



**GUIDELINES FOR
STRUCTURAL
ENGINEERING SERVICES FOR
BUILDING PROJECTS**



**ASSOCIATION OF
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
OF BRITISH COLUMBIA**



FEBRUARY 4, 1993

GUIDELINES FOR

STRUCTURAL

ENGINEERING SERVICES FOR

BUILDING PROJECTS

February 4, 1993

PUBLISHED BY:

**ASSOCIATION OF PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
OF BRITISH COLUMBIA**

200 - 4010 Regent Street, Burnaby, B.C. V5C 6N2

Telephone: (604) 430-8035
E-Mail: apeginfo@apeg.bc.ca

Toll Free (BC) 1-888-430-8035

Fax: (604) 430-8085
Internet: www.apeg.bc.ca

TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	PURPOSE OF GUIDELINES	1
1.2	SCOPE OF GUIDELINES	2
1.3	QUALIFICATION	2
2.0	DEFINITIONS	3
3.0	PROJECT ORGANIZATION AND RESPONSIBILITIES	6
3.1	COMMON FORMS OF PROJECT ORGANIZATION	6
3.2	RESPONSIBILITIES OF ORGANIZATION PARTICIPANTS	6
3.2.1	Owner	6
3.2.2	Coordinating Registered Professional (Prime Consultant)	7
3.2.3	Structural Engineer of Record	7
3.2.4	Specialty Structural Engineers	8
3.2.5	General Contractor	8
3.3	SELECTION OF CONSULTANTS	8
4.0	GUIDELINES FOR PROFESSIONAL PRACTICE	9
4.1	SCOPE OF SERVICES	9
4.2	BASIC STRUCTURAL ENGINEERING SERVICES	9
4.2.1	"Conceptual" or "Schematic" Design Stage	9
4.2.2	Design Development Stage	11
4.2.3	Contract Documents Stage	12
4.2.4	Tendering Stage	17
4.2.5	Construction Stage	18
4.3	ADDITIONAL STRUCTURAL ENGINEERING SERVICES	20
4.4	FABRICATION DRAWINGS AND DOCUMENTS	22
4.4.1	Structural Element Drawings	23
4.4.2	Erection Drawings	23
4.4.3	Shop Fabrication/Connection Design Drawings	23
4.4.4	Construction Engineering Drawings	23
5.0	APPENDIX - COMMON ORGANIZATIONAL CHARTS	24
6.0	BIBLIOGRAPHY	28

GUIDELINES FOR

STRUCTURAL

ENGINEERING SERVICES FOR
BUILDING PROJECTS

1.0 INTRODUCTION

1.1 PURPOSE OF GUIDELINES

The "Guidelines For Structural Engineering Services For Building Projects" have been prepared by a sub-committee of the *Association* of Professional Engineers and Geoscientists of the Province of British Columbia (the "*Association*") and have been adopted by the Council of the *Association*.

The Guidelines have been prepared to set out the standards of practice which *Members* should meet and follow in providing professional engineering services. The *Association* and its Council have a commitment to improve the quality of the services *Members* provide to *Clients* and the public, and have published these Guidelines for that purpose.

It is anticipated that variations in the application of these Guidelines may be required. A *Member* must always exercise professional judgement in providing services. It is not intended that the Guidelines be used as a legal document or to alter contracts between *Members* and *Clients*.

However, a variation that detracts from the overall purpose of the Guidelines should never be made. The Guidelines are intended to establish minimum standards of practice which *Members* must meet to fulfil the *Member's* professional obligations, especially in regard to the primary duty to protect the public. The Council of the *Association* intends that failure to meet these standards may give rise to disciplinary proceedings.

Finally, the *Association* supports the proposition that *Members* should receive fair and adequate compensation for services rendered and that this principle applies to the services provided to comply with these Guidelines. In no event will low fees be justification for services which do not meet the minimum standards set out by these Guidelines. *Members* may wish to discuss these Guidelines with their *Clients* when receiving instructions for assignments and reaching agreements regarding compensation.

1.2 SCOPE OF GUIDELINES

These Guidelines apply to the practice of Structural Engineering for buildings governed by Part 4 of the British Columbia Building Code and the City of Vancouver Building By-law.

The Guidelines outline the professional services which should generally be provided by the *Structural Engineer of Record (SER)* in a building project. They specify tasks which should be performed by the *SER* to achieve designs which are in the best interest of the Client and the public and which are properly coordinated with the work of other design, fabrication and construction team participants. These Guidelines should assist in maintaining the integrity of the overall and detailed designs.

These Guidelines also take into account the commitments which municipalities may require from *Members* as set out in the Letters of Assurance.

1.3 QUALIFICATION

Notwithstanding the purpose and scope of the Guidelines in sections 1 through 4, the decision by the *SER* not to use one or more of these Guidelines does not mean that the *SER* is legally negligent or unprofessional in the performance of professional services as that judgment or decision will depend upon a detailed analysis of all the facts and circumstances to determine if another Structural Engineer in circumstances of a similar nature would have conducted himself/herself in a similar manner.

2.0 DEFINITIONS

Additional Services:

Services which the *SER* may provide in addition to the *Basic Services* as set out in section 4.3

Association:

The *Association* of Professional Engineers and Geoscientists of British Columbia.

As-Built Drawings:

Drawings which are prepared from measurements taken on site to depict accurately the actual sizes of elements of the construction. Structural *As-Built* Drawings should indicate variations from the structural construction documents which occurred during construction.

Authority Having Jurisdiction:

The governmental body (usually municipal) with authority to administer and enforce the British Columbia Building Code or the local building by-law.

Basic Services:

The Services provided by the *SER* as set out in section 4.2.

Client:

The party who engages the *SER* to provide professional structural engineering services.

Contract Documents:

All documents including the engineering and architectural drawings and specifications as defined in the construction contract(s) for the construction of the building.

Coordinating Registered Professional:

Often referred to as the "Prime Consultant", the *Coordinating Registered Professional* is the individual who or firm which is registered as a *Member* in good standing of the *Association* or the Architectural Institute of British Columbia, and who or which has the responsibility to coordinate the design and *Field Reviews* of the various design professionals (such as electrical, structural, mechanical, geotechnical, architectural) for the project.

Field Services:

The services provided by the *SER* as set out in paragraph 4.2.5.3 to ascertain if the structural construction work is generally in accordance with the structural Contract Documents.

General Contractor:

The contractor who has a contract with the *Owner* for the construction of all or a portion of the building.

