Fall 12-9-2016

Pre-Implementation Report - Hope School Dormitory Project

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University of Wyoming

Andrew Apodaka
University of Wyoming

Lindsey Ehinger
University of Wyoming

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University of Wyoming

See next page for additional authors

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### 525 – Pre-Implementation Report

<table>
<thead>
<tr>
<th>Community:</th>
<th>Hope School – Usare Village, Mbita</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country:</td>
<td>Kenya</td>
</tr>
<tr>
<td>Chapter:</td>
<td>University of Wyoming</td>
</tr>
<tr>
<td>Project ID(s):</td>
<td>01112</td>
</tr>
<tr>
<td>Submittal Date:</td>
<td>March 20, 2016</td>
</tr>
<tr>
<td>Authors:</td>
<td>George Andrikopoulos, Andrew Apodaca, Adam Block, Lindsey Ehinger, Katie Johnson, Duncan Kline, David Mukai, Brett Prettyman, Erin Radosevich, Traci Reusser, Joseph Roseno, Brandon Wilde, Shane Wilson, Zachary Witters</td>
</tr>
</tbody>
</table>

**Acknowledgements**

The Project Leads and Mentor Team acknowledge that:

(Please initial each line item to acknowledge that each line item has been completed.)

- [ ] The chapter reviewed the accompanying [525 – Pre-Implementation Report Instructions](#) for accurate completion of this report.

- [ ] The PMEL lead has reviewed the [901B – Program Impact and Monitoring Report Template](#) and is prepared to update the report during the upcoming trip. The chapter acknowledges that the completed 901B is required with the eventual submittal of the [526 – Post-Implementation Report](#).

- [ ] The PMEL lead acknowledges that the [905 – Program Logic Framework](#) is required as an appendix to the 901 and 901B reports.

- [ ] The project monitoring indicators were selected at the post-assessment phase and documented in the [522 – Post-Assessment Report](#). The PMEL lead is prepared to gather updated results for the monitoring indicators on this trip and those results will be included in the 526 post-implementation report.

- [ ] The team has included the Signed [903 – Implementation Agreement](#) as an appendix to this report.

- [ ] The 600 – Health and Safety Plan Part I and Part II are submitted as separate documents with this report.

- [ ] The most current contact information is updated in this report and all other reports included with this submittal.

- [ ] Any new or additional member to the Mentor Team has included their resume, [404 – Mentor Statement of Intent](#), and [408 – Application to become a Professional Mentor](#) for
We, the project team leadership confirm that the above information and tasks have been completed and that this report presents a complete design which meets the normal engineering standard of care for this type of facility.

Project Lead Printed Name: [Name]
Project Lead Signature: [Signature]
Date: [Date]

Mentor Printed Name: [Name]
Mentor Signature: [Signature]
Date: [Date]

Or

Faculty Advisor Printed Name: [Name]
Faculty Advisor Signature: [Signature]
Date: [Date]

It is the responsibility of the Responsible Engineer In Charge (REIC) to ensure that the team’s preparation for this Pre-Implementation Trip meets a reasonable standard of care. I have reviewed the subject project. I am qualified by education and experience to design and provide construction phase services for this type of project. In my best engineering judgement, this report reflects a complete and comprehensive design and is ready for review by the Technical Advisory Committee.

REIC Printed Name: [Name]
REIC Signature: [Signature]
Date: [Date]
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### Part I – Administrative Information

#### 1.0 Contact Information

Table 1 – Contact information for the requested representatives from the University of Wyoming chapter of Engineers Without Borders (EWB-WYO)

Correspondence regarding report reviews will be sent to the emails listed below.

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Name</th>
<th>Email</th>
<th>Phone</th>
<th>Chapter Name or Organization Name</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Lead</td>
<td>Adam Block</td>
<td><a href="mailto:ablock2@uwyo.edu">ablock2@uwyo.edu</a></td>
<td>(307) 287-1454</td>
<td>University of Wyoming</td>
<td></td>
</tr>
<tr>
<td>Additional Project Lead</td>
<td>Brett Prettyman</td>
<td><a href="mailto:bprettym@uwyo.edu">bprettym@uwyo.edu</a></td>
<td>(605) 890-9863</td>
<td>University of Wyoming</td>
<td></td>
</tr>
<tr>
<td>President</td>
<td>John Plunkert</td>
<td><a href="mailto:jplunke2@uwyo.edu">jplunke2@uwyo.edu</a></td>
<td>(720) 255-5715</td>
<td>University of Wyoming</td>
<td></td>
</tr>
<tr>
<td>Responsible Engineer in Charge</td>
<td>Duncan Kline</td>
<td><a href="mailto:dak@malonebeltonabel.com">dak@malonebeltonabel.com</a></td>
<td>(307) 742-4810</td>
<td>Malone Belton Abel, P.C. (University of Wyoming)</td>
<td></td>
</tr>
<tr>
<td>Additional Responsible Engineer in Charge</td>
<td>Erin Radosevich</td>
<td><a href="mailto:erinr@malonebeltonabel.com">erinr@malonebeltonabel.com</a></td>
<td>(307) 343-0062</td>
<td>Malone Belton Abel, P.C. (University of Wyoming)</td>
<td></td>
</tr>
<tr>
<td>Traveling Mentor</td>
<td>Erin Radosevich</td>
<td><a href="mailto:erinr@malonebeltonabel.com">erinr@malonebeltonabel.com</a></td>
<td>(307) 343-0062</td>
<td>Malone Belton Abel, P.C. (University of Wyoming)</td>
<td></td>
</tr>
<tr>
<td>Faculty Advisor (if applicable)</td>
<td>David Mukai</td>
<td><a href="mailto:dmukai@uwyo.edu">dmukai@uwyo.edu</a></td>
<td>(307) 760-6915</td>
<td>University of Wyoming</td>
<td></td>
</tr>
<tr>
<td>Planning, Monitoring, Evaluation and Learning (PMEL) Lead</td>
<td>Traci Reusser</td>
<td><a href="mailto:treusser@uwyo.edu">treusser@uwyo.edu</a></td>
<td>(307) 460-8795</td>
<td>University of Wyoming</td>
<td></td>
</tr>
</tbody>
</table>
# 2.0 Budget

Table 2 – 508: EWB-USA Trip Budget Worksheet

<table>
<thead>
<tr>
<th>EWB-USA TRIP BUDGET</th>
<th>University of Wyoming&lt;br&gt;Project Name :: Hope School Dormitory Project&lt;br&gt;Type of Trip :: Trip Type: A= Assessment; I= Implementation; M= Monitoring + Evaluation&lt;br&gt;NOTE: The fees associated with each trip type will auto-populate the EWB-USA HQ section.&lt;br&gt;Lines with an asterisk are automatically calculated.</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BUDGET (PRE-TRIP)</strong></td>
<td><strong>ACTUAL EXPENSES (POST-TRIP)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DIRECT COSTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel + Logistics for 3 phase implementation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airfare ($2,840/person @ 14 trips [12 people with 2 people travelling twice])</td>
<td>$39,760</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>Food + Lodging ($42/person/day @ avg. 5.33 people/day)</td>
<td>$21,951</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Travel Expenses (Entrance Fee good for three months @ $50/person, Ground Transport @ $5000)</td>
<td>$5,600</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>$67,311</strong></td>
<td><strong>$0</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Labor</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Implementation (Excavation and Infrastructure)</td>
<td>$0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Management</td>
<td>$3,200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foundation</td>
<td>$1,430</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Slab</td>
<td>$900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Masonry</td>
<td>$2,680</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roofing</td>
<td>$1,860</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td>$420</td>
<td></td>
<td></td>
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<tr>
<td>Plaster</td>
<td>$1,820</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paint</td>
<td>$420</td>
<td></td>
<td></td>
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<tr>
<td>Exterior Landscaping</td>
<td>$0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Final Trim</td>
<td>$0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Punch Out</td>
<td>$0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaning</td>
<td>$0</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>$12,730</strong></td>
<td><strong>$0</strong></td>
<td></td>
</tr>
</tbody>
</table>
### EWB-USA HQ (this section is auto-calculated based on trip type)

<table>
<thead>
<tr>
<th>Description</th>
<th>EWB-USA HQ</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Quality Assurance/Quality Control + Infrastructure*</td>
<td>$4,900</td>
<td>$4,900</td>
</tr>
<tr>
<td>Less EWB-USA HQ Subsidy*</td>
<td>$3,690</td>
<td>$3,690</td>
</tr>
<tr>
<td>Owed by Chapter Sub-Total*</td>
<td>$1,210</td>
<td>$1,210</td>
</tr>
</tbody>
</table>

### Project Materials + Equipment (itemized, as appropriate)

<table>
<thead>
<tr>
<th>Description</th>
<th>EWB-USA HQ</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation Cost Estimate (Total Project Estimate TBD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregate (0.5 in., 100 lb/ft^3)</td>
<td></td>
<td>$351</td>
</tr>
<tr>
<td>Sand (100 lb./ft^3)</td>
<td></td>
<td>$191</td>
</tr>
<tr>
<td>Cement</td>
<td></td>
<td>$567</td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td>$0</td>
</tr>
<tr>
<td>12 mm deformed bar</td>
<td></td>
<td>$153</td>
</tr>
<tr>
<td>10 mm deformed bar</td>
<td></td>
<td>$657</td>
</tr>
<tr>
<td>8 mm deformed bar</td>
<td></td>
<td>$32</td>
</tr>
<tr>
<td>Stone</td>
<td></td>
<td>$1,309</td>
</tr>
<tr>
<td>Sub-Total</td>
<td></td>
<td>$3,261</td>
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</tbody>
</table>

### Misc. (details required)

<table>
<thead>
<tr>
<th>Description</th>
<th>EWB-USA HQ</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Total*</td>
<td>$0</td>
<td>$0</td>
</tr>
</tbody>
</table>

**TOTAL DIRECT COST**

<table>
<thead>
<tr>
<th>Description</th>
<th>EWB-USA HQ</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$84,512</td>
<td>$1,210</td>
</tr>
</tbody>
</table>

### IN-KIND CONTRIBUTIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>EWB-USA HQ</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community In-Kind Contributions to Project Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor (5 people/day @ $6/day for 90 days)</td>
<td></td>
<td>$2,700</td>
</tr>
<tr>
<td>Materials (1086 gallons water)</td>
<td></td>
<td>TBD</td>
</tr>
<tr>
<td>Logistics</td>
<td></td>
<td>TBD</td>
</tr>
<tr>
<td>Sub-Total*</td>
<td></td>
<td>$2,700</td>
</tr>
</tbody>
</table>

**TOTAL IN-KIND CONTRIBUTIONS**

<table>
<thead>
<tr>
<th>Description</th>
<th>EWB-USA HQ</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$2,700</td>
<td>$0</td>
</tr>
</tbody>
</table>

### FUNDS RAISED

#### Funds Raised for Project + Grants Received

<table>
<thead>
<tr>
<th>Description</th>
<th>EWB-USA HQ</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash from community (EWB-USA requires a minimum 5% contribution)</td>
<td></td>
<td>$5,000</td>
</tr>
<tr>
<td>Total $ in Project Fund at EWB-USA HQ</td>
<td></td>
<td>$0</td>
</tr>
<tr>
<td>Total $ in Project Fund at University</td>
<td></td>
<td>$14,351</td>
</tr>
<tr>
<td>Total*</td>
<td></td>
<td>$19,351</td>
</tr>
</tbody>
</table>

#### Funds Raised for Chapter

<table>
<thead>
<tr>
<th>Description</th>
<th>EWB-USA HQ</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total $ in Chapter General Fund at EWB-USA HQ</td>
<td></td>
<td>$83,004</td>
</tr>
<tr>
<td>Total $ in Chapter General Fund at University</td>
<td></td>
<td>$88,108</td>
</tr>
<tr>
<td>Total*</td>
<td></td>
<td>$171,112</td>
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</tbody>
</table>
Table 3 – Itemized labor rate and time sheet

<table>
<thead>
<tr>
<th>Resource Name</th>
<th>Group</th>
<th>Std. Rate</th>
<th>Start</th>
<th>Finish</th>
<th>Regular Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>EWB</td>
<td>$0.00/hr</td>
<td>Thu 6/2/16</td>
<td>Tue 8/16/16</td>
<td>800 hrs</td>
</tr>
<tr>
<td>Brandon</td>
<td>EWB-June</td>
<td>$0.00/hr</td>
<td>Wed 7/20/16</td>
<td>Tue 8/16/16</td>
<td>120 hrs</td>
</tr>
<tr>
<td>Brett</td>
<td>EWB-August</td>
<td>$0.00/hr</td>
<td>Tue 8/2/16</td>
<td>Tue 8/16/16</td>
<td>290 hrs</td>
</tr>
<tr>
<td>Erin</td>
<td>EWB-August</td>
<td>$0.00/hr</td>
<td>Tue 8/2/16</td>
<td>Tue 8/16/16</td>
<td>290 hrs</td>
</tr>
<tr>
<td>Jacob</td>
<td>EWB-July</td>
<td>$0.00/hr</td>
<td>Wed 7/20/16</td>
<td>Tue 8/16/16</td>
<td>120 hrs</td>
</tr>
<tr>
<td>Joe</td>
<td>EWB-June</td>
<td>$0.00/hr</td>
<td>Wed 7/20/16</td>
<td>Tue 8/16/16</td>
<td>120 hrs</td>
</tr>
<tr>
<td>Kevin</td>
<td>EWB-June</td>
<td>$0.00/hr</td>
<td>Wed 6/2/16</td>
<td>Thu 7/5/16</td>
<td>300 hrs</td>
</tr>
<tr>
<td>Lindsey</td>
<td>EWB-June</td>
<td>$0.00/hr</td>
<td>Wed 6/2/16</td>
<td>Thu 7/5/16</td>
<td>300 hrs</td>
</tr>
<tr>
<td>Mukai</td>
<td>EWB-June</td>
<td>$0.00/hr</td>
<td>Wed 6/2/16</td>
<td>Thu 7/5/16</td>
<td>300 hrs</td>
</tr>
<tr>
<td>Shane</td>
<td>EWB-July</td>
<td>$0.00/hr</td>
<td>Wed 7/20/16</td>
<td>Tue 8/16/16</td>
<td>120 hrs</td>
</tr>
<tr>
<td>Tristan</td>
<td>EWB-August</td>
<td>$0.00/hr</td>
<td>Tue 8/2/16</td>
<td>Tue 8/16/16</td>
<td>290 hrs</td>
</tr>
<tr>
<td>Zach</td>
<td>EWB-June</td>
<td>$0.00/hr</td>
<td>Wed 6/1/16</td>
<td>Thu 7/5/16</td>
<td>300 hrs</td>
</tr>
<tr>
<td>Professional Mentor</td>
<td>EWB</td>
<td>$0.00/hr</td>
<td>Thu 6/2/16</td>
<td>Tue 8/16/16</td>
<td>800 hrs</td>
</tr>
<tr>
<td>Project Manager</td>
<td>EWB</td>
<td>$1.00/hr</td>
<td>Thu 6/2/16</td>
<td>Fri 9/2/16</td>
<td>800 hrs</td>
</tr>
<tr>
<td>Kennedy Onyango</td>
<td>Hope School / MYI</td>
<td>$0.00/hr</td>
<td>Mon 5/2/16</td>
<td>Fri 9/2/16</td>
<td>1,040 hrs</td>
</tr>
<tr>
<td>Resource Name</td>
<td>Group</td>
<td>Std. Rate</td>
<td>Start</td>
<td>Finish</td>
<td>Regular Work</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------</td>
<td>-----------</td>
<td>-------------</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Unskilled Laborer 1</td>
<td>Hope School / MYI</td>
<td>$0.00/hr</td>
<td>Mon 5/2/16</td>
<td>Fri 9/30/16</td>
<td>840 hrs</td>
</tr>
<tr>
<td>Unskilled Laborer 2</td>
<td>Hope School / MYI</td>
<td>$0.00/hr</td>
<td>Mon 5/2/16</td>
<td>Fri 9/30/16</td>
<td>840 hrs</td>
</tr>
<tr>
<td>Unskilled Laborer 3</td>
<td>Hope School / MYI</td>
<td>$0.00/hr</td>
<td>Mon 5/2/16</td>
<td>Fri 9/30/16</td>
<td>1,270 hrs</td>
</tr>
<tr>
<td>Unskilled Laborer 4</td>
<td>Hope School / MYI</td>
<td>$0.00/hr</td>
<td>Mon 5/2/16</td>
<td>Fri 9/30/16</td>
<td>1,270 hrs</td>
</tr>
<tr>
<td>Unskilled Laborer 5</td>
<td>Hope School / MYI</td>
<td>$0.00/hr</td>
<td>Mon 5/2/16</td>
<td>Fri 9/30/16</td>
<td>1,120 hrs</td>
</tr>
<tr>
<td>Skilled Laborer 1</td>
<td>Contractor</td>
<td>$1.00/hr</td>
<td>Thu 6/2/16</td>
<td>Fri 7/29/16</td>
<td>360 hrs</td>
</tr>
<tr>
<td>Skilled Laborer 2</td>
<td>Contractor</td>
<td>$1.00/hr</td>
<td>Thu 6/2/16</td>
<td>Fri 7/29/16</td>
<td>360 hrs</td>
</tr>
<tr>
<td>Skilled Laborer 3</td>
<td>Contractor</td>
<td>$1.00/hr</td>
<td>Thu 6/2/16</td>
<td>Fri 7/29/16</td>
<td>360 hrs</td>
</tr>
<tr>
<td>Skilled Laborer 4</td>
<td>Contractor</td>
<td>$1.00/hr</td>
<td>Thu 6/2/16</td>
<td>Fri 7/29/16</td>
<td>360 hrs</td>
</tr>
<tr>
<td>Skilled Laborer 5</td>
<td>Contractor</td>
<td>$1.00/hr</td>
<td>Thu 6/2/16</td>
<td>Thu 9/1/16</td>
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3.0 Project Discipline(s)

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<th>Water Supply</th>
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<td>Gray Water System</td>
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<td>Black Water System</td>
<td>Water Storage</td>
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<td>Solid Waste Management</td>
<td>Soil Improvement</td>
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<th>Energy</th>
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<td>Bridge</td>
<td>Fuel</td>
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<tr>
<td>Building</td>
<td>Electricity</td>
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<td>Retaining Wall</td>
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4.0 Number of People Impacted

Number of People Directly Affected: **562**

*(the population that experiences the typical, inevitable and predictable outcomes of our work)*

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>Comments</th>
</tr>
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<tr>
<td>Boarding Students</td>
<td>112</td>
<td>Upon completion of phases I and II, the dormitory will house 120 students</td>
</tr>
<tr>
<td>Day Students</td>
<td>200</td>
<td>At last count, the school provided for 320 students</td>
</tr>
<tr>
<td>Parents and Guardians</td>
<td>190</td>
<td>There are currently 150 parents and 40 guardians for the Hope School children</td>
</tr>
<tr>
<td>School Faculty and Staff</td>
<td>22</td>
<td>This number includes the increase in staff required for the dormitory</td>
</tr>
<tr>
<td>Construction personnel</td>
<td>30</td>
<td>Two crews of 15 people including five unskilled and 10 skilled per day</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>554</strong></td>
<td></td>
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Number of People Indirectly Affected: **2400**

This number was determined based on the estimated population of Usare Village, less the people directly affected who are all members of Usare Village. (Skilled labor may come, in part, from Mbita.)
5.0 Professional Mentor Resumes

David J. Mukai

University of Wyoming
Civil and Architectural Engineering
Department 3295
1000 E. University Ave.
Laramie, WY, 82071-2000 U.S.A.
Phone: 307.766.4224
Fax: 307.766.2221
email: dmukai@uwyo.edu
title: http://www.uwyo.edu/civil/

Born: September 25, 1961—Los Angeles, CA, USA
Nationality: USA

Current position

Associate Professor, Civil and Architectural Engineering, University of Wyoming
37.5% Teaching • 37.5% Research • 25% Administration

Areas of Specialization

Survival Analysis of Building Stock Inventories • Fracture Under High Confining Pressure
Heat-Straightening Repair of Steel • Theoretical Fracture Mechanics • Engineering Education

Education

1991
University of Washington, Seattle, Washington
Ph.D., December 1991
Department of Civil Engineering
Structural and Geotechnical Engineering and Mechanics Division

1985
University of Hawaii, Honolulu, Hawaii
M.S., December 1985
Department of Civil Engineering
Emphasis: Structural Engineering

1983
University of Hawaii, Honolulu, Hawaii
B.S., December 1983
Department of Civil Engineering
Employment

2005-present
Associate Professor, University of Wyoming
Fall 2005 to Present

2001-2004
Assistant Professor, University of Wyoming
Fall 2001 to Summer 2005

1995-2001
Assistant Professor, Louisiana State University
Fall 1995 to Summer 2001

1993-1995
Engineer/Project Manager, Washington State Department of Natural Resources
Winter 1993 to Summer 1995

Honors & Awards

2003
UW Mortar Board "Top Prof."

2002
UW Mortar Board "Top Prof."

1999
B.P. AMOCO 1999 Undergraduate Teaching Excellence Award (1 of 2 awarded University-wide)
$1,750.

1998
National Science Foundation New Century Scholar Workshop, 1998 at Stanford University (15 pairs from universities across the country selected to attend).

Pertinent Teaching

Analysis
Structural Analysis I • Structural Analysis II • CE Materials • Structural Dynamics

Design
Reinforced Concrete • Prestressed Concrete • Masonry • Earthquake Engineering

Projects
Orientation to Engineering • Comprehensive Design Experience in Structures • Structural Building Systems

Scientific and Professional Society Memberships

American Society of Civil Engineers • American Society for Engineering Education • Precast/Prestressed Concrete Institute • Engineers Without Borders

EWB Involvement

2015
Travel to Kenya with EWB-UW Team • EWB Chapter Advisor

2014
Travel to Kenya with EWB-UW Team

2013
Kenya Project Faculty Advisor
ERIN RADOSEVICH, P.E., LEED AP BD+C

QUALIFICATIONS PROFILE

PROFESSIONAL LICENSES
State of Wyoming No. 12037
State of Colorado No. 39375 – NCEES Structural Exam I, 2005

EDUCATION
University of Wyoming – BS Architectural Engineering, 1999

AREAS OF EXPERTISE | CURRENT RESPONSIBILITIES

- PROJECT MANAGEMENT - Interpret building codes, state statutes, safety regulations, and owner instructions. Facilitate client communication with all parties whose services contribute to the success of projects: owners, contractors, construction managers, architects, geotechnical engineers, surveyors, inspectors, commissioning agents, and civil, structural, mechanical, and electrical engineers. Analyze contractor and subcontractor bids for conformance to project documents, budget, and state statutes. Issue and interpret multiple formats of contractual agreements and construction directive documents. Manage architectural and engineering consultants. Provide cost estimates. Review shop drawings and project submittals for conformance to project requirements. Examine pay applications and change order requests. Inspect contractor work to ensure finished project meets Building Codes and project requirements. Assist contractor and design consultants with narratives and analyses for LEED certification.

- REMODEL | REPAIRS - Analyze existing building structural systems for conformance to current building codes, with an emphasis on the re-use or recycling of existing materials. Incorporate budgetary and construction constraints into repair sequences.

