the following tabulation :

TABLE XXII

COCONUT LUMBER AND CURRENT MARKET PRICES OF NEAREST EQUIVALENTS IN COMMERCIAL SPECIES

	Nearest Equivalent Commercial Species	
Coconut Lumber	Name	Current Market Price Rough, A.D.
Grade "A"	"Yakal" (SHOREA GUISOK)	₱2,498.57 ($178.47) per cu.m.
Grade "B"	"Red Lauan" (SHOREA NEGROSENSIS)	1,865.60 ($133.26) per cu.m.
Grade "C"	"Kaatoan Bangkal" (ANTHOCEPALUS CADAMBA)	990.00 ($ 70.71) per cu.m.

According to the findings of V. Sulc (1980 Report, PCA- Zamboanga Research Center), the average lumber recovery from the butt and second log bolts of a coconut tree trunk is as follows :

Grade "A" (High Density) ------------- 70 %
Grade "B" (Medium Density) ----------- 17 %
Grade "C" (Low Density) -------------- 13 %

The equivalent market price of one cubic meter of coconut lumber is thus calculated as follows :

Grade "A" :	70%	x	₱2,498.57	=	₱1,749.00 ($124.93)	per cu.m.
Grade "B" :	17%	x	1,865.60	=	317.15 ($ 22.65)	per cu.m.
Grade "C" :	13%	x	990.00	=	128.70 ($ 9.19)	per cu.m.
			Total	------------	₱2,194.85 ($156.77)	per cu.m.

The coco lumber cost as evolved in this Project was ₱1,665.22 ($118.86) per cubic meter. Allowing for about 12% marketing expenses and profit, the coconut lumber cut in this Project could have been retailed at ₱1,868.26 ($133.45) per cubic meter.

Thus, within the limits and conditions of logging and processing operations undertaken in this Project and the foregoing considerations and assumptions, the maximum distance for hauling coconut tree trunks from cutting area to mill site is calculated as follows :

$$\frac{(₱2,194.85 - ₱1,868.26) \text{ per cu.m.}}{₱7.50 \text{ per cu.m. per km.}} + 60 \text{ kms.} = 103.6 \text{ kms.}$$

It should be noted that the above calculations are based only on the effect of hauling distance on the ex-factory cost of coconut lumber and do not consider at all the effects of possible cost reduction features which may be developed and introduced in sawmilling operations.

Thus, it may be stated conservatively that, for commercial purposes, the maximum economic distance for hauling coconut trunks from cutting area to sawmilling site is 100 kms. Hauling distance farther than 100 kms. from mill site will increase the retail price of coconut lumber beyond comparative prices of lumber cut from equivalent traditional wood species.

However, in the case of real estate developers, or similar entities engaged in mass housing projects, where coco lumber marketing expenses and profit factors may be ignored, the maximum distance for hauling coconut tree trunks from cutting area to mill site is calculated as follows :

$$\frac{(₱2,194.85 - ₱1,665.22) \text{ per cu.m.}}{₱7.50 \text{ per cu.m. per km.}} + 60 \text{ kms.} = \underline{\underline{130.6 \text{ kms.}}}$$

Thus, it may be further stated conservatively that in cases where the supply of coconut lumber is obtained without recourse to the existing marketing system the maximum economic distance for hauling coconut tree trunks from cutting area to sawmilling site is 130 kms.

9.3 MASS HOUSING PROJECTS AND OPTIMUM USE OF COCONUT LUMBER

In spite of the limited volume of coconut tree trunks cut in this Project and the sawmilling constraints to cut specific quantities and grades of selected lumber sizes as specified in the Bill of Materials drawn up by the designers of the demonstration coconut wood house, the wood processing phase of this Project produced coconut lumber at costs which put the material in a competitive position vis-a-vis equivalent traditional species in the domestic lumber market. This fact gives rise to two main directions in the development of coco wood as a source of material for the housing and building construction industries of the country, to wit :

i - Construct low-cost houses 100% or predominantly made of coco lumber, or

ii - Develop coco wood as a replacement for traditional wood species in the fabrication of components for the housing and building construction industry.

The experience derived from the conduct of this Project has brought to light certain facts which bear significantly on the efforts of the government to formulate policies influencing the direction of efforts by the private sector in developing coco wood as a construction material. These are discussed in the following paragraphs.

9.3.1 Coco Wood Houses in Mass Housing Projects

Current Philippine regulations on mass housing projects require :

i - A minimum lot size of 144 square meters ;

ii - A minimum house size of 7.2 m x 7.2 m ; and

iii - Allocation of a maximum of 70% of the land area as housing area, leaving 30% of the land area for roads and open areas for community use.

Thus, 48 units of single detached house model or 58 units of duplex house model, can be erected in one hectare (10,000 square meters) of the land development area.

To simplify the lumber supply aspect of the project, assume that the mass housing project will be located on existing coconut tree farms. Assume further, that the low-cost housing units to be built are duplex models which are predominantly of coco wood according to the design used in this Project.

The construction of the duplex model demonstration coco wood house in this Project required the felling of about 300 coconut trees located in a total land area of 2.76 hectars (27,600 square meters) in order to supply the required grade and size distribution of coco lumber as specified in the Bill of Materials. (Actual coconut lumber usage was about 51 cu.m., while the total volume of coco lumber produced was 91.414 cu.m. The balance of about 40 cu.m. of lumber available after complete construction of the demonstration coco wood house are of sizes and/or grades in excess of specified requirements.) This means that approximately 160 hectares of coconut land are required to supply the coco lumber needs of the 58 duplex housing units for each hectare of the mass housing project. In other words, the project's coco lumber requirements will have to be filled from sources outside the land development area. The availability of coconut trees within the economic hauling distances cited in Section 9.2 of this Report thus becomes another problem for the real estate developer.

It is therefore indicated that except for demonstration or other image-building purposes, the construction of 100% (or predominantly) coco wood housing units should not be encouraged unless thorough studies showing realistic and viable solutions to the logistics problem discussed in the preceding paragraphs indicate otherwise.

9.3.2 Coco Wood as a Substitute for Building and Housing Components Currently Made of Traditional Wood Species

The logistics problem posed in the preceding paragraphs appear to favor the use of coco wood as a substitute for traditional wood species in the fabrication of housing (or buildings) components. This approach to the development of coco wood as a construction material is further buttressed by the results of the wood processing phase of this Project indicating a lower cost of coco lumber as compared to equivalent traditional species. The principal aspects of the Project's house design which offer good potentials for the use of coco lumber are discussed in the following paragraphs.

i - Coco Wood as Roofing Material

Based on cost data furnished by SPDA (Annexes XX, XXI, and XXII), the total roofing cost (including canopies) using coco wood shingles is summarized as follows :

Labor		₱ 7,762.50
Materials :		
Shingles	₱18,378.00	
Ridge Rolls and Eaves Flushing	1,799.60	
Nails and Wires	2,520.00	
Roof Framing	17,622.40	
Sub-Total		₱40,320.00
Total Cost		₱48,082.50

The same roof area, covered with corrugated G.I. sheets, will require less installation labour, less roofing nails and less lumber volume for the roof framing. However, the G.I. roof will need to be painted to give it more resistance to the prevailing humid climate. The corresponding cost for the G.I. roofing system is estimated as follows :

Labour :		
Installation of Roofing System	₱ 4,657.50	
Painting	319.20	
Sub-Total		₱ 4,976.70
Materials :		
Corrugated G.I. Sheets, Ga. 26	₱ 8,640.00	
Plain G.I. Sheets, Ga. 26	1,536.00	
Galvanized Roofing Nails, with washers, and other C.W. Nails	2,142.00	
Roof Framing	15,860.00	
Roofing Paint, Primer and Reducers	7,200.00	
Sub-Total		₱35,378.00
Grand Total		₱40,354.70

5-year exposure tests of CCA-treated coco wood roofing shingles at the PCA-Zamboanga Research Center have shown them still in good condition. The Center's technicians expect the coco wood shingles to give at least another 5 years of serviceable life.

On the other hand, the experience of home owners in the Philippines indicate that G.I. roofing, installed and painted as per Bill of Materials presented above, will require another painting job 5 years (maximum) after installation to keep it in good serviceable condition for another 5 years.

A comparative 10-year installation and maintenance cost comparison between conventional G.I. roofing system and the coco wood shingles system adopted in this Project for a roof area equal to the total roofing area of the demonstration coco wood house (106.4 sq.m.), is given below:

TABLE XXIII

COMPARATIVE COST ANALYSIS
COCO WOOD SHINGLES vs. G.I. SHEET ROOFING
(Based on 10-years service life)

Cost Item	Coco Wood Shingles System		G.I. Sheet Roofing System	
1. Labour :				
a) Installation/ Erection	₱ 7,762.50	($ 554.46)	₱ 4,976.70	($ 355.48)
b) Maintenance	--------	-------	319.20	($ 22.80)
Sub-Total ---------	₱ 7,762.50	($ 554.46)	₱ 5,295.90	($ 378.28)
2. Materials :				
a) As installed, including roof framing fasteners ---------	₱40,320.00	($2,880.00)	₱28,178.00	($2,012.71)
b) First painting -----	--------	-------	7,200.00	($ 514.29)
c) Maintenance Painting ----------	--------	-------	6,500.00	($ 464.29)
Sub-Total ---------	₱40,320.00	($2,880.00)	₱41,878.00	($2,991.29
Total 10-year Cost ----	₱48,082.50	($3,434.46)	₱47,173.90	($3,369.57)

Thus, although its initial cost is higher, coco wood shingles roofing system is comparable to that of conventional corrugated G.I. roofing system for a 10-year service period, or longer. (Note also that in tropical countries, G.I. roofing requires a ceiling, while coco wood shingles roofing does not.)

ii - Coco Wood as Structural Component for the Buildings and Construction Industry

Confirming the findings of V. Sulc (1980 Report, PCA - Zamboanga Research Center), the Grade "A" yield of coco boards cut from 6-meter long coconut log bolts (butt and second logs) during the sawmilling phase of this Project composed almost 70% of the total lumber output at the DGLC sawmill. (Note : The high yield of Grade "A" coco boards made it necessary to mill more coco log bolts to fill up the Project's requirements for Grades "B" and "C" boards). Grade "A" coco boards are highly suitable for use in load-bearing and other structural components of houses and buildings, such as posts, roof, girts, rafters, purlins, floor girts and joists, stair stringers, handrails and treads. These housing components usually require S4S boards with simple rectangular cross-sections, which are easy to mill and surface.

These facts indicate a very high potential for coco wood as a substitute for traditional species, like "Yakal" (SHOREA GUISOK) and "Guijo" (SHOREA GUISO) which are currently and popularly used for structural and load-bearing components of houses and buildings in the country.

The economic justification for this proposed substitution is discussed in the following paragraph.

The prevailing market price for "Yakal" and "Guijo", rough 50 mm thick boards, air-dried is ₱2,498.57 ($178.47) per cubic meter. On the other hand, the cost of coco lumber rough, 50 mm thick boards, as milled in this Project was ₱1,665.22 ($118.86) per cubic meter. Allowing 12% mark-up (for marketing expenses and profit), 50 mm thick coco boards milled in this Project could have been easily sold for about ₱1,868.00 ($133.45) per cubic meter. The price advantage (from the customer's point of view) in favor of coco lumber would have been ₱630.00 ($45.00) per cubic meter, or ₱1.48 ($0.11) per board foot. Inquiries from local lumber dealers confirm that this price advantage is enough to convince designers to specify coco lumber, and engineers and home builders to use coco lumber.

iii - Coco Wood for Joinery and Moulded Products

It was shown during the milling phase of this Project that coco wood can also be surfaced and profiled with cross-sections suitable for mouldings and joinery products, provided properly sharpened and hard-metal-tipped knives are used. The PCA - Zamboanga Research Center found TCT knives effective at normal feed speeds when surfacing and profiling Grades "A" and "B" coco boards. Because TCT knives were not available, the DGLC, on the other hand, developed stellite (No. 12) tipped profiling knives which performed satisfactorily on Grades "A" and "B" coco boards, although at feed speeds lower than normal.

These developments indicate the possibility of using Grades "A" and "B" coco wood for joinery and moulded products.

"Lauan" and "Tanguile", among the Philippne Mahogany species, are predominantly used in the local manufacture of joinery and moulded products. The current market price for "Tanguile" and "Lauan" lumber is ₱1,865.60 ($133.26) per cubic meter.

On the average, coco lumber produced under this Project cost ₱1,665.22 ($118.86) per cubic meter. The cost difference, in favor of coco lumber is ₱200.38 ($14.31) per cubic meter.

In terms of profiled items, this cost difference indicate ₱0.38 ($0.027) lower cost of material input per meter of V-cut boards (12.5 mm x 100 mm cross-section) and ₱0.50 ($0.0358) lower cost of material input per meter of L-cut boards (25 mm x 100 mm cross-sections). Thus, the costs of V-cut and L-cut coco boards (see Table XIX) are ₱3.016 ($0.215) per meter and ₱5.733 ($0.409) per meter, respectively. Allowing 12% mark-up for marketing expenses and profit, the equivalent current market prices for profiled coco boards are :

V-cut boards, (for sidings) 12.5 mm x 100 mm - ₱3.378 ($0.241)/lineal meter
L-cut boards, (for flooring) 25 mm x 100 mm - ₱6.421 ($0.459)/lineal meter

The prevailing market prices for corresponding boards made from "Tanguile" or "Lauan" lumber are :

V-cut boards, (for sidings) 12.5 mm x 100 mm - ₱9.28 *($0.66)/lineal meter
T & G boards, (for flooring) 25 mm x 100 mm - ₱9.28 *($0.66)/lineal meter

(Note: * The accepted practice in the domestic lumber market is to set a price for lumber products with 25 mm or less thickness on the basis of 25 mm thick boards.)

The price differences of ₱5.90 (₱0.42) per lineal meter of sidings boards and ₱2.86 ($0.20) per lineal meter of flooring boards are deemed sufficiently attractive to both users and retailers to convince them to use coco wood moulded products as substitute for similar traditional wood specie products.

The fabrication costs of joinery products under this Project are tabulated below :

TABLE XXIV

FABRICATION COSTS OF COCO WOOD JOINERY PRODUCTS

Product	Total Area Covered	Materials	Labour	Overhead 12 %	Total Cost	Unit Cost
Door Jambs	24.94 m^2	₱1,564.00	₱ 975.00	₱304.68	₱2,843.68	₱114.02/m^2
Window Jambs	42.12 m^2	₱2,362.50	₱2,390.00	₱570.30	₱5,322.80	₱126.37/m^2
Flush Doors, (Hollow Core)	24.94 m^2	₱3,190.69	₱3,145.00	₱760.28	₱7,095.97	₱284.52/m^2
Louvre Windows (Fixed and Movable)	42.12 m^2	₱5,134.50	₱1,965.00	₱851.94	₱5,986.44	₱142.13/m^2

Allowing 20% mark-up for expenses and profi' (per joinery industry practice), the corresponding market prices of of joinery products fabricated under this Project are shown in Table XXV below. The market unit prices of jambs, doors and windows of comparative designs and sizes, together with the corresponding variances from coco wood products are also given in the table for comparison purposes.

TABLE XXV

COMPARATIVE PRICES OF COCO WOOD AND TRADITIONAL SPECIES JOINERY PRODUCTS

Product	Unit Prices (per square meter of opening) Coco Wood	Phil. Mahogany	Variance
Door Jambs	₱136.82	₱141.57	+ 3%
Window Jambs	151.64	164.92	+ 9%
Flush Doors, Hollow Core	341.42	369.88	+ 8%
Louvred Windows	170.56	181.93	+ 7%

The foregoing data indicate the encouraging potentials of coco wood joinery products in the domestic building materials market.

It will also be noted in Table XXV that the problems encountered in machining and nailing coco lumber participate only to a small degree and are not reflected in the over-all cost of coco wood joinery products.

9.4 COCO WOOD IN PRE-FABRICATED HOUSES

The preceding cost and pricing comparisons (coco wood vis-a-vis traditional wood species commonly used in the building and construction industry), which favor the use of coco wood as a substitute material for traditional wood species, may be further exploited in the pre-fabricated housing industry.

The surfacing and profiling problems encountered during the milling phase and the nailing difficulties met during the construction phase of this Project will then be totally eliminated by the use of more appropriate milling facilities and better controlled processing and fabrication techniques which are normally available in high output volume industries like pre-fab housing construction. These conditions will also help enhance the economic advantages of using coco wood mainly as a result of the economies of scale involved in mass housing projects.

Coco wood will find use in pre-fab housing construction according to the following groups of housing components :

i - Structural components (posts, girders, floor joists, rafters or truss members, purlins, etc.) ;

ii - Roofing system (shingles, ridge roll, eaves flushing, etc.) ;

iii - Joinery products (door and window jambs, doors, louvre windows, etc.) ; and

iv - Profiled boards (V-cut sidings, T & G floorings, etc.).

The manner of introducing coco wood into the pre-fab house system, however, must consider the various constraints that affect the grades and sizes of coco lumber milled from coconut stems, the physical properties of the different grades of coco wood and the processing techniques and preservation methods as developed in this Project. On a more general level, the economies of scale possible from the use of coco wood should also be a major consideration.

As a particular example, in the Coco House Model A, single detached type, revised design, (Annex I-A, separate cover, "Terminal Report: The Design, Supervision and Certification Aspects of the Demonstration Coco Wood House", by G. Sta. Maria) the coco lumber grade distribution (based on volume) specified in the corresponding Bill of Materials (Annex II-A, G. Sta. Maria, ibid.), as follows :

Grade "A" Coco Wood	32 %
Grade "B" Coco Wood	40 %
Grade "C" Coco Wood	28 %
Total	100 %

As determined by V. Sulc (PCA-ZRC) and confirmed during the sawmilling phase of this Project, the coco lumber grade distribution of boards (based on volume) cut from the lower portions of coconut stems is as follows :

Grade "A" Coco Wood	70 %
Grade "B" Coco Wood	17 %
Grade "C" Coco Wood	13 %
Total	100 %

The apparent imbalance between the lumber grade potential supply and actual construction requirements of specific coco lumber grades, as indicated above, will influence the direction of thrust in the introduction and eventual acceptance of coco wood as a material for pre-fab housing components.

9.4.1 Structural Components of Pre-Fab Houses

In view of its physical properties, Grade "A" coco lumber is specified for all structural components, such as trusses, girders, floor girts and joists, rafters and purlins. Based on the experience gained at PCA-ZRC and during the milling phase of this Project, 50 mm is the maximum thickness of coco boards which can be cut in quantities sufficient to meet the requirements of mass housing project. Thicker boards could be produced only from coconut trunks with diameters exceptionally larger than average diameters normally found in coconut stems. Thus, the use of coco lumber for housing components thicker than 50 mm is not recommended, because this can be made possible only through built-up coco boards (using glue lamination techniques or nails and bolts) which is a more expensive undertaking.

It also appears that Grade "A" coco boards will be more economically suitable for joists, girders, rafters, girts and purlins, provided the length requirements do not exceed 5.0 meters. This condition is imposed by the fact that 50 mm coco boards longer than 5.0 meters can be produced only from coconut stems with average diameters larger than 300 mm and in sawmilling plants where bandmill carriages are equipped with tapering devices.

These findings also indicate that more coco lumber will be available if used as truss members than if used as rafters.

Thus, the use of coco wood in mass housing projects will influence the roof framing design of the low-cost house to favor the truss-type rather than the rafter type system. However, more experiments are still needed to determine the most economical method of fastening truss members.

9.4.2 Coco Wood Roofing System for Pre-Fab Houses

It has been pointed out in Section 9.3.2 (i) of this Report that for long periods of use, coco shingles roofing require less maintenance than conventional G.I. sheet roofing system. This fact makes coco shingles highly suitable for low-cost housing. Wide use of this construction feature will also lead to the following beneficial consequences :

i - Maximum utilization of the whole length of coconut tree trunks as coco wood shingles will provide an outlet for the upper third portion of the coconut tree stem which was not used in this Project, and which supplies more "C" grade coco boards than the lower portions ;

ii - Increase lumber yield rates in sawmilling operations by providing an outlet for the use of the "C" grade portion of the lower 2/3 length of the coconut tree stem ;

iii - Contribute to the over-all utilization rate of coco lumber by providing an outlet for the use of off-cuts and trimmings which develop during the lumber processing phase of construction activities ; and

iv - Foster the development of a new support activity serving the roofing needs of the construction industry by providing coco wood shingles fabrication and installation services.

9.4.3 Joinery Products Made of Coco Wood

Section 9.3.2 (iii) of this Report has shown that coco wood can be econo[illegible] traditional [illegible] when used as the basic material in the fabrication of door and window jambs, flush doors, louvre windows and stair balusters and railings. The cost picture can be further improved when these items are fabricated on a serial production basis in properly equipped woodworking plants. In this manner, it is estimated that economies of scale will result to at least 7% further reduction in costs due to both maximization of material usage and higher productivity when joinery products are mass produced.

9.4.4 Coco Wood Profiled Boards

This Project has demonstrated the high potential for coco wood to be used as ceiling boards, exterior sidings and interior wallings and partitions. Furthermore, it was also shown that Grade "A" coco wood is ideal for use as floor boards. Considering the expected preponderance of Grade "A" coco boards in sawmilling outputs, it is indicated that to supplement the low supply of Grade "B" coco boards, the excess of Grade "A" boards for structural components can be diverted to the fabrication of profiled boards for sidings, ceiling and floorings.

9.4.5 Priorities in the Introduction of Coco Wood in Pre-Fab Housing Systems

The foregoing discussions indicate that considering the supply and demand aspects of the different grades of coco lumber, together with the technical constraints involved in the proper use of each grade of coco lumber, the material may be introduced into the low-cost housing construction industry in the following order of priorities which blend with the over-all objective of keeping the cost of pre-fabricated houses at low levels :

1st - Development of the coco wood shingles fabrication and installation service industry ;

2nd - Serial production of joinery products ;

3rd - Mass production of profiled coco wood boards for sidings, ceilings and floorings ; and

4th - Use of coco wood for structural components of pre-fab houses.

9.5 GUIDELINES FOR THE ECONOMIC PROCESSING OF COCO WOOD

As in any industrial endeavor, the viability of coco wood processing operations, is greatly affected by economies of scale. This is more particularly true when existing sawmilling, kiln-drying and woodworking facilities are used to process coconut stems into coco lumber or more advanced coco wood products. Most of the sawmilling plants in Northern Luzon, Eastern Visayas and Mindanao have rated capacities ranging from 15 to 100 cu.m. of lumber per day. Available kiln-drying facilities have drying chambers ranging from 23 to 280 cu.m. per load, while planing mills and woodworking plants have rated capacities ranging from 10 to 70 cu.m. per day.

In the beginning, when the demand for coco lumber and lumber products is still small, it is very likely that existing wood processing facilities will accept processing contracts for coco wood only as filler loads in their processing schedules. The main concern therefore is to determine the minimum economic size of the processing run for each phase of the processing operations.