Member:

A *Member* in good standing of the *Association*.

Non-Structural Elements:

Elements of a building that are not part of the *Primary Structural System* or of *Secondary Structural Elements*. Examples of *Non-Structural Elements* are: non-bearing partitions and suspended ceilings.

Owner:

The party who owns the building.

Primary Structural Element:

A beam, column or other structural element which when combined with others forms the *Primary Structural System*.

Primary Structural System:

The combination of elements which support the building's self weight and the applicable live load based on occupancy, use of the spaces and environmental loads such as wind, snow and seismic forces.

Record Drawings:

Drawings which represent the final drawings issued and which normally incorporate such items as addenda, change orders and significant modifications made during construction. Site measurements need not be incorporated onto these drawings unless significant differences from the specified dimensions occur. Variations from the *Contract Documents* may be noted, where appropriate, with remarks or comments.

Secondary Structural Elements:

Elements that are structurally significant for the function they serve but do not contribute to the overall strength or stability of the *Primary Structural System*. Examples of *Secondary Structural Elements* are: elevator support rails and beams, curtain wall systems, cladding, and seismic restraints for architectural, mechanical and electrical elements.

SER:

The *Structural Engineer of Record*.

Specialty Structural Elements:

Structural elements which are designed by the *Specialty Structural Engineer*. These elements, normally fabricated off-site, may require specialized fabrication equipment or a proprietary fabrication process not usually available at the job site (for example open web steel joists, wood trusses, combination wood and metal or plywood joists, precast concrete elements, and prefabricated wood or metal buildings).

Specialty Structural Engineer:

The *Member* who prepares the design and supervises the preparation of documents for any of the *Specialty Structural Elements*.

Specifications:

A written description of the materials, standards of quality and construction requirements for the items included in a building project.

Structural Engineer of Record:

The *Member* with general responsibility for the structural integrity of the *Primary Structural System* as provided by section 3.0 of the Guidelines.

Sub-Contractors:

Contractors who have a sub-contract with the *General Contractor* to provide labour, materials and equipment for the execution and quality control of portions of the work shown in the *Contract Documents*. The *Sub-Contractor's* work is generally performed under the direct supervision of the *General Contractor*.

Submittal(s):

Items required by the *Contract Documents* to be submitted by the *General Contractor*, such as requests for payment, progress reports, shop drawings, manufacturer's literature on equipment, concrete mix designs, aggregate gradation reports, schedules, etc.

Submittals are normally used by the *SER* to aid in determining if the work and work products conform with the intent of the *Contract Documents*.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

3.1 COMMON FORMS OF PROJECT ORGANIZATION

Project organizations vary according to the needs of the project and the parties. Some common organizational charts are included in the Appendix.

3.2 RESPONSIBILITIES OF ORGANIZATION PARTICIPANTS

3.2.1 Owner

3.2.1.1 In order that the design and construction of the project may be carried out in a manner that meets appropriate standards of public safety and the requirements of applicable building regulations, the *Owner* should:

- (a) retain or cause to be retained qualified design professionals including a *Coordinating Registered Professional (CRP)* and a *SER* with responsibility for the design of all aspects of the building;
- (b) cooperate with the *SER* to set out a written description of the scope of the *SER's* services as referred to in paragraph 3.2.3.5;
- (c) not proceed with the contemplated project without adequate financing;
- (d) cooperate with the *Coordinating Registered Professional* so that an adequate written description of the project is developed;
- (e) before the commencement of the *SER's* services, finalize or cause to be finalized a written agreement with the *SER* (directly with the *Owner* or with the *Coordinating Registered Professional* or with another appropriate party);
- (f) cooperate with the *Coordinating Registered Professional* and the *SER* to establish a realistic schedule for the provision of the *SER's* services;
- (g) authorize in writing any additional services that may be required beyond the scope of the *SER's* contract;
- (h) assure that all required approvals, licences and permits from the *Authorities Having Jurisdiction* are obtained;
- (i) recognize that, since no design team nor its design is perfect, some errors or omissions may occur and that accordingly a reasonable contingency should be included in the *Owner's* budget;

- (j) recognize that drawings, *Specifications* and other documents prepared by the *SER* are for the project and that such documents should not be used or copied for other projects without the agreement of the *SER* and without advice from a qualified design professional;
- (k) recognize that, because code interpretation of the *Authority Having Jurisdiction* may differ from the *SER*, some changes may occur.

3.2.1.2 If the *Owner* fails or refuses to carry out the obligations as set out in paragraph 3.2.1.1, the *SER* should:

- (a) consider giving written notice to the *Owner* advising the *Owner* of the *SER*'s recommendations;
- (b) consider whether the *SER* can continue with the project,

because in any event the *SER* must comply with the minimum requirements of these Guidelines.

3.2.2 Coordinating Registered Professional (Prime Consultant)

To enable the *SER* to perform his duties properly, the *Coordinating Registered Professional* (Prime Consultant) should:

3.2.2.1 Interpret and define the needs of the *Owner* and in doing so should define the *Owner*'s intended functions and needs. The *Coordinating Registered Professional* (Prime Consultant) should identify any special design criteria such as equipment and other loads, and span requirements and should advise the *SER* accordingly;

3.2.2.2 Outline the scope of assignment to each design professional for design, preparation of *Contract Documents*, review of work during construction and contract administration;

3.2.2.3 Inform the *SER*, preferably in writing, of fees submitted by all engineers invited to submit service proposals;

3.2.2.4 Provide timely information in sufficient detail as required to adequately perform the *SER* duties;

3.2.2.5 Coordinate and review the designs, drawings and other *Contract Documents* produced by all participants of the design team;

3.2.2.6 Coordinate communication of information between the *Owner* and the contractor and the design professionals including the *SER* so that the work proceeds in a manner that complies with applicable codes and regulations and meets the *Owner*'s needs.

3.2.3 Structural Engineer of Record

3.2.3.1 The *Structural Engineer of Record (SER)* is responsible for the structural integrity of the *Primary Structural System*.

3.2.3.2 The *SER* may rely on other *Members* to be responsible for elements of the *Primary Structural System* but the *SER* has the overall responsibility to see that all design is undertaken as is necessary to achieve a *Primary Structural System* that meets acceptable engineering standards. In this event the *SER* must require the other *Members* to sign and seal the documents for such elements.

