



# CONSTRUCTIVELY SPEAKING

US Army Corps of Engineers—Afghanistan Engineer District—

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Issue No. 6

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## MORTAR FOR STONE AND BRICK MASONRY

By: Bill Neimes, P.E., Laghman PRT

Many of the construction projects in Afghanistan include the use of brick or stone masonry walls. The quality of the mortar being used for these projects is critical for a durable, long-lasting, high-quality product. There are several important steps to assure that a proper mixture is obtained. These steps include: using the proper cement, using a quality sand product, screening the sand, using the correct proportions of cement and sand, proper mixing and staging of mortar.

**Cement.** There are several brands of cement that are readily available in Afghanistan. Photo 1 shows a brand of cement that is commonly found in the bazaars in Afghanistan. Most brands of cement are manufactured in Pakistan and include a label FOR EXPORT ONLY stamped on the brand. This label does not mean that the brand is of inferior quality that is exported and not to be used in Pakistan. Rather, this stamp is placed on a bag of cement that is being exported to avoid excise taxes on the product. Elephant Cement (Photo 2) is not officially banned from use at construction projects but there is a history of poor strength and performance using this cement brand. Many PRT contracts

specifically exclude the use of Elephant Brand Cement and list a brand of cement that is to be used on the project. However, the contractor can use Elephant cement if they can provide a mill test report that fulfills the three requirements listed below. These requirements are in reference to ASTM C 150, "Standard Specification for Portland Cement".

- 1) Strength (3 and 7 day) and set-time (Vicat), and cement fineness requirements in Table 3 of ASTM C 150.
- 2) Strength requirements (28 day) in Table 4 of ASTM C 150.
- 3) Oxide, "loss on ignition," and insoluble residue requirements in Table 1 of ASTM C 150.



*For export only stamped on many cement bags*

# MORTAR FOR STONE AND BRICK MASONRY (cont'd)

Many contractors do not want to test Elephant cement when there are many brands that are available at the bazaar. With cement, the contractor must assure that the cement is stored in a dry and covered area to avoid premature hydration. The contractor should be advised to test each shipment of Elephant cement (or any cement) for 7-day strength and set-time before using the shipment for mass production of concrete. Pakistan cements (Elephant included) are known to have trouble with providing consistent products over time.



*Use Elephant Cement with caution*

**Lime.** Smaller projects that aren't contracted by the USACE might not require hydrated lime. However, hydrated lime is required in all USACE contracts for mortar, with exception for mortar to be used for stone masonry. USACE contracts typically require that mortar meet the requirements of ASTM C 270, Type S. This ASTM allows the use of mortar cement, masonry cement, or cement-lime blends. Mortar and masonry cements are rare in this country, so cement-lime blends is standard. The allowable range of relative bulk volumes for lime:cement is 0.25:1 to 0.5:1.

**Sand.** Sand is the main ingredient in mortar and the contractor must provide a high quality sand to assure a good mortar. There is an ASTM specification for evaluating sand and this is ASTM C 144 "Standard Specification for Aggregate for Masonry Mortar". ASTM C 144 provides the grading requirements for natural sand and these requirements are defined in Table 1.

**Table 1**

**Grading Requirements for Natural Sand**

Sieve Size	Percent Passing
No. 4 (4.75 mm)	100
No. 8 (2.36 mm)	95 to 100
No. 16 (1.18 mm)	70 to 100
No. 30 (0.600 mm)	40 to 75
No. 50 (0.300 mm)	10 to 35
No. 100 (0.150 mm)	2 to 15
No. 200 (0.075 mm)	0 to 5

Table 1 indicates that the sand must be well-graded and between a No. 4 and No. 200 sieve. Sand that is too coarse will not allow proper bonding between particles and may not be very workable. Sand that is too fine will contribute to low mortar strengths and will increase the water demand of the mortar, leading to greater drying shrinkage.

**Sand Screening.** Sands used for construction projects in the Laghman PRT are available from the river beds and the quality can vary significantly based on the deposition location. These sands include small river pebbles that should be removed through sand screening. Unless enforced, contractor will use a variety of screen sizes with the most common being ½" or 12.5 mm chicken wire. This is shown on Photo 3. To meet the specifications of ASTM C 144, the screen should be no larger than 5 mm as shown on Photo 4. It is always a good idea to check the contractor's mortar batch to determine if they have been screening the sand.



