A GUIDE FOR **CONSULTING** STRUCTURAL ENGINEERING **SERVICES** IN COLORADO



A RECOMMENDED STANDARD OF PRACTICE

PREPARED BY: STRUCTURAL ENGINEERS ASSOCIATION OF COLORADO SECOND EDITION October 2004

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STRUCTURAL ENGINEERS ASSOCIATION OF COLORADO (SEAC)

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The Structural Engineers Association of Colorado (SEAC) is a professional association representing the structural engineering community of Colorado. This document is published in keeping with SEAC's stated mission "to advance the structural engineering profession; to provide the public with structures of dependable performance through the application of state of the art structural engineering principles; to assist the public in obtaining professional structural engineering services; to promote natural hazard mitigation; to provide continuing education and encourage research; to provide structural engineers with the most current information and tools to improve their practice; to maintain the honor and dignity of the profession."

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FOREWORD

This recommended standard of practice document was originally prepared and published by the Structural Engineers Association of Colorado (SEAC) in 1987 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 members of SEAC are encouraged to use this document to the fullest extent possible, but are advised its use is voluntary. With this document, each Structural Engineer has an opportunity to compare their practice with this recommended standard. The Guide also provides a more complete basis upon which to negotiate with the Client and for the Client to evaluate the nature and extent of services provided by the Structural Engineer. In updating this document, the committee kept the intent of the original document as a basis for accepting or rejecting any proposed revisions.

The goal of the document is to bring about a better understanding of professional structural engineering services and standards of practice. Since the Structural Engineer is frequently a member of a multidiscipline design team, this document also attempts to define the relationships that may 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 appropriate compensation.

Specifically, this standard of practice defines a possible range of services, as well as the obligations and the limitations of the consulting Structural Engineer of Record and Specialty Structural Engineer when providing 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.

This standard of practice is primarily oriented toward design and construction administration services for 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 typical activities in which Structural Engineers work. These sections include: a detailed Scope of Services; Definitions of terms used in this document and in structural engineering practice in general; a Risk Management Practices and Procedures section; and finally, in the Appendices, checklists of items related to submittal review and site observations during construction.

The particular wording and obligations of specific contracts are beyond the scope of this document. Standard contracts and forms of agreement are available through other sources and should be referenced. Additionally, it is recommended that appropriate legal counsel be retained as needed and liability insurance obtained. Individual contracts may significantly modify the scope of services to be rendered.

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 practice to fit their own practice. It is customary for the

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Structural Engineer to determine the scope of services required for a given project, Client and set of circumstances and to provide these services accordingly. This determination of the Scope of Services must be tempered by the instructions and desires of the Client and by the services for which the Client is willing to pay.

It must also be recognized that the services provided by the Structural Engineer and the corresponding assumption of responsibility require appropriate compensation. The Structural Engineer is not responsible for conditions beyond those areas in which services have been provided. In most instances, the provisions within the contract govern the responsibilities of the Structural Engineer with the Client. However, the ultimate responsibility of the Structural Engineer is to provide services that ensure the health and safety of the general public.

Foreword 2

SCOPE OF SERVICES

INTRODUCTION

The following Scope of Services defines the needs and the typical activities of the Structural Engineer and the services that might be provided during a project. It also includes an indication of what Structural Engineers are and are 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 chapters 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.

Four additional sections – Additional Services, Services Relative to Performance Specified Elements, Services Relative to Pre-Engineered Buildings and Services Relative to Existing Buildings – are included after the sections defining the sequential phases in order to address these important areas separately.

It is important to realize that certain work activities or services may be performed out of the typical sequence or in different phases than indicated in the Scope of Services. This is common 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.

Although the Scope of Services described herein is tailored to fit the most common project needs, Structural Engineers may, under certain circumstances, provide very different services. For some projects, the Structural Engineer may be the Prime Design Professional responsible for managing and coordinating the work of the other necessary disciplines in addition to the work described herein.

CHAPTER 1 - PROJECT DEFINITION PHASE

INTRODUCTION

The Project Definition Phase is typically where the scope of the project is defined. The result is a contract that defines the project scope and fee. It is recommended that substantial work should not proceed until a clear understanding of scope is established and a mutually acceptable contract is executed.

A. BASIC SCOPE OF SERVICES

Meet with the Client to define and negotiate a Scope of Services for the project. Consider such items as design schedule, construction schedule, construction budget, building size, type, and use as well as building department jurisdiction.

B. SPECIAL SERVICES

Review with the Client any special or additional services required involving such items as design of Performance Specified Elements, design of Non-Structural Elements, review of manufacturer's design and design of site development structures.

C. PROJECT SCHEDULE

- Assist in developing and/or reviewing 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.
- Consider such items as bidding and negotiating the construction contract, Fast-Track Construction schedules, Phased Construction and construction budgets.

D. DELIVERABLES (INSTRUMENTS OF SERVICE)

 Establish format and content requirements for deliverables at all project phases including Schematic Design, Design Development, Construction Document and Close-Out (preparation of Record Drawings). Deliverables may include preliminary and final reports, surveys, evaluations, descriptive structural narratives, outline and final specifications, preliminary and study sketches, schematic and design development drawings and/or final Contract Document drawings.

- 2. Establish when preliminary and final determination of construction budget (prepared by others) will occur during the design phase.
- Establish any special drawing presentation standards or procedures if required by the Client or Owner. Establish protocols for transfer of drawings and/or electronic drawing files to the design team during the design phase.
- Establish protocols for transfer of drawings and/or electronic drawing files
 to the contractor and subcontractors for use in preparation of bids and shop
 drawings, if required.
- 5. Determine the number of drawing and calculation sets (if required) for building department submittal.

E. COMMUNICATIONS

- Establish communication protocols relating to structural engineering between design team disciplines, the Owner and the contractor as required.
- Determine responsibilities for documenting communications and distribution of documented communications.
- Establish use of standardized forms, electronic mail, websites and/or specialized communication software.

