On-Site Management of Precast Concrete Construction

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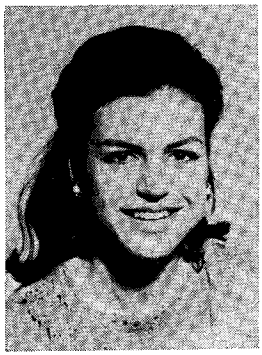

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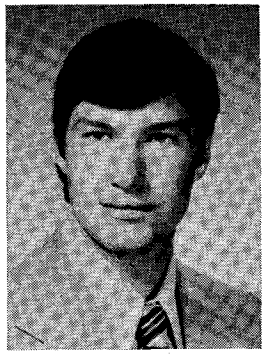

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The current on-site usage of managerial talent in precast concrete construction projects is assessed on the basis of results obtained from a questionnaire survey.

Seventy-seven percent of the respondents employ an on-site manager whose major responsibilities are activity coordination, schedule updating, supervision, and safety control.

Important problems encountered by on-site managers are delivery problems and cost control.

Efficient management is of primary importance for the continuous growth and vitality of precast concrete construction. This work is based on the premise that a first step towards improvement in efficiency of management could be accomplished by an assessment of the current usage of managerial talent on the construction site.

Accordingly, the focus is on identification of tasks, responsibilities, and problems encountered by on-site project managers in precast concrete construction. The scope of this work is limited to a study of on-site managers who are hired by the precast concrete manufacturers, rather than by the general contractor or erection subcontractor.

Since very little data on on-site management of precast concrete construction was available in the literature, it was decided that a questionnaire survey was the best method of approach. Accordingly, a questionnaire was prepared and distributed to members of the precast concrete industry with the specific purpose of gathering information on the following questions:

1. What are the tasks and responsibilities of the person, identified in this work as a project manager, who is hired by the precaster to supervise on-site operations and to control the precast concrete phase of a construction project?

2. What are the tasks and responsibilities (if any) of the project manager in preconstruction activities?

3. What are the problems associated with on-site management of precast concrete construction?

A total of 109 responses from precast concrete manufacturers across the United States and Canada were received and analyzed.

Briefly, we found that only 15 percent of the responding concrete precasters never erect their own products; the remaining 85 percent have erected their products at times. On the average, producers erect their own products in about 60 percent of the cases.

Of the producers that do erect their products at times, 91 percent hire their own on-site project managers. Seventy-three percent of these managers are also involved in preconstruction duties, mostly in the determination of erection methods and procedures.

In the area of on-site management, activity coordination seems to be the manager's most important task. Furthermore, site location problems, truck delays, and keeping the project within budget were cited as the most frequently encountered problems of manager.

The Survey

The survey was limited to precast concrete producers in the United States and Canada. The main directory used for the distribution of questionnaires was the "Precast, Prestressed Concrete Producers and Products Directory for the United States and Canada," published by the Prestressed Concrete Institute (PCI).[1] This directory lists all companies of the precast concrete industry known to the PCI. Some of the companies listed are members of PCI, while others are not.

Questionnaires were sent out to all PCI members, and to all of the nonmembers when complete addresses could be found. The total sent was 271 out of the 320 firms listed in the directory. However, 31 of the questionnaires were returned either because the company had gone out of business, or had moved without leaving a forwarding address, or the address available was incorrect. Therefore, the total number of precast