9.5.1 Sawmilling Coco Stems

Most sawmilling plants operate on the basis of 6-days per week, 8-hours operations per day schedule. It is a common practice among sawmillers not to mix different species in the production line. Furthermore, it takes at least half a day (longer for bigger rated capacity sawmills) to clear the production lines of the in-process materials of one species in preparation for the next run using another species. Thus, a day in the working week is assigned to prepare the production lines for a change in species cut. This indicates that the ideal sawmilling volume for coconut wood to be processed in existing sawmilling plants engaged in the production of lumber from traditional species logs should at least be enough for one-week's production run.

Furthermore, the common practice in existing mills to cut one bolt of traditional species logs into boards of the same thickness can be implemented only to a very limited extent when milling coco log bolts. The distribution of lumber grades throughout the cross-section and length of a coconut log bolt (see Annexes VI, XIII and XIV) limits this practice. It was only in the production of 50 mm x 50 mm coco boards (for studs and nailers) where the same board thickness was cut from one coco log bolt during the sawmilling phase of this Project.

The use of tapering device on the main bandsaw carriage assures higher yields of both "A" grade lumber and over-all lumber output.

9.5.2 Kiln-Drying Coco Lumber

The kiln-drying experience gained in this Project demonstrated that kiln-drying schedules (see Annex XVIII) for coco lumber are not significantly different from the corresponding schedules used for drying wood species under the Philippine Mahogany group. It was also found that thin coco boards (25 mm or less thickness) should be kiln-dried separately from thick (38 mm and 50 mm boards) for the former has a shorter drying cycle than the latter boards. Mixing thick and thin boards in the same kiln-drying charge will require the batch to be dried according to the longer cycle for thick boards, and is thus costlier.

The following general guidelines are therefore recommended when kiln-drying coco lumber :

i - Thin boards (25 mm or less thickness) should be kiln-dried separately from thick boards (38 mm and thicker) ;

ii - "Lauan", "Tanguile" and other species belonging to the Philippine Mahogany group may be kiln-dried in the same charge as coco lumber of the same thickness, provided the whole batch is kiln-dried according to the proper schedule for coco lumber. However, mixing of other species with coco boards in one kiln charge should be rarely done --- only when the economics of the whole kiln-drying operations require doing so ; and iii - A pre-drying stage (see Annex XVIII) should carried out when drying 38 mm and thicker coco boards.

9.5.3 Woodworking Operations Using Coco Lumber

This Project has demonstrated that coco lumber can be surfaced and profiled on the same machines used for surfacing and profiling traditional wood species, provided the cutting tools are tipped with hard metal alloys. TCT is a preferrable tipping material for knives, bits and circular saws. However, Stellite No. 12 may be used as a tipping material when TCT is not available.

Normal feed speeds may be used when surfacing or profiling coco lumber with TCT cutting tools. However, lower feed speeds should be used when surfacing or profiling coco lumber with stellite-tipped cutting tools. The increase in processing cost as a result of using lower than normal feeds speeds when milling coco lumber is still within acceptable limits.

X. CONCLUSIONS AND RECOMMENDATIONS

10.1 CONCLUSIONS

The following conclusions are derived from the results of this Project:

i - Full development of a programme to substitute coco lumber, in the local market, for traditional species like "Lauan", "Tanguile", etc., which in turn can be exported, will create a foreign currency revenue-generating potential of about $1-billion annually, based on current export lumber prices. Furthermore, conversion of only 1/4 of the expected coco lumber output into more advanced lumber products (e.g., doors, windows, furniture, etc.) will add another ₱1-billion annually to the gross national output;

ii - Based on current cost levels, the maximum economic distance between coconut stem cutting area and milling site is about 100 kms. However, this distance is increased for coco wood users (e.g., real estate developers and mass housing builders) who can arrange for a direct supply of coco lumber with coconut farmers and sawmillers;

iii - Existing wood processing facilities in the country can be used to convert coconut tree stems into lumber and lumber products for buildings and construction purposes, without the need for major and costly modifications, provided the techniques developed in this Project are adopted;

iv - Houses made of coconut wood, or using components made from coco lumber, can be designed to allow economically viable processing of coconut tree stems into coco lumber and/or coco wood house components;

v - Step-wise introduction of coco lumber and lumber products in the buildings and construction industry is feasible, and very desirable, in view of the technical limitations on the use of each coco lumber grade and the constraints imposed by the yield distribution of coco lumber grade cut from coconut tree stems; and

vi - The labour skills required in the processing of coconut lumber on an industrial scale, using existing wood processing facilities in the country, are currently available.

10.2 RECOMMENDATIONS

As a result of the coco wood processing techniques, house design and construction methods developed during the conduct of this Project, the following are recommended :

i - Include coco wood in the list of commercial species approved by the Philippine government for domestic processing into lumber and lumber products and as a substitute for traditional wood species like "Yakal", "Guijo", "White Lauan", "Red Lauan", "Tanguile", and other commercially accepted species under the Philippine "Mahogany" group of species which are commonly used by the building and construction industry ;

ii - More emphasis should be laid on efforts to develop the use of coco wood as a substitute for traditional wood species in the fabrication or manufacture of housing components rather than the construction of coco wood houses ;

iii - Encourage the use of coco lumber in mass housing projects, in anticipation of the sizable quantities of coconut tree stems that will become available when the government's coconut tree replanting programme is fully implemented ;

iv - Undertake further development work on the economical and technically sound fastening systems for coco wood used as structural components of houses and buildings ;

v - Formulate a programme to disseminate information on the use of coco wood, and promote the use of coco lumber, on a commercial scale, among architects, construction engineers and key people in the lumber processing and marketing industries of the country ; and

vi - Conduct follow-up projects with the following objectives :

a) To determine, in more specific ways, the most economical use of coco lumber and lumber products as building components in mass housing projects; and

b) To determine and develop the most efficient production methods, particularly the application of available adhesive, abrasive and finishing technologies, in the manufacture of furniture and household furnishings out of coco wood.

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A N N E X I

COCONUT HOUSE MODEL A/DUPLEX

BILL OF MATERIALS

G.G. STA. MARIA ENTERPRISES (01)

34 PITIMINI ST., SFDM, QUEZON CITY

PROJECT: UN - COCO WOOD HOUSING MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		WT. IN KG.
1.0	EXCAVATION					
1.1	COLUMN FOUNDATION	CFE-1	M^3	10.93		
1.2	WALL FOOTING	WFE-1	M^3	4.276		
1.3	STAIR BASE	STBE-1	M^3	0.20		
1.4	SEPTIC VAULT	SVE-1	M^3	10.50		
	Sub-Total		M^3	25.91		
2.0	EXCAVATION BACKFILL					
2.1	COLUMN FOUNDATION	CFE-1	M^3	7.97		
2.2	WALL FOOTING	WFE-1	M^3	2.274		
	Sub-Total		M^3	10.244		
3.0	CONCRETING WORKS					
3.1	COLUMN FOUNDATION	C_1F_1	M^3	3.65		
3.2	WALL FOOTING	W_1F_1	M^3	1.765		
3.3	STAIR BASE	STB	M^3	0.30		
3.4	COLUMN	C_1	M^3	1.70		
3.5	BALCONY CONCRETE BEAM	SB	M^3	1.134		
3.6	LIGHT & VENT SHAFT SLAB	SCR	M^3	1.40		
3.7	STORAGE/SERVICE SLAB	SSS	M^3	1.44		
3.8	SEPTIC VAULT	SV	M^3	1.914		
	Sub-Total		M^3	13.303		
4.0	REINFORCING BARS					
4.1	COLUMN FOUNDATION REBARS					
	12 mm Ø x 1.00 m	CFB-1	PCS.	150		133.20

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(02)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		WT. IN KG.
4.2	WALL FOOTING REBARS					
	12 mm Ø x 0.55 m	WFB-1	pcs.	54		26.37
	10 mm Ø x 2.80 m	WFB-2	pcs.	6		10.35
	10 mm Ø x 1.70 m	WFB-3	pcs.	12		12.57
	10 mm Ø x 1.50 m	WFB-4	pcs.	9		8.32
	10 mm Ø x 0.75 m	DB-1	pcs.	34		15.71
	10 mm Ø x 0.60 m	DB-2	pcs.	18		6.65
4.3	COLUMN REBARS					
	16 mm Ø x 3.40 m	CB-1	pcs.	60		322.12
	10 mm Ø x 0.62 m	CB-2	pcs.	225		85.93
	10 mm Ø x 0.40 m	DB-3	pcs.	49		12.97

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(03)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		WT. IN KG.
4.4	LIGHT & VENT SHAFT SLAB REBARS					
	12 mm Ø x 2.10 m	SB-1	pcs.	4		7.46
	12 mm Ø x 1.30 m	SB-2	pcs.	4		4.62
	12 mm Ø x 3.20 m	SB-3	pcs	4		11.37
	10 mm Ø x 2.20 m	SB-4	pcs.	14		18.97
	10 mm Ø x 1.30 m	SB-5	pcs.	4		3.20
	10 mm Ø x 0.85 m	SB-6	pcs.	4		2.09
	10 mm Ø x 3.80 m	SB-7	pcs.	4		9.36
	10 mm Ø x 3.10 m	SB-8	pcs.	4		7.64
	10 mm Ø x 2.35 m	SB-9	pcs.	4		5.79

G.G. STA. MARIA ENTERPRISES (04)

34 PITIMINI ST., SFDM, QUEZON CITY

PROJECT: UN - COCO WOOD HOUSING MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		WT. IN KG.
	10 mm Ø x 0.35 m	SB-10	pcs.	112		24.15
	10 mm Ø x 3.90 m	SB-11	pcs.	8		19.22
	10 mm Ø x 2.20 m	SB-12	pcs.	8		10.84
4.5	BALCONY SLAB REBARS					
	12 mm Ø x 3.95 m	SB-1a	pcs.	6		39.96
	12 mm Ø x 0.95 m	DB-4	pcs.	6		5.06
	10 mm Ø x 0.78 m	SB-2a	pcs.	50		24.024
	10 mm Ø x 0.45 m	SB-3a	pcs.	6		1.66
	12 mm Ø x 1.80 m	SB-4a	pcs.	32		51.15
	10 mm Ø x 7.35 m	SB-5a	pcs.	6		27.17

G.G. STA. MARIA ENTERPRISES (05)

34 PITIMINI ST., SFDM, QUEZON CITY

PROJECT: UN - COCO WOOD HOUSING MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		WT. IN KG.
4.6	CHB WALL REBARS					
	10 mm Ø x 1.80 m	WB-1	pcs.	24		26.61
	10 mm Ø x 3.30 m	WB-2	pcs.	16		32.52
	10 mm Ø x 1.50 m	WB-3	pcs.	32		29.57
	10 mm Ø x 2.65 m	WB-4	pcs.	35		57.13
	10 mm Ø x 0.50 m	DB-5	pcs.	38		11.70
	12 mm Ø x 3.20 m	WB-5	pcs.	4		11.37
	12 mm Ø x 1.85 m	WB-6	pcs.	8		13.14
	12 mm Ø x 3.70 m	WB-7	pcs.	4		13.14

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(06)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		WT. IN KG.
	12 mm Ø x 0.60 m	DB-5a	pcs.	12		6.39
	12 mm Ø x 0.70 m	DB-6	pcs.	14		8.70
	10 mm Ø x 2.40 m	WB-8	pcs.	12		17.74
	12 mm Ø x 2.40 m	WB-12	pcs.	14		29.84
	10 mm Ø x 0.70 m	DB-7	pcs.	12		5.17
	10 mm Ø x 1.25 m	WB-9	pcs.	12		9.24
	10 mm Ø x 1.90 m	WB-10	pcs.	24		28.09
	10 mm Ø x 0.65 m	WB-11	pcs.	12		4.80
	12 mm Ø x 2.65 m	EB-1	pcs.	14		32.94

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(07)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		WT. IN KG.
4.7	SEPTIC VAULT REBARS					
	12 mm Ø x 2.95 m	SSB-1	pcs.	16		41.91
	12 mm Ø x 1.45 m	SSB-2	pcs.	32		41.20
	12 mm Ø x 1.20 m	SSBD-1	pcs.	16		17.05
	12 mm Ø x 1.60 m	SWB-2	pcs.	24		34.10
	12 mm Ø x 1.85 m	SWB-1	pcs.	46		75.57
	12 mm Ø x 3.15 m	SWB-3	pcs.	16		44.75
	12 mm Ø x 1.85 m	SVB-1	pcs.	12		19.71
	12 mm Ø x 1.45 m	SVB-2	pcs.	14		18.02
	10 mm Ø x 1.45 m	SF-1	pcs.	18		16.08
	12 mm Ø x 0.35 m	SF-2	pcs.	54		16.78
	10 mm Ø x 2.95 m	SF-3	pcs.	12		21.81
4.8	TYING WIRES (#16 G.I. TIE WIRES)		kg.	25		25

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(08)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		WT. IN KG.
5.0	MASONRY WORKS					
	TOILET AND SERVICE AREA					
	150 mm thick CHB		pcs.	610		
	100 mm thick CHB		pcs.	358		
	Cement		bags	62		
	Sand		M^3	6		
	108 x 108 mm glazed					
	wall tiles		pcs.	1770		
	108 x 108 mm unglazed					
	floor tiles		pcs.	420		
	SEPTIC VAULT					
	150 mm thick CHB		pcs.	205		
	Cement		bags	12		
	Sand		M^3	1		

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(09)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	GRADE
6.0	STAKES/BATTER BOARDS/FORMS					
	25 x 50 x 800 Stakes	S-1	pcs.	84	Rough/ Green	
	50 x 50 x 800 "	S-2	pcs.	144	"	
	50 x 50 x 400 "	S-3	pcs.	8	"	
	25 x 50 x 810 "	S-4	pcs.	32	"	
	25 x 50 x 1200 Cross Bracing	CB-1	pcs.	8	"	
	25 x 50 x 1500 Cross Bracing	CB-2	pcs.	16	"	
	50 x 50 x 1700 "	CB-3	pcs.	72	"	
	25 x 50 x 4200 Batter Board	BB-1	pcs.	16	"	
	50 x 125 x 2500 Brace	N-1	pcs.	144	"	
	50 x 50 x 600 "	N-2	pcs.	216	"	
	50 x 100 x 2800 Form Board	FM-1	pcs.	72	"	
	-50 x 125 x 2800	FM-2	pcs.	72	"	
	25 x 100 x 900	FM-3	pcs.	8	"	
	50 x 100 x 2600	SCF-1	pcs.	8	"	
	50 x 100 x 2700	SCF-2	pcs.	10	"	
	50 x 75 x 3000	SCF-3	pcs.	16	"	
	50 x 75 x 2800	SCF-4	pcs.	12	"	
	50 x 100 x 1700	SCF-5	pcs.	12	"	
	25 x 150 x 4700	SCF-6	pcs.	10	"	
	50 x 100 x 2175	SCF-7	pcs.	28	"	
	50 x 100 x 1800	SCF-8	pcs.	8	"	
	50 x 75 x 3400	SCF-9	pcs.	4	"	
	50 x 75 x 2025	SCF-10	pcs.	2	"	
	50 x 75 x 1025	SCF-11	pcs.	2	"	
	25 x 150 x 4700	FW-1	pcs.	6	"	
	25 x 100 x 1200	FW-2	pcs.	80	"	
	25 x 100 x 4700	FW-3	pcs.	4	"	

G.G. STA. MARIA ENTERPRISES (10)
34 PITIMINI ST., SFDM, QUEZON CITY

PROJECT: UN - COCO WOOD HOUSING MODEL - A/DUPLEX
LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	GRADE
	50 x 50 x 3500	FW-4	pcs.	4	Rough/ Green	
	50 x 50 x 1050	FW-5	pcs.	4	"	
	25 x 100 x 1200	FW-6	pcs.	4	"	
	50 x 75 x 1875	FW-7	pcs.	8	"	
	50 x 100 x 2000	FW-8	pcs.	6	"	
	25 x 100 x 1700	FW-9	pcs.	90	"	
	50 x 50 x 1700	FW-10	pcs.	30	"	
7.0	CARPENTRY WORKS					
7.1	WOODEN POSTS					
	50 x 100 x 4500	P-1	pcs.	10	S4S/KD	Grade A
	50 x 100 x 2700	P-2	pcs.	20	"	"
7.2	FLOOR GIRTS					
	50 x 150 x 3700	FG-2	pcs.	14	S4S/AD	"
	50 x 150 x 1700	FG-2	pcs.	6	"	"
	50 x 150 x 2000	FG-3	pcs.	2	"	"
7.3	FLOOR JOISTS AND BRIDGINGS					
	50 x 125 x 3700	FJ-1	pcs.	80	S4S/AD	"
	50 x 125 x 1400	FJ-2	pcs.	4	"	"
	50 x 125 x 4200	FJ-3	pcs.	4	"	"
	50 x 125 x 1000	FJ-4	pcs.	4	"	"
	50 x 125 x 250	BRG	pcs.	160	"	"
7.4	T & G FLOORING					
	25 x 100 x 3700 T & G	T&G-1	pcs.	270	PROF/KD	Grade B

G.G.ST'. MARIA ENTERPRISES (11)

34 PITIMINI ST., SFDM, QUEZON CITY

PROJECT: UN - COCO WOOD HOUSING MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	GRADE
7.5	TIMBER CORBEL					
	50 x 150 x 500	TC	pcs.	4	S4S/AD	Grade A
7.6	ROOF GIRTS					
	50 x 150 x 5100	RG-1	pcs.	12	"	"
	50 x 150 x 3800	RG-2	pcs.	12	"	"
7.7	RAFTERS AND TIMBER BLOCKS					
	50 x 150 x 5500	RF-1	pcs.	25	"	"
	50 x 150 x 5800	RF-2	pcs.	9	"	"
7.7a	PURLINS AND TIMBER BLOCKS					
	50 x 50 x 4200	P-3	pcs.	356	ROUGH/AD	"
	50 x 50 x 77	TB-2	pcs.	1496	"	"
7.8	WOOD SHINGLE ROOFING & SHEATHING					
	100 x 400 mm Wood Shingles	WS-1	pcs.	17000	S4S/AD	Grade B
	6 mm thick x 1219 x 2438					
	Marine Plywood		pcs.	65		"
7.9	FACIA BOARD AND NAILERS					
	25 x 150 x 5500	FB-1	pcs.	12	S4S/KD	"
	25 x 150 x 4900	FB-2	pcs.	24	"	"
	50 x 50 x 4900	FBN-2	pcs.	24	"	"
	50 x 50 x 300	FBN-1	pcs.	132	"	"
7.10	FRAMINGS					
	FRAMING VERTICAL STUDS					
	50 x 75 x 2250	VS-1	pcs.	4	ROUGH/AD	"
	50 x 75 x 2650	VS-2	pcs.	2	"	"
	50 x 75 x [illegible]	VS-3	pcs[illegible]	[illegible]	"	"
	50 x 75 x 550	VS-4	pc[illegible]	4	"	"

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(12)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	GRADE
	50 x 75 x 3100	VS-5	pcs.	4	ROUGH/AD	Grade B
	50 x 75 x 3350	VS-6	pcs.	4	"	"
	50 x 75 x 3600	VS-7	pcs.	4	"	"
	50 x 75 x 4900	VS-8	pcs.	4	"	"
	50 x 75 x 1850	VS-9	pcs.	4	"	"
	50 x 75 x 4100	VS-10	pcs.	4	"	"
	50 x 75 x 3600	VS-12	pcs.	4	"	"
	50 x 75 x 1350	VS-13	pcs.	4	"	"
	50 x 75 x 1500	VS-14	pcs.	4	"	"
	50 x 75 x 2200	VS-15	pcs.	2	"	"
	FRAMING HORIZONTAL STUDS					
	50 x 75 x 2000	HS-1	pcs.	8	"	"
	50 x 75 x 1100	HS-2	pcs.	6	"	"
	50 x 75 x 550	HS-3	pcs.	72	"	"
	50 x 75 x 500	HS-4	pcs.	90	"	"
	50 x 75 x 500	HS-5	pcs.	12	"	"
	50 x 75 x 1100	HS-6	pcs.	4	"	"
	50 x 75 x 800	HS-7	pcs.	4	"	"
	50 x 75 x 1750	HS-8	pcs.	4	"	"
	50 x 75 x 1550	HS-9	pcs.	4	"	"
	50 x 75 x 650	HS-10	pcs.	1	"	"
	50 x 75 x 200	HS-11	pcs.	12	"	"
	50 x 75 x 100	HS-12	pcs.	40	"	"
	50 x 75 x 950	HS-14	pcs.	8	"	"
	50 x 75 x 150	HS-15	pcs.	6	"	"
	50 x 75 x 450	HS-16	pcs.	24	"	"

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(13)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	GRADE
	50 x 75 x 2350	HS-17	pcs.	2	ROUGH/AD	Grade B
	50 x 75 x 1200	HS-18	pcs.	2	"	"
	FRAMING DIAGONAL STUDS					
	50 x 75 x 4200	DS-1	pcs.	4	"	"
7.11	SIDINGS					
	12 x 100 x 2900 V-Cut	VC-1	pcs.	108	PROF/KD	"
	12 x 100 x 350 V-Cut	VC-2	pcs.	317	"	"
	12 x 100 x 450 V-Cut	VC-3	pcs.	22	"	"
	12 x 100 x 2700 V-Cut	VC-4	pcs.	28	"	"
	12 x 100 x 1550 V-Cut	VC-5	pcs.	22	"	"
	12 x 100 x 1450 V-Cut	VC-6	pcs.	32	"	"
	12 x 100 x 3000 V-Cut	VC-12	pcs.	18	"	"
	12 x 100 x 4750 V-Cut	VC-13	pcs.	16	"	"
	12 x 100 x 2000 V-Cut	VC-14	pcs.	44	"	"
	12 x 100 x 4200 V-Cut	VC-15	pcs.	60	"	"
	12 x 100 x 3600 V-Cut	VC-16	pcs.	28	"	"
	12 x 100 x 1200 V-Cut	VC-17	pcs.	24	"	"
7.12	DOUBLE WALLING (V-Cut)					
	12 x 100 x 2400	DW-1	pcs.	398	"	"
	12 x 100 x 2700	DW-2	pcs.	160	"	"
	12 x 100 x 300	DW-3	pcs.	56	"	"
	12 x 100 x 350	DW-4	pcs.	32	"	"
	12 x 100 x 150	DW-7	pcs.	242	"	"
	12 x 100 x 2400	DW-10	pcs.	6	"	"
	12 x 100 x 300	DW-15	pcs.	152	"	"

