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Analysis of the use of precast concrete, Ready Mix and Olahan Concrete on the Cimanggis Cibitung Toll Road construction project with the AHP Method

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Abstract: This research aims to identify the use of ready mix concrete, processed concrete and precast concrete in the Cimanggis Cibitung toll road construction project and to understand the influence of the use of ready mix concrete, processed concrete and precast concrete on time, friendly to liungkungan, production, quality of goods, strength and cost. In its development, concrete is the most widely used building material in the world. Nowadays more and more new modified concrete is found, such as precast concrete, ready mix concrete and processed concrete. The method used to determine the best use of concrete construction between Precast concrete, Ready Mix and Processed Concrete is used AHP (Analytic Hierarchy Process) Method. From the results of calculations with AHP with EVN value, the criteria obtained: time 0.04, curvature 0.03, production 0.22, quality of goods (Quality) 0.48, kekuatan 0.15 and biaya 0.08. For the construction work of the Cimanggis Cibitung Toll Road, the quality of concrete is very important in the construction work of the Cimanggis Cibitung Toll Road construction, for then concrete production becomes the second important thing continued the strength of concrete to know the sturdiness of concrete used in the field then the cost is also an important factor after strength because of the cost that we can know whether the concrete cooking is the most efficient, fast and not problematic only last time in the implementation of cimanggis cibitung road construction work as well as the environment in maintaining the sustainability of the toll environment that can also serve to maintain the strength of concrete

Keywords : construct, AHP, precast concrete , ready mix, beton olahan

INTRODUCTION

The selection of the method of implementation of a construction project is very important because the right implementation method can provide maximum results, especially when viewed in terms of cost and time. One of the efforts carried out by Waskita Karya is in addition to using readymix and processed concrete is also done in more modern ways, namely by applying precast concrete. The purpose of this study is to compare the implementation method between the use of ready mix concrete systems, processed concrete with *precast* systems, analyze the costs required in both systems with RAB calculations and analyze the effect of quality and implementation time between readymix systems, processed concrete and precast on cost, time and quality.

The construction of the Cimanggis Cibitung Toll Road will affect the development of the region & economic improvement, Improve the mobility and accessibility of people and goods, Toll road users will benefit in the form of savings in vehicle operating costs (BOK) and time compared to when passing through non-toll roads and Cimanggis Cibitung toll road management Business Entities get a return on investment through toll revenue that depends on the certainty of toll rates.

Cimanggis Cibitung Toll Road construction uses precast concrete, ready mix and Processed Concrete for its implementation,, for precast used piles, girders, wing stifeners, bariers, fullslabs, panel fences, U ditch channels and ready mix for pierhead column casting, rigid for roads, ashdmen and road barriers, while ready mix is used for lean concreate casting, rigid pavement, pearhead and Kolom, and all concrete both ready mix and Precast concrete are produced at Baching Plant Waskita Beton Precast.

The construction of the Cimanggis Cibitung toll road is inseparable from what materials are used and the Cost Budget Plan (RAB) is calculated after the road construction calculations are made. This is related to the selection of road design and construction used in the planning of the Cibitung Cimanggis toll road. The Budget Plan for the toll road project is prepared as optimally and asfesien as possible with quality and quality that remains guaranteed. In some parts of the toll road there are those that have a large cost, but the part can still be optimized by means of re-efficient.

Therefore, to find out the use of good construction in the implementation of the Cimanggis-Cibitung toll road, a Value Engineering (Value Engineering) is needed so that costs and construction models are needed to maintain the quality of the project and the value of the project. Value Engineering is a way of creative and planned approaches with the aim of identifying and efficiently requiring unnecessary costs. Value engineering is used to look for alternatives or ideas that aim to produce a better/lower cost than the previously planned price with functional limitations and quality of work.

The problem of using readi mix concrete, processed concrete and precast affects the quality that leads to rework often occurs in the implementation of cimanggis Cibitung rework road project causing over cost in the implementation of the project which affects the performance of project costs, and ultimately affects the performance of the company's overall performance.

Rework work occurs a lot in ready mix and processed concrete work, such as cracked pavement concrete, cracked retaining wall, cracked column, which affects rework by dismantling it again.

Theoretical Foundation

The large volume of vehicles that utilize the toll road is certainly a burden on the pavement the pavement is a layer between the traffic load (vehicle) and the base land that is constructive so that it has functional adan structural value. Often we see roads that are damaged or bumpy, this is because the pavement used is not able to withstand a high enough traffic load or exceed the burden of the plan.

