A GUIDE

FOR

Consulting Structural Engineering Services In Colorado

A Recommended Standard of Practice.

SEAC

Prepared and Published by:

Structural
Engineers
Association of
Colorado

June 1987

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CONSULTING STRUCTURAL ENGINEERING SERVICES IN COLORADO

A RECOMMENDED STANDARD OF PRACTICE

Prepared and Published By:

STRUCTURAL ENGINEERS ASSOCIATION OF COLORADO

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June 1987

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FOREWARD

This standard of practice document has been prepared and published by the Structural Engineers' Association of Colorado (SEAC) as a service to its members; it is intended for the use of both SEAC members and for those who typically commission the services of the consulting structural engineer.

The goal of the document is to bring about a better understanding of professional structural engineering services and standards of performance. Since the structural engineer is frequently a member of a multidiscipline design team, this document also attempts to define the relationships that exist between the structural engineer and the other members of the team, especially the team leader. Further, it is intended to assist in improving the quality of professional structural engineering services while providing a basis for establishing adequate compensation.

Specifically, the standard of practice defines the possible range of services, the obligations, and the limitations of the consulting Structural Engineer of Record when (s)he provides typical consulting services. It reflects the recommended industry standard of practice for structural engineering in Colorado, but it is not intended to represent either a minimum or a maximum level of service.

The standard of practice is primarily oriented toward design and contract administration services for construction of new or remodeled buildings and related facilities, but can be used for other structural work as appropriate. It is divided into several sections which cover the normal areas in which structural engineers work: It provides a detailed Scope of Services, and a definition of terms used in this document and in structural engineering practice in general; it has a Selected Office Practices and Procedures section; and finally, in the Appendix, it presents a checklist of items for submittal review and for site observation during construction.

The particular wordings and obligations of specific contracts are beyond the scope of this document. Standard contracts and forms of agreement are available and should be referred to. Additionally, it is recommended appropriate legal counsel be retained as needed. Individual contracts may significantly modify the scope of services to be rendered.

The standard of practice gives each structural engineer an opportunity to compare his practice against a standard, and provides a standardized and more complete basis upon which to negotiate with the client; it also provides a better opportunity for clients to evaluate the services and performance of the structural engineer.

The members of SEAC are encouraged to use this document to the fullest extent possible, but are advised its use is voluntary.

The guidance provided herein can be of value to a wide variety of individuals and firms who practice structural engineering in the State of Colorado, but each must adapt the provisions of this standard of practice to fit their own practice. Since structural engineering is a learned profession, it is customary for the structural engineer to determine the scope of services required for a given project, client and set of circumstances, and to provide these services accordingly. In fact it is common for a portion of the actual services provided by the engineer to be devoted to the judgment of determining what services are needed. This must be further tempered by the instructions and desires of the client, and by the services for which he is willing to pay.

It must also be recognized that the services provided by the structural engineer and his assumption of responsibility require adequate compensation. The structural engineer is not responsible for conditions beyond those areas in which he is retained to provide services. In the final analysis, the provisions of the engineer's contract with the client are what govern.

PART I - INTRODUCTION

The following Scope of Services defines the needs and the normal activities of the Structural Engineer of Record and the services that he or she might provide during a typical assignment. It also includes an indication of what the Structural Engineer of Record is and is not responsible for during the course of providing these services. However, the contract for the services in question always governs the scope of services to be performed by the structural engineer.

The Scope of Services is organized into sections by the sequential phases of a typical design project. Each phase contains those work items that pertain most typically to that phase. These are considered the normal or basic services.

Three additional sections, Additional Services, Services Relative to Pre-Engineered Elements, and Services Relative to Pre-Engineered Buildings, are included at the end of the sections defining the sequential phases of a typical design project, in order to address these important areas separately.

It is important to realize certain work activities or services may be performed out of the sequence or in different phases than indicated in the Scope of Services. This is normal practice since required services are tailored to each project.

However, in developing this Scope of Services document, the intention has been to make the Contract Documents Phase as complete as possible, in order to essentially stand alone, since it is the final stage of the design process for typical projects.

It should be noted cost estimates are listed as an additional service. This merits further elaboration since design professionals have traditionally prepared estimates of project cost during the design phases of their services. The practice of structural engineering in Colorado is moving away from this in certain circumstances. This move has been more or less coincident with three developments: the rise of independent cost estimating specialists, the rampant inflation of the mid-1970's, and the added liability exposure. Independent cost estimators are frequently able to prepare more reliable estimates of cost than structural engineers because of their training, specialization, and commitment to maintaining current cost data. This is not to say structural engineers cannot or will not provide estimates of project cost as a part of their services, and many structural engineers do provide such services. Structural engineers have also retained cost estimating specialists for their projects when it is required. The real point is that inclusion or exclusion of cost estimating services should be agreed to between structural engineer and client at the outset of the project.

SCOPE OF SERVICES

Although the scope of services described herein is tailored to fit the most frequent project needs, structural engineers may provide very different services. For some projects, the structural engineer is the prime design professional, responsible for managing and coordinating the work of the other necessary disciplines in addition to the work described herein. Bridges are commonly done in such a fashion.

For some projects, the structural engineer provides a greatly reduced scope of services. For example, a building might be divided such that there is one Structural Engineer of Record for the foundation and another for the superstructure. Often the superstructure is a pre-engineered system as discussed in this document.

Another example of a reduced scope is the service known as "redlining," in which the structural engineer does not produce independent drawings. Instead, the structural design is shown on the drawings of the prime design professional. In this situation, the structural engineer marks the structural design information on progress prints for final drafting in the office of the prime design professional, hence the term redlining. Other aspects of the structural engineer's service, such as design analysis, submittal review, and construction administration may be very similar to the description herein, or they may also be reduced in scope.

Whatever the mode of reduced scope of service projects, the structural engineer is well advised to have a clear and complete understanding with the client on the services to be provided, and on the responsibilities and liabilities. In most such instances, the structural engineer is the one most qualified to determine if the client, owner, and public interests are being adequately protected in the arrangement, insofar as structural safety is concerned. Therefore, (s)he should weigh these factors in addition to the contract for services in deciding to undertake a reduced scope of service project.