*Photo 3. ½" chicken wire is too large to screen sand*

## MORTAR FOR STONE AND BRICK MASONRY (cont'd)



Photo 5. Worker screening sand



Photo 4. Proper Screen Size  $\approx$  5 mm or 5 openings per inch

**Ratio:** The cement to sand ratio is defined either in the contract or in the design. The typical ratio of cement to sand is 1:3; any ratio higher than 1:4 will not provide enough cement for proper bonding. Again, USACE contracts require the mortar to meet the requirements of ASTM C 270, typically Type S. To meet this ASTM, the ratio of (cement + lime):sand must be between 1:2.25 and 1:3. The required 28-day strength, as measured by 50-mm cubes (ASTM C 109), is 12.4 MPa (1800 psi). The contractor may attempt to increase the ratio of sand to cementitious materials in order to cut their expenses, so the inspector should become familiar with the look and feel of different ratios of cement to sand. The contractor should always have a measuring box at the site so that they can properly measure the cement to sand ratio. Photo 6 shows a measuring box that equals the volume of one bag of cement. The bulk density of cement is approximately 1.51 g/cc (94 lb/ft<sup>3</sup>) and cement is packaged and delivered in 50 kg bags. Therefore the bulk volume of one bag of cement is approximately 33,000 cc. The measuring boxes should equal the bulk volume of one bag of cement. The most common dimensions of a measuring box are 30 cm X 30 cm X 37 cm although the dimensions can vary. As long as the volume of the measuring box equal to approximately 33,000 cubic centimeters, the measuring box is acceptable. Sometimes the contractor does not have a large enough mixer to include a bag of cement and three

or four measuring boxes of sand, and in this case, the contractor should have a measuring box to accommodate a smaller volume of cement. Typically, the mixer has the capacity for a half bag of cement and the contractor could either place 1 ½ or 2 measuring boxes of sand or fabricate a smaller size measuring box for the ½ bag of cement. Photo 7 shows a smaller measuring box for smaller sized mixers. The inspector should make sure that the contractor has a measuring box near the mixer and the measuring box is of the correct size.



Photo 6. Mixing box – equal to the size of a cement bag

## MORTAR FOR STONE AND BRICK MASONRY (cont'd)

**Mixing and Staging.** The contractor workers should be proficient at knowing the proper amount of water to add to the cement and sand to provide a good mortar. If the sand being added is wet than the amount of water added should decrease to avoid too fluid of a mixture. The contractor should use a mechanical mixer unless site conditions prohibit the access of a cement mixer and there should be few exceptions. If the contractor can get bags of cement and piles of sand to the site, they should be able to get a mechanical mixer to this same site. Contractors working on USACE-contracted projects are required to use mortar mixers, rather than concrete mixers. The difference is important if the mortar is mixed properly and has good adhesion properties. A concrete mixer has a rotating drum, with blades that are attached to the inside wall of the drum. A mortar mixer has a stationary drum, with blades that rotate inside the drum. The blades should include rubber scrapers for knocking the mortar off of the inside of the drum.

The mortar must be mixed long enough to preclude clumps in the mortar. If the contractor is constructing a stone masonry structure which can require a significant amount of mortar, the contractor workers may get in the tendency to shorten the mixing period to increase production rates. If the mortar has clumps, this is a good indication that the mortar has not been mixed long enough.



*Photo 8. Mortar coarse and dry*

When at the job site, it is a good idea to test the mortar by checking for oversized stones, lumps in the mortar, and the consistency of the mortar. The consistency can be checked visually or by grabbing a sample as shown on Photos 8 and 9. Photo 8 shows a mortar sample that was dry and appeared to have too many large sand particles for a good bond. Photo 9 is a sample of mortar that had the proper moisture content, enough medium and fine sands and of good consistency. The inspector could also check mortar with a trowel or shovel. The mortar should bond to the trowel or shovel after tapping a sample as shown on Photo 10.

