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

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PHILIPPINES: DEMONSTRATION OF COCONUT WOOD UTILIZATION IN PREFABRICATED HOUSING.

SI/PHI/84/801/17-01

PHILIPPINES

Terminal Report *

Prepared for the Government of the 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

Backstopping officer: R. M. Hallett, Agro-Based Industries Branch

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 ₱18.60 - US$1.00.

The following acronyms are used in this Report :

DGLC	-	Davao Gulf Lumber Corporation, Davao City, Philippines
FAO	-	Food and Agriculture Organization, United Nations
FPRDI	-	Forest Products Research and Development Institute, Los Baños, Laguna, Philippines
NAPOCOR	-	National Power Corporation, Ministry of Energy, Republic of the Philippines
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
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 :

BF	-	Board Foot, a unit board measure 1"x1'x1'
B.I.	-	black iron
CCA	-	Copper-Chrome-Arsenate, a wood preservative compound
CHB	-	concrete hollow blocks
cm.	-	centimeter, 1/100th of a meter
coco	-	coconut

cu.m.	-	cubic meter, metric unit of volume
$CuSO_4$	-	Copper Sulphate, a chemical compound used to augment preservative treatment of wood
DBT	-	dry bulb temperature
EMC	-	equilibrium moisture content
hr.	-	hour
hrs.	-	hours
HSS	-	high speed steel
kgs.	-	kilograms, metric unit of weight, 1000 grams
km.	-	kilometer, 1000 meters
kph	-	kilometers per hour
kw	-	kilowatts, metric unit of measure of power
m	-	meter, metric unit of length
man-hours	-	man-hours, unit of work performed
MC	-	moisture content
mm	-	millimeter, 1/1000th of a meter
NaPCP	-	Sodium Pentachlorophenate, an anti-fungi compound
No.	-	number
pcs.	-	pieces, denoting unit of quantity
PHP	-	Philippine Peso, currency unit of the Republic of the Philippines
RL	-	random length, normally used to denote specified items of various lengths
RPM	-	revolutions per minute, unit of rotational speed
S2S	-	surfaced on 2 sides, referring to a board whose 2 faces have been planed smooth
S4S	-	surfaced on 4 sides, referring to a board whose 4 sides have been planed smooth
TCT	-	Tungsten Carbide Tip, a hard metal alloy used to reinforce the cutting surfaces of tools
T&B	-	toilet and bath
T&G	-	Tongue and Groove, a system of joining wood flooring pieces.
US$	-	U.S. Dollars, currency unit of the United States of America
V	-	volts, unit of electromotive force
V-Cut	-	a system of joining wooden walling boards, characterized by beveled edges toform a V-shaped groove at the joined edges
W	-	watts (unit of power, English system)
WBT	-	wet bulb temperature

°	-	degrees, a circular unit of measure of angles
°C	-	degrees, Celsius, unit of measure of temperature, metric system
°F	-	degrees, Fahrenheit, unit of measure of temperature, British thermal system
'	-	feet, English system of measure of length
"	-	inch, unit of length in the English system, equivalent to 2.54 centimeters
Ø	-	diameter
/	-	per, meaning "for each"
%	-	per cent, 1/100th part of a whole

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TABLE OF CONTENTS

I. INTRODUCTION

1.1 PROJECT BACKGROUND

The United Nations, through its implementing agencies - the FAO and UNIDO, has been promoting vigorously the use of indigenous non-traditional materials in construction and the introduction of substitutes for depleted sources of lumber. Among other activities, it has provided assistance to the government of the Philippines during the last 9 years in the latter's efforts to develop and promote the use of coconut stem (*cocos nucifera*) as a source of material for the building and construction industry. Development work on the techniques of processing coco wood was conducted at the Philippine Coconut Authority - Zamboanga Research Center (PCA-ZRC) during 1978 - 1982. Transfer of the processing technology thus developed to the wood processing industry in the country was initiated in 1983, under UNIDO Project SI/PHI/83/801. A demonstration house, duplex type, was successfully built in Davao City under the Project with a view to demonstrating the use of coco wood on housing construction. The coco lumber materials used in the construction of the demonstration house was processed by the Davao Gulf Lumber Corporation under the supervision of a UNIDO Expert using technology developed at the PCA-ZRC and the Forest Products Research and Development Institute (FPRDI), Los Baños, Laguna. The major findings under Project SI/PHI/83/801 indicated the need to pursue further development work on the use of coco wood in housing construction with a view to using coco wood in prefabricated components of housing units.

1.2 PROJECT CONCEPT AND OBJECTIVES

The Government of Quezon Province has plans to build a low-cost housing project involving the erection of about 500 housing units. The provincial board (Sanguniang Panlalawigan), considering the fact that Quezon Province is the premiere coconut farming area in the country, had expressed, through the Provincial Governor, its desire to make use of coconut stems as a source for building materials for the housing project and avail of the existing technology developed by the UNIDO in previous projects in the Philippines.

It was therefore decided by the Quezon Province authorities to erect a prototype duplex unit to demonstrate the feasibility of using coco wood in prefabricated housing components.

The immediate objectives of this Project are as follows :

" i - Redesign the coconut wood housing unit constructed under SI/PHI/83/801 on the basis of experience to :

(a) introduce prefabrication of components ;

(b) optimize the use of coconut wood in combination with other locally available building materials ;

(c) take into account specific requirements of the Government of Quezon Province ;

ii - Transfer coconut wood processing technology to local commercial sawmill, kiln-drying and planing mills selected to supply lumber and lumber products for the proposed project ;

iii - Set up prefabrication systems for housing components ;

iv - Develop techniques of optimizing utilization of coco lumber cut for the Project by converting lumber trimmings, edgings and offals into low cost furniture and joinery products of simple design ;

v - Determine the costs involved in the erection of the prototype and estimate costs for the proposed housing project ; and

vi - Disseminate the state of the art in coconut wood processing and utilization to builders and wood processing plant operators in Quezon Province."

The terms of reference for the UNIDO coco wood processing expert assigned to this Project are given in the attached Job Description (Annex I).

II. COCONUT STEMS LOGGING OPERATIONS

The coconut stems used in this project came from Barangay Binaha-an, municipality of Pagbilao, Quezon Province, about 23 kms. from the project site in Lucena City. The source area formed part of the 0.5 x 375 km. land clearing project being undertaken by the National Power Corporation (NAPOCOR) in preparation for the erection of steel towers and the installation of a high-voltage transmission line from the geothermal generating plants in the Bicol provinces to the NAPOCOR Southern Luzon Grid terminal at Caliraya, Laguna province.

2.1 LOG BOLTS INPUT ANALYSIS

A total of 641 pieces of coco log bolts were hauled to the sawmill in Candelaria, Quezon Province, of which 506 pcs. were cut to supply the Project requirements. The balance of 135 coco log bolts were milled into coco boards (per specifications of the coconut tree owner) as payment for the acquisition of the coconut stems. All log bolts milled did not have harvesting steps. More detailed data on the coco log bolts input are as follows :

TABLE 2.1

DATA ON COCO LOG BOLT SAWMILLING INPUT

Log Bolt Length (mm)	Average Log Bolt Diameter (mm)	Average Log Bolt Volume (cu.m.)	No. of Pieces	Total Volume (cu.m.)
3500	241	0.1745	21 pcs.	3.665
4000	249	0.1948	103 pcs.	20.070
4500	250	0.2210	82 pcs.	18.120
5000	258	0.2619	270 pcs.	70.725
6000	267	0.3380	30 pcs.	10.140
		Totals - ----	506 pcs.	122.72 cu.m.

The typical average log bolt milled to meet project requirements had an average length of 4670 mm; an average diameter of 257 mm and an average unit volume of 0.2425 cu.m.

In terms of the Project's total coco logs input volume, each log bolt length group participated as follows :

Log Bolt Length, mm	% of Total Log Input Volume
3500	2 %
4000	16 %
4500	14 %
5000	57 %
6000	8 %

Figures 1 to 5 show some of the logging activities during the conduct of the Project.

2.2 LABOUR AND EQUIPMENT USAGE

Logging operations started with bucking the coconut stems into log bolts with the desired lengths, as the coconut trees were already felled by the NAPOCOR clearing team. All log bolts thus cut were manually loaded on dump trucks and transported directly to the Tantuco sawmill in Candelaria, Quezon Province, a hauling distance of approximately 48 kms. Unloading at the mill site was done by tilting the truck body to dump the coco log bolts at the sawmill log yard.

i - Labour Usage

A total of 1584 man-hours was used in the bucking, yarding and loading operations, distributed as follows :

T A B L E 2.2

LABOUR USAGE, LOGGING AND HAULING OPERATIONS *

Labor	No. of Men	Hours Worked/Day	No. of Days	Total Man-Hours
Chainsaw Operator	1	8	14	112
Helpers (Bucking & Yarding)	4	8	16	512
Truck Driver	4	8	10	320
Truck Helper	4	8	10	320
Supervision	2	8	20	320
			Total ----------	1,584

ii - Machine/Equipment Usage

Machinery and equipment usage data are as follows :

T A B L E 2.3

MACHINE/EQUIPMENT USAGE, LOGGING AND HAULING OPERATIONS *

Type of Machine or Equipment	No. of Units Used	Hrs./Day Used	Days Used	Total Machine Hours
Chainsaw, gasoline-driven, 24" blade	1	6	14	84
6x6 Truck, with front winch	1	4	16	84
6x6 Truck	1	8	10	80
Dump Truck	2	8	10	160

Note : * The data given in these tables are still subject to confirmation by the Project Director.

Figure 1

Coconut stem logging site, Barrio Binaha-an Pagbilao, Quezon Province.

Figure 2

Squaring the butt end of a coco log bolt using a 60 mm power chainsaw.

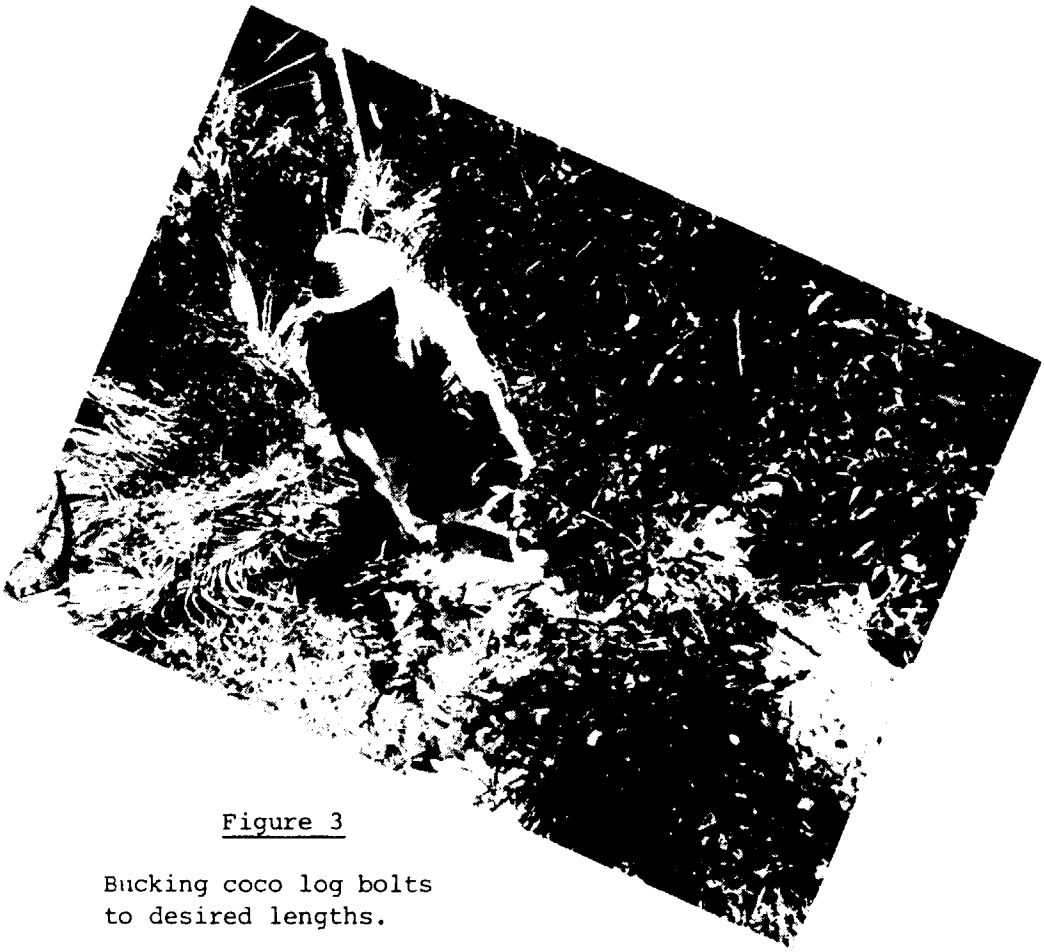


Figure 3

Bucking coco log bolts to desired lengths.

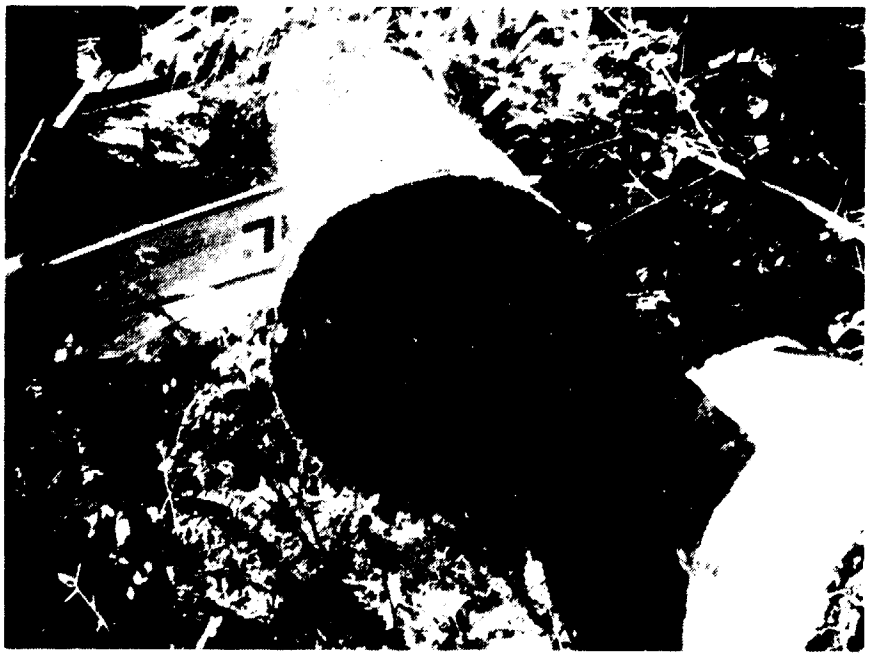


Figure 4

Squaring the butt end of the largest (527 mm, average diameter) coco log bolt produced.

Figure 5

Bucked coco log bolts ready
for yarding operations.

III. COCO LUMBER PROCESSING ACTIVITIES

3.1 SAWMILLING OPERATIONS

3.11 Sawmilling Facilities Used

All coco log bolts produced under this Project were milled into coco lumber at the Tantuco sawmill in Sariaya, Quezon Province. The Tantuco sawmill is a small size, labour-intensive mill, rated at about 23.5 cu.m./8-hr. (10,000 BF/8-hr.) lumber output. All machines (see Annex II) are of Philippine design and manufacture. Material transfer from one work station to another is effected through a system of wooden dead roll conveyors (locally fabricated) and skid ramps. A 10-ton capacity motorized crane is used to transfer coco log bolts from the log yard to the sawmill log deck. Resawing operations are conducted at a separate building about 15 meters east of the main sawmill building. Disposal operations of milling residue and all material handling operations after discharge of slabs and thick boards from the bandmill carriage are done manually. The sawmilling set-up is typical of small sawmilling plants specifically designed to serve the needs of the domestic lumber market in the Philippines.

3.12 Transfer of Sawmilling Technology

A short seminar on coco wood sawmilling techniques, physical characteristics and mechanical properties of coco wood and coco lumber grading (the same topics discussed with the DGLC sawmilling personnel, Davao City, under Project SI/PHI/83/801) was held on 12 February 1985 before actual milling operations were started. The participants were also briefed on the roles of the UNIDO and UNDP in the promotion of the use of indigenous wood species as a substitute for the fast disappearing traditional wood species, in general, and the processing and utilization of coco wood in building and construction, in particular. There were 26 participants in the seminar, composed of key men of the Tantuco sawmill and Project Staff Engineers (see Figure 6). It should

be noted at this point that the staff engineers assigned by the Project Director to the Project were all fresh graduate engineers and had no industrial experience at all, nor sawmilling or wood processing experience.

3.13 Coco Lumber Production

The principal log breakdown operations, ripping to desired width and trimming to desired lengths were done at the main sawmill building to produce boards with thicknesses of 38 mm or more. All boards with final thickness 25 mm or less were re-sawn at the annex re-sawing building (see Figures 7 to 16).

A total of 66.534 cu.m. (28,210 BF) of coco lumber was produced from an input of 122.72 cu.m. (52,033 BF) of coco log bolts. The over-all coco lumber yield rate was 54.21%. The lumber grade distribution of the sawmilling output is as follows :

T A B L E 3.1

% GRADE DISTRIBUTION OF SAWMILLING OUTPUT

Lumber Grade	Volume Milled	% of Total Output
Hard	41.411 cu.m.	64.15%
Medium	8.319 cu.m.	21.13%
Soft	1.266 cu.m.	14.72%

Notes :

i - Material cut specially for ridge roll and eaves flushing (125 mm x 125 mm x RL) and baluster (75 mm x 75 mm x RL) blanks, which included "Hard" and "Medium" grade sections of the coco log cross section, had a total volume of 1.381 cu.m. and accounted for 2.07% of the total output.

ii - Roofing shingles blanks (38 mm x 100 mm x RL), specially cut from the "Medium" and "Soft" grade sections of the coco log bolt, had a total volume of 14.429 cu.m. and accounted for 21.69% of the total output.

Figure 6

Project Staff Engineers and Tantuco Sawmill personnel who attended the short seminar on coco wood sawmilling. (Mr. Rafael Tantuco, 2nd from right, front row, is the owner of the sawmilling plant).

Figure 7

Coco log bolts on log deck,
Tantuco Sawmill, Candelaria, Quezon Province.

Figure 8

Main sawyer controlling movement of carriage on 1st pass of bandsaw blade.

Figure 9

Setting coco log bolt for desired cut thickness at 5th pass of bandsaw blade.

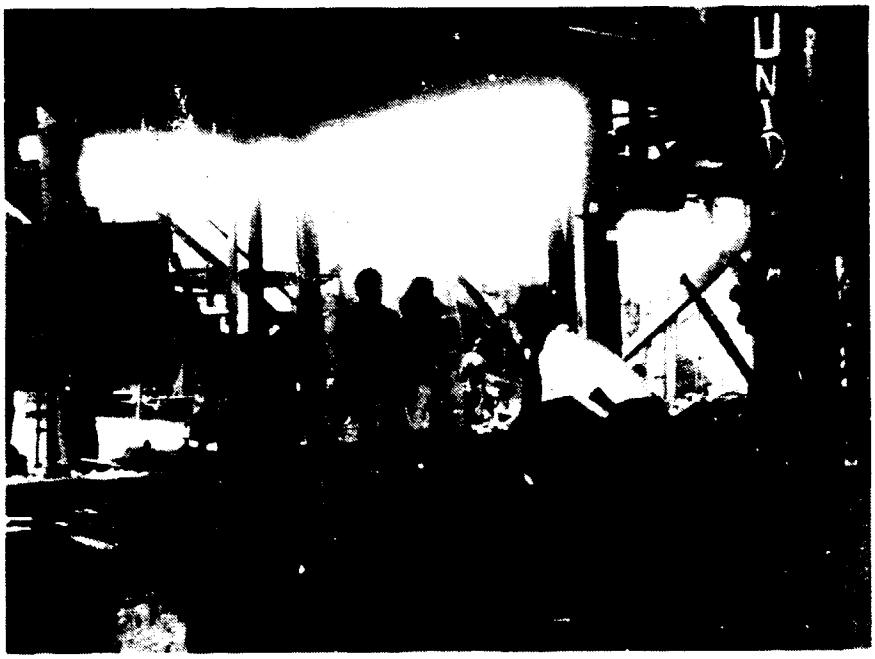


Figure 10

125 mm x 125 mm coco wood piece to be used as blanks for ridge roll and eaves flushing, just unloaded from the bandmill carriage, is pushed to the trim saw station.

Figure 11

Infeed end of edger saw set to cut 50 mm x 100 mm coco boards.

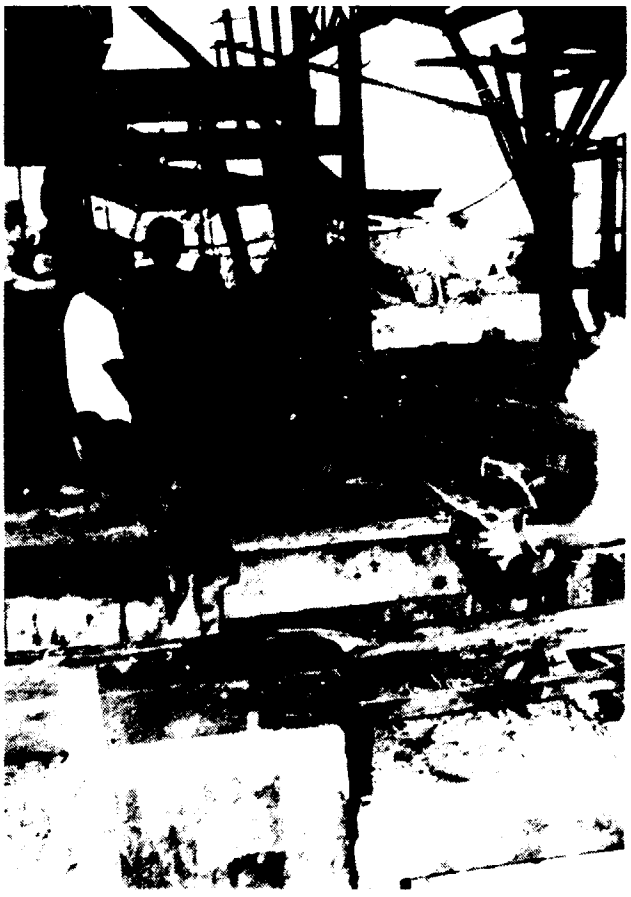


Figure 12

Discharge end of edger saw, cutting 25 mm x 100 mm coco boards.

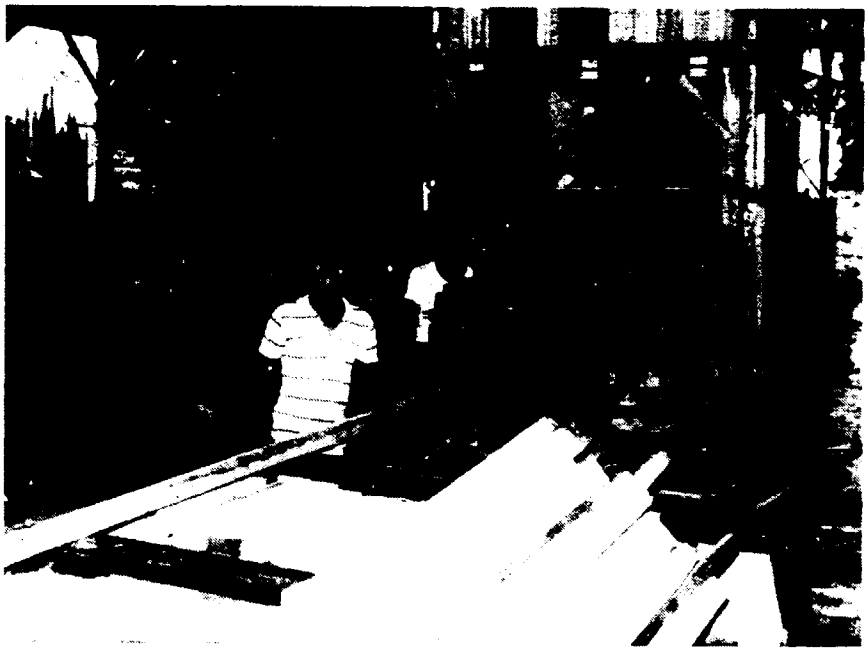


Figure 13

Resawing coco boards into blanks
for roofing shingles using a band resaw
with 150 mm wide blade.

Resawing 50 mm coco blanks into 25 mm boards.

Figure 15

Trim sawing 75 mm x 75 mm coco boards
for baluster blanks.

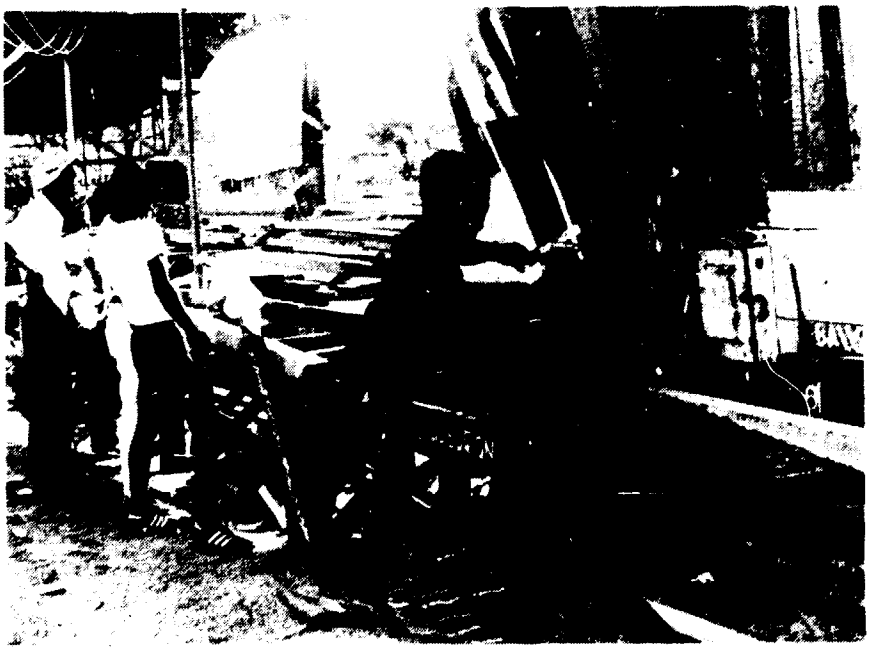


Figure 16

Trim sawing end tapers on coco boards.

A detailed schedule of the lumber grade distribution of standard size coco boards cut for house construction purposes is given in Table 3.2. "Hard" grade coco lumber composed more than 61% of the total sawmilling output. The participation of "Medium" grade coco lumber (12.02%) and "Soft" grade coco lumber (1.89%) in the total sawmilling output, as indicated in Table 3.2, are really much lower than actually available from the coco log bolts milled. This was the result of a revised milling procedure (after "peeling" "Hard" grade boards off the log bolts) to produce blanks for roofing shingles from material straddling the "Medium" and "Soft" grade zones. The roofing shingles blanks thus produced have stronger mechanical properties than pure "Soft" grade coco lumber. More than 14 cu.m. (21.37%) of the total sawmilling output was composed of boards with densities straddling both the "Medium" and "Soft" grades coco wood zones. The width distribution of the various grades of coco boards produced follow the width requirements as specified in the Bill of Materials, with 100 mm wide boards having the largest volume outputs in each coco lumber grade group, followed by 75 mm, then 125 mm wide boards.

