Suspension Canyon and Gully Crossings for Small Scale Community Aqueducts: A Design Guide Based on Experience and Observations from Peace Corps, Dominican Republic

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Lack of clean consistent drinking water is an issue that affects over a billion people worldwide (World Health Organization, 2002). A cost effective method of bringing potable water to mountainous rural areas are small-scale community built and maintained aqueducts. These systems are efficient, relatively inexpensive, and easy to maintain and operate. Projects such as these have been met with considerable success in Nepal, (Jordan, 1980), Honduras (Simpson, 2003; Reents, 2003) and in the Dominican Republic (Niskanen, 2003).

The mountainous terrain that makes these aqueducts possible can also make them difficult to construct. Often pipeline must pass through or around large canyons and across permanent or seasonal rivers and streams. When such an area is encountered a suspension crossing can be a durable, technologically appropriate, and economical solution.

There are many resources on the subject of bridges and even suspension bridges in particular. But, these are more often than not written for a more technical audience in mind. And, even if the engineer has the background to follow the text, the methods can be excessively detailed and complicated for a field-engineering situation pertaining specifically to aqueduct crossings. Jordan (1980) covers a simplified method for designing suspended crossings in an appendix but does not go in to detail or address certain issues that are common during construction.

For example, Jordan simplifies the curve of the cable to a straight line when calculating cable forces and does not provide the reader with an explanation. He only presents the single pipe type of anchor system and doesn't provide enough information to accurately design it. Additionally, the table used to design this anchor neglects a bending moment causing the design to be either extremely conservative or dangerously under-sized. The topics of cable stretch, material selection, and construction relating specifically to cable crossings are also not covered.

Accordingly, the objective of this report is to provide the reader with the method and resources to quickly and efficiently design a suspension crossing for small-scale rural aqueducts. The intended audience is someone without an engineering background, but with sufficient technical competence to design and construct a gravity-fed aqueduct. This report takes much of the complex analysis required for the design of a cable structure and simplifies it to a step-by-step process that can be followed using basic arithmetic and very simple algebra.

This report explains how forces are calculated in the cable and provides a more accurate method for determining the curve of the cable. Three distinct anchor designs are presented and instructions are provided to efficiently design each one. The topic of cable stretch is discussed as is material selection. Also, a method is presented for designing a crossing where one cable fixture point is lower than the other.

It is also an attempt to record the institutional knowledge accumulated through trial and error from Peace Corps Dominican Republic and from various aqueduct projects completed by the NGO Hermandad and designed by its lead engineer and CEO Eric Zalkin. The reader should be aware that this research report is written as a practical design guide; thus, the report highlights practical knowledge the author gained during his two years of service in the Dominican Republic as a water and sanitation engineer with the U.S. Peace Corps.