The mortar should empty into a mortar boat like that shown on Photo 11. The contractor can construct a temporary staging area out of mortar or concrete so that the mortar from the mixer does not empty directly on the ground. This temporary staging area is shown on Photo 12. However, the mortar must not empty on the ground as this will contaminate the mortar. The amount of mortar being staged should be monitored as mortar should not be staged for over a half hour. In the middle of the summer when it is hot and sunny, the duration of staging should even be less. The contractor could cover the mixed mortar to avoid premature setting. In addition, the contractor should not mix too much mortar before a break or lunch.



*Photo 7. Mixing box – for smaller mixers*

## MORTAR FOR STONE AND BRICK MASONRY (cont'd)



*Photo 9: Mortar mixed well with good consistency*



*Photo 10: Testing mortar*



*Photo 11: Mortar Boat*



*Photo 12: Temporary Staging Area for*

**Summary:** Mortar for stone and brick masonry is typically produced on project sites. The ingredients of cement, lime (if applicable), sand, and water must be tightly controlled as well as the mixing and staging to assure a high quality product is achieved. The inspector should make sure the contractor is adding the correct proportions of ingredients, performing proper mixing of the mortar and is generating the correct amount of mortar based on demand.

**We would like to thank Bill Neimes for being the first from the field to write an article for the newsletter. Our hopes is that more will follow suit and share this valuable information.**

**Thanks Bill for a job well done!**

# ONE TEAM

By: Braven Dyer, P.E., Deputy Chief Construction



As I reflect on my first two months in Theatre, I am very impressed with the professionalism and dedication exhibited throughout the Area Offices, Resident Offices and Project Offices. Generally every team member I contact has a good answer to challenging questions about project status and ways forward. I fully recognize that without ground truth and personal attention given by each engineer, construction representative and engineering technician, we will not succeed. Success in this highly demanding contingency environment is not always measured in project completions, but also with development of our Afghanistan partners. Success unfortunately may take the form of a Termination for Default or massive descoping. It is these once in a career contract actions that our customers may not at first realize to be the best path forward, but is essential to advancing the battle plan. To prepare those tedious demanding documents your Qalaa House staff is available to assist and support you in every way possible. The Construction Administration Branch and the Quality Assurance Branch are the tethers that I truly hope you feel as your lifeline (phone a friend). My goal here in AED North as the Assistant Chief of Construction is to provide the necessary administrative support and occasional technical backdrop to help each and every one of you run a well honed field office. We all must manage expectations, foster relationships with customers and battle space owners, be proud when the day is done that I have done the best possible construction contract administration with the hand that is dealt.

Essayons,  
Braven

## Subcontractor Payments

By: Sandy Higgins, Quality Assurance Branch

Back on Issue No. 2, we discussed subcontractor payments. There is another very important aspect of subcontractor payments that you need to be familiar with and that is "Subcontractor Deductions Held By Prime". You'll find this in **column 13** of the Prompt Payment Certification of the contractor's payment request. This column is used when the contractor is showing payment to the subcontractor but there is some outstanding work or deficiencies that are outstanding and the contractor wants to hold money. This is no work on our part. It is merely a way for the contractor to stay honest with us. Here is an example: You get a phone call from a subcontractor and he is telling you that the prime contractor hasn't paid him all of his money. You call up the prime contractor and he tells you that the subcontractor hasn't completed all of his work. Without **column 13**, you have no way of knowing if the prime contractor is telling you the truth. Contractors are quick to "say" the subcontractor hasn't completed the work, but they're not quick to show us that on the pay request. Remember that is a contractual requirement for the contractor to report subcontractor earnings and subcontractor deductions for each pay request. Please feel free to contact CAB or QAB if you or the contractor has any questions.

