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DESIGN OF BIU RIVER STEEL TRUSS BRIDGE PART WAY BIU-SAMURANGAU MUARA SAMU DISTRICT PASER TANA PASER REGENCY EAST KALIMANTAN PROVINCE

Lulu Assegaf and Markawie

Civil Engineering Department, Lambung Mangkurat University

Email: luluassegaf95@gmail.com

ABSTRACT

Samurangau village is located on Muara Samu District, Paser Tana Paser Regency, East Kalimantan Province. Samurangau village has livelihood such as oil palm, farming, and rubber. To make the economy keep going on the people of Samurangau village have to go to the city of Paser Tana Paser regency through Biu village. But the acsess is disconnected by the tributary of Kandilo river, Biu river. Because the exist suspension bridge can only be passed by two-wheeled vehicle and pedestrian, thus it needed bridge enhancement to satisfy the people of Samurangau village. Based on the location, its need the more durability dan it doesn't need special handling thus the steel truss bridge have been choosen. Based on the difference of elevation thus the different foundation in each part way is the best selection.

Methodology that used in this design refers to the bridge imposition For RSNI T-02-2005 about composite bridge structure design method, refers to RSNI T-03-2005 about Steel Structural Design For Bridge, SNI 03-1729-2002 about Steel Structures Planning Procedures and SNI 03-2847-2002 about Concrete Structures Calculation for Building and SAP2000 software to control allowed tension. In sub-structure of Biu village part way used caisson foundation that qualify to shear stability, bolster stability, and bearing capacity of foundation. In sub-strucure of Samurangau village part way used steel pipe pile that qualify to axial and lateral force.

From the planning, structure used the profile of girders are WF 450.300.11.18, WF 900.300.18.34, 2L 180.180.20 for wind truss, WF 400.400.t for main truss with different thick in each frame. The quality of steel used BJ 55. In sub-structure of Biu village part way used foundation of caisson with its diameter 3,00 m and sub-structure of Samurangau village part way used steel sheet pile with its diameter 0,6 m with quality of steel used BJ 37 with fy 240 MPa and quality of concrete used fc' 20 MPa. For descrease the soil pressure used box culvert on Samurangau part way.

Keywords: Bridge, steel truss bridge, caisson, sheet pile, box culvert.

1. INTRODUCTION

Biu village is a village located in the district of Muara Samu Tana Paser Paser Regency of East Kalimantan Province. Not far from the village of Biu, there Samurangau village located in Muara Samu Tana Paser Paser Regency of East Kalimantan Province.

Access between these two villages are separated by a tributary of the River Biu Kandilo that stretched as wide as 20 m. Biu river which has a height difference which Biu village of ± 3.00 m higher than the Samurangau village make the area along the river in the village of Samurangau submerged at high tide, so that the necessary bridge spans to 60 m and uses the structure of the steel frame.

The purpose of making this final project is to design a bridge order safe and can function properly and meet the requirements - technical requirements both structures above and below the bridge so access to transportation between the village of Biu and Village Samurangau Muara Samu Paser Tana Paser in East Kalimantan Province can walk well.

The design is done with the job location Tana Paser Paser Regency of East Kalimantan Province.

2. BASIS THEORY

Bridge is a building that connects physically for the purposes of transportation services from one end to the other was blocked by natural conditions or other buildings.

a. Natural conditions, such as: rivers, valleys, strait (called bridge)
b. Building or road conditions that have been or will be (so-called fly-over)

Secondary data is data obtained indirectly from the source, either orally or in writing. Secondary data is needed at this time include the design of building functions, building dimensions, material data, load plans, soil data, the data stream of the highest water level, and drawing plans.

In planning the bridge over the structure planning is divided into top and bottom structure.Imposition Based Standards for Bridge RSNI T-02-2005, the load acting on the bridge is the primary load, secondary loads, as well as the combination of loading and styleExpensesprimer is a burden which is a major burden that includes the primary load is:

a. dead load that is all steady load coming from its own weight steel frame or part of the framework of the review, including any additional elements are considered to constitute a unity remained with him.
b. Expenses ie additional dead weight of all the ingredients that make up a load on the bridge which is a non-structural elements and the magnitude may change during the life of the bridge
c. burden of life that is all the burdens that come from moving heavy vehicles / traffic / pedestrian who considered working on a steel frame. Traffic load is divided into two: load "D" and the load "T".

- Load "D" is a burden lanes. Expenses lane "D" work on the whole width of the vehicle lane and have an impact on the *piled slab* which is equivalent to a convoy truth.
- Load the truck "T" that is the burden of a heavy vehicle with three axles are placed at some position in the traffic lane plan. Each consists of two fields as contact charging is meant to simulate the effect of a heavy vehicle wheels.

Prior to the structural analysis, modeling is done in advance to facilitate the design of the steel frame. Stages of modeling consists of determining the initial dimensions, the materials to be used, the load - the work load, the model structure, the model placement, and connection types.

1. Plates Considered Beams

In planning slab bridge order which behaves as construction parts, in principle, similar to the bending beam planning, although generally more simple, because:

a. Has a certain width of the plate and in the calculations used a unit width of 1 meter.

b. Shear stresses in the plate is usually low unless there are loads of centralized heavy.

2. Planning moment coefficients plate method

   for determining the moment that occurs in this method, the system should be analyzed whether the floor plate is a plate system of one-way or two-way plate. Plate system is determined based on a comparison of long-span plate against its short span.

3. Calculation of Concrete Reinforcement

Design of reinforcement is done with regard slab as a rectangle beam by taking one set of plates (reviewed every one meter width of the plate).

Magnitude of deflections are calculated assuming the plate as a beam with a width of 1 meter is a barrier between the outskirts of the vehicle with a bridge that serves as a safety for the user traffic passing over the bridge. Pavement serves to provide optimum services to pedestrians in terms of both safety and comfort.

Shear force occurring between the concrete slab and steel profiles must bear a number of shear connec tors, so it does not slip during the service life. According RSNI - T - 03-2005 spacing between the link must not be greater than 600 mm, twice the thickness of floors, four times the height liaison.

