Rock Canyon Culvert Design

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Problem Statement:

Design a box culvert to allow heavy vehicle traffic to pass over the Rock Canyon ditch. The culvert must be designed for a design flow of 280 cubic feet per second and a 100 year flood event of 660 cubic feet per second.

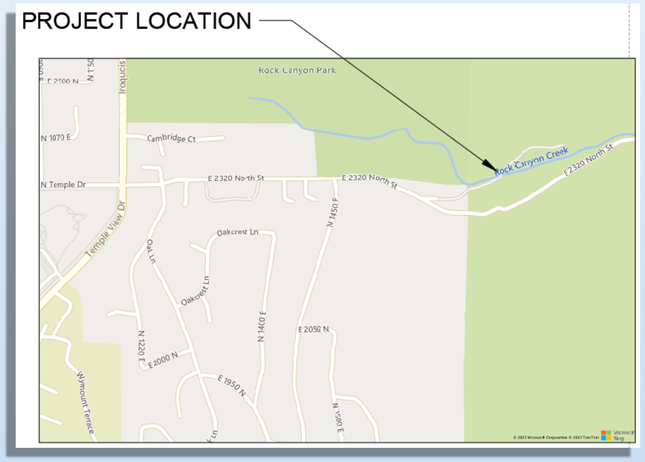


Figure 1: Project Location

Project Requirements:

- Must support a fully loaded cement truck (66,000 pounds, 28,000 pounds on each of the rear axles)
- Must maintain 2 feet of freeboard from the roadway in 100 year flow event.
- Must accommodate the 100 flood event without up-stream or downstream erosion.
- An existing water line runs under the proposed culvert location. It must be rerouted over or around the culvert.

Channel Stabilization:

Figure 2 shows the flow profile of a 10’ by 6’ box culvert. Flow is supercritical resulting in high flow velocities that will erode the downstream channel. The larges size of riprap available is insufficient to stabilize the downstream channel at flows of 660 cubic feet per second.. A *Type III* stilling basin will be used to slow flows and prevent erosion. Stilling basin dimensions were determined using *Water Resource Engineering Third Edition* by David A. Chin.

Class X riprap with a D-50 of 1130 mm will stabilize the downstream channel for flows up to 465 cubic feet per second, or 70 percent of the hundred year flood event. Stilling basins can create a drowning hazard, so Provo City may prefer the less stable riprap over a stilling basin. The original requirements were for the 100 year event, so that is what is presented here.

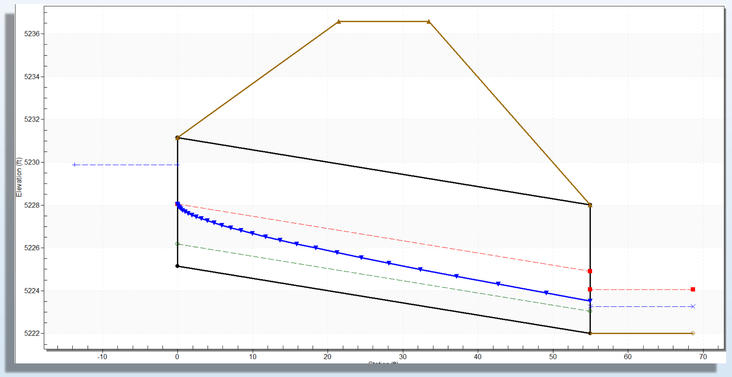
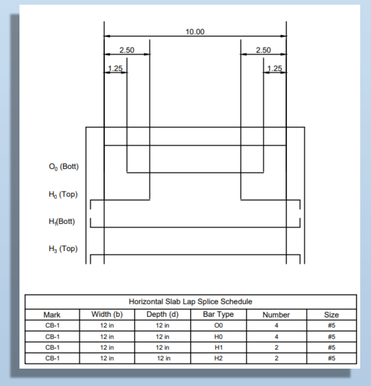


