AC 2008-1122: RESEARCHERS AND PRACTITIONERS: A DUAL TRACK PATH TO TENURE THAT WORKS

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Researchers and Practitioners: A Dual Track Path to Tenure That Works

Abstract

The American Society of Civil Engineers (ASCE) has published the Civil Engineering Body of Knowledge (BOK) for the 21st Century and has produced a draft version of the follow-on BOK II, both which attempt to define the knowledge, skills and attitudes required of a civil engineer. A section of that document addresses who should teach this body of knowledge. It concludes that civil engineering faculty must be scholars, effective teachers, practitioners, and role models. In most universities, practitioners are included on the faculty as adjunct professors. They are paid less and are not viewed as full-fledged partners. The Architectural Engineering program at the California Polytechnic State University in San Luis Obispo is one of the few exceptions where practitioners with a master's degree in structural engineering, a structural engineering license, and a decade or more of experience in industry have an equal path to tenure.

This paper cites the advantages and disadvantages of this program and addresses the most often expressed concerns for this alternative. Such issues as the professional development and scholarship components of the tenure process, the role of consulting, the integration of practitioners into the faculty, the value of their contacts to industry, and the types of classes the practitioners teach are all addressed. The purpose is to describe a model that other universities may wish to consider as the profession debates the CE faculty of the future.

I. Introduction

The American Society of Civil Engineers has defined the Body of Knowledge (BOK) that describes the knowledge, skills and attitudes necessary to become a licensed professional engineer[1,2]. The BOK is presented in the form of 15 outcomes that prescribe the necessary breadth and depth of knowledge required for a practicing civil engineer.

A section of the BOK addresses who should teach this body of knowledge. It concludes that civil engineering faculty must be scholars, effective teachers, practitioners, and role models. While true, there are a number of complex issues that arise such as whether it is possible for one person to possess all of these attributes and whether such a model best serves the projected trends in civil engineering education.

Estes and Welch[3] attempted to identify the most appropriate faculty of the future with respect to each of the required outcomes in the BOK. Their approach is illustrated in Table 1 which lists the 15 outcomes that comprise this body of knowledge. For each BOK outcome, the effort considered four categories of faculty members including a faculty member with only a bachelor's degree, but with at least 15 years of relevant experience as a practicing civil engineer. The bold **xx** indicates that the person is best qualified to teach a particular outcome; a single x indicates

Table 1. Who is Qualified Teacher to Teach the CE BOK

BOK Outcomes		Ph.D. in CE (research)	Masters in CE – some experience	Practitioner (Bachelors (+) 15+ years of experience)	Outside of CE discipline (Ph.D. or Masters)
1	Ability to apply knowledge of mathematics, science, and engineering	X	X	X	**XX**
2	Ability to design and conduct experiments, well as analyze and interpret data	**XX**		**XX**	X
3	Ability to design a system, component or process to meet desired needs	X	X	**XX**	
4	Ability to function on multi-disciplinary teams	X		**XX**	X
5	Ability to identify, formulate, and solve engineering problems	**XX**	X	**XX**	
6	Understanding of professional and ethical responsibility	X	X	X	**XX**
7	Ability to communicate Effectively	X	X	X	**XX**
8	The broad education necessary to understand the impact of engineering solutions in a global and societal context	X	X	**XX**	**XX**
9	Recognition of the need for, and an ability to engage in, life-long learning	**XX**		**XX**	X
10	Knowledge of contemporary issues			X	**XX**
11	Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	**XX**	X	X	
12	Ability to apply knowledge in a specialized area related to civil engineering	**XX**		**XX**	
13	Understanding of the elements of project management, construction, and asset management	**XX**	X	**XX**	
14	Understanding of business and public policy and administration fundamentals			X	**XX**
15	Understanding of the role of the leader and leadership principles and attitudes			X	**XX**

that the person is qualified; and a blank cell indicates that the person is probably unqualified to teach material associated with that outcome.

