



# Quality Time

It often has been lampooned that quality is a topic about which everybody wants to talk, but nobody wants to do anything. No more!

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**A FEW YEARS AGO**, the Building Seismic Safety Council (BSSC) Quality Assurance Committee and members of several other committees, including the AISC Committee on Specifications, the AISC Committee on the Code of Standard Practice, and the National Council of Structural Engineers Associations (NCSEA) Code Advisory Committee (CAC), discussed the future of building codes. The significant variations experienced in application of current prescriptive quality requirements in Chapter 17 of the *International Building Code* (IBC) were identified as a key concern. An idea was born that this shortcoming could be improved if engineers were able to provide the quality inspection plan for the projects they design.

This idea was not without concern. The vision of engineers having to deal with a new burden was evident. It was also clear that steel fabricators and erectors would struggle to incorporate quality activities into their shop and field practices if there were different requirements for every project. No wonder this historically has been an area avoided by all but the brave few. Concentrating on the original concern provided a tightly focused goal: to create a uniform plan with relatively high, effective, and consistent requirements. A process ensued to meet that goal, with the AISC Committee on Specifications leading and receiving input and comments from the other committees.

The first tangible result of this work was realized more than 5 years ago, when AISC added Appendix Q to the 2005 *AISC Seismic Provisions* (AISC 341-05) to provide a quality plan for high-seismic construction. The 2010 versions of AISC standards will see the subsequent results realized:

→ The quality plan in AISC 341-10 (now relocated as Chapter J in that document) has been updated to reflect the emergence of a new reference standard, AWS D1.8.

→ The 2010 *AISC Specification for Structural Steel Buildings* (AISC 360-10) provides a similar plan in Chapter N for all building construction not subject to high-seismic requirements.

AISC 360-10 Chapter N has been written by a task committee consisting of engineers, a general contractor, steel fabricators, steel erectors, and an inspection consultant. In each of several ballot drafts, it has been made available for public review, which generated many comments that were helpful in developing and improving the final version. Additionally, our liaison efforts with the NCSEA CAC also helped us to improve it.

In the course of its development, we also asked steel fabricators and erectors to compare it to their current practices. The feedback we received told us that the plan in Chapter N is consistent with what currently is done in shops recognized for their commitment to quality.

The quality plan in Chapter N provides both a high level of assurance and a consistent set of inspection requirements. We believe it is a significant step forward for all concerned with quality in building construction.

## Why do we believe Chapter N is a significant step forward?

Chapter N offers a quality plan that is of unprecedented clarity, coordination, and completeness. We believe this will help to reduce delays, conflicts and omissions in inspections.

Most of the requirements of Chapter N are derived from current requirements in the *IBC* and those in related standards, such as AWS D1.1 and the *RCSC Specification*. The list of inspections in Chapter N makes the requirements clear and puts them in a single document. These inspections are not new requirements—the list does, however, facilitate planning and providing for them. As another example of a provision that is

not new, a certification of compliance requirement similar to that required in the *IBC* is included.

Some new requirements also are included. For example:

- Chapter N includes provisions for nondestructive testing with a requirement for ultrasonic testing (UT) of a sample of complete-joint-penetration (CJP) groove welds. The UT sample was deemed necessary to indicate that appropriate welding procedures and practices are used.
- A welder identification provision is included as part of the plan, both to help isolate problems as well as to implement reductions in the number of welds to be ultrasonically tested.

### What's in Chapter N?

To answer this question, we will summarize Chapter N section by section. As stated in Section N1, Chapter N provides a plan of requirements for the minimum observation and inspection tasks deemed necessary to ensure quality in structural steel construction. This plan is defined with a comprehensive system of:

- Quality control (QC), which is provided by the fabricator and erector.
- Quality assurance (QA), which is provided by others when required by the authority having jurisdiction (AHJ), applicable building code (ABC), purchaser, owner or engineer of record (EOR).
- Nondestructive testing (NDT), which is to be performed by the agency or firm responsible for quality assurance.

The underlying philosophy of this plan is to involve all levels of management and the workforce in the quality control process to ensure that the necessary levels of quality will be achieved.

Section N2 addresses the requirements that must be met by the fabricator's and erector's QC program. It includes requirements for material identification and items that the fabricator's and erector's QC inspectors must inspect. The requirements in Chapter N recognize that many quality requirements are common from project to project, and that consistency in imposing quality requirements between projects facilitates success and greater uniformity in quality.

Section N3 covers requirements relating to fabricator's and erector's documents. It covers the submittals required of the fabricator and erector—the shop and erection drawings. Also, it lists other supporting documents that must be made available if requested, such as material test reports and manufacturer's certifi-

cations, welding procedure specifications, and quality and inspection procedures.

Section N4 includes requirements for inspection and NDT. This includes the required qualifications for the fabricator's and erector's QC inspectors, as well as for the independent QA inspector and NDT personnel.