- STRUCTURAL DESIGN - Provide construction documents and specifications, reconciling client expectations with budgetary and other constraints. Ensure compliance with local municipalities; International Building Codes; OSHA standards; and University of Wyoming guidelines. Utilize AutoCAD, engineering and office software. Projects include Berry Biodiversity Conservation Center; private residences; a 30-unit development of custom single- and multi-family residences; commercial and municipal structures.

EXPERIENCE

PROJECT MANAGER AND STRUCTURAL ENGINEER, MALONE BELTON ABEL LARAMIE, WY
2008 - PRESENT
- Projects include: UW High Bay Research Facility; Brinton Museum; UW Berry Biodiversity Conservation Center; UW Indoor Tennis Facility; UW Geological Museum Improvements; Garrison Residence; and Big Horn High School/Middle School.

STRUCTURAL ENGINEER, SCHMUESER GORDON MEYER GLENWOOD SPRINGS, CO
2004 - 2008
- Noteworthy initiatives: developed in-house timber design manual; conducted in-house training seminar for colleagues; and developed in-house checklist to facilitate contracts and fee estimates for new projects.
- Managed residential structural design projects utilizing shared employee resources.

DESIGN ENGINEER, S K PEIGHTAL ENGINEERS BASALT, CO
1999 - 2004
- Presented creative structural designs to meet architects’ vision and client expectations.
- Ensured project documents delivered to meet fast-tracked schedules.

TEL 307.343.0062  EMAIL ERINR@MALONEBELTONABEL.COM
Malone Belton Abel P.C.  
Architecture  
Interior Design  
Master Planning  
Structural Engineering  

Duncan Kline, P.E.  
Senior Structural Engineer  

As lead Structural Engineer for Malone Belton Abel as well as heading the firm’s Laramie office, Mr. Kline is responsible for the planning, design and construction engineering services for the structural portion of numerous projects. Mr. Kline’s project experience includes commercial and public buildings, educational and research facilities, bridges, dams and appurtenant structures, and water/wastewater treatment facilities. In addition, Mr. Kline has considerable experience in performing structural investigations and evaluations of existing buildings and bridges. He has been a structural engineer in Wyoming since 1973 and for fifteen years he has taught the capstone course to undergraduates in Structural Engineering at the University of Wyoming.

Education  
B.S. Civil Engineering with Architectural Option, University of Wyoming, 1972

Professional Registrations  
Engineer, State of Wyoming, No. 2659  
Engineer, State of Colorado, No. 15209

Affiliations/Professional Service  
ACEC of Wyoming  
American Concrete Institute  
American Institute of Steel Construction  
Wyoming Engineering Society

Representative Projects  
Wyo Theater Performing Arts Center, Sheridan, Wyoming  
The Brinton Museum, Big Horn, Wyoming  
Lincoln School Community Center, Laramie, Wyoming  
Blacks Fork Bridge Assessment and Repairs, Granger, Wyoming  
Berry Biodiversity Conservation Center, University of Wyoming  
Big Horn Middle School and High School, Big Horn, Wyoming  
Campbell County Fire Department Headquarters, Gillette, Wyoming  
Wyoming State Capitol Foundation Investigation, Cheyenne, Wyoming  
Pedestrian Bridge Over the Little Wind River, Riverton, Wyoming  
Piney Creek Park Fire Dormitory and Classroom Replacement, Colorado State University  
Wyoming Girls School Dormitories, Sheridan, Wyoming  
Tie Hack Dam and Reservoir, Big Horn National Forest, Wyoming  
Shoshone Municipal Water Treatment Plant, Cody, Wyoming  
Widening I-80 Bridges Over the Laramie River, Albany County, Wyoming  
Classroom Building Renovation and Addition, University of Wyoming  
Old Faithful Inn Dormitory, Yellowstone National Park, Wyoming
Adam Block
5122 McCue Dr. Cheyenne, WY 82009
Phone: (307) 287-1454 Email: ablock2@uwyo.edu

Summary
Double major in Mechanical and Energy Systems Engineering. Two years international volunteer work experience in Europe and Africa. Ability to learn and adapt quickly. Personal satisfaction with nothing short of excellence.

Experience
Reservoir Engineer – Intern: Encana Oil and Gas, CO May-Aug 2015
Investigate the applicability of Rate Transient Analysis (RTA) decline parameters for use in high level scoping of unconventional reservoirs. Emphasis was on the evaluation of early wet life performance.

Rotating Equipment Engineer – Intern: Encana Oil and Gas, CO May-Aug 2014
Helped to initiate a fleet wide compressor optimization project across Canada and the United States. Worked to develop a sustainable business model to effectively capitalize on potential production gains.

Drilling Engineer – Intern: Encana Oil and Gas, TX May-Aug 2013
Worked on an analysis project to help optimize drilling parameters and prevent downhole tool failures. Investigated innovative methods to detect downhole vibration without the use of additional equipment.

President – University of Wyoming Engineers Without Borders Aug 2013-Present
Considerable chapter growth under new leadership: the initiation of two brand new service projects in Guatemala and Kenya, more than double the previous year’s membership, new profitable fundraisers, and greatly improved PR.

Project Lead – University of Wyoming Engineers Without Borders, Kenya Aug 2015-Present
Working to develop a dormitory to supplement a school for vulnerable children in Mbita, Kenya.

Volunteer Co-Worker: Camphill Hermanus, South Africa Jan.-Dec. 2010
Helped to lead a house of adolescents with disabilities. Taught practical skills such as landscaping, bridge building, small construction and gardening. Provided living support and social guidance.

Volunteer Co-Worker: Camphill Clanabogan, Northern Ireland Aug 2008-Aug 2009
Worked as a full-time organic farmer and care provider for adults with disabilities. Emphasis on the development of an integral living / working environment for people of various abilities.

Certified-Trainer/Server: Olive Garden – Cheyenne, WY 2008-2013 (2-year intermittent exception)
Team leader. Tasks included training new employees in skills such as communication, teamwork, business, sales and company fundamentals.

Education
Studying Mechanical Engineering and Energy Systems Engineering, a subset of Mechanical Engineering with an emphasis on innovative energy development. Currently enrolled in Senior level, major specific courses.

Received an international Baccalaureate education.

Skills/ Affiliations/ Awards
Well-rounded individual with vigorous educational background and international work experience. Education and work experience have promoted values and skills such as a strong work ethic, a great capacity to learn and adapt quickly, independence and a passion for excellence. Strong knowledge of Microsoft Office, Solidworks, Matlab and Spotfire. Experience working with people from all over the world with various abilities, disabilities and skill sets.

- College of Engineering Outstanding Sophomore (2012-2013)
- Tau Beta Pi – Member and Representative (2013-Present)
- President – Engineers Without Borders, University of Wyoming Chapter (2013-Present)
- Secretary – Engineers Without Borders, University of Wyoming Chapter (2012-2013)
- University Honors Program
Brett Prettyman
1715 Mercil Ct, Laramie Wy 82070 605-890-9863 prettymanb@gmail.com

Education:
- Currently pursuing a Civil Engineering degree (water resource/environmental emphasis) at the University of Wyoming, honor roll
- Casper College, Casper, WY Associate Degree Engineering with honors
- Casper College, Casper, WY Associate Degree GIS with honors

Memberships:
- Tau Beta Pi Honors Member
- Engineers Without Borders (Project Manager)
- American Society of Civil Engineers

Work Experience
- Kenya Program Manager, Engineers Without Borders (Sept 2014 – Current)
  - Monitor and manage operations of dormitory project in Mbita Kenya
  - Scheduling, host meeting, assign tasks, raise funds
  - Oversee design and implementation of project
  - Develop safety guidelines and tasks while in country
  - Supervise on site analysis and feasibility of project
- GIS Contractor Owner/Operator at Compass Consulting (April 2013- Current)
  - 609 Consulting, Casper Wy (main client)
    - Surveying, GIS design, quality control, Presentations, Startup oversight, CAD Editing, Data Collection, Water Gem Design, data management, design and cost estimation, easement and ownership analysis, trimble data collection, oil and gas mapping, well data logging, PLSS analysis, park land mapping and planning, land analysis
  - Black Bison Water Consulting
    - Oil and Gas GIS analysis
- GIS Analyst, Department of Interior Office of Surface Mining, Casper Field Office, Casper WY (May 2012 – August 2013)
  - Additional education in both CAD and GIS training modules
  - Extensive manipulation of data for the purpose of mining reclamation in the formats of CAD, ArcGIS, PDF, and analog formats.
  - Georeferencing and digitizing of aerial imagery.
  - Designed several Geo databases for the organization, and presentation of data that covers a three state area. Nearly 50 geo databases in total
  - Geospatial analysis and data processing of environmental impact of Surface mining, and stages of corrective measures.
  - Land use and impact evaluation on acreage and watershed interference
  - Presentations of project and program use for reclamation oversight
- GIS and Mapping Technician; Natrona County Health Department, Insect Control Department, Casper, WY (May 2011 – August 2013 Summers)
- Designed GIS for seasonal mosquito operation, inspection, auto spray routes, aerial contracting, field inspections and treatment data, maintained database of landowners and chemically sensitive areas, geospatial analysis, corrected and updated current GIS software setup, purchased, operated, and maintained GIS-compatible operations equipment

- Natrona County GIS (2012 fall semester)
  - COGO tool usage for public land survey system mapping

- BNSF Railway
  - Locomotive Engineer, Conductor, and Yard Foreman; Burlington Northern Santa Fe Railroad, Edgemont, SD and Casper, WY (2005-2011)
  - Operated trains for the railroad. This job required work at all hours of the day or night with no supervision. As yard foreman, I organized and supervised train crews and tracked the schedule for the railroad. Monitored FRA regulations, extensive radio and equipment operation, as well as traffic planning.

- Safety Steward, Claims Representative and Negotiations Representative; United Transportation Union (UTU) Local 375, Casper, WY (2005-2010)
  - Organized and presented safety issues to all crew members during monthly safety briefs, processed and submitted UTU claims, and represented union members for negotiations.

- Welding Lead; Nichols Brothers Boat Builders, Freeland, WA (2000-2005)
  - Experienced in all aspects of boat building including operation of a variety of heavy equipment, lead and tool repair, module construction, blue print reading, sheet metal, pipefitting and all forms of welding. As welding lead, I managed shipyard crews of 4-12 employees.

  - Welding and fitting construction (structural building, ornamental work, heavy equipment repair and design), bid estimation, fabrication, operation of all forms of heavy equipment, held an A class permit (CDL). This job required extensive attention to detail under tight deadlines.

- Carpenter; Joe Hanson Construction (2000-2001) Then Periodically
  - Custom home framing, concrete foundations, finish work, interior finish work, and complete home construction.

- Greene Construction (1999-2000) Then periodically
  - Custom home framing, concrete foundations, finish work, interior finish work, and complete home construction.

- Further Work History Available upon request

Additional Training and Qualifications:
- Government approved background clearance
- Management experience
- CPR trained
- MSHA certification
- Fork lift operator’s license
- Held CDL permit with tank endorsement
- All position structural flux core certification, ABS steel welding certification (flux core), Aluminum mig welding certification (Coast Guard and ABS)

References: (Available upon request)
### 5.1 Names and Qualifications of Designers

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<th>Name</th>
<th>Student or Professional</th>
<th>Qualifications</th>
<th>Work Done</th>
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<tr>
<td>David Mukai</td>
<td>Professional (Faculty Adviser)</td>
<td>Associate Professor of Civil Engineering, research in theoretical fracture mechanics, reinforced concrete and structural rehabilitation</td>
<td>Review and consultation of student design</td>
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<tr>
<td>Duncan Kline</td>
<td>Professional (PEIC)</td>
<td>P.E. in structural engineering, 42 years of experience in structural design</td>
<td>Review and consultation of student design</td>
</tr>
<tr>
<td>Erin Radosevich</td>
<td>Professional (PEIC)</td>
<td>P.E. in structural engineering, 16 years structural design experience</td>
<td>Review and consultation of student design</td>
</tr>
<tr>
<td>George Andrikopoulos</td>
<td>Student</td>
<td>Graduate student in structural engineering</td>
<td>Drawings, floorplan, truss design</td>
</tr>
<tr>
<td>Shane Wilson</td>
<td>Student</td>
<td>Graduate student in structural engineering</td>
<td>Wall design, truss design, detail design, connections</td>
</tr>
</tbody>
</table>
Part II – Pre-Assessment Report

(Please provide pertinent figures, tables, and photographs with figure numbers, table numbers and photograph numbers in the section where discussed.)

1.0 Executive Summary

In conjunction with the Hope School Dormitory Project – Project ID 01112, the University of Wyoming Chapter Of Engineers Without Borders (EWB-WYO) and Usare Village submit this 525 – Pre-Implementation Report for review by the Technical Advisory Council (TAC) of Engineers Without Borders (EWB-USA). Details outlining the design and implementation of the first phase of a two phase project are included within this report. (Please note that “Hope School”, “Usare Village” and “Mbita” are used throughout this report to reference the “community”. Each name, respectively, represents a greater segment of the population.)

EWB-WYO and Usare Village request the TAC’s approval of the outlined design and implementation plan of the first phase of the project. The first phase includes a three month implementation from May through August, 2016 where the members of Usare Village will construct the first of two dormitories, fulfilling half the capacity requested by Hope School in their original 501 – Community Program Application. Phase two will consist of the implementation of an identical structure, contingent on the appropriate utility of the first structure as agreed upon by EWB-WYO and Hope School.

The goal of this project is to provide a home for 120 orphaned and vulnerable children (OVC). Within the context of the community, EWB-WYO has determined “vulnerable children” refers to those individuals living at home with someone who has HIV/AIDS. Hope School primarily services the OVC demographic and requested the help of EWB-WYO to provide a safe learning environment for 120 of their students. Introducing a dormitory to the community will allow many of these children an opportunity to avoid various forms of abuse, feared to be all too common within the community. To ensure the financial sustainability of the school, the Hope School Leadership Committee has developed a business plan with three subgroups that will pay full, half, and no tuition. This will be based on the number of living parents of a given child. EWB-WYO verified that this method was agreeable to the parents of Hope School. Although a strong partnership has formed between EWB-WYO and Hope School, to reduce the risk of abuse, EWB-WYO chose to break the dormitory into two phases to ensure that the first structure is being used appropriately before helping to install a second.

Hope School is privately run and has two “campuses”, a rural campus in Usare Village and an urban campus in Mbita proper, commonly referred to as the “Upper School” and “Lower School”, respectively (Figure 1). The original, rural classrooms were made largely from corrugated metal and much of the teaching was conducted under a tree in a field near the school. A Canadian Non-Governmental Organization (NGO), CanAssist, has been working closely with a Community Based Organization (CBO) called Mercy
Youth Initiative, Hope School, and our community contact, Kennedy Oyango, to help improve the students’ educational environment. In 2012, CanAssist provided the funds to construct a new school building at the rural site; this building houses two classrooms and an office. Although CanAssist was largely responsible for financing the new school building, the local community was responsible for organizing, designing and constructing the facility itself. Hope School has been continuously improving its facilities in recent years including the development of a garden that provides basic food for the children of the school for several months in 2012 (although EWB-WYO’s two assessment trips were conducted during a time when food was not being produced by the school). In 2013, the school completed the construction of latrines at both their rural and urban sites. Early in 2014, Hope School partnered with two Spanish NGO’s named Fundacion La Semilla and Spanish Education Development to develop a second classroom building that provides an additional three classrooms for the school.

Figure 1 – Location of the two Hope School campuses

In July, 2013, the Application Review Committee (ARC) granted approval to Hope School and EWB-WYO to enter into a partnership and begin the new Hope School Program. The first project proposed by Hope School and the members of Usare Village
was the Hope School Dormitory Project, which is the active project in the program. Following program approval, EWB-WYO conducted its first and second assessment trips in the summers of 2014 and 2015, respectively. Information collected from these two trips can be found in the corresponding 522 – Post Assessment Reports. Hope School and EWB-WYO will implement the first of two dormitory structures in the summer of 2016 and the second, should it be deemed appropriate, in 2017. To solidify the responsibilities of each of these two parties, and that of Mercy Youth Initiative, document 903 – Implementation Agreement has been drafted and is provided in Appendix I for the review of the TAC.

Two structural engineering graduate students, George Andrikopolous and Shane Wilson, have designed the building in conjunction with the two REIC on the Hope School Dormitory Project, Duncan Kline and Erin Radosevich. The graduate students have designed the structure according to the Kenya Building Code (nearly identical to the IBC) and literature found on confined masonry, provided by the Engineering Earthquake Research Institute (EERI). Refer to the Appendix II for the Hope School Drawings.

Due to the large scope of this project, skilled labor will be required as an integral portion of the implementation process. To find craftsman, contract documents will be prepared and submitted to the Public Works Office in March. The necessary documents will then be distributed to the Ministry of Education, the Ministry of Health, the Ministry of Environment, and the Procurement Office to receive approval and then advertised. After bids are opened, a contractor will be selected and a “Labor Only” contract will be issued. During construction, the Public Works officer will hold periodic meetings with the contactor and project manager at logical milestones.

Implementing a sustainable solution is of the highest concern for EWB-WYO. Through much negotiation, a financially sustainable business structure has been developed to ensure the success of a boarding component to Hope School. The structure itself is robust for the region, capable of withstanding the projected seismic loads without over-complicating construction or diverging too far from the structural norm of the area. Education and community ownership are two of the most important components of sustainability, which is why EWB-WYO has worked diligently to ensure that Hope School is included in as much of the design process as possible.

2.0 Facility Design

2.1 Description of the Proposed Facility

The first structure has a dimension of 70.5 feet by 30 feet and will incorporate 28 bunk beds, allowing 56 students to live comfortably. Additionally, the structure accommodates four adult care providers, providing them with their own quarters while allowing easy
access to the children. It is designed to allow both male and female occupants with the use of temporary, nonstructural walls to separate the two sexes. Confined masonry is the selected technique for construction, chosen due to the moderate seismic activity in the region. The walls will be constructed using concrete pillars with stone masonry "confined" between the pillars. Windows, doors, and the roof system are made from local steel found in the region. The initial structure will have three doors to exit the facility, one at each end, as well as a main entrance on the front. Each bay will have a window located in it with the exception of one bay on each side of the building per design requirements. The facility will have electricity installed for the use of lighting per local requirements. There will also be water located nearby at a washing facility that will be built at a later time. Please refer to the drawings located in Appendix II for specific details of the stated structure.

2.2 Description of Design and Design Calculations

In terms of overall seismic risk, the presence of part of the East African Rift, which runs through the west of Kenya and the Davie fracture just south of the Mombasa, means that Kenya is vulnerable to seismic activity and related natural disasters: earthquakes, volcanic eruption and tsunamis. The cities with the greatest degree of hazard are Nakuru, Eldoret, Kisumu and Kakamega which have a medium degree of seismic hazard. Since Mbita is located very close to Kisumu the seismic risks are of great concern. To prepare for these concerns a building technique called confined masonry will be used for both cost and structural integrity reasons. The confined masonry technique has been used as a low cost and durable technique in other developing seismic regions of the world. This is a method using sections of concrete beams and pillars to reinforce and support the stone masonry - a method found to be more appropriate than the standard masonry construction found in this region. These two materials will outperform standard masonry structures in the event of an earthquake. Following the specifications of “Guide book for building earthquake-resistant houses in confined masonry” will allow us to build a structure to meet the requirements for a seismic resistant confined masonry building. (Carlevaro, 2015) The site is assumed to be class D rated seismic structure classified by International building code (IBC). Figure 2 shows the seismic activity of different areas in Kenya.
The footing was designed per IBC and America Concrete Institute (ACI) specifications. A soil bearing capacity of 2000 psf was determined for design using IBC table 1806.2 based on a soil classification of silty sand and clayey sand. Soil classification was determined through sieve analysis using the USCS and ASTM Designation D2487-11. The depth of soil samples were also done to meet the specifications of ASTM Designation D2487-11. Both sieve analysis and Dynamic Cone Penetrometer measurements were done and can be found in Appendix V. The foundation was designed to follow the requirements for confined masonry and to support the loads from the roof and the wall, using a roof load of 25 psf. Based on the parameters found from sieve analysis the footing size was calculated to be less than 12”, but due to the uncertainty of the soil parameters as well as IBC specification 1809.4, a footing size of 18” was decided to ensure proper distribution of the load. The depth of the footing was determined to be 12” by IBC specification 1809.4. Due to common practices in the area and the grade of the site the footing will be placed at approximately 2’ below grade. The steel reinforcement was determined using ACI specifications and No. 3 bars were selected. From IBC specification 1805.5.2.2 and Table 1805.5 no vertical steel reinforcement is required within the masonry foundation walls. However, the confining vertical columns will have adequate steel for load bearing. Ultimately the foundation depth will be determined on site.
2.3 Drawings  
See Appendix III

2.4 524 – Draft Design Report Comments  
See Appendix VIII.

3.0 Project Ownership  
Hope School will be the sole proprietor of the land and all facilities on it. The father of our community contact, Daniel Onyango, gave the land to his son, Kennedy Onyango, as part of his inheritance. Kennedy Onyango chose to use that land to build a school for orphaned and vulnerable children, known as Hope School. In his mind, Kennedy had officially donated the land to the school by building the school on it. However, during its last assessment, EWB-WYO discovered that the land was still under the title of Daniel Onyango and was never formally transferred. To avoid any future problems, EWB-WYO spoke with the governing body of Hope School known as the School Management Committee (SMC), Executive Director Kennedy Onyango and Head Teacher Daniel Ochien and all parties agreed that the land should be officially transferred to the school. On December 12, 2015, the land was surveyed by the Mbita/Suba District surveyor and a Mutation Form was submitted to the Land Registrar (Appendix IV). The Land Registrar has processed the Mutation Form and is currently processing the title to turn over to Hope School. Upon completion of the dormitory, Hope School will own and operate all facilities thereof.

4.0 Construction Plan  
The facility will be built from May through August, 2016. The project management process includes the following steps.

- Prepare bid documents, including the Bill of Quantities (BQ). EWB-WYO has communicated with an in-country construction manager, Erick Mitawia, to provide assistance as needed with bid document preparation.
- The Public Works Office will distribute drawing sets to the Ministry of Education, the Ministry of Health, the Ministry of Environment, and the Procurement Office. EWB-WYO has already made arrangements with the Public Works Office for this to happen.
- Once approved, the project will be advertised in the appropriate places. We have already located the two most visible venues for advertising these types of projects. We also have a list of pre-qualified contractors in the region.
- After bid opening, EWB-WYO will select a contractor and EWB-WYO, along with community contact Kennedy Onyango, will negotiate a price. We are not required to award the project to the low bidder. We have an agreement with an in-country project manager to assess the contractors. He has agreed to visit past projects by the various contractors and help us select the best contractor for the
project. This in-country manager will also assist in the acquisition and delivery of materials as well as the supervision of earthwork. He will also be present over the entire construction process to assist with local contractors.