PART II - PROJECT DEFINITION PHASE

A.
Meet with the client/owner/developer to define and negotiate a Scope of Services for the project. Consider such items as construction schedule, construction budget, building size, type and use, and professional liability insurance requirements.

B.
Review with the client/owner/developer any special or additional services required involving such items as design of pre-engineered elements, design of nonstructural elements, review of manufacturer's design, and design of site development structures.

C.
Assist in developing and/or review the schedule for project design and construction, and establish milestone dates for completion of various phases of the structural engineering work. Assist in establishing milestone dates for all design team disciplines that affect the structural design. Include a final coordination and review period after all documents are complete. Also, consider such items as bidding and negotiating the construction contract, fast-track construction schedules, phased construction, and construction budgets based on Guaranteed Maximum Price (GMP).

D.
Establish channels of communication relating to structural engineering between various design team disciplines.

E.
Develop a mutually acceptable contract that includes a detailed Scope of Services defining basic and additional services, limitations, and exclusions. Assure coordination with the team leader's contract-for-services regarding appropriate coordination responsibilities, etc.

PART III - SCHEMATIC DESIGN PHASE

A.
Attend initial meetings with the project owner, or his representative, and the design team to discuss and develop initial design parameters based on the project as it was established in the Project Definition Phase. The discussions are typically centered on preliminary drawings.

B.
Establish the criteria required to prepare the Structural Design. This criteria is based on information to be supplied by the owner, design team, building officials and others, and includes the following items:

1. Governing design codes.

2. Special loads other than those minimums required by code.

3. Restrictions on the location and/or size of structural elements.

4. Conceptual requirements of electrical and mechanical systems including preliminary location and magnitude of equipment loads.

5. Any unique architectural features such as pedestrian bridges, unusually long cantilevers, large atriums, etc.

6. Building materials not allowed by either availability, code restrictions, or owner preference.

7. Survey data such as topography, utilities, and boundary.

8. Special environmental conditions.

C.
Consider alternate structural systems and materials that will meet the established project requirements. Expected construction methods, schedule constraints (e.g., fast track), and appropriate seasonal effects are part of the considerations.

D.
Establish the lateral and vertical force resisting system based on the proposed architectural elements of the building. Review possible architectural changes to facilitate a reasonable and cost-effective structural system.

E.
Review proposed scope of geotechnical services and provide necessary structural criteria, for the purpose of assisting the client/owner in obtaining geotechnical services.

F.
Determine the need and make recommendations for any special structural studies such as wind tunnel studies, seismic analysis, or the determination of special site conditions.

G.
Prepare a summary report and/or Schematic Design drawings or sketches (including alternates as appropriate) to illustrate the general components and layout of the various structural systems agreed upon during initial meetings. This should define the lateral and vertical force resisting systems. These documents are also for use by various material and product suppliers, contractors, or others, to assist their efforts to establish preliminary and relative costs of the various structural systems.

H.
Submit structural Schematic Design documents and cost information (prepared by others), along with recommendations from consultants, to prime design professional and owner to allow for selection of a single structural system.

I.
Verify Scope of Services and final design contract.

PART IV - DESIGN DEVELOPMENT PHASE

A.
Participate in the selection of the final structural scheme with the client, the design team, and other interested parties as appropriate.

B.
Review the geotechnical report for structural concerns and for the recommended foundation systems.

C.
Provide liaison with building department or other governing agencies on matters relating to structural engineering as required for interpretation and/or acceptance of structural engineering criteria and design.

D.
Assist the client and design team in preparing a preliminary opinion of costs and an outline of specifications.

E.
Integrate the selected structural system with the architectural and other consultants' work.

F.
Review the initial results of any other special studies required which were established during the Schematic Design Phase and determine their effects on the structural system.

G.
Establish drawing and drafting standards for the project with the client and design team, such as grid lines, match lines, scale, and sheet size.

H.
Prepare a summary report and/or Design Development drawings or sketches showing the foundations and the framing of the proposed Primary Structural System, including materials, gross sizes, and critical details. These documents may become partially completed working drawings.

I.
Submit structural Design Development documents for client approval and acceptance.

PART V - CONTRACT DOCUMENTS PHASE

The Contract Documents Phase is normally the culmination of all design related activities begun in prior phases. The result is the Structural Design which is normally evidenced by a set of design drawings and specifications. These are the structural Contract Documents. Structural calculations are also produced to the extent necessary to aid the Structural Engineer of Record in preparing the Structural Design.

A.
Prepare the final Structural Design of the Primary Structural System. This is based on the following parameters as needed and where reasonably ascertainable:

1. Building code requirements and regulations

2. Geotechnical engineer findings and recommendations

3. Client and functional requirements, including special loads (e.g., special occupancies, fire truck access, drifting snow)

4. Special studies (wind tunnel, etc.)

5. Manufacturer or supplier recommendations

6. Requirements of other design professionals

7. National, regional and/or local standards of practice

8. Contractor suggestions and construction requirements

9. Structural engineering professional judgment and experience

The Structural Engineer of Record defines the Primary Structural System, and determines and specifies which portions (s)he will design and which will be designed by others including pre-engineered elements. Where designs are provided by others, such designs should bear the signature and the professional seal of the engineer who provides the design. The Structural Engineer of Record coordinates the design work to the extent necessary to assure all portions of the Primary Structural System are included.

B.
Consult on nonstructural elements as requested. This consists of reviewing the effect of items not included in the Primary Structural System, but which are attached thereto and/or supported thereon, to assure the structure will properly accept and support such items. Provide members of the design team with information regarding the supporting capability and physical attachment limitations of the structural framing systems. Structural consultation and design of

nonstructural elements themselves may or may not be included in Basic Services. The owner/developer and the design professionals should consider each item on an individual basis. Refer to PART VII - Additional Services for further information.

C.
Coordination and liaison:

1. Attend and participate in meetings with client, other design professionals, and appropriate material and product suppliers.

2. Provide liaison with building department or other governing agencies on matters relating to structural engineering as required for interpretation and/or acceptance of structural criteria and design.

