

Design Build Projects / Project Quality Control Plan (PQCP)



Quality Control / Quality Assurance Manual

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Section 1: Introduction

1.1 Defining Plan Quality

The dictionary defines **Quality Control** as the inspection, analysis and action required to ensure quality of output; the operational techniques and the activities used to fulfill and verify requirements of quality; a procedure for keeping quality of inputs or outputs to specifications.

In an effort to define plan quality, Quality Engineered Structures has concluded that the following characteristics (**The 5 C's**) should provide an indication of the quality of the plans:

Complete

- The plans will be an accurate and thorough representation of the existing project site and existing systems.
- The plans will be an accurate and thorough representation of the proposed project systems and details to be constructed.
- The plans will be supported by a thorough and detailed documented development process.
- The plans will be developed with the active involvement of all affected parties and developmental stage owners throughout all stages of development.

Consistent

The plans will be consistent with other plans developed by and for Quality Engineered Structures and will comply with all standards and guidelines set by the clients design guidelines and electronic standards.

Clear

The plans will not contain any design errors or omissions which will require more than one addendum during the project advertisement period.

Correct

The plans will not contain any design errors or omissions which will cause the delay, postponement, or cancellation of the project letting.

Constructible

The plans will not contain design errors or omissions that require more than two change orders throughout the construction phase which individually causes an increase or decrease of more than 3% of the original contract bid award amount or causes an increase or decrease in the contract time by more than one day.

1.2 Definition of Terms and Abbreviations

The use of some key terms used in this document will be understood to have the following meanings:

Quality Control (QC)

Quality Control is defined as the operational techniques and the activities used to keep the quality of inputs or outputs to specifications; to fulfill and verify requirements of quality.

Quality Assurance (QA)

Quality Assurance refers to those actions, procedures, and methods employed at the management and senior technical levels to observe and ensure that prudent quality procedures are in place and are being carried out and that the desired result of a quality product is achieved.

Engineers of Record (EOR)

The engineers of record are licensed, professional engineers responsible for the direct control and personal supervision of engineering work.

Phase Review (PR)

Phase Review refers to the formal review by various disciplines at various stages of the plans development process. Phase reviews typically occur at the 30%, 60%, 90% and plan-in-hand (95%) completion stages for preliminary plans and at the 60% and 95% completion stages for final plans

Project Manager (PM)

The PM is the person responsible for the planning, coordination and controlling of a project from inception to completion, meeting the project's requirements and ensuring that each project is completed on time, within budget, within scope and to required quality standards. The project manager insures that all phase reviews have occurred and have been completed, that all comments have been satisfactorily addressed and that all forms and checklists have been completed by the appropriate personnel. The PM is ultimately

Project Quality Control Plan (PQCP)

The methods and processes defined in this manual will serve as the Project Quality Control Plan (PQCP) for each project. Every set of construction plans prepared by or for Quality Engineered Structures are required to follow this process.

Quality Assurance Certification (QAC)

Quality assurance certification refers to a signed statement by the project manager certifying that a written, pre-approved Project Quality Control Plan is in place and has been adhered to.

1.3 Purpose

The Quality Engineered Structures Quality Control / Quality Assurance Manual is intended to establish a benchmark for effective development of quality control and to assure that quality control has been effectively implemented. The manual provides for coordinated processes which will assist project development by providing mechanisms for:

- Identifying design considerations which Quality Engineered Structures experience has shown repeatedly require specific attention.
- Providing helpful checklists developed by each major discipline for each phase of project development.
- Providing sufficiency checklists which enumerate the items and the documents required to be submitted with phase submittals. Completion and submittal of the checklists required with each phase review is the responsibility of the architect.

This manual has been developed by Quality Engineered Structures to promote communication among the design disciplines; various Quality Engineered Structures review disciplines, the architects, engineering consultants, and project managers. The Quality Engineered Structures interest in preparing this manual is to emphasize the need for a systematic approach to prepare, review and document the plan development process to insure a quality project.

1.4 Objective

The main objective of the Quality Control process for design projects is to provide a mechanism by which all construction plans can be subject to a systematic and consistent review. The outcome of the review should create a set of quality project plans, which should be substantially error free.

A secondary objective of the Quality Control process is to provide for a well documented "trail" of the design process. A properly documented project file should be a by-product of the quality control process. The parties, as a whole, should be able to substantiate its position from properly documented project files if any legal, social or procedural issues arise regarding the project.

