Registration

● **Policy** ❍ **Procedure**

Guideline for Satisfactory Experience in the Forest Engineering Discipline: Required Competencies for Application of Theory

Approved by Council June 13, 2008

To be used in evaluation of applications for Professional Engineer received on or after September 1, 2008

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PREAMBLE

Registration as a professional engineer in British Columbia is granted in a specific discipline requested by the applicant when supported by:

- the academic training of the candidate,
- achievement of the four years of satisfactory engineering experience,
- receipt of acceptable references; and
- successful completion of a Professional Practice Seminar and Examination.

Where forest engineering applicants have not graduated from a program accredited by the Canadian Engineering Accreditation Board or from a program that is recognized through a mutual recognition agreement, the Engineers Canada Examination Syllabus in Forest Engineering is used to evaluate academic qualifications. The syllabus is meant to reflect the topics that make up a broad-based engineering education in Forest Engineering and is only used as a reference to evaluate the undergraduate education of applicants to assess the relevance and level of the courses taken.

The APEGBC Appendix A - Satisfactory Engineering Experience defines six key *elements of experience* that must be fulfilled to qualify for registration. They are:

1. Application of Theory
2. Practical Experience
3. Management of Engineering
4. Communication Skills
5. Social Implications of Engineering; and
6. Sustainability

The purpose of this document is to elucidate the expectations to applicants in the Forest Engineering discipline when describing or evaluating competencies achieved under *Application of Theory*. The remaining *elements of experience,* e.g. (2) Practical Experience, (3) Management of Engineering, (4) Communication Skills, (5) Social Implications of Engineering, and (6) Sustainability, are as set out in Appendix A - Satisfactory Engineering Experience.

Professional engineer referees are preferred as references; however professional geoscientists with expertise in the area of practice, who have detailed knowledge of the candidate's work may act as referees for the candidate.

DEFINITION OF FOREST ENGINEERING

Forest Engineering identifies and presents solutions to issues resulting from the development of forest resources. It includes planning, designing, evaluating, implementing and management of the practice of professional engineering and the engineering aspects of forest operations with a mandate to protect the public, worker safety, the environment, and promote sustainable forest management.

A Forest Engineer is a professional engineer who applies engineering principles (science, technology, engineering methods and planning) to facilitate development in the forest environment in the following *areas of practice*:

- **A.** access planning and resource roads
- **B.** forest road bridges, culverts and other engineered structures
- **C.** harvesting systems
- **D.** transportation systems
- **E.** machine and woodflow process
- **F.** wood product development

ELEMENTS OF EXPERIENCE

Applicants for registration are expected to demonstrate a *Working Knowledge* in all elements of experience for three of the six areas of practice A through F above.

Working Knowledge is defined as **achievement of all competencies in the area of practice**;

If an applicant has difficulty obtaining a Working Knowledge in three areas of practice, their experience in other areas of practice in Forest Engineering will be evaluated on a case-by-case basis.

Applicants are also expected to demonstrate an awareness of their limitations in all six *areas of practice*.

FOREST ENGINEERING APPLICATION OF THEORY EXPERIENCE: COMPETENCIES BY AREA OF PRACTICE

A. Access Planning and Resource Roads

Access planning and resource road design encompasses the full road design process: from conceptual planning, route selection, surveying and geometric analysis, to consideration and management of construction and operational issues, and road decommissioning. Competencies demonstrating **Application of Theory** include, but are not limited to:

- data sourcing / literature review / compiling of information
- knowledge and application of forest resource development planning including the relationship and implications of route location and geometric road design process, including: reconnaissance, grade lines, p-line and l-line location, detailed road design, mass haul diagram, specifications development, and construction planning
- link and limitations between field data and computer-based design processes
- aerial photo interpretation and photogrammetry
- application of design software demonstrated knowledge of the underlying equations / models and limitations for any software programs used
- knowledge of the roles and interaction / collaboration with other professional engineers, geoscientists, foresters, biologists or other technical specialists, and incorporation of their input into site plans or specifications, e.g. hydrological analysis, terrain stability assessments
- use of terrain management systems / models
- determination of survey levels based on terrain, site and risks
- subsurface investigation
- forest road construction controls and surveys
- knowledge, limitations and application of construction techniques, materials and specifications
- use of terrain management systems / models
- development of drainage management plans
- development of erosion / sediment management plans
- application of applicable codes, guidelines, and best management practices
- resource road safety

FOREST ENGINEERING APPLICATION OF THEORY EXPERIENCE: COMPETENCIES BY AREA OF PRACTICE cont'd

B. Forest Bridges, Culverts And Other Engineered Structures

The design of bridges, culverts and other engineered structures typically encountered in the forestry setting encompasses the full design process: from conceptual planning, structural systems selection, surveying and analysis, to consideration of construction and operational (maintenance / inspection) issues, and rehabilitation or decommissioning. Competencies demonstrating **Application of Theory** include, but are not limited to:

- data sourcing / literature review / compiling of information
- aerial photo interpretation, field assessments, surveys and preparation of site plans
- demonstrated understanding of various bridge structure types and components available for use in the forest industry and their application and limitations
- demonstrated knowledge and application of engineering principles and their linkages for conceptual and general arrangement bridge and engineered culvert designs, including consideration of design flow, foundation support, approach alignment and grade, load determination and distribution, debris management, , construction specifications, maintenance considerations, user safety and protection of the environment, etc.
- link and limitations between field data and the design processes.
- knowledge, limitations and application of subsurface investigation and soil / material testing specification
- knowledge, limitations and application of sediment and erosion control plans;
- procedures for assessing and reusing portable bridges
- assessment and development of load ratings for log structures; demonstrated knowledge and application of appropriate design approaches for log structures used in the forestry setting
- knowledge of the roles and interaction / collaboration with other professional engineers, geoscientists, foresters, biologists and other technical specialists, and incorporation of their input into site plans or specifications
- application of applicable codes, guidelines, and best management practices

FOREST ENGINEERING APPLICATION OF THEORY EXPERIENCE: COMPETENCIES BY AREA OF PRACTICE cont'd

C. Harvesting Systems Planning and Design

Harvesting Systems Planning and Design encompasses the planning, design and implementation of harvesting systems with consideration to cost, productivity, safety and environmental management issues. Competencies demonstrating **Application of Theory** include, but are not limited to:

- data sourcing / literature review / compiling of information
- link and limitations between field data and design processes.
- application of design software, including demonstrated knowledge of the underlying equations / models for any software programs used
- knowledge and application of total chance planning concepts
- knowledge of the roles and interaction / collaboration with other professional engineers, geoscientists, foresters, biologists and other technical specialists, and incorporation of their input into site plans or specifications, e.g. avalanche assessments, terrain stability assessments
- static analysis of cable systems and yarder mechanics
- cutting unit design and layout
- specification of equipment and systems
- optimization of skid distance and road spacing for ground-based operations demonstrated knowledge of silvicultural systems for engineering and harvesting operations
- follow up on cut-block layout and design; evaluate falling boundary choices, yarding "chance"
- coordination amongst all forest development phases
- use of terrain management systems or models
- ecological and societal conditions
- environmental impacts of harvesting operations; effects on soil physical properties
- application of applicable codes, guidelines and best management practices.

FOREST ENGINEERING APPLICATION OF THEORY EXPERIENCE: COMPETENCIES BY AREA OF PRACTICE cont'd

D. Transportation System Design

Transportation System Design encompasses the planning, design and implementation of systems to transport forest products. Competencies demonstrating **Application of Theory** include, but are not limited to:

- data sourcing / literature review / compiling of information
- link between field data and design processes.
- application of design software, including demonstrated knowledge of the underlying equations / models for any software programs used
- knowledge of the roles and interaction / collaboration with other professional engineers, geoscientists or other technical specialists, and incorporation of their input into site plans or specifications
- planning, scheduling and specification
- logistics: analysis and system development to get the "right log to the right mill"
- sort yard design
- design and construction of skid-ways, booming grounds, log dump and boom design, rock embankments
- application of queuing theory; operations research
- knowledge and application of trucking technology; e.g. tire pressure control systems to improve performance, reduce road surface sedimentation, extend the haul season, etc.
- specification and application of truck configurations; vehicle dynamics
- road-vehicle interaction; e.g. modeling the impacts of vehicles on roadbed structures
- development of maintenance programs and implementation of inspection results
- application of applicable codes and guidelines

FOREST ENGINEERING APPLICATION OF THEORY EXPERIENCE: COMPETENCIES BY AREA OF PRACTICE cont'd

E. Machine and Woodflow Process Design

Machine and woodflow process design encompasses the planning, design and implementation of systems and equipment for the processing of wood. It includes consideration of recovery, efficiency, products, economics, and site specifics logistics. Competencies demonstrating **Application of Theory** include, but are not limited to:

- data sourcing / literature review / compiling of information
- link between field data and design processes.
- application of design software, including demonstrated knowledge of the underlying equations / models for any software programs used
- interaction with other professional engineers and technical specialists, and incorporation of their input into analysis, processes and specifications
- use of optimization software
- knowledge of engineering characteristics of logs related to machine design
- consideration of machine utilization, capacity, product recovery, critical path and queuing theory
- development of maintenance programs and implementation of inspection results
- supply chain management
- coordination among all forest development phases
- time / productivity studies
- testing and commissioning
- application of applicable codes and guidelines
- component design and fabrication
- process design application