Sections N5 and N6 address inspection requirements in steel and composite structures, respectively. These sections cover—in significant detail—the list of tasks to be addressed in QC and QA, and identify each as a *perform* (P) task or an *observe* (O) task. P means that the task must be performed for each joint or member,

whereas O means that the task is to be observed on a random basis. Essentially, a classification of P is assigned to tasks that cannot be properly treated using random sampling procedures. These terms differ from common building code terminology,

which uses the terms “continuous” and “periodic.” This change in terminology is explained further later in this article.

Section N7 covers the use of approved fabricators and erectors. When a fabricator or erector participates in an approval process that is acceptable to the AHJ, such as the AISC Quality Certification program, QA inspections (but not NDT) are waived. Additionally, NDT also can be performed by the fabricator when approved by the AHJ, provided the QA agency reviews the fabricator's NDT reports. At the completion of fabrication or erection, the approved fabricator or erector must submit a certificate of compliance to the AHJ stating that the materials supplied and work performed by the erector are in accordance with the construction documents.

Section N8 addresses how nonconforming materials and workmanship are to be handled.

### How Does Chapter N Work With IBC Requirements?

Chapter N is expected to be incorporated by reference in Chapter 17 of the 2012 *IBC* in a manner that is similar to how the quality plan in AISC 341 for high-seismic construction already is referenced in the 2009 *IBC*.

### Why did AISC develop Chapter N?

We developed Chapter N in response to inquiries and requests from BSSC, NCSEA, and others who wanted to have engineers provide quality plans for projects, rather than relying upon a pre-

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scriptive list in the building code that didn't necessarily fit all projects. They also sought explicit quality requirements for all steel construction, not just high-seismic construction. AISC chose to provide a plan to promote uniformity across projects and avoid ineffective requirements as well as to provide a minimum quality assurance level in steel projects across the country.

We focused on the goal of having a **high level** of quality control and assurance applied uniformly on all projects.

#### What philosophy drove the way AISC developed Chapter N?

We focused on the goal of having a high level of quality control and assurance applied uniformly on all projects. We worked with the understanding that real economic pressures exist to reduce inspection on some projects and that pressures in other projects can lead to ineffective inspection demands. We strove to permit quality organizations to work effectively while still providing appropriate levels of inspection.

#### Why is Chapter N an improvement over existing requirements?

The quality plan in Chapter N is a thorough quality plan with requirements that are complete, clear, coordinated, and appropriate. It includes an explicit list of tasks, each with one of two frequency levels assigned to them:

- *Perform* for tasks that must be done each time.
- *Observe* for tasks that are more periodic in nature.

Our explicit listing of tasks for quality control and assurance—and better defining of the frequency at which each task must be evaluated—will deliver greater uniformity in the quality of steel construction. Additionally, our approach engages workers, quality control inspectors, and quality assurance inspectors as a means to achieve quality. All of these aspects mean Chapter N will be more effective than the special-inspections-only focus in the requirements in the 2009 *IBC*.

#### A SEAOC committee has voiced objection to Chapter N. Why?

The contention of the Structural Engineers Association of California (SEAOC) Construction Quality Assurance (CQA) Committee is that the plan in Chapter N should have more inspection. The stated complaint is that Chapter N permits inspection, primarily in welding operations, of samples where they believe current requirements demand inspection of every piece. This complaint is based upon SEAOC CQA's contention that *IBC*'s use of the term "continuous" means 100% inspection. As explained in the next section, this interpretation is not correct.

#### *IBC* uses the terms "continuous" and "periodic." Why do we use *perform* and *observe*?

Chapter 17 in the 2009 *IBC* also assigns two levels of inspection frequency, though the terms used are different: "continuous" and "periodic." The definition of "continuous" is loose and has been debated many times. Indeed, that conflicted definition currently is the subject of a code-change proposal again in this *IBC* cycle.

"Continuous" has been understood to mean that an inspector must be present on-site during welding activities. However, it is

important to note that never has the International Code Council (ICC) equated "continuous" inspection with the idea that every production task must be inspected on every piece. In fact, the *IBC* references other codes, such as AWS D1.1, for requirements associated with "continuous" inspections, and the reference information requires these so-called "continuous" inspections to be performed "at suitable intervals." This highlights the error in the SEAOC CQA interpretation.

To get past the problems associated with the word "continuous," we chose to define inspection levels in terms of *perform* and *observe*, where the former means "for each" and the latter is associated with an appropriate sample consisting of some number that is less than 100% of the pieces. Thus, we raised the bar to 100% for *perform* tasks and based *observe* tasks upon use of a suitable interval less than 100%. Chapter N requires that every weld must be inspected, and permits sampling for some of the intermediate activities. Use of the term *observe* provides the flexibility for inspectors to provide the inspection needed to result in a high level of assurance for the variety of projects built across the U.S. Even with this flexibility, the task list still defines a minimum level of inspection. The term *observe* allows this flexibility while avoiding work interference that could lead to delays. SEAOC CQA contends the term *observe* could allow abuse by special inspectors and there may be some merit to that contention, but specification writers have a duty to write provisions that provide a satisfactory level of safety while permitting good builders to excel at their work. The term *observe* does that where *continuous* provides employment, sometimes when it is unnecessary. Note that for buildings constructed with seismic detailing (designed to AISC 341) we closed that potential by including the word *daily* in the definition of *observe*.

