

	Hokule'a	Calculated Per Design Hawaiiiloa	11/15/91 Weight Revisions	
A) Hulls	12,000	16,000	14,000	11,543 -2,000
1) Wae		990	990	443 0
2) Iako		4,058	3,045	2253 -1,013
3) Gunwales		2,160	1,447	1440 -713
4) Manu		1,728	1,158	2520 -570
5) Lashing	21,600	200	200	18,160 0
6) Caulking		50	50	0 0
7) Back manu spreader	120	73	73	0 0
8) Front manu spreader	80	162	162	0 0
Total	12,200	25,421	21,125	-4,296
B) Other Canoe Parts				
1) Decking				
a) Iako caps	500	0	0	0
b) Pali wae	140	248	124	-124
c) Center rig	120	52	35	-17
d) Decking w/bow platform	1,580	1,608	1,077	-531
e) Cat walk	360	400	268	-132
f) Mast steps				
- mango	100	400	262	-138
- koa	140			0
g) Netting	50	50	50	0
Total	2,990	2,758	1,816	-942
2) Sweeps				
a) Side (2x)	200	500	375	-125
b) Center	140	250	187	-63
Total	340	750	562	-188
3) Posts & Rails				
a) Posts & navigation platform	360	360	360	0
b) Side rails (2 pieces)	260	366	366	0
c) Back rail (1 piece)	60	40	40	0
d) Back spreaders (3 pieces)	60	120	120	0
e) Navigation platform & net rails	0	161	161	0
Total	740	1,047	1,047	0

		Per Design	Weight	
	Hokule'a	Hawaii	Design	Revisions
	Hokule'a	Hawaii	Revisions	
4) rigging				
a) Masts w/rigging		320	320	0
a) Masts w/rigging	240	320	320	0
- 2 1	200			
b) Spars	200	330	330	0
b)- Spars splint	180	330	330	0
- 2 w/splint	160			
c) Boom w/o splint	160	220	220	0
c) Boom	180	220	220	0
- 2 1	140			
d) Donuts & line	60	180	180	0
e) Donuts & line	100	120	120	0
f) Total rigging	0	300	300	0
f) Total rigging	1,260	1,480	1,480	0
Total	1,260	1,470	1,470	0
Grand-Total	17,530	31,446	26,020	
Grand-Total	17,530	31,446	26,020	

	<u>Hokule'a</u>	<u>Calculated Per Design Hawaii Loa</u>	<u>11/15/91 Weight Revisions</u>	
4) rigging				
a) Masts w/rigging		320	320	0
- 1	240			
- 2	200			
b) Spars		330	330	0
- 1 w/splint	180			
- 2 w/o splint	160			
c) Boom		220	220	0
- 1	180			
- 2	140			
d) Donuts & line	60	180	180	0
e) Sails	100	120	120	0
f) Total rigging	0	300	300	0
Total	1,260	1,470	1,470	0
Grand-Total	17,530	31,446	26,020	

