One of the activities of the SEI Business Practice Committee, with members from SEI, NCSEA, and CASE, has been to promote Basic Education for Structural Engineers. The result of the committee’s Phase I effort was the development of a Basic Education Curriculum (Figure 1). By this time, the reader has been exposed, through to several magazine articles and attendance at the National Council of Structural Engineering Associations Annual Conference, to the curriculum that structural engineer peers believe is appropriate for training to be a structural engineer. Academic education, practical experience, and examination are the cornerstones of the Basic Education for a Structural Engineer.

The Phase II effort culminated in the development of course content appropriate to the previously developed curriculum. This is the first publication of the curriculum content. Figure 2 provides an abbreviated version of the curriculum. A comprehensive survey of colleges and universities was conducted over a three year period to determine those schools offering courses which are appropriate for the basic education of a structural engineer. The survey demonstrated that while many schools do not offer the full course listing, almost 40% of the respondents do. A subsequent issue of STRUCTURE magazine will list schools and course offerings.

<table>
<thead>
<tr>
<th>Number of Courses</th>
<th>Semester Credit Hours Per Course</th>
<th>Course</th>
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<tbody>
<tr>
<td>2</td>
<td>3</td>
<td>Analysis</td>
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<tr>
<td>1</td>
<td>3</td>
<td>Matrix Methods</td>
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<tr>
<td>2</td>
<td>3</td>
<td>Steel Design (Including code application)</td>
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<tr>
<td>2</td>
<td>3</td>
<td>Concrete Design (Including code application)</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>Timber Behavior and Design</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>Masonry</td>
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<tr>
<td>1</td>
<td>3</td>
<td>Dynamic Behavior</td>
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<tr>
<td>1</td>
<td>3</td>
<td>Foundation Mechanics / Soils</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>Technical Writing</td>
</tr>
</tbody>
</table>

Figure 1: Basic Education Curriculum for a Structural Engineer

Reproduction of the curriculum and course content for further dissemination by readers is encouraged. See the sidebar on this page for Electronic versions of the curriculum content are available for downloading from the NCSEA website.

The NCSEA Education Committee encourages responses relative to the curriculum and course content from all readers. Comments should be sent by e-mail to CBI1984@aol.com.

Craig E. Barnes, PE is a Principal of CBI Consulting Inc., Boston, and Chairman of NCSEA’s Education Committee and SEI’s BPAD committee.

The reader can access information relevant to the Basic Education series on the Structural Education pages of the STRUCTURE website, www.structuremag.org.

The following information is currently available:

- Curriculum Content
- Full Text
- Survey of Universities and Colleges
- Data
- Basic Education Certification as a Structural Engineer
- Craig Barnes, PE, STRUCTURE February ’04
- A Matter of Degrees
- Disconnect Between Academia and the Work Place for the Structural Engineer
- Eric L. Hung, STRUCTURE Dec/Jan ’04
- Basic Education-A Practitioner’s Point of View
- Daniel L. Lavrich, PE, Structural Forum, STRUCTURE April 03

Preparation Material for FE/PE Exams

NCEES offers hard copy and electronic exam preparation material to civil and structural candidates. Sample questions were developed by the same groups that created the exams, and they conform to current exam specifications. Solutions are provided. Structural I PE and Civil PE candidates can now take a timed Internet Practice Exam at the NCEES web site. For more information visit the NCEES web site at www.ncees.org or call 1-800-250-3196.

National Council of Examiners for Engineering and Surveying
www.ncees.org 1-800-250-3196
Basic Education Course Content

Analysis 1

Topics
1. Introduction to Structures.
2. Forces.
4. Equilibrium and stability.
5. Concept of stress.
6. Concept of strain.
7. Stress-strain relationships.
10. Shear and bending moment diagrams – focus on the relationship between load, shear, moment and deflection.

Objectives (refer to website)

Analysis 2

Topics
1. Introduction and review of statics.
2. Axially loaded members including indeterminate problems.
4. Shear and bending in beams.
5. Torsion including indeterminate problems.
6. Compressive members/instability.
7. Formulate and apply stress transformations and related extensions to principal stresses and maximum in-plane shear stress.
8. Compute shear flow and location of shear center for any thin-walled cross-section.
9. Understand the derivation and application of flexural deformation using basic principles
   a. Slope and displacement of a beam by integration.
   b. Slope and displacement of a beam by moment-area.
   c. Indeterminate beam reactions using moment-area.
10. Formulation and application of the Euler buckling formula.
11. Stress transformation, Mohr’s circle.
13. Stability, morphology, and analysis of statistically determinate two- and three-dimensional structural systems.
15. Slope-deflection method.
17. Virtual work – trusses, beams, and frames.
19. Influence lines.

Objectives (refer to website)

Matrix Methods

Topics
1. Review of matrix algebra.
2. Basic concepts: Flexibility vs. stiffness
3. Flexibility method.
4. Stiffness method: Trusses
5. Stiffness Method: Beams & Frames
7. Stiffness Method: Special Topics.
8. Introduction to Finite Element Analysis and Nonlinear Analysis.

Objectives (refer to website)

Steel Design 1

Topics
1. Historical development of steel as a building material.
2. Loading of steel building structures.
4. Design stresses and factors of safety.
5. Design of laterally braced and un-braced beams.

Objectives (refer to website)

Steel Design 2

Topics
1. Structural design computations for beams, girders, columns and beam-columns.
2. Design of connections (bolted & welded).

Objectives (refer to website)

Concrete 1

Topics
1. Materials.
2. Flexural behavior and design.
3. Deflections.
4. Shear.
5. Development of reinforcement.

Objective (refer to website)
Concrete 2

Topics
1. Introduction to prestressed concrete, general design principle, material and anchorages.
2. Loss of prestress.
3. Analysis of flexural sections.
4. Design of flexural sections.
5. Design of composite sections.
6. Design of shear.
7. Prestress transfer bond, anchorage zone.
8. Cable profile, deflection.
10. Design of continuous beams.

Objectives(refer to website)

Timber

Topics
1. Properties of wood and lumber/Grades.
2. Design of members to resist bending.
3. Design of members to resist axial forces.
4. Design of shear walls and diaphragms.
5. Configuration of timber buildings.
6. Design of connections.

Objectives(refer to website)

Masonry

Topics
1. Introduction: types of masonry, masonry construction, properties of masonry, grout, mortar, and reinforcement.
2. Design and Analysis of Beams and Lintels.
3. Design and Analysis of Columns and Pilasters.

Objectives(refer to website)

Dynamic Behavior (including seismic)

Topics
5. Planar kinematics of a rigid body.
9. Characteristics of earthquakes; causes, faults, seismic waves, plate tectonics, magnitude and intensity; strong ground motion (etc.
10. Response of single D.O.F. structural systems to earthquake ground motion; concept of response spectra; design spectra; damping, damping ratios.
11. Response of multi-D.O.F. structural systems subjected to earthquake ground motion; mode shapes and frequencies; earthquake response analysis by mode superposition.
12. Inelastic seismic behavior and design of structural systems; concept of ductility.

Objectives(refer to website)

Foundation Design/Soil Mechanics

Topics
1. Description and properties of foundation bearing materials
2. Field exploration
3. Lateral earth pressure
4. Slope stability
5. Shallow foundation (footings, rafts, mats)
6. Pile foundations
7. Caisson foundations
8. Retaining walls

Objectives(refer to website)

Technical Writing

Topics
1. Review of basic grammar.
2. Report structure.

Objectives(refer to website)