

## **Undergraduate Student Research in Construction Engineering: The Current Status**

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### Abstract

Undergraduate student research is common in schools of liberal arts and sciences but is not in undergraduate schools of engineering. In schools of engineering technology, undergraduate student research is limited. Student research at the undergraduate level is gaining ground in schools of engineering where faculty are engaged in research and a structure in their curriculum exists whereby students can get credit toward their degree requirement. Unlike programs in civil and environmental engineering, programs in construction engineering and construction technology are not keeping pace with undergraduate research. Evidence of undergraduate research in construction programs is limited. In order to keep research in construction engineering at the forefront, and to keep it at a level that construction discipline attracts the same caliber of students as does civil engineering, it is important that faculty in undergraduate programs in construction provide students the opportunities to do research and to present their findings in regional or national meetings. This paper presents guidelines for developing a structure in engineering and technology curriculums to create room for students to do research. Such a structure will enable students to present their research in a variety of forums at the local, state, or national level. Some examples of undergraduate research are provided to reflect on the current status of undergraduate research in construction engineering.

### Introduction

In January 1999, I came across an announcement concerning research opportunities for undergraduates in civil engineering and geological sciences at the University of Notre Dame. The announcement said, "During the summer of 1999, we will again be offering outstanding undergraduates the opportunity to participate in the research of the faculty." I had received a similar announcement the year before.

During the last several years, the Department of Civil Engineering and Geological Sciences at the University of Notre Dame has invited students with strong backgrounds in engineering or an appropriate field of science to participate in their Undergraduate Research Experience (REU) program. Ten to twenty-four students have participated every year in the REU program. The REU program is an eight-week summer experience. Participants receive a stipend of \$3000 for the period as well as travel and housing allowances. Indeed it is an opportunity of a life time.

I had a similar experience of undergraduate student research at the University of Missouri where students engaged in research with their faculty presented their work. One of my undergraduate engineering technology students also presented but it was not research, but a paper dealing with the work that he had done in a construction company as a part of his part-time job. A couple of

years before that, another engineering technology student of mine presented the results of a research paper dealing with concrete engineering at the Missouri Academy of Science. Similarly, another student of mine who had worked on a local engineering study, presented his results as a part of his Honors Program curriculum.

Undergraduate student research is not common in schools of engineering, and it is limited in schools of engineering technology. In schools of engineering, students wanting to go to graduate school, have an option at the undergraduate level to take a graduate-level course, which also counts toward their undergraduate degree thus allowing the student dual credit. Students while getting the credit for the course also get a very worthwhile research experience.

This paper addresses some issues related to undergraduate student research, and provides guidelines to establish a structure in undergraduate curriculums in construction engineering and construction technology programs which would allow all students to get exposure to undergraduate student research.

### Research in Construction Programs

Construction programs, because of the applied nature of the discipline itself, provide students with an interesting set of research topics. With a little guidance from the faculty, and a little initiative from the students themselves, all students can get elective course credit for research because there are seldom any programs that do not have an in-built elective credits in the structure of the curriculums.

The Council on Undergraduate Research (CUR) offers an excellent model to follow. CUR helps to strengthen the research programs of faculty members in predominantly undergraduate institutions and promotes research by undergraduate students with faculty in all settings of science, mathematics, and engineering education. CUR believes that “education is best served by faculty-student collaborative research combined with investigative teaching strategies.”<sup>1</sup> CUR provides avenues for faculty development and helps administrators to improve and assess the research environments of their institutions. CUR generates awareness and national support for undergraduate research.

The University of Wisconsin-La Crosse has very definite Undergraduate Research Day presentation guidelines for students.<sup>2</sup> In their introductory portion of the document, it says, “For many of you, the presentation you make at the UW-L Undergraduate Research Day will be one of your first “professional” presentations.....The main guiding principle that you should follow in preparing your presentation (and in writing your final written report) for the UW-L Undergraduate Research Program is simply to follow the standard seminar/exhibit/poster format that is commonly utilized at professional meetings within your field." In this context, undergraduate students being inexperienced, faculty have a tremendous obligation to guide students in a simple and sequential manner.

The students from the Division of Liberal Arts and Sciences at Missouri Western State College, participate in Undergraduate Research Summer Institute (URSI); they also participate in Missouri Academy of Science. The participation of engineering technology construction

students, is currently limited but is being encouraged by the Dean of the Division of Professional Studies. In the URSI program, each year 8-10 students earn \$500 to work on summer research projects under the guidance of the collaborating faculty.

Due to the growing understanding all across the country of the value of providing research experiences for undergraduates beyond the walls of the traditional classroom setting, Missouri Western is moving ahead with establishment of a program called, “The Exploration and Discovery (E &D) Program.” The emphasis of the E&D program is on broadening the opportunities for students and faculty to engage in independent learning activities, such as independent student projects. The construction engineering technology students will be encouraged to participate in this model of research.

### Guidelines for Undergraduate Research in Construction

It is common knowledge that engineering attracts high caliber students. High school students who choose to follow engineering as a profession have good ACT and /or SAT scores in sciences and mathematics. Given the right environment, and academic support, they have the potential to do research. Civil engineering programs attract a large number of students, and there is no dearth of potential of undergraduate student research. However, the number of undergraduate programs in construction engineering are limited. The pool of undergraduate construction engineering students is also smaller.

Undergraduate construction technology students are recruited from a wide variety of sources. Some of them come from high school, some from vocational schools, some from industry and are pursuing college on a part-time basis, and some are transfer students from schools of engineering. The transfer students from schools of engineering do not have affinity for theoretical aspects of engineering sciences, and as such are attracted to applied aspects of engineering technology degrees.

To establish an appropriate structure for undergraduate student research program in a college or university, the following steps can be used as a guide:

1. Establish a curriculum in which there is room for electives. In a 124-hour curriculum for an engineering technology degree, or a 135-hour curriculum for an engineering degree, allow as a minimum, six hours for electives in the major field.
2. Offer Independent Research Projects to be used as electives toward the degree requirements.
3. Offer Research Methods course in the freshman or sophomore year, or include basics of research methodology in some freshman/sophomore course. This course should expose students to research methodologies, statistical and experimental design of experiments, report-writing and oral presentations, and familiarity with exhibits/posters.
4. An undergraduate senior seminar or the capstone course in the curriculum can be used as an avenue for student-faculty research.
5. The institution, the department, and the collaborative faculty should take initiatives and find funding for students to travel and present at professional meetings.
6. Establish Undergraduate Student Research Day on campus where students can showcase their research.

## Conclusion

The benefits of undergraduate student research are many. It allows undergraduate students to experience the joy and challenge of doing research on a topic of interest to them. It encourages independence. It lets students explore the depth of their interest in their field of study. The current status of research at the undergraduate level is less than exemplary. One of the goals of the newly-established Construction Institute of the American Society of Civil Engineers is, “Promote Research related to construction process, the application of appropriate materials, and the transfer of practical information to the construction practitioner.”<sup>3</sup> The students have ample opportunity to take initiatives, and the academic institutions should provide funding and avenues to support student-faculty initiatives in the area of undergraduate research. Institutions should take aggressive steps to hire faculty who demonstrate interest in undergraduate research. Such efforts will attract high-caliber students to construction programs, and will definitely advance the ideals of the construction profession.

## Bibliography

1. Council on Undergraduate Research, Washington, D.C.
2. University of Wisconsin-La Crosse Undergraduate Day Presentation Guidelines
3. ASCE News, December 2000 Volume 25, Number 12, p. 1, and p. 2.

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