Road problems that are easily damaged due to heavy traffic and large vehicle loads can be overcome by concrete pavement, Rigid {avement or rigid pavement is a road pavement process consisting of a cement concrete plate as a foundation layer and foundation layer under the base soil datas.

Concrete roads are currently increasingly used in Indonesia, usually roads that use concrete have high traffic conditions, the reason is because the vehicles passing through the road are quite large and the traffic flow is also very dense.

Concrete pavement has several advantages over asphalt pavement even though construction costs are relatively more expensive, so concrete pavement is usually only used on toll roads.

But the next development of concrete roads has now become a substitute for paved roads and this we can see not only on toll roads but now primary roads both main roads, intercity roads, inter-provincial and also environmental roads.

Waskita Beton Precast

Waskita Beton Precast as a supplier of ready mix concrete and Precast concrete for the Cimanggis Cibitung Toll Road Section 1 A project has 31 plants consisting of 8 (Plant) and 24 ready mix / Baching Plant factories and 2 stone crusers (quary) Rumpin and Bojonegara which have a strategic location.

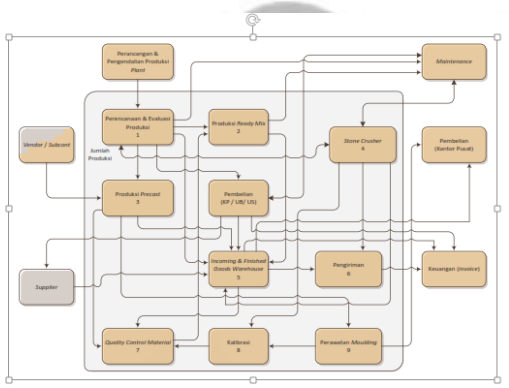
Plant is a location where there are tools to produce concrete to then become precast products (precast concrete) such as piles, bridge beams, Spring WP, Spun Pile, concrete electricity poles, deck slabs, pierheads, PC T Girder, Box Girder, Moveble Concrreate Barrier, CCSP, PC U Girder, PC I Girder, Diaphragm Wall. Plant is permanent / can not be moved due to the need for a large area (at least 3 Ha) and the installation of equipment and machinery of precast concrete production, the location of Plant Waskita Beton Precact is in Prambon sidoarjo, Legundi Gersik. Filigree, Cibitung, Kalijati, Gasing South Sumatra, Bojonegara Banten, and Plant Subang.

For the precast needs of the Cimanggis Cibitung Toll Road project comes from Filigree, Bojonegara, and Cibitung.

Batching Plant is a location where there are tools to produce and distribute to customers of fresh concrete products only (Ready mix), Batching Plant is temporary because it follows the location of projects handled by the company

Production Activities

In carrying out the ready mix and precast production process, waskita Beton Precast divides the production process into several stages:



Picture.1 : Concrete Production

Raw Material Management

To ensure quality products, Waskita Beton Precast applies the principle of prudence and high quality control in selecting and providing raw materials.

Some of the main raw material quality requirements by Waskita Beton Precast are: cement, water, pasir (Fine aggregate), split (kasar aggregate) and aditif bahan (admixture).

Quality of Concrete used

The use of concrete for the Cimanggis cibitung toll project both ready mix concrete and precast concrete is very high in accordance with the needs and age of the toll road in the future, the use of concrete both ready mix and precast concrete can guarantee a long service life, for it needs to be known also about the quality of the concrete itself. . The quality of concrete both ready mix work and Precast work is very important for Cimanggis Cibitung toll road work

The calculations are carried out based on the quality of the concrete that has been determined. The quality of this concrete ultimately determines the size of the blocks, columns, plates, concrete walls. Of course, calculations with lower concrete quality will result in a larger size

of concrete blocks, columns, plates, and concrete walls when compared to the calculation results of higher concrete quality.

So that the quality of the concrete that is determined can be implemented with certainty in the field, then Wastika Beton Precast both ready mix and precast concrete in its manufacture considers carefully everything that affects the quality of concrete, among others: the amount of cement on each m3 of concrete, cement water factor, gradation of aggregate. aggregate hardness, agregrate cleanliness. type and quality of cement, way and length of stirring, how to compact, finish and transport, temperature, maintenance and age of concrete.

Processed Concrete

Site mix is a mixture of small aggregates, namely cement, gravel, water and other additives, which are then processed manually, or by human hands directly without going through the intermediary of electrical machine tools. only for small-scale casting and sometimes the dose given is not right, the processing time is much longer than the ready mix

Conventional concrete is made and cast at the construction site so that it is easier to adjust to the needs of construction, conventional concrete can be formed according to the needs of the parts that are needed. Conventional concrete made directly on the parts needed by this concrete can be made in a narrow place though.conventional concrete can be adjusted to the needs of course this applies to various places and parts in the construction. Conventional concrete manufacturing carried out directly on the construction site makes the supervision easier to do. The process of making conventional concrete is also more controllable because it is included in the construction process as a whole.

