Survey of First-Year Programs

Kenneth P. Brannan, Phillip C. Wankat
The Citadel/Purdue University

Abstract
To assess the current status of first year programs, two surveys of first year programs in engineering were circulated through the ASEE Freshman Programs Division (FPD) listserv. The first survey was sponsored by the FPD, and the second survey was sponsored by the NAE Center for the Advancement of Scholarship on Engineering Education (CASEE). Participation in the surveys involved 91 institutions in the FPD survey and 49 institutions in the CASEE survey.

The FPD survey focused on program structure, staffing, and how advising and tutoring is accomplished. Of the participating institutions, approximately two-thirds of the institutions were about evenly grouped in one of four categories: programs conducted by a formally recognized department or division, by someone on the dean's staff, by a responsible faculty member or group of faculty members in addition to their teaching or research duties, and programs conducted in individual engineering disciplines. The remainder of the programs had unique features that did not neatly correspond with one of the other categories. The paper also presents survey data on how faculty, graduate and undergraduate students, and others are used in teaching, advising, and tutoring; advising services and how these are handled; and availability and administration of tutoring services.

The CASEE survey focused on the content of the curriculum and the teaching methods. An estimated 20% of the entering students were *not* ready to study engineering (range 0 to 90%). The overwhelming weakness reported was mathematics. Twelve institutions reported some effort to integrate courses and one institution reported all courses were integrated. Honors programs of some sort were conducted by 67% and bridge and/or retention programs by 88%. The curriculum appears to be fairly standardized. Only the engineering courses had extensive professional activities such as socially relevant examples, interpersonal skills, leadership skills, and teamwork. Most of the engineering design courses include hands-on projects.

Data from the combined surveys provide a broad picture of the current status of first-year engineering programs. Survey results should serve as a valuable reference for engineering educators who are establishing, modifying, or evaluating a first-year program.

Introduction

Over the past few decades, first-year programs have been enhanced in numerous ways to improve academic performance, stimulate interest and improve retention, help students make a successful transition from high school to college, update the content coverage, and better prepare students for future coursework. These enhancements include development of motivational first-year courses, student assistance programs inside the classroom including the use of various active learning methods, and student assistance programs outside the classroom. Both traditional and non-traditional advising and tutoring would be included in the student assistance categories.

Many "Introduction to Engineering" or similar first-year courses are designed to be motivational. According to a survey[1], some two-thirds of engineering programs had an Introduction to Engineering course in 1992. Data presented in the following sections of this paper show a slightly greater percentage of programs offering "Intro" courses today. Innovative courses for first-year students include active-learning laboratory experiences[2,3], hands-on first-year design experiences[4-6], teaming first-year students with upper level students[7,8] and integrating with non-engineering coursework[9-11]. These are but a few examples of courses or curricula that have been enhanced to improve the first-year experience.

Student assistance programs inside the classroom include advising seminars that also focus on a topic of interest to students[12-14], counselor-tutorial programs for high-risk students[15], and use of peer mentors in class discussion groups[16]. Further, advising or tutoring might be included as a part of a particular class. Student assistance programs outside the classroom include individual and group tutoring, advising, and learning communities[17,18]. Summer bridge programs[19] and special programs for honors students may be either in-class or out-of-class programs.

These programs and initiatives are not intended to be a comprehensive list, but are examples of activities in first-year programs. The literature contains many additional examples of program enhancements. However, it is uncertain how many of these programs and initiatives have been adopted and how first-year programs are structured to accomplish them. The most common current curricula in the first year are also unknown. Therefore, to assess the current status of first-year programs, two surveys of first-year programs in engineering were circulated through the ASEE Freshman Programs Division (FPD) listserv. The first survey, sponsored by the FPD, had responses from 91 institutions. The second survey, sponsored by the CASEE Center for the Advancement of Scholarship on Engineering Education (CASEE), had responses from 49 institutions. Since 27 institutions participated in both surveys, 113 institutions participated in at least one survey. The results of the surveys are presented in the following sections.

FPD Sponsored Survey

The FPD initiated its survey to assess the level of first-year engineering program activities in universities/colleges associated with ASEE during its business meeting at the 2001 ASEE Annual Conference in Albuquerque, NM. Outgoing FPD president Barry Crittenden coordinated the development of the survey and its dissemination among ASEE members. As part of the survey development, feedback was solicited from FPD members attending the business meeting in Albuquerque. The survey was announced through the ASEE listserv and at the 2002 ASEE Annual Conference in Montreal. Respondents completed the survey via a form made available on the Internet.

Survey data was collected based on the organization of an institution's first-year program. Respondents were initially provided with six major categories from which to choose. These are listed in Table 1 along with the number of responses received for each category. The majority of the questions in Survey Categories I, II, III, IV, and V were the same. Because of the wide variety of first-year programs, it was impossible to provide categories that would fit every program. For this reason, Survey Category VI was provided for respondents who felt that none of the first five categories would apply to their programs.

Survey Category	Survey Question	Number of Schools Responding
I	Does your university/college have a formally organized/recognized department/division within your College/School of Engineering associated with freshman engineering?	17
II	Does your university/college have a member of the Dean's staff who is assigned the task of directing a College/School of Engineering program associated with teaching/advising/tutoring freshmen engineering students in addition to their regularly assigned duties?	16
III	Does your university/college have a faculty member or group of faculty members who take on the responsibility of teaching/advising/tutoring at the college/school level engineering freshmen in addition to their regular teaching/research duties?	17
IV	Does your university/college use only graduate students/undergraduate students to teach/advise/tutor at the college/school level its engineering freshmen?	0
V	Do individual engineering departments within your College/School of Engineering teach/advise/tutor their own engineering freshmen?	21
VI	If none of the categories listed in 1 through 5 above apply to your university/college, please furnish the following information:	28
	Total	99

Table 1. Response to Freshman Programs Division Survey.

