

Summary of the Study

This three-year study is reported in a 79-page book that includes 98 figures.

The study, results and discussion are summarized in these 5 pages.

Preliminary Survey Theodore Judah's 1861 preliminary survey map (60 to 90 feet long) reveals significant differences from the alignment that was actually built (in California). Of interest, near Cape Horn, are two facts:

First: Judah intended to cross Long Ravine Gap with a curved track that must have been on either earthen fill or a trestle. Montague chose to use a straight bridge that required realignment to accommodate the straight bridge section.

Second: Judah intended to curve the track further into the hill at Cape Horn thus reducing or eliminating the two retaining walls and fills.

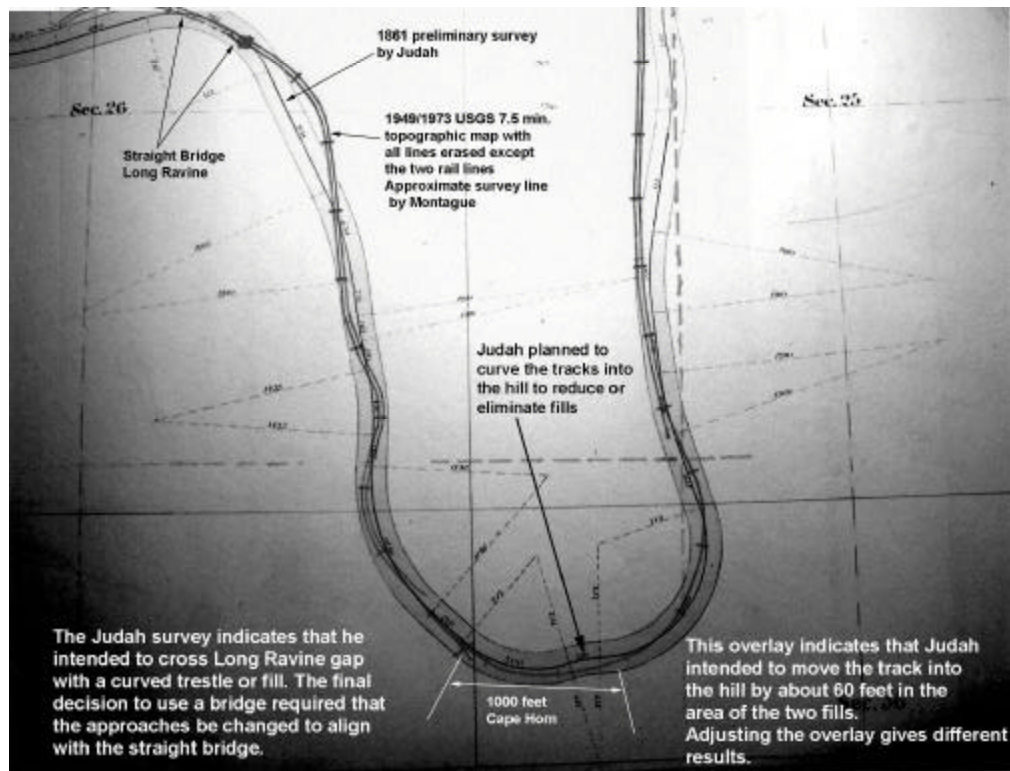


Figure 17 This is an overlay of a 1973 USGS map onto Judah's 1861 preliminary map. The alignments around Cape Horn Ridge are similar but not exact. The differences at Long Ravine and at Cape Horn are visible.

Construction Survey This section examines the reasons for locating the track bed at the 2500 feet elevation instead of locating it either higher or lower. The two gaps, Long Ravine and Secret Town, dictated the elevation at Cape Horn. Higher would have been easier while lower would have been far more difficult.

Surveyors *possibly* used safety ropes at a few locations to place stakes but there was no reason for the excavation laborers to use either chairs or baskets.