Planninglower structure consisting of a foundation plan, oprit, abutment, part of the foundation. The river bridge planning Biu Biu road use - Samurangau, use the form below the structure foundation kaison directions Biu use while under samurangau using pile foundation.

According Rahardjo (2005), the lateral load can work on piles due to seismic forces, the forces of wind on top of the structure, such as a static load on the abutment pressure is on the ground, and others. In the analysis, condition mast head can be divided into head mast free (free head) and head pinched pole (fixed head). Method of analysis that can be used are Method Broms (1964), Theof method Brinch-Hansen (1961), and Method Reese-Matlock (1956).

In the calculation of pile foundations that receive lateral loads, in addition to general conditions mast mast head also needs to be distinguished by their behavior in the short pile (pole stiff) or the foundation of a long pole (pole elastic). In short pile foundation, the axis perpendicular to the pole still burdened laterally conditions. Criteria for determining the short and long pole pole based on the relative stiffness of the pile with the ground.

Kaison foundation is the foundation of cylindrical or box that has been printed first, inserted into the ground, at a certain depth, and then filled with concrete cast in place. According to the method of manufacture, kaison divided into:

1. Kaison open*(open*caisson)
2. Kaison pneumatic*(pneumatic*caisson)
3. Kaison floating*(floating*caisson)

3. DESIGN METHOD

The first step in the preparation of this thesis is to determine the topic of discussion. The topics taken is about the design of the bridge framework. The location was chosen in this design is the village of Biu - Samurangau Subdistrict Regency of East Kalimantan Province.

Secondary data is data obtained from sources it indirectly, either orally or in writing. Secondary data is needed at this time include the design of building functions, building dimensions, material data, load plans, and soil data.

Material structures used in building up and building under the bridge Biu - Samurangau is According to the Technical Specifications Year 2010 Revision - 3 on the bridge, the quality of steel used 410 MPa while for the structure under the vehicle floor concrete quality used fc '25 Mpa with a 60 m span bridge, bridge class B with a 7.0 m wide bridge

Dimensions of bridge classes road which passes through the bridge. In this final project selected bridges preliminary bridge design includes

a. structure on a steel frame
   Length: 60 m
   bridge Class:B
   Quality of steel:4100 kg / cm^2
b. underStructure
   DirectionBiu village
   Highabutment: 1.50 m
   Width abutment:11.00 to 12 , 00 m
   type of foundation:Caison
   Directions Village Samurangau
   High abutment:5.50 m
   Width abutment:11.00 to 12.00 m
   type of foundation:Columnstake

Impositioninclude; dead loads, additional dead load, live load and live load T D. Such expenses are calculated in accordance with the applicable provisions under RSNI T-02-2005.

The forces obtained from the calculation of loading is then used to calculate the girder, reinforcement backrest, welded joints, bolted connection and calculation of transverse beams. To use a concrete slab with quality fc '25 MPa. While at rest using reinforced concrete cast in place with quality fc '20 MPa.

Impositionbottom structure includes ati loads, additional dead loads, soil pressure on the walls of both normal and seismic conditions, live loads, brake force / longitudinal force, friction / friction on the bearing, wind loads, seismic forces. Such expenses are calculated in accordance with the applicable provisions under RSNI T-02-2005.

expenses are computed in the previous step is then combined with a certain combination in accordance with the guidelines of loading RSNI T-02-2005.

After calculating the structure is completed, the next step enter into the calculation of the carrying capacity of either pole axial load carrying capacity (vertical) and the load carrying capacity of the lateral (horizontal). The foundation for the direction of the village of Biu use Caison while the direction of the village of Tiang Samurangau using stakes.

Pile bearing capacity calculation in the previous step to produce a single pile bearing capacity, for local transverse beam (voute) used a single pole while the abutment area used pole group.

After carrying capacity and efficiency of the group already counted pole then the next step is to calculate the reinforcement in abutments are first divided into several sections according to the direction of the force in order to simplify the calculation of engineering mechanics. Abutment use of reinforced concrete cast in place with quality fc '20 MPa.

Once all the planning activities finished the importance of the final design. Result reinforcement calculations and preliminary design and then poured into working drawings using Autocad software 2007. Includes pictures situation, look, cut and detail reinforcement which will then be used as a reference image in the implementation of the field.

4. RESULTS OF DESIGN

Bridge ConditionSteel Frame

Bridge Span = 60 m
ClassBridge = B
Width Bridge = 7 m
Width Traffic = 6m
widthSidewalks = 0.5 m

SpecificationsBridges Steel Frame

Material used in this design namely by taking the following assumptions:

1. Structure on
   a. Plates Floor = Reinforced concrete
   quality of the concrete fc '= 25 MPa
   Quality fy = 410 MPa steel
   plate thickness = 25 cm
   b. Girder Aft = Profile WF 450.300.11.18
   c. Transverse girder = Profile WF 900.300.18.34
   d. Order Parent = Profile WF 400.400.13.21
   e. Bond Wind = Profile L 200.200.16
   f. Shear Connector = Stud
2. Structures under
   a. Abutment
   <u>Biu village</u>
   Highabutment = 2.50 m
   = 11.00 m Width abutment
   quality of the concrete fc '= 20 MPa
   Quality steel fy = 240 MPa
   <u>Samurangau village</u>
   Highabutment = 5.50 m
   = 11.00 m Width abutment
   quality of the concrete fc '= 20 MPa
   Quality fy = 240 MPa steel
   b. foundation
   <u>Biu village</u>
   foundation type = Caisson
   Depth = 2.60 m
   quality of the concrete fc' = 20 MPa
   Quality steel fy = 240 MPa
   <u>Village Samurangau</u>
   foundation type = Column stake
   Depth = 7.60 m

