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ANALYSIS METHOD OF GRADUAL CAST INSITU PROJECT COMPLETION OVERPASS PT. TALENTA BUMI MARABAHAN

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ABSTRACT

Overpass project development Marabahan is a CSR (Corporate Social Responsibility) from PT. Talenta Bumi, namely making public care facilities for the security and facilitate road transport and to improve the welfare of society .This project Overpass consists of main bridge prestressed concrete girders with spans of 30 m and bridges using slab pile construction with a total length of 200 m. This study aims to determine the calculation method of the analysis of in situ casts gradually and to determine the method of implementation of the phased-situ cast on Marabahan Overpass project.

Analysis of cast insitu method stages in the project completion Overpass PT. Marabahan Earth's talents will be obtained security calculations on the structure of the Overpass. Foundry work first is casting with cast in situ on the crown, after it's done casting method cast in situ stages at the slab to be divided into two stages, namely the first layer 20 cm (half slab) and the second layer 15 cm (top slab) using scaffolding as a scaffold and job formwork with main reinforcement ϕut 22-150 which gradually cast directly on the ground with the popularity chart Fc validation test cylinder '30 MPa and graphs coefficient of concrete strength PBI age 71. For loading on board, the work scaffolding (scaffolding) at the time of cast insitu gradually in the field wearing a scaffold with a heavy load capacity (heavy duty) has a maximum load of 675 kg/bay or 0.675 tons/m^2, and using strong wooden scaffolding with wood class III based voltage PKKI 1961 timber permit.

Based on the analysis results of calculations using the method of cast insitu gradually, by doing a test trial error with conditional on calculation of security moment of the plan should be greater than the moment of ultimate, then casting the first layer half slab in getting workable with the concrete less than one day the Fc '5 MPa and to stage a second layer using a comparison chart coefficient PBI age compressive strength, obtained Fc' 9.57 MPa to 1.5 days workmanship of the concrete casting. With the trial based on the test results of the concrete age, can accelerate and cut time jobs and can save the cost of the work, such as the cost of the use of formwork and scaffolding usage. suggestednecessary to test the concrete test cylinders for 1 day, 2 days, 3 days, etc,so that getting the maximum test.

Keywords: Cast in situ stages, age of concrete, moment plan and ultimate.

1. PRELIMINARY

The bridge is a construction that is part of the way that is needed in the road network that will support the development of an area.

Marabahan overpass bridge construction project is a CSR program (Corporate Social Responsibility) from PT. Talents Earth Marabahan, namely making public care facilities for the security and facilitate road transport and to improve the welfare of the surrounding community. The overpass project consists of:

This overpass job takes 300 calendar days for Rp 36,442,500,000.00 (Thirty-Six Billion Four Hundred Forty-Two Million Five Hundred Thousand). This development is a Local Public Infrastructure Improvement of CPS program PT. Talents Earth. The construction contractor is PT. Asphalt Concrete Batulicin and consultant supervisor is CV Fourteen.

2. LITERATURE REVIEW

Cast Insitu Gradually

Casting is the process of mixing the ingredients - the basic ingredient of concrete, namely cement, water, sand, and gravel into the mold a structure element that has been fitted with steel reinforcement.

In Civil Engineering, gradually cast types are of two kinds, namely concrete that has been printed in the plant (pre-cast) and concrete cast on site (in-situ).

Cast insitu gradualfoundry cast concrete directly performed on the location of structural elements that have been planned to be gradual. In high-rise buildings or a bridge overpass this Marabahan, for example the floor which is exceptionally spacious and workmanship are very high elevation makes it impossible to carry out casting an entire floor in one of workmanship.