(9) Subcontractor Name	(10) Total Amount Subcontracted	(11) Previous Subcontractor Payments (Excluding Deductions)	(12) Subcontractor Amount Included in this Payment Estimate (Excluding Deductions)	(13)** Subcontractor Earnings Deducted by Contractor (Total to Date)
Afghan Operators/Drivers	\$0.00	\$0.00	\$0.00	\$0.00
Afghan Rehabilitation Team	\$11,500.00	\$11,500.00	\$0.00	\$0.00
BAHARE KAHKASHAN Co	\$28,000.00	\$28,000.00	\$0.00	\$0.00
Geotechnical Team	\$90,800.00	\$90,800.00	\$0.00	\$0.00
USAN QURBAT CONSTRUCTION COMPANY	\$70,400.00	\$70,400.00	\$0.00	\$0.00

## Schedule Input To The BCOE Process

By: Phillip Di Salvi, Senior Scheduler, Baker Group

When the Corps is preparing to advertise for bids on a specific project, how do we predetermine an accurate and reasonable POP (period of performance) for that project?

We have a work scope; but how does that translate to an accurate and reasonable POP...or why do we need to establish a "reasonable" project duration when we can simply take one "off the shelf", so to speak? Understanding that a reasonable duration takes into account as many variables as possible is central to considering how long a specific project should take, and ultimately its success.

Obviously, a review of the conceptual design documents in concert with the specifications is the starting point when developing a project's duration, or POP. But there is much more to consider.

The location of a project may also be critical to its success. Is it located in a Taliban stronghold; what are the chances that the contractor will experience hostilities? What are the weather conditions, and what is the availability of labor and equipment? Although the contractor is responsible for much of these conditions, historically, we find that all these circumstances play into the success or failure of a project.

Accordingly it's better to plan for success than to experience failure.



***An accurate POP analysis may save your project from the sharks***

Planning for inclement weather days is critical as well. Using the AED Weather Analysis, we can determine the expectations for how inclement weather might impact the work. This information in conjunction with the time frame in which the work will be accomplished is taken into consideration when developing a project's duration. In regions of extreme winter weather, it is not uncommon for a project to be shut down for up to three months. Without taking the historical records and weather data into consideration when determining a project's duration, the project will undoubtedly be delayed.

Have previous projects in the region experienced hostilities? It's difficult to determine if and how hostilities might affect a project. However, if we can deduce that previous projects have been delayed for a determinable average element of time, we can consider this information to the equation.

How then might hostilities add time to a project? Threats and kidnappings have been known to retard progress and even shut down projects for short periods of time. Moreover, contractors may experience a drop in productivity when their employees live and work in fear, and even more so when they actually experience hostile conditions. By taking into consideration a determination of average loss time in a given region due to hostilities, we can better plan for a project's success.

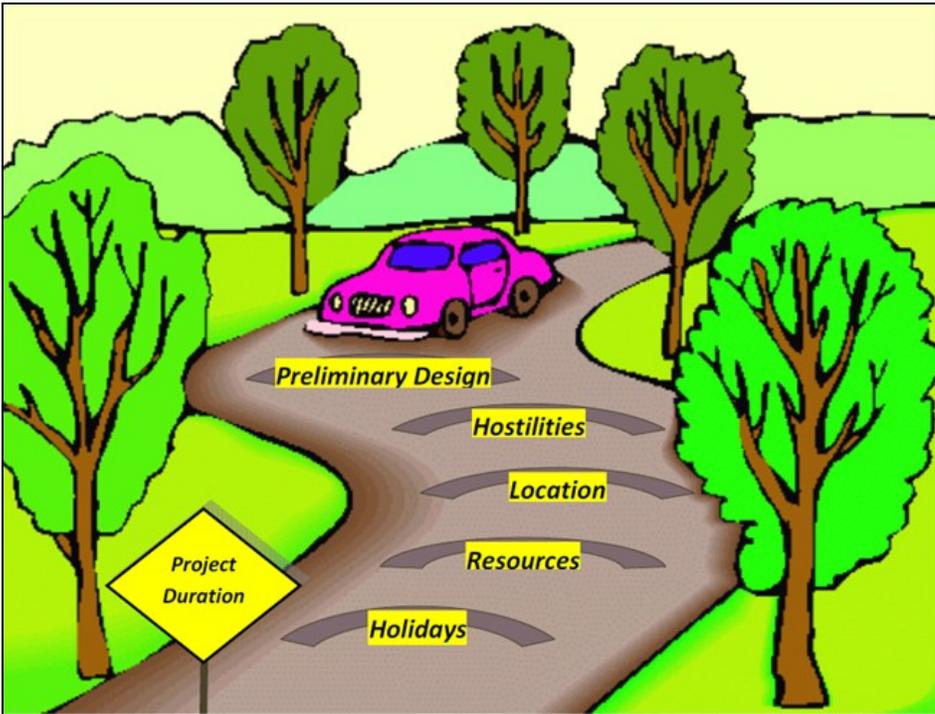
Local construction means and methods are another critical factor when determining a project's duration. For example, how will an existing building be demolished; and how long should it take given local means and methods? How long will it take to form a concrete wall or roof? How long will it take to lay 3000' of underground sewer pipe or electrical conduit; will the trenches be dug by hand or with an excavator?