Another secondary objective of the Quality Control process is to provide information feedback from reviews to the architects. The architect's improved expertise and general increase in knowledge from feedback should result in product improvement at early stages even before a project review is started. The Quality Control process thus serves as a parallel training program.

This manual is intended to be a living document which will be reviewed and updated periodically to ensure compliance with changes to plans preparation requirements, processes and organizational structure.

1.5 Requirements for Quality Control

The Quality Control process includes quality planning, training, providing clear decisions and directions, constant supervision, immediate review of completed activities for accuracy and completeness, and documenting all decisions, assumptions and recommendations.

In the construction plan development process, it is the clear responsibility of the architect to ensure all project elements are economical, accurate, properly prepared, coordinated, checked, and completed. In order for Quality Engineered Structures to consistently meet the needs and expectations of our clients, quality must be as important as the schedule and budget.

All architects and reviewers must recognize that quality is the result of several processes. It requires many individuals performing many appropriate activities at the right time during the plans development process. Quality Control does not solely consist of a review after a product is completed. It is an approach and a realization that quality is something that occurs throughout the design process. Quality requires performing all activities in conformance with valid requirements, no matter how large or small their overall contribution to the design process. Good CAD techniques, attention to detail and ensuring the plans are correct and useful to the contractor are also essential to quality.

- Design personnel shall follow established design policies, procedures, standards and guidelines in the preparation and review of all design products.
- Design consultants are agents for Quality Engineered Structures with the primary responsibility for preparation of construction plans. Consultants must ensure quality and adhere to established design policies.
- Quality Engineered Structures will review plans for compliance with policies, standards, procedures and good engineering practice but that does not limit the responsibility or liability of the architect. **Quality Engineered Structures has no obligation to check plans.**

Section 2: Project Quality Control Requirements

The methods and processes defined in this manual will serve as the Project Quality Control Plan (PQCP) for each project. Every set of construction plans prepared by or for Quality Engineered Structures are required to follow this process.

The Project Quality Control Plan details the proposed methods or processes of providing quality control for all work products. This plan will be kept current with the work requirements. The plan shall include, but is not limited to, the following areas:

- Organization
- Quality Control Reviews
- Proposed method of documentation of comments, coordination responses and Quality Assurance Records
- Quality Assurance Certification

Plans prepared by consultants for Quality Engineered Structures must, at a minimum, follow the procedures set forth in this manual. Consultants may prepare their own Project Quality Control Plan to be submitted to the PM for approval.

2.1 Plans Development Requirements for Review

All phase submittals will be checked prior to presentation to the Quality Engineered Structures for review. Properly completed QA Checklists for all applicable disciplines, signed and dated by the checker, will be submitted with the review prints to

2.2 Conformance to CAD Standards

All plans must meet the CAD/Drafting standards as specified in the engineering contract. Quality Engineered Structures is in the process of developing a formalized CAD standardization process which will ultimately require that all construction plans developed for Quality Engineered Structures be prepared utilizing standardized design software. All plans will have to be certified through a CAD standardization package. .

2.3 Plans Reviews

In addition to plans checking, the architect will conduct a design review of all documents prior to submitting the documents to Quality Engineered Structures. This review shall include, as a minimum, the following activities:

- Compliance with basis of design documentation
- Technical accuracy and adequacy
- Compatibility with other associated project documentation
- Compliance with all design review comments.

The architect will prepare a memorandum documenting the basis of the review, the specific items that were reviewed, the findings of the review, and the follow-up, if any, that was accomplished. Copies of this memorandum will accompany each review submittal.

To facilitate QC reviews of each project, the architect will prepare a written "Project Design Criteria Report" at the onset of the work. A copy of this document will be submitted at the onset of work for the project and will serve as the basis for reports, design analyses, and plans preparation.

2.4 Design Documentation Requirements

A Documentation for Project Delivery will be prepared for the project to document the history of the plans development process and the decisions made during the process.

Section 3: Organization

3.1 Process

- **The Engineers of Record** will review all project plans during the phase reviews for constructability, and areas of possible conflicts.
- The Engineers of Record shall evaluate project plans for compliance with applicable elements from the Construction QC Plan to ensure that specific requirements are addressed during design related activities.
- The Engineers of Record will review all project plans during the phase reviews to determine maintainability, site-specific existing problems not addressed in the plans and areas of conflict with client's basis of design.

Quality Engineered Structures and external partners as a whole must be committed to the QC/QA process to insure a quality product. The reviewing sections and individuals have specific responsibilities as part of the process. Phase reviews are detailed in Chapter 4 of this manual and responsibilities of the individuals are described below (Section 3.2).