F. GEOTECHNICAL SERVICES

Review proposed scope of geotechnical services and provide necessary structural criteria for the purpose of assisting the Client in obtaining geotechnical services.

G. INFORMATION PROVIDED BY OTHERS

The Structural Engineer of Record has the right to rely upon the accuracy and completeness of information provided by others. Examples of information provided by others are:

- 1. Geotechnical report and foundation design recommendations.
- 2. Surveys including description of site condition, topographic information and existing conditions.
- Special loads in excess of code requirements.
- 4. Site specific seismic factors.

- 5. Wind tunnel studies.
- 6. Special environmental conditions and loads.
- 7. Weight, type and location of mechanical and electrical equipment.
- 8. Vibration and acoustical requirements and recommendations.
- 9. Dimensional information.
- 10. Loads and/or forces imposed by elements designed by others.

H. CONTRACT

Develop a mutually acceptable contract that includes a detailed Scope of Services defining Basic Services, Additional Services, limitation of liability provisions, limitations and exclusions. Coordinate this contract with the Client's contract with their client.

I. REDUCED SCOPE OF SERVICES

- For some projects, the Structural Engineer provides a greatly reduced scope of services. For example, a building might be designed in such a way that there is one Structural Engineer of Record for the foundation and another for the superstructure. Often, in these types of projects the superstructure is a Pre-Engineered Building system as discussed later in this document.
- 2. 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. Other aspects of the Structural Engineer's services, 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.
- 3. Whatever the agreed upon reduced scope of service, 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 of all parties. In most instances, the Structural Engineer is the one most qualified to determine if the Client's, Owner's and public's interests (with respect to structural safety) are being adequately protected in the arrangement. The Structural Engineer should weigh these factors in addition to the contract for services in deciding to undertake a reduced scope of services project.

CHAPTER 2 - SCHEMATIC DESIGN PHASE

INTRODUCTION

The Schematic Design Phase is where the structural design process begins. It is when the design criteria are established as well as when alternate structural systems are studied and proposed. The Schematic Design Phase should conclude with a narrative and/or drawings or sketches that can be used to assist in the selection of the structural system.

A. INITIAL MEETINGS

Attend initial meetings with the project Owner or Owner's 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 that are supplied by the Client.

B. STRUCTURAL DESIGN CRITERIA

Establish the criteria required to prepare the structural design. These criteria are based on information to be supplied by the Owner, design team, building officials and others, and may include the following items:

- 1. Governing design codes and design criteria as determined by public agencies.
- 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, and exposed structural steel.
- Building materials not allowed due to availability, code restrictions or Owner preference.
- 7. Survey data, such as topography, utilities and boundary.
- 8. Special environmental conditions.
- 9. Future expansion requirements.
- 10. Deflections, lateral movements and vibration criteria that are other than code minimums or standard.

C. ALTERNATE STRUCTURAL SYSTEMS

Consider alternate lateral and vertical force resisting structural systems and materials that will meet the established project requirements. Construction methods, schedule constraints (e.g., Fast-Track Construction) and appropriate seasonal effects are part of these considerations.

D. STRUCTURAL SYSTEM

Establish the agreed upon lateral and vertical force resisting systems based on the proposed architectural elements of the building. Review possible architectural changes that may be required to facilitate a more reasonable and cost-effective structural system.

E. SPECIAL STRUCTURAL STUDIES

Determine the need and make recommendations for any special structural studies, such as wind tunnel studies, dynamic analysis and/or seismic analysis, as well as load and material testing of existing structures.

F. SPECIAL SITE CONDITION STUDIES

Assist in determining the need for any studies required to evaluate special site conditions, such as mines, avalanches and rockslides.

G. SCHEMATIC DESIGN DOCUMENTS

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

H. DOCUMENT REVIEW

Submit structural Schematic Design documents to the Prime Design Professional and Owner to allow for selection of the most appropriate structural system. Also consider such items as cost information prepared by others, and recommendations from consultants, suppliers and manufacturers.

I. COST SAVINGS REVIEW

Suggest possible changes to affect cost savings.

J. SCOPE OF SERVICES REVIEW

Verify Scope of Services and adjust final design contract, if needed.

CHAPTER 3 - DESIGN DEVELOPMENT PHASE

INTRODUCTION

The Design Development Phase is where the selected structural systems are developed, in order to identify general sizes, depths and layout. The end result of this phase is a set of documents defining major framing sizes and key details of the Primary Structural Systems. Significant coordination items such as structural depth limitations, ceiling heights and mechanical conflicts should be resolved and the location of columns and lateral force resisting elements established.

A. STRUCTURAL SYSTEM SELECTION

Participate in the selection of the final structural system with the Client, the design team and other appropriate parties.

B. PERFORMANCE SPECIFIED ELEMENTS

Identify the Performance Specified structural systems and elements. Identify the design criteria information as appropriate.

C. GEOTECHNICAL INFORMATION

Review the final geotechnical report or recommendations for structural concerns and for the recommended foundation systems. Provide a foundation design based on the geotechnical report.

D. BUILDING DEPARTMENT LIAISON

Communicate with the building department or other governing agencies on matters as required for interpretation and/or acceptance of structural engineering criteria and design.

E. PRELIMINARY COSTS

Assist the Client and design team in preparing a preliminary opinion of costs. Review cost information prepared by others, if requested.

F. OUTLINE SPECIFICATION

Prepare and/or edit outline specification sections for structural items.

G. STRUCTURAL SYSTEM INTEGRATION

Integrate the selected Primary Structural System with the architectural and other consultants' work.

H. SPECIAL STUDIES

Review the results of any special studies, which were established during the Schematic Design Phase and determine their effects on the structural systems.

I. DESIGN DEVELOPMENT DOCUMENTS

Prepare a summary report and/or Design Development drawings or sketches showing the foundations and the framing of the proposed structural systems, including materials, gross sizes and typical details.

J. DESIGN DEVELOPMENT DOCUMENTS SUBMITTAL

Submit final structural Design Development documents to the Client for review, acceptance and approval.

