MODIFIED ROCKFALL CATCH FENCE
MAYFLOWER CREEK - DETROIT DAM

Experimental Feature
Final Report

OR 84-01

by

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MAYFLOWER CREEK - DETROIT DAM
NORTH SANTIAM HIGHWAY #162
MARION COUNTY
EXPERIMENTAL PROJECT NO. 84-01
AUGUST 8, 1988

INTRODUCTION AND BACKGROUND

Many older rock cut slopes along the highways in Oregon are in need of repair. The rockfall from these slopes can present hazards to the traveling public. Ditches are often inadequate to restrict rocks from rolling or bouncing onto the highway. In some cases widening the ditch can solve the problem, but where the slopes are high this is not economically feasible. In these areas the State has used chain link fence draped over the slope and catch fences at the bottom of high slopes. Catch fences consist of an impact section and a screened section. The impact section captures rocks rolling down the slope and channels them through the screened section into the ditch. These types of slope protection can be used if the site is accessible and the slope uniform.

This experimental features project is located on the North Santiam Highway (#162) between Mayflower Creek and Detroit Dam, approximately 40 miles east of Salem. Here access is limited and the slope is nonuniform. To deal with the constant problem of falling rocks in this area the slopes were scaled, catch fences and slope screening were installed, and particularly hazardous rocks were secured with rock bolts. These are all routine functions to secure rockfall areas. On this project however, the following three modifications were proposed to the standard catch fence design and accepted as experimental features:

1. A triple twist (Gabion [TM] type) wire mesh was used instead of chain link fabric for the catch fence.

2. The length of the wire mesh draped from the fence was as long as 80 feet instead of the standard 15 feet.

3. Rock bolts were used to anchor the fence posts.

The construction aspects of these experimental features were rated as good in the Interim Construction Report dated July, 1986. Those evaluations are included again in this report for reference.

In addition, this report includes the results of a two year long evaluation of the fence's durability and performance. Durability is based on the fence's ability to withstand the climate and the impact of falling rock. Performance is based on the fence's capability to control rockfalls and thus reduce maintenance cleanup costs. These factors have been evaluated using a "good, fair, poor" rating system.

CONSTRUCTION EVALUATION

Gabion Type Wire Mesh

Gabion wire mesh fabric was used for the catch fence instead of the normal chain link fencing material. The fabric has 6-sided openings and consisted of #11 gauge wire with 0.8 oz. galvanizing per square *foot. The fabric was flexible and conformed well to the slope. The triple twist feature allowed the fabric to be trimmed without ravelling. The contractor elected to used fabric in 15-foot widths which reduced the number of vertical laps required. The fabric was relatively easy to work with and was given a rating of good.

Length Of Wire Mesh

The cut slopes consist of up to 50 feet of dark gray andesite overlain by bouldery soil The original highway cut in the andesite was constructed on about a 0.25H:1V slope with the overburden cut generally on a 1H:1V. To capture falling rocks, the catch fence was located at the break in the slope between the andesite and the upper 1H:1V slope. The catch fence (Figures 1 through 3) consisted of a 3/8-inch steel support cable with wound wire rope core passed through eyelets in the top of the fence posts; the ends were anchored into the slope. The screening was attached by hog rings to the wire rope than draped down the slope. Additional cables ran from the top of the screen to the bottom for additional support. The screening was not secured to the slope but allowed to hang freely. Another cable was attached at the bottom of the screen. This cable allows the screening to be pulled away from the slope, permitting trapped rocks to fall into the ditch for removal. Had a conventional slope screen been used, without the catch fence at the break, rocks would have collected at the break in the slope. This may have torn down the screen.

No construction problems were encountered. The rating of this feature is good.