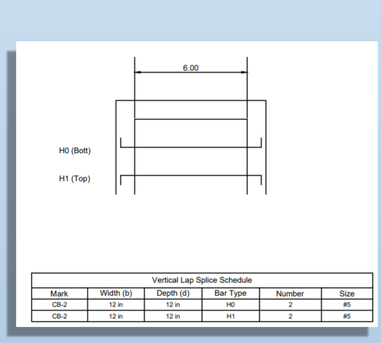
Figure 2: Flow Profile

Reinforcement:

Load calculations and rebar reinforcement calculations were done by hand. RAM Elements was used to verify all hand calculations. Flexural reinforcement schedules are shown in figures 3 and 4. Shear reinforcement schedules are shown in figure 5.



Horizontal Slab Lap Splice Schedule					
Mark	Width (b)	Depth (d)	Bar Type	Number	Size
CB-1	12 in	12 in	O0	4	#5
CB-1	12 in	12 in	H0	4	#5
CB-1	12 in	12 in	H1	2	#5
CB-1	12 in	12 in	H2	2	#5



Vertical Lap Splice Schedule					
Mark	Width (b)	Depth (d)	Bar Type	Number	Size
CB-2	12 in	12 in	H0	2	#5
CB-2	12 in	12 in	H1	2	#5

Figures 3 and 4: Top and Bottom Flexural Reinforcement Details, Side Flexural Reinforcement Details

