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FISHERIES TSUNAMI EMERGENCY PROGRAMME

INDONESIA

Final report on visits to Aceh Province to prepare construction standards for wooden fishing vessels and drawings of wooden vessels to be constructed under the reconstruction and development programme in Indonesia

by
Daniel Davy,
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April 2006

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1. Executive Summary

1.1 Fishing Vessels in Aceh

- Most fishing vessels in Aceh are of traditional timber construction making use of the considerable timber resources of the province.

- The standard of boat construction observed varied widely and at times was down to a level which is considered unacceptable.

- Some good boatbuilding skills do exist in Aceh and there is a tradition of building fishing vessels which are suited to the prevailing conditions.

- Most fishing vessels are lightly built and construction is not equivalent to any international standard.

- Vessel life span is generally short at less than 5 years for small vessels and less than 10 years for larger vessels. Considerable maintenance is required, mainly in the form of re-caulking or sheathing to stop leaks.

- The majority of vessels on the East coast are small (< 8 m), un-decked and motorised. There appears to be a preference for the high bow, broad transom "Aceh" style.

- Most small vessels on the West coast are slender canoe types based on a dug-out and fitted with outriggers and petrol inboards; larger vessels are generally decked and fitted with diesel inboards.

- When considering vessel design and improvement it is important to understand the distribution of vessel types and the local preferences.

- No written construction or safety standards applicable to small fishing vessels in Indonesia or Aceh province are available.

- In theory all fishing vessels in Aceh province should be registered and those over 5 GT should also have a fishing licence.

- FAO in Banda Aceh have been asked by BRR to draw up minimum standards and guidelines for boat construction during the rehabilitation and reconstruction phase.

- Many of the construction problems that are encountered with newly built boats are very basic in nature but can result in poor quality, potentially unsafe and high maintenance boats being delivered to beneficiaries.

- Some replacement fishing vessels handed over to beneficiaries are so poorly built that they may not be useable at all or if used will have a very short lifespan; needing replacement in 1 to 2 years time.

1.2 FAO Boatbuilding Activities

- Continued supervision of the boatyards is required in order that the FAO contracts do in fact produce “better boats”. In particular quality of construction needs to be monitored.

- The improved frame construction has proved difficult for builders to execute as intended by designer.

- The improved keel and shaft log design is generally executed well by the builders and they appreciate the additional strength. However, concerns including: weight, keel depth and the interference with bailing are expressed.

- The availability of sufficient fastenings is an ongoing problem and is a significant factor in progress being slower than planned.

- In order to complete FAO contracts by required dates delivery pressure will need to be applied to NGO’s.

- A number of improved vessel designs were considered for construction by FAO partner boatyards. The basis for all designs is the existing type used in the location; however, specific improvements in design and construction are incorporated where appropriate.

1.3 Development of Construction Standards

- FAO have been asked by BRR to draw up minimum standards and guidelines for boat construction. This is necessary to allow the monitoring of existing boatbuilding contracts, provide guidance to NGO’s and to set standards for new contracts.

- A document titled *Notes on Good Practice for the Construction of Fishing Vessels* was prepared for discussion, comment, translation and publishing in booklet form.

- Adherence to such guidelines should improve overall standards of construction thereby improving safety at sea, reducing vessel maintenance and increasing vessel longevity.

- The international standards investigated are of limited use for small scale and artisanal vessels for a number of reasons but mainly as they take no account of the intended use of vessels and the cost implications may put vessels beyond the reach of fishermen.

- Investigations indicate the need for a new approach to construction standards to ensure that they are applicable to small fishing vessels operating in less severe sea and weather conditions than those covered by most recognised standards.

- The proposal is the introduction of design categories as incorporated in the ISO standard.

- The incorporation of design categories into construction standards provides the means and justification for the use of lighter scantlings in small fishing vessels which operate in less severe conditions.

- Draft standards for timber and FRP construction have been submitted to and remain under development with the IMO correspondence group on fishing vessel safety.

- There is little awareness of health and safety issues and little enforcement of regulations. From the users point of view there may be little perception of the need for further regulation in fisheries.

- If regulation is to be increased in small scale fisheries it will need to be appropriate in terms of technology and economics; sensitive to traditions and expectations of boat owners; locally administered and receptive to the ideas and interests of users.

- It is also considered that new standards should to be a long term objective and that in the short to medium term a phased approach is adopted.

1.4 Conclusions and Recommendations

- Continued supervision of boatyards is necessary to ensure that the FAO contracts do in fact produce “better boats”, in particular construction quality needs to be closely monitored.

- The use of national boatbuilders to inspect boats and provide technical support to boatyards should be promoted. Additional staff may be required.

- The improved construction methods introduced by FAO (frames, keel and shaft log) require further support for builders to help them complete these parts of the boat correctly.

- Pressure to deliver boats for FAO contracts on time should be applied to NGO’s undertaking contracts for FAO.

- Careful monitoring and control of the procurement and supply of fastenings (and other equipment) to boatbuilders is required to avoid stoppages and delay.

- Consideration should be given to the procurement of hot dipped galvanised fastenings locally or in Medan rather than importing them as before.

- If the boatbuilding activities planned by FAO for Nias and Simeulue are not to be completed the identified beneficiaries should be informed so that they can obtain assistance from alternative sources.

- The "Notes on Good Practice" should be published in booklet form and distributed to NGO's and other interested parties for use in the vessel reconstruction programme in Indonesia.

- The construction standards proposed in this report will require further development and refinement.

- Any additional regulation for artisanal fisheries in Indonesia should be appropriate, sensitive and receptive to the interests of users. A phased introduction of standards is likely to assist in compliance.

- The improved designs developed for FAO boatyards should be fully reviewed and discussed with the boatbuilding team in Aceh in order that the details are appropriate for both the builders and the intended users.

2. Findings and Observations

2.1 Fishing Vessels in Aceh

2.1.1 Vessel Construction

During the two visits investigations were made into standards of vessel construction in Aceh. Generally there are some good boatbuilding skills in the province and there is a tradition of building fishing vessels which are suited to the prevailing weather, landing facilities and economic conditions.

However, the standard of construction observed during the visit varied widely and on occasion was down to a level which is considered unacceptable. It is likely that the main causes of this diminished standard are current emphasis on quantity rather than quality of vessels and the increased demand for this specialised skill which brings less experienced workers into the trade.

Overall most types of fishing vessel are lightly built and their scantlings and details of construction are not equivalent to any international standard. However, a carefully built example of a local vessel is capable of providing an adequately safe platform if used in the intended way and if given suitable maintenance.

The steps involved in traditional Aceh boatbuilding are as follows, the technique is similar to that seen in a number of countries in the region.

- Keel set up on supports and curved to the desired shape. Stem and stern post are fastened to the keel;
- First plank on each side fastened to the stem and twisted outward in the middle to form the beginning of the vessel shape;
- Hog is not generally included so first planks are edge fastened to the keel;
- Planking is built up first, judging shape by eye and the use of limited formers;
- Planking is 19/20 mm thick on smaller vessels, increasing to 25 mm and 30 mm as vessel size increases. Planks are generally edge nailed together;
- Planks are often relatively wide at greater than 6 times plank thickness and frequently have butts positioned close together in adjacent strakes;
- Frames are shaped and installed once planking is complete; they are generally spaced between 400 and 550 mm apart;
- Frames and floors are joined in an overlap at the turn of bilge with a pair of bolts. Floors are bolted to keel timber.

The drawbacks of this type of construction are low overall vessel strength and rigidity and the difficulty encountered in the maintenance of watertight integrity. Vessel life span is

generally short at less than 5 years for small vessels and less than 10 years for larger vessels although these may be rebuilt to extend this. Considerable maintenance is required, mainly in the form of re-caulking or sheathing to stop leaks, this results in lost fishing time and additional expense.

2.1.2 Vessel Types

During the two visits investigations were made into the types of fishing vessels in use along the East and West coasts of Aceh including Nias and Simeulue islands. The vessels considered are limited to those less than 24 m in length and by no means represent a complete listing of available types, there may also be some overlap between categories. Vessel details are given in Annex B.

Almost all fishing vessels in Aceh are of traditional timber construction making use of the considerable timber resources of the province.

The majority of vessels in use on the East coast are small (5 to 8 m), un-decked and fitted with engines; the engines used include 4-stroke petrol inboards of 5.5 and 9 hp, diesel inboards of 16 and 23 hp and outboards of 15, 25 and 40 hp. Overall there appears to be a preference for the high bow, broad transom style, see *types three and four*. The most numerous engines are diesel inboards manufactured in China; however, fishermen often express a preference for petrol outboards which they consider to be more reliable. Landing sites vary along the coast and include rivers and harbours as well as open beaches where surf conditions are generally small.

The West coast, including Nias and Simeulue islands, is generally more exposed and rougher than the east coast and this is reflected in the vessel designs. Most small vessels are slender canoe types based on a dug-out and fitted with outriggers and petrol inboards; larger vessels are generally decked and fitted with diesel inboards. Landing sites are mainly rivers and harbours as surf can be large on exposed beaches, however, Nias and Simeulue also have a more protected east coast with good beach landing sites.

For vessel design and improvement it is important to understand the distribution of vessel types and the local preferences as well as the ongoing evolution and design changes. Two important demonstrations of this were observed:

- There appears to be an increasing preference in Aceh for the high bow, broad transom style (*types three and four*). This may be an assertion of Achenese identity and effectively a rejection of vessel designs considered to be from other areas.
- On Nias island some donors have procured boats from boatyards in the south of the island and delivered them to fishermen in the north of the island. Many fishermen have rejected these boats partly due to poor construction quality but mainly as they are not like the boats they use in the north.

2.1.3 Construction Standards

During the two visits investigations into construction regulations were made in Aceh, it was found that no written construction or safety standards applicable to small fishing vessels in Indonesia or Aceh province are available.

Discussions in Jakarta confirmed that regulations applicable to small fishing vessels are not available. However, it was found that the Indonesian Bureau of Classification publish rules for scantlings of wooden vessels (as well as GRP vessels). These rules are written in Indonesian; however, it was possible to establish the following:

- The tables of scantlings are applicable to vessels from about 8 to 10 m in length;
- The scantlings resulting from the rule are heavy compared to those used in traditional construction.

Discussions with DKP indicated that in theory all fishing vessels in Aceh province should be registered and those over 5 GT should also have a fishing licence. In order to apply for a licence a physical inspection of the vessel needs to be made by the harbour master and certificates of measurement, compliance (machinery, anchoring etc) and suitability to proceed to sea issued. The inspection of construction is visual and appears to be based only on the opinion and experience of the inspector.

FAO in Banda Aceh have been asked by BRR (Badan Rehabilitasi dan Rekonstruksi) to draw up minimum standards and guidelines for boat construction during the rehabilitation and reconstruction phase. Such standards are necessary to allow the monitoring of existing boatbuilding contracts, provide guidance to NGO's and to set standards for new contracts.

Many of the construction problems that are being encountered with newly built boats are very basic in nature but can result in poor quality, potentially unsafe and high maintenance boats being delivered to beneficiaries. For understandable reasons initial emphasis in boatbuilding is often on quantity rather than quality of construction and this has contributed to the problem.

Some replacement fishing vessels already handed over to beneficiaries are so poorly built that they may not be useable at all or if used will have a very short lifespan; needing replacement in 1 to 2 years time. Others may be abandoned once the engine is removed. There are very likely to be instances where new vessels are built to such a poor standard that action should be taken to ensure that they are not handed over to beneficiaries at all.

2.2 FAO Boatbuilding Activities

2.2.1 Review of Boatyards

As part of the support to boatbuilding activities four of the six boatyards were visited during the second visit to Aceh in Feb 06.

Visits to boatyards were undertaken at the request of boatbuilders for the following reasons:

- Inspection of vessels in order that construction can proceed;
- Discussion of fastening use and delivery of fastenings;
- Discussion of frame construction;
- Discussion of engine bed installation.

At the time of these visits there were a number of ongoing difficulties with the boatbuilding programme. A report that highlights progress and problems is included in Annex C and the main findings are listed below.

Annex J indicated progress of boatbuilding contracts at the time of the visits.

Continued supervision of the boatyards is required in order that the FAO contracts do in fact produce “better boats”. In particular quality of construction needs to be monitored and the following areas require attention:

- timber selection;
- frame joint details;
- use of primer;
- shaping of deadwood;
- width of plank seams;
- cutting of limber holes.

The improved frame construction has proved difficult for builders to execute as intended by designer. For this reason a variation incorporating gussets on each side of the join was developed. However, boatbuilders still struggle with this and it is executed with varying degrees of success.

It is likely that the improved frame construction has some potential and if completed by the master boatbuilder it would be an improvement and may also make procurement of suitable framing timber easier. Therefore it is recommended that further support is provided to builders to help them complete this part of the boat correctly.

The improved keel and shaft log design is generally executed well by the builders and they appreciate the additional strength provided. However, they often express concerns which include: additional weight of construction, additional keel depth making it difficult for

landing and hauling onto beach and the interference of the hog with bailing water from the bottom of the boat. It is possible that the improved keel/shaft log design will be adopted by some builders as they can see the benefits, however, it is also possible that they will not incorporate the hog as intended as they consider this to be a problem.

The installation of the engine beds requires the support of the international boatbuilder since the NGO's have not been supplied with detailed drawings of the engine beds or welded frame. It was recommended that initial boats had engine beds installed in the traditional manner until the new master boatbuilder was able to provide further supervision.

It was recommended that an audit of fastenings required, available and delivered is completed urgently to establish the position for future boats.

It is recommended that delivery pressure is progressively applied to NGO's undertaking contracts for FAO. It is understandable that the first batches of vessels are slow in production as there is a learning and demonstration process involved.

2.2.2 Delays to Boatbuilding Activities

During the second visit to Aceh it was noted that considerable difficulties were being experienced with the supply of fastenings to the boatyards working on FAO contracts.

The key points are how many fastenings are required to complete FAO boatbuilding activities; have been ordered; have been distributed to boatyards; remain in warehouse and need to be ordered.

It was recommended that the local staff responsible for this work should compile computer based records of the required information on fastenings. Guidance was given to local staff in the use of Excel spreadsheets to do this.

The procurement of fastenings from New Zealand appears to have caused additional delays and complication and it was recommended that consideration was given again to the procurement of hot dipped galvanised fastenings either locally or in Medan.

Information on the number of boats completed by Jan/Feb 06 and for a projection of boats likely to be completed by end June 06 was provided. This information was based on rates of vessels construction to date for resolution, a summary table is included in Annex J.

The NGO (ACTED) building the FAO 12m (INS12) design experienced difficulties and delay with lofting out frame shapes. An attempt was made to assist the staff in resolving some errors in the table of offsets; ultimately the problem was passed back to the designer.

The NGO (AIRO) asked for advice on the design of engine beds and installation of engines. The problems were discussed and it was ensured that the boatbuilders understood the intention of the designer, however, it was decided that initial boats should have engine beds installed in the traditional manner until the new master boatbuilder was able to provide further supervision.

2.2.3 Nias Island

As FAO boatbuilding activities are planned for Nias island and since the intention is to build improved designs there the island was visitied on two occasions. The first visit was of short duration and unfortunately did not cover a weekend which is a time when many fishing vessels are in port. The second visit in Feb 06 was valuable in establishing the types of vessels and gear used in various areas and in particular getting a better understanding of the Banyak Island fishery which is important in the northern part of the island.

Details of the second visit are given in the trip report in annex E.

2.2.4 New Vessel Designs

During the two visits to Aceh the development of improved vessel designs for construction by FAO partner boatyards was worked upon.

Working with the master boatbuilders in Aceh a number of improved vessel designs were considered for construction by FAO partner boatyards. The basis for all designs is the existing type used in the location; however, specific improvements in design and construction are incorporated where appropriate. The designs considered include:

1. **5.5 m planked canoe** *(type 2)* fitted with petrol inboard. This design was originally requested by beneficiaries on the east coast; however, vessels of this type have been supplied by other agencies and there appears to be a growing preference for vessels of the high bow design. Therefore the request for vessels was modified to the second type (below).

2. **5.5 m planked high bow boat** *(type 3)* fitted with petrol inboard. This design is an alternative to that described above and is preferred by beneficiaries, the main reasons given are better stability, comfort at sea and space, also this high bow style is increasingly popular. The design is derived from local boats but features improvements in construction including the use of a shaft log. The engine is the same 5.5 hp petrol unit used in local boats and installed without gearbox.