- Prior to arriving in Kenya, the site will be cleared and leveled, with excess soil removed, ready for the placement of footing and foundation. Materials will also be delivered to the site prior to our arrival.
- Upon EWB-WYO’s arrival we will set forms and begin with the placement of the foundation. The interior portion and footprint of the facility will then be filled with gravel and compacted using local techniques. A pad over the entire interior footprint of the facility will then be poured and the attachments for walls set into the perimeter.
- Once construction starts, the Public Works Officer will hold periodic meetings with the contractor and the owner’s representative. At these meetings, we agree on work done to date and payments. These meetings will be held at logical milestones. We have discussed this in some detail with the Public Works Officer. He is aware that there is a building code in Kenya, but told us he does not have access and will never have access to this code (due to costs). He said he would inspect the project for compliance with our drawings.
- After allowing the pad to cure for 48 hours we will then begin any backfilling of the foundation and erect the walls.
- As per the confined masonry technique, the clear span lengths of the walls will be set by local masons using stone and mortar.
- As the height of the wall approaches the window height, beams of concrete will be set above and below the window space spanning the entire distance to the vertical columns.
- Forms will then be set between the clear spans of the walls, as well as the vertical runs of the windows for the purpose of pouring columns to reinforce the masonry.
- Once all walls are completed, the upper forms for concrete beams will be set.
- Upon the completion of the upper beam surrounding the perimeter of the building, the trusses that were being fabricated during the wall erection will be set and welded to the attachment metal that was set in the upper beam. At this point welding contractors will begin to fabricate the doors and windows for the facility while other contractors install the purlins and roof sheet metal.
- After the completion of the exterior, we will begin installing the lighting and finishing the interior of the structure with tile, interior walls, and interior doors.
- The completion of the structure will occur in August where we will have our program engineer arrive in Kenya to sign off on the structure.
- Final inspection and approval will be done by the Public Works Officer. EWB-WYO will have our Engineer of Record present at this final inspection.

From EWB-WYO, there will be three travel teams, each in country for one month. A Health and Safety officer and a professional mentor will be present for each time period. See Table 6
### Table 5 – Construction and Task Schedule

<table>
<thead>
<tr>
<th>Travel Team #</th>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Resource Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>Pre-Implementation (Excavation and Infrastructure)</td>
<td>24 days</td>
<td>Mon 5/2/16</td>
<td>Sat 5/28/16</td>
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</tr>
<tr>
<td>N/A</td>
<td>Order Stone</td>
<td>1 day</td>
<td>Fri 4/22/16</td>
<td>Fri 4/22/16</td>
<td>Kennedy Onyango</td>
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<tr>
<td>N/A</td>
<td>Water installation</td>
<td>0 days</td>
<td>Mon 5/2/16</td>
<td>Mon 5/2/16</td>
<td>Kennedy Onyango</td>
</tr>
<tr>
<td>N/A</td>
<td>Electrical connection</td>
<td>0 days</td>
<td>Mon 5/2/16</td>
<td>Mon 5/2/16</td>
<td>Kennedy Onyango</td>
</tr>
<tr>
<td>N/A</td>
<td>Materials Acquisition</td>
<td>5 days</td>
<td>Mon 5/2/16</td>
<td>Fri 5/6/16</td>
<td>Kennedy Onyango</td>
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<tr>
<td>N/A</td>
<td>Clear Lot</td>
<td>5 days</td>
<td>Mon 5/2/16</td>
<td>Fri 5/6/16</td>
<td>Kennedy Onyango</td>
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<tr>
<td>N/A</td>
<td>Strip Topsoil &amp; Stockpile</td>
<td>7 days</td>
<td>Sat 5/7/16</td>
<td>Sat 5/14/16</td>
<td>Kennedy Onyango</td>
</tr>
<tr>
<td>N/A</td>
<td>Stake Lot for Excavation</td>
<td>1 day</td>
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<td>Mon 5/16/16</td>
<td>Kennedy Onyango</td>
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<tr>
<td>N/A</td>
<td>Maintain road access to job site</td>
<td>1 day</td>
<td>Tue 5/17/16</td>
<td>Tue 5/17/16</td>
<td>Kennedy Onyango</td>
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<tr>
<td>N/A</td>
<td>Excavate</td>
<td>10 days</td>
<td>Wed 5/18/16</td>
<td>Sat 5/28/16</td>
<td>Kennedy Onyango</td>
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<tr>
<td>N/A</td>
<td>Project Management</td>
<td>80 days</td>
<td>Thu 6/2/16</td>
<td>Fri 9/2/16</td>
<td>Adam Block, Project Manager, Kennedy Onyango</td>
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<tr>
<td>N/A</td>
<td>General Project Management</td>
<td>80 days</td>
<td>Thu 6/2/16</td>
<td>Fri 9/2/16</td>
<td>Kennedy Onyango, Professional Mentor, General Contractor</td>
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<td>1</td>
<td>Foundation</td>
<td>17 days</td>
<td>Thu 6/2/16</td>
<td>Tue 6/21/16</td>
<td>Kennedy Onyango, Professional Mentor, General Contractor</td>
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<td>1</td>
<td>Layout footings</td>
<td>1 day</td>
<td>Thu 6/2/16</td>
<td>Thu 6/2/16</td>
<td>Kennedy Onyango, Professional Mentor, General Contractor</td>
</tr>
<tr>
<td>Task Team #</td>
<td>Task Name</td>
<td>Duration</td>
<td>Start</td>
<td>Finish</td>
<td>Resource Names</td>
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<td>1</td>
<td>Dig footings and Install Reinforcing bars</td>
<td>2 days</td>
<td>Fri 6/3/16</td>
<td>Sat 6/4/16</td>
<td>Skilled Laborer 1, Skilled Laborer 2, Skilled Laborer 3, Skilled Laborer 4, Unskilled Laborer 1, Unskilled Laborer 2</td>
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<td>Footing inspection</td>
<td>0 days</td>
<td>Sat 6/4/16</td>
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<td>1</td>
<td>Pour footings</td>
<td>5 days</td>
<td>Mon 6/6/16</td>
<td>Fri 6/10/16</td>
<td>Skilled Laborer 1, Skilled Laborer 2, Skilled Laborer 3, Skilled Laborer 4, Unskilled Laborer 1, Unskilled Laborer 2</td>
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<td>1</td>
<td>Masonry up to slab level</td>
<td>7 days</td>
<td>Sat 6/11/16</td>
<td>Sat 6/18/16</td>
<td>Skilled Laborer 1, Skilled Laborer 2, Skilled Laborer 3, Skilled Laborer 4, Unskilled Laborer 1, Unskilled Laborer 2</td>
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<td>Foundation Certification</td>
<td>0 days</td>
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<td>Sat 6/18/16</td>
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<td>1</td>
<td>Draw #1 and As-Builts (Location Survey)</td>
<td>0 days</td>
<td>Sat 6/18/16</td>
<td>Sat 6/18/16</td>
<td>Project Manager</td>
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<tr>
<td>1</td>
<td>Setting Forms and Rebar For Beams (pending)</td>
<td>2 days</td>
<td>Mon 6/20/16</td>
<td>Tue 6/21/16</td>
<td>Skilled Laborer 1, Skilled Laborer 2, Skilled Laborer 3, Skilled Laborer 4, Unskilled Laborer 1, Unskilled Laborer 2</td>
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<td>1</td>
<td>Concrete Slab</td>
<td>10 days</td>
<td>Mon 6/20/16</td>
<td>Thu 6/30/16</td>
<td>Skilled Laborer 8, Skilled Laborer 9, Skilled Laborer 10, Unskilled Laborer 5</td>
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<td>Main Floor Slab Preparation</td>
<td>4 days</td>
<td>Mon 6/20/16</td>
<td>Thu 6/23/16</td>
<td>Skilled Laborer 8, Skilled Laborer 9, Skilled Laborer 10, Unskilled Laborer 5</td>
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<td>Washroom Slab Preparation</td>
<td>1 day</td>
<td>Fri 6/24/16</td>
<td>Fri 6/24/16</td>
<td>Skilled Laborer 8, Skilled Laborer 9, Skilled Laborer 10, Unskilled Laborer 5</td>
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<td>Slab Inspection</td>
<td>1 day</td>
<td>Sat 6/25/16</td>
<td>Sat 6/25/16</td>
<td>Skilled Laborer 8, Skilled Laborer 9, Skilled Laborer 10, Unskilled Laborer 5</td>
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<tr>
<td>1</td>
<td>Pour Main Floor Slab</td>
<td>3 days</td>
<td>Mon 6/27/16</td>
<td>Wed 6/29/16</td>
<td>Skilled Laborer 8, Skilled Laborer 9, Skilled Laborer 10, Unskilled Laborer 5</td>
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<td>1</td>
<td>Pour Washroom Slab</td>
<td>1 day</td>
<td>Thu 6/30/16</td>
<td>Thu 6/30/16</td>
<td>Skilled Laborer 8, Skilled Laborer 9, Skilled Laborer 10, Unskilled Laborer 5</td>
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<td>1,2</td>
<td>Masonry</td>
<td>37 days</td>
<td>Thu 6/2/16</td>
<td>Thu 7/14/16</td>
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<td>Travel Team #</td>
<td>Task Name</td>
<td>Duration</td>
<td>Start</td>
<td>Finish</td>
<td>Resource Names</td>
</tr>
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<tr>
<td></td>
<td>Building Column Cages, stirrups, rebar cutting</td>
<td>28 days</td>
<td>Thu 6/2/16</td>
<td>Mon 7/4/16</td>
<td>Skilled Laborer 5, Skilled Laborer 6, Skilled Laborer 7, Unskilled Laborer 3, Unskilled Laborer 4</td>
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<td>2</td>
<td>Set Block</td>
<td>7 days</td>
<td>Mon 7/4/16</td>
<td>Mon 7/11/16</td>
<td>Skilled Laborer 10, Skilled Laborer 9, Skilled Laborer 8, Unskilled Laborer 5</td>
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<td>2</td>
<td>Set prefabricated steel reinforcement</td>
<td>2 days</td>
<td>Wed 7/13/16</td>
<td>Thu 7/14/16</td>
<td>Skilled Laborer 5, Skilled Laborer 6, Skilled Laborer 7, Unskilled Laborer 3, Unskilled Laborer 4</td>
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<tr>
<td>1</td>
<td>Draw #2 (First Floor Wall)</td>
<td>0 days</td>
<td>Fri 6/17/16</td>
<td>Fri 6/17/16</td>
<td>Project Manager</td>
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<tr>
<td>2</td>
<td>Form up columns and beams</td>
<td>7 days</td>
<td>Tue 7/5/16</td>
<td>Tue 7/12/16</td>
<td>Skilled Laborer 5, Skilled Laborer 6, Skilled Laborer 7, Unskilled Laborer 3, Unskilled Laborer 4</td>
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<td>2</td>
<td>Set truss plates</td>
<td>1 day</td>
<td>Wed 7/13/16</td>
<td>Wed 7/13/16</td>
<td>Skilled Laborer 10, Skilled Laborer 9, Skilled Laborer 8, Unskilled Laborer 5</td>
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<td>2</td>
<td>Pour tie-beams and tie-columns</td>
<td>7 days</td>
<td>Wed 7/6/16</td>
<td>Wed 7/13/16</td>
<td>Skilled Laborer 1, Skilled Laborer 2, Skilled Laborer 3, Skilled Laborer 4, Unskilled Laborer 1, Unskilled Laborer 2</td>
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<td>1,2,3</td>
<td>Roofing</td>
<td>68 days</td>
<td>Thu 6/2/16</td>
<td>Fri 8/19/16</td>
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<tr>
<td>1</td>
<td>Fabrication of trusses</td>
<td>14 days</td>
<td>Thu 6/2/16</td>
<td>Fri 6/17/16</td>
<td>Skilled Laborer 10, Skilled Laborer 9, Skilled Laborer 8, Unskilled Laborer 5</td>
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<td>2</td>
<td>Set Roof Trusses</td>
<td>2 days</td>
<td>Sat 7/16/16</td>
<td>Mon 7/18/16</td>
<td>Skilled Laborer 1, Skilled Laborer 2, Skilled Laborer 3, Skilled Laborer 4, Unskilled Laborer 1, Unskilled Laborer 2</td>
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<td>Bracing and Perlins</td>
<td>7 days</td>
<td>Tue 7/19/16</td>
<td>Tue 7/26/16</td>
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<td>Install Roof Metal Sheets</td>
<td>3 days</td>
<td>Wed 7/27/16</td>
<td>Fri 7/29/16</td>
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<td>Fabrication of Windows &amp; Doors</td>
<td>30 days</td>
<td>Thu 7/14/16</td>
<td>Wed 8/17/16</td>
<td>Skilled Laborer 10, Skilled Laborer 9, Skilled Laborer 8, Unskilled Laborer 5</td>
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<td>3</td>
<td>Install Windows &amp; Doors</td>
<td>2 days</td>
<td>Thu 8/18/16</td>
<td>Fri 8/19/16</td>
<td>Skilled Laborer 10, Skilled Laborer 9, Skilled Laborer 8, Unskilled Laborer 5</td>
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<td>Travel Team #</td>
<td>Task Name</td>
<td>Duration</td>
<td>Start</td>
<td>Finish</td>
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<td>3</td>
<td>Draw #3 (Roof, windows, doors)</td>
<td>0 days</td>
<td>Fri 8/19/16</td>
<td>Fri 8/19/16</td>
<td>Project Manager</td>
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<tr>
<td>2</td>
<td>Electrical</td>
<td>14 days</td>
<td>Fri 7/15/16</td>
<td>Sat 7/30/16</td>
<td>Skilled Laborer, 5, Skilled Laborer, 6, Skilled Laborer, 7, Unskilled Laborer, 3, Unskilled Laborer 4</td>
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<td>2</td>
<td>Set Electric Boxes</td>
<td>2 days</td>
<td>Fri 7/15/16</td>
<td>Sat 7/16/16</td>
<td>Skilled Laborer, 5, Skilled Laborer, 6, Skilled Laborer, 7, Unskilled Laborer, 3, Unskilled Laborer 4</td>
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<td>2</td>
<td>Install Electric Service Panel</td>
<td>2 days</td>
<td>Mon 7/18/16</td>
<td>Tue 7/19/16</td>
<td>Skilled Laborer, 5, Skilled Laborer, 6, Skilled Laborer, 7, Unskilled Laborer, 3, Unskilled Laborer 4</td>
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<tr>
<td>2</td>
<td>Electrical Walk-through</td>
<td>1 day</td>
<td>Wed 7/20/16</td>
<td>Wed 7/20/16</td>
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<td>5 days</td>
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<td>2</td>
<td>Conduit</td>
<td>2 days</td>
<td>Wed 7/27/16</td>
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<td>Final Connection</td>
<td>2 days</td>
<td>Fri 7/29/16</td>
<td>Sat 7/30/16</td>
<td>Skilled Laborer, 5, Skilled Laborer, 6, Skilled Laborer, 7, Unskilled Laborer, 3, Unskilled Laborer 4</td>
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<td>2</td>
<td>Draw #4 (Electrical Complete)</td>
<td>0 days</td>
<td>Sat 7/30/16</td>
<td>Sat 7/30/16</td>
<td>Project Manager</td>
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<tr>
<td>2,3</td>
<td>Plaster</td>
<td>14 days</td>
<td>Mon 8/1/16</td>
<td>Tue 8/16/16</td>
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<tr>
<td>2,3</td>
<td>Finish Interior and Exterior Walls</td>
<td>14 days</td>
<td>Mon 8/1/16</td>
<td>Tue 8/16/16</td>
<td>Skilled Laborer, 5, Skilled Laborer, 6, Skilled Laborer, 7, Unskilled Laborer, 3, Unskilled Laborer 4</td>
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<td>3</td>
<td>Final Inspection by REIC</td>
<td>0 days</td>
<td>Tue 8/16/16</td>
<td>Tue 8/16/16</td>
<td>REIC</td>
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<td>Paint</td>
<td>14 days</td>
<td>Wed 8/17/16</td>
<td>Thu 9/1/16</td>
<td>Skilled Laborer 5, Skilled Laborer 6, Skilled Laborer 7, Unskilled Laborer 3, Unskilled Laborer 4</td>
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<td>3</td>
<td>Prep Walls for Prime Coat</td>
<td>2 days</td>
<td>Wed 8/17/16</td>
<td>Thu 8/18/16</td>
<td>Skilled Laborer 5, Skilled Laborer 6, Skilled Laborer 7, Unskilled Laborer 3, Unskilled Laborer 4</td>
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<td>Travel Team #</td>
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<td>Prime Paint</td>
<td>2 days</td>
<td>Fri 8/19/16</td>
<td>Sat 8/20/16</td>
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<td>Skilled Laborer 7, Unskilled Laborer 3, Unskilled Laborer 4</td>
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<td>3</td>
<td>Prep Trim for Prime Coat</td>
<td>2 days</td>
<td>Mon 8/22/16</td>
<td>Tue 8/23/16</td>
<td>Skilled Laborer 5, Skilled Laborer 6,</td>
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<td>Prime Trim</td>
<td>2 days</td>
<td>Wed 8/24/16</td>
<td>Thu 8/25/16</td>
<td>Skilled Laborer 5, Skilled Laborer 6,</td>
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<td>Skilled Laborer 7, Unskilled Laborer 3, Unskilled Laborer 4</td>
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<tr>
<td>3</td>
<td>Finish Coat Trim</td>
<td>2 days</td>
<td>Fri 8/26/16</td>
<td>Sat 8/27/16</td>
<td>Skilled Laborer 5, Skilled Laborer 6,</td>
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<td>Skilled Laborer 7, Unskilled Laborer 3, Unskilled Laborer 4</td>
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<td>3</td>
<td>Finish Coat Wall</td>
<td>2 days</td>
<td>Mon 8/29/16</td>
<td>Tue 8/30/16</td>
<td>Skilled Laborer 5, Skilled Laborer 6,</td>
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<td></td>
<td></td>
<td></td>
<td>Skilled Laborer 7, Unskilled Laborer 3, Unskilled Laborer 4</td>
</tr>
<tr>
<td>3</td>
<td>Caulk Exterior Windows &amp; Doors</td>
<td>1 day</td>
<td>Wed 8/31/16</td>
<td>Wed 8/31/16</td>
<td>Skilled Laborer 5, Skilled Laborer 6,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Skilled Laborer 7, Unskilled Laborer 3, Unskilled Laborer 4</td>
</tr>
<tr>
<td>3</td>
<td>Finish Coat Exterior Trim &amp; Siding</td>
<td>1 day</td>
<td>Thu 9/1/16</td>
<td>Thu 9/1/16</td>
<td>Skilled Laborer 5, Skilled Laborer 6,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Skilled Laborer 7, Unskilled Laborer 3, Unskilled Laborer 4</td>
</tr>
<tr>
<td>N/A</td>
<td>Draw #5 (Roofing, masonry, siding)</td>
<td>0 days</td>
<td>Thu 9/1/16</td>
<td>Thu 9/1/16</td>
<td>Project Manager</td>
</tr>
<tr>
<td>N/A</td>
<td>Exterior Landscaping</td>
<td>11 days</td>
<td>Fri 9/2/16</td>
<td>Wed 9/14/16</td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>Rough Final Grade</td>
<td>5 days</td>
<td>Fri 9/2/16</td>
<td>Wed 9/7/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Pathway to Latrines</td>
<td>1 day</td>
<td>Thu 9/8/16</td>
<td>Thu 9/8/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2,</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Final Grade</td>
<td>5 days</td>
<td>Fri 9/9/16</td>
<td>Wed 9/14/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2,</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Electrical Final Trim</td>
<td>3 days</td>
<td>Thu 9/15/16</td>
<td>Sat 9/17/16</td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>Switch &amp; Plug</td>
<td>1 day</td>
<td>Mon 8/29/16</td>
<td>Mon 8/29/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>Travel Team #</td>
<td>Task Name</td>
<td>Duration</td>
<td>Start</td>
<td>Finish</td>
<td>Resource Names</td>
</tr>
<tr>
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<td>----------------------------</td>
<td>----------</td>
<td>-------------</td>
<td>-------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>N/A</td>
<td>Install Fixtures</td>
<td>1 day</td>
<td>Fri 9/16/16</td>
<td>Fri 9/16/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2, Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Pathway Lighting</td>
<td>1 day</td>
<td>Sat 9/17/16</td>
<td>Sat 9/17/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2, Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Final Punch Out</td>
<td>5 days</td>
<td>Mon 9/19/16</td>
<td>Fri 9/23/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2, Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Punch Out Walk-thru List</td>
<td>1 day</td>
<td>Mon 9/19/16</td>
<td>Mon 9/19/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2, Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Trim and Adjust Doors</td>
<td>2 days</td>
<td>Tue 9/20/16</td>
<td>Wed 9/21/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2, Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Paint Touch-up</td>
<td>1 day</td>
<td>Thu 9/22/16</td>
<td>Thu 9/22/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2, Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Final Inspection</td>
<td>1 day</td>
<td>Fri 9/23/16</td>
<td>Fri 9/23/16</td>
<td>Project Manager</td>
</tr>
<tr>
<td>N/A</td>
<td>Cleaning</td>
<td>6 days</td>
<td>Sat 9/24/16</td>
<td>Fri 9/30/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2, Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Windows</td>
<td>1 day</td>
<td>Sat 9/24/16</td>
<td>Sat 9/24/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2, Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Rough Clean</td>
<td>3 days</td>
<td>Mon 9/26/16</td>
<td>Wed 9/28/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2, Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Final Clean</td>
<td>2 days</td>
<td>Thu 9/29/16</td>
<td>Fri 9/30/16</td>
<td>Unskilled Laborer 1, Unskilled Laborer 2, Unskilled Laborer 3, Unskilled Laborer 4, Unskilled Laborer 5</td>
</tr>
<tr>
<td>N/A</td>
<td>Draw #6 (Final Drawing)</td>
<td>0 days</td>
<td>Fri 9/30/16</td>
<td>Fri 9/30/16</td>
<td>Project Manager</td>
</tr>
</tbody>
</table>
Table 6 – EWB Travel Team Schedule

<table>
<thead>
<tr>
<th>Travel Team Member</th>
<th>Travel Team #</th>
<th>Date(s) of Arrival</th>
<th>Date(s) of Departure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam (International Development Lead)</td>
<td>1,2,3</td>
<td>6/2/2016</td>
<td>8/17/2016</td>
</tr>
<tr>
<td>Brandon (Health and Safety Officer)</td>
<td>3</td>
<td>7/23/2016</td>
<td>8/16/2016</td>
</tr>
<tr>
<td>Brett (Construction Lead)</td>
<td>1,3</td>
<td>6/2/2016</td>
<td>6/23/2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7/23/2016</td>
<td>8/16/2016</td>
</tr>
<tr>
<td>Erin (REIC)</td>
<td>1,3</td>
<td>6/2/2016</td>
<td>6/16/2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8/9/2016</td>
<td>8/16/2016</td>
</tr>
<tr>
<td>Jacob (Health and Safety Officer)</td>
<td>2</td>
<td>6/30/2016</td>
<td>7/23/2016</td>
</tr>
<tr>
<td>Joe (Education/PMEL Lead)</td>
<td>3</td>
<td>7/23/2016</td>
<td>8/16/2016</td>
</tr>
<tr>
<td>Kevin (Education/PMEL Lead)</td>
<td>1</td>
<td>6/2/2016</td>
<td>6/30/2016</td>
</tr>
<tr>
<td>Lindsey (Health and Safety Officer)</td>
<td>1</td>
<td>6/2/2016</td>
<td>6/30/2016</td>
</tr>
<tr>
<td>Mukai (Faculty Adviser)</td>
<td>2</td>
<td>6/20/216</td>
<td>7/7/2016</td>
</tr>
<tr>
<td>Shane (Education/PMEL Lead)</td>
<td>3</td>
<td>7/23/2016</td>
<td>8/16/2016</td>
</tr>
<tr>
<td>Tristan (Health and Safety Officer)</td>
<td>3</td>
<td>7/23/2016</td>
<td>8/16/2016</td>
</tr>
<tr>
<td>Zach (Health and Safety Officer)</td>
<td>1</td>
<td>6/2/2016</td>
<td>6/30/2016</td>
</tr>
</tbody>
</table>
5.0 Materials List and Cost Estimate

Please refer to Table 2 for a cost estimate.