Estes and Welch[3] concluded that the civil engineering faculty of the future needed to consist of researchers and practitioners to best meet these outcomes. As long as civil engineering remains a profession that many students will join upon graduation, members from industry are needed in the classroom. As students are increasingly required to understand the professional responsibilities facing engineers, the ethical and business considerations of an engineering effort, and the social, economic and political implications of engineering projects, practitioners who have experienced the industry first hand will be needed to teach these subjects. Only a person who has worked on numerous real world engineering projects is best qualified to assess whether a student capstone design project is realistic and relevant.

Since practitioners are needed, then there needs to be a career track where their services can be valued and rewarded. In most universities, practitioners are included on the faculty as adjunct professors. They are paid less and are not viewed as full-fledged partners. Most do not have the Ph.D. credential that accords equal status. For many schools this is a business decision. Research funds the universities and the faculty who bring in the funding should be rewarded appropriately. The Architectural Engineering program at Cal Poly San Luis Obispo is one of the few exceptions where practitioners with master's degrees in structural engineering, a structural engineering license, and a decade or more of experience in industry have an equal path to tenure.

This paper cites the advantages and disadvantages of this program and addresses the most often expressed concerns for this alternative. Such issues as the professional development and scholarship components of the tenure process, the role of consulting, the integration of practitioners into the faculty, the value of their contacts to industry, and the types of classes the practitioners teach are all addressed. The purpose is to describe a model that other universities may wish to consider as the profession debates and discusses the CE faculty of the future.

II. Cal Poly Architectural Engineering Program

The Architectural Engineering (ARCE) Program at the California Polytechnic State University is one of 17 such programs in the country.[4] It is currently celebrating its 60th anniversary and has some unique features that make it ideally suited to accept practitioners as equal partners on the faculty. The motto of the university is learn by doing. The mission statement of the university includes, "as a polytechnic university, Cal Poly promotes the application of theory to practice."[6] The mission of the Architectural Engineering program[7] at Cal Poly is to educate students to enter and be successful in the practice of structural engineering. The ARCE program enrolls 350 undergraduates and started a Master's program with an initial cohort of ten students in Fall of 2007. The ARCE program is located in the College of Architecture and Environmental Design which makes it one of the few accredited engineering programs located outside of a college of engineering. Housed in the same college as the Architecture and Construction Management (CM) programs, there is a wonderful opportunity for interdisciplinary collaboration with those same professions that the students will interact with on real projects in the future. To that end, the ARCE students take four design studios from the Architecture Department and both the Architecture and CM students take a five course sequence in structures from the ARCE Department.

The ARCE program goals align with David Svetlik[5] who wrote, "The goal of engineering education should be to prepare future engineers for rich, fulfilling careers in a rapidly evolving world. Unless the education we provide at all levels includes a realistic assessment of the outside world most of our students will work in, we are not fulfilling our obligations." To meet the objectives of a broad based ARCE program in both theory and practice, the ARCE program has developed two basic tracks for a faculty member:

A. One track is a theoretical track. Characteristic of this track is an earned Doctorate degree in Structural Engineering or a closely related field, along with evidence of scholarly work related to building structures.

B. A second track is based on a background in professional practice in the area of structural engineering or a closely related field. Characteristic of this track is an earned Masters degree in structural engineering, a structural engineering (SE) license and significant structural engineering experience (a minimum of 10 years).

The ARCE full time faculty consists of 13 full time faculty members and is currently conducting a search for two more. The current faculty is a healthy mix of researchers, practitioners and those who could qualify as either – faculty members with both a Ph.D. and significant industry experience. While faculty members are expected to develop professionally and pursue scholarly activities, the major focus is on teaching and the teaching loads reflect that emphasis.