3. **9 m planked outrigger canoe** (*type 9*) fitted with petrol inboard, this design is generally referred to in FAO documents as INS 7. This design is intended for use in the islands of Nias and Simeulue, it is derived from local canoes and features improvements in construction and design. The key feature is the use of a planked

lower hull rather than the dug-out traditionally used; this avoids the need to procure increasingly rare (large) trees for this part of the canoe. There are local variations in the arrangement and construction of these canoes these mainly concern the decking and the outriggers these will be modified to meet the local requirements according to island and community. The engine may be either the 5.5 hp or 9 hp petrol units used in local boats and installed without gearbox.

4. **7 m planked outrigger** canoe (*type 8*) fitted with petrol inboard, this design is generally referred to in FAO documents as INS 6. This design is intended for use in the islands of Nias and Simeulue, it is derived from local canoes and features improvements in construction and design. The key points are as described for the 9m above. The engine is the same 5.5 hp petrol unit used in local boats and installed without gearbox.

The omission of gearboxes is important in local designs as it saves both weight and cost and allows the use of a small diameter propeller which is essential in the shallow waters near beaches and rivers. The efficiency of these installations is likely to be less than that for larger, slower turning propellers, however, the overall benefit in terms of operation and cost appears to be worthwhile.

Designs have been completed for all but the first which was not required. Details of the designs are given in Annex D.

2.3 Development of Construction Standards

During the two visits to Aceh work was done on the development of simple construction guidelines and the development of wooden vessel construction standards.

2.3.1 Minimum Standard

FAO in Banda Aceh have been asked by BRR to draw up minimum standards and guidelines for boat construction during the rehabilitation and reconstruction phase. Such standards are necessary to allow the monitoring of existing boatbuilding contracts, provide guidance to NGO's and to set standards for new contracts.

During the first visit to Aceh a document titled *Notes on Good Practice for the Construction of Fishing Vessels* was prepared for discussion and comment. During the second visit this document was updated and finalised for translation into Indonesian and subsequent publishing in booklet form. The final version of the document is shown in Annex F.

As noted earlier many of the construction problems encountered with newly built boats are very basic in nature, for this reason the minimum standard aims to address the most basic requirements of wooden boatbuilding in Aceh. Adherence to the guidelines should

improve overall standards of vessel construction thereby improving safety at sea, reducing vessel maintenance and increasing vessel longevity.

2.3.2 International Construction Standards

Investigations have been made into the suitability and practical application of various internationally recognised construction standards to the artisanal and small scale fishing vessels found in Aceh province. The standards considered include the Nordic Boat Standard, SeaFish Rules and ISO Standard (for recreational vessels); in general these standards are considered to be of limited use for small scale and artisanal vessels for the following reasons:

- No account is taken of intended use of vessel including weather, sea conditions and beach landing;
- No allowances can be made for unusual structural arrangements often found in artisanal fishing vessels;
- Scantlings are based on traditional northern European style construction;
- No allowance can be made for operator preferences such as life expectancy, build cost and maintenance requirements.

Most types of fishing vessel in Aceh are lightly built and their scantlings and details of construction are not equivalent to any recognised standard. However, a carefully built example of a local boat is capable of providing an adequately safe platform if used in the intended conditions and given suitable maintenance.

Small vessels, say less than 7 to 8 m in length, in particular are often built very lightly and whilst not necessarily dangerous they require care in the conditions and areas in which they are used.

The application of recognised construction standards to these types of fishing boats is unlikely to meet with success because the building techniques may be beyond the experience of those building the boats and the cost implications may put small boats beyond the reach of artisanal fishermen.

The key features of the rules considered are shown in Annex G.

2.3.3 New Construction Standards

Consideration of the points discussed in 2.3.2 above indicates the need for a new approach to construction standards to ensure that they are applicable to small fishing vessels operating in less severe sea and weather conditions than those implied by most recognised standards.

The key concept is the introduction of design categories as incorporated in the ISO standard. These categories, named A to D, cover a range of sea and wind conditions

from “Ocean” to “Sheltered” in which vessels are designed to operate safely. The ISO standard includes factors in strength calculations which account for the differing design loads anticipated in each of the design categories. The categories are defined as follows:

Design category A – "ocean" – Category of vessels considered suitable to operate in seas with significant wave heights above 4 m and wind speeds in excess of Beaufort Force 8, but excluding abnormal conditions, e.g. hurricanes.

Design category B – "offshore" – Category of boats considered suitable to operate in seas with significant wave heights up to 4 m and winds of Beaufort Force 8 or less.

Design category C – "inshore" – Category of boats considered suitable to operate in seas with significant wave heights up to 2 m and a typical steady wind force of Beaufort Force 6 or less. [1]

Design category D – "sheltered" – Category of boats considered suitable to operate in waters with significant wave heights up to and including 0,30 m with occasional waves of 0,5 m height, for example from passing vessels, and a typical steady wind force of Beaufort 4 or less.

There is clearly a large gap in the operating conditions defining categories C and D, for this reason it is proposed that a new category is introduced which will be relevant to a large number of small fishing vessels, the proposal is as follows:

New Design category – "nearshore" – Category of boats considered suitable to operate in seas with significant wave heights up to 1 m and a typical steady wind force of Beaufort Force 6 or less.[2]

The incorporation of such categories into construction standards provides the means and justification for the use of lighter scantlings in small fishing vessels which operate in less severe conditions.

The standard of construction to be applied is then defined according to the design category of the vessel, the proposed is shown below.

The appropriate standards of construction for wooden vessels shall be determined as follows:

- Vessels in **ALL** categories shall meet the requirements of **Part 1** of this standard;
- Vessels in categories **A** & **B** shall meet the requirements of **Part 2** of this standard;
- Vessels in category **C** shall meet the requirements of **Part 3** of this standard; [1]

[1] In conjunction with the IMO correspondence group it is proposed that this group be renamed C1
[2] In conjunction with the IMO correspondence group it is proposed that this group be renamed C2

- Vessels in the **New Category** shall meet the requirements of **Part 3** of this standard, however; [2]

- Where judged appropriate by the authorities, vessels in the **New Category**, with a length overall of less than **7 m**, may be required only to meet the requirements of **Part 1**;

- Vessels in category **D** shall meet the requirements of **Part 1** of this standard.

The table below shows the determination of required construction standards.

Category	Part 1	Part 2	Part 3
A	□	□	
B	□	□	
C	□		□
New (L>7 m) [1]	□		□
New (L<7 m) [2]	□		
D	□		

In outline Parts 1, 2 & 3 of the standard are defined as follows:

Part 1 – This section consists of a **recognised standard** for construction of wooden vessels such as the UK Seafish rules or the Nordic Boat Standard.

Part 2 – This section consists of a **minimum standard** defined by FAO.

Part 3 – This section is based on the **good practice** guidelines defined by FAO.

A number of vessel types are not covered by the requirements of these construction standards including the following:

- Vessels constructed of plywood, glued wood or wood sheathed in FRP;

- Vessels propelled by paddles or oars only;

- Dug-out canoes and other simple designs such as rafts.

Details of the construction standards proposed are shown in annex H. It should be noted that these construction standards are under development with the IMO correspondence group and require further refinement.

2.3.4 Implementation of fisheries regulations

Fishing vessels in Aceh province should be registered and those over 5 GT should also have a fishing licence. In order to apply for a licence a physical inspection of the vessel should be made by the local “harbour master” and certificates of measurement and

suitability issued. It may be possible to make use of new construction standards in this process.

The Panglima Laot or “sea captain” is a representative of fishermen at community level; this person is elected and funded by fishermen. The position appears to be affiliated to, but not in the employment of, DKP. It may be possible to make use of the Panglima Laots position in the community to implement safety regulations and new construction standards.

It appears that there is little awareness of health and safety issues and little enforcement of regulations where they exist. Consider for example poor health and safety practices in the workplace, and the dangerous overloading of vehicles. From the users point of view there may be little perception of the need for further regulation in fisheries, especially for small scale activities. If regulation is to be increased in small scale fisheries it will need to be:

- Initially in the form of guidelines;
- Appropriate in terms of technology and economics;
- Sensitive to traditions and expectations of boat owners;
- Locally administered;
- Receptive to the ideas and interests of users.

It is also recommended that any new standards are considered to be a long term objective and that in the short to medium term a phased approach is adopted, this might be along the following lines:

- Immediately all vessels to adhere to good practice guidelines, **Part 3**;
- In 2 to 5 year term relevant vessels to adhere to minimum standards, **Part 2**;
- Beyond 5 year term category A and B vessels to adhere to recognised standard, **Part 1**.

2.4 Other Duties

2.4.1 FRP Boatbuilding

At the request of FIIT, investigations were made into FRP boatbuilding in Indonesia, this work is intended to assist in the planning of the boatbuilding component of project GCP/INS/076/GER. The project includes a component for the procurement and demonstration of FRP fishing vessels in Aceh. A number of existing and planned FRP boatbuilding activities were investigated in Aceh and Jakarta to establish existing capacity in the sector.

Details are given in annex I.

3. Conclusions

1. The standard of vessel construction in Aceh is at times at a level which is unacceptable. The main causes of this low standard are emphasis on quantity rather than quality of vessels and the increased demand for this specialised skill.

2. In the process of improvement of fishing vessels it is important to understand the distribution of vessel types, local preferences and ongoing evolution and design.

3. There are no written construction or safety standards applicable to small fishing vessels in Indonesia or Aceh province.

4. Many of the construction problems encountered in Aceh with new vessels are very basic in nature and result in poor quality, potentially unsafe and high maintenance boats being delivered to beneficiaries.

5. Some replacement vessels handed over to beneficiaries in Aceh are so poorly built that they may not be useable at all or if used will have a very short lifespan; possibly needing replacement in 1 to 2 years time; others may be abandoned once the engine is removed.

6. The improved construction methods introduced by FAO (frames, keel and shaft log) have proved difficult for some builders to execute as intended by designer; in addition builders expressed concerns including weight, keel depth and interference of the hog with water bailing.

7. The sporadic supply of fastenings to FAO boatyards caused frequent stoppages and delays and was a significant factor in boatbuilding progress being slower than planned.

8. Predicting the delivery of FAO vessels based on current construction rates indicated that action was required to speed up boatbuilding activities in order to meet planned delivery dates.

9. Many international standards such as the Nordic Boat Standard and the UK SeaFish rules have limitations to use for artisanal fishing vessel construction. The primary drawback is that such rules cannot account for weather and usage patterns in developing countries.

10. There is a need for a new approach to construction standards to ensure that they are applicable to artisanal fishing vessels operating in less severe sea and weather conditions. The basis for this approach is the use of design categories as incorporated in the ISO construction standard.

11. If regulation is to be increased for artisanal fisheries in Indonesia it will need to be at an appropriate level, sensitive to traditions and receptive to the ideas and interests of users.

12. There are a number of companies in Indonesia (Java) which are capable and willing to produce FRP boats for demonstration to fishermen in Aceh.

13. The participation of entrepreneurs will be critical to any future FRP boatbuilding facilities in Aceh.

14. Where both timber and labour are cheap and plentiful FRP boats are unlikely to be competitive with wooden boats in terms of cost.

15. Any demonstration of FRP boats should include an training for fishermen and crews in repairing FRP structures.

4. Recommendations

1. Continued supervision of the boatyards is required in order that the FAO contracts do in fact produce “better boats”, in particular construction quality needs to be monitored.

2. The use of national boatbuilders to inspect boats and provide technical support to boatyards should be promoted.

3. The improved construction methods introduced by FAO (frames, keel and shaft log) require further support to be given to builders to help them complete these parts of the boat correctly.

4. Careful monitoring and control of the procurement and supply of fastenings (and other equipment) to boatbuilders is required to avoid stoppages and delay.

5. Consideration should be given to the procurement of hot dipped galvanised fastenings locally or in Medan rather than importing them as before.

6. If the boatbuilding activities planned by FAO for Nias and Simeulue are not to be completed the identified beneficiaries should be informed so that they can obtain assistance from alternative sources.

7. The "Notes on Good Practice" should be published in booklet form and distributed to NGO’s and other interested parties for use in the vessel reconstruction programme in Indonesia.

8. The construction standards proposed in this report will require further development and refinement.

9. Any additional regulation for artisanal fisheries in Indonesia should be appropriate, sensitive and receptive to the interests of users. A phased introduction of standards is likely to assist in compliance.

10. The improved designs developed for FAO boatyards should be fully reviewed and discussed with the boatbuilding team in Aceh in order that the details are appropriate for both the builders and the intended users.

11. The improved designs should be tested in prototype form before embarking on mass production in order that problems can be ironed out.

5. Terms of Reference

Under the overall direction of the Chief FIIT, in coordination with the FAO Representative in Indonesia, and in close collaboration with the FAO Fisheries Adviser and FAO Boat Builder Consultant in Indonesia, the incumbent will prepare construction standards for wooden fishing vessels and drawings related to the traditional wooden boats to be constructed under the reconstruction and development programme in Indonesia. In particular, the incumbent will undertake the following duties:

1. Prepare construction standards for wooden fishing vessels to be used in Indonesia. The Seafish standard, the Nordic Boat Standard, as well as other similar standards may be used as a guide.

2. Prepare technical specifications for four (4) designs of wooden fishing vessels. The specifications shall include lines drawings, full construction drawings and a drawing of the propeller shaft arrangements aiming at high propulsion efficiency.

3. Together with the FAO Boat Builder Consultant, supervise and advise on the ongoing building activities of wooden fishing vessels in the tsunami affected areas of Indonesia.

4. Assist FIIT in preparing documents for submission to the IMO correspondence group on the safety of small fishing vessels.

5. Any other duties as requested by FIIT.

6. Prepare mission report and submit to FIIT within 1 week after the completion of the assignment for technical clearance.

Annex A – Itinerary

November
11th - Arrive Banda Aceh. Security briefing
12th - Discussion/briefing with M. Savins. Visit boatyards in Banda Aceh
13th - Travel Banda Aceh to Loksumawe. Visit boatyards & landing sites
14th - Travel around Loksumawe. Visit boatyards & landing sites
15th - Travel Loksumawe to Banda Aceh. Visit boatyards
16th - FAO office. Review of rules & regulations
17th - Prepare "Notes on Good Practice"
18th - Meetings at BRR including Fisheries steering committee
19th - Travel to Sebang island. Work with NGO boatyard
20th - Sebang Island. Work on new boat designs with M. Savins
21st - Travel Sebang to Banda Aceh
22nd - Travel to Nias island via Meulaboh. Visit partner NGO and boat landing sites
23rd - Travel to boatbuilding and boat landing sites
24th - Travel Nias to Meulaboh. Visit FAO boatyard
25th - FAO office Meulaboh. Visit boatyards and boat landing sites
26th & 27th - FAO office preparing new vessel designs
28th - Travel Meulaboh to Simeulue island
29th - Visit fish landing and boatbuilding sites on Simeulue
30th - Travel Simeulue to Banda Aceh.

December
1st to 7th – Work at FAO office Banda Aceh
8th – FAO office Banda Aceh. Visit MMAF
9th – Travel Banda Aceh to Rome.

January
22nd – Arrive Banda Aceh
23rd & 24th – FAO office Banda Aceh
25th – Measure/survey FRP vessels in Banda Aceh
26th to 28th – Work at FAO office Banda Aceh, 5.5 m design
30th – Visit Kurung Raya boatyard to review progress & advise on engine installation
31st – FAO office Banda Aceh, 5.5 m design.

February
1st & 2nd – Visit 2 east coast boatyards to review progress and check vessel compliance with specification
3rd to 9th – FAO office Banda Aceh, 7 m design and development of min. standard
10th to 14th – Travel in Nias
15th – FAO office Banda Aceh, discussions with incoming master boatbuilder, flight to Jakarta
16th – FAO office Jakarta, visit FRP boatbuilding facility
17th – Visit 2nd FRP boatbuilding facility, meetings at DKP
18th – Travel Jakarta to Rome.

March
6th to 10th – IMO London, meeting of correspondence group on safety of small fishing vessels
21st to 24th – FAO Rome.

April
3rd to 7th – South Africa House London, meeting of correspondence group on safety of small fishing vessels.

Annex B – Fishing Vessel Types

This annex shows the types of fishing vessels in use along the coasts of Aceh including Nias and Simeulue islands The vessels listed are those less than 24 m in length and may not represent a complete listing of available types.