strength of concrete fc '= 20 MPa
steel quality fy = 240 MPa
Calculation pipe backrest
Data Planning
permission σ = 400 MPa
steel E = 2.1 x 105 MPa
Technical Data profile
diameter (D) = 76.3 mm
thickness (t) = 4.0 mm
Size (F) = 9.085 cm2
weight (G) = 7.13 kg / m
moment of Inertia (I) = 59,5cm4
finger - the finger of Inertia (i) = 2 , 60 cm
moment Lawan (W) = 15.6 cm
$R = \sqrt{(V^2 + H\ 2)}$
R = √(7.13〗 2+ 〖〖100〗 2)
R = 100.254 kg / m
moment happens to the pipeline backrest:
M_u = 1/8 .q.L_s 〖〗 = 1/8
2.100,254.3.449 〖〗 2 kgm= 149.092
Scroll happened to the pipe backrest:
V = 1/2.q .L_s
= 1/2 .100,254.3,449 = 172.899 kg
Material and Voltage Control Over Existing
Against Deflection of 1.479 <1.874 Ok!
Moment to 955.721 <4000 Ok!
Scroll voltage 45.332 <2320 Ok!
Then used a pipe ø 76.3 mm as a backrest

Floor Planning Sidewalks

a. planning data
SidewalksWidth = 0.50 m
thickness (tt) = 0.20 m
Quality Concrete (fc ') = 25 MPa
Quality Steel (fy) = 410 MPa
Diameter reinforcement = ø 16
Thick Blanket (ds) = 40 mm
Width = 1000 mm Floor Overview
Effective Width (dx) = 200-40- (0,5.16) = 152 mm
b. Charging of
1) DeadExpenses Due
weightsidewalk = 1.3. 1.00. 0.20. 2500 = 600 kg
weight slab = 1.3. 1.0. 0.25. 2500 = 812.5 kg
2) DueLiving Expenses
pedestrianExpenses = 1.8. 500 = 900 kg
Based dead load and live the ultimate load obtained:
Qult = 1.2 + 1.6 qDL QLL
= 1.2 (1462.5) + 1.6 (900)
= 3195 kg

Mmax = 1/8. Qult. L2 = 1/8. 3195. 52
= 9984.375 kgm = 97,913,271NMM

c. Reinforcement
D16-150 as main reinforcement pavement
D8 - 250 as a reinforcement for pavement

Calculation Floor PlatesVehicle

Table 1. Summary of the calculation of moments on the vehicle floor plate

Position Moment	**Moment Due**		
	DeadExpenses KNM	Living Expenses KNM	Total Moment KNM
MLX	73.377	40.418	113.795
Mly	3.124	40.418	43.543
MTX	73.377	-	73.377
Mty	-	-	-

Table 2. Summary of diameter and spacing of reinforcement used

typereinforcement	Utama	Bagi
Reinforcement Pedestal	$D22-150$	$D16-250$
reinforcement Courses	$D22-150$	$D16-250$

Amount deflection occurs:

$I = \frac{1}{12}\, b\,.\,h^3 = \frac{1}{12}\, 1000\,.\,250^3$ = 1302083333 mm^4

f = 0,656 + 5,601 = 6,257 mm

amount deflection occurs:

fizin = $\frac{1}{240}$. L = $\frac{1}{240}\,.\,5000$ = 20,83 mm

f = 6,27 mm < fizin = 20,83 mm......... Ok!

a. Data Planning
Qualityconcrete (fc ') = 25 Mpa
Quality steel (fy) = 410 Mpa
vehicle floor plate thickness = 25 cm
thick pavement = 5 cm
distance between the girder = 1.5 m
Modulus of elasticity of steel = 2 x 10^5 MPa
modulus of elasticity of concrete = $4700\,\sqrt{fc'} = 23500$ MPa

b. Technical Data profile
profile steel WF 450. 300. 11. 18
g = 124 kg/m t_1 = 11 mm
Ix= 56100 cm^4 iy = 7,18 cm
a = 157,4 cm^2 t_2 = 18 mm
A = 450 mm Wx = 2550 cm

Iy = 8110 cm^4 R = 24 mm
B = 300 mm Wx = 541 cm
Ix = 18,9 cm

a. Section Properties

$\frac{h_w}{tw} \leq \frac{1680}{\sqrt{fy}} = 33{,}273 \leq 82{,}969$ .. Ok!

$\frac{b}{2t_f} \leq \frac{170}{\sqrt{fy}} = 8{,}333 \leq 8{,}396$......... Ok!

c. Imposition of

1) Expenses Due Dead

weight of the concrete = 0,25 . 2400 . 1,5 . 1,3
= 1170 kg/m
Heavy profile = 124 . 1,1
= 136,4 kg/m

$$M_{MS} = \frac{1}{8} . Q_{MS} . L^2$$
$$= \frac{1}{8} . 13{,}064 . 5^2$$
$$= 40{,}825 \text{ kNm}$$

2) Due Load Off Extra

Heavy asphalt = 0,05 . 2200 . 1,5 . 2
= 330
Heavy rain = 0,01 . 1000 . 1,5 . 2
= 30

$$M_{MA} = \frac{1}{8} . Q_{MA} . L^2$$
$$= \frac{1}{8} . 3{,}6 . 5^2$$
$$= 11{,}25 \text{ kNm}$$

3) Due Load Off Extra

Q_{TD} = 1,8 . 9 (0,5 + 15/L)
= 1,8 . 9 (0,5 + 15/60)
= 12,15 . 1,5
= 18,225 kN/m

PTD = 1,8 . (1 + DLA) . P
= 1,8 . (1 + 0,375).49
= 121,275 . 1,5
= 181,9125 kN $M_{TD} = \frac{1}{8} . Q_{TD} . L^2 + \frac{1}{4} . P_{TD} . L$

$$= \frac{1}{8} . 18{,}225 . 5^2 + \frac{1}{4} . 181{,}9125 . 5$$
$$= 284{,}344 \text{ kNm}$$

d. Materials and Voltage Control Over Existing

1) Strong Against Nominal

$\phi M_n \geq M_u$

0,9 . 1045,5 kNm ≥ 283,344 kNm

904,95 kNm ≥ 283,344 kNm .. Ok!