D.
Produce final structural calculations and present, if required, in a form acceptable to reviewing agencies. Calculations are provided for the purpose of preparing the Structural Design, and facilitating review; they are not elements of the construction contract or of the Contract Documents.

E.
Prepare final contract drawings for the Primary Structural System which are sufficiently complete and understandable to be accurately priced or submitted for competitive bid, and for the project to be constructed. The documents should show:

1. Foundation and framing plans, elevations, and sections, all sufficiently dimensioned, detailed, and identified to define the Primary Structural System.

2. An indication of nonstructural items which affect the basic structure, or appropriate cross-references to drawings by others for such items.

3. The necessary criteria and other information needed for the design and installation of pre-engineered elements. Refer to PART VIII - Services Relative to Pre-Engineered Elements for additional information.

It is recommended the structural drawings also show items of design criteria such as live and superimposed dead loads, material strengths, code requirements and any provisions for future additions.

F.
Prepare or edit structural specifications. Specifications should include such portions of the contractor's quality control systems, owner's quality assurance program, and plant and product certifications necessary to establish with reasonable expectation that the Primary Structural System, when constructed, will perform in conformance with the design criteria.

G.
Perform an internal review and check of the Structural Design and the structural Contract Documents. Perform a coordination check of the structural Contract Documents including the interrelationship of the Primary Structural System with the designs and documents prepared by the other design disciplines. The prime design professional is responsible for overall coordination of the various engineering and other disciplines.

H.
Assist if requested in obtaining approval by appropriate review agencies.

PART VI - CONSTRUCTION ADMINISTRATION PHASE

A. BIDDING AND NEGOTIATIONS

1. Assist when requested in determining bidders' qualifications; assist when requested in pre-qualification of potential suppliers or subcontractors.

2. Assist when requested in establishing procedure of communication for interpretation of Contract Documents.

3. Provide structural addenda and structural clarification upon request, or when need is determined by the Structural Engineer of Record.

4. Review and act upon submissions of requests for acceptance of alternates and substitutions.

5. Assist when requested in bid evaluation.

B. PRE-CONSTRUCTION

1. Attend scheduled pre-construction meetings with the General Contractor(s), structural subcontractors, and other interested parties. Answer questions about design intent. Interpret, if required, the Contract Documents. Examine the contractors' understanding of the project and its structural requirements. Examine the contractors' quality control systems.

2. Assist in establishing lines of communication with the contractor(s) to be used during construction.

3. Establish with the contractor scheduling requirements for field observations on key structural items.

4. Assist in establishing procedures to be used in accomplishing and reporting required testing and inspections for the owner's quality assurance program.

5. Assist in developing procedures to be used in processing shop drawings, certifications, and other required submittals.

C. REVIEW OF SHOP DRAWINGS AND OTHER SUBMITTALS

1. Review required submittals pertaining to structural items designed by the Structural Engineer of Record and which have been submitted to the Structural Engineer of Record through the established review channels. Assure submittals have received prior approvals as required by the Contract Documents. Also refer to subparagraph 3 below.

2. Review designs and drawings of pre-engineered elements specified by the Structural Engineer of Record and designed by others. Assure such submittals have received prior approvals as required by the Contract Documents. Assure submittals bear the signature and professional seal of the engineer responsible for the design as required by the Contract Documents. Review of pre-engineered elements shall be for type, position, and connection to other elements within the Primary Structural System, and for correct criteria and loads used for their design. Also refer to subparagraph 3 below.

3. Review of all submittal information shall be for general compliance with the project requirements and shall not include responsibility for the accuracy of detailed dimensions or detailed quantities, nor any review of the contractors' safety measures in, on or near the work site, or means, methods or sequences of doing his work. The depth or detail of the review is typically dependent on the type and complexity of the project, and the relative importance (from the standpoint of performance of the completed structure) of the item being reviewed. Each item in the submittal may not be checked: the usual procedure is spot checking; the primary emphasis and time spent is on the more critical items, based on the experience and judgment of the engineer. (See Appendix A for a representative list of items which might be included in the review.)

4. All items changed on resubmittals shall be clearly identified, and only those items identified will be reviewed.

5. When submittals are revised at the discretion of the contractor(s) or supplier(s) after review by the Engineer of Record, and further review is desired, such review will be performed as Additional Services.

D. SITE VISITS DURING CONSTRUCTION

1. As stipulated in the contract with the client, periodically visit the construction site during the progress of the construction. The amount of time anticipated for this effort shall be defined in the contract with the client under the Basic Services portion. Additional visits, as required, will be made as Additional Services.

2. During or shortly after each visit, give clarifications and instructions as required, and document conditions observed and information or instructions given. Promptly distribute reports through established channels.

a. The purpose of the visits to the construction site by the Structural Engineer of Record is to observe the quality and progress of the structural portion of the construction work, and, on the basis of his professional judgment and skill, to ascertain whether the work is generally in conformance with the project

requirements contained in the structural engineering drawings and specifications, and whether there are apparent defects or deficiencies in the work of the contractor(s). The emphasis is on a general overview of the construction work intended to protect the interest of the owner and the public. The Structural Engineer of Record is not responsible for guaranteeing, directing or superintending the contractors' work or work methods, safety in, on or near the work site, timeliness in performance of the work, nor any other aspect of construction for which the contractor has responsibility.

b. The depth and detail of the review of the work at the construction site by the Structural Engineer of Record is typically dependent on the type and complexity of the project, and the relative importance of the item being reviewed. Every item at the construction site is not observed: the usual procedure is spot checking; the primary emphasis and time spent is on the more critical items based on the experience and judgment of the engineer. (See Appendix B for a representative list of items which might be observed.)

E. MATERIAL TESTING AND INSPECTION

1. Assist in specifying scope, standards, procedures and frequency of testing or inspections to be made by independent agencies or others, for the Primary Structural System.

2. Review reports from these agencies for construction compliance. Notify and interpret for the client reported deficiencies in construction, and provide recommendations for correction, if necessary.

PART VII - ADDITIONAL SERVICES

Services beyond those outlined under Basic Services are frequently needed and may be categorized as special and extra services.