G.G.STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(14)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	GRADE
	12 x 100 x 1600 V-Cut	DW-21	pcs.	26	PROF/KD	Grade B
7.13	PARTITION FRAMES					
	PARTITION VERTICAL STUDS					
	50 x 75 x 650	VPS-1	pcs.	4	ROUGH/AD	"
	50 x 75 x 1000	VPS-2	pcs.	2	"	"
	50 x 75 x 1500	VPS-4	pcs.	4	"	"
	50 x 75 x 1350	VPS-5	pcs.	6	"	"
	50 x 75 x 2400	VPS-6	pcs.	2	"	"
	50 x 75 x 2400	VPS-7	pcs.	4	"	"
	50 x 75 x 250	VPS-8	pcs.	4	"	"
	50 x 75 x 2400	VPS-9	pcs.	4	"	"
	50 x 75 x 3100	VPS-10	pcs.	10	"	"
	50 x 75 x 3050	VPS-11	pcs.	2	"	"
	50 x 75 x 2800	VPS-12	pcs.	2	"	"
	50 x 75 x 2600	VPS-13	pcs.	2	"	"
	PARTITION HORIZONTAL STUDS					
	50 x 75 x 1850	HPS-1	pcs.	2	"	"
	50 x 75 x 600	HPS-2	pcs.	2	"	"
	50 x 75 x 1200	HPS-4	pcs.	4	"	"
	50 x 75 x 500	HPS-5	pcs.	40	"	"
	50 x 75 x 650	HPS-6	pcs.	10	"	"
	50 x 75 x 1700	HPS-7	pcs.	2	"	"
	50 x 75 x 800	HPS-8	pcs.	22	"	"
	50 x 75 x 850	HPS-9	pcs.	2	"	"
	50 x 75 x 2300	HPS-10	pcs.	4	"	"
	50 x 75 x 1050	HPS-11	pcs.	2	"	"
	50 x 75 x 450	HPS-12	pcs.	16	"	"

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(15)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	GRADE
	50 x 75 x 3450	HPS-13	pcs.	2	ROUGH/AD	Grade B
	50 x 75 x 1550	HPS-14	pcs.	2	"	"
	PARTITION DIAGONAL STUDS					
	50 x 75 x 2300	DPS-1	pcs.	2	"	"
	50 x 75 x 1200	DPS-4	pcs.	2	"	"
7.14	CEILING FRAMES					
	50 x 50 x 3500	CJ-1	pcs.	40	"	"
	50 x 50 x 600	CJ-2	pcs.	112	"	"
	50 x 50 x 650	CJ-3	pcs.	80	"	"
	50 x 50 x 5200	CJ-4	pcs.	4	"	"
	50 x 50 x 950	CJ-6	pcs.	10	"	"
	50 x 50 x 2400	CJ-8	pcs.	4	"	"
	50 x 50 x 625	CJ-9	pcs.	8	"	"
	50 x 50 x 1050	CJ-11	pcs.	8	"	"
	50 x 50 x 550	CJ-13	pcs.	16	"	"
	50 x 50 x 190	CJ-14	pcs.	6	"	"
	50 x 50 x 3000	CJ-12	pcs.	8	"	"
7.15	CEILING BOARDS					
	12 x 100 x 3500 V-Cut	WC-1	pcs.	300	PROF/KD	"
	12 x 100 x 1350 V-Cut	WC-2	pcs.	592	"	"
	12 x 100 x 1200 V-Cut	WC-3	pcs.	28	"	"
	12 x 100 x 2400 V-Cut	WC-4	pcs.	24	"	"
	12 x 100 x 4200 V-Cut	WC-5	pcs.	64	"	"
	12 x 100 x 2200 V-Cut	WC-6	pcs.	64	"	"

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(16)

PROJECT: UN - COCO WOOD HOUSING
LOCATION:

MODEL - A/DUPLEX

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	GRADE
7.16	BALCONY RAILINGS & L & V SHAFT					
	RAILINGS					
	50 x 100 x 3600	HR-1	pcs.	4	PROF/KD	Grade B
	50 x 100 x 450	HR-2	pcs.	40	"	"
	50 x 100 x 100	HR-3	pcs.	56	"	"
	50 x 100 x 1200	HR-4	pcs.	8	"	"
	50 x 100 x 2400	HR-5	pcs.	4	"	"
	50 x 100 x 400	HR-6	pcs.	16	"	"
	50 x 100 x 2100	HR-7	pcs.	4	"	"
	50 x 50 x 200	HR-8	pcs.	8	"	"
	50 x 100 x 500	HR-9	pcs.	12	"	"
	50 x 100 x 950	VR-1	pcs.	68	"	"
	50 x 100 x 800	DR-1	pcs.	40	"	"
	50 x 100 x 750	DR-2	pcs.	16	"	"
	50 x 100 x 850	DR-3	pcs.	12	"	"
7.17	MAIN STAIRS					
	50 x 150 x 3300 Stringer	ST-1	pcs.	4	S4S/KD	Grade A
	50 x 200 x 200 Stringer Block	ST-2	pcs.	52	PROF/KD	"
	50 x 150 x 900 Tread	TR-1	pcs.	24	S4S/KD	"
	50 x 100 x 900 Tread	TR-2	pcs.	22	"	"
	50 x 50 x 900 Baluster	BAL-1	pcs.	44	PROF/KD	Grade B
	50 x 150 x 3500 Handrail	HR-1	pcs.	4	"	"
	50 x 150 x 900 Handrail	HR-2	pcs.	4	"	"
	50 x 150 x 1000 Baluster	BAL-2	pcs.	4	"	"
	50 x 150 x 250 Brace	BR-1	pcs.	26	S4S/KD	Grade A

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM. QUEZON CITY

(17)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	GRADE
7.18	SERVICE STAIR					
	50 x 150 x 2000 Stringer	ST-3	pcs.	4	S4S/KD	Grade A
	50 x 150 x 1500 Stringer	ST-4	pcs.	4	"	"
	50 x 190 x 150 Stringer Block	ST-5	pcs.	48	PROF/KD	"
	50 x 100 x 700 Treads	ST-5	pcs.	48	S4S/KD	"
	50 x 50 x 900 Balusters	BAL-1	pcs.	40	PROF/KD	Grade B
	LANDING FRAME AND STRINGER BRACE					
	50 x 150 x 700	LF-1	pcs.	20	S4S/AD	Grade A
	50 x 150 x 350	LF-2	pcs.	12	"	"
	50 x 150 x 500	BR-2	pcs.	24	"	"
	HANDRAIL AND RAILINGS					
	-50 x 150 x 900	R-1	pcs.	2	PROF/KD	Grade B
	50 x 150 x 600	R-2	pcs.	2	"	"
	50 x 150 x 950	R-3	pcs.	2	"	"
	50 x 150 x 1700	HR-1	pcs.	2	"	"
	50 x 150 x 1200	HR-2	pcs.	2	"	"
	50 x 150 x 600	HR-3	pcs.	2	"	"
	50 x 150 x 1000	HR-4	pcs.	2	"	"
	LANDING FLOOR					
	25 x 100 x 700 T & G	T&G-2	pcs.	40		"
7.19	CLOSET (Incl. Attached Partition)					
	19 x 100 x 750 T X G	PP-1	pcs.	78	PROF/KD	"

Q.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(18)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	GRADE
	19 x 100 x 600 T & G	CS-1	pcs.	72	PROF/KD	Grade B
	19 x 100 x 1200 T & G	CS-2	pcs.	64	"	"
	12.7 x 100 x 680 V-Cut	CS-3	pcs.	192	"	"
	19 x 100 x 2400 T & G	CP-1	pcs.	32	"	"
	19 x 100 x 2400 T & G	CP-2	pcs.	64	"	"
	50 x 75 x 2400	CF-1	pcs.	4	"	"
	50 x 75 x 2400	CF-2	pcs.	2	"	"
	50 x 75 x 2400	CF-3	pcs.	2	"	"
	50 x 75 x 2400	CF-4	pcs.	2	"	"
	50 x 75 x 2400	CF-5	pcs.	2	"	"
	50 x 75 x 1200	CF-6	pcs.	4	"	"
	50 x 75 x 2400	PF-1	pcs.	4	"	"
	-50 x 75 x 1200	PF-1	pcs.	12	"	"
	50 x 75 x 600	PF-1	pcs.	8	"	"
	50 x 75 x 1100	PF-2	pcs.	4	"	"
	50 x 75 x 1200	CF-8	pcs.	4	"	"
	50 x 75 x 1200	CF-7	pcs.	4	"	"
	50 x 100 x 1200	B-1	pcs.	4	"	"
	50 x 50 x 2100	CDF-1	pcs.	16	"	"
	50 x 50 x 600	CDF-2	pcs.	16	"	"
	50 x 50 x 600	CDF-1	pcs.	16	"	"
	50 x 50 x 600	CDF-3	pcs.	24	"	"
	50 x 50 x 400	CDF-3	pcs.	24	"	"
	50 x 50 x 600	N-1	pcs.	40	"	"
	50 x 50 x 1200	N-2	pcs.	8	"	"
	50 x 50 x 2100	HPS-1	pcs.	4	"	"

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(19)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	GRADE
7.20	KITCHEN COUNTER AND CABINET					
	50 x 100 x 1500 Baseboard	B-2	pcs.	2	S4S/KD	Grade B
	50 x 75 x 1500 Frame	TN-1	pcs.	16	"	"
	50 x 75 x 800 Frame	TN-2	pcs.	16	"	"
	50 x 75 x 300 Frame	TN-3	pcs.	24	"	"
	50 x 75 x 1500 Frame	FN-1	pcs.	2	"	"
	50 x 75 x 600 Frame	FN-3	pcs.	12	"	"
	50 x 50 x 600 Frame	FN-2	pcs.	24	"	"
	19 x 100 x 1500 Cabinet Floor T&G	TG-3	pcs.	30	PROF/KD	"
	19 x 100 x 750 Counter Top T&G	TG-4	pcs.	16	"	"
	12.7 x 100 x 700 Door V-Cut	TG-5	pcs.	36	"	"
	50 x 50 x 700 Door Frame	CDF-1	pcs.	12	"	"
	50 x 50 x 500 Door Frame	CDF-1	pcs.	12	"	"
	50 x 75 x 1500 Frame	CF-7	pcs.	2	"	"
	50 x 50 x 1500 Floor Frame	DCF-3	pcs.	4	"	"
	6 mm x 850 x 1500 Marine Plywood	PW-1	pcs.	2	"	
7.21	DOORS AND WINDOWS (See Shopdrawing for fabrication)					
	44.45 mm thick Flush Type	D-1	set	2	PRE-FAB	
	Hollow Core Door with 12 mm					
	thick coco wood on both faces					
	(includes wood jamb)					
	- do -	D-2	set	4	"	
	- do -	D-3	set	6	"	
	- do -	D-4	set	2	"	

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(20)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.	FINISH	
	COCONUT WOOD LOUVRE WINDOW					
	(includes wood jamb)	W-1	set	6	PRE-FAB	
	- do -	W-2	set	8	"	
	- do -	W-3	set	2	"	
	- do -	W-4	set	2	"	
8.0	MISCELLANEOUS STEEL WORKS					
	6 x 50 x 500 Anchor Steel Strap	SSP-1	pcs.	4		
	6 x 50 x 350 Post Steel Strap	PSP	pcs.	30		
	19 mmØ x 127 mm Bolts	B-1	pcs.	60		
	6 x 50 x 275 Twisted Steel Strap	TSS	pcs.	6		
	19 Ø x 300 mm Anchor Bolts	B-2	pcs.	6		
	19 Ø x 76 mm Bolts	B-3	pcs.	6		
	4.5 x 50 x 30 Twisted Steel Strap	TSP-1	pcs.	68		
	4.5 x 50 x 300 mm Y Strap Plate	YSP	pcs.	34		
	16 mm Ø x 229 mm Machine Bolts	MB-1	pcs.	60		
	16 mm Ø x 76 mm Machine Bolts	MB-2	pcs.	272		
	16 mm Ø x 300 mm Anchor Bolts	B-5	pcs.	2		
	16 mm Ø x 127 mm Bolt	B-6	pcs.	2		
	6 x 50 x 300 mm Anchor Plate	ASP	pcs.	2		
9.0	FIXTURES AND FINISHING HARDWARES					
	CLOSET DOOR HANDLE		pcs.	8		
	CABINET DOOR HANDLE		pcs.	6		
	CATCHES		pcs.	28		

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(21)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		
	Piano Hinges		LM	21		
	90 mm x 90 mm Loose Pin Hinges		pairs	36		
	Locksets		set	12		
	Deadlock		set	2		
	Sliding Door overhead rail					
	and Roller		set	1		
	Barrel Bolt		set	6		
	Closet Door Lock		set	4		
	Sliding Door Lock		set	2		
	Shower Head		set	2		
	Water Closet and Accessories		set	2		
	Lavatory and Accessories		set	2		
	0.90 m x 0.60 m Stainless					
	- Kit Sink		set	2		
	Lavatory Faucet and Valve		set	2		
	Faucet includes accessories		set	4		
	Floor Drain		set	4		
	Shower Valve		set	2		
	Hose Bibb		set	2		
	25 mm Ø x 800 mm G.I. Pipe	HP-1	pcs.	4		
10.0	PIPES AND FITTINGS					
	19 mm Ø G.I. Pipe x 20'		pcs.	8		
	19 mm Ø G.I. Coupling		pcs.	18		
	19 mm Ø G.I. Tee		pcs.	12		
	19 mm Ø G.I. Elbow		pcs.	12		
	100 mm Ø Single Hub Cisp x 1.52 m		pcs.	10		
	100 mm Ø Double Hub Cisp x 1.52 m		pcs.	2		

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(22)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		
	100 mm x 90° Elbow		pcs.	2		
	100 mm x 100 mm Wye		pcs.	2		
	100 mm x 50 mm Wye		pcs.	2		
	50 mm x 90° Elbow		pcs.	2		
	50 mm x 50 mm S Trap		pcs.	2		
	50 mm P Trap		pcs.	4		
	100 mm x 50 mm Wye		pcs.	4		
	100 mm Ø x 1.52 m Single Hub Cisp		pcs.	2		
	100 mm Ø x 1.52 m Double Hub Cisp		pcs.	2		
	75 mm Ø x 1.52 m Double Hub Cisp		pcs.	10		
	50 mm Ø x 1.52 m Double Hub Cisp		pcs.	8		
	50 mm Ø Cisp P Trap		pcs.	8		
	50 mm Ø Cisp P Trap		pcs.	2		
	75 mm Ø Cleanout with Brass Plug		pcs.	4		
	100 mm Ø cleanout with Brass Plug		pcs.	8		
	45°-75 mm x 100 mm Reducing Wye,Cisp		pcs.	6		
	45°-50 mm x 75 mm - do -		pcs.	8		
	45°-50 mm x 100 mm - do -		pcs.	2		
	45°-100mm x 100 mm Elbow		pcs.	8		
	100 mm x 75 mm Reducer Tee		pcs.	6		
	75 mm Ø x 3.0 m PVC Pipe		pcs.	8		
	75 mm Ø x 90° Elbow, PVC		pcs.	4		
	75 mm Ø PVC Tee		pcs.	6		
	75 mm Ø Cisp Wye		pcs.	2		
	75 mm Ø PVC Coupling		pcs.	8		
	100 mm Ø Cisp Wye		pcs.	4		
	Roof Cement		qrt.	1		
	Oakum		bundle	1		
	Epoxy A & B		gal.	1		

G.G. STA. MARIA ENTERPRISES (23)

34 PITIMINI ST., SFDM, QUEZON CITY

PROJECT: UN - COCO WOOD HOUSING MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		
11.0	WATERPROOFING					
	Roof		m^2	184.80		
	Toilet		m^2	16.40		
12.0	ELECTRICAL WORKS					
12.1	FIXTURES AND DEVICES					
	Lamp Receptacle		set	30		
	Incandescent Bulb 1 x i ww		set	30		
	Convenience Outlet		set	16		
	Refrigerator Outlet		set	2		
	Range Outlet		set	2		
	Single Switch		set	16		
	Two Gang Switch		set	2		
	-Three Gang Switch		set	2		
12.2	WIRES					
	#12 T.W. Electrical Wire		rolls	4		
	#8 THW Electrical Wire		meters	24		
	# 4 THW Electrical Wire		meters	100		
12.3	CONDUITS					
	1/2 x 3 m PVC Conduit		length	86		
	1-1/4 x 3 m PVC Conduit		length	14		
	Utility Box 2" x 4"		pcs.	40		
	Junction Box 4 x 4		pcs.	30		
	Locknut and Bushing 1/2" ∅		prs.	100		
	1/2" ∅ PVC Adoptor		prs.	100		
	Pull Box 10" x 8" x 6"		pcs.	2		

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(24)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		
	G.I. Wire #16		rolls	20		
	Tapes 3/4" x 80		kilos	20		
	1-1/4" ø PVC Adaptor		prs.	4		
12.4	SERVICE ENTRANCE					
	2/0 THW Wire		meters	20		
	2" ø RSC Conduit		length	1		
	2" ø RSC Coupling		pcs.	1		
	2" ø Locknut and Bushing		prs.	1		
	Rubber Tape BLB		rolls	2		
	G.I. Wire #10		kilos	1		
13.0	NAILS					
	1" Finishing Nails		kg.	10		
	1-1/4 Finishing Nails		kg.	4		
	2-1/2" Finishing Nails		kg.	4		
	1-1/2" CW Nails		kg.	32		
	2" CW Nails		kg.	32		
	2-1/2" CW Nails		kg.	32		
	3" CW Nails		kg.	34		
	4" CW Nails		kg.	1		

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

(25)

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		
	ADDITIONAL CARPENTRY WORKS					
1.0	CANOPY					
1.1	BASEPLATE (For Brace)					
	50 x 150 x 1500		pcs.	6		
1.2	BRACE					
	50 x 125 x 1000		pcs.	12		
1.3	RAFTER					
	50 x 150 x 1000		pcs.	6		
1.4	PURLINS					
	50 x 50 x 3500		pcs.	18		
1.5	FACIA BOARD					
	25 x 150 x 3500		pcs.	2		
	25 x 150 x 1000		pcs.	4		
1.6	6 mm x 1213 x 2.44					
	Marine Plywood Sheating		pcs.	3		
1.7	WOOD SHINGLES					
	100 x 400 Wood shingles		pcs.	470		
	Note : Additional Carpentry works is for two second floor canopies only.					

(26)

G.G. STA. MARIA ENTERPRISES
34 PITIMINI ST., SFDM, QUEZON CITY

PROJECT: UN - COCO WOOD HOUSING

MODEL - A/DUPLEX

LOCATION:

BILL OF MATERIALS

ITEM NO.	DESCRIPTION	MARK	UNIT	QTY.		
1.0	SIDINGS					
1.1	12 x 100 x 2000	HC-1	pcs.	60		
1.2	12 x 100 x 3600	HC-2	pcs.	30		
1.3	12 x 100 x 4200	HC-3	pcs.	45		
1.4	12 x 100 x 1700	HC-4	pcs.	113		
1.5	12 x 100 x 1200	HC-5	pcs.	60		
1.6	-12 x 100 x 650	HC-6	pcs.	60		
1.7	12 x 100 x 450	HC-7	pcs.	90		
1.8	12 x 100 x 1000	HC-8	pcs.	120		
	Prepared by :					
	(Sgd.) GREGORIO G. STA. MARIA					
	Architect					
	Reg. No. : 1341					
	PTR : 418 B					
	Date : 1-16-84					
	Place : Quezon City					
	TAN : S-3563-L-1737-A-6					

ANNEX II

EQUIPMENT COMPLEMENT OF MAHUSAY BOX FACTORY, A SUBSIDIARY OF DAVAO GULF LUMBER CORPORATION PUNTA DUMALAG, MATINA-APLAYA, DAVAO CITY

1. MAIN SAW AND CARRIAGE - 1 Set

   a) Main Saw - Fabricated at DGLC Machine Maintenance Shop

   Bandsaw Pulleys : 1200 mm diameter ; 650 RPM

   Bandsaw Blade : Width - 125 mm ; thickness - 0.91 mm ; Stellite (No. 12) Tipped Teeth, Kerf - 3 mm ; Pitch - 37 mm

   Cutting Speed - 2,360 meters per minute

   Maximum Log Diameter Capacity : 700 mm

   Motor : 30 KW, 440V, 60 Hertz, 3-phase

   b) Carriage - Fabricated at DGLC Machine Maintenance Shop

   Manually pushed (by one man)

   Work Capacity : 60 mm minimum thickness ; 3000 mm maximum length ; and 700 mm maximum diameter

2. TRIM SAW - 1 Unit - Fabricated at DGLC Machine Maintenance Shop

   Pendulum Type Circular Saw, manually operated, with in-feed and out-feed dead roll conveyor table

   Sawblade : 600 mm diameter ; 100 teeth ; High Speed Steel ; 3000 RPM ; later replaced with TCT circular sawblade, 500 mm diameter, 50 teeth ; 3 mm kerf

   Motor : 7.5 KW, 440V, 60 Hertz, 3-phase

3. TABLE BANDSAW - 5 Units - Imported, Japanese Manufacture

   Bandsaw Pulleys : 812 mm diameter ; 500 RPM

Bandsaw Blade	:	High Speed Steel ; Width - 50 mm ; thickness - 1.5 mm ; Pitch - 19 mm ; Tooth Set Kerf - 2 mm Cutting Speed - 1,200 meters per minute
Manual Feed Motor	:	7.5 KW, 440V, 60 Hertz, 3-phase

NOTE : Machinery and Sawblade maintenance provided by DGLC Main Sawmill.

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ANNEX III

EQUIPMENT COMPLEMENT OF ANGALA SAWMILL
BANAY-BANAY, DAVAO ORIENTAL PROVINCE

1. MAIN SAW AND CARRIAGE - 1 Set - Philippine Made

a) Main Saw

Bandsaw Pulleys : 2590 mm diameter ; 450 RPM

Bandsaw Blade : width - 216 mm ; thickness - 1.63 mm
Stellite (No. 12) Tipped Teeth,
Kerf - 3.25 mm ; Pitch - 45 mm

Cutting Speed - 3600 meters per minute

Maximum Log Diameter Capacity : 1500 mm

Motor : 75 KW, 440V, 60 Hertz, 3-phase

b) Carriage

Winch-operated ; infinitesimal speed control ; manual log setting and log turning device.

Maximum Log Size Capacity : length - 6000 mm ; diameter - 1500 mm

Motors : 22 KW, Forward Travel ; 18 KW, Reverse Travel ; 440V, 60 Hertz, 2-phase

2. PONY RIG - 1 Set - Imported, Japanese Manufacture

a) Pony Saw

Bandsaw Pulleys : 1200 mm diameter ; 560 RPM

Bandsaw Blade : width - 150 mm ; thickness - 1.02 mm
Stellite (No. 12) Tipped Teeth,
Kerf - 3 mm ; Pitch - 38 mm

Cutting Speed - 2000 meters per minute

Maximum Work Dimensions Capacity : 1000 mm x 1000 mm

Motor : 37 KW, 440V, 60 Hertz, 3-phase

b) Pony Carriage

Winch-operated ; infinitesimal speed control ; pneumatic/ hydraulic powered dogging, setting and log turning device ; powered in-feed and out-feed chain conveyors.

Wood Flitch Capacity	:	800 mm x 800 mm x 6000 mm

All controls automatic and push-button operated.