1) Against Voltage

$f_{sa} < \phi\, f_y$
113,641 < 328 MPa .... Ok!

2) Against Deflection

$\delta_{izin} > \delta_{TD}$
6,250 mm > 1,326 mm .... Ok!

2) Shear

$V_a \leq \phi\, V_n$
13651,875 ≤ 1217700 .... Ok!

a. Data Planning
quality of the concrete (fc ') = 25 Mpa
Quality steel (fy) = 410 MPa
Thickness of floor plates of vehicles = 25 cm
thick pavement = 5 cm
distance between the girder = 5 m
Modulus of elasticity of steel = 2×10^5 MPa
Modulus concrete elasticity = 23 500 MPa

b. Technical Data profile
steelprofile WF 900. 300. 18. 34
g = 286 kg/m t_1 = 18 mm
Ix= 498000 cm^4 iy = 6,56 cm
a = 364 cm^2 t_2 = 34 mm
A = 900 mm   Wx = 10900 cm
Iy = 15700 cm^4 R = 28 mm
B = 300 mm   Wx = 1040 cm
Ix = 37 cm

a. Section Properties
$\frac{h_w}{tw} \leq \frac{1680}{\sqrt{fy}} = 43{,}111 \leq 84$ .... Ok!
$\frac{b}{2t_f} \leq \frac{170}{\sqrt{fy}} = 4{,}412 \leq 8{,}5$ .... Ok!
Lebar efektif:
be $= \frac{760}{5}$ = 152 cm
bo = 500 cm
So it takes the less **152 cm**

$$n = \frac{E_{baja}}{E_{beton}} = \frac{200000}{23500} = 8$$

Concrete trnasform:

$$\frac{b_e}{n} = \frac{152}{8} = 19{,}000 \text{ cm}$$

Area of concrete after composite:

$$Act = \frac{b_e}{n} \cdot t_p$$
$$= 19{,}000 \cdot 25 = 475{,}000 \text{ cm}^2$$

b. Charging of
From the combination 1: M = 2838,756 kNm dan V= 1824,808 kN

c. Material and Voltage Control Over Existing

1) Strong Against Nominal
Before composite
$M_u = 1502{,}071$ kNm $< \phi M_n$ 4022,1 kNm ....Ok!
After composite
$M_n = C_c.d' + C_s.d''$
$= 8075000 . 704{,}8 + 3242500 . 565{,}9$
$= 7629831909$ Nmm
$= 7629{,}8319 > 2838{,}745$ kNm...Ok!
2) Against Voltage
Before composite
$f_{sa} < \phi f_y$
$135{,}729 < 328$ MPa .... Ok!
After composite
Total of voltage on upper side
$f_{sa} < \phi f_y$
$165{,}073 < 328$ MPa .... Ok!
Total of voltage on bottom side
$f_{sa} < \phi f_y$
$318{,}569 < 328$ MPa .... Ok!
3) Against deflection
Before composite
$\delta_{izin} > \delta_{TD}$
9,5 mm $>$ 0,647 mm .... Ok!
After composite
$\delta_{izin} > \delta_{TD}$
9,5 mm $>$ 1,126 mm .... Ok!

d. Shear connector
Shear force in one stud
$Q_n = 0{,}5.A_{sc}\sqrt{f'_c.E_c}$
$= 0{,}5 . 283{,}385 . \sqrt{25 . 24102{,}98}$
$= 144526{,}35$ N
$A_{sc}.f_u = 706{,}860 . 550$
$= 360498{,}60 > 144526{,}35$ N Ok!
Total of stud used:
$N = \dfrac{3424500}{144526{,}35} = 32$ pcs/row
Pressure of wind = 150 kg/m^2
Length of bottom side = 60 m
Length of upper side = 55 m
High of bridge = 6,5 m
Area of truss side bridge
$= \left(\frac{60+55}{2}\right) . 6{,}5 = 373{,}75$ m^2
Steel Profil 2 L 180 . 180 . 20
g = 53,7 kg/m a = 6,84 cm^2
Ia = 3260 cm^4 s = 51,8 cm
ia = 6,90 cm v = 73,3 mm

ib = 3,49 cm w = 127 cm
Ib = 830 cm^4 Ix = 2040 cm^4
r = 18 mm ix = 5,47 mm
r1 =9 mm

1) Wind force on side of bridge
- Wind force on truss
  $H_{W1} = 30\,\% \,.\, q_w \,.\, A$
  $= 30\,\% \,.\, 150 \,.\, 373{,}75$
  $= 16818{,}75$ kg
- Wind force on living 2 m
  $H_{W2} = q_w \,.\, A$
  $= 150 \,.\, 373{,}75$
  $= 18000$ kg

2) Wind force on upper bond
   $\sum MB = 0$
   $(H_{W1} \,.\, ½ \,.\, 6{,}5) - (RH_A \,.\, 6{,}5) = 0$
   $(16818{,}75 \,.\, ½ \,.\, 6{,}5) - (RH_A \,.\, 6{,}5) = 0$
   $RH_A \,.\, 6{,}5 = 54660{,}9375$
   $RH_A = 8409{,}375$ kg
   Reaction:
   $R = \frac{1}{2} \,.\, 8409{,}375 = 4204{,}687$ kg
   Distribution:
   $P = \frac{1}{11} \,.\, 8409{,}375 = 764{,}488$ kg
   Wind distribution on edge:
   ½ P $= 382{,}2443$ kg

3) Wind force on under bond
   $\sum KH = 0$
   $H_{W1} + H_{W2} - RH_A - RH_B = 0$
   $16818{,}75 + 18000 - 8409{,}3 - RH_B = 0$
   $RH_B = 26409{,}375$ kg
   Reaction:
   $R = \frac{1}{2} \,.\, 26409{,}375 = 13204{,}687$ kg
   Distribution:
   $P = \frac{1}{12} \,.\, 26409{,}375 = 2200{,}781$ kg
   Distribution:
   ½ P $= 1100{,}391$ kg
   The cslculating used *software* SAP2000

