Important People

Sponsors:
Tim Edwards
Ronald Reed

Faculty Advisor:
Greg Watkins Ph.D, PE
The Water Problem

Almost 50% of Tanzanians do not have a clean water well within a half mile of their home.¹

Currently there are other drills on the market, but they are costly.

Our sponsors currently have produced 17 working models.

¹ wateraid.org
Drilling Operation

- Drilling rig is manufactured and assembled in Chico (currently)
- Shipped to Tanzania via shipping container
- Average drill depth of 50-80ft
- Uses a mud rotary drilling process
- Drill pipe sections are added as hole is drilled
- Drill pipes are removed after drilling using drilling rig
Problem Definition

• Need for an improved, easy to assemble drill rig that is reliable and is able to be transported through rough terrain without failure.

• Original design does not reliably drill deep enough to reach clean water in certain areas due to adverse soil compositions and inability to reach adequate depths.

• Original design is too technical for developing countries to manufacture.
<table>
<thead>
<tr>
<th>Requirements</th>
<th>Engineering Specification</th>
<th>Metric</th>
<th>Method/Device</th>
<th>Target</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to Assemble Machine</td>
<td>Time to Assemble</td>
<td>hr</td>
<td>Stop Watch, 4 People</td>
<td>10</td>
<td>Assembled from Parts, No prior experience</td>
</tr>
<tr>
<td>Maximum Capacity Load</td>
<td>Weight</td>
<td>Lb.</td>
<td>Lift Equivalent Weight of Pipe</td>
<td>1500</td>
<td>Lift the load the full stroke of the cylinder.</td>
</tr>
<tr>
<td>Prepare for Transport</td>
<td>Dimensions</td>
<td>Ft.</td>
<td>Measuring Tape</td>
<td>Max H: 7.5 Max W: 7.6</td>
<td>Current Shipping Method</td>
</tr>
<tr>
<td>Reliable During Drilling</td>
<td>Dimensions</td>
<td>Ft.</td>
<td>Drill a hole</td>
<td>20</td>
<td>Sandy Loam</td>
</tr>
<tr>
<td>Standardize Parts and Assemblies</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
## Should Do

<table>
<thead>
<tr>
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<th>Metric</th>
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</tr>
</thead>
<tbody>
<tr>
<td>No Damage During Transportation</td>
<td>Speed</td>
<td>MPH</td>
<td>Simulate by driving over speed bumps</td>
<td>10</td>
<td>No damage that would make it un-operational or transportable (One trip)</td>
</tr>
<tr>
<td>Reduce Current Cost</td>
<td>Cost</td>
<td>$</td>
<td>Total cost of all Materials</td>
<td>By 10%</td>
<td>Material Availability in Africa</td>
</tr>
<tr>
<td>Same Torque</td>
<td>Force x Length</td>
<td>ft-lbs</td>
<td>Tachometer</td>
<td>Keep Same</td>
<td>Unloaded</td>
</tr>
<tr>
<td>Reduce Operator Work</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Minimize Welding</td>
<td>-</td>
<td>-</td>
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</tr>
</tbody>
</table>
Design Solution

• Converted the manual rig to a completely hydraulic design.

• Optimized the original hydraulic system to power both a rotary motor and cylinder.

• Designed the rig to withstand 2500 lbs
  o Pipe weighs 1500 lbs at 280 ft
  o Drilling conditions add additional stresses
Progression of Design Solution

Design 1 to Design 2

Design 2 to Built Machine
Original vs. New Design
Fabrication

• Simple design
• All steel used for fabrication was purchased from Pollack Steel
• Machinery needed:
  o Drill Press
  o Hand Drills
  o Horizontal Band Saw
  o Vertical Band Saw
  o Cut-off Wheel
  o Grinder
  o Welder
• Fabricators: Dave Lawrence, Katlynn Lawrence, and Brian Givens
Purchased Parts

• We were given an original rig that we partially dismantled to have a base for our rig.
• Hydraulic cylinder was the only purchased part that was not already available at the shop.
• Purchased parts obtained from original rig:
  o Gasoline engine
  o Hydraulic motor
  o Swivel
  o Hydraulic pump
  o Drill Pipe
Resultant Design Changes

• Design changes to utilize original rig parts:
  o Mast supports 1/4" instead of the design 3/8" thick
  o Gussets and an extra brace were added to the mast supports for added strength

• Overall the rig was built how it was designed at the beginning of this semester.

• No significant manufacturing difficulties.
Building
Testing Specifications

• Tested:
  o No Damage During Transport
  o Prepare for Transport
  o Reliable During Drilling
  o Maximum Capacity Load

• Specifications That Don't Need Testing
  o Easy to Assemble
  o Same Torque Output
Tests Performed

• Transportation Test
  o No Damage During Transport
  o Prepare for Transport

• Lift Test
  o Maximum Capacity Load

• Hole Completion Test
  o Reliable During Drilling
Testing
Cost Comparison

- Original Machine: $4039.10
- New Machine: $4610.48
  - Fully Hydraulic
Budget

- Total Project Cost: $38,450.75
Sources of Funding

• Total Project Funding: $38,450.75
Reflection

• Design Changes for Future Rigs
  o Extend slider length
  o UHMW Teflon inserts on slider
  o Control station offset from drill rig
  o Increase the pump size
• Sponsors prefer the new rig for drilling deeper well depths.
• Merits of new design: drills deeper, sturdier, safer, stronger, easier to operate.
• Operation and Assembly manuals make new design ready for the market.
Conclusion

Successful project thanks to the help of:

- Ron Reed
- Tim Edwards
- Dave Lawrence
- Will Bono
- Bruce Gallaway
- R3nown
- Steve Eckart
- Dave Gislow
- Dr. Watkins
- Doug Dauterman
- Kent Dockendors
Questions