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THE ROLE OF NGOS IN SUSTAINABLE DEVELOPMENT: A CASE STUDY OF ENGINEERS WITHOUT BORDERS INCREASING ENERGY CAPACITY IN A RURAL SCHOOL IN TANZANIA

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Engineers without Borders (EWB), USA, is a non-profit organization that focuses on utilizing sustainable solutions to solve human problems. They work by partnering with local communities to identify needs and together find sustainable solutions. Through this model, Northern Illinois University's (NIU) EWB chapter has been involved in working with a local grassroots NGO in Tanzania to provide sustainable energy solutions for a rural school. Specifically, NIU's EWB chapter partnered with UMABU, a local NGO in Musoma area, and Tanzania Development Support, a non-profit based in USA, to design and implement solar lighting for Nyegina Secondary School and assess further sustainable energy needs for the school and the village. Nyegina Secondary School is home to about 560 students, and are all boarders. Since 2009, NIU – EWB students, and professional mentors have designed and installed solar lighting in ten classrooms and a solar thermal water heating system for the kitchen. This has enabled the students to be able to study at night. Furthermore, the solar thermal system has enabled the school to save some money for heating costs in their kitchen. This paper will describe unique collaborative effort between engineering students, professionals, faculty and the local community to create sustainable energy solutions.

Keywords: *NGOs, sustainability, energy, developing countries*

Introduction

The idea of creating sustainable engineering solutions for developing countries started with a visit by Prof. Bernard Amadei of the University of Colorado-Boulder to a small community in San Pablo, Belize. This visit, in the year 2000, at the invitation of the Ministry of Agriculture, was to assess water and sanitation conditions. He quickly learnt the community did not have the skills to resolve the severe conditions of unclean water and poor sanitation. He later returned with a group of students and a civil engineering expert; and together with the community, they installed a clean water system powered by a water fall (EWB-USA, 2016). Two years later, through the efforts of Prof. Amadei and the University of Colorado-Boulder, Engineers Without Borders, USA, was incorporated as a non-profit organization with the University registering the first student chapter. To date there over 16,000 members, more than 100 student chapter and a little over 35 professional chapters distributed all over the 50 states. Nearly all student chapters work with a professional chapter as their mentor.

EWB-USA projects are mostly in developing countries. They work by partnering with local communities to identify a problem. Through this partnership, a solution is determined. The

solution has to be culturally appreciate and sustainable. Typically, a chapter will remain in a community for 5 years, continuing to build on the project, and identifying other projects.

Funding for all the EWB projects are obtained mainly through charitable donations. The fact that EWB is registered by the Internal Revenue Service as 503(c) organization allows individuals or companies to make tax-deductible contributions. This has enabled the organization and its chapters to execute 686 community driven projects in over 40 countries. This has impacted the lives of over 2.5 million people.

Tanzania Project

Background

The project was to design and implement solar lighting for Nyegina Secondary School (NSS), assess further sustainable energy needs for the school and the village, and seek affordable solutions for future implementation. Nyegina village is located 15 miles south of Musoma, a city in the NW part of Tanzania, about 1 hour from the Kenya-Tanzania border (figure 1). NSS is home to about 560 students, and are all boarders. About 2/3 of the students are girls. Based on previous successful involvements in similar projects, EWB-NIU proposed to work with a Tanzania study abroad

student group, Tanzania Development Support (a non-profit registered in the US) and UMABU (a local *Figure 1* NGO) to provide sustainable energy solutions.

Eight students from the NIU Study Abroad



Program and 12 volunteers with Tanzania Development Support (TDS - a 501c3 NGO registered in Illinois) partnered in summer 2009 with the Bukwaya Development Association (UMABU—a grassroots NGO in Musoma, Tanzania) to help construct a new girls boarding facility for the Nyegina Secondary School (NSS). This experiential learning was part of an undergraduate and graduate course on the Role of NGOs in Development. Funds for the construction were raised by

TDS, students and volunteers provided unskilled labor, and UMABU served as project manager and provided local skilled labor and other operational support. Through this project, the NIU study abroad group identified specific areas requiring the involvement of engineers. These included the development of sustainable energy for pumping water and lighting classrooms and dormitories that would complement the unreliable electricity supplied from the national Tanzania grid. The NIU student chapter of Engineers Without Borders (itself an NGO) proposed to participate in the NSS project over the next five years by designing and developing sustainable green energy technology for the school and surrounding villages.

