# Evaluation of Antenna Foundation Elastic Modulus

H. McGinness and G. Anderson
Ground Antennas and Facilities Engineering Section

*An experiment to measure the elastic deflection of the DSS 14 concrete pedestal under the weight of the antenna was conducted in February 1983 and is compared to a similiar experiment made in 1968. Comparison of the results confirms the decrease in elastic modulus measured on core samples recently taken from the pedestal.*

## I. Introduction

The 64-m antennas at DSS 14, 43, and 63 have hydrostatic azimuth thrust bearings. In order for the thin oil films, constituting these hydrostatic bearings, to be maintained at safe finite thicknesses, the bearing runner foundation must have a certain minimum stiffness and dimensional stability. Since the foundation pedestal of this antenna design is made of steel-reinforced concrete which is stressed only moderately by the antenna loads, it was supposed that its stiffness and stability would last indefinitely. Recent investigations have disclosed that the DSS 14 foundation is undergoing alkali-aggregate reaction, a phenomenon caused by acidity of the aggregate. This reaction causes the aggregate-cement bond to fail, thus causing a reduction in the strength and in the elastic modulus. Of the three 64-m antennas, only the one at DSS 14 is known to contain aggregate which permits the occurrence of this phenomenon.

## II. Description of the Experiments

In 1968 a sensitive and accurate level (trade name Talyvel) was placed on a runner outer alignment lug near trough azimuth 283 deg. (See Fig. 1 for definitions of trough and antenna azimuth angles.) The level was mounted so as to read slopes in the tangential direction. When the antenna azimuth was 157 deg, the left front bearing pad was centered opposite the Talyvel level at trough azimuth 283 deg. At this point the level was set to read zero. Then the antenna was moved counterclockwise 120 deg, with the level readings being made every 5 deg. The antenna was then moved clockwise 120 deg, with the level readings being repeated every 5 deg. This was equivalent to measuring the slopes at various distances from the loaded pad.

The relative vertical deflection between two points can be obtained by numerically integrating the slopes between the same two points. The result was that the relative deflection between the pad center and a point halfway to the center of the next pad, 60 deg away, was 1.07 mm. If the assumption of zero absolute deflection at the midpoint between pads is valid, then the relative deflection between the pad and midpoint is also the absolute vertical deflection at the pad center.

