POLICY STATEMENT 465: Why We Must

In October 1998, ASCE's Board of Direction adopted Policy Statement 465, which supports the concept of the master's degree as a prerequisite for the practice of civil engineering at the professional level. Last fall the board adopted refinements and clarifications of the policy statement recommended by the Task Committee on the First Professional Degree. In essence this committee recommended that admission to the practice of civil engineering at the professional level occur at licensure and require a body of specialized knowledge as reflected by a combination of a bachelor's degree and a master's degree or equivalent, appropriate experience, and a commitment to lifelong learning. The board also set up a new task committee in October—the Task Committee on the Academic Prerequisites for Professional Practice—and charged its members with developing a plan for its implementation.

Policy Statement 465 is one of the most profound statements rendered by civil engineering professionals within the past several decades, for it recommends that the profession reconstruct the academic foundation for professional practice. The rationale underlying the recommendation is that a bachelor's degree is becoming inadequate for licensure and the practice of civil engineering at the professional level—that a new model for civil engineering education is needed to prepare practitioners for the increasingly complex work in which they will be engaged in the 21st century.

This article, written by members of the task committee—a committee composed of seasoned practitioners, academics, and young ASCE members—explains why new academic prerequisites for licensure and professional practice are so important to the future of the civil engineering profession and outlines the recommended plan for implementation.

In October 2001, following several years of rigorous study, the Board of Direction unanimously adopted Policy Statement 465 ("Academic Prerequisites for Licensure and Professional Practice"), which states in part: "The ASCE supports the concept of the master's degree or equivalent as the first professional degree for the practice of civil engineering at the professional level. ASCE encourages institutions of higher education, governmental units, employers of civil engineers, and other appropriate organizations to endorse, support, and promote the concept of mandatory postbaccalaureate education for the practice of civil engineering at a professional level. The implementation of this effort should occur through establishing appropriate curricula in the formal education experience, appropriate recognition and compensation in the workplace, and congruent standards for licensure." It is a simple but highly significant statement, for it raises the bar on the educational model that has been used by the civil engineering profession for two centuries.

The reason for the Board of Direction's statement, as clearly outlined in the policy statement itself, is that the civil engineering profession is undergoing significant, rapid, and revolutionary changes making the baccalaureate civil engineering degree an entry-level degree that is inadequate preparation for the practice of civil engineering at the professional level. Globalization, primarily as the result of enhanced communication systems, has challenged geographic boundaries recognized in the past. While information technology has made and continues to make more information available, the analysis and application of this information are becoming more challenging. The diversity of society is challenging traditional views and making greater demands on interpersonal skills. New technologies in engineering and construction are emerging at an accelerating rate. Enhanced public awareness of technical issues is leading to better informed inquiries by the public into the technical, environmental, societal, political, legal, aesthetic, and financial implications of engineering projects. Civil infrastructure systems are deteriorating, and the maintenance and renewal of these systems must be quickly addressed—as must the infrastructure security issues brought to the fore by the events of September 11.

Engineering the Future of Civil Engineering: Report of the Task Committee on the First Professional Degree, which was submitted to ASCE's Board of Direction last May, makes the point that "the question is not . . . what should be the first professional degree, but instead what should be the educational prerequisite for the practice of civil engineering at the professional level. The task committee believes that the fundamental issue addressed by Policy Statement 465 is that the current four-year bachelor's degree is inadequate formal academic preparation for the practice of civil engineering in the 21st century."

"Our objective," explains Jeffrey S. Russell, the chair of the construction and management program at the University of Wisconsin at Madison and the task committee chair, "is to help ensure that civil engineering remains a career and profession that matter and that continue to matter." To this end the

Raise the Bar

committee has recommended that civil engineering educational standards be revised and that a new educational structure be developed to educate civil engineers who can meet the challenges, problems, and complexities they will confront in the year 2025 and beyond.

