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Warm regards,

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We encourage you to approach each lesson with curiosity and enthusiasm as you pave your way

Chapter

10

Quality Control and Quality Assurance

Quality construction is what every builder wants to achieve, and quality of construction has become a key element in an owner's evaluation of a general contractor. The cost of construction and the ability to meet project completion dates will always be important factors in the selection of a general contractor. But quality of product has taken on a more important role in this highly competitive business, and many a contract hinges on the builder's proven track record of quality projects.

There is often confusion about the difference between *quality control* (QC) and *quality assurance* (QA), and there are distinct differences. *Quality control* can be defined as the standard used in the construction or assembly of a building component, while *quality assurance* is a process that verifies that these standards have been met.

The quality of workmanship on a project will be determined, in part, by the nature of the contract documents. Construction specifications define the qualitative requirements for materials, products, equipment, and installation procedures as well as the level of workmanship. Within these defining documents, tolerances are established, often by the various and many trade groups and trade associations referenced in the specifications.

As an example, quality standards for concrete work are established by the American Concrete Institute (ACI), and numerous references to ACI are made in Division 3 of the projects specification manual. ACI Specification 301 contains the following tolerances for cast-in-place concrete:

Plumb—columns, piers, walls

- In any 10 feet: ¼ inch
- Maximum for total height of structure (less than 100 ft): 1 inch

Level—slab soffits, ceilings, beam soffits (measured before removal of shores)

- In any 10 feet: ±¼ inch
- In any bay or in any 20 feet: ±⅜ inch
- Maximum total length of structure: ±¾ inch

Level—columns, walls, beams, partitions (deviation from dimensions on plans)

- In any bay: ±½ inch
- In any 20 feet: ±½ inch
- Maximum for the structure: ±1 inch

These are the tolerances required for cast-in-place concrete members when the ACI requirements are referred to in the contract specifications—this is a quality control standard.

When the superintendent places a level on the concrete beam, column, or wall to determine if it meets these standards, that is quality assurance.

And tolerances for a specific product can vary depending upon the end use of the product. Concrete slabs to receive pad and carpet in an office building will not be required to be finished to the same tolerances as a "superflat" floor for an automated warehouse project. The tolerances included in the specifications ought to consider another criterion—"constructability" tolerances. A wood-frame building will not meet the same level and plumb qualities as a steel stud or structural steel frame building, due primarily to the quality of the materials—wood studs with all of nature's imperfections versus the manufactured tolerances of metal studs or structural steel rolled sections.

Drawings that specify a masonry opening $^1/_8$ inch larger than the window that is designated to fit into that opening defy normal field allowable tolerances and do not take into consideration the space required to properly align the window in both horizontal and vertical axes; nor do they provide room for blocking.

When such constructability issues are discovered during the plan review, they should be brought to the architect/engineer's attention for a relaxation or modification of the tolerances required to install or build a specific component.

But quality control and quality assurance are not limited to construction products, assemblies, and components. Division 1 of the project specification booklet generally includes requirements pertaining to shop drawing submission and review, record documents such as as-built drawing preparation, and even the way in which monthly requisitions are to be prepared and submitted with accompanying backup documentation or substantiation. These are, in effect, quality control standards, and compliance with these standards will be an exercise in quality assurance.

So quality control and quality assurance span the entire spectrum of the construction process, from complying with the requirements to establish a site logistics plan, if included in the specifications, to complying with close-out procedures, to ensuring that the cast-in-place concrete complies with ACI standards.

What Are All of Those Quality Related Programs?

When reading articles about quality control, we hear about Total Quality Management (TQM), the Six Sigma approach, Benchmarking, and International Standards Organization (ISO) programs. A brief explanation of each may be somewhat enlightening.

Total quality management (TQM)

The TQM approach encompasses a company-wide focus on improving operations, not only in the field of actual construction but also in every function within the company—accounting, estimating, and all components that make up corporate overhead.

When the preparation of an owner's monthly requisition is returned by the owner because it lacks sufficient documentation or contains arithmetical errors, the time delay in the contractor's receipt of funds can be measured quite effectively by loss of interest on that money. Conversely, a thoroughly checked, completed requisition accomplishes two goals: it maintains or improves cash flow and it conveys an air of professionalism in the eyes of the owner receiving the requisition.

Estimating errors can certainly impact the bottom line. If a significant cost item has been inadvertently omitted from an estimate and results in a contract award, the potential profit will be diminished. If an error results in a mistake that adds more costs to the estimate than necessary, this may result in a noncompetitive bid. It is easy to measure those consequences.

The quest for quality in every area of a company's activities, accounting, estimating, and construction all represent the TQM approach.

Six sigma

Six Sigma was developed by the Motorola Company in the 1970s. They had sold their Quasar television business to a Japanese company operating in the United States and the new Japanese management instituted a quality control system that reduced the TV manufacturing defects to 1/20th of the number that Motorola was producing. Motorola initially thought that their QC program was pretty good until they saw what the Japanese were producing, and over the next 10 years they devoted a great deal of time to improving their manufacturing process. They called it Six Sigma, sigma being the sixth Greek letter, used by statisticians to measure the variability in any process. Although this data driver approach to quality seems more appropriate to a manufacturing process, some of its methodologies can be applied to construction, particularly their DMAIC process:

D—Define the goals

M—Measure the existing system to establish a metric by which progress toward the goal can be tracked

A—Analyze the system to identify ways to eliminate the gap between existing performance and the desired goal

I—Improve the system

C—Control the new system

Benchmarking

Benchmarking is a process of seeking out the best practices of an operation and trying to emulate those practices. Benchmarking can be both external and internal. External would involve looking at what the best in class is for a particular operation in the industry, in this case construction, and trying to replicate those results. Internal benchmarking is the process of looking at the best performance of an operation within the company and then trying to repeat these results in other similar operations.

A good example of the Benchmarking concept can be seen in an analysis of corporate financial data. The Construction Financial Management Association located in Princeton, New Jersey, publishes the results of their annual financial survey, and one section is entitled "Benchmarking." They compare some financial characteristics of their Best in Class contractors with the overall status of their membership as a whole:

	Return on Assets	Return on Equity	Working Capital Turnover
Overall membership	6.7%	23.7%	14.2
Best in Class	13.4%	39.1%	13.5

In this example, external benchmarking would challenge the general contractor to meet or exceed the benchmark of, say, 13.4 percent on return on assets.

Internal benchmarking would focus the general contractor's attention on a specific task within the company that has performed well in the past but subsequent operations failed to achieve these high marks.

If the company self-performs concrete or carpentry work, as an example, and on one project in which forming and pouring concrete foundations walls was exceptionally efficient, internal benchmarking would take those low unit costs as a standard and try to achieve similar results on other similar projects. Internal benchmarking, in this case, would analyze the conditions that resulted in the low unit costs on that one project and apply those efficiencies to other projects.

International standards organization—ISO

Founded in 1946 to promote voluntary manufacturing standards and trade communication standards, the acronym ISO actually refers to the Greek word "isos," meaning equal. There are a whole series of ISO standards, such as ISO 9000 and variants ISO 9001–9004, which relate to construction and involve basic management principles. Many large U.S. construction companies advertise that they have received ISO certification, meaning that they have complied with the basic quality management standards outlined by that organization.