Concrete Ready mix

Ready Mix is a term for concrete that has been blended with a series of material materials consisting of sand with special formulations. Special formulation processing is carried out in batching plants until they become ready-made cast concrete and become quality concrete ready to be "presented" in the desired project area. Ready mix processing is different from the manufacture of cast concrete that is usually done by ordinary construction workers, in providing doses that are sometimes tailored to taste. The manufacture of ready mix mixtures is carried out by special experts in the field of mixing, so as to produce high-quality concrete quality. High-grade concrete dough makers are called mix designs, designers, formulators as well as determinants of the strength of the concrete made. In the mixing of concrete materials, namely krikil, sand and cement are also commonly given a special additive, namely admixture.

Precast Concrete (Precast)

Precast concrete or precast concrete is a material that has been printed and made in advance in the factory. The texture of precast concrete is generally dry and wet. The material is made based on certain molds and sizes that have been adjusted to the conditions at the construction site. Not only that, precast concrete is also well maintained in accordance with applicable standards until it reaches the age of care. Its own use has been widely used in various developments, such as infrastructure, housing, industry, buildings, and many more.

Precast concrete consists of a number of components made in the factory, after which it is spliced at the construction site until finally forming a whole structure. In precast concrete, the relationship that produces continuity by using the help of special hardware, reinforcement rods and concrete to channel all the shear, tensile and press voltages is called hard joints (Winter and Wilson 1993). At the time of manufacture or fabrication, precast concrete is different from concrete cast in place, because in precast there is installation and unification and splicing between components. Some of the principles of precast concrete

provide more benefits than monolith concrete, among others related to the reduction of cost and time, as well as improved quality assurance (Gibb 1999).
In the installation of precast elements compared to the use of cast systems on the spot, the use of labor becomes less. Precisely the concern in the precast is the coordination of the existing energy to ensure the smooth movement of precast elements in the field until the installation to the last position in the structure.

Concrete Work Control Criteria

a. Time

The work on the Cibitung Cimanggis toll road project is limited by a certain period of time when it can start and when it must be completed, if it is too late then the constractor is hit by dend, the fine is not messing around, in Indonesia the fine is per day 1/1000 x contract value. It turns out that being late is really detrimental considering its importance, it needs to be explained specifically in the letter of procurement agreement for construction work agreements.

b. Milieu

This condition is in line with the perception of environmental damage due to the construction of toll roads, as Walhi argues that some toll road projects convert green land into roads. "This condition will accelerate environmental damage," The construction of toll road infrastructure physically changes the function of land and the Carrying Capacity and Environmental Capacity (D3TLH) in the area passed. Ignoring environmental aspects in the construction of toll roads will lead to a decline in the quality of the environment and life in the long run. "The stages carried out in the construction of toll roads, since the preparation of Pre-Construction, Construction and Operationalization have not touched on environmental aspects so that the impact of damage in the long term is not predicted and anticipated properly,"

Preconstruction Stage: increased community unrest, decreased agricultural production, and decreased pond production. Construction Stage: decrease in surface water quality, decrease in groundwater quality, increased waste generation, decrease in environmental sanitation, gannguan function of existing culverts and drainage, decrease in air quality, decrease in land flora, reduced agricultural land, increased waste generation, increased employment opportunities, increased opportunities of trying, community livelihoods, increased social jealousy, increased noise, increased vibration, increased damage to roads, reduced traffic comfort, increased traffic congestion, reduced RTH as a catchment area, increased surface water runoff, floods (standing water around the site), decreased accessibility of the community, reduced aquatic biota, increased land flora, increased land fauna.

c. Production

Ready mix concrete production for the Cimanggis cibitung toll road project comes from the baching plant locations in Transyogi and Cibitung, where mixing or producing ready mix concrete raw materials or ready-made liquid concrete on a large scale. **Batching Plant** is placed on a piece of land containing offices, laboratories, heavy equipment, and other auxiliary tools that support the concrete production process with the best quality and in accordance with applicable standards.
While for precast itself printed in Filigree and Bojonegoro, especially for Spun pile and Girder.

d. Quality (Quality of Goods)

