

Summer Internships for Engineering Technology Students: Sharing the Experiences

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Abstract

Students in engineering technology programs seek summer employment opportunities to expand their education, provide work experience, and assist in financing their education. Consulting firms, public agencies and contractors provide the majority of summer employment opportunities for students. The variety of students and summer employment opportunities results in a range of student experiences. Assessing the advantages and disadvantages of different summer employment opportunities from student and faculty perspectives can help students pursue opportunities most appropriate for their career goals. In addition, faculty can better advise students on summer job opportunities to suit student academic and professional needs. Student feedback was obtained to assess summer employment experiences and quantify the resulting learning experiences. The interactions between student learning experiences in the classroom and in their summer jobs are assessed and discussed. Suggestions for advising students on summer job opportunities are also presented.

Introduction

Civil Engineering Technology (CET) students at the University of Pittsburgh at Johnstown take advantage of summer employment opportunities within their major to provide work experience in their field of study and assist in financing their education. Some students find positions with consulting firms or contractors. A large number of students however, take advantage of the Engineering, Scientific, and Technical Internship (ESTI) program sponsored by the Pennsylvania Department of Transportation (PennDOT). Students completing their freshman year in Engineering Technology are eligible for the program. PennDOT Interns work on various projects throughout the state. Most are assigned to inspection positions on construction field projects near their homes. Advantages of this program are the professional work experience, the minimum amount of education required to qualify, and the above average pay rate with potential for overtime.

Previous discussions with students suggested the educational experience as a PennDOT summer intern varies greatly depending on the assignment as well as the student. Some students find the experience rewarding. Others have felt their assignment was less challenging. However, considerably lower pay and locations away from home often deter students from considering more challenging summer jobs with consulting engineering firms. As a result, some choose the PennDOT program for financial reasons and convenience, rather than for the challenge of the work experience.

In other cases, students participating in the PennDOT summer internship program are exposed to new knowledge that will be covered in their courses the following year. This can benefit the student, as well as others in the class. Knowledge gained by one student through summer experiences can be shared with others during collaborative learning exercises in a team-based

environment. Other summer experiences require use of knowledge from prior courses. Occasionally faculty have been told that procedures taught in the classroom differ from those used by students during the summer, resulting in confusion for students.

Students with summer jobs in consulting engineering have a variety of experiences, as well. Often paying less than the PennDOT program, summer jobs in consulting can provide valuable experience for students. Consulting work is often based in the office and involves design and calculations. PennDOT positions usually are field oriented involving more construction inspection.

To assess the summer work experiences of CET students, a questionnaire was developed and distributed to sophomore through senior CET students. Completion of the questionnaire was required to receive credit for attending a particular session of the weekly CET seminar course.

Student Questionnaire

The questionnaire was designed to obtain feedback regarding the summer work experiences between the freshman and sophomore year, the sophomore and junior year, and the junior and senior year. Current sophomores therefore only had to complete the first part of the questionnaire. Juniors had to complete the first and second part, while seniors would likely complete all three parts of the questionnaire. If students had essentially the same job each summer, they were allowed to note that on the questionnaire. It was hoped that they would reflect on their experiences each summer individually, relative to their academic level at the time. A copy of the questionnaire is included in the Appendix.

A total of 62 students completed the questionnaire. Table 1 presents the breakdown of the academic level of the students.

Table 1. Current academic level of students completing the questionnaire

Current Academic Level	Number of Students
Sophomore	20
Junior	22
Senior	20
Total	62

Summary of Results

Students reported a total of 107 summer employment experiences. Sophomores have only had one summer work experience. Juniors and seniors have two or three summer work experiences. Not all juniors and seniors reported a work experience for each summer, and it is assumed they did not work during those summers. Of the summer work experiences students reported, 41% of the experiences were in the PennDOT Internship program. Figure 1 and Table 2 summarize the distribution of summer work experiences of the students.

