

## **AC 2007-613: PRACTITIONER INVOLVEMENT IN BUILDING A LAND DEVELOPMENT DESIGN EMPHASIS IN CIVIL ENGINEERING: A CASE STUDY**

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### **Howell Simmons, Paciulli, Simmons & Associates**

Howell Simmons is president of Paciulli, Simmons & Associates, a 70 person consulting engineering firm with offices in Fairfax and Leesburg, Virginia. Howell received a Bachelor of Science and a Master of Science in Civil Engineering from Virginia Tech and a Master of Engineering Administration from George Washington University. He is a licensed professional engineer and surveyor in numerous states. He is a retired Colonel, Civil Engineering Officer from the USAF Reserves. Howell has been President of Paciulli, Simmons & Associates since 1980.

### **Derrick Cave, Kimley-Horn Assoc.**

Derrick Cave is a senior vice president and senior project manager with Kimley-Horn. He has more than 19 years of experience in a wide variety of commercial, residential, and industrial land development projects, including highway design and public improvement projects. Derrick serves as a project manager in the firm's land development program for Wal-Mart, and he has been involved in more than 75 Wal-Mart Supercenter sites. He is responsible for all civil engineering services including preparation of site plans; paving, grading, drainage, and utility plans; stormwater management design; sanitary sewer lift station design; and off-site improvements. In addition, Derrick is one of Kimley-Horn's regional practice coordinators within the firm's Wal-Mart development program. Derrick has a BS in Civil Engineering from Virginia Tech.

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Robert F. Jansen is Vice President of Land Development for the Mid Atlantic Division of KB Home. He is responsible for overseeing all entitlement and land development activities for all of KB Home's communities throughout the Mid Atlantic area.

Bob has spent 26 years in the field of Land Development. Upon graduation from Virginia Tech in 1980 with a BSCE, Bob joined the civil engineering consulting firm, Dewberry, headquartered in Fairfax, Virginia. At Dewberry Bob worked in surveying, flood plain modeling and analysis, computer aided design in its infancy and commercial and residential site planning and engineering design. These past 19 years Bob has worked in the homebuilding industry. His primary areas of responsibility have been to oversee the preparation and governmental approval of all preliminary and final engineering plans for residential communities. In addition Bob has

been responsible for the bidding, contracting and construction management of all development operations for residential communities. Bob has overseen the development of some of the largest PUDs in the Washington Metropolitan area such as Laurel Hill and Faircrest in Northern Virginia and Fallsgrove in Montgomery County, Maryland. He was one of the first homebuilders to employ the use of multiple consulting and general contracting firms all collaborating on the same large project in order to expedite its development.

Bob is a registered Professional Engineer and currently resides in Falls Church, Virginia with his wife of 25 years, Anne (a Virginia Tech alumna) and their son Michael (a rising sophomore at Tech studying environmental science).

# **Practitioner Involvement in Building a Land Development Design Emphasis in Civil Engineering: A Case Study**

## **Introduction**

A large team of practitioners has rallied around a call for strong participation in the development of a new emphasis in land development design within a Department of Civil and Environmental Engineering (CEE) at a major land-grant institution. Land development design is the process of planning, design, and construction of infrastructure and facilities for residential, commercial, industrial, institutional, recreational, and governmental projects. Professionals must have strong knowledge about comprehensive plans, zoning, conceptual design, as well as the engineering background in water resources, transportation, environmental, surveying and projects/construction management. While as many as one-half of graduating civil engineers go to work in the land development industry (university placement statistics, 2001-2005), few civil engineering programs in the country have any course or emphasis in land development within their curriculum. This paper presents a case study of an effort to establish a land development design program and describes lessons learned and recommendations for other universities that may wish to initiate a similar program.

Historically, the CEE department has had one course in Land Development Design available for more than 10 years, taught by various adjunct instructors, who were always fulltime practicing professional engineers. Constant turnover in the position was difficult to handle and an adjunct could not expand the course into a program. Recently, a tenured faculty member began to teach the class and initiated a major collaborative effort with practitioners in the state in order to 1) develop a program in land development within the department, and 2) increase student interest in land development as a possible career. The Land Development Design Initiative (LDDI) involves more than 40 engineering and land development firms and directly involves practitioner volunteers in teaching, mentoring, and promoting land development to undergraduate students.

