

Original Research Article

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Rescue Boat and Life Vest Design Using Recycled Materials for Flood Disaster Risk Mitigation in Manila

Alma E. Nacua^{1,2*}, Marlon Dominguez¹ and Nenita O Santos¹

¹Universidad de Manila, 659-A Cecilia Muñoz St, Ermita, Manila, Metro Manila

²Faculty of Arts and Letters University of Santo Tomas, Espana Blvd., Sampaloc, 1015 Manila, Philippines

**Corresponding author*

ABSTRACT

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At the Universidad de Manila (UDM), formerly City College of Manila (CCM), Philippines, a course research project for Environmental Science constructed a prototype rescue boat and life vest out of recycled polyethylene terephthalate (PET) bottles and polystyrene for flood preparedness. The rescue boat made of PET bottles and a life vest made of polystyrene were tested to float in a 4-5 m deep Pasig River. The rescue boat were constructed using 450 pcs. 1.5L PET bottles and bamboo as a base to hold the bottles, while the life vest were made up of polystyrene. The rescue boat float and sailed smoothly on the Pasig River and the life vest complimented the rescue boat to ensure safety during the testing period. The rescue boat and the life vest were conclusively found out to be safe and cost effective. The research project were donated to District III Barangay 291 Zone 27 and Barangay 828 Zone 89 that were identified to be flood risk areas in Manila.

Introduction

Manila City is one of the most populated and flood prone areas, a city that never sleeps and known to be the economic center of the Philippines. It is famous to be vulnerable to floods during heavy rains because of its geographical location, low elevation, and high density of population, infrastructure, and anthropogenic disturbances.

Not so long ago back in 2009, Ondoy tropical storm caused huge disaster with severe flooding all over Metro Manila.

Many lost lives, houses and infrastructure as documented by NDRRMC in 2009. "Metropolitan Manila has greater exposure to flooding impacts than most other parts of the Philippines. This was illustrated during the passage of Tropical Storm Ondoy (Ketsana) in Greater Metro Manila Area on 26 September 2009 which brought 455 mm of rainfall for 24-hr to its catchments. This event caused severe flooding, resulting in many casualties (464 dead, 529 injured and 37 missing), with direct impacts on around 5 million people; and damages to

infrastructure and agriculture of 11 billion Pesos” (NDRRMC, 2009).

If people will take a look at the solid waste collected every day, many of these are waste made of plastics. Plastic bottles (PET) are everywhere, some people collected it and sold them in the junk shop as recyclable materials and created jobs for the people. It is about time people should learn how to recycle plastic to lessen solid waste and hopefully to prevent floods in the near future.

At the Universidad de Manila (formerly City College of Manila), specifically the faculty members of the Environmental Science course is committed in disseminating information to the students on the proper ways of disposing plastic bottles to teach them to recycle. Also, to develop awareness that plastic bottles can save lives in times of huge flood due to unexpected storm. Philippines is found in the Pacific, strategically Manila Bay is in the heart of Manila and Pasig River runs through the city. Creating a plastic rescue boat and a life vest is a cost effective and a practical investment for an ordinary people in Manila. This research study will prove that recycled material like PET bottles of 1.5L and Polystyrene can create a rescue boat and life vest and will float in a 4- 5 m of water.

Materials used

Recycled materials of 450 pcs of PET bottles (1.5L capacity), fishing nylon cord of 0.5 mm in diameter, iron nails, and bamboo for a rescue boat. A lona(canvas), and polystyrene were used for a life vest.

Rescue Boat Design was Inspired by Archimedes Principle

The Archimedes principle indicates that the

upward buoyant force that is exerted on a body immersed in a fluid, whether fully or partially submerged, is equal to the weight of the fluid that the body displaces”(physics.weber.edu).

The weight of the waste bottles arrangement acts downward, and the buoyant force provided by the displaced fluid acts upward. If these two forces are equal, the rescue boat will float even the fiberglass layer crack. Density is define weight per volume. If the density of an object exceeds the density of water, the object will sink (Faturachman *et al.*, 2012).

The Rescue Boat Buoyancy was tested at Lawton Ferry Station and Escolta Ferry Station

Results and Discussion

Permission was sought at the Ferry Station to allow the boat to dock at the Pasig River. The boat landed on the water with a volunteer passenger with an average of 150 lbs. body weight (a male student of Environmental Science from Universidad de Manila) figure 4 (b). Also 2 boys weighted 60 lbs. equally carried by a raft and smoothly sailing figure 5 (b). Conclusively, the weight of the boat acts downward, and the buoyant force provided by the displaced fluid acts upward. The two forces were found equal, the rescue boat floated on the Pasig River with a medium built passenger. This also validates the study done by Faturachman *et al.* (2012).