Table 7 – Estimated material cost for bulk materials (See Appendix IX for calculations and Document 522 for itemized material prices, taken in conjunction with quotes provided by online sources, including email correspondence with community.)

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity Required</th>
<th>Quantity + 10%</th>
<th>Units</th>
<th>Estimated Cost/Unit (KSH)</th>
<th>Subtotal (KES)</th>
<th>Subtotal ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Foundation and Slab</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregate (0.5 in., 100 lb/ft^3)</td>
<td>22</td>
<td>24.2 ton</td>
<td>1450</td>
<td>35090</td>
<td>350.9</td>
<td></td>
</tr>
<tr>
<td>Sand (100 lb./ft^3)</td>
<td>17.4</td>
<td>19.14 ton</td>
<td>1000</td>
<td>19140</td>
<td>191.4</td>
<td></td>
</tr>
<tr>
<td>Cement</td>
<td>67</td>
<td>73.7/50 kg bag</td>
<td>770</td>
<td>56749</td>
<td>567.49</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>52</td>
<td>57.2/ft^3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>12 mm deformed bar</td>
<td>16</td>
<td>18.20 ft. stick</td>
<td>850</td>
<td>15300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 mm deformed bar</td>
<td>96</td>
<td>106.20 ft. stick</td>
<td>620</td>
<td>65720</td>
<td>657.2</td>
<td></td>
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<tr>
<td>8 mm deformed bar</td>
<td>7</td>
<td>8.20 ft. stick</td>
<td>400</td>
<td>3200</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Stone</td>
<td>1190</td>
<td>1309 one (12x8x6)&quot; block</td>
<td>100</td>
<td>130900</td>
<td>1309</td>
<td></td>
</tr>
<tr>
<td><strong>Wall</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregate</td>
<td>222</td>
<td>244.2/ft^3</td>
<td>1450</td>
<td>354090</td>
<td>3540.9</td>
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<tr>
<td>Sand</td>
<td>148</td>
<td>162.8/ft^3</td>
<td>1000</td>
<td>162800</td>
<td>1628</td>
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<tr>
<td>Cement</td>
<td>43</td>
<td>47.3/50 kg bag</td>
<td>770</td>
<td>36421</td>
<td>364.21</td>
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<tr>
<td>10 mm bar</td>
<td>76</td>
<td>83.6/20 ft. stick</td>
<td>620</td>
<td>51832</td>
<td>518.32</td>
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<tr>
<td>8 mm bar</td>
<td>81</td>
<td>89.1/20 ft. stick</td>
<td>400</td>
<td>35640</td>
<td>356.4</td>
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<tr>
<td>Stone</td>
<td>2510</td>
<td>2761 one (12x8x6)&quot; block</td>
<td>100</td>
<td>276100</td>
<td>2761</td>
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<tr>
<td>Window</td>
<td>13</td>
<td>14.3/#</td>
<td>5000</td>
<td>71500</td>
<td>715</td>
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<tr>
<td>Vision Lite Door</td>
<td>3</td>
<td>3.3/#</td>
<td>10000</td>
<td>33000</td>
<td>330</td>
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<tr>
<td>Hardwood Door</td>
<td>4</td>
<td>4.4/#</td>
<td>5000</td>
<td>22000</td>
<td>220</td>
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<tr>
<td><strong>Roof</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2x2x4 mm steel tube</td>
<td>1032</td>
<td>1135.2/ft</td>
<td>100</td>
<td>113520</td>
<td>1135.2</td>
<td></td>
</tr>
<tr>
<td>2x1x3 mm steel tube</td>
<td>120</td>
<td>132/ft</td>
<td>100</td>
<td>13200</td>
<td>132</td>
<td></td>
</tr>
<tr>
<td>Z perlin</td>
<td>2420</td>
<td>2662/ft</td>
<td>75</td>
<td>199650</td>
<td>1996.5</td>
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<tr>
<td>Galvanized sheet</td>
<td>7990</td>
<td>8789/ft^2</td>
<td>100</td>
<td>878900</td>
<td>8789</td>
<td></td>
</tr>
<tr>
<td>6 mm Sheet metal (truss and gusset plates)</td>
<td>14</td>
<td>15.4/ft^2</td>
<td>100</td>
<td>1540</td>
<td>15.4</td>
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<td><strong>Total</strong></td>
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<td>2576292</td>
<td>25609.92</td>
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</table>

6.0 Operation and Maintenance

See Appendix IV

7.0 Sustainability

7.1 Financial Sustainability

The primary issue EWB-WYO encountered during assessment was Hope School’s aptitude for financial sustainability. Hope School’s long term plan is to seek out donors who would be willing to subsidize the OVC population of their school. Based on their historical success obtaining funding from at least four separate NGO’s, including EWB-WYO, Hope School is confident that they will be able to find funding for their orphaned and vulnerable children once the
dormitories are built and the boarding portion of the school is established. In the interim, and of greatest concern to EWB-WYO, Hope School needs to sustainably and independently meet the needs of the children boarding at their school, as well as the teachers, staff and the property itself.

EWB-WYO and the Hope School Leadership Committee have worked together to develop a plan to ensure that all students housed on Hope School grounds will be well taken care of. While it is outside the scope of EWB to develop the business plan for Hope School, it is certainly within the scope of EWB-WYO to ensure to the best of its ability that any implemented project will be sustainable and meet the desired goals. Together, the leaders of Hope School and EWB-WYO were able to develop a sustainable plan for the dormitory that would allow for Hope School to meet all anticipated expenses, charge competitive tuition and maximize the number of total orphans and children with one parent housed at the school. The negotiations that took place to arrive at a solution that would be acceptable to both the community and EWB-WYO were a tremendous success for both parties. This process developed a capacity for both parties to work together to solve a difficult problem. Inter- and intra-party arguments were had, ultimately leading to a stronger team and a greater understanding of the nuances associated with the development of the dormitory.

7.2 **Structural Sustainability**

While financial sustainability is an important aspect of this project, the structural durability and sustainability is also a main concern. EWB-WYO spent a large portion of its summer 2015 assessment trip further learning the construction techniques of the community to determine if the local practices would withstand required seismic loads that are shown in Figure 1 below. The area of the project and of concern is Kisumu, located in the eastern part of Kenya. It was determined that local practices would not be adequate enough for seismic activities and longevity of the building. Thus, confined masonry was determined to be a feasible alternative as it is similar to their construction techniques, works with local materials, and will handle the seismic loads required for the project.

To ensure the sustainability and in turn, the durability and longevity of the building, local community members will be trained in maintaining the structure. The School Management Committee will elect a caretaker for the building and perform reelectons every year to ensure the elected member is performing the required duties. To ensure that the caretaker knows how to maintain the structure, EWB-WYO will conduct an educational session to the entire School Management Committee, leave instructional maintenance guides, give a community-wide information session on the importance of the structural integrity, and teach the elected caretaker during construction of the building to promote understanding of
the importance of structural integrity of the building and foster passing down of the knowledge required to maintain the building for future generations.

Kennedy has signed an official agreement between EWB-WYO and Hope School in which he consents to: collecting annual maintenance fees from the community for maintenance purposes, supply the required materials for repairing the structure, and to provide manual labor for required repairs. To determine if these steps will ensure structural durability of the building a more thorough analysis will be required in the design completion report, including review of maintenance costs for similar completed projects.

Figure 1. Map of Kenya with earthquake information including peak ground acceleration and significant earthquake data. (Rao, 2013)

7.3 Organizational Capacity of the Community

As is often the case in this region, this project hinges on key people in the community. To satisfy the needs of international NGO’s and other aid agencies such as EWB, they have the necessary organizational structures in place. There is the local NGO, Mercy Youth Initiative (MYI), the school, Hope School, and the community, Usare village. That being said, we have determined that Kennedy Onyango is both the director of MYI and Hope School. Essentially, MYI is a charity and Hope School is a business. MYI enables him to secure external funding but he is savvy enough to know that true sustainability will require Hope School to be a for-profit enterprise. There are boards for both MYI and Hope School, but we have determined that they are advisory and have no authority over Mr. Onyango. Also, it seems that Mr. Onyango is in the good graces of both the Village elder and the area Chief.

Of course, having one person with so much influence is a cause of concern. After two assessment visits and some frank discussions with Mr. Onyango and his close
associates, we have decided that Mr. Onyango is trustworthy. We come to this conclusion based on the following observations: 1. Mr. Onyango has made huge sacrifices for Hope School. He has returned to Mbita, had his family donate the land for the school (which is now in the name of the school), and has been living a very modest life while building the infrastructure of the school. 2. Mr. Onyango has taken criticism and instruction very well. We are very sensitive to not imposing western mores on this project, but at a minimum we required that the land be officially in the name of the school — not just a verbal donation. Mr. Onyango has taken all the necessary steps to have the land officially in the name of the school (keep in mind that as a country, Kenya did not have land deeds until roughly five years ago). 3. Mr. Onyango seems to have a genuine love for the children of the community.

7.4 Financial Capacity of the Community

We are concerned about the financial capacity of the community. Their past school buildings have cost roughly $50k each. Our buildings will be seismically resistant and thus more expensive. The actual price will depend on the bids we obtain at bid opening. Assuming a cap of $100k, a 5% match will mean a $5k or 0.5 Million KES match from the community.

We have, for the last two years, continually put this 500K KES commitment to the community in our meetings. They assure us that they can meet this commitment. The average annual income in Kenya is 120,000 KES, but we would not be surprised if the average annual income in Mbita is 20,000 KES.

To alleviate our concerns about the community’s ability to come up with the match, we have set up a bank account in Mbita. The community has been instructed that when we see the matching 5% funds in our account, we will then transfer the remaining 95% from our funds. We have already done this for the land survey for the deed transfer and the environmental impact consultant. We are the first external organization they have worked with that requires a cash match in advance.

7.5 Technical Capacity of the Community

While the community has the technical capacity to construct buildings (they constructed the previous two buildings funded by NGOs), there seems to be no experience in the region (perhaps the country) with seismic-resistant design and construction. The disaster in Nepal (I wonder how many of those structures were constructed by NGOs?) convinced them of the need for seismic-resistant structures, even in a developing region. To address this issue, as previously stated, the School Management Committee will be educated on the maintenance of the building as well as a community wide information session will be conducted.
caretaker will be the main component of this technical education and will be an advocate and a teacher of the technical aspects of the building in the future.

The community at large also seems to not have the technical capacity to develop complex budgets. Fortunately, one of the school board members, Daniel Ochien, has experience as a director of a boarding school and is very experienced with budget issues and operational expenses. He is our primary contact with developing the fee structure and understands all of the calculations on costs and tuition fees. In fact, he was instrumental in developing our cost analysis.

### 7.6 Education

In conducting assessment trips EWB-WYO has focused on providing the tools require to run a successful and safe dormitory. First, the community has been given a method to gather public opinion, which was done through ballot gathering at community meetings. The community has expressed how much they appreciate this and have used this in their own community meetings. Second, we have stressed the importance of seismic risk and plan to continue to stress this during construction. This community has heard about recent earthquakes and understands the building must be built such that it is safe to live in. Third, we have worked with Hope School in preparing a business plan for after the construction, sought to help the community plan ahead, and also prepare Hope School to better approach NGO's. This has not only increased our confidence that the building will be sustainable and continue to operate for years to come, but has brought a greater understanding to the project and allow for us to better predict what to look out for after construction to determine if the project is a success. Fourth, we have discussed the needs of land management and some of the requirements for the children. Hope School has retitled the land under their name, and recently are connecting water to their land, which they are currently working on. Finally, we have educated the community in the concept of buying in bulk and buying off season to save money. Hope School plans to develop a food storage system in which they can store food and reduce costs. EWB-WYO has worked with the community to provide them with the knowledge and tools required to run their dormitory as successfully as possible.

EWB-WYO is determined to help Hope School use the dormitory in the most effective, safest, and longest fashion possible. To ensure this, EWB-WYO has sought to provide Hope School with the tools and knowledge required to run a sustainable dormitory. EWB-WYO has already been teaching the community as much as possible to hopefully prepare them for the challenges they face. Through a community wide education plan, teaching during construction, maintenance plans, and other educational tools EWB-WYO hopes to continue teaching the community to its best abilities.
8.0 **Site Assessment Activities**

Prior to construction, there are several commitments the Hope School community has made to ensure the successful implementation of the dormitory project, as outlined in document 903. Those activities that must be completed prior to EWB-WYO’s arrival are outlined below.

- Hope School has agreed to connect to the city water supply. During both assessment trips, Mbita did not have running water. The community has, however, guaranteed access to water during implementation. Before traveling, EWB-WYO will require photo documentation of the Hope School connection. The adequacy of the connection will then be verified and evaluated on site.
- Hope School has agreed to connect to the city electric supply. All connections are above ground and will, as with the plumbing, require photo documentation prior to EWB-WYO’s departure from the United States.
- The community has agreed to excavate the site prior to EWB-WYO’s arrival. Photo documentation will be required.
- EWB-WYO has been informed that the title has been formally transferred to Hope School. The SMC is awaiting its arrival and will photocopy the document and provide it to EWB-WYO.

Assessment activities that will take place on site will focus on holding all parties accountable for the commitments they have made in the 903 and any other subcontracts.
EWB-USA projects are most successful when there is a three-way partnership between each of the entities listed below. Each partner has specific skills and expertise, which together, contribute to a more sustainable project over the long-term.

- **Community** - Community-Based Organization (CBO) and Community Members  
  (Examples include: water board, community development committee, women's committee, village council, individual families, etc.)
- **Local Partner Organization(s)** - Local NGO and/or municipal/city government
- **EWB-USA Chapter**

This contract is between University of Wyoming chapter of Engineers Without Borders, USA, Hope School-Usare and Mercy Youth Initiative (MYI) for the purpose of setting guidelines for Hope School Dormitory Project. The specific conditions listed below must be included in the standard EWB-USA Implementation Agreement. Additional roles and responsibilities identified by any party to the agreement may be added at the discretion of all parties to the agreement. This document must be signed by all parties in order to begin construction of Hope School Dormitory Project. The roles and responsibilities agreed to in the previously-signed Project Agreement remain in effect in addition to the commitments outlined below.

**PRE-CONSTRUCTION PHASE**

**Hope School-Usare responsibilities:**

- Provide 2.5% of the capital construction cost in cash before construction begins.
- Provide written confirmation that the land required for the project implementation is owned by the community before construction begins.
• Provide written confirmation that all dormitory furnishings be provided by the community.

• Provide one (1) meal per day of construction for EWB-UWYO members and unskilled laborers working on a volunteer basis.

• Provide written confirmation that it has the legal right to use the water supply that is being developed in this project.

• Provide written confirmation that Hope School is connected to the Mbita Township Water Supply before implementation.

• Provide written confirmation that the community will provide water during the implementation of the project.

• Commit five (5) unskilled laborers for ten (10) hours per day to the construction site.

• Provide the name of the community representative responsible for organizing the in-kind labor.

• Provide written confirmation that Hope School will provide electricity to the project location before implementation.

• Provide the following list of equipment and tools for construction:
  - 1 Measuring tape
  - 1 Level
  - 2 Carpentry pencils
  - 2 Utility knife
  - 2 Hammers
  - 3 Screwdrivers
  - 2 Pliers
  - 2 Strings
  - 1 Handsaw
  - 2 Step Ladders

• Provide the following materials for construction:
  - Water (portable and construction purposes)

Mercy Youth Initiative responsibilities:
• Provide 2.5% of the capital construction cost in cash before construction begins.

• Provide the following list of equipment and tools required for construction:
  - 4 Shovels
  - 3 Wheel Barrows
Provide the following materials for construction of:
  - Rough stones for foundation backfilling

**University of Wyoming chapter of EWB-USA responsibilities:**
- Provide 95% of the capital construction cost in cash before construction begins.
- Provide qualified representatives of the design team during construction for observation or oversight.
- Communicate the requirements of site preparation prior to the chapter arriving for construction. This will be communicated to the community and the local partner two months prior to construction, or earlier as determined by the project needs.
- Provide the following list of equipment and tools required for construction:
  - All power tools and other electrical equipment not provided by the community will be provided by the general contractor or sub-contractors and paid for by EWB-UWYO and deducted out of the 95% contribution.
- Provide the following materials for construction:
  - All materials not provided by the community will be provided by the general contractor or sub-contractors and paid for by EWB-UWYO and deducted out of the 95% contribution.

**POST-CONSTRUCTION/OPERATIONS AND MAINTENANCE PHASE**

**Hope School-Usare Village responsibilities:**
- Pay for 100% of the costs to operate and maintain the project, Hope School Dormitory. This cost is estimated to be 100,000 KES per year, local currency.
- Monetary resources will be collected from the community for operations and repairs per use on a monthly/annual basis in form of fee collection.
- The amount collected per the schedule above will be: KES 120,000.
- The position/committee responsible for identifying maintenance needs is: School Management Committee (SMC) Members
- This committee will be elected
• This committee will serve in this role for 1 year.
• The position responsible for performing maintenance is: the School Manager
• This position will be appointed by the School Management Committee
• This position will serve in this role for 2 years subject to re-appointment.

Mercy Youth Initiative responsibilities:
• Provide ongoing support to Hope School-Usare Village for a minimum of five (5) years after construction is complete, as needed.
• Assist with additional monitoring activities as identified by University of Wyoming chapter of EWB-USA as long as the program is active for the EWB-USA chapter.

University of Wyoming chapter of EWB-USA responsibilities:
• Develop a detailed operation and maintenance manual for the community (including applicable photos and local language, as appropriate). The manual will include a maintenance schedule and anticipated costs.
• Provide monitoring and evaluation of the project, Hope School Dormitory, for a period of not less than one year post-construction and as long as the program is active.
• Perform repairs to the project that are the result of errors in the design until they are corrected.

In addition to the responsibilities listed above, indicate the responsible party for each of the following:

• Coordination of transportation for travel team members of University of Wyoming chapter of EWB-USA will be provided by University of Wyoming Chapter.
• Coordination of translation services for travel team members of University of Wyoming chapter of EWB-USA will be provided by Hope School Faculty.
• Scheduling of community-provided labor will be provided by Kennedy Onyango. This includes five (5) community workers for ten (10) hours per day at the construction site.
• Procurement of construction materials before University of Wyoming chapter of EWB-USA arrives for construction will be provided by Mercy Youth Initiative.
• Transportation of materials will be funded by University of Wyoming Chapter.
On behalf of, and acting with the authority of the residents of Hope School – Usare Village, the NGO/Local Municipal Partner, Mercy Youth Initiative and University of Wyoming chapter of EWB-USA, the under-signed agree to abide by the above conditions.

Signature

Date

Printed Name

Position in University of Wyoming chapter of EWB-USA

Signature

Date: 24/12/2015

Kennedy Edwine Onyango
Printed Name

Director/Legal Representative

Position in Community-Based Organization, Hope School-Usare

Signature

Date: 24/12/2015

Leonard Okello
Printed Name

Secretary

Position in Local Partner Organization, Mercy Youth Initiative
Images from Google Earth maps are shown above. 
Left: Map of Kenya with major cities and geography. 
Middle: Map of Kenya with major cities, bodies of water, and bordering countries, and Mbita's location. 
Right: Image of Mbita from Google Earth maps.
The image below is an image from Google Earth maps, showing the boundaries of Mbita.

The image to the right is a photo from Google Earth images of Hope School property with dimensions as measured on the site. The dormitory is for the Usare Village, Mbita.
Figure 1. Google Earth image of Hope School property with dimensions as measured on site.

(- 1,200 m²)
The image to the left is a photo of the foundation elements used by the Public Works Office in Mbita for all school buildings.

We are currently working on the foundation design and will modify these drawings if necessary.

The dimensions are in mm.
All doors and windows are designed to have the same dimensions. Above: Typical dimensions of doors and windows. Note: Windows must not have burglar proofing/student retaining bars.
The image on the left is a photo of the electrical systems for lighting used by the Public Works Office in Mbita for all school buildings.

We are currently working on the electrical design and will modify these drawings if necessary.
Appendix III – Revised drawing set

Notes regarding the revised drawing set:

1. Attached to this submission is a pdf version of Appendix III.
2. While all other drawings are called out in metric units, drawing A2 uses English units. This was done for conceptual simplicity and will be modified when connected to the final bid documents. It should be noted that the community uses both measuring systems interchangeably and is often contextually based.
3. Refer to Legend below for stone masonry and reinforced concrete

LEGEND

STONE MASONRY FROM LOCAL QUARRY WITH HAND FACING

REINFORCED CONCRETE
Hope School Dormitory

P.O. Box 337, Mbita, Kenya – Telephone: (+254 728 211759)

Structural and Architectural Drawings

<table>
<thead>
<tr>
<th>Abbreviations</th>
<th>3D Rendering of Dormitory Unit</th>
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Vicinity Map

Maps and GIS:
- M1 – Kenya and Mbita Maps
- M2 – Upper School Property

Architectural Drawings:
- A1 – Topographic Map of Upper School Plot
- A2 – Floor Plan
- A3 – Building Elevations (South/East)
- A4 – Building Elevations (North/West)
- A5 – Building Sections
- A6 – Door and Window Schedules

Structural Drawings:
- S1 – Foundation Plan
- S2 – Concrete Details
- S3 – Concrete Details (Continued)
- S4 – Standard CM Reinforcement
- S5 – RC Tie-Beams and Tie Columns
- S6 – Hooks and Straps
- S7 – Roof Framing Plan
- S8 – Roof Truss Elevation
- S9 – Roof Framing Details
- S10 – Room Framing Details (Continued)
- S11 – Roof Framing Details (Continued)

Lighting Drawings:
- L1 – Lighting Plan and Install
From Left to Right:

- Geographic Map of Kenya
- Geopolitical Map of Kenya
- Map of Mbita and relative locations of the two Hope School campuses
NOTES

- RC columns to be keyed into stone masonry; see SE details.
- All dimensions are in mm unless otherwise specified.
- Drawings are not to be scaled. Only figured dimensions to be used.
- The contractor shall check and verify all the dimensions before commencement of work.