In Survey Category I, there were three sets of responses prepared by different individuals from the same schools. Similarly, there was a duplicate pair in Category III and in Category VI. Therefore, a total of 104 responses were received from 99 institutions. The duplicate responses within a given survey category were combined for purposes of analysis. Two sets of duplicate institutions were also found in Category V. However, because Category V represented programs associated with individual engineering departments and the "duplicates" were from different departments within the same institution, these were considered to be unique responses. Finally, there were six sets of duplicates in which individuals from the same school responded to different survey questions. When considering composite data from Categories I through VI, there were 93 different institutions involved.

As shown in Table 1, approximately two-thirds of the institutions responding to the survey were almost equally represented among Categories I, II, III, and V. No response to Category IV was received. The remainder of the institutions had unique characteristics that did not suitably

correspond with one of those categories. Clearly, a healthy variety of first-year programs currently exist among colleges and universities.

Considering that Categories I, II, and III represent common programs and Category V generally represents non-common programs, roughly 70% of the programs responding to those categories of the survey had common programs. This number is in excellent agreement with the 71.4% value noted in the CASEE survey (see section entitled "NAE CASEE Sponsored Survey"). As noted earlier, Category VI represents a number of programs with characteristics that differ from the other categories, and may not neatly fit the traditional "common" or "separate" categories.

Within each of Categories I, II, III, and V, respondents were asked to provide a breakdown of how their programs were staffed. Respondents supplied the number of full-time faculty, graduate students, undergraduate students, and other persons who work in one of the following seven categories: teaching, advising, tutoring, both teaching and advising, both teaching and tutoring, both advising and tutoring, and all three. For Category I, respondents were also asked to supply the number of faculty from other departments assigned to teach/advise/tutor for the freshman engineering department/division. An overview of how the efforts of faculty, staff, and students are used in the various types of freshmen programs is shown in Table 2. Of course, as staffing needs change from term to term, the percentages may vary.

In Table 2, the values in each box represent the percentages of programs that had at least one person working in that capacity. Identical values in a given survey category imply that the same *percentage* of programs staffed those positions. It does not imply that the same schools staffed those positions. For example, the three 41.2% values in the first column under Category I indicate that of the 17 schools in Category I, 41.2% (or 7) schools had full-time faculty that teach only, 41.2% of the schools used faculty from other departments that teach only, and 41.2% of the schools had graduate assistance that teach only. It is coincidental that the three values are the same; some of the schools included in those percentages are the same and some are different.

From the summary section of Table 2, over 60% of the first-year programs have full-time faculty who teach only. Almost half the schools use full-time faculty for advising only responsibilities. A significant percentage of schools use other persons for advising. To determine who represented the "other persons" position, the survey asked: "What is the classification of these persons who are neither faculty nor students?" Survey responses indicate that other persons are primarily from professional, academic, and clerical staff. It may also be noted in Table 2 that over 60% of the schools have full-time faculty that divide their time between teaching and advising. Full-time faculty members are used much less in tutoring. Undergraduate and graduate students more often handle these responsibilities.

Some programs offer a wide range of first-year courses and others offer only a few basic courses. As indicated in Table 3, the average number of first-year courses offered is just over three, while the overall range of first-year courses offered by these programs is one to eighteen. In addition to the number of courses, respondents were asked to provide the name and description of the courses offered. Course information for a selected number of first-year courses or topics included in first-year courses is shown in Table 4. The data for Tables 3 and 4 were extracted from responses in Categories I, II, III, and V. Only limited information on courses was found in

	Teaching	Advising	Tutoring	Teaching and advising	Teaching and tutoring	Advising and tutoring	All three
I. Formally recognized department/division associated with first-year programs							
Full-time faculty	41.2%	23.5%	5.9%	76.5%	5.9%	0.0%	29.4%
Faculty from other departments	41.2%	23.5%	5.9%	17.6%	0.0%	0.0%	5.9%
Graduate Assistants	41.2%	0.0%	23.5%	0.0%	0.0%	0.0%	5.9%
Undergraduate Assistants	17.6%	5.9%	23.5%	0.0%	0.0%	5.9%	5.9%
Other persons	5.9%	35.3%	5.9%	0.0%	0.0%	0.0%	11.8%
II. Programs directed by someone on dean's staff							
Full-time faculty	93.8%	37.5%	12.5%	62.5%	6.3%	12.5%	12.5%
Graduate Assistants	56.3%	6.3%	12.5%	0.0%	6.3%	0.0%	0.0%
Undergraduate Assistants	12.5%	25.0%	50.0%	0.0%	6.3%	6.3%	12.5%
Other persons	12.5%	31.3%	18.8%	6.3%	6.3%	0.0%	0.0%
III. Programs directed by a responsible faculty member(s) in addition to regular teaching or research duties							
Full-time faculty	52.9%	35.3%	0.0%	58.8%	11.8%	5.9%	29.4%
Graduate Assistants	23.5%	0.0%	5.9%	0.0%	11.8%	0.0%	0.0%
Undergraduate Assistants	5.9%	0.0%	52.9%	0.0%	5.9%	0.0%	0.0%
Other persons	23.5%	11.8%	0.0%	0.0%	0.0%	5.9%	11.8%
V. Programs conducted in individual departments							
Full-time faculty	63.2%	78.9%	10.5%	52.6%	15.8%	5.3%	5.3%
Graduate Assistants	10.5%	5.3%	15.8%	5.3%	10.5%	0.0%	5.3%
Undergraduate Assistants	5.3%	0.0%	36.8%	0.0%	0.0%	10.5%	0.0%
Other persons	0.0%	10.5%	0.0%	0.0%	0.0%	0.0%	5.3%

Table 2. Percentage of first-year programs with staff assigned to teaching, advising, and tutoring responsibilities.

