15 GRC AS AN ALTERNATIVE MATERIAL FOR LOW-COST, HIGH-DURABILITY FISHING BOATS

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SUMMARY: Indonesia consists of approximately 17,000 islands and covers an area of 1,919,440 km^2, comprising 93,000 km^2 of water and 1,826,440 km^2 of land. To conserve our forest against illegal logging and to reduce poverty among the Indonesian people, an alternative material needs to be introduced in order to minimize the demand for wood within Indonesian society. Since 1999 the Civil Engineering Department of the University of Indonesia and PT KRAZU, together with the collaboration of Saint Gobain, have been conducting research into the use of GRC as a material for fishing boats. GRC boats are high-durability, easy to maintain and are produced quickly and all of these things will reduce the cost of the boat. More fishermen will be able to afford to buy the boats and this will improve their standard of living.

The latest model of GRC boat has already been put to use at sea. It is 12 metres long, with a 1-3cm wall and it weighs 1.9 tonnes. It can achieve a speed of 23 km/h with a single 40 PK motor.

On 26th December 2004 a great earthquake, followed by a giant tsunami, struck Aceh, in the northern part of Sumatra island. People in Aceh suffered the loss of their families and belongings and most of the local fishing boats were destroyed. A seven-metre GRC boat, of a similar design to the destroyed Aceh boats and equipped with a 20 PM motor, will be sent to the people of Aceh as an alternative fishing boat for the people who have lost everything. The GRC boat has proven itself a high-quality boat at a low cost, with mass production capabilities, built of an environmentally-friendly material and suitable for the disaster area. GRC material has proven itself to be the best material for these boats and is saving the forests at the same time.
KEYWORDS: Environmentally-friendly, GRC, GRC boats, tsunami.

INTRODUCTION

Being the largest archipelago in the world, Indonesia has approximately 17,000 islands, of which more than 11,000 are inhabited. The total area of the archipelago is 1,919,440km^2, which consists of 93,000km^2 of water and 1,826,440km^2 of land area.

Figure 1 - Indonesian archipelago

Indonesia has 6,458km of railways, 342,700km of highways and 21,579km of inland waterways, and water transportation is the major method of travel and work for a large portion of the population.

Indonesia has a serious problem with illegal logging, making it more difficult to find suitable wood for boat building. It also forces up the price, making it more difficult for the fishermen to afford timber boats. This combination is leading to the collapse of traditional shipbuilding industries.

The students of the Civil Engineering Department of the University of Indonesia have been trying to find an alternative material to the timber used traditionally by the fishermen for their boats. Concrete is a low-cost material and, combined with GRC technology, it offers a thin skin thickness, acceptable weight and performance, and an increased durability. This is what the fishermen need.

The current version of the GRC boat is suitable for river transportation, with an overall length of 9m, a beam of 1.5m and depth of 1.2m. It has passed the testing phase, and is ready for market development.

The sea version of the boat has a 9m overall length, and is designed for 10 fishermen at sea for 3–4 days, with a fully loaded capacity of 4 tonnes.

On 26 December 2004, a massive earthquake occurred off the coast of Aceh, a province in the north of the island of Sumatra. It created gigantic tsunami waves 10–12m in height, which swept away virtually all of the fishing villages in the province, destroying all of the houses, and the most important thing to the fishermen – their boats, which numbered more than 108,000 in total.

More than 220,000 people lost their lives, with millions more today still suffering from the damage and loss, and many still struggling to recover and rebuild their lives, following this, the most devastating catastrophe in Indonesian history.

Figure 2 - A tsunami wave strikes the coast

Figure 3 - After the wave has passed

Figure 4 - After the water receded

To date, the GRC boat is proving to be a viable and effective alternative method of boat construction, and will help the people of Aceh regain their livelihoods and reconstruct their lives.

With continuing collaboration of the GRC industry and political and financial support from the Government, further research work can be undertaken by the University, leading to the recovery of our fishing industry, and giving some prosperity to our hard-working fishermen.