An aggregate of 2,074 man-hours of production labour was used, composed of 9.61% highly-skilled; 5.03% skilled; 19.18% semi-skilled and 66.15% unskilled labour. This labour usage was complimented by 66.5 man-hours (3.2%) of supervisory work and 133 man-hours (6.41%) of saw-doctoring labour. The over-all productivity level was calculated at 0.03208 cu.m. of lumber output per man-hour of labour usage.

Due to various delay factors (heavy rains, electric power cut-offs, unavailability of the sawmill, etc.) sawmilling activities were conducted at intermittent runs in 12 days of operations. The lumber yield rate averaged 64.16% during milling runs for thick boards (38 mm and thicker). As expected, the lumber yield rate decreased to an average of 51.66% during milling runs for coco boards 25 mm or less in thickness. The over-all lumber yield rate for the Project was 54.21%.

TABLE 3.2

COCO BOARD GRADE DISTRIBUTION, STANDARD SIZE BOARDS FOR HOUSE CONSTRUCTION PURPOSES (cu.m. produced)

Lumber Grade	Board Thickness (mm)	Boards Widths 50 mm	75 mm	100 mm	125 mm	150 mm	Total Volumes (cu.m.)	% of Total Output
Hard	75	---	0.383	---	---	---	0.383	0.57%
Hard	50	2.088	3.739	8.426	5.264	0.487	20.004	29.94%
Hard	38	0.025	0.031	0.076	0.026	0.025	0.183	0.27%
Hard	25	2.298	2.963	7.969	0.266	0.056	13.552	20.29%
Hard	19	0.655	1.163	4.917	0.208	0.005	6.948	10.40%
Hard	13	0.003	0.025	0.018	---	---	0.046	0.07%
Totals	----------	5.069	8.304	21.406	5.764	0.573	41.116	
Percent of Total Output	----------	7.59%	12.43%	32.04%	8.63%	0.85%		61.54%
Medium	75	---	1.552	---	---	---	1.552	2.32%
Medium	50	0.092	1.267	1.614	0.471	0.074	3.518	5.26%
Medium	38	0.021	0.088	0.103	---	---	0.212	0.32%
Medium	25	0.186	0.424	1.380	0.077	0.015	2.082	3.12%
Medium	19	0.065	0.123	0.398	0.084	---	0.670	1.00%
Totals	----------	0.364	3.454	3.495	0.632	0.089	8.034	
Percent of Total Output	----------	0.54%	5.17%	5.23%	0.95%	0.13%		12.02%
Soft	75	---	0.030	---	---	---	0.030	0.05%
Soft	50	---	0.050	0.050	---	---	0.100	0.15%
Soft	25	0.028	0.021	0.091	---	0.041	0.181	0.27%
Soft	19	0.038	0.066	0.845	---	---	0.949	1.42%
Totals	----------	0.066	0.167	0.986	---	0.041	1.260	
Percent of Total Output	----------	0.10%	0.25%	1.48%	---	0.06%		1.89%

3.14 Grading Coco Lumber

The coco lumber grading technique developed during the conduct of the Davao City coco house project (SI/PHI/83/801) used interpolated and extrapolated deflection values in addition to the empirical values obtained during tests conducted by the PCA-ZRC. The deflection values were obtained from curves plotted on cross-sectional paper using the empirical values obtained through regression analysis of test data at the PCA-ZRC. The reliability of the deflection values thus obtained of course depended on the accuracy of plotting the PCA-ZRC deflections. The nature of the curves thus plotted (apparently parabolic) reduces the accuracy of deflection values at board lengths which correspond to points near the assymptotes (x- and y-axes). This was compensated in actual coco lumber grading by assigning the next lower grades to boards with deflection values in these areas of the plotted curve (i.e., for boards shorter than 3000 mm or longer than 5000 mm), which of course shifted the grade distribution of coco boards toward grades lower than what it should actually be.

For purposes of this Project, a mathematical approach was used to calculate the interpolated and extrapolated deflection values for coco boards with thicknesses and lengths other than those tested at the PCA-ZRC tests. Using the PCA-ZRC empirical deflection data, a matrix was set up as follows :

	y		
x	25	38	50
3000	a	b	c
4000	d	e	f
5000	g	h	i

where :

x = coco board length, mm

y = coco board thickness, mm

a, b, c, ...i = empirical deflections, mm

The general solution to this type of matrix may be achieved by the use of the incremental method, as developed by Professor Susana D. Livelo, University of the Philippines, Quezon City, thus :

$$f(x,y) = \left\{ I + \frac{x-3000}{1000} \underset{1000}{\Delta} x + (x-3000)(x-4000) \underset{1000}{\Delta^2} x \right\} \cdot \left\{ I + (y-25) \underset{38}{\Delta} y + (y-25)(-38) \underset{38,50}{\Delta^2} y \right\} \cdot \left\{ f(3000,25) \right\}$$

/---------- Eq.1

The application of the general solution (Fq. 1) to the matrix given in the preceding paragraph gives rise to the following relationship :

$$f(x,y) = a + (y-25)\left(\frac{b-a}{13}\right) + (y-25)(y-38)\left\{\frac{\frac{c-b}{12} - \frac{b-a}{13}}{25}\right\}$$

$$+ \left(\frac{x-3000}{1000}\right)(d-a) + \left(\frac{x-3000}{1000}\right)(y-25)\left\{\frac{e-b-d+a}{13}\right\}$$

$$+ \left(\frac{x-3000}{1000}\right)(y-25)(y-38)\left\{\frac{\frac{f-c-e+b}{12} - \frac{e-b-d+a}{13}}{25}\right\}$$

$$+ \frac{(x-3000)(x-4000)}{2!1000^2}\left\{g-2(d)+a\right\}$$

$$+ \frac{(x-3000)(x-4000)}{2!1000^2}(y-25)\left\{\frac{h-g-2(e-d)+b-a}{13}\right\}$$

$$+ \frac{(x-3000)(x-4000)}{2!1000^2}(y-25)(y-38)\left\{\frac{13(i-h-f+e+c-b)-12(h-g-e+d+b-a)}{12 \cdot 13 \cdot 25}\right\}$$

/---------- Eq.2

Table 3.3 below gives the deflection data obtained by running Eq. 2 through a microcomputer, for 25 mm, 38 mm and 50 mm thick boards with lengths varying from 3000 mm to 6000 mm.

T A B L E 3.3

COCO LUMBER DEFLECTION CHART

Board Length (mm)	Board Thickness (mm)	Deflection (mm) at Mid-Length of "GREEN" Coco Boards		
		"Hard"	"Medium"	"Soft"
6000*	50	Below 93	93 to 136	Above 136
	38	Below 112	112 to 148	Above 148
	25	Below 331	331 to 450	Above 450
5500*	50	Below 65	65 to 95	Above 95
	38	Below 84	84 to 111	Above 111
	25	Below 252	252 to 344	Above 344
5000**	50	Below 42	42 to 60	Above 60
	38	Below 60	60 to 80	Above 80
	25	Below 185	185 to 252	Above 252
4500***	50	Below 24	24 to 34	Above 34
	38	Below 40	40 to 54	Above 54
	25	Below 128	128 to 175	Above 175
4000**	50	Below 12	12 to 16	Above 16
	38	Below 25	25 to 34	Above 34
	25	Below 82	82 to 112	Above 112
3500***	50	Below 4	4 to 6	Above 6
	38	Below 14	14 to 19	Above 19
	25	Below 46	46 to 64	Above 64
3000**	50	Below 3	3 to 5	Above 5
	38	Below 7	7 to 10	Above 10
	25	Below 22	22 to 30	Above 30

Note : * extrapolated deflection values
** empirical deflection values, PCA-ZRC
*** interpolated deflection values

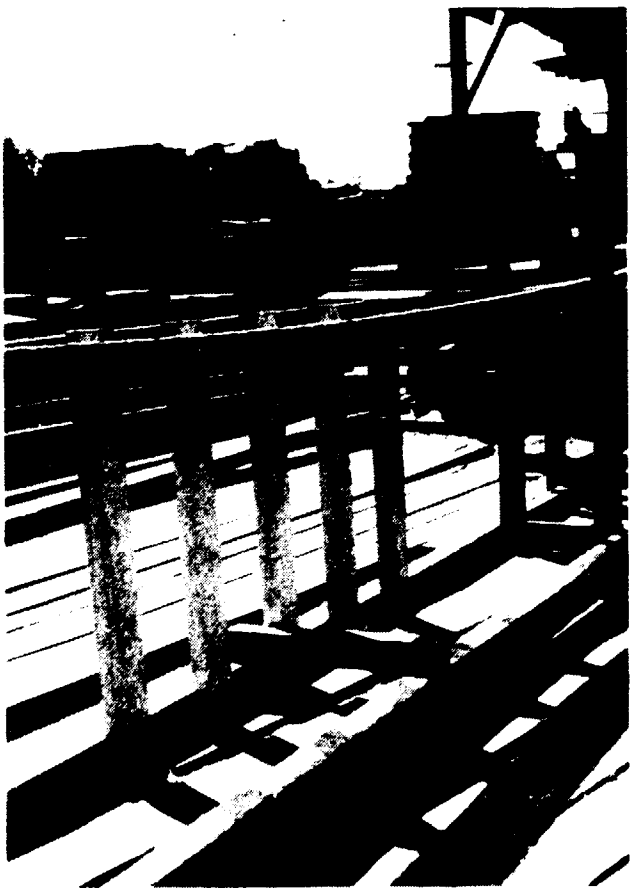
An improved grading fixture (see Figures 17 to 20) was fabricated on the basis of the deflection values given in Table 3.3 above, which are deemed more accurate than the corresponding values obtained from curves plotted from the empirical deflection values as was done under Project SI/PHI/83/801.

Figure 17

Grading coco boards on specially constructed grading fixture.

Figure 18

Close-up view of deflection scales on coco lumber grading fixture.



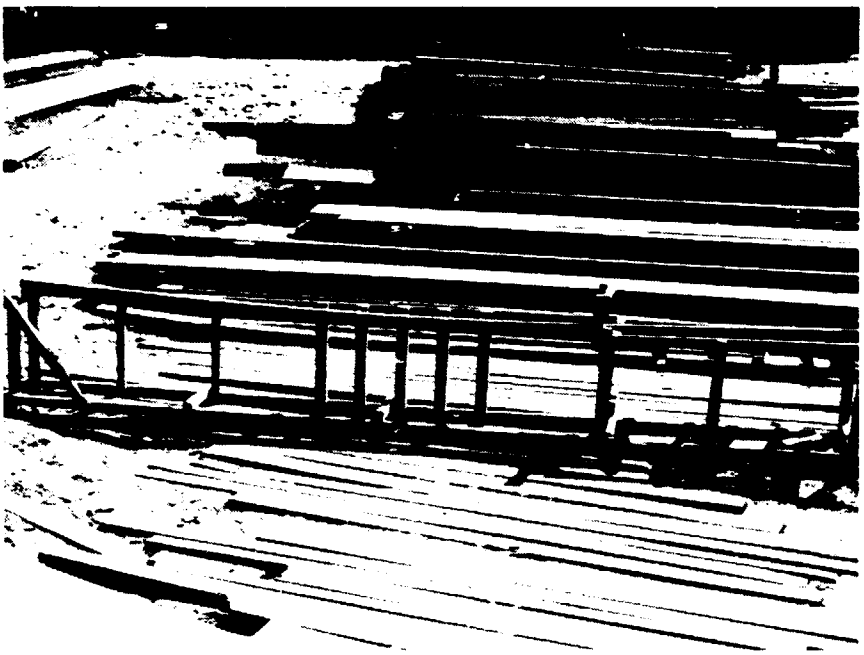
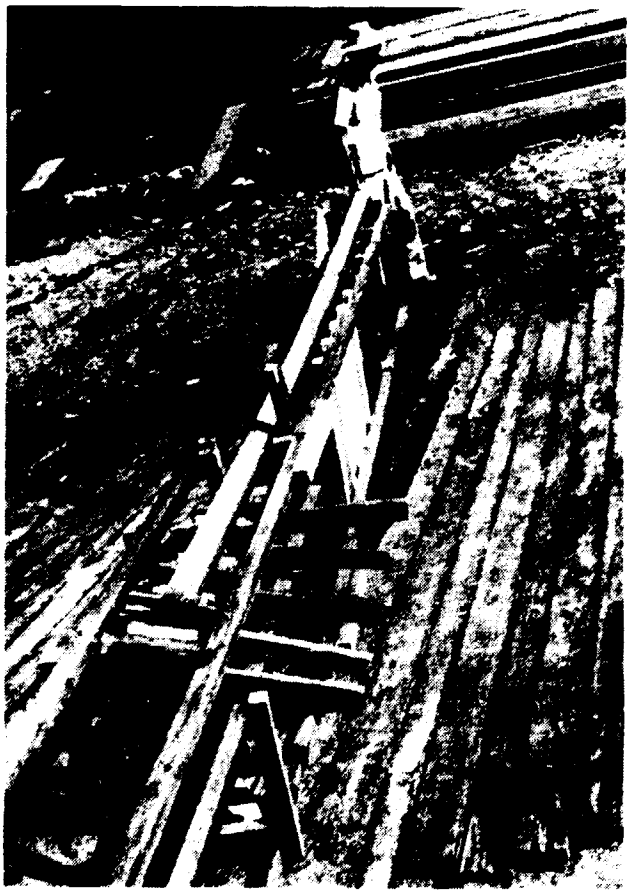


Figure 19

A view of the discharge end of the coco lumber grading fixture.

Figure 20

Close-up view of the specially improvised levers installed at the infeed end to accommodate coco boards of different lengths on the lumber grading fixture.



3.2 KILN-DRYING OPERATIONS

All kiln dried coco lumber requirements of the project were processed at the Tantuco wood processing complex in Candelaria, Quezon Province. There were two major constraints that had to be tackled before actual kiln-drying operations could be started, namely :

i - the kiln-drying chamber was not adequately equipped for proper control of humidity of the air inside the kiln-drying chamber ; and

ii - the kiln capacity (40,000 BF or 93.5 cu.m. per charge) was too large for either the volume of thick or thin coco lumber to be dried in one charge. This situation required that the kiln chamber be filled up to about 15-30 cm below the fan in order to reduce the shunting of hot air between adjacent fans as there were no baffles to prevent such undesirable kiln condition.

3.21 Kiln-Drying Facilities

The kiln-drying chamber (see Figure 21) was of local design and construction, with concrete walls, roof and floor. Loading the kiln chamber is done manually (see Figure 22). It is basically of the hot-air reversible air flow type of kiln.

Heat is derived from the flue gas generated by a waste wood burning furnace and is transferred to the air inside the drying chamber by means of a system of 38 cm diameter B.I. pipe heat exchanger (see Figure 24). Hot-air circulation is provided by four (4) fan units mounted on individual drive shafts connected to the drive motor by means of a system of pulleys and V-belts. Direction of fan rotation is electrically controlled through a reversing switch and timing device. Kiln air temperature is indicated by two dry bulb thermometers (bi-metallic dial gauge type), one mounted on the front wall between the two kiln doors, and the other, mounted on the personnel access door at the rear of the kiln chamber. The kiln set-up was thus not capable of

Figure 21

The kiln-drying facilities at the Tantuco Sawmill, Candelaria, Quezon Province. (Philippine design and manufacture)

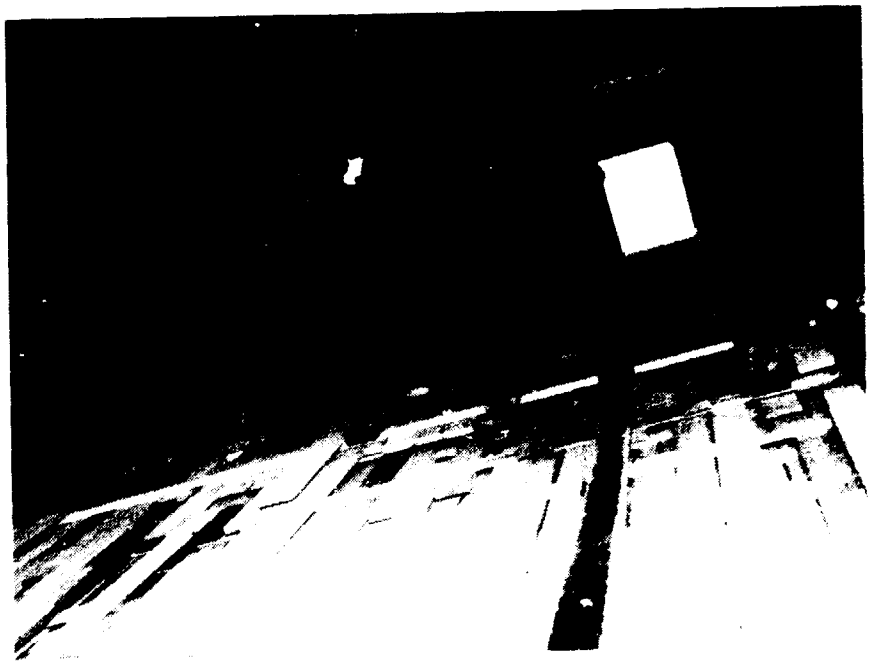


Figure 22

Piling coco boards manually inside the kiln chamber.

controlling the rate of evaporation of moisture from the lumber to the kiln air. Neither was there any means of determining whether the air inside the kiln chamber was already too humid to allow a desirable level of moisture transfer from the wood to the air inside the kiln. This problem was solved by :

i - converting one of the dry-bulb thermometers to the wet bulb type by installing a source of water to keep the muslin cloth wrapped around the thermometer sensor probe moist (see Figure 23) ; and

ii - installing a water spray system (a water spray head, see Figure 24, supplied with water from elevated water tanks, see Figure 25).

In this manner, the humidity (and temperature) of the air inside the kiln was better controlled.

3.22 Transfer of Technology

Another problem that confronted the UNIDO expert was the fact that the Tantuco kiln-drying personnel did not have adequate educational background to be able to assimilate the techniques on the use of the psychrometric chart in kiln-drying operations. Five (5) engineers from the Project Staff (3 principals and 2 alternates) were given a 10-day course on the principles of kiln-drying as applied to coco lumber. Of the five trainees only one principal and the two alternates were chosen as kiln-drying shift supervisors on the basis of their satisfactory individual performances during the training period.

3.23 Kiln-Drying Schedules

The first kiln charge was composed of about 33 cu.m. (14,000 BF) of thin coco boards (25 mm or less thickness) and approximately 16.5 cu.m. (7000 BF) of Philippine hardwood (*pterocarpus indicus*) with thicknesses ranging from 64 mm to 100 mm and widths of 100 mm to 3000 mm. Both wood species in the first kiln charge had initial moisture contents (MC) above 80%. It was expected that the thin coco boards would dry faster than the much thicker

Figure 23

Improvised wet bulb thermometer (can of water holds water supply to thermometer probe wrapped in unbleached muslin cloth).

Figure 24

Water spray system installed between heat exchanger segments at the Tantuco kiln drier.

Figure 25

Elevated water tanks
(2 units of 200-liter steel drums)
supply water to the water spray system
inside the kiln.

hardwood species. Thus, lower kiln temperatures and a pre-drying stage longer than that used in the Davao City coco house project (SI/PHI/83/801) were used. The revised kiln-drying schedule, together with the resulting time period for each drying stage and sub-stages are given in the following table.

T A B L E 3.4

MODIFIED KILN-DRYING SCHEDULE FOR FIRST KILN CHARGE
(Thin Coco Boards Mixed with Philippine Hardwood)

K.D. Stage	Target MC (%)	DBT	WBT	Kiln Air EMC	Actual Number of Hours Run	
Pre-Drying Stage	60 %	38°C(100°F)	36°C(96°F)	17.5 %	30 hrs.	
	40 %	49°C(120°F)	46°C(115°F)	15.1 %	45 hrs.	
	30 %	54°C(130°F)	49°C(120°F)	12.1 %	17 hrs.	
			Total hours ----------			92 hrs.
Main Drying Stage	40 %	66°C(150°F)	54°C(130°F)	8.0 %	15 hrs.	
	30 %	71°C(160°F)	57°C(135°F)	6.8 %	22 hrs.	
	12 %	71°C(160°F)	60°C(140°F)	7.9 %	35 hrs.	
			Total hours ----------			72 hrs.
Equalization and Conditioning	14 % to 16 %	71°C(160°F)	70°C(156°F)	19.8 %		4 hrs.
			Total Drying Time ----------			168 hrs.

At the end of the kiln-drying run the thin coco boards were found to have 15% MC, while the hardwood boards had 34% MC. The coco boards were thus unloaded from the kiln, while the hardwood boards were left inside the kiln for further drying together with thick coco boards (38 mm and 50 mm thick boards) of the second kiln charge.

The second kiln charge was composed of three different wood species the 16.5 cu.m. (7000 BF) of Philippine hardwood (*pterocarpus indicus*) left-over from the first kiln charge; about 8.8 cu.m. of thick coco boards (38 mm and 50 mm thicknesses) and approximately 14 cu.m. (6000 BF) of 25 mm thick *Tanguile* (shorea polysperma) boards. Both the coco and *Tanguile* boards had initial MC's above 80%. Based on the experience gained during the conduct of the Davao City coco house project (SI/PHI/83/801), a modified kiln-drying

schedule was used to dry the mixture of 3 wood species. The kiln-drying schedule and the resulting time period for each drying stage and sub-stage are given in the table below. Under standard kiln-drying conditions (i.e., single wood specie in one kiln charge), the *Tanguile* boards are expected to dry faster than the thick coco boards. Since the mill owner did not impose any time constraint on the drying of his part of the kiln charge (the two hardwood species), it was decided to dry the mixed charge according to a schedule more suitable for drying thick coco boards.

T A B L E 3.5

MODIFIED KILN-DRYING SCHEDULE FOR SECOND KILN CHARGE COMPOSED OF THREE DIFFERENT WOOD SPECIES

K.D. Stage	Target MC (%)	DBT	WBT	Kiln Air EMC	Actual Number of Hours Run
Pre-Drying Stage	50 %	54°C(130°F)	52°C(125°F)	16.0 %	72 hrs.
	30 %	57°C(135°F)	53°C(128°F)	13.9 %	42 hrs.
			Total hours ----------		114 hrs.
Main Drying Stage	25 %	60°C(140°F)	54°C(130°F)	11.9 %	65 hrs.
	20 %	66°C(150°F)	57°C(135°F)	9.5 %	75 hrs.
	12 %	66°C(150°F)	54°C(130°F)	8.0 %	88 hrs.
			Total hours ----------		228 hrs.
Equalization Stage	14 %	71°C(160°F)	66°C(150°F)	10.6 %	18 hrs.
Conditioning Stage	14 % to 16 %	71°C(160°F)	68°C(155°F)	9.8 %	4 hrs.
			Total Drying Time ----------		364 hrs.

Note : The main drying stage was made longer than the corresponding period under standard coco board kiln-drying schedules in order to avoid rapid evaporation of moisture from the thin "Tanguile" boards, thus minimizing kiln down-grades.

At the end of the kiln-drying run, the thick coco boards had 16% MC, the "Tanguile" boards had 14% MC, while the other hardwood boards had 17% MC. All the 3 wood species were unloaded from the kiln, as the kiln owner accepted the dryness of the two hardwood species, considering that the EMC for the Lucena City

area of Quezon Province is 13% - 15% during the dry season and 15% - 17% during the rainy season.

3.24 Kiln-Drying Results

Negligible kiln de-grades were found in the thin coco boards of the first charge, mostly slight twisting and few checking on board surfaces at the top layer of the piles. This is to be expected as the top layer boards were directly exposed to the hot-air flow, the same situation encountered during the kiln-drying runs of the Davao City coco house project (SI/PHI/83/801).

No kiln de-grades were encountered in the thick coco boards of the second kiln charge. This is attributed to the tempering effect of the "Tanguile" boards piled on top of the coco boards.

Loading and unloading of the kiln accounted for more than 51% of the kiln-drying labour usage for the two kiln charges as indicated in the following table :

T A B L E 3.6

LABOUR USAGE, KILN-DRYING OPERATIONS

Kiln Charge	Loading (Man-Hours)	Unloading (Man-Hours)	Kiln-Operator (Man-Hours)	Supervision (Man-Hours)	Total
First	320	160	168	168	816 man-hrs.
Second	384	244	364	364	1,356 man-hrs.
Totals ----	704	404	532	532	2,172 man-hrs.

The labour usage chargeable to the volume of coco boards prorated to the total volume of boards kiln dried is indicated in Table 3.7 :

T A B L E 3.7

LABOUR USAGE CHARGEABLE TO KILN-DRYING COCO BOARDS

Kiln Charge	Loading (Man-Hours)	Unloading (Man-Hours)	Kiln-Operator (Man-Hours)	Supervision (Man-Hours)	Total
First	213	160	112	112	597 man-hrs.
Second	149	95	142	142	528 man-hrs.
Totals ----	362	255	254	254	1,125 man-hrs.

3.3 SURFACING AND PROFILING OPERATIONS

All S2S, S4S, V-Cut and T&G boards required by the Project were processed at the Tantuco surfacing mill in Sariaya, Quezon Province. The mill is about 16 kms. from the jobsite in Lucena City and 14 kms. from the prefabrication shop at the Provincial Engineer's Office, Barangay Talipan, Municipality of Pagbilao, Quezon Province.

3.31 Coco Board Surfacing Facilities

The Tantuco surfacing mill in Sariaya is typical of such mills in Lucena City and suburbs, which are usually integral components of the bigger lumber and hardware stores of the area. The principal input are thick boards (50 mm and thicker) or squared timber flitches (150 mm square or larger) which are re-sawn, planed (S2S, S3S, S4S) or profiled (T&G, V-Cut, quarter-round cuts, etc.) according to the daily needs of the lumber and hardware store business. There are three principal pieces of machinery at the Tantuco surfacing mill: a band re-saw (150 mm width sawblade) with powered feed rolls, a double-head planer (500 mm width by 250 mm thick capacity), and a 4-head planer-matcher (200 mm width by 100 mm thick capacity), all designed and manufactured in the Philippines. Trimming to final length or ripping to desired width is done on a locally fabricated table saw with a 250 mm diameter circular sawblade. (See Annex III for machine specifications.) Material handling activities at all work stations are done by hand. Again, characteristic of similar surfacing (or woodworking) mills in the Philippines, the Tantuco mill is not provided with pneumatic or mechanical type of dust or mill residue disposal system. Sawdust and other mill residues are accumulated on the factory floor, packed in sacks or plastic bags as the accumulated volume required, and then sold as cooking fuel. (See Figures 26 to 35.) Grinding of profiled knives is done on a 2-wheel table grinder by hand. A locally fabricated fixture is used to sharpen straight knives.