Table 2 (Continued)

	Teaching	Advising	Tutoring	Teaching and advising	Teaching and tutoring	Advising and tutoring	All three
Summary (weighted)							
Full-time faculty	62.3%	45.9%	7.3%	62.0%	10.3%	5.8%	18.5%
Faculty from other departments (Survey I only)	41.2%	23.5%	5.9%	17.6%	0.0%	0.0%	5.9%
Graduate Assistants	31.3%	3.0%	14.5%	1.6%	7.3%	0.0%	3.0%
Undergraduate Assistants	10.0%	7.0%	40.5%	0.0%	2.8%	5.9%	4.2%
Other persons	9.9%	21.4%	5.6%	1.4%	1.4%	1.4%	7.2%

Survey	Average Number of Courses	Range
I (N = 16)	3.4	2 – 11
II (N = 16)	3.6	1 – 11
III (N = 17)	3.0	1 – 6
V (N = 21)	3.0	1 – 18
Total (Weighted)	3.2	1 – 18

Table 3. Number of first-year courses offered in first-year programs.

Category VI, and was not included in Table 4. Percentages shown for each entry in Table 4 are based only on those responses that provided clearly defined course descriptions or titles. Approximately half of the schools reported offering courses that included an introduction to the engineering profession in the course material. Problem solving was another topic mentioned by almost half of the schools. Graphics, design, programming, and computer tools are often integrated with other course material.

A comparison of the percentages shown for programming, design, and graphics courses shown in Table 4 with the same information collected in the CASEE survey (see Table 12 – discussed later) reveals that significantly higher percentages were reported in the CASEE survey. Unless a significant number of topics was omitted in the course descriptions of the FPD survey, it is likely that the difference may be attributed to first-year courses offered outside the first-year program (for example, a programming course offered by a computer science department instead of a first-year program). Course information collected by the CASEE survey was not dependent on which

department offered it, while course information collected in the FPD survey was only for first-year courses taught by first-year programs.

Course or Topic Taught by First-Year Programs	Number of Schools	Percent of Schools
Introduction to engineering profession (N = 46)	24	52.2%
Success skills (N = 49)	9	18.4%
Computer tools integrated with other topics (N = 48)	21	43.8%
Programming courses (N = 68)	9	13.2%
Programming integrated with other topics (N = 48)	13	27.1%
Problem solving (N = 46)	22	47.8%
Design courses (N = 68)	13	19.1%
Design integrated with other topics (N = 47)	21	44.7%
Graphics Courses (N = 68)	17	25.0%
Graphics and graphics software tools integrated with other topics (N = 49)	14	28.6%
N = Total number of respondents supplying clearly defined course descriptions or titles applying to a given topic		

Table 4. First-year program course information.

To explore the type of advising services offered by first-year programs, the survey asked the following question for Categories I, II, III, and V: "Advising: Description of freshman engineering academic advising services offered." For Category VI, respondents were asked to "Please supply any information about your university/college with respect to teaching/advising/tutoring freshman engineering students." Information on advising services provided in first-year programs compiled from these open-ended questions is summarized in Tables 5 and 6. Respondents often listed more than one comment. Course schedule planning and career planning were the types of advising services most often mentioned, as shown in Table 5. Respondents' comments on how advising is handled are shown in Table 6. The most frequently mentioned advising method was department-specific advising. Interestingly, over half the department-specific comments were generated in Categories II, III, and VI.

Information on tutoring services was solicited in a similar manner as information on advising services. For Categories I, II, III, and V, the following question was asked: "Tutoring:

Description of freshman engineering tutoring services offered." As noted above, those responding to Category VI were asked: "Please supply any information about your university/college with respect to teaching/advising/tutoring freshman engineering students." Table 7 is a summary of respondents' comments on first-year subjects for which tutoring is available. Clearly, tutoring for engineering, mathematics, and science is widely available for first-year students. A tabulation of respondents' comments on the administration of tutoring services is presented in Table 8. It should be noted that some respondents had entries in more than one category. Based on the comments in the FPD survey, half of the tutoring services available to first-year students are accomplished at the University level. Some schools reported handling tutoring in class sessions or in courses or workshops. Also, a few schools reported the use of group tutoring sessions outside of class or in supplemental instruction sessions.

Number of entries listing the type of advising services	40	43.0% of 93 schools
Course schedule planning	15	37.5%
Career planning	10	25.0%
Refer students to campus services (e.g., counseling service)	8	20.0%
High school to college transition	7	17.5%
Regular or mandatory advising	7	17.5%
Selection of discipline	7	17.5%
Improve academic performance (e.g., students at risk)	5	12.5%
Involvement in special programs (e.g., co-op program)	5	12.5%
Transfer program advising	5	12.5%
Guide through university rules and regulations	3	7.5%
Planning, study skills, and time management	3	7.5%
Orientation	2	5.0%
Special problems of students in underrepresented groups	2	5.0%
Course articulation agreements	1	2.5%
Transfer credit analysis	1	2.5%
Preparation of paperwork for course substitution or transfer to program	1	2.5%
Accommodations	1	2.5%
Extracurricular activities	1	2.5%
Enrichment activities	1	2.5%
Credit analysis for financial aid planning	1	2.5%

Table 5. Types of advising services in first-year programs.