Policy Statement 465 advocates additional formal education beyond the bachelor of science prior to licensure as a registered professional engineer for four primary reasons: (1) Civil engineering practice today is vastly different than it was a few decades ago and continues to undergo rapid change; (2) the educational preparation for civil engineers has not kept pace with these technical advances and changes in society and the engineered environment—it is too narrowly focused and in some cases it has regressed relative to other professions; (3) in response to the changing needs of their clients and to changing business practices, other licensed professions have enhanced and strengthened their educational preparation and licensing criteria; and (4) civil engineers are not educated to be leaders, and this lack of leadership has slowly eroded the prestige and caliber of the profession in today's technology-centered global economy.

The risk in not responding to these factors is indeed very real—and threatens the very future of the profession. Unless civil engineers are better prepared to cope with the changing demands of professional practice, they will find in the not-so-distant future that management positions are increasingly occupied by nonengineers. They will also find that there are fewer opportunities for civil engineers to serve as project leaders and as leaders shaping public policy on such matters as the infrastructure and the safety and security of the built environment. The prospect of civil engineers sitting on the sidelines in secondary roles is a threat that all civil engineering stakeholders should take seriously. As explained by ASCE's president, H. Gerard Schwartz, Jr., in Houston in his inaugural speech, the board's "decisive statement about the future of our profession will raise the academic bar for the professional practice of civil engineering in the twenty-first century. To do otherwise would be to countenance a steadily eroding role for the civil engineers of the future."

A new, global economy, 24-hour business environments, a burgeoning world population, and such attendant problems as increased energy use, land despoliation, increasingly intricate infrastructures, and dwindling natural resources will require civil engineers to devise new approaches to the various social, political, environmental, economic, and technical aspects of

Reasons behind the Master's Or Equivalent (MOE)

Learning styles, like career goals and aspirations, depend on the individual. There are a number of ways in which a civil engineer may advance his or her knowledge and skills. ASCE approved the master's degree or equivalent (MOE) because it is inclusive in scope and recognizes the diversity of choices available to ASCE members throughout their careers.

The MOE is predicated upon three propositions: inclusion, flexibility, and nontraditional delivery methods. "The fundamental concept is to help civil engineers increase the breadth and depth of their formal education," explains Gerald E. Galloway, Jr., the secretary of the U.S. Section of the International Joint Commission, in Washington, D.C., and a task committee member. "Not all civil engineers will advance their professional knowledge through a traditional master's degree program with structured on-campus learning. They may achieve the 'or equivalent' level of knowledge through a combination of on-campus courses and participation in such nontraditional programs as distance learning and courses taught by agencies and other providers, as long as these latter courses meet well-defined quality standards. Nontraditional approaches will also provide the basis for an introduction to a lifelong commitment to continuing professional development," he says.

Engineering MOEs

(For Holders of ABET-Accredited B.S.C.E.)

1. M.Engr. or M.S. in CIVIL ENGINEERING
2. M.Engr. or M.S. in OTHER ENGINEERING
3. Ph.D. in CIVIL ENGINEERING
4. Ph.D. in OTHER ENGINEERING
5. 30 semester credits of course work acceptable as graduate level beyond that required for the baccalaureate

Possible Nonengineering MOEs

(For Holders of ABET-Accredited B.S.C.E.)

1. M.S. in SCIENCE
2. M.S. in ARCHITECTURE
3. M.S. in CITY AND URBAN PLANNING
4. MASTER of BUSINESS ADMINISTRATION
5. MASTER OF PUBLIC ADMINISTRATION
6. Ph.D. in SCIENCE

civil engineering practice. Partnering with other professions to shape a global environmental agenda will become critical in the 21st century—as will shaping a new development model. The world's current environmental crisis has to a large extent been precipitated by the development model used by both industrial and emerging nations during the 20th century: an approach that exploited nonrenewable resources to achieve economic growth, relied largely on fossil fuels, and disregarded environmental ramifications. "In the future," says Schwartz, "civil engineers will have to learn to appreciate and predict with more accuracy the far-reaching consequences of projects in terms of environmental impact."

Developing engineering systems for the 21st century will be extremely challenging. This point was voiced again and again by civil engineering leaders the task committee interviewed in the process of formulating their recommendations. "The fluidity of rapid change surrounds us, and that helps shape the challenge," observes Patricia D. Galloway, the chief executive officer and president of the Nielsen-Wurster Group, based in Princeton, New Jersey. Galloway also makes the point that these developments dictate changes in the educational model the civil engineering profession embraces. "In the face of changing technology, the increased complexity of projects, and a reduced number of credits required for a bachelor of science in civil engineering degree, how can we remain wedded to a two-hundred-year tradition of a four-year degree?"