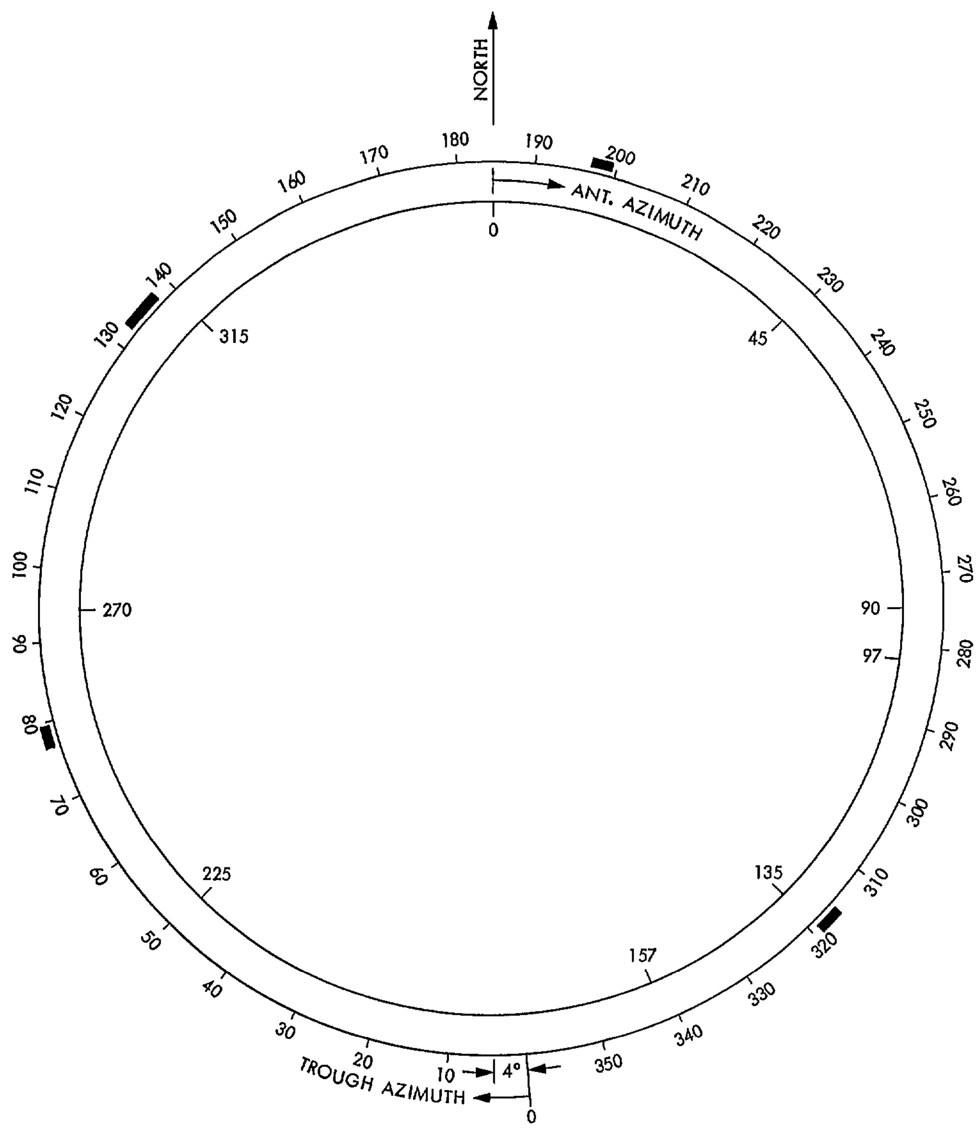
On February 28, 1983, similar experiments were made. Talyvel levels had been mounted on the runner outer alignment lugs near trough azimuth stations 79, 199, 319, and 135 deg. Additionally, levels had been mounted near the outer edges of the top of the concrete pedestal at these same trough azimuth angles. Since the first three of these angles are spaced 120 deg apart, which is also the spacing between the three hydrostatic bearing pads, three sets of data were collected simultaneously. The fourth level position at 135 deg trough azimuth was so placed because of the history of much runner shimming at this station. Unfortunately the level on the alignment lug at station 319 deg did not work properly, but all the other levels performed satisfactorily and the repetition errors were small. Because of symmetry it is believed that the deflections derived from these levels can legitimately be compared to the 1968 deflection. The three relative deflections derived are 1.59, 1.59 and 1.80 mm, the average value of which is 1.66 mm. When the pad centerline was within 10 deg of the level, readings were taken in 1-deg increments. When the pad was more than 10 deg from the level, readings were taken in 5-deg increments.

It is believed that the errors on these deflections do not exceed 10%.

## III. Conclusion

The relative deflection between points of an isotropically elastic structure is inversely portional to the elastic modulus. Since the present average relative deflection of 1.66 mm is significantly greater than the 1968 relative deflection of 1.07 mm, the present elastic modulus is 1.07/1.66 or 64% of the 1968 elastic modulus.

Several core samples have been taken from the pedestal within the last year. The measured elastic moduli of eight samples taken in December 1982 had an average value of $2.3 \times 10^{10}$ pascals and a standard deviation of $0.5 \times 10^{10}$ pascals. Soon after construction of the pedestal in 1964 the elastic modulus was $3.8 \times 10^{10}$ pascals. It is believed that there had been no deterioration of the modulus by 1968. The ratio of the current modulus to the 1964 modulus is 2.3/3.8 or 60%. This core sample modulus ratio of 60% checks fairly well with the measured deflection ratio of 64%.




$A_{TROUGH} = A_{ANT} + 360\,n - 174°$, WHERE $n = 0$ OR 1

**Fig. 1. Location of level instruments on runner outer lugs**