Proper Design Concepts of Original Anchor Bolt Installations

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Technology from the Leaders in Foundation Repair and Regrouting

Anchor bolts have not been properly installed on many of the heavy machinery installations built in the past. This deficiency has resulted in drastically reduced bolt effectiveness, created grout problems, and in many instances been responsible for cracking of foundations.

It is a standard practice to install anchor bolts in a foundation at the same time the reinforcing steel cage is fabricated and installed. Typically, the anchor bolts are located with the aid of a template created from engineering drawings. It should be a common practice to isolate the upper portion of the bolt with a sleeve. The purposes of these sleeves are twofold. First, it allows stretch of the bolt during torquing. Secondly, it provides a degree of freedom for the anchor bolt, which compensates for minor positioning errors. The proper terminology for these sleeves is "anchor bolt sleeves". These sleeves are often incorrectly referred to as "grout sleeves". Grout should never be placed in anchor bolt sleeves because bonding to the anchor bolt by the grout, particularly epoxy grout, prevents proper stretching and defeats the main purpose of the sleeves.

The stretching of an anchor bolt between the bottom of the sleeve and the bottom of the nut is desirable to create a spring effect that will absorb impact without fatiguing when the bolt is tightened to proper torque. Bolt load should be calculated to prevent separation between the bottom surface of the nut and the machine boss when the bolts are subjected to operating forces, and in cases involving cyclic loading, to protect the bolt from fatigue effects of alternating tensile and compressive stresses.

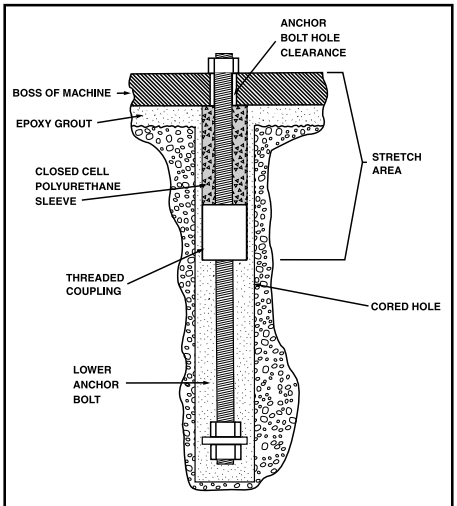


Fig. 1: A sketch of a properly designed original anchor bolt installation.



Fig. 2: A photograph showing foundation cracks at an anchor bolt. This crack is in a plane perpendicular to the crankshaft.

Figure 1 is a sketch illustrating a proper anchor bolt installation. Molded polyethylene sleeves are manufactured for the popular bolt sizes. They are designed so the ends of the sleeve fit tightly around the bolt in order to center the sleeve, prevent concrete from entering the sleeve when the concrete foundation is poured, and at the same time, prevent water applied to the foundation for moist concrete curing or rainwater from entering the sleeve. After the concrete has cured, the surfaces to be in contact with grout are chipped away to expose the coarse aggregate. Immediately before positioning the equipment on the foundation, the upper end of the sleeve is cut off even with the top of the foundation and removed. Care must be taken to assure that water will not enter the sleeves and be allowed to freeze and crack to foundation, particularly on outdoor installations. After the equipment has been positioned on the foundation, leveled and aligned, the grout sleeves are filled with a pliable material such as a castable polysulfide-epoxy joint sealant or closed-cell polyurethane sleeve.

Filling the sleeve with a pliable material will allow for movement and stretch, and at the same time prevent accumulation of lubricating oil in the sleeve after equipment startup. Lubricating oil will, in time, degrade concrete.

Figure 2 is a photograph illustrating the cracking of a foundation at an anchor bolt with the plane of the crack perpendicular to the crankshaft. After startup, the machine may grow as much as 0.25" from thermal expansion. This crack was caused by grout being placed in the anchor bolt sleeve during original construction thereby restricting movement of the bolt.

Figure 3 is a photograph of the foundation after regrouting. The exposed portion of the anchor bolt was isolated with a tubular closed-cell polyurethane sleeve prior to repouring the epoxy grout. An expansion joint was installed to prevent new cracks from forming. After the grout has cured and the forms have been removed, the expansion joints and the outer periphery of the machine base where the grout contacts the boss are sealed with oil-resistant silicone rubber. The silicone provides a barrier against infiltration of oil and other liquids into the foundation.



Fig. 3: A photograph after regrouting. Note the expansion joint at the anchor bolt and that the outer periphery of the machine base has been sealed with a fillet of silicone rubber.

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