Realistic durations for these types of activities can be determined by understanding local construction means and methods. An awareness of how specific components of the work will be accomplished by our Afghan contractors and their durations will then be used in determining a project's overall duration.

Can the contractor get enough workers to the project when he needs them even though the worker might be far from home and family for an extended duration of time? Will the contractor need to bring in workers from outside the area? Manpower can be a decisive factor in the success of remote projects.

*continued*

# Schedule Input To The BCOE Process



Taken together, these factors are indispensable in formulating a reasonable project duration prior to bid time.

Conversely, failure to effectively plan for a reasonable project duration is a recipe for disappointment. The result may be a project duration that is too short to ensure the contractor's success and result in a contractor's request for time extension and/or delay claim for unconstructability; or even liquidated damages assessed by the Corps against the contractor. Either way, it's not the way we would want to wrap up a project.

Just as a project is reviewed during the BCOE process for design, safety, and cost; it is additionally imperative that the schedule aspect be reviewed by scheduling professionals to determine a reasonable project duration as part of the overall effort to ensure a successful project.

As suggested, various regions experience different issues such as hostilities, inclement weather, or lack of skilled workers that may in fact add to the overall consideration when determining the recommended duration of a project. In addition, the month of Ramadan and other religious and national holidays need to also be considered in a project's duration.

In Islam, Ramadan is the holiest month of the year and considered the most sacred of Muslim holiday periods. Therefore, it is common for families to gather together during this holy time. Historical data indicates that the month of Ramadan may result in the loss of three weeks critical path work over the course of the month long celebration due to workers absence during the holiday period.

For example, an Afghan National Police compound is being built in an outlying border region some distance from an urban area, where the workers are housed at the project site; productivity will almost certainly be slowed due to the extended Ramadan holiday.

Accordingly, it is imperative that all national and religious holidays be considered when determining a project's duration.

ing professionals to determine a reasonable project duration as part of the overall effort to ensure a successful project.

If you have any questions regarding this topic, please contact the Baker Group via email [TAN.BAKER.GROUP@USACE.ARMY.MIL](mailto:TAN.BAKER.GROUP@USACE.ARMY.MIL), or stop by the Azadi Office. Baker provides construction management support services to the Corps of Engineers, including analysis of contractor baseline and update schedules. The Baker group also provides scheduling assistance to contractors, in addition to offering formal schedule training classes.