As mentioned previously, almost one-third of the respondents felt that their programs had unique features such that the program would not appropriately fall in Categories I through V. These respondents selected Category VI to describe their programs. Descriptions of the programs were provided in response to the question listed in the previous paragraph on tutoring services. There were a variety of different programs included in the 28 Category VI schools. Table 9 summarizes the descriptions of these programs. Descriptions most often reported were schools with transfer programs, small schools, and beginning programs. Several schools had hybrid programs with some common elements and some elements handled in individual departments.

Number of entries listing how advising is handled	53	57.0% of 93 schools
Advising is department-specific	17	32.1%
Advising office staffed with counselors, staff, faculty or advising by other university office or administrator	8	15.1%
Advising at summer orientation	8	15.1%
Advising by a select group of faculty (one, two, or more)	7	13.2%
Instructor of first-year course serves as advisor	6	11.3%
Advising through a first-year course or seminar	6	11.3%
Dean's office participates in advising	6	11.3%
Advising through hired professionals	2	3.8%
Special programs (e.g., Women in Engineering, Engineers in Residence, Multi-cultural Engineering Program) participate in advising	2	3.8%
Advising by upperclassmen	2	3.8%
Special advisors for at-risk students	1	1.9%
Course-load reduction for faculty that advise	1	1.9%
Advising by graduate students	1	1.9%
Advising spread uniformly among all engineering faculty (small program)	1	1.9%
Advising on college level	1	1.9%

Table 6. How advising in first-year programs is handled.

Respondents providing comments on tutoring for specific subjects	37	39.8% of 93 schools
Tutoring reported for most or all first-year subjects	14	37.8%
Tutoring reported for a limited number of subjects	23	62.2%
Tutoring reported for specific subjects:		
Engineering	24	64.9%
Mathematics	22	59.5%
Science (Chemistry/Physics/Biology)	24	64.9%
English/Writing	9	24.3%
Computer	14	37.8%

Table 7. Tutoring services: first-year subjects for which tutoring is available.

Individually, each of the tables compiled from the results of the FPD survey would provide only limited information on the status of first-year programs. Collectively, however, the information on types of programs, staffing, course offerings, advising, and tutoring indicates:

- First-year engineering programs currently exist in a variety of forms.

- While there are many common elements among first-year programs at many institutions, individual programs have been tailored to help students build solid foundations, make well-informed choices, and find the right kind of assistance as they progress through the programs.
- In addition to persons directly involved with first-year programs, there are many other people and programs external to first-year programs that contribute significantly to the development of first-year students (teaching, advising, and tutoring).

Respondents providing comments on availability of tutoring for first-year students	68	73.1% of 93 schools
Tutoring programs administered by first-year program or College of Engineering	30	44.1%
Tutoring programs administered by other university units	34	50.0%
Tutoring reported but who administers program not specified	13	19.1%
Tutoring reported as not available or not applicable	4	5.9%
Tutoring conducted in class work sessions, courses, or workshops	6	8.8%
Supplemental instruction and group tutoring sessions	6	8.8%
Note: Examples of tutoring programs administered by other university units included: University Learning Center, Honors Program, Counseling and Student Growth Office, Student Support Services, University First Year Studies Program, Student Support Services, University First Year Studies Program, Academic Achievement Center, Student Success Department, Educational Resources Center, Student Government Association, and Student Services. There were a number of university units providing tutoring services that were not specified.		

Table 8. Administration of tutoring services for first-year students.

NAE CASEE Sponsored Survey

As the Walter L. Robb Engineering Education Senior Fellow of the National Academy of Engineering, Phil Wankat was asked to do a survey of first-year programs in engineering with a particular emphasis on curriculum, teaching methods used, and skill development. This survey was distributed in spring 2004 through the FPD listserv and at the FPD meeting at the ASEE Annual meeting in Salt Lake City in 2004. The survey was divided into two parts with the shorter Part I being more widely distributed. A total of 53 responses to Part I from 49 institutions were received. The duplicate responses were combined so that there was only one response from each institution. Ten surveys from nine institutions were received for Part II. Because of the small number of responses from Part II, the Part II results are only suggestive.

The first question of the survey asked if the program was common, and if it was, what was the period of the common program. The respondents indicated that 71.4% of the programs are common. As noted previously, this percentage is within the range reported in the FPD survey (Table 1). For schools with common programs, 2.9% had one semester, 74.3% had one year, 11.4 % had 1 ½ years, and 11.4 % had two years in common.

1	Two-year technology program with transfer to four-year engineering technology program
2	Two-year technology program
3	2+2 transfer program
4	Two-year transfer program
5	Pre-engineering program for transfer students
6	Engineering Physics program plus a transfer program
7	Developing pre-engineering program of community college to prepare students to transfer
8	Small institution; teaching/advising/tutoring handled uniformly by faculty of engineering program
9	Small program; administers science/math/engineering majors
10	Small program; one person teaches all; advising shared with faculty in mathematics and science
11	New program
12	Beginning program
13	Beginning program
14	Administered by Undergraduate Programs of College of Engineering
15	Unclassified engineering program administered by member of dean's staff
16	One engineering department administers two majors; freshmen have common curriculum
17	Common program in school of engineering; select group of faculty teach/advise/tutor
18	Administered in College of Engineering; select faculty teach/advise
19	Administered in College of Engineering; many faculty participate in teaching first-year courses
20	Administered in Engineering Department
21	Program administered by Department of Physics and Engineering
22	Common Freshman Engineering courses; advising in departments; dean's office coordinates tutoring
23	Common introductory course in College for undeclared majors; separate introductory course in departments
24	Separate departments with certain common first-year engineering courses
25	Engineering Services office for advising/administration of tutoring and teaching provided from engineering faculty
26	Teaching and advising by engineering faculty; student services for tutoring
27	Multi-campus system; program offers freshman/sophomore courses and distance education to a number of campuses
28	No uniform handling of all freshmen; departments handle curricula differently; common Freshman Interest Group program for percentage of students

Table 9. Summary of first-year program characteristics in Survey Category VI.

