National Radio Astronomy Observatory
Socorro, New Mexico

VLBA Antenna Memo Series No. 12

Brewster, WA VLBA Site Azimuth Rail Maintenance, July 14th

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Attachments: Repair Plot, Comparison Plot

This report details the use of our spot repair technique to stabilize and repair the VLBA Azimuth rail grout. This technique can be used to halt the growth of sagging areas but will not completely level the track if there has been extensive damage.

During the repair of the VLBA Azimuth Rail splices the entire rail was measured at each site. The rails are also now measured during every Tiger Team visit. These measurements revealed some areas of sagging rails between the previously repaired splices. These sagging areas will often sink deeper and grow with time. In 1997 the Los Alamos VLBA site suffered a dramatic failure at one of the sagging areas which required immediate repair. At the Mauna Kea site a sagging area began sinking at an exponential rate, requiring extensive repair.

These repairs require removing the old grout down to the foundation, cutting the jacking bolts and placing a plate under the rail to level it. We then replace the old grout with a superior grout to prevent future failures. This process requires a lot of time, people, equipment, and money.

During an early repair at the Mauna Kea site, we developed and tested a spot repair. This repair only requires the removal of the grout immediately under rail, creating a trench. This is then filled with new epoxy grout, which provides much better strength, weather resistance, and consistency than the original grout. This should stabilize the rail and prevent further damage but is much cheaper than repairing a major failure.

I performed a survey of the VLBA sites using the previously obtained rail elevations as well as new data from the Tiger Teams. A few sites had sagging areas forming, the most apparent of which were at Los Alamos and Brewster. By this time the spot repair at Mauna Kea had been supporting the antenna for two years with no degradation.

The work at Brewster was intended to be a preventative repair rather than a response to a major failure. In February we measured the rail elevations at Brewster to determine the extent of the work to be done at this site.

On Tuesday, July 14th, 1998, John Wall and I arrived at the Brewster, WA VLBA Site. We first measured the rail to see if there had been any movement since February. The rail does not appear to have sagged much since then.

To ensure that we would have enough new grout to fill in all the areas that we dug out (and prevent an embarrassing error) we performed this job in stages, removing a small section of grout and then pouring the new in.

On Tuesday and Wednesday we removed the grout from bolts 25-36 and 75-79. Using two 1.5" electric hammer drills, we first removed the Vulkem from the top of the old grout using a sharpened chisel bit. Large chunks of grout, up to 2" in diameter, would stick to the bottom of the Vulkem. This indicates that some of the grout is broken and detached. We then dug a trench approximately 10" wide and 2" deep between every bolt using a long 1" wide chisel bit. At a depth of two inches the grout was harder and becoming difficult to remove, a good sign that the damage was only to the top layer.

We used 1/4 inch plywood and clear packing tape to make forms and held them in place with concrete screws. Clear packing tape does not stick to the grout at all and

allows easy removal of the form. We mixed the grout using a wheelbarrow and hoe and used the full amount of component C (dry component). Normally, during a larger repair we short the C component a small amount to help the new grout to flow more easily. The high ambient temperature, about 90 degrees Fahrenheit, kept the grout runny and easy to handle.

We then similarly replaced the grout from the area between bolts 107 to 116.