Age Concrete

For determining the quality of the concrete compressive strength may be tested within 28 days. In-PBI has mentioned that there is a factor of the concrete to test the age of 28 days. As these factors are at 3 days of age 7 days 0,46 14 days 0.88 and 0.7 at 28 days can be seen in the form of the following table:

Age (Days)	Portland cement	High early strength Portland

	(ordinary)	cement
1	0.231	
2	0.319	
3	0.46	0.55
5	0.525	0.65
7	0.7	0.75
14	0.88	0.9
21	0.96	0.95
28	1	1
90	1.2	1.15
360	1.35	1.2

As for the test specimen and the compressive strength comparison can be seen from the following table:

No.	test specimen	A comparison of compressive strength
1	Cube 15 x 15 x 15 cm	1.00
2	Cube 20 x 20 x 20 cm	0.95
3	Cylinder 15 x 30 cm	0.83

Planning Plates

Plate is a structural element that is often used in a variety of bridge or overpass. Plates on a bridge or overpass has the function, among others separation between the basement and a room on the bridge, where diletakannya electrical wiring and lighting in the basement, muffle noise (noise) from the upper room or basement, adding stiffness horizontally on the building and as the basis of vehicle passing.

Plates without thickening: 125 mm while the plate thickening: 100 mm.

tp = Minimum thickness of the slab without beams can be seen in the table below:

Tegangan leleh, f_y MPa†	Tanpa penebalan‡			Dengan penebalan‡		
	Panel eksterior		Panel interior	Panel eksterior		Panel interior
	Tanpa balok pinggir	Dengan balok pinggir§		Tanpa balok pinggir	Dengan balok pinggir§	
280	ℓ_n / 33	ℓ_n / 36	ℓ_n / 36	ℓ_n / 36	ℓ_n / 40	ℓ_n / 40
420	ℓ_n / 30	ℓ_n / 33	ℓ_n / 33	ℓ_n / 33	ℓ_n / 36	ℓ_n / 36
520	ℓ_n / 28	ℓ_n / 31	ℓ_n / 31	ℓ_n / 31	ℓ_n / 34	ℓ_n / 34

*Untuk konstruksi dua arah, ℓ_n adalah panjang bentang bersih dalam arah panjang, diukur muka ke muka tumpuan pada pelat tanpa balok dan muka ke muka balok atau tumpuan lainnya pada kasus yang lain.
†Untuk f_y antara nilai yang diberikan dalam tabel, tebal mínimum harus ditentukan dengan interpolasi linier.
‡Panel drop didefinisikan dalam 13.2.5.
§Pelat dengan balok di antara kolom kolomnya di sepanjang tepi eksterior. Nilai α_f untuk balok tepi tidak boleh kurang dari 0,8.

Plates floor or slab is thin field elements that bear the burden of the transversal (latitude) through the action of the bending force distributed on each pedestal of the plate. Some types of floor slabs which are widely used in the construction of which is a:

a. Flat Slab System

   Flat Slab system is reinforced concrete slab, which is directly supported by the columns without beams.

b. Grid Flooring Systems

   The grid floor system (Waffle system) has beams that intersect each other at a distance that is relatively dense, with a thin top plate

Scaffolding

Scaffolding is a temporary work platform or as a temporary structure used to support people and material in the construction or repair of buildings and other large buildings. The usefulness of the scaffold is as a safe haven for workers or workers to work at high altitudes so that the safety of the workers or artisans assured. And benefit from the use of this scaffolding is the cost savings and efficiency scaffolding installation time.

And for the classification of the capacity or ability of the scaffold there are no 3, namely:

1. Light weights (light duty) to have the burden of 225 kg/bay.
2. Charges are being (medium duty) has a maximum load with a weight of 450 kg/bay.
3. Heavy load (heavyduty) maximum load of 675 kg/bay

Scaffolding Wood

Although somewhat outdated, but the type of wood scaffolding can still be found in use. For scaffolding of wood usually used timber with a diameter of 5-10 cm, 6-12 cm long, and 8-12 cm.

Voltage Timber Permit

Voltage allowed for wood by 1961 PKKI permitted load voltage for A quality wood, while wood quality B allowable stress of the second list should be multiplied by a factor of 0.75.