1. EAST ELEVATION

2. SOUTH ELEVATION
NOTES

- RC columns to be keyed into stone masonry, see SE details.
- All dimensions are in mm unless otherwise specified.
- Drawings are not to be scaled. Only fig. dimensions to be used.
- The contractor shall check and verify all the dimensions before commencement of work.
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<th>D3</th>
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<td>900 mm x 2440 mm</td>
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<td>WINDOW HEAD HEIGHT</td>
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2D SYMBOL

4 DOOR SWING DIRECTION

2D FRONT VIEW

- PAINTED STEEL LOUVERS, MATCH EXISTING
- 8mm THICK GLASS LITE PANEL WITH PAINTED SECURITY BARS, SIMILAR TO EXISTING
- PAINTED STEEL PANEL, MATCH EXISTING
- CIRCULAR ACCESS PANEL WITH INTERIOR LATCH, MATCH EXISTING

NOTE: BURGLAR PROOFING/STUDENT RETAINING BAR PANELS ON INTRIOR SIDE SHALL BE INSTALLED AS SHOWN. MINIMUM SECTIONS TO ALLOW FREE OPERATION OF UPPER CASEMENT WINDOW SECTIONS. GLASS TO BE 8MM THICK.
WALL ELEVATION

TYPICAL WALL & FOOTING

SCALE 1:4 = 1'-0"

NOTE:
SOL. SHALL BE INSPECTED PRIOR TO DETERMINING BOTTOM OF FOOTING LOCATION. REMOVE ORGANIC MATERIAL, REMOVE SOFT SPOTS AND PROVIDE MINIMUM ONE-PASS COMPACTION.

University of Wyoming
College of Engineering

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NOTE: THIS DRAWING SERVES TO ILLUSTRATE
DOOR FRAME & WINDOW FRAME RC CONNECTIONS
TYPICAL WITH TIE-BEAM/COLUMN, SEE A3

REFER TO FOUNDATION
DRAWINGS FOR DETAILS

COLUMN CONTINUOUS
TO SLOPING TIE BEAM
AT GABLE END WALL

TIE-BEAM AND TIE-COLUMN REINFORCING
RE: DETAIL SHEET S6
TYPICAL

TRUSS PLATE
DETAIL
SEE ROOF FRAMING
PLANS AND DETAILS

REINFORCEMENT INTERSECTION
DETAIL, S6
NOTES:

N1: Stirrups will be provided at all locations where reinforcement is required to be hooked. Stirrups will overlap a distance no less than \( \frac{1}{3} \) of the hooked length.

N2: Stirrups will be provided at all locations where truss plates are installed. Stirrups will overlap a distance no less than \( \frac{1}{3} \) of the hooked length.

N3: Hooked reinforcement will be placed inside of the intersecting tie-beam or tie-column longitudinal reinforcement.

N4: Stirrup spacing at intersections is per Sheet S5

N5: Rebar tie wire or baling wire shall be used to maintain 25 mm clear at beam and 40 mm clear at columns.
Appendix IV – Design Calculations

Wall Design
Given:
\[ H = 8 \text{ ft} + 8 \text{ in} = 104 \text{ in} \]
\[ L = 10 \text{ ft} + 120 \text{ in} = 120 \text{ in} \]
\[ L_{\text{min}} = L - 4 \text{ ft} = 72 \text{ in} \]
\[ t_{\text{wall}} = 6 \text{ in} \]
\[ h_c = 6 \text{ in} \]
\[ f_c = 2500 \text{ psi} \]
\[ f_m = 900 \text{ psi} \]
\[ f_y = 29 \text{ ksi} \]
\[ f_c = 17.237 \text{ MPa} \]
\[ f_m = 6.205 \text{ MPa} \]
\[ f_y = 199.948 \text{ MPa} \]

Loads:
\[ S = 5 \text{ ft} \]
\[ A_4 = 16.5 \text{ ft} \times S = 82.5 \text{ ft}^2 \]
\[ D_{\text{Lrv}} = 10 \text{ psf} \]
\[ L_{\text{Lrv}} = 20 \text{ psf} \]
\[ W_{\text{rv}} = 14.17 \text{ psf} \]
\[ S_{\text{H}} = 148.9 \text{ kip} \]

Longitudinal Steel:
\[ A_{\text{min}} = 0.2 \frac{f_c}{f_y} t_{\text{wall}}^2 = 400.444 \text{ mm}^2 \]
\[ A_{\text{min}} = 0.621 \text{ in}^2 \]

Try:
\[ 12.0 \quad n_{\text{st}} = 4 \quad A_{\text{st}} = 113 \text{ mm}^2 \]
\[ A_{\text{st}} = 0.175 \text{ in}^2 \]

\[ A_S = n_{\text{st}} A_{\text{st}} = 452 \text{ mm}^2 \]
\[ A_S = 0.701 \text{ in}^2 \]
\[ \psi_t := 1 \]
\[ \psi_e := 1 \]
\[ \psi_s := 0.8 \]
\[ \gamma := 1 \quad d_b := 10 \text{mm} \quad b := 6 \text{in} \]
\[ c := \frac{b}{2} - \frac{d_b}{2} = 2.803 \text{in} \]
\[ l_d := \frac{f_y \psi_t \psi_e d_b}{25 \gamma \sqrt{f_c} \text{psi}} = 9.134 \text{in} \]

**Hook is required**

\[ l_{dh} := d_b \left( \frac{0.02 \psi_e f_y}{\gamma \sqrt{f_c} \text{psi}} \right) = 4.567 \text{in} \]

Use: \( 3.75 \text{in} \)

**Extension:**

\[ l_{dh2} := 6 \cdot d_b = 2.362 \text{in} \]

Use: \( 2.5 \text{in} \)

**Radius:**

\[ r := 3 \cdot d_b = 1.181 \text{in} \]

Use: \( 1.25 \text{in} \)

**Stirrup Steel:**

\[ s := \min (1.5 t_{\text{wall}}, 200 \text{mm}) = 7.874 \text{in} \]

Use: \( 200 \text{mm} \)

\[ A_{2scmin} := \frac{10000 N \cdot s}{f_y \cdot h_c} = 0.102 \text{in}^2 \]

Use: \( A_{2scmin} = 65.634 \text{mm}^2 \)

\[ A_{scmin} := \frac{A_{2scmin}}{2} = 0.051 \text{in}^2 \]

Use: \( A_{scmin} = 32.817 \text{mm}^2 \)

**Try:**

\[ n_{sc} := 1 \quad A_{.5sc} := 113 \text{mm}^2 \]

\[ A_{sc} := n_{sc} \cdot A_{st} = 113 \text{mm}^2 \]

Use: \( A_{sc} = 0.175 \text{in}^2 \)
Compressive Strength:

\[ b_h = 4\text{ in} \]
\[ e_c = \frac{t_{\text{wall}}}{2} - \frac{b}{3} = 1.667\text{ in} \]
\[ e'_c = \frac{t_{\text{wall}}}{24} = 0.25\text{ in} \]
\[ k = 2 \quad \text{(Walls without retrained lateral displacement)} \]

\[ L' = L \]
\[ F_e = \left[ \left( 1 - \frac{2e'}{t_{\text{wall}}} \right) \left( 1 - \left( \frac{kH}{30t_{\text{wall}}} \right)^2 \right) \left( 1 - \frac{H}{L'} \right) + \frac{H}{L'} \right] = 0.826 \]
\[ F_E = \min(F_e, 0.9) = 0.826 \]
\[ F_R = 0.6 \]
\[ A_T = L_{\text{min}} t_{\text{wall}} \]
\[ P_R = F_R F_E \left( f_y A_T + n_{st} A_y f_y \right) = 232.878 \text{kip} \]
\[ P_r = \frac{P_R}{L} = 23.288 \text{kip/ft} \]

In-Plane Flexural Moment Strength:

\[ d' = L - h_c \]
\[ d = \frac{h_c}{2} \]
\[ M_o = A_y f_y d' = 193.016 \text{kip-ft} \]
\[ p_u = \left( 1.2D_{\text{rv}} + 1.6L_{\text{rv}} + W_{\text{rv}} \right) \frac{A_t}{S} = 0.96 \text{kip/ft} \]
\[ P_u = p_u S = 4.799 \text{kip} \]
\[ M_R = \begin{cases} 
(1.5F_R M_o + 0.15 P_R d) \left( 1 - \frac{P_u}{P_R} \right) & \text{if } P_u \geq \frac{P_R}{3} \\
(F_R M_o + 0.3 P_u d) & \text{if } 0 \leq P_u \leq \frac{P_R}{3} 
\end{cases} \]
\[ M_R = 116.169 \text{kip-ft} \]
Truss Design

Given:

\[ E = 29000 	ext{ksi} \]
\[ f_y = 60 	ext{ksi} \]
\[ f_c = 2500 	ext{psi} \]
\[ q_{1w} = 15.6 	ext{psf} \]
\[ q_{2w} = -24.8 	ext{psf} \]
\[ q_{Dy} = 10 	ext{psf} \]
\[ q_{Lx} = 20 	ext{psf} \]
\[ \text{pitch} = \frac{6}{12} \]
\[ B_1 = 30.3 \text{ft} \]
\[ B_2 = 70.5 \text{ft} \]
\[ b = 2 \text{in} \]
\[ h = 5 \text{ft} \]

*Note: All chord members use 2x2x4mm (1) sections
All web members use 2x1x3mm (2) sections
All connections are welded

\[ I_{1x} = 0.005 	ext{in}^4 \]
\[ I_{2x} = 0.005 	ext{in}^4 \]
\[ I_{1y} = 0.005 	ext{in}^4 \]
\[ I_{2y} = 0.005 	ext{in}^4 \]
\[ K_1 = 1.0 \]
\[ K_2 = 1.0 \]
\[ A_1 = 1.16 \text{in}^2 \]
\[ A_2 = 1.16 \text{in}^2 \]
\[ r_{1x} = 0.755 \text{in} \]
\[ r_{2x} = 0.755 \text{in} \]
\[ r_{1y} = 0.755 \text{in} \]
\[ r_{2y} = 0.755 \text{in} \]
\[ z_x = 0.8 \text{in} \]
\[ z_y = 0.8 \text{in} \]

Geometry:

\[ L_{\text{top}} = \sqrt{\left( \frac{B_1}{2} \times \text{pitch} \right)^2 + \left( \frac{B_1}{2} \right)^2} = 16.938 \text{ ft} \]
\[ L_{\text{bot}} = \frac{B_1}{2} = 15.15 \text{ ft} \]
\[ A_{\text{tr}} = 5 L_{\text{top}} = 84.691 \text{ ft}^2 \]

\[ L_{11} = 69.3 \text{ in} \]
\[ L_{w1} = 31 \text{ in} \]
\[ L_{b1} = 62 \text{ in} \]
\[ L_{12} = 69.3 \text{ in} \]
\[ L_{w2} = 69.3 \text{ in} \]
\[ L_{b2} = 62 \text{ in} \]
\[ L_{13} = 69.3 \text{ in} \]
\[ L_{w3} = 62 \text{ in} \]
\[ L_{b3} = 62 \text{ in} \]
\[ L_{w4} = 87.7 \text{ in} \]
\[ L_{w5} = 93 \text{ in} \]
Vertical Loads:

Downward Loads:

\[ q_1 = \max \left( 1.2q_{Dr} + 1.6q_{Lr} + 0.5q_{1W}, 1.2q_{Dr} + 0.9q_{Dr} + q_{1W} \right) \]

\[ q_1 = 51.8 \frac{\text{lbf}}{\text{ft}} \]

\[ w_1 = q_1S = 259 \frac{\text{lbf}}{\text{ft}} \]

Uplift Loads:

\[ q_2 = \min \left( 1.2q_{Dr} + 1.6q_{Lr} + 0.5q_{2W}, 1.2q_{Dr} + q_{2W}, 0.9q_{Dr} + q_{2W} \right) \]

\[ q_2 = -15.8 \frac{\text{lbf}}{\text{ft}} \]

\[ w_2 = q_2S = -79 \frac{\text{lbf}}{\text{ft}} \]

Member forces calculated in SAP2000. Refer to Excel "Loads" for tabulated values.

Controlling Axial Loads:

Tension:

\[ P_{11t} = 2.06 \text{ kip} \quad P_{w1t} = 0.16 \text{ kip} \quad P_{b1t} = 4.60 \text{ kip} \]

\[ P_{12t} = 1.81 \text{ kip} \quad P_{w2t} = 0.27 \text{ kip} \quad P_{b2t} = 4.65 \text{ kip} \]

\[ P_{13t} = 2.06 \text{ kip} \quad P_{w3t} = 0.65 \text{ kip} \quad P_{b3t} = 3.76 \text{ kip} \]

\[ P_{w4t} = 0.65 \text{ kip} \]

\[ P_{w5t} = 1.55 \text{ kip} \]
Compression:
\[ P_{c1} = -5.60 \text{kip} \]
\[ P_{c2} = -4.48 \text{kip} \]
\[ P_{c3} = -2.84 \text{kip} \]
\[ P_{c4} = -2.16 \text{kip} \]
\[ P_{c5} = -0.62 \text{kip} \]

Beam-Column Moments:
\[ M_{rxt1} = 13.2 \text{kip-in} \]
\[ M_{rxt2} = 13.2 \text{kip-in} \]
\[ M_{rxt3} = 13.2 \text{kip-in} \]

Critical Loads:

Tension:
Yield on Gross:
\[ \phi F_{t1} = \phi f_y A_1 = 33.408 \text{kip} \]
\[ \phi F_{t2} = \phi f_y A_2 = 33.408 \text{kip} \]

Compression:
Slenderness Checks:
\[ b_1 = 1.75 \text{in} \]
\[ t_1 = \frac{1}{8} \text{in} \]
check_1 := if \( \left( \frac{b_1}{t_1} \leq 1.40 \sqrt{\frac{E}{f_y}}, \text{"Nonslender"}, \text{"Slender"} \right) \) = "Nonslender"
\[ b_2 = 0.843 \text{in} \]
\[ t_2 = \frac{1}{8} \text{in} \]
check_2 := if \( \left( \frac{b_2}{t_2} \leq 1.40 \sqrt{\frac{E}{f_y}}, \text{"Nonslender"}, \text{"Slender"} \right) \) = "Nonslender"
\[
\frac{K_1 L_{t1}}{r_{1x}} = 91.788 \quad \frac{K_1 L_{t1}}{r_{1y}} = 91.788
\]
\[
\frac{K_2 L_{w5}}{r_{1x}} = 123.179 \quad \frac{K_2 L_{w5}}{r_{2y}} = 123.179
\]

Critical Loading:

T1:

\[
F_{et1} := \frac{\pi^2 E}{\left(\frac{K_1 L_{t1}}{r_{1x}}\right)^2} = 33.972 \text{ ksi}
\]

\[
F_{cr1} := \left[4.71 \sqrt{\frac{E}{f_y}} \geq \frac{K_1 L_{t1}}{r_{1x}}\right] \left[0.658 \left(\frac{f_y}{F_{et1}}\right) - f_y, 0.877 F_{et1}\right] = 23.104 \text{ ksi}
\]

\[
P_{cr1} := F_{cr1} \cdot A_1 = 26.8 \text{ kip}
\]

check 3 := if \(P_{cr1} > f_y \cdot A_1, "Yield Controls", "Buckling Controls"\) := "Buckling Controls"

\[
\phi_{P_{ct1}} := \min(\phi_c f_y A_1, \phi_c P_{ct1}) = 24.12 \text{ kip}
\]

\[
M_{ct1} := f_y Z_x = 28.8 \text{ kip-in}
\]

Interaction:

\[
\frac{P_{tlc}}{\phi P_{ct1}} = 0.232
\]

\[
a := \left[\frac{P_{tlc}}{\phi P_{ct1}} \geq 0.2, \frac{P_{tlc}}{\phi P_{ct1}} = \frac{g \left(\frac{M_{rt1}}{M_{ct1}}\right)}{g \left(\frac{P_{tlc}}{M_{ct1}}\right)}, -2 \phi P_{ct1} = \frac{M_{rt1}}{M_{ct1}}\right] = 0.64
\]

T2:

\[
F_{et2} := \frac{\pi^2 E}{\left(\frac{K_1 L_{t2}}{r_{1x}}\right)^2} = 33.972 \text{ ksi}
\]
\[ F_{cr2} = \begin{cases} \left( 4.71 \frac{E}{f_y} \geq \frac{K_1 L_{l2} \text{ in}^2}{r_{1x}} \right), & 0.658 \left( \frac{f_y}{F_{et2}} \right) \cdot f_y, 0.877 \cdot F_{et2} \end{cases} = 23.104 \text{ ksi} \]

\[ P_{ct2} = F_{cr2} \cdot A_1 = 26.8 \text{ kip} \]

\[ \text{check2: if } \left( P_{ct2} > f_y \cdot A_1, "Yield Controls", "Buckling Controls" \right) = "Buckling Controls" \]

\[ \phi_{P_{ct2}} = \min(\phi_c f_y A_1, \phi_c P_{ct2}) = 24.12 \text{ kip} \]

\[ M_{cxt2} = f_y Z_x = 28.8 \text{ kip in} \]

Interaction:

\[ \frac{P_{\omega c}}{\phi_{P_{ct2}}} = 0.186 \]

\[ \text{Ax: if } \left[ \frac{P_{\omega c}}{\phi_{P_{ct2}}} \geq 0.2, \frac{P_{\omega c}}{\phi_{P_{ct2}}} \cdot \frac{M_{nt2}}{M_{cxt2}} = \frac{P_{\omega c}}{2 \cdot \phi_{P_{ct2}}} + \frac{M_{nt2}}{M_{cxt2}} \right] = 0.551 \]

T3:

\[ F_{et3} = \frac{\pi^2 E}{L_{l3}^2} = 33.972 \text{ ksi} \]

\[ F_{cr3} = \begin{cases} \left( 4.71 \frac{E}{f_y} \geq \frac{K_1 L_{l3} \text{ in}^2}{r_{1x}} \right), & 0.658 \left( \frac{f_y}{F_{et3}} \right) \cdot f_y, 0.877 \cdot F_{et3} \end{cases} = 23.104 \text{ ksi} \]

\[ P_{ct3} = F_{cr3} \cdot A_1 = 26.8 \text{ kip} \]

\[ \text{check3: if } \left( P_{ct3} > f_y \cdot A_1, "Yield Controls", "Buckling Controls" \right) = "Buckling Controls" \]

\[ \phi_{P_{ct3}} = \min(\phi_c f_y A_1, \phi_c P_{ct3}) = 24.12 \text{ kip} \]

\[ M_{cxt3} = f_y Z_x = 28.8 \text{ kip in} \]
Interaction:

$$\frac{P_{t3c}}{-\phi P_{ct3}} = 0.118$$

\[A = \begin{cases}
\frac{P_{t3c}}{-\phi P_{ct3}} \geq 0.2, & \frac{P_{t3c}}{-\phi P_{ct3}} + \frac{8}{9} \left( \frac{M_{xt3}}{M_{ct3}} \right), \frac{P_{t3c}}{-2\cdot\phi P_{ct3}} + \left( \frac{M_{xt3}}{M_{ct3}} \right) = 0.517 \\
\end{cases}\]

**W1:**

$$F_{ew1} = \frac{\pi^2 E}{\left( \frac{K_2 L_{w1}}{r_{2x \text{ in}}^2} \right)^2} = 169.773 \text{ ksi}$$

$$F_{crw1} = \begin{cases}
\left( 4.71 \sqrt{\frac{E}{f_y}} \right) \left( \frac{K_2 L_{w1} \text{ in}}{r_{2x}} \right)^2 f_y \frac{F_{ew1}}{0.658} \cdot f_y \cdot 0.877 \cdot F_{ew1} = 32.943 \text{ ksi} \\
\end{cases}$$

$$P_{crw1} = F_{crw1} \cdot A_2 = 38.213 \text{ kip}$$

check: $$P_{crw1} > f_y \cdot A_2, "Yield Controls", "Buckling Controls"$$

$$\phi P_{cw1} = \min(\phi_c \cdot f_y \cdot A_2, \phi_c \cdot P_{crw1}) = 34.392 \text{ kip}$$

**W2:**

$$F_{ew2} = \frac{\pi^2 E}{\left( \frac{K_2 L_{w2}}{r_{2x \text{ in}}^2} \right)^2} = 33.972 \text{ ksi}$$

$$F_{crw2} = \begin{cases}
\left( 4.71 \sqrt{\frac{E}{f_y}} \right) \left( \frac{K_2 L_{w2} \text{ in}}{r_{2x}} \right)^2 f_y \frac{F_{ew2}}{0.658} \cdot f_y \cdot 0.877 \cdot F_{ew2} = 23.104 \text{ ksi} \\
\end{cases}$$

$$P_{crw2} = F_{crw2} \cdot A_2 = 26.8 \text{ kip}$$

check: $$P_{crw2} > f_y \cdot A_2, "Yield Controls", "Buckling Controls"$$

$$\phi P_{cw2} = \min(\phi_c \cdot f_y \cdot A_2, \phi_c \cdot P_{crw2}) = 24.12 \text{ kip}$$
W3:

\[ F_{ew3} = \frac{\pi^2 E}{K_2 L_{w3}^2} \left( \frac{I_{w3}}{r_{2x}^2} \right) = 42.443 \text{ ksi} \]

\[ F_{crw3} = \begin{cases} 4.71 \left( \frac{E}{f_y} \right) \geq \frac{K_2 L_{w3}^2}{r_{2x}^2} & \left[ 0.658 \left( \frac{f_y}{F_{ew3}} \right) \right] \left[ f_y, 0.877 \cdot F_{ew3} \right] = 25.242 \text{ ksi} \\
F_{crw3} \cdot A_2 = 29.281 \text{ kip} 
\end{cases} \]

Check1: if \( P_{crw3} > f_y \cdot A_2 \), "Yield Controls", "Buckling Controls" = "Buckling Controls"

\[ \phi P_{crw3} = \min(\phi_c f_y A_2, \phi_c P_{crw3}) = 26.353 \text{ kip} \]

W4:

\[ F_{ew4} = \frac{\pi^2 E}{K_2 L_{w4}^2} \left( \frac{I_{w4}}{r_{2x}^2} \right) = 21.213 \text{ ksi} \]

\[ F_{crw4} = \begin{cases} 4.71 \left( \frac{E}{f_y} \right) \geq \frac{K_2 L_{w4}^2}{r_{2x}^2} & \left[ 0.658 \left( \frac{f_y}{F_{ew4}} \right) \right] \left[ f_y, 0.877 \cdot F_{ew4} \right] = 17.693 \text{ ksi} \\
F_{crw4} \cdot A_2 = 20.524 \text{ kip} 
\end{cases} \]

Check2: if \( P_{crw4} > f_y \cdot A_2 \), "Yield Controls", "Buckling Controls" = "Buckling Controls"

\[ \phi P_{crw4} = \min(\phi_c f_y A_2, \phi_c P_{crw4}) = 18.472 \text{ kip} \]

W5:

\[ F_{ew5} = \frac{\pi^2 E}{K_2 L_{w5}^2} \left( \frac{I_{w5}}{r_{2x}^2} \right) = 18.864 \text{ ksi} \]

\[ F_{crw5} = \begin{cases} 4.71 \left( \frac{E}{f_y} \right) \geq \frac{K_2 L_{w5}^2}{r_{2x}^2} & \left[ 0.658 \left( \frac{f_y}{F_{ew5}} \right) \right] \left[ f_y, 0.877 \cdot F_{ew5} \right] = 16.196 \text{ ksi} \\
\end{cases} \]
\[ P_{crw5} := F_{crw5} \cdot A_2 = 18.787 \text{kip} \]

\[ \text{check} := \text{if} \left( P_{crw5} > f_y \cdot A_2, "Yield Controls", "Buckling Controls" \right) = "Buckling Controls" \]

\[ \phi P_{crw5} := \min \left( \phi_c \cdot f_y \cdot A_2, \phi_c \cdot P_{crw5} \right) = 16.908 \text{kip} \]