Demographic data was collected in question 2. The results are tabulated in Table 10. The range in size of the first-year class is from 15 to 1600 with an average of 416. Some idea of the representativeness of the sample can be obtained by comparing with Engineering Workforce

Code#	Number 1st year eng. students	Percent women	Percent underrepresented minorities	Percent international students	Percent not ready to study engineering
1	350	18%	23%	3%	55%
2	800	18%	17%	3%	?
3	250	20%	30%	2%	25%
4	Blank	33%	2-5%	2-5%	25%
5	100	10%	5%	1%	0%
6	850	35%	15%	5%	0%
7	710	28%	7.3%	12.4%	0%
8	40	10%	10%	0%	60%
9	150	28%	8%	8%	0%
10	55	10%	15%	10%	15%
11	220	20%	7%	3%	0%
12	1250	18%	17%	4%	-
13	15	13%	6%	6%	25%
14	300	5%	2%	1%	25%
15	30	20%	20%	15%	5%
16	600	21%	8%	0%	5%
17	580	18.5%	11%	4%	10%
19	300	16%	16%	5%	20%
20	725	20%	5%	2%	5%
21	50	15%	0%	4%	50%
22	400	20%	8%	0%	10%
23	40	18%	20%	15%	10%
24	1250	23%	20%	3.9%	5%
25	20	25%	15%	25%	5%
26	120	20%	3%	2%	8%
27	77	15%	5%	5%	25%
30	700	14.3%	Blank	Blank	75%
31	72	2%	12%	3%	35%
32	280	20%	5%	1%	N/A
33	1100	17%	10%	3%	15%
34	500	10%	10%	5%	8%
35	300	14.19%	4.5%	1%	30%
36	350	25%	7%	6%	5-10%
37	400 in ECE only	10%	10%	10%	None

Table 10. Demographic data for first-year engineering programs (CASEE survey).

Table 10 (Continued)

Code#	Number 1st year eng. students	Percent women	Percent underrepresented minorities	Percent international students	Percent not ready to study engineering
38	1200	18%	10%	6%	1%
39	See Comments	10%	12%	7% (See Comments)	50
40	45	15%	7%	2%	60%
41	550	24%	12%	4%	15%
42	1600	19%	6%	9%	5%
43	25	8%	12%	20%	25%
44	1200	18%	4%	7%	1%
45	400	10%	10%	1%	10%
46	50	15%	0%	0%	50%
47	375	25%	16%	11%	<1%
48	480	20%	12%	2%	20%
49	250	25%	75%	5%	90%
50	55	20%	4%	2%	16%
51	525	25%	9%	5%	5%
52	110	10%	5%	10%	15%?
Avg	416 (48)	17.8% (49)	11.7% (48)	6.0% (48)	19.6% (47)

Commission data for first-year classes in fall 2003[20]. They reported 16.4% women, 16.0% underrepresented minorities and 4.1% foreign nationals. Except for underrepresented minorities, the percentages we obtained, 17.8%, 11.7% and 6.0%, respectively, are reasonably close to the Engineering Workforce Commission numbers. Respondents to this survey appeared to be underrepresented from institutions that serve predominately underrepresented students. In other respects the survey appears to be fairly representative of US institutions.

The question on the approximate percentage of entering engineering students who are not ready to study engineering resulted in a wide range of answers (Table 10). Responses, which are obviously estimates, ranged from none to 90% with an average of 19.6% who were not ready to study engineering. The open-ended question, "In what areas are they [entering engineering students] weak?" elicited a number of comments that are tabulated in Table 11. Clearly, mathematics preparation is an area of major concern. As in any tabulation from an open-ended question, the percentages for specific areas would undoubtedly be higher if respondents had been given a box to check.

Since the first-year curriculum was the major interest of this survey, the survey included a very extensive list of possible first-year courses for both first and second semesters. Respondents were asked to check the appropriate courses taken by first-year engineering students, and list the credits and hours per week for the courses. They were not asked to indicate which department

Mathematics	36	73.4% of 49 Schools
Calculus ready	9	18.4%
College Algebra	5	10.2%
Trig	3	6.1%
Science	12	24.4%
Physics	8	16.3%
Chemistry	6	12.2%
General Science	4	8.2%
Computer Science	1	2.0%
Communication	5	10.2%
General	1	2.0%
English-written	4	8.2%
Life Skills	9	18.4%
Maturity	2	4.1%
Direction	4	8.2%
Study Skills	7	14.3%
Time Management	5	10.2%

Table 11. Areas of weakness observed in entering engineering students (Q 2 CASEE survey).

taught the courses. This data is tabulated in Table 12. Since ABET has relaxed the requirements for specific science courses required in the curriculum, it is interesting that although 92% of the schools require a first chemistry course in the freshman year, only 37% require a second chemistry course. Of course, one limitation of the data is it does not indicate what courses are taken after the first year. Based on ABET requirements for mathematics, it is not surprising that all the schools require calculus I during the first year and 90% require calculus II.

Computer programming and computer tools have essentially equal representation. Thirty schools (61%) require either programming or tools or both in the first year. Despite the large number of papers on first-year engineering design, less than half (40.8%) of the schools have some type of first-year engineering design. Computer drawing/graphics is also required by less than half (46.9%) of the programs. The biggest surprise in this data is the small number of programs (4.1%) that have adopted biology courses in the first year. The biological revolution has not penetrated the first year of engineering programs.