3.2 Quality Control Responsibilities / Architectural / Engineering

The Project Manager is the person responsible for the planning, coordination and controlling of a project from inception to completion, meeting the project's requirements and ensuring that each project is completed on time, within budget and to required quality standards. The PM is typically responsible for the distribution of review prints at the phase reviews. The PM may review plans for general quality, appearance, accuracy and completeness. The PM insures that all phase reviews have occurred and have been completed, that all comments have been satisfactorily addressed and that all forms and checklists have been completed by the appropriate personnel. The PM is ultimately responsible for each project's adherence to the quality control plan.

The Architect or the Engineers of Record is responsible for accuracy and completeness of the plans and related designs prepared for the project. The architect is responsible for the quality of work of each person involved in the efforts to bring individual projects to production readiness. The architect is responsible for the use of the standardized QC procedures and is responsible for completing and submitting to the PM all checks and checklists, review reports, computations, and other project documentation.

The Mechanical Engineer will review all project plans during the phase reviews for adherence to Quality Engineered Structures design specifications and code compliance.

The Electrical Engineer will review all project plans during the phase reviews to determine the conformance of any electrical design to Quality Engineered Structures specifications and code compliance.

The Structural Engineer is responsible for review of structural details, such as building structural integrity, roof loads, suspended loads, and process equipment load requirements to Quality Engineered Structures specifications and code compliance.

The Building Management Control or Process Control Engineer reviews design plans at various stages of plan development, and should participate in the Plan-in-Hand Inspection and advises the architect on the acceptability of plan details related to constructability of the building management systems.

The Fire Suppression Engineer is responsible for the development or review of fire suppression design and calculations to meet code compliance.

The Environmental Engineer will perform necessary re-evaluations of the documents supporting the need for the project and environmental impacts. The Environmental engineer will insure that all environmental commitments have been addressed.

Threshold Inspections are required by all engineering disciplines at key points in the construction scheduling to assure subcontractors compliance with engineered drawings. These will typically be at receiving of major components, at key installation points of major components, and at start-up of major components.

3.3 Quality Control Responsibilities / Subcontractors

The Mechanical Subcontractor is responsible for the supply, installation, and start up, test and balancing, and training of staff on the operation of all HVAC mechanical systems. The mechanical subcontractor shall maintain a competent person on site to assure compliance with all construction documents and safety programs.

The Electrical Subcontractor is responsible for coordinating with the owners of utilities located within each project to insure that all utility conflicts are addressed prior to construction. These sections review the plans for potential utility conflicts and make recommendations as necessary. As part of this function, they prepare relocation cost estimates and review plans prepared by the utility companies. The electrical contractor shall maintain a competent person on site to assure compliance with all construction documents and safety programs.

The Plumbing / Process Piping Subcontractor is responsible for coordinating with the owners of utilities located within each project to insure that all utility conflicts are addressed prior to construction. These sections review the plans for potential utility conflicts and make recommendations as necessary. As part of this function, they prepare relocation cost estimates and review plans prepared by the utility companies. The plumbing / process piping contractor shall maintain a competent person on site to assure compliance with all construction documents and safety programs.

The Structural Subcontractor shall maintain a competent person on site to assure all structural components are installed and erected to the specifications in the construction documents and drawings. The competent person will also be responsible for all safety program implementation. At no time should any structural component be buried or concealed without a threshold inspection by the structural engineer of record to verify compliance with the construction documentation and drawings.

The Environmental Subcontractor will review with the environmental engineer to assure all environmental control and utility systems are installed and operating per the construction documents and drawings.

Validation of Systems if required will be performed by validation subcontractor. Validation report will list all required parameters affecting performance of systems.

Cleanroom Certification if required will be performed by certification subcontractor and list all parameters required by the construction documentation and drawings.

Section 4 - Quality Control Reviews

4.1 Design Review Requirements

During the entire design period Quality Engineered Structures will monitor the architect's implementation of the QC plan and require compliance and documentation.

All major reconstruction projects will be reviewed by the Quality Engineered Structures at key stages of development. These "Phase" reviews will take place at the plan submittal payment milestones as detailed in the Design Build Contract. These phase reviews include, as a minimum, the 30%, 60% and plan-in-hand (95%) submittal stages for preliminary plans and the 60% and 95% submittal for final plans

The QA Checklists contained in the *"Design Build Contract"* provide a list of elements which should be considered and addressed by the architect during each phase of design development. The checklists should not be considered as including all items necessary for a review by discipline, but should be considered as a guide to be expanded or reduced as necessary for each individual project. Design review checklists included in this guideline are intended to assist the architect in preparing an adequate submittal. The sufficiency checklists included in the guideline establishes the submittal requirements which must be met to satisfy the documentation requirements for each project. The architect's attention is directed to the documentation items

The architect will check each plan element. If an error is found in a plan element, additional elements will be checked to determine if the procedural error was repeated.

