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Our First Collaboration with an International Consulting Firm on Capstone Design Project

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For sixteen years, the Department of Civil and Environmental Engineering (CE) at Rose-Hulman Institute of Technology (RHIT) has incorporated at least one international design project in its yearlong, capstone design course. Past collaborations involved partnerships with Kwame Nkrumah University of Science and Technology (KNUST) in Ghana and other international non-technical clients in various Asian, African, and Central American countries. However, in 2018, the CE Department at Rose-Hulman sought to establish collaborative work with ABP Consult, one of the leading private consulting firms in Ghana because of the benefits of such partnership. Based on the memorandum of understanding (MOU) with ABP Consult, we began our first collaboration in the 2019-20 academic year. The project involved the upgrade of existing infrastructure in an urban community in Ghana. As part of the capstone design requirements, a student team of five civil engineering seniors was commissioned to work on this project. In the fall of 2019, the student team had the invaluable experience of undertaking a site reconnaissance trip to Ghana. This paper discusses the framework that was established for guided mentorship by ABP Consult, the assessment tool utilized during our visit and plans for a long-lasting partnership with ABP Consult.

Keywords: *partnerships, service-learning, assessment, consulting firm, international*

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Background Information

Since 2005, the CE department at RHIT has incorporated at least one international design project in its yearlong, client-based capstone design course. So far, a total of 92 civil engineering seniors have worked on 22 international projects in 9 countries: Ghana, Haiti, India, Kenya, Pakistan, Sudan, Trinidad, Uganda and Zimbabwe. Past collaborations involved partnerships with KNUST in Ghana and other international technical and non-technical clients (Aidoo et al.[1], Hanson et al.[2], Aidoo et al.[3], and Aidoo et. al.[4]). However, in 2018 the CE department at RHIT sought to establish collaborative work with ABP Consult, a civil engineering firm in Ghana. Some of the benefits of such partnerships are:

1. Mentorship to the student team by a professional engineer in the project source country.
2. Knowledge in the design codes, local construction practices and local construction materials.
3. Knowledge of the impact of their design decisions on project stakeholders.

Partnership with ABP Consult, Ghana

ABP Consult founded in 1969, is one of the leading private consulting firms in Ghana. It provides engineering services to private, public and international institutions. It's a wholly Ghanaian-owned entity of professional engineers, environmentalists, quantity surveyors, and technicians (ABP Consult[5]). ABP Consult was selected as one of the consulting firms for capstone design collaboration due to its long-standing experience of similar collaborative efforts with KNUST. Additionally, the types of projects undertaken by ABP Consult, will offer the students the technical, professional and social expertise required by the Accreditation Board for Engineering and Technology (ABET). Most importantly, through this partnership, students will understand the impact of engineering solutions in a global, economic, environmental and societal context.

For a long-lasting partnership with ABP Consult, both partners have agreed in principle to pursue humanitarian projects in under-developed communities in Ghana. Such

projects will be initiated by creating master plans for the development of such communities. Subsequent senior design teams will work on different aspects of the master plan until the entire project is completed. Thus, ensuring the longevity of the partnership and providing a meaningful global service-learning to the students (Aidoo et. al.[6]).

Framework for Collaboration with ABP Consult

One of the biggest impediments with our collaboration with KNUST is the different academic timeline in both institutions: KNUST is on the semester system and Rose-Hulman on the quarter system. However, this problem is non-existent with our collaboration with ABP Consult. To facilitate student learning and establish a framework for mentorship, the CE department and ABP Consult created a timeline for key project deliverables, that promoted regular interactions between the student team and ABP Consult. In the fall, mentorship by ABP Consult consisted of providing region-specific geologic and soil mapping information, information about previous and current land use, photos of the site, and topographic data. In the winter, ABP Consult provided guidance with the technical design of the project: information on local construction and design practices, pertinent codes and related engineering data. In the spring, the student team had limited interactions with ABP Consult, since the student team was working on construction design, cost analysis and the final project report. Table 1 shows the timeline for key project deliverables for the capstone design course for fall, winter and spring quarters.