FOREST ENGINEERING APPLICATION OF THEORY EXPERIENCE: COMPETENCIES BY AREA OF PRACTICE cont'd

F. Wood Product Development

Wood product development encompasses the planning, design and implementation of engineered wood products. This includes manipulation of wood from the cellular level to development of composite wood products. Competencies demonstrating **Application of Theory** include, but are not limited to:

- data sourcing / literature review / compiling of information
- link between field data and design processes.
- application of design software, including demonstrated knowledge of the underlying equations / models for any software programs used
- interaction with and collaboration between disciplines (i.e. when to involve expertise of other engineering disciplines in designs)
- life cycle analysis and summary statistics of the wood products industry in Canada
- wood adhesives: types and their selection for specific end applications
- hot-pressing processes for wood composites
- knowledge of engineering characteristics of wood and wood fibre
- manufacturing process for dimension lumber
- machinery and processes to manufacture finger-joined lumber; plywood; oriented strand board; fiberboard; particleboard; glued-laminated timber; structural composite lumber; wood I-joists; and wood - plastic composite lumber
- knowledge of moisture flow through wood
- materials testing
- product development
- knowledge of manufacturing processes to affect wood fibre properties
- research & development, prototyping, production process design, etc, etc.
- consideration of relative density, dimensional changes, and moisture effects
- application of applicable codes and guidelines

Appendix A - Satisfactory Engineering Experience

Work experience is an essential element in determining whether or not an individual is acceptable for professional registration/licensing. The responsibility for providing the proper environment, opportunities, range and progression of activities necessary to meet the work experience requirements rests with the employers of applicants, and the individuals who provide supervision during the internship period.

Acceptable engineering work experience must include the application of theory and should provide exposure to, or experience in the following broad areas: practical experience, management, communication, the social implications of engineering and sustainability. Assessment of the acceptability of the work experience is based on the extent to which the applicant's experience includes these areas, each of which is outlined in the following sections.

1) Application of Theory

The skilful application of theory is the hallmark of quality engineering work, and an applicant's experience shall include meaningful participation in one or more of the following:

a) analysis

for example: scope and operating conditions, feasibility assessment, safety and environmental issues, technology assessment, and economic assessment, etc.;

b) design and synthesis

for example: functionality or product specification, component selection, integration of components and subsystems into larger systems, reliability and maintenance factors, human and environmental aspects, and the societal implications of the product or process, etc;

c) testing methods

for example: devising testing methodology and techniques, functional specification verification, and new product or technology commissioning and assessment, etc.; and,

d) implementation methods

for example: technology application, engineering cost studies, optimization techniques, process flow and time studies, quality assurance implementation, cost/benefit analysis, safety and environmental issues and recommendations, and maintenance and replacement evaluation, etc.

2) Practical Experience

Practical experience allows applicants to understand the practical limitations of real systems. Practical experience should include:

a) site visits to existing engineering works, with opportunities to see equipment and systems in both operational and maintenance circumstances;

b) application of equipment as part of the larger system, including, for example, the merits of reliability, the role of computer software, and understanding the end product or engineering work in relationship to the equipment;

c) opportunities to experience and understand the limitations of practical engineering and related human systems in achieving desired goals, including limitations of production methods, manufacturing tolerances, performance minima, maintenance philosophies, etc.; and,

d) opportunities to experience the significance of time in the engineering process, including workflow, scheduling, equipment wear-out and replacement scheduling, etc.

3) Management of Engineering

Management of engineering works includes the supervision of staff, project management, general exposure to an engineering business environment, and the management of technology.

Engineering management includes:

a) planning, from conception through to implementation. This includes: needs assessment, concept development, assessment of resources required, and assessment of impacts, including societal and project implementation;

b) scheduling, from establishing interactions and constraints, developing activity or task schedules, and allocation of resources, through to the assessment of delay impacts and beyond to broader aspects, such as interactions with other projects and the marketplace;

c) budgeting, including the development of preliminary and detailed budgets, identifying labour, materials and overhead, risk analysis, life-cycle analysis, and tracking;

d) supervision, including leadership, professional conduct, organization of human resources, team building, and management of technology;

e) project control, including co-ordination of work phases, tracking and monitoring costs and progress, and implementing changes to reflect actual progress and needs; and,

f) risk-analysis related to operating equipment and system performance, product performance evaluation, and evaluation of societal and environmental impacts.

4) Communication Skills

Developing and practicing communication skills is an essential experience requirement. This applies to all areas of the work environment including communication with superiors, colleagues, regulators, clients, and the public.