On subsequent submittals, the architect will review the disposition of comments from the previous submittal. It is important for the architect to recognize that a review comment is not a directive to make changes to the plans. Comments are frequently made to ensure the architect has considered an option. Responses should indicate the architect's reasoning.

Every project will undergo a quality control review. The reviewer will be an experienced engineer who was not actively involved in the preparation of the product. Checking procedures for these quality control reviews are discussed in Sections below. Also, note that there is an overlap among reports, calculations and plans. Most reports and calculations are incorporated into the plans. Checks should be made to ensure that calculations/reports are correctly incorporated into the plans.

4.2 Phase reviews

4.2.1 Review Process

All projects are required to be reviewed at the phase reviews as noted in Section 4.1. The guidelines and checklists contained in the *"Design Build Contract"* define those tasks which should be completed by each submittal and those items that will be reviewed. The Plans Distribution list clearly outlines who is to receive and review prints at each phase review. At each submittal stage, the Project Manager will review the submittal for the degree of completeness required by that phase. Plans will be returned to the architect if they are incomplete, which could cause delays to the project's schedule. Plans will be distributed by the Project Manager as detailed on the Plans Distribution list. The Project Manager will provide a date by which all comments are to be received by the PM. It is the responsibility of each reviewer to review the plans in accordance with their area of expertise and return their comments to the PM by the date specified. Any breakdown in the review process or untimely comments can result in plan errors, delays and increased project costs.

4.2.2 Review Reports

Comments from phase reviews can be in the form of marked-up plans, meeting minutes (as in a plan-in-hand review meeting) or review memoranda. It is the responsibility of each reviewer to insure that their comments are submitted to and recorded with the Project Manager. It is the Project Manager's responsibility to compile comments, document the comments and distribute the comments to the architect and others if necessary. It is then the architect's responsibility, in consultation with the Project Manager, to review the comments and to determine how each comment will be addressed. The architect will prepare a formal response to the PM stating how the comment will be addressed. The Project Manager will forward these responses to the appropriate reviewer and will insure that all comments and responses have been documented in the project files. It is the architect's responsibility to insure that comments are incorporated into the construction plans as appropriate.

4.2.3 Checking Drawings

Drawings are prepared under the direction of an assigned architect. They are developed progressively by an interactive process using sources of information such as survey data, reports, record data, preliminary sketches, samples, official maps, etc, in conformance with the requirements, design criteria, and standards and guidelines required by QUALITY ENGINEERED STRUCTURES. Before a drawing is considered final, it will be independently checked for (notice the 5 C's):

- Conformance with the basis of design and project requirements (scope), including graphic standards (CADD Standards), compatibility standards and good plans preparation practice (Correct and Consistent)
- Completeness and clarity
- Coordination with other aspects of the project, i.e., structural, mechanical, electrical, process piping, etc., and with other associated project documents (Constructable)
- Coordination with project elements being developed or planned development on adjacent projects

4.2.4 Constructability Review

The constructability review occurs at the 60% preliminary plans phase. Plans are sent to Quality Engineered Structures to provide the constructability review.

Too often, work that is to be performed during construction is primarily defined by the architect emphasizing an architect's perspective without adequately addressing the actual "build-ability" of the project. The constructability review during the design phase is intended to save on project costs, anticipate and mitigate field problems, minimize potential change orders, improve the overall project timeline, and still achieve the architect's intent. Some of the items to be considered include scheduling requirements, sequencing, phase conflicts, completeness and clarity, errors, omissions, inconsistencies, change order potential, construction means, construction methods, contracting strategy, construction materials and fabrication requirements.

4.2.5 Bidability Review

Bidability reviews shall be performed on every project. These reviews shall be done as part of the final plans processing and is initiated by the Project Manager, typically as part of the ACP phase review. The purpose of this review is to discuss and develop strategies that will facilitate clear and competitive bids and yield lower bid prices. The bidability review should help to avoid claims since a well thought-out bid schedule leaves fewer obstacles to resolution

4.3 Resolution of Disputes

During the review and checking process, if the architect does not agree with the review comments, he will first discuss the matter with the Project Manager. The Project Manager may also have some disagreements with the comments. The Project Manager will discuss the comments with the reviewer to achieve a resolution. Likewise, if a reviewer is in disagreement with a response to a comment, the reviewer will discuss the issue with the Project Manager. If the difference cannot be resolved between the Project Manager and the reviewer, Quality Engineered Structures will be consulted to assist in the resolution of the dispute.