3.32 Control of Board Dimensions and Profile

Before the mills' participation in this Project, machines were set on the basis of individual manual measurement of the surfaced

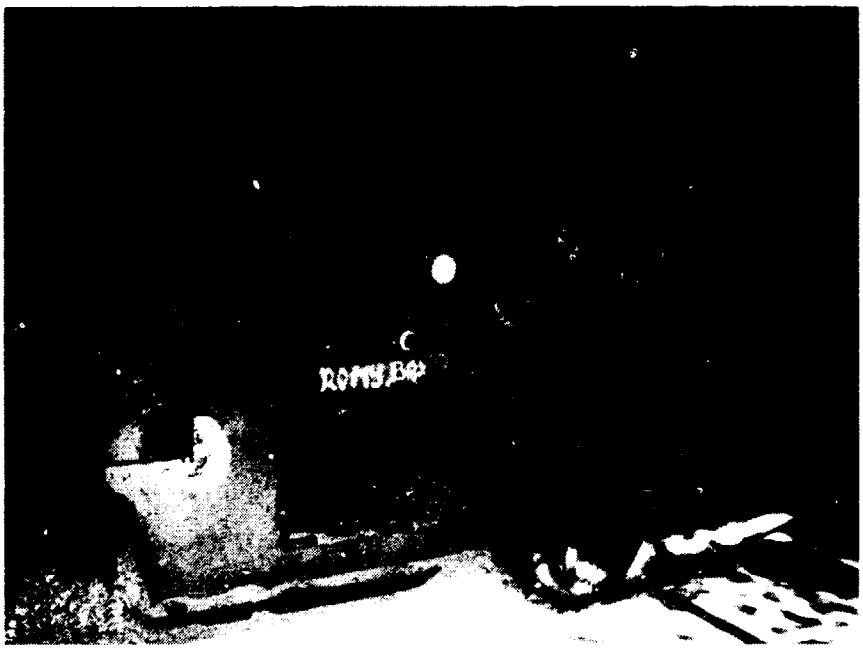


Figure 26

Philippine made four-side planer-matcher used in the manufacture of S4S, T&G, and V-Cut coco boards, Tantuco Planing Mill, Sariaya, Quezon Province.

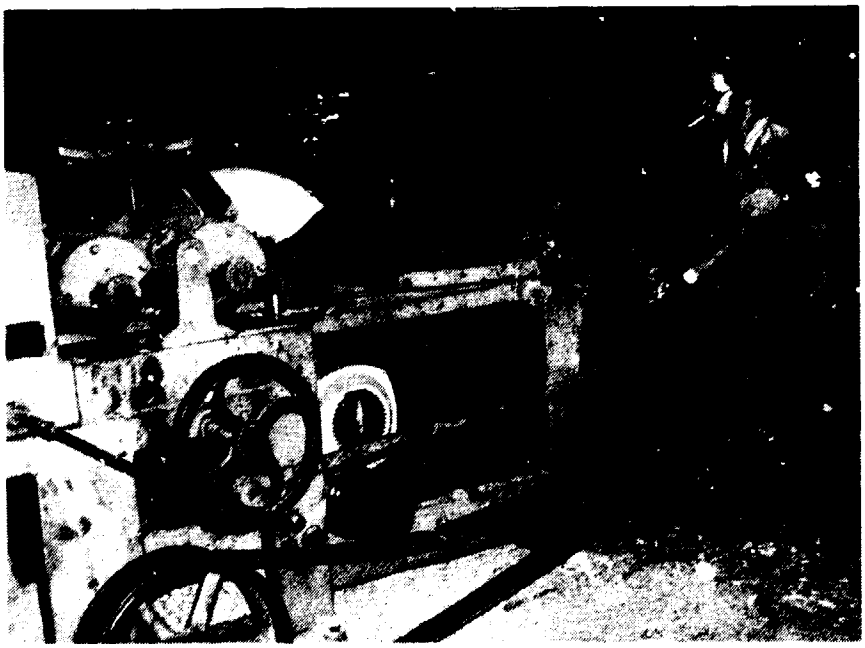


Figure 27

Adjustments being made on feed rolls pressure in preparation for S4S run on the planer-matcher.

Figure 28

Checking dimensions of sample board before production run on planer-matcher.

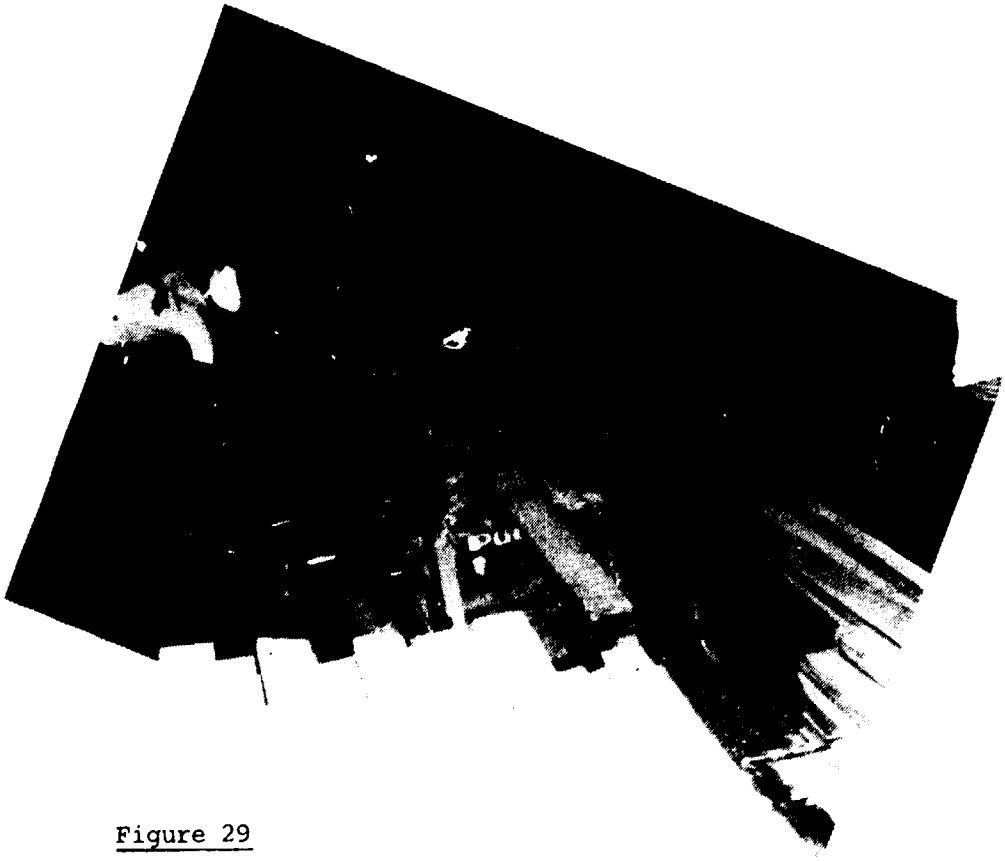


Figure 29

Infeed end of planer-matcher during S4S surfacing operations.

Figure 30

Checking coco board dimensions with "GO-OR-NO-GO" metal gauges.

Figure 31

Close-up view of the use of "GO-OR-NO-GO" gauge.

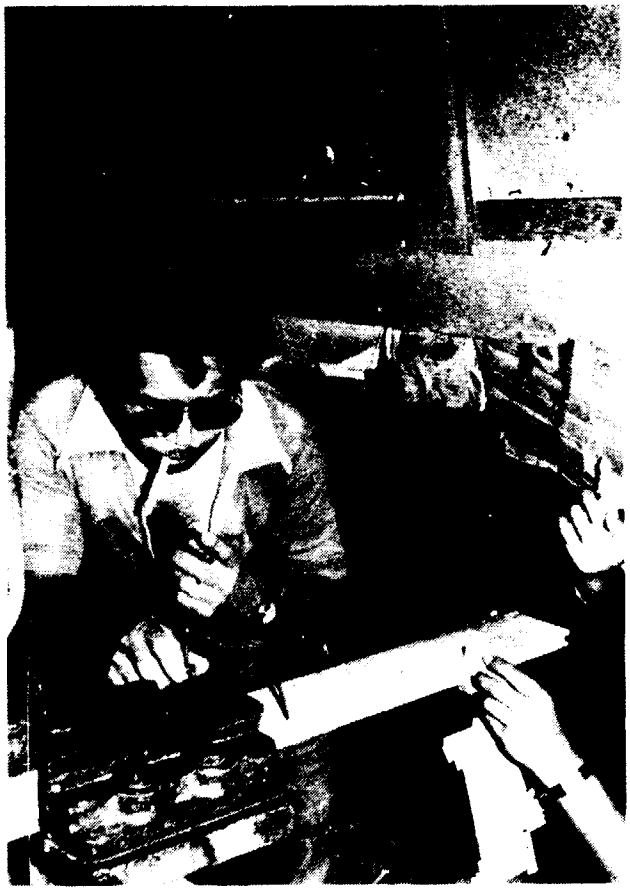


Figure 32

Checking evenness of board thickness with calipher and squareness of edges with "GO-OR-NO-GO" gauge.

Figure 33

Infeed end of Philippine-made double head planer during S2S run of coco boards.

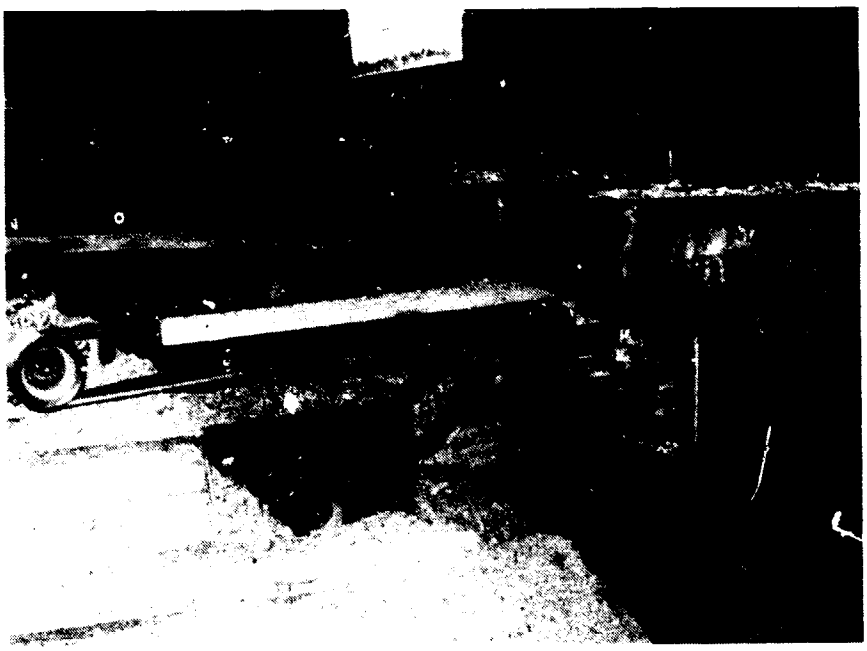


Figure 34

S2S operations on 50 mm x 50 mm coco boards,
Tantuco Planing Mill, Sariaya, Quezon Province

Figure 35

Resawing for 50 mm x 50 mm coco boards on
Philippine-made band resaw at the
Tantuco Planing Mill, Sariaya, Quezon Province.

boards. Once the machine is set-up, the day's quota for the surfaced or profiled products is run, without random checks on the machine output. This practice led to variation in dimensions of the surfaced or profiled products during the day's run and, also, of the outputs from day-to-day. Profiled knives are ground to the desired shape on the basis of the skill of the shop millwright technician.

The concept of the use of "GO-OR-NO-GO" gauges was introduced during surfacing and profiling operations for coco boards. (See Figures 30-32). This helped speed up (i.e., shorten) machine set-up time by more than 50% and, also, preserved the uniformity of dimensions and profiles from one board to another.

3.33 Results of Surfacing and Profiling Operations

All cutting tools (straight and profiled knives) were of the thin HSS type, plain ground, and mounted on the cutterheads to give cutting angles ranging from 33°-38°. Trial runs on both the double-head planer and the 4-head planer-matcher produced plain surfaced and profiled surfaces, respectively, with acceptable surface smoothness. Both machines have 40% higher cutting speeds than that used in the Davao City Project and use thin knives of the much harder steel-vanadium alloy. Thus, there was no need for stellite-tipping of the cutting tools, as was done in Davao City during the conduct of Project SI/PHI/83/801. Tantuco standard profiles for T&G and V-Cut boards were used. A total of 18.5 cu.m. of coco boards were converted to S4S boards, while another 22.1 cu.m. were profiled to T&G and V-Cut boards, to be used as materials for prefabricated housing components. Details on the surfaced and profiled products given in Table 3.8 include the following considerations.

i - all 50 x 125 mm S4S requirements for door and window jambs were replaced by 50 x 100 mm S4S coco boards ;

ii - deficiencies in 50 x 50 mm S4S, air-dried, "Hard" and "Medium" grade boards, were filled up from available stock of 50 x 75 mm coco boards, to be used as nailers and studdings ;

iii - an additional 5% to 10% of each item, based on total lengths required, were also surfaced and profiled to allow for dressing rejects and other defects.

(Note : Surfaced or profiled boards in excess of actual usage in the house construction activities will be used for the fabrication of furniture and furnishings.)

TABLE 3.8

SURFACING AND PROFILING OPERATIONS
COCO BOARD INPUTS FOR HOUSING COMPONENTS

Dressing Specifications	Lumber Grade	Board Cross-Section (mm.)	Total Length (m.)		Total Volume (cu.m.)	
S4S/AD	Hard	50 x 150	10.07		0.076	
S4S/AD	Hard	50 x 125	801.78		5.011	
S4S/AD	Hard	50 x 100	605.00		3.025	
S4S/AD	Hard	50 x 50	1,080.98		2.702	
S4S/AD	Hard	25 x 125	32.21		0.101	
S4S/AD	Hard	25 x 100	8.05		0.020	
S4S/AD	Medium	50 x 100	8.05		0.040	
S4S/AD	Medium	50 x 75	832.95		3.124	
S4S/AD	Medium	50 x 50	419.10		1.048	
S4S/AD	Medium	25 x 50	267.73		0.335	
	Sub-Totals	----------		4,065.92	---------	15.482
S4S/KD	Hard	50 x 125	40.46		0.253	
S4S/KD	Hard	50 x 100	283.54		1.418	
S4S/KD	Hard	50 x 75	268.40		1.007	
S4S/KD	Hard	50 x 50	88.57		0.221	
S4S/KD	Hard	25 x 100	57.71		0.144	
S4S/KD	Hard	25 x 75	64.42		0.121	
	Sub-Totals	----------		803.10	---------	3.164
T&G/KD	Hard	25 x 100	64.42		0.161	
T&G/KD	Hard	19 x 100	296.96		0.564	
T&G/KD	Medium	25 x 100	150.30		0.376	
	Sub-Totals	----------		511.68	---------	1.101
V-Cut/AD	Medium	25 x 100	189.22		0.473	
	Sub-Totals	----------		189.22	---------	0.473
V-Cut/KD	Hard	19 x 100	2,524.49		4.933	
V-Cut/KD	Medium	25 x 100	5,634.39		14.080	
V-Cut/KD	Medium	19 x 100	866.93		1.560	
	Sub-Totals	----------		9,025.81	---------	20.573
	GRAND TOTALS	----------		14,595.73	---------	40.793

3.4 ROOFING SHINGLES MANUFACTURING

3.41 Revised Production Technique

About 9,500 coco roofing shingles were re-sawn from 42 mm x 100 mm x 600 mm blanks. The band re-saw at the Tantuco mill in Sariaya, Quezon Province, was made available to the Project only in the afternoon of 1st June 1985. It was planned to cant re-saw the blanks and produce two 10/20 x 100 x 600 mm shingles out of each blank. However, the set screws controlling the first right feed roll was too short to push the feed roll far enough (with respect to the bandsaw blade) to get the desired taper angle (arctan 1/60).

Considering the time pressure and the request of the Project Director to keep fabrication costs as low as possible in view of the meager funds available, it was decided to re-saw the blanks into two equal parts at the Tantuco band re-saw. The required taper was obtained by passing one end of the shingle on a 200-mm manual jointer at the PEO shop in Pagbilao, Quezon Province. The tapering operation on the manual jointer was not accurate enough so that a 3-mm deviation on the thickness of each end of the shingle was deemed acceptable. The new shingles thickness thus allowed were : 9-12 mm on the thin end; and 17-20 mm on the thick end of each roofing shingle.

A few pieces of coco wood shingles were fabricated at the Tantuco mill to demonstrate the above-described fabrication technique. Further fabrication of coco wood shingles to complete the project's requirements was done after this expert's extended tour of duty ended on 31 May 1985. The following data on roofing shingles fabrication was furnished during the first Project Monitoring Visit to Lucena City, 5 August 1985, by the staff engineer in-charge of fabrication activities.

See Figures 36-38.

The production data thus obtained is given in Table 3.9 :

Figure 36

Resawing coco wood shingles on band resaw
with roller feed mechanism,
Tantuco Planing Mill, Sariaya, Quezon Province.

Figure 37

Adjusting feed roll pressure while resawing blanks
for coco roofing shingles.

Figure 38

Resawn blanks for coco roofing shingles coming out of the band resaw.

TABLE 3.9

OPERATIONS DATA - ROOFING SHINGLE FABRICATION

1. MANPOWER USED :

i - Trim Saw :

Machine Operator	-	1 man
Infeed Helper	-	1 man
Outfeed Helper	-	2 men

ii - Band Re-Saw :

Machine Operator	-	1 man
Infeed Helper	-	1 man
Outfeed Helper	-	2 men

iii - Hand Jointer :

Machine Operator	-	1 man
Helpers	-	2 men

2. MATERIALS INPUT :

42 x 100 x 600 mm - "Hard", "Medium" and "Soft" Grades

3. OPERATIONS OUTPUTS :

i - Trimming 42 mm x 100 mm boards to 600 mm lengths - 1,800 pieces per hour ;

ii - Re-sawing blanks into 19 mm x 100 mm x 600 mm shingles - 2,500 pieces per hour ; and

iii - Taper jointing - 120 pieces per hour.

3.42 Preservative Treatment - Coco Wood Roofing Shingles

The coco wood roofing shingles thus fabricated were then coated with a coal-tar-based material, which was not the same preservative treatment system as specified in the Erection Manual (DP/ID/SER.A/613) for the coco wood demonstration house. All the coco wood roofing shingles thus fabricated and paint-coated were rejected by the Project Designing Architect. (See Annex VI, Report on 2nd Project Monitoring Visit.)

3.5 FABRICATION OF BALUSTERS

Fabrication of 36 pieces of coco wood balusters from 75 mm x 75 mm x 740 mm coco wood blanks was sub-contracted to a small joinery shop in the town proper of Pagbilao, Quezon Province, after a sample baluster turned at the contractor's shop was approved by the UNIDO Expert.

The sub-contractor was furnished coco wood blanks for the balusters. The sub-contract value was ₱3,500.00 or approximately ₱97.20 per piece, as reported by the Project Director (see Annex IX). No data on actual labour usage was submitted by the Project Director.

3.6 PRESERVATIVE TREATMENT ACTIVITIES

The diffusion method of CCA preservative treatment for coconut lumber, as developed by the PCA - ZRC and adapted to field conditions during the conduct of the coconut wood demonstration house project in Davao City (SI/PHI/83/801), was used again in this Project. The method is shown in Figures 39-43, where coco lumber was boiled in plain water and then immediately immersed in cold 3% CCA solution according to the following schedule :

TABLE 3.10

SCHEDULE OF PRESERVATIVE TREATMENT, DIFFUSION METHOD

A. Soaking in Boiling Water :

Board Thickness	Soaking Time
12 mm boards	1 hour
25 mm boards	2 hours
50 or thicker boards	at least 4 hours

B. Soaking in Cold CCA Solution (3%) :

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

The specific gravity of the CCA solution was checked with a hydrometer after each batch of coco wood was taken out of the cold CCA

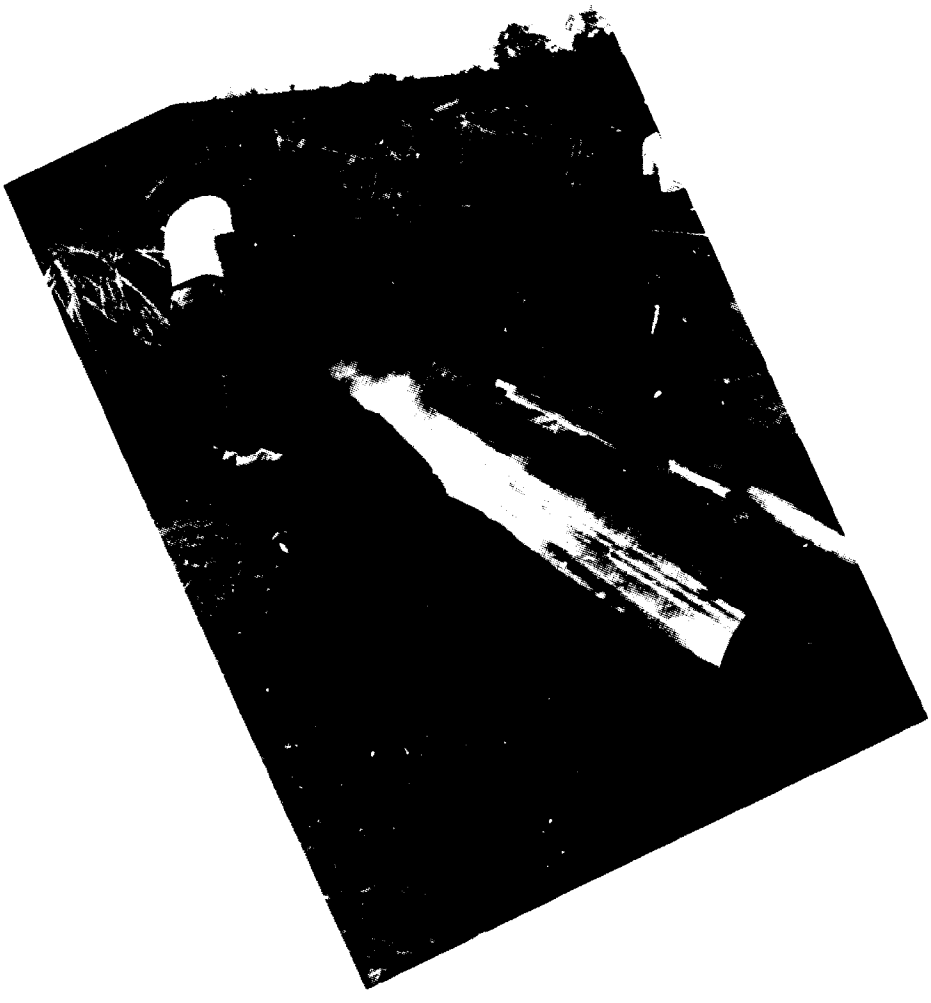


Figure 39

Boiling coco boards prior to preservative treatment,
Provincial Engineer's Officer,
Pagbilao, Quezon Province.

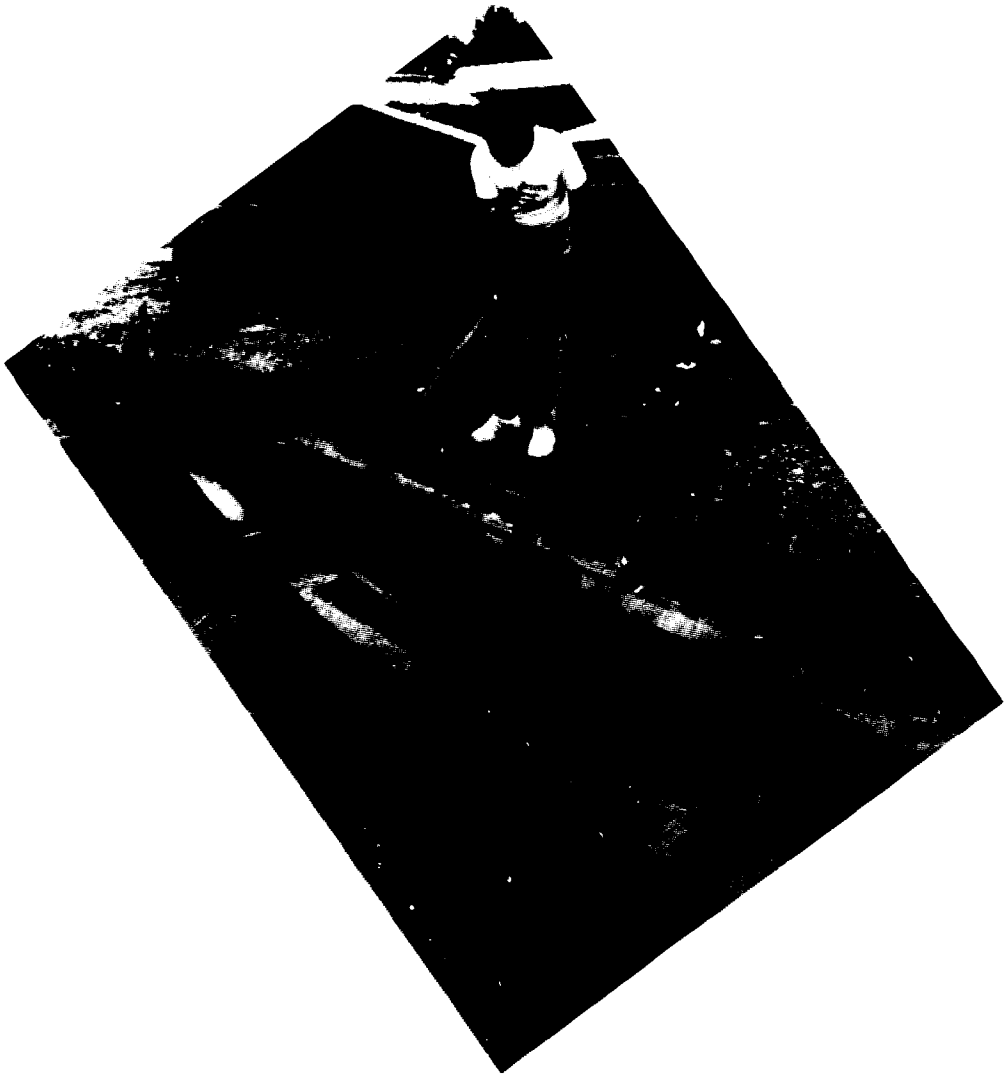


Figure 40

Removing scum while boiling coco boards
preparatory to CCA treatment.

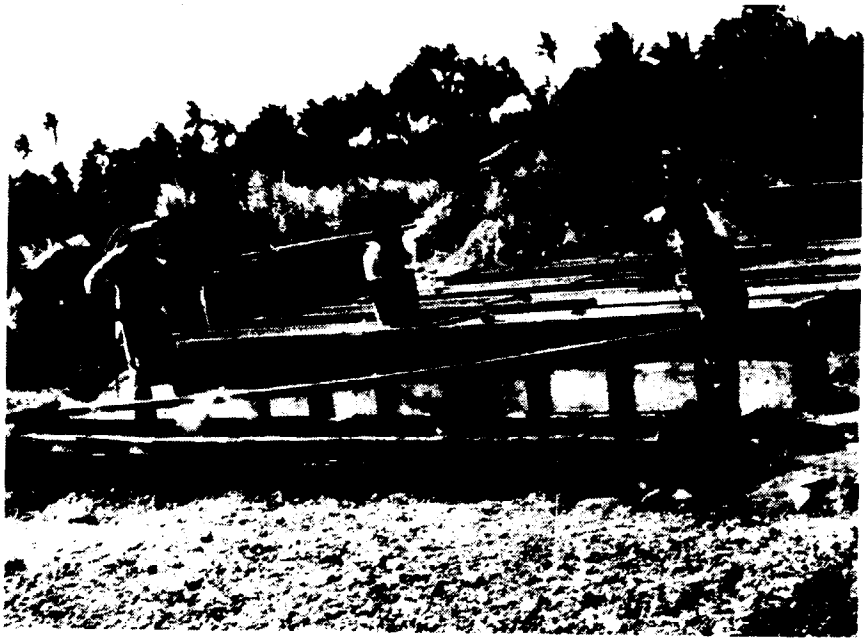


Figure 41

Hot coco boards are lifted out of improvised steel troughs after several hours of boiling.

