NATIONAL RADIO ASTRONOMY OBSERVATORY

June 12, 1978

ENGINEERING MEMO #123

STEPPING BAR SURVEY FOR THE 140-foot Telescope FOUR RADII TEST

John N. Ralston

1. Background

The first survey of the 140-foot telescope with the stepping bar was used in May 1977 on one radius. Countersunk holes were drilled into the 0.125 inch thick aluminum surface panels. These holes were fixed in depth and diameter as well as the distance between each hole. Although each distance between holes was drilled with a constant tool, they were measured separately since small lineal error was made during drilling.

The stepping bar, 650 millimeter nominal length, consisted of an aluminum channel with two precision steel tooling balls representing the measuring points. One tooling ball was fixed and the other one could be fixed and adjusted horizontally. With a micrometer fixed on the stepping bar, we could measure the distance between the tooling balls very precisely and in turn measure distance between the countersunk holes very precisely.

When the first survey was made we only measured the angular tilt of each step with an LSOC tilt-sensor.

The above survey was only to verify the behavior of the stepping bar on the telescope and to determine the feasibility of a complete survey of 48 radii later. Although it seemed feasible to measure the entire surface we still had the problem of drilling approximately 1550 countersunk holes in the 140-foot surface panels. Drilling that many holes seemed damaging to the surface and also very time consuming, so we decided to find another method of locating the stepping points on the radii.

Since the stepping bar points were precision steel tooling balls, it was only natural that we use a V-notched fixture for the tooling ball to rest against. The V-notched fixture required glueing so we came up with the nylon adhesive backed mounts manufactured by Panduit Corporation. These mounts are 1"13 x 1"13 x .187" thick. Our shop fabricated a tool to notch the nylon mounts. These mounts can be removed from the surfce without any damage to the surface.

It was also decided that we need to start the survey at a known vertex instead of assuming the x-y coordinates of a start point on the inner panel. We therefore established the vertex of the telescope through fixtures and instrumentation well known to our work. From this vertex we employed a special made bar and vertex target fixture which allowed us to span the opening under the Cassegrain Building to the design x-y coordinates on the inner panel.

We set the first start point with the coordinates fixed in the bar and a precise level on the bar. From the datum start point we set the remaining 47 points by rotating the bar from the fixed vertex. The difference in elevation was recorded for each start point from the datum start point.

The start point level data along with the perimeter levels may be used to determine the tilt constant of the telescope in the survey data reduction.

2. <u>Procedure for Setting the Vertex Start Points and Other Stepping Points</u>

Install the aluminum frame on the Cassegrain Building supports. Level the top plate in two directions using the Hilger-Watts Inclinometer with one-second resolution.

Install the vertex target fixture on the top plate and align to the mechanical axis of the telescope. The mechanical axis is defined by planizing the Hilger-Watts theodolite at the declination shaft mount to four hard points on the telescope superstructure. The target fixture is C-clamped so it will not move. After the axis is defined with the target, remove the target and install the fixed dimension bar in the vertex target fixture. The bar will now span the opening to the inner panel. Align the tooling bar on the pencil scribe line and install the first start point.

Rotate the bar in 7°.5 increments and install the remaining start points. Record the micrometer reading for the 48 start points.

Now that all of the start points have been established we continue to install the radius points using the 650 millimeter stepping bar as a fixed length tool. With the tooling bar resting on the surface and against the V-notched start point the other tooling ball on the stepping bar is aligned on the scribed line and a V-notched mount is snugged against the tooling ball making contact in the V-notch. This now establishes a second point on the radius which is used to step the bar to the next point on the radius by fixing a V-notched mount at each step. This procedure is continued until the 32 points are mounted on the radii.

The procedure for surveying the radii is exactly as the test survey in May, 1977 except that we have added the distance sensor as an input to the computer, as we measure, whereas before the distance was measured independent of the survey and may not have been exactly the same as when we actually surveyed.

3. Schedule for Personnel and Time

The actual survey of the four radii require a minimum of three people stetting the bar, handling the signal cables and communicating to the computer operator in the control room through the intercom. With this set-up the average time span to completely measure one radii is approximately twenty minutes including moving and changing cable connections and related computer operations between runs.

NOTE: Previous Engineering and 25-Meter Millimeter Wave Telescope memo's related to the stepping bar survey are Nos. 68, 70, 82, 94, 95, 121 and 122.