Recently, ISO has embarked on a mission to create a common computer language to enable vendors and manufacturers to communicate clearly with architect and engineers worldwide.

First Steps First

To fully understand the general contractor's obligations and responsibilities, a read, or reread, of the contract with the owner is necessary. That which is included in the scope of work and that which is not included should be defined. What exceptions is the owner making to the terms and conditions of a standard AIA contract?

The project superintendent should be familiar with the terms and conditions of the contract with the owner that affect the supervision of the project. The next order of business is to begin the process of carefully reviewing the plans and specifications, making notes of important things to remember and any obvious problems, errors and omissions, or inconsistencies contained in the contract plans and specifications.

An in-house kickoff meeting is strongly recommended at this time, if this is not standard procedure in your company. This meeting should be attended by the estimator, the project manager assigned to the project, and the staff member who will be buying out the job, if it is not being done by the project manager. The intricacies of the project can be discussed as well as any problem areas uncovered during the estimating process, pointing out any constructability or quality concerns expressed by anyone attending the meeting. The estimator may have noted problems or concerns during the takeoffs, and these problems or concerns need to be passed on to the construction team. Quite often, during the bidding process, subcontractors or vendors submitting their quotes will qualify their bids, or take exception to the bid documents, stating concerns about specific product or installation procedures contained in either the plans or the specifications. Sometimes these subcontractors or vendors will actually offer suggestions to improve quality at no additional cost, and these suggestions should be passed on to the architect/engineer for review and comment.

Remember Article 3 of AIA Document A201, General Conditions of the Contract for Construction, states that any design errors or omissions noted by the contractor during the review shall be promptly reported to the architect as a request for information or clarification. The first pass at any errors and omissions issue should be made at this kickoff meeting. By doing so the contractor establishes an early relationship with the architect, one that says, "I read and understand my obligations and will continue to act as a professional all the way through this project—I hope you do the same."

A typical agenda for a kickoff meeting would include most of these items:

1. Review of the project superintendent's and project manager's responsibilities
2. The schedule included in the bid and the need to establish a baseline schedule as soon as possible

3. The budget and any potential shortcomings or problems with the scope of work assigned to a particular line item in the budget
4. Quality control and quality assurance
   a. Inspections required and who is responsible to provide them and pay for them
   b. Any preinstallation meetings required by contract
   c. Any required mock-ups
   d. Controlling the quality of subcontractor work and how inspection of the work is to be carried out. Will this be performed primarily by the project superintendent, who will report directly to the project manager or directly to the subcontractor with a copy to the project manager?
5. Safety
   a. Location of closest area medical center and fire station
   b. MSDS requirements and compliance with OSHA hazcom
   c. Toolbox talks
   d. Safety violation forms and their use
   e. Periodic inspections by the company's safety director
   f. Dealing with OSHA inspections, if and when they occur (Will project manager be required to meet with the inspector, or will this responsibility fall to the project superintendent alone?)
6. Company policies and procedures
   a. Review of company manuals
   b. Review of field report forms
   c. Issuance of Request for Information (RFI) and Request for Clarification (RFC)
   d. Subcontractor meeting procedures and preparation of meeting minutes
   e. Notice to correct and backcharge procedures
7. Review of the shop drawing submittal log
   a. Will the responsibility to conduct periodic reviews of the status of the shop drawing log lie with the project manager or project superintendent?
   b. Will the superintendent be given an advance copy of the shop drawing for review and comment? (It is always a good idea to do so!)
   c. Who will assume primary responsibility to notify a subcontractor or vendor if the shop drawing is late in being submitted?
   d. Who will follow up on delivery of supplies or equipment when an approved shop drawing has been returned to the subcontractor or vendor?
8. Status of buyouts and critical nature of specific items and subcontracts
   a. Establishment of a priority in buyouts, what trade or product is needed immediately, etc.
   b. Quality and performance records, if known, of the subcontractor and vendors under consideration for the current project
9. Role of general field superintendent in this particular project

10. Site logistics, availability of office and storage trailers, supplies and equipment
11. Availability of utilities at the site and need to supplement, if required
12. Review of closeout procedures and assigned responsibilities
    a. Preparation of as-builts by the general contractor
    b. Periodic inspections of as-builts required of subcontractors

Testing and Inspections

Probably the first encounter with QA/QC will occur in the site and excavation phase of the project when, in many cases, the owner's consultants will be engaged to inspect the excavation operations, including soils analysis, requiring specific tests such as a Proctor test with related reports. This test is used to determine the optimum moisture content of the soil removed from the excavation in order to achieve the desired compaction. The firm hired by the owner to perform these tests may also be retained to conduct cast-in-place concrete inspections and testing.

The geotechnical engineer—first encounter with QA/QC

The determination of acceptable or unsuitable soils will test the project superintendent's knowledge of this subject, and control over acceptable levels of compaction requires close attention.

The owner frequently hires the geotechnical or civil engineer to observe, inspect, and perform the various tests required during the site work phase of the project. The geotechnical consultant may be hired to perform any or all of the following tasks:

1. On-site inspection of rough grading operations to verify quantities of cuts and fills and elevations of rough or finish grades
2. Testing of soils, either on-site materials or off-site (borrow) materials, to include compliance with soil composition and gradations, moisture content, and compactability
3. Visual inspection of any underground obstructions encountered, whether indicated on the contract drawings or not
4. Verification of quantities of unsuitable soils removed form the site and the import of acceptable replacement materials
5. Verification of any rock removal and quantities blasted and removed
6. Inspection of site utilities to ensure compliance with the materials and installation procedures contained in the contract documents
7. Inspection of foundation subsoils to verify proper depth and adequate bearing capacity

8. Inspection and testing of ready-mix concrete to ensure compliance with the mix design, other quality-of-materials issues, and inspections of concrete forming and placement procedures
9. Inspection of the placement of concrete in footings, foundations, and slabs, including proper size, fabrication, and installation of reinforcing steel, wire mesh.
10. Review of the contractor's request for extras relating to the scope of work being performed by the geotechnical engineer

The division of quality assurance and quality control is rather easy to apply in each of these geotechnical procedures because the standards are specific in nature and allow little tolerance in their application. For example, soils testing for compaction will either meet or fail the 95 percent compaction requirement.

The key to working successfully with the owner's geotechnical consultant is based upon good communication and recognizing the role of each player in the process; that is, the geotechnical consultant is there to confirm to the owner that the contractor is complying with all the contract requirements. The project superintendent's job is to ensure that the specifications are being met, and when the scope of the contract work is increased or decreased, that the owner is made aware of these scope changes and any resultant time and cost implications.