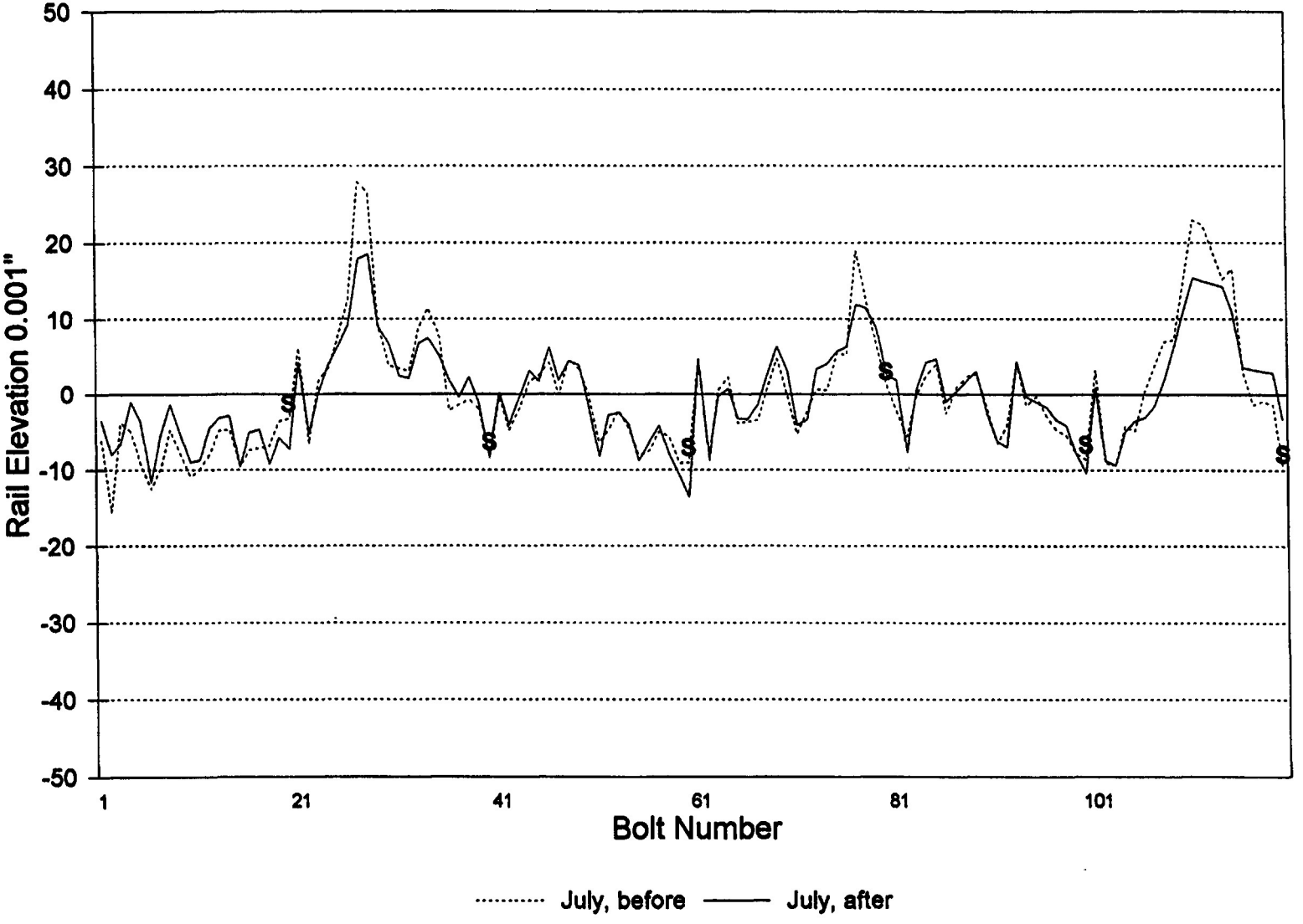
Using spot repairs, we were able to repair the area under 24 bolts with 10 units of grout and 90 person-hours. To do this with a full repair would have required about 44 units of grout, 225 person-hours, the rental of a 185 CFM compressor, 8 steel 220lb plates, and shipment of an 8x20ft container to the site. The approximate costs are about $4000 for travel, materials and tools for the spot repair, $13,000 for a complete repair.

I would not recommend using the spot repair technique where the rail has sagged more than 0.030", the grout is damaged or weak below the very top layer, or re-leveling of the rail is required. The spot repair also does not repair the grout immediately under the bolt plates.

The two charts following this report show the progression of the sag forming at Brewster from 1994, and the effects of our spot repair.

BR Azimuth Rail

Repair 1998



BR Azimuth Rail

Comparison 1994 through 1998