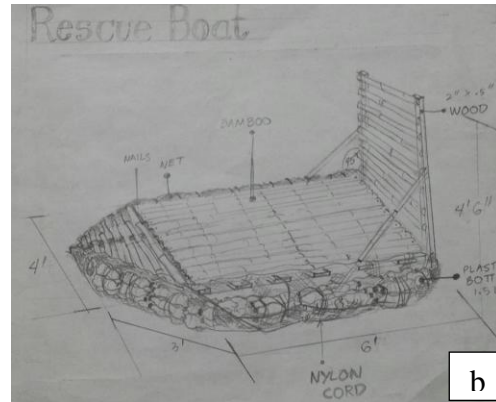
The boats were found to be stable along the Pasig River smoothly sailing for a few minutes, however apart of the back support, a piece of bamboo was detached and broken during the testing period. It was found out that the iron nails were not properly hammered. The plastic bottles were strongly

tied up and the riding passenger was safe and secured on the rescue boat on the silted Pasig River with the average of 4-6 meters depth.

It was also tried and tested, that 150 pieces of 1.5 Lt of plastic bottles can make a rescue

boat and can accommodate one person only with a weight not greater than 80 lbs. and a 100 pieces of boat can accommodate a weight of a person for about 60 lbs. The Density of the rescue boat with a required number of passenger is important to prevent it from sinking.

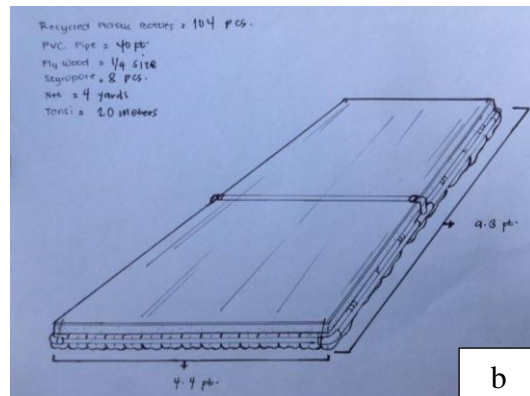
Figure.1 Measurements (a) The Rescue boat Length's is about 6 feet and 4 feet width, wood is 2"x 5" that holds the bamboo, head rest made of bamboo is about 450 from the boat, the bow of the boat is about 3' An upward buoyant force was supported by 450 pcs of 1.5 Lt of plastic bottles, (b) the structural design of the rescue boat



a

b

Figure.2 Another raft was tested at the Pasig River a 4.7 x 9.4 feet of fly wood with 105 pcs of plastic bottles (1.5 Lt capacity). (a) Recycled raft (b) the Prototyped design



a

b

Figure.3 The map of UDM (Universidad de Manila) and Lawton Ferry station (taken from Google maps), the rescue boat was made at the UDM by the Environmental Science students as their course requirement. The distance from UDM to the Ferry Station was in the average of 420 meters as it is seen in Figure 4. The students brought the rescue boat by walking from UDM to the Lawton Ferry Station

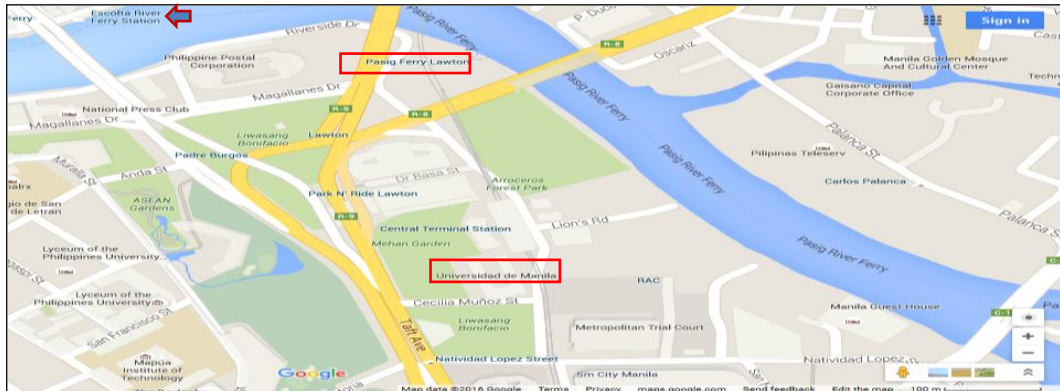


Figure.4 the rescue boat tested at the Pasig River (Lawton Ferry Station), (a) the rescue boat was brought to the Lawton Ferry Station (b) Mr. Marlon Dominguez student of UDM volunteered to ride on the boat with the supervision of the faculty involved and staff of the ferry station. The rescue boat floated successfully which is found on figure 4 (b)



Figure.5 A Raft made of Fly Wood and Plastic Bottles 1.5 Lt. was Tested at Escolta Ferry Station of Pasig River (please see figure 3 of the map). It was found out that it Effectively Floated in 4-5 m Depth of Water Please see figure 5 (b)