NO	Jenis Tegangan	Kelas Kuat Kayu					Kayu Jati (Tectonograndies)
		I	II	III	IV	V	
1	$\overline{\sigma}lt$	150	100	75	50	-	130
2	$\overline{\sigma}tk// = \overline{\sigma}tr//$	130	85	60	45	-	110
3	$\overline{\sigma}tk \perp$	40	25	15	10	-	30
4	$\overline{\tau}//$	20	12	8	5	-	15

Where :

σ lt = allowable bending stress

σ // tk = Voltage allowable parallel press

σ // tr align = Tensile permitted

σ tk ⊥ = Voltage press allowable perpendicular fibers

τ // = allowable shear stress parallel

As for the modulus of elasticity of the wood, the planning calculations, and rod bending beam press, there are several formulas that require massive wood elasticity modulus (E) required to calculate the elastic deformation.

Strong class Wood	Elasticity kg / cm²
I	125.000
II	100,000
III	80,000
IV	60,000

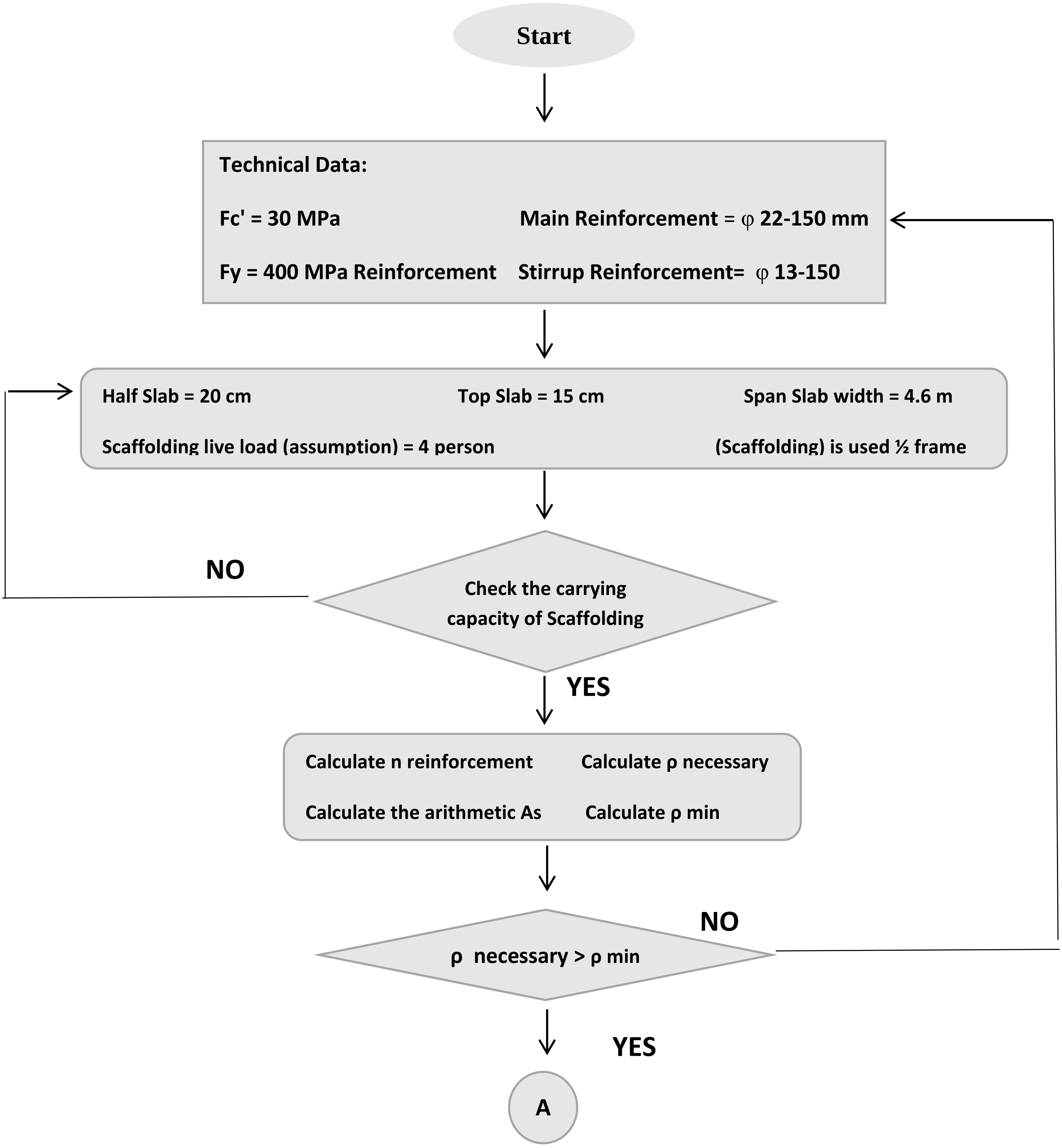
And for determining the amount of a maximum deflection according to PKKI 1961 on the construction due to its weight and load remains limited as follows:

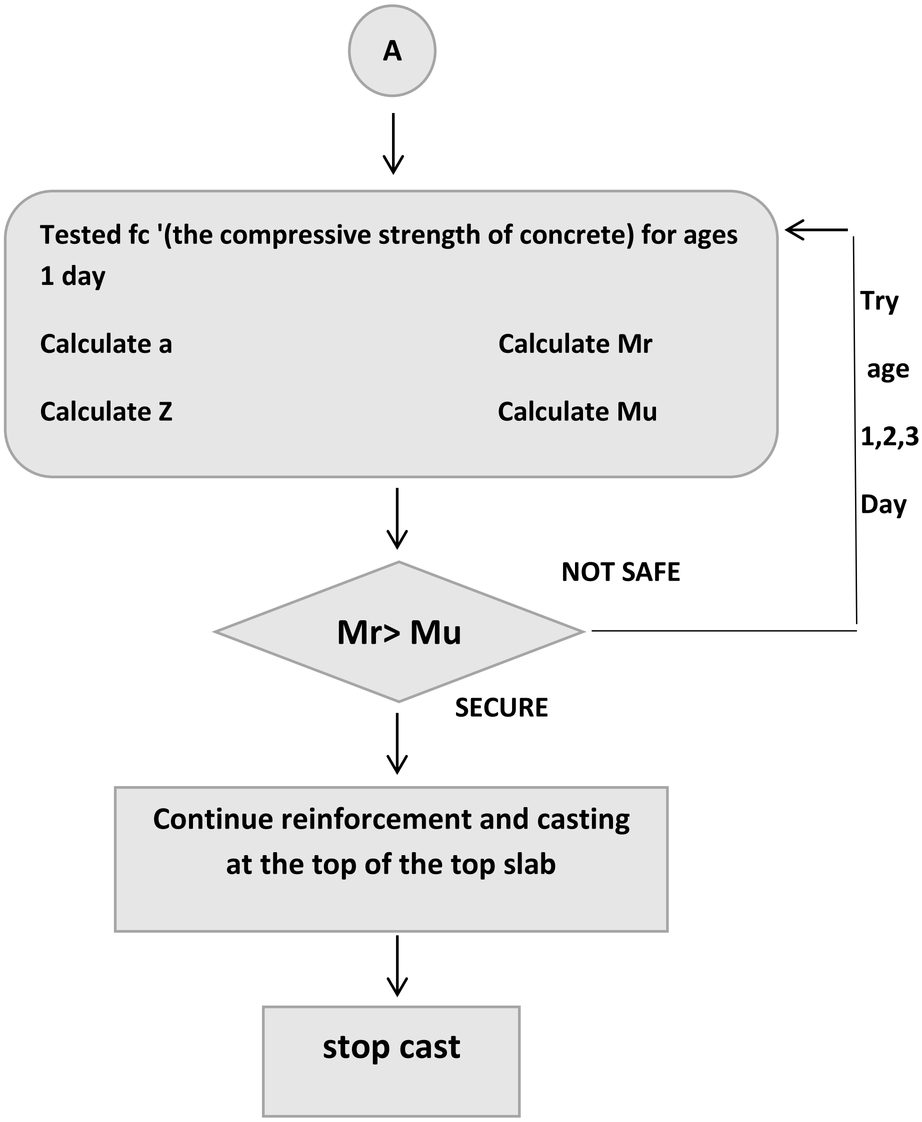
a. For beams on construction shielded (f) ≤ L / 300
b. To block the construction is not shielded (f) ≤ L / 400
c. To block the construction horses (f) ≤ L / 200

d. The construction of trusses that are not protected (f) ≤ L / 30

3. RESEARCH METHODS

The research method presented in the flow chart below:





4. RESULTS AND DISCUSSION

Overpass condition and the material used in the design is known as follows:

a. Overpass span = 30 m

b. Bridge width = 10.50 m

c. Width Traffic = 8.5 m

d. The pavement width = 1.0 m

e. Gravity RC = 2400 kg / m3

Stages Methods Insitu Cor Staged

Stages cast insitu method of gradual implementation in Marabahan City Overpass construction project on the floor plate (slab), namely:

1. On Overpass project has advantages in terms of design in the reinforcement that has a large diameter that is d22-150, and have Fc' of 30 MPa, and the quality fy = 400 MPa and done with segmental is divided into two stages of casting.
2. The first to do is reinforcing work, which assembles iron-steel reinforcement.
3. Then, preparing formwork.
4. After the formwork has been prepared, and the irons that have been assembled was placed into the formwork has been made by with the initial design in this formwork work using scaffolding ½ frame.
5. Before the foundry work performed checks on the power of the formwork, after checking his strength, then proceed to do the job pegecoran with the cast in situ on the crown.
6. After that, then do casting on a slab. At the foundry casting is done for first-tier stage (half slab), which is done with the casting use 20 cm thick, using a formwork with reinforcement d22-150 mm in the cast in the field.
7. Then the next stage is done for the casting of the second layer (top slab) together with the first layer, but with some additions to determine the load - load, top slab with a thickness of 15 cm
8. Then made by calculating your weight due to load half slab, coupled with his heavy burden on the top slab.
9. After that, compared with the value of Mr and Mu, if Mr > Mu then cast stop work (completed).

Reinforcement Calculation On Crown (v shell)

Calculations on the crown or v shell
Length = 10.5 m
Height = 0.55 m

Formula	result

Broad trapezoidal = $\frac{(a+b)}{2} x\ t$ $= \frac{(2+1)}{2} x\ 0{,}55$	0.825 m²
Volume = area x length of the segment trapezoid = 0.825 m² x 10.5 m	8.6625 m³
The total weight of the formwork =volume bekisting x berat jenis beton = $8{,}6625\ m^3\ x\ 2400\ kg/m^3$	20790 kg = $\boldsymbol{20{,}79\ ton}$

Calculation ability and Safety Scaffolding (Scaffolding)

Data is known :	Heavy load of scaffolding (scaffolding) (Heavy duty) maximum load of 675 kg / bay
Scaffolding job boards in length = 1.8 m and width = 1,2 m	The ability for one frame scaffold $= \frac{0{,}675}{1{,}8\ .\ 1{,}2} = 0{,}3125\ \text{t/m}^2$
In the field wearing a ½ frame scaffold, then = 2 x 0.3125 = 0.625 t / m²	Distance - the distance on the beam scaffolding (scaffolding) = 0.6 m
Wood Class III: b = 8 cm = 0.08 m h = 12 cm = 0.12 m y = 6 cm = 0.06 m	Elasticity timber permit (E) = 80 kg / cm²

On the job crown in the field, to the load on the crown also borne by the pile so that it can be in the assumption right to his calculations are borne 50% by the stake, and 50% of them again shouldered by scaffold, so on the field - a field that distributes the load q in crown

$= \frac{\textbf{total losf of the crown}}{\textbf{scaffolding length x crown length}}$

$= \frac{\textbf{20,79 ton}}{\textbf{1,8 m . 12,5 m}}$ = 0.924 t / m² = 924 kg / m²