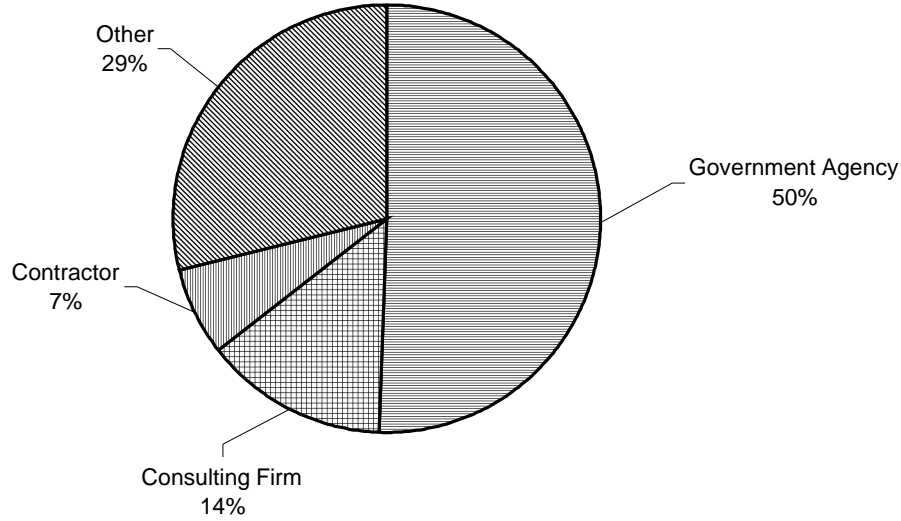


Figure 1. Summary of student summer work experiences

Table 2. PennDOT Summer Internships compared to other employment

Current Academic Level	PennDOT Internship	Other Employment
Sophomore	6	14
Junior	16	23
Senior	22	26
Total	44	63
Percent	41 %	59 %

As can be seen in Figure 1, half of all summer jobs were with government agencies. Most of these were with PennDOT. Almost 30% of summer jobs were not related to engineering.

The majority (71%) of summer experiences lasted 16 weeks. Students found summer jobs primarily through friends, relatives, and previous employers, as well as on their own. Few student jobs resulted from interaction with a speaker in seminar or were found on the on-line.

Students indicated the main reason for accepting a job was to gain work experience. Location and rate of pay were also important considerations for students. Table 3 presents the reasons indicated by students for accepting a summer job.

Table 3. Summary of main reason for accepting a summer job

Main Reason for Accepting Summer Job	Number of Responses	Percent of Total
Location	31	28.4
Pay Rate	30	27.5
Work Experience	45	41.3
Other	3	2.8
Total	109	100

Students indicated the approximate breakdown of the work performed as part of their summer experiences. The largest proportion of student work involved construction inspection. Physical labor and surveying also were common. Table 4 summarizes the breakdown of student job duties during summer employment.

Table 4. Summary of student job duties during summer employment

Job Duty	Average % for All Academic Levels
Design	10.3
Inspection	39.3
Surveying	13.1
Labor	16.8
CAD	4.7
Administration	6.5
Other	9.3

The job duties performed by students varied depending on the student's academic level. Figure 2 shows the variation in job duties for sophomores, juniors and seniors.

