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Briefing

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Commentary: Educating global engineers through footbridges

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Thombile Tsela's children are celebrating that, for the first time in their lives, they will not need to worry about crossing the Mbuluzi River. Likewise, Thombile can relax, knowing she can now sell her bread year-round and have more stability to her income. For about 75% of the 1.4 million people in the kingdom of Eswatini, walking is the primary mode of mobility. When the rainy seasons come, rivers flood and people must choose between risking their lives, or being isolated from essential resources. With a pedestrian bridge, crossing the river becomes much safer, and people are no longer isolated. In 2017, that became a reality for the community of Edlangeni when a 73-metre pedestrian suspended bridge was built within a student project run by Engineers in Action (EIA), a global NGO based in the USA. This footbridge (Figure 1) provides 200 families safe access to schools, clinics, farm fields and markets. This and other EIA footbridge projects have enabled civil engineering students from Universities in multiple countries, including University College London (UK) and University of Colorado Boulder (USA), to apply their engineering knowledge, management capabilities and people interaction skills in a worthwhile practical context.

The Edlangeni footbridge utilized a standardized suspended bridge design developed by Bridges to Prosperity. This design responds to the typical challenges presented by a remote construction site in a resource-constrained environment. Typically there is a shortage of skilled labor, electricity, and materials. To meet these challenges, the design utilizes local materials as much as possible, and rudimentary construction techniques that can be led by a trained local foreman. The primary structural system consists of a wood deck supported by steel wire rope, which spans between two stone masonry abutments (Figure 2) that utilize stone and aggregate collected from the river. Conservative design assumptions and factors of safety allow this type of bridge to be safely implemented in a wide variety of locations and topographies. The construction time for a project like this footbridge is typically 10–12 weeks.

The success of the Edlangeni footbridge is attributed to the relationship between the many stakeholders involved. Students from the Engineers in Action chapter at the University of Colorado performed the bridge design and planned the construction under the supervision of a registered professional engineer. The project was resourced by various means. These included voluntary labour and annual tax contributions from the community, government funding via Eswatini Microprojects (responsible for much of the country's rural infrastructure) and EIA funding. The students were at the core of the siteworks, and before that they fundraised through their local networks to cover their travel and living costs, and for contributions to the costs of cables and clamps.

Engineers in Action has partnered with students from over 30 universities in the UK, USA and Canada to construct footbridges alongside rural communities in 11 countries. In 2019, this partnership included students from University College London (UCL) in the UK, led by Signe Swarttouw, alongside students from Rutgers University in the USA. Figure 3 shows the students building a 51 m span bridge across the Mbuluzi River in Eswatini, for the Bhekinkhosi community.

The students worked alongside Bridge Corps members who are experienced bridge builders, local masons and other Bhekinkhosi community members. The bridge opened in late August 2019 after six weeks of construction. The inaugural party was attended by the entire community, including local politicians and chiefs. During the project the students formed bonds with each other and with members of the community, – for example see Figure 4. These bonds, like the bridge itself, will greatly outlive the summer construction project and will serve as a reminder of the lasting legacy that is achievable when people come together in earnest for a noble cause.

A key component of the partnership between Engineers in Action and the University students is use of the footbridge

Figure 1. The Edlangeni footbridge, completed in July 2017

Figure 2. Preparing to pour an anchor after completion of towers

project as a learning tool. Students are involved in the design and construction of footbridges which provides them the opportunity to apply their newly gained civil engineering skills in the context of a real-world project. Since students are excavating foundations and anchors by hand to the depth that they designed, they are incentivised to consider how their design decisions will impact the construction schedule and excavation volumes. Students are also faced with solving unique problems that require out-of-the-box solutions. For example, if students arrive to site and find that their proposed anchor will be infeasible to excavate with picks and shovels, they must problem-solve to consider alternative excavation techniques or a rework of the design. As the students have not been siloed into only having a focus on the construction or the design, they are well-equipped to develop solutions while on-site to move the project forward.

Figure 3. UCL and Rutgers University students building the 51 m Bhengkoshi bridge in August 2019

Figure 4. Celebrating completion of the Bhengkoshi bridge: Students from UCL (UK) and Rutgers University (USA) alongside local community members

Students with Engineers in Action develop their knowledge of the design and construction of footbridges through a series of synchronous and asynchronous online courses with students from different universities. University faculty are involved in a variety of ways, supporting student chapters as faculty advisers. Some even use these footbridges as capstone projects.

If you are a student interested in using your engineering knowledge to make a difference in the world, a faculty member looking for a real-world project for your students to learn through, or a professional interested in mentoring tomorrow's global engineers, you can find out more by visiting <http://www.engineersinaction.org> and clicking on the 'Bridge Program' tab, or by emailing EIA's Bridge Program Director at ethan.gingerich@engineersinaction.org.