3.2.3.3 Unless otherwise noted, the *SER* is not responsible for the design of any *Secondary Structural Elements* or *Non-Structural Elements*. However, the *SER* remains responsible for designing the *Primary Structural System* to accommodate these elements and for allowing for their effects on the *Primary Structural System*. For this purpose the *SER* is responsible to review these elements.

3.2.3.4 The *SER* signs the Assurance Of Professional Design And Commitment For Field Review regarding the structural design plans and supporting documents which he prepares. When required by the *Authorities Having Jurisdiction*, the *SER* coordinates the preparation and submission of the *Record Drawings* of the project.

3.2.3.5 The *SER* together with the Client is responsible for setting out a written description of the scope of the *SER's* services sufficient to enable and permit the *SER* to meet the design and field review requirements of these Guidelines and applicable building regulations.

3.2.4 Specialty Structural Engineers

3.2.4.1 The *SER* should define clearly the scope of work to be performed by the *Specialty Structural Engineer*. The *Specialty Structural Engineers* are responsible for the integrity of their design.

3.2.5 General Contractor

3.2.5.1 The *General Contractor* has a contract with the *Owner*. This contract usually provides that the *General Contractor* is responsible for the labour, materials and equipment for the work and that the *General Contractor* is responsible for the construction methods, techniques, sequences, procedures, safety precautions and programs associated with the construction work, all as set out in the *Contract Documents*.

3.2.5.2 The *General Contractor* is responsible for coordinating the work of the *Sub-Contractors* and for checking the *Sub-Contractor's* work prior to field review by the *SER*.

3.2.5.3 The *General Contractor* is responsible for providing reasonable notice to the *SER* when components are ready for field review.

3.3 SELECTION OF CONSULTANTS

The recommended procedures for selecting a consultant are as described in the "Outline of Services and Schedule of Fees to Sub-Consultants" booklet published by the

Association of Professional Engineers and Geoscientists of B.C. and the Consulting Engineers of B.C.

4.0 GUIDELINES FOR PROFESSIONAL PRACTICE

The following are outlines of the Services which an *SER* should consider providing as part of good practice. They may assist an *SER* in explaining his services to a *Client*. These outlines are not intended to be exhaustive, and should not be interpreted to detract in any way from the previous provisions of these Guidelines.

4.1 SCOPE OF SERVICES

Before commencement of design Services, the *SER* shall meet with the Client, (who generally is the *Owner* or the *Coordinating Registered Professional*, but who may be others such as the contractor in a design-build contract) to:

4.1.1 Determine the terms of reference and the scope of work for *Basic Services* and *Additional Services*;

4.1.2 Reach agreement on fees, payment schedule and professional liability insurance coverage;

4.1.3 Reach agreement on a contract. (Documents No. 31, 32 or 32-S prepared by the Association of Consulting Engineers of Canada are recommended as a basis for this contract);

4.1.4 For a "fast-track" project, in addition to the above, the *SER* should:

- (a) Establish with the *Client* the terms and conditions under which preliminary or partially complete *Contract Documents* may be issued in advance and clearly define the requirements for partially complete *Contract Documents*;
- (b) Advise the *Client* that no part of the structural documents can be considered complete before all *Contract Documents* including architectural, mechanical and electrical drawings are completed.

4.2 BASIC STRUCTURAL ENGINEERING SERVICES

The usual stages of the *Basic Services*, as discussed below, are generally organized in an agreement according to the sequential stages of a typical project. Although each stage of the *Basic Services* generally contains those items which pertain most typically to the progress of work for that construction stage, it is normal practice, because of the requirements of a specific project, for certain *Basic Services* activities to be performed out of the normal sequence or in different stages than indicated in the scope of Services.

4.2.1 "Conceptual" or "Schematic" Design Stage

In the Conceptual or Schematic Stage, the *SER* may:

4.2.1.1 Attend, as required, periodic meetings with the *Client* and design team to obtain the *Client's* instructions regarding the *Client's* functional, aesthetic, cost and scheduling requirements, to prepare a preliminary design concept, and to report on the structural systems considering economy, performance, capital cost, compatibility with other design elements and requirements of relevant codes and authorities;

4.2.1.2 If required, assist the *Coordinating Registered Professional* (Prime Consultant) and *Owner* in:

- (a) Defining the need for any specialist consultants who may be required for the project with respect to the *Primary Structural System*, such as geotechnical, material testing, vibration analysis and wind tunnel testing;
- (b) Developing or reviewing the project schedule, including any milestone dates;
- (c) Determining channels of communication;
- (d) Defining the responsibility for showing overall and detail dimensions on the drawings;
- (e) Determining drawing standards and *Specifications* format;
- (f) Determining the number and timing of project team meetings during each stage of the project;

4.2.1.3 Establish dates by which information affecting the structural design will be needed from other disciplines, such as electrical and mechanical;

4.2.1.4 Conduct field reviews and review existing drawings where appropriate;

4.2.1.5 Establish criteria relating to the *Primary Structural System* for the geotechnical consultant and other consultants as required. Comment on reports presented;

4.2.1.6 Establish structural design criteria for the *Primary Structural System*;

4.2.1.7 Check applicable codes, regulations and restrictions, insurance requirements and other factors affecting the design of the project;

4.2.1.8 Establish, where appropriate, comparative information to be used in selection of a *Primary Structural System* for the project;

4.2.1.9 Develop the structural scheme for the *Primary Structural Systems*, together with alternate schemes where appropriate. Consider materials and systems suitable to the project requirements. Consider the requirements of the other design professionals and provide the information relating to the *Primary Structural System* they require;

4.2.1.10 Provide, if required, brief outline specifications for proposed materials;

4.2.1.11 Describe the *Primary Structural System(s)* detailing each significant component and material;

4.2.1.12 Explain in writing to the *Client* all new construction materials or new techniques the *SER* proposes for use in the project and the alternatives, including the risks, advantages and disadvantages over both the short and long term, so that the *Client* can weigh the choices and make an informed decision before the *SER* proceeds further;

4.2.1.13 If required, recommend to the *Client* a *Primary Structural System*. Review the effect of the selection on the structural construction budget for the project;

4.2.1.14 Prepare a summary report which defines the *Primary Structural System* selected for the project and outlines the reasons for the selection;

4.2.1.15 A *Client* may assume responsibility for all or some of the foregoing Conceptual or Schematic Design Stage activities provided:

- (a) the *SER's* ability to satisfy the requirements of the subsequent stages of these Guidelines is unimpaired;
- (b) the responsibility for such preliminary design activities is clearly defined in writing; and
- (c) the *Client*, in writing, waives the *SER's* responsibility for such preliminary design activities and their effect on the selection of the *Primary Structural System*.

