
AC 2011-859: THE LAND DEVELOPMENT DESIGN INITIATIVE

Randel L. Dymond, Virginia Tech

Dr. Randy Dymond is a professional engineer and an Associate Professor of Civil and Environmental Engineering and the Coordinator of the Land Development Design Initiative (LDDI) at Virginia Tech. After obtaining degrees from Bucknell and Penn State, Dr. Dymond has accumulated more than 25 years of experience in civil and environmental engineering instruction, research, consulting, and software development. He has taught at Penn State, the University of Wisconsin-Platteville, and has been at Virginia Tech for 12 years. Dr. Dymond has published more than 40 refereed journal articles and proceedings papers, and been the principal or co-principal investigator for more than 70 research proposals from many diverse funding agencies. His research areas include urban stormwater modeling, low impact development, watershed and floodplain management, and sustainable land development. He teaches classes in GIS, land development, and water resources and has won numerous teaching awards, as well as a second place award in the 2009 NCEES Engineering Competition for Connecting Professional Practice and Education. His latest award is the 2010 National James M. Robbins Excellence in Teaching Award from Chi Epsilon.

The Land Development Design Initiative

Introduction and Background

A large team of professional engineers has rallied around a call for 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 government projects. Land development engineers must have strong knowledge about comprehensive plans, zoning, conceptual design, as well as the engineering background in water resources, transportation, environmental, surveying and project/construction management. While as many as one third 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 describes an ongoing initiative that brings together undergraduate CEE students and faculty with industry professionals in an effort to improve land development design education.

Prior to this initiative, the CEE Department had one course titled “Land Development Design”, taught once per year and it was available for more than 10 years. Historically, this course was always taught by an adjunct instructor, usually a fulltime practicing professional engineer. Constant turnover in the position was difficult to handle and an adjunct could not expand the course into a program. In 2006, the author began to teach the class and initiated a major collaborative effort with practitioners in the state in order to 1) improve land development design education, including increasing student awareness of land development design as a career path, and 2) increase student – practitioner interaction. The Land Development Design Initiative (LDDI) involves more than 70 engineering and land development firms and directly involves industry professionals in teaching, mentoring, curriculum development, and promoting land development to undergraduate students.

Strategic planning for LDDI began in early 2006 with the development of an advisory board and continued with statewide outreach meetings in four major regions of the state. The purpose of these meetings was to share the LDDI vision and recruit industry professionals to participate in development of the land development design program at the University. These early efforts have resulted in over 200 practitioners who now participate in this initiative, donating time, energy, and their firms’ resources to achieve LDDI priorities. Participation is kept active by the advisory board’s biweekly teleconferences and quarterly meetings, semiannual general membership meetings, email, a quarterly newsletter, and a collaboration website that enables sharing files, discussions, and a chat room. LDDI has established its own website as well as a 501 c(3) non-profit corporate identity outside of the University. The creation of LDDI, Inc. provides a means to obtain working capital through various fundraising efforts and streamline procurement and travel expenses outside of university requirements. This working capital is used to directly support LDDI’s primary goal of improving land development design education. Organization of the LDDI group has resulted in the creation of three major committees: Curriculum and Course Enhancement, Outreach, and Practitioner Involvement.

The major objective of the Curriculum and Course Enhancement Committee is to develop a strong land development design curriculum with coursework that prepares students for the land development design profession. The major objective of the Practitioner Involvement Committee

is to develop a strong and sustainable relationship between the private and public sectors of the land development profession and CEE students at the University. The Outreach Committee produces publicity about the profession and the program for students and uninformed practitioners. One of the goals is to increase student awareness of land development as a career path.

The paper describes the development of LDDI, including the support and sustainability of the program with regards to financial sponsorship and academic acceptance.

Curriculum Innovation

Upon creation of LDDI’s Curriculum & Course Enhancement Committee (CCEC), the Committee was given the following charge:

“Develop a strong land development design curriculum and coursework that prepares students for the land development design profession.”

