

AC 2000-93: Construction Safety Education Satisfying Industry Needs

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CONSTRUCTION SAFETY EDUCATION SATISFYING INDUSTRY NEEDS

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Introduction

Implementation of safety and health programs on construction projects requires a well-educated workforce that is knowledgeable in safety requirements and procedures. Suckarieh and Diamantes (1995) indicated that time dedicated to construction safety training is not adequate. He mentioned that formal training could have a significant impact on students' performance as soon as they graduate. Coble et al. (1998) mentioned that safety education for the Building Construction Management students has not often been a high priority in US universities. J. Christian (1999) observed that teaching a class like safety is sometimes difficult as the students regard its regulatory nature as is "boring".

The need for construction safety education is now a consensus issue among the construction educators and the industry for its enormous contribution towards the reduction of number and costs of accidents. A literature review reveals that very limited study has been carried out regarding the scope of this course and how it can be taught in the construction management/engineering programs. The content and approach of teaching safety courses in different schools varies according to the background of the faculty and the available resources of the department.

The Construction Department at Southern Polytechnic State University (SPSU) has already made safety education a high priority for construction students by making it one of the required courses for graduation. The safety class, which has been taught for several years in the Department, is still evolving with industry needs and expectations. It is important to find the answer to the queries "What are students learning from the course? Should the course include only OSHA's 10-h or 30-h requirements or 30-h requirements with additional materials?"

In this scenario, the construction industry can provide excellent guidelines on the appropriate content of the course. Course evaluation by the industry is a necessity in order to develop such a course with the increasingly stringent rules of Occupational Safety and Health Administration (OSHA). Their suggestions and requirements would need to be incorporated into the curriculum so that the course achieves desired objectives. Finding an answer to the question of contractor expectations is a fundamental step in determining the baseline for course content. The topics that most closely match the needs of industry will be a likely choice for inclusion in the course. Discussion time for each topic will also be dependent on the industry's priorities.

Methodology

A survey technique was chosen to solicit information on construction safety knowledge and/or responsibilities, which a construction student should have during the different stages of his career. The industry safety management was asked to identify the career development stage at which employees were required to have certain safety knowledge. The construction students work generally as a field/office engineer/assistant project manager after graduation, project manager/construction engineer with 5 years working experience, senior project manager/construction manager with 10 years working experience. S/he may work as a safety manager/director or as a superintendent as well. Primary interest was for entry-level employees (recent graduates) and employees of five and ten year experience. Since the purpose of the survey was to investigate the course content for construction students at SPSU, the survey targeted known and prospective employers of SPSU construction students-predominantly in the Southeast United States (GA, FL, TN, AL, NC, and SC). Sixty-five contractors were identified as working in the southeastern region at the beginning of the survey, which has a work volume in excess of \$30 million per year. Twenty-seven contractors filled-up the questionnaire and returned it to us. The response was about 41.5%.

The first three questions were asked about the annual revenues, number of the permanent employees and type of work of the company. The fourth question of the questionnaire contains 15 safety responsibility areas identified from the literature and OSHA document. The respondent was asked to identify if a person was responsible for that area or not. The fifth question was asked about eight non-regulatory but very important aspects of construction safety. The respondents were asked to indicate if they expected construction graduates to have knowledge of Experience Modification Rates (EMR); OSHA recordable incidence rate; direct and indirect accident costs; safety incentive programs; accident impacts on moral and productivity; accident impact on scheduling and total costs; workers compensation; and liabilities related to accidents. The sixth question listed the Code of Federal Regulations 1926 subparts with titles and asked which of these the newly hired graduate would be expected to know. Respondents were asked to select all, none, or choose individual subpart requirements. The seventh question was asked to list three most important items from their experience that need to be included in the safety class. This question was a kind of open-ended question. It was included to know what aspects left out from the current OSHA regulation that has enormous implication on safety. The last question was asked about the industry opinion how the course could be made interesting and exciting for the students.

Some telephone interviews were also conducted with those well-known contractors in the Atlanta area who largely hire SPSU Construction students for the quick return and clarity of their response.

Results

The survey revealed a wide variety of informations regarding the company and the company requirements related to construction safety. Sixty Percent of the companies that sent the responses had annual revenue of more than \$100 Million. About 11% of the companies had annual revenue of more than \$1 Billion. Forty Percent of the companies had permanent employees numbering more than 100. Most of the companies are involved in building and commercial construction. Only three contractors were involved in heavy civil construction.

Table 1 summarizes the responses to the fourth question of the survey. Total response to any question is more than 100% since more than single responses were applicable for the individual question. Decisions were made from the survey where more than 50% of the

respondents expressed the same view or marked in the affirmative. That means 50% of the respondents' expression/desire should be considered as the baseline of their requirement in the modified safety course. From Table 1, it is revealed that participation in project safety meetings, recognition in common hazards and suggestions of corrective actions are the most important activities for construction graduates in their careers irrespective of their positions. All respondents supported the views that project safety meetings and recognition of the common hazards are the critical responsibilities for the construction graduates. About 95% of the respondent's felt that they should suggest the corrective actions for the common hazard either they are working as a field engineer/project engineer/manager. From this perspective, it can be concluded that safety course should emphasize how to conduct effectively project safety meetings, what are the most common hazards in the specific construction areas depending on the type of the construction, and what corrective measures can be taken to reduce those common hazards. Bureau of Labor Statistics (BLS) and OSHA citation data can be used to identify the common hazards for the particular type of construction and the OSHA rules and regulations (1926 CFR) can be used as a guideline to suggest the predictive/preventive/corrective actions. Thirty One Percent of respondents suggested that to prepare a safety manual was the responsibility of field engineer/first year employee in contrast to the 96% who felt that it should be the safety director/manager's responsibility. In this scenario, it is appropriate to spend less class time for the preparation of the safety manual.