4.2.2 Design Development Stage

In the Design Development Stage when the selected scheme is developed in sufficient detail to enable commencement of the final design and construction documents by all participants of the design team, the *SER* may:

4.2.2.1 Attend, if required, meetings with the *Client* and design team;

4.2.2.2 Identify desired standards of quality and the effect of such standards on serviceability requirements such as:

- (a) Deflection of slabs and beams and the effect of deflection on non-structural items such as curtain walls and glazing;
- (b) Control of potential vibration induced by footfall or machinery;
- (c) Lateral drift of the structure;

(d) Crack control in concrete and masonry elements;

- (e) Foundation settlement;
- (f) Soil-structure interaction;
- (g) Seismic deformations (permanent) and movements.

4.2.2.3 Review reports by specialist consultants, such as geotechnical, dynamics or wind tunnel;

4.2.2.4 Prepare preliminary structural analysis and design calculations for typical *Structural Elements* of the *Primary Structural System*;

4.2.2.5 Prepare preliminary foundation drawings based on recommendations by the geotechnical consultant;

4.2.2.6 Prepare preliminary framing design and drawings showing layouts of typical areas;

4.2.2.7 Prepare or edit the "outline *Specifications*" for structural items, as required;

4.2.2.8 Coordinate structural design with deflection and lateral movement criteria to meet the requirements of the other design team participants;

4.2.2.9 Submit design development documentation for review and approval by the *Client*.

4.2.3 Contract Documents Stage

4.2.3.1 General:

- (a) Design the *Primary Structural System*;
- (b) Determine and specify in the *contract documents* which *Structural Elements*, such as connection details and proprietary products, are to be designed by *Specialty Structural Engineers*. Specify the type of element, its position within the structure and the method of connecting to the *Primary Structural System*. Specify the loads and design criteria for use by the *Specialty Structural Engineer* in his design;
- (c) Review the effect of *Non-Structural Elements* attached to the *Primary Structural System* and design the structure to accept and support such items. Provide information regarding the supporting capability and physical attachment limitations of the *Primary Structural System*;
- (d) Attend periodic coordination meetings, as required;
- (e) Assist in coordination with the *Authority Having Jurisdiction*, as required;

- (f) Assist in establishing testing and inspection requirements;
- (g) Comply with fire resistance requirements as determined by the *Coordinating Registered Professional* or specialty consultants.

4.2.3.2 Structural Calculations

The *SER* must prepare structural calculations to support all structural designs. The structural calculations should be prepared legibly and presentably and filed by the *SER* for record purposes. Hard copy of input and output of any computer analysis should be included as well as description of the software used.

In general, structural calculations include but are not limited to:

- (a) Design criteria:
 - Discussion and description of design basis including assumptions;
 - Building codes used with edition dates;
 - List of live loads, snow loads, seismic factors and wind load criteria and any special loads and provisions greater than building code requirements as requested by the *Client* or otherwise used by the *SER*;
 - Structural material specifications for concrete, reinforcing steel, masonry, structural steel, wood and other materials used;
 - Geotechnical report information and design criteria;
 - Deflection limitations of structural elements and systems.
- (b) Location diagrams for structural elements;
- (c) Vertical load analysis and design of:
 - Roof structures;
 - Floor structures;
 - Frames or trusses;
 - Columns;
 - Walls;
 - Foundations.

- (d) Lateral load analysis and design for seismic and wind forces;
- (e) Computer analysis and design results, if applicable;
- (f) Special studies and analysis (dynamic, vibration, etc.), where used;
- (g) Independent check of the final structural design and documents to confirm the adequacy and appropriateness of the design. The independent check shall be performed by an engineer other than the original design engineer, but not necessarily from a separate company;
- (h) The names of the structural design engineer(s) and design check engineer;
- (i) Table of contents for or index to the structural calculations.

4.2.3.3 Structural Drawings

Structural drawings typically show the locations, sizes, reinforcing, and connections of the structural elements in sufficient scale and detail to enable the fabrication, installation, and connection of the members in a reasonable sequence by a competent contractor familiar with the techniques of construction for the specified materials.

Framing plans may refer to architectural drawings for dimensions where appropriate and mutually agreed to by the *SER* and the architect. Elevations, sections, and details should be of appropriate scale, number, and extent to portray the relationship of members to each other and their interconnection(s). Care should be taken to ascertain and determine that details noted "typical" are applicable to the condition being portrayed and that their location and extent are explicit;

The drawings should define the complete extent and detail of the work;

The drawings which should include but not necessarily be limited to the following may vary depending on the complexity of the job and the materials:

- (a) Structural Notes:
 - Design criteria indicating all superimposed vertical and horizontal loads used in the design including live, snow, earthquake, wind and dead loads (such as landscape, partition and equipment loads) not shown on the structural drawings. These loads should be designated as unfactored;
 - Reference to the geotechnical report on which the foundation design is based;
 - Brief material *specifications*;
 - Absolute or relative deflection criteria for structural members;

- Where forces are shown, the forces should be clearly identified as factored or unfactored;
 - Pertinent design standards;
 - Reference to drawings and *Specifications* prepared by other participants of the design team.
- (b) Typical Details;
- (c) Foundation Plans and Schedules:
- Allowable soil-bearing capacity, pile capacities and lateral earth pressures for retaining structures;
 - Sizes, locations, dimensions and details of all foundations;
 - Assumed bearing strata or elevation(s);
 - Estimated pile length(s) or source of this information;
 - Location of known existing Services and existing foundations which conflict with structural foundations or reference to the source where this information can be found;
 - If underpinning or temporary shoring is specified to be designed by others, indication on the drawings of the areas designated to be shored or underpinned. If shoring or underpinning is designed by the *SER*, indication of all details and construction sequences.
- (d) Floor and roof framing plans and details:
- General gridline dimensions and overall building dimensions;
 - Sizes, locations, dimensions and details of all structural elements;
 - Elevations, including slopes and depressions;
 - Lateral load resisting system;
 - Governing forces, moments, shears or torsion required for the preparation of shop and detail drawings;
 - Reinforcing bar sizes and details with fabrication and placing criteria;
 - Locations and details of control, construction, contraction and expansion joints;