THE DEVELOPMENT

Figure 5 - The first-generation GRC boat

The first concrete boat had an overall length of 4m, 1.2m beam and 0.65m depth. The wall thicknesses were on average 20mm, the boat having a total weight of 2 tonnes, with deadweight of 1 tonne.

The boat was very stable and had a draft of only 15cm at the 1.0-tonne deadweight. The design was similar to the type of cargo boat used for transporting produce from remote areas to the markets. The boat was finished in March 2003, and successfully passed the loading, impact, stability and repairing test procedures.

The second GRC prototype boat was designed as a passenger vessel. This boat had to be faster than the cargo boats, so a more streamlined design was required. Powered by a 2hp motor the boat was tested at sea, just off Anyer beach, and performed well in all aspects of boat safety and efficiency.

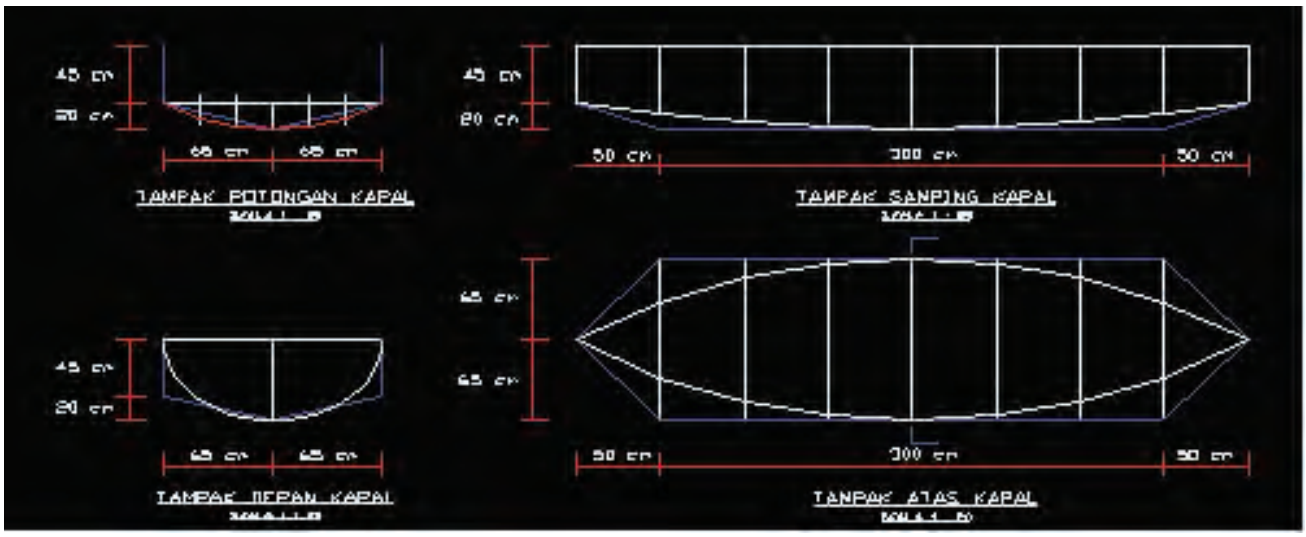

Figure 6 - The second-generation GRC boat

The third generation of GRC boats is entirely different from the first two, and is based on a study of a selection of traditional designs used by fishermen in the Indonesian rivers. A 9.0m-long boat was selected, with a very streamlined hull design, a maximum deadweight of 4 tonnes, with vessel weight of 1.8 tonnes. The boat is equipped with a 12hp benzene motor, giving it a maximum speed of 23.4km/hr; i.e. 12.64 knots. The boat has good maneuverability, and has successfully passed the capsizing test. It has a 9m overall length, 1.6m height and 1.1m beam. The block coefficient is 0.48 and prismatic coefficient is 0.674, with a wet zone of 16.78m, on full load condition.