The fourth item asked, "Please list which courses are for engineers only or have engineering only sections (if none, please write "None")." The tabulated results are given in Table 13. Note that many surveys had more than one response marked. Several respondents commented that it was not necessary to make the engineering courses "Engineering only" since no other students wanted to take them. Comments on advantages and disadvantages were equally split between those who thought that the more homogeneous classes resulting from engineering-only sections were easier to teach and helped socialize students into engineering, and those who thought that engineering students should be exposed to students from all disciplines.

Question 5 asked, "If any of the courses are taught in an integrated fashion with other courses, please explain which courses are grouped together. (If none, please write "None"). Comments

Topic	#	% Schools	Avg Credits	Avg hr/wk	Comments
Chem I – Sem 1	42	85.7%	3.3	3.5	
Chem I – Sem 2	3	6.1%	3.3	3.3	45 (91.8% of Schools) require Chem I in first year
Chem I Lab – Sem 1	35	71.4%	1.2	2.6	7 schools have no separate credit for lab
Chem I Lab – Sem 2	3	6.1%	1.0	2.3	90.5% schools that require Chem I require lab
Chem II	18	36.7%	3.2	3.2	
Chem II Lab	17	34.7%	1.1	2.3	94.4% schools that require Chem II require lab
Calculus I – Sem 1	48	98.0%	4.4	4.2	
Calculus I – Sem 2	1	2.0%	4.0	4.0	100% schools require Calculus I in first year
Calculus II	44	89.8%	4.4	4.6	
Other Math – Sem 1	3	6.1%	3.7	3.7	
Other Math – Sem 2	4	8.2%	2.25	2.75	
English I – Sem 1	39	79.6%	3.3	3.2	
English I – Sem 2	2	4.1%	3.5	3.5	41 (83.7%) of schools require English I in first year
English II	21	42.9%	3.2	3.2	
Speech I – Sem 1	6	12.2%	3.3	3.3	
Speech I – Sem 2	3	6.1%	3.0	3.0	9 (18.4%) require Speech I in first year
Speech II	2	4.1%	3.5	4.0	
Intro Engr I – Sem 1	32	65.3%	1.6	1.9	Some Intro. Engr. courses are zero credit
Intro Engr II	7	14.3%	1.6	2.0	21.9% of schools with Intro Engr., do both semesters.
Coll. Survival Seminar – Sem 1	11	22.4%	1.2	1.2	
Coll. Survival Seminar – Sem 2	1	2.0%	2.0	2.0	12 (24.5%) schools have College Survival Course
Computer Tools I – Sem 1	15	30.6%	1.5	1.9	
Computer Tools I – Sem 2	5	10.2%	1.9	3.0	20 (40.8%) schools require Computer Tools I in first year
Computer Tools II	2	4.1%	0.5	1.0	

Table 12. Curriculum results from question 3 of the CASEE survey.

Table 12 (Continued)

Topic	#	% Schools	Avg Credits	Avg hr/wk	Comments
Computer Prog. I – Sem 1	9	18.4%	1.7	2.1	
Computer Prog. I – Sem 2	12	24.5%	3.0	3.4	21 (42.9%) schools require Computer Prog I in first yr. 11 (22.4%) schools both Prog & Tools (may be single course)
Computer Prog. II	1	2.0%	3.0	3.0	
Engr. Design Lecture I – Sem 1	9	18.4%	1.9	1.6	Some credits count for lab also
Engr. Design Lecture I – Sem 2	8	16.3%	1.7	2.0	17 (34.7%) schools require Engr. Design lecture first year
Engr. Design Lecture II	1	2.0%	2.0	2.0	
Engr. Des. Lab I – Sem 1	9	18.4%	1.4	2.3	4 have no lecture
Engr. Des. Lab I – Sem 2	5	10.2%	1.0	2.4	20 schools (40.8%) require Engr. Design lecture &/or lab
Engr. Des. Lab II	3	6.1%	1.5	2.3	1 with lecture / other 2 without
Comp. Draw/Graphics – Sem 1	13	26.5%	1.9	2.8	
Comp. Draw/Graphics – Sem 2	10	20.4%	2.2	3.4	23 (46.9%) schools require comp. draw/graphics first year
Computer Draw/Graphics II	3	6.1%	2.3	2.7	
Physics I – Sem 1	13	26.5%	3.4	3.8	
Physics I – Sem 2	30	61.2%	3.4	3.7	43 (87.8%) schools require Physics I in first year
Physics II	10	20.4%	3.2	3.9	
Physics Lab I – Sem 1	9	18.4%	1.1	1.5	
Physics Lab I – Sem 2	24	49.0%	1.1	2.2	76.7% of schools that require Physics I also require lab I
Physics Lab II	7	14.3%	0.8	1.6	70% of schools that require Physics II also require lab II

Table 12 (Continued)

Topic	#	% Schools	Avg Credits	Avg hr/wk	Comments
Biology I – Sem 1	1	2.0%	3	3	
Biology I – Sem 2	1	2.0%	4	4	
Biology II	1	2.0%	3	3	
Biology Lab	0	0	0	0	
Other Courses – Sem 1	21	42.9%	2.9	3.3	23 (46.9%) schools with 1 or more "Other" in first year. 15 schools with "Other" Sem 2 also have "Other" sem. 1.
Other Courses – Sem 2	18	36.7%	3.1	3.3	Most Popular "Other" (21 courses) – General Education Elective (Humanities/Social Science)

