

A Study of
Cape Horn Construction
on the Central Pacific Railroad
1865-1866

by
Jack E. Duncan



An early eastbound work train on Curve 149 entering Cape Horn



Figure 2 USGS aerial photo of Cape Horn area



Kirby

Figure 1 Above is an aerial photograph taken in 2004 of the section of railroad near Colfax, California known as Cape Horn. This study focuses on the 1000-foot section of Central Pacific Railroad indicated by the numbers on the photograph.

Introduction

The discussions in this book were initiated after reading the facts presented by Ed Strobridge in his book *Legend of Cape Horn*. As discussed by Ed, there are virtually no primary sources written by on-site workers or writers in either the 1860s or 1870s. There are no known pre-construction or construction photographs. The few 1860s photographs of other sites that have been found are useable in this study but they offer no information about construction *methods* such as blasting, carting spoil and stone masonry.

Many sources, sources written in later years, are not only unreliable but some of them enhance legends and amplify incorrect ideas, as described in *Legend of Cape Horn*. The result is that **no logical description of construction along that notorious 1000-foot section of the Central Pacific Railroad in 1865-1866 has been found**. The obviously incorrect writings have survived and grown. I recommend that you first read the book *Legend of Cape Horn* to learn what did *not* happen. (The many legends referred to are not repeated in this study). Then read this book to learn what *did* happen and what I believe *may have* happened. Not every opinion stated in this study can be substantiated by primary documents produced in the 1860s and 1870s.

This book strives to:

First----- present conditions, as they are today, 2005

Second--deduce what conditions existed before construction began in 1865

Third---theorize about how men constructed the roadbed around Cape Horn Ridge.

This book is in response to some of the following misleading descriptions that have appeared in literature:

*A sheer granite buttress, vertical cliff, nothing between them and their ancestors but faith, over the side of the cliff on ropes, men swung from the top in baskets, lowered from the bluff above by ropes, picking away at that solid granite, almost perpendicular, lowered over the cliff in boson's chairs, boson's chairs swung out into thin air, swaying on a thin rope's end over dizzy emptiness, suspended between sky and earth, swaying in the wind, 75 degrees slope, scrambled up the lines, many fell below, many died, an occasional basket or wide coolie hat would be seen bobbing on the surface of the American River far below. **Not one of these comments has been found in primary historical documents. They are all fiction.***

These comments, plus artist's drawings, were meant to dramatize the site. They have perpetuated the boson's chair and wicker basket legends that Ed described and commented about. I agree with Ed: *the workers did not use either boson's chairs or wicker baskets*. Based on my findings in this study, the chairs or baskets would have been unnecessary, impractical, non-functional, inefficient, and nearly impossible to use and there was no reason to attempt to use them. References to baskets started only 50 years ago but they have proliferated since that time.

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.