Table 1.0. Timeline for Key Project Deliverables

Quarter	Timeline	Deliverables	Mentorship by ABP Consult
Fall	Sept. to Nov.	Desk Study, Geotechnical Investigation, Design Options and Recommended Design	Weekly meetings via videoconference
Winter	Dec. to Feb.	Technical Design for the Civil Engineering Sub-disciplines	Bi-weekly meetings Guidance with codes, design guides, local construction practices etc.
spring	Mar. to May.	Constructability, Land Development and Cost Public Meeting Presentations	Cost Estimate Final Design Report Final Presentation

Our First Humanitarian Project with ABP Consult

Based on the MOU with ABP Consult, we began our first collaboration in the 2019-20 academic year. The project involved upgrading the existing infrastructure in an urban community in Ghana. The goal was to improve the livelihood of citizens in the Ayeduase community. The Ayeduase community, which is a suburb of the city of Kumasi, has been struggling to meet the growing demands on roadways, sewage systems and building development. This is partly due to the increased student population of the nearby Kwame Nkrumah University of Science and Technology (KNUST), the country's second largest tertiary institution.

The project site is made up of multiple locations across approximately 307 acres located on the eastern side of Kumasi. The area is relatively developed, occupied by both residential and commercial structures. The site also provides multiple high-traffic roadways, including both vehicle and pedestrian traffic. These two-lane roadways provide public transit services to the community. Drainage along the heavily trafficked roads appear to be functional but tend to flood during severe rainfall events (Thompson et. al.[7]).

As part of the capstone design requirements, a student team of five civil engineering seniors was commissioned to work on this project. Specifically, the project involved the structural design of a hostel, a geotechnical investigation for the hostel facility, the redesign of a congested intersection, design for major roadways, and the design of improved infrastructure for wastewater treatment and clean drinking water supply. This project provided a meaningful global service-learning experience to the students and a viable way of upgrading existing infrastructure in the Ayeduase community. In addition, the project provided a greater exposure of ABP Consult, their impact on the underprivileged, and greater awareness of the types of engineering services they provide.

Travel to Ghana with Student Team

In the fall of 2019, the student team commissioned to work on the project had the invaluable experience of taking a 5-day site reconnaissance trip to Ghana. The goals for this trip were to obtain site-specific engineering data, to discuss the use of pertinent codes and local construction practices and to present their design proposal to the engineers at ABP Consult. In addition, the team obtained first-hand knowledge of how consulting firms operated in Ghana. The rationale for scheduling the trip prior to the winter quarter, was to make it feasible for the team to incorporate any new site-specific engineering data into their technical design after they returned to the United States.

To obtain site-specific engineering data, the team travelled to the project site in Kumasi, located about 155

miles northwest of the capital Accra. At the site, the team interviewed civic leaders, professional engineers and citizens of the community to gather additional information about the project. On their return to ABP Consult, the team met with the engineers to review the data and discuss critical aspects of their technical design.

Assessment

Assessment for this collaboration was done by utilizing the Global Service Learning (GSL) Model. GSL is a curricular model that lies at the intersection of service learning, study abroad, and global education (Aidoo et. al.[6]). During their 5-day trip to Ghana, each student of the team, was required to complete a reflection journal of their daily activities. The students' daily journals provide compelling insights into the student experience that would be diluted by an attempt to summarize them. Therefore, some highlights are presented here to provide an example of the type of content included in them.

Second Day

The student team presented their design proposal to the engineers at ABP Consult.

"We were able to give our presentation and received feedback. The feedback was extremely beneficial as they gave us more insights on working on a project in Ghana." – Student A

"The conversations we had were enlightening to both the project specific work as well as the culture and way of life in Ghana. The engineers were truly passionate about their work because they understood the direct impact that it has on their local community."- Student B

Third Day

The student team travelled to the project site in Kumasi to obtain site-specific engineering data.

"From our project site visit we learned that we must change most of our design recommendations to ensure they are feasible. If we didn't travel our ideas would still work however, they could not actually be used for further development as they are not feasible."

– Student C

Fourth Day

The team visited some of the historic slave castles in Cape Coast, Ghana.

"I want to remember the feeling of stark solemnity that I had when observing the landmarks for some of the greatest stains in human history. I would like to learn more about the different aspects of Ghanaian history regarding settlement, independence, development of faith and religion. It just piqued my interest in the culture and history about this part of the world."

- Student D

"Understanding history's mistakes are what can lead us to a better future, and I can't think of a more powerful example than that of the slave castles in Cape Coast." – Student A

Future Work

For a long-lasting partnership with ABP Consult, our long-term goals are to:

1. Continue collaborative efforts with ABP Consult on humanitarian projects in under-developed communities in Ghana.
2. Assess faculty and community partner experiences as they are crucial to the students' learning experience.
3. Provide an avenue for ABP Consult, to promote the types of engineering services they provide through publications and presentations at professional meetings or conferences.

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