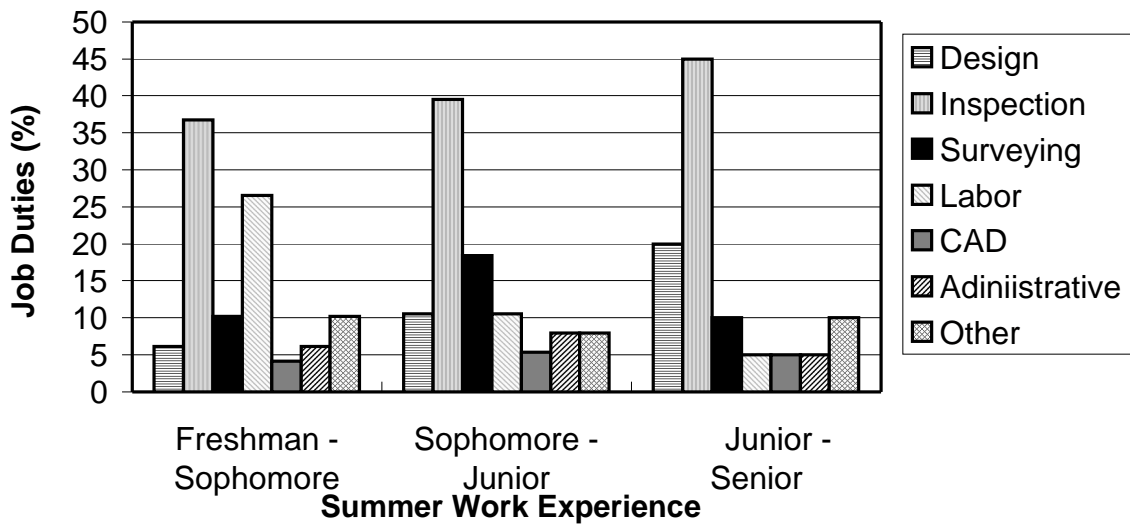


Figure 2. Variation in job duties depending on academic level

As can be seen in Figure 2, inspection duties are significant portions of summer work duties for students at all academic levels. Summer jobs involving physical labor are more common between freshman and sophomore year, than in subsequent summers. This seems reasonable since during the first summer of employment, students have little academic background to perform other duties. Design work is not all that common for students, although it does increase with increasing academic level.

Students also indicated which courses helped them most in performing their summer jobs. Table 5 summarizes the courses most commonly cited by students at the different academic levels.

Table 5. Summary of courses most commonly cited by students as helping them perform their job duties

Summer Work Experience	Courses	% of Students
Freshman – Sophomore	None	31.7
	Sciences	34.1
	Surveying	9.8
	Drawing	17.1
Sophomore - Junior	None	7.1
	Surveying	35.7
	Drawing	11.9
	Computer	21.4
Junior - Senior	None	5.3
	Highways & Transportation	23.7
	Surveying	18.4
	Steel & Concrete	18.4
	Hydrology & Hydraulics	13.2
	Soils	10.5
	CE Materials	5.3

In the summer following their freshman year, about one-third of students felt that their basic science courses (chemistry, physics, calculus) helped them perform their job duties. Close to one-third of the students felt they used none of their courses from freshman year to perform their job. As expected, students at higher academic levels used more of their academic background during summer jobs. Surveying was the course most noted by students as being used in performing their duties in summer jobs.

Students were asked to indicate the approximate percent of their academic background necessary to perform their job. The average response varied with the academic level of the students at the time of the summer work experience. Most students between freshman and sophomore year felt they did not need any academic background to perform their job. On average, these students felt less than 20% of what they learned in school was actually used on the job. In subsequent summers, as students completed more courses within their major, students used more of their academic knowledge in their jobs. Figure 3 summarizes the average student response.

Students were also asked to indicate the approximate percent of what they learned during a summer job that they used in subsequent courses. A summary of the average results is presented in Figure 4.

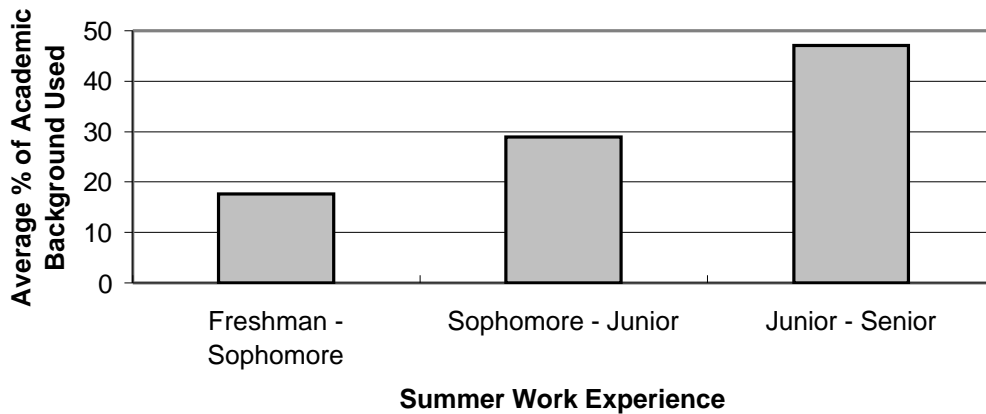


Figure 3. Summary of student response on average percent of academic background used