Assumption 50% borne by the stake = $\frac{\textbf{0,924 ton/m}^2}{\textbf{2}}$= 0,462 tons / m² = 462 kg / m^2

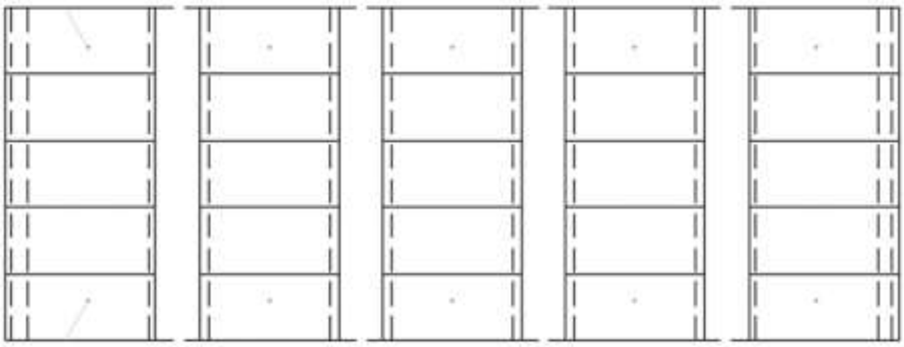
Then, to be able to know how much weight carried by the crown per meter. Furthermore multiplied right with scaffolding 1.8 m long and 0.6 m at the girder spacing can = 0,462 tons / m² x 1.8 m x 0.6 m = 0.49896 ton / m (As q conversion).

To work on the crown can q conversion = 0.49896 t/m, which has the burden is smaller than the heavy load of scaffolding used is ½ frame = 0.625 t / m²> 0,462 tonnes / m² (Secure).

Wooden girder calculation:

moment of wood	inertia timber	Wood bending moment field σ lt	Wood bending moment permits σ lt	The shear stress field τ	The shear stress permits τ	deflection field	deflection permits
0.0673596 ton.m	1152 CM4	35.083 kg / cm²	75 kg / cm²	7.017 kg / cm²	8 kg / cm²	0.592 cm	0.9 cm
		SECURE		**SECURE**		**SECURE**	

Security calculation Scaffolding (scaffolding) in Floor Plates



- Long slab = 10.5 m and a width of reviews long slab = 4.6 m
- For the calculation of its own weight in half slab floor plate2.4 tonnes / m3 x 0.20 m = 0.48 ton / m2 which has a smaller load than a heavy load of scaffolding used is ½ frame = 0.625 tons / m2> 0.48 ton / m2 (Secure).
- Based on the calculation of casting for the second phase (top slab) does not require scaffolding again, because in casting the first phase (half slab) can be said to have been strong to bear the burden themselves, and in other words, may help substitute as scaffolding (scaffolding).

Calculation At First Casting (half slab)

Using a floor plate thickness, tp = 200 mm = 20 cm

Formula	result
$\beta_1 = 0{,}85 - 0{,}005\ x\ (\frac{fc' - 28}{7})\ (28MPa \leq f_c' \leq 56MPa)$ $= 0{,}85 - 0{,}005\ x\ (\frac{30-28}{7})$	0.835
Ds = 50 mm $d' = h - d_s - \frac{1}{2}\phi ut$ $d' = 200 - 50 - (\frac{1}{2}22)$	139 mm
As needed Calculate n =$\frac{1000}{150} = 6{,}667\ buah\ \cong 7\ buah$ hitung $As = n.As$ $As = n.As$ $= 6{,}6667.\ \frac{1}{4}.\pi.22^2$	$2534{,}218\ mm^2$
Need reinforcement ratio (ρ_{perlu}) $\rho_{perlu} = \frac{As}{b.d} = \frac{2534{,}218}{1000.139} = 0.018231785$ The minimum reinforcement ratio (ρ_{min}) $\rho_{min} = \frac{1{,}4}{fy} = \frac{1{,}4}{400} = 0{,}0035$ (ISO-2847-2013) it is used:$\rho_{min} = 0{,}0035$	*p* need> p min (Secure)