III. Benefits of a Dual Tenure Track System

Table 1 indicates that the benefits of hiring practitioners should manifest themselves in areas such as solving engineering problems, designing systems, understanding problems in a global and societal context, lifelong learning and functioning on interdisciplinary teams. The Body of Knowledge II committee has produced the draft follow-on revision to the BOK and has proposed 28 outcomes that every civil engineer should attain[8]. Most of these outcomes are the result of sub dividing BOK outcomes. The benefits of including practitioners on the faculty can be observed in terms of these outcomes.

a. Curriculum Development

BOK II identifies the outcomes that engineering students should achieve in preparation for professional careers in the 21st century. Yet, at most universities the development and implementation of curricula to achieve these outcomes and to prepare students for professional engineering practice, is developed by tenured / tenure track faculty with little or no professional practice experience.

In the ARCE program at Cal Poly, professional practice tenure track faculty bring years of professional practice experience into curriculum committees and curriculum development.

- **Professional Skills –** Faculty with professional practice experience bring an enhanced appreciation for professional skills to curriculum development such as graphical communication, written communication, oral communication, team work, project management, etc. While these topics are critically important to future success of engineering graduates, they can often be under emphasized in curriculum developed by research focused faculty. Of the 28 outcomes listed in the draft BOK II, ten were classified as professional outcomes.[8] The seasoned practitioner has dealt with these outcomes on real projects under real social, political, and economic constraints and can bring that perspective to the curriculum.

- **Evolving Curriculum to Reflect an Evolving Profession –** There is a natural resistance to change, and this is certainly true in curriculum development. The profession of engineering is evolving, yet the courses taught or the topics covered are often static. Faculty with professional experience bring a perspective on curriculum from outside academia. "If the world needs anything at all, it is for academia to branch out of itself and embrace a larger picture."[5] For a specific example, one practitioner member of the Cal Poly ARCE faculty has been actively consulting in cold formed steel framing systems. Cold formed steel is an evolving state of the art construction type in the large scale residential market on the west coast. The faculty member used consulting work experience to develop a new cold formed steel design course.[9] This Cal Poly ARCE advanced structural elective is one of the few cold formed steel design classes available in the country. Because of the timely, relevant state-of-the-art nature of this course, it may even be exportable to industry through distance learning or otherwise in the future.

- **Focus on Relevant Technical Skills –** Faculty are all faced with an ever increasing amount of information and limited time in designated courses. Faculty members with professional practice experience are able to help guide curriculum development toward topics of greatest relevance to engineering graduates. The ARCE faculty developed five new courses as the ARCE program offered a Master's program for the first time this year.[10] As the course objectives and nature of topics were discussed for these courses the researcher and practitioner members of the master's committee engaged in healthy and productive debate to create courses that contained both technical rigor and practical usefulness. For example, in the finite element course the discussion concerning whether to focus on calculus of variations, shape functions, and error analysis versus topics such as mesh size, element choice and real project application created a balance that will ultimately benefit the students. The ability to offer industry-focused master's projects instead of a traditional research-based master's thesis is available largely because of practitioner presence on the faculty.

b. Systems Design

Entry level engineers should be able to **"**design a system or process to meet desired needs, within realistic constraints such as economic, environmental, social, political, ethical, health and safety, constructability, and sustainability." [8] Most engineering education seems to focus on the analysis or design of components, or small pieces of a system. While a solid understanding of component design is critical to designing systems, a system is more that just the sum of the parts. The layout, configuration, and interaction of the components are all extremely important in the design of a system. This critical system design process is often ignored in engineering education.

The Architectural Engineering curriculum at Cal Poly includes four required systems design courses. Students are required to develop and design structural systems in the each of the primary structural materials considering the effects of framing configuration, layout, cost, constructability, interaction with mechanical, electrical and plumbing systems, aesthetic considerations, coordination with architectural layouts, and sustainability issues. ARCE 452, Concrete Structures Design and Constructability Laboratory, will be specifically examined later in this paper.