Figure 42

Hot coco boards are immediately dipped in cold CCA solution.

Figure 43

Checking the strength of CCA solution
in between cold dipping operations
with the use of a hydrometer.

bath. Proper adjustments on the strength of the CCA solution were made, as indicated by the hydrometer reading.

The treated coco boards were then air-dried for at least 48 hours before they were used in the fabrication of housing components.

3.61 Labour and Materials Usage - Coco Wood Truss Members

Initial CCA treatment activities were conducted on coco boards (50 mm thick) to be used in the fabrication of coco wood trusses. 22 kgs. of CCA crystals were dissolved in 750 liters of plain water to obtain a 3% CCA solution. 171 pieces of 50 mm thick boards (with various widths and lengths), having an aggregate volume of approximately 3.88 cu.m. were treated with CCA in accordance to the schedule discussed in the preceding paragraph. The results of the operation are as follows :

Labour Usage	441 man-hours
3% CCA Solution Used	185 liters
Volume of Coco Wood Treated	3.88 cu.m.
Depth of CCA penetration on lateral faces of coco boards	3.00 mm

3.62 Other CCA Treated Housing Components

In view of the long delay in the implementation of the Project, only the truss components were CCA treated during the extended tour of duty of the UNIDO expert, which ended on 31 May 1985.

Data submitted by the Project Director (see Annex IX) on the CCA treatment of housing components were erroneous and not acceptable (see Annex X).

3.7 PREFABRICATION ACTIVITIES

3.71 Coco Wood Trusses

A total of 13 units of coco wood trusses were fabricated using CCA treated coco lumber. Five units of trusses were of the "nail-on-plate" type, while the rest were all of the conventional bolted truss type. Truss components were cut to the desired sizes with the use of hand saws and a locally fabricated table

saw with a 10-inch diameter circular sawblade. Bolt holes were bored with a heavy duty (1-inch chuck capacity) portable electric drill, while pilot holes for nails were drilled with a smaller (1/2-inch chuck capacity) portable electric drill. (See Figures 44 to 47.)

The following labour usage data were obtained :

For Bolted Type Trusses ----------	320 man-hours
For "Nail-On-Plate" Trusses ----------	80 man-hours
Supervision ----------	64 man-hours

3.72 Roofing Sections

i - Frameworks for Roofing Shingles

The 16 units of frameworks for the installation of roofing shingles were completed during the week ending 24 May 1985. (See Figures 48 to 52.) However, there were seven (7) frame units which were rejected and should be repaired before installation of roofing shingles. The coco board members of the frames were cracked or split in the areas where nails were driven to join purlins to the braces without pre-drilling proper pilot holes. The recommended repair work on the seven (7) frame units has not yet been implemented as of the Second Project Monitoring Visit on 8-9 November 1985.

The resulting labour usage data on this aspect of the Project are as follows :

Total Labour Usage ----------	320 man-hours
Supervision ----------	64 man-hours
Unit Labour Usage ----------	1.75 man-hours/ sq.m. of roofing

ii - Installation of Roofing Shingles

All of the project's requirement of coco wood roofing shingles were rejected by the Project Designing Architect during the Second Project Monitoring Visit,

Figure 44

Checking location of G.I. plate on bottom chord of "nail-on-plate" coco wood truss.

Figure 45

Drilling pilot holes for nails on rafter of "nail-on-plate" coco wood truss.

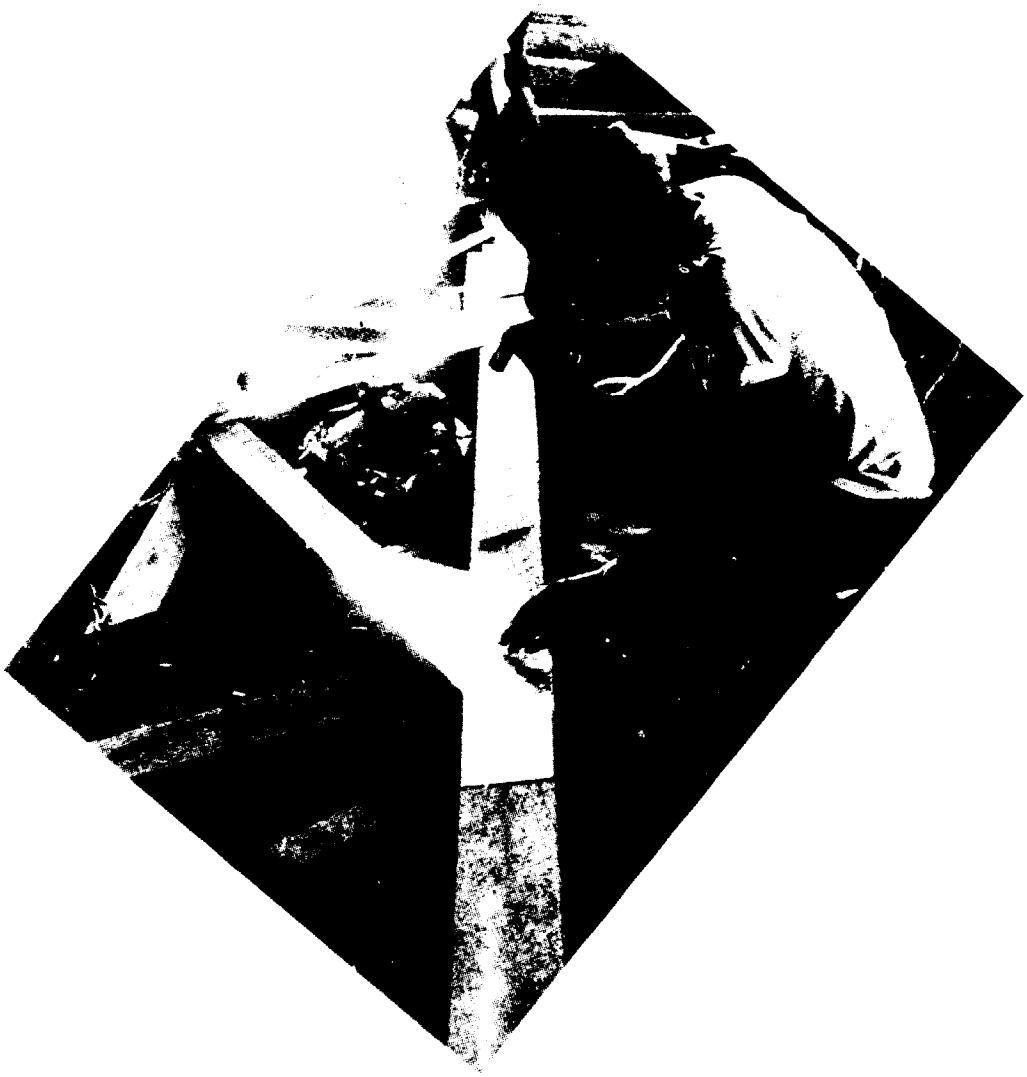


Figure 46

Driving nails into pre-drilled pilot holes
during assembling operations of
"nail-on-plate" coco wood trusses.

Figure 47

Coco wood trusses ready for transport to construction site.

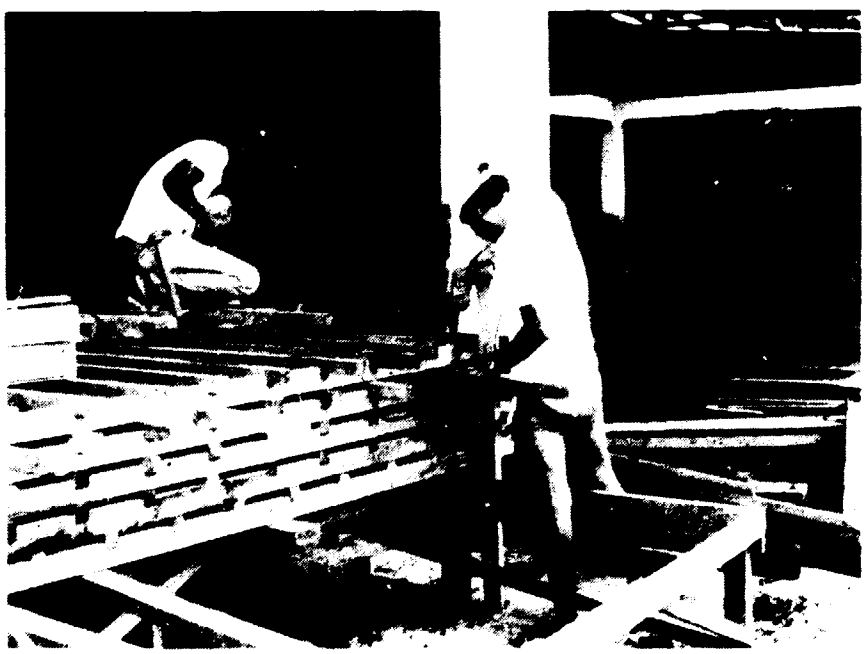


Figure 48

Drilling pilot holes preparatory to driving nails on coco wood framings for shingles roofing sub-assemblies.

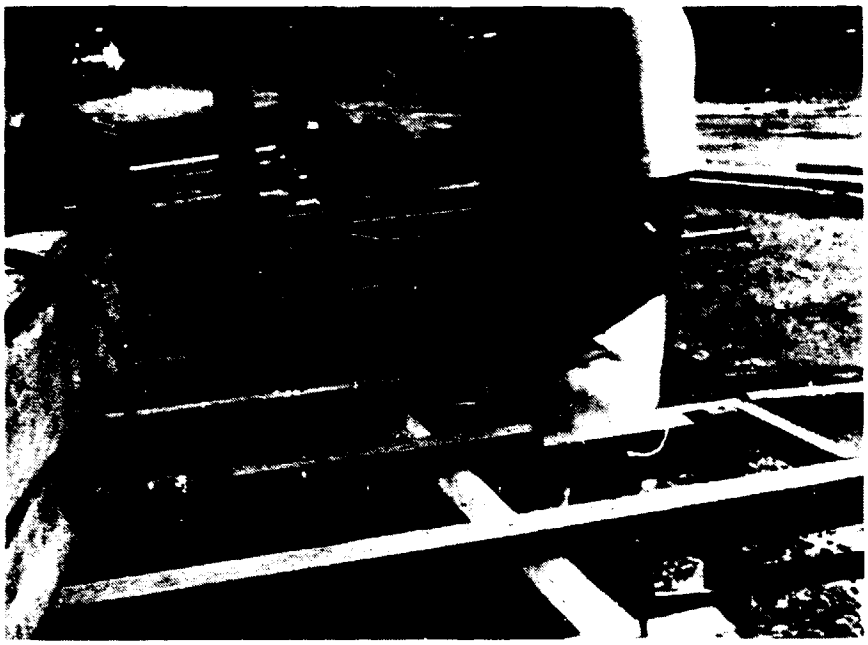


Figure 49

Driving nails through pre-drilled pilot holes
to fix purlins on braces of shingles roofing sub-assembly.

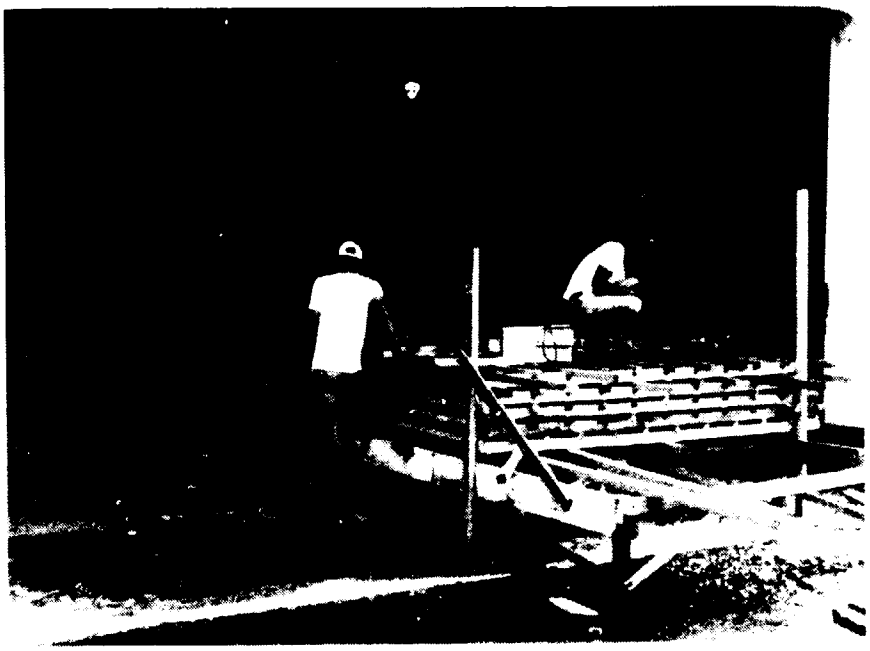


Figure 50

Trimming purlin ends on framework
for shingles roofing sub-assemblies.

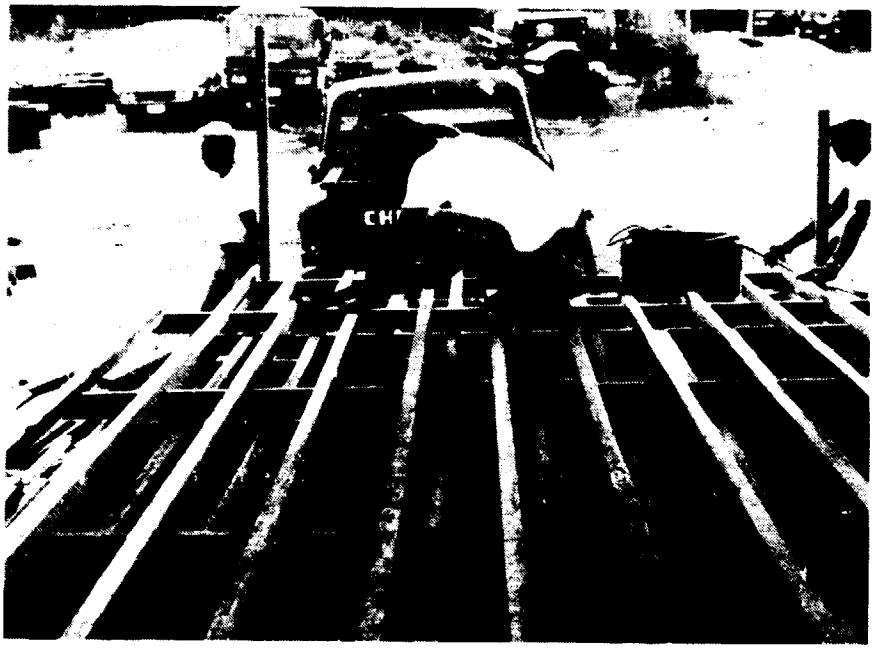


Figure 51

Handsawing purlin ends to proper length.

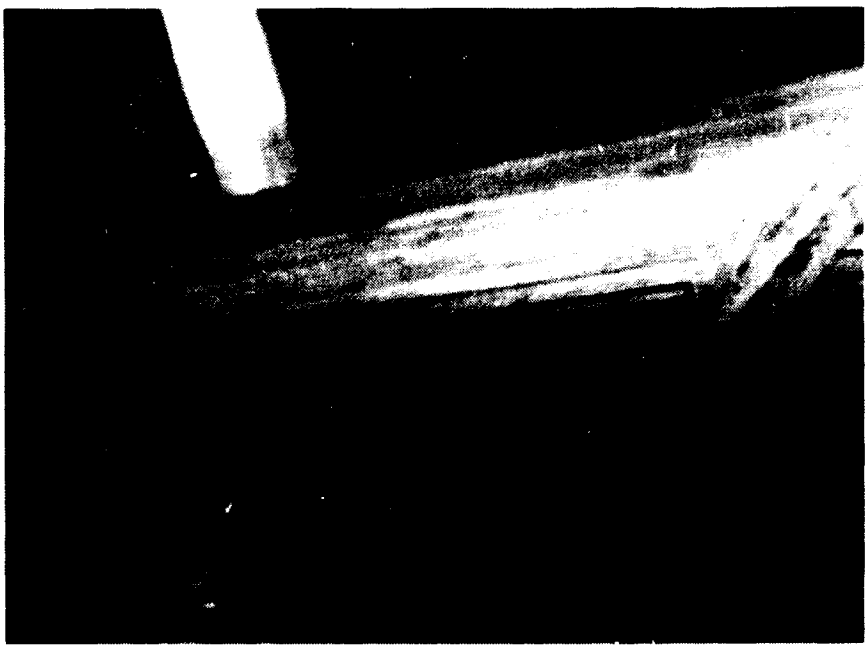


Figure 52

Completed frameworks of coco lumber ready for coco shingles assembling.

because the preservative material used ("Weathercote", a tar-based product sold by Shell Chemical Co.) was not the specified material (CCA). (See Annex VI.)

3.73 Ridge Roll and Eaves Flushing

A total of 20 meters of ridge roll and 35 meters of eaves flushing were fabricated from 48 pieces of 125 mm x 125 mm x RL coco wood blanks. Initial machining operations were set up to obtain the desired profiles of the roofing components. In the beginning this was done on a table-type circular saw (see Figures 53 and 54). However, it was realized that this was a slow process, and was abandoned in favor of a chainsaw (see Figures 55 and 56) inasmuch as the accuracy requirements were also obtained by the latter process and at a much faster rate. The joints were then shaped (manually by saw, chisel and hammer) to form open mortise and tenon joints, which will facilitate installation activities and provide better anchorage and alignment of the components on the roof (see Annex VII).

The results obtained from this aspect of the Project are as follows :

T A B L E 3.11

OPERATIONS DATA - FABRICATION OF RIDGE ROLL AND EAVES FLUSHING

A. Machining Profile by Table Saw :

Number of Men	3	
Output	2.5	meters/man-hour

B. Machining Profile by Chainsaw :

Number of Men	2	
Output	7.5	meters/man-hour

C. Hand Shaping End Joints :

Number of Men	2	
Output	2	sets of joints/ man-hour

D. Labour Usage :

Machining Profile	6.67 man-hours
Hand Shaping End Joints	24.00 man-hours
Total Labour Usage	30.67 man-hours

Figure 53

Fabricating coco eaves flushing on
locally-made table saw.

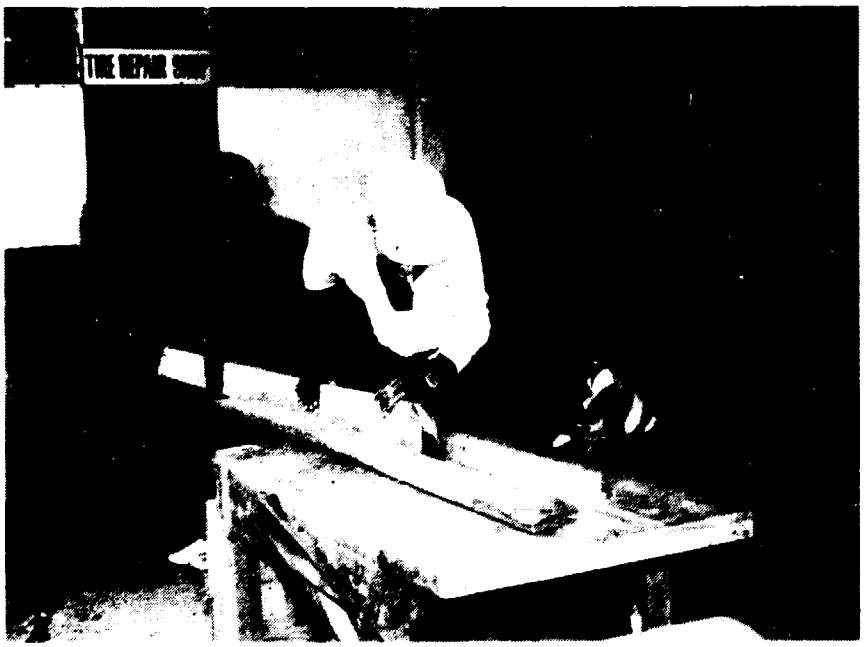


Figure 54

Fabricating coco ridge rolls on
locally fabricated table saw.

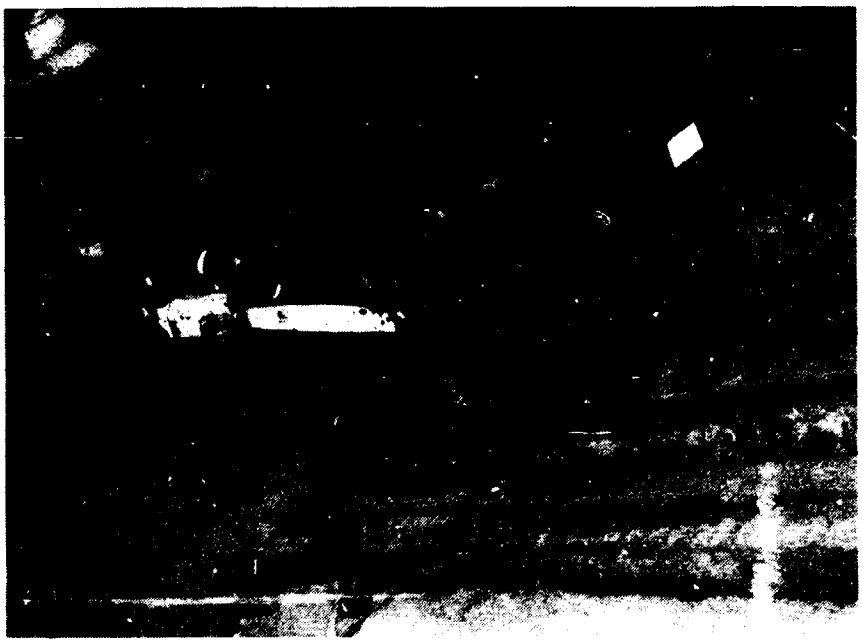


Figure 55

Cutting coco eaves flushing with 60 mm chainsaw.

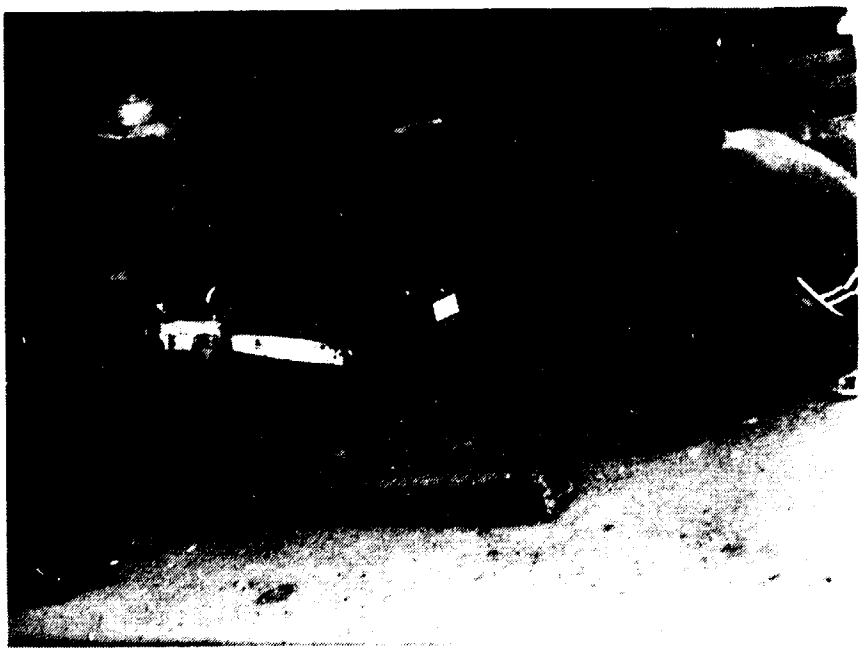


Figure 56

Cutting coco ridge rolls with 60 mm chainsaw.

These roofing components are specified to be CCA treated. However, these have not yet been CCA treated as of the Second Project Monitoring Visit, 8-9 November 1985.

3.74 Other Prefabricated Housing Components

Doors and door jambs, windows and window-jambs, sidings, partitions, and stairs and balcony sub-assemblies have not yet been prefabricated as of 31 May 1985, the last day of the UNIDO expert's extended tour of duty with the Project.

It became very evident during the Second Project Monitoring visit (see Figures 76-87) that these sub-assemblies were not prefabricated according to the Project's Erection Manual.

IV. COCO LUMBER UNIT COSTS

This chapter was intended to develop unit costs of coco lumber in the various forms and at the different stages the coco stem undergoes during its conversion to housing components. The format to be followed is roughly similar to that used in the Davao City Project Report (DP/ID/SER.B/484, 13 December 1984), with a view to evolving data which are comparable.

However, calculations for unit costs of coco wood items used in this Project could not be made because the cost data as submitted by the Project Director (see Annext IX) were considered unreliable and not acceptable (see Annex X).

V. THE DEMONSTRATION PREFABRICATED COCO WOOD HOUSE

Construction activities started with site preparation, formworks lay-out and excavations on 21 January 1985, and proceeded sporadically as funding and material supply availability permitted. This condition persisted until the end of the UNIDO Consultant's tour of duty with the Project on 31 May 1985, and is easily seen in the intermittent progress of construction work shown in Figures 57 to 73. As of 31 May 1985, only one truss unit had been installed. Sixty-five days later, during the First Project Monitoring Visit, (see Annex V), there was no construction activity at all. However, all coco wood trusses have been erected and floor joists have been installed only on the bedroom areas of both wings of the demonstration house (see Figures 74 and 75). Limited carpentry activities were found at the prefabrication shop in the Provincial Engineer's Office, Pagbilao, Quezon Province (see Annex V). Another 63 days later, during the Second Project Monitoring Visit, (see Annex VI), the demonstration house was still unfinished as shown in Figures 76 to 87, in spite of the assurance given by the Project Director to the UNDP Monitoring team that the demonstration house will be completed within sixty (60) days from the first visit.

The UNDP team saw no prefabrication activities at all. The sidings and partitions were apparently installed en situ, by the conventional measure-cut-and-nail method. At this point therefore, the major objective of the Project, which is to point out potential advantages of prefabrication in low-cost coco wood housing construction, appears to have been ignored by the Project implementors.

A Third Monitoring Visit was conducted on 4 April 1986 by a team composed of: Messrs. G. L. Narashiman, E. Bos, G. Sta. Maria, C. Caliwara and H. P. Brion, (see Annex VIII). The demonstration house was found to be incomplete yet, see Figures 88 to 96. Some errors in construction were pointed out by the Project Designing Architect, which the Project Director promised to correct later.

Labour usage and cost data on this aspect of the Project as submitted by the Project Director (see Annex IX) were considered unreliable and not acceptable (see Annex X).