To adequately perform quality assurance procedures relating to site work, the project superintendent should

1. Reread the specification sections pertaining to site work
2. Read Division 1, which may include testing procedures required for this particular project and the contractor procedures pertaining to receipt of and responses to reports issued by the owner or the owner's consultants
3. Be present to observe all soil and concrete testing and inspection performed by the owner's geotechnical engineer and request "pencil" copies if available
4. Note and correct any deficiencies as the operation continues, and have the geotechnical consultant note that corrective action was initiated
5. Be familiar with the proper procedures to achieve "design" compaction requirements and visual recognition of suitable and unsuitable soil conditions

Field observations and reports and copies of test results prepared during this phase of work will be sent directly to the owner or the owner's representative and should include copies to the general contractor. After comparing the test results with the contract requirements, the architect or engineer will issue a report to the contractor with comments regarding acceptance of the test data or noting any deficiencies and corrective action required.

The project superintendent should maintain daily contact with the on-site geotechnician to be aware of all acceptable, marginal, or unacceptable earthwork operations.

Other testing and inspection requirements

Other testing requirements may be listed in the specification section to which they apply, such as this one:

Division 3—Concrete

Testing inspections may apply to ensuring that the subgrade for foundations is at the elevation required and that the subsurface presents the specified bearing capacity. Inspection of the type of concrete forms and their proper installation may also be a function of testing and inspection procedures in Division 3, as would the proper fabrication and installation of reinforcing steel or welded wire mesh.

Approved shop drawings containing concrete mix design and reinforcing steel should be close at hand so the project superintendent can refer to them from time to time to ensure compliance with the contract requirements.

And of course placement of concrete, specifically during "cold" or "hot" weather as well as with correct curing procedures, would qualify as quality control/assurance procedures. These instructions are often included in the specific section of Division 3 or contained in a separate section devoted to installation.

Division 4—Masonry

With the appropriate approved shop drawings in hand, the project superintendent is ready to review the QC requirements for masonry work.

Are the correct concrete masonry units (CMUs) on-site? Are they lightweight or regular weight, as required, and of the proper size? What about reinforcement, both vertical and horizontal? Does it comply with the approved shop drawing? Not only will inspection of these materials be required, but also the project superintendent should periodically check to ensure that they are installed properly.

Flashings installed improperly, or even missing, in masonry walls will be a source of trouble (spelled *cost*) for years to come. The project superintendent must be familiar with the project's flashing details; but if they appear to be inadequate, a conversation with the architect is in order to discuss any suggested improvements. *Note:* If any such conversation takes place and the architect directs the superintendent to proceed with the installation per the drawings, it is critical to confirm that conversation as soon as possible, so that the responsibility for any future leaks can be laid at the door of the designer. If revision to flashing details or installation procedures is suggested by the architect, request a sketch before proceeding.

Cavity wall inspections must be frequent to ensure that this space is kept free from mortar and will weep moisture as designed.

And often more than a casual inspection is required. The writer had such an experience while working at a campus setting where two three-story, 180,000-square-foot brick-veneer office buildings were under construction. The brickwork had lots of intricate details, and the limestone quoins and pediments were representative of the high-quality design and the owner's high-quality expectations. It was important for the masonry contractor to have quality issues at the forefront of the work so that close inspection as the first courses of brick were installed would be key to establishing the quality standards. As the brickwork proceeded to the height of about 4 feet, the writer inspected the cavity and found excessive mortar buildup, which would prevent any moisture in the cavity from weeping out through the pea gravel placed there for that purpose. He told the masonry contractor's crew supervisor that this condition was not acceptable and the excess mortar was to be removed, carefully, so as not to damage any installed flashings. About 3 hours later when this wall was reinspected with the masonry crew supervisor, the appearance of the cavity had changed dramatically. All that could be seen was a layer of clean pea gravel with very little trace of mortar. In fact, it looked too clean. The writer found a rebar and probed through about 2 inches of clean pea gravel before hitting a layer of hardened mortar. What the foreman had done was merely to place a clean layer of gravel over the mortar that had previously dropped into the cavity and hardened to the point where no moisture would be able to reach the weep holes underneath. After being instructed to tear down about 100 feet of constructed wall, the masonry crew supervisor finally realized that we would accept no substandard work, and the balance of the brickwork was installed properly.

And of course, just as in concrete work, cold weather and hot weather installation procedures are to be followed per the specification instructions.

Mortar mix—does it meet specification?

An often overlooked item in the inspection process is confirmation of the correct mortar mix. This is of particular importance if the specification does not require the mason to prepare and submit mortar cubes for testing. Mortar types generally fall into the following categories:

Type M—high compressive strength (2500 pounds per square inch average). This type is highly durable; therefore, it is generally recommended for unreinforced masonry walls below grade.

Type S—reasonably high compressive strength (1800 pounds per square inch average), having great tensile strength and recommended for reinforced masonry walls where maximum flexural strength is desired.

Type N—midrange compressive strength (750 pounds per square inch average), suitable for general above-grade masonry work for parapets and chimneys.

Type O—low compressive strength (350 pounds per square inch average) and suitable for interior non-load-bearing masonry walls.

Type K—very low compressive strength (75 pounds per square inch average). Occasionally used for interior non-load-bearing walls where permitted by code.

The project superintendent, from time to time, ought to look at the full or even empty mortar bags to verify that the correct type of mortar is being used.

Division 5—metals. Along with shop drawing approval, the engineer frequently requires *mill reports*—basically a chemical analysis of the steel used to form the rolled sections such as beams and columns. This report contains all the elements incorporated into the steel along with its certification. This report verifies that the exact type of steel, such as grade A572 or A992 (high-strength) or grade A242 (corrosion-resistant), that has been specified has been supplied.

A Word about Mill Reports

Requesting, receiving, and verifying information contained in the mill report obtained from the steel manufacturer can have serious consequences if not pursued diligently when this requirement is included in the contract specifications. These mill reports are prepared by the steel mill producing the product and contain the detailed chemical composition of each representative sized rolled section produced and shipped to the steel fabricator. They also contain a certification that the steel meets specific American Institute of Steel Construction (AISC) standards.

Another "war story" experienced by the writer will vividly reveal the importance of mill reports. The writer was the project manager on a 16-story, structural steel framed apartment building some years ago. In this particular project, Division 5 of the specifications included a requirement for the structural steel contractor to submit a mill report that contained the detailed composition of the steel being produced for this particular job along with the certification that the steel met specific American Institute of Steel Construction standards.

Repeated requests to the steel subcontractor for these reports went unheeded, even as steel began arriving on site. As erection began, the threat of nonpayment resulted in the structural steel subcontractor finally submitting a thick stack of mill reports, which were sent on to the design engineer. A week or two later as erection passed the 10th floor and concrete decks were being poured on the lower floors, the engineer began to question several of the mill reports, indicating that some of them applied to beam sizes that were not called for on the job. There were several mill reports for W 24 × 56 and W 18 × 36 steel when no such sized members were required. Further investigation revealed that the subcontractor had falsified the reports, and the engineer questioned whether the high-strength steel, as required, was actually furnished and installed. He directed that some coupons (small rectangles of steel) be removed from several beams and submitted for destructive testing to determine if high-strength steel, as specified, was or was not furnished and installed. When the writer attempted to contact the steel subcontractor, he found that the subcontractor's phones were disconnected and the office had shut down. So much for the low bidder! The outcome could have been much worse. A computer analysis of the structural steel calculations and design, by the structural engineer, indicated that a dozen or so fish plates throughout the building would suffice, and coupled with the cost of the design reevaluation, the final bill for this mishap was not so bad. But it did instill the importance of having mill reports prior to the delivery of steel.