CHAPTER 4 - CONTRACT DOCUMENTS PHASE

INTRODUCTION

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

A. FINAL STRUCTURAL DESIGN

Prepare the final structural design of the Primary Structural System. This is based upon the consideration of the following parameters as needed and where reasonably ascertainable:

- 1. Building code requirements and regulations.
- 2. The Geotechnical engineering findings and recommendations as presented in the final geotechnical report.
- Client and functional requirements, including special loads (e.g., special occupancies, fire truck access and specialty equipment).
- 4. The final results of any special studies (wind tunnel, existing building surveys, etc.).
- 5. Manufacturer or supplier recommendations.
- 6. Requirements of other design team professionals.
- 7. National, regional and/or local standards of practice.
- 8. Contractor suggestions and construction requirements.
- 9. Structural engineering professional judgment and experience.

B. INTERFACE WITH PERFORMANCE SPECIFIED ELEMENTS

The Structural Engineer of Record defines the Primary Structural System, and determines and specifies which portions the Structural Engineer of Record will design and which will be designed by others including Performance Specified Elements. Provide and/or assist others with the structural design criteria for the design of the Performance Specified 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.

C. INTERFACE WITH NON-STRUCTURAL ELEMENTS

Consult on Non-Structural Elements. This consists of reviewing the effect of items not included in the Primary Structural System, but which are connected to and/or supported by the Primary Structural System, 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 Non-Structural Elements themselves may or may not be included in Basic Services. The design team professionals should consider each item on an individual basis. Refer to Chapter 6 - Additional Services for further information.

D. DESIGN COORDINATION

Attend and participate in meetings with Client, other design team professionals and appropriate material and product suppliers. Participate in the coordination of the Structural Contract Documents with those of other disciplines. The Prime Design Professional is responsible for overall coordination of the services of the various engineering and other disciplines.

E. BUILDING DEPARTMENT LIAISON

Coordinate with the governing building department and/or other agencies on matters relating to code interpretation and compliance.

F. STRUCTURAL CALCULATIONS

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 part of the construction contract or the Contract Documents.

G. FINAL STRUCTURAL DRAWINGS

Prepare final Structural drawings describing the Primary Structural System, which are sufficiently complete and understandable to be accurately priced or submitted for competitive bid and for construction. The documents may include:

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

System. Framing plans may refer to other drawings for dimensions where appropriate.

- The necessary criteria and other information needed for the design and installation of Performance Specified Elements. Refer to Chapter 7 -Services Relative to Performance Specified Elements for additional information.
- An indication of Non-Structural Elements, which affect the Primary Structural System or appropriate cross-references to drawings by others for such items.
- 4. The structural drawings should identify design criteria, such as live and superimposed dead loads, material strengths, code requirements and any provisions for future structural additions.

Final Structural Contract Documents do not typically include information on construction means and methods.

H. STRUCTURAL SPECIFICATIONS

Prepare or edit Structural Specifications as required. Specifications should include such portions of the contractor's Quality Control requirements, Owner's Quality Assurance program and product certifications necessary to establish with reasonable expectation that the Primary Structural System, when constructed, will perform in general conformance with the design criteria. Assist in establishing testing and inspection requirements, including Special Inspections. Structural Specifications do not typically include information on construction means and methods.

I. REVIEW AND COORDINATION CHECK

Perform a review and check of the structural design and the Structural Contract Documents. Perform a coordination check of the Structural Contract Documents including the inter-relationship of the Primary Structural System with the designs and documents prepared by the other design team disciplines. The Prime Design Professional is responsible for leading the overall coordination effort.

J. BUILDING DEPARTMENT REVIEW

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

CHAPTER 5 - CONSTRUCTION ADMINISTRATION PHASE

INTRODUCTION

The Construction Administration Phase of a project involves the process of the contractor interpreting the Structural Contract Documents in order to construct the structural systems. The Structural Engineer may provide services that involve the review of submittals and may conduct observations of the structural systems to determine if the construction is in general conformance with the intent of the Structural Contract Documents. Participation of the Structural Engineer with the design team and the construction team in the construction process can contribute to a properly completed project.

A. BIDDING AND NEGOTIATIONS

- Assist, when requested, in determining bidders' qualifications and/or prequalification of potential suppliers or subcontractors.
- 2. Assist, when requested, in establishing procedure of communication for interpretation of Contract Documents.
- 3. Attend and participate in pre-bid meetings when appropriate.
- Prepare structural addenda and structural clarifications upon request or when need is determined by the Structural Engineer of Record.
- Review and act upon submissions of requests for acceptance of alternates and substitutions.
- 6. Assist, when requested, in evaluation of bids.

B. PRE-CONSTRUCTION SERVICES

- Attend, as appropriate, scheduled pre-construction and pre-detailing meetings with the contractor, structural subcontractors, subcontractors that may interact with structural components and systems and other interested parties. Answer questions about structural design intent. Interpret, if required, the Structural Contract Documents. Review the structural requirements and the Quality Control systems with the contractor.
- Assist in establishing lines of communication and procedures with the contractor to be used during construction.
- Establish, with the contractor, scheduling requirements for field observations on structural items.

- Assist in establishing procedures to be used in accomplishing and reporting required testing and inspections for the Owner's Quality Assurance program. Assist in selection of a materials testing and inspection agency.
- 5. Assist in developing procedures to be used in processing shop drawings, certifications and other required submittals.

C. REVIEW SHOP DRAWINGS AND OTHER SUBMITTALS

- 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. Confirm that submittals have received prior approvals as required by the Contract Documents.
- 2. Review the designs and drawings of Performance Specified Elements designated by the Structural Engineer of Record and designed by others. Confirm such submittals have received prior approvals as required by the Contract Documents. Confirm that submittals bear the signature and professional seal of the engineer responsible for the design as required by the Contract Documents. Review of Performance Specified Elements shall be for type, position and connection to other elements within the Primary Structural System and for correct design criteria and loads used for their design.
- 3. Review of submittal information is for general compliance with the project requirements and does 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 this work. 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. See Appendix A for representative list of items which might be included in the review.
- Items changed on resubmittals shall be clearly identified by others and only those items identified will be reviewed by the Structural Engineer of Record.
- When submittals are revised at the discretion of the contractor or supplier
 after review by the Structural Engineer of Record and further review is
 desired, such review may be performed as an Additional Service.