Table 3. Force used on upper bond

Frame	P		Frame	P	
	Tarik (+) Kg	Tekan(-) Kg		Tarik (+) Kg	Tekan(-) Kg
A1	0	837,18	V7	698,33	0
A2	0	3448,05	V8	698,23	0
A3	0	5346,81	V9	699,53	0
A4	0	6712,98	V10	683,5	0
A5	0	7531,99	V11	881,07	0
A6	0	7805,03	V12	0	1554,3
A7	0	7531,99	D1	0	3257,07
A8	0	6712,98	D2	1440,35	0
A9	0	5346,81	D3	0	2523,1
A10	0	3448,05	D4	1234,84	0
A11	0	837,18	D5	0	2074,79
B1	0	3977,31	D6	743,66	0
B2	0	1673,6	D7	0	1603,31
B3	250,08	0	D8	275,66	0
B4	1614,22	0	D9	0	1133,71
B5	2433,4	0	D10	0	194,23
B6	2706,43	0	D11	0	663,96
B7	2433,4	0	D12	0	663,96
B8	1614,22	0	D13	0	194,23
B9	250,08	0	D14	0	1133,71
B10	0	1673,6	D15	275,66	0
B11	0	3977,31	D16	0	1603,31
V1	0	1554,3	D17	743,66	0
V2	881,07	0	D18	0	2074,79
V3	683,5	0	D19	1234,84	0
V4	699,53	0	D20	0	2523,1
V5	698,23	0	D21	1440,35	0
V6	698,33	0	D22	0	3257,07

Tabel 4. Force used on under bond

Frame	P		Frame	P	
	Tekan (-) Kg	Tarik (+) Kg		Tekan (-) Kg	Tarik (+) Kg
A1	2568,42	0	V8	0	2561,66
A2	10910,46	0	V9	0	2561,35
A3	17160,17	0	V10	0	2565,26
A4	21879,16	0	V11	0	2515,96
A5	25022,89	0	V12	0	3137,38
A6	26594,9	0	V13	4696,18	0
A7	26594,9	0	D1	10456,14	0
A8	25022,89	0	D2	0	4418,87
A9	21879,16	0	D3	8274,41	0
A10	17160,17	0	D4	0	3896,06
A11	10910,46	0	D5	6987,93	0
A12	2568,42	0	D6	0	2477,99
B1	14032,17	0	D7	5630,44	0
B2	6654,35	0	D8	0	1130,93
B3	328,16	0	D9	4278,58	0
B4		4384,76	D10	221,76	0
B5		7528,98	D11	2926,27	0
B6		9100,95	D12	1574	0
B7		9100,95	D13	1574	0
B8		7528,98	D14	2926,27	0
B9		4384,76	D15	221,76	0
B10	328,16		D16	4278,58	0
B11	6654,35		D17		1130,93
B12	14032,17		D18	5630,44	0
V1	4696,18		D19		2477,99
V2		3137,38	D20	6987,93	
V3		2515,96	D21		3896,06
V4		2565,26	D22	8274,41	
V5		2561,35	D23		4418,87
V6		2561,66	D24	10456,14	
V7		2561,63			

a. Material control

1) Upper wind bond (press)

N_u = 7805,03 kg

Using profil 2 L 180 . 180 . 20

k = 1,0 (tumpuan sendi – sendi)

– Checking

$\frac{b}{t} \quad < \frac{200}{\sqrt{fy}}$

$\frac{180}{20} \quad < \frac{200}{\sqrt{410}}$

$9 \quad < 9{,}87$

Using 12 pcs pelat kopel

$L_1 = \frac{5000}{12-1} = 454{,}545 \text{ mm}$

$\lambda_1 = \frac{L_1}{i_b} = \frac{454{,}545}{34{,}9}$

$= 13{,}024 < 50$ .... Ok!

$\lambda_x \quad > 1{,}2 \, . \, \lambda_1$

$\frac{L_k}{i_x} \quad > 1{,}2 \, . \, \lambda_1$

$\frac{5000}{54{,}7} \quad > 1{,}2 \, . \, 13{,}024$

$91{,}408 \ > \ 15{,}629$...................... Ok!

Area of profil = 2 . 6840 = 13680 cm^2

$I_{yp} = n \left\{ I + A_g \left(e + \frac{t_p}{2} \right)^2 \right\}$

$= 2 \left\{ 2040 \, . \, 10^4 + 13680 \left(51{,}8 + \frac{10}{2} \right)^2 \right\}$

$= 129069926{,}40 \text{ mm}^4$

$r_y = \sqrt{\frac{I_{yp}}{A_{profil}}} = \sqrt{\frac{12{,}91 \, . \, 10^7}{13680}} = 97{,}134 \text{ mm}$

$\lambda_y = \frac{k \, . \, L_k}{r_y} = \frac{5000}{97{,}134} = 51{,}475$

$\lambda_{iy} \quad > 1{,}2 \, . \, \lambda_1$

$\sqrt{\lambda_y^2 + {}^{n}/_{2} \times \lambda_1^2} \quad > 1{,}2 \, . \, \lambda_1$

$\sqrt{51{,}475^2 + {}^{2}/_{2} \times 13{,}024^2} \quad > 1{,}2 \, . \, 13{,}024$

$53{,}098 \quad > 15{,}629$.. Ok!

$\lambda_c = \frac{\lambda_x}{\pi} \sqrt{\frac{f_f}{E}} = \frac{91{,}408}{\pi} \sqrt{\frac{410}{2 \, . \, 10^5}} = 1{,}118$

$\omega = \frac{1{,}43}{1{,}6 - 0{,}67 \, \lambda_c} = \frac{1{,}43}{1{,}6 - (0{,}67 \, . \, 1{,}118)} = 1{,}680$

$\emptyset \, . \, N_n \quad > N_u$

$\emptyset \, . \, A_g \, . \, \frac{f_y}{\omega} \quad > N_u$

$0{,}85 \, . \, 12360 \, . \, \frac{410}{1{,}68} \quad > 7805{,}03$

$2836950{,}651 \quad > 7805{,}03$.. Ok!