A. SPECIAL SERVICES

These are services which usually can be foreseen at the beginning of design stages but are not part of the Primary Structural System. This includes the structural consultation, review, analysis, design, and/or preparation of drawings, details and specifications in the Contract Documents, for items such as the following (including their attachment to supporting structural elements):

1. Glazing, window walls, skylights or door systems

2. Curtain wall systems

3. Antennas or flagpoles

4. Interior or exterior cladding (e.g., architectural precast concrete)

5. Window washing systems

6. Partitions or partition systems

7. Ceiling or lighting systems

8. Case work or furniture

9. Special equipment (e.g., stage equipment, catwalks, acoustical fixtures, snow fences, solar collectors)

10. Decorative work (e.g., sculptures, screens)

11. Handrails or guardrails

12. Anchorages or pads for mechanical or electrical equipment

13. Special support assemblies (e.g., wall bracket, platforms, for mechanical or electrical equipment)

14. Review of mechanical or electrical drawings, or specifications for adequacy of anchorage or bracing

15. Mechanisms or guide systems for elevators, escalators, or other conveyor systems

16. Site work elements, exterior and noncontiguous with buildings (e.g., retaining walls, culverts, tunnels, fountains, signs)

17. Review of design information prepared by others to determine adequacy of anchorage of nonstructural elements

18. Special analysis such as floor response, or vibratory equipment

19. Special wind analyses such as wind tunnel tests

20. Investigations or condition surveys of existing buildings or structures;

verification of existing conditions

21. Studies of various schemes to accommodate special energy requirements

22. Preparation of documents for alternate bids or segregated contracts for phased or fast-track construction

23. Design for future expansion

24. Filing application for or obtaining building permit

25. Seismic safety analysis for special conditions beyond Basic Services

26. Providing probable construction cost, quantity surveys, or inventories of material, equipment or labor

27. Tenant-related design services

28. Preparation of shop or fabrication drawings

29. Review or determination of fire-resistance requirements

30. Design or review of shoring or construction bracing

31. Preparation of as-built drawings or other record documents

32. Reviewing work of other previous or contemporaneous structural design engineers or coordinating a change from one design engineer to another

If services are specifically requested relative to nonstructural elements, the Structural Engineer of Record is responsible only for those items for which (s)he has actually performed structural design and stamped the drawings with his or her professional seal. The review of documents prepared by others is normally undertaken solely to ascertain whether or not the designs satisfy the general structural requirements of the project. See Section C. Review of Shop Drawings and Other Submittals in Part VI - Construction Administration Phase.

B. EXTRA SERVICES

These are services which usually arise as a result of unforeseen circumstances that occur during the design or construction process, such as:

1. Work resulting from changes in scope or magnitude of the project.

2. Work resulting from changes or substitutions proposed by the contractor(s) or others.

3. Work resulting from a change in scope due to recommendations of other consultants, or to undiscovered conditions (such as a change from a slab-on-grade to a structural slab or unknown foundation conditions), or to changes in governmental requirements.

4. Changes necessary because of construction cost overrun.

5. Revisions that are inconsistent with prior approvals or instructions.

6. Services in connection with evaluation or replacement of any work damaged during construction, or necessitated by the contractors' default or by defects in the work of the contractor, or by the contractor not adhering to the requirements of the Contract Documents.

7. Providing more extensive representation and/or observation at the work site during construction, than previously agreed.

8. Furnishing opinions as an expert or serving as an expert witness.

PART VIII - SERVICES RELATIVE TO PRE-ENGINEERING ELEMENTS

For pre-engineered elements, the Structural Engineer of Record ordinarily specifies the type of element, the position within and the connection to other elements within the Primary Structural System, the criteria and specific loads for which the element is to be designed, the required limitations and constraints, and the procedure by which the design and fabrication is to be reviewed. The responsibility of the Structural Engineer of Record is limited to this basic design criteria and the proper integration of the component into the structure.

Pre-engineered elements are normally designed by or under the supervision of a registered professional engineer retained by or employed by a structural material or component supplier. The material or component supplier, and/or the engineer who designed the element, are fully responsible for the design, fabrication, and, in some instances, also the installation of the component.

Designs and drawings necessary to convey the structural design information principal to the fabrication, production or manufacture, transportation and installation, including in-service conditions, should be prepared by the supplier or his agent for the pre-engineered elements, and should be submitted to the Structural Engineer of Record. These submittals should bear the signature and professional seal of the structural engineer responsible for their preparation. They must be submitted prior to acceptance for inclusion in the project. The Structural Engineer of Record is not responsible for the work performed by the engineer responsible for pre-engineered elements.

Examples of pre-engineered elements may include the following:

A. Curtain wall systems

B. Skylight systems

C. Stairs

D. Open-web steel joists or joist girders

E. Wood trusses

F. Combination wood, metal, or plywood joists

G. Precast and/or prestressed concrete slabs, beams, panels, or columns

PART IX - SERVICES RELATIVE TO PRE-ENGINEERED BUILDINGS

Pre-engineered building superstructures are normally designed by or under the supervision of a registered professional engineer retained by or employed by a building or component manufacturer. The manufacturer, and/or the engineer who designed the building, are fully responsible for the design, fabrication, and, in some instances, also the construction of the building.

The individual who prepares and/or is responsible for the structural design is the Structural Engineer of Record for that portion of the project, and the design drawings should bear the signature and professional seal of this engineer.

In addition, the building owner/developer will usually retain the services of an independent structural engineer to design the building foundations. Such foundation design is usually based on loading and layout criteria furnished by the building manufacturer and/or his structural engineer.

In this capacity, the independent structural engineer has responsibility for, and is the Structural Engineer of Record for the foundations only.

DEFINITIONS

This section contains definitions, given within the general context of structural engineering, for specific terms and key words used in this standard of practice document or in common usage within the profession of structural engineering.

Client

A person or entity that retains the services of the structural engineer. Structural engineers frequently are retained by owners, managers and developers of real property, and by engineers, architects, contractors, government agencies, and manufacturers.

