

# CONSTRUCTION ENGINEERING GRADUATE EDUCATION SURVEY

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**ABSTRACT:** In order to ensure that graduate-level construction engineering project-management education programs best serve the needs of the construction industry, it is deemed essential that a continuing dialogue between university professors and practitioners be maintained. Based upon three surveys conducted among the top 400 contractors as listed by ENR 1978, 1982, and 1984, six-year trends in educational needs are covered. They represent the shifting in the priorities among graduate courses and show the reflection of the evaluation of construction management in the USA. Construction industry expectations should be translated at the university level into a variety of new regular courses offered by various programs in the country. Short courses for practitioners should be offered by both universities or professional societies to complement their college education.

## INTRODUCTION

Modern construction engineering enterprises generally involve many tasks of great complexity that require skillful organization in planning, controlling, construction, and operation. The function of construction or project engineering management is to oversee the performance of these tasks. At the highest level of an organization, even in a technologically based corporation, the officers (president, vice-president, chief engineer) are professional managers who are often removed from daily technical tasks. If performance is the ultimate measure of management, productivity is the immediate objective of construction engineering management.

Several studies have indicated that better working relationships between universities and industry could strengthen the innovation process.

The University of Texas College of Engineering, Civil Engineering, recently completed a short-term research project based upon a survey of the top U. S. contractors listed in the 1983 ENR Directory, regarding the construction industry expectations from graduate construction engineering programs.

A similar survey was done by the writer in June 1978 and 1982. The findings were published in the proceedings of the ASCE Conference on Civil Engineering Education held April 19–21, 1979, at the University of Wisconsin, Madison, and the ASCE Gulf Southwest Regional Conference Proceedings, March 1982, at Houston, Texas.

The reason for surveying the same population was to identify trends in expectations, trends clearly influenced by economic, political, and technological changes in the construction industry in the U.S.

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## QUESTIONNAIRE RESULTS

In order to ensure that graduate construction education programs will best serve the interests of the construction industry, it is deemed essential that an ongoing dialogue between professors and practitioners be maintained. This was the reason for the design of the questionnaire which contains input from 38 graduate construction programs in the country. The same questionnaire has been used in three surveys which span six years.

Questionnaires were sent to 398 top U. S. contractors as listed in the ENR 1983 Directory. Of those, six were returned because of address changes or because they were no longer in business.

Completed questionnaires were received from 17.8% of the contractors (70 responses), compared with 16.3% received in 1978, and 22.7% received in 1982. Responses were received from top executives, which reflects more interest in construction graduate education. The questionnaires were organized in two parts: (1) Whether a civil engineering bachelor's degree (4 years) is needed to better perform at the middle or principal management level; and (2) matters concerning interaction between the university at the graduate level and construction contractors.

Results of this survey indicate not only actual areas requiring more attention from educators to upgrade the graduate programs (construction engineering) to fulfill the future contractor's needs, but, at the same time, a trend and a shift in priorities that has occurred in the last four years.

Ranked results by percentage of "Yes" and "Unsure" answers to the first question: "Evaluate the following areas as to whether you believe that knowledge above a civil engineering bachelor's degree (4 years) is needed to better perform at the middle or principal management level" are shown in Fig. 1. It is easy to note a shift in priorities compared with the 1978 and 1982 surveys.

	June 1978				January '82				June 1984			
	RANK	Received 63/ 16.3% Mailed 386			RANK	Received 81/ 22% Mailed 357			RANK	Received 70/ 17.8% Mailed 392		
		Yes	Unsure	No.		Yes	Unsure	No		Yes	Unsure	No
		%	%	%		%	%	%		%	%	%
A. Technical Knowledge												
1. Managerial accounting	5	59	16	25	14	56	16	28	7	70	6	24
2. Financial management	1	67	22	11	4	70	15	15	3	60	14	26
3. Cost estimating and bidding	9	56	8	36	8	63	1	36	12	61	6	33
4. Operation research	19	29	43	28	26	17	41	42	26	14	34	52
5. Applied Statistics	28	11	43	46	23	21	40	40	25	11	17	72
6. Decision analysis and forecasting techniques	20	29	35	36	10	59	18	23	14	47	21	29
7. Productivity measurement and methods improvement	6	59	16	25	12	58	16	26	17	44	19	37
8. Construction equipment management	16	40	16	44	18	47	19	35	20	41	13	46
9. Urban planning and public works	13	37	50	28	16	21	63	24	13	17	70	
10. Construction site - layout and organization	12	51	13	36	15	54	8	38	16	54	14	32
11. Value Engineering	13	49	16	35	16	51	24	25	11	60	13	27
12. Computer systems design and management	25	19	38	43	17	47	26	27	15	44	29	30
13. Analysis in real estate development	27	16	27	57	25	19	25	56	23	26	24	50
14. Industrialized construction systems	29	24	46	30	22	35	35	30	21	30	33	37
15. Building codes and standardization	18	32	17	51	21	41	19	40	18	43	41	53
B. Managerial Knowledge												
16. Project planning scheduling and control	7	59	10	31	5	68	7	25	3	73	6	21
17. Material and manpower control	10	52	19	29	7	63	7	30	6	67	6	27
18. Contract administration	3	65	6	29	2	74	11	15	2	77	3	20
19. Cost control and trend analysis	4	60	14	26	9	62	17	21	4	68	10	24
20. Management of international projects	26	16	36	49	27	17	39	44	27	12	24	64
21. Administration of research and development	23	24	25	51	24	20	31	41	28	9	29	71
22. Legal issues in construction and project mng.	15	40	24	34	11	80	10	10	1	81	4	15
23. Design of organization structure	17	40	24	36	20	43	27	30	11	38	19	45
24. Writing/visual/graphic communication	21	27	27	49	11	58	17	25	4	67	12	21
25. Labor management relations - labor law	8	59	5	36	6	67	13	20	10	68	13	21
26. Construction law and legislation	2	67	14	19	3	72	9	19	5	70	15	15
27. Public speaking and public relations	14	41	16	43	13	56	25	19	9	62	12	28
28. Collective bargaining	11	51	16	33	19	44	28	20	22	34	15	51

