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Analysis Value Engineering Fly Ash Optimum for Mass Concrete

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Abstract: As the background of the research is a project which has a big budget for mass concrete raft foundation volume 24,603 m3, fc35 MPa, wctitious ratio 0,4, fly ash 15%, fresh concrete 32^{0}C, concrete using ice water. Thus, the purpose of this study, to find alternative concrete, by analyzing the Value Engineering analysis of the optimum fly ash, it is expected that the cost of concrete is more economical, with quality still achieved. The research was carried out with the research concept of comparing the above concrete with an alternative concrete optimum fly ash, with stage on stages of information, stages of functional analysis, stages of creative, evaluation stage, recommendation stage, implementation stage, the research alternative began on concrete designs, conducting experiments, analyzing fresh concrete, analyzing peak temperatures, analyzing strength and analyzing costs. The results of fly ash concrete 35%, compressive strength achieved fc 35 MPa, the cost was more efficient 12.69% than the initial cost of Rp. 24,233,955,000.00 Concrete fly ash 35% could be used as alternative. Regarding the application of value engineering, it is influenced by knowledge of value engineering and practices of it from decision holders and the absence of conflicts, of interest, of certain parties in the Indonesian construction industry.

Keywords: big budget mass concrete, fresh concrete, peak temperature.

INTRODUCTION

Today, many construction service providers are using various methods in order to provide the best service to project owners, there needs to be a serious treatment to solve any existing problems, so that the desired results can be quickly achieved, with cost-efficient it is necessary to do improvement called Value Engineering, which is an engineering effort to find a way out of a problem, which is creative and structured, to achieve the same or better quality of a product with a short time, in order to achieve cost savings or more economical. In the current era of green concrete, using fly ash are produced through the combustion process of powdered coal which is widely used in PLTU (Choi, et al., 2015).

In the BAPPENAS report, Indonesia has fly ash from burning coal in the abundant power plant, in the period 2016 to 2019, coal demand in 2016 was 86.7 million tons, in 2017 amounted to 88.4 million tons, in 2018 it increased to 107.2 million tons and in 2019 it will be 166 million tons. And also based on previous research, concrete composition of 100% cement compared to the composition of 80% cement + 20% fly ash, the peak temperature of concrete using 100% cement is 65,76^0 C, while using fly ash, the peak temperature of concrete is 52,44^0 C (Tang, et al., 2018).

Guidelines for quality acceptance used are the Indonesian Concrete Regulation (1971) and SNI 2847 (2013). Cost concrete on mass concrete raft foundation super block project as Rp. 24,233,955,000.00, fc35 MPa, wctitious ratio 0.4, workability 14-18 cm, fly ash 15%, max. fresh concrete 32^{0}C, concrete using ice water, Value Engineering analysis research on the optimum composition fly ash for concrete on mass concrete raft foundation, it is expected that there is a positive value in the concrete budget cost more efficiently.

LITERATURE REVIEW

Value Engineering is getting products with more efficient costs, and the quality of products produced in creative and structured stages so as to produce products with the same or better quality,

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these products are produced through a professional team approach in its application, function oriented and systematic used to analyze and improve the value of a product, design of facilities, systems, or services, a methodology that is good for solving problems and / or reducing costs while maintaining the specified performance or quality requirements by finding the optimum balance between time, cost, and quality , so an increase in value for money can be done (Rahman, 2014).

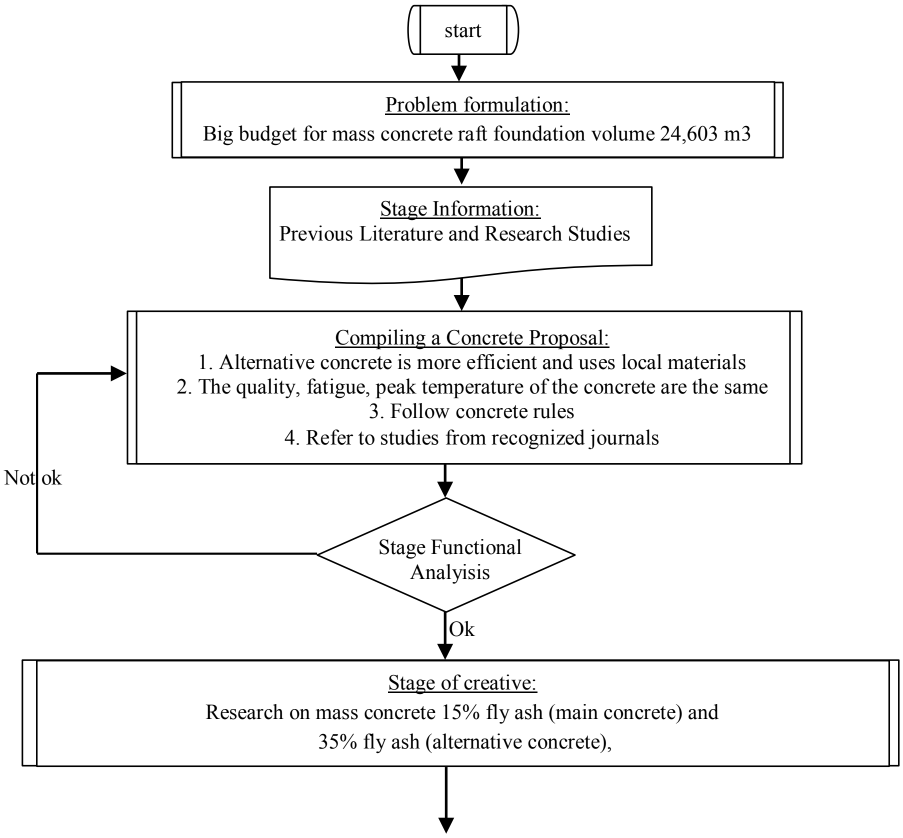
From the study of Application of Value Engineering to Geotechnical Design for a Factory Structures on Soft Alluvial Flood Plain in Indonesia (Liew, 2002), The purpose of value engineering is to eliminate the unnecessary costs that do not contribute to functions of the product. there are six stages, where each stage is carried out in a structured sequence, including: Stages of information, Stages of functional analysis, Stages of creative, Evaluation stage, Recommendation stage, Implementation stage.

