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ANALYSIS OF COST AND CASTING TIME WITH CONVENTIONAL AND PRECAST METHODS ON THE CITEREUP FLYOVER CONSTRUCTION PROJECT

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Abstract

The concrete manufacturing process, also known as casting, is the final stage that determines the success of a flyover construction project. The benchmark lies in the casting method which of course has a direct effect on resource efficiency, processing time, budget, and quality. Generally, the process of casting concrete in flyover construction projects in Indonesia uses the conventional method in which the process is carried out and cast in situ. However, the development of science and the paradigm of efficiency in the dimensions of flyover construction projects has given birth to a new method in which the concrete hardening process can be carried out elsewhere and made precast.The conventional method and the precast method are now the best alternative by taking into account aspects of cost, quality and time which are considered for efficiency in flyover construction projects. For this reason, the researchers analyzed the efficiency of the Citeureup flyover construction project using the concrete casting method used in the process.

Keywords: Efficiency, Conventional, Precast, Flyover Construction

INTRODUCTION

Along with the times in the era of globalization which is so rapid, the growth of the construction industry is also getting stronger. There are several factors that influence this. Among them, the population growth rate which then raises the human need for facilities/ facilities (residence & place of work) and infrastructure (roads & bridges) in large numbers, as well as the development of science which enables humans to accommodate every need for the common good. With the emergence of these factors, the construction industry is required to be able to meet the capacity of large projects in benchmarks that are dynamic, economical, but still practical in terms of time.

The larger the size of the project, the more complex and immanent the utilization of resources and the use of technology will be. In terms of quality and quantity, the needs of all aspects of the project will affect the results that are timely and effective. These aspects include cost, time, and quality aspects. So, a successful construction project is one that is in accordance with the budget plan, on time, and with maximum quality based on predetermined benchmarks. It is this aspect of success that drives the birth of new casting methods and is developing to this day. That is, the casting method*Precast.*

In its development, this precast method has become one of the best solutions and alternatives in the implementation of construction projects. This is because, the precast method can ensure the manufacture of modules in accordance with the geometry of the final result and the production is mass and repetitive. In addition, precast modules can be used for various structural components such as stairs, columns, curbs, wall cladding, plates and others (Diasanto, 2008).

The formulation of the problems in this study are 1) How much time does the road casting work take when using the precast method?, 2) Which method is more time and cost effective? While the research objectives are 1) to determine time efficiency in the implementation of the

Citeureup flyover construction project, 2) to determine the effectiveness and success rate of the process of working on the Citeureup flyover construction project.

Structure Concrete

Etymologically, structure is an arrangement of materials that are organized to form a new object/order/building. Meanwhile, concrete is a building material composed of aggregate and cement binder. Thus, the concrete structure can be interpreted as an arrangement of materials whose arrangement is composed by aggregate and cement binders to be able to form new objects/orders/organized buildings.

Conventional Concrete Casting Method

The conventional casting method is a reinforced concrete casting system where the process is carried out directly on the spot (cast in situ). The following are the stages or processes of conventional casting methods:

1. Early Work
2. Formwork installation
3. Empowerment Framework
4. Casting concrete
5. Opening of Formwork

Factor of demolition of concrete deck

In general, the size of concrete maturation time is 14-28 days. This provision is ensured to be able to determine when the concrete is not dismantled. If the demolition is carried out before the specified time, cracks will most likely occur in the concrete. Because there is still a shrinkage factor in the concrete after demolition, and it starts to be free to carry the weight of the mass independently. Shrinkage or cracks that arise in new concrete occur naturally because of its nature as a solid substance that occurs due to mixing water with cement. In the process of compacting concrete, the water content must of course be ensured until the demolition of the concrete. Due to reduced water content after the concrete has matured, it can cause shrinkage. But conversely, excess water content can also cause cracks after the ripening process. It is also influenced by the cross-sectional area and volume. The large cross-sectional area and volume will shorten the shrinkage period of the concrete (evaporation).