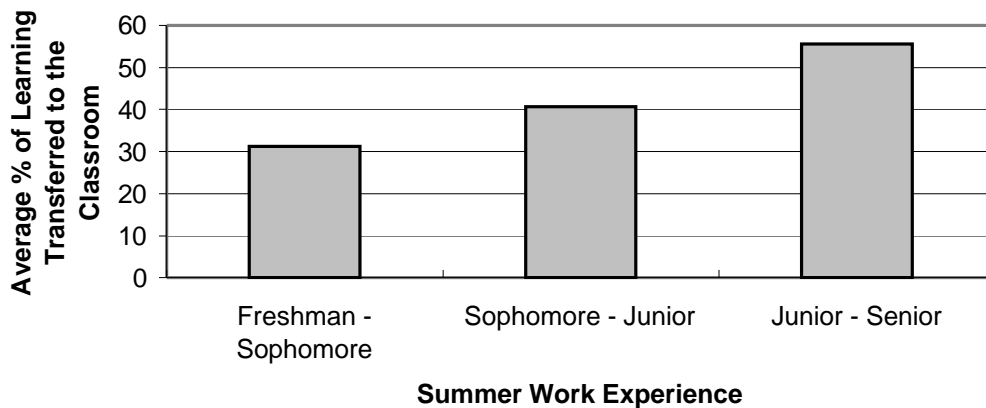


Figure 4. Summary of average student response on percent of learning on the job transferred to the classroom

As shown in Figure 4, with increasing academic level, students utilized a greater percentage of summer work experiences in subsequent courses. More than half the students feel they used less than 20% of what they learned on the job during the summer after freshman year in subsequent courses. On average, students indicated that only about 30% of their work experience during that summer helped them in subsequent courses. Students found summer work after the sophomore and junior year provided more experiences that could be transferred to the classroom. About half the students believe they have used more than 60% of their work experience gained during the summers between their sophomore and junior and junior and senior years in subsequent courses. An average of about 40% of the work experiences from the summer after sophomore year were related to subsequent courses, while about 55% of the work experiences from the summer after the junior year were relevant in subsequent courses.

Overall, most students indicated their summer work experiences helped them in subsequent courses. The courses most often mentioned were highway design, and surveying. Soil

mechanics and foundations, construction management, and concrete and structures were also mentioned, though less frequently.

Over 75% of students indicated they had a mentor or trainer as part of their summer employment experience.

Students were asked to quantify the value of their summer work experiences relative to several different criteria. Evaluation of each criterion was based on a scale of 1 to 5. Table 7 summarizes the criteria and average student response.

Table 7 Summary of evaluation criteria and average student response

Criteria	Freshman – Sophomore	Sophomore - Junior	Junior – Senior	Average Response All Summers
Challenge of Summer Work (1 Not Challenging – 5 Very Challenging)	2.65	2.87	3.30	2.86
Benefit of Experience Relative to your Major (1 Not Beneficial – 5 Very Beneficial)	3.10	3.40	3.55	3.29
Benefit of Experience Relative to your Interests within your Major (1 Not Beneficial – 5 Very Beneficial)	2.92	3.26	3.45	3.14
Extent to which your Work Experience was Shared with Others in Your Courses (1 No Sharing – 5 Much Sharing)	2.78	2.74	3.05	2.81
Pay Relative to Other Summer Jobs you Could Have Gotten (1 Much Lower – 5 Much Higher)	3.88	4.13	3.90	3.98

This table shows that the challenge of summer jobs increased slightly with increasing academic level. Overall, students generally find the challenge of their summer jobs only slightly above average. Students find the benefit of their summer job experiences, relative to their major, as above average. When considering their particular area of interest within the CET field, generally

they find their summer jobs to be above average, but not as beneficial as they are to the general CET field. This indicates student summer jobs tend not to correspond as well with the specific career interests of students. Students tended to be slightly above average regarding the sharing of their experiences from summer work experiences with others in the classroom. The amount of sharing increased slightly with increasing academic level. Sharing of experiences from summer jobs could possibly be improved through encouragement from faculty in class. Most students feel that the pay rate for their summer jobs has been well above what they would have been paid in other possible jobs.