Figure 57

21 January 1985
Site lay-out and excavations
for concrete footings started.

Figure 58

30 January 1985
Excavations completed.

Figure 59

31 January 1985
Formworks and scaffoldings erection started.

Figure 60

9 February 1985
Concrete stilts completed.

Figure 61

11 February 1985
Erection of wooden posts started.

Figure 62

14 February 1985
Erection of wooden posts completed.

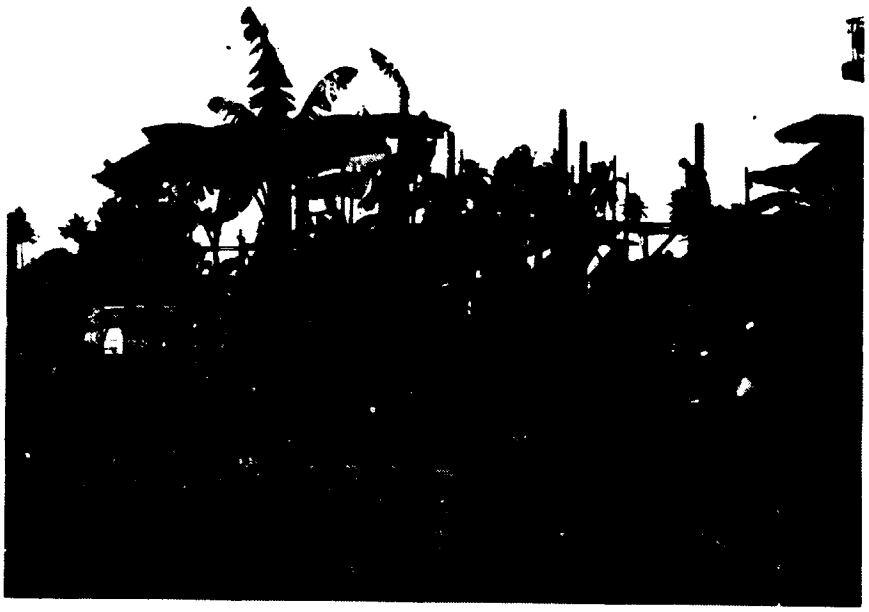


Figure 63

15 February 1985
Installation of floor girts started.

Figure 64

16 February 1985
Installation of roof girts started.

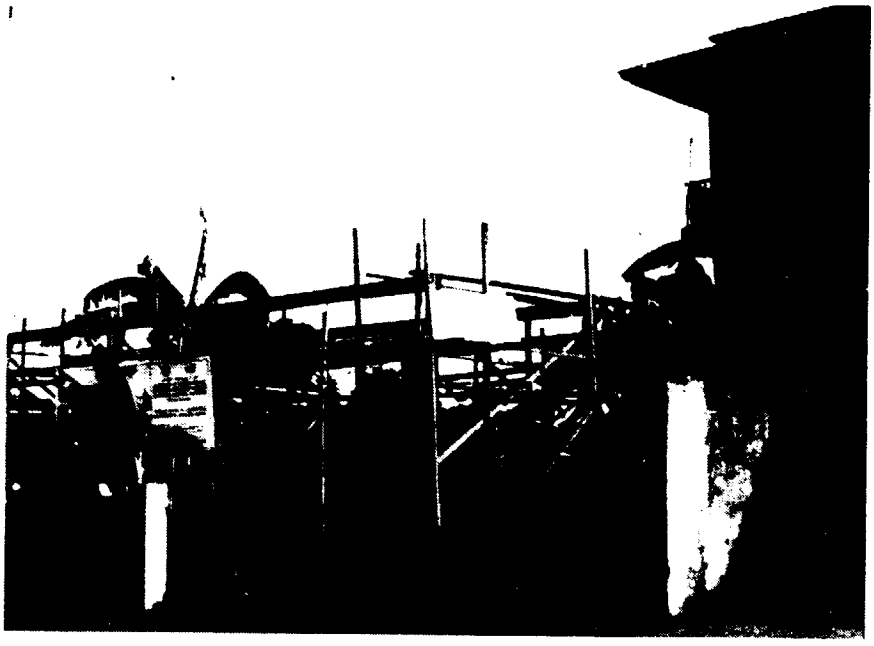


Figure 65

19 April 1985
Structural frameworks
ready to receive coco wood trusses.

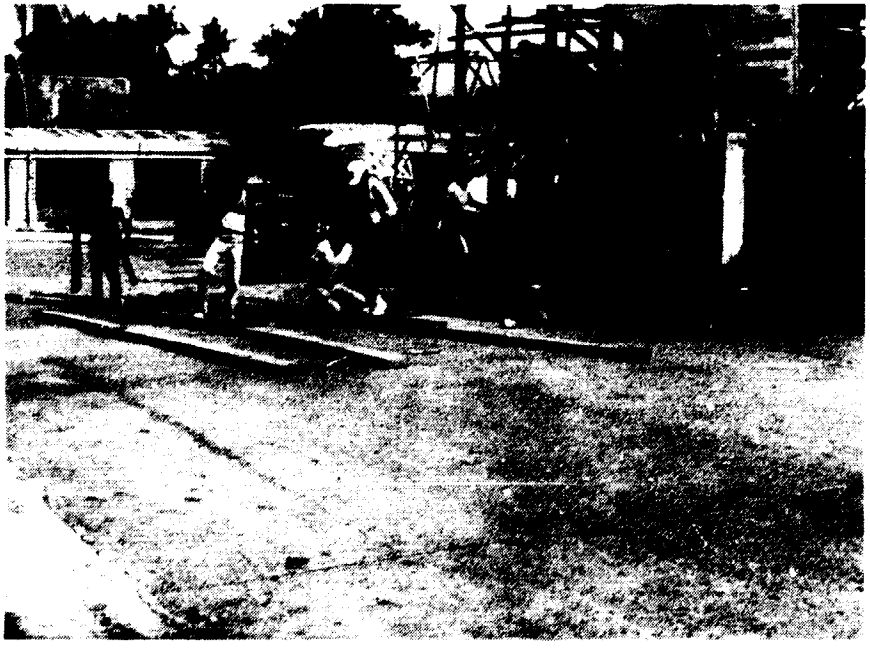


Figure 66

23 May 1985
Preparing wooden ramps to be used in lifting
wooden trusses on top of roof girts.

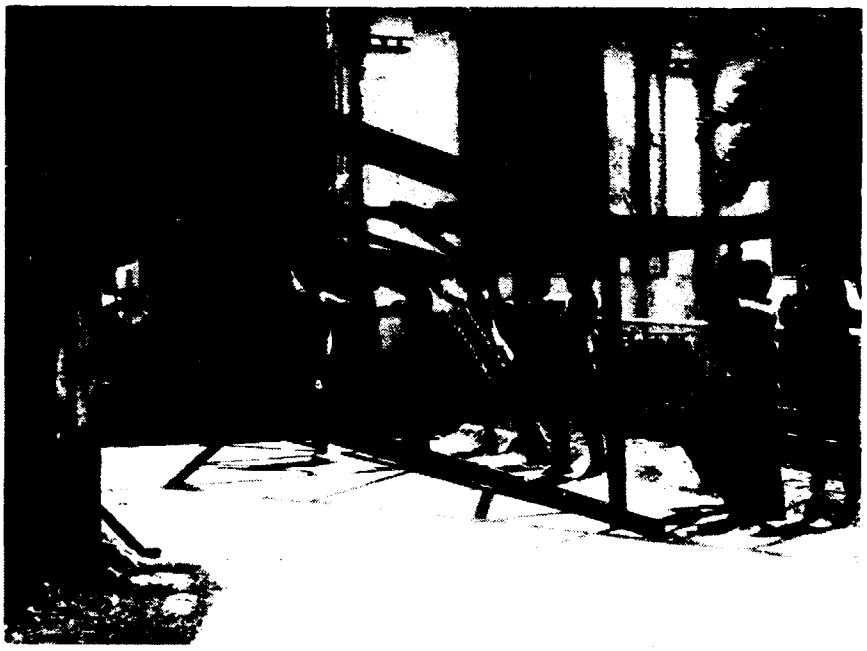


Figure 67

24 May 1985
The first coco wood truss, bolted type,
is raised to the wooden ramp.

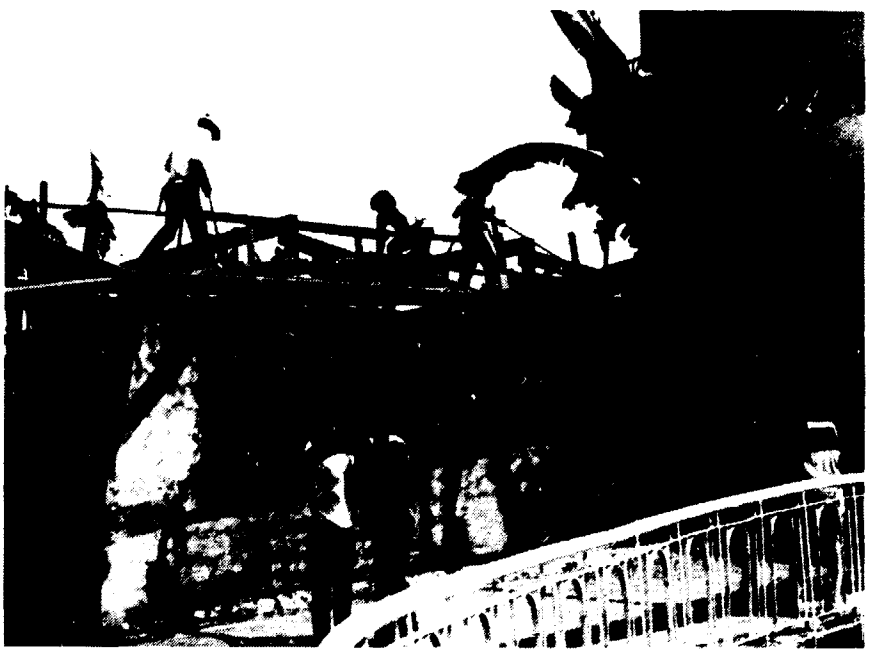


Figure 68

The first coco wood truss is on its way to the
top of the structural frameworks.

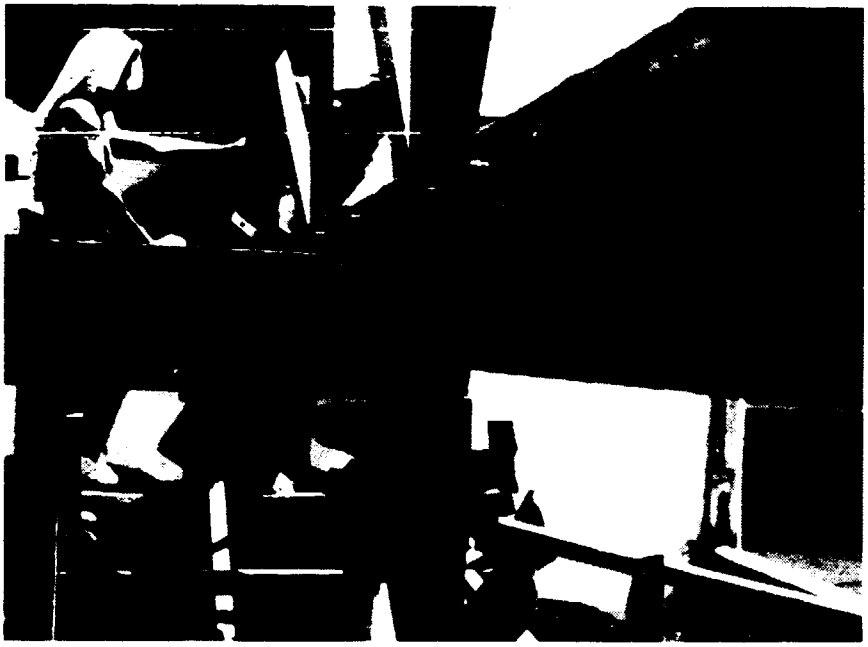


Figure 69

The first coco wood truss erected in its proper location.

Figure 70

The first coco wood truss is fixed to the roof girts with carriage bolts and mild steel plates.

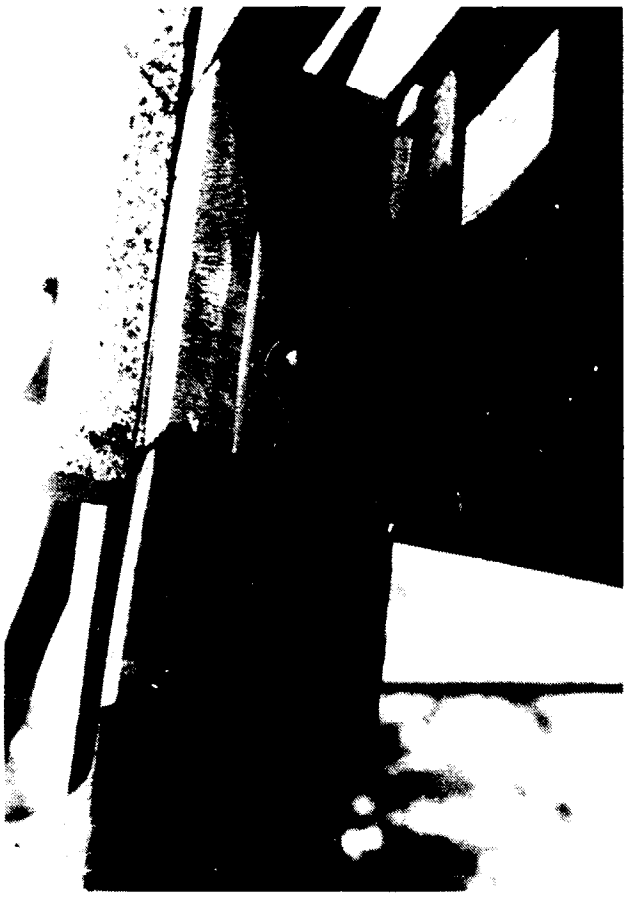


Figure 71

Bolted joints on north-east corner post showing location of coco wood truss bottom chord.

Figure 72

Coco wood truss is anchored to roof girt with twisted steel straps.

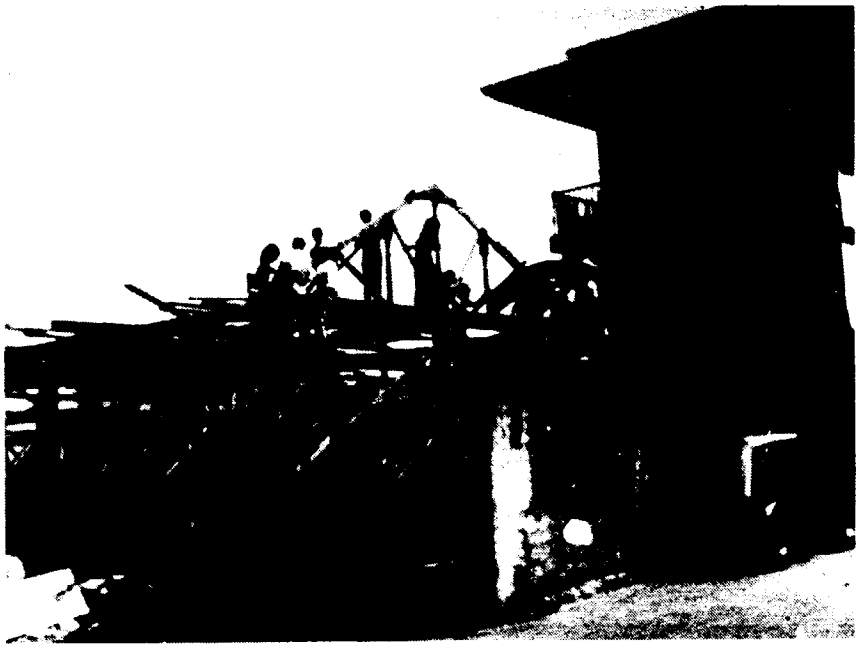


Figure 73

Tightening bolts to fix the first coco wood truss
in its proper place,
24 May 1985.

FIRST PROJECT MONITORING VISIT
5 August 1985

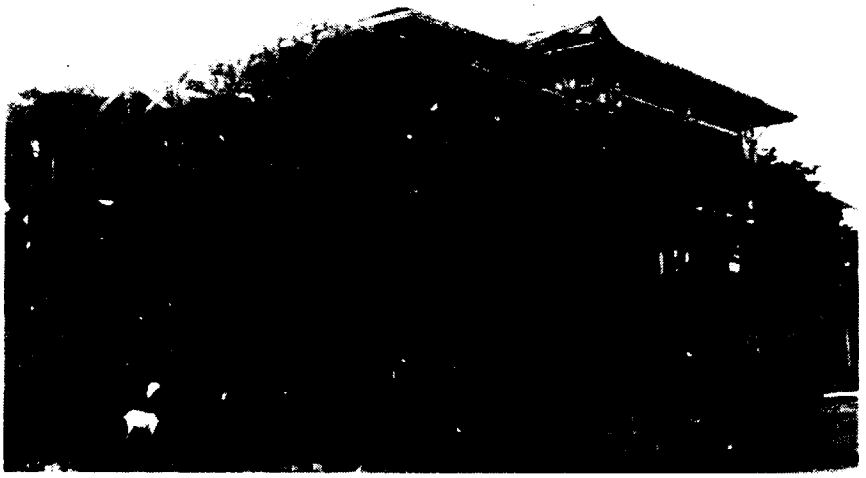


Figure 74

All coco wood trusses
installed in place.

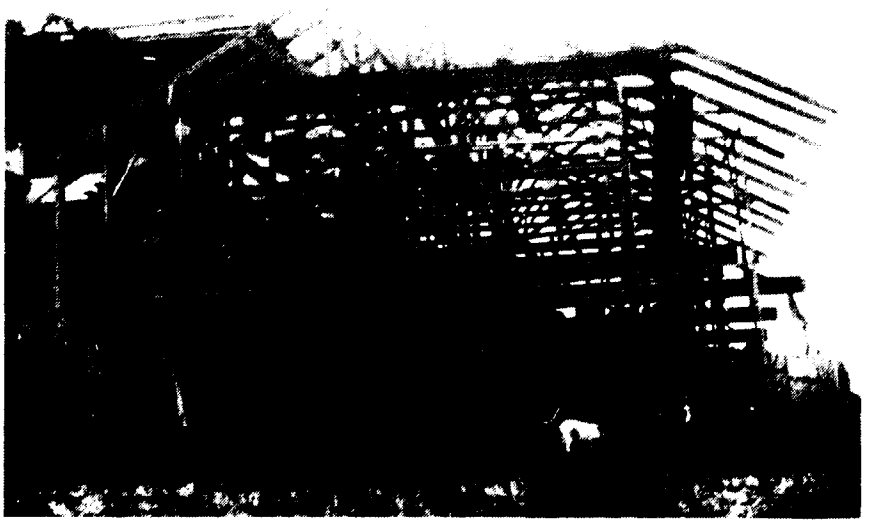


Figure 75

Floor joists already installed on
bedroom areas of both wings of the
demonstration house, but not on the
living, dining and balcony areas.

SECOND PROJECT MONITORING VISIT
8 November 1985

Figure 76

Exterior sidings installed *en situ*. Note temporary roofing to protect floor and interior walls from weather elements.

Figure 77

View of southwest portion of coco wood demonstration house.

SECOND PROJECT MONITORING VISIT
8 November 1985

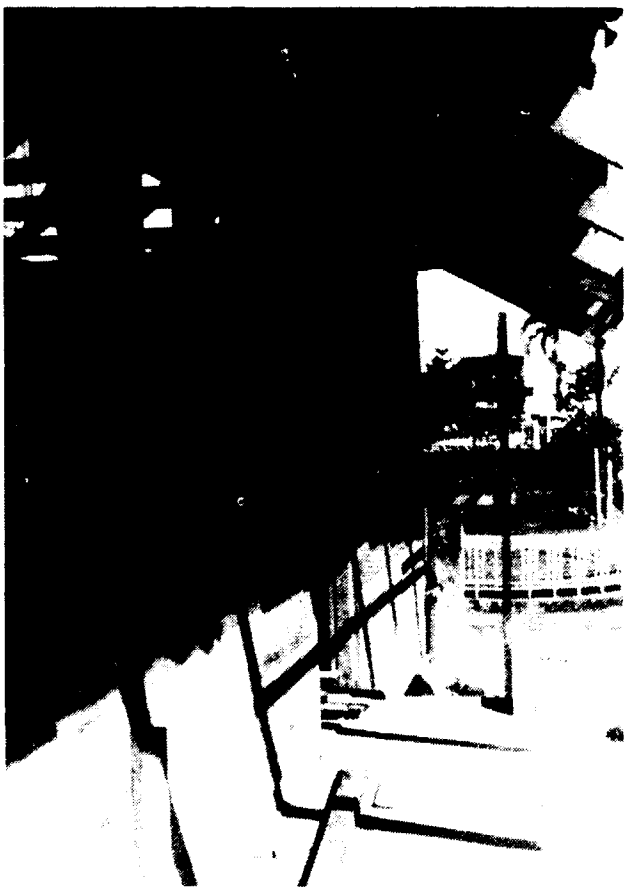


Figure 78

View of balcony area looking eastward.

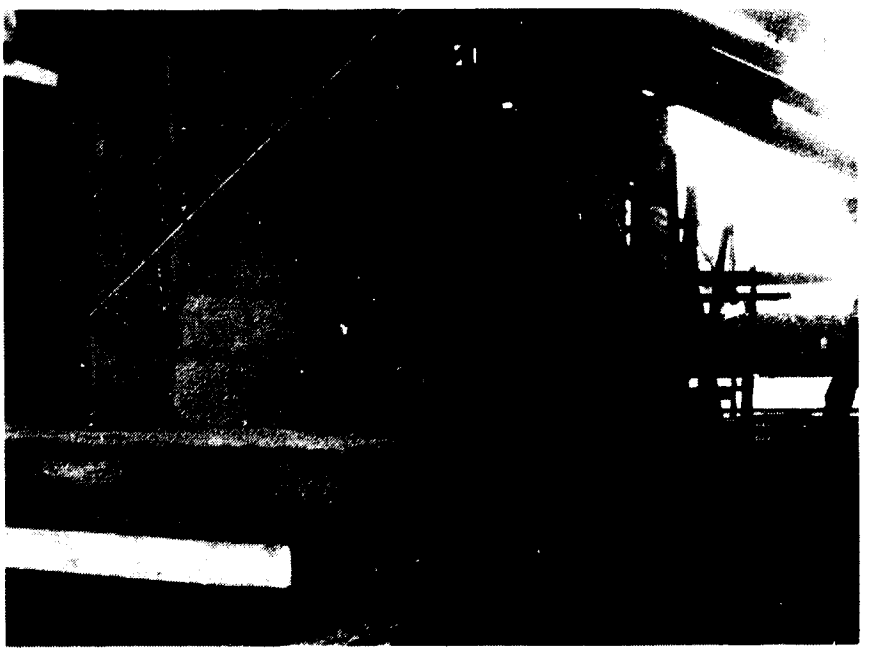


Figure 79

View of back stairs area, looking westward.

SECOND PROJECT MONITORING VISIT
8 November 1985

Figure 80

View of "nail-on-plate" coco wood trusses above living-dining area.

Figure 81

Vertical and horizontal studs of partition wall between living and bedroom (northwest) areas, with door jamb assembly installed *en situ*.

SECOND PROJECT MONITORING VISIT
8 November 1985

Figure 82

Southeast corner of east wing with interior walls already installed in place. Note door jamb assembly located preparatory to installation of interior partition walls.

Figure 83

Northeast corner of east wing with exterior sidings already installed on north wall and interior sidings already installed on east wall.

SECOND PROJECT MONITORING VISIT
8 November 1985

Figure 84

View of northwest corner of west wing with exterior sidings already installed in place and installation of interior sidings in progress.

ıre 85

View of southwest corner of west wing, with interior sidings already installed on south wall, while west wall is ready for installation of interior sidings.

SECOND PROJECT MONITORING VISIT
8 November 1985

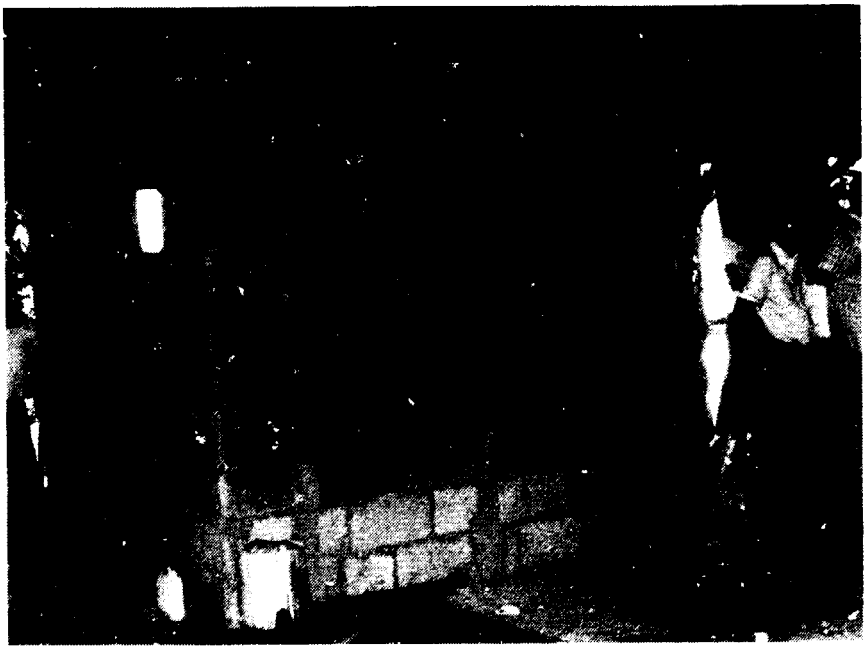
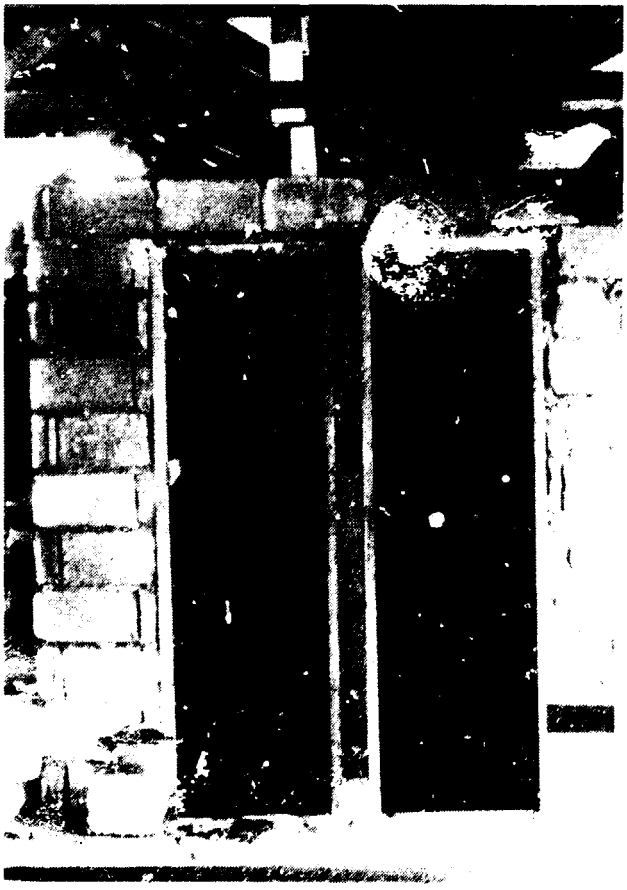


Figure 86

CHB (Concrete-Hollow-Block) walls enclosing the Toilet and Bath area ready for plastering.

Figure 87

Coco wood door jambs installed on entries to Toilet and Bath area of east wing of coco wood demonstration house.