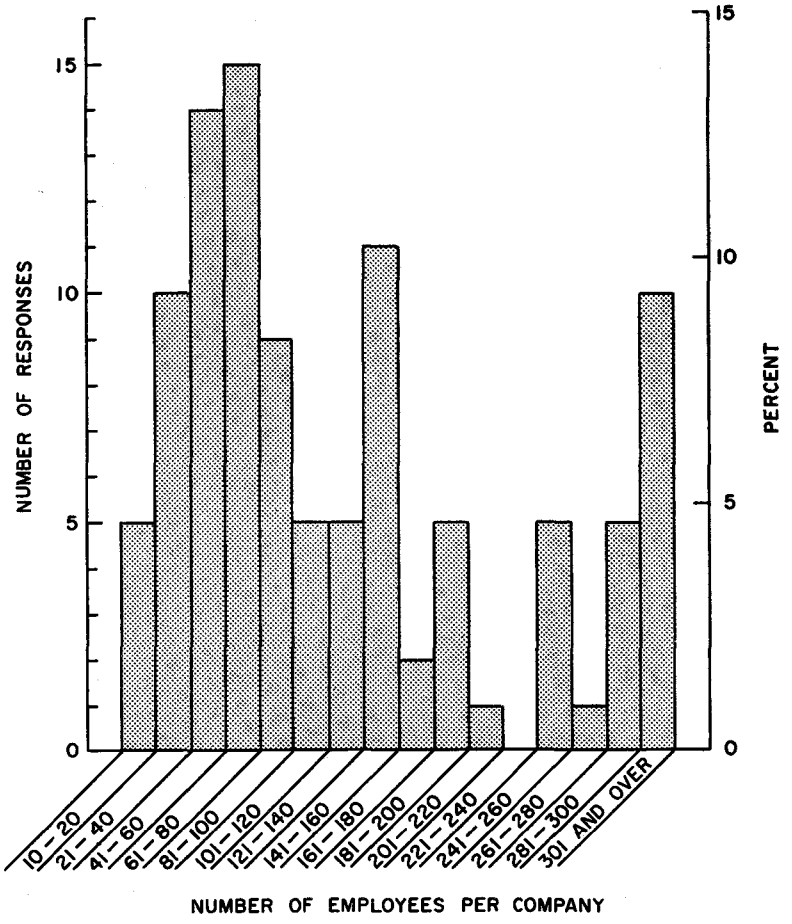

Fig. 1. Histogram showing number of employees per responding company to number of responses (in percent).

manufacturers contacted was 240, of whom a total of 109 or 45 percent responded.

Some of the questionnaires had not been entirely filled out, presumably either because of lack of information, or because the respondent disregarded the question. Any question that was completely answered was used in the tabulation of results. All tables indicate the number of responses the results were based on.

The questionnaire can be found in the Appendix. It is divided into four sections. Section 1 (Questions 1 to 4) deals with general company statistics —number of employees, percent of the time a precaster erects his own products—whether the company hires its own on-site manager and, if so, what his title is. Section 2 (Question 5) refers to the involvement (if any) of on-site project managers in preconstruction activities, while Section 3 (Question 6) determines their on-site tasks and responsibilities. Finally, Section 4 (Question

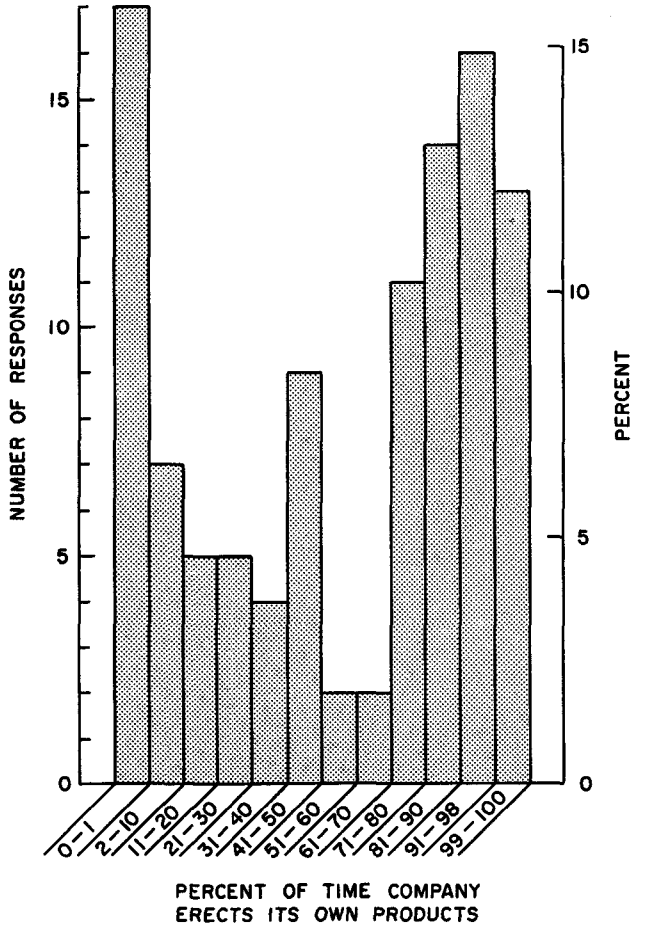

Fig. 2. Histogram showing percent of time company erects its own products to number of responses (in percent).