- Locations, sizes and reinforcing of significant openings;
 - Provision for future extensions.
- (e) Schedules and Details for Columns, Beams and Walls:
- Element sizes;
 - Elevation of bottom of columns;
 - Reinforcing steel and splice details for concrete columns;
 - Splice locations for structural steel columns;
 - Structural details of masonry or reinforced concrete walls including lintels, details and reinforcing of significant openings;
 - Stiffeners, lateral bracing and local reinforcements for steel members.
- (f) Connections:
- Where connections are specified to be designed by *Specialty Structural Engineers*, indicate on the contract drawings all required information and governing forces. In such cases the *Specialty Structural Engineer* shall seal, sign and date the fabrication drawings. Where connections are designed by the *SER*, show all dimensions and comprehensive connection details requiring no further engineering input. Under these circumstances, the *SER* retains responsibility for these connections;
 - The *SER* shall consider the design of the connections when sizing the structural members, e.g., HSS truss joints, post-tensioned anchorages;
 - Show general arrangement and details at intersections of different structural materials.
- (g) Sequence of construction, if this is critical to the functioning of the finished structure;

4.2.3.4 *Specifications*

- (a) *Specifications* are prepared using a format suitable for inclusion with the overall *Contract Documents*;
- (b) The *Specifications* should include information on the following:
- standards, codes, by-laws governing work;

- *Submittals* required;
 - quality control requirements;
 - materials;
 - workmanship and fabrication;
 - tolerances;
 - information for temporary works and erection information, where necessary, to ensure the intent and integrity of the design;
 - construction inspection and testing;
 - notification by the contractor before significant segments of the work are begun;
 - warranties;
 - performance criteria for design by *Specialty Structural Engineers*.
- (c) Where appropriate, the *Specifications* may be abbreviated and become part of the drawings;
- (d) The *Specifications* generally set out that the SER's review of *Submittals* and inspection of work as well as any testing by independent agencies reporting to the *Client* are undertaken to inform the *Client* of the quality of the contractor's performance and that this review and testing are not for the benefit of the contractor. The contractor must provide his own independent quality control program.

4.2.4 Tendering Stage

- 4.2.4.1 Assist in the preparation of pre-qualification documents, if required;
- 4.2.4.2 Assist in the preparation of the contract, if required;
- 4.2.4.3 Assist in reviewing bidder's qualifications, if required;
- 4.2.4.4 Assist the *Client* in obtaining required approvals, licences and permits. Prepare Letters of Assurance and documents required by the *Authority Having Jurisdiction*;
- 4.2.4.5 Assist in analysis and evaluation of tenders submitted;
- 4.2.4.6 Provide structural addenda and clarification of structural documents, as required.

4.2.5 Construction Stage

It is essential that Services during construction be provided for all systems for which the *SER* is responsible.

It is preferable that the Services during construction be provided by the *SER*; however, where practical the *SER* may delegate these duties to others.

Services during construction by the *SER* should not be construed to relieve the contractor of the contractor's responsibility for building the project in accordance with the *Contract Documents*, controlling the progress, providing safe working conditions, and correcting any deviations from the project requirements.

Some items reviewed by the *SER* may also require review by other members of the design team or by testing and inspection agencies. Such work may include piles, anchors, precast concrete elements, structural steel, welding, proprietary products, and *Secondary Structural Elements* designed by others.

4.2.5.1 General Services During Construction

Field Services should include, but not necessarily be limited to, the following and may vary depending on the complexity of the job.

- (a) Attend construction meetings, if required;
- (b) Confirm communication channels and procedures;
- (c) Assist in confirming, reporting and scheduling procedures for testing and inspections;
- (d) Assist in confirming procedures for shop drawings and other *Submittals*;
- (e) Confirm that the qualifications of fabricators meet the *Specifications*;
- (f) Advise the contractor and the *Coordinating Registered Professional* on the interpretation of the structural drawings and *Specifications* and, if required, issue supplementary details and instructions during the construction period as required;
- (g) If requested, advise, the *Client* on the validity of charges for additions or deletions from the contract and on the issue of change orders;
- (h) Review and comment on, if requested by the Client, the contractor's applications for progress payments. Estimate, if required, completed work and materials on site for payment according to the terms of the construction contract;

- (i) Review reports from the testing and inspection agencies to determine if the agency has verified compliance of the reported item of work with structural *Contract Documents*;
- (j) Conduct substantial and total performance inspections of the structural components of the project noting deficiencies observed and inspect completed corrections;
- (k) Submit, if required, *Record Drawings* to the *Authority Having Jurisdiction*.

4.2.5.2 Review of *Submittals*

Submittals should be reviewed for general compliance with the structural *Contract Documents* but generally the review does not go so far as to include matters such as checking dimensions or quantities or the review of the contractor's safety measures or methods of construction.

- (a) Confirm that the *Submittals* have been reviewed by the *General Contractor* before review by the *SER*;
- (b) Review the shop drawings and other *Submittals* for conformance with the *Contract Documents* and the intent of the design;
- (c) When required by the *Contract Documents*, confirm that the shop drawings bear the signature and seal of the responsible *Specialty Structural Engineer*. The *Specialty Structural Engineer* whose seal and signature appear on the drawings is responsible for the design of the *Specialty Structural Elements* and connections indicated. To clarify responsibility, the *Specialty Structural Engineer* may qualify the extent of work which has been designed by the *Specialty Structural Engineer*. In the absence of a signature and professional seal by a *Specialty Structural Engineer*, the *SER* may have responsibility for the design of the elements and connections shown on the *Submittals*;
- (d) Review shop drawings and other *Submittals* of pre-engineered or proprietary structural elements for type, position, and connection to elements of the *Primary Structural System* and for criteria and loads used for the design.

4.2.5.3 Field Review

- (a) Visit the site at intervals appropriate to the stage of construction to observe the quality and the progress of the construction of those elements designed by the *SER*. At the discretion of the *SER*, proprietary products, connections and other structural elements which have been designed by *Specialty Structural Engineers* should be inspected by those other engineers at the appropriate stage of construction and reported in writing to the *SER*.

- (b) Prepare site visit reports outlining observations and deficiencies in the work and bring them to the attention of the contractor's site representative;
- (c) Distribute site visit reports to the contractor and the *Coordinating Registered Professional*. Where the *Owner* directly retains the services of the *SER*, it is recommended that the *Owner* also be sent copies of the reports;
- (d) Conduct a final project review and advise the *Client* of continuing or newly-observed defects or deficiencies in the project.