The underlying philosophy of this plan is to involve all levels of management and the workplace in the quality control process.

#### Did we consider this opposition in our process?

Yes. Public review comments were submitted by the chairman of SEAOC CQA, proposing increased levels of required inspection. AISC's Committee on Specifications (COS) discussed these recommendations at length. The fundamental recommendation from the SEAOC CQA chairman—that all *observe* tasks should be changed to *perform* tasks to require 100% inspection in intermediate welding tasks—was not accepted. The AISC COS rejected this recommendation because it represents a massive increase in inspection over current levels, and would create hold points at every step of the process that do not exist today—and are not required to achieve quality. For a similar reason, this proposal also has been rejected by every other national group to which it has been presented.

#### Does Chapter N reduce the amount of inspection that is currently required?

No. Chapter N meets 2009 *IBC* requirements, and goes further in some cases as explained below. Chapter N also improves on the requirements of the 2009 *IBC* by delineating a very specific list of tasks

that must be performed. We believe this is the key benefit, because this list of task assignments will provide a much more uniform and thorough inspection regimen than a code requirement that a special inspector must be continuously employed. Chapter N provides minimum requirements equal to or better than current *IBC* requirements and allows for good special inspectors to provide the services they know is suitable to the project.

### Why will the use of perform and observe tasks in Chapter N achieve better quality than the “continuous” and “periodic” approach used in the IBC?

Detractors contend that requiring the special inspector to be on site “continuously” will result in more reliable structures, and that inspection of samples less than 100% will allow bad practices. Underlying the controversy is the concern that the sampling permitted in Chapter N for *observe* tasks will be insufficiently strict to catch errors. We disagree.

The fundamental rationale for our use of the terms *perform* and *observe* instead of “continuous” and “periodic” is that requiring specific tasks and appropriate levels of inspection is effective, while

requiring an inspector to be present on site often is not. Requiring “continuous” presence means that the inspector is on the clock when there is little to inspect and does not prevent the problem of not having enough inspectors on site when there is a significant volume of inspection required. Our approach is based upon having clear and distinct inspection tasks with an effective level of inspection frequency associated with each.

Said another way, we abandoned the approach of prescribing presence and an inspection time requirement, which left the actions to be determined by the special inspector. Instead, we defined the inspection tasks that must be performed, and involved the worker, the quality control inspector, and the quality assurance inspector in those tasks as appropriate. The time required to do these activities is dictated by the activities, not arbitrary presence without necessarily being engaged. This will result in more uniform quality assurance than the current *IBC* “continuous” requirement provides.

### How does Chapter N exceed 2009 IBC requirements?

Chapter N requires inspection of every weld in its final condition. Additionally, Chapter N requires non-destructive testing of a sample of complete-joint-penetration (CJP) groove welds. Chapter 17 in the 2009 *IBC* does not. Chapter N also requires welder qualification, weld procedures, confirmation of consumables, and many other inspections that are not required in Chapter 17 in the 2009 *IBC*. Some of these are permitted to be performed on samples, but the frequency can be described in the inspection procedures,

which are subject to review by the engineer and implemented by the quality assurance inspector, not the fabricator. If defects are found, inspection will be increased.

### Why do we not explicitly define the frequency of observe tasks in Chapter N?

Professional quality methods depend on inspection plans such as the one we have in Chapter N, and recognize that routine observation is appropriate to prevent bad practices. Some inspection tasks require 100% inspection, and we have designated those as *perform* tasks.

Where inspection does not need to be 100%, we have used the term *observe*, and we require the frequency to be “at suitable intervals.” Recognize, though, that the suitable interval varies by task, application, and actual performance. Accordingly, there is no way to predetermine the minimum frequency for *observe* tasks.

Any code-specified frequency for *observe*-level tasks will be too little in one specific case and too much in another. Instead, the engineer must be allowed to adjust for the specific situation that is observed. Consequently, we explicitly chose to not define any one frequency for

*observe*-level tasks to permit the necessary adjustment to suit the specifics of the project.

### How does Chapter N promote better performance?

Clearly, observation of bad practices will result in increased inspection. However, Chapter N requires measures that are intended to prevent poor work in the first place. Our requirements for written procedures and qualification of workers result in greater consistency, which also permits quality inspections to be focused where they can be most effective. While there may be instances where more inspection is being done than Chapter N requires, any rational evaluation of Chapter N will show that our explicit requirements will result in more uniform, more effective quality control and assurance practices than the often misinterpreted, unclear requirements in Chapter 17 of the current *IBC*.

### Doesn't high-seismic construction require more than Chapter N provides?

Yes. That is why we have Chapter J in AISC 341-10, which has different and generally more stringent quality control and quality assurance requirements for high-seismic construction than what is required in Chapter N of AISC 360-10.

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