7) identifies the major problems encountered by the on-site project managers.

Section 1—General Company Statistics

The size of the responding companies varied from small firms employing as few as 10 people to very large manufacturers employing more than 300. Fig. 1 is a histogram showing the number of responses (in percent) in relation to the number of employees per responding company.

Fifteen percent of the companies never erect their products. The remaining 85 percent do erect their products on occasion. A detailed percent analysis of cases where concrete precasters erect their products is shown in the histogram of Fig. 2. The tail-end increments of the histogram, 0-1 and 99-100 percent, have been deliberately reduced in size in order to reveal the significant number of companies which are within these extreme regions.

On the average, companies erect

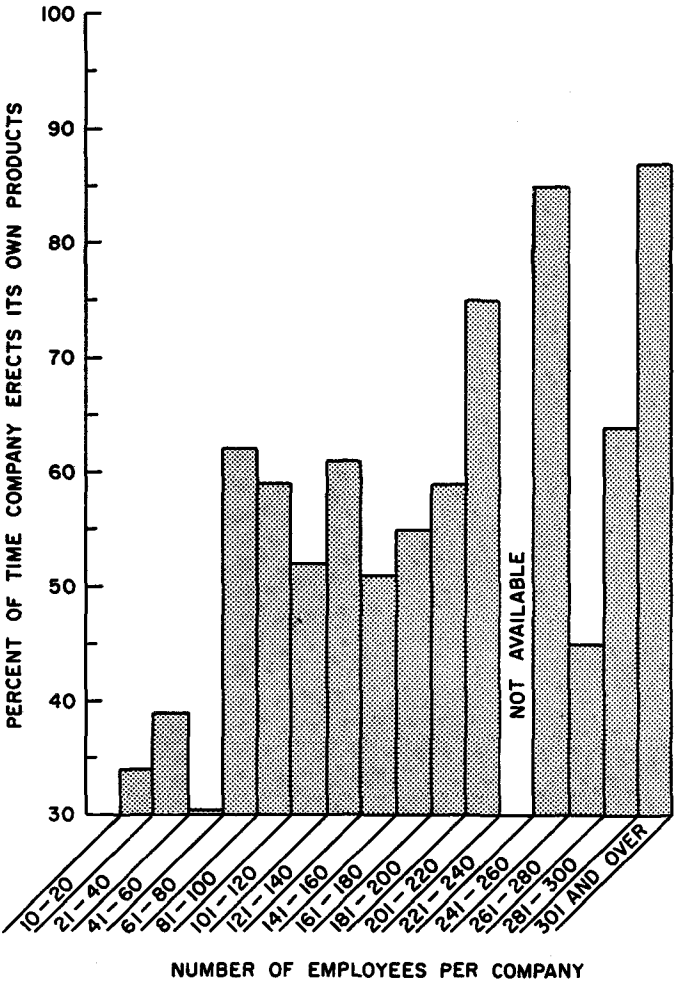

Fig. 3. Histogram showing relation of company size (by number of employees) to percent of time company erects its products.

their own products about 60 percent of the time. Presumably, the rest of the time the general contractor will either erect the precast components himself or hire a subcontractor to do it.

It is interesting to study the relation of the company's size, as measured by the number of its employees, to the extent of its involvement in erection responsibilities.Our results indicate that companies with larger staffs tend to be more involved in delivery and erection of precast components, the additional people being associated with the erection responsibilities (Fig. 3).

Eighty-two out of 107 companies, or 77 percent of the respondents to Question 3, stated that they hire a person responsible for the on-site management of a project the company is involved in. The more often a company is involved in erection re-

sponsibilities, the more likely it will hire an on-site manager. Indeed, more than 50 percent of the companies that do not hire an on-site manager never erect their products, while 60 percent of the companies that do hire an on-site manager erect their products more than 70 percent of the time (Table 1).