Introduction to Engineering	21	42.9%
None	13	26.5%
Programming/Computer Science	9	18.4%
Engineering Design	8	16.3%
Engineering Courses	7	14.3%
Engineering Graphics	7	14.3%
Chemistry	6	12.2%
Calculus	5	10.2%
Computer Tools	4	8.2%
Explore given Engineering disciplines	3	6.1%
Chemistry Lab, Honors	2	4.1% each
All, Physics	1	2.0% each

Table 13. Courses for engineering students only or that have engineering only sections, from question 4 in CASEE survey.

about success/difficulties of integration?" The tabulated results are given in Table 14. The number of integrated courses is small compared to the number of papers that have appeared on this topic. Six respondents commented on the difficulties of integrating including "finding common courses is difficult because placement of entering students is so varied," "it is a scheduling nightmare," and "don't have enough faculty who are willing/able to teach in such an interdisciplinary environment." The two main comments in favor of course integration were, "Not having the integration [of microprocessors and programming] resulted in constant complaints" and "These courses work and re-invigorate the engineering programs. It just takes administrative vision and support."

None	26	53.1%
None, except cohorts go together	3	6.1%
Calculus & Physics	2	4.1%
10 responses: All, Lab, Microproc & Prog., Design & CAD, Intro. Engr & Math, Intro. Engr., Intro. Engr. & Graphics, Pilot Engr. & English, Physics & Graphics/Computer tools & lab & design, Honors: Engr & Math & Physics	1	2.0% each
Total 12 integrated and 3 cohorts.		

Table 14. Courses in the first year taught in an integrated fashion with other courses, from question 5 in CASEE survey.

Question 6 was, "Please briefly describe programs available for outstanding or honors students to keep them interested in engineering." The results are tabulated in Table 15. Respondents often listed more than one program. Two-thirds of the schools had some form of these programs for their first-year students.

Number of entries listing programs for outstanding or honors students	33	67.3%
Research Opportunities	11	22.4%
Intro. To Engr. Course	8	16.3%
University Honors Program	7	14.3%
Residence Halls	4	8.2%
7 topics: Seminars, hands-on Intro. Engr, Majors, Physics, scholarship program, travel, all courses:	3	6.1% each
Tools and Programming	2	4.1%
7 topics: Advisor, some courses, calculus, chemistry, integrated studies, competitions, other	1	2.0% each

Table 15. Programs for outstanding and honors students from question 6 in CASEE survey.

Question 7 requested that respondents, "Please briefly describe bridge and retention programs for unprepared students and other students who struggle in the engineering program." Tabulated results are in Table 16. Respondents often listed more than one program. Almost 90 % of the schools offered one or more forms of these programs. Several respondents commented that these programs were available for underrepresented minority and other students. The question mark by special retention programs indicates that interpretation of which programs fit in this category was subjective.

This completed Part I of the survey. Part II started with question 8, "Teaching Methods, A. "Lecture" courses. Please estimate the approximate % of teaching time per week for each teaching method in "lecture" courses." The listed methods were: lectures, demos, group exercises, quiz & test, discussion, and Q & A. Part B was, "Other Teaching Methods: Please estimate the approximate % of teaching time per week for each of these other teaching methods." The methods listed were coop-group learning, PBL, computer tutorials, case studies, hands on, and other. The responses where percentages added correctly from the ten surveys were tabulated. Because of the small number of responses for the individual subjects (e.g., seven

responses for calculus), it is difficult to draw any conclusions about teaching methods in individual subjects. The summation results for 36 courses show the following percentages of time: lecture, 58%; demos, 8%; group exercises, 15%; quiz & test, 7%; discussion, 4%; question and answer, 6%; and PBL 2%. It appears that lecture remains the most popular teaching method for this small sample. This result agrees with an extensive survey of professors in all disciplines that showed 47.2% of respondents used lecture extensively[21].

Number of entries listing a bridge or retention program	43	87.8%
Individual tutoring	16	32.7%
Summer bridge	14	28.6%
Advising	10	20.4%
Remedial Math	9	18.4%
Special retention program	6 ?	12.2%
2 topics: Students (peer mentor), study-skill course	5	10.2% each
Special calculus section	4	8.2%
5 topics: Remedial physics, lab/gp prob. solving, engr. study room, residence hall learning community, supplemental instruction	3	6.1% each
Remedial chemistry	2	4.1%
6 topics: Remedial computer skills, remedial English, community college, academic excellence groups, cohorts, non-accredited major	1	2.0% each

Table 16. Bridge and retention programs from question 7 in CASEE survey.

Question 9 in Part II asked, "Which courses include the following topics (if none, please write "None"). Please indicate the approximate % of course time spent on each topic." The results from this open-ended question consist of the tabulation of comments given in Table 17. The examples listed may provide ideas to professors developing courses.

Question 10 in Part II asked a series of questions about first-year engineering design courses. The results are again presented as a tabulation of the comments (Table 18). The examples of projects listed for Part c may help professors teaching such courses develop ideas for new projects. The three comments listed in Part d show that at least three respondents think that first-year design courses are well worth the effort.

The last question in Part II of the CASEE survey asked for additional comments. There were responses from five schools about first-year programs and one response about upper division courses. Three people requested copies of the results. Two people commented that curriculum is under revision. One of these stated, "the current program is a reasonable simulation of Purgatory." We hope that presenting the results of these surveys will help schools find an upward exit from purgatory.