The CCEC is chaired by a professional engineer not otherwise affiliated with the University, and is comprised of other practicing engineers and University faculty. Among the ways the CCEC is improving land development design education at the University are: 1) ensuring that land development design is accepted by the faculty as a “specialty” area within the CEE curriculum, 2) expanding the University’s offering of land development design courses, and 3) making provisions to include practitioners into courses whenever possible.

Recently the CEE Department modified its curriculum away from a “track” system; however, plans had been made to include a land development design track prior to this change. The new curriculum is identical for all CEE students and is based to some degree on the American Society of Civil Engineering’s Body of Knowledge¹. As a general description, students now take 7 of the 8 available junior level fundamental CEE courses for breadth, then choose 3 of these 7 areas and take a second, advanced class, then choose 1 of these 3 areas and take a third (2nd advanced class). Figure 1 illustrates the CEE Electives requirement.

CEE ELECTIVES – 33 CR.: CEE electives have been arranged to ensure adequate breadth of knowledge and depth of knowledge in your disciplines of interest. *Thirty three credits of CEE courses must be selected such that the following four criteria are met:*

- 1) Complete 7 of the 8 fundamentals courses shown in the table below.
- 2) Complete one advanced course in three of the seven specialty areas in which fundamentals courses were selected in (1).
- 3) Complete an additional advanced course in one of the three specialty areas in which advanced courses were selected in (2).
- 4) Within the choices above, you must complete at least one design project course (CEE 3434, 4014, 4104, 4274, 4544, or 4664).

CEE Specialty Areas	Fundamentals Courses	Advanced Courses (courses may require pre-requisites)
Construction	3014	4014, 4024, 4074
Environmental	3104	4104, 4114, 4144, 4164, 4174, 4594
Geotechnical	3514 (Lab)	4514, 4534, 4544, 4554
Land Development	3274	4204, 4264, 4274, 4284
Materials	3684 (Lab)	4614, 4634, 4664
Structures	3404	3424, 3434, 4404, 4424, 4444, 4474, 4494
Transportation	3604	4604, 4624, 4654, 4674, 4684
Water Resources	3314 (Lab)	4304, 4314, 4334, 4344, 4354

Figure 1 – CEE Elective requirements

As a result of the CCEC activities and presentations to the departmental Curriculum Committee, Land Development is now clearly delineated as one of the “Specialty Areas” within CEE. Based on University placement statistics, as many as one third of graduating civil engineering students are employed in the land development industry. The visibility of having a CEE Fundamentals course in Land Development listed on the checklist for all CEE students helps them understand the importance of this area of study.

The overall LDDI curriculum has been expanded to include a number of new courses, all of which include significant practitioner involvement. Prior to creation of LDDI, students at the University had only one land development design course offering (CEE 4274, Land Development Design). Due to the efforts of LDDI, there are now six different course offerings, the design of which included significant practitioner input. These courses are listed below with the frequency of course of offering, followed by a short discussion.

1. Introduction to Land Development Design (CEE 3274, 2x/yr))
2. Land Development Design (CEE 4274, 2x/yr)
3. Sustainable Land Development (CEE 4264, 1x/yr)
4. Advanced Land Development Design (CEE 4284, 1x/alternate yr)
5. Municipal Engineering (CEE 4984, 1x/alternate yr)
6. Geotechnics for Land Development (CEE 4544, 1x/yr)

1. Introduction to Land Development (CEE 3274): Introduction to Land Development is a relatively new class, just put into full production in Fall 2010 with an enrollment of 120 students. The class was jointly designed by the CCEC and included basic topics in land development such as comprehensive plans, zoning ordinances, base mapping techniques, conceptual design, sustainable development, parcel layout, utilities, topography, grading, hydrology basics, and erosion and sediment control. The course included several guest lectures from LDDI’s practitioner volunteers. The course is a prerequisite for Land Development Design.