These systems design courses are typically taught in a project based studio format by professional practice tenure track faculty with extensive professional experience in the design of systems. Experience has shown that while not impossible, it is difficult for faculty to develop the expertise required to teach a systems design course without the experience of actually designing numerous systems in professional practice. Regarding practical experience, the BOK II states, "Engineering is a profession of practice, so the education process must integrate this experiential component to be successful. You should have an appropriate level of relevant practical experience in the engineering subjects that you teach. Faculty have difficulty being passionate about the subjects they teach or fully communicating the relevance of the topic to students without having appropriate experience." [8] Some would contend that the ABET requirement that those who teach courses that are primarily design in content need to attain professional licensure[12] is sufficient. Many faculty members attain their licenses by studying for and passing the licensing examination. That is a poor substitute for real professional experience.

c. Interdisciplinary Design

Entry level engineers should be able to "function effectively as members of a multi-disciplinary team." [8] The days of engineers working in isolated cubicles are gone. Today's engineers are expected to collaborate effectively with many other design and construction professionals during the development of a project. Research focused faculty have not necessarily experienced the collaborative design process that current engineering practice demands.

Professional practice tenure track faculty bring years of interdisciplinary collaborative experience into the classroom. Within the ARCE program, faculty who have worked together with architects and project managers on real projects understand the roles and dynamics of these professions and are leading the push toward interdisciplinary educational experiences for engineering students. Examples include:

- **Interdisciplinary Entry Level Courses** - Entry level engineering courses within the ARCE program (statics, strength of materials) have traditionally been taught in an integrated format with engineering, architecture and construction students all in the same class. In recent years, the structure of these courses was changed from three 50 minute lectures per week to two 50 minute lectures and a two-hour activity period. The hands-on activities teach engineering principles in the context of architectural form and hands-on construction of physical models. Gravity load flow through a structure, for example, is enhanced by students constructing three-dimensional models of a building prior to performing the calculations. Similarly, physical stick models of space trusses greatly enhance the understanding of the rules governing structural stability. This push towards integration was instigated and guided by the professional practice track faculty in the ARCE program.

- **Interdisciplinary Advanced Design Courses** - Senior level interdisciplinary design courses are being used to instill in students the need for collaboration among disciplines. Drawing on professional practice experiences, these courses have typically been developed and taught by professional practice tenure track faculty with significant professional practice experience. In several cases, the courses have been team taught with faculty from non-engineering majors such as Architecture and Construction Management. The most recent example is ARCE x410, Integrated Building Envelopes[11] , an interdisciplinary building cladding course co-taught by full time faculty members from ARCE (practitioner), Architecture and CM. The course uses REVIT, a state of the art Building Information Management (BIM) software package being increasingly adopted by the building and design industry. The faculty members relied heavily on industry contacts to learn how BIM was currently being implemented.

- **Interdisciplinary Design Principles** - Interdisciplinary design principles are integrated into all design courses. Based on design experience, professional practice tenure track faculty are able to weave interdisciplinary design principles into the design of engineering components and systems. For example, most engineering students learn how to size a beam by checking shear strength, bending strength and deflections. In the capstone ARCE design courses, appropriate beam depths must consider not only engineering criteria but interdisciplinary considerations such MEP system coordination, effects on architectural ceiling height, added cost to increase building height for increased beam depth, etc. The consideration of interdisciplinary criteria in engineering design courses creates an awareness of a total project solution that is typically missing in engineering curricula.

d. Role Models

All faculty can and should be positive role models for students. Professional practice tenure track faculty provide students with a positive role model for their future careers as engineers. The BOK II notes that the first civil engineer that most engineering students encounter will be a faculty member.[8]

Professional practice experience is a key component in serving as an effective role model and mentor for students. Professional practice experience is highly regarded for all faculty in the ARCE program. Faculty with professional practice experience also help link students to industry role models through their industry contacts. This is accomplished through organizing guest speakers, arranging student field trips to various firms, and using industry points of contact to assist with student internships. As the department sought industry feedback on the new masters program and on the ABET program outcomes and objectives, the practitioner faculty organized meetings with the major structural design firms in San Francisco, Sacramento, Los Angeles, San Diego and on the Central Coast. These well attended meetings provided valuable feedback, strengthened the program’s partnership with industry, and provided new candidates for the ARCE Advisory Board.