The quality of concrete on the market is very diverse, so it can affect the price. The quality of concrete can be divided into concrete quality classes and their use. The quality of concrete is one of the important parts to determine its application to the structure of the building. The quality of concrete itself can vary according to the use and selection of the

composition of the material used. Generally, high-quality concrete is intended for high-rise buildings, piers, silos, chimneys, tunnels, aprons, dams and bridge structures, road structures both highways or environmental roads and buildings with a press firm reaching 40 MPa.

e. Strength

Ready mix concrete is a mixture between portland cement or other hydraulic cements, fine aggregates, coarse aggregates and water with or without additional materials forming a solid mass. Its characteristics have a high press crush voltage and a low tensile crush voltage. This building material is needed for casting such as cast dak floor buildings, houses, shophouses, roads, warehouses, factories, and other buildings. Readymix concrete is produced from a set of mechanical and chemical interactions of a number of materials that form it, which is a homogeneous mixture of cement, water and frigates.

f. Cost

Construction costs are the costs incurred to run a project. Financing policies are usually influenced by the financial condition of the company in question. If the financial condition cannot support the implementation of the project, it can be taken in a way according to Ariyanto (2003), namely:

1) Lending to banks or financial institutions for cash financing purposes in order to reduce costs, but must pay interest on loans.
2) Do not borrow money, but use the necessary goods or services credit policy. By using this method will be able to avoid interest on the loan, but the price obtained is higher compared to the cash way.

The calculation of project costs is very important to do in controlling existing resources considering that existing resources are increasingly limited. For this reason, the role of a cost engineer is twofold, namely, estimating project costs and controlling (controlling) the realization of costs in accordance with the limits that exist in the estimation.

3.RESEARCH METHODS

3.1 Alternative Measurements and Alternative Assessments

Alternative measurements and assessments are carried out based on a combination of criteria that affect the alternative use of concrete in the field.

1. Assessment Analysis with Non Cost criteria (MDCM)

One form of analysis of these creative ideas discusses judgment very subjectively because it is difficult to get the ideal value. Therefore taken into account the alternative rating of the concrete structure to be used. Aspects taken into account:

Tabel 3.1 Perhitungan kriteria terhadap tujuan

No	Aspek	Uraian
A	waktu	Lamanya pekerjaan
B	Lingkungan	Perbaikan lingkungan dari kerusakan
C	Produksi	Kecepatan dalam produksi beton
D	Mutu	Mutu bahan konstruksi
E	Kekuatan	Kekuatan struktur beton
F	Biaya	Mahal dan Murah

Next look for the weight of each criterion by using the *Analytical Hierarchy Process* (AHP) Method:

1) Hierarchical Structure Arrangement

Determination of weight criteria using *Analitycal Hierarchy Process* (AHP), because *Analitycal Hierarchy Process* (AHP) is a functional hierarkhi with its main input of human perception. AHP was developed by Thomas L. Saaty. AHP can solve complex problems with the use of aspects or criteria taken quite a lot and also complex. This is due to the unclear structure of the problem, the uncertainty of decision-making perception as well as the uncertainty of the availability of accurate or even non-existent statistical data. AHP is able to analyze qualitative objectives and alternatives. The main objective of AHP is to decide the multi-criterion case by combining qualitative and quantitative factors in the overall evaluation of existing alternatives to meet the objectives of the problem at hand. Basically the steps in AHP include:

1. Define the problem and determine the desired solution.
2. Creating a hierarkhi structure that begins with a general purpose, followed by sub-concepts, criteria and possible alternatives at the lowest level of criteria

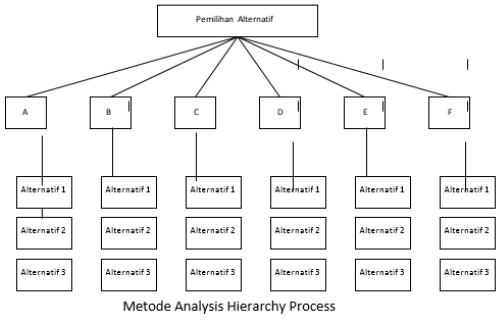


Figure 2 : Analysisi Hierachy Process Method

3. Create a paired comparison matrix that describes the relative contribution or influence of each element to each goal or criterion at the level above. Comparisons are made based on *judgment*" from decision makers by assessing the level of importance of an element compared to other elemen. Prioritization, according to Thomas L. Saaty (1993) by setting a quantative scale of 1 to 9 to assess comparison.
4. Compare the pairs so that *the entire judgement* is obtained as much as n x [(n-1)/2] fruit, with n being the number of elements compared.
5. Calculate the value of the eigence and test its consistency, if it is inconsistent then the data retrieval is repeated by iteration.