American colleges and universities of the early 19th century favored the liberal arts tradition of the British educational system as exemplified by the curricula of Cambridge and Oxford. Because these colleges and universities rejected the integration of engineering courses into the liberal arts system, separate colleges of engineering were established. West Point was founded in 1802 to educate military engineers, and Rensselaer Polytechnic Institute, which graduated its first civil engineers in 1835, was established to educate civilian engineers. A four-year program was formulated, probably because that was the college paradigm. Thus the study of civil engineering in the United States was born as parallel to and remains parallel to the liberal arts curriculum. Most other professions, in contrast, have positioned their formal education in sequence with a liberal arts education or at least with a more general education. While such other exacting professions as law and medicine have devised a sequenced educational model, whereby students completing a four-year liberal arts or other broadly based undergraduate program begin an advanced program of specialized education, the engineering profession embraces a model that *substitutes* a professional education for one that is more broadly based. The flaw in the evolution of engineering education is that engineering students study engineering *instead of* rather than *in addition to* the liberal arts.

Civil engineers are not adequately prepared to compete for leadership positions because their formal education gives short shrift to the professional skills that a leader must possess. Nonengineers are increasingly managing civil engineers, the principal reason being that the nonengineers are more adept at leadership and communication and have better business sense.

An additional weakness that has crept into the engineering model is a reduction in the number of semester hours required for graduation. With a four-year education that included 155 or more satisfactorily completed semester hours, the civil engineering graduate of 1900 was among the best-educated college graduates in the nation. This four-year education was technically quite rigorous. Today's civil engineering graduates, by comparison, earn an average of just 125 credit hours. Furthermore, the total credit hours of engineering content have significantly decreased in many of the nation's leading civil engineering programs. Although civil engineers were once considered highly educated, that is no longer the case. The civil engineering profession has not kept in step with, for example, the legal and medical professions, which continue to claim highly educated members. Until the early 1900s practitioners of law and medicine typically had no more than one to four years of specialized training. In the early 20th century, however, practitioners in those fields came to the realization that changes in the world dictated more rigorous academic requirements. "When compared to other professions, civil engineering has lost its edge," says Brook A. Maples, a civil engineer with KPFF Consulting Engineers in Seattle and a task committee member.

The current educational model is also coming under criticism because of its narrow focus. It goes without saying that fundamental technical knowledge is a prerequisite for civil engineering practice. But vision and an ability to lead, manage, and communicate are equally important, and many contend that engineers should be trained in these areas as well. Civil engineers are not being prepared to compete for leadership positions; their formal education is woefully deficient in nontechnical areas. Another member of the task committee, Stuart G. Walesh, of Valparaiso, Indiana, an engineering consultant and author, suggests that a new approach is needed for engineering

education and practice: "We need to develop a new paradigm for civil engineering education and practice that includes a marked change in the length and content of the program and in our expectations of it."

Many practitioners agree. Recent interviews conducted by task committee members revealed that industry leaders repeatedly cite a number of common deficiencies among both entry-level and experienced civil engineers—deficiencies they believe to be inherent in the current educational model. These shortcomings include poor communication skills, an inability to manage projects profitably, a lack of interest in marketing, excessive attention to technical matters, a failure to meet client expectations, a lack of visibility within the community, an inability to understand global cultural differences, a lack of business sense, an inability to manage conflict proactively, and a lack of understanding of the negotiation process. Technical fundamentals will remain the foundation of the civil engineer's education, but technical know-how alone is no longer sufficient. Instruction in such areas as communication, project management, marketing, team building, cultural sensitivity, and leadership must now be blended with the traditional technical foundation.

Engineering the Future of Civil Engineering concludes that civil engineers are not adequately prepared to compete for leadership positions because their formal education gives short shrift to the professional skills that a leader must possess. Nonengineers are increasingly managing civil engineers, the principal reason being that the nonengineers are more adept at leadership and communication and have better business sense. "The need is not for less technically prepared civil engineers, but for more broadly trained engineers with an education that more closely parallels the liberal arts experience at the basic level," says Walesh. An education rich in basic science, engineering, and the liberal arts would help produce civil engineers better equipped to lead and contribute to society.

