Martyr Mohamed Hossam floating bridge

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Abstract

In ordinary life, it was found out that the Egyptian nation faces several issues that create barriers to reach the desired target which is sustainable development goals (SDG) and the perfect for the nation. Capstone ideas try to solve these challenges and barriers using scientific research, innovation, and creativity. It's essential to solve urban congestion and overpopulation, which are two parallel issues; as they have large effects on the economy and lifestyle of people. Crossing waterways are one of the challenges Egypt suffers from, bridges cost the government a lot of money to build and maintain. So, floating bridges have been used as an answer to these barriers; as those not only do the same work of fixed bridges with the same efficiency but also with low cost, therefore our government inaugurated five floating bridges on Suez Canal. So we decided to make a floating bridge on the River Nile in Dakahlia governorate and to make a simulation for it in the tested prototype and only two pontoons were used. We decided to create the design of the prototype with arches as they distribute the pressure on the body of the bridge. We chose our design requirements which are high efficiency, easiness of maintenance and low cost and we recorded the results of test plans, we obtained data and concluded that the test plans showed the ability of the project to achieve the design requirements.

Introduction

Egypt's total area is approximately 1.002 million km² and the population in Egypt is 99,673,611 citizens according to population census in 2017 ,therefore, it should be 99 people in every one kilometer.

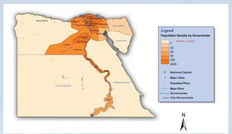


Figure (1): represent the population centers and density

Population is increasing at average 2.28 %, so it leads us to urban congestion and Many other issues, which have a critical effect on the economy, health of the citizens and job opportunities as the population increases and they live in a small area. These barriers lead to two main challenges which are urban congestion and overpopulation. There are natural interventions, that cause these issues; as the sources of water and agricultural areas but the human interventions are in the first position because of immigration from villages to cities and the early marriage for girls. Egypt applied public solutions, that are building bridges and new cities in the east of Nile river like new Menia city to help people travel from west to east; because there are many agricultural areas in the west. These solutions solved the problem by perfect way but the bridges have weakness points ,for instance, it cannot be transferred from place to other and can not be extended. There are many types of bridges, the best of them are floating bridges; due to they are easy for transportation, able to be expanded and has a design with low efforts. We chose the arch design, which was applied in Japan especially in the Yumemai bridge, as it built in 2001 and took about two years for the opening and it has high efficiency. The arch design was applied in this bridge; as the scientific idea of the design is the distribution of pressure falls over the bridge and the pontoons. Finally, using suitable and eco-friendly materials with low cost is the first aim for applying a high-efficiency bridge.

Materials

No.	item	Cost	Quantity	Source of purchase	picture
1-	Sticks	28.5 L.E	285 sticks	Hossam el-din library	
2-	gloss varnish 901	13.75 L.E	250 gm.	Mohamed Aly store	
3-	Superglue amir alpha	9 L.E	9 tubes	Mohamed Aly store	
4-	Glue gun	-	1	From home	
5-	Glue gun sticks	7.5 L.E	5 glue sticks	Hossam el- din library	
6-	Scissors	-	1	From home	
7-	Brush	-	1	From home	
	Total cost	58.75 L.E			

Table(1): materials and cost

Methods

First Step: drawing the main parts on a sheet of paper.
After making the scale and get the right dimensions, we designed a prototype on a piece of paper with the needed dimensions and started to cut sticks on paper. From the design, we determined the number of sticks and the dimensions for every stick and on paper, we divided our prototype into three main parts:
1) Arches
2) Deck
3) pontoons
Second step: cutting sticks forming the parts of the prototype:
First part: The arches:
In our design, we made two arches in every side of the bridge.
The first arch function is holding the deck over the pontoon and it is advantages are preventing water to over the deck.

Figure(2): represents the arches

The second arch function is to connect the bridge with pontoon and it is advantages are to distribute the pressure all over the bridge. We connected between two arches and bridge by cables made from sticks and connected between arches in two sides with sticks.
Second part: The deck:
On the paper, we made the deck in a rectangular shape on the bases with dimensions of cuboid: width= 13 cm., length= 60 cm. and height = 1.8cm. It was built with two bases With different arrangement shape, as the first was with a horizontal arrangement to make the deck stronger as the pressure distributes on the two bases.

Figure(3): represents the deck of the bridge

Third part: The pontoons:
The most important part of the prototype as many calculations performed on it as vertical displacement.
We chose dimensions of cuboid solid:
length;13.5 cm, width: 25 cm and height: 9 cm and made two pontoons.

Figure(4): represents one of the pontoons of the bridge

The test plan was like that:
- ➢ First getting the prototype in the laboratory.
- ➢ Then filling the container with water and put the prototype in it.
- ➢ Next the motion sensor was used to get the vertical displacement and Pasco capstone software was used to collect data.
- ➢ After that, the results were written.
- ➢ Finally, getting the maximum mass that can be put on the bridge and measuring the efficiency of the prototype

Figure(5): represents the prototype

Results

The prototype was made in different ways with many different changes on its pontoons that affects the vertical displacement of the bridge and the maximum mass fell on its center mass, so we get many results which were positive and negative results.

Negative results:

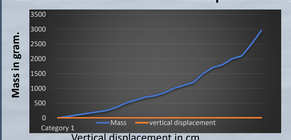
The first mistake was in the dimensions of the pontoons were not equal to each other as it led the bridge to slope after putting a load on bridge equals 250 gm, so it failed in achieving the design requirements.