Motor	:	7.5 KW, 440V, 60 Hertz, 3-phase

3. EDGER SAW - 1 Unit - Imported, Japanese Manufacture

Minimum Work Width	:	100 mm
Maximum Work Thickness	:	100 mm
Circular Sawblade	:	TCT ; 500 mm diameter ; 50 teeth ; Kerf - 3 mm ; 1800 RPM
Feed Speed	:	30 meters per minute
Motor	:	55 KW, 440V, 60 Hertz, 3-phase

4. BAND RE-SAW - 2 Units - Philippine Made

Fixed Table Type ; with serrated gear-driven feed roll ; manually fed ; single feed speed - 20 meters per minute

Bandsaw Pulleys	:	1100 mm diameter ; 560 RPM
Bandsaw Blade	:	width - 125 mm ; thickness - 1.15 mm Pitch - 38 mm Cutting Speed - 1835 meters per minute
Maximum Workpiece Cross Section Capacity	:	300 mm x 230 mm
Motor	:	22 KW, 440V, 60 Hertz, 3-phase

5. TRIM SAW - 2 Units - Philippine Made

Manually fed and operated, pendulum type, with locally fabricated in-feed and out-feed dead roll conveyor table

Circular Sawblade	:	500 mm diameter ; 80 teeth, normal set, Kerf - 2.5 mm ; 2500 RPM

6. ONE complete SET of sawblade filing, grinding, swaging, setting and tungsten carbide tipping equipment.

ANNEX IV

EQUIPMENT COMPLEMENT OF DAVAO GULF LUMBER CORPORATION
PUNTA DUMALAG, MATINA-APLAYA, DAVAO CITY

I. SAWMILLING PLANT - All Machines and Conveyor Systems were Imported, Japanese Manufacture

A. Main Saw and Carriage - 1 Set

1. Main Saw

Bandsaw Pulleys	:	1500 mm diameter ; 520 RPM
Bandsaw Blade	:	width - 200 mm ; thickness - 1.15 mm ; Stellite (No. 12) Tipped Teeth, Kerf - 3.5 mm ; Pitch - 45 mm Cutting Speed - 2320 meters per minute
Maximum Log Diameter Capacity	:	1500 mm
Motor	:	75 KW, 440V, 60 Hertz, 3-phase

2. Carriage

Fully automatic controls, hydraulic powered dogging and setting devices; heavy duty chain type log turning device; pneumatic controlled log tapering device; pneumatic controlled cutting thickness feed device; all systems push-button operated, including infinitesimal carriage speed control.

Log Capacity	:	1300 mm diameter ; length - 6000 mm
Motor	:	18 KW, Forward Travel ; 15 KW, Reverse Travel ; both 440V, 60 Hertz, 3-phase

3. Log Deck Conveyor

Heavy Duty Chain Type Conveyor, 4-lines, push-button operated.

B. Pony Rig - 2 Sets

1. Pony Bandsaw

Bandsaw Pulleys	:	1200 mm diameter ; 560 RPM
Bandsaw Blade	:	width - 150 mm ; thickness - 1.02 mm ; Stellite (No. 12) Tipped Teeth, Kerf - 3 mm ; Pitch - 38 mm Cutting Speed - 2000 meters per minute
Maximum Wood Flitch Capacity	:	1000 mm x 1000 mm
Motor	:	37 KW, 440V, 60 Hertz, 3-phase

2. Pony Carriage

Maximum Wood Flitch Capacity	:	length - 6000 mm ; width - 800 mm ; thickness - 800 mm

With automatic carriage flitch loading device, pneumatic/ hydraulic operated dogging and setting devices; pneumatic operated work tapering device; all controls push-button operated.

Motor	:	10 KW, Forward Travel ; 7.5 KW, Reverse Travel ; 440V, 60 Hertz, 3-phase

C. EDGER SAW - 2 Units

Minimum Work Width	:	100 mm
Maximum Work Thickness	:	100 mm
Two (2) Sawblades	:	TCT, 500 mm diameter ; 50 teeth ; Kerf - 3 mm ; 2800 RPM Feed Speed - 30 meters per minute
Motor	:	55 KW, 440V, 60 Hertz, 3-phase

All control systems push-button operated.

D. BAND RE-SAW - 3 Units

Fixed Table Type	:	Manually Fed
Bandsaw Pulleys	:	1100 mm diameter ; 560 RPM
Bandsaw Blade	:	width - 125 mm ; thickness - 0.91 mm

		Stellite (No. 12) Tipped Teeth, Kerf - 2 mm ; Pitch - 35 mm Cutting Speed - 1835 meters per minute
Feed Roll	:	Serrated, pneumatic pressure controlled, 300 mm diameter x 300 mm thick
Work Piece Capacity	:	300 mm x 230 mm
Motor	:	30 KW, 440V, 60 Hertz, 3-phase

E. TRIM SAW - 3 Units

Pendulum Type Circular Saw, Manually Operated.

Sawblade	:	TCT, 50 mm diameter ; 80 teeth ; 3000 RPM

F. TABLE BANDSAW - 1 Unit

Bandsaw Pulleys	:	812 mm diameter ; 500 RPM
Bandsaw Blade	:	High Speed Steel ; width - 50 mm ; thickness - 1.15 mm ; Pitch - 19 mm Kerf - 2 mm Cutting Speed - 1200 meters per minute
Manual Feed		
Motor	:	7.5 KW, 440V, 60 Hertz, 3-phase

G. Two complete sets of sawblade filing, grinding, swaging and setting equipment, with special grinding wheels for TCT and stellite tipped sawblades; complete set of stellite and tungsten carbide tipping tools.

H. OTHER EQUIPMENT

All production machines connected by powered roll and chain main conveyor system, centrally controlled. Gravity type conveyor sections with double wheels and dead roll conveyor at Re-saw and Trim Saw Sections. Out-feed conveyor system includes fungicide dipping tank for automatic treating of sawn timber and 30 meters sorting and grading table. Pneumatic exhaustion of sawdust from all machines. Flat belt conveyor system of disposing edgings, trimmings and slabs. Yard material handling equipment includes : 1 unit, 250 Hp front loader with articulating front wheels ; 2 units, 3-ton fork-lift and 1 unit, 5-ton fork-lift.

II. KILN-DRYING EQUIPMENT

A. Kiln-Drier - 1 Chamber - Locally Designed and Fabricated

Hot Air, Reversible flow, Batch Type

Chamber Inside Dimensions	: length - 23 meters ; width - 4.57 meters working height - 4.0 meters
Rated Capacity	: 95 cubic meters per charge

Cam-Type Automatic Temperature (DB and WB) Recorder ; manually controlled vents; with 10 circulating fans, 1.22 meter diameter, 390 RPM each, powered by 1.5 KW, 440V, 60 Hertz, 3-phase electric motor.

B. Wood Waste Burning Furnace - Locally designed and built with finned mild steel pipe hot air exchanger system.

C. Moisture Meter - 1 Unit - Imported, Japanese Manufacture

Resistance Type	: 0 to 30% Moisture Content
Dry Cell Powered	

III. SURFACING/PROFILING EQUIPEMNT - 1 Unit

A. Planer - Matcher - 1 Unit - Imported, U.S. Made (Old Model)

4-head matcher, flat belt driven, hand fed

Work Capacity	: 100 mm x 500 mm
Feed Speed	: Maximum - 15 meters per minute Minimum - 12 meters per minute
Horizontal Cutterheads	: Square Type ; 5000 RPM
Knives	: 9.5 mm x 75 mm x 508 mm ; 4 pcs. maximum per head
Vertical Cutterheads	: Square Type ; 4350 RPM
Knives	: 9.5 mm x 75 mm x 75 mm ; 4 pcs. maximum per head
Motor	: 37 KW, 440V, 60 Hertz, 3-phase, 1915 RPM

B. Universal Grinder - 1 Unit - Imported, German Made

Maximum Knife Capacity : 75 mm wide x 508 mm long

Complete with knife holding device; TCT grinding wheels and precision grinding bite device.

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ANNEX V

COMPARATIVE HARDNESS AND TOUGHNESS, COCONUT vs. TANGUILE AND LAUAN LUMBER

(At "GREEN" Condition)

I. SIDE HARDNESS

HARDEST	-----	Coconut, Grade "A" (*Cocos Nucifera*) Tanguile (*Shorea Polysperma*) White Lauan (*Pentacme Contorta*) Red Lauan (*Shorea Negrosensis*) Coconut, Grade "B" (*Cocos Nucifera*)
SOFTEST	-----	Coconut, Grade "C" (*Cocos Nucifera*)

II. TOUGHNESS

TOUGHEST	-----	Coconut, Grade "A" (*Cocos Nucifera*) Red Lauan (*Shorea Negrosensis*) White Lauan (*Pentacme Contorta*) Tanguile (*Shorea Polysperma*) Coconut, Grade "B" (*Cocos Nucifera*)
LEAST TOUGHEST	-----	Coconut, Grade "C" (*Cocos Nucifera*)

Note : The wood species are listed in the descending order of the mechanical property.

Sources :

1) MECHANICAL PROPERTIES OF COCONUT PALM WOOD, V. K. Sulc, PCA-Zamboanga Research Center, 1983.

2) PHILIPPINE TIMBER SERIES, No. 1, Forest Products Research Institute, U. P., Los Baños, 1967.

3) Observations of Coconut Wood Sawmilling at the PCA-Zamboanga Research Center & BOA Brothers Sawmill, Zamboanga City and other sawmills in Luzon, Samar and Mindanao.

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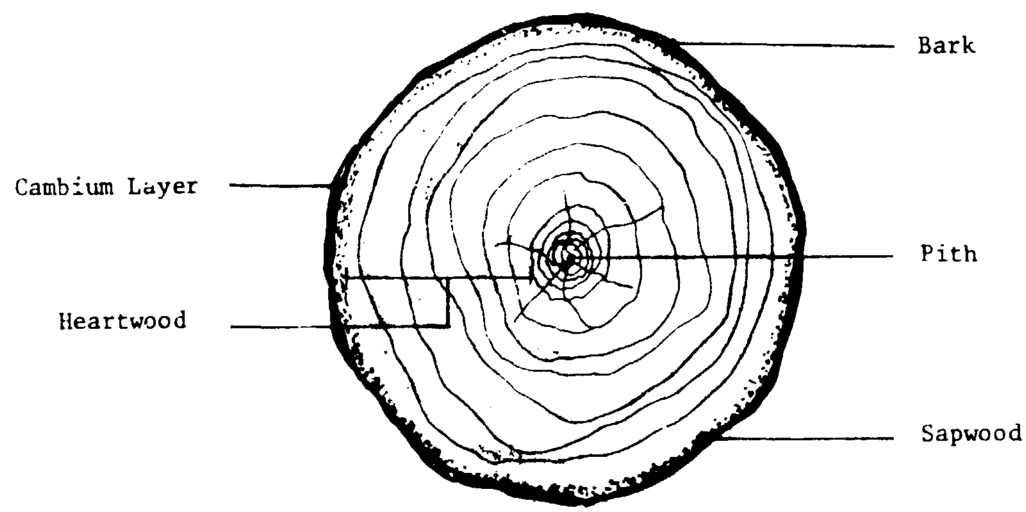
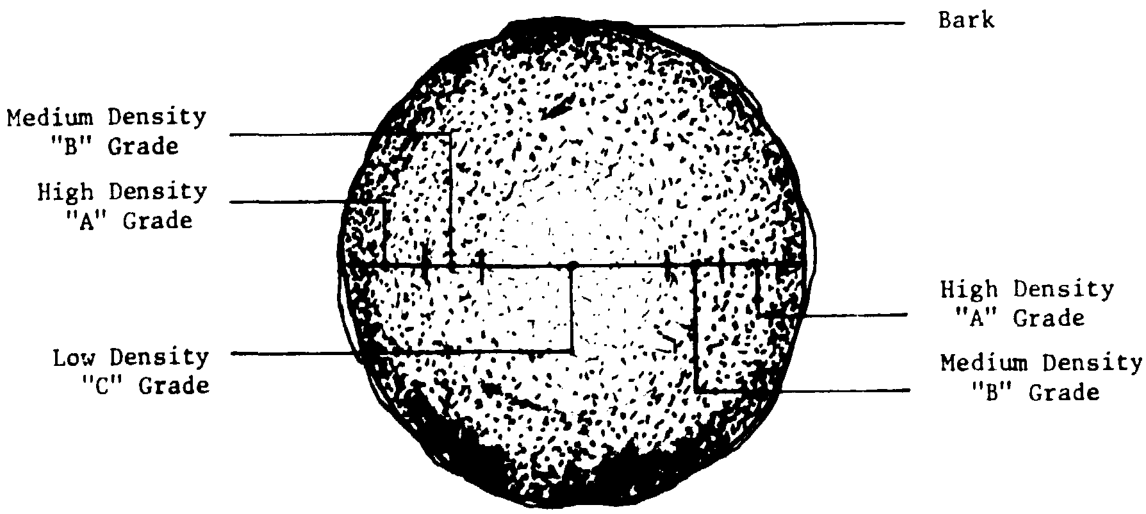
ANNEX VI

TYPICAL CROSS SECTIONS OF PHILIPPINE MAHOGANY
(Lauan, Tanguile, etc.) and COCONUT PALM TREE



A. Typical Cross Section of Lauan (Shorea Family)

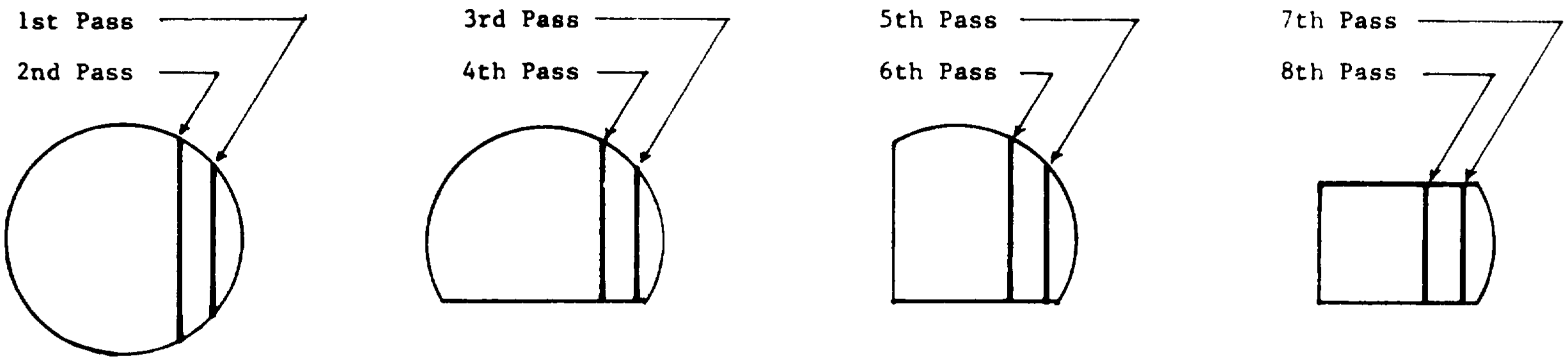


B. Typical Cross Section of Coconut Palm Tree (Cocos Nucifera)

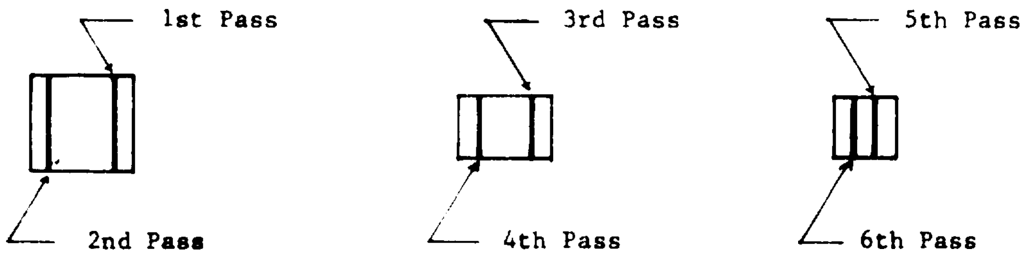
ANNEX VII

RECOMMENDED SAWMILLING PATTERN
For STRAIGHT AND NORMALLY TAPERED COCO LOG BOLT

AT PONY RIG BANDSAW :



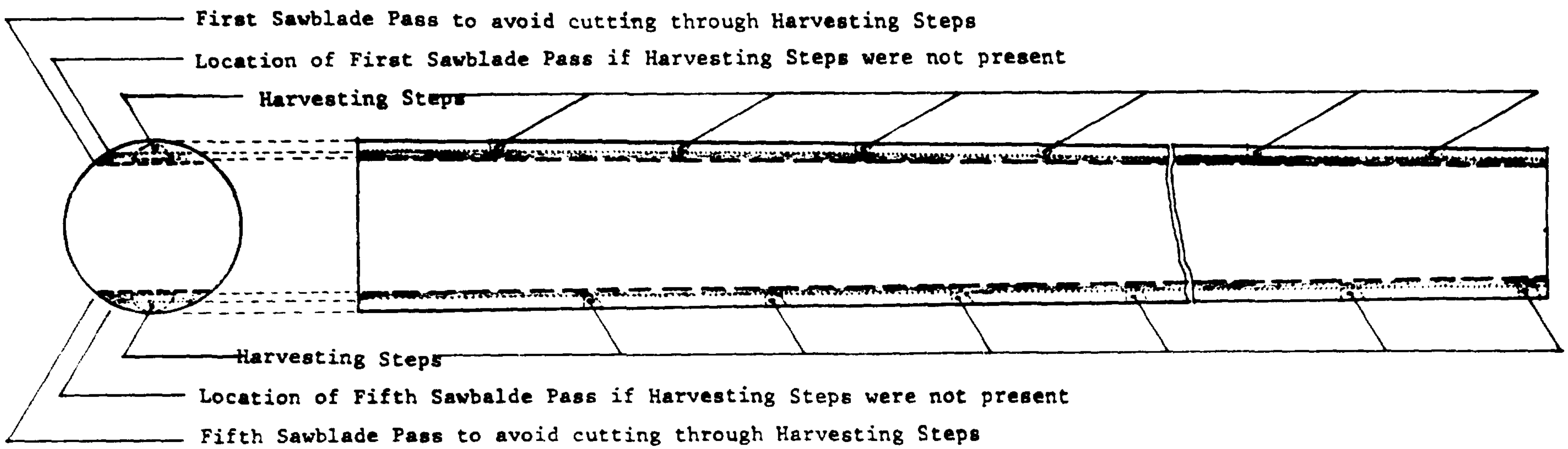
AT BAND RE-SAW :



SOURCE : THE PRODUCTION OF COCONUT LUMBER, SAWING AND SAWING FACILITIES, R.M. Madrazo & R. A. Juson, PCA-Zamboanga Research Center, CWUT 103, Zamboanga City, 1983

ANNEX VIII

EFFECT OF HARVESTING STEPS ON SAWMILLING PATTERN

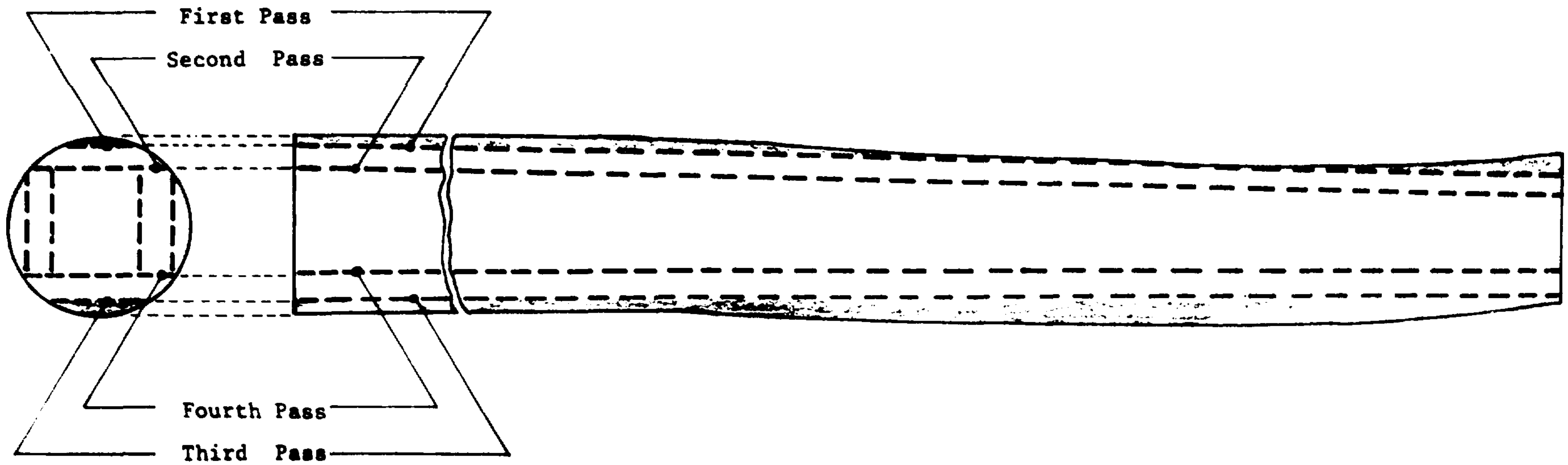


Cross Section | Longitudinal Section

Note : Shaded areas indicate LOSS of "A" Grade coco lumber volume as a result of modification of standard sawmilling pattern to avoid cutting through Harvesting Steps.

ANNEX IX

RECOMMENDED SAWMILLING PATTERN for SLIGHTLY BENT, NORMALLY TAPERED LOG BOLT, USING TAPERING DEVICE ON BANDMILL CARRIAGE, TO MAXIMIZE RECOVERY OF "A" GRADE COCONUT LUMBER



Cross Section

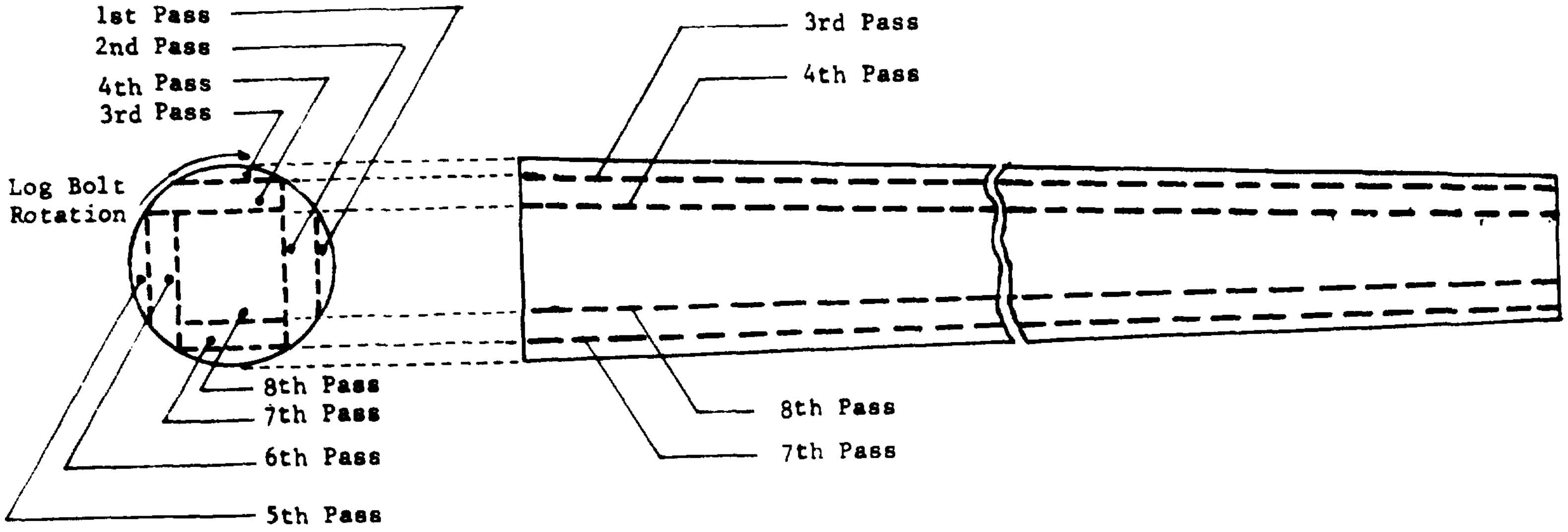
Longitudinal Section

Source : BOA BROTHERS SAWMILL, Zamboanga City

ANNEX X

SAWMILLING PATTERN TO OBTAIN MAXIMUM VOLUME OF "A" GRADE COCO LUMBER, USING TAPERING DEVICE OF BANDMILL CARRIAGE

(As applied to normally straight and slightly tapered coco log bolt.)



