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WHITE PAPER

**QA/QC PROCESS ASSOCIATED WITH
CONTROLLED MODULUS COLUMN
(CMC)[®] RIGID INCLUSIONS**

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INTRODUCTION Quality assurance and quality control (QA/QC) is an area Menard takes great pride in for all of its geotechnical solutions. With respect to Controlled Modulus Column (CMC)[®] rigid inclusions, Menard has developed an extensive QA/QC program covering all aspects of the project, including material testing, real-time monitoring, and field verification tests, to ensure that a quality solution is delivered every time.

BACKGROUND With any geotechnical solution, QA/QC is arguably the second most important area to understand (next to safety). By employing a well-defined, well-executed, and thorough QA/QC program, Menard ensures that the solution we provide will meet the requirements of the project and design, while satisfying the expectations of the client. A poorly executed QA/QC program can lead to discrepancies between what was designed and what is built, resulting in issues with the performance of the installed system. Since this is not a desirable outcome for Menard or the client, we have developed a QA/QC program that starts before we arrive on site, continues through the duration of the installation process and extends even after the installation of the CMC rigid inclusions.

The QA/QC Process for CMC Rigid Inclusions

The QA/QC process begins before the project starts, through the submittal of Means and Methods and Supplemental Specifications documents. Not only do these documents contain a step-by-step description of the installation process, but they also outline the QA/QC measures that will be put in place and explain the requirements of each measure. Communicating these

requirements early on in the process allows everyone involved in the project to review the QA/QC and develop an understanding for the deliverables expected and required from each party involved.

Before any CMC rigid inclusion project begins, Menard will provide an acceptable grout mix design from the preferred supplier. This mix design is reviewed by Menard and designed to meet the minimum compressive strength indicated in the design report, while maintaining the pumpability requirements needed to safely and

effectively be pumped through the grout lines of the installation equipment. Every batch of concrete that arrives on site will be checked against this mix design to ensure that the appropriate mix is being used at all times. Additionally, grout break cylinders will be taken and slump tests will be performed on a daily basis to check the performance of the mix design against the minimum design requirements and specifications.

As the CMC rigid inclusions are being installed, a real-time monitoring system is utilized in the rig to track installation parameters constantly during the installation process. Parameters that are tracked include rotary and crowd pressure, depth, grout pump strokes and pressure, rotation speed, and torque. The monitored information is displayed in real time on a screen in the drill rig, so the



Fig 1: Onboard real-time monitoring system for CMC rigid inclusions

operator is able to instantly observe the installation parameters as the CMC rigid inclusion is being installed. Because the operator is able to view the installation parameters in real time, in many cases a CMC rigid inclusion that is installed outside of acceptable tolerances can be immediately replaced in line with normal production in that area. In addition to displaying in the rig, the monitoring system also records the parameters for every CMC rigid inclusion that is installed. At the end of each shift, the engineer processes these files to create installation reports of every CMC rigid inclusion installed during that shift. Through careful examination of each report, Menard can determine if any of the CMC rigid inclusions were not installed in accordance to the specifications and take the necessary remediation steps. Though rare, if the monitoring system fails, the operator always keeps a handwritten log of each CMC rigid inclusion installed.

In order to confirm the validity of the design of the CMC rigid inclusion system, Menard has the capability of performing several different types of load tests. The most commonly utilized load test most closely resembles the ASTM 1143D “quick load test”. This single element load test is effective for confirming the parameters used in the design of the CMC rigid inclusions are justified. In most cases, the load test will be set up by installing four reaction elements, followed by the test element. While Menard continues to install production elements, the load test CMC rigid inclusion is allowed to cure until sufficient grout strength has been achieved—typically seven days, although strength may be reached and the test performed sooner in some cases. Once the load test apparatus is set up and the test is run,



Fig 2: Example of single element load test on CMC rigid inclusion

Menard’s engineers evaluate the data and provide a written report on the performance of the load test. In some cases, an area load test is more appropriate to properly evaluate performance of the CMC rigid inclusion system. An area load test would typically include the installation of an array of CMC rigid inclusions, the placement of a Load Transfer Platform (LTP) and instrumentation such as settlement plates, multi-depth extensometers, strain gauges, inclinometers, piezometers and shape arrays. The area load test is then loaded, generally using a fill material,

to model or exceed the design load from the future structure. The benefit of the area load test is that it enables the engineers to test the CMC rigid inclusions as a combined system, rather than testing a single element. The area load test requires careful planning, additional monitoring time and setup, while also incorporating more advanced instrumentation. However, the results can be much more useful for analyzing the performance of the CMC rigid inclusion system as a whole and offers geotechnical feedback that allows for added economy through the refinement of the CMC design.

Finally, once the CMC rigid inclusion installation is complete, Menard requires compaction testing during specific intervals of the LTP placement. The LTP is an integral part of the CMC rigid inclusion design and as such requires careful observation, inspection, and testing while it is

being placed. The frequency for the compaction testing can be found in the supplemental specifications or the CMC rigid inclusion shop drawings provided by Menard. Additionally, the LTP material will have to be approved to meet the specified gradation requirements, which can also be found

in the supplemental specification or shop drawing submittals.

CONCLUSION QA/QC is an important part of every project—it's how Menard can ensure that the system being installed is on par with the geotechnical demand required of the ground improvement system. By assessing the quality of the materials used in the installation process, monitoring the CMC rigid inclusions as they are installed in real time, and verifying the CMC rigid inclusions through field testing, Menard has developed a comprehensive plan to confirm that the ground improvement solution provided will meet the needs of its clients.

GOING FORWARD Interested in learning more about our QA/QC processes? Contact Menard today!

Get in touch with Menard today at **412-620-6000** or visit us at **www.menardusa.com** today to find your local Menard representative. For more information, sign up for Menard's newsletter, The Column.



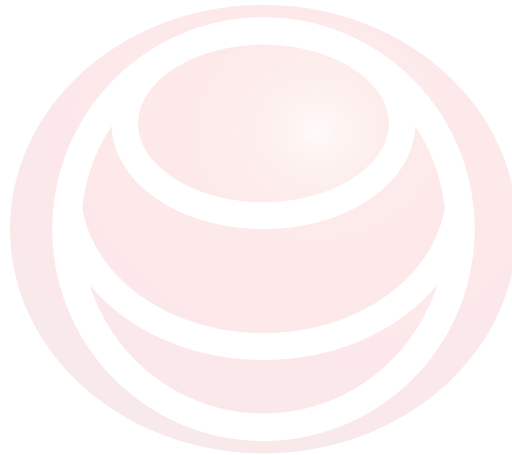
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