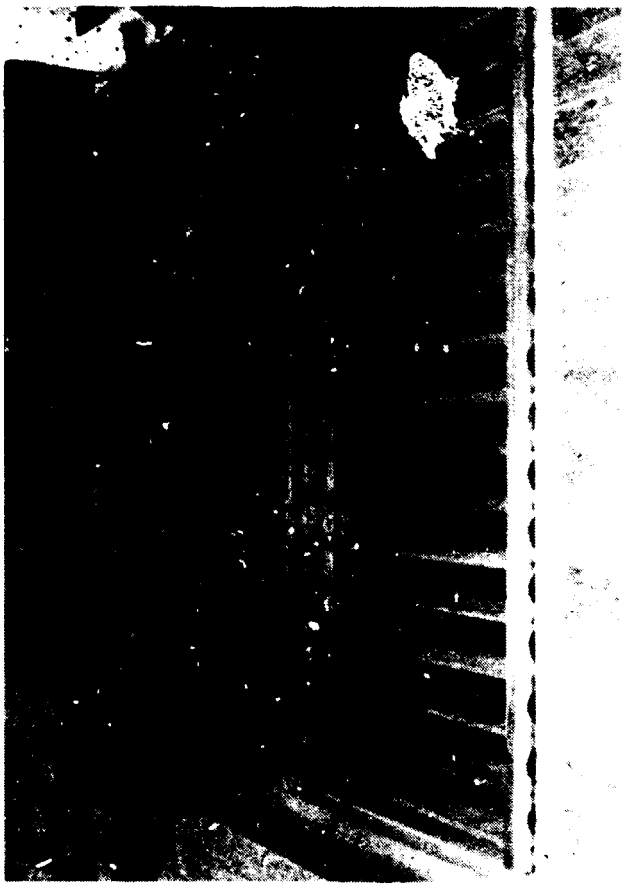


Figure 88

Coco wood louvre windows facing the balcony.

THIRD MONITORING VISIT
4 April 1986

Figure 89

View of west end of coco house.

Figure 90

Nail-on-Plate trusses above the
living-dining room area

Figure 91

Coco wood kitchen sink cabinet

Figure 92

Dining area, east wing of coco wood house. (Note trusses for canopy on the floor.

Figure 93

Northeast corner of east wing bedroom.

Figure 94

View of west wing of
coco wood demonstration house.

Figure 95

Southwest view of the
coco wood demonstration house.

Figure 96

The COCO WOOD DEMONSTRATION HOUSE
viewed from the southeast corner

VI. THE ECONOMICS OF PREFABRICATION IN LOW-COST COCO WOOD HOUSING CONSTRUCTION

Inasmuch as the data submitted by the Project Director (see Annex IX) were deemed unreliable and not acceptable (see Annex X), an economic analysis of the results of this Project is not possible.

VII. COMPARATIVE ANALYSIS - DAVAO CITY AND QUEZON PROVINCE COCO HOUSE PROJECTS

The results of the Davao City coco house project (SI/PHI/83/801) in comparison with those obtained during the conduct of the Quezon Province coco house project (SI/PHI/84/801) are presented in the following paragraphs.

7.1 COCO LOGS INPUT

7.11 Coco Stems Sources

Coconut stems sources in both the Davao City and Quezon Province projects have a number of things in common, to wit :

i - both are in wet tropical areas of the Philippines ;

ii - both are within 10 kilometers from the sea ;

iii - both have soil of volcanic origin, the Quezon source being on the foothills of Mt. Banahaw, an extinct volcano, while the two Davao sources are within 15 kilometers from the slopes of Mt. Apo, an active volcano ; and

iv - coconut trees cut in both projects were 50 years or older.

However, Quezon Province is lashed by typhoons (hurricanes) annually while the Davao source is not visited by any typhoon at all. It was postulated that exposure to strong winds (above 100 kph) and heavy rains could cause a significant difference between the cross-sectional structure and physical properties of the coco log bolts produced under the two projects. The following paragraphs seek to bring out the differences, if any exist.

7.12 Log Bolt Diameters and Thicknesses of Grade Rings

For purposes of this sub-study, an analysis of the cross-sectional structure of the coco log bolts input of both projects

was carried out using the average dimensions of butt (1st) logs and 2nd log bolts with lengths (4500 mm, 5000 mm and 6000 mm) common to both the Davao and Quezon projects. The average diameters were calculated for each group of log lengths and the grade ring thicknesses were computed on the basis of the corresponding lumber grade distribution obtained for each project. The results are enumerated and discussed in the paragraphs and tabulations that follow.

Table 7.1 shows the quantities and volumes of log bolts for each selected length group used in this sub-study. For the Davao project, the butt and 2nd log bolts account for 83% of the total number and about 80% of the total volume of log bolts milled. Correspondingly, the butt and 2nd log bolts milled during the conduct of the Quezon project account for 73% of the total number of log bolts milled, with an aggregate volume of 78% of the total volume of log bolts. Thus, the use of corresponding output lumber grade distributions in the calculation of grade ring thicknesses is justified.

T A B L E 7.1

QUANTITY AND VOLUME OF LOG BOLTS WITH SELECTED LENGTHS

Log Bolt Type	Log Bolt Length	Number and Total Volume of Log Bolts Cut			
		Davao Project		Quezon Project	
		Quantity	Volume	Quantity	Volume
Butt Logs	4500 mm	22 pcs.	6.969 cu.m.	40 pcs.	10.332 cu.m.
Butt Logs	5000 mm	64 pcs.	22.322 cu.m.	143 pcs.	44.492 cu.m.
Butt Logs	6000 mm	134 pcs.	62.363 cu.m.	24 pcs.	8.443 cu.m.
Totals	----------	220 pcs.	91.654 cu.m.	207 pcs.	63.267 cu.m.
2nd Logs	4500 mm	24 pcs.	5.575 cu.m.	42 pcs.	7.785 cu.m.
2nd Logs	5000 mm	54 pcs.	14.386 cu.m.	112 pcs.	23.726 cu.m.
2nd Logs	6000 mm	117 pcs.	33.646 cu.m.	7 pcs.	1.698 cu.m.
Totals	----------	195 pcs.	53.607 cu.m.	161 pcs.	32.809 cu.m.

Table 7.2 shows the calculated average diameters and grade ring thicknesses for each log bolt type and length group. The general

pattern is for Davao coco logs to have diameters larger than Quezon coco logs. The difference in diameters ranged from 17 mm to 41 mm for coco butt logs and 21 mm to 28 mm for 2nd coco log bolts. Commensurately, the thicknesses of grade rings in Davao coco logs are larger than the corresponding thicknesses in Quezon coco logs.

TABLE 7.2

AVERAGE DIAMETERS AND GRADE RING THICKNESSES
(millimeters)

Log Bolt Type	Log Bolt Length	Davao Project				Quezon Project			
		Ave. Dia.	Thickness of "Hard" Ring	Thickness of "Medium" Ring	"Soft" Zone Dia.	Ave. Dia.	Thickness of "Hard" Ring	Thickness of "Medium" Ring	"Soft" Zone Dia.
Butt Logs	4500 mm	299	64	25	119	270	54	28	103
Butt Logs	5000 mm	298	63	25	119	281	56	29	107
Butt Logs	6000 mm	314	67	26	125	273	54	29	104
2nd Logs	4500 mm	256	55	21	102	229	45	24	87
2nd Logs	5000 mm	260	55	22	104	232	46	24	89
2nd Logs	6000 mm	247	52	21	98	226	45	23	87

A further analysis, Table 7.3 based on the ratio of each grade ring thickness to the corresponding average diameter in each log length group, showed a marked consistency in the grade ring thickness distribtuion for all lengths of both butt and 2nd coco log bolts. The general grade ring thickness distribution, in % of the average log bolt diameter, is summarized as follows :

i - For Davao Coco Logs :

"Hard" - 42% - 43% of log bolt average diameter
"Medium" - 16% - 17% of log bolt average diameter
"Soft" - 40% - 41% of log bolt average diameter

ii - For Quezon Coco Logs :

"Hard" - 39% - 40% of log bolt average diameter
"Medium" - 21% of log bolt average diameter
"Soft" - 39% - 40% of log bolt average diameter

In general, it may be summarized that coconut stems coming from typhoon-visited areas tend to have smaller diameters and thinner grade ring thicknesses than those coming from typhoon-free are s. However, specific studies are still required to determine any differences in the strength properties of the coco log bolts.

T A B L E 7.3

GRADE RINGS THICKNESS,
% OF AVERAGE DIAMETERS OF EACH LOG LENGTH GROUP

Log Bolt Type	Log Bolt Length	Davao Project			Quezon Project		
		"Hard"	"Medium"	"Soft"	"Hard"	"Medium"	"Soft"
Butt Logs	4500 mm	42%	17%	41%	40%	21%	39%
Butt Logs	5000 mm	42%	17%	41%	40%	21%	39%
Butt Logs	6000 mm	43%	17%	40%	40%	21%	39%
2nd Logs	4500 mm	43%	16%	41%	39%	21%	40%
2nd Logs	5000 mm	42%	17%	41%	40%	21%	39%
2nd Logs	6000 mm	42%	17%	41%	40%	21%	39%

7.2 SAWMILLING OPERATIONS

Sawmilling operations in the two projects, although having used basically the same sawmilling pattern, are not directly comparable, in view of the following reasons :

i - the Bill of Materials for the Davao project specified for a significantly larger quantity of thick and wide boards (50 mm x 150 mm and 50 mm x 125 mm) than the Quezon project ; and

ii - the sawmilling facilities used in the Quezon project was much less sophisticated than that used during the conduct of the Davao project.

The salient features of the results of sawmilling operations under the two projects are given below :

T A B L E 7.4

COMPARATIVE RESULTS - SAWMILLING OPERATIONS

	Davao Project	Quezon Project
Coco Log Input :		
Number of Log Bolts Milled	498 pieces	506 pieces
Total Input Volume	180.789 cu.m.	122.720 cu.m.
Coco Lumber Output :		
Total Volume of Output	91.414 cu.m.	66.534 cu.m.
% Volume of "Hard" Boards	67.29 %	64.15 %
% Volume of "Medium" Boards	16.74 %	21.13 %
% Volume of "Soft" Boards	15.97 %	14.72 %
Lumber Yield Rate	50.56 %	54.21 %
Productivity Level	0.0858 cu.m./ man-hour	0.03208 cu.. / man-hour

The higher lumber yield rate in the Quezon project could be attributed principally to the concept used in the coco house design to optimize material utilization by specifying truss-type roof framing design and standard lumber sizes, allowing better optimization of lumber recovery from each coco log bolt.

7.3 KILN-DRYING OPERATIONS

In spite of the varied mixture of lumber species in both kiln charges dried during the conduct of the Quezon project, the basic kiln-drying schedules for thin and thick coco lumber used in the Davao project were found to be still effective in kiln-drying coco lumber. The kiln-drying operations conducted under the Quezon project, however, confirmed the findings under the Davao project, that coco boards can be dried in a kiln charge mixed with other hardwood species, provided kiln temperatures do not exceed the maximum temperature (71°C or 160°F) allowed when drying coco lumber.

7.4 OTHER PROJECT ASPECTS

Comparative cost analysis between the Quezon Province and Davao City coco wood demonstration house projects is made impossible because the cost data as submitted by the Project Director (see Annex IX) were deemed unreliable and not acceptable (see Annex X).

VIII. DISSEMINATION OF INFORMATION ON PROCESSING AND UTILIZATION OF COCO WOOD IN THE BUILDING AND CONSTRUCTION INDUSTRY

In line with one of the immediate objectives of the project, activities to disseminate information on coco wood processing and its utilization in the building and construction industry were held in the form of a seminar (Lucena City) and a workshop - seminar (Davao City).

8.1 INTERNATIONAL SEMINAR ON TECHNOLOGY OF COCONUT WOOD PROCESSING AND UTILIZATION OF COCONUT WOOD AS A BUILDING MATERIAL, Lucena City

A total of 96 participants registered for the seminar on coco wood processing and utilization held in Lucena City, Quezon Province, on 20-22 February 1985. There were 16 foreign participants representing 8 countries in the Pacific basin, Southeast Asia and the Indian Ocean. The local participation was composed as follows :

Sectors Represented	No. of Participants
Wood Processing and Construction Industries	32
Philippine Government Agencies	27
Architecture and Engineering Professional Groups	9
Schools	3
Media	9
Totals	80

Various technical papers on the processing and utilization of coco wood were presented by research specialists from the Forest Products Research and Development Institute, Los Baños, Laguna, UNIDO consultants and the architectural and civil engineering professions in the Philippines. Demonstration runs on the sawmilling and surfacing of coconut lumber were conducted during the plant visits on 22 February 1985. A special visit was made to the Lucena City Integrated Complex on 21 February 1985 where the seminar participants saw coco lumber converted into handicrafts and novelty products, with the use of basic woodworking machines.

The seminar was organized by the Government of Quezon Province, in cooperation with the United Architects of the Philippines, Philippine Institute of Civil Engineers, Philippine Constructors Association, the UNDP and UNIDO.

8.2 SOUTHERN PHILIPPINES SEMINAR ON COCONUT WOOD AS BUILDING MATERIAL, Davao City

Another seminar (workshop type) was conducted in Davao City on 10-13 April 1985, as an extended activity of this Project.

A total of 45 participants registered for the workshop - seminar, composed as follows :

Sectors Represented	No. of Participant
Philippine Government Agencies	26
Industry	12
Schools	3
Media	4
Totals	45

Technical papers on coco wood processing and marketing, and the utilization of coco wood in construction were presented by research specialists from FPRDI, Los Baños, Laguna, executives from wood processing firms in Davao City, prominent professionals from the civil engineering and architectural professions and UNIDO consultants.

Visits were conducted in the afternoon of 10 April to sawmilling and wood preservation plants in Davao City, in addition to an ocular inspection of the demonstration coco wood house built under UNIDO Project SI/PHI/83/801.

Discussions/open forum were conducted after each topic presented by the resource persons. The participants were then divided into two working groups, each of which was assigned specific areas for discussion. The general objective of the workshop groups was to crystallize the problems which have to be solved in order to accelerate the use of coconut wood in construction, considering the technical information currently available on coco wood processing and utilization.

Furthermore, the workshop groups were asked to submit recommendations on the problems thus discussed. Annex IV is the Report of the Rapporteur Committee, based on the discussions and findings of the workshop groups.

The workshop-seminar was sponsored by the Southern Philippines Development Authority and the UNIDO, in collaboration with the Philippine Coconut Authority, Ministry of Human Settlements, Coconut Federation of the Philippines and the Davao Chapters of the United Architects of the Philippines, Philippine Institute of Civil Engineers and the Philippine Constructors Association.

IX. CONCLUSIONS AND RECOMMENDATIONS

Among the immediate objectives set for this Project, only the following were substantially accomplished :

i - redesign of the coconut wood housing unit constructed under SI/PHI/83/801 to allow prefabrication of components and sub-assemblies ;

ii - transfer of coconut wood processing technology to local commercial sawmill, kiln-drying and planing mills ; and

iii - dissemination of the state of art in coconut wood processing and utilization among builders, national and provincial professional groups engaged in the design and construction professions, and wood processing plant operations in Quezon Province.

All the other objectives were not satisfactorily met because :

i - the Project implementors did not follow the prefabrication instructions furnished by the UNIDO Consultants, but instead erected the coco wood demonstration house *en situ* ; and

ii - the Project cost data as submitted by the Project Director (see Annex IX) were deemed unrealistic, and thus, rejected by the UNIDO Consultants (see Annex X).

The results of this Project, therefore, did not show whether there were or there were no advantages in the prefabrication technique of erecting the coco wood demonstration house.

The experience gained under this Project indicate that the following arrangements should be made part of the conditions of any future agreement between UNIDO and the government counterpart agency which accepted responsibility for the implementation of Project plans:

i - implementation of the Project should be started only when the necessary funds for the Project has been made available by the local counterpart agency (or Project proponent) ;

ii - the UNIDO Consultant (or Expert) assigned to the Project should be given monitoring rights and unlimited access to the cost records and daily costing activities of the Project ; and

iii - a regular/periodic audit of the Project's funding and spending transactions should be made by representatives of both UNIDO and the counterpart agency.

ANNEX I

JOB DESCRIPTION

POST TITLE : Local Consultant in Coconut Wood Processing Technology

DURATION : Four (4) Months

DATE REQUIRED : As soon as possible

DUTY STATION : Lucena City, Quezon Province and Manila

PURPOSE OF PROJECT : To demonstrate the feasibility of utilizing coconut wood for a low cost housing project in Quezon Province using prefabricated building components by erecting a prototype unit.

DUTIES : The consultant will be attached to the office of the Governor, Quezon Province, and will specifically be expected to perform the following :

1. Advise the Designing Architect on optimization of coconut wood utilization in the proposed design for low cost coconut wood housing from prefabricated components ;

2. Assist the Designing Architect on the identification of suitable components for prefabrication ;

3. Advise selected commercial wood processing plants in the adaptation of their facilities for coconut wood sawmilling, kiln-drying and wood preservation, and woodworking ;

4. Train wood processing plant personnel and management in coconut wood processing ;

5. Set up, with the Designing Architect, prefabrication systems for components ;

6. Undertake an economic study of the operation to determine the costs of :

   (a) the construction of the proposed prototype, and

   (b) the construction of the proposed housing project ;

7. Conduct a workshop/seminar on the processing and utilization of coconut lumber in low cost housing units.

QUALIFICATIONS : Engineer or wood technician with experience in coconut wood processing and conduct of technical seminars. Should have been associated with SI/PHI/83/801.

LANGUAGE : English and Pilipino

BACKGROUND INFORMATION : The government of the Republic of the Philippines has embarked on a programme to replace existing coconut trees with more productive hybrid species. An average of 3,500,000 coconut tree stems is expected to become available annually when the program is in full swing. In order to avoid potential phyto-sanitary problems posed by unused coconut stems left to rot in the coconut farms, the Philippine government has launched a complimentary program to identify further uses of coconut stems and make their utilization a part of the nation's economic development program. The use of coconut wood in housing and construction offers an immediate solution to the problem of disposing coconut stems cut during the replanting activities.

Low cost housing units have been designed and erected, en situ, under previous UNIDO projects. A design for prefab low cost housing units maximizing the use of coconut lumber, and the construction of a prototype prefab housing unit are expected to be achieved in this Project.

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ANNEX II

EQUIPMENT COMPLEMENT, TANTUCO SAWMILL CANDELARIA, QUEZON PROVINCE

A. MAIN SAWMILLING SHOP

1. Main Saw and Carriage - 1 Set - Philippine Made

(a) Main Saw :

Bandsaw Pulleys	:	2000 mm diameter; 450 RPM
Bandsaw Blade	:	width - 216 mm; thickness - 1.63 mm; Stellite (No. 12)-Tipped Teeth, kerf - 3.20 mm; pitch - 45 mm
Maximum Log Diameter Capacity	:	1250 mm
Motor	:	134 KW, 440V, 60-Hertz, 3-phase

(b) Carriage :

Winch-operated; infinitesimal speed control; manual log setting and log turning device; winch drum coupled with system of gears, shaft, V-belts and pulleys driven by main saw motor.

Maximum Log Size Capacity : length - 6000 mm; diameter - 1250 mm

2. Edger Saw - 1 Unit - Philippine Made

Minimum Work Width (without spacers)	:	100 mm
Minimum Work Width (with spacers)	:	25 mm
Maximum Work Thickness	:	100 mm
Circular Sawblade (2 pieces)	:	Inserted Teeth type; 60 mm diameter; 18 teeth Stellite teeth; kerf - 3.5 mm; 1500 RPM
Motor	:	55 KW, 440V, 60-Hertz, 3-phase

3. Trim Saw - 1 Unit - Philippine Made

Manually fed and operated, pendulum type, with locally fabricated wooden dead roll conveyor table

Circular Sawblade	:	500 mm diameter; 80 teeth; round set; kerf - 3.0 mm; 2500 RPM

4. Table Saw - 1 Unit - Philippine Made

Manual feed; fixed table type

Circular Sawblade : 250 mm; 80 teeth; kerf - 2.5 mm; spring set

Motor : 7.5 KW; 220V; 60-Hertz; 3-phase

B. RESAWING SHOP

1. Band Re-saw - 1 Unit - Philippine Made

Fixed table type, with 4-feed rolls (plain, 100 mm diameter)

Bandsaw Pulleys : 1100 mm diameter; 560 RPM

Bandsaw Blade : width - 125 mm; thickness - 1.15 mm; pitch - 38 mm; cutting speed - 1835 meters/minute

Maximum Workpiece Cross Section Capacity : 150 mm x 300 mm

Motor : 35 KW; 440V; 60-Hertz; 3-phase

2. Trim Saw - 1 Unit - Philippine Made

Manually fed and operated, pendulum type, with locally fabricated wooden dead roll conveyor table

Circular Sawblade : 500 mm diameter; 100 teeth, spring set; kerf - 3.0 mm; 2500 RPM

Note : Thick boards for resawing are transferred from the main sawmilling shop to the re-sawing shop manually.

ANNEX III

EQUIPMENT COMPLEMENT, TANTUCO SURFACING MILL SARIAYA, QUEZON PROVINCE

1. BAND RESAW - 1 Unit - Philippine Made

Manually fed and operated, pendulum type, with locally fabricated wooden dead roll conveyor table

Fixed table type, with 4-feed rolls (plain, 100 mm diameter)

Bandsaw Pulleys	:	1100 mm diameter; 560 RPM
Bandsaw Blade	:	width - 125 mm; thickness - 1.15 mm; pitch - 38 mm; cutting speed - 1835 meters/minute
Maximum Workspiece Cross Section Capacity	:	150 mm x 300 mm
Motor	:	35 KW; 440V; 60-Hertz; 3-phase

2. PLANER-SURFACE - 1 Unit - Philippine Made

Double-head planer, with round cutterheads, 2 thin knives per cutterhead; manually raised feed table; manual feed

Cutterhead Speed	:	4500 RPM
Maximum Work Capacity	:	150 mm x 500 mm
Feed Speed	:	10 meters per minute
Feed Motor	:	7.5 KW; 440V; 60-Hertz; 3-phase

3. PLANER-MATCHER - 1 Unit - Philippine Made

4-head planer-matcher, with limited variable feed speeds; flat belt feed drive

Maximum Workpiece Capacity	:	100 mm x 200 mm
Cutterhead Arrangement	:	First - Top Horizontal Second - Left Vertical Third - Right Vertical Fourth - Bottom Horizontal
Horizontal Cutterheads	:	250 mm wide; round; 2 thin knives/head; 4500 RPM
Vertical Cutterheads	:	150 mm wide; square; 2 thin knives/head; 3500 RPM
Feed Speeds	:	High - 16 meters per minute Medium - 12 meters per minute Low - 6 meters per minute

Motors :

Feed Motor	:	15 KW
Bottom Head Motor	:	15 KW
Top Head Motor	:	40 KW
Vertical Head Motors	:	10 KW each

(All motors wired for 440V; 60-Hertz, 3-phase)

4. Table Saw - 1 Unit - Philippine Made

Manual feed; fixed table type

Circular Sawblade	:	250 mm, 80 teeth; kerf - 2.5 mm; spring set
Motor :	:	7.5 KW; 220V; 60-Hertz; 3-phase

5. One set of sawfiling and grinding tools and equipment for bandsaw and circular saw blades (excluding side grinder)

6. Table grinder, two wheels, with grinding fixtures for straight and profiled knives.

ANNEX IV

DEMONSTRATION OF COCONUT WOOD UTILIZATION IN PREFABRICATED HOUSING
UNIDO Project SI/PHI/84/801
Lucena, Quezon Province

17 April 1985

T o : The Chairman, Executive Committee
Southern Philippines Seminar
On Coconut Wood as a Building Material

F r o m : H. P. Brion
Chief Rapporteur

Subject : REPORT ON THE PLENARY SESSION,
WORKSHOP GROUPS A AND B, 13 APRIL 1985

The attached report on the consensus of the plenary meeting of Workshop Groups A and B, held on 13 April 1985, at the SPDA Maharlika Hall, SPDA Headquarters, Catalunan Pequeño, Davao City, is respectfully submitted for corresponding action and distribution.

Among others, it is recommended that copies of this report be furnished :

i - The Hon. Minister Rolando dela Cuesta
Chairman, Philippine Coconut Authority

ii - The Hon. Minister Rodolfo del Rosario
Ministry of Natural Resources

iii - The Hon. Deputy Minister Aber Canlas
Ministry of Public Works and Highways

iv - The Administrator, Southern Philippines
Development Authority

v - UNDP - Manila

vi - UNIDO - Vienna, Attn.: R. M. Hallett

vii - The President, United Architects of the Philippines

viii - The President, Philippine Institute of Civil Engineers

ix - The President, Philippine Constructors Association

x - The President, Philippine Society of Structural Engineers

xi - The Director, Forest Products Research Institute

xii - The Director, PCA - Zamboanga Research Center,
Zamboanga City

(Sgd.) HORATIO P. BRION

SOUTHERN PHILIPPINES SEMINAR
ON COCONUT WOOD AS BUILDING MATERIAL
Davao City, Philippines

REPORT ON THE PLENARY SESSION,
WORKSHOP GROUPS A AND B, 13 APRIL 1985

Upon motion of Mr. Lamberto Mordeno, (Butuan City), duly seconded by Mr. Lauro Gecosala (Cotabato City), the following consensus was adopted during the plenary session of the workshop participants, as reported by the Committee of Rapporteurs.

1.0 GENERAL

The rationalization of a programme to develop the processing and utilization of coco wood as a building and construction material, as well as in the manufacture of furniture and joinery products, is deemed imperative and merits immediate action. It was agreed that although the total available sawmilling and woodworking capacity (on a national basis) could easily allow the conversion of coco stems into coco lumber, the realization of an effective programme greatly depends on the national coconut tree replanting programme as drawn-up by the Philippine Coconut Authority. Furthermore, while it has already been proven that coconut wood can be used as a material for the housing construction industry and initial results at SPDA indicate good potentials for coco lumber as a raw material for the furniture and joinery industry, certain technical, legal, financial, marketing and administrative constraints still have to be hurdled in order for the coco wood utilization program to gain headway.

2.0 LEGAL AND ADMINISTRATIVE ASPECTS

2.1 Existing laws and government regulations indicate that the responsibility of the PCA ends when the coconut tree

is cut and replaced with a better yielding coconut specie. Furthermore, the Bureau of Forest Development, which is empowered to grant operating licenses to sawmill operators in the country, does not have jurisdiction over the processing of plantation species, like the coconut tree. There is, therefore, a need to fill-in this void in the jurisdiction over coco wood processing, if it is desired to hasten the development of the coco wood processing industry.

2.2 There is a very urgent need for coconut wood to be included in the list of materials approved by government regulatory agencies for housing and construction.[1/] An immediate solution to this problem will encourage home builders to use coco wood as a substitute for equivalent traditional wood species already included in the list of approved materials for housing and construction. Such an inclusion for coco wood will lead to approval by existing home financing institutions, whether public or private entities, to approve loan applications for houses using coco wood as a major building material.

3.0 MATERIAL SOURCING ASPECTS

Existing wood processors are not aware of the time, location and volume of coconut trees planned to be cut under the national coconut tree replanting program. These information are also important to entrepreneurs who would like to engage in coco wood processing, particularly in cases where the source areas are beyond the economic hauling distance from existing sawmilling facilities. A wider dissemination among wood processors of information on the national coconut replanting program is indicated.

[1/] At this writing, associations of professionals (architects, civil engineers and structural engineers) and industry group (Philippine Constructors Association) have accepted the use of coco wood in buildings and construction and have asked the government to include coco wood in the list of building materials endorsed by the national structural code.

4.0 TECHNICAL ASPECTS

There is a need to :

i - overcome the high cost of preserving coco wood ;

ii - overcome the problems in fastening coco lumber to attain lower labour costs ;

iii - know more about the finishing properties of coco wood ;

iv - train more workers in the techniques of saw-milling, kiln-drying, preservative treatment, finishing and furniture and joinery manufacture using coco lumber as the basic raw material ; and

v - develop designing concepts and techniques using coco wood as the basic raw material.

