Walking on Water

EDSGN 100, Section 8
Team 8: ICM^2
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March 2nd, 2016

Fig. 1. Device

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Design task description

Our design process and approach

Evaluation

Engineering analysis

Our device

Summary/conclusion
Our team was assigned the task of designing a walk-on-water device for college students.

Mission Statement:

To operate a business geared towards college students to provide them with an effective method of traveling across the length of a pool by means of walking. This device should be suitable for the 100-200 lbs. weight range, and allow for additional cargo capacity.

Stakeholders:

- ICM²
- Dr. Colledge
- Potential Customers
- Natatorium
- Solidworks (Dassault Systemes)
- Learning Factory
- Material Suppliers
- Media Coverage
- Penn State University
- Waste Management
- Production Facilities
The survey we created helped influence the features of our device.

**Fig. 2. Needs Assessment Data**

- **What is your current age?**
  - 16-18: 28 (33.7%)  
  - 19-21: 35 (42.2%)  
  - 22-24: 5 (6%)  
  - 25-27: 1 (1.2%)  
  - 27+: 14 (16.9%)

- **How would you like this device to work?**
  - I need to be able to get on/off while in the water: 67 (70.4%)  
  - I need safety straps to keep me on at all times: 24 (29.6%)

- **Should this device prevent you from getting wet?**
  - Yes, I need to stay dry while using it: 42 (51.9%)  
  - No, I plan to be in the water: 28 (34.6%)  
  - I don't know: 11 (13.6%)
The device specifications meet the requirements and constraints of stakeholders.

<table>
<thead>
<tr>
<th>Speed</th>
<th>0.5 mph</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td>$100-$500</td>
</tr>
<tr>
<td><strong>Cargo Mass</strong></td>
<td>≤ 40 lbs</td>
</tr>
<tr>
<td><strong>Occupant Mass</strong></td>
<td>136.0-172.2 lbs</td>
</tr>
<tr>
<td><strong>Ease of Assembly</strong></td>
<td>Less than 5 mins</td>
</tr>
<tr>
<td><strong>Appearance</strong></td>
<td>Safe and appealing</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td>Human power only</td>
</tr>
<tr>
<td><strong>Conditions</strong></td>
<td>32-120 °F, still/slowly moving water</td>
</tr>
</tbody>
</table>

**Features**
- Adjustable strap for any shoe size
- Able to get on and off in the water
- Guaranteed to stay dry under normal conditions
- Capable of multiple uses
- Optional poles
- 100% recyclable
- Cushioned handles and stability tether
- Not Coast Guard approved

Table 1. Device Specs

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Our team came up with five possible designs to fit the product constraints.

Fig. 3. Design Idea Sketches

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We evaluated five potential ideas to pursue as our prototype.
We identified these key aspects to be essential to the success of our design.

Subsystems

Propulsion
Stability
Buoyancy
Structure
Sustainability
Marketability

Fig. 5. Production of Device
Accurate calculations proved the design functional under the given constraints.

<table>
<thead>
<tr>
<th>Mass of Device (lbs)</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Area of Device (m^2)</td>
<td>0.54</td>
</tr>
<tr>
<td>Volume of Device (m^3)</td>
<td>0.11</td>
</tr>
<tr>
<td>Density of Device (kg/m^3)</td>
<td>46.54</td>
</tr>
<tr>
<td>Maximum Occupant Mass (lbs)</td>
<td>224</td>
</tr>
<tr>
<td>Dimensions</td>
<td>4 ft 2 in x 1 ft 6 in x 10 in</td>
</tr>
<tr>
<td>Average Total Weight (N)</td>
<td>733.82</td>
</tr>
<tr>
<td>Buoyancy Force (N)</td>
<td>1,048.6</td>
</tr>
</tbody>
</table>

Table 5. Calculations

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Fig. 6. Free Body Diagram

Fig. 7. Center of Mass

Fig. 8. Force of Gravity

Buoyancy Force

Average Total Weight
We worked with CAD to effectively design and assist in construction of our prototype.

Fig. 8. Interior

Fig. 9. Multiview

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Only the best materials were used for the design with minimized cost.

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
<th>Cost per Unit ($)</th>
<th>Total ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foam Insulation Board (4’X8’X2”)</td>
<td>2</td>
<td>$32.00</td>
<td>$64.00</td>
</tr>
<tr>
<td>3/4”X10' PVC Pipe</td>
<td>2</td>
<td>$2.69</td>
<td>$5.38</td>
</tr>
<tr>
<td>1”X10' PVC Pipe</td>
<td>1</td>
<td>$1.96</td>
<td>$1.96</td>
</tr>
<tr>
<td>3/4” 90 Degree PVC Elbow</td>
<td>8</td>
<td>$0.48</td>
<td>$3.84</td>
</tr>
<tr>
<td>3/4” Threaded 90 Degree PVC Tee</td>
<td>2</td>
<td>$0.88</td>
<td>$1.76</td>
</tr>
<tr>
<td>3/4” PVC Tee</td>
<td>8</td>
<td>$0.48</td>
<td>$3.84</td>
</tr>
<tr>
<td>1”X3/4” Male Adapter</td>
<td>2</td>
<td>$0.98</td>
<td>$1.96</td>
</tr>
<tr>
<td>1” PVC Cap</td>
<td>2</td>
<td>$0.68</td>
<td>$1.36</td>
</tr>
<tr>
<td>PVC Cement</td>
<td>1</td>
<td>$4.94</td>
<td>$4.94</td>
</tr>
<tr>
<td>Foam Board Adhesive</td>
<td>3</td>
<td>$3.58</td>
<td>$10.74</td>
</tr>
<tr>
<td>Nylon Straps (2PK)</td>
<td>1</td>
<td>$7.97</td>
<td>$7.97</td>
</tr>
<tr>
<td>Nylon Cord</td>
<td>1</td>
<td>$2.98</td>
<td>$2.98</td>
</tr>
<tr>
<td>Paint Roller Handles (2PK)</td>
<td>1</td>
<td>$4.97</td>
<td>$4.97</td>
</tr>
<tr>
<td>Duct Tape</td>
<td>1</td>
<td>$3.98</td>
<td>$3.98</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$119.68</strong></td>
<td></td>
</tr>
</tbody>
</table>
Testing our prototype determined what changes needed to be made to improve our design.

- Sharper bow
- Sharper treads
- Duck tape

https://youtu.be/SY7TDual86k

EDSGN 100 Design Project: Walking on Water
Grounded on our prototype, our final product was deemed successful.

1. Functionality
2. Weight capacity
3. Speed
4. Cost
5. Practicality/Fun

https://youtu.be/CHrJNIdwi28
EDSGN 100 Design Project: Walking on Water
Our project was managed in a professional and efficient way.

Table 7. Gantt Chart
References


Starn Tool and Manufacturing Company (Feb, 2016). Engineering Consultation.
Questions