In trying to use Fc '5 MPa→ $a = \frac{As.fy}{(0{,}85.fc')b} = \frac{2534{,}218\ .400}{(0{,}85.5)1000}$

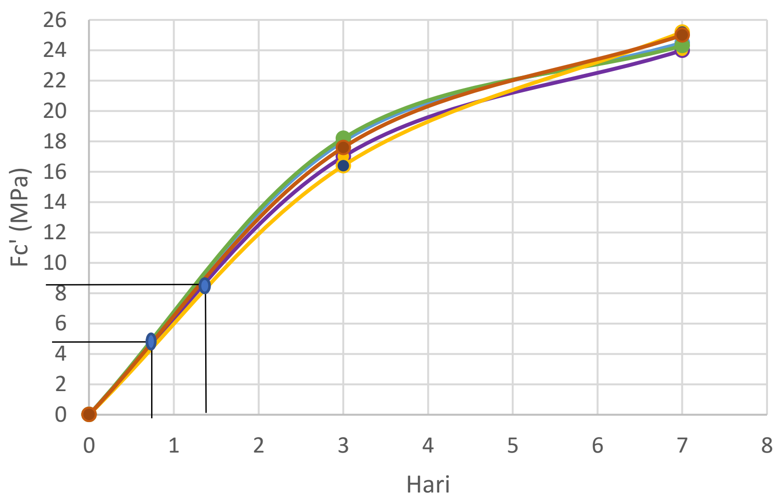
$= 238{,}5146422\ mm$

$z = \left(d - \frac{a}{2}\right) = \left(139 - \frac{238{,}5146422}{2}\right)$ =19.74267888 mm

Nominal Moment (As.fy.z)	Moment Plan (0.8, Mn)	Ultimate Moment ($\frac{1}{24}$, q. l2)
20.01290145 kNm	16.01032116 $kN.m$	6.489066667 $kN.m$

With the popularity graph of the validation test cylinder Fc '30 MPa, and conducted trial error trials MPa the concrete, for the casting of half slab in the Fc' 5 MPa with a thickness of 20 cm and is assisted by a bearer scaffolding then for half slab is able to bear the weight of its own less of 1 day (24 hours). Based on Mr> Mu (Secure).

Chart based on cylinder validation based fc' 30 MPa



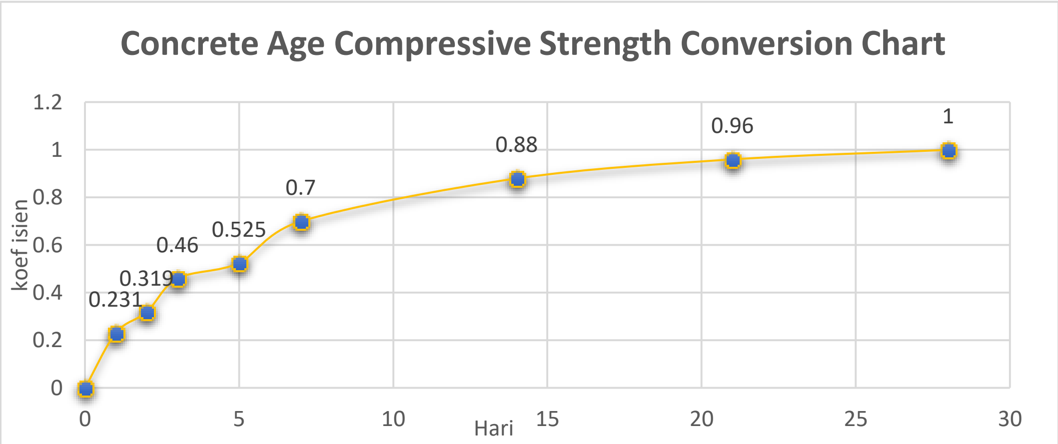
	Tabel Trial Error Uji Coba MPa Umur Beton						
	no	fc' (MPa)	*Mr*	*Mu*	*Mr > Mu*	SF = *Mr/Mu*	hari
	1	1	-370,836	6,489066667	CEK LAGI!	-57,15	
	2	2	-129,057	6,489066667	CEK LAGI!	-19,89	
	3	3	-48,464	6,489066667	CEK LAGI!	-7,47	
	4	4	-8,168	6,489066667	CEK LAGI!	-1,26	
Half slab	5	5	16,010	6,489066667	AMAN	2,47	
	6	6	32,129	6,489066667	AMAN	4,95	
	7	7	43,642	6,489066667	AMAN	6,73	
	8	8	52,277	6,489066667	AMAN	8,06	
	9	9	58,993	6,489066667	AMAN	9,09	
Top slab	10	10	21,646	5,219466667	AMAN	4,15	
	11	11	68,762	5,219466667	AMAN	13,17	
	12	12	72,425	5,219466667	AMAN	13,88	
	13	13	75,525	5,219466667	AMAN	14,47	
	14	14	78,182	5,219466667	AMAN	14,98	
	15	15	80,485	5,219466667	AMAN	15,42	