Type one – 4 to 5 m open outrigger canoe based on dugout, which is paddled or sailed. Used for near shore fishery with hand lines etc. Design varies with location and trees available, outriggers may be timber or bamboo and around half the vessel length. Specification as follows:

1		
Description	4 to 5 m outrigger	
Type	Dugout canoe	
Typical L x B x D	4.4 x 0.6 x 0.45	
Locations	East coast	
Landing	Beach, river	
Fishing Gear	Hand & trolling lines	
Fishing Grounds	Day fishing	
Engine	None	
Crew	Typically 1	

Type two – 5.5 to 6.5 m planked, open canoe usually fitted with an inboard petrol engine. This type is most often used in sheltered water and operates at modest speeds of 4 to 6 knots. Specification as follows:

2		
Description	5.5 to 6.5 m canoe	
Type	Planked canoe	
Typical L x B x D	5.5 x 1.1 x 0.5	
Locations	East coast	
Landing	Beach	
Fishing Gear	Hand & trolling lines, shrimp net, gill net	
Fishing Grounds	Day fishing	
Engine	Petrol inboard, 5.5 hp	
Crew	Typically 1 or 2	

Type three – 5.5 to 6.5 m planked, open high bow boat which is generally fitted with an inboard petrol engine. Operates at around 4 to 6 knots and is more stable and versatile than the *type two* canoe, this boat has been identified as a candidate for improved design and construction by FAO. The boat is considered to be easier to work being more stable and better for beach landing in (small) surf. Specification as follows:

3		
Description	5.5 to 6.5 m high bow	
Type	Planked boat	
Typical L x B x D	5.5 x 1.2 x 0.5	
Locations	East coast	
Landing	Beach/river	
Fishing Gear	Hand & trolling lines	
Fishing Grounds	Day fishing	
Engine	Petrol inboard, 5.5 hp	
Crew	Typically 2	

Type four – 7 to 8 m planked, open high bow boat which is generally fitted with an inboard diesel engine of either 16 or 23 hp. The larger engine gives this boat considerable speed potential of up to 12 knots which may be used for trolling and finding schools of tuna. This type is the basis for FAO design INS-10 which is under construction in a number of locations. Specification as follows:

4		
Description	7 to 8 m high bow	
Type	Planked boat	
Typical L x B x D	8.0 x 1.6 x 0.75	
Locations	East coast	
Landing	Beach/river	
Fishing Gear	Hand & trolling lines	
Fishing Grounds	Day fishing	
Engine	Diesel inboard	
Crew	2 or 3	

Type five – 17 to 20 m planked and decked high bow boat using an outboard motor set in a tunnel. This rather specialised design has developed in response to operating a larger decked purse seine vessel out of a shallow river or harbour. It is likely that the single 40 hp outboard used produces poor speed and high fuel consumption when the vessel is loaded. Specification as follows:

5		
Description	17 to 20 m high bow	
Type	Planked	
Typical L x B x D	-	
Locations	East coast	
Landing	Shallow river	
Fishing Gear	Purse seine	
Fishing Grounds	Day fishing	
Engine	Petrol outboard, 40 hp	
Crew	-	

Type six – up to 24 m boat, fitted with an inboard diesel engine. This category contains various sub groups which are not considered in detail as FAO is not currently working with vessels of this size. Specification as follows:

6		
Description	Up to 24 m	
Type	Planked boat	
Typical L x B x D	-	
Locations	East coast & Banda Aceh	
Landing	River / port	
Fishing Gear	Various inc. purse seine, gill net	
Fishing Grounds	-	
Engine	Diesel up to 230 hp, often Mitsubishi 100 – 120 hp	
Crew	-	

Type seven – 4 to 5 m outrigger canoe based on dugout, generally paddled or sailed. Used for near shore fishery with hand lines etc. Outriggers may be timber or bamboo and are short at around half of vessel length. Specification as follows:

7		
Description	4 to 5 m outrigger	
Type	Dugout canoe	
Typical L x B x D	4.4 x 0.6 x 0.45	
Locations	Nias & Simeulue	
Landing	Beach	
Fishing Gear	Hand & trolling lines	
Fishing Grounds	Day fishing	
Engine	None	
Crew	Typically 1	

Type eight – 6 to 6.5 m outrigger canoe based on dugout with additional plank(s), generally fitted with petrol inboard. Used for day fishery with hand lines etc, some converted for use with beach seines. This boat has been identified as a candidate for improved design and construction by FAO and designated INS6. Specification as follows

8		
Description	6 to 6.5 m outrigger	
Type	Planked dugout canoe	
Typical L x B x D	6.5 x 1.10 x 0.55	
Locations	Nias, Simeulue	
Landing	Beach & river	
Fishing Gear	Hand & trolling lines, Beach seine	
Fishing Grounds	Day fishing	
Engine	Petrol inboard, 5.5 hp	
Crew	1 or 2	
Comments	Outriggers are shorter and made from timber in Nias and longer and from bamboo in Simeulue. Some boats in day fishery in Nias remove outriggers.	

Type nine – 7 to 9 m outrigger canoe, generally planked, fitted with petrol inboard. Used for day fishery and multi-day fishery. This boat has been identified as a candidate for improved design and construction by FAO and designated INS7. Specification as follows:

9		
Description	7 to 9 m outrigger	
Type	Planked dugout canoe	
Typical L x B x D	8.3 x 1.3 x 0.6	
Locations	Nias, Simeulue	
Landing	Beach & river	
Fishing Gear	Hand & trolling lines, some beach seine	
Fishing Grounds	Day fishing	
Engine	Petrol inboard, 5.5 hp	
Crew	1 to 3	
Comments	Outrigger is generally shorter and from timber in Nias and longer and from bamboo in Simeulue	

Type ten – Very similar to the east coast *type four*, a 7 to 8 m planked high bow boat which may be fitted with either an outboard petrol or inboard diesel engine. Specification as follows:

10		
Description	7 to 8 m high bow	
Type	Planked boat	
Typical L x B x D	8.0 x 1.6 x 0.75	
Locations	West coast & Banda Aceh	
Landing	Beach/river	
Fishing Gear	Hand & trolling lines, gill net	
Fishing Grounds	Day fishing	
Engine	Outboard 15, 25 or 40 hp or inboard 16 or 23 hp	
Crew	2 or 3	

Type eleven – 9 to 10m planked boat fitted with diesel engine and outriggers, some operate in Banyak island fishery on multi-day trips. Capacity for 3 ice boxes carrying 100 to 300 kg fish. Specification as follows:

11		
Description	9 to 12m	
Type	Planked boat	
Typical L x B x D	-	
Locations	Nias	
Landing	Beach & river	
Fishing Gear	Hand & trolling line, bottom long line	
Fishing Grounds	Multi-day fishing & Banyak islands	
Engine	Diesel inboard, typ. 16 hp	
Crew	Typ 3 or 4	

Type eleven A – 12m/13m planked boat fitted with diesel engine. These operate in various fisheries and some operate in Banyak island fishery on multi-day trips. Specification as follows:

11A		
Description	12 to 13m	
Type	Planked boat	
Typical L x B x D	13 x 2.7 x 0.75	
Locations	Nias	
Landing	Beach & river	
Fishing Gear	Hand & trolling lines, bottom long line, gill net	
Fishing Grounds	Day & night fishing & Banyak islands	
Engine	Diesel inboard, 23 hp & others	
Crew	3 or more	

Type twelve – 11 to 15 m planked boats fitted with diesel engines. Specification as follows:

12		
Description	11 to 15 m	
Type	Planked boat	
Typical L x B x D	12.5 x 2.3 x 0.9	
Locations	West coast	
Landing	River	
Fishing Gear	Hand & trolling lines, purse seine, trawl net, gill net	
Fishing Grounds	Day fishing	
Engine	Diesel inboard, various	
Crew	-	

Type thirteen – 6 m planked boats fitted with petrol engines. Specification as follows:

13		
Description	6 m	
Type	Planked dugout canoe	
Typical L x B x D	6m	
Locations	Nias (south)	
Landing	Beach	
Fishing Gear	Hand & trolling lines	
Fishing Grounds	Day fishing	
Engine	5.5 hp petrol inboard	
Crew	1 or 2	

Annex C – Review of some current boatbuilding activities under FAO contracts

This is a brief summary of findings of visits to 4 of the 6 boatyards contracted by FAO to build boats in Aceh, the visits were made on or around 3rd February 2006. At the time of submission of this report some of the problems identified here will have been addressed, however, it is considered that the comments are still relevant as some still remain problematic.

1. Yayasan Ikan Tenggiri – Muara Batu

Two boats of the 8 m INS10 design are underway at this boatyard.

8m boats under construction

Boat 1

- Hull complete.
- Caulking and painting required.
- Engine beds to be fitted.
- Engine, stern tube, rudder and skin fittings to be installed.
- Keel installation is not in accordance with the design; the hog has not been fitted although the shaft log has.
- The design has also been modified to give 70 mm less depth to the keel which is considered important.
- Frames are spaced at 400 not 350 and made using the local style frame joint.
- Construction quality is mainly acceptable but some areas require attention including:
    - knots in hull planking
    - frame joint details
    - Use of primer on joined surfaces.

Hog not installed in boat 1

Boat 2

- Hull complete.
- Caulking and painting required.
- Engine beds to be fitted.
- Engine, stern tube, rudder and skin fittings to be installed.
- The keel installation has been completed in accordance with the design.
- Most parts are in accordance with design scantlings.
- Local style frame joint has been used and well executed.
- Construction quality is mainly acceptable but some areas require attention including:
    - frame joint details
    - use of primer on joined surfaces.

Boat 2 almost complete

Contractual arrangements

- Boatyard has (in theory) received sufficient fastenings for 5 boats, they seem unsure about this.

- Normally the workforce is 3 boatbuilders including master. To build 3 boats/month they claim that they will need 10 boatbuilders, this is unlikely and 5 or 6 is more typical. With more boatbuilders working they claim to need more tools.

- There is a need to start applying delivery pressure to NGO's, it is understandable that first batch of boats are slow in production as there is a learning and demonstration process. However, the next batch should be delivered as close to on-time as possible.

The (INS10) design

- The programme for the next 3 boats was discussed. It was agreed that they should build the next 3 boats to the INS 10 design – but not with the locally modified keel. However they will use the <u>local style overlapping frame joint</u>; this was thought to be sensible as they have sufficient suitably curved grain timber.

- After the current batch of 3 boats there should be trials results and feedback from the end users regarding the construction and design changes.

- Boatbuilders and fishermen believe that the FAO (INS10) design is "strong" but have some problems with it:

- The keel/skeg depth makes it difficult to haul on beach and at low tide could cause difficulty in entering river

Shallow river entrance

- The hog will prevent the easy bailing of the boat by sweeping a scoop or bucket from side to side.

Hog not present in local version

- The nearby port landing area and river entrance were inspected and are indeed shallow at low water, the entrance is probably only 30 to 40 cm deep.

- The local 7 to 8 m boats equivalent to INS10 were observed in the river, they are relatively fast, achieving in excess of planing speeds and possibly up to 12 knots.

- Note: Boats being used for recreation was observed here (such as racing). This is not an unusual occurrence having been observed in various locations on the east and West coasts.

Local boat at speed

2. LSM Bina Aneuk Nanggroe – Laweung

Four boats of 8 m (INS10) design are underway at this boatyard.

INS10 designs under construction

Boats 1, 2 and 3

- Hull complete.
- Caulking and painting required.
- Engine beds to be fitted.
- Engine, stern tube, rudder and skin fittings to be installed.
- The keel installation has been completed in accordance with design.
- Construction is mainly in accordance with design scantlings.
- Improved style frame joint has been used although not well executed.
- Construction quality mainly acceptable but some areas require attention including:

    - frame joint details
    - Use of primer on joined surfaces

Boat 4

- Hull 70% complete.
- Requires transom, stringers, gunwhale, rail cap etc
- Caulking and painting required.
- Engine beds to be fitted.
- Engine, stern tube, rudder and skin fittings to be installed.

Comments on quality

- The improved frame construction is not well executed, being the opposite orientation to the design and not being bolted through the bilge stringer.

- Occasional large gaps between planks were noted. Builders blamed this on availability of seasoned timber; the timber storage arrangements at the yard do not help this. . delete

- Some frames are unevenly spaced and in appear to be miss-aligned. One particular frame location was moved by the builder as he said it would improve access for engine starting.

- Occasional limber holes are not cut and those that are cut are often too small.

- Some knots in hull planking noted.

- At the turn of bilge the use of wide planks (170 mm) means that the frame shape has had to be modified by the builder to suit the plank width. It was explained that narrower planks should be used in this area but the builder has also modified the hull lines to give the locally preferred knuckle. When incorporated this allows the use of wide boards.

- At present the yard does not have sufficient threaded rod to finish fastening the 4th boat.

- Comments received about the hull design:

  - The keel depth will make the boat difficult to haul on beach, the builder suggested reducing the depth by 50 mm.

  - The hog will prevent the easy bailing of the boat by sweeping a scoop or bucket from side to side.

The design

- The programme for the next 5 boats was discussed. The main area of concern is the "improved" frame design which requires further development. Other FAO yards have added gussets to support the joint; it was not known by this yard if they should start doing this.

- Vessels coming into the beach landing area were observed and the beach is very gently shelving making shallow draught desirable for approach. All smaller boats here are hauled up the beach after use, making light weight desirable.

- The local 7 to 8 m boats equivalent to INS10 were again noted to be relatively fast, achieving in excess of planing speeds and possibly up to 12 knots.

3. AIRO – Krueng Raya

Five boats of 8 m (INS10) design are underway at this boatyard.

Boats nearing completion at Kureng Raya

Boats 1 and 2

- Hulls complete including caulking and painting.
- Engine beds to be fitted.
- Engines, stern tubes, rudders and skin fittings to be fitted.
- Keel has been installation completed in accordance with design.
- Construction is mostly in accordance with design scantlings.
- Improved style frame joint has been used with the additional gussets proposed by the designer, used on alternate frames.
- Construction quality mainly acceptable but some areas require attention including:
    - maintain quality of frame joint details
    - deadwood requires shaping
    - use primer on joined surfaces.

Boats 3 and 4

- Hulls complete.
- Caulking and painting required.
- Engine beds to be fitted.
- Engine, stern tube, rudder and skin fittings to be installed.
- Keel installation has been completed in accordance with design.
- Construction is mostly in accordance with design scantlings.
- Improved style frame joint has been used with the additional gussets proposed by the designer, used on alternate frames.
- Construction quality mainly acceptable but some areas require attention including:
    - maintain quality of frame joint details
    - deadwood requires shaping
    - use primer on joined surfaces

Boat ready for painting

Boat 5

- Hulls 90% complete
- Caulking and painting required.
- Engine beds to be fitted.
- Engine, stern tube, rudder and skin fittings to be installed.
- Keel installation has been completed in accordance with design.
- Construction is mostly in accordance with design scantlings.
- Improved style frame joint has been used with the additional gussets proposed by the designer, used on alternate frames.

Frame joint with double gusset

- Construction quality mainly acceptable but some areas require attention including:

- maintain quality of frame joint details
- deadwood requires shaping
- use primer on joined surfaces

Comments

- The installation of engine beds was discussed with the boatbuilder since he has not been supplied with detailed drawings of the engine beds or welded frame. It was agreed that for the first 5 boats he should install the beds in his usual fashion that he should ensure that the beds are shaped from 80 x 200 mm timber and supported by 4 frames. For subsequent boats the naval architect and boatbuilder will need to work together to ensure that engine beds are installed as the designer intended.

- It was noted by boatbuilder that timber with curved grain suitable for cutting frames can be hard to procure. This is an advantage of the butted frame joint with gussets on each side.

- Comments from boatbuilders indicate that they like the improved keel system and shaft log, although they think it is likely to be heavy. However, they have considerable doubts about the improved frame design both with and without gussets.

4. Yayasan Ibrahim Nain – Banda Aceh

Two boats of 8 m (INS10) design are underway.

Stage of completion of boats at Ibrahim Nain

Boats 1 and 2

- Hulls 30% complete
- Require planking
- Require transom, stringers, gunwhale, rail cap etc
- Require caulking and painting.
- Require engine beds.
- Require engine, stern tube, rudder and skin fittings.
- Keel/skeg installation completed in accordance with design.
- Construction mostly in accordance with design scantlings.
- Improved style frame joint has been used with the additional gussets proposed by the designer, used on every frame. The execution of these gussets is not in accordance with the design, the problems include:

    - Some gussets < 20mm thick, which is design requirement.
    - Some gussets from light red timber (meranti), which is not the intended type.
    - Some gussets have split in line with bolts
    - Some bolts are not spaced in accordance with the design.