4.3 ADDITIONAL STRUCTURAL ENGINEERING SERVICES

In addition to the *Basic Services*, the *SER* may provide the following *Additional Services* if the *SER* and the *Client* reach appropriate mutual agreements. They are generally not considered intrinsic parts of the basic structural design services, as discussed in paragraph 4.2, and are not part of the minimum services which the *SER* should provide under these Guidelines.

The *Client* should retain the *SER* as an *Additional Service* to review items designed by others to confirm compatibility with the design of the *Primary Structural System*.

Examples of *Additional Services* are:

4.3.1 Design work resulting from changes the project as originally described and agreed to under the contract between the *SER* and *Client*, such as changes in scope, complexity, diversity or magnitude of the project;

4.3.2 Preparation of alternate structural designs and related documentation after selection of the *Primary Structural System* made during the conceptual and schematic design stages;

4.3.3 Review, design and preparation of documentation of alternate or substitute systems if requested by the *Coordinating Registered Professional* (Prime Consultant), the *Client* or the contractor for tendering to obtain competitive bids for items such as proprietary products;

4.3.4 Work connected with the preparation of documents for tendering segregated contracts, pre-tendered contracts, phased or fast-track construction;

4.3.5 Review of alternate designs or products after completion of the *Contract Documents*;

4.3.6 Work resulting from changes necessary because of construction cost over-run which is outside the control of the *SER*;

4.3.7 Translation of *contract documents* into a second language, conversion to other units, special preparation of drawings for reduction;

4.3.8 Work associated with *Non-Structural Elements* beyond those described under *Basic Services*, such as:

4.3.8.1 Curtain wall systems and store fronts;

4.3.8.2 Building facing systems;

4.3.8.3 Architectural pre-cast or pre-fabricated systems and cladding;

4.3.8.4 Window-washing systems and tie downs;

4.3.8.5 Antennae and flagpoles;

4.3.8.6 Elevators and escalators;

4.3.8.7 Mechanical, electrical and plumbing equipment, cooling towers and storage tanks;

4.3.8.8 Site-work elements exterior to and non-contiguous with the buildings such as retaining walls, culverts, bridges, etc., and support for landscape furnishing such as lighting poles, benches, fountains, pools, signs, etc.;

4.3.9 Review of design drawings or *Specifications* prepared by others to determine adequacy of anchorage of *Non-Structural Elements*;

4.3.10 Preparing or assisting with cost estimates. The *SER* shall inform the *Client* of the variables inherent in the estimate and the expected degree of variation from the estimate. Where the degree of variation is critical, the *Owner* should have the estimate independently verified;

4.3.11 Quantity take-offs and preparation of bills of materials;

4.3.12 Seismic risk analysis;

4.3.13 Special dynamic analysis beyond that required by the building codes such as spectrum or time-history response to seismic forces or floor-response to vibratory equipment;

4.3.14 Seismic restraints for mechanical or electrical equipment, architectural features and other *Non-Structural Elements*;

4.3.15 Special physical model analysis such as wind-tunnel tests or shaking table tests;

4.3.16 Field investigation of existing buildings and structures including surveys of existing construction;

- 4.3.17 Filing application for and obtaining permits;
- 4.3.18 Preparation of demolition documents;
- 4.3.19 Determination of structural fire-resistance requirements;
- 4.3.20 Tenant-related design Services;
- 4.3.21 Preparation of shop or fabrication drawings;
- 4.3.22 Preparation of reinforcing steel bending schedules or other types of shop drawings;
- 4.3.23 Continuous or detailed inspections of construction;
- 4.3.24 Design review or field observations of shoring or of bracing for excavations and building or of underpinning of adjacent structures;
- 4.3.25 Design or review of the contractor's methods, procedures and construction equipment with respect to the effect on the structure;
- 4.3.26 Design or review of the contractor's design of formwork, falsework or construction bracing;
- 4.3.27 Review of additional *Submittals* when occasioned by improper or incomplete *Submittals*;
- 4.3.28 Work resulting from corrections or revisions required because of errors or omissions in construction by the contractor;
- 4.3.29 Preparation of *Record Drawings* of the structures;
- 4.3.30 Work due to extended time schedules for design or construction;
- 4.3.31 Services as an expert witness in connection with any public hearing, arbitration, or court proceedings concerning the project, including attendant preparation for same;
- 4.3.32 Work resulting from damage as the result of fires, man-made disasters, or natural disasters;
- 4.3.33 Overtime work requiring premium pay when authorized;
- 4.3.34 Travelling time outside of normal requirements.

4.4 FABRICATION DRAWINGS AND DOCUMENTS

The fabricator or manufacturer shall produce all necessary drawings and documents to represent the work covered by his contract with the contractor. These drawings and documents are prepared following a review of the design drawings, *Specifications* and *Contract Documents* supplied by the *SER* and following the resolution of any errors or requested changes. Fabrication drawings and documents usually include:

4.4.1 Structural Element Drawings

The drawings for proprietary structural elements, such as open web steel joists, shall be sealed, signed and dated by the *Specialty Structural Engineer* who designed these items;

4.4.2 Erection Drawings

These drawings shall specifically show the location of structural members, connections and components to be supplied by the fabricator. When these drawings incorporate design by the *Specialty Structural Engineer*, the drawings shall be sealed, signed and dated by the *Specialty Structural Engineer*. To clarify responsibility, the *Specialty Structural Engineer* may qualify the extent of work which has been designed by him;

4.4.3 Shop Fabrication/Connection Design Drawings

These drawings produced by the fabricator shall provide all information necessary for shop personnel to fabricate and assemble the items. The drawings shall be sealed, signed and dated when incorporating design by the *Specialty Structural Engineer*,

4.4.4 Construction Engineering Drawings

These drawings or documents produced by the contractor shall cover temporary loadings, temporary bracing, falsework and erection sequence instructions. The drawings shall be sealed, signed and dated by a qualified *Member*.