**B1:**

\[ F_{eb1} := \frac{\pi^2 \cdot E}{\left( \frac{K_1 \cdot L_{b1}}{r_{1x} \cdot \text{in}^2} \right)^2} = 42.443 \text{ksi} \]

\[ F_{crb1} := \begin{cases} 4.71 \cdot \sqrt{\frac{E \cdot L_{b1} \cdot \text{in}^2}{f_y}} & \leq \frac{0.658 \cdot f_y}{F_{eb1}}, 0.877 \cdot F_{eb1} \\ \text{min} & \end{cases} = 25.242 \text{ksi} \]

\[ P_{crb1} := F_{crb1} \cdot A_1 = 29.281 \text{kip} \]

\[ \text{check} := \text{if} \left( P_{crb1} > f_y \cdot A_1, "Yield Controls", "Buckling Controls" \right) = "Buckling Controls" \]

\[ \phi P_{cb1} := \min \left( \phi_c \cdot f_y \cdot A_1, \phi_c \cdot P_{crb1} \right) = 26.353 \text{kip} \]

**B2:**

\[ F_{eb2} := \frac{\pi^2 \cdot E}{\left( \frac{K_1 \cdot L_{b2}}{r_{1x} \cdot \text{in}^2} \right)^2} = 42.443 \text{ksi} \]

\[ F_{crb2} := \begin{cases} 4.71 \cdot \sqrt{\frac{E \cdot L_{b2} \cdot \text{in}^2}{f_y}} & \leq \frac{0.658 \cdot f_y}{F_{eb2}}, 0.877 \cdot F_{eb2} \\ \text{min} & \end{cases} = 25.242 \text{ksi} \]

\[ P_{crb2} := F_{crb2} \cdot A_1 = 29.281 \text{kip} \]

\[ \text{check} := \text{if} \left( P_{crb2} > f_y \cdot A_1, "Yield Controls", "Buckling Controls" \right) = "Buckling Controls" \]

\[ \phi P_{cb2} := \min \left( \phi_c \cdot f_y \cdot A_1, \phi_c \cdot P_{crb2} \right) = 26.353 \text{kip} \]
B3:

\[ F_{eb3} = \frac{\pi^2 E}{(K_1 L_{b3})^2} \times \frac{1}{(r_{1x})^2} = 42.443 \text{ ksi} \]

\[ F_{crb3} = \left[ \left( 4.71 \sqrt{\frac{E}{f_y}} - \frac{K_2 L_{b3}}{r_{1x}} \right)^2, 0.658 \left( \frac{f_y}{F_{eb3}} \right), 0.877 F_{eb3} \right] = 25.242 \text{ ksi} \]

\[ P_{crb3} = F_{crb3} A_1 = 29.281 \text{ kip} \]

\[ \text{check 3: if } P_{crb3} > f_y A_1, \text{ "Yield Controls", "Buckling Controls" } = \text{ "Buckling Controls"} \]

\[ \phi P_{cb3} = \min(\phi_c f_y A_1, \phi_c P_{crb3}) = 20.353 \text{ kip} \]
Wind Loads - MWFRS:

Given:
- $V_w = 115 \text{mph}$
- $\theta = 26.6^\circ \text{deg}$
- $h = 12.78 \text{ft}$
- $I = 1$
- $K_d = 0.85$
- Surface Roughness: D
- Exposer Category: C
- Directional Procedure

Wind Load:
- $\alpha = 9.5$
- $z_g = 900 \text{ft}$
- $z_{\min} = 15 \text{ft}$
- $z_{\text{peak}} = 16.88 \text{ft}$

\[
K_{z_{\text{peak}}} = 2.01 \left( \frac{z_{\text{peak}}}{z_g} \right)^{\frac{2}{\alpha}} = 0.87 \quad \text{Exposer } z > 15 \text{ft}
\]

\[
K_z = 2.01 \left( \frac{15 \text{ft}}{z_g} \right)^{\frac{2}{\alpha}} = 0.849 \quad \text{Exposer } z < 15 \text{ft}
\]

$K_{h_{\text{peak}}} = 0.87$

$K_h = 0.85$

$K_1 = 0.17$

$K_2 = 1.00$

$K_3 = 1.00$

$K_{zt} = 1 = 1$

$C_{w1} = 0.84$

$C_{w2} = 1.14$

\[
h = 8.75 \text{ft} + 8 \frac{\text{ft}}{2} = 12.75 \text{ft}
\]

\[
n_a = \frac{385 \frac{\text{ft}}{s} C_{w1}^{0.5}}{h} = 27.675 \frac{1}{s}
\]
\[ n_a > 1 \quad \text{Therefore, rigid} \]
\[ B_1 := 30.4 \text{ ft} \]
\[ B_2 := 70.5 \text{ ft} \]
\[ L := 500 \text{ ft} \]
\[ \varepsilon := \frac{1}{5} \]
\[ L_z := 1 \left( \frac{z_{\text{min}}}{33 \text{ ft}} \right)^{\varepsilon} = 427.057 \text{ ft} \]
\[ Q_1 := \frac{1}{\sqrt{1 + 0.63 \cdot \left( \frac{B_1 + h}{L_z} \right)^{0.63}}} = 0.97 \]
\[ Q_2 := \frac{1}{\sqrt{1 + 0.63 \cdot \left( \frac{B_2 + h}{L_z} \right)^{0.63}}} = 0.904 \]

\[ g_Q := 3.4 \]
\[ g_v := 3.4 \]

\[ L_z := \frac{c}{z_{\text{min}}} \left( \frac{1}{6} \right) = 0.228 \]

\[ G_1 := 0.925 \left( \frac{1 + 1.7 \cdot g_Q L_z Q_1}{1 + 1.7 \cdot g_v L_z} \right) = 0.909 \]

\[ G_2 := 0.925 \left( \frac{1 + 1.7 \cdot g_Q L_z Q_2}{1 + 1.7 \cdot g_v L_z} \right) = 0.874 \]

\[ G_{C_{\text{pi}}} := 0.55 \]

\[ q_{z_{\text{peak}}} := 0.00256 \cdot 0.87 \cdot 1 \cdot 0.85 \cdot 115^2 = 25.037 \]

\[ q := 25.037 \frac{\text{lbf}}{\text{ft}^2} \]

*Use for all heights
Direction 1: (Long)

\[ L_1 = 70.5 \text{ ft} \]
\[ B_1 = 30.4 \text{ ft} \]
\[ \frac{L_1}{B_1} = 2.319 \]
\[ h = 0.181 \]

Windward Walls:
\[ C_{pww1} = 0.8 \]
\[ P_{ww1} = q \cdot G_1 \cdot C_{pww1} - q \cdot G_C p_i = 4.437 \frac{\text{lb}}{\text{ft}^2} \]
\[ P_{ww1} = q \cdot G_1 \cdot C_{pww1} + q \cdot G_C p_i = 31.978 \frac{\text{lb}}{\text{ft}^2} \]

Leeward Walls:
\[ C_{plw1} = -0.284 \]
\[ P_{lw1} = q \cdot G_1 \cdot C_{plw1} - q \cdot G_C p_i = -20.234 \frac{\text{lb}}{\text{ft}^2} \]
\[ P_{lw1} = q \cdot G_1 \cdot C_{plw1} + q \cdot G_C p_i = 7.307 \frac{\text{lb}}{\text{ft}^2} \]

Side Walls:
\[ C_{psw1} = -0.7 \]
\[ P_{sw1} = q \cdot G_1 \cdot C_{psw1} - q \cdot G_C p_i = -29.702 \frac{\text{lb}}{\text{ft}^2} \]
\[ P_{sw1} = q \cdot G_1 \cdot C_{psw1} + q \cdot G_C p_i = -2.161 \frac{\text{lb}}{\text{ft}^2} \]

Windward Roof:
\[ C_{pww1a} = -0.2 \]
\[ P_{ww1a} = q \cdot G_1 \cdot C_{pww1a} - q \cdot G_C p_i = -18.322 \frac{\text{lb}}{\text{ft}^2} \]
\[ P_{ww1a} = q \cdot G_1 \cdot C_{pww1a} + q \cdot G_C p_i = 9.219 \frac{\text{lb}}{\text{ft}^2} \]
\[ C_{pww1b} = 0.3 \]
\[ P_{ww1b} = q \cdot G_1 \cdot C_{pww1b} - q \cdot G_C p_i = -6.943 \frac{\text{lb}}{\text{ft}^2} \]
Leeward Roof:

\[ C_{plw 1} = -0.6 \]
\[ P_{lw 1} = q \cdot G_1 \cdot C_{plw 1} - q \cdot G_{C_p} = -27.426 \text{ lbf/ft}^2 \]
\[ R_{lw 1} = q \cdot G_1 \cdot C_{plw 1} + q \cdot G_{C_p} = 0.115 \text{ lbf/ft}^2 \]

Direction 2: (Short)

\[ L_2 = 30.4 \text{ ft} \]
\[ B_2 = 70.5 \text{ ft} \]
\[ L_2 = 0.431 \]
\[ B_2 = 0.419 \]

Windward Walls:

\[ C_{pw 2} = 0.8 \]
\[ P_{ww 2} = q \cdot G_2 \cdot C_{pw 2} - q \cdot G_{C_p} = 3.741 \text{ lbf/ft}^2 \]
\[ R_{ww 2} = q \cdot G_2 \cdot C_{pw 2} + q \cdot G_{C_p} = 31.282 \text{ lbf/ft}^2 \]

Leeward Walls:

\[ C_{plw 2} = -0.5 \]
\[ P_{lw 2} = q \cdot G_2 \cdot C_{plw 2} - q \cdot G_{C_p} = -24.715 \text{ lbf/ft}^2 \]
\[ R_{lw 2} = q \cdot G_2 \cdot C_{plw 2} + q \cdot G_{C_p} = 2.826 \text{ lbf/ft}^2 \]

Side Walls:

\[ C_{psw 2} = -0.7 \]
\[ P_{sw 2} = q \cdot G_2 \cdot C_{psw 2} - q \cdot G_{C_p} = -29.093 \text{ lbf/ft}^2 \]
\[ R_{sw 2} = q \cdot G_2 \cdot C_{psw 2} + q \cdot G_{C_p} = -1.552 \text{ lbf/ft}^2 \]
Windward Roof:

\[ C_{pwrr2a} := -0.25 \]
\[ P_{wrr2a} := q \cdot G_2 \cdot C_{pwrr2a} - q \cdot G_{C_p} = -19.243 \, \frac{\text{lbf}}{\text{ft}^2} \]
\[ P_{wrr2a} = q \cdot G_2 \cdot C_{pwrr2a} + q \cdot G_{C_p} = 8.298 \, \frac{\text{lbf}}{\text{ft}^2} \]
\[ C_{pwrr2b} := 0.22 \]
\[ P_{wrr2b} := q \cdot G_2 \cdot C_{pwrr2b} - q \cdot G_{C_p} = -8.955 \, \frac{\text{lbf}}{\text{ft}^2} \]
\[ P_{wrr2b} = q \cdot G_2 \cdot C_{pwrr2b} + q \cdot G_{C_p} = 18.586 \, \frac{\text{lbf}}{\text{ft}^2} \]

Leeward Roof:

\[ C_{plwr2} := -0.6 \]
\[ P_{lwr2} := q \cdot G_2 \cdot C_{plwr2} - q \cdot G_{C_p} = -26.904 \, \frac{\text{lbf}}{\text{ft}^2} \]
\[ P_{lwr2} = q \cdot G_2 \cdot C_{plwr2} + q \cdot G_{C_p} = 0.637 \, \frac{\text{lbf}}{\text{ft}^2} \]
Allowable Masonry Out-of-Plane Flexure Stress:

By: Shane Wilson

Given:
Assume unreinforced masonry
Type N Mortar

\[ f_r = 100 \text{ psi} \]
\[ \phi = 0.6 \]
\[ \phi f_r = \phi f_y = 60 \text{ psi} \]
\[ t = 6 \text{ in} \]
\[ c_m = \frac{t}{2} = 3 \text{ in} \]
\[ L_m = 12 \text{ in} \]
\[ t_{fs} = \frac{t}{2} = 3 \text{ in} \]
\[ h = 8.67 \text{ ft} \]

Normal to bed joint

Average height above tie-column

Maximum Allowable Loading:

\[ I = 2 \left[ \frac{L_m t_{fs}^3}{12} + L_m t_{fs} \left( c_m - \frac{t_{fs}}{2} \right)^2 \right] = 216 \text{ in}^4 \]

Assumes simply supported

Concrete Out-of-Plane Flexure:

Given:

\[ f_c = 3000 \text{ psi} \]
\[ f_y = 40 \text{ ksi} \]
\[ E_s = 29000 \text{ ksi} \]
\[ b = 6 \text{ in} \]
\[ L_c = 16.73 \text{ ft} \]
\[ d_b = 10 \text{ mm} \]
\[ A_{st} = 2.113 \text{ mm}^2 \]
Maximum Allowable Loading:

\[ n := \frac{E_s}{57000 \sqrt{f_c \text{ psi}}} = 9.289 \]

\[ c_c := \frac{b}{2} = 3 \text{ in} \]

\[ d := 6 \text{ in} - 1.75 \text{ in} = 4.25 \text{ in} \]

\[ \rho_{0.005} := 0.0203 \]

\[ a := \frac{A_{st} f_y}{0.85 f_c b} = 0.916 \text{ in} \]

\[ \rho := \frac{A_{st}}{36 \text{in}^2} = 9.731 \times 10^{-3} \]

\[ R := 335 \text{ psi} + (369 \text{ psi} - 335 \text{ psi}) \times 0.731 = 0.36 \text{ ksi} \]

\[ M_n := R \cdot b \cdot d^2 = 38.999 \text{ kip-in} \]
Truss Plate Design

Given:

- $f_y = 29$ ksi
- $f_c = 2500$ psi
- $q_{1w} = 15.6$ psf
- $q_{2w} = -24.8$ psf
- $q_{Dx} = 10$ psf
- $q_{Lx} = 20$ psf
- $\text{pitch} = \frac{6}{12}$
- $B_1 = 30.3$ ft
- $B_2 = 70.5$ ft
- $b = 6$ in
- $s = 5$ ft

Geometry:

- $L_{top} = \sqrt{\left(\frac{B_1}{2}\right)^2 + \left(\frac{B_1}{2}\right)^2} = 16.938$ ft
- $L_{bot} = \frac{B_1}{2} = 15.15$ ft
- $A_y = 5L_{top} = 84.691$ ft$^2$

Loads:

- Downward Loads:
  - $q_1 = \max(1.2q_{Dx} + 1.6q_{Lx} + 0.5q_{1w}, 1.2q_{Dx} + q_{1w}, 0.9q_{Dx} + q_{1w})$
  - $q_1 = 51.8 \frac{lb}{ft^2}$
  - $w_1 = q_1L_{top} = 877.4 \frac{lb}{ft}$

By: Shane Wilson
\[ P_1 := w_1 S = 4.387 \text{ kip} \]

**Uplift Loads:**

\[ q_2 := \min(1.2q_{D_r} + 1.6q_{Lr} + 0.5q_{2w}, 1.2q_{D_r} + q_{2w}, 0.9q_{D_r} + q_{2w}) \]

\[ q_2 = -15.8 \frac{\text{lb}}{\text{ft}} \]

\[ w_2 := q_2 L_{\text{top}} = -267.624 \frac{\text{lb}}{\text{ft}} \]

\[ P_2 := w_2 S = -1.338 \text{ kip} \]

**Design for Pullout:**

\[ A_{\text{min}} := -\frac{P_2}{f_y} = 0.046 \text{ in}^2 \]

\[ A_{\text{min}} = 29.769 \text{ mm}^2 \]

Try 2 - 8mm  
\[ d_b = 8 \text{ mm} \]

\[ A_g := 2.503 \text{ mm}^2 = 100.6 \text{ mm}^2 \]

\[ f_t := A_g f_y = 4.522 \text{ kip} \]

**OKAY**

**Determine development length**

\[ \psi_t := 1 \]

\[ \psi_e := 1 \]

\[ \psi_g := .8 \]

\[ \lambda := 1 \]

\[ \lambda_c := \frac{b}{2} - \frac{d_b}{2} = 2.843 \text{ in} \]

\[ l_d := \frac{f_y \psi_t \psi_e d_b}{25 \lambda_s \sqrt{f_c \text{ psi}}} = 7.307 \text{ in} \]

**Hook is required**

\[ l_{dh} := d_b \left( \frac{0.02 \psi_e f_y}{\lambda_s \sqrt{f_c \text{ psi}}} \right) = 3.654 \text{ in} \]

Use: 3.75in

**Extension:**

\[ l_{dh2} := 6d_b = 1.89 \text{ in} \]

Use: 2in
ASCE.7.2002

Building Dimensions:

\[
\begin{align*}
B_1 &= 70.5 \text{ ft} & \text{Length of Building (Direction 1)} \\
B_2 &= 29.5 \text{ ft} & \text{Width of Building (Direction 2)} \\
H_{wall} &= 9.5 \text{ ft} \\
\text{Roof Pitch:} &= 6 :12 & \text{Gable Roof} \\
\text{Overhang:} &= 1 \text{ ft} \\
\text{Truss Spacing:} &= 5 \text{ ft}
\end{align*}
\]

Occupancy Category II

16.491

Roof Loads

Live Loads 4.0

Section 4.9

\[
\begin{align*}
A_t &= 104 \text{ ft}^2 & \text{(Based on truss spacing)} \\
R_1 &= 1 \\
F &= 6.00 \\
R_2 &= 0.6 \\
L_r &= 12 \text{ psf} \\
\text{Use:} &= 20 \text{ psf}
\end{align*}
\]

Dead Loads 3.0

Metal Roof: 2 psf
Truss: 2.79 psf \hspace{1cm} \text{(Assumed 2"x2"x1.8" A36, Double Fan Truss)}

\[
\begin{align*}
D_r &= 4.79 \text{ psf} \\
\text{Use:} &= 10 \text{ psf}
\end{align*}
\]

Wall Dead Loads

3.6396

Wall: 170 pcf
85 lb/ft

\[
\begin{array}{|c|c|c|c|c|}
\hline
& 1 & 2 & 3 & 4 \\
\hline
\text{Area (ft}^2\text{)} & 498 & 2080 & 2080 & 498 \\
\text{W (kip)} & 42.31 & 176.78 & 176.78 & 42.31 \\
\hline
\end{array}
\]
Wind Load 6.0
Section 6.5, Method 2

General:

\[ V = 115 \text{ mph} \] (Assumed)
\[ I = 1 \] (T. 6-1)
\[ K_d = 0.85 \] (T. 6-4)

Exposer:

Surf. Rough.: D (Assumed Worse Case)
Exposer: C

\[ h = 13.19 \text{ ft} \]
\[ \alpha = 11.5 \] (T. 6-2)
\[ z_b = 700 \text{ ft} \] (T. 6-2)
\[ z_{min} = 7 \text{ ft} \] (T. 6-2)
\[ K_h = 1.03 \] (T. 6-3)
\[ z_{peak} = 16.88 \text{ ft} \]
\[ K_z = 1.03 \text{ for } z < 15 \text{ft} \] (T. 6-3) Case 1 & 2 (Valid only for exposer C or D)
\[ K_z = 1.05 \text{ for } z = z_{peak} \] (T. 6-3) Case 1 & 2 (Valid only for exposer C or D)

Topography:

\[ 0 < H/LH < 0.2 \] (F. 6-4) (Assumed Flat Terrain)
\[ K_1 = 0.17 \]
\[ K_2 = 1.00 \]
\[ K_3 = 1.00 \]
\[ K_{zt} = 1.37 \] (Eq. 6-3)

Gust Effect:

\[ \bar{z} = 7.91 \text{ ft} \text{ Okay, Greater Than Minimum} \]
\[ g_Q = 3.4 \]
\[ g_v = 3.4 \]
\[ \check{L} = 650 \text{ ft} \] (T. 6-2)
\[ \check{C} = 0.125 \] (T. 6-2)
\[ c = 0.15 \] (T. 6-2)
\[ L_x = 543.74 \text{ ft} \] (Eq. 6-7) Integral Length Scale of Turbulence
\[ Q_1 = 0.92 \] (Eq. 6-6) Background Response, Direction 1
\[ Q_2 = 0.94 \] (Eq. 6-6) Background Response, Direction 2
\[ \check{I}_x = 0.19 \] (Eq. 6-5) Intensity of Turbulence
\[ G_1 = 0.88 \] (Eq. 6-4) Gust Effect Factor, Direction 1
\[ G_2 = 0.90 \] (Eq. 6-4) Gust Effect Factor, Direction 2
Seismic Design (ASCE.7.2002)

Flexible/Dynamically Sensitive Structures:
Assume that Structure is Rigid.
Check for fundamental frequency > 1 Hz. (S. 6.2)

Enclosure Classification:
Enclosed (S. 6.2)

Wind-Borne Debris:
N/A (S. 6.5.9.3)

Velocity Pressure:
\[ q_z = 40.58 \text{ psf} \]  (Eq. 6-15) for \( z < 15 \text{ ft} \)
\[ q_{z\text{peak}} = 41.42 \text{ psf} \]  (Eq. 6-15)
Use \( q_z = 42 \text{ psf} \)

Pressure and Force Coefficients: (MWFRS)
\[ GC_{pi} = 0.18 \quad -0.18 \]  (F. 6-5)

Wall Pressure Coefficients:

<table>
<thead>
<tr>
<th>Direction 1</th>
<th>Direction 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>L/B</td>
<td>2.39</td>
</tr>
<tr>
<td>WW ( C_p )</td>
<td>0.80</td>
</tr>
<tr>
<td>SW ( C_p )</td>
<td>-0.70</td>
</tr>
<tr>
<td>LW ( C_p )</td>
<td>-0.28</td>
</tr>
</tbody>
</table>

Roof Pressure Coefficients:
\[ \theta = 27 \text{ degrees} \] (Roof Angle)
\[ A = 2080 \text{ ft}^2 \]

<table>
<thead>
<tr>
<th>Direction 1</th>
<th>Direction 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>h/L</td>
<td>0.19</td>
</tr>
<tr>
<td>WW ( C_p )</td>
<td>-0.90</td>
</tr>
<tr>
<td>LW ( C_p )</td>
<td>--</td>
</tr>
</tbody>
</table>

* \( C_p \) for Direction 1 is chosen as worst case.