A related issue is the American Society of Civil Engineers (ASCE) Policy Statement 465 "Academic Prerequisites for Licensure & Professional Practice"<sup>1</sup> and its implementation through the Body of Knowledge (BOK) Committee's report, "Civil Engineering Body of Knowledge for the 21st Century"<sup>2</sup>. The BOK report specifically discusses three themes: 1) What should be taught and learned, 2) How knowledge should be taught and learned, and 3) Who should teach and learn the knowledge. The principal effort of the report was to address the "What" while the second two themes will be further developed by ASCE Committees. In its own way, all three of these themes are being developed by the LDDI with regards to the land development area of civil engineering.

The BOK Committee has developed 15 outcomes to define the "what" dimension of the civil engineering BOK (see Appendix A). Eleven of these are taken directly from the Accreditation Board for Engineering and Technology (ABET) and four other outcomes were developed by the committee. In a similar vein, the LDDI group collectively established a list of desired knowledge for civil engineering graduates that would like to enter the land development field (Appendix B). These topics were generalized into seven categories (Planning, Design, Surveying, Environmental requirements, Construction process, Communication, and Application Software). The intent of this list is to focus curricular discussions on providing these prioritized topics to the students.

The remaining themes of the BOK report that are still undefined are “How should the BOK be taught and learned” and “Who should teach it and learn it”. LDDI discussions have focused on various methods of delivery and techniques for the “How” question, realizing that a university degree program spans multiple years and develops layers of knowledge that continue to build throughout a student’s matriculation. As to the “Who” question, the LDDI members are actively collaborating with fulltime faculty as design project mentors and as teams of instructors. The LDDI members have no direct intent to address the BOK Committee’s themes; however, the themes are fundamentally a part of the program as the effort moves forward.

Strategic planning for LDDI began at the start of 2006 with the development of an advisory board and continued with statewide outreach meetings in four major regions of the state. This resulted in over 50 practitioners now participating in this initiative, donating time, energy, and their firms’ resources to achieve LDDI priorities. Participation is kept active by advisory board teleconferences and quarterly meetings, semiannual general membership meetings, email, and a collaboration website that enables sharing files, discussions, and a chat room. LDDI has recently established its own website and is organizing a corporate identity outside of the university. Organization of the LDDI group has resulted in creation of two major committees: Practitioner Involvement and Curriculum and Course Enhancement.

### **Practitioner Involvement**

The goal of the Practitioner Involvement activities is to increase practitioner interaction with the student body in a variety of ways, with the view that more interaction will result in better education about land development and available careers. Many activities are being coordinated through this group:

- An LDDI website has been constructed in order to provide access to valuable student and practitioner information pertaining to land development projects, courses, and careers. The site will be a major benefit to the LDDI group in communicating with the students.
- Two “Land Development Information Night” sessions have now been coordinated, the evening prior to the fall and spring departmental career fairs. Representatives presented information to 15-25 students about the types of projects and careers that are available to students with an interest in land development.
- Three promotional brochures have been developed, one defines land development, and a second describes the LDDI program at the university. A third brochure details various career paths available to graduating students in the profession.
- Development of a “Best Practices for Internships” guidance document is underway to ensure positive internship experiences for both companies and students.
- An LDDI sponsorship plan is being created with the intent of providing a stream of funding for items such as student field trips, website development, newsletter creation, and funded scholarships.

The web site is of particular importance as the effort moves forward as students are more web-oriented than the practitioners. There are several features of the site that are considered vital. The site is providing project summaries of various land development projects highlighting some of the key elements of the project. The web site will also contain alumni biographies of alumni at various

stages in their career (2yrs, 5yrs, 10yrs, 20 yrs, and 30yrs). These biographies give students a glimpse of what they could be doing at those various stages in their career after their graduation. Other important features of the website include videos and web-cams of site development projects and a student resume database.

Practitioners have shown a strong interest in returning to campus to host “Land Development Informational Nights”. Practicing engineers talk about their job experiences and present typical land development projects designed by their respective firms, shaping their presentations to be interactive, allowing the students the ability to pour over plan sets, hold samples of erosion control measures, and ask questions.