Cross Section

Longitudinal Section

Note : Taper of log bolt is exaggerated.

ANNEX XI

SUGGESTED FEED SPEEDS, COCOWOOD SAWMILLING OPERATIONS

I. BANDMILLING (PONY RIG) OPERATIONS, Stellite Tipped Saw Teeth

Sawblade Pass	Feed Speed Range (Maximum)
1st	10 to 15 meters/minute
2nd	13 to 20 meters/minute
3rd	17 to 26 meters/minute
4th	25 to 30 meters/minute
5th	19 to 26 meters/minute
6th	25 to 30 meters/minute
7th	20 to 27 meters/minute
8th	25 to 30 meters/minute
9th	25 and up
10th	25 and up

II. EDGING (RIPPING) OPERATIONS, Circular Saw, TCT or Stellite Tipped Teeth Insert

A. For "A" and "B" Grade Boards

Thickness of Board	Feed Speed Range (Maximum)
25 m.m.	30 to 45 meters/minute
50 m.m.	20 to 30 meters/minute
100 m.m.	12 to 20 meters/minute

B. For "C" Grade Boards

Thickness of Board	Feed Speed Range (Maximum)
25 m.m.	40 to 50 meters/minute
50 m.m.	35 to 40 meters/minute
100 m.m.	20 to 30 meters/minute

III. RE-SAWING (BAND RE-SAW), Stellite Tipped Saw Teeth

A. For "A" and "B" Grade Boards

Thickness of Board	Feed Speed Range (Maximum)
12 m.m.	40 and up meters/minute
19 m.m.	35 to 40 meters/minute
25 m.m.	30 to 35 meters/minute
35 m.m.	25 to 35 meters/minute
50 m.m.	20 to 30 meters/minute

B. For "C" Grade Boards

Thickness of Board	Feed Speed Range (Maximum)
12 m.m.	45 and up meters/minute
19 m.m.	40 to 45 meters/minute
25 m.m.	35 to 40 meters/minute
35 m.m.	35 to 40 meters/minute
50 m.m.	30 to 35 meters/minute

Source : Demonstration Run, BOA Brothers Sawmill, Zamboanga City, 1983.

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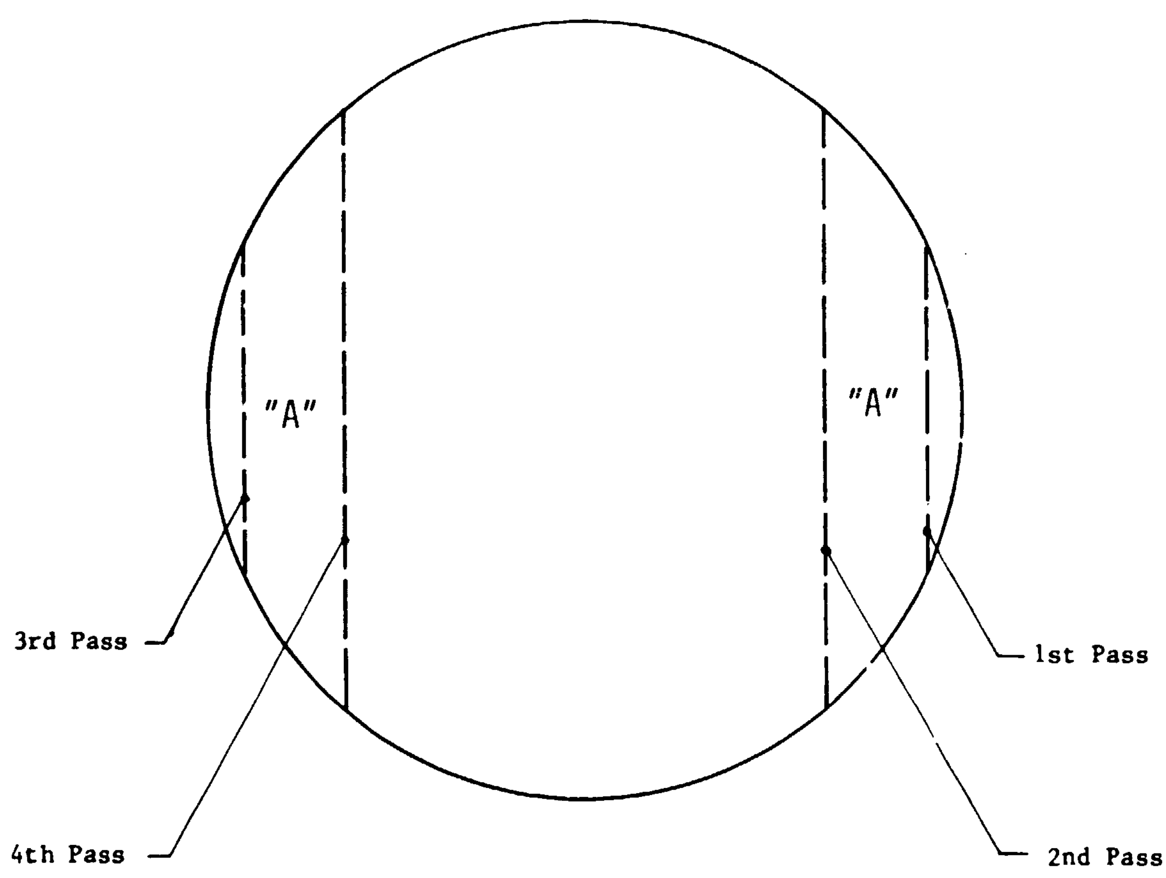
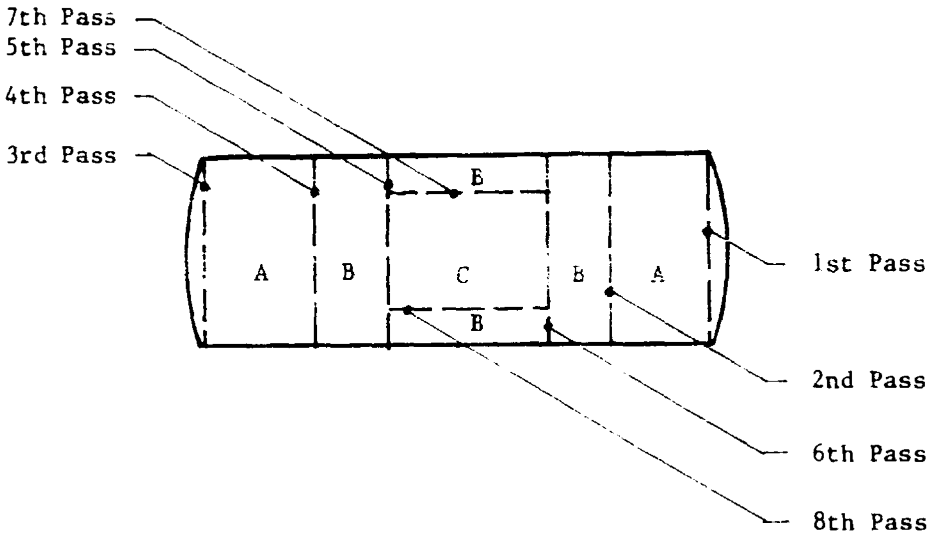
ANNEX XII

CUTTING SCHEDULE FOR FULLY CONVEYORIZED SAWMILLING OPERATIONS

I. HEADRIG (MAIN SAW) :

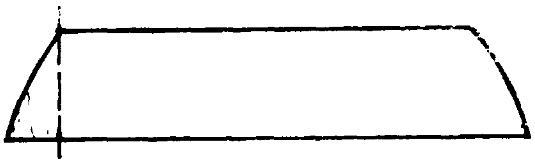


II. PONY RIG : (One or Two Units)

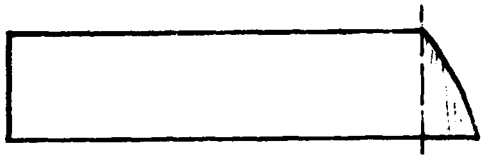


III. EDGER SAW : (First and Second Boards coming from Headrig)

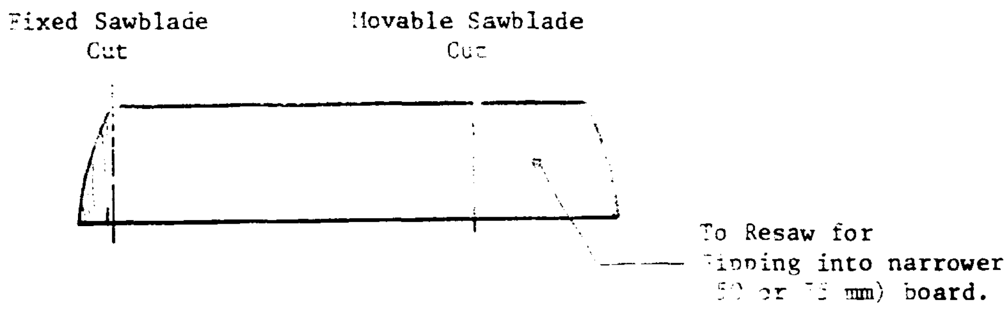
A. If clean cut faces (1st and 3rd passes) on 1st and 2nd "A" Grade Boards are less than 100 mm (narrowest width fixed and movable saws can be brought nearest each other) : ONE EDGE CUT ONLY.



Then, with RE-SAW or RETURN-PASS on EDGER :



E. If clean cut faces are more than 100 mm wide, then desired width wider than 100 mm can be cut in <u>one</u> pass on the edger :



Narrow boards (50 mm and 75 mm) may be cut from the rest of the board by passing the board (or slab) thru the RE-SAW.

IV. <u>RE-SAW (With Feed Roll)</u>

This may be used for the following purposes :

A. Final edging of boards narrower than 100 m.m.

B. Re-sawing of Double Thickness Boards into thinner boards (12 mm, 19 mm and 25 mm)

C. Re-manufacturing of <u>Edgings</u> and thick slabs.

V. <u>TRIMMER SAW</u>

A. Unless otherwise required, <u>REGULAR SIZE BOARDS</u> need <u>NOT</u> be trimmed.

B. Trim re-manufactured narrow boards to obtain uniform thickness and width and obtain longest possible length.

ANNEX XIII

"A" GRADE COCO BOARD YIELD RELATED TO FIRST SLAB THICKNESS AND AVERAGE LOG BOLT DIAMETER

(Basis: "Percentage of Lumber by Density Grades", Appendix 10, PCA-Zamboanga Research Center, (CWUT 103, SULC, 1980)

Log Bolt No.	Average Log Bolt Diameter (m.m.)	Estimated Thickness "A" Grade Zone (m.m.)	Thickness Parameters	DESIRED WIDTH OF FIRST "A" GRADE BOARD 200 mm	150 mm	125 mm	100 mm	75 mm	Estimated Thickness "B" Grade Zone (m.m.)
1st (butt log)	400	98	Thickness, 1st Slab Cut	30	16	11	7	xx	44
			Max. Thickness, 1st "A" Grade Board	68	82	87	91	xx	
	380	93	Thickness, 1st Slab Cut	32	17	12	8	xx	42
			Max. Thickness, 1st "A" Grade Board	61	76	81	85	xx	
	360	88	Thickness, 1st Slab Cut	35	18	13	8	5	39
			Max. Thickness, 1st "A" Grade Board	53	70	75	80	83	
	340	83	Thickness, 1st Slab Cut	37	19	13	8	5	37
			Max. Thickness, 1st "A" Grade Board	46	64	70	75	78	
	320	78	Thickness, 1st Slab Cut	40	21	14	9	5	35
			Max. Thickness, 1st "A" Grade Board	38	57	64	69	73	
	300	73	Thickness, 1st Slab Cut	44	22	15	10	5	33
			Max. Thickness, 1st "A" Grade Board	29	51	58	63	68	
	280	68	Thickness, 1st Slab Cut	49	24	17	10	6	31
			Max. Thickness, 1st "A" Grade Board	19	44	51	58	62	
	260	63	Thickness, 1st Slab Cut	xx	27	18	11	6	28
			Max. Thickness, 1st "A" Grade Board	xx	36	45	52	57	
	240	58	Thickness, 1st Slab Cut	xx	30	20	12	7	26
			Max. Thickness, 1st "A" Grade Board	xx	28	38	46	51	
	220	53	Thickness, 1st Slab Cut	xx	33	22	14	8	24
			Max. Thickness, 1st "A" Grade Board	xx	20	31	39	45	
	200	49	Thickness, 1st Slab Cut	xx	xx	34	15	8	22
			Max. Thickness, 1st "A" Grade Board	xx	xx	15	34	41	
2nd	320	64	Thickness, 1st Slab Cut	40	20	14	9	5	25
			Max. Thickness, 1st "A" Grade Board	24	44	50	55	59	
	300	60	Thickness, 1st Slab Cut	44	22	15	10	5	23
			Max. Thickness, 1st "A" Grade Board	16	38	45	50	55	
	280	56	Thickness, 1st Slab Cut	xx	24	17	10	6	22
			Max. Thickness, 1st "A" Grade Board	xx	32	39	46	50	
	260	52	Thickness, 1st Slab Cut	xx	27	18	11	6	20
			Max. Thickness, 1st "A" Grade Board	xx	25	34	41	46	
	240	48	Thickness, 1st Slab Cut	xx	30	20	12	7	19
			Max. Thickness, 1st "A" Grade Board	xx	18	28	36	41	
	220	44	Thickness, 1st Slab Cut	xx	xx	22	14	8	17
			Max. Thickness, 1st "A" Grade Board	xx	xx	22	30	36	
	200	40	Thickness, 1st Slab Cut	xx	xx	25	15	8	15
			Max. Thickness, 1st "A" Grade Board	xx	xx	15	25	32	
	180	36	Thickness, 1st Slab Cut	xx	xx	xx	17	9	14
			Max. Thickness, 1st "A" Grade Board	xx	xx	xx	19	27	
3rd	220	32	Thickness, 1st Slab Cut	xx	xx	22	14	8	33
			Max. Thickness, 1st "A" Grade Board	xx	xx	10	18	24	
	200	29	Thickness, 1st Slab Cut	xx	xx	25	15	8	30
			Max. Thickness, 1st "A" Grade Board	xx	xx	4	14	21	
	180	26	Thickness, 1st Slab Cut	xx	xx	xx	17	9	27
			Max. Thickness, 1st "A" Grade Board	xx	xx	xx	9	17	
	160	23	Thickness, 1st Slab Cut	xx	xx	xx	20	11	24
			Max. Thickness, 1st "A" Grade Board	xx	xx	xx	3	8	
	140	20	Thickness, 1st Slab Cut	xx	xx	xx	13	5	21
			Max. Thickness, 1st "A" Grade Board	xx	xx	xx	7	15	
4th	200	5	Thickness, 1st Slab Cut	xx	xx	xx	xx	xx	35
			Max. Thickness, 1st "A" Grade Board	xx	xx	xx	xx	xx	
	180	4	Thickness, 1st Slab Cut	xx	xx	xx	xx	xx	31
			Max. Thickness, 1st "A" Grade Board	xx	xx	xx	xx	xx	
	160	4	Thickness, 1st Slab Cut	xx	xx	xx	xx	xx	28
			Max. Thickness, 1st "A" Grade Board	xx	xx	xx	xx	xx	
	140	3	Thickness, 1st Slab Cut	xx	xx	xx	xx	xx	24
			Max. Thickness, 1st "A" Grade Board	xx	xx	xx	xx	xx	
	120	3	Thickness, 1st Slab Cut	xx	xx	xx	xx	xx	21
			Max. Thickness, 1st "A" Grade Board	xx	xx	xx	xx	xx	

ANNEX XIV

COCO LUMBER THICKNESS CUT vs. LOG BOLT AVERAGE DIAMETER

Average Bolt Diameter	Thickness "A" Grade Ring	To Cut 50 mm "A" Grade Board: 1st Slab Thickness	To Cut 50 mm "A" Grade Board: Qty. - Widest 50 mm Board	Alternate Cuts, Qty. - Thickness				Thickness "B" Grade Ring
I. For LOG BOLT No. 1 (BUTT LOG)								
350	85	34	1 - 200	1 - 38 1 - 12	1 - 25 1 - 19	2 - 19	3 - 12	38
340	83	19	1 - 150	1 - 38 1 - 19	2 - 25	2 - 19 1 - 12	5 - 12	37
330	80	20	1 - 150	1 - 38 1 - 12	2 - 25	2 - 29	3 - 12	36
320	78	21	1 - 150	1 - 38 1 - 12	1 - 25 1 - 19	2 - 19	3 - 12	35
310	75	18	1 - 150	1 - 38	1 - 25 1 - 19	2 - 19	3 - 12	34
300	73	15	1 - 125	1 - 38 1 - 12	1 - 25 1 - 19	2 - 19	3 - 12	33
290	70	13	1 - 125	1 - 38	1 - 25 1 - 19	2 - 19	3 - 12	32
280	68	12	1 - 100	1 - 38	1 - 25 1 - 19	2 - 19	3 - 12	31
270	65	10	CUT FOR "A" GRADE BOARDS THINNER THAN 50 mm.	1 - 38	1 - 25 1 - 19	2 - 19	3 - 12	29.5
260	63	11		1 - 38	1 - 25 1 - 12	2 - 19	3 - 12	28
250	60	7		1 - 38	1 - 25 1 - 12	2 - 19	3 - 12	27
240	58	7		1 - 38	1 - 25 1 - 12	2 - 19	3 - 12	26
230	55	8		1 - 38	1 - 25 1 - 12	1 - 19 1 - 12	2 - 12	25
220	53	CUT FOR "B" GRADE BOARD						24
210	51	CUT FOR "B" GRADE BOARD						23
200	49	CUT FOR "B" GRADE BOARD						22
II. For LOG BOLT No. 2								
320	64	9	1 - 100	1 - 38	1 - 25 1 - 19	2 - 19	3 - 12	25
310	62	7	1 - 75	1 - 38	1 - 25 1 - 19	2 - 19	3 - 12	24
300	60	5	1 - 75	1 - 38	1 - 25 1 - 19	2 - 19	3 - 12	23
290	58	6	1 - 50	1 - 38	1 - 25	2 - 19	3 - 12	22.5
280	56	CUT FOR "B" GRADE BOARD						22
270	54	CUT FOR "B" GRADE BOARD						21
260	52	CUT FOR "B" GRADE BOARD						20
250	50	CUT FOR "B" GRADE BOARD						19.5
240	48	CUT FOR "B" GRADE BOARD						19
230	46	CUT FOR "B" GRADE BOARD						18
220	44	CUT FOR "B" GRADE BOARD						17
210	42	CUT FOR "B" GRADE BOARD						16
200	40	CUT FOR "B" GRADE BOARD						15

Assumptions :
1) Bandsaw Blade Kerf = 4 mm
2) Shrinkage Allowance = 6 %

Note :
1) Cut for "B" and "C" Grade Boards only when milling 3rd and 4th Log Bolts.
2) Cut for "C" Grade Boards only when milling 5th and 6th Log Bolts.
3) Refer to Annex XIII for "B" Grade Ring Thickness of given Log Bolt Average Diameter.