   Calculates the eigen vector of each paired comparison matrix. The vector value of the eigen is the weight of each element. This step is to synthesize *judgment* in determining the priority scale at the lowest hyerarkhi level until the achievement of the goal.
6. Check the consistency of the hierarchy. What is measured in AHP is the consistency ratio by looking at the consistency index. The expected consistency is the one that is close to perfect in order to produce a decision that is close to valid. Although it is difficult to achieve a perfect one, the consistency ratio is expected to be less than or equal to 10 percent.

4.Analysis and Discussion

4.1 Analysis and Discussion

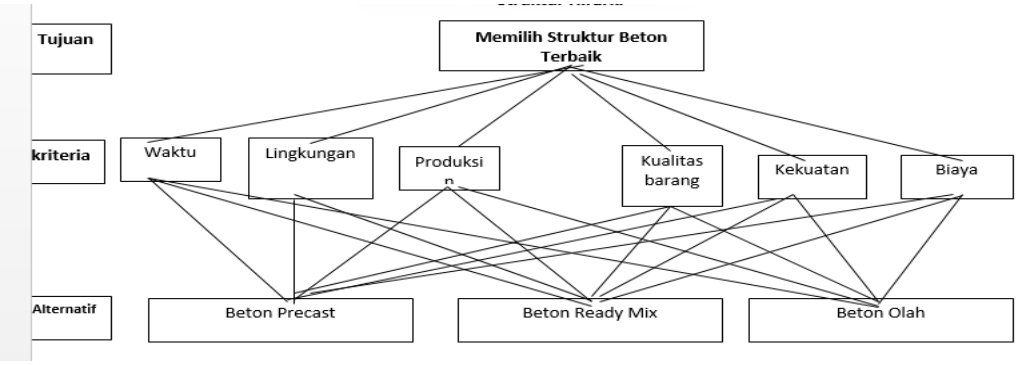


Figure 3 : Hierarkhy Concrete Construction Work

After the preparation of the hierarchy is completed, the next step is to make a comparison between the elements by paying attention to the influence of other elements at the level above. The first comparison is made at the criteria level by paying attention to the goal level.

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1. **Criterion Consistency Test**.

By multiplying the initial matrix by relative weight (*Priority Vector).* Next look for the quotient, which is obtained from the results of times divided by relative weights.

Table 1 - Criterion Consistent Test

EV N : Eigen Vektor Normalisasi								
Kriteria	C1	C2	C3	C4	C5	C6	JUMLAH	EVN
C1	6,00	9,71	1,89	1,03	2,25	3,58	24,47	0,04
C2	4,78	5,71	1,63	0,58	2,06	2,81	17,57	0,03
C3	37,07	50,00	6,00	3,31	9,71	19,33	125,43	0,22
C4	80,67	96,00	15,73	6,00	28,78	44,00	271,18	0,48
C5	23,73	36,67	4,67	2,78	5,71	11,33	84,90	0,15
C6	11,73	19,33	2,98	1,56	3,70	6,00	45,30	0,08
KESELURUHAN							568,85	

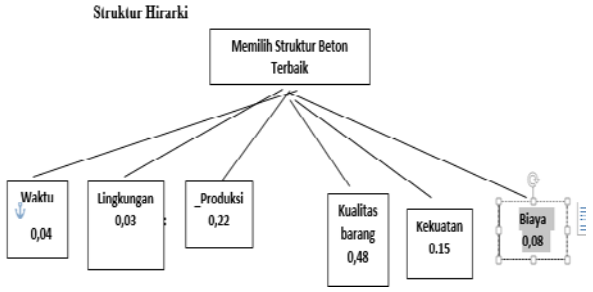

Figure 4 : Results of the Concrete Construct Criteria Hierarchy

From the results of the calculations in table 1 above, it can be concluded which criteria are the most important criteria, namely as follows:

1. Kiteria Mutu has the first highest weight which is 0.48
2. Kiteria Production has a second weight of 0.22

3. Kiteria Strength has the third highest weight at 0.15
4. Kiteria Cost has the fourth highest weight at 0.080
5. Kiteria Time has the fourth highest weight at 0.04
6. Environmental Kiteria has the fourth highest weight at 0.03

After calculating the weight of the criteria in Table 1, the maximum lamda value (λMaks) is calculated, which is to sum the result of the multiplication of priority weights by the number of columns. The maximum value obtained is

: *λMaks* = (21,333*0,04+22*0,03+7,067*0,22+1,943*0,48+9,676*0,15+12,667*0,08) = 6, 53

Calculates *consistency index* (CI) values: CI = (*λMaks – n) / (n-1)*
= (6,53-6) / (6 -1) = **0,11**

Calculates the consistent ratio value (CR), which is to divide CI by random index (RI). For matrix order n = 6. Then the value of RI is 1.24
CR= CI / RI = 0.11 / 1.24 **0.086**

The consistent ratio of 0.086 is less than the tolerance limit of 0.1. Then the comparison matrix is said to be consistent. This suggests that the research does not need to be repeated or corrected.