Condition Survey

An inspection or survey performed by the structural engineer for the purpose of observing, assessing, and/or documenting the present condition of an existing facility. The scope may vary from extensive to nominal, depending on the purpose and nature of the survey. The condition survey is normally undertaken when real property is bought and sold, when remodeling or repair is contemplated, or as a management procedure when planning maintenance operations or reserves. The survey frequently consists of a visual inspection, but may also include destructive as well as nondestructive testing, measurement, excavation, removal of finish materials, and evaluation of the structure and its design.

Fabricated Elements

Items specifically designed, assembled, fabricated, modified or produced for the project, such as precast concrete components, fabricated structural steel, prefabricated masonry components, and ready-mixed concrete. Such items are usually prepared in a plant away from the project site but may also be prepared on the construction site but not in their final position in the structure. They may or may not be pre-engineered elements.

Fast-Track Construction

A project in which the construction commences before the design is complete. The design for some portion of the structure, such as the foundation, is completed and released before the design for the remainder of the structure is completed. The intent is to reduce the total elapsed time from the beginning of design to the completion of construction.

Manufactured Products

Items not specifically designed or modified for the project, such as nails, bolts, bricks, concrete blocks.

Nonstructural Elements

Elements or components of a building or other facility that are not a portion of the Primary Structural System and are not intended to support applied loads or forces other than their own self-weight and those environmental loads (such as thermal, snow, wind, and seismic) that are applied directly to the elements themselves. Examples are nonbearing partitions, exterior curtain walls, and mechanical or electrical equipment.

Observation

Visual observation by the structural engineer or his delegate of a project during the construction phase. See Section D. Site Visits During Construction in Part VI - Construction Administration Phase for additional information.

Phased Construction

A project which is divided into somewhat independent portions, with one portion normally bid and executed prior to another. The design or the construction or both may be phased. A phased project may or may not be executed as a fast-track project.

Pre-engineered Buildings

Complete building superstructures supplied by a building or component manufacturer. Refer to Scope of Services for elaboration and further clarification.

Pre-engineered Elements

Structural elements or components of a building or other structural project which are specified but not designed by the Structural Engineer of Record. Refer to Scope of Services for elaboration and further clarification.

Primary Structural System

The principal framing elements and connections that support the building or other facility, and resist the applied lateral and vertical loads and forces. This typically consists of footings, piling or drilled piers, as well as other foundation elements such as beams and structural walls; and superstructure elements such as columns, beams, structural walls, slabs, joists, and trusses.

Prime Design Professional

The leader of the design team charged with the design of a new or remodeled facility. (S)he is usually an architect or an engineer; for the design of building related projects, the prime design professional is usually an architect. The prime design professional is responsible for determining and interpreting the needs of the client/owner/developer and for coordinating the work of the consultants and other members of the design team.

DEFINITIONS

Project Peer Review

A part of a quality assurance program consisting of a review, commissioned by the owner/developer, of the structural portions of the Contract Documents by a qualified independent structural engineer who is not contractually associated with the Structural Engineer of Record. The depth and scope of this review should be tailored to the importance and structural complexity of the project. It should address such issues as: the integrity and redundancy of the Primary Structural System; the appropriateness of structural design criteria, assumptions and computational procedures used; conformance to building codes and regulations; clarity of the contract documents; and a spot design check of typical and/or critical structural components.

Quality Assurance

Procedures, programs or systems established by an owner/developer contracting for the design and construction of a building or other facility. As related to structural design, quality assurance may consist of the retention of special design consultants to advise the Structural Engineer of Record and/or retention of an independent structural engineer to perform a peer review of the structural portions of the Contract Documents. As related to construction, quality assurance normally consists of the retention of an independent agency to perform acceptance testing and to observe the work of the contractor(s) during the course of construction. Quality assurance is an additional level of review designed to protect the interests of the owner/developer and to provide a reasonable level of assurance that the design and construction is carried out in accordance with contract requirements and applicable codes and regulations.

Quality Control

Procedures, programs or systems established by the party contractually responsible for the execution of the design or construction of a building or other facility, or portions thereof. As related to structural design, quality control is the means by which the responsible design professional assures him(her)self that the structural portion of the Contract Documents are in accordance with applicable codes and regulations and current industry standards of practice, and are suitable for their intended function. As related to construction, quality control is the means by which the responsible contractor assures him(her)self that the construction work is in accordance with contract requirements and with current industry standards of workmanship and care.

Structural

Anything pertaining to the load-supporting or force resisting elements of a structure or facility, or the engineering design thereof, or the engineers who design such features.

Structural Assessment

The structural engineering evaluation of an existing facility or a specific condition. The assessment of a structure is frequently the end result of a condition survey or visual inspection. The structural engineer often relies on information furnished by others in making the assessment.

Structural Design

The final design prepared and/or specified by the Structural Engineer of Record to define the structure of a building or facility. The design is usually presented in the form of drawings, sketches, plans, and specifications. The design consists of, for example, the dimensions, locations, components, reinforcements, and construction details for the foundations, columns, beams, slabs, connections, and other elements which compose the structure or structural system.

Structural Engineer

An engineer who directs or participates in planning, designing, or reviewing plans for the erection of structures requiring engineering analysis: (S)he designs structures to meet estimated load requirements, computing size, shape, strength and type of structural members, or performs structural analysis of structures, and may inspect existing facilities and recommend repair or replacement of defective members. This work may be done as the Structural Engineer of Record for a project or for a material or component supplier.

Structural Engineer of Record

A registered professional engineer who specializes in structural engineering and is responsible for preparing and/or coordinating the overall structural design of an entire building or other constructed facility. Usually, there should be one, and only one, such engineer on each project; on small projects or under special circumstances where a structural engineer is retained to design only a small portion of a project, there may not be a Structural Engineer of Record; in other situations there may be more than one Structural Engineer of Record (e.g., prefabricated metal buildings).

Structural Specifications

Those items or portions of the overall project specifications or project manual that deal primarily with structural work within the project. Such specifications are normally prepared by or reviewed by the Structural Engineer of Record; they are a part of the Structural Design, and become part of the Contract Documents.