The second mistake was after making the right dimensions of pontoons during the test plan there was a hole in a pontoon, so it allowed water to enter it, so the bridge sloped again and sank.

Positive results:

The needed requirements were achieved after editing in the dimensions of pontoons, as those were high efficiency, safety and low cost.

The most important result is that the bridge can hold to maximum mass equals 2.95 kg.



Graph(1): represents the vertical displacement until 4cm

Mass in gram	Vertical displacement in cm.
0	0
50	0.3
150	0.4
200	0.4
250	0.5
350	0.7
500	0.8
600	0.9
700	1
750	1.1
850	1.2
1000	1.5
1100	1.7
1200	1.8
1500	2.3
1700	2.4
1800	2.5
2000	2.6
2100	2.8
2500	3.5
2950	4

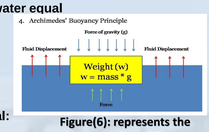
Table(2): represents the mass and vertical displacement

Analysis

The idea of the floating bridge is about solving the crossing waterways with low cost, safety and high efficiency so it will help the government to save more money for the transportation of the citizens into the country with low cost and help also In distributing the population of citizens into new cities, so it helps the government to overpass the urban congestion and overpopulation.

Floating bridges have many advantages than the traditional bridges as they have a straightforward structure, which is able to be expanded, can be transferred from place to another and can be maintained by low effort. The idea of making the floating bridge by the arch design because it is able to distribute the stress falling on it as it works as a supporter for the deck of the bridge and works as a safety. It makes the bridge at low cost by decreasing the number of pontoons to only two pontoons. so it achieved the solution requirements that are high efficiency, safety and low cost.

Depending on specific gravity that says that the density of water minus the density of the bridge gives us the sank part of the bridge and using the center of mass the load was put on it to give the vertical displacement and using newton's second law which says force equal mass multiply acceleration due to gravity $F=M\times G$ as, the Archimedes law of floating that says the force that body applies on water equal the weight of water that is displaced so, we get the weight of the mass that is fallen on the bridge and the vertical displacement of the bridge until it reaches to 4 cm



Figure(6): represents the Archimedes law of floating

The errors of the dimensions of the prototype were equal:
1.The deck: length= (60±0.5) cm and width= (13±0.1) cm
2.The pontoons: length= (13.5±0.15) cm, width= (25±0.2) cm and height= (9±1) cm .

for every 100 m in the deck, there is 1 m in the width of the arch, so the arch's width is 2 m.

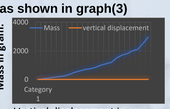
the scaling factor is 0.3 ,so the Prototype dimensions are shown in table(3).

dimension	Real dimensions	Dimension with scale	Prototype dimension
Length	200 m	60 cm	60 cm
Width	28 m	8.4 cm	13 cm
Pontoon length	30 m	9 cm	13.5 cm
Pontoon width	50 m	15 cm	25 cm
Pontoon height	9 m	2.7 cm	9 cm

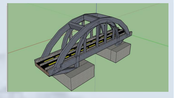
Table(3): represents dimensions and scaling

after making prototype and testing it, successful results were recorded as shown in graph(3)

sketch up was software was used for making 3d model simulation for the prototype as shown In figure(7)



Graph(3): represents the vertical displacement until 4cm



Figure(7): represents the 3d model of the floating bridge

Real bridge location:

The real bridge is located between Talkha and El Mansoura in Dakahlia government .There are three bridges in Talkha but all of them are located in south of the city ,so population living in the north are forced to cross the river on ferries or drive a long distance equal to(2km) from north to south to cross the river, so it depletes long time and much fuel. This problem gives a perfect reason to solve it by that floating bridge.

Figure(8): represents the place of the real bridge on the Nile river

Learning Transfer

Chemistry	Lo 1	This Lo helped us to use the scientific method to write and use the EDP steps.
Biology	Lo 2	This Lo helped us to know that our project will help eliminate tuberculosis which appears in overpopulation.
Maths	Lo 1	Use their concepts to determine and measure any angle in the project by using "Six trigonometric functions" concept also the related angles and sin& cos laws.
	Lo 2	The 2&3d dimension will help to make perfect prototype.
Physics	Lo 1	This l.o helps us in measuring the length and height and width of the floating bridge. Avoid or got away from measurement errors which might be happen causes by human or the device he used.
English	Los	We used it to write our poster and portfolio with academic writing.
Computer science	Lo1	we learnt how to make a 3d model for our prototype by using sketch up

Table(4): learning transfer

Conclusions

Depending on the test plans results and analysis, the conclusion was that the prototype achieve the needed design requirements and the real bridge will be able to solve the crossing waterways issue that will help the government to solve the two main challenges that are urban congestion and overpopulation barriers by helping the citizens to transfer to new cities with less effort.

Recommendations

Nothing is perfect, there will be always missed points and there is no endpoint for any scientific research, so we recommend you:
In prototype:
1- To get a perfect background about floating bridges and research for new designs.
2- To use strong sticks, a suitable and eco-friendly glue with high efficiency and finally use burned rubber as waterproof material.
3- To perform more than one test plan to get more results and information about your simulation.
4- Choose bridge suitable with your scaling.
In real bridge:
1- Search for the most suitable area to build the bridge on it.
2- Ask special engineers about your idea and its advantages and disadvantages.
3- Use strong materials in making the body of the bridge and aqua friendly cement and waterproof.
4- Estimate the time to finish the bridge in the real life.
At the end we wish these pieces of advice help you as they can and we think the project will be less cost, eco-friendly, more efficiency and independent.

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