\[ q_{z} = 42.00 \text{ psf} \] Use for all pressure values

<table>
<thead>
<tr>
<th>Building Surface (F. 6-10)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>( G_1C_p )</td>
<td>0.71</td>
<td>-0.80</td>
<td>-0.80</td>
<td>-0.25</td>
<td>-0.62</td>
<td>-0.62</td>
</tr>
<tr>
<td>(+) ( p_1 ) (psf)</td>
<td>22.14</td>
<td>-40.97</td>
<td>-40.97</td>
<td>-17.99</td>
<td>-33.55</td>
<td>-33.55</td>
</tr>
<tr>
<td>(-) ( p_1 ) (psf)</td>
<td>37.26</td>
<td>-25.85</td>
<td>-25.85</td>
<td>-2.87</td>
<td>-18.43</td>
<td>-18.43</td>
</tr>
<tr>
<td>( G_2C_p )</td>
<td>0.72</td>
<td>0.20</td>
<td>-0.22</td>
<td>-0.45</td>
<td>-0.63</td>
<td>-0.63</td>
</tr>
<tr>
<td>(+) ( p_2 ) (psf)</td>
<td>22.58</td>
<td>0.73</td>
<td>-16.90</td>
<td>-26.40</td>
<td>-33.93</td>
<td>-33.93</td>
</tr>
<tr>
<td>(-) ( p_2 ) (psf)</td>
<td>37.70</td>
<td>15.85</td>
<td>-1.78</td>
<td>-11.28</td>
<td>-18.81</td>
<td>-18.81</td>
</tr>
</tbody>
</table>
Wind Load Cases: (Walls)
Design only for load cases 1 and 3 (S. 6.5.12.3)

<table>
<thead>
<tr>
<th></th>
<th>Case 1 (psf)</th>
<th>Case 2 (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$P_{WX}$</td>
<td>$P_{LY}$</td>
</tr>
<tr>
<td>Walls</td>
<td>37.26</td>
<td>37.70</td>
</tr>
<tr>
<td>Roof (nor.)</td>
<td>0.00</td>
<td>15.85</td>
</tr>
<tr>
<td>Roof (hor.)</td>
<td>0.00</td>
<td>7.09</td>
</tr>
<tr>
<td>Roof (ver.)</td>
<td>0.00</td>
<td>14.17</td>
</tr>
</tbody>
</table>

Horizontal Loads
### Vertical Loads

**Case 1**

<table>
<thead>
<tr>
<th>Area (ft²)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Total (kip)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F₁ (lbf)</td>
<td>18549</td>
<td>0</td>
<td>0</td>
<td>8957</td>
<td>0</td>
<td>0</td>
<td>28</td>
</tr>
<tr>
<td>Area (ft²)</td>
<td>2080</td>
<td>1163</td>
<td>1163</td>
<td>2080</td>
<td>498</td>
<td>498</td>
<td></td>
</tr>
<tr>
<td>F₂ (lbf)</td>
<td>78400</td>
<td>8240</td>
<td>21303</td>
<td>23450</td>
<td>0</td>
<td>0</td>
<td>131</td>
</tr>
</tbody>
</table>

**Case 2**

<table>
<thead>
<tr>
<th>Area (ft²)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Total (kip)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F₁ (lbf)</td>
<td>13911</td>
<td>0</td>
<td>0</td>
<td>6718</td>
<td>0</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>Area (ft²)</td>
<td>1560</td>
<td>872</td>
<td>872</td>
<td>1560</td>
<td>373</td>
<td>373</td>
<td></td>
</tr>
<tr>
<td>F₂ (lbf)</td>
<td>58800</td>
<td>6180</td>
<td>15977</td>
<td>17588</td>
<td>0</td>
<td>0</td>
<td>99</td>
</tr>
</tbody>
</table>

- **F₁ = 28 kip**  Base Shear Direction 1
- **F₂ = 131 kip**  Base Shear Direction 2

**Components and Cladding:**

Snow Loads 7.0

N/A
Vertical Loads Summary (unfactored)

At Top of Wall:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DL (lb/ft)</td>
<td>148</td>
<td>0</td>
<td>0</td>
<td>148</td>
<td>295</td>
</tr>
<tr>
<td>(+)LL (lb/ft)</td>
<td>209</td>
<td>0</td>
<td>0</td>
<td>209</td>
<td>418</td>
</tr>
<tr>
<td>(-)LL (lb/ft)</td>
<td>-541</td>
<td>0</td>
<td>0</td>
<td>-541</td>
<td>-1081</td>
</tr>
</tbody>
</table>

Total DL = 59 kip 8 % of total dead load

At Top of Foundation:

<table>
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<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DL (lb/ft)</td>
<td>955</td>
<td>808</td>
<td>808</td>
<td>955</td>
<td>3525</td>
</tr>
<tr>
<td>(+)LL (lb/ft)</td>
<td>1017</td>
<td>808</td>
<td>808</td>
<td>1017</td>
<td>3648</td>
</tr>
<tr>
<td>(-)LL (lb/ft)</td>
<td>267</td>
<td>808</td>
<td>808</td>
<td>267</td>
<td>2149</td>
</tr>
</tbody>
</table>

Total DL = 705 kip 100 % of total dead load

Earthquake Loads 9.0

Based on OCHA regional data, Mbita is a degree VI (Strong) seismic region. Assume degree VII (Very Strong).

*Ground motion values for San Francisco will be used

Seismic Use Group I

Importance Factor, I: 1.00 (T. 9.1.4)

Ω = 2.5 (T. 9.5.2.2)
R = 2.5 (T. 9.5.2.2)
Cp = 2.25 (T. 9.5.2.2)
W = 705 kip

Site Class: C (Assumed based on surrounding topography and DCP test data) (S. 9.4.1.2.2)

Sx = 66 %g 0.66 g (F. 9.4.1.1a)
Sy = 26 %g 0.26 g (F. 9.4.1.1b)
Fx = 1 (T. 9.4.1.2.4a)
Fy = 1.3 (T. 9.4.1.2.4b)
Sm = 0.66 g (Eq. 9.4.1.2.4-1)
Sm3 = 0.34 g (Eq. 9.4.1.2.4-2)
SDS = 0.44 g (Eq. 9.4.1.2.5-1)
SD1 = 0.23 g (Eq. 9.4.1.2.5-2)
hx = 8.67 ft
hy = 8.67 ft
A1 = 1127.11 ft²
A2 = 1264.89 ft²
A0 = 6764.70 ft²

V = 148.90 kip (Eq. 9.5.4.1) 0.176

FXroof = 0.59 kip (Eq. 9.5.3-1)
FXwall = 7.05 kip (Eq. 9.5.3-1)
### Direction 1

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>10.00</td>
<td>8.67</td>
<td>8.67</td>
<td>2.83</td>
<td>2.83</td>
<td>8.67</td>
<td>8.67</td>
<td>10.00</td>
</tr>
<tr>
<td>A</td>
<td>74.67</td>
<td>63.11</td>
<td>63.11</td>
<td>24.56</td>
<td>24.56</td>
<td>63.11</td>
<td>63.11</td>
<td>74.67</td>
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<tr>
<td>Cw</td>
<td>45.99</td>
<td>34.49</td>
<td>34.49</td>
<td>2.80</td>
<td>2.80</td>
<td>34.49</td>
<td>34.49</td>
<td>45.99</td>
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<td>12</td>
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<td>14</td>
<td>15</td>
<td>16</td>
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<tr>
<td>D</td>
<td>10.00</td>
<td>8.67</td>
<td>8.67</td>
<td>4.33</td>
<td>4.33</td>
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<td>8.67</td>
<td>8.67</td>
<td>8.67</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>A</td>
<td>24.56</td>
<td>75.11</td>
<td>75.11</td>
<td>24.56</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Cw</td>
<td>2.80</td>
<td>41.04</td>
<td>41.04</td>
<td>2.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ C_w = 0.84 \] \hspace{1cm} \text{(Eq. 9.5.5.3.2-3)}

\[ T_{a1} = 0.018 \] \hspace{1cm} \text{(Eq. 9.5.5.3.2-1)}

\[ k = 1.000 \]

\[ w_1 = 9.50 \text{ ft} \]

\[ w_x = 9.50 \text{ ft} \]

\[ h_1 = 9.50 \text{ ft} \]

\[ h_x = 9.50 \text{ ft} \]

\[ C_{vw} = 1.00 \] \hspace{1cm} \text{(Eq. 9.5.5.4-2)}

\[ F_{x1} = 148.90 \text{ kip} \] \hspace{1cm} \text{(Eq. 9.5.5.4-1)}

### Direction 2

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
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<td>D</td>
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<td>8.67</td>
<td>10.00</td>
<td>8.00</td>
<td>8.67</td>
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<td>6.00</td>
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<td>A</td>
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<td>74.67</td>
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</tr>
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<td>45.99</td>
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<td>D</td>
<td>6.00</td>
<td>6.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>40.00</td>
<td>40.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cw</td>
<td>14.64</td>
<td>14.64</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ C_w = 1.14 \] \hspace{1cm} \text{(Eq. 9.5.5.3.2-3)}

\[ T_{a2} = 0.015 \] \hspace{1cm} \text{(Eq. 9.5.5.3.2-1)}

\[ k = 1.000 \]

\[ w_1 = 9.50 \text{ ft} \]

\[ w_x = 9.50 \text{ ft} \]

\[ h_1 = 9.50 \text{ ft} \]

\[ h_x = 9.50 \text{ ft} \]

\[ C_{vw} = 1.00 \] \hspace{1cm} \text{(Eq. 9.5.5.4-2)}

\[ F_{x1} = 148.90 \text{ kip} \] \hspace{1cm} \text{(Eq. 9.5.5.4-1)}

\[ T_0 = 0.10 \]

\[ T_3 = 0.51 \]
Appendix V – Mutation Form

Republic of Kenya

The Registered Land Act, 1963

Mutation Form
(This form is to be completed in triplicate)

Form RL 29

Title No. 04198093

Approximate Area 10.65 Hectares

Registry Map Sheet No.

Registered Proprietors’ Instructions to the Surveyor

1. Present boundaries of parcel are shown on the sketch on page 2.
   (a) (i) The proprietor wishes to subdivide the parcel as shown by the dotted lines on the sketch, or
   (ii) The proprietors wish to change their common boundary as shown by dotted lines on the sketch, or
   (iii) The proprietors wish to partition the parcel as shown by the dotted lines on the sketch, or
   (iv) The proprietor wishes to combine his parcels as shown by the brace on the sketch.

   (b) The new parcel numbers will be: relevant approximate area

   (c) The relevant Letter or Consent to subdivide/partition the parcel is attached.

   (d) The persons interested, and their addresses are:

   Daniel Ongayo Magula

   Bag

They will meet the Surveyor at

on 1/12/15

Please advise the Land Registrar when the mutation is surveyed and Registry Index Map amended.
Signature of registered proprietor(s) present on the land at the time of Survey:

Name:Daniel Onyango

Signature:

To Land Registrar:

Homa-Bay

District

I certify that the survey has been carried out. You may now register the Mutation.

Date:

J. R. R. AGANYO & ASSOCIATES
P. O. Box 11738 - 00400
NAIROBI

DISTRICT / LICENSED SURVEYOR

REGISTERED THIS day of

LAND REGISTRAR

To:
Director of surveys,

Tho’
The District Surveyor

District

This Mutation has now been registered. Please amend the Registry Index Map to conform with the Diagram on Page Three (3) and supply me with a copy of the amended Registry Index Map.

LAND REGISTRAR
Appendix VI – Operation and Maintenance Manual

Operation & Maintenance Manual
Operation

Each Hope School Dormitory building is designed to house 56 children when implementing two-level bunkbeds. The large hall dividing the building into two halves allows for the boys' and girls' bunks to be kept separate from each other. Four 10'×10' single-bed rooms have been included as quarters for the dormitory caretakers. Heating and cooling can be accomplished by mechanical opening and closing of the windows.

Maintenance

- Repaint all steel surfaces every 7 years.
- Replace broken glass as needed.
- Repair any faults found in mortar, bricks, or concrete as soon as possible (See following figures for detailed instruction.)

We recommend that the facility be inspected periodically (perhaps yearly). Seasonal inspections could also be useful in determining the impact of different seasons' weather (rain, wind, humidity, etc.) on the structure. It is also recommended that a single person or committee be responsible for all maintenance and record keeping.

Note: All figures and associated information were taken from the document by Craig Totten (P.E., Editor), “Confined Masonry Workshop Handbook” (2010)
REPAIR WALL CRACKS

IF ANY WALL HAS DIAGONAL CRACKS NOT MORE THAN 1.5mm THICK AND THE CONCRETE IN THE BEAMS AND COLUMNS IS NOT SEVERELY DAMAGED, YOU CAN REPAIR THE WALL IN THE FOLLOWING WAY:

1. REMOVE MORTAR FROM CRACKED JOINTS AND ELIMINATE ALL LOOSE MATERIAL. TRY NOT TO HIT NEARBY BLOCKS.

2. CLEAN CRACKED JOINTS THOROUGHLY WITH PRESSURIZED WATER. LET WATER DRAIN DURING 15 MINUTES.

3. REFILL THE JOINT WITH NEW 1:4 (CEMENT:SAND) MORTAR. APPLY AND COMPACT THE MORTAR UNTIL YOU COMPLETELY FILL THE JOINT.
REPLACEMENT OF DAMAGED BLOCKS

IF ANY WALL HAS BROKEN OR DETERIORATED BLOCKS, YOU CAN REPLACE THEM IN THE FOLLOWING WAY:

1. CAREFULLY REMOVE THE DAMAGED BLOCK. CLEAN UP THE MORTAR THAT REMAINS IN THE HOLE.

2. GET A NEW GOOD QUALITY BLOCK TO REPLACE THE REMOVED BLOCK.

3. THOROUGHLY WET THE BLOCKS IN THE WALL AND ADJACENT TO THE NEW BLOCK AND PLACE NEW 1:4 (CEMENT:SAND) MORTAR ALONG THE EDGES OF THE HOLE. CAREFULLY PLACE THE NEW BLOCK. TO FINISH, FILL ANY REMAINING SPACES AROUND THE NEW BLOCK WITH MORTAR.
REPAIR OF COLUMNS WITH POOR CONCRETE

1. CAREFULLY BREAK ALL DETERIORATED CONCRETE UNTIL YOU GET A ROUGH UNDAMAGED SURFACE.

2. THOROUGHLY CLEAN THE RUSTED BAR WITH A STEEL BRUSH. TO ELIMINATE RESIDUES SOFTLY SANDPAPER THE STEEL.

3. APPLY CEMENT PASTE TO OLD CONCRETE SO THAT NEW CONCRETE WILL EASILY ADHERE.

4. COMPLETELY FILL THE HOLE LEFT BY THE REMOVED CONCRETE WITH 1:4 (CEMENT:SAND) MORTAR. CAREFULLY ALIGN THE SURFACE OF THE NEW CONCRETE WITH THE EXISTING SURFACE. CURE THE NEW CONCRETE FOR 7 DAYS WATERING IT EVERY 8 HOURS.
Appendix VII – Data collected from soil analysis

Table 1. Sieve tray results for soil are shown below

<table>
<thead>
<tr>
<th>Sieve</th>
<th>Opening (in/mm)</th>
<th>Sieve Wt. (g)</th>
<th>Wt. with Sample (g)</th>
<th>Sample Wt (g)</th>
<th>% Retained</th>
<th>Sum % Retained</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-Mar</td>
<td>0.375/9.51</td>
<td>518</td>
<td>564.2</td>
<td>46.2</td>
<td>4.88%</td>
<td>4.88%</td>
<td>95.12%</td>
</tr>
<tr>
<td>#4</td>
<td>0.190/4.75</td>
<td>520</td>
<td>603.4</td>
<td>83.4</td>
<td>8.81%</td>
<td>13.70%</td>
<td>86.30%</td>
</tr>
<tr>
<td>#8</td>
<td>0.092/2.36</td>
<td>491.5</td>
<td>632.8</td>
<td>141.3</td>
<td>14.93%</td>
<td>28.63%</td>
<td>71.37%</td>
</tr>
<tr>
<td>#16</td>
<td>0.046/1.18</td>
<td>427.1</td>
<td>642.9</td>
<td>215.8</td>
<td>22.80%</td>
<td>51.43%</td>
<td>48.57%</td>
</tr>
<tr>
<td>#30</td>
<td>0.023/0.60</td>
<td>407.4</td>
<td>594.1</td>
<td>186.7</td>
<td>19.73%</td>
<td>71.16%</td>
<td>28.84%</td>
</tr>
<tr>
<td>#50</td>
<td>0.018/0.30</td>
<td>337.3</td>
<td>458.5</td>
<td>121.2</td>
<td>12.81%</td>
<td>83.97%</td>
<td>16.03%</td>
</tr>
<tr>
<td>#100</td>
<td>0.006/0.15</td>
<td>317.6</td>
<td>395.9</td>
<td>78.3</td>
<td>8.27%</td>
<td>92.24%</td>
<td>7.76%</td>
</tr>
<tr>
<td>#200</td>
<td>0.0029/0.074</td>
<td>335.6</td>
<td>378.9</td>
<td>43.3</td>
<td>4.58%</td>
<td>96.82%</td>
<td>3.18%</td>
</tr>
<tr>
<td>Pan</td>
<td>N/A</td>
<td>381.8</td>
<td>411.9</td>
<td>30.1</td>
<td>3.18%</td>
<td>100.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>3736.3</td>
<td>4682.6</td>
<td>946.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Shows the DCP data taken at Hope School: South Hole -0.441866°, 34.214516°
Figure 2. Shows DCP data taken at Hope School: North Hole -0.441867°, 34.214519°
Appendix VIII – Education Plan

Education Plan
What are Earthquakes?

The world has numerous moving plates that are called tectonic plates. An earthquake is caused by a sudden slip on a fault, where a fault is a section between two tectonic plates. The tectonic plates are always slowly moving, but they get stuck at their edges due to friction. When the stress on the edge overcomes the friction, there is an earthquake that releases energy in waves that travel through the earth's crust and cause the shaking, bending, expanding, and contracting of buildings. This bends the walls, which can cause them break if they are not built properly. For reference, known plates are shown below.
The closer you are to a fault the more likely you are to experiencing a larger magnitude earthquake, this is due to the compression of the ground which can lessen the intensity of an earthquake over larger distances. Most earthquakes have shown to occur in relatively the same location due to fault movements. The three primary locations for earthquakes are:

1. The **circum-Pacific seismic belt**, or the “**Ring of Fire**,” which loops around the Pacific ocean taking in the South American coast, Central America, the West coast of America and on to Japan, the Philippines the South Pacific Islands and New Zealand. **81%** of the world’s earthquakes occur here due to the number of converging plates and young, growing mountains and deep ocean trenches.

2. The **Alpide**, which extends from Java to Sumatra through the Himalayas, the Mediterranean, and out into the Atlantic. This area accounts for **17%** of the world’s earthquakes and also some of the most destructive in history.

3. The **mid-Atlantic Ridge**, which is a fracture zone along the bottom of the Atlantic Ocean where molten mantle comes to the surface and creates new crust.

Recent earthquakes in Nepal and Haiti, both of which are on fault lines, can depict the dangers of earthquakes.
Haiti
Haiti located on the Caribbean fault experience an earthquake of magnitude 7.0 on January 12th 2010. The death toll was estimated to be about 160,000 people, destroying roughly 250,000 homes and 30,000 government buildings. Haiti has not enforced a building code in the past and buildings had not been built to resist seismic activity. (Pallardy, 2010)

Nepal
Located on the Indianan Plate experienced an earthquake of magnitude 7.8 in April 2015. Roughly 8,900 were estimated to have died from the earthquake, and thousands of homes were destroyed. Nepal has strong building codes however they are poorly enforced. (April 2015 Nepal earthquake, 2016)
While Kenya is not located on a fault line, it is still known to have moderate activity. This means that buildings that are not built properly have a chance of falling. To ensure that the building does not fall, a building technique called confined masonry will be used.

What to do during and after an earthquake.

Earthquakes can happen at any time and can be dangerous if the correct procedures are not followed. Most injuries related to earthquakes are due to falling debris or collapsing buildings and not from the actual shaking.

If an earthquake does occur what should be done depends on the location. When inside a building, getting away from windows and glass and going under a desk or table would be best. If a desk or table cannot be reached immediately other furniture, such as beds, can also be used for some cover. In the case that there is no cover available it is recommended to fall to floor and cover your neck and head with whatever is available. Leaving the building during an earthquake is extremely dangerous. Since the ground will be shaking it will be likely that exiting will be impossible because you will be unable to stand. Also, if many people are attempting to exit at the same time it can cause people to be waiting in an unprotected area.

When outside of a building it is best to move away from any structures and fall to the ground and cover your head and neck. If getting away from buildings is not possible then it may be necessary to go inside a building to avoid debris. In the case of needing to go into a building, the same procedures as before should be applied. (Security)

After the earthquake is over look for a way to get out, if it is unsafe to get out wait and try to notify people where you are at. Listen to local reports from officials about information and further instructions. Be prepared for smaller earthquakes called aftershocks that frequently happen after a larger earthquake. To make the chances of injury from earthquakes small, these...
procedures should be practiced so that everyone is prepared. Lastly, the building should be inspected for any damage to make sure that it is still safe to use. (Ready)

Technology

What is confined masonry?
Confined masonry uses the same materials as you are used to just in different ways. Typically, concrete frame buildings with masonry infills perform very poorly when subjected to strong ground shaking, as do buildings of unreinforced brick masonry. An alternative construction technology, using the same construction materials, is CONFINED MASONRY construction. Confined masonry is a construction system where the masonry walls are built first, and the concrete columns and beams are poured in afterwards to enclose (confine) the wall. Masonry is used for housing because of its low material cost and simplicity of construction. Masonry is a sturdy and durable material for wind and vertical loads that houses must routinely withstand, however masonry does not withstand the loads present in earthquakes.

Confined masonry construction consists of masonry walls (made of concrete blocks) and horizontal and vertical-confining members built on all four sides of a masonry wall panel. The confined wall’s Vertical members are called tie-columns and horizontal members are called tie beams. (National Information Centre of Earthquake Engineering).

Confining elements (ties)

Confining the walls is like holding a pile of books together with a string; they can still move but they will not fall apart.

Horizontal ties (tie-beam) and vertical ties (tie-column).

Figure 4. Purpose of confinement walls

Why do we need confined masonry?
A confined block masonry earthquake-resistant structure is designed and constructed so the walls are able to resist earthquakes (AIDG, 2010). Designing a structure this way helps transmit the
loads from the structure to the ground in the event of an earthquake. Very few cases have found to actually collapse during high seismic activity. To develop sturdy confined masonry buildings the following criteria must be met. These requirements allow for the building to sway evenly during an earthquake, meaning there is no weak point in the structure. One weak point might cause a wall to collapse, destroying the joint action of all the walls. Since all the walls rely on each other for their joint action, if one wall fails during an earthquake all walls will fail. You might notice some of these characteristics in your building.

**What are the characteristics of confined masonry?**
Overall, the structure must be simple and symmetrical, with the load bearing walls confined by reinforced concrete columns and beams.

Some of the characteristics of a well-designed and safe structure include:
- Many confined walls in both directions
- Columns and beams without air pockets in concrete
- Well-located and well-proportioned door and window openings
- Uniform thickness of mortar joints between blocks
- A symmetrical structure

![Figure 5. Earthquake Resistant Structure](image)
Some of the characteristics to avoid include:

- Irregular shape of building
- Columns and beams with voids in the concrete
- Exposed reinforcement bars
- Many openings in roof slab
- Cantilevers
- Walls without columns
- Footing over loose soil
- No vertical continuity of openings
- Excessively long walls
- Many openings in the walls
- Insufficient number of resistant walls in both directions
- Non-uniform joints

A visual representation of some of these considerations is provided on the following pages.
If you want your house to resist earthquakes successfully, your design must have a good shape and an adequate distribution of walls.

Yes!
Build the block walls first then pour the columns and floors directly against the blocks.