5.0 DISSEMINATION OF TECHNICAL AND COMMERCIAL INFORMATION ON COCO WOOD

There is need for a wider and immediate dissemination of information relative to the following aspects of coco wood processing and marketing :

i - coco lumber grading and the corresponding end-uses of each coco lumber grade ;

ii - correct sawmilling and other processing techniques for coco wood, as developed by the PCA-ZRC and confirmed in both the Davao City (SI/PHI/83/801) and Lucena City (SI/PHI/84/801) coco wood projects sponsored by UNIDO and co-sponsored by SPDA and the Quezon Provincial Government, respectively ;

iii - properties of coco wood with respect to fastening construction joints, and its behaviour under existing climatic conditons ;

iv - pricing approach to the commercialization of coco lumber vis-a-vis current trading practices in the domestic lumber market for traditional wood species.

WHEREFOR, it is respectfully recommended to the various international and national agencies concerned with the development of coconut wood as a building and construction, and furniture and joinery material, that immediate action be taken along the lines described in the preceding paragraphs to help assure a healthy and steady development of coconut wood processing and utilization in the Philippines. Furthermore, it is vehemently recommended that immediate steps be taken to correct the improper sawmilling and utilization of coco wood as reported by the participants from Cebu City and Misamis Occidental, in order to preserve the gains so far attained in the development of coco wood as a building and construction material.

Certified Correct :

(Sgd.) HORATIO P. BRION
Chief Rapporteur

Attested :

(Sgd.) CESAR A. CALIWARA
Rapporteur, Group A

(Sgd.) G. G. STA. MARIA
Rapporteur, Group B

ANNEX V

DEMONSTRATION OF COCONUT WOOD UTILIZATION IN PREFABRICATED HOUSING
UNIDO Project SI/PHI/84/801
Lucena, Quezon Province

6 August 1985

T o : Mr. N. Brown
Assistant Resident Representative (Programme)
UNDP - Manila

F r o m : H. P. Brion
UNIDO Consultant

Subject : OBSERVATIONS DURING MONITORING VISIT,
PREFABRICATION SHOP, COCO WOOD HOUSING COMPONENTS

The following were observed during the Project Monitoring visit yesterday at the Prefabrication Shop, Provincial Engineer's Office, Pagbilao, Quezon Province :

i - Purlins and Brace Frames for Shingles Roofing Sections :

The seven (7) units of roofing frames (purlin and brace sub-assembly) previously rejected (refer to section 8, Progress Report No. 5, dated 3 June 1985) due to non-use of pilot holes for nailed joints have not yet been repaired as of 5 August 1985 inspite of the Project Director's assurance (last 30 May 1985) that the rejected frames will be repaired immediately.

Mr. Lito Ayala and Ms. Evaline Enriquez, Project Staff Engineers responsible for prefabrication activities were instructed by this Consultant on the technique of repairing the split-and-cracked joints.

Important :

Anchorage of the coco wood purlins to the braces in these rejected units have already been weakened by the splitting of coco wood at the nailed joints. The wind resistance of the rejected units, when covered with coco wood shingles and installed as roofing on the demonstration coco house, will be lower than as designed. This situation may cause the shingles roofing sections in question to be blown off the coco house by wind forces appreciably below the design specifications !!!

ii - Coco Wood Roofing Shingles :

(a) The roofing shingles already installed on two frame sections are NOT properly treated with CCA preservative. The same is true with shingles piled beside the assembling fixture and near the new dipping trough, which were alledgedly dipped in CCA solution.

Important :

These coco shingles will have a much shorter life than originally expected, thus negating its choice (over corrugated galvanized iron sheets) as roofing material.

(b) A majority of the coco wood shingles (50 out of 70 pieces selected at random) inspected at four (4) of the piles at the prefabrication shop have thicknesses which are out of specifications as per sample approved by this Consultant.

Important :

This defect will cause hardships (and higher labour usage) during installation of the coco wood shingles to the roofing frames.

iii - Window and Door Jambs :

(a) All of the window and door jambs inspected have poor mitered joints.

(b) Furthermore, all units inspected showed at least two jamb members fabricated out of B and C grade coco boards. The specified material for these components is coco lumber grade A (refer to pages BM-17 through BM-21, Erection Manual for the Demonstration of Coconut Wood Utilization in Prefabricated Housing, SI/PHI/84/801). The Project Director was furnished a copy of the erection manual.

iv - T&G Coco Boards Flooring :

All T&G coco boards are piled together, mixing grade A (for flooring) with grade B (only good for shelves flooring, closet flooring, etc.) boards.

Important :

The same situation led to the mistake of using grade B (softer than grade A) boards as flooring material (subsequently rejected by the Project Designing Arthitect) for the SPDA - Davao City coco wood demonstration house (SI/PHI/83/801).

All the above described faults were committed after the tour of duty of the UNIDO Consultant expired on 31 May 1985. Furthermore, these negate the statement of the Project Director during the meeting with the UNDP Assistant Resident Representative (Programme) at the Provincial Engineer's Office, Pagbilao, that they can successfully complete the Project without technical assistance from outside sources.

The foregoing observations and comments indicate the need for immediate action on the part of UNDP lest the demonstration house be erected NOT according to the approved specifications, and the principal project objective NOT adequately complied with.

(Sgd.) HORATIO P. BRION

ANNEX VI

DEMONSTRATION OF COCONUT WOOD UTILIZATION IN PREFABRICATED HOUSING
UNIDO Project SI/PHI/84/801
Lucena, Quezon Province

11 November 1985

T o : The Resident Representative
Thru: Mr. N. Brown, A.R.R. (Programme)
UNDP - Manila

F r o m : H. P. Brion
UNIDO Consultant

Subject : **OBSERVATIONS DURING THE SECOND MONITORING VISIT, PROJECT SITE, LUCENA CITY AND PREFABRICATION SHOP, PAGBILAO, QUEZON PROVINCE**

The following were observed during the Project Monitoring visits to the coconut wood demonstration house, Lucena City, and the Prefabrication shop, Provincial Engineer's Office, Pagbilao, Quezon Province, on 8 and 9 November 1985 :

i - Sidings :

All exterior sidings (V-Cut boards) have already been installed en situ. Interior walls on the south and west sides of the west wing of the house, and the east side of the east wing of the house have also been installed en situ. Installation of the other interior walls was in progress during the visit.

ii - Partitions :

Studdings for partitions were already installed, with door jambs located in the specified places. These indicate that the partition walls are to be installed en situ also.

iii - Flooring and Floor Joists :

Marked "springiness" was felt while walking on the floor area of the living-dining area. This was, however, very slightly felt in the two bedroom wings. An inspection of the floor joists under the living-dining area floor showed that only 25% of the floor joists and bracings used were of the specified "A" grade lumber. Furthermore, only 20% of the floor joists under the balcony floor were of the specified "A" grade lumber.

iv - Window and Door Jambs :

The use of sub-standard coco lumber grade for window jambs, as observed during the previous monitoring visit (paragraph iii, 6 August 1985 Report) was not corrected. The jambs, with some sub-standard members, are now installed in the coco wood demonstration house.

v - Purlins and Brace Frames for Shingles Roofing Sections :

The seven (7) units of roofing frames previously rejected (see Section 8, Progress Report No. 5, dated 3 June 1985 and paragraph i, 6 August 1985 Report on 1st Monitoring Visit) have not yet been repaired.

vi - Roofing Shingles :

All roofing shingles have been brush-coated with a tar based product (produced and commercially distributed by the Shell Chemical Co., under the brand name "Weathercote"), which was not the specified CCA diffusion method of preservative treatment.

vii - Prefabrication Activities :

A visit to the prefabrication shop at Pagbilao showed no prefabrication activities at all. Prefabrication jigs and fixtures as recommended by the UNIDO Consultant were not fabricated. These could only mean that all the remaining house components will be installed en situ.

viii - Project Data :

When asked for data on costs and labour usage so far incurred during the conduct of the Project, Mr. Lito Ayala, project engineer, informed this Consultant that the data are not yet available.

The foregoing observations indicate that the primary objective of the Project (SI/PHI/84/801) to demonstrate the use of coconut wood as a material for prefabricated housing components is not being given due consideration at all by the project implementation staff.

(Sgd.) HORATIO P. BRION

ANNEX VII

DEMONSTRATION OF COCONUT WOOD UTILIZATION IN PREFABRICATED HOUSING
UNIDO Project SI/PHI/84/801
Lucena, Quezon Province

28 May 1985

Ref.: HPB/85-25

T o : The Project Director
Coco House Project

F r o m : H. P. Brion
UNIDO Consultant

Subject : RIDGE ROLL AND EAVES FLUSHING JOINT

Please find attached sketches (Figures 1 and 2) of the joint designs for ridge roll and eaves flushing pieces.

IMPORTANT : When installing eaves flushing pieces, be sure that the TENON end is lower than the open MORTIZE end.

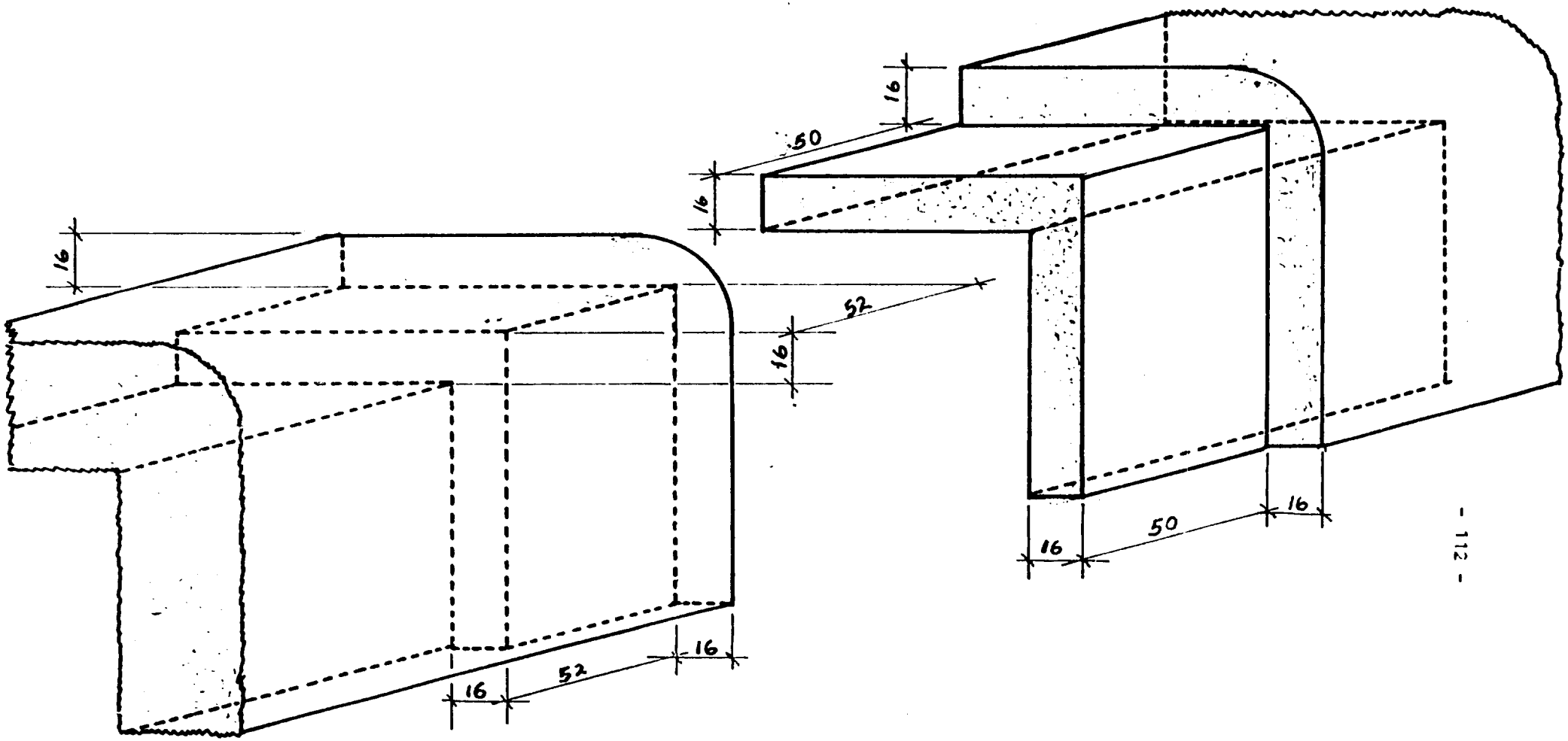
Samples of these joinery technique will be fabricated during this week.

(Sgd.) HORATIO P. BRION

cc: UNDP - Manila
R. M. Hallett, UNIDO, Vienna
Office of the Governor, Quezon Prov.
Project Engineers (2)
G. G. Sta. Maria, Designing Consultant

Fig. 1

Open Mortize and Tenon Joint
for Eaves Flushing Pieces



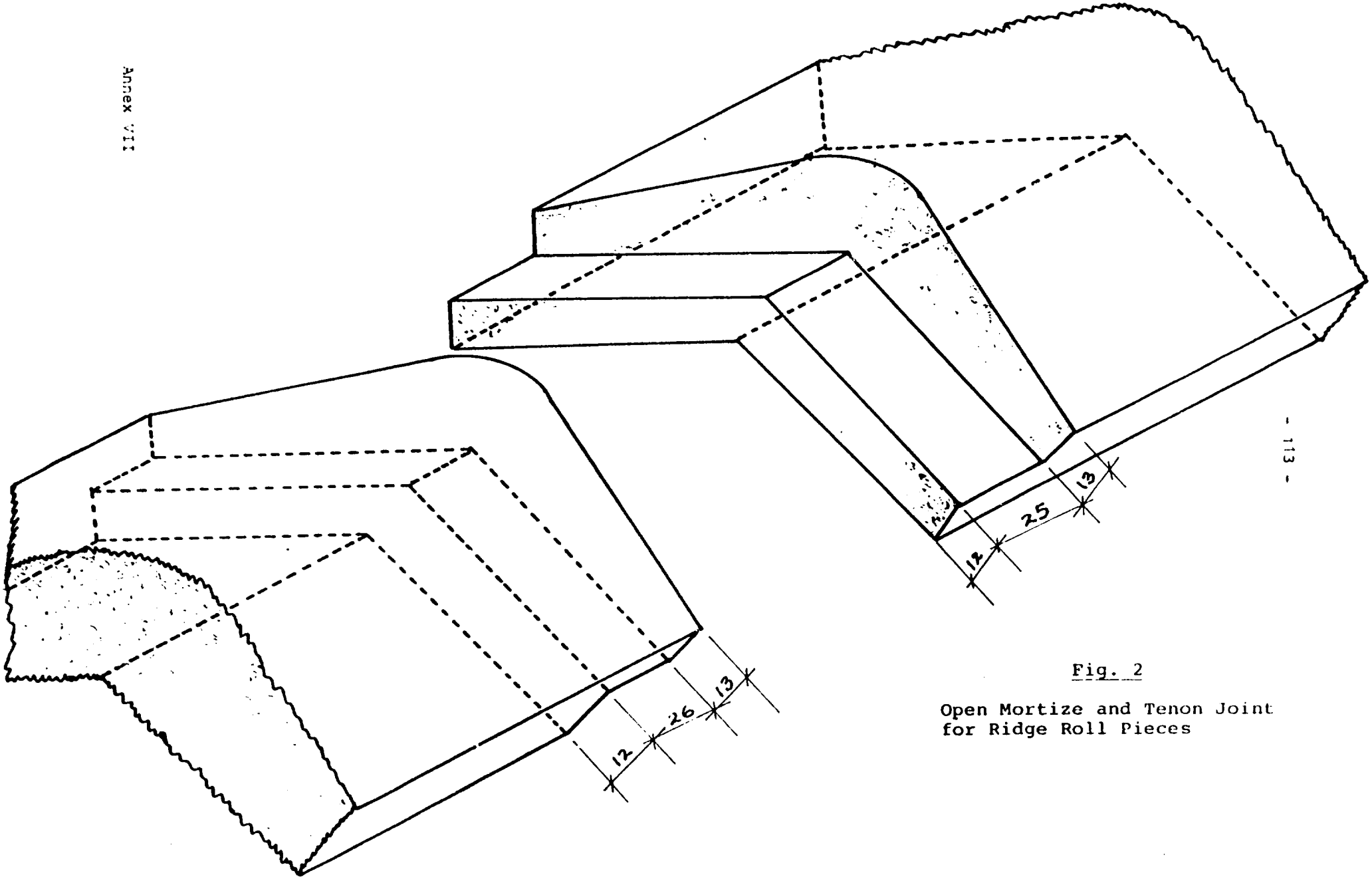


Fig. 2

Open Mortize and Tenon Joint
for Ridge Roll Pieces

ANNEX VIII

9 April 1986

NOTE FOR THE FILE

SI/PHI/84/801 Demonstration of Coconut Wood Utilization in Prefabricated Housing

1. A monitoring visit was undertaken to Lucena City in connection with the above project on 4 April 1986, together with Mr. Erik Bos, JPO, UNDP/UNIDO, Manila, Arch. G. Sta. Maria, Engr. C. Caliwara and Mr. H. Brion. Engr. A. Radovan was present at the site during the entire course of the visit and the discussions.

2. The immediate purpose of the visit was to find a professionally satisfactory rounding up project activities given the long delays that have already taken place and the fact that UNIDO funds on the project have already been over obligated.

3. We were informed by Engr. Radovan that work on the demonstration building had stopped since February 1986 when the Government budget was frozen and no expenditures could be incurred. No indications were forthcoming as to when the situation with regard to the Government counterpart funds would improve nor whether funds would be available for continuation of the activities towards the completion of the demonstration building in all aspects. Given the present fluid situation it is not possible to make any conjecture in this regard.

4. On inspection, however, it is my opinion that

a) all the structural members of the building have been erected and are in place;

b) the finishing work including wall panellings, ceiling boards, etc. have been completed in a part of the building;

c) sanitary works as well as electrical works are incomplete, however, the tiling of the toilet/bath section has been completed;

d) it was also found that some of the trusses were not properly fixed but it was understood this will be corrected at the first opportunity The present status with regard to the building construction definitely provides a reliable technical basis for making extrapolations with regard to both the technical and economic aspects of the completed building. Since the future programme for completion of the building is uncertain, it is recommended that the terminal technical and economic reports be completed on the basis of the experience so far available and data so far generated.

5. Everyone present during the visit namely, Arch. Sta. Maria, Engr. Caliwara, Mr. Brion and Engr. Radovan were in complete agreement with the above course of action.

Annex VIII

Specifically, these involve:

a) Arch. Sta. Maria would proceed to prepare his terminal report based upon the experience and data so far available and drawing attention to the works still to be completed, the variations from the originally intended design and plan of action and providing perceptive conclusions on the various aspects for which this project was specifically designed, namely

   i) degree of prefabrication feasible

   ii) extent of use of non-coco timber in order to lead to optimal timber utilization

   iii) jointing details, etc.

b) Mr. Brion would, based upon data of cost so far incurred, estimate the cost for the completed building and make necessary cost comparisons with the Davao experience.

c) For the above purpose Engr. Radovan promised to make available the data of cost so far incurred in the next week or maximum 15 days and Engr. Caliwara undertook to follow up on this. Should for any reason the data of cost not be available within a reasonable time, it is suggested that the cost data should be constructed using extrapolations of man-hour estimates from Davao experience and applying local labor rates. Mr. Brion is in agreement with this suggestion.

It is felt that the above represents the only professional way of rounding up project activities given the extreme uncertainty with regard to further activities towards completion of the construction.

G. L. Narasimhan
SIDFA

cc: Mr. T. Mangun, RR/Manila
Mr. R. Hallett, AGRO/DIO, UNIDO/Vienna
Mr. H. Brion
Arch. G. Sta. Maria
Engr. C. Caliwara
Engr. A. Radovan

ANNEX IX

REPUBLIC OF THE PHILIPPINES
PROVINCE OF QUEZON

OFFICE OF THE PROVINCIAL ENGINEER

BRGY. TALIPAN, PAGBILAO, QUEZON

1st Indorsement
25 April 1986

Respectfully transmitted to Mr. Horatio P. Brion, UNIDO Consultant, 29 Linaw Street, S.F.D.M. Quezon City, Metro Manila, the Coco House Project Cost Data as required.

ABELARDO S. RADOVAN
Provincial Engineer

Encl.: as stated.

ASR/za

2.0 COSTING FORMAT

2.1 Unit Log Cost

From Mrs. Cabreros (owner)
Total No. of coconut tree - 648 pcs.
Total vol. of coconut tree - 101,172.4 cu.m.
Total vol. of coconut tree delivered to owner in term of "payment"
53 pcs. coco log bolt x 4500 = 6815 bd.ft.
V = 16.094 cu.m.

Total Cost of coconut tree = 6815 bd.ft. @ ₱1.00/bd.ft.
= ₱6,815.00

∴ Cost of coconut tree - ₱10.52/pc.
Cost per bd.ft. - - ₱0.067/bd.ft.

NOTE: Additional coco log bolts from Dr. Radovan

84 pcs. coco log bolts x 5000 mm = 10801 bd.ft., V = 25.51 cu.m.
53 " " " " x 4500 mm = 6815 bd.ft., V = 16.094 cu.m.

2.12 COST OF BUCKING COCO LOG TREES @ 15 DAYS

i - Cost of Labour	₱ 2,850.00
ii - Cost of Fuel	1,890.00
iii - Cost of Equipment Usage	10,431.50
	₱15,171.50

i - Cost of Labour:

1 - Engineer @ ₱70.00/day x 15 days	₱ 1,050.00
1 - Powersaw man @ ₱50.00/day x 15 days	750.00
2 - Helper @ ₱35.00/day x 15 days	1,050.00
	₱ 2,850.00

ii - Cost of Fuel:

150 ltrs. Extra Gasoline @ ₱8.40	₱ 1,260.00
21 ltrs. Motor Oil #30 @ ₱30.00	630.00
	₱ 1,890.00

iii - Cost of Equipment Usage:

Rental - - - - - @ ₱500.00/day x 15 days	₱ 7,500.00
Spare parts of powersaw	2,931.50
	₱10,431.50

2.13 COST OF YARDING - ₱30.92/cu.m.

i - Cost of Labour	₱ 1,110.00
ii - Cost of Fuel	962.40
iii - Cost of Equipment Usage	5,310.00
	₱ 7,382.40

i - Cost of Labour:

1 - Engineer @ ₱70.00/day x 6 days	₱ 420.00
1 - Driver @ ₱45.00/day x 6 days	270.00
2 - Helper @ ₱35.00/day x 6 days	420.00
	₱ 1,110.00

ii - Cost of Fuel @ 6 days:

120 ltrs. Diesel Fuel @ ₱6.52	₱ 782.40
6 ltrs. Motor Oil @ ₱30.00	180.00
	₱ 962.40

iii - Cost of Equipment Usage:

Rental 6 x 6 @ ₱885.00/day x 6 days	₱ 5,310.00

2.14 COST OF LOADING AND UNLOADING @ 10 DAYS

COCO LOG BOLTS	₱168.52/cu.m.

i - Cost of Labour	₱ 3,100.00
ii - Cost of Fuel	3,208.00
iii - Cost of Equipment Usage	33,920.00
	₱40,228.00

i - Cost of Labour @ 10 days:

1 - Engineer @ ₱70.00/day x 10 days	₱ 700.00
2 - Operator @₱50.00/day x 10 days	1,000.00
4 - Helper @ ₱35.00/day x 10 days	1,400.00
	₱ 3,100.00

ii - Cost of Fuel:

400 ltrs. Diesel Fuel @₱6.52	₱ 2,608.00
20 ltrs. Motor Oil @ ₱30.00	600.00
	₱ 3,208.00

Forklift - 200 ltrs diesel fuel + 10 ltrs. Motor oil
Crane - 200 ltrs. diesel fuel + 10 ltrs. Motor oil

iii - Rental:

Forklift @ ₱212.00/hr. x 80 hrs.	₱16,960.00
Crane @ ₱212.00/hr. x 80 hrs.	16,960.00
	₱33,920.00

2.15 COST OF HAULING COCO LOG BOLTS - ₱172.70/cu.m. @ 10 days

i - Cost of Labour	₱ 2,050.00
ii - Cost of Fuel	12,636.00
iii - Cost of Equipment Usage	26,550.00
	₱41,236.00

i - Cost of Labour:

1 - Engineer @ ₱70.00/day x 10 days	₱ 700.00
3 - Driver @ ₱45.00/day x 10 days	1,350.00
	₱ 2,050.00

ii - Cost of Fuel:

3 Dump Truck @ 30 ltrs./trip and 1 ltr. Motor Oil/trip	
@ 60 trips x 30 ltrs. = 1800 ltrs. @₱6.52	₱11,736.00
30 ltrs. Motor Oil @₱30.00	900.00
	₱12,636.00

iii - Cost of Equipment Usage:

Rental - 3 dump truck @ ₱885.00/day x 10 days ₱ 26,550.00

2.2 UNIT COCO LUMBER COST

2.21 Sawmilling Cost	₱424.00/cu.m.
2.22 Hauling Cost	159.00/cu.m.

2.221

i - Tantuco, Sariaya	37.5 cu.m.	₱7,013.60
ii - PEO, Talipan	123.78 cu.m.	24,326.00
iii - Jobsite, Lucena City	20 cums.	6,622.40
	181.28 cu.m.	₱37,962.00

i - Tantuco, Sariaya - 2 days

12 trips @ 15 ltrs./trip = 180 ltrs. @ ₱6.52 - - -	₱1,173.60
4 ltrsl M.O. @ ₱30.00	120.00
	₱1,293.60

Rental:

3 - Dump truck @ ₱885.00/day x 2 days - - - - - -	₱5,310.00

Labour:

3 - Driver @ ₱45.00/day x 2 days - - - - - - - -	₱ 270.00
1 - Engineer @ ₱70.00/day x 2 days - - - - - - -	140.00
	₱ 410.00
TOTAL - - - -	₱7,013.60

ii - PEO, Talipan - 5 days

40 trips @ 20 ltrs./trip = 800 ltrs. @ ₱6.52 - -	₱5,216.00
10 ltrs. M.O. @₱30.00	300.00
	₱5,516.00

Rental:

4 - Dump Trucks @ ₱885.00/day x 5 days - - - - -	₱17,700.00

Labour:

4 - Driver @ ₱45.00/day x 5 days - - - - - - - -	₱ 900.00
1 - C. E. @ ₱70.00/day x 3 days - - - - - - - -	210.00
	₱1,110.00
TOTAL - - - -	₱24,326.00

iii - Job site, Lucena City - 2 days

6 trips @ 20 ltrs./trip = 120 ltrs. @ ₱6.52 - - -	₱ 782.40
4 ltrs. M.O. @ ₱30.00	120.00
	₱ 902.40

Rental:

3 - Dump truck @ ₱885.00/day x 2 days - - - - - -	₱5,310.00

Labour:

3 - Driver @ ₱45.00/day x 2 days - - - - - - - -	₱ 270.00
1 - Engineer @ ₱70.00/day x 2 days - - - - - - -	140.00
	₱ 410.00
TOTAL - - - -	₱6,622.40

2.222 Volume of treated lumber transported - - - - - - - - - - - - - - 6 cu.m.

Cost of Transportation - - - - - - - - - ₱205.10/cu.m.

