



Monitoring Factors in Quality Control of Reinforced Concrete Casting Works

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Monitoring Factors in Quality Control of Reinforced Concrete Casting Works

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Abstract. Quality control of casting work is very necessary to be prepared to minimize material misuse and procedural errors in the field, so that it will produce quality concrete. Concrete quality that is not in accordance with planning is due to the absence of guidelines that will be a reference for a supervisor so that the implementation of the work is not in accordance with the quality standards used. The purpose of the study was to determine the factors of casting job supervision that can be used as a reference for supervision of reinforced concrete works. The study was conducted in the city of Medan by survey method. The research sample used was a multilevel development project located in the city of Medan with a total of 20 construction projects with purposive random sampling method. The research instrument is the supervisor's guide in the field and interviews developed by the research team. Research data obtained and processed using descriptive statistical analysis. The results of the study are that the factors for supervisors so that the casting can run well and in accordance with the quality of works are as follows: 1) Preparation stage: determine the quality of concrete, working track (ready mix mobilization), equipment placement, workforce preparation, and schedule casting. 2) Implementation phase: determination of casting lines, slump testing, manufacturing of test objects, Pouring / concreting and compaction. 3) Finishing Phase: Finishing, Maintenance, Scaffolding and mold opening.

1. Introduction

The development of the construction world today has an impact on the increasing use of concrete as a material in strengthening structures which is the key to the level of building safety. Concrete is the main choice as the structure of building that is built by concrete is easy to work and has a high compressive strength compared to other materials. Concrete serves as a binding material which is a structural forming element which is a mixture of cement, fine aggregate, coarse aggregate, water and additional materials. There are often various problems encountered in doing reinforced concrete casting works, during the construction process until post construction, which causes damage and weakening of the construction structure. Damage that occurs in concrete works can be found on concrete structural elements namely in columns, beams, plates and concrete walls [1]. Damage is shaped like cracks in concrete (cracks), there are holes that are relatively wide and deep (voids), shallow slippage on the surface (scaling), the concrete surface detached in the form of spallings and particle release as smooth as dust (dusting). As a result of the porous concrete that is caused by the use of vibrators in compaction is not maximal or the use of a vibrator that is too long [1], cracks in concrete caused by concrete quality are not in accordance with planning, bleeding (watergain) in concrete caused by the inability to bind the mixture so that it causes water to come out onto the



concrete surface, the height of the concrete mixture to be poured due to the method used is not in accordance with the procedure. Concrete damage is often caused by human error due to errors in planning, implementation, and management which will result in low concrete quality. Preferably the concrete that will be used in the field is done carefully in planning and supervision [2]. The results of monitoring in the field, the main failure of the structure of the building is caused by 1) negligence in the work; 2) ignorance about the work done; 3) poor communication; 4) project administration reports on field facts are not appropriate; 5) improper quality control, 6) inaccurate supervision caused by the absence of guidelines that serve as a reference for supervisors in the field. Vicknasyon [3]. argues, 80% of the total risk in the project is caused by human factors, [4] suggest that 73% of job failures are caused by the ability factor of human resources. According to [5] Oyfer (2002) stated that construction defects in America were caused by humans (54%), inappropriate designs (17%), treatments that were not fully carried out (15%), material (12%) and unexpected things (2%) From some expert opinions it was concluded that human error was the biggest thing that caused construction risks and defects in projects caused by supervisors and workers. The level of ability of workers will affect the quality of work that will be produced in the development process [6] the success rate of the project is influenced by planning, commitment, motivation and goal orientation, technical capabilities of the project manager, work scope and definition, and system supervision [7].

The weak supervision system in a project has always been a daily media commodity. Job deviations often occur in every construction work, due to lack of planning and lack of available guidance on project monitoring in the field, so that field supervisors work not optimally. This opinion is supported by [4]. the cause of construction project failure 83% due to lack of data and guidance for supervisors in carrying out construction projects. Some cases that occurred due to the low quality of supervisors that were in the project. 1) Becakayu Toll pier head collapsed due to hanging scaffolding that was broken during the casting process caused by less powerful scaffolding installed, 2) the Tuo River Bridge located in Fenghuang, China, the bridge it collapses due to the bridge supporting frame not yet released, 3) the rainbow bridge collapses due to poor welding joints. The above case is caused by the supervisory function in the implementation of the construction is not going well.

The main task for a supervisor is to supervise the implementation of the project, work professionally and carry out supervision in accordance with the supervisory committee, but the reality that often occurs is that the supervisor is only a companion and only receives reports without conducting field visits. According to [8], since the existence of professional certification for experts has the right to sign the supervision file, so in the supervision guidelines for foundry needs to be legalized for the validity of each concrete work. This is supported by the existence of the SK Regulations. SK 91, implementation of concrete works and all stages of work must be supervised by an expert supervisor who is capable and responsible for the products produced. The role of supervisors in the field has a significant influence on the quality of the project produced, [9], [10], so that workers need to be more careful in the field to control the work, information flow and material delivery. On the other hand, some things that often occur in the field caused by supervisors are: 1) Not performing monitoring procedures properly, 2) Not following the TOR, 3) Work that is not in accordance with the specifications, 4) Proposals that are not supported by the correct construction method, 5) Work plan drawings that are not calculated correctly.