Applicants should have regular and progressive opportunities to participate in:

a) preparation of written work, including day-to-day correspondence, record- keeping, and report writing;

b) making oral reports or presentations to colleagues, supervisors, senior management, and an exposure to, or participation in, reports to clients and regulators; and,

c) making public presentations.

5) Social Implications of Engineering

The overriding objective of the "social implications of engineering" requirement is to provide experiences which increase awareness of an engineer's professional responsibility to guard against conditions dangerous or threatening to life, limb, property, or the environment, and to call any such conditions to the attention of those responsible.

The social implications of engineering are an important aspect of the practice of engineering. The work environment should provide opportunities for applicants to heighten their awareness of the potential consequences of engineering work. This should include:

a) a recognition of the value and benefits of the engineering work to the public;

b) an understanding of the safeguards required to protect the public and methods of mitigating adverse impacts;

c) an understanding of the relationship between the engineering activity and the public;

d) a demonstrated interest and involvement in the broader social implications of engineering;

e) an appreciation of the role of regulatory bodies on the practice of engineering; and,

f) an understanding of the provincial health and safety of the workplace legislation.

6) Sustainability

The Association of Professional Engineers and Geoscientists of British Columbia is committed to integrating sustainability principles and practices into engineering and geoscience professions in the province of B.C. All applicants, Engineers-in-Training, Geoscientist-in-Training and members are expected to:

a. Maintain a basic awareness of the principles of sustainability. The Association's web site contains several sources of information on this subject.
b. Be aware of any specific sustainability clauses that have been added to practice guidelines that apply to their area.
c. To the extent possible, recognizing their position of influence, consider how sustainability principles could be applied and promoted in their specific work.

d. Support opportunities to form partnerships with others, such as government and public bodies, educational institutions and other professional associations, to expand the global networks that seek to embed sustainability concepts in society as a whole.

Sponsorship and the Requirement for Experience in a Canadian Environment

7) Sponsorship

Referees provide confirmation of the candidate's experience. References are required from practicing professional engineers familiar with details of the candidate's work during the internship. Present and past direct supervisors are the most suitable referees. If a candidate claims experience from several positions, extra references may be required.

All candidates are required to nominate four or more Canadian and/or US referees. All should be professional engineers with first-hand knowledge of the candidate's work. At least two of the referees should have directly supervised the candidate and at least one professional engineer familiar with the candidate's work from outside his or her company should be nominated if possible. If experience outside Canada/United States must be verified, additional referees are required. A separate letter is required to explain if the candidate cannot nominate the required referees. Professional engineers with indirect knowledge of the candidate's work may be nominated if absolutely necessary. Please refer to the reference forms for more information.

8) Requirement for Experience in a Canadian Environment

Within the four-year minimum satisfactory engineering work experience requirement, all applicants are required to gain at least one year of satisfactory engineering work experience in a Canadian Environment*, under the direct supervision of a Canadian Professional Engineer from the discipline of engineering demonstrated in the experience. Where appropriate, the direct supervision of an engineer licensed by a State Board in the United States will be accepted, or other supporting referees/references that is at Council's discretion to accept as equivalent.

This is to ensure that applicants have demonstrated that they have had experience of a satisfactory depth and breadth; and that they are conversant with the applicable Canadian engineering laws, practices, standards, customs, codes, conditions and climates.

In exceptional circumstances, a candidate with less than one year of satisfactory engineering experience in a Canadian Environment may be deemed, at the discretion of Council, to have satisfied the requirement. Each case will be assessed on its own merits.

All applicants **must** demonstrate that their Canadian Environment experience:

1) is supported by the undergraduate and/or postgraduate academic formation of the applicant;
2) is supported by a minimum of two Canadian and/or U.S. Professional Engineer referees/references from the discipline of engineering demonstrated in the experience, and who have detailed knowledge of the work of the applicant; or supporting referees/references that is at Council's discretion to accept as equivalent;

3) is broad-based and at the level of complexity and responsibility that demonstrates that the applicant is ready to accept the full professional responsibility held by registered professional engineers, and has reached the level of professional maturity needed to judge when he/she is out of his/her area of competence. This includes the application of engineering principles at a satisfactory level, adhering to the Appendix A - *Satisfactory Engineering Experience* Guidelines for all applicants as set out in the CCPE *Guideline on Admission to the Practice of Engineering in Canada*, and/or the discipline-specific requirements established by Council, where applicable.

**The term "Canadian Environment" is defined as:*

- *work experience obtained in Canada, supervised by a professional engineer, registered or licensed in the applicable Canadian jurisdiction; or,*
- *work experience acquired outside Canada, where applicants demonstrate a good knowledge of local Canadian engineering laws, practices, standards, customs, codes, conditions and climates.*