Implementation of the Precast Casting Method

Precast casting or precast casting can be interpreted as casting activities carried out in fabrication (manufacturing) at the project site or outside the project site with various modules or shapes, according to the geometry of the projected object.

Because the casting activity is carried out precast, all concrete components that have been made only need to be assembled and attached to the steel frame to form a new structure that becomes a unit in accordance with the construction plan.

Precast Method Working Process

In implementing the precast (precast) casting method, of course all concrete components and construction structures are ordered in advance so as to ensure the duration of the work. This of course has a direct effect on cost efficiency/available budget. Because, in the precast method, most of the work activities are carried out by tools, heavy equipment, and transportation equipment on a large scale. All of these tools and equipment are provided with a rental system, which of course requires a large budget every day.

In contrast to the conventional method, the pre-installed concrete components are cured within 2 weeks after production by continuous hot steam treatment (70℃-80℃). *manufacturing*. Thus, the quality of the concrete produced by the precast method is superior to the concrete produced by the conventional method.

Other advantages of this precast:
1. Shorter project time frame;
2. Work on the flyover project site looks more minimalist;
3. Easier to control cost estimates and monitor work schedules;
4. Not many human resources;
5. Can reduce construction costs;
6. Better quality and accuracy.

Weaknesses of Precast concrete:
1. Bonding or damage may occur during shipping;
2. Large capacity lifting equipment is required for precast ridgit installation;
3. There is a potential for problems with the requirements and costs for ridgit installation;
4. A large capacity post-delivery container for concrete components is required.

Preecast Fabrication Method

Here are some precast concrete fabrication methods:
1. *Stationary production*, Fabrication of modules that are fixed (not moving). The module must be confirmed in advance so that the removal process is easy.
2. *Slip-form production*, Fabrication on a module that moves along the casting bed. Module release is done by vibrating the compacted concrete.
3. *Flow-line production*, A continuous fabrication process that mass-produces uniformly shaped parts.

Cost Planning in Construction Projects

There are several elements of financing in construction projects which include the following:
1. Cost of Precast Materials & Rental/Purchase of Construction Equipment;
2. Labor costs or wages;
3. Subcontract Budget;
4. Transportation Budget;
5. Overhead and Administration (fees, profits, contingencies)

In addition, construction project cost planning also has other categories and conditions. These provisions are of 2 types. Among them:
1. Direct cost. Direct costs are the allocation of costs related to all planning and initial capital which are the initial preparation and permanent installation stages of a construction project.
2. Indirect Costs. Indirect costs are the allocation of costs related to all ongoing operations and payment activities during construction projects that are (not) permanent installations.

METHOD

Research methods

The following is a design research method related to the Citeureup Flyover Construction project:
1. Direct observation and observation;
2. Retrieval of documents, data, and project work drawings.
3. The research hypothesis is the answer to the research question.
4. *Direct interview* about:
   a. Contingent costs in projects
   b. Field conditions
   c. Implementation of project work

5. Data collection
6. Research implementation
7. Data processing
8. Data analysis
9. Comparison of 2 (two) casting methods (conventional and precast)
10. Conclusion

Method of collecting data

The information or data needed to make this report is collected by the following methods:

1. Observation or direct observation in the field;
2. Direct information from the executor of work in the field;
3. Documentation, data and project work drawings;
4. Library/literature data related to construction and precast methods;
5. Direct Interview with site managers and contractors/practitioners in the field to obtain data: Contingency costs in projects, site conditions, work implementation, etc.

RESEARCH RESULTS AND DISCUSSION

Project Location and Scope of Work

The Elevated Construction Development Project is located in Sanja Village, Ministry of Public Works and Public Housing, Citeureup Construction, Bogor Regency (Suherman, 2022).