Implementation

Throughout spring 2010, EWB-NIU students designed a solar lighting systems with the help of a local professional and the author. The design included calculations to size the solar photovoltaic (PV) modules and battery storage systems bases on the solar and meteorology data available from NASA.

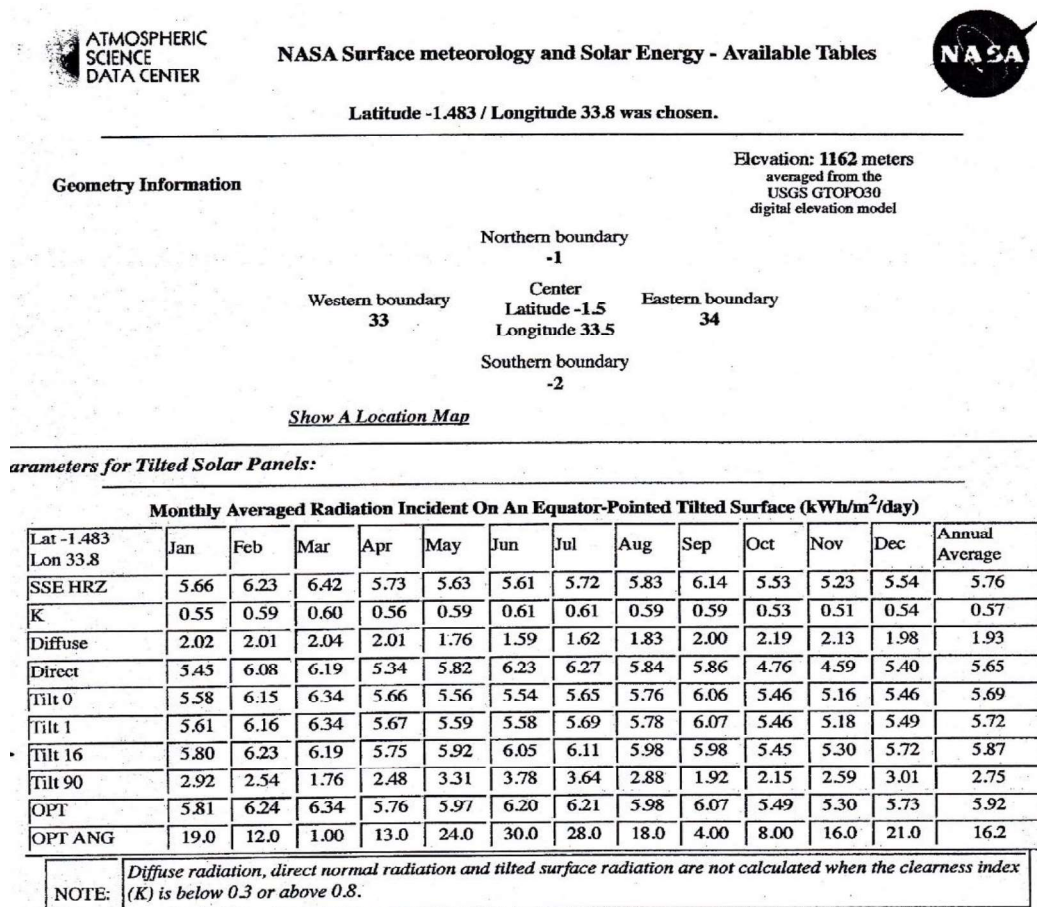
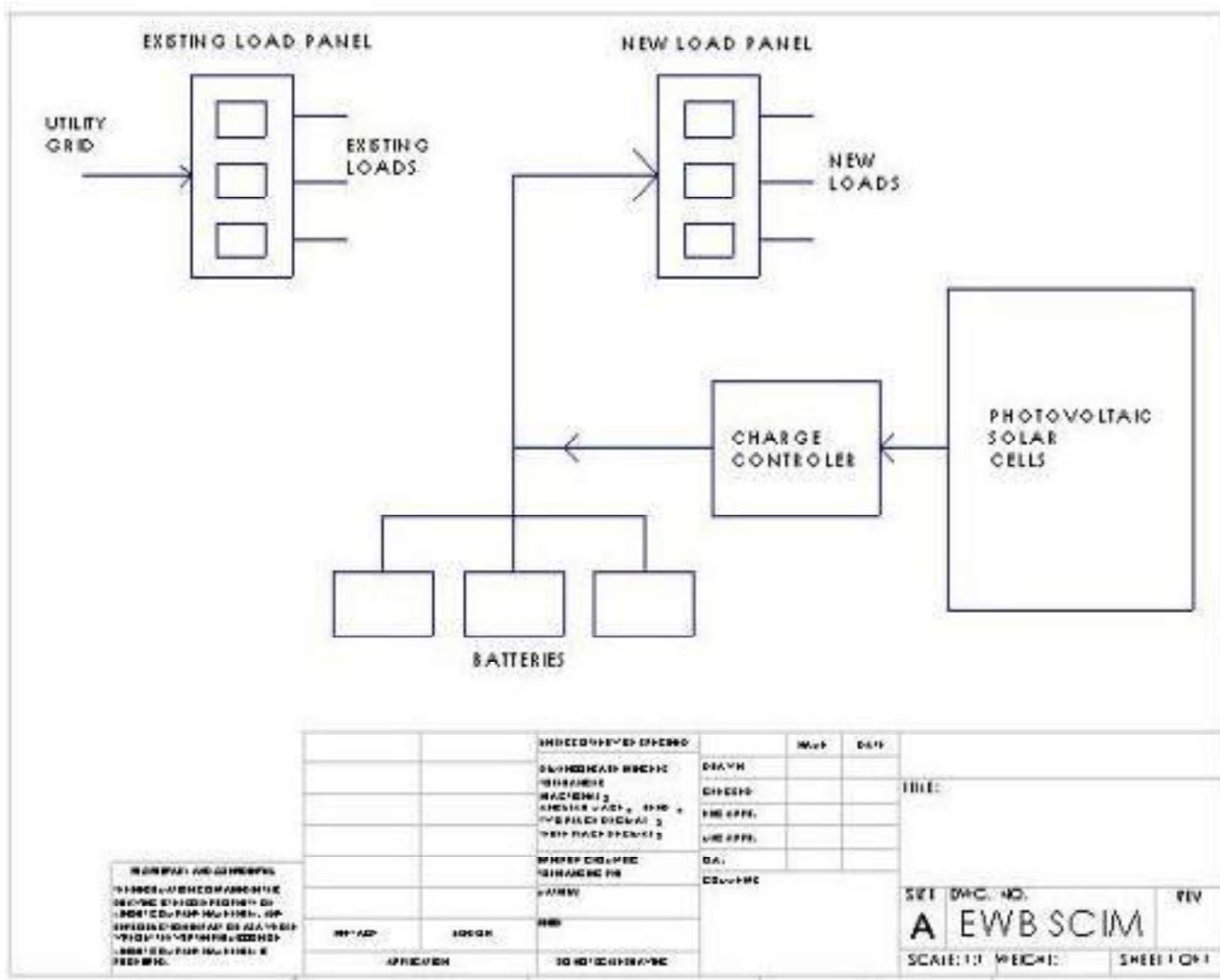
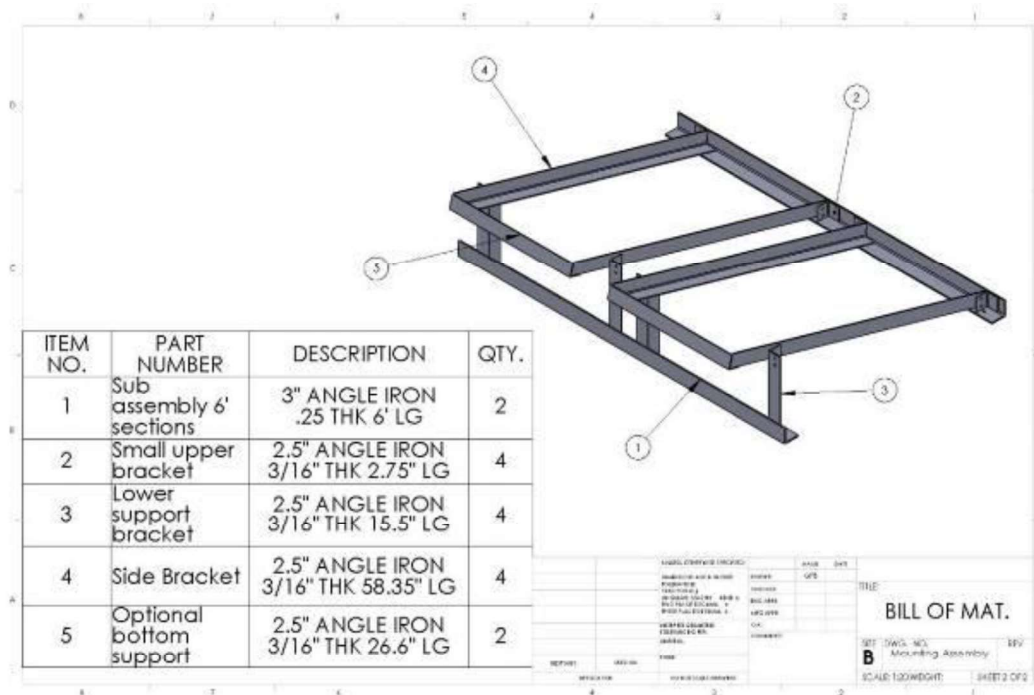