Value Engineering study process

From the Madi study, Jandsem Heo, (2018), the variation of the composition of 28 days age fly ash at 0% was 57.21 MPa, 30% was 58.77 MPa, 35% was 61.97 MPa, 40% was 63, 75 MPa, and 45% at 62.38 MPa, 50% at 57.89 MPa. For the use of fly ash with certain levels, the better workability, reduce the coefficient of permeability, increase durability and can reduce production costs (Agustin and Kristiawan, 2014). Where as the concrete added to the superplastisizer (Sikament-NN) was 0%, 0.3%, 0.8%, 1.3%, 1.8% and 2.3% at 28 days compressive strength test, shows a graph of compressive strength increase with the addition of a percentage of 1.3% and 1.8% (Megasari, 2017). Concrete price per m^3 has been set on Rp. 950,000.00 and Rp. 35,000.00 for ice. This study refers to the 1971 concrete regulation-PBI '71 and SNI 2847: 2013 concerning acceptance of concrete quality.

RESEARCH METHODS

The research alternative are on concrete designs, conducting experiments, analyzing fresh concrete, analyzing peak temperatures, analyzing strength and analyzing costs. Began by alternative concrete design compaire with main concrete design, fc35 MPa, water cement ratio of 0.4, fly ash 15%, fresh concrete 32^0 C, using ice water.



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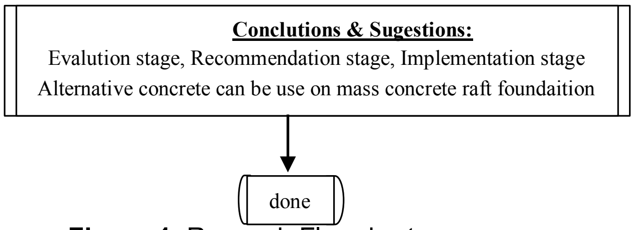

Figure 1. Reseach Flowchart

There are some pitfalls to be bear in mind during value engineering as follows:

- Maintain an objective approach to prevent Value Engineering from degrading to design review,
- Avoid habitual solution reestablished within Value Engineering (mind set effect),
- Avoid target percentage saving (potentially degrading design quality),
- Improve sale technique for Value Engineering solution,
- Optimisation based on value and function,
- Incentive to all parties to achieve ultimate objective of Value Engineering (win-win situation)

The benefits of value engineering in design management are as follows:

- Organised design approach,
- Understand project function/requirements,
- Avoid habitual solution & promote thorough and focused thought on design,
- Focus on high cost areas

RESULT

The primary requirements of the contractor's value engineering are as follows: Innovative concrete engineering design optimized for cost efficiency of concrete, use of locally available natural materials & reduce transported construction materials from outside, unuse ice water, but peak concrete not more than peak main concrete use ice water and savings for construction cost

1. Mix design

Table 1. Mix design

Material	Main concrete FA 15%	Altervative concrete FA 35%
Water	100	180
Chruser Ice	100	0
Cement	425	314
Fly Ash	75	169
Fine Agregate	822	849
Coarse aggregate	856	883
Add, Tipe D	1,69	0,96
Add, Tipe F	0,00	2,66
Wctts	0,40	0,37
% Fly Ash	15%	35%

The alternative concrete FA 35% more efficient than main concrete FA 15%. Cost concrete on mass pouring volume 24,603 m3, alternative concrete FA 35% is Rp. 21,158,574,840, and main concrete FA15% is Rp. 24,233,955,000.