More than 75% of students have been happy with their employers and would recommend them to others. They also would recommend the particular summer job they had. The main reason for recommending the employer and job was the ability to get real-world work experience. Students also noted they would recommend the employer due to the respect shown and the pay rate. Students who would not recommend an employer or summer job to others generally had jobs that were not related to CET.

Students were asked how the CET department might better prepare students for summer jobs and internships. Students noted that the CET department should make students aware of available summer internships and summer jobs. They thought talking more about internships in seminar and having students give presentations on their summer experiences would help. Some felt that faculty should place more emphasis on practical, real-world problems, rather than theory. Others noted that equipment used in class should be upgraded to correspond with what they will use in industry. Some felt that students need more opportunities for developing interpersonal and communication skills, rather than technical skills. Some feel discussing issues related to bidding and contractors would be helpful.

Students were also asked to comment on what ways summer employers can coordinate better with the CET department regarding summer jobs and student preparation. Students felt employers could communicate with the CET department about summer job openings. They also would like employers to continue to give presentations in seminar. Students would like to know more about the jobs and projects they will work on. They suggest employers provide clearer job descriptions and be more specific about the qualifications needed. Some noted they would like to see the plans of the jobs they are working on. One suggested having both students and employers fill evaluation forms about their experiences.

Students were also asked for any additional comments regarding summer jobs, internships, and co-ops. Most of the comments regarding summer employment experiences were good. Some sophomores noted that with only one summer work experience, it was difficult to objectively evaluate the value of their experience. One student noted that even though one summer job was mostly physical labor, it was still a useful experience. It may help develop an appreciation of construction methods and how things get put together. Some students indicate they hope their summer jobs result in permanent employment offers after graduation. One student noted that their work experience in the private sector was more challenging than their previous experience as a PennDOT Summer Intern. Another stated, however, that not all their experiences with PennDOT were the same. They found their last experience with PennDOT to be the most

educational. One student commented that their employer did not pay well but the job provided experience.

Other students had comments that were not so good regarding summer employment. One student stated their summer job helped them decide that they were not in the field that they really want to pursue as a career. Hopefully this was the right decision for the student and not just the result of one bad summer work experience. Another student noted the engineering consultant they worked for did not know how to deal with or train an intern. The firm had a lot of work but no one knew how to utilize the student.

Conclusions and Recommendations

The foregoing discussions assessed the advantages and disadvantages of different summer employment opportunities at UPJ from student perspectives. The study revealed a number of problems in the planning of current summer internships due to lack of coordination and advice including:

- Almost a third of summer internships were non engineering. Many students lost the opportunity to get closer to their future potential careers in engineering technology.
- Labor work was the primary duty for about 17% of students including some seniors. Many of these students were after the high pay rate and were unaware of the opportunities available to them that pay as much or even higher with PennDOT and other engineering employers.
- The majority of students select their summer jobs based on their own individual efforts with advice mostly from nonprofessionals such as a relative or a friend.
- The sharing of good summer experiences with other students and faculty has been relatively limited and requires further attention.

