Causes and Solutions for Voids in Grouts

OVERVIEW
Cementitious and epoxy grouts are used in a variety of industrial applications. Construction and installation conditions on a project often result in departure from recommended means and methods documented in the product literature. One common result of such field deviations is the occurrence of voids, or hollow areas, under a baseplate. Many of these issues can be repaired with little to no concern for the long-term serviceability of the grout; some cannot. This document will address various causes of voids in grouts and provide guidance for making informed decisions about the overall condition of the grout. Methodologies for repairing such voids will also be presented to ensure the long-term performance of the installed equipment.

UNDERSTANDING VOIDS
Voids, or hollow areas, can occur under baseplates as a result of several variables (Figures 1, 2, 3). Several of the more common reasons are as follows:

• Mixing
  o Improper (or over) mixing a grout may result in the entrapment of air bubbles within the grout. As the grout flows under the equipment and fills the void under the baseplate, settlement results in this excess air migrating to the surface of the grout at the bond between the grout and the baseplate. Such voids are typically discrete and cannot be easily repaired. Overwatering cementitious grouts can result in segregation. In the event of segregate, a froth can result that, again, will migrate to the bond line between the grout and the base plate. Improper or overmixing epoxy grout (Figures 4,5) typically results in the entrapment of air bubbles that result in a poor bearing area. These small voids are typically discontinuous and cannot be readily repaired.

• Temperature
  o Both elevated and cool temperatures affect the workability of most grouts. Cold temperatures can result in sluggish flow and elevated temperatures often result in shorter working times. During installation, one may attempt to compensate for poor flow by pouring the grout from multiple locations in an attempt to get the grout to flow under all areas of the baseplate. In doing so, voids often form as a result of the grout not flowing completely under all areas of the baseplate. Such voids usually occur as large pockets that range in size from several square inches to several square feet. Typically discovered from sounding the baseplate or noticing a variance in material yield, such voids can often be repaired if access to the voids can be gained.

• Loss of bearing area
  o Formwork that is not water-tight can result in a loss of bearing area of the grout. Small gaps in formwork result in the installed grout leaking as it sets, resulting in separation between the grout and the baseplate. This small gap can typically be repaired using standard injection methods with no concern of long-term serviceability.

• Loss of head pressure
  o When not pumping, a head box is recommended for grout installations to ensure adequate head pressure to force the grout across the dimension to be grouted. If a continuous head pressure is not maintained, large air bubbles or gaps will become incorporated within the grout and may collect at the baseplate/grout bond line. Moreover, a lack of head pressure may require placing the grout from opposite sides of the installation, thereby resulting in gaps or voids as described earlier.
  o If pumping, it is important to utilize a tremie methodology and slowly back the hose out from the far end of the volume to be grouted, limiting hose movements. Pumping from a single location requires the grout to flow on its own. Without the benefit of positive pressure from the pump, gaps or voids can occur as described above. If a tremie methodology cannot be employed, it is important to secure or weld hose couplings to the plate to ensure positive pressure.

Figure 1: Poor bearing area showing many, discrete voids as a result of overmixing a cementitious grout.
SOLUTIONS FOR REPAIRING VOIDS

Small, discrete voids at the bond line between the grout and the baseplate are difficult to detect and cannot be repaired. Too much air or segregation typically presents itself as low compressive strength if samples are being tested on a project. If compressive strength samples are not being taken, such voids typically go undetected.

Larger sized voids can be filled or repaired if access is created. Tapping the baseplate or drilling horizontally through the foundation or grout (Figure 6) are two common techniques to generate access to voids. In such cases, the crack surface should be sealed using a structural epoxy paste (e.g. MasterEmaco® ADH 327RS) and injection ports such as Zerk fittings should be fixed over the crack on 4–6” centers. A low viscosity, structural epoxy resin (e.g. MasterInject® 1380) can then be injected into the crack using a grease gun (Figure 7) or a plural component pump (Figure 8). For existing cracks in an aged grout that may contain water and/or oil, MasterFlow® 647 should be used. Note that this product is a 1:5:1 mix ratio and most plural component pumps cannot be used.

An alternate solution for addressing fine, vertical cracks is to not fill them; rather a coating can be applied to limit water ingress in exterior applications where freeze-thaw is of concern. When coating grout shoulders, MasterProtect® HB400, or similar, should be considered. With any coating, the grout surface must be mechanically prepared to provide an adequate bond.

Horizontally oriented cracks at or below the grout/foundation interface are cause for concern. Shear stresses associated with the mechanical transfer of energy from the equipment through the grout and into the foundation will result in continued cracking, loss of adhesion and misalignment of the equipment. In many cases, it is possible to engineer a solution to ensure continued performance and reliability of the grouted equipment. In other cases, removal and replacement will be the only option. It is advisable to consult BASF Technical Support for options in such situations.
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