ANNEX XV

ACTUAL COCO BOARDS REQUIRMENTS AND BOARDS DISPOSITION

Item No.	Nominal (Actual) Board Sizes	Grade	Total Boards to Cut	DISPOSITION OF COCO BOARDS CUT: Green Rough	Air-Dried Boards: Total	Air-Dried Boards: Rough	Air-Dried Boards: S4S	Kiln-Dried Boards: Total	Kiln-Dried Boards: S4S	Kiln-Dried Boards: Profiled
1. 1	50 x 50 x 4500 (53 x 53 x 4500)	A	272	---	272	272	---	---	---	---
1. 2	25 x 50 x 4500 (27 x 53 x 4500)	A	1	---	---	---	---	1	---	1
1. 3	50 x 50 x 4500 (53 x 53 x 4500)	B	97	30	---	---	---	67	9	58
1. 4	50 x 75 x 4500 (53 x 80 x 4500)	B	15	---	15	15	---	---	---	---
1. 5	50 x 50 x 4500 (53 x 53 x 4500)	C	45	45	---	---	---	---	---	---
1. 6	50 x 75 x 4500 (53 x 80 x 4500)	C	37	37	---	---	---	---	---	---
1. 7	12 x 100 x 4500 (13 x 106 x 4500)	C	38	---	---	---	---	38	---	38
2. 1	50 x 50 x 5000 (53 x 53 x 5000)	A	172	---	106	106	---	66	4	62
2. 2	50 x 75 x 5000 (53 x 80 x 5000)	A	34	---	---	---	---	34	25	9
2. 3	50 x 100 x 5000 (53 x 106 x 5000)	A	71	---	---	---	---	71	71	---
2. 4	50 x 150 x 5000 (53 x 159 x 5000)	A	83	---	4	---	4	79	11	68
2. 5	50 x 190 x 5000 (53 x 201 x 5000)	A	2	---	---	---	---	2	---	2
2. 6	25 x 50 x 5000 (27 x 53 x 5000)	A	1	---	---	---	---	1	---	1
2. 7	50 x 50 x 5000 (53 x 53 x 5000)	B	24	---	---	---	---	24	24	---
2. 8	50 x 75 x 5000 (53 x 80 x 5000)	B	104	---	88	88	---	16	---	16
2. 9	50 x 100 x 5000 (53 x 106 x 5000)	B	46	46	---	---	---	---	---	---
2.10	25 x 50 x 5000 (27 x 53 x 5000)	B	1	1	---	---	---	---	---	---
2.11	12 x 100 x 5000 (13 x 106 x 5000)	C	564	---	---	---	---	564	---	564
3. 1	50 x 50 x 5500 (53 x 53 x 5500)	A	4	---	4	4	---	---	---	---
3. 2	50 x 125 x 5500 (53 x 133 x 5500)	A	13	---	---	---	---	13	13	---
3. 3	50 x 150 x 5500 (53 x 159 x 5500)	A	12	---	12	---	12	---	---	---
3. 4	50 x 200 x 5500 (53 x 212 x 5500)	A	2	---	---	---	---	2	---	2
3. 5	25 x 50 x 5500 (27 x 53 x 5500)	A	268	---	---	---	---	268	---	268
3. 6	25 x 75 x 5500 (27 x 80 x 5500)	A	43	---	---	---	---	43	43	---
3. 7	25 x 100 x 5500 (27 x 106 x 5500)	A	121	---	---	---	---	121	---	121
3. 8	50 x 100 x 5500 (53 x 106 x 5500)	B	31	29	---	---	---	2	2	---
3. 9	50 x 150 x 5500 (53 x 159 x 5500)	B	3	---	---	---	---	3	---	3
3.10	35 x 100 x 5500 (37 x 106 x 5500)	B	64	---	64	---	64	---	---	---
3.11	25 x 50 x 5500 (27 x 53 x 5500)	B	1	1	---	---	---	---	---	---
3.12	12 x 100 x 5500 (13 x 106 x 5500)	C	18	---	---	---	---	18	---	18
4. 1	50 x 100 x 6000 (53 x 106 x 6000)	A	9	---	---	---	---	9	---	9
4. 2	50 x 125 x 6000 (53 x 133 x 6000)	A	79	---	---	---	---	79	79	---
4. 3	50 x 150 x 6000 (53 x 159 x 6000)	A	46	---	45	---	45	1	1	---
4. 4	19 x 100 x 6000 (20 x 106 x 6000)	A	12	---	---	---	---	12	11	1
4. 5	12.7 x 100 x 6000 (14 x 106 x 6000)	A	39	---	---	---	---	39	---	39
4. 6	12 x 100 x 6000 (13 x 106 x 6000)	A	75	---	---	---	---	75	---	75
4. 7	50 x 75 x 6000 (53 x 80 x 6000)	B	12	---	12	12	---	---	---	---
4. 8	50 x 125 x 6000 (53 x 133 x 6000)	B	119	119	---	---	---	---	---	---
4. 9	35 x 100 x 6000 (37 x 106 x 6000)	B	578	---	578	---	578	---	---	---
4.10	25 x 50 x 6000 (27 x 53 x 6000)	B	37	37	---	---	---	---	---	---
4.11	25 x 100 x 6000 (27 x 106 x 6000)	B	59	59	---	---	---	---	---	---
4.12	25 x 150 x 6000 (27 x 159 x 6000)	B	57	16	---	---	---	41	41	---
4.13	19 x 100 x 6000 (20 x 106 x 6000)	B	81	---	---	---	---	81	---	81
4.14	12 x 100 x 6000 (13 x 106 x 6000)	B	495	---	---	---	---	495	---	495
XCS.	12 x 100 x 6000 (13 x 106 x 6000)	C	51	---	---	---	---	51	---	51
XCS.	50 x 50 x 6000 (53 x 53 x 6000)	C	3	3	---	---	---	---	---	---
XCS.	50 x 75 x 6000 (53 x 80 x 6000)	C	3	3	---	---	---	---	---	---
XCS.	50 x 50 x 6000 (53 x 53 x 6000)	B	9	---	---	---	---	9	---	9
XCS.	50 x 100 x 6000 (53 x 106 x 6000)	B	7	7	---	---	---	---	---	---
XCS.	50 x 150 x 6000 (53 x 159 x 6000)	B	1	---	---	---	---	1	---	1
XCS.	50 x 50 x 6000 (53 x 53 x 6000)	A	35	---	15	15	---	20	20	---
XCS.	50 x 75 x 6000 (53 x 80 x 6000)	A	34	---	14	14	---	20	20	---

SECTION 1

ANNEX XVI

COCO BOARDS TRIMMING DETAILS

Item No.	Nominal (Actual) Board Size	Grade	Total Boards To Cut	Qty. Boards to Trim, MC and Surface Prep.	T R I M M I N G: Trim Length, m.m.	Qty. Pieces Cut Per Board	Trim Length, m.m.	Qty. Pieces Cut Per Board	D E T A I L S: Trim Length, m.m.	Qty. Pieces Cut Per Board	Trim Length m.m.	Qty. Pieces Cut Per Board
1. 1	50 x 50 x 4500 (53 x 53 x 4500)	A	272	6 AD-R	4200 x	1	190 x	1	77 x	1	----	---
				266 AD-R	4200 x	1	77 x	1	----	---	----	---
1. 2	25 x 50 x 4500 (27 x 53 x 4500)	A	1	1 KD-P	3700 x	1	700 x	1	----	---	----	---
1. 3	50 x 50 x 4500 (53 x 53 x 4500)	B	97	8 KD-P	2100 x	2	200 x	1	----	---	----	---
				2 KD-P	2100 x	2	----	---	----	---	----	---
				24 KD-P	1700 x	2	600 x	1	400 x	1	----	---
				12 KD-P	1700 x	2	600 x	1	300 x	1	----	---
				2 KD-P	1200 x	3	600 x	1	----	---	----	---
				1 KD-P	1200 x	2	600 x	3	----	---	----	---
				30 G-R	600 x	7	----	---	----	---	----	---
				50 KD-P	600 x	7	----	---	----	---	----	---
				1 KD-P	600 x	5	300 x	4	----	---	----	---
				8 KD-S	300 x	14	----	---	----	---	----	---
				1 KD-S	300 x	4	----	---	----	---	----	---
1. 4	50 x 75 x 4500 (53 x 80 x 4500)	B	15	4 AD-R	4200 x	1	250 x	1	----	---	----	---
				4 AD-R	4100 x	1	200 x	1	150 x	1	----	---
				2 AD-R	3600 x	1	850 x	1	----	---	----	---
				5 AD-R	3600 x	1	800 x	1	----	---	----	---
1. 5	50 x 50 x 4500 (53 x 53 x 4500)	C	45	4 G-R	3500 x	1	800 x	1	----	---	----	---
				4 G-R	1700 x	2	1050 x	1	----	---	----	---
				11 G-R	1700 x	2	800 x	1	----	---	----	---
				8 G-R	800 x	5	400 x	1	----	---	----	---
				17 G-R	800 x	5	----	---	----	---	----	---
				1 G-R	800 x	4	----	---	----	---	----	---
1. 6	50 x 75 x 4500 (53 x 80 x 4500)	C	37	2 G-R	3400 x	1	1025 x	1	----	---	----	---
				2 G-R	3400 x	1	----	---	----	---	----	---
				16 G-R	3000 x	1	----	---	----	---	----	---
				12 G-R	2800 x	1	----	---	----	---	----	---
				1 G-R	2025 x	2	----	---	----	---	----	---
				4 G-R	1875 x	2	----	---	----	---	----	---
1. 7	12 x 100 x 4500 (13 x 106 x 4500)	C	38	38 KD-P	4200 x	1	150 x	1	----	---	----	---
2. 1	50 x 50 x 5000 (53 x 53 x 5000)	A	172	12 {AD-R / KD-P}	4200 x	1-R	700 x	1-P	77 x	1-R	----	---
				72 AD-R	4200 x	1	650 x	1	77 x	1	----	---
				8 AD-R	3500 x	1	1050 x	1	77 x	1	----	---
				10 {AD-R / KD-P}	3500 x	1-R	950 x	1-R	500 x	1-P	----	---
				16 {AD-R / KD-P}	3500 x	1-R	900 x	1-P	550 x	1-R	----	---
				2 {AD-R / KD-P}	3500 x	1-R	900 x	1-P	500 x	1-P	----	---
				4 {AD-R / KD-P}	3500 x	1-R	900 x	1-P	77 x	7-R	----	---
				4 {AD-R / KD-P}	3000 x	1-R	1500 x	1-P	77 x	5-R	----	---
				4 {AD-R / KD-P}	3000 x	1-R	900 x	2-P	77 x	2-R	----	---
				2 AD-R	2400 x	2	77 x	2	----	---	----	---
				10 {AD-R / KD-P}	900 x	5-P	77 x	5-R	----	---	----	---
				1 {AD-R / KD-P}	900 x	[illegible]-P	650 x	[illegible]-R	----	---	----	---
				[illegible] AD-R	[illegible] x	[illegible]	625 x	1				---
				1 [illegible]	625 x	[illegible]	77 x	2	----	---	----	
				14 AD-R	600 x	8	77 x	1	----	---	----	
				1 KD-P	600 x	8	77 x	1	----	---	----	---
				7 AD-R	77 x	60	----	---	----		----	----
				1 AD-P	[illegible]	[illegible]						
2. 2	50 x 75 x 5000 (53 x 80 x 5000)	A	34	[illegible] KD-{P / S}	2250 x	2-P	300 x	1-S	----	---	----	
				[illegible] KD-[illegible]	2150 x	2	600 x	1	----	---	----	---
				6 KD-{P / S}	1500 x	[illegible]-P	300 x	1-S	----	---	----	---
				1 KD-S	300 x	16	----	---	----	---	----	---
				1 KD-P	[illegible]		[illegible]					

				1 KD-S 1 KD-P
				[illegible] {AD-R, KD-P} {AD-R, KD-P} {AD-R, KD-P} {AD-R, KD-P} 4 {AD-R, KD-P} 2 AD-R 10 {AD-R, KD-P} 1 {AD-R, KD-P} 1 AD-R 1 AD-R [illegible]
2. 2	50 x 75 x 5000 (53 x 80 x 5000)	A	34	[illegible] KD-{P, S} 12 KD-S 6 KD-{P, S} 1 KD-S 1 KD-P 1 KD-S 1 KD-S 8 KD-S 1 KD-S 1 KD-S
2. 3	50 x 100 x 5000 (53 x 106 x 5000)	A	71	4 KD-{P, S} 6 KD-{P, S} 4 KD-P 4 KD-{P, S} 4 KD-{P, S} 8 KD-{P, S} 4 KD-{P, S} 2 KD-P 10 KD-P 1 KD-{P, S} 4 KD-{P, S} 1 KD-P 1 KD-{P, S} 1 KD-P 2 KD-P 4 KD-P 1 KD-P 1 KD-P 1 KD-{P, S} 6 KD-S 1 KD-{S, P} 1 KD-P
2. 4	50 x 150 x 5000 (53 x 159 x 5000)	A	83	4 KD-{S, P} 8 KD-S 6 KD-S 8 KD-S 4 KD-{P, S} 4 KD-S 4 KD-S 16 KD-S 2 KD-P 2 KD-P 2 KD-{P, S} [illegible]
				[illegible] 1 AD-R
[illegible]	50 x 190 x 5000 ([illegible] x 5000)	A	2	1 KD-P 1 KD-P

SECTION 2

300	x	10	----		---	----		---	----		--
[illegible]			[illegible]								

[redacted]

[illegible]	x	[illegible]	[illegible]	x	[illegible]	[illegible]	x	[illegible]	[illegible]		[illegible]
[illegible]	x	1-R	900	x	1-P	[illegible]	x	1-R	---		-
3500	x	1-R	900	x	1-P	77	x	[illegible]-R	---		---
3000	x	1-R	1500	x	1-P	77	x	5-R	---		---
3000	x	1-R	900	x	2-P	77	x	2-R	----		---
2400	x	2	77	x	2	----		---	----		---
900	x	5-P	77	x	5-R	----		---	----		---
900	x	4-P	650	x	2-R	----		---	----		---
650	x	6	625	x	1	77	x	5	----		---
625	x	7	77	x	7	----		--			
[illegible]	x		77	x	1						
[illegible]	x	[illegible]	77	x	1						
[illegible]	x	[illegible]	--								
[illegible]	x	2-[illegible]	900	x	1-[illegible]						
2150	x	2	600	x	1	--		--	-		
1500	x	3-P	300	x	1-S	----		--	----		--
300	x	10	----		---	----		---	----		--
1500	x	2	900	x	2	----		---	----		---
900	x	5	300	x	1	----		---	----		---
900	x	1	800	x	5	----		---	----		---
800	x	6	----		---	----		---	----		---
800	x	3	700	x	3	300	x	1	----		---
700	x	5	300	x	4	----		---	----		---
4500	x	1-S	450	x	1-P	----		---	----		---
4500	x	1-S	400	x	1-P	----		---	----		---
3600	x	1	1200	x	1	100	x	1	----		---
2700	x	1-S	2250	x	1-P	----		---	----		---
2700	x	1-S	2100	x	1-P	100	x	1-P	----		---
2700	x	1-S	1200	x	1-P	950	x	1-P	100	x	1-P
2700	x	1-S	950	x	2-P	100	x	3-P	----		---
2400	x	1	100	x	1	----		---	----		---
950	x	5	100	x	2	----		---	----		---
950	x	2-P	900	x	3-S	100	x	3-P	----		---
900	x	5-S	400	x	1-P	----		---	----		--
900	x	1	850	x	4	500	x	1	100	x	1
850	x	5-P	700	x	1-S	----		---	----		---
850	x	3	800	x	3	----		---	----		---
800	x	6	100	x	1	----		---	----		---
800	x	6	----		---	----		---	----		---
800	x	1	750	x	5	400	x	1	----		---
750	x	6	400	x	1	----		---	----		---
750	x	5-P	700	x	1-S	500	x	1-P	----		---
700	x	7	----		---	----		---	----		---
700	x	4-S	500	x	4-P	----		---	----		---
500	x	6	400	x	4	----		---	----		---
3800	x	1-S	1000	x	1-P	----		---	----		---
3800	x	1	900	x	1	250	x	1	----		---
3700	x	1	1250	x	1	----		---	----		---
3700	x	1	900	x	1	350	x	1	----		---
3500	x	1-P	900	x	1-P	500	x	1-S	----		--
3500	x	1	1600	x	1	----		---	----		---
2300	x	2	350	x	1	----		---	----		---
2300	x	2	250	x	1	----		---	---		
2250	x	[illegible]	250	x	1	---		---	-		
2250	x	2	----		---	----		---			
2150	x	2-[illegible]	[illegible]	x	1	---					
[illegible]	x	[illegible]	[illegible]								
[illegible]	x		[illegible]	x							
[illegible]	x										
[illegible]	x										
[illegible]	x		---								
[illegible]	x		---		--	--					
[illegible]	x	[illegible]	----		--	-		--			

2. 4	50 x 150 x 5000 (53 x 159 x 5000)	A	83
2. 5	50 x 190 x 5000 (53 x 201 x 5000)	A	2
2. 6	25 x 50 x 5000 (27 x 53 x 5000)	A	1
2. 7	50 x 50 x 5000 (53 x 53 x 5000)	B	24
2. 8	50 x 75 x 5000 (53 x 80 x 5000)	B	104

SECTION 3

2. 9	50 x 100 x 5000 (53 x 106 x 5000)	B	46

[illegible] KD-P	[illegible]	x		----					---			---
[illegible] KD-P	800	x	1	750	x	1	400	x	1	----		---
1 KD-P	750	x	1	400	x	1	----		---	----		---
2 KD-{P, S}	750	x	1-P	700	x	1-S	500	x	1-P	----		---
6 KD-S	700	x	7	----		---	----		---	----		---
1 KD-{S, P}	700	x	4-S	500	x	4-P	----		---	----		---
1 KD-P	500	x	6	400	x	4	----		---	----		---
4 KD-{S, P}	3800	x	1-S	1000	x	1-P	----		---	----		---
8 KD-S	3800	x	1	900	x	1	250	x	1	----		---
6 KD-S	3700	x	1	1250	x	1	----		---	----		---
8 KD-S	3700	x	1	900	v	1	350	x	1	----		---
4 KD-{P, S}	3500	x	1-P	900	x	1-P	500	x	1-S	----		---
4 KD-S	3300	x	1	1600	x	1	----		---	----		---
4 KD-S	2300	x	2	350	x	1	----		---	----		---
16 KD-S	2300	x	2	250	x	1	----		---	----		---
2 KD-P	2250	x	2	250	x	1	----		---	----		---
2 KD-P	225[illegible]	x	2	----		---	----		---	----		---
2 KD-{P, S}	2150	x	2-P	650	x	1-S	----		---	----		---
3 KD-S	[illegible]	x	2	[illegible]	x	1	----					
[illegible] KD-S	17[illegible]	x	[illegible]	1[illegible]	x	1	--					
[illegible] KD-S	1[illegible]	x		[illegible]								
[illegible] KD-[illegible]	[illegible]	x		[illegible]								
[illegible] AD-[illegible]	[illegible]	x										
[illegible] AD-R	[illegible]	x		--								
1 KD-P	1[illegible]	x	8	----		-						
1 KD-P	150	x	16	----		---	----					
1 KD-S	3700	x	1	900	x	1	----		---	----		---
24 KD-S	4900	x	1	----		---	----		---	----		---
4 AD-R	4900	x	1	----		---	----		---	----		---
1 AD-R	3600	x	1	1350	x	1	----		---	----		---
2 AD-R	3450	x	1	1500	x	1	----		---	----		---
4 AD-R	3350	x	1	1550	x	1	----		---	----		---
6 AD-R	3100	x	1	1850	x	1	----		---	----		---
4 AD-R	3100	x	1	1750	x	1	100	x	1	----		---
2 AD-R	3100	x	1	1700	x	1	150	x	1	----		---
2 AD-R	3100	x	1	1550	x	1	200	x	1	100	x	1
2 AD-R	3050	x	1	1500	x	1	200	x	2	----		---
2 AD-R	2800	x	1	2000	x	1	150	x	1	----		---
2 AD-R	2650	x	1	2300	x	1	----		---	----		---
2 AD-R	2600	x	1	2350	x	1	----		---	----		---
2 AD-R	2400	x	2	150	x	1	----		---	----		---
8 KD-P	2400	x	2	150	x	1	----		---	----		---
1 AD-R	2400	x	2	100	x	1	----		---	----		---
2 AD-R	2300	x	2	200	x	1	100	x	1	----		---
2 AD-R	2250	x	2	450	x	1	----		---	----		---
1 AD-R	2200	x	2	550	x	1	----		---	----		---
3 AD-R	2000	x	2	950	x	1	----		---	----		---
1 AD-R	1500	x	3	450	x	1	----		---	----		---
1 AD-R	1500	x	1	1350	x	2	650	x	1	100	x	1
2 AD-R	1350	x	3	800	x	1	100	x	1	----		---
1 AD-R	1350	x	1	1200	x	3	----		---	----		---
1 AD-R	1200	x	4	100	x	1	----		---	----		---
6 KD-P	1200	x	4	100	x	1	----		---	----		---
1 AD-R	1200	x	1	1100	x	3	450	x	1	----		---
1 AD-R	1100	x	4	550	x	1	----		---	----		---
1 KD-P	1100	x	4	550	x	1	----		---	----		---
1 AD-R	1100	x	3	1050	x	1	600	x	1	----		---
1 AD-R	1050	x	1	1000	x	2	950	x	2	----		---
1 AD-R	950	x	3	800	x	2	500	x	1	----		---
2 AD-R	800	x	6	700	x	1	----		---	----		---
1 AD-R	800	x	5	650	x	1	100	x	3	----		---
1 AD-R	650	x	7	100	x	1	----		---	----		---
1 AD-R	650	x	6	600	x	1	450	x	1	----		---
1 {KD-P, AD-R}	600	x	8-KD-P	100	x	1-AD-R	----		---	----		---
8 AD-R	550	x	9	----		---	----		---	----		---
1 AD-R	550	x	1	500	x	8	100	x	2	----		---
2 AD-R	500	x	9	100	x	4	----		---	----		---
1 AD-R	500	x	9	100	x	1	----		---	----		---
11 AD-R	500	x	9	----		---	----		---	----		---
1 AD-R	500	x	7	450	x	3	----		---	----		---
3 AD-R	450	x	10	----		---	----		---	----		---
1 AD-R	450	x	2	----		---	----		---	----		---
[illegible] [illegible]-R	28[illegible]	x	1	2175	x	1	----		---	----		---
[illegible] [illegible]-R	[illegible]	x	1	2000	x	1	----		---	----		---
[illegible]	[illegible]	x	1	[illegible]	x	1	----		---	----		
[illegible]	[illegible]	x	1	[illegible]	x	1	----		---	----		---

SECTION 1

2.10	25 x 50 x 5000 (27 x 53 x 5000)	B	1	1 G-R
2.11	12 x 100 x 5000 (13 x 106 x 5000)	C	564	16 KD-P 22 KD-P 24 KD-P 4 KD-P 18 KD-P 44 KD-P 8 KD-P 22 KD-P 32 KD-P 2 KD-P 41 KD-P 1 KD-P 24 KD-P 1 KD-P 3 KD-P 1 KD-P 117 KD-P 184 KD-P
3. 1	50 x 50 x 5500 (53 x 53 x 5500)	A	4	4 AD-R
3. 2	50 x 125 x 5500 (53 x 133 x 5500)	A	13	4 KD-S 4 KD-S 3 KD-(S/P) 2 KD-S
3. 3	50 x 150 x 5500 (53 x 159 x 5500)	A	12	12 AD-S
3. 4	50 x 200 x 5500 (53 x 212 x 5500)	A	2	2 KD-P
3.5	25 x 50 x 5500 (27 x 53 x 5500)	A	268	11 KD-(P/S) 24 KD-(P/S) 1 KD-(P/S) 5 KD-(P/S) 227 KD-P
3. 6	25 x 75 x 5500 (27 x 80 x 5500)	A	43	24 KD-S 17 KD-S 1 KD-S 1 KD-S
3. 7	25 x 100 x 5500 (27 x 106 x 5500)	A	121	110 KD-P 5 KD-P 1 KD-P 4 KD-P 1 KD-P
3. 8	50 x 100 x 5500 (53 x 106 x 5500)	B	31	8 G-R 8 G-R 2 KD-S 8 G-R 5 G-R
3. 9	50 x 150 x 5500 (53 x 159 x 5500)	B	3	1 KD-P 1 KD-P 1 KD-P
3.10	35 x 100 x 5500 (37 x 106 x 5 [illegible])	B	64	64 AD-S
3.11	25 x 50 x 5500 (27 x 53 x 5500)	B	1	1 [illegible]
3.12	12 x 100 x 5500 [illegible] 5500)	C	18	18 KD-P

ANNEX [illegible]