\* PER 1" compression @ hwl = 4683 LB of Displ

		Calculated	11/15/91	
		Per Design	Weight	
	Holeing a	Holeing a	Retentions	
A) Holes	1210000	1616000	1416000	-2,0000
1) 1) Wale		9990	9990	0 0
2) 2) Jalko		4,4558	3,0451	-1,0103
3) 3) Gravelles		2,2060	1,4477	-71213
4) 4) Manu		1,7228	1,1558	-57970
5) 5) Ashing		2000	2000	0 0
6) 6) Ashing		5050	5050	0 0
7) 7) Backfill at the pier	1200	7373	7373	0 0
8) 8) Friction at the pier	800	1662	1662	0 0
Total	1212000	2542421	21212625	-4,2986
B) Other Details				
1) 1) Decking				
a) a) Jalko caps	5000	0 0	0 0	0 0
b) b) Pile wale	14040	24248	12424	-12424
c) c) Decking	12020	5252	3535	-1717
d) d) Decking at the pier	1,5980	1,8008	1,07077	-5331
e) e) Decking	3660	4000	2668	-1332
f) f) Manholes				
- manhole	1000	4000	2662	-1338
- kapa	14040			0 0
g) g) Netting	5050	5050	5050	0 0
Total	2,9990	2,7558	1,81616	-9442
2) 2) Fenders				
a) a) Fender (2x)	2000	5000	37575	-12525
b) b) Center	14040	2550	18737	-6363
Total	34040	7550	5632	-1888
3) 3) Pile Details				
a) a) Pile at the pier	3660	3660	3660	0 0
b) b) Pile at the pier (pieces)	2660	3666	3666	0 0
c) c) Backfill (pieces)	6060	4040	4040	0 0
d) d) Backfill at the pier (pieces)	6060	12020	12020	0 0
e) e) Navigation at the pier & other Pile	0 0	16161	16161	0 0
Total	74240	1,9447	1,9447	0 0
		Calculated	11/15/91	

Canoe Weights - LWL @ 2' draft: Hokule'a, 25,000 and Hawaii'loa, 26,000  
 Canoe Weights - Maximum full weights: Hokule'a, 26,000 and Hawaii'loa, 27,000

	<u>Hokule'a</u>	<u>Hawaii'loa</u> <u>(for voyage)</u>	<u>Calculated</u> <u>Per Design</u> <u>(for sea trials)</u>	<u>11/15/91</u> <u>Weight Revisions</u> <u>(for sea trials)</u>
A) Bare Boat				
1) Hulls	12,200		25,421	21,125
2) Decking	2,990		2,758	1,816
3) Sweeps	340		750	562
4) Posts & Rails	740		1,047	1,047
5) Rigging	1,260		1,470	1,470
Total Bare Boat	17,530	0	31,446	26,020
B) Loaded				
1) Persons	2,380	1,360	1,700	1,700
2) Water	2,145	1,820	98	65
3) Food	1,470	840	50	25
4) Equipment	2,500	1,500	1,000	500
Total Loaded	8,495	5,520	2,848	2,290
ESTIMATED LOADED WEIGHT	26,025	5,520	34,294	28,310

		Calculated Per Design	11/15/91 Weight	
	<u>Hokule'a</u>	<u>Hawailoa</u>	<u>Revisions</u>	
4) rigging				
a) Masts w/rigging		320	320	0
- 1	240			
- 2	200			
b) Spars		330	330	0
- 1 w/splint	180			
- 2 w/o splint	160			
c) Boom		220	220	0
- 1	180			
- 2	140			
d) Donuts & line	60	180	180	0
e) Sails	100	120	120	0
f) Total rigging	0	300	300	0
Total	1,260	1,470	1,470	0
<b>Grand-Total</b>	<b>17,530</b>	<b>31,446</b>	<b>26,020</b>	

Canoe Weights - Maximum full weights: Hokule'a, 26,000 and Hawaii'loa, 27,000			
	Hokule'a	Hawaii'loa	Hawaii'loa
		(for voyage)	(for sea trials)
A) Bare Boat			
1) Hulls	12,200	16,494	19,674
2) Decking	2,940	2,010	2,010
3) Sweeps	340	374	374
4) Posts & Rails	740	797	797
5) Rigging	1,260	1,397	1,397
Total Bare Boat	17,480	21,072	24,252
B) Loaded			
1) Persons	2,380	1,360	1,700
2) Water	2,145	1,820	98
3) Food	1,470	840	50
4) Equipment PACALA (INC)	2,500	1,500	1,000
Total Loaded	8,495	5,520	2,848
ESTIMATED LOADED WEIGHT	25,975	26,592	27,100

3700 16,974  
✓  
✓  
✓

1/2 x 2 x

50

↓

~~2~~

1000

12

60

↓

~~2~~

720

600



## SAILS

The canoe sails (ra) which are now made of canvas were formerly made of pandanus leaf, plaited in long, narrow sections which were sewn together. Two matting sails were still in existence on the atoll during our visit, and we were so fortunate as to procure one of the complete strips of matting used in the manufacture of sails (fig. 73). This strip now in Bishop Museum (C. 10083) is 34.5 feet long and 9.2 inches wide, and the plaiting has 7.5 wefts to the inch.

