QA/QC Construction Supervision . . . or "Just Wing It"

By Major Jeffrey J. Johnson

Quality assurance (QA) and quality control (QC) are two of the most important elements of any engineer construction project. However, QA/QC have not been officially proclaimed a part of the engineering process, and there is a trend among the junior officers and non-commissioned officers (NCOs) throughout the services to not employ the conceptual practices of QC. Additionally, senior leaders in the battalions and squadrons are not mentoring and developing a solid QA program within their organizations that ensures the success of the project and the service members involved in the construction.

The unit is responsible for maintaining construction standards as outlined in the design specifications, plans, and other standard engineering documents. How is this guaranteed? Supervision. Why is it important? There are many obvious reasons: safety; savings in time and materials; superior product or outcome; service member satisfaction and reduced frustration; training in organization, management, and construction techniques; unit reputation; and mission accomplishment. In other words, QA/QC provide a little more predictability in an often-unpredictable profession. Figure 1 shows improper bracing and construction of forms.

Figure 1. These forms were poorly constructed and not inspected. Notice the blowing and waving effect.

Engineering Process

Thousands of military engineers are trained in the engineering process annually at our formal schools. This process involves six fundamental elements: project management, planning, design, construction, operations/maintenance, and disposal. All six elements exist in almost any engineering undertaking. So which element does QA/QC fall under? None, some, or all? Up until now, not once during that formal school experience in the military was the phrase "QA/QC" emphasized, nor did students receive a block of instruction on how to set up a QA/QC program and implement it on a construction project. It's possible that it was camouflaged in the title of "leadership" or cloaked somewhere in the project management block of construction. Yet, as a company grade officer and the officer in charge (OIC) of many projects, I often found myself figuring things out through "on-the-job training"—and many of the problems were related to QA/QC.

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Units from all services execute various types of projects (from simple to very technical) and implement their own concept of a QC program. Some of the programs are very good, but some are almost nonexistent. The quality of the program depends partly on the leadership, but a lot also has to do with the lack of formal instruction on the QA/QC process. It is a refined skill and program that needs to be taught as well as learned.

QC Recommendations

The project OIC needs to be concerned with the QC of the project, which can be broken into a phased control method. The complete performance of the control phases is the unit's responsibility, not the customer's or any third party's (such as outside contractors, material procurement representatives, or inspectors). The role of the S3 shop is to ensure that the control phases are performed thoroughly, in a timely manner, and by knowledgeable, unit-designated QC staff. Enforcing an existing unit SOP is always a good method. If there is no SOP, the U.S. Army Corps of Engineers implements a QC concept consisting of four phases: [1]

Preparatory Phase

This phase begins with actions in advance of construction. A few examples are reviews of designs, details, specifications, test reports, and mix designs; a physical check of material on-site against approvals and customer requirements; safety checks of equipment; and other preparatory steps that depend on the particular operation. This phase is active from the start of planning to the initiation of construction.

Initial Phase

This is the time for the unit, customer, and any third party to ensure or reestablish standards of workmanship. If there are differences of opinion on the interpretation of construction requirements, the issue can be discussed and settled at the outset of work rather than after the work is in place. The initial inspection phase is a practical method of performing preventive inspection and reaching agreements (in writing) in advance. Proper coordination from the unit must be made before construction starts and during the initial phase. This is to ensure that construction techniques meet specifications and the intent of the designer and that tests are identified.

Follow-Up Phase

This phase includes inspections and testing to determine continuation of compliance and workmanship established during the preparatory and initial phases. Follow-up inspections may occur on a daily, routine, or predetermined basis as required to ensure strict construction compliance (see Figure 2). This happens throughout the project. For example, units can construct "mock-ups"—such as sample footings, walls (masonry or lumber), and trusses—to establish standards or have inspectors approve the mock-ups before constructing the proportionate load of the project. Figure 3, page 18, shows a county inspector conducting a slump test on a grout place for a concrete masonry unit wall.

Completion Phase

When a segment of work or a project is near completion, the unit should carefully examine this work and prepare a list (called a punch list) of anything that is not completed or that does not conform to design/customer requirements. Prefinal and final inspections should be conducted by the customer, unit, and third parties about a week before the project is completed and turned over to the customer. This will ensure that all items are identified on the list and that the customer is satisfied.

Everyone in the unit—from commanders down to the junior NCOs—can make a big difference in the QC system by implementing daily meetings and establishing a team-building/project-ownership concept into the mission. First, daily meetings help the unit prepare for future tasks, identify possible material or equipment problems, recognize QC tests or measurements, and organize for the next day's operations (possibly for a week, if feasible). For instance, a platoon

Figure 2. This QC NCO ensures that the CMU wall and block are properly located and measured/cut for placement.

Figure 3. County inspectors assist the unit QC representative in conducting a "slump" test for a grout fill on a CMU block wall. The slump was to be about 8 inches.

preparing for a large concrete placement on a project can conduct daily meetings, which can help monitor and define the materials required (on-hand/shortfall), the equipment needed (such as vibrators, screed, a power trough, floats, and a pump truck), the personnel responsibilities and duties in support of that task, mandatory testing (such as slum or cylinder), deliveries, start and stop times, and on and on. This can be done for each task or subtask, using the critical path method of evaluation.