Rental:

1 Dump Truck @ ₱885.00/day - - - - - - - -	₱ 885.00

Labour:

1 - Driver @ ₱45.00 - - - - - - - - - - - -	₱ 45.00
2 - Helper @ ₱35.00 - - - - - - - - - - - -	70.00
1 - Engineer @ ₱70.00 - - - - - - - - - - -	70.00
	₱ 185.00

Fuel:

20 ltrs. @ ₱6.52 - - - - - - - - - - - - - -	₱ 130.40
1 ltr. Motor Oil @ ₱30.00 - - - - - - - -	30.00
	₱ 160.40
TOTAL - - - -	₱1,230.40

2.3 COCO LUMBER SURFACING AND PROFILING COST

Surfacing and profiling charges,
Tantuco Mill - ₱209.20/cu.m.

2.4 COCO LUMBER PRESERVATIVE TREATMENT COST

2.41 CCA DIFFUSION METHOD

i - Cost of CCA Chemicals - - - - - - - - - - - ₱137.00/kg.
ii - Volume of Original 3% CCA Solution Mixed - - - - - - - - - - - - _____ liters
iii - Volume of CCA Solution Left after dipping operations - - - - - - - - NONE liters
iv - Total volume of coco lumber items dipped - - - - - - - - - - - - - 8 cu.m.
v - Dipping labour cost:
Labour Usage - - - - - - - - - - - - - - - 96 Man-Hours
Labour Pay Rate - - - - - - - - - - - - - ₱30.625/Man-Hour

v - Dipping Labour Cost
Labour
1 - Engineer @ ₱70.00/day x 12 days - - - - - - - ₱ 840.00
5 - Laborer @ ₱35.00/day x 12 days - - - - - - - 2100.00
TOTAL - - - - - - ₱2,940.00

2.5 PRE-FABRICATION COST

2.51 BALUSTRADE TURNINGS

Sub-contract cost - - - - - - - - - - - - - - - - ₱3,500.00

2.52 RIDGE ROLL AND EAVES FLUSHING FABRICATION

Labour Usage - 64 Man-Hours
Labour Pay Rate - - - - - - - - - - - - - - - - - - ₱30.00/Man-Hour

Labour:
1 - Engineer @ ₱70.00 x 8 - - - - - - - - - - - - - - - ₱ 560.00
2 - Carpenter @ ₱50.00 x 8 - - - - - - - - - - - - - - 800.00
2 - Laborer @ ₱35.00 x 8 - - - - - - - - - - - - - - - 560.00
TOTAL - - - - - - - ₱1,920.00

2.53 SHINGLES ROOFING SECTION FABRICATION

Labour Usage - 80 Man-Hours
Labour Pay Rate - - - - - - - - - - - - - - - - - - ₱30.00/Man-Hour
Equipment Usage Cost - - - - - - - - - - - - - - - NONE

Labour:
1 - Engineer @ ₱70.00 x 10 - - - - - - - - - - - - - - ₱ 700.00
2 - Carpenter @ ₱50.00 x 10 - - - - - - - - - - - - - - 1000.00
2 - Laborer @ ₱35.00 x 10 - - - - - - - - - - - - - - - 700.00
TOTAL - - - - - - - ₱2,400.00

2.54 SIDING FABRICATION

Labor Usage - 120 Man-Hours
Labor Pay Rate - - - - - - - - - - - - - - - - - - - ₱30.00/Man-Hour
Equipment Usage Cost - - - - - - - - - - - - - - - - ₱ NONE

Labour:

1 - Engineer @ ₱70.00 x 15	₱1,050.00
2 - Carpenter @ ₱50.00 x 15	1,500.00
2 - Laborer @ ₱35.00 x 15	1,050.00
	₱ 3,600.00

2.55 PARTITIONS FABRICATION

Labour Usage	120 Man-Hours
Labour Pay Rate	₱30.00/Man-Hour
Equipment Usage Cost	₱ NONE

Labour:

1 - Engineer @ ₱70.00 x 15	₱ 1,050.00
2 - Carpenter @ ₱50.00 x 15	1,500.00
2 - Laborer @ ₱35.00 x 15	1,050.00
TOTAL	₱ 3,600.00

2.56 SHINGLES FABRICATION COST

Sub-Contract Cost	₱ 4,128.00
No. of shingles fabricated	8,256 pcs.

2.57 DOOR AND WINDOW FABRICATION COST

Sub-Contract Cost	₱ 6,800.00

2.58 TRUSS FABRICATION COST

2.581 BOLTED TRUSS CONSTRUCTION

No. of Unit Fabricated	8 units
Labour Usage	80 Man-Hours
Labour Pay Rate	₱30.00/Man-Hour
Non-Coco Lumber Materials Cost	₱1,835.00

Labour:

1 - C.E. @ ₱70.00/day x 10	₱ 700.00
2 - Carpenter @ ₱50.00/day x 10	1,000.00
2 - Laborer @ ₱35.00/day x 10	700.00
TOTAL	₱2,400.00

Non-coco lumber materials - - - - - - - - - - - - - - ₱1,835.00

2.582 NAIL-AND-PLATE CONSTRUCTION

No. of units fabricated	5 units
Labour usage	56 Man-Hours
Labour Pay Rate	₱36.25/Man-Hour
Non-coco Lumber Materials	₱3,000.00

Labour:

1 - C. E. @ ₱70.00 x 7	₱ 490.00
2 - Carpenter @ ₱50.00 x 7	700.00
2 - Laborer @ ₱35.00 x 7	490.00
1 - Tinsmith @ ₱50.00 x 7	350.00
TOTAL	₱2,030.00

Non-coco lumber materials - - - - - - - - - - - - - ₱3,000.00

3.0 COCO HOUSE CONSTRUCTION COST

3.11 CONCRETE AND MASONRY WORKS

a) Footing and column - - - - - ₱ 14,130.00
b) Toilet and bath - - - - - - 10,500.00
c) Septic vault - - - - - - - 9,600.00
d) Miscellaneous Materials - - 13,614.80

3.12 Hardware and Fasteners - - - - ₱ 47,731.00

3.13 Plumbing Supplies and Fixture - 19,389.00

3.14 Plywood or (Tar Paper) - - - - 7,100.00

3.15 Electrical Fixture and Supplies - - - - - - - - - - - 10,812.05

3.2 COST OF LABOUR

1) Masonry and concrete work, including site preparation and earthworks

Labour @ 160 hours

1 - C. E. @ ₱70.00 x 20 days - - - - - - - -	₱ 1,400.00
1 - Foreman @ ₱60.00 - - - - - - - - - - -	1,200.00
2 - Carpenter @ ₱50.00 - - - - - - - - - -	2,000.00
2 - Mason @ ₱50.00 - - - - - - - - - - - - -	2,000.00
1 - Steelman @ ₱50.00 - - - - - - - - - - -	1,000.00
8 - Laborer @ ₱35.00 - - - - - - - - - - - -	5,600.00
TOTAL - - - -	₱ 13,200.00

2) Building Frameworks

Labour @ 120 hours

1 - C. E. @ ₱70.00 x 15 - - - - - - - - - - -	₱ 1,050.00
1 - Foreman @ ₱60.00 x 15 - - - - - - - - - -	900.00
4 - Carpenter @ ₱50.00 x 15 - - - - - - - - -	3,000.00
8 - Laborer @ ₱35.00 x 15 - - - - - - - - - -	4,200.00
TOTAL - - - - -	₱ 9,150.00

3) Sidings and Partition Installation

Labour @ 160 hours

1 - C. E. @ ₱70.00 x 20 - - - - - - - - - - -	₱ 1,400.00
1 - Foreman @ ₱60.00 x 20 @ - - - - - - - - -	1,200.00
4 - Carpenter @ ₱50.00 x 20 - - - - - - - - -	4,000.00
6 - Laborer @ ₱35.00 x 20 - - - - - - - - - -	4,200.00
TOTAL - - - - -	₱10,800.00

4) Flooring @ 80 hours

1 - C. E. @ ₱70.00 x 10 - - - - - - - - - - -	₱ 700.00
1 - Foreman @ ₱60.00 x 10 - - - - - - - - - -	600.00
4 - Carpenter @ ₱50.00 x 10 - - - - - - - - -	2,000.00
4 - Laborer @ ₱35.00 x 10 - - - - - - - - - -	1,400.00
TOTAL - - - - -	₱ 4,700.00

5) Ceiling @ 80 hours

1 - C. E. @ ₱70.00 x 10 - - - - - - - - - - -	₱ 700.00
1 - Foreman @ ₱60.00 x 10 - - - - - - - - - -	600.00
4 - Carpenter @ ₱50.00 x 10 - - - - - - - - -	2,000.00
4 - Laborer @ ₱35.00 x 10 - - - - - - - - - -	1,400.00
TOTAL - - - - -	₱ 4,700.00

6) Roofing and Canopies Installation

Roofing 95% completed @ 160 hours
Canopies 0 % _____ 0 hours

Labour:

1 - C. E. @ ₱70.00 x 20	₱ 1,400.00
1 - Foreman @ ₱60.00 x 20	1,200.00
4 - Carpenter @ ₱50.00 x 20	4,000.00
4 - Laborer @ ₱35.00 x 20	2,800.00
TOTAL	₱ 9,400.00

7) Joinery Installation @ 64 hours

Labour:

1 - C. E. @ ₱70.00 x 8	₱ 560.00
1 - Foreman @ ₱60.00 x 8	480.00
2 - Carpenter @ ₱50.00 x 8	800.00
2 - Laborer @ ₱35.00 x 8	560.00
TOTAL	₱ 2,400.00

8) Cabinetry 96% completed @ 80 hours

1 - C. E. @ ₱70.00 x 10	₱ 700.00
1 - Foreman @ ₱60.00 x 10	600.00
2 - Carpenter @ ₱50.00 x 10	1,000.00
1 - Laborer @ ₱35.00 x 10	350.00
TOTAL	₱ 2,650.00

9) Plumbing and Water Installation @ 64 hours

Plumbing 95% completed
Water 96% completed

1 - C. E. @ ₱70.00 x 8	₱ 560.00
1 - Plumber @₱50.00 x 8	400.00
1 - Foreman @ ₱60.00 x 8	480.00
2 - Laborer @ ₱35.00 x 8	560.00
TOTAL	₱ 2,000.00

10) Electrical Works @ 64 hours

Labour:

1 - C. E. @ ₱70.00 x 8	₱ 560.00
1 - Foreman @ ₱60.00 x 8	480.00
1 - Electrician @ ₱50.00 x 8	400.00
1 - Helper @ ₱35.00 x 8	280.00
TOTAL	₱ 1,720.00

4.0 PROJECT SUPERVISION AND ADMINISTRATION

Personnel	Man-Hours Usage	Cost
1. Project Engineer	1032 MH	₱72,240.00
2. Foreman	1032 MH	61,920.00
3. Timekeeper/Records	1032 MH	51,600.00
4. Toolkeeper/Storekeeper	1032 MH	51,600.00
		₱237,360.00

NOTE: 2,709.9 ltrs. diesel fuel and 18 ltrs. Motor Oil #30 were used in hauling local material from Mabuhay Lumber and Tantuco Lumber and also use in daily inspection of coconut wood house at Mansion House, Lucena City.

Annex IX

29 May 1985

Ref.: HPB/85-27

T O : The Project Director
Coco House Project

FROM : H. P. BRION
UNIDO Consultant

SUBJECT: PROJECT COSTING GUIDELINES

In order to evolve project cost data which can be properly compared with previous and future coco house projects here and abroad, it is recommended that the following guidelines be observed during the preparation of cost data.

1.0 GENERAL

1.1 Only materials actually used in the construction of the demonstration coco house and the fabrication of coco wood furnitures and furnishings should be charged to the Project.

1.2 All labour usage should be expressed in man-hours and labor cost, in terms of Pesos per man-hour used (₱/H), segregated according to the following levels of skill: highly skilled, skilled, semi-skilled and unskilled.

1.3 Separate cost data should be set up to cover project supervision and administration activities.

1.4 A separate tabulation should be set up for the cost of housing components rejected by the Project Consultants; together with the cost of replacing or repairing the rejected components.

1.5 Project costs should be presented according to the costing format presented in the following paragraphs.

2.0 COSTING FORMAT

2.1 UNIT LOG COST

2.11 COST OF COCONUT TREE - ₱ 6,815.00

(Note: This is equivalent to the sawmilling charges pro-rated to the volume of coco lumber delivered to the owners of the coconut trees (vs. total volume of coco lumber cost) used in the Project under the "Payment-in-Kind" arrangement.

2.12 COST OF BUCKING COCO LOG BOLTS

This is the cost of cutting the fallen coconut stem to the desired log bolt lengths and includes:

i – Cost of Labour - - - - - - ₱ 2,850.00
ii – Cost of Fuel - - - - - - - ₱ 1,890.00
iii – Cost of Equipment Usage - ₱ 10,431.50

2.13 COST OF YARDING - - - - - - - - ₱ 30.92 /Cu.M.

This is the cost of dragging coco log bolts from cutting to loading sites and includes:

i - Cost of Labour - - - - - ₱ 1,110.00
ii - Cost of Fuel - - - - - - ₱ 962.40
iii - Cost of Equipment Usage- ₱ 5,310.00

2.14 COST OF LOADING AND UNLOADING COCO LOG BOLTS - - - - - - - - ₱ 168.52 /Cu.M.

This is the cost of loading coco log bolts at cutting site and unloading them at the sawmill site. This cost item includes:

i - Cost of Labour - - - - - ₱ 3,100.00
ii - Cost of Fuel - - - - - - ₱ 3,208.00
iii - Cost of Equipment Usage- ₱ 33,920.00

2.15 COST OF HAULING COCO LOG BOLTS-₱ 172.74 /Cu.M.

This item covers the cost of transporting the coco log bolts from the cutting site to the TANTUCO Sawmill at Barrio Taguan, Candelaria, Quezon Province and includes:

i - Cost of Labour - - - - - ₱ 2,050.00
ii - Cost of Fuel - - - - - - ₱12,636.00
iii - Cost of Equipment/Vehicle Usage - - - - - - - ₱26,550.00

2.2 UNIT COCO LUMBER COST

2.21 SAWMILLING COST - - - - - - - - ₱ 424.00 /Cu.M. of log input

2.22 HAULING COST - - - - - - - - - ₱ 159.00 /Cu.M. of coco lumber

2.221 This cost item covers the cost of transporting the milled lumber from the sawmill site to:

	Vol. of Coco Lumber Transported		Cost
i - Tantuco, Sariaya --	37.5	Cu.m.	₱ 7,013.60
ii - PEO, Pagbilao - - -	123.78	Cu.M.	₱ 24,526.0
iii - Job Site, Lucena City - - - - -	20	Cu.M.	₱ 6,622.40

2.222 This cost item also covers the cost of transporting semi-processed coco lumber from the preservative treatment site (PEO, Pagbilao) to the Job Site:

Volume of Treated Lumber Transported - - - - - - 6 Cu.M.
Cost of Transportation - ₱ 295.10 /Cu.M.

2.3 COCO LUMBER SURFACING AND PROFILING COST

Surfacing and Profiling Charges, Tantuco Mill- - - - - - - - - - - - - - - - ₱ 209.20 /M.

2.4 COCO LUMBER PRESERVATIVE TREATMENT COST

2.41 CCA DIFFUSION METHOD

i - Cost of CCA Chemicals - - - - - ₱ 137.00 /Kg.
ii - Volume of Original 3% CCA Solution Mixed - - - - - - _____ liters
iii - Volume of CCA Solution Left after Dipping Operations - NONE liters
iv - Total Volume of Coco lumber items Dipped - - - - - - - - - 8 Cu.M.
v - Dipping Labour Cost:
Labour Usage - - - - - - - - - - 96 Man-Hours
Labour Pay Rate - - - - - - - - ₱ 30.625 /Man-Hour

2.5 PRE-FABRICATION COST

2.51 BALUSTRADE TURNINGS

Sub-Contract Cost - - - - - - - - - - ₱ 3,500.00

2.52 RIDGE ROLL AND EAVES FLUSHING FABRICATION

Labour Usage - - - - - - - - - - - - 64 Man-Hours
Labour Pay Rate - - - - - - - - - - ₱ 30.00 /Man-Hour

2.53 SHINGLES ROOFING SECTIONS FABRICATION

Labour Usage - - - - - - - - - - - - 80 Man-Hours
Labour Pay Rate - - - - - - - - - - ₱ 30.00 /Man-Hour
Equipment Usage Cost - - - - - - - ₱ _____

2.54 SIDINGS FABRICATION

Labour - - - - - - - - - - - - - - - 120 Man-Hours
Labour Pay Rate - - - - - - - - - - ₱ 30.00 /Man-Hour
Equipment Usage Cost - - - - - - - ₱ _____

2.55 PARTITIONS FABRICATION

Labour - - - - - - - - - - - - - - - 120 Man-Hours
Labour Pay Rate - - - - - - - - - - ₱ 30.00 /Man-Hour
Equipment Usage Cost - - - - - - - ₱ _____

2.56 SHINGLES FABRICATION COST

Sub-Contract Cost - - - - - - - - - ₱ 4,128.00
No. of Shingles Fabricated - - 8,256 pcs.

2.57 DOORS AND WINDOWS FABRICATION COST

Sub-Contract Cost - - - - - - - - ₱ 6,800.00

2.58 TRUSS FABRICATION COST

2.581 BOLTED TRUSS CONSTRUCTION

No. of Units Fabricated - - - - - 8 Units
Labour Usage - - - - - - - 80 Man-Hours
Labour Pay Rate - - - -₱ 30.00 /Man-Hour
Non-Coco Lumber Materials
Cost - - - - - - - - -₱ 1,835.00

2.582 NAIL-AND-PLATE CONSTRUCTION

No. of Units Fabricated - - - - - 5 Units
Labour Usage - - - - - - 56 Man-Hours
Labour Pay Rate - - - -₱ 36.25 /Man-Hour
Non-Coco Lumber Materials Cost - - - - - ₱ 3,000.00

3.0 COCO HOUSE CONSTRUCTION COST

3.1 COST OF MATERIALS (Other than Coco Lumber)

3.11 CONCRETE AND MASONRY

a) Footing and Columns - - - -₱ 14,120.00
b) Toilet and Bath - - - - - -₱ 10,500.00
c) Septic Vault - - - - - - -₱ 9,600.00

3.12 Hardware and Fasteners - - - -₱ 47,731.00

3.13 Plumbing Supplies and Fixtures - - - - - - - - -₱ 19,389.00

3.14 Plywood (or Tar Paper) ₱ 7,100.00

3.15 Electrical Fixtures and Supplies - - - - - - - - - -₱ 10,812.05

3.2 COST OF LABOUR

Project Aspect	Highly Skilled (₱ 60 / MH)	Skilled (₱ 50 / MH)	Semi-Skilled (₱ 45/MH)	Unskilled (₱ 35 / MH)
1. Masonry and concrete works, including site preparation and earthworks	160 MH	800 MH	____ MH	1280 MH
2. Building Frameworks	120	480	____	960
3. Sidings & Partitions Installation	160	640	____	1280
4. Flooring	80	320	____	320
5. Ceiling	80	320	____	320
6. Roofing and Canopies Installation	160	640	____	640

7. Joinery Installation	64	128		128
8. Cabinetry	80	160		80
9. Plumbing and Water	64	64		128
10. Electrical Works	64	64		64
11. Others				

4.0 PROJECT SUPERVISION AND ADMINISTRATION

Personnel	Man-Hours Usage		Cost
1. Project Engineer	1032	MH	₱ 72,240.00
2. Foreman	1032	MH	61,920.00
3. Timekeeper/Records	1032	MH	51,600.00
4. Toolkeeper/Storekeeper	1032	MH	51,600.00

5.0 COST OF FABRICATION OF FURNITURE AND FIXTURES

Labour Usage - - - - - - - - - - - - - - - - NONE Man-Hours
Labour Pay Rate - - - - - - - - - - - - - - ₱ NONE /Man-Hour
Cost of Non-Coco Lumber Materials and Supplies - - - - - - - - - - - - - - - ₱ NONE

Items Produced:

Bed Frame - - - - - - - - - - - - - - - - - NONE Units
Chairs - - - - - - - - - - - - - - - - - - NONE "
Etc. - - - - - - - - - - - - - - - - - - - NONE "

Please feel free to discuss the above scheme with your Consultant on or before 31 May 1985.

It will be highly appreciated if the above requested data be available within two (2) weeks after completion of the Project.

H. P. BRION

Cc.: UNDP - Manila
R. M. Hallet, UNIDO - Vienna
Office of the Governor, Quezon Province
Project Engineers (6)
G. G. Sta. Maria, Project Designing Architect

ANNEX X

3 July 1986

The Officer-in-Charge
Office of the Governor
Lucena City
Quezon Province

Subject : COCONUT WOOD DEMONSTRATION HOUSE,
UNIDO Project No. SI/PHI/84/801

Dear Sir :

We are in receipt of cost data on the above Project, which was jointly sponsored by UNIDO-Vienna and UNDP-Manila, in cooperation with your office. The cost data was submitted to the undersigned on 2nd May 1986, almost a year after the same data was requested from the Project Director, who is also the Provincial Engineer of Quezon Province. We have analyzed the cost data and would like to share with you our observations and findings on the data submitted to us by the Project Director :

(a) The total project cost amounted to about ₱647,000. This amounts to ₱6,470 per sq.m., which is approximately the cost of multi-storey condominiums or first class residential buildings in Dasmariñas Village or Forbes Park, in the Philippines' premiere town of Makati, Metro Manila.

(b) There is a charge of ₱237,360 for project supervision and administration. This amount is quite unrealistic. This is the first project we have handled under UNIDO sponsorship where the supervision and administration cost amount to 36.67% of the total project cost.

Among the charges under this item were : 1,032 man-hours each for the Project Engineer, the Foremen, the Timekeeper/ Record Clerk, and the Toolkeeper/Storekeeper Clerk. It may be possible for the Project Engineer and the Foremen to have spent 129 man-days each (1,032 an-hours) if they were on the job. However, the Consultants do not recall that the Project Engineer spent that much time during the construction of the Project. In fact, the first Project Engineer, Mr. Nierva, was relieved of his duties in this Project because of excessive absenteeism which led to mistakes in delineating the lay-out of the coco wood house. The post of Project Engineer was then assigned to Mr. Lito Ayala, who had to carry this responsibility in addition to his other multifarious duties at the office of the Provincial Engineer's Office and supervisor for coco wood preservation and prefabrication operations. This prevented him from devoting the stated length of time to the Project.

Furthermore, for each group of construction activities, as can be seen in the attached sheets, it will be noted that

there are charges for the services of Foremen and Civil Engineers. Therefore, there is no basis for charging another 1,032 man-hours or 129 man-days each for Project Engineer and Foremen. As far as the services of the Timekeeper and Tool-keeper are concerned, we believe that 1,032 man-hours for the job under the Project is too much! Had they really spent that much time working on the Project then this cost data would have been submitted to us at a much earlier date and in a more understandable and usable form!!!

The same odd situation is also reflected when the Project's unit construction cost and supervision and administration costs are compared to data from the local construction industry.

Among the more glaring discrepancies in the presentation of cost elements, we would like to call your attention to the following :

(c) ITEM 2.12 COST OF BUCKING COCO LOG BOLTS

Cost Element (iii) Cost of Equipment Usage: ₱10,431.50

The equipment used in bucking coco log bolts into desired lengths is the chainsaw. The chainsaw used in the Project is the short model having a sawblade length of about 20" or 50 cm. At the time the chainsaw was used in the Project it cost about ₱6,500. Therefore, it means that the Project was charged with the cost of about 1-1/2 times the original value of the equipment used. This is quite unrealistic and leads one to question the accuracy of the manner the cost data was generated.

(d) ITEM 2.14 COST OF LOADING AND UNLOADING COCO LOG BOLTS

Cost Element (iii) Cost of Equipment Usage: ₱33,920.00

An amount of ₱33,920 was charged for the cost of equipment used in loading and unloading coco log bolts. During actual observations of the loading and unloading operations in the course of the early stages of the Project, loading was principally done manually with the aid of a winch cable attached to the front of the six-by-six dump trucks. This method of loading coco log bolts on the dump trucks was never changed throughout the course of the Project. Unloading at the sawmill site was done by tilting the dump carriage of the dump truck and the job was done within a few minutes' time. In case the dump truck tilting mechanism did not operate while unloading coco log bolts at the mill site, the crane (equipped with grappling claws) belonging to the sawmilling contractor was used to unload the dump truck at no charge to the Project. This was done upon representation of this Consultant with the sawmill management. Unfortunately, no forklift or crane was observed during the visits to the coconut stem logging operations at Binaha-an, Pagbilao.

In the light of this observation, therefore, the amount of ₱33,920 could not be accepted as realistic.

(e) ITEM 2.15 COST OF HAULING COCO LOG BOLTS

Cost Element (iii) Cost of Equipment/Vehicle Usage: ₱26,550.00

This amount should be adjusted to deduct the cost of vehicle or equipment usage during one leg of the round-trip journey from coco log cutting site to the sawmill, or vice-versa, when the vehicle was used for other purposes (like hauling other forms of materials : rocks, cement, etc., which were needed by the Engineer's Office for other projects). There were a number of instances when this happened.

(f) ITEM 2.221 HAULING COST COMPONENT ALLOTED TO THE TRANSPORT OF MILLED LUMBER FROM THE SAWMILL TO SARIAYA, PAGBILAO OR THE JOB SITE IN LUCENA CITY

The cost report indicate a total of 181.28 cu.m. of milled coco lumber as having been transported at a total cost of ₱37,962. Records in the possession of this Consultant on the daily coco lumber production showed a total of approximately 66 cu.m. of milled lumber for the entire Project. It is therefore, impossible to have transported 181 cu.m. of lumber from the sawmill to any of the three (3) processing or utilization areas of the Project.

(g) ITEM 2.222 and ITEM 2.41 COST CHARGES ON CCA TREATED COCO WOOD

It is a fact, supported by pictures taken by these Consultants during the progress of the construction phase of the Project, and including the pictures taken during the monitoring visits in company with officials from UNDP-Manila, that there was no prefabrication activity involving the above-cited item-components of the coconut house. In fact, these items : shingles roofing, sidings and partitions were installed "en situ". Therefore, charges on the prefabrication of the above-mentioned three (3) components of the coco wood house are not acceptable.

Among other minor discrepancies in cost charges are the following :

i - It is not readily acceptable that the labour pay rate in the Philippines particularly in Lucena City is ₱30 per man-hour. This amounts to about ₱240 per day, which is unbelievable in the Philippines. Perhaps it was meant as ₱30 per day ?

ii - There is also a possible breach of professional regulation in connection with electrical installation works. There is a cost charge of ₱560 for the labour of a C.E. (Civil Engineer). If this Civil Engineer was used to supervise the electrical installation works then the Project management broke the professional regulation code requiring that an Electrical Engineer should supervise electrical installation works.

In view of the foregoing, your Consultants find it impossible to accept the coco wood project costs, dated 25 April 1986, as reported by the Provincial Engineer, who was concurrently the Project Director. We are,

therefore, constrained by time limits to proceed with the completion of our respective reports without the use of the cost data submitted by the Project Director.

Very respectfully yours,

UNIDO Project Consultants :

HORATIO P. BRION
Secondary Wood Processing Consultant

GREGORIO G. STA.MARIA
Designing Architect

Attcht.: as stated.

cc: R. M. Hallett, UNIDO-Vienna
SIDFA, UNDP - Manila

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