The plaiting technique is identical with that of the pandanus mats already described. Commencing at the lower left corner, a working edge of 12 dextrals was established in check. The butt portions for the dextrals were added at the upper end of the working edge, and the butt portions for the sinistrals were added at the lower edge of the plaiting. The plaiting continued in check with the working edge of 12 dextrals, six down and six up, for a convenient distance, as it would have been too complicated to continue the section continuously for the length of 34.5 feet. Therefore, having reached a length of 5 or 6 feet, some of the dextrals were doubled back under crossing wefts to prevent the right end of the section from unraveling. The first section in check is 1.1 inches in depth.

Returning to the left, another section was built up at the left edge but the unsplit butt portions at the upper edge of the plaiting must have been cut off to clear the way for the next section of plaiting. In this second section, the pattern was changed to a twilled-two, and this was continued to the end of the section. Some of the dextrals were again doubled back to lock the right end of the plaiting. A series of sections was added until the twilled part of the plaiting reached a depth of 7.0 inches. The last section was now built up from the turned left edge in check until the working edge was composed of 12 dextrals. The top left corner was formed with the same technique as that in figure 71, and the top edge formed in the same way. This last section in check is 1.1 inches deep, thus making the full depth of the plaited band 9.2 inches. The cutting off of the lower butt portions and of the individual dextrals and sinistrals at the upper part of the plaiting was the same as in the sleeping mats.

The technique described completed the left end of the plaited band for the five or six feet that was undertaken at one time. The rest of the 34.5 feet was continued with the same technique until the full length was attained. The right lower corner and the right edge were completed in the usual mat technique. In the right upper corner, however, the last two dextrals, instead of being pushed back under crossing wefts, were simply tied together with a reef knot.

The long bands were rolled up until used in making the sail. The full type specimen is 9.2 inches wide, as stated, but a piece of another specimen collected is 11.75 inches in width. It was made in the same way with the first and last sections in check and the part between in twilled-twos. The plaited bands used in the two sails seen were all made in the same way. The method of using the plaited bands in the construction of the sails is described in the section dealing with canoes.

The last three wefts from the right edge play the principal part in the technique described, but the reverse technique may be adopted, that is, using the last three top dextrals to complete the upper and right edges.

#### SAILS

The canoe sails (*ra*) which are now made of canvas were formerly made of pandanus leaf, plaited in long, narrow sections which were sewn together. Two matting sails were still in existence on the atoll during our visit, and we were so fortunate as to procure one of the complete strips of matting used in the manufacture of sails (fig. 73). This strip now in Bishop Museum (C.10083) is 34.5 feet long and 9.2 inches wide, and the plaiting has 7.5 wefts to the inch.

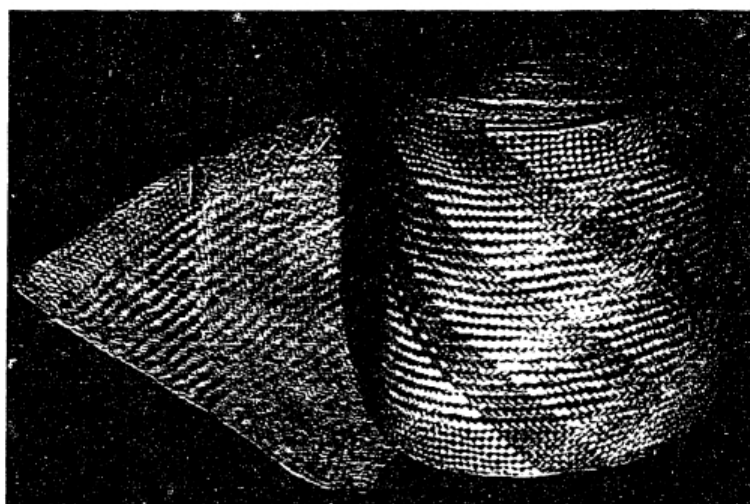


FIGURE 73.—Panel of sail matting.