The LDDI members have created a document describing the “Best Practices for Internships” in order to set a minimum standard to insure that the students get exposure to a firm’s various activities, and educating them about the relevance of their assigned activities. The major objective of these “Best Practices” is to ensure all land development internships are meaningful to both the student and the employer. Student interns take a brief survey at the end of their intern experience so LDDI can insure each participating firm is striving to meet the intent of these “Best Practices”.

The LDDI Sponsorship program will contain varying levels of participation and primarily become a part of the website. Sponsoring firms will be able to advertise their firm on the web site to gain exposure to the students. A student resume database will also be available to certain levels of the sponsorship.

## **Curriculum and Course Enhancement**

The impact of the LDDI group on the university’s curriculum and course offerings has been significant. Very early in the process, the LDDI advisory board members invested considerable time learning about the departmental curriculum requirements for four specialty tracks and seven group course areas. At the first general membership meeting in June 2006, an explanation of the current curriculum was one of the major topics. These curricular discussions have proven to be helpful in developing new courses as well as developing an understanding that students in a senior elective course such as Land Development Design (CEE 4274) do not bring the same coursework experience into the class. At the first general meeting, plans were made to expand the course offerings with the help of practitioners acting as volunteer instructors and mentors. Action items have resulted in significant accomplishments, including:

- As previously described, the group has assembled a prioritized list of knowledge topics (Appendix B) that are most important to have in a graduating engineer, forming the basis for course objectives.
- The CEE Department has added a land development “group” of courses as one of the group choices that students must choose as part of their curriculum. A handout has been created recommending a group of courses for students interested in a land development career (Appendix C). Discussions are beginning on a possible full curriculum “track” that students could elect.

- Beginning in fall semester 2006 in CEE 4274, practitioners are serving as mentors aiding students in design projects that have five major submissions during the semester.
- In spring semester 2007, an Advanced Land Development Design course is being taught by three teams of practitioners in an alternative class meeting time arrangement where practitioners can come to campus and students can travel to project sites.
- Discussions have begun on the possibility of practitioners helping to teach a junior level “Intro to Land Development” seminar course to show students how exciting the land development career can be.

The impact of having practitioner-volunteers in the classroom has been significant. The last three bullet items listed above have made a tremendous impact on the available coursework and the exposure that students can get to the professionals. The CEE 4274 course covers the process of land development and the basic engineering components necessary for a land development project (See Appendix D for a course description and objectives). Students work in design teams of 4 while working with one mentor from a participating company supplying digital information about a project site, zoning and ordinances, and intended purpose to the team. The students work on 5 major project assignments on one site throughout the semester (feasibility report, conceptual design, preliminary site and roadway design, preliminary stormwater management, final design deliverables). Mentors traveled to campus at the beginning of the semester to meet with the group and explain the project site and constraints. Communication with the students throughout the semester was by email and telephone, while several mentors did have the opportunity to return to campus during the semester. Mentors then returned to campus at the end of the semester for final presentations.

While assessment data was not collected during the first semester (Fall 2006), it is believed that mentoring by practitioners in CEE 4274 has improved the course experience for the students and strengthened the feeling of collaboration between the practicing engineers and the CEE department. Mentors were able to provide input to student questions regarding specific land development design aspects, as well as gain an understanding of the effort required by the students to provide an appropriate solution to the design issues that the practitioners are confronted with on a daily basis. Mentors gained an appreciation of the difference between fulltime employees and students who have simultaneous classes and activities. Mentors have commented on how much material they themselves take for granted that is critical to teach to the students. The students appreciate having professional contact, although some have expressed feeling intimidated by doing schoolwork for a possible future employer. Fulltime faculty have appreciated the mentoring interaction and reinforcement of the need for a strong work ethic and communication skills.

A new special topics course, “Advanced Land Development Design” is being taught in Spring 2007 by volunteer practicing engineers from three LDDI firms (See Appendix D for a course description and objectives). The philosophy of the course is to build complexity from the 4274 course by digging deeper into three particularly important areas. Scheduling has been the most difficult issue to face as all of the volunteers are more than 3 hours from campus. Even though the class meets Friday night and Saturday mornings sporadically throughout the semester, the class size of 10 students indicates a strong desire to learn. A solution for remote teaching is being pursued for next year.