Division 5 testing and inspection requirements can include inspection of metal deck welds, shear stud inspections, framed openings, edge stops, structural steel moment connection-bolted connections, and welds.

Structural steel QC/QA measures begin before one piece of steel is purchased or fabricated. Many specifications include bidder qualification requirements, such as the fabricator must demonstrate experience in the specific type of structural steel system being proposed.

The structural steel fabricator's shop may be required to meet American Institute of Steel Construction standards and be so certified, and if not, the design structural engineer may be required to visit the fabricator's shop and approve the facility (and the general contractor will have to pay for all such travel and inspection fees).

Field inspections nearly always require the following:

1. Inspection of field welding
2. Ascertaining that fit-up and alignment are proper
3. Inspection of placement of bolts with proper tension (when torsion-control self-indicating bolts are used, the torsion test is a visible one)
4. Inspection to ensure compliance with the approved shop drawings

And where welding occurs, the following are included:

1. 100 percent visual inspection
2. Fillet welds—one spot test per member (magnetic particle)
3. Partial penetration welds—one spot test per weld (magnetic particle)
4. Full-penetration welds in joints and splices—tested 100 percent by ultrasonic testing

Generally if more than 10 percent of tested welds are rejected, an additional 10 percent are to be taken.

Metal deck with shear studs will be tested by tapping each stud with a hammer to obtain the desired "ring," and even structural steel shop paint may be subjected to QA to ensure that all field touchup, as required, has been satisfactorily completed.

Don't assume anything when it comes to testing and inspections. Only a complete read of the specifications will uncover all the inspection and testing requirements and, in combination with any contract modifications, reveal whether the owner, general contractor, or subcontractor is responsible for the testing and/or inspection.

When the owner is responsible for testing, ample notice must be given to allow the owner to schedule a consultant to visit the site and not delay any of the general contractor's operations.

Mechanical and Electrical Testing and Inspections

Carefully read Division 15 (mechanical) and Division 16 (electrical) specification sections where significant inspection and testing requirements frequently appear. In fact one subsection of Division 15 may even be entitled "Testing, Adjusting, Balancing," often referred to simply as TAB. Many QC/QA requirements rest within the pages of Divisions 15 and 16, and one place to start to look for this type of work is in the General Mechanical and General Electrical Requirements section that prefaces each division.

A typical general mechanical requirement, as an example, could include the following:

1. Approval of the selection of the subcontractor by the engineer prior to the general contractor's awarding a contract to that subcontractor
2. Compliance with state and local authorities and standards and specifications issued by various trade associations such as ASHRAE, ASME, AABC, and ADC
3. Air pressure or hydrostatic pressure testing of various systems prior to closing up a wall or ceiling assembly
4. Record drawings
5. Operating and maintenance manuals (O&Ms)
6. Air and water balancing reports
7. System and product identification tags, charts, plaques, and color coding
8. Interim and final inspections by governing authorities and by the design architect/engineer team

Reread the contract documents relating to testing

Testing and inspection requirements for a construction project can vary considerably from job to job. Don't assume that the same testing and inspection procedures required on that last project apply to the current one. *Read the contract, the specifications, and the general notes on the drawings.*

Contract requirements

AIA A201, General Conditions of the Contract, contains several sections relating to testing and inspection. Article 13.5 is entitled "Tests and Inspections," and Article 12.1 describes the procedure to be followed if a portion of work is covered without being inspected when the specifications require inspection. In such as case, the architect may require the work to be exposed for inspection and replaced at the contractor's time and expense.

When subcontractors are to provide testing, such as pressure testing on pipe prior to its being enclosed, it behooves them to perform these tests in a manner that does not affect the progress of other trades. If, in fact, that does occur, those affected subcontractors will look to the general contractor for any time/cost impact, and the project superintendent will share some of the responsibility if these delays occurred but could have been avoided with proper notification and scheduling.

Specification requirements

Testing and inspections can be listed in the specification section to which they refer, that is, concrete in Division 3, structural steel in Division 5, roofing in Division 7, and so forth; or in related sections; or in Division 0 or Division 1 of the specifications book. By scanning the entire specifications book, those provisions dealing with testing and inspections can be highlighted and tabbed. If there is a question regarding testing or inspections, now is the time to resolve these issues. Contact the project manager who can prepare a Request for Information or Request for Clarification and send it on to the architect or engineer. And don't assume that even though testing and inspections are included in specification sections for which subcontracts have been issued, this work may have been excluded by the subcontractor.

Subcontracted work and the testing and inspection process

When it appears that an inspection or test is required of a subcontractor, notify the subcontractor well in advance by phone call, followed up by a letter or fax, and include that item in the next subcontractor's meeting. If the contract requires testing to be provided by the owner, it is incumbent upon the subcontractor to notify the project superintendent well in advance of the test or inspection, thereby providing the owner with enough time to get the inspector on the job site or to make arrangements for the required test.

Remind the subcontractor that if a request for inspection is not made in a timely manner and the work involved has been closed in by another trade, the cost to uncover or expose the item to be tested, along with the cost to recover or encase the work, will be borne by that subcontractor.

The Preinstallation Conference

The specifications often include a requirement for a preinstallation conference for certain trades, to ensure that the product and installation procedures for the applicable construction component will fully and completely comply with those specification sections. Although product certification may have been obtained via an approved shop drawing, the architect or engineer would like to be assured that the detailed installation and inspection procedures set forth in the related specification section will be followed.

These preinstallation conferences are frequently required whenever a system related to water or air infiltration is involved, that is, roofing, curtain wall, exterior metal siding, masonry wall construction or exterior insulating finish systems (EIFS), windows, flashing, and so forth.

If not specifically required by contract, in many cases, it is a good idea for the superintendent to require subcontractors to prepare for and participate in these types of meetings.

For example, let's look at a structure with a metal stud and exterior-grade gypsum board wall system clad with a brick-veneer surface. There are several areas where less than acceptable workmanship can create a source of future water leaks. The general contractor can incur lots of client wrath and spend lots of time and money to repair work if any leaks occur during the standard 1-year warranty period—or even beyond, if a reliable contractor feels an obligation to correct these defects. A preconstruction conference in this case would involve the following subcontractors:

1. Steel stud and drywall contractor ensures that the joints on the exterior-grade drywall are properly sealed, and that the waterproof integrity of the gypsum board's surface has not been damaged (if so, the subcontractor must repair).
2. Where windows are to be installed in openings in the brick veneer, the window installer should be present to review and discuss flashing details, blocking for the proper securing of the windows, and acceptance of the correct size masonry opening for the windows.
3. Depending upon which trade will be responsible for supplying and installing all flashing, that subcontractor(s) will be a key participant in this preconstruction conference since the proper installation of flashing is one of the most important aspects of attaining waterproof integrity.
4. And last, but not by degree of importance, the mason subcontractor will be a major factor in this process. Not only will the company be responsible for adhering to its own specification section, but also it must work in concert with other related trades to ensure that the exterior wall assembly, when completed, meets the specifications and "the best practices of the trade."