Construction of the Citeureup flyover, The Citeureup flyover construction project was initiated by the need for human resources in Indonesia who are able to support infrastructure development and have been the government's focus since 2021. What's more, currently elevated construction is one of the constructions that is often carried out, especially in big cities in Indonesia. The elevated construction facilities and infrastructure are equipped with 5 pier blocks and 4 spans with a length of 30.6 meters each span. There are 4 types of concrete blocks prepared for training materials, including:

- PCU Girder
- PC I Girder
- Box Girder with Span by Span method
- Box Girder with Cantilever Balance method.

The types of projects to be worked on are:

- Earthworks
- Substructure Work
- Floor Plate Work
- Drainage work
- Access road works
- Procurement of gantry launchers & hydraulic jacks.
- Precast pier work
- Procurement of girders & pot bearings.

Conventional Casting

1. Conventional Concrete Work Description
   a. Road Leveling

      Before being projected into a flyover, of course the project construction area to be executed must first be clean of large rocks, wood, garbage and various other materials that are not needed in the construction project. This cleaning process will certainly have a direct effect on the mixture to the density of the concrete layer. After the site is cleaned, the next process is compaction of the soil that will be built into a flyover.

The compaction process must be carried out carefully to maintain the standard slope of the soil. Because, this layer of soil will then become the road surface.

b. Making Concrete Foundations

The next process after cleaning is stockpiling the location where the concrete road will be built. This stockpiling was carried out with macadam stone material until it reached a thickness of ± 30 cm. The size of the stones used as material for backfilling concrete road foundations is generally smaller than the foundations of houses or other buildings. After the macadam stone hoarding process is carried out, the next layer must be added with a layer of sirdam. This second backfill is targeted with the same thickness. Its function is to close the gap in the first hoarding. After the second backfill is complete, further compaction is carried out with a concrete vibrator so that the foundation density is more perfect.

c. Concrete Casting Platform

After the concrete foundation is finished, the next process is to cover the foundation surface with plastic overlays. Furthermore, this stretch of plastic will become the basis for casting concrete. This is done so that the water mixture in the concrete casting does not seep into the foundation layer. Thus, a solid concrete layer will be formed that can withstand the load of flyover traffic.

d. Installation of the Concrete Framework

Not enough with a layer of plastic, then the surface will be added with an iron framework as concrete bones as a layer of concrete decking. In general, this iron frame has a thickness of ±8mm which is then formed into*letter* "S". The installation of the concrete bone framework is carried out to create boundaries as well as wiremesh ties on the bottom and top layers.

e. Concrete Casting Process

Concrete casting is*core action* of concrete road construction projects. In this casting process, of course, the concrete mix is the most important focus to be able to determine the final quality. The right composition (no more or less) is the key to the quality of the concrete which will minimize the occurrence of damage or cracks on the concrete road surface. After the concrete casting is complete, the surface must be covered first. Usually use plastic or mining sack material. This aims to maintain the process of maturation and hardening of concrete. When the concrete has matured and hardened, it is generally necessary to do further leveling and smoothing as the surface is still rough and small irregularities develop around it. The process of casting concrete certainly requires good weather conditions during its implementation. Because the maturation of concrete depends on the hot sun. With the sun's heat when the weather is sunny, ripening will occur optimally, naturally, and take place quickly.

f. Concrete Compaction Process

After the casting process until maturation is complete, then the density of the concrete must be tested first. This test aims to ensure the quality / quality of concrete according to planning standards. The testing process is carried out using*concrete test hammer* as a measuring tool. In addition to its density, the results of concrete casting must be tested for shrinkage by using*Hydraulic Shrinkage Determination*. Even though the testing process has been completed and the finished concrete road meets planning standards, generally the concrete must receive water intensity (spraying) for 23 days continuously. This aims to maintain the water content in the concrete layer. Like living things, concrete roads after casting can become dehydrated which will also have an impact on surface damage/cracks. For this process, it takes*moisture concrete test* or*moisture concrete meter* as a measure of the moisture content of concrete.