IV. Drawbacks of a Dual Tenure Track System

Few institutions have chosen to select a dual track tenure system. There are some disadvantages that are greater for some universities than they are for the Cal Poly ARCE program.

a. Research Funding

Cal Poly has traditionally been a "teaching" university with primarily undergraduate programs. While the university is quickly expanding it's masters level programs, the teaching centered focus and "learn by doing" motto are alive and well. Tenure track faculty are expected to complete significant and meaningful professional development and scholarship. Working to their strengths, professional practice tenure track faculty typically focus on the scholarships of teaching, integration and application, rather than discovery[13].

However, many universities currently rely heavily on their tenure track faculty positions for obtaining externally funded research grants. Those grants contribute greatly to funding equipment, graduate student support, and university overhead. Research is also a university's source of prestige and competes with teaching as its greatest contribution to society. Because educating students for the work force is also a major contribution, there is no reason universities cannot do well at both.

Since research helps fund universities, professors who bring in those funds should be rewarded appropriately. Industry sponsored research, which is more likely to fall within the scholarship of application[13] might be quite appropriate for the practitioner. Perhaps a similar model can be established where the practitioner is expected to generate consulting funds and a percentage of those earnings are used as overhead to support the university. The tenure decision could be based on the amount and quality of the consulting in the same manner as research is currently considered for research tenure track faculty. In return, the practitioner is provided equal status, equal pay and equal benefits.

A more workable solution would be for industry to provide endowed professorships for full time tenure track practitioner positions. The professional development expectations for the practitioner faculty would be different; they could potentially assume larger teaching loads; and the arrangement would at least be revenue neutral for the university. Since industry benefits most from having their future employees taught by someone who has had design experience, they have an incentive to participate. Industry can even benefit from the arrangement in secondary and tertiary ways. Nuttall[14], for example, recently noted that the reason building codes have become so complex and difficult to understand is that academics rather than practitioners comprise all of the code committees. Because of the service and professional development requirements for tenure, there is an incentive for academicians to participate on technical committees that industry practitioners do not have. A practitioner faculty member is motivated to join and lead professional society committees and there could be tangible benefits as a result.

b. Promotion and Tenure

Most university promotion and tenure processes require substantial contributions in scholarship, teaching and service with scholarship in the form of published research being the largest component. Under such a system, is it possible for professional practice tenure track faculty to achieve tenure?

At Cal Poly, tenure is based on teaching, professional development, and service. Professional development is more broadly defined to include technical research, educational research, consulting that is brought into the classroom, and contributions to the profession. Since the establishment of formal professional practice tenure track positions eight years ago, the program has had two candidates apply for promotion and tenure. Both candidates were successful in achieving promotion to the rank of associate professor. In fact one of the candidates was promoted one year early and the other candidate was promoted two years early. One candidate has achieved tenure on time (6 year probationary period) and the second candidate is on track to achieve tenure in Fall 2009. It is worthwhile to examine some of the professional development contributions that made these faculty members successful.

One faculty member has maintained his professional connections with a nationally recognized structural engineering firm. He has remained involved as a consultant on real world projects, too numerous to list here, all of which have been integrated into his classroom teaching. The benefits have included guest speakers, field trips, partnerships with industry, and direct integration of case studies into the curriculum. In addition, this faculty member has engaged in research in the areas of special truss moment frame systems and signature energy absorbing walls. He has successfully engaged in activities that leverage all areas of teaching, scholarship and service. One specific example is the Printery Building in Atascadero, California. The faculty member was the lead engineer for assessing the damage and developing the rehabilitation plan for this historic structure that was damaged in the 2003 San Simeon earthquake. As a result of this effort, he was able to use this project as a case study in his ARCE 448 Seismic Rehabilitation course and he arranged several site visits for the students. The faculty member also served as faculty advisor for undergraduate senior projects on the same topic. In addition, he serves as the Chair of the Structural Engineering Institute Design Practices Committee.