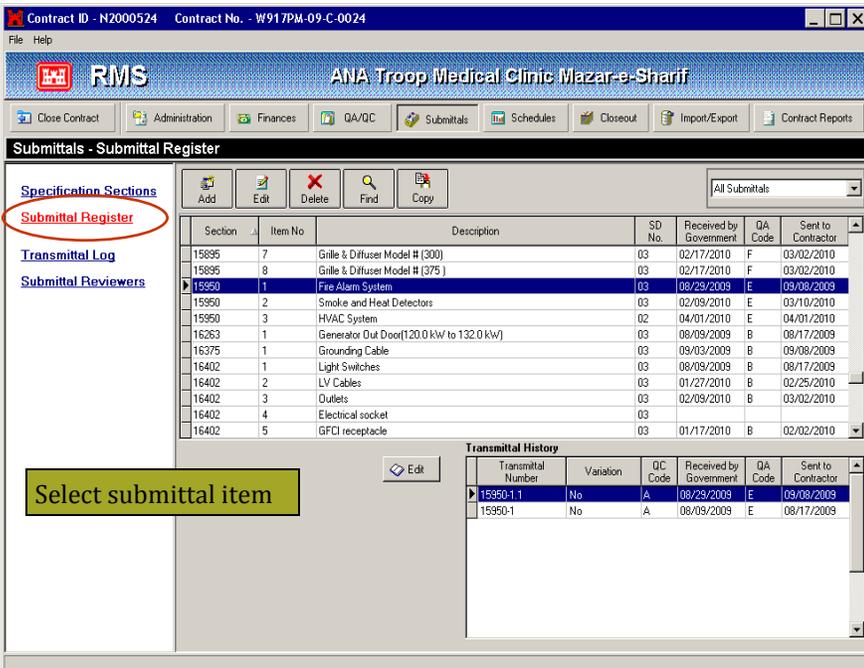
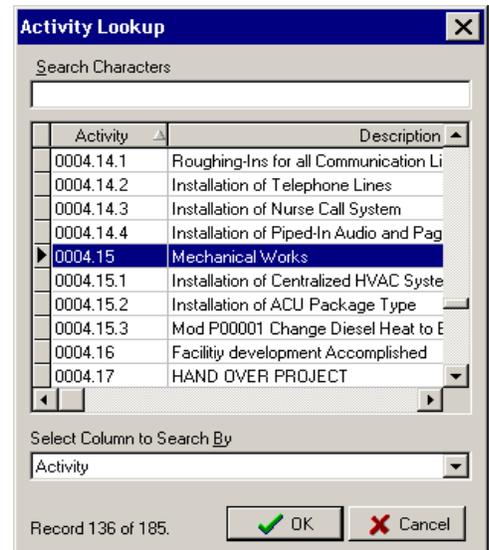
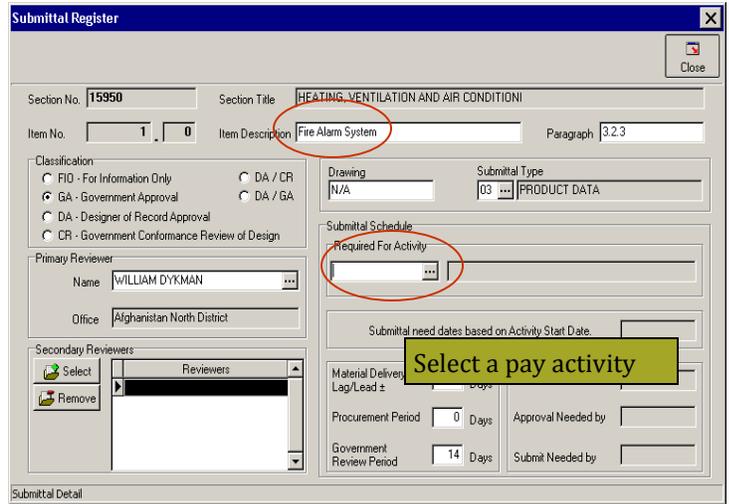
# LINKING ITEMS TO PAY ACTIVITIES IN RMS

By: Sandy Higgins, Quality Assurance Branch

I've received several requests lately on linking certain items in RMS to the contractor's pay activities. The Contract Administration Branch and the Quality Assurance Branch are currently in the process of developing new RMS "How-To's" on a wide range of topics. This is one of them so I thought I would put it in the newsletter hoping to reach more folks including our contractors and Local National Quality Assurance Representatives.

The contractor has the ability in QCS to link submittal items, QC Tests, and QC deficiencies to applicable pay activities in order to track these certain items. Many of our contractors don't use this feature because it will flag when a contractor asked for payment on that activity if something is outstanding.

If the contractor is not linking these items, you have the ability to do this from RMS. Let's start with submittals. The sure way to tell if these are linked by the contractor is to view or print the contractor's submittal register. If the first column is blank then the activities are not linked. At this point, you can either direct the contractor to do it or you can identify the critical submittals that you want to see prior to final payment of that activity such as mix designs, test reports, samples, ect... Once you've identified these go to "Submittal Register"



When selecting the pay activity make sure there is money on it otherwise, you'll never see it on the pay request worksheet. Rather you are doing this or the contractor it's a good idea to print out the register and run a report of Activities by CLIN and determine how the submittals need to be linked. In this particular example there wasn't a pay activity directly related to the Fire Alarm System so I would consult the contractor to find out which activity he plans on asking for payment when he installs the Fire Alarm System.

