

# Avenida Fatima I

International Senior Design – May 2008

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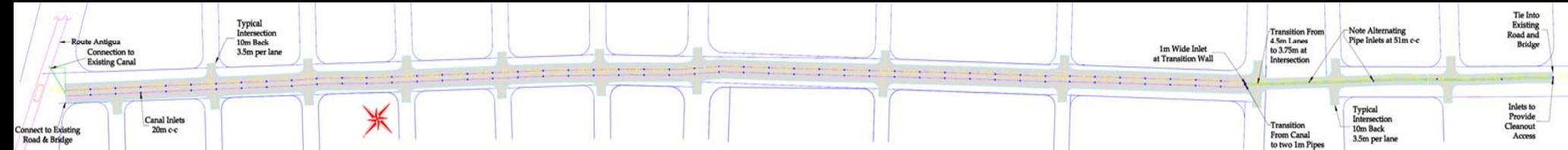


Figure 6: Avenida Fatima I Road Alignment

## Background

In April of 2008 the Design-Build firm of Cinco Cero Eng. (C.C.E.) was established in part of the International Senior Design (ISD) Program at MTU. C.C.E. is comprised of three undergraduate civil engineering students: Dylan Gerhart, Kari Klaboe, and Travis Velasco, pictured in Figure 1.



Figure 1: (a) May ISD Group at Walter Henry School (b) Team C.C.E. (c) May ISD Group at Guembe.

## Project Scope



Figure 2: (a) – (c) Avenida Fatima I

In the same month of its conception, C.C.E. was given the challenge of designing a road and storm drainage system for a community in Santa Cruz, Bolivia. C.C.E. travelled to Santa Cruz in May of 2008 to research their project site, Avenida Fatima I, and the surrounding area.

Avenida Fatima I is an area prone to flooding during the wet season and standing stagnant water throughout the year, Figure 2. The project was petitioned for by the local community and is focused on eliminating standing water along the roadway and improving road quality.

## Design Concerns

- **Safety:** Avenida Fatima I will connect two major roadways and is expected to experience high traffic flows. Also, the area surrounding Avenida Fatima I is residential; children, commuters, and animals use the road daily.
- **Health:** Standing storm water promotes the reproduction of mosquitoes that carry dengue, yellow fever, and malaria. All being serious diseases of the tropics.
- **Cost:** The city of Santa Cruz is composed of nine co-centric rings, centered about the city core. As you move from the city core outwards the average family income decreases. Avenida Fatima I is located between the 6<sup>th</sup> and 7<sup>th</sup> rings. A low-cost design is therefore vital to ensure implementation and maintenance.

## Design Options

### Underground Storm Sewer Pipes



Figure 3: Option 1

#### Advantages

- Safe: Underground Structure
- Maintenance: Less Required

#### Disadvantages

- Incompatible with existing topography

**Not Feasible Due to Topography**

### Precast Box Culverts



Figure 4: Option 2

#### Advantages

- Safe: Covered Structure
- Maintenance: Less Required

#### Disadvantages

- More Costly

**Feasible: 7,180,000 Bs or 1,012,100 USD**

### Open Canal



Figure 5: Option 3

#### Advantages

- Typical construction practice
- Less Costly

#### Disadvantages

- Maintenance: More Required

**Feasible: 5,270,000 Bs or 742,900 USD**

## Recommendation

C.C.E. recommended that an open rectangular canal with pedestrian and traffic barrier walls be implemented along Avenida Fatima I. The proposed alignment is shown above in Figure 6. This design option was chosen because:

1. **Constructible:** Design was compatible with the existing topography.
2. **Cost Effective:** Design is less costly than Design Option 2.
3. **Typical Practice:** Connecting municipal drainage structures are both open canals.

## Conclusion

The above design was based off the entire Avenida Fatima I watershed being directed into a single drainage structure. However, there is a dirt road to the northwest that runs parallel with Avenida Fatima I, in red in Figure 7. It was suggested by C.C.E., that if a drainage structure is expected to be developed there, a combined drainage design should be created incorporating both projects. This would reduce the required drainage capacity of the Avenida Fatima I structure.



Figure 7: Avenida Fatima I Watershed