Based on the identification carried out the main cause of concrete work does not produce good quality due to lack of supervision and implementation stages that are not guided by the work schedule [11] as well as the factors of supervision to conduct quality control of foundry work. overall recorded and arranged, so that the casting process does not take place properly. Quality control of casting work is very necessary to be prepared to minimize material misuse and procedural errors in the field so that it will produce quality concrete. According to [12] quality is defined as the description and characteristics of goods/services in accordance with the rules determined or implied [13]. Quality usually describes the direct characteristics of a product or service, such as: performance , reliability , easy to use ,aesthetics, etc. [14].

Based on the description above, the problems examined in this study are the factors that must be prepared so it can be used for field supervisors as a guide for quality control of concrete work starting from the preparation stage of casting until the casting works are complete.

2. Methodology

The research was conducted to find out the indicators of supervision of casting work that can be used as a reference for supervision of reinforced concrete works. The method used is survey method. According to the Medan City statistical data in 2015, there were 363 General Contractors in Medan City. But the contractors involved in the construction project were only 120 contractors and contractors who had supervisory guidelines and supervised the work well, only 20 contractors. The research sample was determined by purposive randomize sampling technique. Then the sample of this study amounted to 20 construction projects managed by the Contractors. Data collection techniques is done by using supervisory guides in the field and interviews. The validity of the instrument in this study is based on content validity. Data processing techniques used are descriptive statistical analysis techniques.

3. Results and Discussion

Before concrete work is done, it is necessary to pay attention to the checklist form of formwork and cleaning work that has been inspected by the supervisory consultant, then a site review is conducted to see the formwork and reinforcement installed to ensure the formwork is really strong, not leaky, clean against dirt. Then make sure the reinforcement is as planned and check if the waterstop is installed to maintain the concrete Cement Water Factor. Furthermore, concrete work is carried out, that is casting work. Based on observations of several supervisory guidelines and interview results, it can be concluded that the implementation phase of concrete work can be done in several stages, namely: 1) before casting (preparation stage), 2) casting, 3) after casting (finishing stage) which can be described in Figure 1.

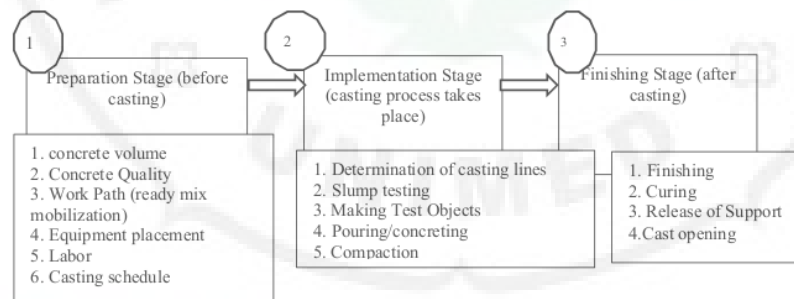


Figure 1. Concrete Work Phase

3.1. Preparation stage

What is meant by the preparation stage for the implementation of concrete work is the stage before casting is carried out. The steps that will be carried out are as follows:

a. *Calculate the concrete volume requirements*

Calculation of concrete volume is needed to determine the amount of concrete needed, so that in the execution of the casting there is no shortage. Concrete volume is also needed to prepare work sites, equipment and labor that will be prepared in the field.

b. *Determine the Quality of Concrete*

Concrete quality is very important to be considered in accordance with the type of work, so that when the concrete order is done there is no error.

c. *Work Path (ready mix mobilization)*

Before the ready mix comes to the location, it is better to make a working path or entry point and the ready mix car exit, so that when casting does not occur there is no obstacle if the other ready

mix comes in. This work path should be attached to a checklist of casting jobs in the form of mapping.

d. *Equipment placement*

The placement of equipment before casting is very important to be done so that when the work takes place the tool can be directly used. The tools that need to be prepared are: vibrators, concrete pumps, towels, test cubes, slump tests, measuring instruments, and lighting lamps.

e. *Preparing labor*

Workers are prepared based on the volume of concrete at the time of casting, to determine the amount of labor and shifts of workers, if the casting work is carried out more than the working time.

f. *Creating a casting schedule*

The casting schedule is very important to determine the location and volume of concrete (per mixer) that is needed based on the work so that the poured concrete does not accumulate in one place and the concrete poured is not excessive. This schedule should be made mapping the concrete position per mixer, according to the zone. Mapping is very necessary as a guide to find out where to stop casting. Table 1 shows the preparation stage for casting.

3.2. *Implementation Stage*

What is meant by the implementation stage in concrete work is when the casting stage takes place. The steps that will be carried out are as follows:

a. *Determination of the starting line to the end of casting*

The implementer has started the mapping/drawing of the casting path so that there will be no concrete experiencing the setting time for the new cast meeting with the previous cast.