No

Inadequate opening proportions

Yes!
Openings weaken the walls. Do not make openings larger than half the length of the wall. (Distance A must be less than half of distance L.)

A

Adequate opening proportions

Figure 7. Wall Distributions

Figure 8. Wall Openings
Figure 9. Number of Confined Walls

Figure 10. Symmetry of Structure
Figure 11. Proportionality

Figure 12. Beam and Column Spacing
Water, Sanitation and Hygiene Standards
(Summary of the World Health Organization publication "Water, sanitation and hygiene standards for schools in low-cost settings" (2009) edited by John Adams, Jamie Bartram, Yves Chartier, and Jackie Sims.)

Introduction
Diseases related to inadequate water, sanitation and hygiene are a tremendous burden on all those who they affect. Health conditions in educational facilities are of particular importance because of the amount of close contact between individuals, and the crucial role regular attendance plays in the success of the facility. A student’s ability to learn as well as an educator’s ability to teach can be affected by unsafe conditions in many ways. Those who suffer from disease not only have to endure the illness, but also risk missing school days. It is also important to recognize that different types of students have different needs, which all must be adequately provided for. For these reasons, the World Health Organization has identified 8 guidelines to outline safe environmental practices that can be applied to schools and dormitories.

Importance of Sanitation and Hygiene in Schools

- Disease Prevention
  - Schools with poor water, sanitation and hygiene conditions are high-risk environments for both the students and staff because of the intense levels of person-to-person contact. Following guidelines to help strengthen the water supply, sanitation and hygiene measures will greatly reduce these risks.

- Learning
  - Poor health conditions in the classroom presents challenges to both the students and educators. When teachers are ill, impaired performance and increased absenteeism directly lessens the learning opportunities. The children in the area are susceptible to many diseases and infections that can lead to impaired learning ability and many absences.

- Gender and Disability
  - Girls, boys, and children with disabilities can be affected in different ways by inadequate water, sanitation and hygiene conditions in schools. This can contribute to unequal learning opportunities for those more negatively impacted. Examples include
    - Toilets that are inaccessible can lead a disabled child to abstain from food and drink all day in order to avoid needing to use the toilet.
    - Lack of facilities for menstrual hygiene can cause every girl to miss days at school once they reach puberty.
    - All of these situations can cause students to drop out of schooling altogether, for reasons that have nothing to do with their education itself.

- The Community and Life-Long Skills
  - Children and staff who have adequate environmental conditions at school are able to both integrate this hygiene education into their daily lives and can be effective
messengers for their families and the community as a whole. These good habits are skills they are able to maintain as adults and pass on to their own children.

**Everyone Can Be Involved**

Each and every person in the facility can be an active participant in promoting good hygiene behavior. Here are some ways to support the effort.

- **Students**
  - Comply with all procedures regarding water, sanitation and hygiene
  - Observe appropriate hygiene measures
  - Participate in the process of developing hygiene measures
  - Actively participate in the cleaning and maintenance of the facility

- **Student’s Families**
  - Encourage the students to comply with all procedures to develop positive hygiene behaviors
  - Actively participate in and support in any parent-teacher involvement opportunities

- **Educators**
  - Monitor the state and use of the water, sanitation and hygiene at the school
  - Organize the maintenance and care of the building
  - Encourage students to practice positive hygiene behaviors both at school and at home through hygiene education

- **School Directors or Head Teachers**
  - Organize goals for water, sanitation and hygiene at the facility
  - Create conditions in which staff are motivated to achieve and maintain these goals
  - Develop and enforce rules when required
  - Encourage parent-teacher interactions

**Guidelines**

It is understandable that it is not always possible to perfectly adhere to all of the guidelines listed below. It is also important to realize that the more guidelines maintained, the safer the health environment provided will be for all who occupy the school.

1. **Water Quality** - Water for drinking, cooking, personal hygiene, cleaning and laundry is safe for the purpose intended.
2. **Water Quantity** - Sufficient water is available at all times for drinking, personal hygiene, food preparation, cleaning and laundry
3. **Water Facilities and Access to Water** – Sufficient water-collection points and water-use facilities are available in the school to allow convenient access to, and use of, water for drinking, personal hygiene, food preparation, cleaning and laundry.
4. **Hygiene Promotion** – Correct use and maintenance of water and sanitation facilities is ensured through sustained hygiene promotion. Water and sanitation facilities are used as resources for improved hygiene behaviors.

5. **Toilets** – Sufficient, accessible, private, secure, clean and culturally appropriate toilets are provided for students and staff.

6. **Control of Vector-Born Disease** – Students, staff and visitors are protected from disease vectors.

7. **Cleaning and Waste Disposal** – The school environment is kept clean and safe.

8. **Food Storage and Preparation** – Food for students and staff is stored and prepared so as to minimize the risk of disease transmission.
Bibliography


Appendix IX – Tool to Calculate Foundation Material Quantities

Foundation Calculator

clear,clc;

Total Wall Length
Outer wall length (ft)

Outer_Lengt h = 70.5;
% Outer wall width (ft)
Outer_Width = 30.33;
% Inner wall sections, parallel to outer wall width (ft)
% Inner_Width = 30.33-6.83;
% Inner wall sections, parallel to outer wall length (ft)
% Inner_Length = 9.5;
% Total wall length (ft)
% Wall_Lengt h = 2*(Outer_Lengt h+Outer_Width)+6*Inner_Width+4*Inner_Length;
% Total perimeter wall (ft)
Wall_Lengt h = 2*(Outer_Lengt h+Outer_Width);

Concrete Strip Footing
Height of strip (ft)

Strip_Height = 1;
% Width of strip (ft)
Strip_Width = 1.5;
% Length of strip (ft)
Strip_Lengt h = Wall_Lengt h;
% Strip volume (ft^3)
Strip_Volume = Strip_Height * Strip_Width * Strip_Lengt h;
% Number of longitudinal rebar (12 mm) (#)
Bar_Long = 3;
% Bar Length (ft)
Bar_Length = 40;
% Total number of bars (#)
Twelve_Bar_Num = Bar_Long*Wall_Lengt h/Bar_Length;
% Cross-sectional area of #4 (12mm) rebar (ft^2)
Bar_Area = 0.001389;
% Rebar volume (ft^3)
Bar_Volume = Bar_Long*Bar_Area*Wall_Lengt h;
% Concrete volume (ft^3)
Concrete_Footing_Volume = Strip_Volume- Bar_Volume;

Masonry
Average height of masonry foundation BG (ft)
BG Height = 2.5;
% Average height of masonry foundation AG (ft)
AG Height = 1;
% Total height of masonry (ft)
Masonry Height = BG Height + AG Height;
% Width of masonry block (ft)
Block_Width = 8/12;
% Height of masonry block (ft)
Block_Height = 0.5;
% Length of masonry block (ft)
Block_Length = 1;
% Volume of masonry block (ft^3)
Block_Volume = Block_Length * Block_Width * Block_Height;
% Total number of columns (#)
Column_Num = 50;
% Number of perimeter columns (ft)
Column_Num = 24;
% Width of column (ft)
Column_Width = 0.666;
% Length of column (ft)
Column_Length = 0.666;
% Total volume of column in foundation (ft^3)
Column_Volume = Column_Num * Column_Width * Column_Length * Masonry_Height;
% Total volume of masonry, assuming continuous block (ft^3)
Masonry_Volume = Masonry_Height * Block_Width * Wall_Length - Column_Volume;
% Thickness of mortar (ft)
Mortar_Thickness = 0.03125;
% Volume of block with mortar (ft^3)
Block_Mortar_Volume =
( (Block_Length + Mortar_Thickness) * Block_Width * (Block_Height + Mortar_Thickness) );
% Total number of blocks required (#)
Block_Num = Masonry_Volume / Block_Mortar_Volume;
% Total volume of mortar required (ft^3)
Mortar_Volume = Block_Num * (Block_Mortar_Volume - Block_Volume);

Columns (Within Foundation)
Column_Num, Column_Width, Column_Length, Column_Volume already defined Length of Stirrup (ft)

Stirrup_Length = 1.65;
% Spacing of Stirrups (ft)
Stirrup_Spacing = 0.5;
% Number of stirrups per column (#)
Stirrup_Column = Masonry_Height / Stirrup_Spacing;
% Total number of Stirrups (#)
Stirrup_Num = Stirrup_Column * Column_Num
% Total length of Stirrups (ft)
Stirrup_Total_Length = Stirrup_Length*Stirrup_Num;
% Total number of 8 mm bar required (#)
Eight_Bar_Num = Stirrup_Total_Length/Bar_Length;
% Cross-sectional area of 8 mm bar (ft^2)
Eight_Bar_Area = 0.000541;
% Total volume of 8 mm bar required (ft^3)
Eight_Bar_Volume = Eight_Bar_Area*Stirrup_Total_Length;
% Total volume of 10 mm (#3-4) bar within columns (ft^3)
Ten_Bar_Volume = 4*Column_Num*Masonry_Height*Bar_Area;
% Total number of #3-4 (10 mm) bar required for columns (#)
Ten_Bar_Num = 4*Column_Num;
% Total volume of bar within all columns (ft^3)
Bar_Column_Volume = Eight_Bar_Volume+Ten_Bar_Volume;
% Total concrete volume within columns (ft^3)
Concrete_Column_Volume = Column_Volume-Bar_Column_Volume;

Plinth Beam
Total Volume of Plinth (ft^3)
Plinth_Volume = Column_Width*Column_Length*Wall_Length;
% Total length of #3-4 bar (10 mm) (ft)
Plinth_Bar_Length = 4*Wall_Length;
% Total #3-4 bar (#)
Plinth_Bar_Num = Plinth_Bar_Length/20;
% Total stirrups in plinth beam (3 inch spacing for two feet at columns (#)
Plinth_Stirrup_Num = Wall_Length/0.5+8*Column_Num
% Total length 8 mm bar required (ft)
Plinth_Stirrup_Length = Plinth_Stirrup_Num*Stirrup_Length;
% Total 8 mm bar required (#)
Plinth_Eight_Num = Plinth_Stirrup_Length/20;
% Plinth Concrete Volume (ft^3)
Concrete_Plinth_Volume = Plinth_Volume;

Concrete and Mortar
Assume a mix of 1:2:3 for concrete, 1:5 for mortar Total concrete required for foundation (ft^3)
Concrete_Total = Concrete_Column_Volume+Concrete_Footing_Volume+Concrete_Plinth_Volume;
% Cement Volume per bag (ft^3)
Cement_Volume_Bag = 1.17;
% Total bags of cement required (#)
Cement_Bags_Concrete = Concrete_Total/6/Cement_Volume_Bag;
% Volume of sand required (ft^3)
Sand_Volume_Concrete = Concrete_Total/3;
% Volume of 1/2" aggregate required (ft^3)
Aggregate_Volume_Concrete = Concrete_Total/2;
% Volume of cement for mortar (ft^3)
Cement_Bags_Mortar = Mortar_Volume/6/Cement_Volume_Bag;
% Volume of sand for mortar (ft^3)
    Sand_Volume_Mortar = Mortar_Volume*5/6;
% Total Sand Volume (ft^3)
    Sand_Volume = Sand_Volume_Mortar+Sand_Volume_Concrete;
% Volume of water required for concrete (3/4 part mix) (ft^3)
    Water_Volume_Concrete = 0.75/6.75*Concrete_Total;
% Volume of water required for concrete (3/4 part mix) (ft^3)
    Water_Volume_Mortar = 0.75/6.75*Mortar_Volume;
% Total Bags Cement (#)
    Cement_Bags = Cement_Bags_Concrete+Cement_Bags_Mortar;
% Total Water Volume (ft^3)
    Water_Volume = Water_Volume_Concrete+Water_Volume_Mortar;
### Appendix X – 524 Report Review

#### Chapter Name
University of Wyoming

#### Project Type
School Dormitory, Structures

#### Project community location
Kenya, Usare

#### Date of call with chapter
February 5, 2016

#### EWB-USA Project Manager
Chris Brandewie

#### Chapter attendees on the call
David Mukai, Brett Prettyman, Adam Block

#### PM Decision
Required Follow-up Yes will discuss

#### Project Submittal Rating
2 ok

### Contacts:

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Name</th>
<th>Email</th>
<th>Phone</th>
<th>Chair Org.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Lead</td>
<td>Adam Block</td>
<td><a href="mailto:ablock2@uwyo.edu">ablock2@uwyo.edu</a></td>
<td>(307) 287-1454</td>
<td>Univ</td>
</tr>
<tr>
<td>Additional Project Lead</td>
<td>Brett Prettyman</td>
<td><a href="mailto:bprettym@uwyo.edu">bprettym@uwyo.edu</a></td>
<td>(605) 890-9863</td>
<td>Univ</td>
</tr>
<tr>
<td>President</td>
<td>John Plunkert</td>
<td><a href="mailto:jplunkert@uwyo.edu">jplunkert@uwyo.edu</a></td>
<td>(720) 255-5715</td>
<td>Univ</td>
</tr>
<tr>
<td>Responsible Engineer in Charge</td>
<td>Duncan Kline</td>
<td><a href="mailto:dak@milonebeltonabel.com">dak@milonebeltonabel.com</a></td>
<td>(307) 742-4810</td>
<td>Mak (Uni)</td>
</tr>
<tr>
<td>Additional Responsible Engineer in Charge</td>
<td>Erm Radosevich</td>
<td><a href="mailto:ermr@milonebeltonabel.com">ermr@milonebeltonabel.com</a></td>
<td>(307) 343-0062</td>
<td>Mak (Uni)</td>
</tr>
<tr>
<td>Traveling Mentor</td>
<td>Erm Radosevich</td>
<td><a href="mailto:ermr@milonebeltonabel.com">ermr@milonebeltonabel.com</a></td>
<td>(307) 343-0062</td>
<td>Mak</td>
</tr>
<tr>
<td>Faculty Advisor (if applicable)</td>
<td>David Mukai</td>
<td><a href="mailto:dmu@uwyo.edu">dmu@uwyo.edu</a></td>
<td>(307) 760-6915</td>
<td>Univ</td>
</tr>
<tr>
<td>Planning, Monitoring, Evaluation and Learning (PMEL) Lead</td>
<td>Traci Reusser</td>
<td><a href="mailto:treusser@uwyo.edu">treusser@uwyo.edu</a></td>
<td>(307) 460-8795</td>
<td>Univ</td>
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### PE Comments:

<table>
<thead>
<tr>
<th>No.</th>
<th>EWB-USA PM Comment</th>
<th>Chapter Response</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Foundation Designs:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>What is the status?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Estimated Completion Date?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Please refresh the reader of your soils investigation when get to the 524/525 and the preapproved plan from the Min of Ed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Design of building was being worked out to find the load.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil characterization was forgotten. Will include in 525.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>You have 10 members budgeted for travel – We limit our trips size to 8. Is this two implementation groups overlapping? This is a large implementation so if you could convince me, but I will need a detailed construction schedule showing what each person will be doing. Also it would be recommended to have 2 traveling mentor if such a large groups goes or if overlapping.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 periods where ppl will be cycling in.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A couple of the members will be spending the entire summer, but there will be many others needed for certain parts of the build.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Have that to you by next week.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Your budget has some line items that I could not find in the dwgs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. #2,3, nor4 Rebar (they are there they are just not labeled)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Ballasts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Type of roofing (tin corrugated??)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. 22’ or 30’4” truss</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Also Table 1 is the contacts table, so this should be table 2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Going to be involved in the fill process. The excavate then the backfill is call ballast.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Perlins will ideally be steel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Note on pg 13 your welding these together. Still work out that detail.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. 30”4”</td>
<td></td>
</tr>
</tbody>
</table>

### Part II

<p>| 4   | Three month Implementation |
|     | Is there a schedule that outlines what Chp and community will each do? |
|     | Phase 2: Be specific in you TAC presentation that this design will be |</p>
<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Fig 1</td>
<td>The Upper and Lower school labels should be on Page 2 of your Dwg Set.</td>
</tr>
<tr>
<td>6</td>
<td>Sec 2.1</td>
<td>Double Door - Not consistent with dwgs. Moving to single doors.</td>
</tr>
<tr>
<td>7</td>
<td>Sec 3.0</td>
<td>This is a great accomplishment! When you have the completed Mutation Form please include in Appendix of your 525 Pre-Implementation Report.</td>
</tr>
<tr>
<td>8</td>
<td>Sec 4.0</td>
<td>Generally the Const Plan is very detailed. A chart with dates and dependencies could be developed that would facilitate a more smooth implementation. The question that remains is when is your chapter going to be there? This could fit nicely into a chart. Please define “we” when saying “we will select a contactor and negotiate price.” &amp; “we agree on work done and payment.” The community should be a part of this decision, and they will likely be able to better negotiate prices. Im a geotech – please use the term “earthwork” not dirt work. Is Eric Kerah going to be the In-country Project manager that is referenced in the budget? State that more clearly. Before you compact the gravel you Certain phases of the construction will have inspections and then portions of payments. Will know more when we go to the biding process. “We” is EWB and school</td>
</tr>
<tr>
<td>No.</td>
<td>Section</td>
<td>Comment</td>
</tr>
<tr>
<td>-----</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>9</td>
<td>Sec 5.0</td>
<td>I think it is ok to include the materials list in the Trip Budget, but this is a large project with lots of components. You should probably have a separate table in this section, and then just give material totals in the budget section. This might make preparing the BQ easier. This should probably be in section 5 of the report as opposed to an appendix. Also I think a bit of text explaining where your unit prices came from would really add to this section.</td>
</tr>
<tr>
<td>10</td>
<td>Sec 6</td>
<td>In your 525 you should have some text as to the development of the O&amp;M and identify key persons in-country that will likely carry out these tasks. Ok maybe reference 7.2 Just had a peek at App IV: You discuss Hygiene this sounds more like App V Education. In the part where you suggest a periodic inspection of the building – include some language to inspect after a seismic event.</td>
</tr>
<tr>
<td>11</td>
<td>Sec 7.2</td>
<td>What is the seismic event or lateral acceleration that this structure is designed for?</td>
</tr>
</tbody>
</table>

**Chapter Questions:**

<table>
<thead>
<tr>
<th>No.</th>
<th>Chapter Question</th>
<th>EWB-USA PM Response</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Have a lot of things to pull together by deadline</th>
<th>Text, Call or email.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam or Brett where thinking we might have one individual in the country.</td>
<td>Min 2ppl, I must be a mentor, both would need qualify HSO.</td>
</tr>
<tr>
<td>Is there any requirement for reporting</td>
<td></td>
</tr>
<tr>
<td>Bid docs will be sent out on March 18th. Available material might</td>
<td></td>
</tr>
<tr>
<td>Are there any forms for contracting?</td>
<td>No but will reach out to PSP for help or LL on their recent trip to Nicaragua.</td>
</tr>
</tbody>
</table>
Appendix XI – Application to install connection to city water supply

CONSUMER AGREEMENT

KENNEDY ONYANGO NO. 22175917 P.O Box 237 MBETTA

Agree to abide by the water services providers rules, the water Act 2002 and the special conditions set out below.

SPECIAL CONDITIONS OF THE WATER SUPPLY

1. The water undertakers Rules and the water Act 2002 shall be deemed to be incorporated in and to form part of these conditions of supply.

2. Execution of the approved works will as rule be dealt with in the order of application date priority.

3. All charges shall be on demand.

4. If any account is overdue the water supply may be cut off under the provision of the water rules, Water Act 2002 and proceeding taken to recover the charges due.

5. Any changes in the charges are notified in the Gazette and in addition details they shall be sent to each consumer with the monthly account proceedings such charges.

6. The water undertaker shall have the right forthwith to terminate the agreement by the consumer of the condition of supply, but without prejudice to any antecedent right against the consumer including the right to take proceedings.

7. a) No consumer shall use, or permit to be used, any water supplied in pursuance of an application made by him under regulation 3 of these regulation except for such as specified by him in the application.

b) No consumer shall convey or permit to be conveyed by any means whatever for use outside his plot, for sale, any water supplied to him by the water undertaker.
The consumer shall deposit Kshs.________ which shall be retained by the water undertaker for the period during which the consumer is supplied with water.

The consumer will meet all charges in respect of water supply without a written authority from undertakers. Should this happen the undertaker will have every right to take legal action and demand financial compensation for the loss at rates determined by himself.

No consumer is allowed to interfere with the water lines for whatever reasons.

The accountant and the connection number is not transferable to any other person or party and should the applicant be interested in discontinuing the service he must inform the undertaker in writing failure to which shall be assumed he is enjoying the services to which he must pay.

The consumer is to ensure that the meters are properly taken care of no tampered with and are housed in lockable meters chambers.

Approved water kiosk:

The meter must always be running and should it stop for whatever reason, the sale of water must be stopped forthwith. Failure to which the undertaker will have every right to either take legal actions, estimate the quantity of water lost and demand financial compensation, disconnect the connection or both.

The applicant must ensure good personal hygiene practice and conform to the requirement of the public health act, in addition he will be expected to give an organisation letter from Government Public Health Officer allowing him to handle water which is in this case is considered just like food and beverage.

No applicant in this category will be allowed to sell water to more than 20 households or sell more than 25m3 per day.

____________________ hereby confirm that I have read and understood this agreement and is ready and willing to abide by them.

Agreement made the day________ of______________ between South Nyanza Services Limited of the one part and____________ of the other part.

South Nyanza Water Service Limited, the water supply undertaker is defined by the act part 1, Clause 2(1) as Water Service Provider. The South Nyanza Water is providing water service under and in accordance with an agreement with the Lake Victoria South Water Services Board (LVWSWB) within whose limits of supply are provided.
Witness where of the parties thereto have caused this agreement to be executed the day and first before written:

Binding signature / Seal of customer

In the presence of:

Name: DANIEL ORWA

Address: 327 MBITA

Signature:  

Date:

Binding signature / Seal of service provider

In the presence of:

Name:

Address:

Signature:  

Date:

OFFICIAL USE

No of connection  

Account No  

Meter No:  

Meter size:  

SIL No:  

Meter Book No:  

Initial Meter Reading:  

Deposit Ledger:  

Deposit Receipt No:  

Works Receipt No:  

Date water turned on:

Remarks:

Approved by:  

Signature:  

Date:  

Technical Manager / Commercial Manager.
### NEW CONNECTION COST ESTIMATE

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>Size</th>
<th>Quantity</th>
<th>Unit</th>
<th>Rate</th>
<th>Total</th>
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<td>PVC pipes</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>Tee / Sandie clamp</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Gate valve</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>Union</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Bond</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Socket / adaptor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Socket</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Elbow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Thread seal</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>10</td>
<td>Solvent</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Tap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Reducing socket</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Unskilled labour provision</td>
<td></td>
<td></td>
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**GRAND TOTAL**

20% of Grand total

### OFFICE DUES

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<thead>
<tr>
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<th>Total</th>
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<td>Survey fee</td>
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</tr>
<tr>
<td>2</td>
<td>Registration</td>
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</tr>
<tr>
<td>3</td>
<td>Decent</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Skilled lab</td>
<td></td>
</tr>
</tbody>
</table>

Total 20% of Grand total

Prepared by: __________________________ Confirmed by: __________________________

Signature: __________________________ Date: __________________________

**SCHEME MANAGER**

Signature: __________________________ Date: __________________________

**TECHNICAL MANAGER**
Appendix XII – Electricity Installation Report provided by Hope School