[illegible] BOARD TRIMMING DETAILS

4200	x	1	----		---	----		---	----		---
4750	x	1	150	x	1	----		---	----		---
4200	x	1	450	x	1	300	x	1	----		---
3600	x	1	1200	x	1	150	x	1	----		---
3600	x	1	350	x	3	300	x	1	----		---
3000	x	1	1600	x	1	350	x	1	----		---
2900	x	1	2000	x	1	----		---	----		---
2900	x	1	1600	x	1	350	x	1	----		---
2900	x	1	1550	x	1	350	x	1	150	x	1
2900	x	1	1450	x	1	350	x	1	150	x	1
2900	x	1	350	x	5	300	x	1	----		---
2700	x	1	350	x	6	150	x	1	----		---
2700	x	1	350	x	1	300	x	6	----		---
2700	x	1	300	x	7	150	x	1	----		---
2700	x	1	300	x	6	150	x	2	----		---
2700	x	1	150	x	14	----		---	----		---
2700	x	1	150	x	1	----		---	----		---
2700	x	1	----		---	----		---	----		---
2400	x	2	----		---	----		---	----		---
5200	x	1	----		---	----		---	----		---
4200	x	1	1000	x	1	250	x	1	----		---
3700	x	1	1400	x	1	250	x	1	----		---
3700	x	1-S	800	x	1-P	----		---	----		---
3700	x	1	250	x	7	----		---	----		---
5100	x	1	----		---	----		---	----		---
200	x	26	----		---	----		---	----		---
3700	x	1-P	900	x	1-S	8800	x	1-S	----		---
3700	x	1-P	800	x	2-S	----		---	----		---
3700	x	1-P	800	x	1-S	700	x	1-S	----		---
3700	x	1-P	700	x	2-S	----		---	----		---
3700	x	1	----		---	----		---	----		---
1300	x	4	----		---	----		---	----		---
850	x	6	----		---	----		---	----		---
850	x	2	600	x	6	----		---	----		---
600	x	2	----		---	----		---	----		---
800	x	6	650	x	1	----		---	----		---
700	x	7	----		---	----		---	----		---
700	x	5	650	x	3	----		---	----		---
650	x	8	----		---	----		---	----		---
650	x	7	----		---	----		---	----		---
2800	x	1	2600	x	1	----		---	----		---
2800	x	1	1700	x	1	----		---	----		---
2800	x	1	1500	x	1	----		---	----		---
2800	x	1	----		---	----		---	----		---
2700	x	2	----		---	----		---	----		---
1700	x	2	1200	x	1	600	x	1	----		---
1200	x	1	1000	x	2	950	x	2	----		---
900	x	2	600	x	3	----		---	----		---
400	x	13	----		---	----		---	----		---
4200	x	1	1200	x	1	----		---	----		---
2400	x	2	----		---	----		---	----		---

SECTION 2

3.12 12 x 100 x 5500 C 18 18 KD-P
(13 x 106 x 5500)

				[illegible]	[illegible]	
				2[illegible]	[illegible]	
3. [illegible]	25 x 75 x 5500 (27 x 80 x 5500)	A	43	24 KD-[illegible]	[illegible]	x
				1 KD-[illegible]	[illegible]	x
				1 [illegible]	[illegible]	x
				1 [illegible]	[illegible]	x
3. [illegible]	25 x 100 x 5500 (27 x 106 x 5500)	A	121	[illegible]	[illegible]	x
				5 KD-P	700	x
				1 KD-P	700	x
				4 KD-P	650	x
				1 KD-P	650	x
3. 8	50 x 100 x 5500 (53 x 106 x 5500)	B	31	8 G-R	2800	x
				8 G-R	2800	x
				2 KD-S	2800	x
				8 G-R	2800	x
				5 G-R	2700	x
3. 9	50 x 150 x 5500 (53 x 159 x 5500)	B	3	1 KD-P	1700	x
				1 KD-P	1200	x
				1 KD-P	900	x
3.10	35 x 100 x 5500 (37 x 106 x 5500)	B	64	64 AD-S	400	x
3.11	25 x 50 x 5500 (27 x 53 x 5500)	B	1	1 G-R	4200	x
3.12	12 x 100 x 5500 (13 x 106 x 5500)	C	18	18 KD-P	2400	x
4. 1	50 x 100 x 6000 (53 x 106 x 6000)	A	9	3 KD-P	450	x
				6 KD-P	6000	x
4. 2	50 x 125 x 6000 (53 x 133 x 6000)	A	79	12 KD{S/P}	3700	x
				17 KD-S	3700	x
				1 KD-S	3700	x
				41 KD-S	3700	x
				8 KD-S	6000	x
4. 3	50 x 150 x 6000 (53 x 159 x 6000)	A	46	9 AD-S	5800	x
				25 AD-S	5500	x
				1 KD-S	650	x
				11 AD-S	6000	x
4. 4	19 x 100 x 6000 (20 x 106 x 6000)	A	12	10 KD{S/P}	1500	x
				1 KD-P	750	x
				1 KD-S	6000	x
4. 5	12.7 x 100 x 6000 (14 x 106 x 6000)	A	39	4 KD-P	700	x
				1 KD-P	700	x
				23 KD-P	680	x
				1 KD-P	680	x
				10 KD-P	6000	x
4. 6	12 x 100 x 6000 (13 x 106 x 6000)	A	75	74 KD-P	1900	x
				1 KD-P	1900	x
4. 7	50 x 75 x 6000 (53 x 80 x 6000)	B	12	2 AD-R	2400	x
				10 AD-R	6000	x
4. 8	50 x 125 x 6000 (53 x 133 x 6000)	B	119	36 G-R	2800	x
				72 G-R	2500	x
				11 G-R	6000	x
4. 9	35 x 100 x 6000 (37 x 106 x 6000)	B	578	548 AD-S	400	x
				30 AD-S	6000	x
4.10	25 x 50 x 6000 (27 x 53 x 6000)	B	37	14 G-R	4200	x
				1 G-R	1500	x
				1 G-R	1200	x
				1 G-R	1200	x
				3 G-R	810	x
				1 G-R	810	x
				11 G-R	800	x
				1 G-R	800	x
				4 G-R	6000	x
4.11	25 x 100 x 6000 (27 x 106 x 6000)	B	59	4 G-R	4700	x
				30 G-R	1700	x
				8 G-R	1200	x
				12 G-R	1200	x
				5 G-R	6000	x
4.12	25 x 150 x 6000 (27 x 159 x 6000)	B	57	12 KD-S	5500	x
				24 KD-S	4900	x
				16 [illegible]	3700	x
				[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	81	[illegible]	[illegible]	
4.14	12 x 100 x 6000 (13 x 106 x 6000)	[illegible]	495	[illegible]	[illegible]	
				24 [illegible]	[illegible]	
				64 KD-[illegible]	[illegible]	
				2[illegible] KD-P	[illegible]	

7	----		---	----		---	----	---
5	650	x	3	----		---	----	---
8	----		---	----		---	----	---
7	----		---	----		---	----	---
1	2600	x	1	----		---	----	---
1	1700	x	1	----		---	----	---
1	1500	x	1	----		---	----	---
1	----		---	----		---	----	---
2	----		---	----		---	----	---
2	1200	x	1	600	x	1	----	---
1	1000	x	2	950	x	2	----	---
2	600	x	3	----		---	----	---
13	----		---	----		---	----	---
1	1200	x	1	----		---	----	---
2	----		---	----		---	----	---
13	----		---	----		---	----	---
1	----		---	----		---	----	---
1-S	2250	x	1-P	----		---	----	---
1	250	x	8	----		---	----	---
1	250	x	2	----		---	----	---
1	----		---	----		---	----	---
1	----		---	----		---	----	---
1	----		---	----		---	----	---
1	----		---	----		---	----	---
9	----		---	----		---	----	---
1	----		---	----		---	----	---
3-S	750	x	1-P	----		---	----	---
6	----		---	----		---	----	---
1	----		---	----		---	----	---
8	----		---	----		---	----	---
4	680	x	4	----		---	----	---
8	----		---	----		---	----	---
4	----		---	----		---	----	---
1	----		---	----		---	----	---
3	----		---	----		---	----	---
2	----		---	----		---	----	---
2	----		---	----		---	----	---
1	----		---	----		---	----	---
2	----		---	----		---	----	---
2	----		---	----		---	----	---
1	----		---	----		---	----	---
14	----		---	----		---	----	---
1	----		---	----		---	----	---
1	1500	x	1	----		---	----	---
2	1200	x	2	----		---	----	---
4	810	x	1	----		---	----	---
1	810	x	5	----		---	----	---
7	----		---	----		---	----	---
5	800	x	2	----		---	----	---
7	----		---	----		---	----	---
5	----		---	----		---	----	---
1	----		---	----		---	----	---
1	1200	x	1	----		---	----	---
3	----		---	----		---	----	---
4	900	x	1	----		---	----	---
4	----		---	----		---	----	---
1	----		---	----		---	----	---
1	----		---	----		---	----	---
1	----		---	----		---	----	---
1				----		---	----	---

SECTION 3

	(13 x 106 x 6000)			64 KD-P 212 KD-P
				[illegible] P 1 G-R [illegible]
4.11	25 x 100 x 6000 (27 x 106 x 6000)	B	59	[illegible]
4.12	25 x 150 x 6000 (27 x 159 x 6000)	B	52	[illegible] KD-S [illegible] KD-S 16 G-R 5 KD-S
4.13	19 x 100 x 6000 (20 x 106 x 6000)	B	81	48 KD-P 16 KD-P 2 KD-P 7 KD-P 1 KD-P 7 KD-P
4.14	12 x 100 x 6000 (13 x 106 x 6000)	B	495	64 KD-P 24 KD-P 64 KD-P 212 KD-P 79 KD-P 7 KD-P 45 KD-P
XCS.	12 x 100 x 6000 (13 x 106 x 6000)	C	51	51 KD-P
XCS.	50 x 50 x 6000 (53 x 53 x 6000)	C	3	3 G-R
XCS.	50 x 75 x 6000 (53 x 80 x 6000)	C	3	3 G-R
XCS.	50 x 50 x 6000 (53 x 53 x 6000)	B	9	9 KD-P
XCS.	50 x 100 x 6000 (53 x 106 x 6000)	B	7	7 G-R
XCS.	50 x 150 x 6000 (53 x 159 x 6000)	B	1	1 KD-P
XCS.	50 x 50 x 6000 (53 x 53 x 6000)	A	35	15 AD-R 20 KD-S
XCS.	50 x 75 x 6000 (53 x 80 x 6000)	A	34	14 AD-R 20 KD-S

Legend :
- G - Green Lumber
- AD - Air-Dried Lumber
- KD - Kiln-Dried Lumber
- R - Rough
- S - S4S
- P - Profiled

4900	x	[illegible]							
4700	x	[illegible]							
6000	x	1	----		---	----	---	----	---
2400	x	[illegible]	[illegible]	x	1	----	---	----	
1200	x	[illegible]	[illegible]	x	1	----	---	----	---
750	x	[illegible]	[illegible]	x	1	----	---	----	---
600	x	9	----		---	----	---	----	---
600	x	7	----		---	----	---	----	---
6000	x	1	----		---	----	---	----	---
4200	x	1	1350	x	1	----	---	----	---
3500	x	1	2400	x	1	----	---	----	---
3500	x	1	2200	x	1	----	---	----	---
3500	x	1	1350	x	1	----	---	----	---
1350	x	4	----		---	----	---	----	---
1200	x	4	----		---	----	---	----	---
6000	x	4	----		---	----	---	----	---
6000	x	1	----		---	----	---	----	---
6000	x	1	----		---	----	---	----	---
6000	x	1	----		---	----	---	----	---
6000	x	1	----		---	----	---	----	---
6000	x	1	----		---	----	---	----	---
6000	x	1	----		---	----	---	----	---
6000	x	1	----		---	----	---	----	---
6000	x	1	----		---	----	---	----	---
6000	x	1	----		---	----	---	----	---
6000	x	1	----		---	----	---	----	---

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ANNEX XVII

COCO LUMBER TREATMENT PROCEDURES FOR DEMONSTRATION HOUSE COMPONENTS

I. MODIFIED DIPPING METHOD

To be used for coco wood shingles, facia boards, coco wood flushing, etc. :

Step A : Soak raw sawn timber in boiling water long enough to raise the temperature of the sawn timber possibly up to boiling point of water. The following soaking periods are suggested :

Board Thickness	Soaking Time
12 mm boards	1 hour
25 mm boards	2 hours
50 mm or Thicker Boards	(To be determined during process.)

Step B : Hot boards are immediately soaked in cold CCA solution (3% to 4%) for the following time periods :

Board Thickness	Soaking Time
12 mm boards	8 to 12 hours
25 mm boards	12 hours max.
50 mm boards	18 hours
75 mm boards	24 hours

Step C : AIR DRY treated boards for at least 48 hours in properly stickered piles before installing.

II. BRUSHING METHOD

May be used for components exposed to the weather elements but covered by the house roofing assembly (e.g., sidings, window frames, exterior doors and jambs, etc.).

A. Exposed Surfaces of Coco Wood Posts and Post Ends in Contact with Concrete Stilts

Apply three coats of SOLIGNUM or equivalent commercial brand of NaPCP preservative as follows :

	Diluent	Preservative
First Coat	40 %	60 %
Second Coat	60 %	40 %
Third Coat	0 %	100 %

Each coat must be sufficiently "DRY TO TOUCH" before the next coat is applied.

Note : However, for wooden post ends in contact with concrete one or two coats of full strength (100%) preservative solution should be brushed on both areas of contact (concrete and post ends) before erection of posts.

B. Surfaces of Doors, Door Jambs, Windows (Jalousies or Louvres) and Frames, Sidings and other House Parts Exposed to the Elements but under Roof Cover

1. Using a 3% CCA solution, brush the preservative on the exposed surfaces after installation of coco wood component.
2. Allow to dry sufficiently before a second coating is applied to the surface, if such is indicated by appearance of the surface.

Note : Use Oil Borne CCA Solution

III. PROTECTION OF INTERIOR SURFACES

Interior surfaces may be protected against fungus and insect infestation by brushing 30% Boron Solution on the surface. Allow sufficient drying before being touched by human hands.

IV. PRIMARY TREATMENT - DIPPING

This process is applied to all green coco wood immediately after sawmilling operations, to protect the wood from insect borers and fungus infestations while in storage preparatory to the next processing operations. 0.5 to 1.5% NaPCP solution or equivalent commercial brand is recommended.

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ANNEX XVIII

KILN-DRYING SCHEDULES FOR COCONUT LUMBER

I. For 50 mm THICK COCO BOARDS

A. Pre-Kiln-Drying Conditions

i - Air-dried to 30% MC.

ii - Proper stickering of boards, with spaces provided at strategic points in the box-pile, for sample boards.

B. Kiln-Drying Schedule

i - Pre-drying kiln atmosphere conditions for loads with average moisture content above 30% :

Dry Bulb - 50°C (122°F)
Wet Bulb - 40°C (104°F)

Maintain this condition until the average moisture content of the load is 25% - 30%.

ii - The following schedule is applied when the load has reached 25% - 30% average moisture content :

K.D. Stage	Initial Ave. MC of Load	KILN ATMOSPHERE CONDITIONS Dry Bulb Temp.	Wet Bulb Temp.	Target Ave. MC of Load	Approximate No. of Hours Run
A	30 %	60°C (140°F)	54°C (130°F)	25 %	36 hrs.
B	25 %	66°C (150°F)	57°C (135°F)	20 %	52 hrs.
C	20 %	66°C (150°F)	54°C (130°F)	12 %	72 hrs.
D	Final Conditioning	71°C (160°F)	70°C (158°F)	14 %	8 hrs.

Note : 1. Kiln atmosphere conditions may be changed to the next stage levels only when the TARGET load moisture content level for each stage is reached.

2. Frequency of SAMPLE BOARD MC Readings :

Stage	Frequency
A	Every 12 Hours
B	Every 13 Hours
C	Every 18 Hours
D	Every 8 Hours

II. For 25 mm and THINNER COCO BOARDS

A. Pre-Kiln-Drying Conditions

i - Green lumber condition.

ii - Proper stickering of boards, with spaces provided at strategic points in the box-pile, for sample boards.

B. Kiln-Drying Schedule :

K.D. Stage	Initial Ave. MC of Load	KILN ATMOSPHERE CONDITIONS Dry Bulb Temp.	Wet Bulb Temp.	Target Ave. MC of Load	Approximate No. of Hours Run
A	Green	60°C (140°F)	54°C (130°F)	100 %	60 hrs.
B	100 %	60°C (140°F)	51°C (125°F)	60 %	72 hrs.
C	60 %	71°C (160°F)	60°C (140°F)	12 %	105 hrs.
D	Final Conditioning	77°C (170°F)	76°C (168°F)	14 %	4 hrs.

Note : 1. Kiln atmosphere conditions may be changed to the next stage levels only when the TARGET load MC level for each stage is reached.

2. Frequency of SAMPLE BOARD MC Readings :

Stage	Frequency
A	Every 12 Hours
B	Every 24 Hours
C	Every 24 Hours
D	Every 2 Hours

REFERENCES : 1. "CURRENT STATE OF KNOWLEDGE OF DRYING COCONUT WOOD", J. A. Kininmonth, Forest Research Institute, Rotorua, New Zealand, 1983.

2. "AIR AND KILN-DRYING OF COCO WOOD", L. J. Peñamora, CWUT 310, PCA - Zamboanga Research Center, 1983.

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ANNEX XIX

26 January 1984

T o : Davao Gulf Lumber Corporation
Attn. : Plant Manager

Southern Philippines Development Authority
Attn. : Project Officer
Coco Demonstration House Project

F r o m : Horatio P. Brion
UNIDO Project Consultant

Subject : PREPARATION, HANDLING AND M.C. TESTING OF SAMPLE BOARDS FROM KILN-DRYING CHARGES

Based on available testing facilities, the following scheme of activities is recommended for the preparation, handling and testing (for Moisture Content) of sample boards obtained from representative lumber pieces in each kiln-drying charge.

1.0 CHOICE AND PREPARATION OF SAMPLE BOARDS

1.1 Sample boards should be taken from lumber pieces, which gave moisture meter readings that were approximately the average of MC readings taken from a number of boards randomly chosen from the box-piles composing the kiln charge.

1.2 At least four (4) sample boards should be prepared for each kiln charge. In case the kiln charge is composed of boards with different thicknesses, half of the number of sample boards should be taken from the thinnest planks.

1.3 For purposes of this Project, each sample board should be 50 mm long, with a width corresponding to the widest board from each group of thicknesses composing the kiln charge. The sample boards should be cut from the mid-length of the boards exhibiting average MC's for the kiln charge as indicated by moisture meter readings.

1.4 Each 500 mm sample board should be cut into 250 mm long sections and marked according to Section 2.1 below. One set of 250 mm long sample boards should be oven-dried to obtain the original moisture content of the kiln charge. The other set of 250 mm sample boards shall be used as kiln control sample boards and will be kiln-dried together with the kiln charge.

2.0 IDENTIFICATION AND LOCATION OF CONTROL SAMPLE BOARDS WITHIN THE KILN CHARGE

2.1 Sample boards should be identified according to the following nomenclature :

i - The sample board code number is composed of two principal parts : the first portion referring to the kiln charge number and the second portion indicating the location of the sample board within the lumber box-piles composing the kiln charge. For example : 12A - L2

ii - The kiln-load number assigned to the charge is indicated by the numerical component of the first portion of the sample board number. In the above example, the kiln-load number is "12", indicating that the charge is the 12th kiln charge for the year.

Note : All sample boards from the same kiln charge should have the same numerical component of the first portion of the sample board number.

iii - The letter component of the first portion of the sample board number identifies whether the sample board is for kiln control or for oven-drying to determine the ORIGINAL MOISTURE CONTENT. The letter "A" is assigned to sample boards used for kiln control while the letter "B" refers to the corresponding sample board for oven-drying to determine the ORIGINAL MOISTURE CONTENT. Hence, all sample boards for control are marked "A", while those for determining the ORIGINAL MOISTURE CONTENT are marked "B".

iv - The second portion of the sample board number refers to the location of the sample board within the lumber box-piles composing the kiln charge. The letter "L" indicates that the sample board is on the left side of the box-piles, while the letter "R" indicates that the sample board is on the right side of the box-pile, as viewed when entering the kiln from the main loading door. The numerical part of the second portion indicates the location of the sample board along the length of the kiln, based on its proximity to the kiln loading door. The number "1" is assigned to the sample board nearest the kiln's main loading door, while the farthest sample board will be assigned the highest last digits.

2.2 Thus, the example given in paragraph 2.1(i) above refers to a sample board used for kiln control during kiln-drying operations of the 12th kiln charge in the year.

It is the second sample board nearest the kiln's main loading door, on the left side of the box-piles. The corresponding sample board for oven-drying to determine the ORIGINAL MOISTURE CONTENT should bear the number 12B - L2.

2.3 Sample Boards Location Inside the Kiln

Kiln control sample boards location should be uniformly spaced along the whole length of lumber box-piles composing the kiln charge, with equal number of sample boards on the left and right sides of the lumber box-piles. The sample board locations should be roughly mid-way up the height of the lumber box piles, but within easy reach of the kiln operator.

3.0 DETERMINATION OF MOISTURE CONTENTS OF SAMPLE BOARDS

3.1 Original Moisture Content

All sample boards marked "B" in the first portion of the code number will be oven-dried and tested for original moisture content at the IFMC Laboratory, SPDA, Catalunan Pequeño, Davao City. Observed data should be entered on Form No. KD-1 (attached to Memo dated 18 January 1984).

3.2 Kiln Control Sample Boards

Moisture content of kiln control sample boards will be determined with the use of the DGLC moisture meter. MC readings of all sample boards, "A" and "B" groups, should be taken and entered on Form No. KD-1. Observation data on kiln atmosphere conditions should be entered in Form No. KD-2, at frequencies indicated in the 18 January memo.