Discussion and Conclusions

Fortuitously, these two surveys, conceived of and developed independently, complement each other. When we realized that there were two surveys using the same pool of potential respondents with complementary foci, we decided to combine the results into a single paper. Because the surveys were developed independently, the fit is not perfect; however, we believe

Q 9. Which courses include the following topics (if none, please write "None").

a) Real world or socially relevant example: Responses from 9 schools.
Briefly describe examples: Hands on dynamics of NASA hot air balloons.
Reverse engineering of liquid soap dispenser or super soaker.
Estimation of size & design of gravel parking lot.
Modify house to reduce energy bills.
Study building failures reported in newspaper.
Build assistive technology devices for a real disabled client.
Design & build assistive technology device for disabled child.
CAD integrated with high school machine shop to make items.
Some years have design problems submitted by clients.

b) Communication skills: Responses from 11 schools.
Briefly describe methods: Team presentations in design.
Students submit pre-report, final design report & make PowerPoint presentation.
Students write 2 executive summaries, 2-3 lab reports, group presentation with PowerPoint, develop a visioning statement and write a resume.
Students make PowerPoint presentation of critical design review.
Students write research papers, team lab reports, bridge project short report.
CAD students drawings critiqued, drawings corrected, and device is produced.
Integrate English with chemistry, physics & engineering.

c) Interpersonal skills: Responses from 10 schools.
Briefly describe methods: Personality tests & learning styles are studied.
Design projects done in pairs or teams (8 responses)
Icebreakers first class period. Students introduced to social styles. Use team building exercises. Peer reviews used to identify areas that need work.
Seminar course using "Let's talk" method.
Extra credit for participation as coach for High School ChE Car team or leading science activities with Brownie Girl Scouts.

d) Managerial/leadership skills: Comments from 10 schools, see also question 9c.
Briefly describe methods: Enforce team membership guidelines.
Individuals take turns leading teams. (2 responses)
Team self-selects leader/manager.
Discuss general categories of responsibility & coping with adverse circumstances.
Review models of team behavior & do self-analysis of own team.
Evaluate other teams' designs.
Time management is optional assignment.

e) Other "soft skills": Please delineate skill and course. Responses from 7 schools.
Briefly describe methods: Case studies in ethics.
Professional ethics: "selling the same design to more than one customer."

Table 17. Responses for Question 9 in CASEE survey on topical content of courses

Table 17 (Continued)

"Ethics – We inadvertently created a brine spill. Tested & remediated the site. These and other active ethics lessons are much more valuable than lectures, etc."
Website development & post weblogs.
University success
"Lecture on vocations and faith – encourages students to think of engineering as a vocation."

f) Comments: 1 response.
"Design & Intro attempt to emulate the real world of engineering"

Q10. For your first year engineering design course(s) [if none, go to question 11],
a) Is design taught along with other subjects (e.g. computer programming or MATLAB)? 10 positive responses. *If yes, what other topics:* _____
CAD 4, communication 3, FORTRAN 2, Excel 2, MATLAB 2, ProE 1.

b) Briefly describe the teaching procedure(s) for design. Responses from 10 schools. Answers overlapped with answers to questions 9a and 10c. Examples are listed in the answers to those questions. Nine responses describe process starting with design and ending with hands-on building of device or prototype. One response described design on paper.

c) Please give examples of the type of projects that are done. Indicate if they are "paper" design or if the students build the objects. Responses from 10 schools.
Dissect artifacts, programmable robots (2), hot air balloons (2), mousetrap powered cars, glider launcher, catapults/trebuchets (2), human powered pumps, wooden block transport, weather monitoring station, desalination pump, blood filtration system, gravel parking lot design, energy reduction for house, wooden truss bridge (2) with 3 oz winning bridges supporting 400 pounds, roll bar for sit ski, tilt table, bicycle training wheels for adults, bicycle with torso support for child with cerebral palsy, outrigger grips for sit skiers, toys such as paper airplane launcher & castle, tower building with file cards & masking tape, rubber band powered car, elevator control, steam engines, steam powered cars, electric powered cars, assistive technology devices for disabled children, Rube Goldberg contraptions, devices for developing countries.

d) Comments: Responses from 3 schools.
"Expensive in time and money but well worth it from a retention and level interest perspective."
"The students show off these projects at the end-of-semester Design Expo that is attended by more than 500 including the public."
""We use the projects to demonstrate the design process. We work hard at helping students work in teams. We place maximum responsibility on students. In general, students enjoy this course."

Table 18. Responses to question 10 in CASEE survey on first-year design courses

that presenting the results of the two surveys simultaneously gives a much more complete picture of the current state of first-year engineering programs than either survey would by itself.

Both surveys were distributed through ASEE using the FPD listserve and at FPD sessions at ASEE national meetings. Thus, the surveys can, at best, only be representative of first-year programs that have someone who is active in ASEE. This limits complete generalization of the results, but we feel this limitation will not detract from the usefulness of the results.

The surveys provide broad benchmarking of first-year programs. A program can compare its structure or curriculum to other programs and in the process may find evidence supporting desired changes. The tables can also provide ideas for new advising and retention programs, new ways to teach courses, new design projects and so forth. We hope that readers find these results useful.

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Biographical Information

KENNETH P. BRANNAN
Ken Brannan is Professor and Head of the Department of Civil and Environmental Engineering at The Citadel. He was Chair of the Freshman Programs Division during 2001-2002 and served as President of the Southeastern Section in 1998-1999. He earned B.C.E and M.S. degrees from Auburn University and the Ph.D. from Virginia Tech. His professional interests include freshman engineering education and wastewater treatment.

PHILLIP C. WANKAT
Phil Wankat is the Clifton L. Lovell Distinguished Professor in Chemical Engineering and Engineering Education at Purdue University. He earned his BSChE from Purdue, his Ph.D. from Princeton University and an MSED from Purdue University. He was Head of the Department of Freshman Engineering at Purdue for 8 ½ years. His technical research is in separation processes and he is interested in improving teaching and learning in engineering education.