Visual Inspection

An inspection performed by a structural engineer of an existing facility, using only the engineer's primary senses. The inspection may be brief or comprehensive in scope and is usually performed as a portion of a structural assessment. It has the limitation that only conditions that are normally visible and accessible can be evaluated. In many facilities, the structure is covered by finished materials, earth, or other items and cannot be observed directly, and must, therefore, be excluded from the inspection. Such an inspection is based on the philosophy that a qualified structural engineer can frequently find conditions, damage, or structural concerns in a brief period of time for minimal cost, without conducting extensive testing.

SELECTED OFFICE PRACTICES AND PROCEDURES

The following list is intended to point out some of the most important items that can help to reduce liability exposure and problems that might occur during the progress of a project.

A.
Projects should have a written Scope of Services stating in detail the services to be performed, and services excluded. The Scope of Services document is part of the proposal and the final contract.

B.
Projects should have an approved contract or letter agreement which includes the Scope of Services. Contracting directly with the owner/developer is recommended where possible.

C.
Projects should have an adequate fee commensurate with the work and skill required and the responsibility assumed.

D.
Establish and follow appropriate agreed upon deadlines for performing all services.

E.
Extra services should not be started without written authorization.

F.
Quality control procedures should be in place to assure a check of design and drawings occurs for all projects. It is recommended the check be performed by an independent reviewer, but under some circumstances this is not necessary. (This check is a feature of the engineer's quality control program and is not to be confused with specific project peer review.) The cost of the check should be clearly identified in the project design budget, and the job records should indicate both the people involved and the time expended.

G.
Specific project peer review is recognized as an important part of project quality assurance and should be encouraged where possible.

H.
The client/owner/developer should be advised on important assumptions made during the design/construction process, out-of-the-ordinary conditions and risks, limitations of design and materials, and the level of expected performance of structural materials and systems.

I.
Phased or fast-track projects will often increase liability exposure and design costs. They require more careful planning and liaison with all members of the design and construction team. Particular care in design, coordination, checking, documentation and communication

must be exercised when suppliers are permitted to proceed with shop drawing preparation or when fabrication or construction is permitted to proceed before the contract documents are complete.

J.
Note unusual construction requirements on drawings and/or specifications, e.g., order of construction, shoring. Do not assume responsibility for these functions but point out the need for observance by others.

K.
Phone calls on each project should be documented on appropriate forms and decisions recorded. Copies should be sent to parties involved when appropriate.

L.
Meetings should be summarized by the engineer in attendance regarding structural matters. Such summarization should be distributed to others in attendance if no other responsible party takes official minutes.

M.
Minutes of meetings recorded by others should be reviewed for accuracy and clarity. Differences of opinion should be expressed in writing immediately. Job-related minutes should be retained in the project file.

N.
Do not allow final structural contract drawings to be used for shop drawings.

O.
In general, shop, fabrication and erection drawings should be required for most structural items and components. Those required should be clearly specified in the Contract Documents.

P.
Review of shop drawings and other submittals should be done under the supervision of the Structural Engineer of Record. (S)he should review the correctness of connection details. Review and return of submittals should be prompt and timely, or consistent with previously agreed upon schedules where such exist. Date of receipt and return should be recorded and retained in the project file.

Q.
Questions concerning interpretation of the drawings should be answered by the head project design engineer. Requests for deviations or changes should be approved only by a principal or officer of the firm.

APPENDIX A - SUBMITTALS

SUBMITTAL ITEMS TO REVIEW

The following is a representative check list of items contained in typical submittals that should be reviewed by the Structural Engineer of Record. It is presented for general information. It is not necessarily complete and for some projects it may be inappropriate or too comprehensive. Thus, it should be tailored for each specific project. Also included in the review should be coordination, where required, between different structural materials and labor trades.

PART I - SUBMITTALS RELATED TO STRUCTURAL CONCRETE

A. STRUCTURAL CONCRETE MIX DESIGN:

1. Required and average strengths such as compressive strength, splitting tensile strength, or modulus of rupture

2. Type of cementitious materials (cement, fly ash,...)

3. Air content, slump, unit weight, water-cement ratio

4. Aggregate maximum size, type, and gradation

5. Mix proportions (quantities)

6. Admixtures

7. Mix classification of concrete and locations in project

B. CONCRETE REINFORCING STEEL:

1. Bar size, grade, configuration and coatings

2. Bar location

3. Bar spacing or total number of bars

4. Bar splice lap length and proper location

5. Support accessories for proper bar location and clearances

6. Welding requirements

7. Field bending requirements

8. Column ties and beam stirrups: shape, positioning, dimensions

9. Special reinforcement such as corner bars, dowels, and trim bars around openings, blockouts, re-entrant corners

10. Welded wire fabric designation, orientation, positioning, splicing

11. Reinforcing steel accessories such as mechanical splices, inserts, embedded items

APPENDIX A - SUBMITTALS

C. CONCRETE FORMWORK LAYOUT:

General concrete outlines, including such items as location of pans for rib slabs, openings which affect the structure. Structural support of formwork and detailed form dimensions are not the responsibility of the structural engineer and are not normally reviewed.

D. EMBEDDED ITEMS:

1. Anchor bolt size, grade, location, spacing

2. Plate dimensions, location, anchorage

3. Anchor type: deformed bar, headed stud

E. SITE-CAST TILT-UP CONCRETE:

1. Engineering calculations (when design is by others): loading conditions, lifting insert type and capacity, panel dimensions and weight, concrete strengths, and reinforcement (refer to Section I.B).

2. Formwork layout (refer to Section I.C)

3. Embedded items (refer to Section I.D)

4. Panel erection plan and sequence

5. Structural connections

F. PRECAST AND PRECAST/PRESTRESSED CONCRETE:

1. Engineering calculations (when design is by others): superimposed loading conditions, material strengths, concrete and steel stresses (initial and final such as total load, flexure, shear, bearing), camber and deflection, special loading conditions, reinforcement (refer to Section I.B), prestressing tendon type, size and position.

