USE OF GROUT PADS FOR SIGN AND LIGHTING STRUCTURES

PROBLEM STATEMENT

Base plates are structural elements used to connect structural members to their foundations. They are commonly used in conjunction with tubular high mast poles, roadway light poles, and traffic mast arms. The base plate connects the sign or lighting structure to its foundation with anchor bolts using a double nut installation.

The Florida Department of Transportation (FDOT) recommends that a grout pad be placed beneath the base plates of all of its sign and lighting structures. Many states are eliminating this requirement from their specifications for these structures, suggesting that grout pads prevent visual inspection of the anchor bolts for possible corrosion due to weathering. Currently, very little information is available regarding both the structural and serviceability benefits of placing a grout pad beneath base plates.

OBJECTIVES

This research study was conducted in two parts: the first part dealt with structural evaluation and the second with durability. The objectives of Part I were to evaluate the structural behavior of sign and lighting structure base plates with and without grout pads, and to develop design criteria for evaluating strength and serviceability. The objectives of Part II were to acquire sufficient data to investigate the corrosion of the base plate arrangement, to compare the corrosion of embedded bolts and nuts of the base plate arrangements with and without grouts, and to make recommendations for the use of grout pads under base plates for lighting and signing posts.

FINDINGS AND CONCLUSIONS

A total of ten base plate tests were performed in Part I of this study. The test system consisted of a tubular member socket-welded to an annular base plate, which was connected to a concrete test block with multiple anchor bolts. Each of four base plate specimens were tested with and without a grout pad. Two additional tests were conducted

on two of the four specimens, utilizing both grout pads and plate stiffeners. Based on the tests, the following conclusions were drawn:

- The use of a grout pad with unstiffened annular base plates was not found to provide significant enhancement to the stiffness of the base plate connection. In fact, the additional stiffness was found to be offset by the amplification of the loads carried by the tension bolts. The increased loads on the tension bolts was a result of a reduction in the internal moment arm due to the flexibility of the base plate coupled with the large contact area between the compression region of the plate and the grout pad. As opposed to the condition with no grout when the compressive reaction is located on the bolts, the combination of the flexible base plate and grout pad permitted the compressive reaction to move inward toward the attached member reducing the internal moment arm, thus increasing the loads on the tension bolts.
- The connection stiffnesses of the base plate specimens tested with grout pads and plate stiffeners were notably improved by the combination of these two components. In addition, the loads in the tension bolts of the base plates fitted with both grout pads and stiffeners were lower than the loads in the tension bolts of the plain base plates. This was because the combination of the grout pad and stiffeners forced the plate to rotate largely as a rigid body, thus increasing the internal moment arm of the connection.
- The use of beveled washers beneath the base plates in conjunction with the grout pads did not have any visible benefit based on a single test performed with beveled washers. No additional load was carried by the grout, the connection stiffness was not enhanced, and the tension bolt loads were not reduced.
- Design criteria are recommended for the strength design of base plates, including plate thickness and the size of the anchor bolts. The experimental observations found that bearing of the base plates on the grout pads was not a primary concern for the design of these elements when using typical manufactured grouts approved for use by the FDOT.
- Design criteria are also recommended for evaluating deflections of the mast arm structure caused by rotation of the base plate assembly (including the effects of both plate rotation and rotation resulting from the flexibility of the anchor bolts).
- The use of a grout pad alone with annular base plate specimens was not found to provide a significant structural enhancement to the connections. Structural improvements were observed when the grout pads were combined with plate stiffeners.

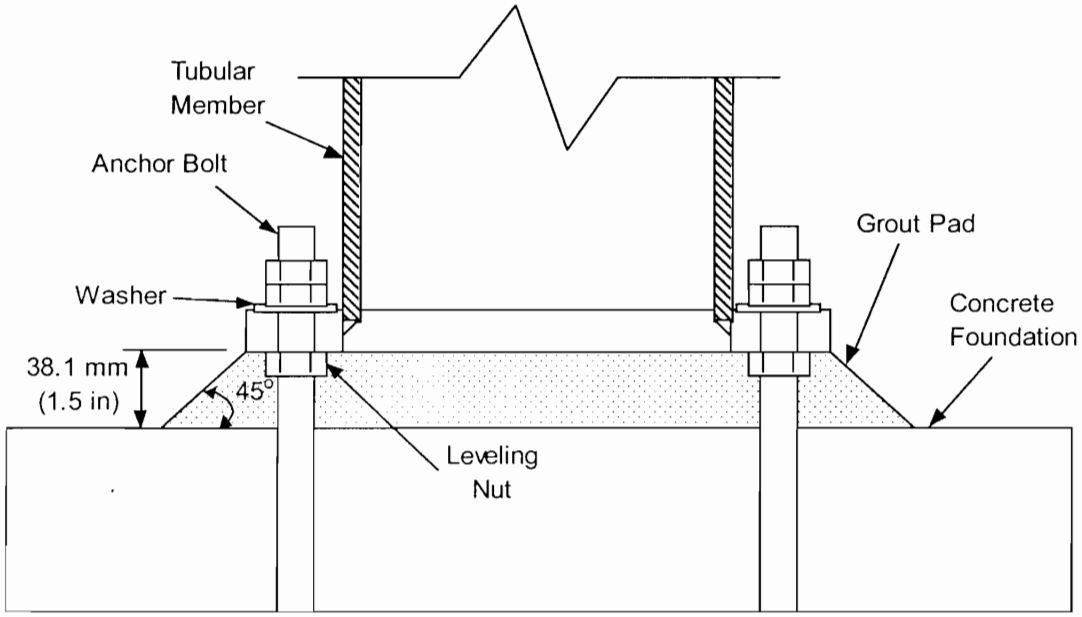
In Part II, measurements of the corrosion of the embedded bolts and nuts in two grouted base plate assemblies, one with a grout of high water absorption rate and the other with a grout of lower water absorption rate, were made and compared with the corrosion of bolts and nuts in similar base plate arrangements without grout pads. Three methods of measurement were employed: (1) electrochemical, (2) weight loss, and (3) visual assessment. The results of the tests demonstrated the following:

- The use of a grout pad under signing and lighting poles protects both the embedded metals and the base plate of the assembly. The weight loss measurements showed that the corrosion of the anchor bolts and nuts in the assembly without a grout pad was of the order of about 10 times the corrosion in the assembly with a grout pad. Also, grouts protected the annular base plates. Maintenance of the base structures, therefore, can be significantly minimized with the introduction of grout pads.
- Corrosion of the embedded anchor bolts in the base plate assemblies could not effectively be

monitored with the electrochemical measurements using the linear polarization resistance technique with the guard ring electrodes as in the P-R monitor version 4.40C. Difficulty in positioning the guard ring electrode directly over the bolts, the presence of varying moisture contents in the different test specimen configurations, and the presence of the effect of zinc made the half cell corrosion potentials and corrosion rates measured in this project not quite reliable and so could not be used as a basis of comparison for the three different arrangements.

- The statistical analysis of corrosion measurements by the weight loss technique showed that there was no significant difference in the protection offered by different grouts used in this study.

In summary, the use of grout pads provides a substantial increase in resistance to corrosion but does not provide a significant structural enhancement to the connection unless coupled with the use of base plate stiffeners.



FDOT grout pad requirement

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