## Recommendations and Conclusions

Seriously involving practicing engineers into the educational process is a time consuming process, but one that has significant benefits for the students, the educators, and the practitioners. The LDDI is a new organization of practitioners and academics at a major university aimed at helping civil engineering students discover the land development profession. This experimental program has produced several excellent achievements to date and the authors offer recommendations for other programs that may follow.

**1. Administrative Support:** Administrative support is critical. In this case, the department head accompanied the faculty for the statewide meetings at the beginning of the project and provided summer support for the faculty.

**2. Communication is key:** Practicing engineers and academics are both overextended in their respective jobs. Faculty need to be prepared to be the instigator of communication at any time using multiple methods.

**3. Find Practitioner Support:** Finding strong practitioner supporters who believe in the mission is critical. Develop these relationships into an advisory board that can help achieve program goals.

**4. Reach out to the students:** Students get excited that the university is bringing in professional engineers to help them learn. They see a program developing and want to be involved.

**5. Adjunct instructors versus fulltime faculty:** Adjunct instructors normally do an excellent job sharing their experience. However, they often have serious time scheduling issues, usually working fulltime and teaching class simultaneously. A faculty-moderated class that involves professionals seems to have more predictable work levels and schedules and students can get the help they need during office hours on campus. Fulltime faculty can give the program a home and a mission.

**6. Keep Professionals' Expectations Realistic:** In the business world, projects can move along quickly when multiple people are working on it fulltime. Students take multiple courses at the same time and are not as mature as their counterparts in industry. Mentors and instructors who are working in the field tend to expect too much from the students and can become disappointed in their efforts.

Through the LDDI, practitioners are now actively involved in formulating curriculum, teaching and mentoring classes, helping to educate students about land development design as a career, and promoting more interaction between the industry and the students. LDDI affords a very interested and motivated industry the opportunity to advance the profession of land development. For years many practitioners in the land development industry felt universities were not addressing the needs of the profession. Many learned the trade on the job, but felt that the universities could improve the educational experience for students who wanted to work in the land development industry. By partnering with a major university, practitioners are making a difference in several ways. While the university benefits from this partnership through an enhanced educational opportunity, the profession benefits by attracting top notch students who are well prepared to enter the land development industry. The collective LDDI effort is addressing the "What", the "Who", and the

“How” issues of ASCE’s Policy 465. With substantial progress in organization and achievements in a year, the future is very bright for this unique effort.

**Bibliography:**

1. ASCE, Policy Statement 465: “Academic Prerequisites for Licensure and Professional Practice”  
[http://www.asce.org/pressroom/news/policy\\_details.cfm?hdlid=15](http://www.asce.org/pressroom/news/policy_details.cfm?hdlid=15)
2. ASCE, “Civil Engineering Body of Knowledge for the 21st Century”,  
<http://www.asce.org/professional/educ/bodyofknowledge.cfm>

## Appendix A

### BOK Committee Recommended Outcomes

- 1 An ability to apply knowledge of mathematics, science and engineering
- 2 An ability to design and conduct experiments, as well as analyze and interpret data
- 3 An ability to design a system, component or process to meet desired needs
- 4 An ability to function on multi-disciplinary teams
- 5 An ability to identify, formulate and solve engineering problems
- 6 An understanding of professional and ethical responsibility
- 7 An ability to communicate effectively
- 8 The broad education necessary to understand the impact of engineering solutions in a global and societal context
- 9 A recognition of the need for, and an ability to engage in, life-long learning
- 10 A knowledge of contemporary issues
- 11 An ability to understand the techniques, skills, and modern engineering tools necessary for engineering practice
- 12 An ability to apply knowledge in a specialized area related to civil engineering
- 13 An understanding of the elements of project management, construction, and asset management
- 14 An understanding of business and public policy and administration fundamentals
- 15 An understanding of the role of the leader and leadership principles and attitudes