2) Upper wind bond (pull)

$T_u = 2706{,}43$ kg

$T_n > T_u$

$$68{,}4 > \frac{2706{,}43}{0{,}9 \, . \, 4100}$$

$68{,}4 > 0{,}733$ .... Ok!

$T_n > T_u$

$$68{,}4 > \frac{2706{,}43}{0{,}75 \, . \, 0{,}9 \, . \, 550}$$

$68{,}4 > 0{,}729$ .... Ok!

a. Charging of line

1) Charging on live (BTR)

q = 9 (0,5 + 15/L)

= 9 (0,5 + 15/60)

= 6,75 ton/m^2 = 675 kg/m^2

2) Charging on pedestrian

q3 = 0,5 . 500 = 250 kg

3) Charging on point live (BGT)

(P_1) = (1 + DLA).P .2

= (1 + 0,375) . 49 . 2

= 13475 kg

Tabel 5. Force on frame

Frame		Beban				Total Beban		Keterangan
		Mati		Hidup				
		Tekan (-) (kg)	Tarik (+) (kg)	Tekan (-) (kg)	Tarik (+) (kg)	Tekan (-) (kg)	Tarik (+) (kg)	
Batang Atas	A1	93751,01	0	82304,69	0	176055,7	0	A1 = A11
	A2	170758,96	0	151210,94	0	321969,9	0	A2 = A10
	A3	230654,03	0	204804,69	0	435458,72	0	A3 = A9
	A4	273436,22	0	243085,94	0	516522,16	0	A4 = A8
	A5	299105,54	0	266054,69	0	565160,23	0	A5 = A7
	A6	307661,98	0	273710,94	0	581372,92	0	A6
	A7	299105,54	0	266054,69	0	565160,23	0	
	A8	273436,22	0	243085,94	0	516522,16	0	
	A9	230654,03	0	204804,69	0	435458,72	0	
	A10	170758,96	0	151210,94	0	321969,9	0	
	A11	93751,01	0	82304,69	0	176055,7	0	
Batang Bawah	B1	0	47437,27	0	42109,38	0	89546,65	B1 = B12
	B2	0	133001,66	0	118671,88	0	251673,54	B2 = B11
	B3	0	201453,17	0	179921,88	0	381375,05	B3 = B10
	B4	0	252791,8	0	225859,38	0	478651,18	B4 = B9
	B5	0	287017,56	0	256484,38	0	543501,94	B5 = B8
	B6	0	304130,43	0	271796,88	0	575927,31	B6 = B7
	B7	0	304130,43	0	271796,88	0	575927,31	
	B8	0	287017,56	0	256484,38	0	543501,94	
	B9	0	252791,8	0	225859,38	0	478651,18	
	B10	0	201453,17	0	179921,88	0	381375,05	
	B11	0	133001,66	0	118671,88	0	251673,54	
	B12	0	47437,27	0	42109,38	0	89546,65	
Batang Diagonal	D1	132144,95	0	117303,15	0	249448,1	0	D1 = D24
	D2	0	129015,14	0	111971,18	0	240986,32	D2 = D23
	D3	109339,66	0	101307,26	0	210646,92	0	D3 = D22
	D4	0	105179,66	0	90643,34	0	195823	D4 = D21
	D5	85504,18	0	79979,42	0	165483,6	0	D5 = D20
	D6	0	81344,18	0	69315,49	0	150659,67	D6 = D19
	D7	61668,7	0	58651,57	0	120320,27	0	D7 = D18
	D8	0	57508,7	0	47987,65	0	105496,35	D8 = D17
	D9	37833,22	0	37323,73	0	75156,95	0	D9 = D16
	D10	0	33673,22	0	26659,81	0	60333,03	D10 = D15
	D11	13997,74	0	15995,88	0	29993,62	0	D11 = D14
	D12	0	9837,74	0	5331,96	0	15169,7	D12 = D13
	D13	0	9837,74	0	5331,96	0	15169,7	
	D14	13997,74	0	15995,88	0	29993,62	0	
	D15	0	33673,22	0	26659,81	0	60333,03	
	D16	37833,22	0	37323,73	0	75156,95	0	
	D17	0	57508,7	0	47987,65	0	105496,35	
	D18	61668,7	0	58651,57	0	120320,27	0	
	D19	0	81344,18	0	69315,49	0	150659,67	
	D20	85504,18	0	79979,42	0	165483,6	0	
	D21	0	105179,66	0	90643,34	0	195823	
	D22	109339,66	0	101307,26	0	210646,92	0	
	D23	0	129015,14	0	111971,18	0	240986,32	
	D24	132144,95	0	117303,15	0	249448,1	0	

Tabel 6. Using profile

Frame		Digunakan Profil WF
Batang Atas	A1 = A11	400 . 400 . 15 . 15
	A2 = A10	400 . 400 . 20 . 35
	A3 = A9	400 . 400 . 30 . 50
	A4 = A8	400 . 400 . 30 . 50
	A5 = A7	400 . 400 . 30 . 50
	A6	400 . 400 . 45 . 70
Batang Bawah	B1 = B12	400 . 400 . 15 . 15
	B2 = B11	400 . 400 . 13 . 21
	B3 = B10	400 . 400 . 18 . 28
	B4 = B9	400 . 400 . 20 . 35
	B5 = B8	400 . 400 . 30 . 50
	B6 = B7	400 . 400 . 30 . 50
Batang Diagonal	D1 = D24	400 . 400 . 18 . 28
	D2 = D23	400 . 400 . 21 . 21
	D3 = D22	400 . 400 . 21 . 21
	D4 = D21	400 . 400 . 21 . 21
	D5 = D20	400 . 400 . 13 . 21
	D6 = D19	400 . 400 . 13 . 21
	D7 = D18	400 . 400 . 13 . 21
	D8 = D17	400 . 400 . 13 . 21
	D9 = D16	400 . 400 . 18 . 18
	D10 = D15	400 . 400 . 18 . 18
	D11 = D14	400 . 400 . 15 . 15
	D12 = D13	400 . 400 . 15 . 15

