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Humanitarian Civil Engineering

Practical solutions for an interdisciplinary approach

Edited by
Georgia Kremmyda
University of Warwick

In a health project in North Kivu Province it was apparent that even pedestrian access to present and planned clinics was very poor. Local bridges were constructed of timber and supported by creepers (Figure 2.3). These sufficed for fit persons, but were unsuitable for carrying in building and medical supplies or for people on stretchers. During the project-planning phase, two people died: one of malaria because the old clinic was not stocked with the relevant drugs, and the other, a woman in childbirth, because she could not be carried to the clinic in time. The bridges are also susceptible to flooding, so more robust and higher suspended bridges were planned.

Medair has worked in infrastructure throughout the DRC, on the construction of reinforced concrete bridges, the refurbishment of Bailey bridges and building a number of pedestrian suspension bridges. Two recently completed bridges are discussed in detail below: the first is a suspended pedestrian bridge, the second is a two-span road bridge. A very brief description of the technical design is provided, and the challenges experienced are also described.

Suspended bridges

Medair has built several suspended bridges following the Bridges to Prosperity guidelines (B2P, 2014). These bridges are simple in principle and have the advantage of not using piers in the rivers. There are four main components to these bridges: the cables, the towers, the anchors and the deck. The design is relatively simple, determined by basic statics, the construction is relatively straightforward and the cost is attractive. Figure 2.4 shows a free-body diagram of the tower and the anchor. From this diagram it is relatively simple to determine the demand on the main cables supporting the live and permanent loads, on the tower and its foundations, and on the anchor, which is designed for uplift and sliding. Once these demands are established, all members can be designed. Full explanations on this process can be found in the B2P guidelines. Figure 2.5 shows a typical suspended bridge built by Medair.

Figure 2.3 Locally built pedestrian bridge

Figure 3.1 Hospital waste incinerator, Masaka, Uganda

Atatur Hospital in 2007, and a new group in Manchester did the same for Kumi Mission Hospital, following approaches from Dolen Ffermio.

The Picken incinerator burns at very high temperatures and so needs repair every 5 years or so. EFOD has repaired the Soroti and Kumi models, and the hospital maintenance team in Masaka did so themselves. The local project manager from the build in Soroti Hospital has been involved in the repairs, and now has a business building and repairing medical waste incinerators, employing some of the original workforce from 2005.

Soroti Baptist Medical Centre, Uganda, 2005–2009

When building the incinerator at Soroti Hospital, EFOD Cardiff had more volunteers willing to travel to site than necessary. In response, SaltPeter Trust provided funds for them to lay the foundations of a 16-room not-for-profit medical centre in the grounds of Soroti Baptist Church at the same time. Welcoming the challenge, the team offered to complete the design, and to construct the superstructure of the £100 000 single-storey building. Work restarted in early 2008 with supervision from 16 EFOD engineers visiting in pairs. A frame was built from reinforced concrete columns cast within hollow blocks, topped with a reinforced concrete ring beam. The infill walls were formed from ISSBs cast on site using murrum won from site excavations. A steel-framed mono-pitched roof was planned, but construction was affected by a steel shortage in early 2009. Electoral disputes in Kenya led to the closure of the border with Uganda, and so the team made a last-minute design change, constructing timber trusses clad with locally produced profiled roof sheeting. Two 50 000 l circular rainwater harvesting tanks were built to the rear of the unit using curved ISSBs.

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Georgia Kremmyda
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Chapter 4

Learning from humanitarian engineering projects

Abstract

The chapter provides case studies of best practices and challenges reported in humanitarian engineering projects. The case studies are provided by professionals who commend on the availability, accessibility, affordability, and scalability of interventions in the developing and world. The chapter shares knowledge, experiences and good practices on the folowing. How can collaborative working be better supported, including across international boundaries? How might organisations with different missions and roles (e.g. humanitarian relief, development assistance and environmental protection) work more effectively together to build resilience? How might local communities and actors be empowered to make choices about how to build resilience, and what are the constraints on this? Who is excluded or marginalised in the process of building resilience and how might more inclusive participatory processes be developed? How do these challenges differ in different socio-economic and cultural situations? How does building resilience intersect with issues of gender, voice, power and inequality?

DELIVERING A NEW MATERNITY UNIT IN KACHUMBALA, UGANDA

Ian Flower and Dan Flower

Introduction

Engineers for Overseas Development (EFOD) is a small charitable company that manages teams of young civil engineers and others in construction in the delivery of humanitarian aid projects to enhance their management and organisational skills as they work towards professional qualifications. Teams are set a project to design a solution, raise funds, and travel to site in pairs for just 2 weeks to hire labour, buy materials, supervise construction and commission the scheme. More details are given later in this sub-chapter.