2. Land Development Design (CEE 4274): This original LDDI course has been substantially modified to further engage industry professionals with students. The senior-level Land Development Design course has long been one of the department’s “design courses”, one of which must be taken by each student as a requirement for attainment of a Bachelor of Science degree in CEE at the University. Students work in design teams of three or four students and are assigned a semester-long design project. Design groups are paired with one or two professional engineers from an LDDI company and they serve as mentors throughout the course on a real project site that the mentor has chosen. The course offering is tremendously popular among students, and typically sees an enrollment of 30 to 40 students per semester. Facilitated by LDDI, course instructors have been able to secure between 9 and 11 professional engineers each semester to serve as mentors to the student design groups. With guidelines provided by the course instructor, mentors select a site that their firm has worked on. The mentor will then provide their assigned group with raw site data including topography, planimetrics, and various design guidance such as zoning and subdivision regulations for the locality in which the site is located. Practitioners typically visit campus during the third week of the semester, and spend a full class period acquainting themselves with their assigned student group and introducing the group to the characteristics of the site on which they will be designing. Throughout the semester,

students and mentors communicate with weekly conference calls, email, and face-to-face meetings. The course does not include a final exam, opting instead to require student groups to give an oral presentation of their final, comprehensive design. Mentors provide feedback on each of the five report submissions throughout the semester and on the final presentations. The involvement of practitioners as mentors supplements traditional classroom instruction by 1) providing a real-world site design experience that is unique to that of other groups in the class, 2) providing technical expertise and design advice that extends beyond that which is possible solely by course instructors, 3) providing constructive criticism and feedback that is used by course instructors in assigning grades to the design project, and 4) reiterating to the students the importance of professional licensure.

3. Sustainable Land Development (CEE 4264): Sustainable Land Development was first offered in the spring 2008 semester as a one credit seminar and has since been expanded to a three credit course offered each fall semester. The course is taught by a licensed professional engineer whose firm specializes in sustainable development projects. In creating the Sustainable Land Development course, the CCEC felt that, due to its specialized nature, the course should be restricted to only those students with senior standing, but open to students from any major. This is important as students will be required to work alongside students from outside of their own major. This “cross pollination” will introduce various perspectives to classroom discussion and better prepare students for their careers where they will inevitably cross paths with professionals from a myriad of academic backgrounds. The Sustainable Land Development course focuses on the developed site’s long term sustainability and preservation of the pre-development quality of its environment. Specific topics include site selection and linkage; development impacts on water, air, and soil; microclimate; industrial ecology and materials; energy; and incentive driven sustainability efforts. The course will also introduce students to third party site evaluation methods including Leadership in Energy and Environmental Design for Neighborhood Development (LEED ND) and Earthcraft Communities. Students visit development projects employing innovative, sustainable design features. The enrollment is typically 30 students per semester.

4. Advanced Land Development Design (CEE 4284): The course is unique in the academic community in that it is coordinated by a tenured University faculty member, but taught exclusively by three teams of industry professionals. This arrangement ensures that course content and structure meets University requirements while simultaneously exposing students to front line issues facing the industry. This course, first offered in the spring 2007 semester, expands upon topics first introduced in the aforementioned Land Development Design course by providing in-depth study of site grading, Americans With Disabilities Act (ADA) site design requirements, erosion and sedimentation control, and stormwater management including application of water quality best management practices (BMPs). The University requires that a three credit course provide students and instructors with 45 contact hours per semester. In order to meet this requirement while accommodating the work schedule and travel time of the course’s practitioner instructors, each spring semester the Advanced Land Development course is offered on Friday evenings (7-9pm) and Saturday mornings (9am-12pm) approximately biweekly. Practitioner teams from three engineering firms divide course content such that each team covers roughly one third of the course material. Despite the non-traditional meeting times, student interest in the course has been strong and the spring 2011 semester has an enrollment of 22 students. Solicited

feedback from recent graduates who have taken the course has been very favorable, with students citing course value in terms of job attainment and easing the transition from an academic to a professional environment.