D. SITE VISITS AND OBSERVATIONS

- As stipulated in the contract with the Client, periodically visit the
 construction site. The amount of time anticipated for this effort should be as
 defined in the contract with the Client under the Basic Services portion.
 Structural Observations conducted by the Structural Engineer should not be
 considered as a substitute for site inspections by an independent agency or
 Special Inspections.
- During or shortly after each visit, give clarifications and instructions as required. Document conditions observed and information or instructions given. Distribute reports in a timely manner through established communication procedures.
- 3. 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 professional judgment and skill, to ascertain if the work is generally in conformance with the project requirements contained in the Structural Contract Documents and Structural Specifications or if there are apparent defects or deficiencies in the work of the contractor. 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.
- 4. 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. See Appendix B for a representative list of items that might be observed.

E. MATERIAL TESTING AND INSPECTION

1. Review reports from independent agencies for construction compliance. Interpret for the Client reported deficiencies in construction and provide recommendations for correction if necessary.

F. OTHER CONSTRUCTION ADMINISTRATION PHASE SERVICES

- 1. Provide interpretations and clarifications of Structural Contract Documents.
- When required, provide a letter addressing issues of general conformance/compliance.

CHAPTER 6 - ADDITIONAL SERVICES

INTRODUCTION

Services beyond those defined as Basic Services are frequently needed and may be categorized as Special and Extra services. It is recommended that discussions be conducted with the Client regarding these Additional Services.

If services are specifically requested relative to Non-Structural Elements, the Structural Engineer of Record is responsible only for those items for which the engineer has actually performed structural design and stamped the drawings with a professional seal. The review of documents prepared by others is undertaken solely to ascertain whether or not the designs satisfy the general structural requirements of the project.

A. SPECIAL SERVICES

These are services that usually can be foreseen at the beginning of the design phases, but are not part of the design of the Primary Structural System. They include 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 attachments to supporting structural elements):

- 1. Glazing, window walls, skylights or door systems.
- 2. Curtain wall systems.
- 3. Non-load bearing exterior wall systems.
- 4. Antennas, flagpoles and/or light poles.
- 5. Interior or exterior cladding.
- 6. Window washing systems and tie-downs.
- 7. Partitions and/or partition systems.
- 8. Ceiling and/or lighting systems.
- 9. Casework and/or furniture.
- Special equipment (e.g., stage equipment, catwalks, acoustical fixtures, snow fences, solar collectors).
- 11. Decorative work (e.g., sculptures).

- 12. Handrails, guardrails and stairs.
- 13. Anchorages and/or support for mechanical or electrical equipment.
- Special support assemblies (e.g., wall brackets, platforms for mechanical or electrical equipment).
- 15. Review of drawings and/or specifications prepared by other design disciplines for adequacy of anchorage or bracing.
- 16. Mechanisms and/or guide systems and their support for elevators, escalators or other conveyor systems.
- 17. Site work elements, exterior and noncontiguous with buildings (e.g., retaining walls, culverts, tunnels, fountains, signs, frames for mockup panels, equipment supports).
- 18. Review of design information prepared by others to determine adequacy of anchorage, bracing and/or support of Non-Structural Elements.
- Special analysis for floor response, vibratory equipment, blast analysis, progressive collapse, non-linear "pushover" analysis, spectrum or time history analysis.
- 20. Special wind analysis (e.g., wind tunnel tests).
- 21. Investigations and/or condition surveys of existing buildings or structures and verification of existing conditions.
- 22. Studies of various schemes to accommodate special energy requirements (e.g., LEED certification).
- 23. Preparation of documents for alternate bids or segregated contracts for Phased or Fast-Track Construction.
- 24. Design for future expansion.
- 25. Filing application for and/or obtaining building permit.
- 26. Seismic safety analysis for special conditions beyond Basic Services.
- Providing probable construction cost, quantity surveys or inventories of material, equipment or labor.
- 28. Tenant related design services.
- 29. Preparation of shop or fabrication drawings.

- 30. Review or determination of fire resistance properties.
- 31. Design and/or review of shoring or construction bracing.
- 32. Design of swimming pools.
- 33. Services related to Project Peer Review.
- 34. Services related to value engineering.
- 35. Services related to Special Inspections.
- 36. Services related to design of fall protection.
- 37. Preparation of demolition and demolition safety plans.
- 38. Preparation of Record Drawings or other documents.
- 39. Services associated with sequencing of construction.
- 40. Reviewing work of other previous or contemporaneous structural design engineers or coordinating a change from one design engineer to another.

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 and/or magnitude of the project.
- 2. Work resulting from changes and/or substitutions proposed by the contractor, subcontractors, material suppliers or others.
- 3. Work resulting from a change in scope due to recommendations of other consultants or due to undiscovered conditions (such as a change from a slab-on-grade to a structural slab, or unknown foundation and/or soil conditions) or due to changes in governmental requirements.
- Services resulting from changes necessary because of construction cost overrun.
- 5. Addressing revisions that are inconsistent with prior approvals or instructions.

- 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 and/or services for dispute resolution.

CHAPTER 7 - SERVICES RELATIVE TO PERFORMANCE SPECIFIED ELEMENTS

INTRODUCTION

For Performance Specified Elements, the Structural Engineer of Record ordinarily specifies the type of element, the position within and the interface 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 these basic design criteria and the proper integration of the component into the Primary Structural System.

A. DESIGN RESPONSIBILITIES

Performance Specified Elements are normally designed by or under the supervision of a Specialty Structural 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 for the final in-place loads and the forces associated with designing for fabrication and, in some instances, also the installation of the element.