Rock Bolt Fence Posts

The rock bolt fence post assembly is shown on Figure 4. The construction sequence was as follows. First, a hole was drilled into the rock and a continuously threaded rock bolt, 3/4 inches in diameter by 24 inches long, was grouted in place. Next a key hole plate and hex nut were put on the rock bolt. The rock surface had been preleveled for the plate. The nut and plate were set so one inch of the rock bolt extended above the hex nut. A two-inch stop type coupling was added and above this a 3/4-inch steel tie rod was installed. Extra tie rod length was included to accommodate slope variations. A four-inch O.D. steel fence post (minimum length six feet) slid over the tie rod. Longer fence posts were used where needed to maintain a level top fence line. The tie rod was cut so that one inch extended above the fence post. To the top of the tie rod a 1/4-inch steel plate and a one-inch eye bolt with a 3/4-inch tap was installed and used to tighten the fence post in place.

The rock bolt anchoring system for the fence post assemblies was recommended for two reasons:

1. To speed installation time where jack hammering a standard three-foot deep hole in rock would be too costly and difficult.

2. To allow for quicker and easier post replacement if a post was damaged after construction.

There were a few construction concerns with this feature. The first was due to the contractor and his fabricator misinterpreting the plans. They understood the plans to call for the key hole plate to be welded to the bottom of the fence posts. This made tightening the hex nut and the stop type coupling impossible. This error was corrected in the field by cutting the plates off the posts and regalvanizing the steel. The attached expanded assembly sequence drawing (Figure 5) which is now included in the plans has corrected this type of problem from occurring on recent projects.

Secondly, the contractor had difficulty developing level surfaces for the key hole plates in the rock. The rock tended to spall off along lines roughly parallel to the slope. This problem may have been avoided if a little more care and effort had been taken. In some cases the contractor had to develop level surfaces with grout. This proved to be an effective solution.

Finally, although attention was given to properly tightening the threaded eye bolt on top of the post, the fence posts had a tendency to slip along the key hole plate. Movement occurred when the fence support cable running from post to post was tightened to the prescribed amount. This caused no appreciable construction problems. However, on recent projects, this slippage has been eliminated by adding a one-inch high sleeve to the key hole plate. This addition is also shown on Figure 5. The short sleeve does not hinder tightening the hex nut or the stop type coupling, but helps to strengthen the system.

None of the above concerns were significant problems. The rating of the rock bolt fence posts is good.

DURABILITY AND PERFORMANCE EVALUATION

The modified catch fence has worked well during the past two years in restricting rockfall from the roadway. Most of the rockfall has been on the order of one foot or less in diameter; however some as large as two feet in diameter have occurred. The components have withstood numerous rockfall impacts without sustaining any noticeable damage or loss of ffectiveness. The rock bolt fence posts were designed to facilitate replacement if necessary. Since none of the fence components have required repair or replacement, this feature has not been utilized.

The fence is located in an area that normally receives 70 to 80 inches of precipitation annually. Much of this falls as snow. At times, plowed snow has buried the lower end of the catch fence allowing as much as five feet of rockfall debris to build up under the mesh. Although this was not anticipated, it has not caused any permanent damage to the mesh or the fence support system.

According to the area maintenance foreman, the modified catch fence has been very successful. Rockfalls are restricted to the narrow ditch; thus the daily road patrols once required to keep the highway cleared are no longer necessary. Ditch maintenance is performed as part of a scheduled routine.

Based on this two year evaluation, the modified catch fence has earned an overall rating of good both for its durability and performance.