What is the title of the on-site manager, the person identified as a "project manager" in this work? "Erection Supervisor" is the most popular title mentioned by the respondents. The title "project manager" comes second in popularity, together with the name "field supervisor" (Table 2).

Section 2: Involvement of Project Managers in Preconstruction Activities

The overwhelming majority of precasters felt it was advisable and made it a practice to involve project managers in preconstruction activities, such as project planning and design. Some felt strongly enough about such involvement to volunteer useful comments. To quote one such comment:

"Designers . . . lack the knowledge and experience in the proper use of precast. This is improving, but has a long way to go. Jobs where design is complete and where all bids can be coordinated before construction starts presents less disputes, less bulk changes, less delivery problems and better construction practices."

Of the 82 companies that hire a project manager, 60 or 73 percent stated that this person was also involved to some extent in preconstruction activities.

The next question is: What are the preconstruction activities the project manager is actually involved in? The second part of Question 5 listed several preconstruction activities, and the companies were asked to check the manager's involvement in each of them. They were to answer according

Table 1. Relation of frequency of involvement in erection procedures to a company's employment of an on-site project manager.

Percent of Time Company Erects Its Own Products	Total Responding Companies	Companies Employing a Project Manager	Companies Not Employing a Project Manager
0 - 1	17	4	13
2 - 10	7	3	4
11 - 20	5	4	1
21 - 30	5	5	0
31 - 40	4	3	1
41 - 50	5	3	2
51 - 60	8	8	0
61 - 70	2	2	0
71 - 80	11	10	1
81 - 90	14	12	2
91 - 98	15	15	0
99 - 100	14	13	1
Total	107	82	25

Table 2. Titles of on-site managers in the precast concrete industry (in alphabetical order).

Title	No. of Responses
Chief Engineer	1
Contracts Manager	1
Construction Manager	7
Construction Supervisor	1
Engineering Consultant	1
Engineering Coordinator	1
Erection Coordinator	2
Erection Foreman	7
Erection Superintendent	3
Erection Supervisor	16
Field Coordinator	1
Field Engineer	1
Field Manager	3
Field Services Manager	2
Field Supervisor	9
Installation Supervisor	1
Job Site Coordinator	2
Job Supervisor	1
Operations Manager	4
Planning Department Manager	1
Plant Engineer	1
Plant Manager	2
Product Coordinator	1
Production Engineer	1
Production Manager	1
Project Coordinato	4
Project Engineer	4
Project Manager	10
Project Supervisor	2
Sales Engineer	1
Superintendent	3
Systems Coordinator	1
Total Number of Responses: 82. (Note that some respondents mentioned more than one title).	

to: A—quite often involved; B—occasionally involved; C—seldom involved; and D—never involved.

A mean was calculated for each activity as a weighted average of the A, B, C, and D responses. Each response with a level of responsibility checked as A was given a weight of 7, B a weight of 5, C a weight of 3, and D a weight of 1.

A summary of the responses to Question 5 is presented in Table 3, where preconstruction activities are ranked according to the calculated mean values; from a value of 7 (frequent involvement), to a value of 1 (no involvement).

The results presented in Table 3 reveal that involvement in the determination of erection methods and

Table 3. Involvement of project managers in preconstruction activities.

Activity	Frequency of Involvement (Mean Value)
Determine erection methods and procedures	7.0
Determine transportation and delivery procedures	6.5
Selection of cranes and/or other equipment	6.0
Determine project staging/ timing	5.8
Determine joint and connection procedures	5.8
Determine technical feasibility	4.9
Prepare bid/proposal	4.9
Negotiation of contract	3.9
Determine component selection	3.8
Determine resource allocations	3.7
Conception of project	3.6
Economic feasibility analysis	3.0
Site acquisition	1.8
Approve design documents	1.8
Note: Total Responses: 60	

Table 4. Comparison of tasks of project managers in precast and cast-in-place construction.