Time spent reviewing each participant's role in the process under consideration will ensure that these subcontractors fully understand what is expected of them and their intent to comply with all the requirements and instructions discussed at that meeting. The project superintendent should follow up by issuing detailed minutes of this meeting in which all these procedures are reviewed and discussed, and responsibility for implementation is agreed to. Without such documentation, it is possible for any one of the attending subcontractors to misinterpret what was discussed and later dispute or deny responsibility for previously agreed upon actions.

Preconstruction conferences or meetings are particularly useful when dealing with any of the following components of construction:

- Sedimentation control and maintenance
- Cast-in-place concrete work
- Structural steel and metal decks
- Waterproofing—foundations, above-grade walls
- Insulation—in-wall, ceilings, foundations

- Exterior wall assemblies such as stucco, masonry, wall, vinyl, metal siding
- Windows, vents, louvers, and related flashings installed in exterior wall systems
- Roofing, skylights, sheet metal flashings, gutters, downspouts
- Joint sealers—caulking
- Gypsum board and related in-wall blocking
- Kitchen and bath cabinets (in-wall blocking, scribe pieces, etc.)
- Finishes, walls, flooring, signage, window treatments

Prior to the commencement of certain items of work and systems, a re-review of the related plans and corresponding specification sections and approved shop drawings primarily with the subcontractor involved is desirable to ensure that the contract document requirements will be achieved or that some modifications may be required, with the architect/engineer's approval. These print, specification, and shop drawing review meetings are helpful prior to work commencing for

- Elevator installations
- Millwork, cabinetry
- Fire protection systems
- Storm drains—interior and exterior
- HVAC systems—ductwork and equipment
- Electrical systems
- Data and communications systems
- Other low-voltage work, that is, security systems

Sample panels and mock-ups

Sample panels are often required when extensive brickwork or other types of decorative exterior masonry unit wall construction are to be built. Some masons use the sample panel process as a way to display their master masonry skills, but they must also take into account the fact that the architect, once the sample panel is erected and approved, will expect to see the same quality in the mass-produced product that follows. Sample panels are often required when metal siding is to be installed as part of a wall system containing other materials. The architect may wish to verify that the flashings or details connecting one material to another are visually correct or may require design modification.

Mock-ups usually include two or more construction products that together will form a wall assembly or a system or a finish schedule. Curtain wall construction often begins by constructing an "in-place" mock-up so that the architect can inspect this sample segment and be assured that a structurally secure, weathertight system will be built. This mock-up process allows all related trades to determine how they will integrate their individual products into the overall system.

To afford the owner a snapshot view of the color scheme as outlined by the finish schedule, an architect may request a sample board be prepared containing a ceiling tile, small gypsum board painted wall, a few floor tiles, or a small piece of carpet.

And it is not solely an architect or engineer's prerogative to request a sample panel or a mock-up. Many general contractors will do so when a particularly complex or complicated exterior wall system is required. All participating subcontractors and vendors are invited to participate in the process to ensure that when the actual in-place work begins, they will have worked out any minor, or sometimes major, details so that the work can continue smoothly and efficiently.

Does the Punch List Qualify for QA/QC?

In a perfect world, there would be no need for a punch list. But as we all know, we live in a less-than-perfect world in the construction business. During the final phase of the construction process, one goal is to limit the inevitable punch list by carefully supervising the work as it progresses. However, the project superintendent cannot be everywhere on the site, checking every trade along each step of the operation daily. The project superintendent needs to establish some procedures along the way to assist in striving for a zero-tolerance punch list.

A clean site will affect punch list work

The project superintendent must display an attitude about quality work, and this will filter down throughout the various crews on the project. When a construction site is neat and not littered with debris, where there are sufficient numbers of trash containers placed strategically around the site and in the building, when worker temporary lunchroom areas are policed and kept clean, a clean environment will ultimately lead to higher-quality work. And conversely, a sloppy, trash-strewn site and building sends the message that the project superintendent does not really have too much interest in maintaining order.

So a clean and orderly construction site is the first step in conveying the proper quality message. If cleaning rules and regulations are ignored by subcontractors, depending upon the penalties included in their respective subcontract agreements, strict and prompt enforcement is necessary to bring discipline to the site, which in turn should be reflected in better attention to other work practices.

Matters relating to quality should be addressed at every subcontractor meeting, and the importance of each trade achieving high-quality work ought to be stressed. It must be made perfectly clear that shortcuts will not be tolerated if they shortchange quality. Nonconforming or defective work will not be acceptable, and subcontractor monthly requests for payment may be delayed or partially reduced if defective work becomes a major problem. Each subcontractor crew supervisor will be held responsible for the quality of the respective work teams, and once this message is spread repeatedly, the project superintendent's watchdog activities relating to potential punch list work may be relaxed somewhat.

Reduce your punch list—prepunch the building

That basic contract document A201, General Conditions, includes a provision placing responsibility on the contractor to inspect the work, in effect a requirement to prepunch the building prior to an inspection by the architect. Document A201 states:

> The contractor shall be responsible for inspection of portions of work already performed under this contract to determine that such portions are in proper condition to receive subsequent work.

This same AIA document continues with a statement relating to punch lists:

> When the Contractor considers that the work, or a portion thereof which the owner agrees to accept separately is substantially complete, the contractor shall prepare and submit to the architect a comprehensive list of items to be completed or corrected.

If you recall from Chap. 6, most subcontractor contracts issued by the general contractor include a provision linking the terms and conditions of the contract between owner and general contractor with those of the subcontractor and general contractor. Therefore these "inspection" requirements, contained in the General Conditions contract included in the general contractor's contract with the owner, will apply to the subcontractor as well. The subcontractor, therefore, has a contractual requirement to inspect the work to "determine that such portions are in proper condition to receive subsequent work," that is, to inspect and prepunch the work.

All trades should be advised that they are *required* to "punch out" their own work before leaving the job. Once they have gone, it is difficult to get tradespeople back to complete or repair minor defective work; they are off on that new project. But before demobilizing, all subcontractors should be made aware of their responsibility to carefully and thoroughly review their work in place, to correct any items that could possibly be picked up on a future punch list. A rapid walkthrough with the subcontractor crew supervisor at the beginning of the prepunch list work will show the supervisor work that will be acceptable, and work will show up on the architect/engineer's punch list if it is not corrected at this time.

In fact there is a responsibility to do more than prepunch the work. Subcontractors are obliged to ascertain *that such portions are in proper condition to receive subsequent work.* Does this mean that the painting subcontractor is responsible for inspecting drywall surfaces to ensure that their subsequent painting work will be acceptable, and does it also mean that the flooring subcontractor is to inspect the flooring substrate to determine if it is acceptable for resilient flooring or carpeting? Although it might take the threat of legal action to firmly establish such responsibility, as a project superintendent, it appears that subcontractors ought to have more than a passing responsibility in maintaining levels of quality assurance for the work included in their contract scope.