Comments

- It is recommended that:

    - gussets < 20mm thick are replaced
    - gussets should be cut from the same timber as frames (or at least a timber of > 700kg/m3)
    - split gussets should be replaced
    - bolts should be spaced in accordance with the design.

Gusset thickness < 20 mm

Split gussets

- The above work will require the supervision of a master boatbuilder.

5. Conclusions and recommendations

1. It is obvious that continued supervision of these boatyards is required in order that the FAO contracts do in fact produce “better boats”.

2. The original version of the improved frame design proved difficult for builders to execute as intended by designer. For this reason a variation incorporating gussets on each side of the join was developed. Boatbuilders still struggle with this and it is executed with varying degrees of success.

3. There is no doubt that the new frame design has potential and if completed by the master boatbuilder would be an improvement and may also make procurement of suitable framing timber easier.

4. It is recommended that further support is provided to builders to help them complete this part of the boat correctly.

5. It is also recommended that a decision is made for each NGO as to whether they install framing in the improved way or the traditional way.

6. The improved keel/shaft log design is mainly executed well by the builders and they appreciate the additional strength. They express some concerns which include: additional weight, additional keel depth (difficult for landing and hauling) and the interference of the hog (internal part of keel) with bailing (scooping) water from the bottom of the boat.

7. It is possible that the improved keel/shaft log design will be adopted by some builders as they can see the benefits, however, it is also possible that they will not incorporate the hog as intended as they consider this to be a problem.

8. The installation of the engine beds requires the support of the international boatbuilder since the NGO's have not been supplied with detailed drawings of the engine beds or welded frame.

9. Quality of construction needs to be monitored, in particular the following areas require attention:

    - timber selection – knots in hull planking
    - frame joint details including gussets
    - use of primer on joined surfaces
    - shaping of deadwood ahead of propeller
    - width of plank seams
    - cutting of limber holes.

10. It is recommended that an audit of fastenings required, available and delivered is completed urgently to establish the position for future boats.

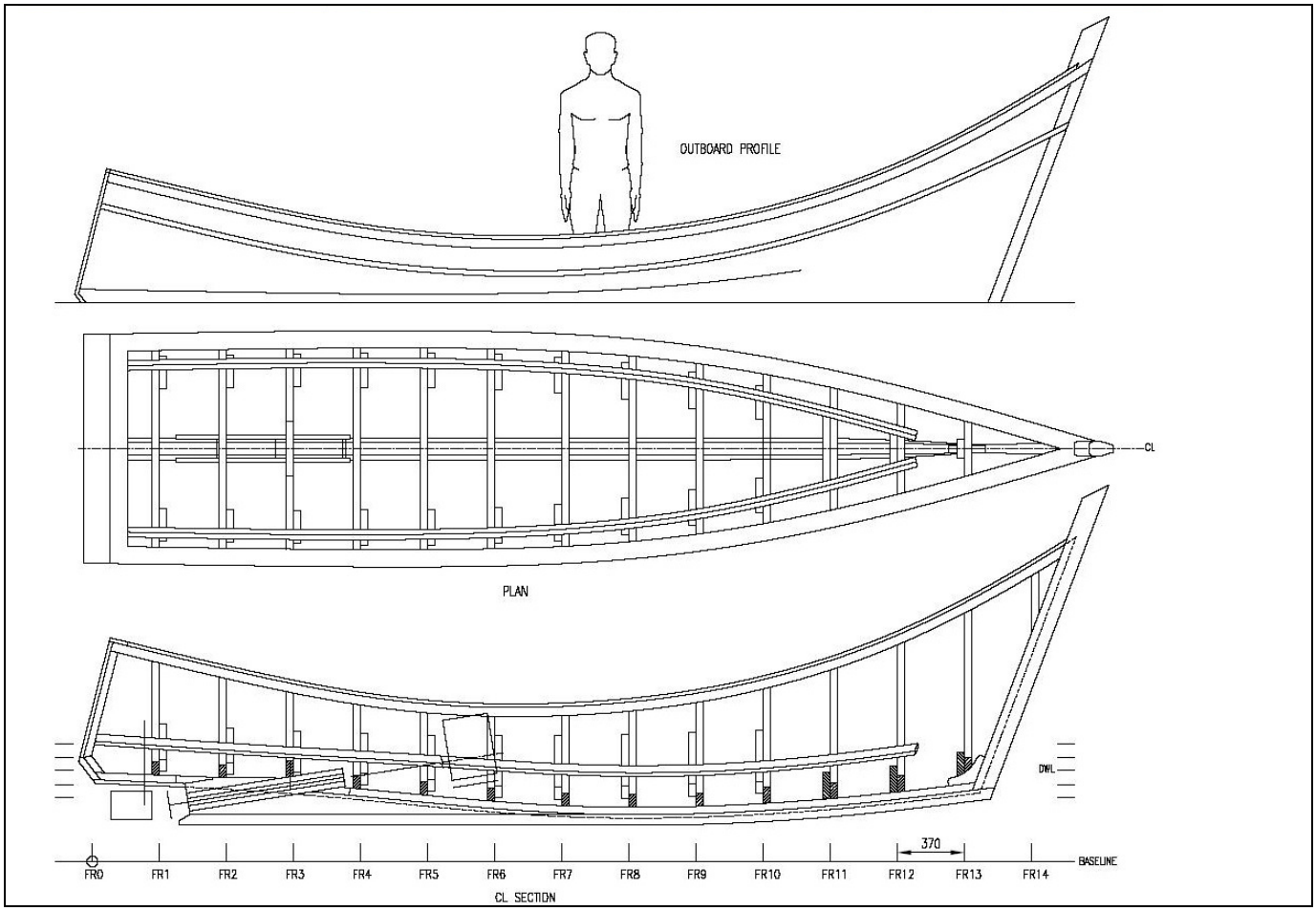
11. Urgent action is needed to establish if the NGO Yayasan Ibrahim Nain in Banda Aceh is able to continue his contract as there are obvious problems with delay and the quality of construction of the boats.

12. The local 7 to 8 m boats equivalent to INS10 are relatively fast, achieving in excess of planing speeds and possibly up to 12 knots (when fitted with 23hp diesel). Fishermen favour these speeds for certain types of fishing such as trolling. It is not known if the improved design will be able to match this and it is recommended that trials be made of the first of the INS10 designs to establish performance relative to local designs.

Annex D – New Fishing Vessel Designs

A number of improved vessel designs were considered for construction by FAO boatyards. The basis for all designs is the preferred style used in the location; however, specific improvements in design and construction are incorporated where appropriate.

5.5 m East coast	
Status of Design	Version 3 of the design is complete and under review
Type	Planked high bow boat *(Type three)*
Locations	East coast
Port/landing	Beach and shallow river
Fishing Gear	Hand & trolling lines
Fishing Grounds	Day fishing
Length/Beam/Depth (m)	5.6 / 1.3 / 0.66
CUNO	4.8
Displacement, Light (kg)	360
Displacement, Loaded (kg)	510
Engine	Honda GX160, 5.5 hp, no gearbox fitted.
Crew	Typically 2
Key Features	• Light for beach hauling • Shallow draught for beach hauling • Improved stability and comfort at sea • Improved boatbuilding including shaft log.
Typical users	Beneficiaries have been identified in Laweung.


OUTBOARD PROFILE
CL
PLAN
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370
BASELINE
FR0
FR1
FR2
FR3
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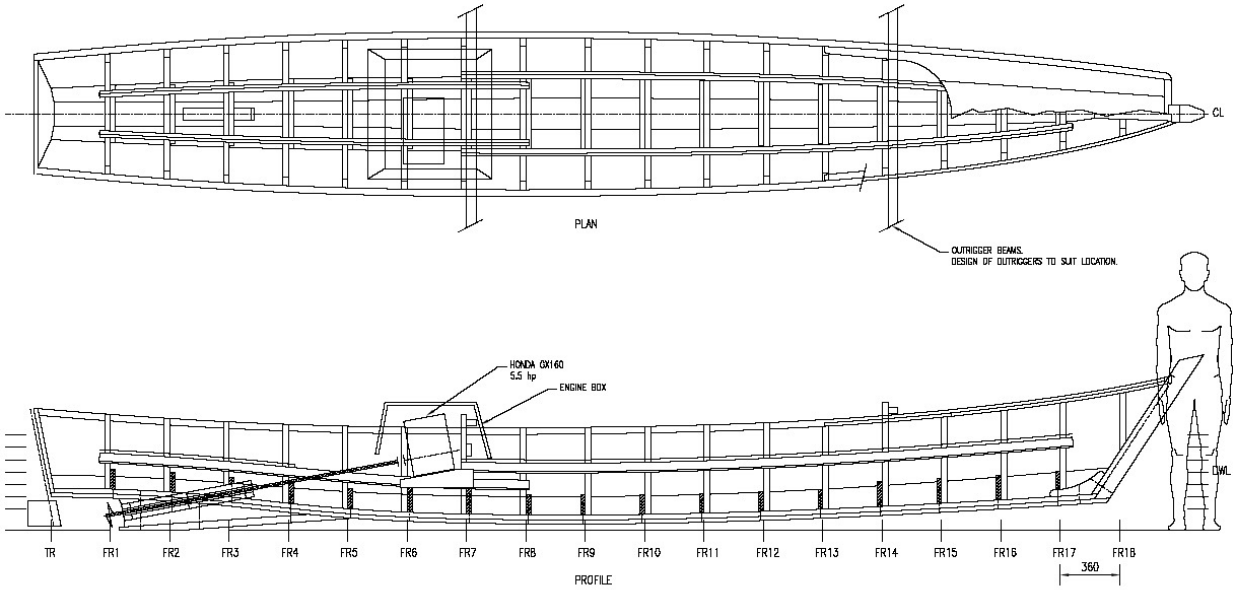
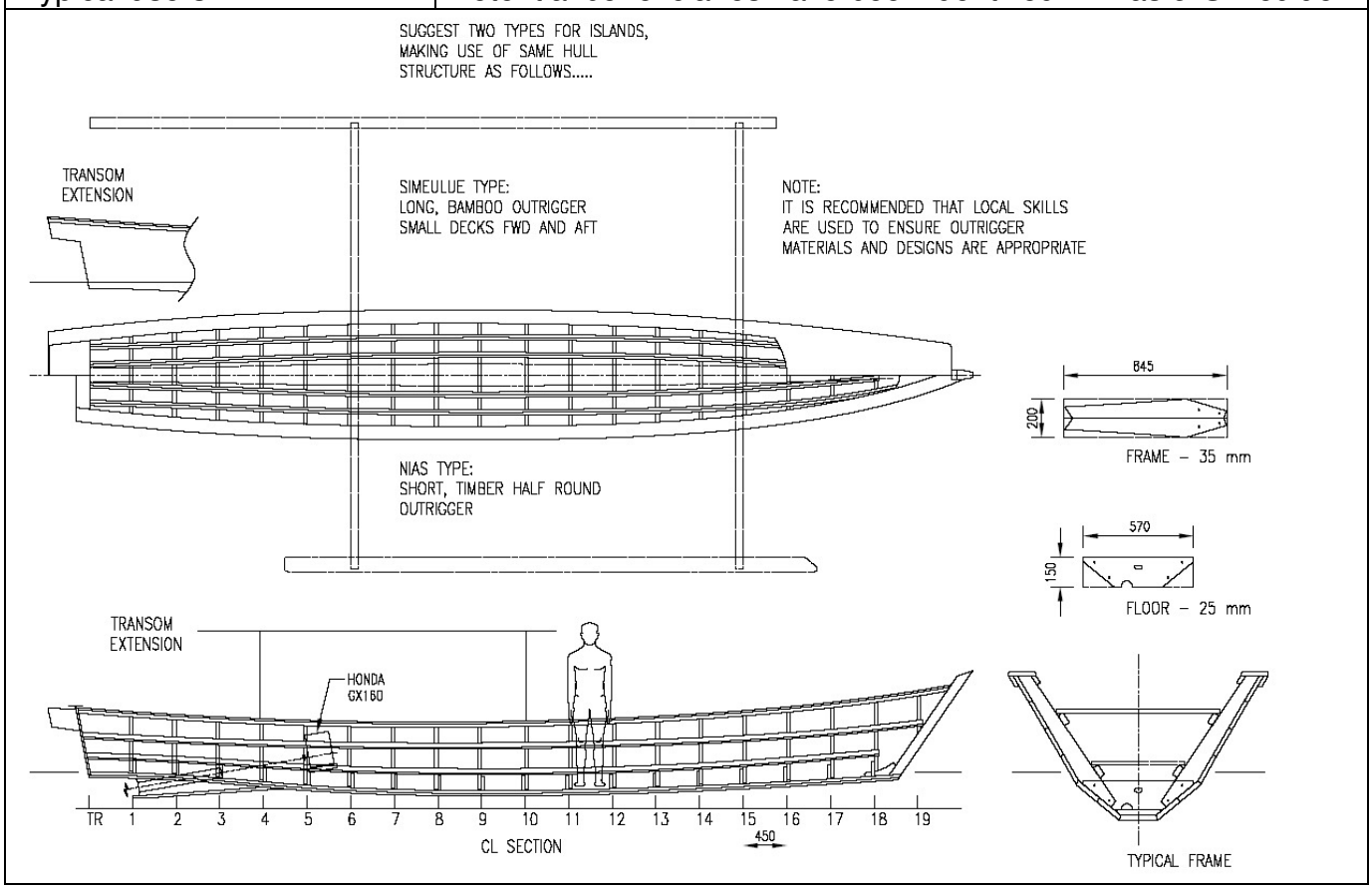
FR5
FR6
FR7
FR8
FR9
FR10
FR11
FR12
FR13
FR14
CL SECTION

7 m Island	
Status of Design	Version 2 of the design is complete and under review by boatbuilder in Aceh.
Type	Outrigger canoe *(Type eight)*
Locations	Nias and Simeulue islands
Port/landing	Beach and shallow river
Fishing Gear	Various
Fishing Grounds	Day fishing
Length/Beam/Depth (m)	7.0 / 1.0 / 0.58
CUNO	4.1
Displacement, Light (kg)	385
Displacement, Loaded (kg)	575
Engine	Honda GX160, 5.5 hp, no gearbox fitted.
Crew	Typically 2
Key Features	• Light for beach hauling • Shallow draught for beach hauling • Improved boatbuilding including shaft log • Planked hull bottom replaces dug out log which can be heavy and hard to procure. • The design of outriggers and decking to meet local requirements according to island and community.
Typical users	Potential beneficiaries have been identified in Nias & Simeulue.



9 m Island	
Status of Design	Work in progress
Type	Outrigger canoe *(Type nine)*
Locations	Nias and Simeulue islands
Port/landing	Beach and shallow river
Fishing Gear	Various
Fishing Grounds	Day and multiday fishing
Length/Beam/Depth (m)	9.1 / 1.3 / 0.74
CUNO	8.7
Displacement, Light (kg)	550
Displacement, Loaded (kg)	720
Engine	Honda GX160, 5.5 hp
Crew	2 to 4
Key Features	• Shallow draught • Improved boatbuilding including shaft log • Planked hull bottom replaces dug out log which can be heavy and hard to procure. • The design of outriggers and decking to meet local requirements according to island and community.
Typical users	Potential beneficiaries have been identified in Nias & Simeulue.



Annex E – REPORT FROM TRAVEL TO NIAS 10TH TO 14TH FEBRUARY 2006

SUMMARY OF FINDINGS

FAO Boatsheds

The first boatshed is to be located in an area called Olora beach, which is a few km north of Gunung Sitoli. Progress so far (Feb 11th) is limited to clearing the site of palms and marking out the position of the shed. The site is adjacent to a beach used by small outrigger canoes and larger boats (12 to 13 m) which are anchored off. It is possible to drive onto the site.

The second boatshed is located in an area called Gamo a few km beyond the first boatshed. As before progress so far (Feb 11th) involves clearing the site of palms and marking out the position of the shed although some timber has also been cut for construction. It is not possible to drive onto the site although vehicles can be parked nearby. The site is adjacent to a beach and small river outlet used by small outrigger canoes and larger boats (12 to 13 m) which are anchored off.

The NGO undertaking the shed construction stated that the facilities should be complete within a month; this should be possible if enough manpower is applied.