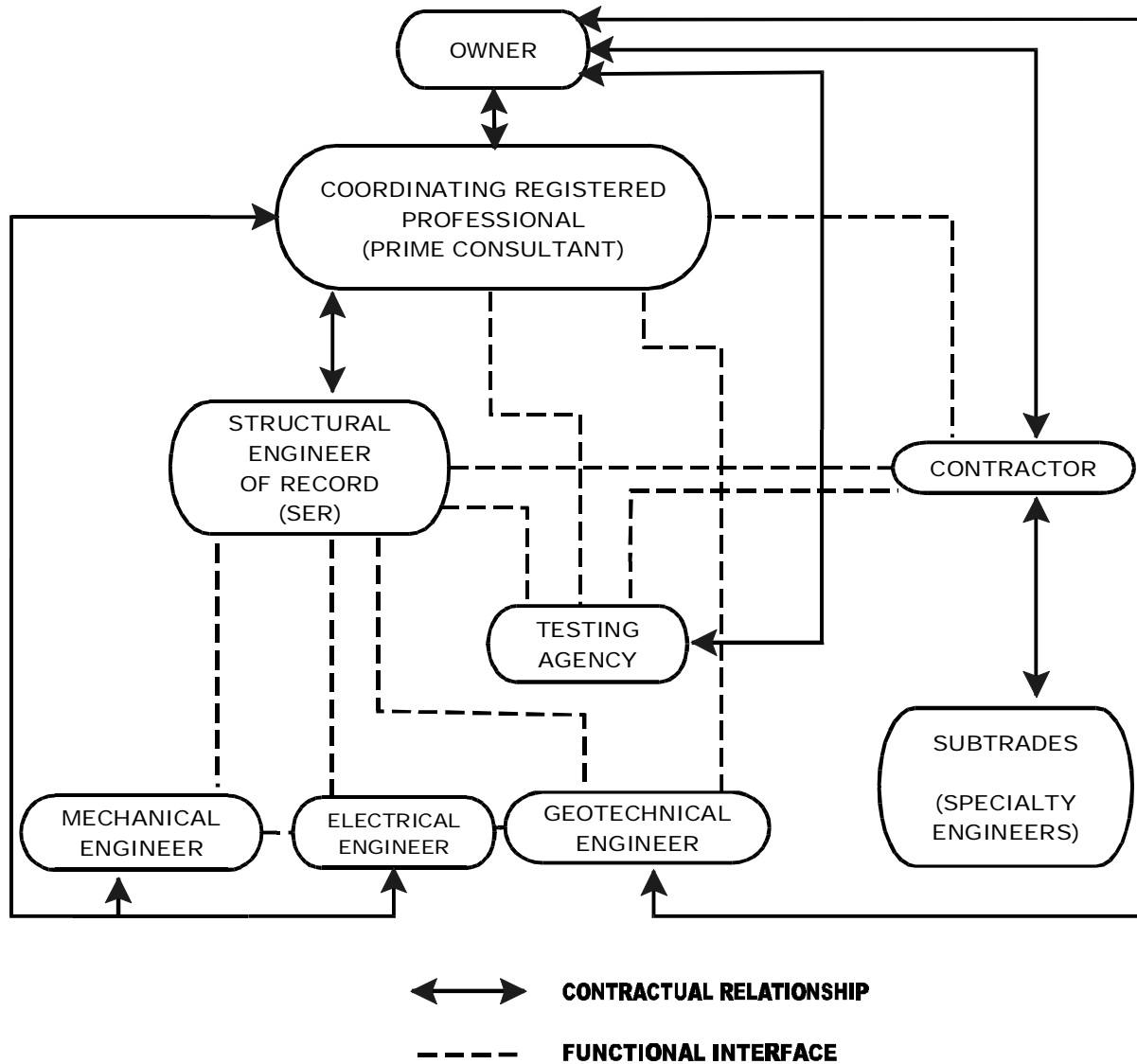
5.0

APPENDIX

COMMON ORGANIZATIONAL CHARTS

COMMON ORGANIZATIONAL CHARTS

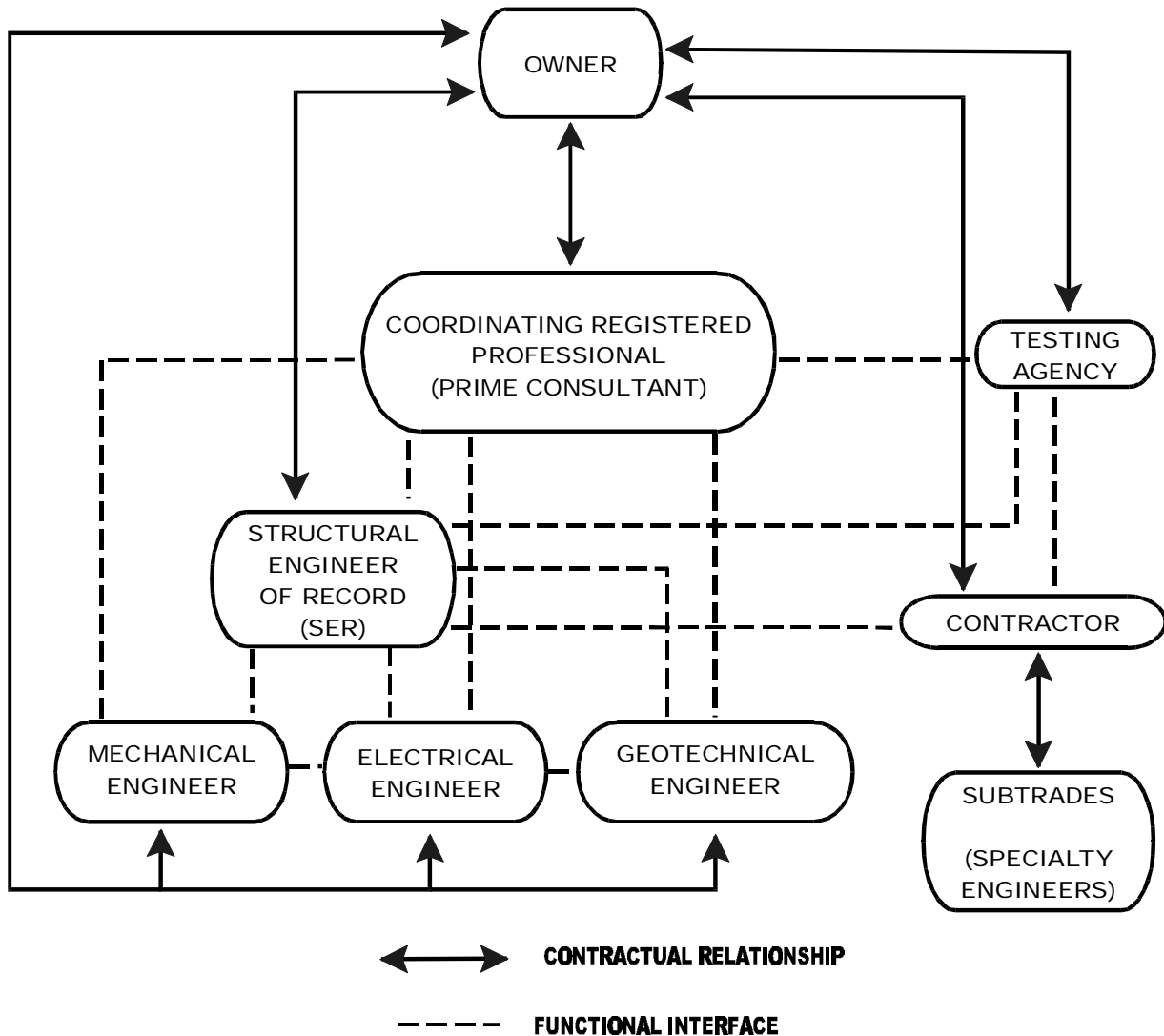
1. STRUCTURAL ENGINEER OF RECORD (SER)/ PRIME CONSULTANT CONTRACT



NOTE: The *Specialty Engineer* may be hired by the *Owner*, the *Structural Engineer of Record* or by contractors