Are these issues new? No indeed. Findings of a seven-year study described in the *Report of the Investigation of Engineering Education, 1923–1929,* for example, called for broadening engineering education in the humanistic and scientific areas rather than for extending technical instruction to more advanced levels—a sentiment shared by one of ASCE's former presidents, Carlton S. Proctor, who in 1932 asked, "Is it not time we should agree that a professional man (woman) cannot be produced in four years, but that an accredited civil engineering training must be definitely postgraduate, with a broad undergraduate training as a prerequisite?"

"It has been the same for more than seventy-five years, but now the time is critical," says ASCE's president-elect, Thomas L. Jackson, a vice president of DMJM+HARRIS in New Orleans. "How many more times do we need to get together on this? How much more analysis do we need? It's time to get behind Policy Statement 465 and implement it. Additional broad-based education is not only the right response to a more complex world; it is the proactive, ethical, and exciting response."

The civil engineering profession is not the only profession grappling with current educational inadequacies. The accountancy, occupational therapy, and pharmacy professions have recently concluded that an undergraduate education is no longer adequate for professional practice. Here are some insights into how these professions are responding to our rapidly changing world:

Accountancy: A 150-hour, five-year educational requirement is being adopted as a prerequisite for the certified public accountant examination. Data indicate that while first-year accounting salaries have remained equivalent to those of civil engineering, salaries have increased in states that have adopted new educational requirements.

Occupational therapy: A master's degree has recently been made the first degree for professional practice. The prior standard had been a bachelor's degree. Proponents of the new standard contended that occupational therapists were not being accorded the same stature as such other professions as medicine, physical therapy, and social work and thus were being penalized financially and professionally.

Pharmacy: Educational requirements have been adjusted a number of times. Citing the significant advances made in the fields of science and technology in the 20th century, the American Association of Colleges of Pharmacy recently endorsed a six-year program and now regards the doctor of pharmacy as the first professional degree for practice.

Educational reform within these professions did not come about quickly, but leaders in these fields recognized the need to elevate training requirements. And one of the primary benefits is, of course, the increase in salary associated with the increase in educational requirements. Between 1990 and 2000 starting salaries for civil engineers increased 35 percent, whereas starting salaries in the occupational therapy and pharmacy professions increased by respectively 70 percent and 76 percent. It is worth noting that civil engineers with advanced degrees are compensated significantly for their additional education.

These examples help benchmark the civil engineering profession against others, highlighting the opportunity for—and need for—change. Unless the present educational requirements are revised, the typical civil engineering graduate can expect to earn less than lawyers, optometrists, occupational therapists, pharmacists, and physicians and can look forward to working under managers who are not engineers. Because today's civil engineering graduates have had little formal training in the areas of communication, teamwork, management, and marketing, they can expect fewer leadership opportunities. Over time, the best and brightest students will choose other professions because of the image, stature, prestige, and salaries enjoyed by those working in these professions.

And this is precisely why ASCE is addressing these concerns to create a robust future for civil engineering. "We have studied the past and other professions," says Russell. "We can visualize the future. We want civil engineering to do more than improve its stature. We also want civil engineering to reclaim its position of leadership in building and rebuilding the modern world."

The issue of requiring the master's degree or equivalent as a prerequisite to professional civil engineering practice is about much more than keeping pace with other professions. It is about overcoming the threat that is aimed at the future of the profession. "If we don't move ahead," warns Russell, "the profession will continue to be marginalized, leading to a slow death of the profession as we know it. As civil engineers, we need to be in the leadership business and not solely in the technical proficiency business. We focus on technological expertise, but leadership is much broader than that."