It is recommended that the CET get more involved in advising and coordinating efforts leading to summer internships. Development of a summer internship program is perhaps the answer. Similar regional campuses have experienced a success in developing such programs. ⁽¹⁾

The program would emphasize the importance of a relevant summer experience to student's current program and future career. Any type of summer work may be useful experience but quality or effective internships enable students to "learn how to learn" in ways that are highly applicable in their future work environment not otherwise attainable in classroom learning. ⁽²⁾ Even improving the grade point average as students gain appreciation to learning from summer internships has also been reported ⁽³⁾

Any proposed advisory internship program should insure continuous two-way communications with summer potential employers especially PennDOT. A key to the success of an internship program is the assessment when both students and employers provide feedback about their experiences to improve such a program in addition to matching students' interests, qualifications, and skills with the host companies interests and needs. ⁽⁴⁾

The CET may also explore and assess other approaches to bring industry closer to the students such as a Guest Lecture Program, the use of the Internet, and special field trips. ⁽⁵⁾ In addition,

the program will find ways to increase the sharing of summer experiences with other students and faculty for optimum benefits to students and the CET program.

Appendix

TO: CET Students

FROM: Professor Rose
Professor Murad

SUBJECT: Questionnaire on Summer Employment Experiences of CET Students

DATE: November 29, 2001

We are in the process of preparing a conference paper on summer employment and internship experiences of our students. The attached questionnaire is needed to obtain feedback from you so we can assess the variety of different summer employment and internship experiences our students encounter. This will assist us in preparing the paper and provide information for the CET faculty to utilize in advising students regarding summer employment and internship opportunities that best meet their needs and interests.

Please complete the attached questionnaire and return it to either of us in class, or place your completed questionnaire in one of our mailboxes in the Engineering Technology office by 5 PM, Monday, December 3, 2001. Please complete a separate form for each of your summers while you have been a student at UPJ. Do not worry if you do not remember all the details. Answer all questions to the best of your ability. Please provide any additional comments at the end of the forms. If you have done a co-op or a formal internship, as well as held traditional summer jobs, please compare your experiences in Number 4.

We appreciate your completing this questionnaire and will share our findings with you in seminar next semester.

Summer Internships/Job Questionnaire

1.0 Summer between freshman and sophomore year

1.1 Employer and Location:

Type of Employer: Government Agency, Consulting Firm,
Contractor, Other:

Employment Duration (weeks)

1.2 How did you find this job?

Indicate the MAIN reason for taking this job.

Location, Pay Rate, Work Experience, Other:

1.3 Description of work/duties you performed:

1.4 Indicate the approximate % of your job duties:

Design Inspection Administration
Other (describe)

1.5 List courses/subjects that helped you perform in this job:

1.6 Indicate the approximate % of college academic background needed for you to perform your job:

1.7 Indicate the approximate % of what you learned from this job that you used in subsequent courses:

1.8 List the courses/subjects this job helped you understand better:

1.9 Did you have a mentor or trainer to help you understand and perform your job duties?

1.10 In what ways could the CET Department better prepare students for summer jobs?

1.11 In what ways could summer employers better connect to or coordinate with the CET Department regarding student preparation?

1.12 Indicate the relative value of this summer work experience:

Challenge of Summer Work

1 2 3 4 5
Not Challenging Very Challenging

Benefit of Experience Relative to Your Major

1 2 3 4 5
Not Beneficial Very Beneficial

Benefit of Experience Relative to Your Interests within your Major

1 2 3 4 5
Not Beneficial Very Beneficial

Extent to which Your Work Experience Was Shared with Others in your Courses

1 2 3 4 5
No Sharing Much Sharing

Pay Relative to Other Summer Jobs You Could Have Gotten

1 2 3 4 5
Much Lower Average Much Higher

1.13 Would you recommend this employer to someone else?

Why or why not?

1.14 Would you recommend this summer job/internship to someone else?

Why or why not?

1.15 Additional Comments

2.0 Summer between Sophomore and Junior year

2.1 Employer and Location:

Type of Employer: Government Agency, Consulting Firm,
Contractor, Other:

Employment Duration (weeks)