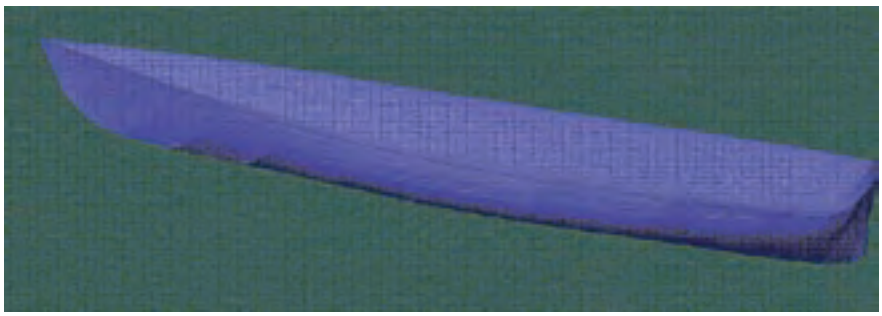

Figure 7 - Computer design of the third-generation GRC boat

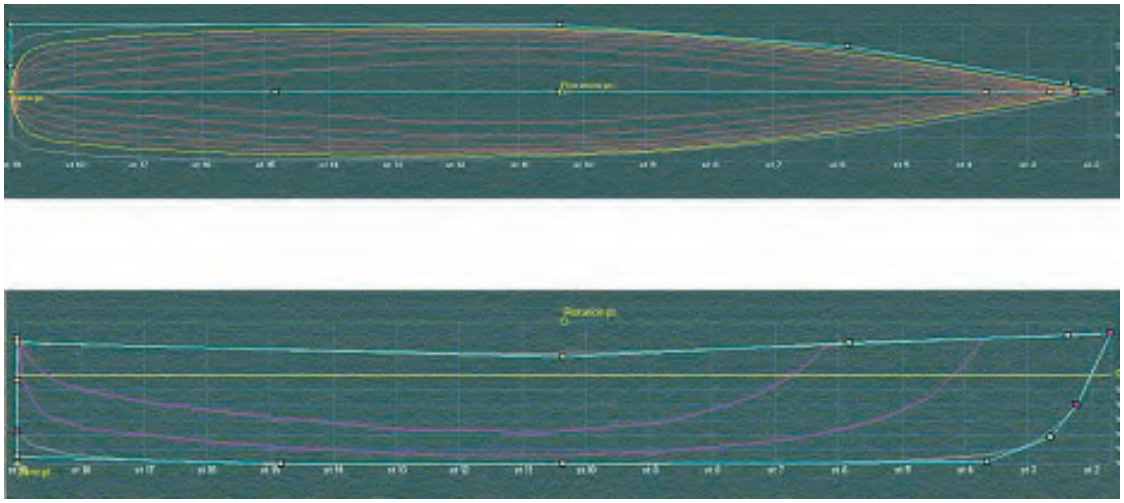

Figure 8 - Plan and elevation of the third-generation GRC boat

Figure 9 - Manufacture of the third-generation GRC boat

The boat was manufactured in a glassfibre mould, left to cure in the mould for 7 days, and then removed for fitting out.

Testing of coupons taken from test boards manufactured during the spraying process has indicated that it will be possible to consistently attain the required 21MPa flexural strength.

Figure 10 - Preparing for test launching of the third-generation GRC boat

Figure 11 - View of the third-generation GRC boat showing the fish-holding tanks

Figure 12 - The official launch day of the third-generation GRC boat

Figure 13 - The third-generation GRC boat at sea

Figure 14 - Capsizing test of the third-generation GRC boat

The boat sailed in August 2005 from the port of Jakarta to the island of Untung Jawa, an island in the 'one thousand island archipelago'. The boat travelled approximately 40km north of Jakarta, at an average speed of 8 knots, and marked the beginning of the new era of the GRC boats conquering the rivers and seas of the Indonesian archipelago.

The fourth-generation vessel will be launched in January 2006, and is designed for use at sea. The boat will enable the fishermen to travel 3–4 days at sea, and will be equipped with chilled fish-holding tanks, a rest room with roof, and storage compartments for tools and logistic equipment.

The vessel will be based on the same design as the third generation, i.e. 9m overall length, 1.6m depth and 1.1m beam. The block coefficient is 0.51, with a prismatic coefficient of 0.68 and wet zone of 17.32m, on full load condition.

This boat will be more stable than the previous vessel, due to higher bow design, and will have an operating speed of 24.12km/hr, or 13 knots.