# LINKING ITEMS TO PAY ACTIVITIES IN RMS

Now let's say that there is some QC testing that I want to make sure gets done before I pay the contractor. First, I want to make sure the test is entered under "QC Requirements" in the QA/QC Module.

Contract ID - N2000281    Contract No. - W917PM-08-C-0009

**RMS**    ANA Garrison Gamberi Phase 1

Close Contract    Administration    Finances    **QA/QC**    Submittals    Schedules    Closeout    Import/Export    Contract Reports

**QA/QC - QC Requirements**

QA/QC Daily Reports  
 QA/QC Summary  
 Weather Delays  
 Features of Work  
 3 Phase Inspections  
 Hazard Analysis  
QC Requirements  
 Equipment Checks  
 Exposure Hours  
 QA Tests  
 Required Verifications  
 Planned Interviews

Section	QC Test	Location	Description
03300	CT-01160	M.Hs-Comp B	Concrete Compressive Strength test for Communicational Manhole in Complex B.
03300	CT-01161	M.H-Comp. A	Concrete Compressive Strength test for Man Hole Covers in Complex A & B.
03300	CT-01162	M.H-comp B	Concrete Compressive Strength test for Man Hole Covers in Complex A & B.
03300	CT-01163	Comp B	Concrete Compressive Strength test for Man Hole Covers in Complex A & B.
03300	CT-01164	M.H-Comp B	Concrete Compressive Strength test for Man Hole Covers in Complex A & B.
03300	CT-01166	M.Hs-BOQ	Concrete Compressive Strength test for Man Hole Covers in Complex A & B.
03300	CT-01167	north Gate	Concrete Compressive Strength test for Transformer pad near North Main Gate.
03300	CT-01168	Bldg # 401	Concrete Compressive Strength test for DFAC #1 Wood Stove Building.
03300	CT-01169	Bldg #401	Concrete Compressive Strength test for DFAC #1 Wood Stove building.
03300	CT-01170	DFAC #1	Concrete Compressive Strength test for AC Split Unit Pads.
03300	CT-01171	DFAC #1	Concrete Compressive Strength test for AC Split Unit Pads.
03300	CT-01172	Comp. A & B.	Concrete Compressive Strength test for Hand hole in Complex A & B.
03300	CT-01176	Comp-C	Concrete Compressive Strength test for Comm. hand holes in Complex C.
03300	CT-01178	Comp-B	Concrete Compressive strength test for Comm. Manholes in Complex B.
03300	CT-01180	Comp-B	Concrete Compressive Strength test for Comm. manholes in Complex B.
03300	CT-01181	Complex A	Concrete Compressive Strength test for electrical Manhole in Complex A.
03300	CT-01182	Complex B	Concrete Compressive Strength test for elec. Manholes in Complex B.

**Description**    Section: 03300    Paragraph: 1.4.2.1  
 Concrete Compressive Strength test for AC Split Unit Pads.

The contractor has linked this test to a pay activity so when they ask for payment, you will see an action item on the Pay Request Worksheet if this has not been done.