A second faculty member has also remained a structural engineering consultant for a world leader in structural engineering and continually brings the lessons learned from real life projects into the classroom. He developed an interdisciplinary senior project incorporating a dozen Cal Poly ARCE students with Iowa State architecture students and presented the results at the ASEE annual convention. He offered case studies from his consulting work with structural engineering firms at the 2003 Architectural Engineering Institute national convention. He has developed a Statics is Your Friend presentation that he has delivered at both the ASEE convention and at Arizona State University. Many of his efforts were made possible through the Professional Development Grant, Innovations in Teaching Grant and the University Summer Services Grant that he applied for and received. In addition, this faculty member develops the material for the California S.E. seismic examination. He is also the Director of the new master's program and navigated the administrative process in getting it approved.

The consulting activities are important for maintaining currency in the discipline, contacts with industry, and the professional practice needs of the profession. Without them, the practitioner faculty member is no longer familiar with the current advances and techniques used by the industry.

c. Doctoral Programs

While professional practice tenure track faculty are highly qualified to teach undergraduate and master's level courses, they are typically not qualified to teach theoretical doctoral courses or supervise theoretical academic research. Cal Poly is a state university that does not have a doctoral program. At universities with a doctoral program, professional practice tenure track faculty would most appropriately be focused on undergraduate courses, master's level courses and applied research projects.

V. A Specific Look at Two Courses

To appreciate the value that a practitioner faculty member brings to the Cal Poly ARCE curriculum, it is helpful to look at two specific courses. The first course is a senior level design laboratory taught almost exclusively by practitioner track faculty. The second course is an advanced technical elective that was co-taught by a practitioner and a researcher.

ARCE 452 - Concrete Structures Design and Constructability Laboratory

ARCE 452 is the capstone design course, of four project based system design courses, required in the ARCE curriculum. These system design courses are critical to the effectiveness of the ARCE curriculum and are ideally taught by professional practice tenure track faculty. The ARCE 452 course content is presented in the context of an open ended student project that spans the entire quarter. Students are required to conceptualize, configure, design, and document the structural system of a multi-story reinforced concrete building. The learning outcomes for the ARCE 452 course are geared toward final preparation of the engineering graduates, not just in technical knowledge, but also in the broader "soft" professional skills required to function effectively.

The ARCE 452 course content builds on student's knowledge of basic reinforced concrete design principles learned in a prior course. In ARCE 452, students configure and design a basic framing system for an entire building for both gravity and lateral loading. This creative process requires students to synthesize the knowledge they have learned in many courses. Students go beyond just the basic element design to consider the interaction of the elements as a global building system. In the process of configuring and designing the system, students begin to recognize the interconnectivity of decisions and the ripple effect that one decision has on many other elements of the building. The meaning of design expands beyond just solving for a required steel area when the load, span, cross section and material properties are given by a professor. Design becomes a creative process with many opportunities and constraints.

The ARCE 452 course content obviously includes many new technical engineering concepts and skills such as shear wall design, diaphragm design, foundation design, etc. In addition, the technical content of the course also includes a healthy dose of constructability, requiring students to understand how their design can be built and ways of simplifying the construction of their design. Students must not only insure that their designs are safe but are also buildable and cost effective. For example, cost and constructability criteria are considered as students determine slab spans, beam spacing, column spacing, formwork configuration, rebar layout, etc.

Another aspect of the ARCE 452 course that is ideally suited for professional practice tenure track faculty is the interdisciplinary aspect of design. The ARCE 452 course requires that students coordinate their structural design decisions with MEP systems, aesthetics, building function, etc. Today's engineer needs to be capable of interacting with many other professional disciplines and evaluating their design in the context of the entire project, not just engineering.

Coupled with the technical course content in ARCE 452, students also learn critical non-technical skills. For example, students learn basic project management abilities as they are faced with multiple inter-related tasks for their project that all need to be completed within a fixed submittal deadline. They are forced to plan, prioritize, understand relationships between tasks, etc. Another non-technical skill that students develop during the course is communication. A great design is of little use if it is not effectively communicated. A key component of the course is the preparation of documents that effectively communicate the design to others. In fact, it is not unusual to have half of the grade in the course directly related to effective communication through drawings, oral presentations, etc.