B. DOCUMENTATION

Documentation and/or drawings necessary to convey the structural design information essential to the fabrication, production or manufacture, transportation and installation, including in-service conditions, should be prepared by the supplier or his agent for the Performance Specified Elements and should be submitted to the Structural Engineer of Record, as required by the Contract Documents. These submittals should bear the signature and professional seal of the Specialty 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 Specialty Structural Engineer.

Examples of Performance Specified Elements may include the following:

- 1. Curtain wall systems.
- 2. Structural steel connections.
- Skylight systems.
- 4. Non-load bearing exterior wall systems.

- 5. Stairs.
- 6. Handrails and/or guardrails.
- 7. Open-web steel joists and/or joist girders.
- 8. Wood and/or light gage trusses.
- 9. Combination wood, metal and/or plywood joists.
- 10. Precast and/or prestressed concrete slabs, beams, panels or columns.
- 11. Tilt-up concrete panel reinforcement and hardware required for lifting panels to position.

CHAPTER 8 - SERVICES RELATIVE TO PRE-ENGINEERED BUILDINGS

INTRODUCTION

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.

A. DESIGN RESPONSIBILITIES

- The project may have more than one Structural Engineer of Record. 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 that engineer.
- 2. The Client will retain the services of a Structural Engineer to design the building foundations and other elements as agreed. This Structural Engineer has responsibility for and is the Structural Engineer of Record for the foundations and may be responsible for other elements of the building that require coordination with the Structural Engineer of Record for the Pre-Engineered Building such as deflection criteria and loading. Design of the foundations and other elements is based on code required loading and layout criteria furnished by the building manufacturer and/or their Structural Engineer.

CHAPTER 9 - SERVICES RELATIVE TO EXISTING BUILDINGS

A Structural Assessment of an existing building may be undertaken for a number of purposes, and is commonly requested for the following reasons:

- 1. To generate a condition report as part of a potential purchase or sale of the property.
- 2. As part of a remodeling, addition or repair project.
- 3. To determine whether the structure complies with a particular building code.
- 4. To evaluate the condition of the structure in the aftermath of a natural disaster or fire.
- 5. As a management procedure when planning maintenance operations or reserves.
- 6. To determine a safe load capacity.
- 7. As part of a historic preservation effort.

A Structural Assessment is 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 survey frequently consists of a Visual Inspection, but may also include destructive as well as nondestructive testing, measurement, excavation and removal of finish materials. The survey may also include other structural evaluations not listed above.

It should be emphasized that the scope of the assessment must be clearly defined and may vary from extensive to nominal, depending on the purpose and nature of the project.

DEFINITIONS

INTRODUCTION

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

Basic Services The services of the Structural Engineer of Record necessary to provide construction documents and construction administration services for use in the construction of the Primary Structural System and as defined in the contract.

Client A person or entity that retains the services of the Structural Engineer. Structural Engineers are typically retained by Owners, managers and developers of real property and by engineers, architects, contractors, government agencies and manufacturers.

Contract Documents The owner-contractor agreement, the conditions of the contract (general, supplementary and other conditions), drawings, specifications, clarification drawings and all addenda issued prior to and all modifications issued after execution of the contract and any other items that may be specially stipulated as being included.

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.

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 and concrete blocks.

Non-Structural Elements Elements or components of a building or other facility that are not a part 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 (e.g., thermal, snow, wind and seismic) that are applied directly to the elements themselves. Examples are non-load bearing partitions, exterior curtain walls and mechanical or electrical equipment. These elements are typically not designed by the Structural Engineer of Record.

Owner The individual or entity who has legal possession or equitable interest in the structure.

Performance Specified Elements Structural elements or components of a building or other structural project, which are specified but not designed by the Structural Engineer of Record. These may also be referred to as Pre-Engineered Elements.

Phased Construction A project, which is divided into interrelated phases, in which one phase may be bid and executed prior to another. The design or the construction or both may be phased. A Phased Construction project may or may not be executed as a Fast-Track project.

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

Primary Structural System The combination of 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, piles 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. The individual is usually an architect or an engineer for the design of building related projects. The Prime Design Professional is responsible for determining and interpreting the needs of the Client and for coordinating the work of the consultants and other members of the design team.

Project Peer Review A part of a Quality Assurance program commissioned by the Client consisting of a review 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 needs of the Client. It may address such issues as the integrity and redundancy of the Primary Structural System, the appropriateness of the 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 a Client contracting for the design and construction of a building or portions thereof. 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 during the course of construction. Quality Assurance is an additional level of review designed to protect the interest of the Client 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 is assured that the construction work is in accordance with contract requirements and with current industry standards of workmanship and care.

Record Drawings Record drawings incorporate modifications or changes that occurred during the construction process into the Contract Documents. These changes may be a result of addenda issued during bidding, approved substitutions, RFI responses, change orders, construction change directives, orders for minor changes in the work and/or structural observation reports. Record Drawings may contain information provided by the contractor, but should not be relied upon as "as-built" drawings. "As-built" drawings are understood to be complete and accurate representations of the constructed work.

Special Inspection An inspection performed by the Special Inspector for the types of work required by the governing code and the Contract Documents.

Special Inspector A qualified person who shall demonstrate competence to the satisfaction of the building official for inspections of the particular type of construction or operation requiring Special Inspection.

Specialty Structural Engineer A licensed Professional Engineer, other than the Structural Engineer of Record, who performs structural engineering services necessary for the structure to be completed and who has shown experience and/or training in the specific specialty. The Specialty Structural Engineer is usually retained by a supplier or subcontractor who is responsible for the design, fabrication and sometimes installation of engineered elements, or by the contractor or subcontractor responsible for construction related services.

Structural Anything pertaining to the vertical load supporting or lateral force resisting elements of a structure or facility.