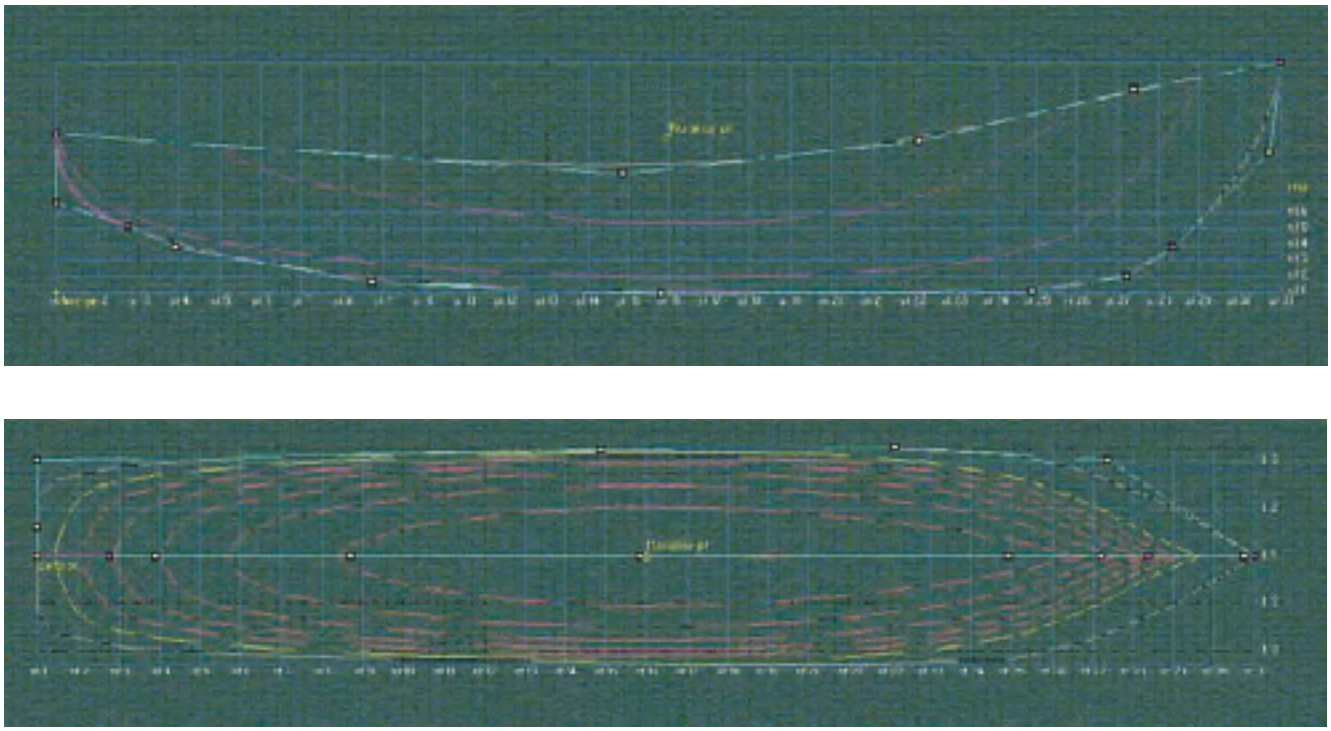

Figure 15 - Plan and elevation the fourth-generation GRC boat

CONCLUSION

The suitability of GRC as a material for the manufacture of fishing boats has now been proved by the joint effort of research undertaken by the students of the University of Indonesia and the support of the GRC industry.

Further developments will need to be undertaken to confirm the preliminary results that it is possible to build a safe, cost-effective and efficient GRC fishing boat.

These developments will continue as a joint effort of the Government of Indonesia, the University of Indonesia, PT Krazu Nusantara and Cem-FIL.

This activity also shows that with the University of Indonesia as a partner of industry, it is possible to develop and design new products which are of benefit to the people of Indonesia, as indeed the fishing boat project has become.

Furthermore, the research experience not only broadens the links to industry, it helps and develops the teaching and learning process of the University and its students, and assists in student development and knowledge in the manufacturing and construction industries.