g. Conventional Concrete Cost Plan

Table 1 Cost of Conventional Concrete

No	Description	Amount
1	General	970.136.856
2	Lower Structure Work	16.617.815.350
3	Training Area Floor Slab Work	4.514.340.600
4	Drainage Work	238.304.878
5	Pier, Girder and Pavement Works	14.257.476.247
6	Procurement of Gantry Launchers	27.331.000.000
Amount		**63.929.073.930**
PPN 10%		**6.392.907.393**
Grand Total		**70.321.981.323**

Precast Concrete Casting

1. Precast Concrete Work Description
   Precast work steps:
   - Measure the planned elevation;
   - Carry out subgrade excavation according to the planned elevation;
   - Compaction / vibro subgrade;
   - After compaction, CBR test is carried out (minimum 6%);
   - Overlay materials*lime stone* (If the soil conditions are less qualified);
   - Compaction of the lime stone area is carried out after the paving process is complete;
   - Floor casting*(lean concreate)*;
   - Installation of precast ridgit according to the specified module (5 meters for each module, according to the specified module);
   - Ridgit module leveling injection, after appropriate leveling, each end of the module/GAP is given silent or per (asphalt);
   - Installation of road shoulder studs and casting;
   - Asphalt will be done if needed.
2. Precast Concrete Budget Plan

Table 2 Cost of Precast Concrete

No	**Description**	**Amount**
1	General	970.136.856
2	Lower Structure Work	16.617.815.350
3	Area Floor Slab Work	4.514.340.600
4	Drainage Work	238.304.878
5	Pier, Girder and Pavement Works	17.808.615.007
6	Procurement of Gantry Launchers	27.331.000.000
Amount		**67.480.212.690**
PPN 10%		**6.748.021.269**
Grand Total		**74.228.233.959**

CONCLUSION

Based on comparative studies and analysis in research, several conclusions can be conveyed as follows:

1. The cost of the Citeureup Flyover using the precast system is 74,228,223,959 including the 10% VAT fee
2. The cost of the Citeureup flyover using a conventional system is 70,321,981,959 including 10% VAT.
   Time required:

- Conventional Concrete : 60 Days
- Beton Preecast : 300 days

3. It can be concluded that the precast method requires a larger budget because it requires a budget allocation related to the rental of heavy equipment and large conveyances, but is far more efficient in time.
4. While the conventional method is relatively more cost effective, the processing time is considerably longer than the precast method and the difference is 270 days.

REFERENCES

Handbook, 2021, PT. Wika Beton Citeureup Elevated Construction Project Data.

Diasanto, 2008, Comparison of Superstructure Costs Between Using Conventional Methods and Precast Methods Using Bolted Connections, in the Rusunawa Project, Cimahi-Bandung,*Thesis*, University of Indonesia, Jakarta

El Sayary, S., & Omar, O. (2021). Designing a BIM energy-consumption template to calculate and achieve a net-zero-energy house. *Solar Energy*, *216*, 315–320. Accessed Februari 2022. https://doi.org/10.1016/j.solener.2021.01.003

Fakhruddin, et.al., (2019). Dissemination of Building Information Modeling (BIM) Technology Applications in the Indonesian Construction Sector.*Journal of Applied Technology for Community Service (TEPAT)*, *2*(2). Accessed Januari 2022. https://eng.unhas.ac.id/tepat/index.php/Jurnal_Tepat/article/view/82/49

Raflis, Yuwono, B. E., & Rayshanda, R. (2018). Benefits of Using Building Information Modeling (BIM) in Construction Projects as Stakeholders Communication Media. *Jurnal Construction Engineering and Sustainable Development (CESD)*, *1*(2), 62–66. Accessed Mei 2022. https://www.researchgate.net/publication/341402841

Suherman, Tata, 2022, *Interview result*, Supervisor of PT Wika Beton Elevated Construction Project