2. **Alternative** Consistency Test

By multiplying the initial matrix by relative weight (*Priority Vector).* Next look for the quotient, which is obtained from the results of times divided by relative weights.

Table 2 - Alternative Consistent Test

EV N : Eigen Vektor Normalisasi					
Kriteria	C1	C2	C3	Jumlah	EVN
C1	3,00	7,67	19,00	29,67	0,64
C2	1,67	2,33	7,67	11,67	0,25
C3	0,51	1,27	3,00	4,78	0,10
KESELURUHAN				46,11	

From the results of the calculations in table 2 above, it can be concluded which alternative is the most important alternative, namely as follows:
1. Precast Concrete Alternative has the first highest weight which is 0.64
2. Ready Mix Concrete Alternative has a second weight of 0.25
3. Alternative Concrete Olah has the third highest weight, which is 0.10

After calculating the weight of the criteria in Table 2, then calculated the maximum lamda value (λMaks), which is to sum the result of the multiplication of priority weights by the number of columns. The maximum value obtained is: *λMaks* = (1.5*0.64+4.3*0,25+9*0.10) = 3.02

Calculates *consistency index* (CI) values: CI= (*λMaks – n) / (n-1)*
= (3,02-3) / (3 -1) = **0,01**

Calculates the consistent ratio value (CR), which is to divide CI by random index (RI). For matrix order n = 3. Then the value of RI is 0.58
CR = CI / RI = 0.01 / 0.58 = **0.013**

The consistent ratio of 0.013 is less than the tolerance limit of 0.1. Then the comparison matrix is said to be consistent. This suggests that the research does not need to be repeated or corrected.

3. Calculation of alternative comparison matrix based on time criteria

Table 3 - Alternative Selection Values based on time criteria

	NILAI
Waskita beton Precast lebih penting dari Beton Read	3
Waskita beton Precast lebih peting dari Beton olah	3
Beton Ready Mix lebih penting dari Beton Olah	3

Alternate comparison matrix in table 4 below:

Table 4 - Alternative Comparison Matrix based on time criteria

Kriteria	C1	C2	C3
C1	1	3	3,000
C2	0,333	1	3
C3	0,33	0,333	1
	1,667	4,333	7,000

Normalize the matrix and determine *the Priority Vector* with the result of the number of rows divided by 3, as in table 5 below:

Table 5 - Matrix Normalization based on time criteria

EV N : Eigen Vektor Normalisasi					
Kriteria	C1	C2	C3	Jumlah	EVN
C1	3,00	7,00	15,00	25,00	0,60
C2	1,67	2,33	7,00	11,00	0,27
C3	0,78	1,67	3,00	5,44	0,13
KESELURUHAN				41,44	

4. Calculation of alternative comparison matrices based on Environmental criteria

Table 6 - Alternative Selection Values based on Environmental criteria

	NILAI
Waskita beton Precast lebih penting dari Beton Read	7
Waskita beton Precast lebih peting dari Beton olah	7
Beton Ready Mix lebih penting dari Beton Olah	3

Alternative comparison matrix, in table 7 as follows:

Table 7 - Alternative Comparison Matrix based on Environmental criteria

Kriteria	C1	C2	C3
C1	1	7	7
C2	0,143	1	3
C3	0,14	0,333	1
	1,286	8,333	11,000

Normalize the matrix and determine *the Priority Vector* with the result of the number of rows divided by 3, as in table 8 below:

Table 8 - Matrix Normalization based on Environment criteria

EV N : Eigen Vektor Normalisasi					
Kriteria	C1	C2	C3	Jumlah	EVN
C1	3,00	16,33	35,00	54,33	0,78
C2	1,29	2,14	7,00	10,43	0,15
C3	0,33	1,67	3,00	5,00	0,07
KESELURUHAN				69,76	

5. Calculation of alternative comparison Matrix based on Production criteria

Table 9 - Alternative Selection Values based on Production criteria

	NILAI
Waskita beton Precast lebih penting dari Beton Read	7
Waskita beton Precast lebih peting dari Beton olah	7
Beton Ready Mix lebih penting dari Beton Olah	5