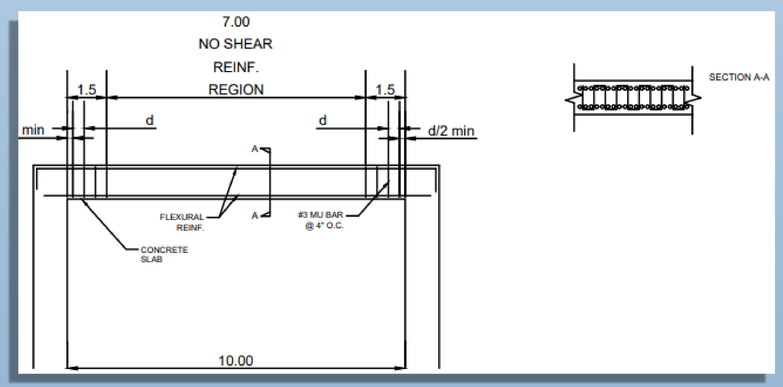


Figure 5: Shear Reinforcement Details

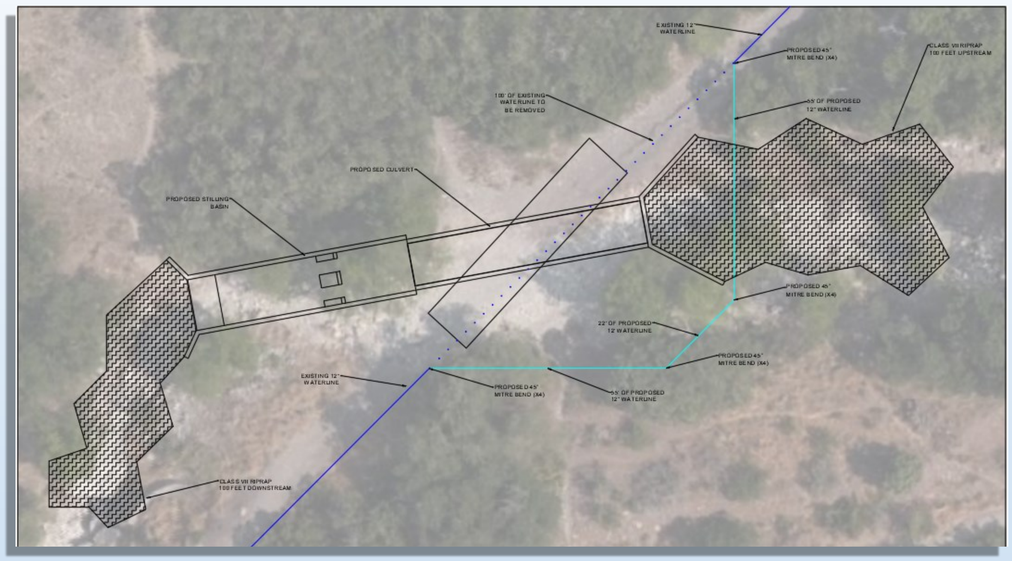


Figure 6: Plan View

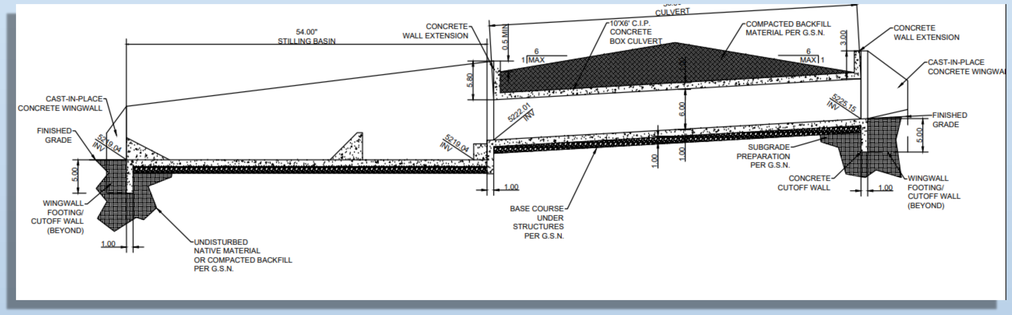


Figure 7: Profile View

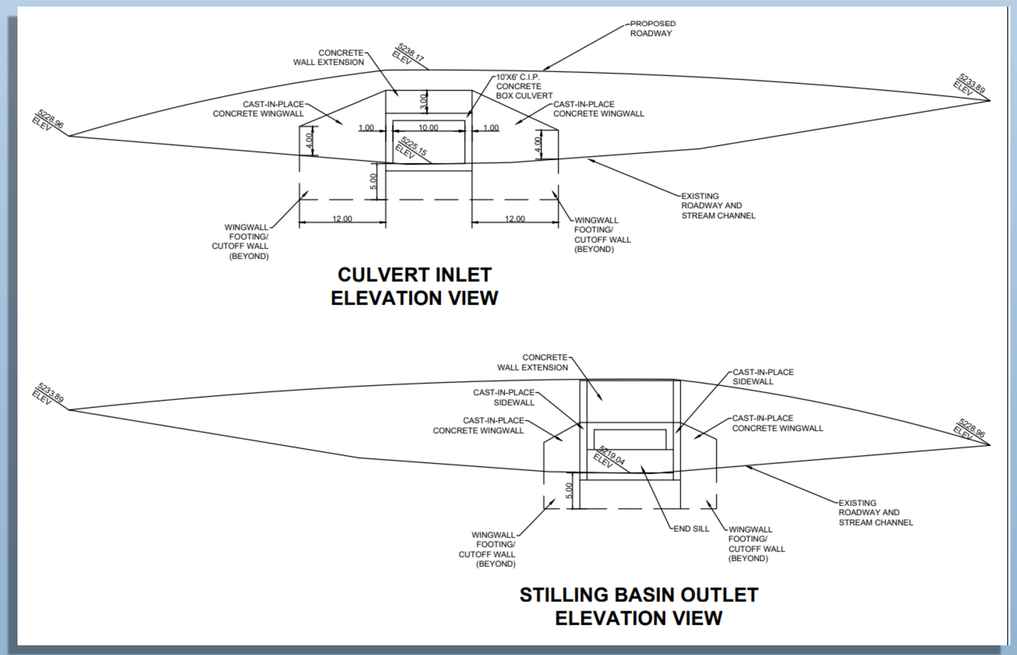


Figure 8: Elevation Views