The subcontractor crew supervisor should willingly participate in this prepunch exercise since she or he will be the recipient of the end result of this process. Failure to correct minor items at this time may result in significant backcharges later on. If a drywall subcontractor fails to correct an unacceptable tape joint now and a semigloss to high-gloss paint is applied over this surface, the drywall subcontractor may be required not only to repair the defective joint, but also to absorb the costs to repaint the entire wall to avoid the appearance of a patch.

Subcontractors must also be reminded that their retainage and final payment are contingent upon completing all closeout requirements, including punch list work. The longer it takes to complete the punch list, the longer it will take for the subcontractor to receive the balance due on the account.

Electronic aids to the rescue

Following quickly on the heels of the personal computer and the wireless cellular phone, the *personal digital assistant* (PDA) has become more sophisticated than ever. Although at first the PDA was relegated to the task of keeping a telephone directory and an appointments schedule, much more computing power has been added to the latest editions of PDAs, and software programs including Daily Diary and Punch List Preparation are now on the market. One such firm, Onsyss, headquartered in Rockville, Maryland, developed punch list software that was incorporated into the Meridian Project Systems field management program (Figs. 10-1 and 10-2), used extensively at the Mohegan Sun Casino construction project by Massachusetts-based general contractor Perini, Inc. This fast-tracked project, valued at $870 million and employing 200 tradespeople, generated 21,000 punch list items which were captured on seven handheld PDAs. These lists were regularly transmitted to approximately 30 subcontractors and greatly speeded up the entire punch list process.

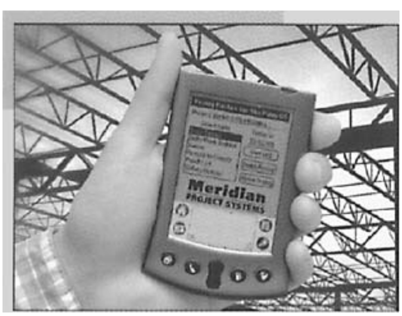

Figure 10-1 Field management software for handheld computers.

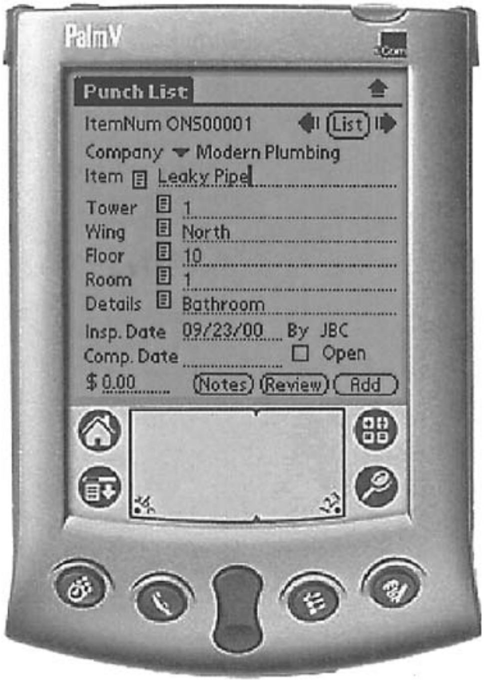

Figure 10-2 Screen shot of handheld computer with punch list software.

Dealing with subcontractors who diligently/reluctantly approach punch list work

On every project there are some subcontractors who diligently attack punch list work and complete it promptly. And then there are subcontractors who promise to complete their work quickly, but nibble away, one item at a time, over a period of weeks.

The architect generally will not release retainage until all punch list and closeout work has been completed and accepted. That diligent subcontractor may therefore be penalized and have to wait weeks before receiving funds just because another subcontractor is in the process of correcting its work to satisfy the design team.

If this is the case, suggest a system that will withhold money for incomplete punch list work by one subcontractor while releasing funds for the subcontractor who fully cooperated in completing the work. Propose to the architect or engineer that a realistic value be placed on each incomplete item of work; then double or even triple this amount and withhold it from payment. When each item has been completed, the architect will then approve payment.

This system, which works well for everyone, can follow these guidelines:

- The amount retained should be recognized as being sufficient to correct the defective work even if another subcontractor has to be brought on site to do so. In other words, the general contractor and owner have been afforded a degree of protection.

- It allows retainage to be released for all punch list work properly completed and approved, thereby rewarding those subcontractors who performed properly.
- It serves as a recognizable penalty to the offending subcontractor since it represents significantly higher costs than those actually required to complete the work.

To reduce your punch list, try the following

1. Inspect for quality on each walk-through of the job, but at a bare minimum inspect for quality once each week.
2. Promptly notify a subcontractor or vendor of any unacceptable work, materials, or equipment, and request immediate replacement or rework.
3. If substandard work or repeated lack of product quality continues, call the subcontractor's owners or manufacturer/vendor representative to the site to inform the person of these quality issues, and obtain the representative's verbal commitment to change and improve. Follow up with a written confirmation of that meeting. If a change in crew supervisor is deemed necessary, so state and make the request.
4. Prior to that particular subcontractor's leaving the site, conduct a walk-through to create a punch list, giving one copy to the subcontractor's crew supervisor and faxing or emailing a copy to the subcontractor's office. Advise both parties that this punch list must be completed, inspected, and signed off before the subcontractor demobilizes. If this is not done, further payments to the subcontractor will be delayed.
5. Advise the subcontractor that *release* by the project superintendent does not relieve the subcontractor from further punch list responsibility but was merely an exercise in reducing the potential for extensive punch list work when the architect/engineers prepare their lists.

The Distinction between Punch List and Warranty Work

During the preparation of the architect/engineer's punch list, certain items on the list may require the contractor to order parts or entire assemblies that could take weeks or months to arrive at the site. When the superintendent is wrapping things up and anxious to leave for that new project as soon as possible, this incomplete work may delay that departure. If the item is included in the punch list and not signed off when the project is substantially or finally completed and occupied, monies will be withheld from the final payment and such items as bond signoff and final releases by the owner may not be forthcoming. But is that last item on the punch list, possibly one that requires replacing a defective motor on a backup water circulating pump, really a punch list item—or is it a warranty item? There is a big difference between the two. *Punch list work* is defined, and accepted by most professionals, as work which has not yet been completed in accordance with the contract scope, or rework required to conform to the project requirements.

Warranty work is "guarantee" work whereby the contractor is responsible to repair or replace any defective materials and equipment, including installation during the warranty period established in the contract. Let's take the circulating pump as an example. If it was furnished and installed in accordance with the contract requirements, but upon start or shortly thereafter it failed, then this is a warranty item. The builder's (and subcontractor's) warranty was issued to cover such situations, and the builder (and subcontractor) has a responsibility to replace, in this case, the defective pump within the warranty period, which is usually 1 year after owner's acceptance of the structure. So a case can be made to the architect that this is not a punch list item and no funds should be withheld until the defective pump is replaced. "Mr. Architect, please delete this item from the punch list, release our final payment, and when the replacement pump arrives, we will install it." The same case can be made for a number of other so-called punch list items—think of a few.

