

The formulae  $\frac{\partial \bar{U}_i}{\partial t} + \frac{\partial}{\partial x_i} (\rho U_i \bar{U}_j) = -\frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j} \left( \mu \frac{\partial U_i}{\partial x_j} \right) + g_i(\rho - \rho_s)$  for building  $\frac{\partial}{\partial x_i} (\rho \bar{U}_i \bar{U}_j) = -\frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j} \left( \mu \frac{\partial \bar{U}_i}{\partial x_j} - \rho \bar{U}_i \bar{U}_j' \right) + g_i(\rho - \rho_s)$  state of the art  $\frac{\partial}{\partial x_i} (\rho \bar{U}_i \bar{U}_j) = \frac{\partial}{\partial x_i} \left( \lambda \frac{\partial \bar{U}}{\partial x_i} - \rho \bar{U}_i \bar{U}_j \right)$  biomedical research facilities.

## Quality Assurance & Quality Control for Construction Documents

**Q**uality assurance (QA) and quality control (QC) are increasingly crucial for the development of construction documents as projects become larger and more complex. The terms QA and QC are often mistakenly used interchangeably, but they are distinct processes which function together to ensure delivery of only the highest quality products. QA ensures the quality of a product, with a focus on defect prevention. QC ensures that a product meets established expectations, with a focus on defect detection. QA and QC are critical for construction projects to successfully meet programmatic requirements and avoid RFIs, change orders, and delays.

**QA** for construction documents is an integral part of the design team's internal processes, beginning with project initiation. QA processes must foster a culture of quality and include established procedures and policies. For a design project, these include:

- A well-defined set of quality and project criteria (e.g., design, functionality and performance, efficiency and flexibility, code compliance) aligned with the project's contractual requirement, scope, budget, schedule, and professional standards of care.
- A well-organized process flow, which establishes quality goals and priorities, gathers information, identifies problems, and sets schedules.
- An experienced staff with appropriate expertise, clearly defined roles and responsibilities, and adequate time, resources, support, oversight, and management.
- Processes for quickly and effectively addressing and coordinating review comments, programs modifications, site conditions, consultant information, and other changes, updates, and new information.
- An established set of systems for clear communication, effective project management, progress tracking, and process assessment and improvement.

Successful QA enables the complete and accurate development of documents and reduces the time and energy required for document production and subsequent QC activities.

**QC** for construction documents ensures and confirms that completed documents meet the contract requirements and the project quality criteria. A QC review is conducted by a team of professionals with the requisite experience and seniority who have not been directly involved with the document development and can provide a critical, unbiased assessment. QC typically begins with a review of project quality criteria and a 'page turn' of all documents. The scale and complexity of the project determines the extent of QC,

including the potential use of a third-party QC team. A review typically includes:

- Confirmation of compliance with project quality criteria, contract requirements, and professional standards of care.
- Identification and documentation of discrepancies, unresolved comments, coordination and constructability issues, errors, and other issues that must be corrected.
- General assessment of document quality and required improvement of the production and QA processes.
- Back-check of corrections made and approval for release of documents. The QC team may be required to submit documentation, signed by firm principles, that a QC review has been conducted and successfully completed.

Successful QC ensures that documents meet contractual requirements and quality criteria and avoid the hazards of poor-quality documents, including excessive review comments, rejected submissions, and schedule delays.

### Design Requirements Manual Compliance

The requirements for quality documents are repeated in many sections of the *DRM*, and individual sections should be referenced as applicable. Appendix E specifically addresses both QA and QC with regards to general submission requirements for different aspects of document development, including:

- The design team and each firm must have a QA plan to review and document processes and procedures to assure coordination.
- A QC review must be conducted by an experienced professional interdisciplinary team for each submission.
- *DRM* Appendix E, "A/E Submission Requirements," should be referenced as the minimum required content for each submission.

### Conclusion

Effective QA and QC procedures form an essential part of construction document production by both facilitating (QA) and assuring (QC) the production of quality documents. Benefits include time and cost savings throughout the design and construction processes and avoiding RFIs, change orders, and delays.