**QC Tests**

QC Test No. CT-01170    Performed by NCCL Material Testing Lab

Section 03300    Location DFAC #1

Paragraph 1.4.2.1

Required for Activity 000504    DFAC Number 1

Activity Start Date 05/07/2008

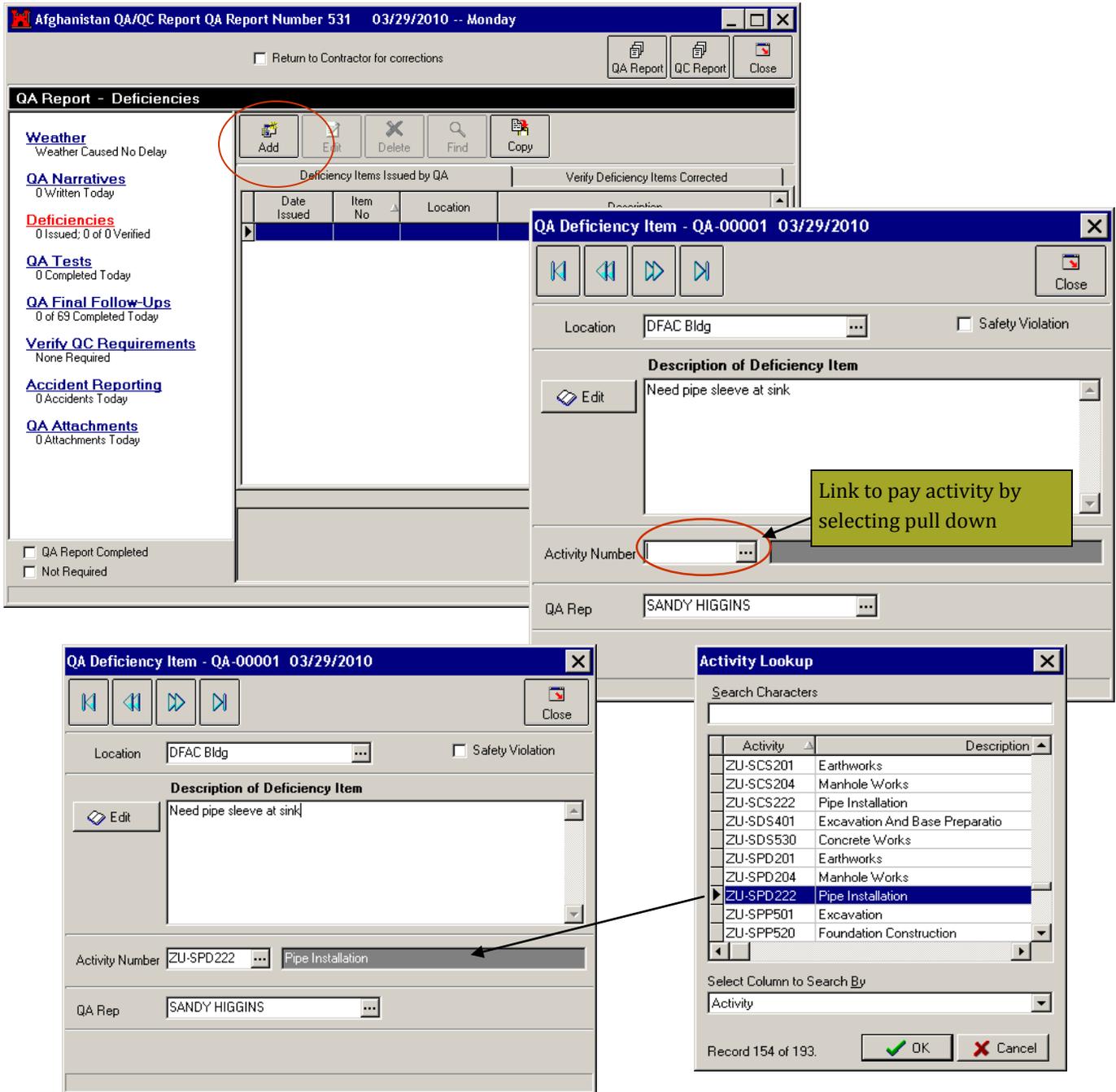
Requirement Lag/Lead 7 (days)    Requirement Needed by 05/14/2008

**Description**  
 Edit    Concrete Compressive Strength test for AC Split Unit Pads.

# LINKING ITEMS TO PAY ACTIVITIES IN RMS

## LINKING QC AND QA DEFICIENCIES

This is probably one of the best features in the linking abilities in RMS. In order for this to be effective, the contractor and USACE must actively be tracking deficiencies. This is a very simple process but once again you need to familiarize yourself with the pay activities so that you can be certain to link the deficiency to the correct activity. When you are in your daily report and you want to add a deficiency for that day, select add as shown below



Now before the contractor will be paid 100% on Activity ZU-SPD222 "Pipe Installation", this deficiency will have to be corrected by the contractor.