It appears that this NGO will be able to take on a contract to build a number of boats if it makes use of the FAO trained boatbuilder, Amir, and his brother who is said to be a very experienced. These two boatbuilders already have experience building the FAO flat bottom boat designs such as INS5.

Locations visited

Lahewa – Selected by fisheries team in October 05 as location for provision of 25 x INS6 design canoes. It is clear that there is a need for boats in the 6 to 6.5 m category (typically 6.4 x 0.92 x 0.45) powered by Honda 5.5 hp inboards. Typical boats were photographed and measured to ensure that the INS6 design is appropriate to needs of fishermen.

The "chief" of the port area of the town was met, he indicated that the 6.5 m design is what is required and provided a list of 25 beneficiaries. He also indicated a preference for 1 person, 1 boat stating that some NGO's have provided boats to groups.

Mo Awe – Selected by fisheries team in October 05 as location for provision of 15 x INS6 design canoes. Here also there is a need for boats in the 6 to 6.5 m category (typically 6.2 x 0.90 x 0.40) powered by Honda 5.5 hp inboards.

Again it is vital to account for the requirements of the local fishermen and provide a quality product.

Lawu Lawu – Visited on first mission to Nias *(Bridge crossing on river about 11 km north of Gunung Sitoli. Here there are about 13 boats around 9m to 10m in length with outriggers and 16hp Dong Feng engines, These are involved in the Banyak islands fishery. These boats are at sea Monday to Friday, returning with min. 100kg reef fish and*

some tunas etc caught by trolling, all but 3 were at sea during our visit. Getting to the fishing grounds takes about 10 hours. Home made ice and is transported in ice boxes for preserving fish). This second visit aimed to established correct dimensions for boats working in the *Banyak* island fishery.

It was stated previously that the new FAO INS7 design would be aimed at fishing in the *Banyak* Islands; however, the existing vessels are mainly 10 m in length and have good carrying capacity (300 kg+). Interestingly some boats are locally built copies of FAO flat bottomed designs.

The fisheries team stated in October 05 that *Ladara* and *Sawo* (bases for boats active in *Banyak* fishery) should receive 3 x INS5 (8.6 m existing design) and 15 x INS7 (9 m new design) respectively. It is the opinion of the author that if these are intended to replace boats lost from the *Banyak* fishery they should be closer to 10 m and of sufficient capacity to be suitable for this multi-day fishery. It seems possible that *Ladara* is not an active base for the *Banyak* fishery and so the proposed 3 x INS5 (8.6 m existing design) will be adequate.

Boat Data

A list of boats lost by village was obtained from DKP in Gunung Sitoli, it is not known how current or accurate this is.

BRR were also approached for data regarding boat numbers and in particular numbers of boats already provided or pledged by NGO's.

4. Conclusions and Recommendations

1. FAO should proceed with the planned boatbuilding activities as soon as possible.

2. If this is not to be done the selected locations and beneficiaries should be informed so that they can obtain assistance from alternative sources. Moawe is a particular case where FAO's inputs are being awaited.

3. The requirements of the fishermen in each location must be accounted in boat specifications otherwise boats provided may be rejected by fishermen.

4. If it is proposed to replace boats working in the Banyak Island fishery they should be of appropriate design and capacity.

Annex F

NOTES ON GOOD PRACTICE FOR THE CONSTRUCTION OF TRADITIONAL WOODEN FISHING VESSELS

This document aims to describe good practice for the construction of traditional wooden, open and decked fishing vessels of up to 12 m in length in Aceh. It is an interim measure applicable to boats constructed as part of the rehabilitation and reconstruction work following the Tsunami of December 2004. Compliance with the notes set out below should improve overall standards of vessel construction thereby improving safety at sea, reducing vessel maintenance and increasing vessel longevity.

1. Introduction

This document aims to describe good practice for the construction of traditional wooden, open or decked fishing vessels of up to 12 m in length in Aceh. It is an interim measure applicable to boats constructed as part of the rehabilitation and reconstruction work following the Tsunami of December 2004.

The good practice described here may be applied to fishing vessels of artisanal and small commercial type operating at moderate speeds – generally less than 10 knots. Typically scantlings (timber sizes) given relate to vessels of conventional form, vessels which are more extreme in length, beam, displacement or speed may need special consideration.

It is assumed that vessels will be operating in the inshore fishery – generally within 5 miles of the shore.


8 m open boat


6m open boat


10m decked boat

The construction details described here will in general not meet accepted international standards for wooden vessels. However, indications are given on good and bad practices and these should help improve overall standards of vessel construction thereby improving safety at sea, reducing vessel maintenance and increasing vessel longevity.


Poor Practice


Good Practice

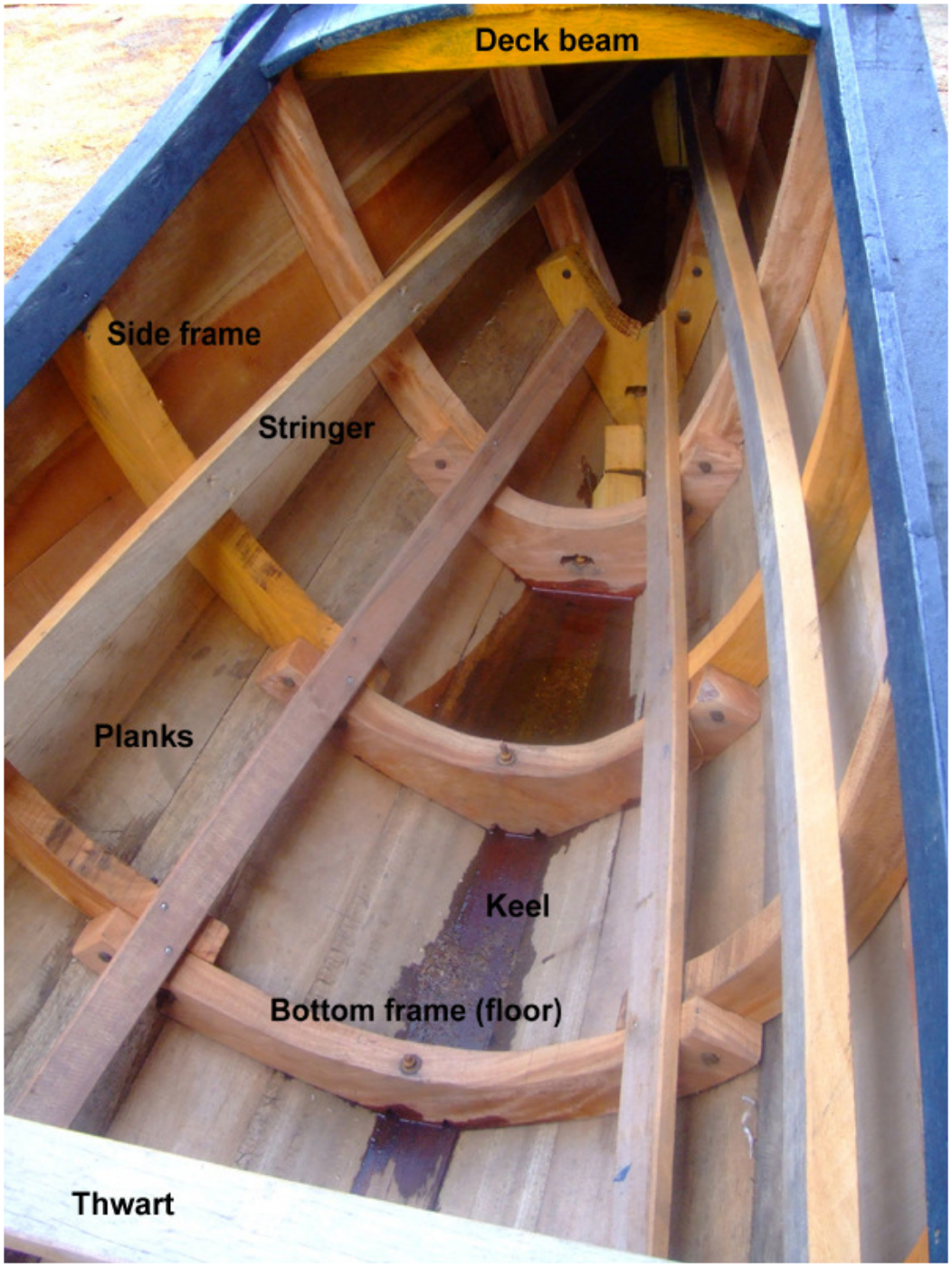
This document does not aim cover standards for stability, safety at sea or equipment to be carried.

Section 2 describes good practice for wooden vessel construction and section 3 contains illustrations of traditional boatbuilding in Aceh.

2. Construction

2.1 General

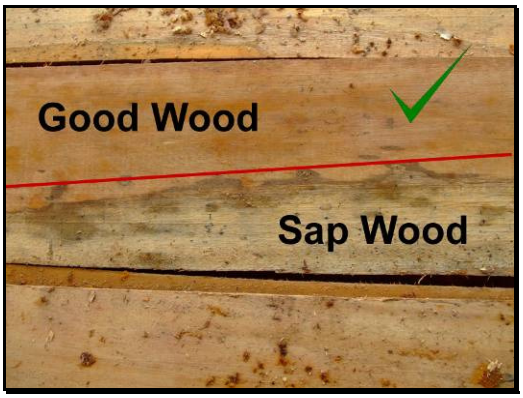
The parts and details referred to in the text are illustrated below.



7.5 m Traditional boat from Banda Aceh

2.2 Timber

Timber to be used in construction should be reasonably well seasoned, of good quality and free from knots, splits and sap wood. In order to meet this requirement it is important to carefully select each piece of timber and frequently to purchase excess stock, this will allow the rejection of sub standard timber.



Good wood & sap wood

Carefully selected timber

Timber should be selected according to location in the vessel, generally this will involve:

Light strong timber for hull and deck planking, the density of which should be at least 480 kg/m^3 (560 kg/m^3 is recommended).

Heavier timber for keel, frames and backbone components, the density of which should be at least 600 kg/m^3 (650 kg/m^3 is recommended).

Timber should be selected which is known to have good durability and resistance to rot and which has a proven record in the construction of good boats.

2.3 Planking

General – hull planking should be from long or continuous lengths where possible and where a sufficient quantity of quality timber is available. The width of planks should be kept as small as practical and generally less than 8 times plank thickness (6 times plank thickness or less is recommended).

For planks up to 150 mm wide 2 fastenings should be used at each frame, over this width 3 fastenings should be used.

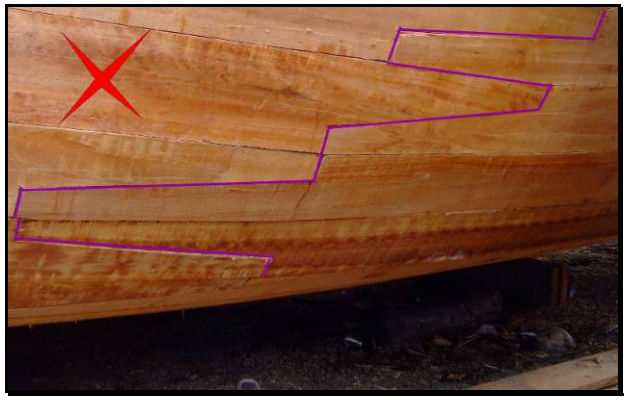
Thickness - hull planking should be of a thickness which is suitable for the size of boat and the spacing of frames, see section on frame spacing below. In general planking of 16 mm or less should not be used unless special arrangements are made for framing.

Seams - plank seams should have a maximum gap of 3 mm on the inside and it is recommended that a caulking gap is included on the outside. Gaps between planks of more than 6mm should never be used.

Caulking – the seams between planks should be caulked with an organic material such as oakum and then filled with a flexible waterproof filler. The use of synthetic fibres for caulking is not recommended.

Joints – plank joints (butts) should be staggered so that they are not in the same position in adjacent planks. Good practice is to stagger butts in adjacent planks so that they are separated by at least 2 frames (4 frames is recommended). Where butts are to land on the same frame it is good practice to have 1 passing plank between them (3 passing planks is recommended).

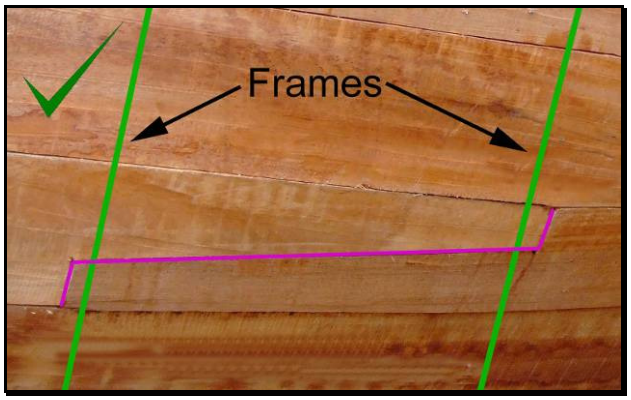
Large gap in planking



Plank butts in adjacent planks

Joints in planks may be made as follows:

On frames – in cases where planks and frames are sufficiently large, this will generally be for double sawn frames (double width frames).
Between frames – using butt blocks on the inside of the planking (recommended).
Scarf joint – spanning two frames, this is often seen in traditional construction and is adequate if well fastened.



Acceptable scarf joint

2.4 Frames

General – frames may be of sawn or grown type according to their position and shape. Grown timber should be carefully selected for each frame. Lower frames (floors) should be fastened to the keel with bolts.

Spacing - the space between frames should be appropriate for the size and type of boat and the thickness of hull planking. The figures below are approximate guidelines.

5 to 6 metre boat – maximum frame spacing 350 mm
6 to 8 metre boat – maximum frame spacing 400 mm
> 8 metre boat – maximum frame spacing 450 mm.

Size of side frames – should be appropriate for the size of boat and the spacing between frames, the figures below are approximate guidelines. Frames which are less than 30 mm in either dimension should never be used.

5 to 6 metre boat – minimum frame width x depth 40 x 40 mm
6 to 8 metre boat – minimum frame width x depth 40 x 50 mm
> 8 metre boat – minimum frame width x depth 40 x 60 mm.

Size of bottom frames (floors) - should be appropriate for the size of boat and frame spacing. In general the depth is increased by 50% over side frames. Frames which are less than 30 mm in either dimension should never be used.

Size change – frames size should increase in the area of the joint to account for timber grain and bolts. Frame size may decrease slightly at the top.

Joint – the frame joint should have a minimum overlap of 200 mm and have 2 bolts spaced 100 mm apart at each joint. Alternative arrangements may be used with special consideration.

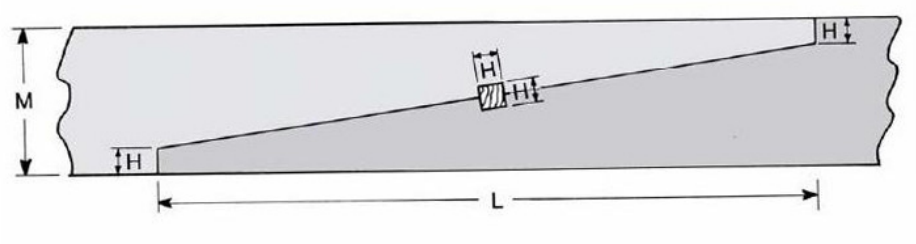
Frame depth too small in joint area Frame overlap and bolting

Thwart – where the layout permits it is desirable to fit thwarts at two or three locations in an open vessel. These are cross braces (or seats) fastened across frame arms at or near deck height to stiffen the structure.

All components should be primed before assembly and bedding compound should be used between all joined surfaces.

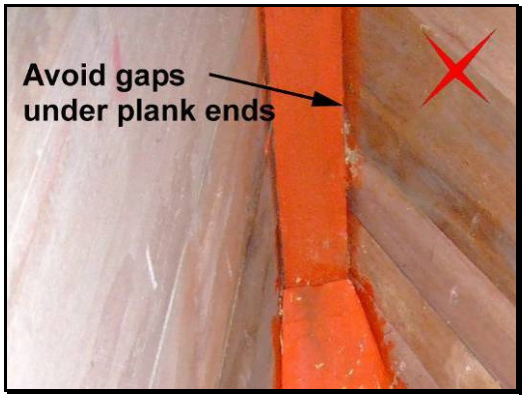
2.5 Backbone & Other Components

Keel – The size of keel should be appropriate for the size and type of boat. For vessels up to 7m good practice is to have the keel timber in one length, where this is not possible the join should be a scarf of length 5 times keel depth with a stopwater.