The second casting stages

Floor plate thickness = 150 mm = 15 cm

Planned concrete cover 50 mm

Formula	result
$d' = h - d_s - \phi ut$ $d' = 150 - 50 - 16 - (\frac{1}{2}22)$	89 mm
As needed $As = n.As$ $= 6{,}6667.\ \frac{1}{4}.\pi.22^2$	2534,218 mm^2
$\rho_{perlu} = \frac{As}{b.d} = \frac{2534{,}218}{1000.89} = 0.01823178$ The minimum reinforcement ratio $\rho_{min} = \frac{\sqrt{fc'}}{4.fy} = \frac{\sqrt{30}}{4.400} = 0{,}003423266$ Should not be less than $\rho_{min} = {}^{1,4}/_{f_y} =$ $\frac{1{,}4}{400} = 0{,}0035$ it is used: $\rho_{min} = 0{,}0035$	p need> p min (Secure)



For the second casting (top slab) compared to using graphics coefficient concrete compressive strength PBI age 71.

Age of concrete for 2 days = 0.319 MPa

$= 0{,}319.30 = 9{,}57\ MPa$

then used $fc' = 9{,}57 MPa \rightarrow a = \frac{As.fy}{(0{,}85.fc')b} = \frac{2534{,}218\ .400}{(0{,}85.9{,}57)1000}$

$=124.6158005\ mm$

$z = \left(d - \frac{a}{2}\right) = \left(89 - \frac{124{,}6158005}{2}\right) = 26.69209973\ mm$

Nominal moment (As.fy.z)	Moment Plan (0.8, Mn)	Ultimate Moment ($\frac{1}{24}$, q. l2)
27 KNM	$21.6459525\ kNm$	$5.219466667\ kN.m$

With the popularity graph of the validation test cylinder Fc '30 MPa, and compared with a chart age compressive strength of concrete PBI. For casting the top slab with Fc '9.57 MPa 15 cm thick to do a second casting (top slab) by the charts is the concrete life of 1.5 days with Mr > Mu (Secure).

CONCLUSION

Conclusions from the analysis of foundry work stages using cast in-situ stages after of the project Overpass cities Marabahan on roads Marabahan - Margasari South Kalimantan is that by using cast in-situ stages can speed up or cut back on jobs and save costs, for example the use of formwork and scaffolding usage fee. To cast insitu casting stages in the first tier (half slab) is less than one day been able to carry his weight with the added help of scaffolding to carry the weight, and for casting the second layer (top slab) can be done on the day of its day. But in the field of workers usually takes 1-2 days to work formwork and reinforcement installation.

Suggestion

To get the maximum test test test needs to be done to the concrete cylinder 1 day, 2 days, 3 days, and so on. Test cylinders conducted to validate the coefficients used in the calculation method of cast insitu gradually, and addition also it is necessary to the application of occupational safety, and health K3 must be done and done, the work of construction of the bridge Overpass with the process is carried out at an altitude high enough, if not carried out and implemented correctly as well as good supervision, it is feared could lead to accidents.

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