Second, explain the process, methods, and techniques to the most junior service members so they will understand the duties involved in concrete placement. This will help them appreciate what they are doing and why. It will also develop a sense of accountability for the workmanship quality. It should parallel the same actions taken by an infantry unit preparing for a patrol: inspections, briefs, sand table exercises, rock drills, and rehearsals.

Lessons Learned

Many lessons are learned on each project, and no project is ever the same as the last one. But there are a few consistent slipups that can mean the difference between quality workmanship and poor workmanship on any project.

Units seem to wrestle against developing a QC notebook that contains all daily QC reports, tests, and measurements. This notebook helps the project OIC or senior NCO formally document many things. It can help track deficiencies in materials and trends in production (positive or negative); document corrective actions; identify positions of assigned personnel, equipment usage, and tests or measurements conducted; and help maintain those reports in a neat and orderly fashion.

For example, a unit was placing several hundred yards of concrete for the foundation of a simunitions facility in North Bronx, New York. A few days after the placement, the customer requested documentation of the slump tests conducted on each batch of concrete delivered. The unit could provide only two handwritten documents on the entire placement (more than 12 truckloads), because the test results were either never documented or were lost. The unit was very close to hammering out the entire placement and starting all over. This could have been prevented if a QC representative had been supervising the requirements and the paper trail of testing for that task.

Units fall short in identifying the control, inspection, and testing procedures—both on- and off-site—for each task and assigning these responsibilities to the QC staff. On one project, a unit was placing concrete and didn't have a slump test kit. The trucks were turned away, and the placement was delayed until they found a kit. QC supervision, which was missing during this installation, could have helped identify tests to be performed for each task and state who was responsible for the results and who should have prepared and signed reports.

Checking the designs, details, notes, specifications, and checks, and measurements and ensuring that they match materials on hand are commonly overlooked until they affect the progress of the project. A unit that was constructing a facility in San Diego cut the rebar, bent it, and started placing it in the footers in preparation for the first placement of concrete. A county inspector failed the footings because specifications called for grade 60 rebar in about 90 percent of the foundation, but the unit had used grade 40. Figure 4 shows how rebar is marked and graded.

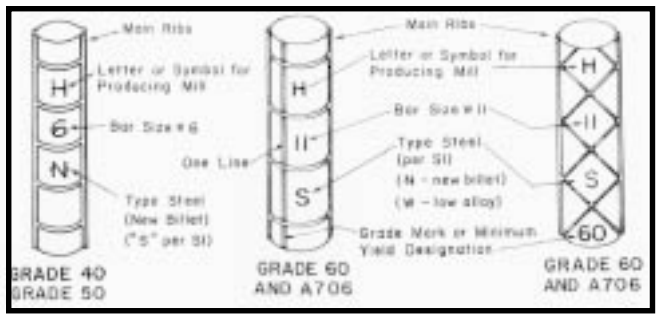

Figure 4. This is an example of the identification markings rolled onto the surface of reinforcing bars. The unit did not verify design specifications with the materials being used.

Constant QC oversight or supervision during the workday on tasks being performed is often sporadic. This causes a lot of problems with workmanship quality and construction techniques, which leads to many tasks being repeated. For example, one unit built, tore down, and rebuilt a concrete wall three times because it was not using proper masonry construction methods, and the wall consistently lost its bond and was out of plumb. Figure 5 shows a pilaster that was constructed incorrectly.

Figure 5. This pilaster is "out of plumb" by 1 1/4 inch on the seventh course, the second course CMU block is cut, and the mortar joints are sloppy.

QA Supervision

Now that a few control measures are in place, unit leaders must guarantee that QC actions are being followed through. As in troop-leading procedures, supervision is critical to the success of any mission. Therefore, QA becomes the final engineer troop-leading step on a construction project. This includes such things as inspections, intelligence updates (design changes or guidance), rehearsals (practicing essential tasks, revealing weaknesses, and improving understanding of the concept of operations at all levels), brief backs, rock/sand table drills, stick drills, site visits, meetings (daily/weekly/monthly after-action reviews), encouragement, motivation, mentorship, and participation. These are just a few effects that the leadership in a unit can bring to bear on a QC program and help set up young officers and NCOs for success. Figure 6 shows rebar with grease accidentally smeared on it. Adequate supervision could have prevented this problem.

Figure 6. The grease on this rebar will not allow the concrete to adhere around the reinforcement as it should. More care should be taken when lubricating forms.

Summary

It is possible that a QA/QC program could evolve by itself if solid "Leadership 101" was exercised; however, there are many negative lessons learned on a construction project that could be avoided if units would implement a formal program (the unit's SOP). Often, junior troops are fixing, replacing, working harder, taking longer, and exercising poor construction habits because the QA/QC program on the site for that project is broken. Thus, those experiences are carried over into the next project or back in garrison with sour attitudes about the leadership and the service. Behaviors then become a reflection of that attitude, and ultimately unit *esprit de corps*, motivation, and workmanship decline. As leaders, we owe it to our troops, our superiors, and our customers to not "just wing it" but to exercise excellence in organization and fineness in declaration.

Endnote

[1] U.S. Army Corps of Engineers, Engineer Pamphlet 415-1-261, *Quality Assurance Representatives Guide*, Volumes 1-5, 1992.

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