Alternate comparison matrix in table 10 below:

Table 10 - Alternative Comparison Matrix based on Production criteria

Kriteria	C1	C2	C3
C1	1	7	7
C2	0,143	1	5
C3	0,14	0,200	1
	1,286	8,200	13,000

Normalize the matrix and determine the *Priority Vector* with the result of the number of rows divided

3, as in Table 11 below:

Table 11 - Matrix Normalization based on Production criteria

EV N : Eigen Vektor Normalisasi					
Kriteria	C1	C2	C3	Jumlah	EVN
C1	3,00	15,40	49,00	67,40	0,78
C2	1,29	2,14	11,00	14,43	0,17
C3	0,31	1,40	3,00	4,71	0,05
KESELURUHAN				86,54	

1. Calculation of alternative comparison Matrix based on Quality criteria

Table 12 - Alternative Selection Values based on Quality criteria

	NILAI
Waskita beton Precast lebih penting dari Beton Read	7
Waskita beton Precast lebih peting dari Beton olah	7
Beton Ready Mix lebih penting dari Beton Olah	5

Alternate comparison matrix in table 13 below:

Table 13 - Alternative Comparison Matrix based on Quality criteria

Kriteria	C1	C2	C3
C1	1	7	7
C2	0,143	1	5
C3	0,14	0,200	1
	1,286	8,200	13,000

Normalize the matrix and determine *the Priority Vector* with the result of the number of rows divided by 3, as in table 14 below:

Table 14 - Matrix Normalization based on Quality criteria

EV N : Eigen Vektor Normalisasi					
Kriteria	C1	C2	C3	Jumlah	EVN
C1	3,00	15,40	49,00	67,40	0,78
C2	1,29	2,14	11,00	14,43	0,17
C3	0,31	1,40	3,00	4,71	0,05
KESELURUHAN				86,54	

2. Calculation of alternative comparison matrices based on Strength criteria

Table 15 - Alternative Selection Values based on Strength criteria

	NILAI
Waskita beton Precast lebih penting dari Beton Read	7
Waskita beton Precast lebih peting dari Beton olah	7
Beton Ready Mix lebih penting dari Beton Olah	3

Alternative comparison matrix, in table 16 as follows:

Table 16 - Alternative Comparison Matrix based on Strength criteria

Kriteria	C1	C2	C3
C1	1	7	7
C2	0,143	1	3
C3	0,14	0,333	1
	1,286	8,333	11,000

Normalize the matrix and determine *the Priority Vector* with the result of the number of rows divided by 3, as in Table 17 below:

Table 17 - Matrix Normalization based on strength criteria

EV N : Eigen Vektor Normalisasi					
Kriteria	C1	C2	C3	Jumlah	EVN
C1	3,00	16,33	35,00	54,33	0,78
C2	1,29	2,14	7,00	10,43	0,15
C3	0,33	1,67	3,00	5,00	0,07
KESELURUHAN				69,76	

3. Alternative comparison Matrix Calculation based on Cost criteria

Table 18 - Alternative Selection Value based on Cost criteria

	NILAI
Waskita beton Precast lebih penting dari Beton Read	3
Waskita beton Precast lebih peting dari Beton olah	3
Beton Ready Mix lebih penting dari Beton Olah	3

Alternate comparison matrix in table 19 below:

Table 19 - Alternative Comparison Matrix based on Cost criteria

Kriteria	C1	C2	C3
C1	1	3	3
C2	0,333	1	3
C3	0,33	0,333	1
	1,667	4,333	7,000

Normalize the matrix and determine the *Priority Vector* with the result of the number of rows divided

3, as in Table 20 below:

Table 20 - Matrix Normalization based on cost criteria

EV N : Eigen Vektor Normalisasi					
Kriteria	C1	C2	C3	Jumlah	EVN
C1	3,00	7,00	15,00	25,00	0,60
C2	1,67	2,33	7,00	11,00	0,27
C3	0,78	1,67	3,00	5,44	0,13
KESELURUHAN				41,44	

1.1 *Eigen* Criterion and Alternative Final Result

After finding the weight of each criterion against the alternative that has been determined by the company, the next step is to multiply the weight of each criterion by the weight of each alternative, then the multiplication results are summed up by the distribution. So that the total global priority is obtained as in table 21 below:

Table 21 - Normalization Criteria Weighting Vector Matrix

	Nilai Eigen Alternatif					
Alternatif	Waktu	Lingkungan	Produksi	Mutu	Kekuatan	Biaya
Beton Precast	0,64	0,60	0,78	0,78	0,78	0,60
Beton Readi Mix	0,25	0,27	0,15	0,17	0,15	0,27
Beton Olah	0,10	0,13	0,07	0,05	0,07	0,13
EVIN	0,04	0,03	0,22	0,48	0,15	0,08

Next look for the total *ranking*, by way of the line results of each *eigen* value the alternative is multiplied by the *priority vector* value column. Here's the explanation: =

Precast concrete = (0.04*0.64) + (0.03*0.6) + (0.22*0.78) + (0.48*0.78) + (0.15*0.78) + (0.08*0.6) = 0.754

Concrete Rreadymix = (0.04*0.25) + (0.03*0.27) + (0.22*0.15) + (0.48*0.17) + (0.15*0.15) + (0.08*0.27) = 0.175

Processed Concrete = (0.04*0.10) + (0.03*0.13) + (0.22*0.07) + (0.48*0.05) + (0.15*0.07) + (0.08*0.13) = 0.071

From the results of the above calculations, it is known that the global priority sequence of good concrete calculations used in the Cimanggis Cibitung toll road work is as follows:

- Precast Concrete (C01), ranked first with a total value of **0.754**
- Ready Mix Concrete (C02), ranked second with a total value of **0.175**
- Beton Olah(C03), ranked third with a total value of **0.071**

Thus, what will match the concrete used to accelerate the Cimanggis Cibitung Toll Road is Precast Concrete

V. Conclusions and Suggestions

5.1 Conclusion

1. To find out the Value Engineering in the Cimanggis Cibitung Toll Road construction project, it is necessary to assess the best use of concrete construction in the implementation of cimanggis Cibitung Toll Road work.
2. The type of use of concrete construction on the construction of the Cimanggis Cibitung Toll Road is to precast used piles, girders, wing stifeners, bariers, fullslabs, panel fences, U ditch channels and ready mix for foundry pierhead columns, rigid for roads, ashdmen and road bariers, while ready mix is used for lean concreate casting, rigid pavement, pearhead and Column and for Processed Concrete used for stone pair work times as retaining walls, drainage channels, parking lots.
3. The method used to find out the best use of concrete construction between Precast concrete, Ready Mix and Processed Concrete is used AHP Method (**Analytic Hierarchy Process),**
4. For the use of AHP, there must be as follows **:**
   Purpose: Choosing a good type of concrete construction
   Criteria for Time, Environment, Production, quality of goods, strength and cost
   Alternatives : Precast Concrete, Ready Mix Concrete and Olah Concrete
5. From the results of calculations with AHP with EVN values, the criteria are obtained:
   a. Time 0.04
   b. Lingkungan0,03
   c. Production 0.22
   d. Quality of goods 0.48
   e. Kekuatan0,15
   f. Biaya0,08

   For the construction work of the Cimanggis Cibitung Toll Road, the quality of concrete is very important in the construction work of the Cimanggis Cibitung Toll Road construction, for then concrete production becomes the second important thing continued the strength of concrete to know the sturdiness of concrete used in the field then the cost is also an important factor after strength because of the cost that we can know whether the concrete cooking is the most efficient, fast and not problematic only last time in the implementation of cimanggis cibitung road construction work as well as the environment in maintaining the sustainability of the toll environment that can also serve to maintain the strength of concrete.

6. From the selected alternatives such as Precast Concrete, Ready Mix and Processed Concrete, the results of Precast Concrete, Ready Mix Concrete and Processed Concrete are seen from the aspects of time, environment, production, quality of goods, strength and cost, the results obtained through the AHP Method are as follows:
   a. Precast Concrete 0.754
   b. Concrete Readymix 0.178
   c. Processed Concrete 0.071

So the cultivation of Precast Concrete in the Cimanggis Cibitung project is very important, especially for efficiency, environmentally friendly and dust hazards while Ready Mix Concrete is important for casting parts that are difficult to use precast concrete, lastly processed concrete for casting certain parts in the field.

5.2 Suggestions

1. The result of the observation that the use of Precast Concrete for large projects, especially for toll road projects, is needed, especially in terms of Quality, Time< cost, Environment, Strength and production speed.
2. In using the *AHP* program we can make the best consideration of alternatives to the use of precast concrete, Ready Mix Concrete and Processed Concrete, AHP calculations can also get the best criteria from concrete construction work in the field, especially toll road construction work.
3. From the results obtained by using the AHP Method by spreading Quisioner to respondents, it is known that the majority of respondents want the future of Precast concrete as an alternative to the construction of toll roads.

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