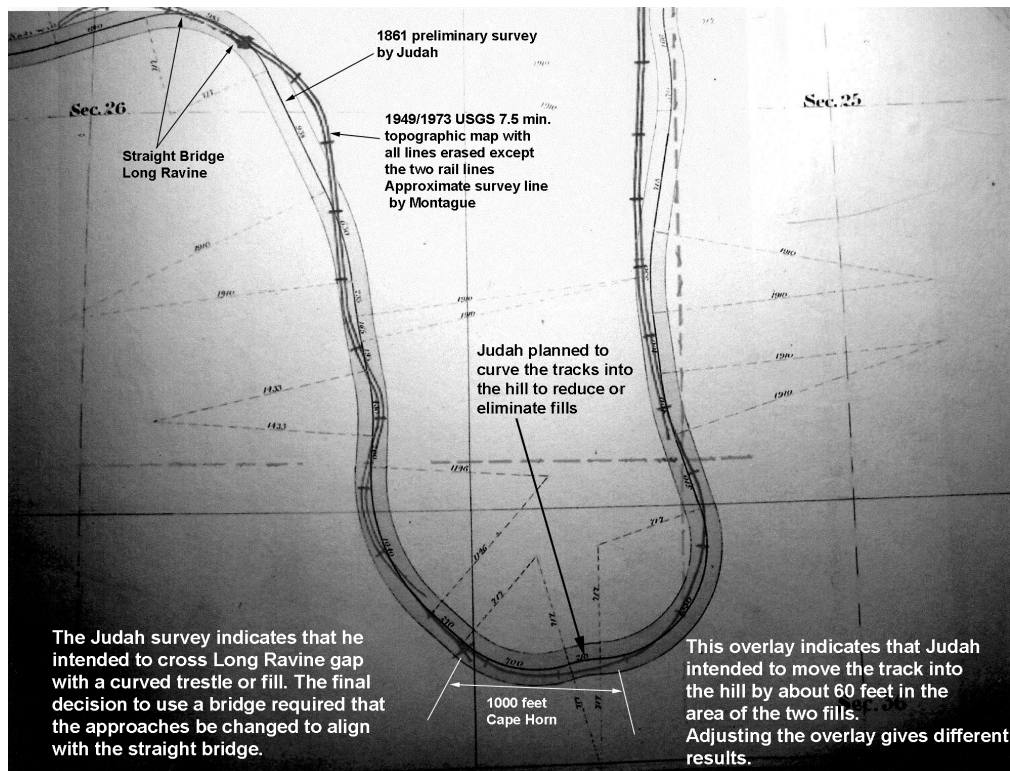


Figure 17 This is an overlay of a 1973 USGS map onto Judah's 1861 preliminary map. The alignments around Cape Horn Ridge are similar but not exact. The differences at Long Ravine and at Cape Horn are visible.

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.

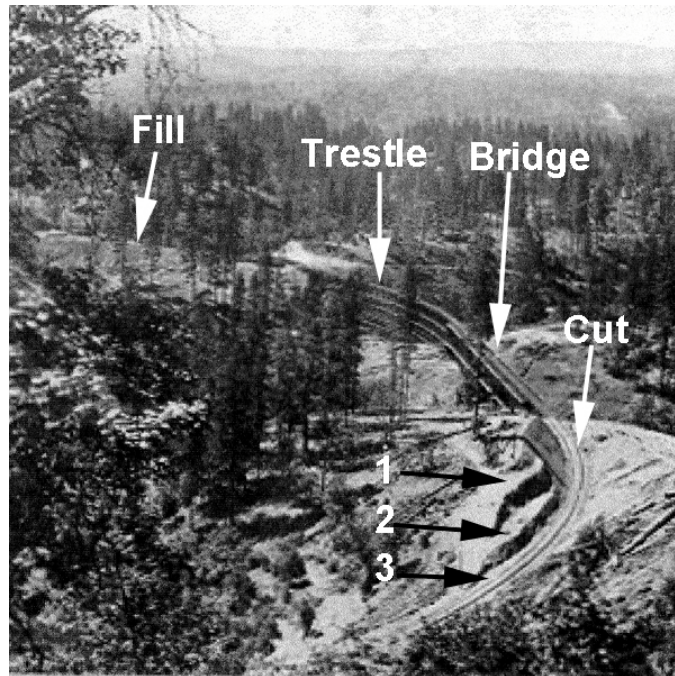


Figure 18 Choosing the best elevation for crossing Long Ravine Gap required compromising on the fill/trestle/bridge/cut as shown. The three cart roads that were used in 1865 are visible in the cut.

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.

About the Author

Jack's early years were spent in a small lumber town in the Sierra, Stirling City. That was a *company town* for over 50 years, owned and managed by the Diamond Match Company. Hauling logs from the woods to the mill was by Shay locomotives supported by small 0-6-0 saddle tank Porter yard engines. The lumber was then hauled to market by Southern Pacific. His father built and maintained the log hauling railroad cars. Riding in the engine cab or on the flat cars was allowed in those days. Railroading was fun for teenaged kids.

Company men operating D8 logging Cats with bulldozer blades built the railroads and truck roads in the woods. Jack was fascinated by the accomplishments of these operators on steep hillsides. They seemed to never make a mistake.

After graduating from UC Berkeley as a mechanical engineer he devoted most of his career to nuclear explosives but some other experiences involved photo analysis, surveying, civil engineering and foreign construction analysis. Probably the experience of analyzing construction activities, by studying overhead photographs in detail, was the most useful training of all for this study.

While Jack is not a railroad historian, he decided to use some of his experiences as an engineer to try to understand how the Central Pacific Railroad men built the road around Cape Horn. He became interested in that construction while reading the book *Legend of Cape Horn*.

This study made use of most of the experiences mentioned above. Previous to this study, he wrote the history book *To Donner Pass from the Pacific*. That book is a 150-year history of roads across California along the present I-80, primarily in the Sierra Nevada Mountains.



An eastbound freight train on curve 150 leaving Cape Horn in 2004

The book is available at Big Bend Ranger Station, Dutch Flat Historical Society, Placer Sierra Railroad Heritage Society, Placer County Historical Society and Smith's Bookstore in Auburn. It is also available from the author.

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Retail price \$13.95
 plus \$1.05 tax in California
 \$2.00 if mailed