FIG. 1. Ranked Results of Question 1

	June 1978			January 1982				June 1984		
	Yes	Unsure	No	Yes	Unsure	No		Yes	Unsure	No.
C. <u>University - Construction Industry</u>										
1. Will your company provide full or partial financial support for an employee to complete an M.S. in construction (1 year) under certain contractual obligations?	[38]	[22]	[40]	[37]	[25]	[38]	[53]	[53]	[17]	[30]
2. Will your company provide a one-year leave of absence to complete an M.S. in Construction?	[38]	[20]	[42]	[36]	[29]		[35]	[29]	[23]	[48]
3. Should a master's degree be a criterion for promotion?	[ 2]	[04]	[94]	[ 5]	[ 5]		[90]	[ 3]	[ 4]	[93]
4. Should an M.S. in construction be a requirement for the principal management level position?	[ 0]	[05]	[95]	[ 4]	[ 6]		[90]	[ 3]	[ 8]	[89]
5. Is your company in favor of providing financial grants to institutions for graduate education support?	[29]	[30]	[41]	[26]	[37]		[37]	[18]	[42]	[40]
6. Does your company feel that current construction engineering graduate programs are doing a good job?	[27]	[62]	[11]	[42]	[49]		[ 9]	[50]	[37]	[13]
7. Do you consider a man without a practical experience with an M.S. degree to be over-educated for your purposes?	[48]	[12]	[40]	[40]	[14]		[46]	[52]	[24]	[24]

**FIG. 2. Construction Engineering Graduate Education-Construction Industry Relations Results**

Regarding construction engineering graduate education-construction industry relations results have been compiled for the whole industry in Fig. 2, showing a strong consistency with the 1978 and 1982 survey results. Although 1/3 of the general contractors are willing to support their selected employees in the continuation of graduate studies (questions 1 and 2), very few (3%) consider that a Master's degree in construction engineering and management should be a requirement for principal management position or a criterion for promotion.

In the field of additional technical and managerial knowledge required for a new graduate to better perform in a managerial position, the most required topics of the 28 surveyed are shown in Fig. 3 in comparison with the 1978 survey and the 1982 survey.

Surprisingly, "legal issues in construction in project management," which ranked 15 in the 1978 survey is at the top of the list in both 1982 and 1984.

Assuming that each topic could be covered in a three-credit course, 30 credit hours in graduate work could include the topics necessary to satisfy the top 400 contractors' requirements. Considering these results, minor changes in present curricula may be beneficial not only to future graduates for employment but for the entire construction industry. In their responses, a few general contractors suggested other topics or areas of interest to be included in graduate construction engineering curricula as listed in the following; most of them are in fact part of the surveyed topics. They include: (1) Cost analysis in preliminary design; (2) motivation studies; (3) marketing; (4) employee time management; (5) long-range/strategic/corporate planning; (6) construction safety; and (7) work and business ethics.

It is certain that not all of the 28 topics that appear in the questionnaire can be taught during academic education. Some of the topics might be

Rank	June 1978 Survey	Rank	January 1982 Survey	Rank	June 1984 Survey
1.	Financial Management	1.	(15) Legal issues in construction and project management	1.	[1] Legal issues in construction and Project Management
2.	Construction law and legislation	2.	(3) Contract administration	2.	[2] Contract administration
3.	Contract administration	3.	(2) Construction law and legislation	3.	[5] Project planning, scheduling and control
4.	Cost control and trend analysis	4.	(1) Financial management	4.	[3] Construction law and legislation
5.	Managerial accounting	5.	(7) Project planning scheduling and control	5.	[ ] Managerial accounting
6.	Productivity measurement and methods improvement	6.	(8) Labor management relations	6.	[ ] Writing/visual/graphic communication
7.	Project planning scheduling and control	7.	(10) Material and manpower control	7.	[7] Material and manpower control
8.	Labor management relations and labor law	8.	(9) Cost estimating and bidding	8.	[6] Labor management relations, labor law
9.	Cost estimating and bidding	9.	(4) Cost control and trend analysis	9.	[9] Cost control and trend analysis
10.	Material and manpower control	10.	(20) Decision analysis and forecasting techniques	10.	[ ] Public speaking and public relations

(#) Ranked in 1978.

[#] Ranked in 1982

### FIG. 3. Most Desired Knowledge in Graduate-Level Construction Engineering Students

sufficiently covered by short courses offered by universities for practitioners.

### CONCLUSION

It is clear that graduate construction engineering programs present a greater variation in educational curricula than do undergraduate programs.

It is essential that a continuing dialogue between professors and contractors be maintained to better serve the interests of the students and construction industry. Significant changes occurred in a six-year span due to dynamic economic national and international changes. Construction industry expectations should at the university level be translated into a variety of new courses, offered by existing professors or by highly qualified local practitioners. The final test of graduate construction engineering programs must be based on their products, the individuals who apply for managerial positions in the construction industry.

### APPENDIX. REFERENCES

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