2.2 How did you find this job?

- Indicate the MAIN reason for taking this job.
 Location, Pay Rate, Work Experience, Other:
- 2.3 Description of work/duties you performed:
- 2.4 Indicate the approximate % of your job duties:
 Design Inspection Administration
 Other (describe)
- 2.5 List courses/subjects that helped you perform in this job:
- 2.6 Indicate the approximate % of college academic background needed for you to perform your job:
- 2.7 Indicate the approximate % of what you learned from this job that you used in subsequent courses:
- 2.8 List the courses/subjects this job helped you understand better:
- 2.9 Did you have a mentor or trainer to help you understand and perform your job duties?
- 2.10 In what ways could the CET Department better prepare students for summer jobs?
- 2.11 In what ways could summer employers better connect to or coordinate with the CET Department regarding student preparation?
- 2.12 Indicate the relative value of this summer work experience:
- Challenge of Summer Work
 1 2 3 4 5
 Not Challenging Very Challenging
- Benefit of Experience Relative to Your Major
 1 2 3 4 5
 Not Beneficial Very Beneficial
- Benefit of Experience Relative to Your Interests within your Major
 1 2 3 4 5
 Not Beneficial Very Beneficial
- Extent to which Your Work Experience Was Shared with Others in your Courses
 1 2 3 4 5
 No Sharing Much Sharing
- Pay Relative to Other Summer Jobs You Could Have Gotten
 1 2 3 4 5
 Much Lower Average Much Higher
- 2.13 Would you recommend this employer to someone else?
 Why or why not?
- 2.14 Would you recommend this summer job/internship to someone else?
 Why or why not?
- 2.15 Additional Comments
- 3.0 Summer between Junior and Senior year
- 3.1 Employer and Location:
 Type of Employer: Government Agency, Consulting Firm,
 Contractor, Other:
- 3.2 Employment Duration (weeks)
 How did you find this job?
- 3.2 Indicate the MAIN reason for taking this job.
 Location, Pay Rate, Work Experience, Other:
- 3.3 Description of work/duties you performed:
- 3.4 Indicate the approximate % of your job duties:
 Design Inspection Administration
 Other (describe)
- 3.5 List courses/subjects that helped you perform in this job:
- 3.6 Indicate the approximate % of college academic background needed for you to perform your job:

- 3.7 Indicate the approximate % of what you learned from this job that you used in subsequent courses:
- 3.8 List the courses/subjects this job helped you understand better:
- 3.9 Did you have a mentor or trainer to help you understand and perform your job duties?
- 3.10 In what ways could the CET Department better prepare students for summer jobs?
- 3.11 In what ways could summer employers better connect to or coordinate with the CET Department regarding student preparation?
- 3.12 Indicate the relative value of this summer work experience:

Challenge of Summer Work

1	2	3	4	5
Not Challenging			Very Challenging	

Benefit of Experience Relative to Your Major

1	2	3	4	5
Not Beneficial			Very Beneficial	

Benefit of Experience Relative to Your Interests within your Major

1	2	3	4	5
Not Beneficial			Very Beneficial	

Extent to which Your Work Experience Was Shared with Others in your Courses

1	2	3	4	5
No Sharing			Much Sharing	

Pay Relative to Other Summer Jobs You Could Have Gotten

1	2	3	4	5
Much Lower		Average	Much Higher	

- 3.13 Would you recommend this employer to someone else?
Why or why not?
- 3.14 Would you recommend this summer job/internship to someone else?
Why or why not?
- 3.15 Additional Comments
4. If you have done a co-op or formal internship, please comment on the differences between your co-op or internship experiences and your other summer employment experiences.

References

- Anwar, S., Winsor, F., "Internship Development for a New Baccalaureate Degree Program: Student Preparation, Sponsor Development, and Internship Follow-Up," *Proceedings, ASEE Annual Conference*, 1999.
- Tener R., Winstead, M., Smaglik, E., "Experiential Learning from Internships in Construction Engineering," *Proceedings, ASEE Annual Conference*, 2001.
- Wiggins, J., "Summer Internships in the Construction Industry; NJIT and NJBCA, Partners in Education," *Proceedings, ASEE Annual Conference*, 1999.
- Tufenkjian M., "A New Engineering Educator's Guide for Creating a Summer Engineering Internship Program," *Proceedings, ASEE Annual Conference*, 1999.
- Lozano-Nieto, A., "Learning the Culture of the Workplace in an Engineering Technology Program," *Proceedings, ASEE Annual Conference*, 1999.

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