Detail of keel scarf

Stem – The stem should be appropriate for the size and type of boat, in general the dimensions can be equivalent to those of the keel. Where an apron is not fitted, attention should be paid to the rebate in the stem to ensure plank ends achieve a close fit.

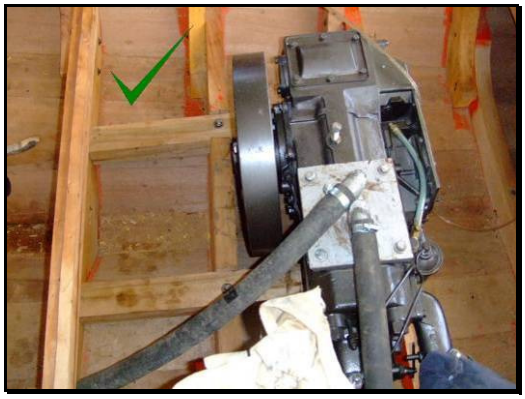


Detail at stem rebate

Stringers – The size of stringers should be appropriate for the size and type of boat. Good practice is to have 2 or 3 stringers on each side with one (the bilge stringer) close to the frame joint. Stringers should run continuously from stem to transom and where possible be a single length of timber. It is good practice for the bilge stringer to be bolted in place.

Transom – the transom should be constructed from the same materials as the hull sides as a minimum. Generally the transom should be connected to the backbone by the used of a knee bolted in place.

Engine beds – engine beds should be supported by substantial floors over at least 3 frames and should be bolted in place. Additional transverse support may be required where beds extend above floors.



Engine beds well supported

Gunwhale & rubbing strake – it is recommended that these components are at least 25 mm thick.

Knees – a knee should be incorporated at the keel / stem join, for boats less than 6 metres it is recommended that the knee should extend at least 150 mm along each joint and should be bolted in place. for boats of 6 metres and above this should be increase to 250 mm.

All components should be primed before assembly and bedding compound should be used between all joined surfaces.

2.6 Deck

On some larger vessels a full or partial deck may be required, the deck should be watertight and of sufficient strength to support any loads placed upon it.

General – deck planking should be from long lengths where possible and the width of planks should be kept as small as practical (125 mm or less is recommended). It is an accepted standard that deck planking extends the full width of the vessel and that hull frames do not pass through the planking. However, on many traditionally constructed vessels this is not done, this may be adequate where careful attention is given to the watertight construction of the deck.

Thickness - deck planking can be of the same thickness as the hull sides. Planking of 16 mm or less should not be used unless special arrangements are made.

Seams - plank seams should have a maximum gap of 3 mm on the inside and it is recommended that a caulking gap is included on the outside. Gaps between planks of more than 6mm should never be used.

Caulking – the seams between planks should be caulked with an organic material such as oakum and then filled with a flexible waterproof filler. The use of synthetic fibres for caulking is not recommended.

Joints – plank joints should be staggered so that they are not in the same position in adjacent planks. Good practice is to stagger butts in so that they are separated by at least 1 metre. Where butts are to land on the same frame it is good practice to have at least 1 passing plank between them (3 passing planks is recommended).

Deck Beams – The deck is supported by beams; these should be curved (cambered) by at least 20 mm per metre of length. The beams are generally spaced at the same centres as the hull framing and their ends are supported by a stringer. Beams which are less than 30 mm in either dimension should generally not be used.

Vessels having features such as a deckhouse, heavy deck gear (e.g. a winch) and large deck hatches should be fitted with larger “main beams” in way of these. Main beams have width increased by at least 50% over deck beams. Main beams should also be used to support the ends of partial decks.

On larger vessels it is an accepted standard that main deck beams, highly loaded areas and the transom are supported by horizontal (lodging) knees. These will increase the rigidity and strength of the structure and will contribute to a more watertight and longer lasting deck.

2.6 Fastenings

The use of hot dipped galvanised nails and bolts throughout the vessel is recommended.

Galvanised fastenings

The minimum bolt size used should be 8mm although in many cases larger bolts may be required.

The minimum nail gauge used should be 3mm, although in many cases larger nails may be required. The minimum nail length should be 2 x thickness of plank being fastened.

All nails should be punched and filled.

Bolts passing through the hull should have caulking grommets under their heads.

2.7 Construction Quality

The quality of construction should be checked regularly through the build to ensure good practice in accordance with the notes above.

In particular timber quality and splits should be checked. Knots, splits and sap wood should be avoided in all locations and should never be allowed in hull planking below the waterline.

Sap wood in frames

Sap wood in planking

Splits in plank ends should be avoided, two or more splits in plank ends should never be allowed.

Split plank ends

3. Equipment and Fittings.

Skin fittings – Suitable fabricated or cast metal fittings should always be used for through hull penetrations. Plastic piping installed without suitable fittings is not recommended.

Pipework connected to skin fittings should always be firmly attached with clips, connections made with inappropriate materials such rope and rubber should never be used.

Metal skin fittings

Fittings should be seated on bedding compound and should be bolted in place.

Stern tube – the stern tube should be rigidly supported by fixed structures at 2 or 3 frames.

Stern tube poorly supported

Stern tube well supported

Annex G – International Standards

1. Nordic Boat Standard

1.1 Outline:

- Applicable to commercial vessels < 15m in length;
- Scantlings based on sea load given graphically for vessels of 3, 6, 9, 12 & 15 m in length;
- Sea loads derived from vessel length and speed (min. 10 knots);
- Sea loads corrected for longitudinal position to give hull pressures;
- Sea loads corrected for vertical height to give pressures for sides, decks etc;
- For wooden vessels scantlings are based on length and derived loads;
- Applicable to timber, FRP, aluminium and steel construction;
- For timber covers carvel, clinker, plywood, laminated and strip planked construction;
- Scantlings corrected for timber density;
- Keel and stem size are given as required section modulus and based on Loa^2 ;
- Size of frames, longitudinals, deck beams etc are given as required section modulus and based on load;
- Hull or deck planking thickness based on load or Loa.

1.2 Limitations:

- No account is taken of vessel CUNO or displacement;
- Minimum vessel speed in calculation is 10 knots;
- Little account is taken of quantity or effectiveness of fastenings;
- No account is taken of intended use of vessel including weather, sea conditions and beach landing;

- No allowances can be made for unusual structural arrangements often found in artisanal fishing vessels;
- Scantlings are based on traditional northern European style construction;
- Scantlings are heavy for small scale vessels operating in less severe seas.

2. UK SeaFish Rules

2.1 Outline:

- Applicable to fishing vessels <24 m in length;
- Scantlings based on tabulated values, according to Scantling Numeral (CUNO);
- Applicable to timber carvel, clinker and plywood construction as well as FRP and steel construction.

2.2 Limitations:

- Scantlings are based on traditional northern European style construction;
- No account is taken of intended use of vessel including weather, sea conditions and beach landing;
- No account is taken of vessel speed;
- Little account is taken of quantity or effectiveness of fastenings;
- No allowances can be made for unusual structural arrangements often found in artisanal fishing vessels;
- Scantlings are heavy for small scale vessels operating in less severe seas.

3. ISO Standard

3.1 Outline:

- Primarily applicable to recreational and charter vessels <24 m in length;
- Makes use of design categories to account for weather and sea conditions;
- Takes account of vessel displacement;
- Takes account of dynamic loads;

- Able to take account of hull deadrise;
- Calculated pressure is corrected for longitudinal and vertical positions and reference panel;
- Applicable to FRP (single skin and sandwich), metal (aluminium and steel) and timber (plywood, laminated and strip planked) construction;
- Scantling calculations are detailed and able to account for numerous features and structural arrangements;
- Contains simplified methods for scantling calculation for smaller vessels operating in inshore and sheltered waters.

3.2 Limitations:

- Intended mainly for use in recreational vessels;
- No methods included for plank on frame (traditional) timber construction.

Annex H – Annexes on draft construction standards submitted by FAO to the IMO correspondence group on the safety of small fishing vessels

Annexes II and III included below form part of the proposed IMO Standard of Safety for Small Fishing Vessels.

ANNEX II CONSTRUCTION STANDARDS FOR WOODEN FISHING VESSELS

Scope

These construction standards apply to decked fishing vessels of less than 12 m in length and undecked fishing vessels of any size.

These construction standards are under development and require further work and refinement.

In general the construction standards apply to fishing vessels of conventional form and wooden construction; that is single hull vessels of plank on frame construction with metal fastenings which in general should consist of:

- substantial backbone structure
- close spaced transverse frames
- fore and aft carvel planking fastened to frames with metal fasteners
- deck, partial deck or full deck
- longitudinal structure including gunwhale, bilge stringer and engine beds.

Incorporate illustrations.

In general the standards apply to vessels operating at moderate speeds. The figures below are guidelines:

- 5 to 6 metre vessel – maximum operating speed 12 knots
- 6 to 8 metre vessel – maximum operating speed 14 knots
- > 8 metre vessel – maximum operating speed 16 knots.

Vessels operating at higher speeds will require special consideration by the competent authority.

A number of vessel types are not covered by the requirements of these construction standards including the following:

- Vessels constructed of plywood, glued wood or wood sheathed in FRP;
- Vessels propelled by paddles or oars only;
- Vessels judged by the competent authority to be outside the scope of this standard.

Design categories

These construction standards are based on the division of vessels into appropriate design categories, the categories indicate sea and wind conditions for which a vessel is considered to be suitable, provided that the vessel is correctly operated and at a speed appropriate to the prevailing sea state. The design categories are listed in section 1.2.12.

Construction standards

The appropriate standards of construction for wooden vessels shall be determined as follows:

- Vessels in **ALL** categories shall meet the requirements of **Part 1** of this standard;
- Vessels in categories **A** & **B** shall meet the requirements of **Part 2** of this standard;
- Vessels in category **C1** shall meet the requirements of **Part 3** of this standard;
- Vessels in category **C2** shall meet the requirements of **Part 3** of this standard, however;
- Where judged appropriate by the competent authority, vessels in category **C1**, with a length overall of less than **7 m**[1], may be required only to meet the requirements of **Part 1**.
- Vessels in category **D** shall meet the requirements of **Part 1** of this standard.

The table below shows the determination of required construction standards.

Category	Part 1	Part 2	Part 3
A	□	□	
B	□	□	
C1	□		□
C2 (L > 7 m)	□		□
C2 (L < 7 m)	□		
D	□		

Notes on categories:

1. Undecked vessels are considered to operate in categories C1, C2 and D only.
2. Vessels fitted with sails are considered to operate in categories C1, C2 and D only unless given special consideration by the competent authority.
3. Boats operated by one crew member are [not encouraged but where permitted by the competent authority are] considered to operate in category D only.

[1] The boundary for C1 vessels may require further definition and may use other parameters such as tonnage in accordance with competent authority experience.

PART 1

1. Introduction

The construction standard described here should be applied to all decked fishing vessels of less than 12 m in length and undecked fishing vessels of any size.

2. Construction

2.1 Timber

2.1.1 Timber should be well seasoned, of good quality and free from knots, splits and sap wood. In order to meet this requirement it is necessary to carefully select each piece of timber. Timber for planking should have a moisture content of 15 to 20%.

2.1.2 Timber should be selected according to location in the vessel as follows:

2.1.3 Hull and deck planking, the density of timber should be at least 480 kg/m^3, 560 kg/m^3 is recommended.

2.1.4 Keel, stem and deadwood components, the density of timber should be at least 600 kg/m^3, 640 kg/m^3 is recommended.

2.1.5 Frames and engine beds, the density of timber should be at least 700 kg/m^3, 720 kg/m^3 is recommended.

2.1.6 Timber should be selected from available species known to have good durability and resistance to rot, marine borers and which have a locally proven record in boatbuilding.

2.2 Planking

2.2.1 Hull planking should be from long or continuous lengths where possible.

2.2.2 The width of planks should be kept as small as practical and generally less than 8 times plank thickness, between 4 and 6 times plank thickness or less is recommended.

2.2.3 For planks up to 150 mm wide 2 fastenings should be used at each frame, over 150 mm wide 3 fastenings should be used at each frame.

2.2.4 Hull planking should be of a thickness which is suitable for the size of boat and the frame spacing. In general planking of 16 mm or less should not be used unless special arrangements are made for framing. The figures below are guidelines.

- 5 to 6 metre vessel – minimum plank thickness 18 mm
- 6 to 8 metre vessel – minimum plank thickness 20 mm

- > 8 metre vessel – minimum plank thickness 25 mm.

2.2.5 Plank seams should have a maximum gap of 3 mm on the inside and it is recommended that a caulking gap is included on the outside. Gaps between planks of more than 6mm should never be allowed.

2.2.6 Seams between planks should be caulked with an organic material such as oakum and then filled with flexible waterproof filler. The use of synthetic fibres for caulking is not recommended.

2.2.7 Plank joints (butts) should be staggered so that they are not in the same position in adjacent planks. Butts in adjacent planks should be staggered so that they are separated by at least 2 frames, 4 frames is recommended. Where butts land on the same frame there should be at least 1 passing plank between them, 3 passing planks is recommended.

2.2.8 Joints in planks may be made by one of the following methods: on frames where planks and frames are sufficiently large, this will generally be for double sawn frames (double width frames); between frames using butt blocks on the inside of the planking; or by scarf joint spanning two frames.

2.3 Frames

2.3.1 Frames should be of sawn or grown type according to their position and shape. Grown timber should be carefully selected for each frame. Lower frames (floors) should be fastened to the keel with bolts.

2.3.2 The space between frames should be appropriate for the size and type of vessel and the thickness of hull planking. The figures below are guidelines.

- 5 to 6 metre vessel – maximum frame spacing 350 mm
- 6 to 8 metre vessel – maximum frame spacing 400 mm
- > 8 metre vessel – maximum frame spacing 450 mm.

2.3.3 The size of side frames should be appropriate for the size of vessel and the spacing between frames, the figures below are guidelines. Frames which are less than 30 mm in either dimension should never be used.

- 5 to 6 metre vessel – minimum frame width x depth 40 x 40 mm
- 6 to 8 metre vessel – minimum frame width x depth 40 x 50 mm
- > 8 metre vessel – minimum frame width x depth 50 x 60 mm.

2.3.4 The size of bottom frames (floors) should be appropriate for the size of vessel and frame spacing. In general the depth is increased by 50% over side frames.

2.3.5 Frames size should increase in the area of the joint or turn of bilge to account for timber grain and fastenings. Frame size may decrease slightly at the top.

2.3.6 Where there are joints or overlaps in frame construction, the joint should have a minimum overlap of 200 mm and have 2 bolts spaced 100 mm apart.

2.3.7 Where the layout permits it is recommended that thwarts are fitted at two or three locations in an undecked vessel. These cross members (or seats) are fastened across frame arms at or near deck height to stiffen the structure.

2.3.8 All frame components should be painted with primer before assembly and bedding compound should be used between all joined surfaces.

2.4 Keel and Other Components

2.4.1 The size of keel should be appropriate for the size and type of vessel. For vessels up to 7 metres in length it is good practice is to have the keel timber in one length, where this is not possible the join should be a scarf of length 5 times keel depth and include a stopwater.

- 5 to 6 metre vessel – minimum frame keel area 60 cm^2
- 6 to 8 metre vessel – minimum frame keel area 80 cm^2
- > 8 metre vessel – minimum frame keel area 130 cm^2.

2.4.2 The stem should be appropriate for the size and type of vessel; in general the dimensions can be equivalent to those of the keel. Where an apron (inner stem) is not fitted, attention should be paid to the rebate in the stem to ensure plank ends achieve a close fit.

2.4.3 The size of stringers should be appropriate for the size and type of vessel. Stringers should run continuously from stem to transom and where possible be a single length of timber. It is good practice for the bilge stringer to be bolted in place.

2.4.4 The transom should be constructed in the same manner as the hull. Generally the transom should be connected to the backbone by the use of a knee bolted in place. Special arrangements should be made where there are large loads from fishing gear or where damage by gear is possible.

2.4.5 The engine beds should be supported by substantial floors over at least 3 frame spaces and should be bolted in place.

2.4.5 A gunwhale and rubbing strake should be fitted and should be from timber at least 25 mm thick. Special arrangements should be made where there are large loads from fishing gear or where damage by gear is possible.

2.4.6 Knees should be used at the keel to stem join, for boats less than 6 metres in length it is recommended that the knee should extend at least 150 mm along each joint and should be bolted in place. For boats of 6 metres and above the knee length should be increase to 250 mm.