2. Erection scheme

3. Member type, overall dimensions, location (individual piece drawings will be submitted to the Structural Engineer of Record only when specifically requested)

4. Embedded items (refer to Section I.D)

5. Connection locations and capacity

6. Welding procedures and requirements

7. Corbels and haunches: reinforcing, dimensions, location

G. POST-TENSIONED CONCRETE:

1. Post-tensioned force calculations: stressing forces, short and long-term losses, elongation, anchorage zone stresses

2. Reinforcing bars (refer to Section I.B)

3. Prestressing ducts and tendons: size, type, and strength, stressing procedures and sequencing, profile and spacing (e.g., banded and non-banded requirements), anchorages

4. Concrete strengths required at time of stressing (refer to Section I.A)

5. Embedded items (refer to Section I.D)

6. Formwork layout (refer to Section I.C)

7. Special items: pour strip location and size; dowel sleeve size, locations and spacing; grouting scheme; corrosion protection

PART II - SUBMITTALS RELATED TO STRUCTURAL STEEL

A. PRIMARY STEEL FRAMES AND STRUCTURAL COMPONENTS:

1. Members

a. Rolled shapes, built-up shapes, trusses

b. Size, material grade, overall dimensions, tolerances, configuration, camber, location

c. Stiffeners, penetrations, reinforcements, shear studs

2. Connections and General Fabrications

a. Calculations (when design is by others) for capacity and net sections

b. Bolted: Type, grade, size, tolerance, net section, installation requirements, testing

c. Welded: Shop or field, electrodes, size, length, spacing, location, preparation, backer bars, testing procedure

d. Special Joints: Slip or rocking, turnbuckles

3. Embedded Items (refer to Section I.D.)

B. OPEN WEB STEEL JOISTS AND GIRDERS (Including All Pre-Engineered Steel Trusses):

1. Type, size, configuration, camber, spacing, lengths, location

2. Bridging requirements, including anchorage of bridging

3. Joist headers

4. Top and bottom chord extensions

5. End bearing conditions and connections

6. Splice designs and details

7. Engineering calculations and design considerations:

Magnitude and location of distributed and concentrated live and dead loads; special loads such as axial loads on chords, diaphragm boundary conditions, moments induced by frame action, and uplift loading; camber, deflection and roof ponding; bottom chord compression bracing

C. STEEL DECKING:

1. Material grade, configuration, gauge, depth, minimum section properties

2. Piece lengths, lap lengths, lay out

3. Finishes such as painted or galvanized

4. Connections

a. Weld, screw, button-punch, crimp

b. Shear studs

c. Size, spacing, location

5. Diaphragm shear capacity and uplift

6. Accessories such as closures, sump pans, edge supports

D. LIGHT GAUGE AND COLD-FORMED STEEL:

1. Material grade, type, configuration, gauge, size, spacing, allowable stress, finish, minimum section properties

2. Bracing and bridging

3. Connections

4. Accessories

PART III - SUBMITTALS RELATED TO STRUCTURAL LUMBER

A. PRE-ENGINEERED TRUSSES, JOISTS, AND PANELS:

1. Type, size, configuration, camber, spacing, lengths, locations, lumber species and grade

2. Bridging, blocking, and stiffener requirements, anchorage of bridging

3. Joist headers

4. Top and bottom chord extensions

5. End bearing conditions and connections

6. Splice designs and details

7. Accessories such as hangers, clip angles

8. Engineering calculations (when design is by others):

a. Magnitude and location of distributed and concentrated live and dead loads, load duration factor

b. Special loads such as axial loads on chords, diaphragm boundary conditions, moments induced by frame action, and uplift loading

c. Deflection and roof ponding

d. Bottom chord compression bracing

e. Connections such as nails, glue, bolts, screws, toothed plates, pins, light gage framing connectors

B. GLUED LAMINATED TIMBER:

1. Members

a. Type, shape, size, location, length, radius, camber, size and number of laminations

b. Design values, combination symbol, species

c. Adhesive (wet- or dry-use), preservative treatment

d. Appearance grade, end sealer, protection

2. Connections:

a. Fasteners, shear plates, split rings, bolts, lag bolts

b. Connection hardware: standard hangers, plates, bases, custom steel plates (refer to Section II.A.2)

PART IV - SUBMITTALS RELATED TO STRUCTURAL MASONRY

A. MASONRY UNIT:

Type, strength, size, location, unit weight, shrinkage

B. MORTAR:

Type, proportions, strength

C. GROUT:

Refer to Sections IV.B or I.A

D. REINFORCEMENT:

1. Reinforcing bars (refer to Section I.B)

2. Horizontal joint reinforcing: Size, location, spacing, configuration

E. EMBEDDED ITEMS:

Refer to Section I.D

PART V - SUBMITTALS RELATED TO ALL MATERIALS

A. CERTIFICATIONS REQUIRED:

1. Fabricated elements - accreditation by an independent authority, provision of a program for reporting plant tests and inspections, in-plant verification, or similar procedures.

2. Manufactured products - conformance to specification requirements.

3. Pre-engineered elements - signature and professional seal of engineer responsible for the element, plant accreditation where appropriate.

B. SUBSTITUTIONS:

Review for testing appropriate for the project and for accreditation of the material, product, or procedure by proper authorities.

C. OTHER MATERIALS OR SYSTEMS:

Review for general compliance with the project requirements.

SITE OBSERVATIONS DURING CONSTRUCTION

The following is a representative check list of items that should be reviewed and/or verified for acceptability by the Structural Engineer of Record during the course of site visits during construction. It is presented for general information. It is not necessarily complete and for some projects it may be inappropriate or too comprehensive. Thus, it should be tailored for each specific project.