Leadership in the future will mean embracing a vision of an enhanced quality of life for humankind that will be realized through a judicious stewardship of natural resources under conditions of limited financial resources. Leadership conveys a competitive advantage based on integrity and character. It is about communicating a vision, rallying a team for a common cause, and understanding and balancing the conflicting and, at times, ambiguous political, social, environmental, business, and technological aspects of a project. Civil engineers are not being prepared to compete for leadership positions, and as a consequence they run the risk of having to relinquish the leadership of projects and programs to those who are not engineers. Individuals educated in the law, business administration, or public administration have a liberal arts background and often have more business acumen and are better at leading and communicating than civil engineers. And these individuals to an increasing extent are managing civil engineers. "Our aim is to strengthen civil engineering and to help develop future leaders who can successfully integrate their people and technology skills," says committee member Norman L. Buehring, an engineer with the Las Virgenes, California, municipal water district. "We want civil engineers in the future to enter the marketplace qualified to perform at a higher level and to compete more successfully for leadership positions."

What might the future hold for civil engineers if revisions are not made to the current educational requirements and curricula? Envision these scenarios:

- Projects once within the logical domain of civil engineers will be led and managed by nonengineers. The primary reasons for this appear to be the perceived inability of civil engineers to communicate effectively, manage responsibly, and lead a business or organization. Research by members of the committee produced some startling findings about a class of public positions historically occupied by civil engineers: state secretaries of transportation. As of January of this year only 18 hold bachelor's degrees in civil engineering while 30 hold bachelor's degrees in liberal arts or in business or management.

Equally startling are findings dealing with the professional education of current and former U.S. secretaries of transportation. This department is responsible for planning, designing, building, and maintaining the nation's public transportation infrastructure. In its 30 years of existence, only one appointee has been an engineer—and not a civil engineer—compared with nine such appointees with law degrees. "What we're seeing is that being technologically competent is no longer sufficient to lead large organizations," says task committee member Angela DeSoto Duncan, a structural engineer with the U.S. Army Corps of Engineers in New Orleans. "A broad perspective of society acquired through an understanding of history, philosophy, and literature is necessary. Positions thought to be held by civil engineers are no longer being held by people with those credentials."

- The civil engineering profession will diminish in stature and remuneration, leading to decreasing numbers of talented students entering the field. Consider these points as further evidence of the lag in salaries civil engineers have experienced and may continue to experience: One salary survey analyzing trends from 1955 to 1988 found that civil engineers' salaries increased by just 7 percent in real dollars during that period. In comparison, the salaries of most of those employed in all professions within that time frame increased by between 35 and 45 percent, with physicians' salaries increasing by 64 percent. Compensation for civil engineers has been static for the past decade and falls below that of most other engineering disciplines and, indeed, of most other professions.
- Civil engineers will become marginalized and they will not be involved in projects as privileged participants or leaders but as technical observers or simply technicians.

Moving ahead will require a continual influx of bright, talented, and ambitious students, but unfortunately such people are likely to be attracted to professions other than civil engineering. The reasons have to do with low compensation coupled with a model for education, experience, licensing, certification, and continuing professional development that is out of step with the times.

In response to its charge to develop a plan for fully realizing Policy Statement 465, the task committee set forth 17 strategies that could form a basis in this regard. The recommended strategies include such key elements as determining and working with stakeholders, protecting the status of current members of the civil engineering profession, learning from other professions—as well as from other nations—and

encouraging innovation and variety in undergraduate and graduate engineering education. The committee outlined the strategies as follows:

1) Lead, don't wait. ASCE should not "wait" for other engineering societies to recommend changes before implementing Policy Statement 465. In keeping with its status as the nation's first national engineering society, ASCE's leadership in advancing formal educational requirements seems particularly fitting.

2) Determine and proactively work with stakeholders. Partnering with stakeholders is essential in effecting a significant improvement in the civil engineering education and licensing process.

3) Protect the status of current members of the civil engineering profession. Licensed civil engineers who do not possess a master's degree or the equivalent would remain licensed engineers: Their status would not be diminished. While requiring a master's degree or its equivalent as well as licensure for practice at the professional level may negatively affect some holders of civil engineering baccalaureates who have no desire to become licensed, their options for obtaining a master's degree or its equivalent and licensure remain open.

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4) Coordinate efforts with ASCE's sesquicentennial. ASCE's 150th anniversary affords an auspicious opportunity to officially begin implementing the combination of the bachelor's degee and master's degree or equivalent (BS-MOE) as a prerequisite for the practice of civil engineering at the professional level.