EFOD South West Wales (SWW) formed in 2011, to provide an opportunity for apprentices training at Coleg Sir Gâr in Ammanford to work with engineers and technicians delivering schemes in Uganda, supported by several building and construction companies in the area.

The commission

In 2014, EFOD SWW was constructing a grinding mill and grain store in Kachumbala for a widow's cooperative, supported by the UK charity SaltPeter Trust, when Carwyn Jones, then the First Minister for Wales, visited the site to see the work his government had helped to fund. The cooperative members had arranged a party to welcome him with music, singing and

create solutions for the poor in general. Such views are reinforced by Ramalingam (2013) discussing the international aid sector, which uses antiquated top-down models to overcome issues, without considering the true nature of the system, or community, they are conducted in. Such interventions often fail and are ineffective or unsustainable when outsider help inevitably leaves.

It becomes the role of the humanitarian engineer to not only provide technical know-how to solve an issue but also do so in a way that allows the project to be self-sustaining when the engineer leaves (Amadei *et al.*, 2009). Humanitarian engineers must take knowledge learnt in the global north (or techno-bureaucratic knowledge) and apply this to community practices (or local–traditional knowledge) (Ali, 2015). In doing so, humanitarian engineers are not only able to help produce effective interventions but also ensure their sustainability (Amadei and Wallace, 2009). The two following case studies discuss how this is done over the project management process.

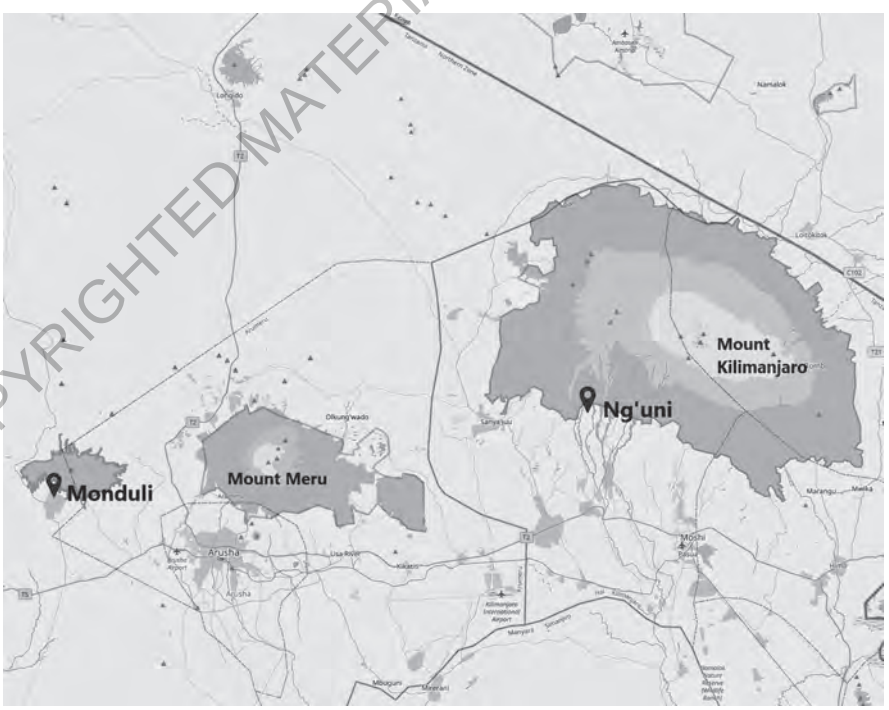
Project backgrounds

A map showing the locations of the projects is given in Figure 4.7.

Monduli – district hospital water tank and rainwater harvesting system

The traditional civil engineering project that will be discussed is the construction of the water system serving the new wing of Monduli District Hospital. The project aim was to ensure an adequate water supply for the hospital's two new wards, collecting water during the rainy

Figure 4.7 Map of the project locations: Monduli and Ng'uni, Tanzania



A case in point to highlight the unplanned difficulty of managing projects in developing countries was the laying of resources for the road project. The planned approach was to have tipper trucks bring up sand, murram and crushed rocks in that order. The sand and murram were to be dropped centrally in four strategic locations, then transported to the areas of road where they were needed. The rocks were to be dropped at the area of road where they were required, reducing the burden of transporting these. The rocks selected were larger than needed, and were to be broken on site; this option was cheaper and had less logistical burden. However, as the truck drivers were paid per load, there was competition between drivers to drop as many loads as possible. The first truck that arrived dropped its load of rocks at the start of the Nure Ridge, blocking the road for the other trucks (Figure 4.10). This caused long delays for the other lorries and for trade out of the village until the boulders could be broken up and moved.

The lack of structure and planning, as well as the informal nature of the labour, made coordinating the drops difficult. Local drivers had been given little information about the project and had not been introduced to the project manager (the author) nor any of the community

Figure 4.10 Map of Nure and the proposed drop sites versus the first drop blocking the road