PART I - ITEMS RELATED TO STRUCTURAL CONCRETE

A. STRUCTURAL CONCRETE:

1. Work acceptance and testing procedures

2. Concrete mix classification and locations in project

3. Transporting, placing, consolidating, finishing, curing, protecting, and form removal procedures

B. CONCRETE REINFORCING STEEL:

1. Bar size, grade, configuration, coatings, surface condition

2. Bar location

3. Bar spacing or total number of bars

4. Bar splice lap length and proper location

5. Support accessories for proper bar location and clearances

6. Welding procedures and testing procedures

7. Field bending procedures

8. Reinforcing steel placement, in general, and congestion at joints, in particular

9. Other reinforcement such as corner bars, dowels, trim bars around openings, blockouts, re-entrant corners

10. Welded wire fabric type, orientation, positioning, splicing

11. Reinforcing steel accessories such as mechanical splices, inserts, embedded items

APPENDIX B - SITE OBSERVATIONS

C. CONCRETE FORMWORK:

General concrete outlines, including such items as location of pans for rib slabs, cross-sectional dimensions significant in the proper performance of the structure, openings which affect the structure, recesses, construction joints, void space requirements, debris removal. Structural support of formwork and detailed form dimensions are not the responsibility of the structural engineer and are not normally reviewed.

D. EMBEDDED ITEMS:

1. Size and location of anchor bolts, plates, inserts, anchors

2. Nonstructural items that affect the structure such as electrical conduit, plumbing, openings, and sleeves

E. SITE-CAST TILT-UP CONCRETE:

1. Refer to Sections I.A Structural Concrete, I.B Concrete Reinforcing Steel, I.C Concrete Formwork, and I.D Embedded Items.

2. Structural connections

F. PRECAST AND PRECAST/PRESTRESSED CONCRETE:

1. Member type, location

2. Connections

3. Welding procedures and weld testing procedures

4. Removal of temporary connections and erection devices

5. Bearing conditions such as condition of bearing surface, bearing length, bearing pads, expansion joints, grouting or dry packing

G. POST-TENSIONED CONCRETE:

1. Refer to Sections I.A Structural Concrete, I.B Concrete Reinforcing Steel, I.C Concrete Formwork, and I.D Embedded Items.

2. Prestressing tendons: size and type, stressing procedures and sequencing, profile, alignment, arrangement, spacing, placement around openings, anchorages, condition of sheathing, supports and accessories

3. Concrete strengths required at time of stressing

4. Special items: pour strip location and size; dowel sleeve size, locations and spacing; grouting scheme; corrosion protection; anchorage reinforcement

H. GENERAL:

Damaged or defective concrete construction such as cracks, inadequate reinforcing cover, inadequate consolidation of concrete.

PART II - ITEMS RELATED TO STRUCTURAL STEEL

A. PRIMARY STEEL FRAMES AND STRUCTURAL COMPONENTS:

1. Members

a. Nominal size, general arrangement and configuration, location, general condition

b. Stiffeners, penetrations, reinforcements, shear studs

c. Permanent structural bracing, bridging

2. Connections and General Fabrications

a. Correct and complete installation, general arrangement, condition, proper fit-up, field modifications, work acceptance and testing procedures

b. Bolted: Type, grade, size, installation

c. Welded: Size, length, spacing, location

d. Special Joints: Slip or rocking, turnbuckles

3. Removal of temporary connections and erection devices

4. Bearing conditions such as condition of bearing surface, bearing length, bearing pads, expansion joints, grouting or dry packing

B. OPEN WEB STEEL JOISTS AND GIRDERS (Including All Pre-Engineered Steel Trusses):

1. Nominal size, general arrangement and configuration, condition, spacing, location, field modifications

2. Bridging, including anchorage of bridging

3. Joist headers

4. Top and bottom chord extensions

5. End bearing conditions and connections

6. Splices

C. STEEL DECKING:

1. General arrangement and configuration, condition, nominal depth, location, field modifications and substitutions

2. Lap lengths, lay out

3. Finishes such as painted or galvanized

4. Connections: size, spacing, location...welds, especially weld burn-throughs; screws; button-punches; crimps, especially full engagement;

shear studs; special diaphragm requirements

5. Edge supports and opening framing

6. Accessories such as closures, sump pans, edge supports

D. LIGHT GAUGE AND COLD-FORMED STEEL:

1. General arrangement and configuration, condition, location, nominal size, spacing, finish, field modifications and substitutions

2. Bracing and bridging

3. Connections, especially weld burn-throughs

4. Accessories

PART III - ITEMS RELATED TO STRUCTURAL LUMBER

A. PRE-ENGINEERED TRUSSES, JOISTS, AND PANELS:

1. Nominal size, general arrangement and configuration, condition, spacing, location, field modifications

2. Bracing, bridging, blocking, including anchorage of bridging, stiffeners

3. Joist headers

4. Top and bottom chord extensions

5. End bearing conditions and connections

6. Splices

7. Accessories such as hangers, clip angles

8. Connections such as nails, glue, bolts, screws, toothed plates, pins, light gage framing connectors

B. GLUED LAMINATED TIMBER:

1. Nominal size, general arrangement and configuration, condition, spacing, location, identifying marks, field modifications

2. Bridging, blocking

3. Bearing conditions, holes, notches, splices

4. Connections including nails, glue, bolts, screws, toothed plates, pins, light gage framing connectors, hangers, clip angles

C. ROUGH CARPENTRY
(Framing, Decking, Sheathing):

1. Nominal size, general arrangement and configuration, condition, spacing, location, species and grade, panel identification, field modifications

2. Bridging, blocking

3. Bearing conditions, holes, notches, splices

4. Connections including nails, glue, bolts, screws, toothed plates, pins, light gage framing connectors, hangers, clip angles

APPENDIX B - SITE OBSERVATIONS

PART IV - ITEMS RELATED TO STRUCTURAL MASONRY

A. GENERAL:

General arrangement and configuration, condition, workmanship, weather protection, bonding, type, nominal size, location

B. ACCEPTANCE:

Work acceptance and testing procedures, including special inspection if required, periodic inspection, and testing of wall assemblies (prism testing)

C. GROUT:

Materials and procedures...condition of grout space, cleanouts, consolidation

D. REINFORCEMENT:

1. Reinforcing bars (refer to Section I.B)

2. Horizontal joint reinforcing: Size, location, spacing, configuration

E. CONTROL AND EXPANSION JOINTS:

Removal of unwanted mortar and debris in joints and clear spaces

F. LINTELS:

Type, size, location, bearing

G. EMBEDDED ITEMS:

Refer to Section I.D

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