Importance of the Task	Precast Construction	Cast-in-Place Construction*
	Preconstruction Activities	
HIGH	Determination of erection methods and procedures Determination of transportation and delivery procedures Selection of cranes and/or other equipment	Determination of project staging/time Economic feasibility analysis Approval of design documents
INTER-MEDIATE	Determination of project staging and timing	
LOW	Economic feasibility analysis Site acquisition Approval of design documents	Site acquisition
	Construction Activities	
HIGH	Activity coordination Schedule updating Supervision of field personnel Safety control Inspection responsibilities	Negotiation of change orders Monitoring of construction costs
INTER-MEDIATE	Monitoring of construction costs Negotiation of change orders	
LOW	Hiring of subcontractors, labor force and equipment Assembly of construction teams Negotiation of labor disputes and/or contracts	Inspection responsibilities Supervision of field personnel Hiring of subcontractors, labor force and equipment Assembly of construction team Negotiation of labor disputes and/or contracts

* After Reference 2

procedures is the task in the preconstruction phase that is most often performed by the project manager. Frequent involvement of the project manager was also established for determination of transportation and delivery procedures, selection of cranes and other equipment, determination of project staging/timing, and determination of joint and connection procedures.

On the other hand, project managers are almost never involved in the approval of design documents, site acquisition, and economic feasibility analysis.

We have compared our own findings in this section with those of the author's in Reference 2, which includes an assessment of the role of project managers in cast-in-place, rather than precast, construction industry (see Table 4). According to this author, the primary role of a project manager in the preconstruction activities of cast-in-place construction is the determination of project staging and timing (an activity that ranked fourth in terms of importance in our list which concerns precast construction), and to prepare preliminary budget estimates (an activity very close to what we called economic feasibility analysis, which comes

Table 5. Tasks performed by on-site managers.

Task	Frequency of Involvement (Mean Value)
Activity coordination	6.1
Schedule up-dating	6.1
Supervision of field personnel	6.1
Safety control	6.1
Inspection responsibilities	6.0
Development of construction schedule	6.0
Determination of construction methods and procedures	6.0
Estimation of percent complete	6.0
Monitoring of construction costs	5.1
Negotiation of change orders	5.0
Accept completed work	5.0
Hiring of subcontractors, labor force, and equipment	5.0
Assembly of construction team	5.0
Negotiation of labor disputes and/or contracts	4.0

Note: Total Number of Responses: 81

near the bottom of our list).

Our findings confirm once more the overriding importance of erection methods in the success of a precast project, a consideration of no importance in cast-in-place construction. Indeed, among the most often cited advantages of precasting over cast-in-place construction methods is speed of construction and reduced dependence on on-site labor. Both of these advantages can be lost in the absence of effective erection methods.

More than 60 percent of the respondents in the questionnaire analyzed in Reference 2 had their project managers participate in the preparation of cost estimates and in the approval of design documents during the planning and design stages. By contrast, both of the above activities (which we have called "Economic Feasibility Analysis" and "Approve Design Documents") are found to be among the least important for managers of precast construction.

This fact seems to indicate that the scope of involvement of project managers in the preconstruction stage of precast construction is limited when compared to their role in the early steps of cast-in-place construction. In other words, in precasting, the manager enters the picture later on in the operation. An economic feasibility analysis of a precasting project is probably performed at a relatively early stage of the preconstruction period, at a time when the details of erection techniques, joints, connec-

tions, etc. (a main concern of the project manager) usually have not been identified.

Furthermore, our results show that in precast construction the approval of design documents seems to be the domain of the engineer and the architect, with no significant input from the project manager. This result confirms the findings of the authors in Reference 3.

Site acquistion is not an important responsibility of project managers in both cast-in-place and precast construction. Unless either the precaster or the contractor are also the developers, the project site is usually a predetermined quantity, in which case on-site project managers would of course not be involved in site selection.

Section 3: Tasks and Responsibilities of Project Managers on the Site

Precast concrete construction presents different challenges to a project manager than cast-in-place construction. The tasks and responsibilities of a project manager were identified in Question 6, in which the precasters were asked to check their project manager's involvement in the identified activities according to: A—quite often involved; B—occasionally involved; C—seldom involved; and D—never involved.

Eighty-one precasters responded to this question. Their responses were analyzed in the same way as responses to the previous question (Question 5) and are presented in Table 5, which ranks the tasks and responsibilities according to the calculated mean value.