Each concrete from the mixer car is in the data and image of the position of its use, so that if there is any doubt about the concrete quality of the mixer car with certain police numbers it can be easily tracked

b. *Slump Testing*

Before casting work is carried out, first test the slump to determine the concrete thickness limit. This is done to ensure the value of water-cement a. After being measured and the value of the slump meets, then making a test object (sampling) is carried out

Table 1. List of Casting Examinations in the Preparation Stage

Casting Checklist in the Preparation Stage			
Project name :			
Location :			
		Unit	Status Signature
Formwork Inspection			
Reinforcement Checks			
Work floor inspection			
a. Waterproofing, water stop			
b. Cleanliness			
Concrete Volume		M3	
Concrete Quality		MPa	
ready mix mobilization	Attach the mixer path mapping		
Casting Checklist in the Preparation Stage			
Peralatan			
a. Vibrator		Bh	
b. Concrete pump		Bh	
c. Trowel		Bh	
d. Test cube		Bh	
e. Slump test		Bh	
f. Measuring tools		Bh	

g. Lightning	Bh
Labor	Person/shift
Casting Schedule	Attach the casting schedule

c. *Making Test Objects*

To evaluate the quality of concrete according to the planned quality. In making the test object, it is necessary to map the specimen as the representative of each mixer according to the quality of the concrete.

d. *Pouring/Concreting*

Pouring is a fresh concrete poured into the mold, taking into account the high fall of concrete to be poured.

e. *Compaction*

Compaction is done to remove the cavity so that the concrete becomes solid.

In Table 2, there is a checklist for supervisors at the preparation stage.

Table 2. Casting Inspection List at the Casting Implementation Stage

Casting Checklist in the Preparation Stage				
		Unit	Status	Signature
Project name :				
Location :				
Mapping the casting path	Make a mapping of the concrete position per mixer			
Casting Elevation check				
Slump Test				
Making Test Object				
Pouring/concreting				
Compacting				
Concrete Volume (Plan vs Actual)				
Plan.....		M3		
Actual.....		M3		
Difference.....		M3		

3.3. *Finishing Stage*

The next steps are: a) final finishing, b) curing, c) scaffolding release and d). Mold opening

a. *Final finishing,*

The final quality of concrete depends on the demand for specifications, some are asking for slippery or some are asking for a bit rough. The final casting job must be done by a special team, don't rely on the casting team which is sometimes tired so the results are not of good quality.

b. *Curing*

Concrete treatment is done to avoid things that are not desired by: 1) avoiding concrete movement by reducing casting activities, 2) watering after 24 hours of casting. Maintenance is also carried out to prevent sudden evaporation of water on the concrete surface, preventing, fog spraying with water.

c. *Scaffolding Release*

Time of the scaffolding release must be really precise so that the strength of the concrete can be reached maximally. We recommend that the time for the release of scaffolding in the inspection list be written down with the date and signature of the authorized party to give permission for the release of scaffolding. The release of scaffolding can be done after 7 (seven) days from the casting process and can be replaced by reshoring. Reshoring consists of only single supporting pole. This is done if there is work to be done on the floor so it can be done immediately without

having to wait for the concrete to reach maximum quality. Reshoring will be released at 28 days from the time of casting. When the release of scaffolding must be really precise so that the strength of the concrete can be reached maximally. We recommend that the time for the release of scaffolding in the inspection list is written down with the date and signature of the authorized party.

d. *Cast Opening*

Sometimes cast production can be done in conjunction with a scaffolding, but some cases of mold are opened longer than the support. In table 3 looks at the checklist for supervisors at the Finishing stage.

Table 3. Casting Check List on Finishing Stage

Casting Checklist in the Preparation Stage				
Project name :				
Location :				
Final Finishing	Smooth / rough	Unit	Status	Signature
Curing				
Scaffolding Release	Create release date			
Cast Opening	Create the date of cast opening			
Constuction joint	Create the date of constuction joint			
disassembly	disassembly			
Cube Test Results	Attach cube test results			
Report				

4. Conclusion

In casting work there is often damage to concrete work that causes cracks, scaling and dusting that caused by segregation, bleeding and improper use of vibrators and treatments. this happened because the factors of supervision were not available in the field. factors that are used as a reference for supervisors in overseeing concrete work consist of:

- Preparation Stage. The preparations that must be considered are: a) calculating volume requirements, b) determining the quality of concrete to be used, c) work paths (ready mix mobilization when going to the place where casting will be carried out, d) preparing equipment and labor and making a schedule casting.
- Implementation Stage. The implementation stage is when the casting stage takes place, which needs to be done are: a) Determination of the initial path to the end of the casting, b) slump testing, manufacturing of samples and the process of concrete pouring and compaction.
- Finishing Stage. What needs to be done at the finishing stage are a) final finishing of the concrete surface, b) concrete maintenance processes, c) support/scaffolding and d) opening of the cast.

These stages are carried out by making a checklist guide so that the supervision phase can be carried out properly and correctly.

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