COMMON ORGANIZATIONAL CHARTS

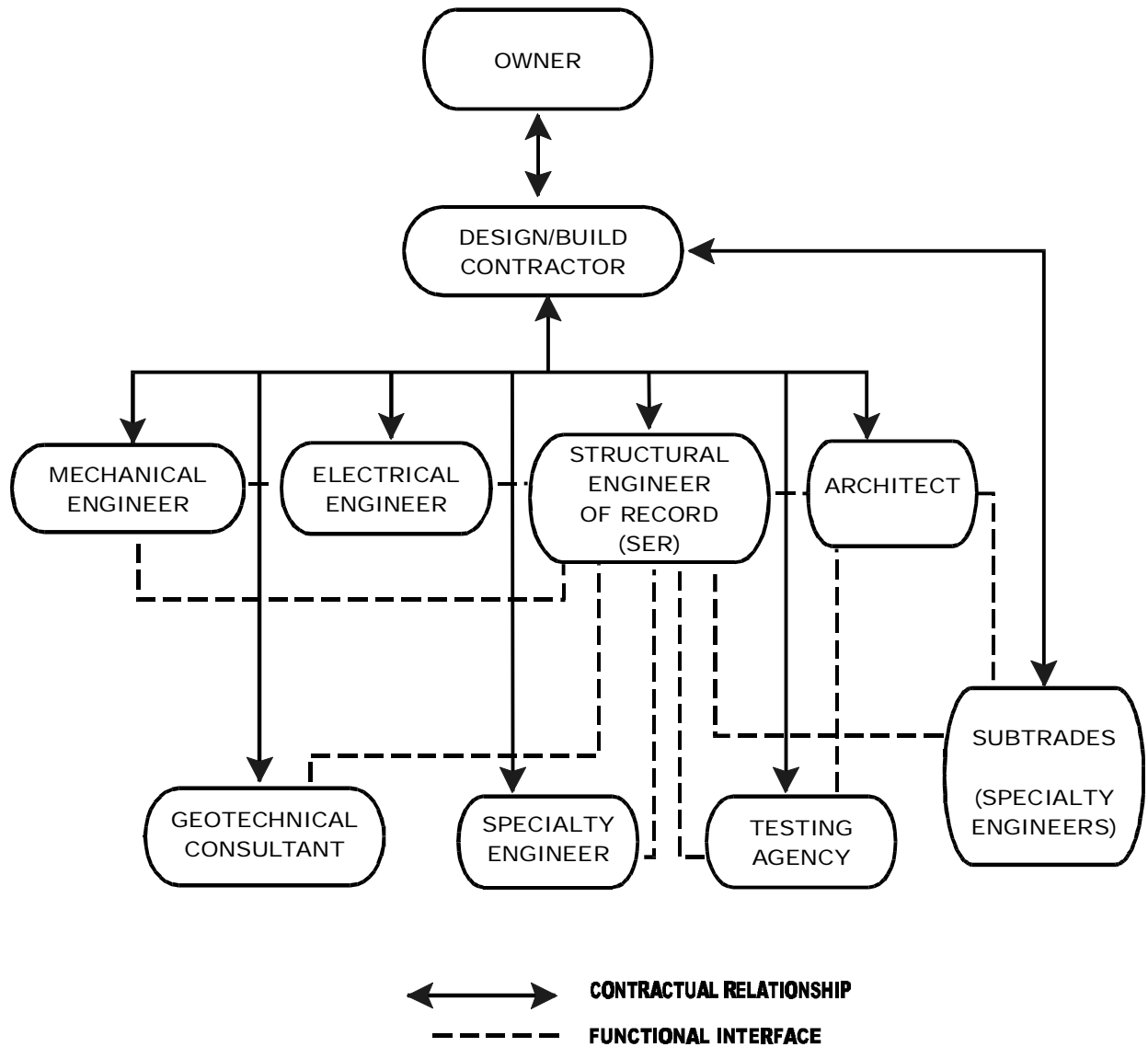
2. STRUCTURAL ENGINEER OF RECORD (SER)/ OWNER CONTRACT



- NOTE: 1. The *Specialty Engineer* may be hired by the *Owner*, the *Structural Engineer of Record* or by the *contractors*
2. The *Coordinating Registered Professional* shall be responsible for coordination of the *subconsultants* even though they are hired by the *Owner*.

COMMON ORGANIZATIONAL CHARTS

3. DESIGN/BUILD CONTRACT



NOTE: The *Specialty Engineer* may be hired by the *owner*, the *Structural Engineer of Record* or by contractors

6.0

BIBLIOGRAPHY

"National Practice Guidelines for the Structural Engineer of Record" reported by CASE National Guidelines Committee, October 1988.

"Guideline for Professional Engineers Providing Structural Engineering Work in Buildings", Association of Professional Engineers of Ontario.

"Suggested Guidelines for Outlining the Scope of Consulting Structural Engineering Services", Structural Engineers Association of Northern California, May 1988.

"Document No. 31-S", Association of Consulting Engineers of Canada.

"Outline of Services and Schedule of Fees for General Engineering Practice", Association of Professional Engineers and Geoscientists of British Columbia and Consulting Engineer of British Columbia.

"The Guide for Consulting Structural Engineering Services" by CEAC (Consulting Engineering Association of California) and SEAOC (Structural Engineering Association of California) (1979).

"Standards of Practice - Structural Engineering" by CEAC-SEAOC Joint Committee (draft, 1986).



**ASSOCIATION OF
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
OF BRITISH COLUMBIA**