2. Workability

Table 2. Workability

Concrete Workability
1. Main Concrete FA 15%: 18 cm 2. Alternative Concrete FA 35%: 18 cm

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3. Fresh concrete temperature

Table 3. Fresh Concrete Temperature

Concrete Workability / Slump Test Results
1. Main Concrete FA 15%: 30.8⁰ C 2. Alternative Concrete FA 35%: 35,6⁰ C

calculation use formula from the literature Evaluation of Temperature Prediction Methods for Mass Concrete, (2006) from the American Concrete Institute [14]

$$T_{max} = T_i + \left(12 \cdot \frac{W_c}{100}\right) + \left(6 \cdot \frac{W_{scm}}{100}\right)$$

Table 4. Calculation Peak Temperature

Concrete Peak Temperature
1. Main Concrete FA 15%: 86,3⁰ C 2. Alternative Concrete FA 35%: 83,4⁰ C

Figure 2. Main concrete FA15% Workability 18 cm, temperature fresh concrete 30,8⁰C and alternative concrete FA35% Workability 18 cm, temperature fresh concrete 35,6⁰C

4. Compresive strength

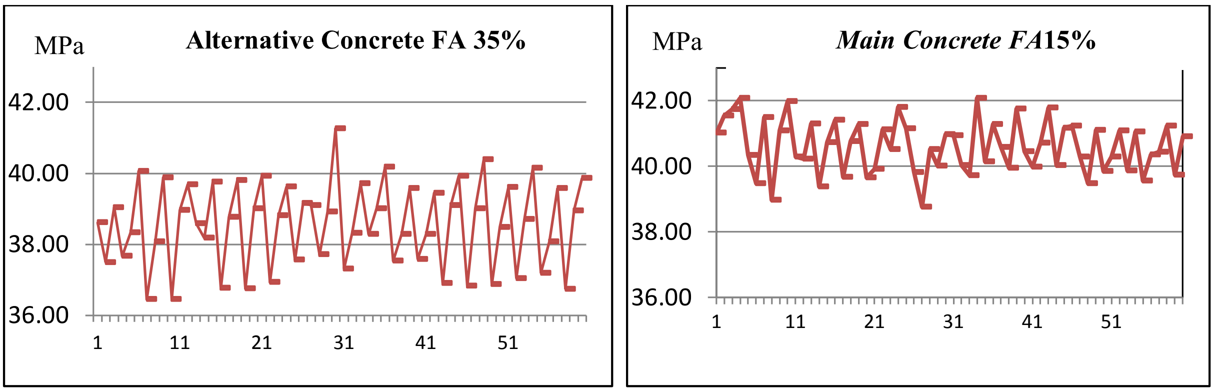

Figure 3. Graph of compressive strength, alternative concrete FA35% and FA15%

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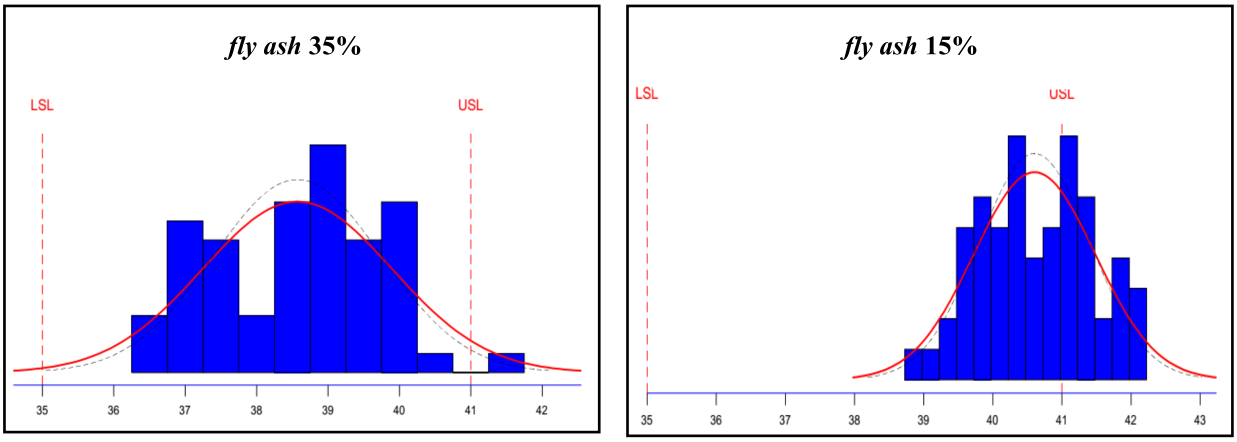

Figure 4.2. Histogram Alternative concrete compressive strength Composition of fly ash 35% and fly ash 15%

CONCLUSION

The following conclusions can be drawn:

1) The alternative concrete fc35 MPa, FA 35%, its quality is achieved.
2) Workability alternative concrete FA 35% is same as with main concrete FA 15%.
3) Peak temperature alternative concrete FA 35% is lower than main concrete FA 15%.
4) Alternative concrete FA35% more efficient 12.69% for mass pouring volume 24,603 m3 than main concrete FA15%.
5) Application of value engineering in this case history has could fulfilled the requirements by the project client.

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