5. Municipal Engineering (CEE 4984): First offered in Spring 2010 with an enrollment of 30 students, the Municipal Engineering provides students with an understanding of the field of municipal engineering and the important role municipal engineers play in planning and managing large public projects, operating and maintaining public infrastructure, supporting community disaster response, and regulating development through permitting programs. The course has been developed by the CCEC and co-taught by a retired Director of Public Works for a large urbanized County and a Director of Engineering and GIS for a smaller town. The interaction between municipal engineers and land development engineers is significant and is underscored. The course also provides students with exposure to municipal engineering as a career option.

6. Geotechnics for Land Development (CEE 4544): First offered in 2008, the Geotechnics for Land Development course focuses exclusively on geotechnical issues as they pertain to land development projects. Topics include foundations, soil stability, geotextiles, and retaining walls. This course is taught once per year by a tenured faculty in the department.

Modification of the existing Land Development Design course and the development of these new courses has significantly expanded the Department's curriculum and introduced numerous opportunities to bring students together with industry professionals in the formal classroom environment. Working closely with the professional engineering community, this innovative curriculum provides students with a significant jumpstart into the land development profession. One further goal in the curricular area is to work closely with other on-campus initiatives and departments to enable collaborations in the general area of real estate. The new CEE curriculum enables students to take 12 credits of free electives and a slate of related courses in other University Schools and Departments including Architecture and Urban Studies, Building Construction, Landscape Architecture, and Business.

Practitioner Involvement

Upon establishment of LDDI's Practitioner Involvement Committee (PIC), the Committee was given the following charge:

“Develop a strong and sustainable relationship between the private and public sectors of the Land Development Design profession and the students within the Department of Civil and Environmental Engineering. This relationship is intended to create interest and help students prepare for a career in the land development design profession.”

In support of this charge, the PIC initiated a number of activities to build student/practitioner relationships. First, in collaboration with the CCEC, opportunities were found to integrate practitioners into the classroom environment as guest speakers, instructors, field trip leaders, and mentors for design projects. Other ideas were developed to create additional interaction.

- Practitioners began presenting information about the land development industry to students at “Land Development Information Nights”. These information sessions have evolved into very successful social outings between employers and students interested in land development immediately preceding the two annual career fairs.
- A “Young Members” group has formed in order to provide social networking among graduates of the program in regional areas.
- An annual tailgate party has been held at a home football game to promote socializing between students and practitioners.
- The PIC has provided support for the development of a Sustainable Land Development Student Club (SLDC). The purpose of this club is to bring together students with common academic interests and professional goals related to land development. Since its creation in the spring semester of 2008, the SLDC has assembled for numerous social outings, volunteered for a local charity organization, organized field trips to land development sites, performed service design projects, and brought guest speakers to campus.
- The PIC has organized and funded overnight field trips to land development project sites for interested students.
- An internship program has been instituted to encourage pre-graduation employment for students to gain valuable work experience.
- A scholarship program has been initiated and plans are underway to expand the program.

Outreach

One of the early issues of LDDI was getting the message out to students about land development and to practitioners about LDDI. Hence, the charge for the Outreach Committee (OC) covered these major issues:

“Promote the field of land development engineering to students and encourage their participation and support; and promote the Land Development Design Initiative to land development professionals and encourage their participation and support of the program.”

The outreach effort toward students began by making presentations at student meetings such as the student chapter of the American Society of Civil Engineers (ASCE), while the effort aimed at practitioners began by presenting the initial idea of LDDI to practitioners at four regional meetings around the state. As the LDDI effort gained traction, more ideas were developed:

- An LDDI website has been created targeted largely toward students, and it showcases interesting and/or unique land development projects, spotlights the career achievements of land development professionals, contains a student resume bank, and highlights curriculum information and advice. The website also provides an outlet through which LDDI can communicate to industry firms about opportunities for them to become involved with the student mentoring program.
- Social networking has been promoted through use of a Facebook and a Linked-In page.