(Sgd.) HORATIO P. BRION
UNIDO Project Consultant

cc : SIDFA, UNDP-Manila
SPDA (2)
DGLC (2)

ANNEX XX

PROJECT : SPDA - UNIDO COCONUT WOOD HOUSE DEMONSTRATION PROJECT

LOCATION : SPDA Main Office Complex, Catalunan Pequeño, Davao City

SUBJECT : Cost Estimates and Bill of Materials

Item No. and Description	Quantity/Unit		Unit Cost	Total Cost
I. SITE PREPARATION (Labor)				
II. EARTHWORKS (Labor)				
III. CONCRETE AND MASONRY				
A. Footings and Columns				
1. Portland Cement	48	bags	₱ 39.00	₱1,872.00
2. Sand, fine	2.50	cu.m.	70.00	175.00
3. Gravel	4.60	cu.m.	65.00	299.00
4. Reinf. deformed bars				
10 mm ∅ x 6 m	38	pcs.	26.50	1,007.00
12 mm ∅ x 6 m	30	pcs.	32.00	960.00
16 mm ∅ x 6 m	34	pcs.	52.00	1,768.00
5. Tie Wire #16	5	kgs.	18.00	90.00
			Sub-Total ----	₱6,171.00
B. Beams and Slabs - Balcony				
1. Portland Cement	17	bags	₱ 39.00	₱ 663.00
2. Sand, fine	1.20	cu.m.	70.00	84.00
3. Gravel	0.90	cu.m.	65.00	58.50
4. Reinf. deformed bars				
10 mm ∅ x 6 m	18	pcs.	26.50	477.00
12 mm ∅ x 6 m	14	pcs.	32.00	448.00
5. Tie Wire #16	2	kgs.	18.00	36.00
			Sub-Total ----	₱1,766.50
C. T & B Slabs and CHB Walls - Ground Flr.				
1. T & B				
Portland Cement	32	bags	₱ 39.00	₱1,248.00
Sand, fine	3.4	cu.m.	70.00	238.00
Gravel	1.65	cu.m.	65.00	107.25
6" CHB	390	pcs.	2.25	877.50
einf. deformed bars				
10 mm ∅ x 6 m	28	pcs.	26.50	742.00
12 mm ∅ x 6 m	20	pcs.	32.00	640.00
Tie Wire #16	2.5	kgs.	18.00	45.00
			Sub-Total ----	₱3,897.75

Item No. and Description	Quantity/Unit		Unit Cost	Total Cost	
2. Office and Storage Room					
Portland Cement	27	bags	₱ 39.00	₱1,053.00	
Sand, fine	3.20	cu.m.	70.00	224.00	
Gravel	1.40	cu.m.	65.00	91.00	
6" CHB	390	pcs	2.25	695.25	
Reinf. deformed bars					
10 mm Ø x 6 m	22	pcs.	26.50	583.00	
12 mm Ø x 6 m	16	pcs.	32.00	512.00	
Tie Wire #16	2	kgs.	18.00	36.00	
			Sub-Total ----	₱3,194.25	
D. Stairwell and Kitchen Slab and CHB Walls					
1. Portland Cement	25	bags	₱ 39.00	₱ 975.00	
2. Sand, fine	2.55	cu.m.	70.00	178.50	
3. Gravel	1.60	cu.m.	65.00	104.00	
4. 4" CHB	358	pcs.	2.00	716.00	
5. Reinf. deformed bars					
10 mm Ø x 6 m	42	pcs.	26.50	1,113.00	
6. Tie Wire #16	2.50	kgs.	18.00	45.00	
			Sub-Total ----	₱3,131.50	
E. Septic Vault					
1. Portland Cement	18	bags	₱ 39.00	₱ 702.00	
2. Sand	1.65	cu.m.	70.00	115.50	
3. Gravel	1.85	cu.m.	65.00	120.25	
4. 6" CHB	116	pcs.	2.25	261.00	
5. Reinf. deformed bars					
12 mm Ø x 6 m	17	pcs.	32.00	544.00	
6. Tie Wire	1.0	kgs.	18.00	18.00	
			Sub-Total ----	₱1,760.75	
	Total for Item III		----------	----------	₱19,921.75
V. HARDWARE					
1. C.W. Nails					
4"	85	kgs.	₱ 9.80	₱ 833.00	
3"	10	kgs.	9.80	98.00	
2-1/2"	34	kgs.	11.50	391.00	
2"	2	kgs.	10.00	20.00	
1-1/2"	40	kgs.	10.00	400.00	
2. Finishing Nails					
2-1/2"	3	kgs.	10.00	30.00	
2"	35	kgs.	12.50	437.50	
1-1/2"	1	kg.	12.50	12.50	
1"	8	kgs.	11.00	88.00	
3. Machine Bolts with Nuts and Washer					
1/2" Ø x 3"	60	pcs.	11.50	690.00	
5/8" Ø x 3"	75	pcs.	6.75	506.25	
5/8" Ø x 9"	62	pcs.	10.50	651.00	

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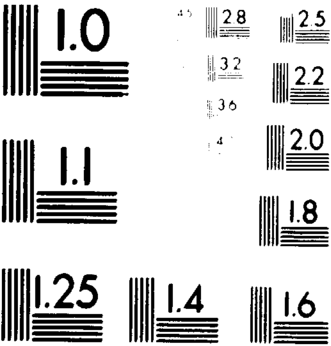

MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS

STANDARD REFERENCE MATERIAL 1010a

(ANSI and ISO TEST CHART No. 2)

Item No. and Description	Quantity/Unit		Unit Cost	Total Cost	
4. G.I. Roofing Nails					
2-1/2"	71	kgs.	₱ 15.50	₱1,100.50	
2"	88	kgs.	15.50	1,364.00	
5. Lead Wire Fastener	2.8	kgs.	10.00	56.00	
6. Twisted Steel Strap	36	pcs.	13.50	486.00	
7. Fabricated Y-Steel Strap	30	pcs.	27.00	810.00	
8. Steel Door Track x 8'	16	ft.	20.00	320.00	
9. Steel Door Hanger - Brackets	2	sets	180.00	360.00	
10. Sanding Disc					
# 80	16	pcs.	13.70	219.20	
#100	11	pcs.	13.70	150.70	
11. Weld Wood Glue	2	qrts.	53.00	106.00	
12. Welding Rod	5	pcs.	6.00	30.00	
13. Door Hinges					
3-1/2" x 3-1/2"	11	pairs	4.90	53.90	
3" x 3"	8	pairs	5.00	40.00	
2" x 2"	8	pairs	3.20	25.60	
14. Door Lockset	8	sets	189.00	1,512.00	
15. Door Catches	32	pcs.	3.00	96.00	
16. Cabinet Door Handles, Brass	8	pcs.	17.50	140.00	
17. Door Pull, Round, Chrome	8	pcs.	4.00	32.00	
	Total for Item V			------------------------	₱11,059.15

VI. PLUMBING

Item No. and Description	Quantity/Unit		Unit Cost	Total Cost
A. 1. C.I. Soil Pipe Bend 6" ø x 1/8"	1	pc.	₱ 118.40	₱ 118.40
2. CISP Reducer 6" ø x 4" ø	5	pcs.	210.20	1,051.00
3. CISP Wye 4" ø x 4" ø	4	pcs.	68.65	274.60
4. CISP Bend 6" ø x 1/8"	6	pcs.	118.40	710.40
5. CISP Cleanout Plug	3	pcs.	98.00	294.00
6. CISP SH 4" ø x 5'	2	pcs.	141.50	283.00
7. CISP DH 4" ø x 5'	6	pcs.	155.30	931.80
8. CISP DH 2" ø x 5'	6	pcs.	97.75	586.50
9. CISP Cleanout Plug x 6" ø	4	pcs.	98.00	392.00
10. CISP Cleanout Plug x 4" ø	6	pcs.	55.00	330.00
11. CISP Tee x 6" ø	2	pcs.	239.30	478.60
12. CISP Wye x 6" ø	2	pcs.	239.30	478.60

Item No. and Description	Quantity/Unit		Unit Cost	Total Cost
13. CISP Tee x 4" ∅	3	pcs.	₱ 68.65	₱ 205.95
14. CISP Wye, 4" ∅ x 2" ∅	3	pcs.	63.00	189.00
15. CISP Tee x 2" ∅	4	pcs.	36.851	147.40
16. CISP Bend 1/8" x 2" ∅	6	pcs.	18.20	109.20
17. CISP Bend 1/4" x 2" ∅	1	pc.	23.00	23.00
18. CISP Bend 1/8" x 4" ∅	5	pcs.	34.60	173.00
19. CISP P-Trap 4" ∅	2	pcs.	48.35	96.70
20. Gate Valve x 3/4" ∅	1	pc.	160.00	160.00
21. G.I. Plug x 3/4" ∅	2	pcs.	4.40	8.80
22. G.I. Union x 3/4" ∅	1	pc.	5.30	5.30
23. G.I. Elbow x 3/4" ∅	14	pcs.	7.60	106.40
24. G.I. Elbow x 1/2" ∅	14	pcs.	4.15	58.10
25. G.I. Coupling x 1/2" ∅	4	pcs.	3.80	15.20
26. G. I. Bushing Reducer, 3/4" ∅ x 3/8"	4	pcs.	6.00	24.00
27. G.I. Nipple, 3/8" ∅ x 2"	6	pcs.	2.70	16.20
28. G.I. Plug, 1/2" ∅	2	pcs.	3.20	6.40
29. G.I. Plug, 3/4" ∅	2	pcs.	4.40	8.80
30. G.I. Nipple, 3/4" ∅ x 3"	3	pcs.	3.36	10.08
31. G.I. Coupling, 3/4" ∅	5	pcs.	5.30	26.50
32. G.I. Nipple, 1/2" ∅ x 3"	5	pcs.	2.16	10.80
33. G.I. Bushing Reducer, 1/2" ∅ x 3/4" ∅	6	pcs.	4.90	29.40
34. G.I. Tee, 3/4" ∅	10	pcs.	9.60	96.00
35. G.I. Pipe, 3/4" ∅ x 20'	8	pcs.	125.00	1,000.00
36. G.I. Pipe, 1/2" ∅ x 20'	3	pcs.	91.00	273.00
37. C.I. Tee, 1/2" ∅	2	pcs.	6.00	12.00
38. G.I. Bushing Reducer, 3/4" ∅ x 1/2" ∅	7	pcs.	5.80	40.60
39. PVC Vent Pipe, 2" ∅ x 10'	12	pcs.	57.80	693.60
40. CISP SH, 6" ∅ x 5'	6	pcs.	405.00	2,430.00
41. CISP DH, 6" ∅ x 5'	2	pcs.	452.50	905.00
42. Shower Valve, 1/2" ∅	2	pcs.	240.00	480.00
43. Gate Valve, 1/2" ∅	2	pcs.	40.00	80.00
44. Gasket Maker	1	pc.	20.00	20.00
45. Portland Cement	10	bags	39.00	390.00
46. Tapelon Tape	4	rolls	6.50	26.00
47. Roof Cement	1	can	19.00	19.00
48. Pig Lead	40	kgs.	16.00	640.00
49. Oakum	5	kgs.	15.00	75.00
			Sub-Total ---	₱14,539.33

Item No. and Description	Quantity/Unit		Unit Cost	Total Cost	
B. Plumbing Fixtures					
1. Water Closets comp. with fittings	2	sets	₱1,950.00	₱ 3,900.00	
2. Lavatory with fittings	2	sets	1,900.00	3,800.00	
3. Kitchen Sink, Enamel Type	1	set	350.00	350.00	
4. Shower Head, Chrome	2	pcs.	80.00	160.00	
5. Faucet, 1/2" ø	2	pcs.	75.00	150.00	
6. Floor Drain, 4" x 4"	2	pcs.	24.00	48.00	
			Sub-Total ----	₱ 8,408.00	
Total for Item VI -----------------------					₱22,947.33
VII. TILEWORKS					
1. Unglazed Floor Tiles	490	pcs.	₱ 1.45	₱ 710.05	
2. White Cement	10	kgs.	6.50	65.00	
3. Glazed Wall Tiles	1,000	pcs.	1.70	1,700.00	
Total for Item VII -----------------------					₱ 2,475.05
VIII. ELECTRICAL WORKS					
1. Double Convenience Outlets	2	pcs.	₱ 26.00	₱ 52.00	
2. Electrial Tape, Small	1	roll	8.80	8.80	
3. Stranded Wire #6	44	mtrs.	13.50	594.00	
4. Rack with Screw Bolt	1	unit	65.00	65.00	
5. Switch, flush Type, 2-gang	3	pcs.	60.00	180.00	
6. Wood Screw	40	pcs.	0.15	6.00	
7. Light Bulb, 15W incandescent	10	pcs.	7.50	75.00	
8. PVC Conduit, 1/2" ø x 10'	79	pcs.	34.20	2,701.80	
9. PVC Coupling, 1/2" ø	81	pcs.	1.20	97.20	
10. Convenience outlet, Double	6	pcs.	26.00	156.00	
11. Circular Loom	2	rolls	140.00	280.00	
12. Electrical Tape	8	rolls	8.80	70.40	
13. PVC Conduit, 2" ø x 10'	36	pcs.	57.80	2,080.80	
14. PVC Conduit, 1" ø x 10'	7	pcs.	40.00	280.00	
15. PVC Conduit, 1/2" ø x 8'	6	pcs.	20.00	120.00	
16. Porcelain Rack	1	pc.	53.00	53.00	

Item No. and Description	Quantity/Unit		Unit Cost	Total Cost	
17. 4" Ø Bolts with nut and washer	4	pcs.	₱ 10.50	₱ 42.00	
18. Stranded Wire, #8	40	mtrs.	10.40	416.00	
19. Junction Box, 8" x 8"	2	pcs.	20.00	40.00	
20. Locknut No. 2	1	pc.	14.00	14.00	
21. Flourescent Bulb, 100W	6	pcs.	10.00	60.00	
22. Junction Box, 2" x 4"	13	pcs.	8.50	110.50	
23. Circuit Breaker	2	units	200.00	400.00	
24. Entrance Cap., 2" Ø	1	pc.	68.50	68.50	
25. PVC Conduit, 1-1/4" Ø x 10'	1	pc.	6.10	6.10	
26. Junction Box, 4" x 4"	33	pcs.	8.50	280.50	
27. THW Stranded Wire, 60 mm	40	mtrs.	68.00	2,720.00	
Total for Item VIII					₱10,977.60
GRAND TOTAL					₱67,380.00

Prepared by :

(Sgd.) Dioscoro E. Onez
Civil Engineer

Noted by :

(Sgd.) Pio J.A. Velasco
Chief
T. T. S. Division
OIC, CWHDP

ANNEX XXI

COCONUT WOOD HOUSE DEMONSTRATION PROJECT

SPDA Complex, Davao City

LUMBER USAGE

Component	Pcs.	Size	Volume (Bd.Ft.)		
I. FORMWORKS					
(Chainsawn Lumber)	32	2 " x 5" x 16'	427		
	40	2 " x 4" x 16'	960		
	20	2 " x 3" x 16'	160		
	40	2 " x 2" x 16'	214		
	16	1 " x 6" x 16'	128		
	42	1 " x 4" x 16'	224		
	28	1 " x 2" x 16'	75		2,188
II. BUILDING FRAMEWORKS					
A. Posts	16	2 " x 4" x 16'	171		
	14	2 " x 4" x 18'	168	339	
B. Studdings	3	2 " x 3" x 12'	18		
	6	2 " x 3" x 14'	42		
	42	2 " x 3" x 16'	336		
	11	2 " x 3" x 18'	99		
	32	2 " x 3" x 20'	320	815	1,154
III. SIDINGS AND WALLINGS					
A. Exterior Walls	31	1/2" x 4" x 6'	31		
	13	1/2" x 4" x 8'	18		
	42	1/2" x 4" x 10'	70		
	3	1/2" x 4" x 12'	6		
	18	1/2" x 4" x 14'	42		
	36	1/2" x 4" x 16'	96		
	20	1/2" x 4" x 18'	60		
	48	1/2" x 4" x 20'	160	483	
B. Double Walls	48	1/2" x 4" x 10'	80		
	22	1/2" x 4" x 16'	59		
	45	1/2" x 4" x 18'	135		
	59	1/2" x 4" x 20'	197	471	
C. Interior Partitions and Nailers	32	2 " x 3" x 14'	224		
	4	2 " x 3" x 16'	32		
	12	2 " x 3" x 18'	108		
	38	2 " x 3" x 20'	380	744	
	11	1/2" x 4" x 6'	21		
	33	1/2" x 4" x 8'	44		
	68	1/2" x 4" x 10'	114	179	1,877

Component	Pcs.	Size	Volume (Bd.Ft.)		
IV. FLOORING					
A. Floor Boards	18	1 " x 4" x 12'	72		
	20	1 " x 4" x 14'	94		
	129	1 " x 4" x 16'	688		
	52	1 " x 4" x 18'	312		
	87	1 " x 4" x 20'	580	1,746	
B. Floor Framing					
1) Floor Girts	4	2 " x 6" x 8'	32		
	9	2 " x 6" x 14'	126		
	3	2 " x 6" x 16'	48	206	
2) Floor Joists and Bridging	1	2 " x 5" x 6'	5		
	4	2 " x 5" x 8'	27		
	3	2 " x 5" x 10'	25		
	9	2 " x 5" x 14'	105		
	29	2 " x 5" x 16'	387		
	13	2 " x 5" x 18'	195		
	34	2 " x 5" x 20'	567	1,311	3,263
V. CEILING					
A. Ceiling Frames	40	2 " x 2" x 8'	107		
	38	2 " x 2" x 10'	127		
	50	2 " x 2" x 12'	200		
	9	2 " x 2" x 14'	42		
	12	2 " x 2" x 16'	64	540	
B. Ceiling Boards	28	1/2" x 4" x 10'	47		
	18	1/2" x 4" x 16'	48		
	10	1/2" x 4' x 18'	30		
	274	1/2" x 4" x 20'	914	1,039	1,579
VI. ROOFING					
A. Main Roof					
1) Shingles	12,248				
2) Ridge Rolls and Flushing (fabricated	144 ft.				
Facia	28	1 " x 4" x 20'	187	187	
3) Roof Framing					
a) Purlins, blocks	4	2 " x 2" x 4'	6		
	29	2 " x 2" x 6'	58		
	82	2 " x 2" x 16'	438		
	24	2 " x 2" x 18'	144		
	86	2 " x 2" x 20'	574	1,220	
b) Rafters	34	2 " x 6" x 20'	680		
c) Roof Girts	26	2 " x 6" x 16'	416	1,096	
B. Canopies					
1) Shingles	740				
2) Framing	7	2 " x 5" x 18'	105		
	12	2 " x 2" x 20'	80		
	4	1 " x 4" x 14'	19	204	2,707

Component	Pcs.	Size	Volume (Bd.Ft.)		
VII. JOINERY					
A. Door Jambs	14	2 " x 5" x 20'	234		
	4	2 " x 5" x 18'	60	294	
B. Window Jambs	38	2 " x 5" x 14'	444	444	
C. Doors	18	2 " x 3" x 8'	72		
	9	2 " x 3" x 12'	54		
	4	2 " x 4" x 10'	27		
	3	2 " x 4" x 14'	28	181	
	32	1 " x 4" x 8'	86		
	28	1 " x 4" x 10'	94		
	42	1 " x 4" x 16'	224	404	
D. Louvre Windows (Fixed and Movable Louvres)	93	1 " x 4" x 6'	186		
	90	1 " x 4" x 8'	240		
	70	1 " x 4" x 10'	234		
	46	1 " x 4" x 12'	184		
	20	1 " x 4" x 14'	94	938	
E. Stairs & Balusters	6	2 " x 8" x 16'	128		
	1	2 " x 8" x 20'	27		
	13	2 " x 6" x 10'	130		
	14	2 " x 6" x 18'	252		
	6	2 " x 4" x 10'	40		
	18	2 " x 4" x 14'	84	661	
F. Balcony Railings	39	2 " x 4" x 19'	468	468	2,923
VIII. CABINETRY					
A. Built-in Closets	44	2 " x 2" x 10'	147		
	12	2 " x 2" x 12'	48	195	
	36	1/2" x 4" x 8'	48		
	18	1/2" x 4" x 10'	30		
	4	1/2" x 4" x 16'	11		
	8	1/2" x 4" x 18'	24	113	
B. Kitchen Counter	6	2 " x 4" x 14'	56		
	8	2 " x 4" x 16'	86		
	29	1 " x 4" x 10'	97		
	5	1 " x 4" x 16'	27	266	
C. Bar Counter	2	2 " x 5" x 14'	24		
	2	2 " x 5" x 16'	14		
	11	2 " x 4" x 10'	74		
	5	1 " x 4" x 6'	10		
	8	1 " x 4" x 10'	27		
	26	1 " x 4" x 12'	104	253	827
IX. NON-COCONUT LUMBER COMPONENTS					
A. Roof Plywood Sheating	86	3/16" x 4" x 8'	Marine Plywood		
B. Cabinet Lining	12	3/16" x 4" x 8'	Plywood		

Prepared by :

(Sgd.) Oscar C. Paradero

ANNEX XXII

COCONUT WOOD HOUSE DEMONSTRATION PROJECT

SPDA Complex, Davao City

LABOUR USAGE

Activity	Highly Skilled	Skilled	Semi-Skilled	Unskilled	Total
	Man-Hours Used				
I. MASONRY AND CONCRETE WORKS					
A. Footings and Columns	---	482	40	912	1,434
B. Beams and Balcony Slab	---	150	23	190	363
C. Bathroom Slab & CHP Wall	---	178	16	280	474
D. Septic Vault	---	48	---	96	144
Sub-Total -----------	---	858	79	1,478	2,415
II. BUILDING FRAMEWORKS					
A. Posts	---	88	---	---	88
B. Horizontal and Vertical Studs	---	173	---	84	257
Sub-Total -----------	---	261	---	84	345
III. SIDINGS AND WALLINGS					
A. Exterior Walls	---	610	---	92	702
B. Double Walls	---	240	---	44	284
C. Interior Partitions with Nailers	---	293	---	37	330
Sub-Total -----------	---	1,143	---	173	1,316
IV. FLOORING					
A. Floor Boards	---	118	---	65	183
B. Floor Framing					
1) Floor Girts	---	48	---	84	132
2) Floor Joists and Bridging	---	200	---	38	238
Sub-Total -----------	---	366	---	187	553
V. CEILING					
A. Ceiling Joists	---	215	---	52	267
B. Hangers	---	36	---	24	60
Sub-Total -----------	---	251	---	76	327
VI. ROOFING					
A. Main Roof					
1) Shingles	---	625	---	384	1,009
2) Ridge Rolls, Flushing Facia Boards	---	205	---	144	349
3) Plywood Sheating	--	84	---	46	130
4) Roof Framing					
a) Purlins & Bridgings	---	384	---	176	560
b) Rafters	---	128	---	8	136
c) Roof Girts	---	24	---	16	40
B. Canopies	---	96	---	12	108
Sub-Total -----------	---	1,546	---	786	2,332

Activity	Man-Hours Used: Highly Skilled	Skilled	Semi-Skilled	Unskilled	Total
VII. JOINERY					
A. Door Jambs	162	---	---	66	228
B. Window Jambs	426	---	---	104	530
C. Doors	550	---	---	158	708
D. Louvre Windows (Movable and Fixed)	270	---	---	94	364
E. Stairs and Balusters	134	---	---	76	210
F. Balcony Railings	48	---	---	14	62
Sub-Total ----------	1,590	---	---	512	2,102
VIII. CABINETRY					
A. Built-In Closets	204	---	---	32	236
B. Kitchen Counter	56	---	---	---	56
C. Bar Counter	96	---	---	---	96
Sub-Total ----------	356	---	---	32	388
IX. PLUMBING AND WATER PIPING	95	---	65	---	160
X. ELECTRICAL WORKS	89	---	92	---	181
XI. BRUSHING OF INSTALLED MEMBERS	---	12	---	---	12
XII. SUPERVISION/OVERHEAD					
A. Project Engineer/s	242	---	---	---	242
B. Foreman	1,008	---	---	---	1,008
C. Timekeeper/Recorder	160	---	---	---	160
D. Toolkeeper/Storekeeper	132	---	---	---	132
Sub-Total ----------	1,542	---	---	---	1,542
GRAND TOTAL --------	3,672	4,437	236	3,328	11,673

XIII. UNACCOUNTED LABOUR

Fabrication of Movable Jalousies (planing, shaping, trimming, drilling)

Job Order ------------- ₱380.00

Prepared by :

(Sgd.) Oscar C. Paradero

Dated 18 June 1984

From data collected by :

(Sgd.) James C. Salvador

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