Structural Assessment The structural engineering evaluation of an existing facility for 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 Contract Documents
That portion of the Contract Documents
related to the Structural part of the work. This often includes the drawings and
specifications sealed by the Structural Engineer of Record and issued for construction
purposes, plus any clarification drawings, addenda and change orders issued and
acknowledged by the Structural Engineer of Record.

Structural Engineer An engineer who directs or participates in planning, designing or reviewing plans for the construction of structures requiring engineering analysis. The engineer 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 project or as a Specialty Structural Engineer 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. Preferably, there should be one and only one such engineer on each project. 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., Pre-Engineered Buildings).

Structural Observation Visual observations by the Structural Engineer or his delegate of a project during the construction phase.

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 typically prepared by or reviewed by the Structural Engineer of Record. They 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.

RISK MANAGEMENT PRACTICES AND PROCEDURES

INTRODUCTION

The following list is intended to highlight some of the important items that will help to reduce liability exposure and problems that might occur during a project.

A. SCOPE OF SERVICES

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

B. CONTRACT

Projects should have a signed contract or letter agreement that includes the Scope of Services. Contracting directly with the Owner/developer is recommended where possible.

C. PROFESSIONAL FEE

Projects should have an adequate fee commensurate with the level of services and skill required and the responsibility assumed.

D. PROJECT SCHEDULE

Establish and follow appropriate agreed upon schedules for performing services during all phases of the project. Establish exchange of required and essential information and when this information needs to be provided.

E. EXTRA SERVICES

Extra Services should not be started without written authorization.

F. QUALITY CONTROL

Quality Control procedures should be in place to assure a check of design and drawings occurs for all projects. It is recommended that 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.

G. PROJECT PEER REVIEW

Specific Project Peer Review is recognized as an important part of project Quality Assurance and should be encouraged where possible.

H. DESIGN ASSUMPTIONS AND LIMITATIONS

The Client should be advised on important assumptions made during the design and/or 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 AND FAST-TRACK CONSTRUCTION

Phased or Fast-Track Construction projects will often increase liability exposure and design costs. They require more careful planning and liaison with all members of the project 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. UNUSUAL CONSTRUCTION REQUIREMENTS

Note unusual construction requirements on drawings and/or specifications (e.g., order of construction, shoring that needs special attention from the contractor). It is the contractor's responsibility for observance of these requirements.

K. PROJECT COMMUNICATIONS

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

L. PROJECT MEETING RECORDS

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. 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.

M. REPRODUCTION OF DRAWINGS

Final structural drawings and/or electronic drawing files should not be reproduced as shop drawings.

N. ELECTRONIC MEDIA

Electronic media should not be released for use without an appropriate electronic file license defining the use of the electronic media.

O. SHOP DRAWINGS

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

P. SHOP DRAWING REVIEW

Review of shop drawings and other submittals should be done under the supervision of the Structural Engineer of Record. Review and return of submittals should be timely or consistent with previously agreed upon schedules and the quantity of shop drawings submitted in that review period. Date of receipt and return should be recorded by the engineer.

O. INTERPRETATION OF CONTRACT DOCUMENTS

Questions concerning interpretation of the Contract Documents should be answered by a project engineer familiar with the design. A senior engineer should approve any requests for deviations or changes.

R. ARCHIVING DOCUMENTS

Establish an office policy for consistent archiving of documents.

S. EXISTING BUILDINGS

Projects involving an existing building will often increase liability risks of the Structural Engineer. Care should be taken in use of existing Contract Documents (e.g., drawings, surveys, reports). Appropriate field investigation should be completed where appropriate. The Owner should be made aware of additional risks due to unforeseen conditions and from deviations in as-built conditions.

APPENDIX A – SUBMITTALS

SUBMITTAL ITEMS TO REVIEW

The following is a representative checklist 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. Where calculations are required for Performance Specified Elements, they shall be stamped and signed by the Specialty Structural Engineer of Record.

SECTION 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, etc.).
- 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.
- Field bending requirements.
- 8. Column ties and beam stirrups: shape, positioning, dimensions.
- 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.

C. CONCRETE FORMWORK LAYOUT

General concrete outlines, including such items as location of pans for rib slabs, or openings, which affect the structure. Support of formwork and detailed form dimensions are not the responsibility of the Structural Engineer and are not typically reviewed.

D. EMBEDDED ITEMS

- 1. Anchor bolt size, length, embedment depth, grade, location, and spacing.
- 2. Plate dimensions, location, anchorage, configuration and orientation.
- 3. Anchor type: deformed bar and headed anchor 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, panel to panel connections, concrete strengths and reinforcement (refer to Section 1.B).
- 2. Formwork layout (refer to Section 1.C).
- 3. Embedded items (refer to Section 1.D).
- 4. Panel erection plan and sequence.
- 5. Structural connections (e.g., panel to foundation, panel to superstructure).

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 1.B), prestressing tendon type, size and position.
- 2. Erection plan and sequence.
- Member type, overall dimensions and location. Individual piece drawings will be submitted to the Structural Engineer of Record only when specifically requested.
- Embedded items (refer to Section 1.D).
- 5. Connection locations and capacities.
- 6. Welding procedures and requirements.
- 7. Corbels and haunches: reinforcing, dimensions, location.
- 8. Special Items: topping thickness and corrosion protection.

G. POST-TENSIONED CONCRETE

- Engineering calculations (when design is by others): stressing forces, short-term and long-term losses, elongation, anchorage zone stresses.
- 2. Reinforcing bars (refer to Section 1.B).
- 3. Ducts and tendons: size, type and strength, stressing procedures and sequencing, profile and spacing (e.g., bonded and non-bonded requirements), anchorages.
- 4. Concrete strengths required at time of stressing (refer to Section 1.A).
- 5. Embedded items (refer to Section 1.D).
- Formwork layout (refer to Section 1.C).
- 7. Special items: pour strip location and size, dowel sleeve size, locations and spacing, grouting scheme, corrosion protection.