The Preprinted Quality Assurance Checklist Approach

Several general contractors prepare generic quality control type of checklists that also allow for modification to include specific individual project requirements. Although the initial preparation of lists such as these can be very time-consuming, once prepared, they can serve as quick reference documents to check on compliance with contract requirements for various trades and work tasks or to create a punch list.

Figure 10-3 is a concrete checklist that can be used during the entire cast-in-place concrete process, starting with inspection of forms, checking reinforcement steel and embeds, and underground rough-ins. Figure 10-4 is typical checklists for earthwork and Fig. 10-5 is for doors/frames. (Other quality assurance checklists may be found on the CD that accompanies this book.)

But whichever approach to quality is employed, remember that quality is a state of mind. It begins with a clean and safe working environment and ends with a 10-item punch list.

Developing a Quality Control/Quality Assurance Program

A quality control program has several goals:

- To complete the work in accordance with the contract documents, on time, and within the budget established for the project.
- To utilize the general contractor and the subcontractor's time more productively because the effort devoted to quality control/quality assurance will result in fewer rework and fewer call-backs.

- Improve the day-to-day relationships with the owner and their design consultants, creating an atmosphere of mutual trust.
- To build a reputation as a quality builder in the contractor's marketing and sales development area of operations.

The project superintendent plays a critical role in the daily on-site operations that directly translate into QA/QC activities, and to do this best, a company-wide quality control program is required.

The construction quality control plan (CQCP)

If the company wishes to create a quality control plan, it will need not only the plan but also a corporate commitment backed by the company's top executive and the appointment of a qualified individual to assume the duties of a CQCP

Concrete Checklist

Building Concrete Work:

Footings:

1)_____ Ensure proper sub grade elevation at building pad.

2)_____ Confirm footing size and location in relation to building stakeout with subcontractor. Contact site engineer if necessary.

3)_____ Check forms for right elevation, width, and depth of footings and piers. Check for the right set backs. Tape all measurements for length and width of building and all interior bearing and non-bearing footings and piers. After step-down footings, landings, and slope footings are formed, set up builder's level and double check elevations before pouring. Make sure forms are well braced, tight, free of debris, and coated with approved compound for ease of removal. Check grading plans for deepened footings and raised stem walls.

4)_____ Check steel to verify proper size and location. Make sure rebar is properly fabricated and installed.

5)_____ Call municipal inspector for footing inspection>

6)_____ Before pouring footings, check for the following:

A) _____ Check for proper thickness, correct steel and proper concrete mix to ensure that the concrete reaches the required P.S.I.

B) _____ Get a ticket for every load of concrete poured. Check the type of concrete, cement sack mix, and water ratio. Make sure it is as per contract and soils report. Fill out daily pour sheets. Take cylinder samples and slump tests, as required.

C) _____ Check anchor bolt, hold-down, post anchor, column base, and post base locations for proper sizes and heights.

D) _____ Make sure all depths are correct per plans and soils report. Make sure footing trenches and rebar are three inches away from the forms and dirt banks. Make sure trenches are free of debris and dirt clods.

E) _____ Check for eased edges at stem walls and step downs, as required.

F) _____ Check installation of special expansion joints at split level, step, or grade break areas.

G) _____ Make sure concrete is placed properly.

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Figure 10-3 Example of checklist prepared for concrete inspections.

Slabs:

7) _____ When grading for the slab area, be sure that all footings, including interior, are exposed, and cleaned of all loose dirt. Keep visqueen off of all footings. Check mil. size of visqueen. Prior to visqueen and sand or gravel fill, the underslab plumbing rough-in should be installed. Check for the following:

A) _____ Confirm proper type and size of copper line for underslab plumbing rough-in: type "K" or "L."
B) _____ Make sure there are no splices under slab.
C) _____ Make sure no copper is exposed to concrete and that all copper installed has approved plastic sleeves to prevent electrolysis.
D) _____ Recheck forms for correct elevations. Check all buildings for backfill with the proper gravel at raised slab area. Check visqueen - repair any holes or rips. String line all slab areas for four-inch nominal slab. Make sure interior trenches are wheel rolled and filled with good native soil or import sand, whichever is required. Make sure wire mesh is per contract and soils report. Check electrical conduit and floor boxes. Make sure all plumbing and electrical is tied down so that it will not move or float during the pour. Schedule a pre-slab inspection.

8)_____ Before pouring house and garage slabs, check the following:
A)_____ Check the concrete load tickets for proper type of concrete, cement sack mix, and water ratio.
B)_____ Make sure the concrete is placed properly and not poured too wet.
C)_____ Take cylinders and required slump tests.
D)_____ Make sure mesh is pulled up when pouring and that chairs (if required) are installed. Make sure the "hook-man" does not stand or walk on mesh after it has been centered in the slab. If mesh is hooked and centered, do not allow workmen to stand or walk on it.
E)_____ Make sure tops of footings are clean. They should be swept or hosed off prior to the pour.
F)_____ Check for screed pins or grade stakes at proper spacing.
H)_____ Check for even screed - no highs or lows.

I)_____ Check for control joints as required (tooled, pre-formed, saw cut).
J)_____ Check for proper spacing of anchor bolts. Make sure

2

Figure 10-3 (*Continued*)

manager. This manager, once the plan has been formulated and implemented, will take charge in much the same way that a director of safety administers the company's safety plan.

The CQCP plan should include, as a minimum:

- An organization chart designating a CQCP manager and how this manager fits into the overall company management structure.
- Proposed personnel and support staff—just the positions, names, and personnel may change from time to time.
- The authority commensurate with each position along with their duties and responsibilities.

Quality Control Check List

Project no.

Section: Earthwork

No.: 02200

Date

1. Soil information report is on job and reviewed. Note elevation of water table.
2. Job survey is reviewed; monuments and stakes are located. Limits of work are establisehd.
3. Job surveyor is on site if required.
4. Observe removal of existing buildings and foundations or other items.
5. Note condition of, or photograph, offsite and onsite improvements to remain, such as paving curbs, gutters and walks before work begins.
6. Existing vegetation to remain is protected.
7. Existing utility lines to remain are located, staked, and protected. Observe condtions of uncovered lines. Verify utility companies have been notified. All lines to be removed or abandoned are properly capped. If unknown lines are encountered, notify proper personnel.
8. Adjacent property is protected. Verify whether adjacent property owner is notified as required by work or code.
9. Shoring and underpinning is provided if required.
10. Extent of grubbing and removal of stumps and matted roots is performed. Depressions are properly filled compacted.
11. Spillage of materials or soil on streets and sidewalks is promptly removed for public safety.
12. Spillage of gas, oil, slurry, etc., is prevented in areas to be planted or near existing vegetation to be retained.
13. Dust control is provided as required.
14. Stripping of site, preservation and depth of removal of topsoil, and location of stockpile are performed and established.
15. Observe that topsoil is not contaminated wtih subsoil and is free from roots, stones, and other deleterious materials.
16. Check that satisfactory materials are used and unsuitable materials are disposed of in waste areas. Note contamination if it occurs.
17. Observe removal of material, note unusual conditions. Observe subsoil conditions for irregularities such as soft spots, springs, previous debris, etc
18. Excavation is performed in scheduled sequence if required.
19. Excavating does not cause unusual rutting and appears adequate for work to be performed.
20. Observe that over-excavation does not occur.
21. Drainage is provided continuously as excavation progresses: other de-watering methods such as well points are provided, drainage ditches are maintained, and ponding does not occur.
22. Testing, inspection, and compaction are performed during excavation and filling as required.
23. Borrow excavation procedures and materials are adequate.
24. Source and type of imported materials are as approved. Verify samples are tested and approved.
25. Compaction is performed in lifts required.
26. Observe that building layout is properly established, set-backs are observed, and batterboards and elevations are established. See that compacted material extends beyond foundation line as required.
27. Observe foundation excavating for adequacy, bracing, form clearances, type of soil, etc., and that the work is inspected by the contractor.
28. Observe that corrective measures are performed where over-excavation occurs.
29. Observe methods of de-watering foundation excavations and see that footing beds are not disturbed or softened. Methods for surface drainage are provided.
30. Footing drains are installed in manner specified.
31. Backfill materials are from approved source. They are installed in specified layers and adequate compaction equipment is used. Relative density of backfill is checked. Walls are properly cured before backfilling.
32. Waterproof membranes are protected against damage during backfilling operations.