The plaiting technique is identical with that of the pandanus mats already described. Commencing at the lower left corner, a working edge of 12 dextrals was established in check. The butt portions for the dextrals were added at the upper end of the working edge, and the butt portions for the sinistrals were added at the lower edge of the plaiting. The plaiting continued in check with the working edge of 12 dextrals, six down and six up, for a convenient distance, as it would have been too complicated to continue the section continuously for the length of 34.5 feet. Therefore, having reached a length of 5 or 6 feet,

## DOCUMENTS C'ABITIBEN A LA MEMORIA DE...

**To:** PVS

From: Wright Bowman, Jr.

3

1

Break down for additional materials needed for the HawaiiIoa.

## Koa

**Mast step** 2 pcs.

Mast spine 2 pcs

Pali wae (top) 4 pcs

Pali wae 4 pcs

904.71

445.55

## Ohio

**Mast** 3 pcs.

**Spar 4 pcs.**

**Boom** 4 pcs.

**7386.50**

138.25.

**Other Cost**

### Shipping from Hilo to Honolulu

### Hauling from pier to Bishop Museum

Atherton Halau in canoe work area

225.00

50.00

**Total**

**9150.01**

• **9150.01**

Working in coordination with the Polynesian Voyaging Society (PVS), contractor will coordinate, oversee and construct a lauhala sail for the voyaging canoe, *Hawaiiloa*. Contractor will follow the design specifications listed below.

**Design Specifications:**

- Construct 8 panels
- Each panel will measure 39" wide
- Panel lengths will measure: 24', 22', 19', 16', 13', 10', 8' and 7'

Contractor will coordinate individuals, monitor progress of project and give verbal progress reports to PVS administrator.

Contractor will possess the following qualifications:

- 1) Experience and knowledge of lauhala weaving;
- 2) Knowledge of lauhala properties;
- 3) Demonstrated ability to network and cooperate with people throughout the community; and
- 4) Demonstrated commitment to the Native Hawaiian community and culture.

In full consideration of the work satisfactorily performed by the Contractor under this contract, PVS will pay the Contractor a total sum of \$15,000.

Payments will be made upon submission by the Contractor of an invoice for satisfactory completion of work to PVS.

This contract is hereby agreed upon by the following parties and executed on the signed date of this contract:

**POLYNESIAN VOYAGING SOCIETY**

\_\_\_\_\_  
Myron B. Thompson, President

\_\_\_\_\_  
Date

**CONTRACTOR**

By: \_\_\_\_\_  
Signature

\_\_\_\_\_  
Title

\_\_\_\_\_  
Date

coor-lau - 2/17/93

Food purchased

[OUR RECEIPT  
Thank you  
Call again]

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20:56  
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04 •2435 I  
03 •275 I  
03 •275 I  
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4  
•2985EI  
•119II  
31190

Chk #101  
12/23/95

**LAUHALA WATERPROOFING  
INITIAL TEST RESULTS**

**WEIGHT SOAKED IN FRESH WATER**

	DRY WT.	5 min.	10 min.	20 min.	30min.
Linseed oil	1.0 oz.	1.5 oz.	1.5 oz.	1.55 oz.	1.6 oz.
Coconut oil	1.75 oz.	2.0 oz.	2.0 oz.	2.0 oz.	2.0 oz.
Flecto oil	1.0 oz.	1.25 oz.	1.5 oz.	1.5 oz.	1.7 oz.
Thompsons w.s.	1.0 oz.	1.25 oz.	1.35 oz.	1.35 oz.	1.5 oz.
Scotch guard	1.5 oz.	1.75 oz.	1.85 oz.	2.0 oz.	2.5 oz.
Kukui nut oil	-----	-----	-----	-----	-----

**RECOMMENDATION :** Based on the test results shown above, Coconut oil seems to offer better waterproofing qualities than the synthetics tested. Therefore in keeping with ancient traditions, and staying within the guidelines of the HAWAII LOA project, Coconut oil will be the best waterproofing treatment for the Lauhala sails and Pa'u covers.