1) Upper horizontal (batang tekan)

Maksimum force (A6) = 581372,92 kg

WF 400 . 400 . 45 . 70

$$\lambda_f < \lambda_s$$

$$\frac{b}{2\,t_f} < \frac{250}{\sqrt{fy}}$$

$$\frac{400}{2\,.\,70} < \frac{250}{\sqrt{410}}$$

$2{,}857 < 12{,}346$ .... Ok!

$$\frac{L_k}{i_{min}} \le 50$$

$$\text{so, } i_{min} = \frac{L_k}{50} = \frac{5000}{50} = 100 \text{ mm}$$

$$\lambda_c = \frac{1}{\pi} \cdot \frac{L_k}{i_{min}} \cdot \sqrt{\frac{f_y}{E}}$$

$$= \frac{1}{\pi} \cdot \frac{5000}{100} \cdot \sqrt{\frac{410}{200000}} = 0{,}721$$

Because $0{,}25 < \lambda_c < 1{,}2$ maka,

$$\omega = \frac{1{,}43}{1{,}6 - 0{,}67\,\lambda_c} = \frac{1{,}43}{1{,}6 - (0{,}67\,.\,0{,}721)} = 1{,}28$$

$$N_u < \phi\, N_n$$

$$N_u < \phi\, A_g \,.\, f_{cr}$$

$581372{,}92 < 0{,}85 . \frac{770{,}1 . 410}{1{,}28}$

$5813{,}7292 < 2096271{,}8$ .... Ok!

2) Under horizontal (batang tarik)

Gaya (B6=B7) = 575927,31 kg

WF 400 . 400 . 30 . 50

$T_n > T_u$

$Ag > \frac{T_u}{\phi . fy}$

$528{,}6 > 156{,}078$ .... Ok!

$T_n > T_u$

$Ag > \frac{T_u}{\phi . fu}$

$528{,}6 > 155{,}13$ .... Ok!

1) Bolt connection for long girder dan latitude

Shear bolt nominal control

$V_f^* \leq \emptyset V_f$

$V_f^*/_n \leq 0{,}75 . 0{,}62 . f_{up} . k_r . (n_n A_c + n_x A_o)$

$177373{,}5/_4 \leq 0{,}75 . 0{,}62 . 825 . 1$

$44343{,}31 \leq 586179$ .... Ok!

2) Bolt connection for latitde girder and truss

Shear bolt nominal control

$V_f^* \leq \emptyset V_f$

$V_f^*/_n \leq 0{,}75 . 0{,}62 . f_{up} . k_r . (n_n A_c + n_x A_o)$

$1824808{,}2/_{10} \leq 0{,}75 . 0{,}62 . 825$

$304134{,}7 \leq 586179$ .... Ok!

3) Connection for wind bond and truss

– Bolt connection

$\emptyset T_n > T_u$

$\emptyset . 0{,}6 . f_y . A_{gv} + f_u . A_{nt} > T_u$

$0{,}75 . 0{,}6 . 410 . 1600 > 9100{,}95$

1694400 kg $> 9100{,}95$ .... Ok!

– Weld connectuion

$$L_w = \frac{Tu}{\phi R_{nw}} = \frac{9100{,}95}{68{,}598} \approx 150 \text{ mm}$$

4) Bolt connection on truss

$\emptyset T_n > T_u$

$\emptyset . 0{,}6 . f_y . A_{gv} > T_u$

$0{,}75 . 0{,}6 . 410 . 9175 > 9100{,}95$

$414200{,}625$ kg $> 289288{,}2$ .... Ok!

$\delta_{terjadi} < \delta_{izin}$

$6{,}684 \text{ cm} < \frac{6000}{800}$

$6{,}684 \text{ cm} < 7{,}5 \text{ cm}$ .... Ok!

Maximum deflection on the middle frame x = 3000

$y = -0{,}83 \,.\, 10^{-6} \,.\, x^2 + 4{,}98 \,.\, 10^{-3} \,.\, x$

$= -0{,}83 \,.\, 10^{-6} \,.\, (3000)^2 + 4{,}98 \,.\, 10^{-3} \,.\, (3000)$

$= -7{,}47 + 14{,}94$

$= 7{,}47 \text{ cm} \approx 7{,}5 \text{ cm}$

High of abutment = 2,50 m
Wide of abutment = 11,00 m
Concrete *fc'* = 20 MPa
Steel*fy* = 240 MPa

Tabel 7. Combination

No	Jenis beban	Simbol	Beban		Momen (kNm)
			Vertikal (kN)	Horizontal (kN)	
1	Beban mati	MS	6536,03		-392,18
2	Beban mati tambahan	MA	431,28		
3	Beban trotoar	MT	345,00		
4	Tekanan tanah kondisi normal	TA		359,98	348,54
5	Tekanan tanah kondisi gempa	TA		395,97	383,39
6	Beban hidup D	TD	2793,21		
7	Gaya rem	TB		139,66	600,54
8	Gesekan pada perletakan	BF		497,16	1287,64
9	Beban angin	EW		46,66	174,96
10	Beban gempa	EQ		696,74	1543,10
11	Perubahan suhu	T		7,92	15,84
12	Arus/Hanyutan	EF			
13	Beban Tumbukan	TC			
14	Beban Pelaksanaan	CL			

Vertikal (V) = 9760,51 kN
Horizontal (H) = 895,61 kN
Momen (M) = 940,29 kNm

Calcultaing force on pile

$Vi = \frac{Vo}{n} = \frac{9760{,}51}{2} = 4880{,}255 \text{ kN}$

a. Data Calculating
   Type = Caisson
   Depth = 2,40 m
   Number = 2 buah
b. Strength Capacity of Caisson Foundation