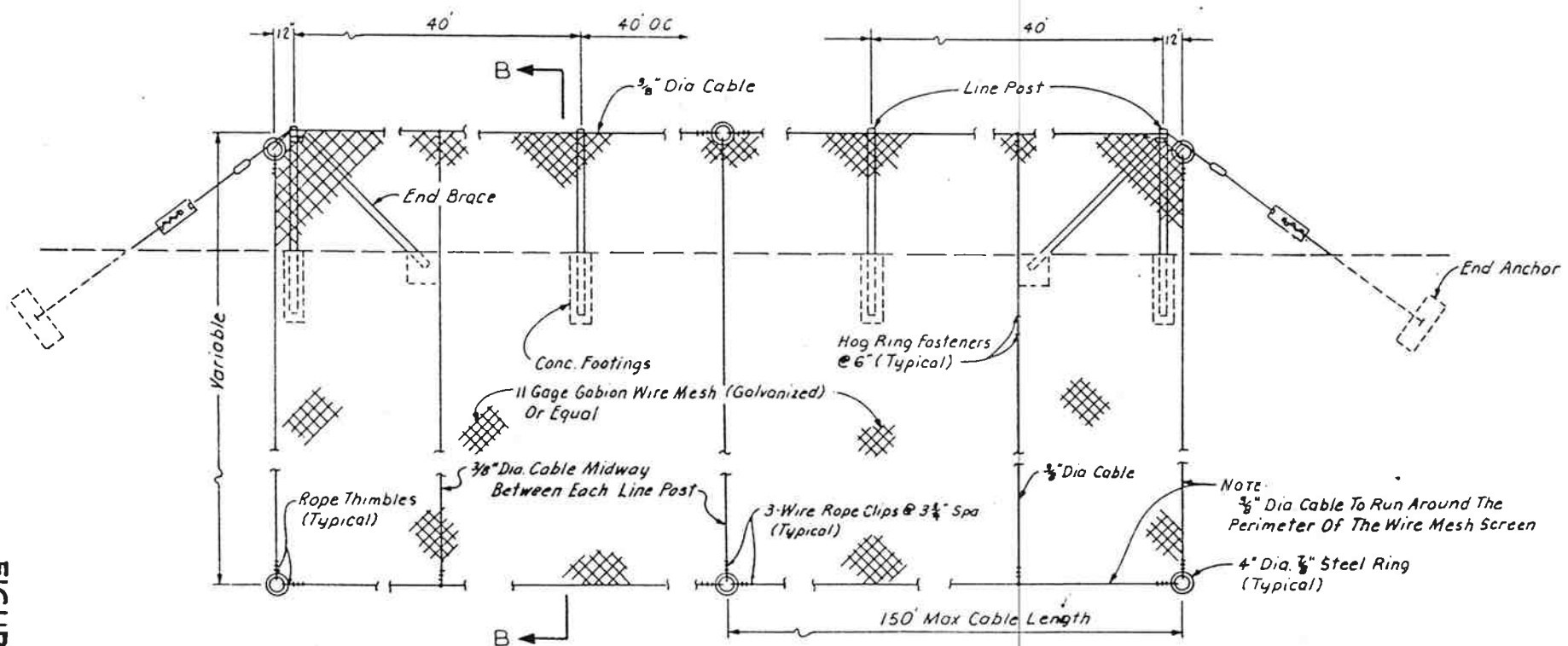
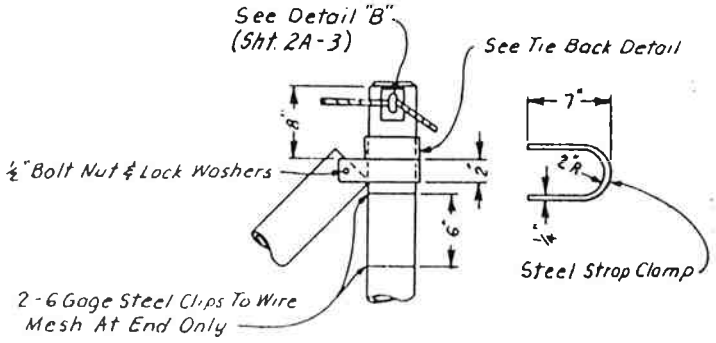
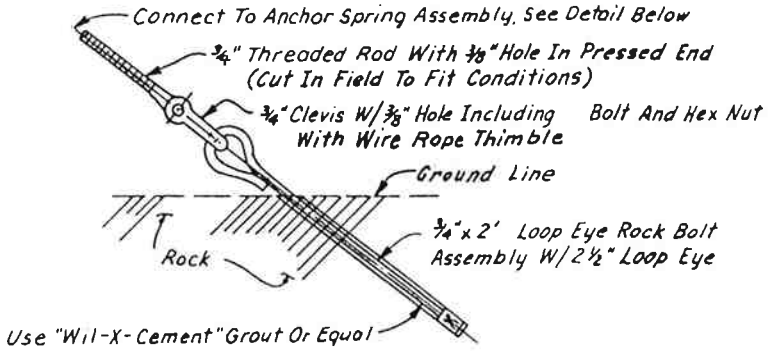