Out of the eight additional topics, Table 2 reveals that seven topics were considered important that had more than 50% respondent support. Only the incentive program for safety had less than 50% support. OSHA recordable incidence rate, accident impact on moral and productivity, and liabilities related to accidents need to be incorporated and widely discussed in the class since these have more than 80% industry support. Experience modification rate (EMR), accident impact on scheduling and total cost, determination of direct and indirect costs of accidents, and worker compensation insurance was respectively measured as 74%, 74%, 67% and 78% of the respondents who emphasized. Therefore, these should be covered in the class in

Table 1 Percentages of YES responses regarding responsibilities

Responsibility	Recent Graduate / Field Engineer	Project Manager /Construction Engineer with 5 Years Experience	Senior PM or Construction Manager with 10 Years Exp.	Safety Manager /director/Engineer/ Officer	Superintendent /Other Personnel
Conduct Preproject Hazard Analysis	48	76	71	95	80
Conduct Site Safety Audits	50	78	84	100	95
Conduct Toolbox Meeting	47	50	29	73	92
First Aid Inventory and Supplies	50	33	27	83	96
Jobsite Posters (OSHA and Emergency Contacts)	31	17	0	80	96
Maintain MSDS Files	44	23	23	83	96
Maintain OSHA 200 Log	20	14	14	75	81
Maintain Safety Training Records	33	33	23	83	96
Participation in Toolbox Meeting	47	50	29	73	92
Participate in Project Safety Meetings	100	100	92	100	100
Perform Hazard Analysis	47	56	50	89	95
Permits (Confined spaces etc.)	38	55	45	73	70
Prepare Project Safety Manual	31	47	48	96	44
Recognize Common Hazards	100	100	100	100	100
Suggest Corrective Actions	95	100	96	100	96

depth because the construction industry feels these items have enormous implications on construction safety. Smith and Arnold (1999) found a similar consistency of incorporating these additional items in the construction safety class.

Table 2 Expected knowledge of newly hired graduates on Non-regulatory Aspect of Safety (Percentages)

	Yes
Experience Modification Rate	74
OSHA Recordable Incidence Rate	89
Safety Incentives Schemes	30
Determination of Direct and Indirect Costs	67
Accident Impact on Morality and Productivity	85
Accident Impact on Project Scheduling and Project Costs	74
Workers Compensation	78
Liabilities Related to Accidents	85

All the OSHA major subparts, which are important to construction safety, have been identified in Table 3. Sixteen respondents (58%) mentioned that all the newly hired construction graduates/field engineers should have knowledge of all section of 29 CFR 1926. Although it is industry expectation to cover all the subparts, probably it is not possible considering the time and resource limitations. Table 3 summarizes those subparts that received 70% or more responses.

Table 4 summarizes the three most important items that must be included in the construction safety class from their education and experience. Since it was the open-ended questions, the responses varied widely because of respondents' backgrounds. Some of the responses were not even from OSHA subparts. About 46% of the contractors ranked that fall protection was their first priority, 8% ranked this as the second priority, 14% as third priority. Trench and excavation was ranked by 14% as their first priority, 8% as second priority and 14% as third priority. Some of the contractors also mentioned some unregulated items such as workers behavior, time of accidents, zero accidents goal, safety culture, top management responsibilities, substance abuse, insurance fraud, handling compensation costs, subcontractor coordination etc. to be included in safety education.

Table 3 OSHA Regulations Subparts with 70% or more supports

Subpart	Yes
Subpart A General	74
Subpart C General Safety and Health	70
Subpart E Personal Protective and Life Saving Equipment	78
Subpart F Fire Protection and Prevention	74
Subpart K Electrical	85
Subpart L Scaffolding	81
Subpart M Fall Protection	89
Subpart P Excavation	81
Subpart Q Concrete and Masonry Operation	70
Subpart X Stairways and Ladders	81
Subpart Z Toxic and Hazardous Substances	78

To make the class more interesting and to create a positive learning environment, open-ended suggestions were asked from the contractors. Invariably they suggest visits to the actual site of construction as many times as possible to show the practical nature of work and to identify the common safety hazards. They also suggest demonstration of some safety tools in the class. Safety tools can be used to show how important they are for the specific safety hazards and how students can effectively use them to minimize that hazard.

Table 4 Three most important topics according to the priority (Percentages)

Topics	First Priority	Second Priority	Third Priority
Fall Protection	46	8	14
Excavation	14	8	14
Electrical	8	14	8
Safety Planning	8	8	14
Recognize Hazards	14	8	0
OSHA-General	8	0	8
Subcontractor Safety	0	14	8
Accident Costs	0	8	14
Handling Compensation Costs	0	14	0

Conclusions

The construction safety education can not be accomplished by teaching only the fundamental requirements of the OSHA 10-hour course. The responsibilities of construction graduates vary according to the position they will hold, type of the company, nature of work, company goals and regulations, and other considerations. It is therefore, imperative to provide general guidelines and create awareness about overall safety. Because of limitation of time it is not possible to cover all aspects of construction safety, which are required for a construction graduate throughout his career from contractor perspective. If a construction graduate wants to work in the safety department or as a superintendent, his/her safety knowledge requirement is more extensive and very thorough (Table-1) than the requirement for the field/project engineer/manager. The author identifies the 11 topic areas (Table 3) that had the greatest amount of agreement among the contractors surveyed and should be covered in more detail. The author feels that the information received from the survey is generally representative of the overall industry expectations, not only the southeastern region of the United States. However, it would be better if data can be collected from all regions, with the increasing number of participation.

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