2.4.7 All components should be primed before assembly and bedding compound should be used between all joined surfaces.

2.5 Deck

2.5.1 Where a full or partial deck is fitted it should be watertight and of sufficient strength to support any loads placed upon it.

2.5.2 Deck planking should be from long lengths where possible and the width of planks should be kept as small as practical, 125 mm or less is recommended.

2.5.3 Deck planking should be of the same thickness as the hull sides. Planking of 16 mm or less should not be used unless special arrangements are made.

2.5.4 Plank seams should have a maximum gap of 3 mm on the inside and it is recommended that a caulking gap is included on the outside. Gaps between planks of more than 6mm should never be allowed.

2.5.5 The seams between planks should be caulked with an organic material such as oakum and then filled with flexible waterproof filler. The use of synthetic fibres for caulking is not recommended.

2.5.6 Plank joints should be staggered so that they are not in the same position in adjacent planks. Butts in adjacent planks should be separated by at least 1 metre. Where butts are to land on the same frame there should be at least 1 passing plank between them, 3 passing planks is recommended.

2.5.7 The deck should be supported by beams; these should be curved (cambered) by at least 20 mm per metre of length. The beams may be spaced at the same centres as the hull framing and their ends are supported by a stringer. Beams which are less than 30 mm in either dimension should generally not be allowed.

2.5.8 Vessels having features such as a deckhouse, heavy deck gear and large deck hatches should be fitted with larger main beams each side of these. Main beams have width increased by at least 50% over deck beams. Main beams should also be used to support the ends of partial decks.

2.5.9 It is good practice to support main deck beams, highly loaded areas and the transom by horizontal knees. These will increase the rigidity and strength of the structure and will contribute to a more watertight and longer lasting deck.

2.6 Fastenings

2.6.1 Hot dipped galvanised nails and bolts should be used throughout the vessel. Galvanised bolts may be substituted by stainless steel fastenings.

2.6.2 The minimum bolt size used should be 8mm; in many cases larger bolts will be required. The bolts in the keel assembly should be as follows.

- 5 to 6 metre vessel – keel bolts = 8 mm

- 6 to 8 metre vessel – keel bolts = 10 mm
- > 8 metre vessel – keel bolts = 12 mm.

2.6.4 The minimum nail gauge used should be 4mm; in many cases larger nails will be required. The minimum nail length should be 2.5 x thickness of plank being fastened, 3 x thickness of plank is recommended.

2.6.5 All holes for nails should be pre-drilled to avoid splits and all nails should be punched and filled.

2.6.6 Bolts passing through the hull should have caulking grommets under their heads.

2.6.7 Spacing of fastenings should be in accordance with the guidelines below.

- Minimum distance from end of timber – 7 x diameter of fastening.
- Minimum distance from edge of timber – 3 x diameter of fastening.

2.7 Construction Quality

2.7.1 The quality of construction should be checked regularly through the build to ensure good practice in accordance with the standards described.

2.7.2 Timber quality and should be checked. Knots, splits and sap wood should be avoided in all locations and should not be allowed in hull planking below the waterline.

2.7.3 Use of fastenings should be checked. Poor positioning of fastenings and splits caused by fastenings should be avoided in all locations and should not be allowed in hull planking below the waterline.

PART 2

1. Introduction

1.1 The construction standard described here should be applied to all decked fishing vessels in design categories A and B.

2. Construction

2.1 In general the requirements of **Part 1** should be complied with in addition to the requirements below.

2.2 The strength and construction of the hull, deck and other structures should be built to withstand all foreseeable conditions of the intended service.

2.3 Generally vessels should meet the requirements of an internationally recognized wooden vessel construction standard and be built to the satisfaction of the competent authority.

2.4 The standards recognized include:

- The Nordic Boat Standard;
- The construction rules of the UK Sea Fish Industry Authority (Seafish);
- Construction rules of national authority;
- Construction rules of classification society.

PART 3

1. Introduction

The construction standard described here should be applied to all decked and undecked fishing vessels in design category C1 and vessels over 7 metres in length in design category C2. It should be read in conjunction with Part 1 of this standard.

2. Construction

The requirements of **Part 1** of this standard should be complied with in addition to the requirements below.

2.1 Timber

Careful attention should be paid to the requirements for timber described in **Part 1**.

2.2 Planking

Hull planking should be of a thickness which is suitable for the size of boat and the frame spacing; table 2.2 shows the relationship between plank thickness and frame spacing. Note that the plank thicknesses shown are the minimum and the frame spacings are the maximum values.

2.3 Frames

The space between frames should be appropriate for the size and type of vessel and the thickness of hull planking; table 2.2 shows the relationship between plank thickness and frame spacing.

The size of frames should be appropriate for the size of vessel and the spacing between frames; table 2.3 shows minimum frame dimensions.

2.4 Keel and Other Components

The size of keel should be appropriate for the size and type of vessel; table 2.4 shows the minimum frame dimensions.

In undecked vessels with a CUNo of 15 or less the hog may be omitted where this is the convention with local construction methods.

Tables

These tables are under development and require further work and refinement.

Table 2.2 – Plank thickness and frame spacing

CUNo	Design Category C Planking thk / frame space					Design Category D Planking thk / frame space				
	18	20	25	30	35	18	20	25	30	35
3	410	450				430				
5	380	410				395	430			
10	345	375				360	390			
15	320	345	420			330	360	440		
20	305	330	400			320	345	420		
25	295	320	390			305	335	410		
30	290	310	380	445		300	325	395		
35	280	305	370	435		295	320	385	450	
40	275	300	365	425		290	315	380	445	
45	270	300	360	420		285	310	375	435	
50	265	290	350	410		280	305	370	430	
55	260	285	345	405		270	300	360	420	
60	255	280	335	400	450	265	290	350	410	
65	250	275	330	390	445	260	285	345	405	
70		270	325	380	440	260	280	340	400	455
75		270	325	380	430	255	280	335	395	450
80		265	320	375	425	250	275	335	390	445

Table 2.3 – Frame dimensions

CUNo	Category C				Category D			
	W	Df	Db	Dd	W	Df	Db	Dd
3	40	60	50	40	40	60	50	40
5	40	65	50	45	40	60	50	40
10	50	80	60	50	50	70	55	45
15	50	85	65	50	50	75	60	50
20	55	85	70	60	55	80	65	55
25	55	90	75	60	55	85	70	55
30	60	95	75	60	60	90	70	60
35	60	100	80	65	60	95	75	60
40	60	100	80	65	60	95	75	60
45	60	105	80	70	60	95	75	65
50	65	105	85	70	65	95	75	65
55	65	110	85	70	65	100	75	65
60	65	110	85	70	65	100	75	65
65	65	115	90	75	65	105	80	70
70	65	115	90	75	65	105	80	70
75	65	115	90	75	65	110	80	70
80	70	115	90	80	70	110	80	75

Note:
W = width (siding) of frame
Df = depth (moulding) of frame at floor; Db = depth of frame at bilge; Dd = depth of frame at deck

Table 2.4 – Keel and Hog dimensions

CUNo	Category C				Category D			
	Keel		Hog		Keel		Hog	
	W	H	H	W	W	H	H	W
3	70	70	Not Fitted		70	60	Not Fitted	
5	75	75			75	70		
10	80	90			80	85		
15	90	100			90	90		
20	90	100	50	145	90	95	50	145
25	90	105	50	155	90	100	50	155
30	95	115	50	165	95	105	50	165
35	100	120	55	175	100	115	55	175
40	105	130	55	185	105	120	55	185
45	110	140	60	190	110	130	55	190
50	115	145	60	200				
55	115	150	60	200				
60	120	150	60	205				
65	120	160	60	210				
70	120	160	65	210				
75	130	160	65	210				
80	130	160	65	210				

ANNEX III CONSTRUCTION STANDARDS FOR FRP FISHING VESSELS

CONSTRUCTION STANDARDS FOR GRP FISHING VESSELS

Scope

These construction standards apply to decked fishing vessels of less than 12 m in length and undecked fishing vessels of any size.

These construction standards are under development and require further work and refinement.

In general the standards apply to fishing vessels of conventional form and of glass reinforced plastic construction (GRP); that is single hull vessels of glass rovings and mat and polyester resin construction which in general should consist of:

- moulded hull of single-skin or sandwich construction
- deck of GRP sheathed plywood, GRP or traditional timber construction
- transverse framing
- longitudinal structure including gunwhale, stringers, engine beds.

Incorporate illustration.

In general the standards apply to vessels operating at moderate speeds. The figures below are guidelines:

- 5 to 6 metre vessel – maximum operating speed 12 knots
- 6 to 8 metre vessel – maximum operating speed 14 knots
- > 8 metre vessel – maximum operating speed 16 knots.

Vessels operating at higher speeds will require special consideration by the competent authority.

A number of vessel types are not covered by the requirements of these construction standards including the following:

- Vessels constructed of other materials such as Kevlar reinforcements and epoxy resins;
- Vessels propelled by paddles or oars only;
- Vessels judged by the competent authority to be outside the scope of this standard.

Design categories

These construction standards are based on the division of vessels into appropriate design categories, the categories indicate sea and wind conditions for which a vessel is considered to be suitable, provided that the vessel is correctly operated and at a speed appropriate to the prevailing sea state. The design categories are listed in section 1.2.12.

Construction standards

The appropriate standards of construction for wooden vessels shall be determined as follows:

- Vessels in **ALL** categories shall meet the requirements of **Part 1** of this standard;
- Vessels in categories **A** & **B** shall meet the requirements of **Part 2** of this standard;
- Vessels in category **C1** shall meet the requirements of **Part 3** of this standard;
- Vessels in category **C2** shall meet the requirements of **Part 3** of this standard, however;
- Where judged appropriate by the competent authority, vessels in category **C1**, with a length overall of less than **7 m**[2], may be required only to meet the requirements of **Part 1**.
- Vessels in category **D** shall meet the requirements of **Part 1** of this standard.

The table below shows the determination of required construction standards.

Category	Part 1	Part 2	Part 3
A	□	□	
B	□	□	
C1	□		□
C2 (L > 7 m)	□		□
C2 (L < 7 m)	□		
D	□		

Notes on categories:

4. Undecked vessels are considered to operate in categories C1, C2 and D only.

5. Vessels fitted with sails are considered to operate in categories C1, C2 and D only unless given special consideration by the competent authority.

6. Boats operated by one crew member are [not encouraged but where permitted by the competent authority are] considered to operate in category D only.

[2] The boundary for C1 vessels may require further definition and may use other parameters such as tonnage in accordance with competent authority experience.

PART 1

1. Introduction

The construction standard described here should be applied to all decked fishing vessels of less than 12 m in length and undecked fishing vessels of any size.

2. Construction [3] [4]

2.1 Materials

Resins should be approved for marine use and be mixed and used in accordance with the manufacturers' recommendations.

Glass reinforcements should be approved for marine use and may be in the form of chopped strand mat, woven rovings, fabric, powder bound mat or other approved materials.

Colour pigment may be used in the gel coat sufficient to give a satisfactory colour; the amount used should be in accordance with the manufacturers' recommendations. No pigment should be used in the lay-up resin of the hull laminates.

Formers for stiffeners should be of rigid foam, timber, metal or other approved materials. Where timber is used it should have a moisture content of not more than 15%.

Careful attention should be paid to the manufacturers' recommendations concerning the storage and use dates of the materials to be used.

2.2 Workshop practice

All building activities should be carried out under a fixed roof and preferably in an enclosed workshop.

The cleanliness of the workshop is important for the health of workers and to prevent the contamination of the resin and reinforcements.

Waste material, dust, sand and other contaminants should be removed from the workshop immediately.

The moulding area should be kept clear of dust and accumulations of waste material which could contaminate the mould surfaces.

The recommended humidity and temperature ranges under which laminating may take place are: temperature 15 to 25 C, humidity 70%. The moulding process should cease if the following limits are reached: temperature 13 to 32 C, humidity 80%.

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[3] This part is based on extracts from the UK Seafish and NBS standards.
[4] Reference should be made to FAO Fisheries Technical Paper No 321 – Building a Fibreglass Fishing Boat

The workshop should be as free as practical from dust and fumes to allow comfortable and safe working conditions. Styrene fumes are heavier than air and should be removed from moulds by the use of mechanical ventilation systems.

Completed mouldings should not be taken outside the workshop environment within 7 days of the start of the moulding process. Where mouldings are moved outside after this period they should be protected from rain.

The addition of catalyst to polyester products should be strictly controlled within the limits of 1% to 3% by weight. Tables indicating amounts of catalyst and resin should be provided in the workshop.

The catalyst **must** be properly dispersed through the resin by very thorough mixing.

2.3 Laminate lay up

The outside surface of all laminates should have a layer of gel coat or be treated with equivalent surface protection after completion of moulding. This layer should be 0.4 to 0.6 mm thick.

The gel coat should only be left exposed in accordance with the manufacturers' recommendations; generally this will be a maximum of 24 hours.

Heavy reinforcements should not be applied directly to the gel coat; the first two layers should consist of a light chopped strand mat of maximum weight 300 g/m^2.

Where woven rovings are incorporated these should be alternated with a layers of chopped strand.

A suitable top coat should be applied in bilge and keel areas where water will accumulate.

Laminates should be locally increased in thickness in way of fittings and equipment, the increased is to be gradually reduced to the normal thickness by stepped layers.

Any holes or openings cut in laminates should be sealed with resin.

The overlap of mats or woven rovings should be a least 50 mm and the shift of subsequent reinforcement overlaps should be at least 100 mm.

Laminate should be laid up in accordance with a documented sequence.

Laminates should be worked in such a way that they are fully consolidated; that is thoroughly wetted out, free from blisters, air gaps, delamination, resin starved areas or excess resin.

The interval between layers is to be carefully timed to enable proper completion of each laminate.

The time elapsed between the completion of hull or deck laminate and the bonding of structural members should be kept within the limits of the manufacturers' recommendations.

2.4 Hull construction

All figures given are subject to further work and refinement and checks.

The hull bottom should be a solid laminate of glass reinforcements in resin, laid up to a satisfactory weight, the following are minimum recommendations.

- 5 to 6 metre vessel – minimum weight of reinforcement 2150 g/m^2
- 6 to 8 metre vessel – minimum weight of reinforcement 2500 g/m^2
- > 8 metre vessel – minimum weight of reinforcement 2850 g/m^2.

The hull sides above the waterline should be a solid laminate of glass reinforcements in resin, laid up to a satisfactory weight, the following are minimum recommendations.

- 5 to 6 metre vessel – minimum weight of reinforcement 1400 g/m^2
- 6 to 8 metre vessel – minimum weight of reinforcement 1700 g/m^2
- > 8 metre vessel – minimum weight of reinforcement 2000 g/m^2.

The keel and sheerstrake areas of the hull should have additional reinforcements, the following are minimum recommendations.

- Keel – increase weight of reinforcement by 40% over a width of 200 to 600 mm according to vessel size
- Sheerstrake – increase weight of reinforcement by 10% over a width of 150 to 450 mm according to vessel size.

Hulls should be adequately stiffened; this may be in the form of longitudinal or transverse stiffeners or a combination of both. Transverse frames and stiffening should be equally spaced throughout the length of the hull.

Size of frames are to be .... and constructed by moulding over formers which should be bonded to the inside hull laminate while it is still in an uncured state. Frame formers may be of top hat or rectangular section. Where frames have gunwales or stringers through bolted, the core of the frames is to be of timber.

Floors moulded over formers are to be fitted to the tops of the frames at the centreline and bonded to the frames.

Stringers where fitted, are to be matted to the hull shell, with spacing and scantling size obtained from ..... They may form a combination of other longitudinal structural members to the approval of the competent authority.

Where through-bolting connections are required, e.g. for gunwales or beam stringers, fastenings should be hot dip galvanized. The edges of the laminate and the fastening holes should be sealed.

The hull surface gel coat is to be adequately protected in way of all fishing gear hauling positions by GRP sheathing, metal, hard rubber or plastic to prevent damage.

Discontinuities and hard points in the structure should be avoided. Where the strength of a stiffener may be reduced by attachment of fittings, openings, etc. additional laminates should be included.

In vessels below 7m LOA where a combination of bonding of internal furniture and hull form provides adequate stiffening, the framing may be omitted subject to the approval of the competent authority.

In undecked boats the required bottom stiffening may be provided wholly or partly formed by the bonded-in flooring arrangement.