12"
40'
40' OC
40'
12"
B
5/8" Dia Cable
Line Post
End Brace
End Anchor
Variable
Conc. Footings
Hog Ring Fasteners @ 6" (Typical)
11 Gage Gabion Wire Mesh (Galvanized) Or Equal
3/8" Dia. Cable Midway Between Each Line Post
Rope Thimbles (Typical)
3-Wire Rope Clips @ 3 1/4" Spa (Typical)
3/8" Dia Cable
NOTE
3/8" Dia Cable To Run Around The Perimeter Of The Wire Mesh Screen
4" Dia. 7/8" Steel Ring (Typical)
150' Max Cable Length
B

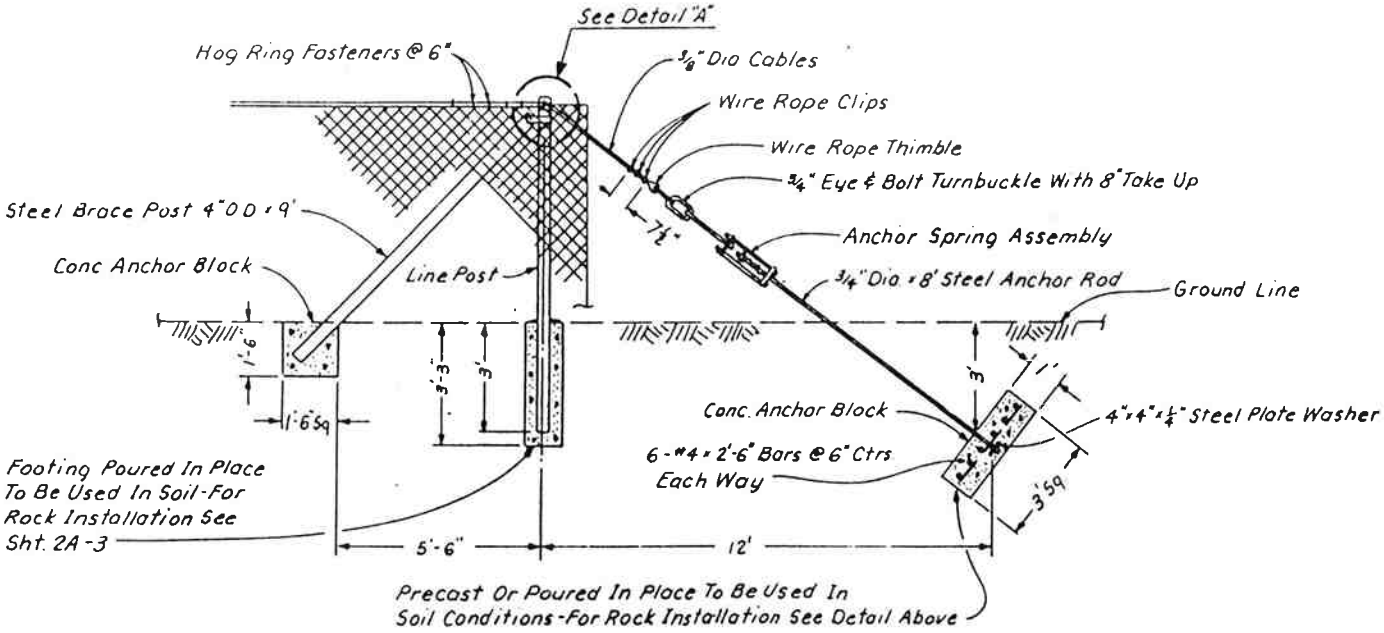
FIGURE 1 OF 5



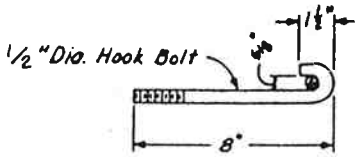
DETAIL "A"