USE REVERSE SIDE FOR ADDITIONAL REMARKS AND COMMENTS

Accepted By ______________________________

Figure 10-4 Typical checklists for earthwork.

Quality Control Check List

Project no.

Section: Metal Doors and Frames

No. 08101

Date

1. Shop drawings and schedule are approved and on site.
2. Doors are as approved: type, design, material, etc.
3. Check panel, lights, louvers, and features. 4. Check defects: dents, buckles, and wraps.
5. Fabrication, construction and workmanship. 6. Smooth edges, joints, finish, and straightness.
7. Additional reinforcement provided for hardware.
8. Observe backing plates during drilling operations.
9. Observe that closure channels are provided.
10. Provisions to receive hardware are adequate.
11. Observe type of factory-installed hardware.
12. Backset is matched to finish hardware.
13. Stile edges, astragals, required for pairs of doors.
14. Fire-rated doors have labels and proper identification.
15. Wire glass is provided.
16. Fusible-link holders provided at louvers.
17. Observe installation and verify proper clearance.
18. Doors are hung straight, level and plumb.
19. Door functions smoothly and easily.
20. Hardware is properly adjusted.
21. Observe glazing operation.
22. Factory prime is retouched.
23. Surfaces are adequate to receive applied finish.
24. Report doors that cannot be properly cleaned.
25. Protection provided to avoid marring.
26. Bumper buttons installed.
27. Fabrication and construction of frame as required.
28. Frames are prebraced if required.
29. Extra reinforcement on frames at head, corners, and hardware.
30. Proper type and number of anchors are provided.
31. Verify adequate anchorage made during installation.
32. Sound-deadening treatment is provided if required.
33. Fire-rated frames have labels and proper identification.
34. Light/sound-proof, lead-lined frames as required.
35. Provide features such as silencer holes if required.
36. Frame is grouted during installation if required.
37. Frame is caulked if required.
38. Frames are installed straight, level and plumb.
39. Frames adequately braced where "built-in".
40. Provide spreaders (masonry walls).
41. Protect threads of hinge plates in buck.

USE REVERSE SIDE FOR ADDITIONAL REMARKS AND COMMENTS

Accepted By ________________________

Figure 10-5 Typical checklist for doors/frames.

- Establishing the operating procedures—what inspections will take place, when they will take place, and the documentation produced as a result of these inspections.
- A procedure for dealing with failed inspections and tests.
- Development of a subcontractor and vendor rating system so that site supervisors can evaluate and report on subcontractor and vendor quality and performance matters.
- A system that will allow the field supervisors, the project manager, and purchasing personnel to talk to each other about selecting competent and quality-oriented vendors and subcontractors and also about being aware of substandard vendors/subcontractors.
- Establish some form of QC/QA training program for field personnel—possibly monthly meetings in which one construction component is discussed in depth.
- Development of field inspection reports to assist personnel in their inspections procedures.
- Develop a series of reporting forms to alert vendors and subcontractors of work that requires rework in order to meet the company's quality expectations.
- Create a focused inspection program—one that focuses on a particular trade or operations that may be ongoing for a specific period of time.

Some companies conduct monthly meetings for project superintendents devoted solely to QC/QA issues. Each meeting will focus on a specific subject such as the American Construction Institute (ACI) quality standards for cast-in-place concrete, soils testing procedures, proper construction of masonry cavity walls, and so forth.

Frequently vendors of construction materials or equipment are invited to attend and discuss their product or equipment placement and operations. Handouts are prepared and distributed and supers are encouraged to take notes. This pass-through of information is further disseminated at the job site, making all concerned parties more aware of what makes a quality construction site.

Some quality inspection tips

1. When going from Point A to Point B on the construction site, be on the lookout for quality work or substandard work and make notes for further action.
2. At a bare minimum, conduct a weekly quality inspection trip. It may not need to encompass all trades but only a selected few this week and another selected few next week.
3. Promptly notify a subcontractor or vendor of any unacceptable work or equipment, set a date for reinspection, and hold to that date.
4. If a particular subcontractor's work continues to remain substandard, call the subcontractor's owner, meet them at the site to review the problem, and get

their commitment to change. Follow up with a written memorandum of the meeting. If a change in their supervisor becomes necessary, make the request.

5. If a particular vendor's products are substandard or consistently delivered damaged, call the vendor's office and advise them of the problem. If the problem continues, notify your purchasing department and request another vendor if these conditions persist.
6. Advise all subcontractors of the pre-punch-out procedure and that all punch list items developed by this walk-through are to be completed before they demobilize. Make them aware that if the pre-punch-list work is incomplete when they demobilize, you will direct the office to withhold funds from their current request for payment.

This quest to achieve and maintain high quality standards on the job site is never ending, as new subcontractors and vendors may be brought on board on the next project, but a general contractor's reputation as a quality builder will soon spread, making future efforts a little easier.

CONSTRUCTION
MANAGEMENT
CERTIFICATION

End of Lesson Wrap-Up

Congratulations on completing this lesson! You've taken another important step in your journey to becoming a certified professional in the construction industry.

Up Next: Quiz Time

Before we move forward, there's a short quiz waiting for you. Remember, this quiz isn't designed to trip you up but to reinforce your understanding of the concepts we've covered. It's a way to ensure that you have grasped the essential elements of the lesson and are ready to build on this knowledge in subsequent modules.

You're Doing Great!

You're doing an excellent job so far, and we encourage you to keep up the momentum. Every quiz and lesson is a building block towards your ultimate goal of certification and professional advancement.

See You in the Next Lesson!

We are excited to continue this journey with you and look forward to seeing you in the next lesson. Keep up the great work and stay motivated—your future in construction management looks promising!

Keep learning, keep growing, and remember, we are here to support you every step of the way. See you soon for more learning and development

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