Figure 1. (PV) modules and battery storage systems bases on the solar and meteorology data available from NASA.

*Figure 2. Final design of the system*

**Figure 3.** PV module brackets**Table 1.** Specifications of each pair of classrooms.

Component	Quantity
Angle Iron	7 (6-foot sections)
Zara Solar 120-Watt, 12-Volt PV module	2
Morningstar Sunsaver 20A charge controller*	1
90Ah, 12V Battery	5
Lamp Base	10
25W CFL Bulbs	10

The team implemented the project ahead of schedule. The bulk of the materials and items were purchased locally. Each block consisted of two classrooms that share a solar electrical system. The panels on the south building faced north. The panels on the north building faced south. The charge controllers were placed by the wall that was shared with the two classrooms and directly below the solar panels approximately 4 feet off the ground. This optimized the use of wires. The batteries

(in sets of 3) were placed on the floor directly below the controller. Each room was installed either 4 or 5 light fixtures depending on the trusses.



Figure 4. Implementation activities

For this project, the plan was to buy all materials for construction in Tanzania. That being said, the planned implementation was variable from the start. We were able to find all of the supplies that we needed in local shops except for plated bolts for the frame. It was the intension of the design to use a few plated bolts to hold the sub-structure together. The design required zinc plated bolts because of the corrosion resistance. Since plated bolts could not be found, an alternative design had to be implemented. This design was a fully welded one piece system. Unlike the original design, it only required two lower supports (the supports that give the panels the proper angle in relation to the earth). This design also used a single cross bar; originally there were two cross bars. This actually gave the structure some added rigidity. The implemented design ironically used less material and we were able to keep some stock angle iron for the next implementation trip.

Conclusions

This projects illustrates how US policies enable interaction between non-profits, private sectors, individuals and higher education institutions to enhance nation building in developing countries. Firstly, the tax code (503(c)) encourages individuals and companies to make tax-deductible contributions to charitable organizations. In this case, these contributions were used to develop sustainable energy solutions in a developing country. Secondly, this project illustrate a unique case where students in the US interact with local communities in developing nations to solve problems using their engineering skills. They design and implement sustainable solutions. In the case of NSS, we have been involved since 2009 and every year that we travel, we test the systems and they are still working reliably. A PV module is anticipated to have a life span of 29 years (Umachandran et al, 2015) and we believe this will be the case for NSS. The only things they will replace in the short time will be bulbs (every two years or as needed) and batteries (every 10 years). Our perception is that this is a demonstration of how US government policies can allow citizens

to make tax-deductible donations towards aiding small communities in developing countries. In the case of EWB-USA, over 2.5 million people have been impacted positively.

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