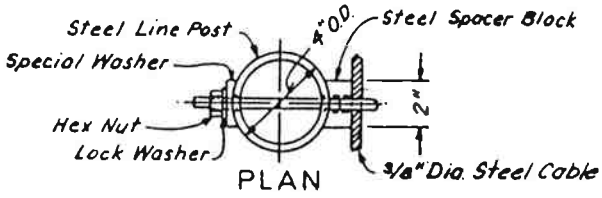
END ANCHOR
(INSTALLATION IN ROCK)



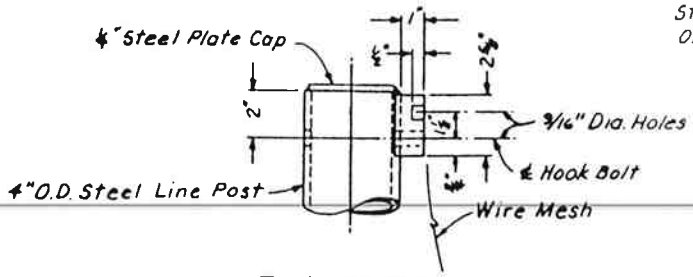
END ANCHOR
(INSTALLATION IN SOIL)



HOOK BOLT DETAIL

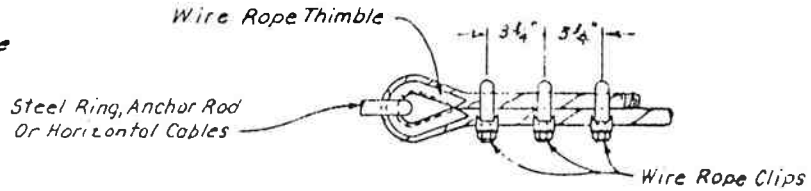


PLAN

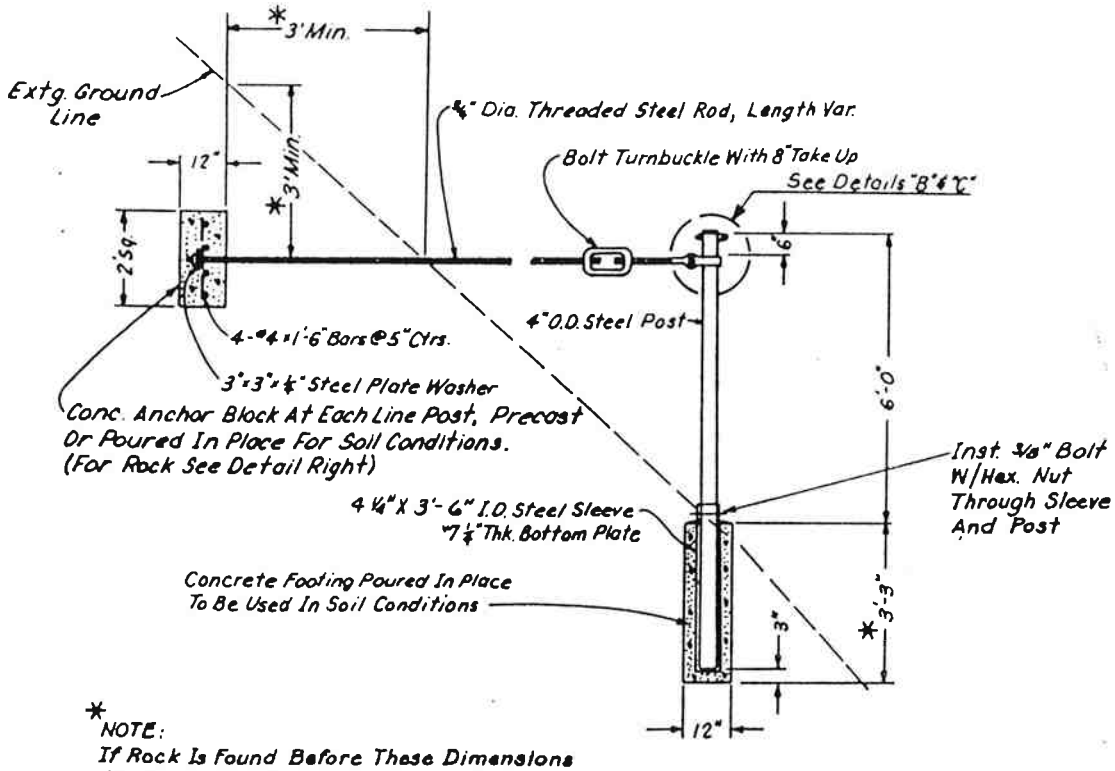