Section 5: Method of Documentation of Comments, Coordination and Responses

5.1 Documentation of Comments and Responses

All comments made by phase reviewers shall be recorded either by copy of memos, e-mail, letters and/or marked plans received from the reviewers. In the event that comments are received through meetings with reviewers, there shall be minutes prepared that summarize the comments received. All comments shall be addressed by the architect responsible for the discipline that prepared the document being reviewed. The response shall be in writing and shall be formatted in a manner that identifies the document review date, reviewer's comments and responses to the comments. All comments received shall be copied to the architect if not first received by the architect. The architect will be responsible for submittal of comment responses to the reviewing entity.

Where it is necessary and prudent to discuss the comments with the reviewer(s) prior to making a response, the architect shall arrange for the meeting.

Copies of all comments and responses shall be kept in the project files.

5.2 Requests for Changes to the Scope

The PM and the architect shall evaluate comments or requests that are not covered in the “Final Project Scope.” Additions to the scope usually increase the project costs (a.k.a., Scope Creep). These requests should be evaluated on a case by case basis. The PM may recommend changes to the scope of a project to Quality Engineered Structures and the client, but only the client or his designee has the authority for the approval/denial of a scope change.

Section 6: Quality Assurance

6.1 General

QA does not include only periodic reviews to ensure compliance with the QC process but also includes review of several other established processes. Quality Engineered Structures shall ensure that appropriate levels of review (and cooperativeness in the review process) have occurred for:

- Constructability
- Bidability
- Value Engineering
- Project Documentation

QA also incorporates a general review of personnel to ensure an acceptable level of expertise is maintained for quality design products. All design personnel shall be advised of the details of the QC plan.

Communication is also a vital element in all processes. QA includes the review of the level and quality of communications and documentation accomplished during the various processes.

6.2 QA of Consultant Projects

Consultant projects shall undergo the same QA review as in-house projects. Consultants Project Quality Control Plans shall be submitted to Quality Engineered Structures in advance of any design work and shall include but not be limited to the following areas:

- Organization
- Quality Control Review of Plans, Reports, Calculations & Correspondence
- Proposed Method of Documentation of Comments, Coordination, Response and QA Records
- Control of Sub-Consultants and Vendors Efficiency
- Quality Assurance Certification

All submittals shall also be subject to quality assurance audits by Quality Engineered Structures. Problem areas shall be discussed with the consultant and agreed upon remedial actions shall be taken by the consultant prior to any further payment of consultant invoices.

6.2.1 Quality Engineered Structures Reviews of Consultant Designs

Projects in Quality Engineered Structures work program are identified for various levels of review by Quality Engineered Structures. Where any review by Quality Engineered Structures is performed, consultants must not rely on Quality Engineered Structures as a part of their QC plan either formally or informally. Consultants are expected to follow their own QC plans and accepted engineering practices

6.3 Feedback

The project engineers for each construction project are required to prepare a 'post-construction' checklist to provide feedback as to the quality and accuracy of the construction plans. This feedback is to be provided to Quality Engineered Structures to serve as 'lessons learned' to the architect and to be considered in the final rating for consultant designed plans. These checklists will be compiled and categorized and distributed to all of the various design sections to serve as a knowledge base to improve the quality of construction.

The construction section should schedule a semiannual construction feedback meeting with the engineering disciplines. At this meeting, the construction section should provide technical presentations to the architects for updates on construction and production issues as it relates to plan preparation and constructability

6.4 Process Improvement

Quality Engineered Structures will establish a plan change review committee. The committee will hold monthly meetings to review recent plan changes. The committee will categorize the cause of the plan changes. Common and recurring problems will be identified and a method for eliminating the problems will be formulated. This information will be disseminated to the architects to prevent recurring plan errors.

6.5 Accountability

For consultant designed plans, the quality of plan submittals, evaluated by the type and severity of comments received during the phase reviews, will be used by the PM in preparing the consultant's performance rating.

References:

Checklists (included in the *"Design Build Contract"*)

Check List for Pre-Design

Pre-Design Conference Evaluation

Plan-In-Hand Check List

Check List of Proposed Construction Notes for Plan in Hand

Plan-In-Hand Review

Check List for Reviewing Advanced Check Prints

Constructability Review