SECTION 2 - SUBMITTALS RELATED TO STRUCTURAL STEEL

A. STEEL FRAMES AND STRUCTURAL COMPONENTS

- 1. Members.
 - a. Rolled shapes, built-up shapes, trusses.
 - b. Size, material grade, overall dimensions and elevations, configuration, camber, location.
 - c. Stiffeners, penetrations, reinforcements, shear studs.
 - Secondary members: edge, clip, lintel, wind gusts and bracing members.
- 2. Connections and General Fabrications.
 - a. Engineering calculations (when design is by others).
 - b. Bolted: type, grade, size, installation requirements and testing.
 - c. Welded: shop or field, electrodes, size, length, spacing, location, preparation, backer bars, testing procedure.
 - d. Special Joints: slide rocking bearings and turnbuckles.
 - e. Surface preparations: bare steel, shop primer and galvanization.
- 3. Embedded Items (refer to Section 1.D).
- 4. Special requirements for Architecturally Exposed Structural Steel (AESS).
- B. OPEN WEB STEEL JOISTS AND GIRDERS (Including all Performance Specified Structural 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 and bottom chord compression bracing.
- 8. Finishes: bare steel, shop primed and galvanized.

C. STEEL DECKING

- 1. Material grade, configuration, gauge, depth, minimum section properties.
- 2. Piece lengths, lap lengths, layout.
- 3. Finishes such as painted or galvanized.
- 4. Connections.
- 5. Accessories: closures, sump pans, edge supports.
- 6. Temporary shoring requirements.

D. COLD-FORMED STEEL

- Material grade, type, configuration, gauge, size spacing, allowable stress, finish, minimum section properties.
- Bracing and bridging.
- Connections.
- Accessories.
- 5. Engineering calculations (when design is by others): loads, load capacity, layout, deflection.

E. PERFORMANCE SPECIFIED COLD-FORMED STEEL TRUSSES

- Type, size, configuration, spacing, spans, locations and material grade.
- 2. Bridging, blocking and stiffener requirements, anchorage of bridging.
- Top and bottom chord extensions.

- 4. End bearing conditions and connections.
- 5. Splice designs and details.
- 6. Accessories, such as hangers and clip angles.
- 7. Connections.
- 8. Engineering calculations (when design is by others):
 - Magnitude and location of distributed and concentrated live and dead loads.
 - b. Special loads such as axial loads on chords, diaphragm boundary conditions, moments induced by frame action, uplift loading.
 - c. Deflection and roof ponding.
 - d. Bottom chord compression bracing.
 - e. Connections such as bolts, screws, welds, pins, cold-formed framing connectors.
 - f. Calculations for capacity, assemblies and connections.

SECTION 3 - SUBMITTALS RELATED TO STRUCTURAL LUMBER

A. PERFORMANCE SPECIFIED TRUSSES, JOISTS AND PANELS

- 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.
- End bearing conditions, seat depths and connections.
- 6. Splice designs and details.
- Accessories such as hangers, clip angles and holdowns.
- 8. Engineering calculations (when design is by others):
 - Magnitude and location of distributed and concentrated live and dead loads, load duration factor.
 - Special loads such as axial loads on chords, diaphragm boundary conditions, moments induced by frame action, uplift loading and shear wall loading.
 - c. Deflection and roof ponding.
 - Bottom chord compression bracing.
 - e. Connections such as nails, glue, bolts, screws, toothed plates, pins, cold-formed framing connectors.

B. GLUED LAMINATED TIMBER

Members.

- a. Type, shape, size, location, length, radius, camber, size and number of laminations.
- b. Design values, combination symbol and species.
- c. Adhesive (wet or dry use), preservative treatment.
- Appearance grade, end sealer and protection.

2. Connections.

- a. Fasteners, shear plates, split rings, bolts and lag bolts.
- b. Connection hardware: standard and special hangers, plates and bases.

SECTION 4 - SUBMITTALS RELATED TO STRUCTURAL MASONRY

A. MASONRY UNIT

Type, compressive strength, size, location, unit weight, shrinkage and absorption.

B. MORTAR

Type, proportions and compressive strength.

C. GROUT

Refer to Sections 4.B or 1.A.

D. REINFORCEMENT

- 1. Reinforcing bars (refer to Section 1.B).
- 2. Horizontal joint reinforcing: size, location, spacing and configuration.

E. EMBEDDED ITEMS

- 1. Anchor bolt size, length, embedment depth, grade, location, and spacing.
- 2. Plate dimensions, location, anchorage, configuration and orientation.
- 3. Anchor type: deformed bar and headed anchor stud.

SECTION 5 - SUBMITTALS RELATED TO ALL MATERIALS

A. QUALITY ASSURANCE AND/OR CERTIFICATIONS REQUIRED

- Fabricated Elements: certification 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.
- Performance Specified Elements: signature and professional seal of Specialty Engineer of Record responsible for the element, plant certification where appropriate.

B. SUBSTITUTIONS

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

C. OTHER MATERIALS OR SYSTEMS

Review for general compliance with the project requirements.

APPENDIX B - SITE OBSERVATIONS

SITE OBSERVATIONS DURING CONSTRUCTION

The following is a checklist of items that should be reviewed and/or verified for acceptability by a designated representative of the Structural Engineer of Record while conducting periodic site visits during construction. It is presented for general information. It is not necessarily a complete checklist and for some projects it may be inappropriate or too comprehensive. Thus, it should be tailored for each specific project. The engineer should observe a representative sample of the items from the following checklist while at the site. These observations are not intended as a substitute for the Special Inspections that may be required.

SECTION 1 - 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, vibrating, finishing, curing, protecting and form removal procedures.

B. CONCRETE REINFORCING STEEL

- 1. Bar size, grade, configuration, coatings and surface condition.
- 2. Bar location.
- 3. Bar spacing or total number of bars.
- Bar splice lap length and proper location.
- Support accessories for proper bar location and clearances.
- 6. Welding 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 and re-entrant corners.

- 10. Welded wire fabric type, orientation, positioning and splicing.
- Reinforcing steel accessories such as mechanical splices, inserts and embedded items.