## Appendix B

### Suggested Knowledge for Land Development Design (CEE) Graduates

Category/Description	Current Value	Category/Description	Current Value
<b>Planning</b>		<b>Design</b>	
GIS (Geographic Information Systems)	1	Detailed Layout	1
Geometric Layouts	1	Road Design	1
Feasibility Study/Due Diligence	3	Drainage Design	1
Environmental Regulations	1	Floodplain Studies	2
Sustainable Design	3	Stormwater Management	1
Comprehensive Planning	3	BMP's	1
Zoning Process	3	Grading	1
Subdivision Process	2	Water Distribution Design	2
Site Plan Process	1	Earthwork	1
Building Codes	3	Wastewater Collection Design	2
Codes	3	Drawings and Specifications	1
		Cost Estimating	1
		Landscape Plans	3
<b>Surveying</b>			
Boundary Survey - Deed Research, Traverse	2		
Topographic Survey - Photogrammetric Methods, Utility Information	2	<b>Environmental requirements</b>	
Topography, Utilities, Planimetric Features	2	Wetlands	2
GPS (Global Position System)	2	Preservation Areas - Streams, Shores, Trees, Open Space	3
Plat Preparation - Boundary, Subdivision, Easements, Legal Descriptions	2	Chemical Contaminations - Asbestos, Radon, Arsenic, Archeology/Historic, Air Quality, Noise Reduction.	3
Cut Sheet Preparation/Checking	2		
Construction Stakeout - Clearing, Grading, Curb & Gutter and Pavement, Utilities, Building	2	Low Impact Development Development (LID), LEED Certified Design	2
		<b>Construction Process</b>	
<b>Application Software</b>		Erosion and Sedimentation Control	1
AutoCAD	1	SWPPP (Stormwater Pollution Prevention Plans)	2
Excel	1	Engineers role in construction certification	2
ARC GIS	2	Site permits	1
Pond Pack	2	Building Permits	2
HEC-HMS	3	Certificates of Occupancy/Use	2
HEC-RAS	3		
Word	1	<b>Communication</b>	
WaterCAD	2	Listening	1
Culvert Master (Culvert Design)	2	Public Speaking, Technical Writing	1
Win TR-55	1		
Acrobat	2		
Power Point	2		

## **Appendix C**

### **Current Recommended Electives for students interested in Land Development**

Fall 2006

#### **General Civil Engineering**

- CEE 4274\* Land Development Design
- CEE 4204 CAD Applications in CEE

#### **Environmental and Water Resources Engineering**

- CEE 4304 Hydrology
- CEE 4334 Hydraulic Structures
- CEE 4354 Environmental Hydrology
- CEE 4314 Groundwater Resources

#### **Transportation Infrastructure and Systems Engineering**

- CEE 4604 Traffic Engineering
- CEE 4656 Geometric Design of Highways
- CEE 4664\* Pavement Engineering

#### **Construction Engineering**

- CEE 4104\* Estimating, Production and Cost Engineering

#### **Structural Engineering and Materials**

- CEE 3424 Reinforced Concrete Structures I

*\* indicates the course fulfills the Design Project requirement*

## **Appendix D**

### **Course Descriptions and Objectives**

#### **CEE 4274 - Land Development Design**

##### **Catalog Description:**

Overview of land development projects including factors, construction practices, legal issues, and government policies. Design project includes feasibility study, engineering evaluation of site, and layout design of lots, buildings, streets, sewers, etc.

##### **Specific Course Objectives :**

- Learn where to go to find a locality's standards for site and subdivision development and how to interpret those
- Prepare a feasibility study for a land development project.
- Recognize environmental considerations associated with land development projects.
- Interpret and understand topographic maps and prepare grading plans for a site development.
- Design major infrastructure systems for a site, including sanitary, storm, water and roadway systems.
- Develop written and verbal communications to explain and support engineering approaches and concepts.

#### **CEE 4984 - Advanced Land Development Design**

##### **Course Description:**

Three teams of professionals will each teach for a 5 week period (15 contact hours) with the goal of presenting project constraints, issues, and applicable codes, and then giving the student groups a chance to come up with a design that works, while payin

##### **Specific Course Objectives :**

- Learn about the politics involved in turning a land development concept into a constructed project.
- Develop a sense of visualizing design issues and alternatives for a given project site.
- Prepare and present design alternatives for a site designated for a particular type of development.
- Prepare an engineering design with full deliverables for a land development project.