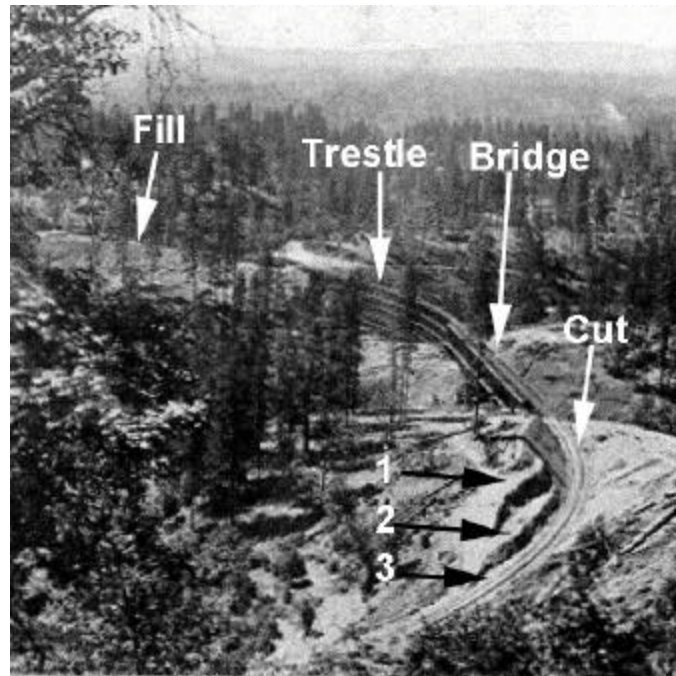


Figure 18 Choosing the best elevation for crossing Long Ravine Gap required compromising on the fill/trestle/bridge/cut as shown. The three cart roads that were used in 1865 are visible in the cut.

Order of Events This section examines the likely order of construction around Cape Horn Ridge. There was no engineering reason that prevented excavation at Cape Horn simultaneous with excavation both west and east of that steep hillside.

West Cape Horn The one-mile section along the west side of Cape Horn Ridge is addressed as a separate excavation project since conditions differed from those at Cape Horn and there was no apparent reason to coordinate activities at the two areas. Some horse/cart transport of cuttings was employed here but use of carts at Cape Horn appears to be extremely unlikely. Both cutting and filling were required along this hillside.

East Cape Horn The one-mile section east of Cape Horn is also addressed as a separate activity for the same reason. This cut and fill was easier to accomplish than was that along West Cape Horn because the terrain was relatively less sloped. Referring back to the construction survey, construction east of Cape Horn would have been extremely difficult had the track level been only 100 feet lower.

Cape Horn Appearance in 2004 About 140 slope measurements were recorded along the 1000 foot Cape Horn in 2004 using the *slope gauge* shown in Figure 32. This convenient tool was used along the roadbed, also above and below the roadbed. Using these slope figures, cross sections of the existing cut were drawn at each 100-foot station. The reader can develop an excellent idea of the volume of rock that has been cut along this hillside by examining these cross sections. The vast majority of this excavation occurred in 1929, not in 1865.



Figure 32 Slope gauge with weighted pointer reads 36 degrees. While using surveyor's equipment could make more precise measurements, this simple tool easily measured within 1 degree, which is adequate for this study.

Cape Horn Appearance in 1866 This somewhat technical section describes the cut as it existed when rails were laid in 1866.

Also, cross sections were developed in this section as they existed in 1866.

The procedure used for developing the cross sections used drawings and photos from the 1860s and early 1870s. The results of this *back engineering* procedure are shown in Figure 51. Modifying the 2004 Figure 52 developed this figure. The purpose of Figure 51 is to show the small early cut compared to the present large cut. Brush and tree coverage is of course artificial but it is intended to indicate rather sparse cover as determined from many photos in the 1870s.



Figure 51 Cape Horn in 1866 after completion of construction.



Figure 52 Cape Horn in 2004. Most of the additional cutting and some retaining wall improvements occurred in 1929. After 16 years of abandonment (1913-1929) this roadbed was improved allowing the eastbound, uphill traffic to be removed from Tunnels 33 and 34, and returned to this original 1866 location.

Dip of the Ledge This term was used by Montague to describe conditions at Cape Horn. His statement was “The dip of the ledge is about seventy-five degrees, or nearly perpendicular....”. Many authors and artists have misunderstood this to mean that the mountain surface sloped 75 degrees. Analysis of conditions as they existed indicates that this interpretation was incorrect leading to legends and drawings that were presented as

facts. Examination of the rocks and terrain has lead us to a different understanding of Montague's comment. This analysis is described in detail in the book.

Retaining Walls at Cape Horn This section describes the construction, repairs and replacement of the retaining walls in two ravines. Indications are that skilled craftsmen did not do the original stone mason work. Both walls needed either repairs or replacement within a few years.

Later Construction---After 1866 This section is a general *catchall*. It includes repairs, the little known steel truss bridge, guard rails, re-alignment and re-location of the tracks, addition of concrete parapet walls and a look at camera locations for both early and recent photos.

Appendix This contains references and sketches that support the study.

Below the Railroad While there was probably no work done below the rail bed, it is helpful to understand some of the commentary in the earlier sections of this study. This includes searching for the elusive 75-degree slope.