Figure .6 The Rescue Boat. with Bamboomaterials and Plastic Bottles were Donated and officially Received by Chairman Strauss Tugnao of Barangay 828 zone 89 of Paco Manila. While the Raft with Ply Wood and Plastic Bottles were Donated and Officially Received by Mr. Perfecto G Villaruel, the Secretary to the Barangay 291 zone 27 of District III of Manila



Figure.7 A Life Vest made of 8 Pieces of 1.5 lt of Bottles, (a) 4 Pieces at the Front and (b)4 Pieces at the Back. (c) The Bottles are Tuck in at the Lona, with Strap Found on the Structural Design. When Tested to 6 Feet Depth Water the Person Floated. (d) A Person Weight Nearly 90 lbs. was Floated wWearing the Life Vest made

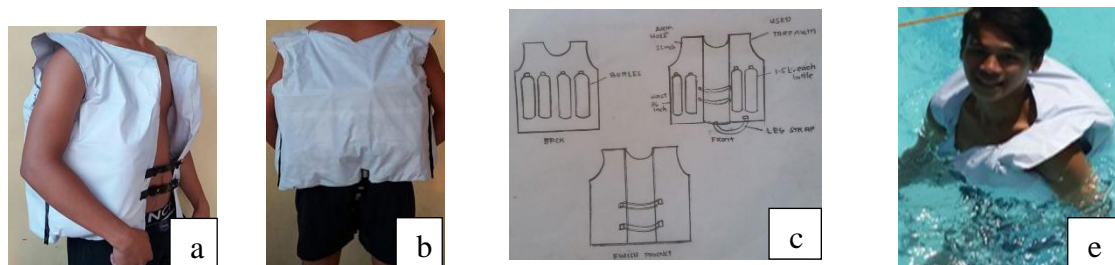
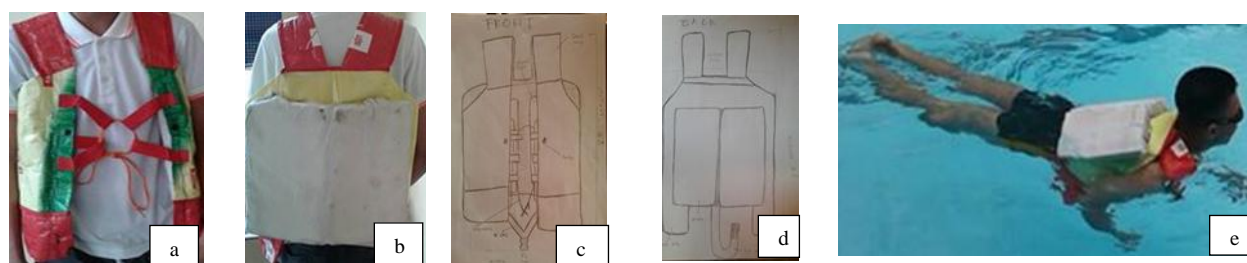


Figure.8 (a) and (b) A Styropor materials were Tucked in a Lona, (c) and (d) was the Structural Design (e) the Man wWeighted 95 lbs. Floated on a 6 ft. Depth Water



According to Faturachman *et al.* (2012), if the density of an object exceeds the density of water, the object will sink.

A recycled plastic bottles, and a Styropor created as Life vest are equally important in saving lives on flood drowning specially for

those who don't know how to swim. In Table 1. Life vest was found to be 99.96% effective even it was only made from recycled materials collected at Manila areas. In conclusion, the rescue boat made of 1.5 plastic bottles is safe and cost effective for practical use. The rescue boat budget spent was 28.26 USD (1,300. Pesos) constructed the boat for seven days while the life vest cost budget spent 10.86 USD (500.00 Pesos) and made for 1 day only. It is recommended that this prototype rescue boat and life vest be adopted in the community areas especially to those city that are susceptible to heavy rains and floods. However, the life vest created from the recycled material like plastic bottles and a Styropor were also found to be effective to float on water. May the residence of Manila emulate this project to ensure preparedness in times of flood calamities that each barangay should have at least five (5) rescue boats and each residential houses should have at least 2 life vests per family, considering it is not very expensive to create. A simple project made by the Environmental Science students of UDM and May the readers find this significant and beneficial for all.

Acknowledgement

The authors are grateful to the Environmental Science students of Universidad de Manila for their enthusiasm,

dedication and commitment in finishing this tedious research project. This research study is an initial International research Publication of UDM and the Authors, dedicates this to Universidad de Manila and to the academic coordinators, respective deans and Administrators (President Atty. Ernesto P. Maceda Jr. and the VPAA Dr. Ronald Herrera,). May this research publication inspire other students and members of the faculty to do research for more publication and to above all to God almighty.

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