It appears that our questionnaire does include the tasks most often performed. Indeed, eight of the identified tasks got a mean value of about 6 (often involved), and only one got a mean value as low as 4 (between seldom and occasional involvement).

Activity coordination seems to be a major responsibility of a project manager, as is schedule development and updating, determination of construction methods and procedures, supervision, inspection, safety control, and estimation of percent complete. On the other hand, negotiation of labor disputes and/or contracts comes at the bottom of the list. Apparently, this is a duty of a person higher up in the hierarchy than the project manager.

We have compared our findings with those of Reference 2, which includes an assessment of a project manager's involvement in on-site activities in cast-in-place construction (Table 4). Whereas the findings of this author[2] state that negotiation of change orders and monitoring of construction costs come first in the list of responsibilities, we find that these tasks are of intermediate importance for managers of precast construction.

Furthermore, inspection responsibilities which rank high among the tasks of project managers in precast construction are of low importance for project managers in cast-in-place construction. On the other hand, negotiation of labor disputes, hiring of subcontractors, labor force and equipment, and assembly of the construction team come at the bottom of both lists.

Section 4: Problems Encountered by On-Site Project Manager

We have identified the major problems encountered by on-site project managers (Question 7 of our questionnaire) and have asked the companies to rank them from A to D (A for problems occurring quite often, to D, problems that never occur). We calculated the mean of the responses as explained in Section 2.

Table 6. Problems encountered by on-site managers.

Problem	Frequency of Involvement (Mean Value)
Truck frequently delayed	5
Site location creates delivery problems	5
Keeping project within budget	5
Too many trucks arrive at once	4
Technical problems: components do not match, or line up, etc.	4
Too many joints, slows erection	4
Joints too complicated	4
Up-dating of schedule	4
Sequencing of erection and deliveries	4
Keeping project on schedule	4
Equipment not used to maximum capacity	4
Keeping productivity at expected levels	4
Lack of skilled labor available	4
Strikes, sit-downs, etc.	3

Note: Total Number of Responses: 81

Our results are presented in Table 6, where it can be seen that delayed trucks, delivery problems created by the site location, and keeping the project within budget were the most often encountered problems. On the other end of the scale, strikes and sit-downs were seldom a problem.

Conclusions

According to the results of the survey, a successful project manager in the area of precast construction must be able to assume diverse tasks and responsibilities ranging from the delivery of technical to managerial skills. These tasks and responsibilities are not always similar to those required for cast-in-place construction.

In the area of technical expertise, the precast project manager's contribution is primarily in the area of erection methods and procedures. By contrast to his colleagues in the area of cast-in-place construction, his input in the design stage is minimal.

In the area of managerial knowledge, the ability to coordinate activities is of primary importance. Once more, this contrasts with the low level of responsibility assumed in this area by the project manager in cast-in-place construction. The difference is

due to the special aspects of precast construction, where poor timing of delivery and erection procedures would result in under-utilization of expensive equipment and labor, and would cancel the expected advantages of this form of construction.

It follows that a good command of scheduling techniques is an essential prerequisite for effective project management in precast construction. Confirmation of the above comes from our findings, that among the most frequent problems of on-site managers are delayed trucks and delivery problems.

The strengths required of a project manager in precast concrete construction are summarized in an anonymous comment of one of the respondents:

"The fundamental ideal for on-site precast erection supervision is very high technical competence combined with the ability to work effectively with the general contractor . . . plus effective coordination with shipping and plant production."

References

1. *Precast, Prestressed Concrete Producers and Products Directory —United States and Canada,* Prestressed Concrete Institute, Chicago, Illinois, 1969.
2. Kispert, R. G., "Project Managers in the Construction Industry," *Report,* Massachusetts Institute of Technology, Cambridge, Massachusetts, February, 1973.
3. Waddell J. J., *Precast Concrete: Handling and Erection,* Iowa State University Press, Ames, Iowa, and American Concrete Institute, Detroit, Michigan 1974.

Discussion of this paper is invited. Please send your comments to PCI Headquarters by December 1, 1976.

NOTE: Details of the Questionnaire Survey that was sent out to precast concrete producers are shown on the following two pages.