ELEVATION

DETAIL "B"



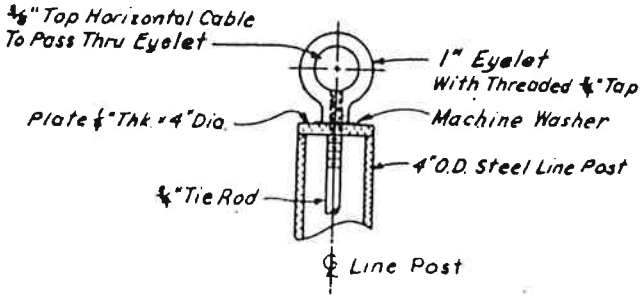
CABLE CONNECTION



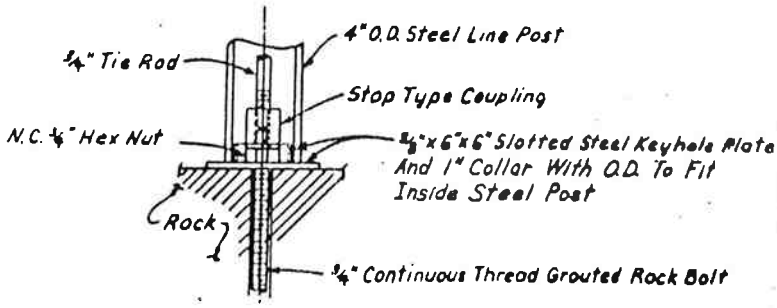
*NOTE:
If Rock Is Found Before These Dimensions Are Obtained, Then Use Method Shown In Detail At Right.