**TEST PERFORMED BY:**

**ALLEN M. PAQUIN  
HAWAII MARITIME CENTER**

### **Pros**

- Less strain on booms
- Easier to fit sails to boom
- Easier to repair boom and spar
- Safer rig to triest in bad weather
- Easier to sheet
- Center of effort lower
- Easier to stretch out sail
- Boom is replaceable with rail
- Easier and safer to lower in storms
- Strain on boom equally distributed
- Provide more sail area for length of boom and spar
- Booms are easier to construct

### **Cons**

- Less support for leech
- More strain on top of spar
- Less asthetic
- May not be traditional

### **1 Sail vs 2 Sails**

#### **Pros**

- Lighter (reduce weight by 400#)
- More space
- Less weather helm
- Less required gear
- Rig less complicated
- Easier and faster to triest or lower rig in bad weather
- Easier to steer
- Can lower full rig on deck
- Require half the rigging material
- Less costs
- Easier to steer on different points of sail

#### **Cons**

- Less speed
- Less windward performance



July 2, 1991

CONTACT PERSON FOR LAUHALA: TAHITI

- I. Ms. Milda Lee
  - A. Work = Institut d'Emission d'outre mer
    - 1. phone: 430-986
    - 2. home phone: 482-958
  - \* Dial 011-689 and then above numbers
  - B. Other contact: Yoland Lee (mother of Milda)
    - 1. phone: 420-960
- II. Lauhala: 105 rolls confirmed July 2, 1991
  - A. Milda has spoken with lady handling order; rolls of hala (paore) is coming from the Austral Islands (Rimitaha ?)
  - B. It will take a month to gather; storms, etc.
  - C. Cost is still \$7/roll, not including freight, etc.  
Milda called this date to request payment to lady. Particulars to send \$ shared with Jarnell.
    - 1. Lady requesting payment.
    - 2. Jarnell will need invoice.
  - D. Elisa will be in Tahiti on the 12th. Either she or Wayne Chang who also leaves for Tahiti on the 12th can deliver check if necessary.
- III. Bank Info: if money is sent for lauhala
  - A. Ms. Milda Lee
  - B. Bank of SOPREDO  
P.O. Box 130  
Papeete, Tahiti
  - C. Office #: 00001
  - D. Acct #: 00249300725
  - E. Code:
  - F. Key:

LAUHALA WATERPROOFING  
INITIAL TEST RESULTS

WEIGHT SOAKED IN FRESH WATER					
	DRY WT.	5 min.	10 min.	20 min.	30min.
Linseed oil	1.0 oz.	1.5 oz.	1.5 oz.	1.55 oz.	1.6 oz.
Coconut oil	1.75 oz.	2.0 oz.	2.0 oz.	2.0 oz.	2.0 oz.
Flecto oil	1.0 oz.	1.25 oz.	1.5 oz.	1.5 oz.	1.7 oz.
Thompsons w.s.	1.0 oz.	1.25 oz.	1.35 oz.	1.35 oz.	1.5 oz.
Scotch guard	1.5 oz.	1.75 oz.	1.85 oz.	2.0 oz.	2.5 oz.
Kukui nut oil	-----	-----	-----	-----	-----

RECOMMENDATION : Based on the test results shown above, Coconut oil seems to offer better waterproofing qualities than the synthetics tested. Therefore in keeping with ancient traditions, and staying within the guidelines of the HAWAII LOA project, Coconut oil will be the best waterproofing treatment for the Lauhala sails and Pa'u covers.

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