Resolution of Deficiencies in Engineering Education

By Prof. Kevin Dong, P.E., S.E.

In earlier articles, the reader was introduced to self-teaching curriculum content for structural steel and concrete (STRUCTURE's June 2011and January 2012). In this final article of this series, the reader will see a new approach–a split mission. Since the Basic Education program for Structural Engineers was introduced in 2002, NCSEA has been working with practitioners and educators to improve the education program provided by schools to those students looking to Structural Engineering as a profession. Since 2002, for a variety of reasons, schools have not found it easier to equip the student with an appropriate education, but have found it all the more difficult. The cost of attending school has risen much faster than inflation. Schools are under more and more pressure to reduce required credits necessary for graduation. Research dollars that support schools, and which have a definite impact on tuition and instructor salaries, are tougher to come by.

Elements of the basic curriculum are still necessary, but the route to the end may be changing. With each of the previous national surveys, three parts of the curriculum have stood out as a deficiency in more schools than any of the other core components; Masonry, Timber, and Technical Writing. Starting with Technical Writing, schools have found ways to accomplish the education requirements by utilizing other in-school opportunities for training the student to become a competent communicator. Northeastern University in Boston, MA, is one of the leading schools in the Technical Writing area. Refer to article by Peter Furth, PhD, titled *Embedding Communication Education within the Civil Engineering Curriculum* in the April 2007 issue of STRUCTURE®.

Using a cram-down approach, the author combines **Timber and Masonry** instruction in one three-credit course. The course contains the major elements needed for both core Basic Education courses in Timber and Masonry, and provides a sound platform for a student to self-teach. The 2013 survey, which began in October 2011 with the school interview process, acknowledges those schools that have developed a way to address core curriculum deficiencies.

Below, the author adds to the self-teaching curriculum series for Structural Steel, Reinforced Concrete, Masonry, and Timber. The Basic Education Committee of NCSEA appreciates your comments.

Timber and Masonry Design Course Content

- Mechanics and assumptions of masonry and wood design
  - For masonry:
    - Allowable stress versus strength design
    - Reinforcement ratios and the balanced condition
    - Cracked section properties
    - Typical block dimensions and types (terminology)
  - For timber
    - Shrinkage
    - Allowable stress and the use of service loads
    - Nomenclature and the use of a non-ductile material
- Gravity load resisting systems
  - Column design
    - Premise of design equations
    - Un-braced length, slenderness ratio (h/t or l/d), and second order effects
  - Beam design
    - Flexural design
      - For timber: solid sawn versus glue laminated beams and simulated continuity
    - Shear design
    - Deflection and serviceability limits
      - Creep
  - Beam-column elements
    - Combined stresses
    - Second order effects and slenderness
  - Basic connection principles
    - Beam seats, tie downs, straps, nails, lag screws, anchor bolts, blocking
- Lateral load resisting systems
  - Understand the failure mechanisms and required detailing to ensure the failure mechanism can be formed. The system proposed for study: special concrete walls
  - Walls – masonry and wood panel
  - Diaphragms
    - Sub diaphragms
    - Diaphragm shear
    - Drags and chords
    - Wall ties
    - Amplified loads and capacity based design
- Construction Documentation
  - General Notes
    - Relation to project specifications
    - Content and purpose of general note sheets
  - Framing Plans and "industry standards" for notation
    - Line weights, line types, hatching, dimensioning, text work
    - Information required to build, such as openings, dimensioning, and miscellaneous framing members.
  - Detailing
    - Load path and detailing for typical gravity elements
    - Load path and detailing for diaphragms and shear walls: collectors
    - The bread and butter of the industry, but again, academia does not adequately cover this topic and this is integral to design and ultimately building performance.
- Elective Topics – not necessary to achieve the goal of lifelong learning, but helpful to integrate into practice
  - Masonry
    - Shear walls
    - Retaining walls
  - Diaphragms
    - Openings and discontinuities

The full Basic Education for Structural Engineers program containing curriculum, course content and desired outcomes can be viewed in the Education section on the STRUCTURE website, **www.STRUCTUREmag.org**.

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