- Brochures about land development and career opportunities were created for prospective students.
- Quarterly newsletters have been produced since 2007 highlighting the achievements of the program, current events, sponsoring company projects, alumni career, and interviews of Advisory Board members.
- Email “EUpdates” have been sent out to the general email list for LDDI beginning in 2010 to maintain regular contact with interested professionals and students about the events of the program on and off campus.
- During Fall 2010, a series of four outreach meetings around the state were held for the purpose of presenting the achievements and future goals of LDDI to the practitioner community. The meetings have been successful in developing new contacts and increasing the LDDI sponsorship program.

Reaching out to students, alumni, and professionals is a critical piece of the mission of LDDI. It is important to complete the triangle of academic, student, and professional in order for each to have a well-rounded view of the educational process.

Organizational Issues

From the beginning, it was clear that LDDI would only succeed if the industry professionals were enthusiastic and participatory and they certainly have been. An Advisory Board was formed in late 2006 and has grown to 19 members that meet via teleconference biweekly and in person quarterly. The Board is very active and each member serves on one or more of the aforementioned committees. The general membership email list has grown organically to over 220 members and general membership meetings of LDDI are held biannually.

LDDI has consistently enjoyed strong administrative support from the department and the College of Engineering. LDDI is seen as a novel model to develop a new specialty area that has long been needed in civil engineering and one that has drawn significant alumni support during a time of reduced state support. While LDDI is a noteworthy story from the administration’s point of view, it is primarily a curricular improvement effort, rather than a research effort which is the focus of all large universities at this point due to the financial return of the research contracts. Therefore, financial sponsorship of LDDI has become a critical aspect of the organization.

The staffing, scholarships, travel, and other needs of LDDI are substantial. Financial resources for LDDI are provided by the department to some degree in supporting the author to teach two courses per year in the land development area. However, a corporate and individual sponsorship program was started in 2007 with a set of benefits to encourage investment. A current drive to provide sustainable support in the form of endowment money is underway.

Conclusion

A major collaborative effort between professional engineers, faculty, and students has produced a unique and innovative program in land development design within the civil and environmental

engineering department at a major land grant university in the US. LDDI has made tremendous strides in educating students about land development as a career opportunity, developing a meaningful curriculum, and has involved the practitioner community in every step of the process.

Prior to LDDI, there existed one land development design course in the Department, offered only once per academic year. The efforts of the CCEC have resulted in the development of a Land Development specialty area and a total of six related courses, all of which actively engage industry practitioners in the classroom to some degree. LDDI's practitioner mentorship program is tremendously popular among these students, with roughly 40% of graduates electing to take the senior-level Land Development Design course. The course's popularity among students can be viewed as a success in terms of LDDI's mission to improve student awareness of land development design as a career path and to actively bring together students and industry professionals.

LDDI's practitioner involvement committee facilitates numerous events each semester that bring students together with industry professionals. LDDI-sponsored information sessions provide an opportunity for students and practitioners to meet, mingle, and discuss the land development profession. The new Sustainable Land Development Club continues to grow and build a network among students that will carry forward as they move into their professional careers. The website, brochures, newsletter, and regular emails to the general membership have proven to be very effective in building a true sense of purpose within the professional engineering community and has provided students with bonds to this community that are proving to be long lasting.

LDDI is making a significant impact in the lives of our students and providing a means for our profession to be integrated into the educational process of our next generation of engineers. The program has achieved strong financial support, even during this difficult economic time, attesting to the strong belief in the program from the professional community. Perhaps most flattering to those who have made and continue to make LDDI a reality were comments received during the fall 2008 ABET accreditation review of the Department, where the lead reviewer mentioned LDDI as one the major highlights of the department.

Bibliography

1. ASCE, Body of Knowledge for the 21st Century, 2nd edition, ISBN-10:078440965-X, 2008.