INSTALLATION IN SOIL

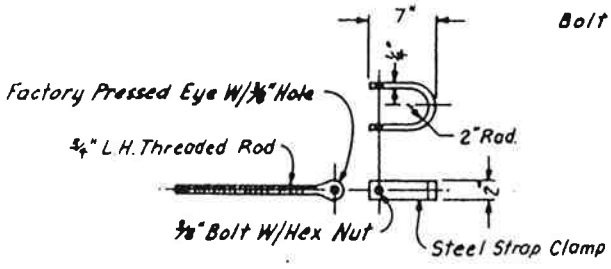
FIGURE 3 OF 5



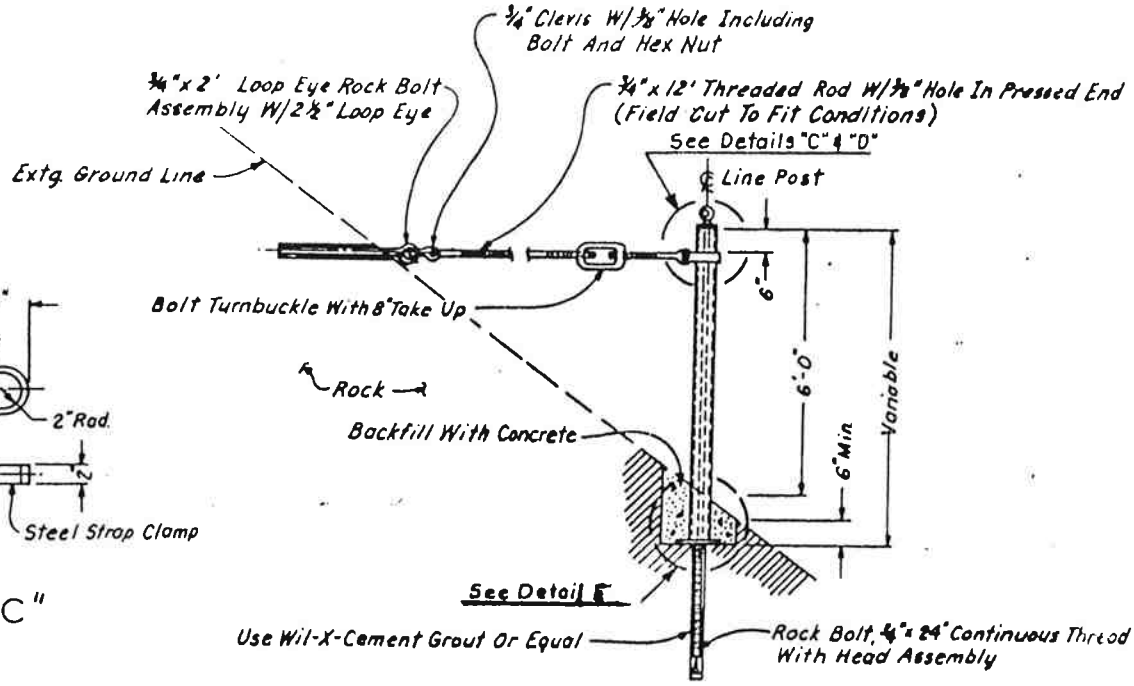
DETAIL "D"



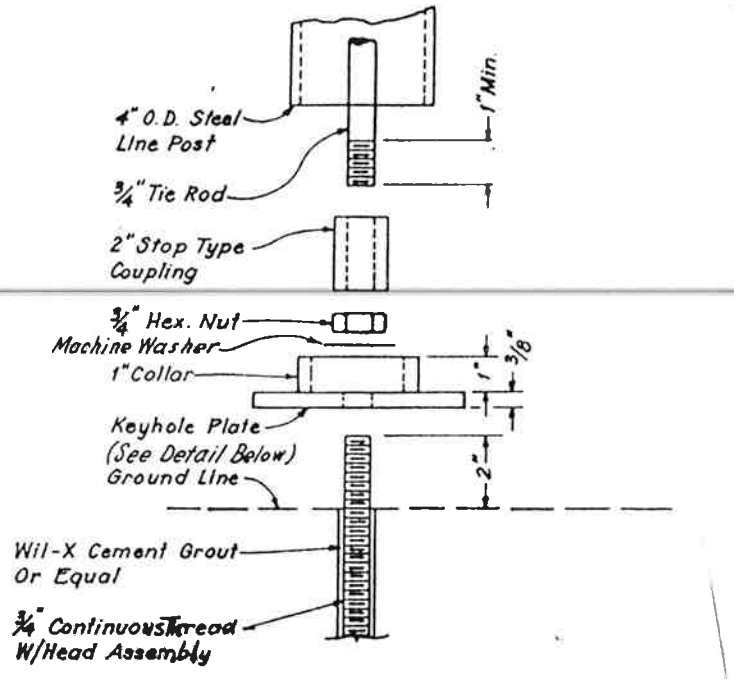
DETAIL "E"
(See Exploded View)



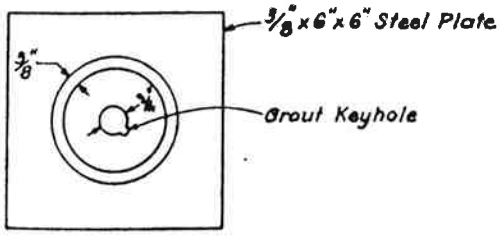
DETAIL "C"



INSTALLATION IN ROCK



EXPLODED VIEW DETAIL "E"



KEYHOLE PLATE

FIGURE 5 OF 5