Bridge Design on a Rural, Unpaved Roadway

Las Trancas, Comarca Ngäbe-Buglé, Panamá

Project Overview

Trancas Associates is a group of four undergraduate Civil Engineering students in the iDesign program at Michigan Technological University. In August 2016, Trancas Associates travelled to Panamá to collect data for a vehicle bridge design project on a mountainous, unpaved roadway servicing the village of Las Trancas.

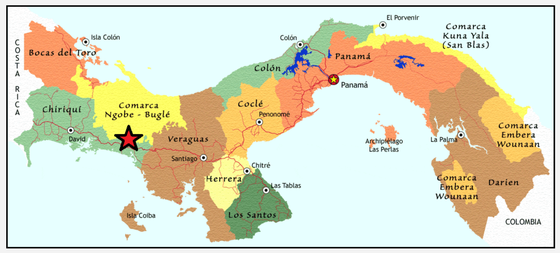

Figure 1. Map of Panama with Las Trancas starred

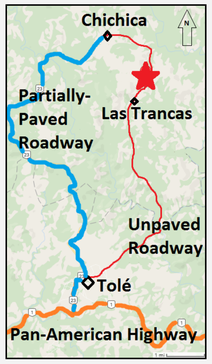

Figure 2. Map of transportation routes near Las Trancas with project site starred

Community Background & Problem Description

- Indigenous Ngäbe community, subsistence farmers
- 1500 - 2000 community members, 100 - 200 households
- Single, unpaved roadway to village from Pan-American highway for transport of people and supplies
- Community has constructed bridges over a problem stream crossing on this roadway; bridges have washed out in rainy season
- Vehicles currently using ford through stream when water level is low enough; stream unpassable in the rainy season
- Permanent solution needed to keep route safe and accessible year-round

Figure 3. Project Site Overview

Data Collection & Analysis

- Surveyed the stream crossing using level surveying and created topographical map
- Performed visual analysis of soils: fat clay with stones
- Estimated hydrologic conditions and peak flow using watershed area and 100-year, 24-hour rainfall event
- Data was used to establish design requirements, such as:
  - ⇒ Ease of mobilization on unpaved roads
  - ⇒ Cost effectiveness
  - ⇒ Minimal differential settlement of footings
  - ⇒ Sufficient flow and drainage capacity
  - ⇒ Resistance to environmental factors
    - * Corrosion, upstream bank wall erosion, footing scour

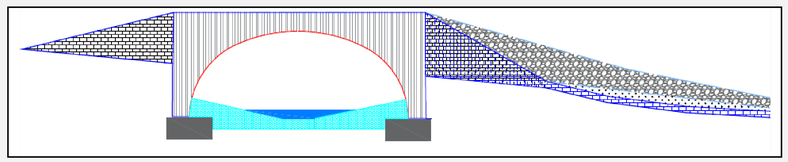

Figure 4. Structure, Footings, & Roadway Profile View

Final Design Recommendations

- A flexible buried steel bridge was selected as the final design; best fit design constraints
- Gravel is backfilled and compacted overtop the structure; strength of gravel gives structure load-carrying capacity
- Stream channel will be graded and lined with rip-rap to control flow and protect structure
- Roadway leading to the structure will be filled with gravel and reasonably graded
- Roadway will be enclosed by headwall to control drainage and prevent roadbed washout
- Expected 50-year service life if properly maintained

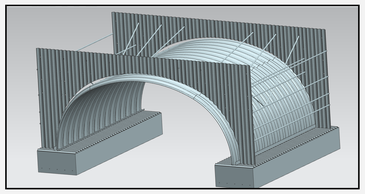

Figure 5. Model of Structure

Figure 6. Similar Real-World Example

Project Scheduling & Estimate

- Can be constructed in 55 working days
- Fully constructed in the short, dry season of the year (Jan. — Apr.)
- Estimate close to typical grant allowance for projects of a similar scope

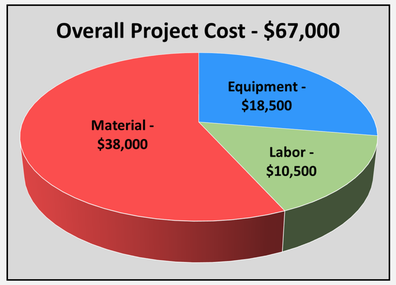

Figure 7. Project Estimate

Michigan Tech

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International Senior Design (iDesign)
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