Transoms not subjected to loads from outboard engines or steering arrangements should have scantlings as required for the shell laminate.

The glass weight at the corner of the transom and hull shell should be increased by 100%. The additional reinforcement should stepped down by 40mm per 600g/m2 of reinforcement weight.

Transoms that are to be used for the mounting of outboard engines shall be constructed to include a marine grade plywood panel of sufficient dimension and of adequate strength for the proposed installation.

The stem should be moulded to include a gradual reduction from the keel weight to that required for the sheer.

The centre of the hull aft of the keel to the transom is to be stiffened by lay-ups as required for the keel.

Where fitted, rubbing strakes may be of hardwood, rubber or plastic; securing bolts should be hot dip galvanised and sealed to prevent leakage.

Engine seatings should be continuous and shall be of low density or foam core, GRP sheathed, or of fabricated steel construction. Where space permits, the seating is to extend at least twice the length of the engine.

The seatings should be bonded to the hull and stiffened transversely with floor sections and side support brackets. A continuous flat steel plate of adequate thickness and width is to be fitted to the top of the seating in way of the engine and gearbox and bonded to the seating.

Where fitted, it is recommended that bulkheads are fitted to a rigid foam core seating or frame section. When not practical to fit on a frame position, the bulkhead shall be bonded to the shell with double angles of a satisfactory weight.

Bolt connections to be well sealed and glassed over to prevent leakage.

2.5 Deck construction

Decks should be in accordance with .... and may be of GRP sheathed plywood, GRP or traditional timber construction.

A beam shelf or stringer is to be bonded to the hull shell to support the deck beams. A system combining through bolting and bonding is recommended.

Deck beams should be in accordance with .... with longitudinal stiffening provided by hatches and carlings as required. Beams are to be fitted at each frame position.

Decks in way of gallows, warp leads, deck machinery and heavy work positions should have additional stiffening and pillars to the approval of the competent authority.

Main beams should be fitted in way of all deck openings, machinery and deckhouse casings, and in way of masts and heavy deck machinery.

Deck beams of timber, where fitted, are to be in accordance with the following:-

- Beams shall be moulded, sided and spaced in accordance with Tables 3.17 and 3.18, and may be moulded 25mm less at the ends.

- All deck beams shall have a round of beam (camber) less than 20mm per meter of breadth unless otherwise agreed with the Surveyor.

Where decks and deck beams are of GRP construction, openings in the deck may be stiffened by forming continuously moulded flanges, the weight of which shall be 25% greater than the laid up deck laminate weight. Deck openings over 500mm in length shall be fitted with longitudinal stiffening.

Plywood decks should be bolted and bonded to the beam shelf and bonded to the hull. The complete deck area should be sheathed with a GRP laminate. Special attention should be paid to the sheathing in way of working areas that may require extra protection.

Where conventional timber planked decking is used, scantlings should be in accordance with ..... refer to section from wooden rules.

2.6 Construction Quality

2.7.1 The quality of construction should be checked regularly through the build to ensure good practice in accordance with the standards described.

2.7.2 Careful attention should be paid to the proper consolidation of laminates so that they are thoroughly wetted out, free from blisters, air gaps, delamination, resin starved areas or excess resin.

PART 2

1. Introduction

1.1 The construction standard described here should be applied to all decked fishing vessels in design categories A and B.

2. Construction

2.1 In general the requirements of **Part 1** should be complied with in addition to the requirements below.

2.2 The strength and construction of the hull, deck and other structures should be built to withstand all foreseeable conditions of the intended service.

2.3 Generally vessels should meet the requirements of an internationally recognized GRP vessel construction standard and be built to the satisfaction of the competent authority.

2.4 The standards recognized include:

- The Nordic Boat Standard;
- The construction rules of the UK Sea Fish Industry Authority (Seafish);
- Construction rules of national authority;
- Construction rules of classification society. LR, ABS etc.

The UK Seafish rules to be included here for reference.

PART 3

1. Introduction

The construction standard described here should be applied to all decked and undecked fishing vessels in design category C1 and vessels over 7 metres in length in design category C2. It should be read in conjunction with Part 1 of this standard.

2. Construction

2.1 All of the requirements of **Part 1** should be complied with in addition to the requirements below.

2.2 A standard is defined here which accounts for the less severe sea conditions encountered in design categories C and D.

Annex I – Findings on FRP Boats in Aceh & Indonesia.

(Updated to Version 3 on 15th June 06)

1. General

The demonstration of FRP fishing vessels in Aceh needs to be considered against the background of what is already available or planned. FRP boats and projects which are known about in Aceh at the time of writing are as follows:

I. The Kuwait Red Cross provided over 100 FRP canoes early in 2005. These are fitted with inboard diesels; however, the necessary outriggers were not fitted when the boats arrived in Aceh. It appears that when tested by fishermen they were prone to capsize due to the absence of outriggers and therefore the boats were abandoned.

II. Funds from Saudi Arabia are said to be available to provide 1000 FRP fishing boats in 2006. These will be similar to the traditional Aceh fishing craft (likely to be 7 to 8 m). Few details are known about these boats and BRR are trying to have the number reduced, FAO has suggested that the donor to consider supporting other programmes.

III. A Malaysian boatbuilding company is said to wish to establish a commercial fibreglass boatbuilding factory in Sabang, there has been no activity to date. The company is probably Explorer Boats which produces a wide range of boats including small fishing vessels in the 6 to 12 m range.

IV. The Java based fish trading company Susi Air have delivered about 20 FRP outrigger canoes of 9m fitted with 15hp outboards. These are built in Java by an unknown company; the moulds are now on Simeulue and more building may be planned there.

V. The Java based company P.T. Samudera Dockindo Prima built and delivered two 9 m FRP Acehnese style fishing boats to Banda Aceh for evaluation. See notes on company below.

2. FRP boatbuilding

There are FRP boatbuilding activities in various parts of Indonesia and in particular Java, the companies listed below have been investigated.

<u>PT Carita Boat Indonesia</u>
Taman Tekno Blok H1 no 3A – BSD
Tel: 021 7562277

This relatively new company claims to be the largest FRP boatbuilder in Indonesia, however, this may be on basis of facilities rather than production; the company has two facilities near Jakarta.

The company offers a wide range of designs for various applications including fishing vessels, some of which are designed for a specific locations such as the 8 m outrigger canoe shown below which was built for Sulawesi.

Other recent designs include a 9.5 m fishing vessel of which 5 units have been built for Aceh province. The company also builds larger fishing vessels up to 20m as well as patrol boats and passenger vessels.

All boats are said to be built to the requirements of Biro Klasifikasi Indonesia with materials imported from Japan and Singapore. The cost is claimed to be typically about $5 per kilo of finished boat excluding equipment, this appears low given the cost of raw materials.

The concept of building boats to specifically suit Aceh was discussed and the company expressed an interest in this indicating that building boats and conducting training and demonstrations actually in Aceh province might be possible.

Overall the company appeared to be interested in developing new designs and projects for Indonesia but perhaps less commercial in nature than others; the directors even ststed that they were more interested in the projects they undertake than the profits.

PT Sarana Fiberindo Marina
Jl Labu 1 Jayakarta Plaza Rm 2031-2032 Jakarta
Tel: 021-315-4611

An established company occupying a large site to the North West of Jakarta, the yard appears active and has a number of FRP vessels in build or repair.

The company has a large range of designs including patrol, transport and fishing vessels up to 36 m in length. The company also has an in-house naval architect.

Fishing vessel designs include various models from 8 to 20 m in length for fishing gear including longline, trawl and purse seine. It was stated that a mould for almost any (smaller) design could be produced as required, although cost would be dependent on number of boats purchased. The company appears to have a contract to build (under a subcontract) and fitout a large number of wooden fishing vessels for Nias island.

The facility includes a large open area and a range of sheds and berths on jetties, also machinery and welding shops, however, the general appearance is untidy and little consideration is given to health and safety or waste disposal

The boats are said to be built to the requirements of Biro Klasifikasi Indonesia and although the finish of boats is not perfect the construction is probably sound.

The concept of building boats to specifically suit Aceh was discussed and the company expressed an interest in this but wanted to know the size and quantity of boats required. It appears that building boats and conducting training and demonstrations actually in Aceh province might be possible but this would depend on the size of the project.

Overall the company appeared to be interested in developing new designs and projects for Indonesia, however, the company is very commercial in nature and will be mainly interested in the bottom line of any future projects.

PT Damudera Dockindo Prima
Apartmen Tropik Unit 703, JL. S. Parman Kav. 3 Slipi Jakarta
Tel: 021 5641428

It was not possible to visit this company as it has closed its Jakarta office and the yard facility is situated a 12 hour drive east of city. The company appears to offer several designs for small fishing vessels from 7 to 11 m including two designs which appear to be specifically intended for Aceh.

Two 9 m FRP Acehnese style fishing boats have been built by the company and delivered to Banda Aceh for evaluation. Arrangements were made with local fishermen to

use the boats, however, it appears that they have had very limited use. A fisherman operating the boat (fitted with a 23 hp inboard diesel) stated that the boat was seaworthy and was of acceptable design but was too slow. This is most likely due to having a reduction gearbox fitted but with incorrect propeller selection. It is possible that with some improvements this boat would make an ideal FRP design for demonstration.

The construction of the boats delivered to Banda Aceh appears adequate although it is a little rough in terms of finish and may be rather heavy.

It is not known if this company is still active and in a position to build boats for any future project in Aceh.

PT Prima Maritim Nusantara

This Jakarta based firm is not a producer of FRP boats but of moulded polyethylene boats. The company has delivered 400 units of 6.2 m boat fitted with 25 hp outboard which have been distributed amongst districts in Aceh. This project has been coordinated by the Ministry of Peoples Welfare and Poverty Alleviation.

The design is based on a standard Yamaha boat apparently reduced in length. The boat is said not to be particularly liked by fishermen as they find it is un-suitable for open sea conditions.

A major concern with this type of construction is that it will be very hard to repair when damaged, as with all plastic and FRP boats damage can easily occur in ports and harbours.

3. Cost considerations

It is desirable to build an FRP boat to come out at the same weight as the traditional wooden boat upon which it is based. If this is not done the design will have to be modified to account for the weight difference and fishermen may find the characteristics of the boat and in particular stability unfamiliar.

In general a FRP boat could be built lighter than the equivalent wooden vessel and therefore additional material may need to be incorporated in the construction.

In the case where wood and FRP boats are the same weight a simple calculation can be made about relative material costs.

Timber planks rough sawn in Aceh cost in the region of US$180 to US$200 per m^3, at a density of 500 kg/m^3 this equates to US$0.36 to US$0.40 per kg. Final preparation costs (machining) need to be added and are in the region of US$125 per m^3 or US$0.25 per kg. This equates to a total of US$0.61 to US$0.65 per kg.

At the time of writing FRP resin, woven rovings (WR) and glass mat (CSM) procured in Medan cost approximately US$5/kg, US$6/kg and US$4/kg respectively. The average in a typical boat is assumed to be about US$5/kg. It is likely that materials procured from Singapore or Japan in bulk will be a little cheaper than this, for the purpose of this discussion (as pricing information is not available) 10% is assumed. Therefore the average in a typical boat will be about US$4.50/kg.

An 8m Aceh style boat of wooden construction has a structural weight of around 600 kg; that is no metallic items apart from the fastenings necessary in a wooden boat. This gives:

- Around US$390 of **timber materials** not including wastage and requires around US$290 of fastenings, total cost around US$680.
- Around US$2700 of **FRP materials** not including wastage and consumables (acetone, brushes, rollers etc).

The FRP boat also requires the initial construction of a mould which is likely to be more expensive to produce than an individual FRP boat. There are also consumables required for FRP boatbuilding, the main ones are acetone (cleaner), mould treatments (wax and release agents), health and safety items (masks, gloves etc) and special tools for mixing, laminating and consolidating (rolling).

In terms of known boats the following costs are useful for comparison:

- A 9m Aceh style FRP boat from Jakarta costs about US$4000 to US$5000 complete with engine;
- An 8m Aceh style timber boat under FAO contract costs about US$2000 complete with engine.

It is obvious that a traditionally built timber boat is significantly cheaper than an FRP boat of similar design; however, there are additional factors to consider when making the comparison:

- It appears that much of the timber used in boatbuilding in Aceh is not legally cut and as a result is significantly cheaper than it should be;
- An FRP boat should be strong, watertight and have a good life expectancy which many locally built boats in Aceh are not therefore care is needed when comparing costs.
- Good quality FRP boatbuilding requires considerably more investment in facilities and setting up than for wooden boatbuilding; mass production is therefore the key to keeping costs low.

The benefits of FRP construction over timber are mainly related to time that is:

- Reduced man-hours for manufacture of each unit;
- Reduced time for manufacture of multiple units;
- Reduced maintenance users;
- Increased life expectancy.

4. Conclusions

1. There are at least two companies (PT Carita Boat Indonesia and PT Sarana Fiberindo Marina) in Indonesia (Java) which are capable and willing to produce vessels for demonstration to fishermen in Aceh;

2. The company PT Damudera Dockindo Prima appears to have a mould for an 8-9 m Aceh type vessel as found in Banda Aceh, however, this company does not appear to be active in FRP boatbuilding any longer;

3. The companies active in the FRP sector can easily produce a mould for Aceh style vessels to meet FAO requirements;

4. Building of FRP boats is a more industrial process than wooden boatbuilding and requires more formal facilities and investment. Thus the participation of entrepreneurs will be critical to any future FRP boatbuilding facilities in Aceh;

5. Where both timber and labour are cheap and plentiful FRP boats are very unlikely to be competitive with wooden boats in terms of initial cost;

6. Demonstration of the benefits of FRP boats and in particular longevity will be necessary for potential owners of FRP boats to understand the higher costs involved.

5. Recommendations

1. A demonstration of a small number, say 2 or 3, of FRP fishing vessels should be conducted in Aceh to allow fishermen to see benefits and to experience the operational and maintenance requirements of the type;

2. It is considered that the most time and cost effective method is to produce these initial vessels in Java at the premises of the selected builder;

3. The selected builder must express a strong interest in establishing a future building facility in Aceh following the demonstration period;

4. The demonstration should include training for fishermen and crews in FRP repairing as such skills are essential to the longevity and therefore cost effectiveness of the vessels.

Annex J – Status of FAO boatbuilding contracts at end Jan 06

NGO	Location	No. boat	FAO Design	Size/type boat	Fund	Built by end Jan 06	Forecast June 06	Progress	Comments	Recommendations
Yayasan Ikan Tenggiri	Muara Batu, Aceh Utara	20	INS10	7.5 mtr East Coast	509 EC	2 boats 90% complete	7	Slow	One boat done to local rather than FAO improved design.	Continue. Accept one local design boat under contract.
LSM Pelangi	Simeulue Island	5 30	INS4 INS6	7.5 mtr planked 7.5 mtr dugout	509 EC	Await figures (estimate 3 boats)	18	Not known	Yard visit underway by master fish.	Check status
AIRO	Krueng Raya	30	INS10	7.5 mtr East coast	509 EC	5 boats complete, ex engines	18	Good	Currently held up by lack of galvanized fastenings and by need for drawing for engine installation.	Continue. Ensure fastenings and drawings are available.
Yayasan Pengembangan Kawasan (YPK)	Meulaboh	20	INS12	12.5 mtr West Coast	509 EC				Not signed	
Yayasan Pengembangan Sumberdaya (YPS)	Meulaboh	15	INS11	12.5 mtr West Coast	509 EC				Not signed	
Total for EC		**120**					**43**			
Yayasan Ibrahim Nain	Banda Aceh	20	INS10	7.5 mtr East Coast	504 GER	2 boats 30% complete	5	Very poor	Currently held up by absence of boatbuilders. Poorly executed frame construction needs re-work to correct, this will require FAO supervision.	Supervise re-work. Consider cancelling contract?
LSM Bina Aneuk Nanggroe	Laweung, Sigli	15 15	INS10 -	7.5 mtr East Coast 5.5 mtr East Coast	504 GER	1 boat complete, 3 boats 40% complete	7	Slow	?	
LSM Mita Illeume	Sabang	10 10	INS10 -	7.5 mtr east coast inboard 7.5 mtr east coast outboard	504 GER	5 boats complete, 5 boats started	18	Very good	Yard appear very quick and require little supervision (to be checked).	Check status
Total for GER		**70**					**30**			
TOTAL BOATS		**190**					**73**			