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 that affect the structure, recesses, construction joints, void space requirements and debris removal. Support of formwork and detailed form dimensions are not the responsibility of the Structural Engineer and are not typically reviewed.

D. EMBEDDED ITEMS

- 1. Size, configuration and location of anchor bolts, plates, inserts, anchors.
- Nonstructural items that affect the structure such as electrical conduit, plumbing, openings, blockouts and sleeves.

E. SITE CAST TILT-UP CONCRETE

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

F. PRECAST AND PRECAST/PRESTRESSED CONCRETE

- 1. Member type and location.
- Connections.
- 3. Welding and weld testing procedures.
- 4. Bearing conditions such as condition of bearing surface, bearing length, bearing pads, expansion joints and grouting or dry packing.

G. POST-TENSIONED CONCRETE

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

- Ducts and tendons: size and type, stressing procedures and sequencing, profile and spacing, 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 and anchorage reinforcement.

H. GENERAL

Evidence of damaged or defective concrete construction such as excessive cracks, inadequate reinforcing cover or inadequate consolidation of concrete.

SECTION 2 - ITEMS RELATED TO STRUCTURAL STEEL

A. STEEL FRAMES AND STRUCTURAL COMPONENTS

- 1. Members.
 - a. Nominal size, general arrangement and configuration, location and general condition.
 - b. Stiffeners, penetrations, reinforcements and shear studs.
 - c. Permanent structural bracing and bridging.
 - Installation of secondary members.
- 2. Connections and General Fabrications.
 - Correct and complete installation, general arrangement, condition, proper fit-up, field modifications, work acceptance and testing procedures.
 - b. Bolted: type, grade, size and installation.
 - c. Welded: size, length, spacing and location.
 - d. Special joints: slide or rocking bearing and turnbuckles.
- Bearing conditions such as condition of bearing surface, bearing length, bearing pads, expansion joints, grouting or dry packing.
- 4. Field modifications to members and connections.
- B. OPEN WEB STEEL JOISTS AND GIRDERS (Including All Performance Specified Structural Steel Trusses)
 - 1. Nominal size, general arrangement and configuration, condition, spacing, location and field modifications.
 - Bridging, including anchorage for bridging.
 - Joist headers.
 - Top and bottom chord extensions.
 - End bearing conditions and connections.
 - Splices.

C. STEEL DECKING

- 1. General arrangement and configuration, condition, nominal depth, location, field modifications and substitution.
- 2. Lap lengths and layout.
- Finishes such as painted or galvanized.
- 4. Connections: type, size, spacing, location; e.g., welds, screws, button-punches, shear studs, special diaphragm requirements.
- 5. Edge supports and opening framing.
- 6. Accessories such as closures, sump pans and edge supports.
- Removal of temporary shoring as specified by the Structural Engineer of Record.

D. COLD-FORMED STEEL

- 1. General arrangement and configuration, condition, location, nominal size, spacing, finish, field modifications and substitutions.
- 2. Bracing and bridging.
- Connections, especially weld burn-through.
- Accessories.

E. PERFORMANCE SPECIFIED COLD-FORMED STEEL TRUSSES

- Sizes of chord and web members, general arrangement and configuration, condition, spacing, location and field modifications.
- Bracing, bridging, blocking, including anchorage of bridging and stiffeners.
- Top and bottom chord extensions.
- 4. End bearing conditions and connections.
- Splices.
- 6. Accessories, such as hangers and clip angles.
- Connections.

SECTION 3 - ITEMS RELATED TO STRUCTURAL LUMBER

A. PERFORMANCE SPECIFIED TRUSSES, JOISTS AND PANELS

- 1. Nominal member size, general arrangement and configuration, condition, spacing, location and field modifications.
- Bracing, bridging, blocking, including anchorage of bridging and stiffeners.
- Joist headers.
- 4. Top and bottom chord extensions.
- End bearing conditions and connections.
- 6. Splices.
- 7. Accessories such as hangers, clip angles and holdowns.
- Connections such as nails, glue, bolts, screws, toothed plates, pins and light gage framing connectors.
- 9. Installation and spacing of connections of sheathing to supports and blocking at vertical and horizontal lateral resisting elements.
- 10. Installation and spacing of anchor bolts and holdowns at base connections.

B. GLUED LAMINATED TIMBER

- 1. Nominal size, general arrangement and configuration, condition, spacing, location, identifying marks and field modifications.
- 2. Bridging and blocking.
- 3. Bearing conditions, holes and notches, splices.
- 4. Connections including nails, glue, bolts, screws, toothed plates, pins, light gage framing connectors, hangers, clip angles and plates.

C. ROUGH CARPENTRY (Framing, Decking, Sheathing)

- Nominal member size, general arrangement and configuration, condition, spacing, location, species and grade, panel identification and field modification.
- 2. Bridging and blocking.

- 3. Bearing conditions, holes, notches and splices.
- 4. Connections including nails, glue, bolts, screws, toothed plates, pins, light gage framing connectors, hangers and clip angles.
- Installation and spacing of connections of sheathing to supports and blocking at vertical and horizontal lateral resisting elements.
- 6. Installation and spacing of anchor bolts and holdowns at base connections.
- 7. Verification of use of treated lumber at specified locations.

SECTION 4 - ITEMS RELATED TO STRUCTURAL MASONRY

A. GENERAL

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

D. REINFORCEMENT

- 1. Reinforcing bars (refer to Section 1.B).
- 2. Horizontal joint reinforcing: size, location, spacing and configuration.

E. CONTROL AND EXPANSION JOINTS

Removal of unwanted mortar and debris in joints and clear spaces. Configuration of reinforcing and horizontal joint reinforcing.

F. LINTELS

Type, size, location and bearing.

G. EMBEDDED ITEMS

- 1. Anchor bolt size, length, embedment depth, grade, location, and spacing.
- 2. Plate dimensions, location, anchorage, configuration and orientation.
- 3. Anchor type: deformed bar and headed anchor stud.





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