Professional practice tenure track faculty, with years of experience designing numerous real world projects, are ideally suited to teach comprehensive system design, constructability, and interdisciplinary engineering design principles. Students in engineering design courses benefit from the experience and knowledge that professional practice tenure track faculty bring to the classroom.

ARCE 448 - Seismic Rehabilitation Laboratory

Both professors and students benefit from a faculty comprised of researchers and practitioners as illustrated when two such instructors co-taught the Seismic Rehabilitation Laboratory, ARCE 448. The course focuses on introducing students to the seismic rehabilitation of buildings including understanding basic rehabilitation issues, determining the performance of buildings, relating analysis results to rehabilitation objectives, and understanding options for improving building performance. The majority of the course focuses on three seismic rehabilitation projects. The students are given structural drawings for buildings that either have been or need to be rehabilitated. The projects are

designed to provide hands on experience for students implementing the evaluation and rehabilitation topics covered in the course.

The practitioner's experience in over a decade of seismic rehabilitation projects combined with the researcher's background in experimental testing, analytical investigation, and seismic rehabilitation projects provided a unique experience for the students. The practitioner used his extensive design background to provide students with access to numerous buildings to evaluate for the seismic rehabilitation projects as well as assist students with creating a complete set of drawings including developing practical structural details that can be built in the field. During recent meetings with structural engineers throughout California, complete drawings and practical structural details were considered a major weakness of young engineers. The practitioner faculty member also arranged access for students to local seismic rehabilitation sites on which he is currently consulting. The practitioner routinely fielded questions from both students and his co-teacher about what is typically designed and built in the field such as practical limits on the thickness of shotcrete walls; practical weight/sq.ft. and cost/sq.ft. for steel, concrete, masonry, and timber structures; boundary conditions used to model buildings; and concrete stiffness values used in design offices.

The research faculty member's research/consulting background provided insight for students into the background of FEMA 356, one of the main texts used for the course. These insights included the need for improved allowable deformation values and stiffness values for reinforced concrete members as well as current research topics to improve the seismic rehabilitation document. The researcher also discussed the intricacies of nonlinear analysis of structures with the students, including predicting the displacement response of buildings, which is central to performance based design. The inadequacies of the both the current building code and FEMA 356 displacement predictions were highlighted to prepare students to improve the future prediction of building behavior in earthquakes. The research faculty member also discussed current research on energy dissipating systems including attempts to implement low cost energy dissipating systems in developing countries.

In the final course evaluations, students expressed the value of having two professors bring different view points to the course.

"We were exposed to different ways of approaching design"
"Each professor gave different perspectives on the same topic"
"Each professor brings their own expertise to class, providing more knowledge on a subject"

The balance of practical experience and research experience provided the students with a unique perspective that will help shape how they think and solve problems when they work as professional engineers. Students learned that there is more than one way to approach and solve a problem, a valuable perspective for interacting with building owners, architects, and contractors.

V. Conclusions

This paper discusses the strengths and weakness of a dual track path to tenure where researchers and practitioners can both attain equal status on the faculty. The BOK I and BOK II help illustrate the need for full time practitioner faculty members and the contributions they can be expected to make. The Cal Poly ARCE program was used to illustrate some specific contributions that practitioners make in terms of curriculum development, industry contacts, professional skills, interdisciplinary design and being a role model. There were also some specific examples to illustrate how a practitioner can attain tenure, particularly in the area of professional development and scholarship.

The tenure track practitioner model is very well suited for those universities with predominately undergraduate and masters programs. In order to make the practitioner tenure track faculty a more widely considered option among research focused universities, financial participation from the engineering industry may be required. Nevertheless, the paper suggests how research focused universities can benefit from the addition of tenure track practitioner faculty. The civil engineering faculty of the future needs full practitioner participation to achieve the educational requirements of the 21st century. Students benefit greatly from the practitioner perspective and the industry and the profession will be the big winners.

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