5) Develop specialty certification. A specialty certification program established under the auspices of ASCE's institutes would build on the master's or equivalent effort by officially recognizing expertise beyond that needed for licensure.

6) Define what is meant by master's degree or equivalent. The degree required for the practice of civil engineering at the professional level may assume many forms. An underlying criterion is holding at least one degree in a program approved by the Accreditation Board for Engineering and Technology (ABET) and a civil engineering degree. While there are 27 possible combinations of bachelor's and graduate degrees that satisfy the BS-MOE requirement defined by the task committee, the vast majority may be described as meeting one of four conditions. A candidate for civil engineering licensure will be deemed to have met the BS-MOE requirement if he or she meets any of the four conditions:

- Holds a bachelor of science in civil engineering from an ABET-accredited program and at least a master's degree in civil engineering or some other relevant area;
- Holds a bachelor's degree not in civil engineering from an ABET-accredited engineering program and a civil engineering master's degree (not necessarily accredited) or a higher civil engineering degree;
- Holds a bachelor of science in civil engineering from a nonaccredited program and an ABET-accredited master's in engineering;
- Holds a bachelor of science in civil engineering from an ABET-accredited program with at least 30 semester credits of acceptable graduate-level course work beyond that required for the baccalaureate.

7) Learn from engineering education practices in other countries. The European educational system requires formal education beyond a baccalaureate as a condition for entering engineering practice. The United Kingdom, for example, is moving toward formal education beyond the bachelor's degree as a licensing requirement.

8) Use distance learning to best advantage. The expected rapid growth of distance learning will provide more options for earning a master's degree or the equivalent.

9) Incorporate cooperative education. While cooperative education may provide a valuable growth experience, it is not likely to play a major role in the implementation of the BS-MOE as a prerequisite for licensure and the practice of civil engineering at the professional level.

10) Evaluate opportunities for those interested primarily in undergraduate civil engineering programs. Ironically, the implementation of enhanced formal educational requirements for civil engineers will create opportunities for those in progressive undergraduate civil engineering programs.

11) Consider new graduate programs that would offer a variety of master's degrees. In this way, academic departments could assist their students in satisfying the BS-MOE requirement while continuing to foster research and offer other programs.

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12) Learn from nonengineering professions that recently raised their educational standards. ASCE can draw on the experience of other professions that have raised or are now raising their educational and other standards.

13) Recognize the support that can be provided by ABET. That organization's goal of encouraging and accommodating new educational paradigms meshes neatly with ASCE's efforts to expand the formal education of civil engineers.

14) Build on the relationship between the accreditation aspects of Policy Statement 465 and accreditation in other countries. Accreditation of advanced degrees is likely to grow in importance with the globalization of both engineering practice and engineering education. There will probably be a continuous move toward some international standard.

15) Build on the supportive aspects of the new licensure model developed by the National Society of Professional Engineers (NSPE). By explicitly recognizing an appropriate advanced degree, the NSPE's model supports ASCE's Policy Statement 465.

16) Recognize the potential support of the National Council of Examiners of Engineering and Surveying (NCEES). That organization may buttress ASCE's efforts to strengthen the formal educational requirements for the practice of civil engineering at the professional level.

17) Support the fundamentals of engineering examination. This examination introduces civil engineering students to the need for licensing and to the licensing process.

Building on and linking the 17 strategies, the implementation plan recommended by the committee determines principal participants, defines action items and supporting tasks, and establishes milestones. The three principal participants in the plan are ASCE together with its institutes, its members, and the employers of its members; the NCEES; and ABET. Four major action items, each with supporting tasks, should be completed over the course of the next 20 years. These items are supported by a total of 31 particular tasks, each of which is assigned to one or more principal participants. Outputs are defined for each of the tasks, and each has a deadline. The action items and supporting tasks are as follows:

- Action item A: ASCE leads through continuous interaction with other stakeholders.
  1) Approve Policy Statement 465 as refined.
  2) Form an implementation committee.
  3) Accept and endorse the report.
  4) Distribute the report to leaders of the NCEES, ABET, founder societies, and others as appropriate.
  5) Interact with stakeholders.
  6) Ask the ASCE committees dealing with professional practice and educational activities and the ASCE institutes to support the report's recommendations.
  7) Ask professional societies and organizations to support the BS-MOE as a prerequisite for the practice of civil engineering at the professional level.
  8) Revisit ASCE membership grade requirements.
- Action item B: Licensing jurisdictions adopt the BS-MOE as a requirement for the practice of civil engineering at the professional level.
  1) Review the change processes used by other professions.
  2) Interact with licensing jurisdictions.
  3) Prepare fact sheets and guidelines.
  4) Convince state legislators and regulators.
  5) Refine the NSPE's model law for the licensing of engineers.
  6) Pass legislation and adopt rules as needed.
  7) Encourage employees to obtain licensure.
  8) Encourage users of civil engineering services to be more rigorous in making licensed civil engineers responsible for civil engineering projects.
- Action item C: ABET, universities, and others revise civil engineering curricula, programs, and culture.
  1) Obtain input from individual practitioners and employers.
  2) Emphasize the role of employers in partnering with employees on the BS-MOE and continuing education.
  3) Select BS-MOE models and design curricula.
  4) Develop BS-MOE certification criteria.
  5) Provide opportunities for faculty development.
  6) Develop accreditation criteria, including dual-level accreditation.
  7) Obtain accreditation.
  8) Explore the professional school model.
- Action item D: ASCE institutes lead the development of specialty certification.
  1) Determine interested institutes.
  2) Explore relationships with other professional societies.
  3) Prepare common criteria.
  4) Pilot the specialty certification program with one institute.
  5) Expand the specialty certification program with other institutes.
  6) Encourage other practitioners to obtain specialty certification.
  7) Encourage users of specialized civil engineering services to require civil engineers to have the appropriate specialty certifications.

For reform to take place within civil engineering education there must be acceptance of this reform and participation in it on the part of accreditation and licensing organizations. According to Bobby E. Price, a committee member and the chair of the NSPE's committee on licensure and the qualifications for practice, the NSPE endorsed the concept of a master's degree or its equivalent in January of this year as additional engineering education beyond the four-year degree for the practice of engineering at the professional level. What is more, ABET has stated in its strategic plan its desire to "encourage and accommodate new educational paradigms [by] assist[ing] engineering disciplines in defining the first degree for professional

practice." According to committee member Richard O. Anderson, a past president of Detroit-based Somat Engineering, Inc., and one of ASCE's representatives to ABET's Board of Direction, "For civil engineering, this means supporting the concept of the master's degree or equivalent as the first professional degree for civil engineering."

ABET has also recently implemented an outcomes-based assessment process for undergraduate engineering education. Included in this process are 11 required outcomes for graduates of engineering programs, 6 of which relate to course content beyond the typical realm of math, science, and engineering. The latter include an ability to function on multidisciplinary teams, an understanding of professional and ethical responsibility, an ability to communicate effectively, the broad education necessary to understand the ramifications of engineering solutions within societal and global contexts, a recognition of the need to engage in lifelong learning, and an understanding of contemporary issues.

"Better educational preparation means better futures for tomorrow's civil engineering graduates," says Delon Hampton, a former ASCE president and the chairman of the board of Delon Hampton and Associates, based in Washington, D.C. "With increased knowledge and skills, young civil engineers will be positioned for leadership roles, will experience greater levels of job satisfaction in public and private practice, and will better serve our clients: humankind."

It is important for civil engineers currently practicing not to worry that this proposed revision to the educational prerequisites will diminish their accomplishments or saddle them with additional educational requirements. These proposed changes to the educational and licensing structures of the profession will take time to implement, and any changes will include a "no harm" policy to protect practicing engineers. Of course a cutoff point—after which civil engineering graduates will be required to earn a master's degree or its equivalent to practice professionally—will have to be set, but that date will most likely be beyond 2020.

"We have a plan for the future," says Russell, "but we need the help of all practicing civil engineers as well as of affected stakeholders in order to make this plan succeed. What can you do to help realize a vital future for the profession? You can accept this invitation to support and help implement ASCE's Policy Statement 465." ■

To read *Engineering the Future of Civil Engineering: Report of the Task Committee on the First Professional Degree,* refer to *(www.asce.org/firstprofdegree/report050701.cfm)*.

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