$Q_u = 1{,}3\, c\, N_c + p_o\, N_q + 0{,}3\, B\, \gamma\, N_\gamma$

$= 1{,}3\, c\, N_c + (D_f \,.\, \gamma)\, N_q + 0{,}3\, B\, \gamma\, N_\gamma$

$= 1{,}3\; 2200 \,.\, 109{,}98 + (2{,}4 \,.\, 1900)\; 63{,}571 + 0{,}3 \,.\, 3 \,.\, 1900 \,.\, 62{,}571$

$= 1084112{,}1 \text{ kg}$

$Q_s = F_{total} \,.\, \pi \,.\, d$

$= 23670 \,.\, \pi \,.\, 3$

$= 241556{,}55 \text{ kg}$

$Q_{ult} = Q_p + Q_s$

$= 1084112{,}1 + 241556{,}55$

$= 1325669 \text{ kg}$

$= 13256{,}69 \text{ kN}$

$Q_{izin} > Q_{kerja}$

$\frac{13256{,}69 \text{ kN}}{SF = 3} > 3695{,}88 \text{ kN}$

$4418{,}90 \text{ kN} > 3695{,}88 \text{ kN}$. Ok!

c. Stability of Shear

$SF \geq 1{,}5$

$\frac{3033{,}328 \text{ kN}}{281{,}944 \text{ kN}} \geq 1{,}5$

$10{,}756 \geq 1{,}5$.... Ok!

d. Stability of Bolstres

$SF \geq 2$

$\frac{5541{,}448 \text{ kN}}{610{,}094 \text{ kN}} \geq 2$

$9{,}08 \geq 2$....... Ok!

Abutment Reinforced of Biu Partway

1) Segment I
   Main Reinforced = 2 . ØD 25 – 200
   Second Reinforced = 2 . ØP16 – 200
2) Segment II
   Main Reinforced = 2 . ØD 19 – 200
   Second Reinforced = 2 . ØP16 – 200
3) Segment III
   Main Reinforced = 2 . ØD 25 – 200
   Second Reinforced = 2 . ØP16 – 200
4) Segment IV
   Main Reinforced = 2 . ØD 19 – 200
   Second Reinforced = 2 . ØP16 – 200
5) Segment V
   Main Reinforced = 2 . ØD 19 – 200
   Second Reinforced = 2 . ØP12 – 200
6) Segment VI
   Main Reinforced = 2 . ØD 19 – 200
   Second Reinforced = 2 . ØP12 – 200
   High of abutment = 5,50 m
   Wide of abutment = 11,00 m
   Concrete *fc'* = 20 MPa
   Steel *fy* = 240 MPa
   Table 8. Analyze of Load

No	Jenis beban	Simbol	Beban		Momen (kNm)
			Vertikal (kN)	Horizontal (kN)	
1	Beban mati	MS	6022,22		301,81
2	Beban mati tambahan	MA	431,28		
3	Beban trotoar	MT	345,00		
4	Tekanan tanah kondisi normal	TA		1167,10	-2330,95
5	Tekanan tanah kondisi gempa	TA		1283,81	-2564,05
6	Beban hidup D	TD	2793,21		
7	Gaya rem	TB		139,66	-1019,52
8	Gesekan pada perletakan	BF		497,16	-2779,12
9	Beban angin	EW		46,66	-314,93
10	Beban gempa	EQ		696,74	-1543,10
11	Perubahan suhu	T		7,92	-15,84
12	Arus/Hanyutan	EF			
13	Beban Tumbukan	TC			
14	Beban Pelaksanaan	CL			

Force on combination 1:

Vertikal (V) = 9246,70 kN

Horizontal (H) = 616,96 kN

Momen (M) = - 1076,80 kNm

Tabel 9. Force on works

Kombinasi	Satuan	Baris I			Baris II		
		Vi	Hi	Vn Aksial	Vi	Hi	Vn Aksial
Kombinasi I	kN	1044,32	102,18	1047,94	805,03	15,15	805,03
Kombinasi II	kN	686,21	73,13	688,59	673,48	15,95	673,48
Kombinasi III	kN	651,71	71,46	653,97	638,98	17,15	638,98
Kombinasi IV	kN	57,23	77,04	689,09	603,99	19,82	603,99
Kombinasi V	kN	823,17	137,85	826,02	467,53	69,25	467,53
Kombinasi VI	kN	651,71	71,46	653,97	638,98	17,15	638,98

a. Efficience of Single Pile

Based on Converse – Labarre Formula:

$$E_{ff} = 1 - \frac{\theta \times ((n-1) \times m + (m-1) \times n)}{90 \times m \times n}$$

$$= 1 - \frac{11{,}425 \times ((5-1) \times 2 + (2-1) \times 5)}{90 \times 5 \times 2}$$

$$= 0{,}855$$

b. Strength Capicty on Single Pile

$$Q_p = Cn_{\text{rata-rata ujung}} \,.\, A_{\text{ujung tiang}}$$

$$= \frac{½\,(Cn_1 + Cn_2) + Cn_3}{2} \,.\, A_{\text{ujung tiang}}$$

$$= \frac{½\,(150 + 150) + 43{,}4}{2} \,.\, ¼ \,.\, \pi \,.\, 50^2$$

$$= 189773{,}8 \text{ kg}$$

$$Q_s == \sum_{li=0}^{li=8D} \Sigma\ \text{Kc atau Ks} \left[\frac{li}{8D} \,.\, HPi \,.\, Oi\right] + \sum_{li=8D}^{li=L} \Sigma\ \text{Kc atau Ks}\ (HPi \,.\, Oi)$$

$$= 0{,}93 \,.\, [0{,}03 \,.\, 7{,}49 \,.\, 314] + 0$$

$$= 54{,}60 \text{ kg}$$

$$Q_{izin} = \frac{Q_p}{SF_1} + \frac{Q_s}{SF_2}$$

$$= \frac{189773{,}8}{3} + \frac{98462{,}61{,}5}{5}$$

$$= 169457{,}97 \text{ kg}$$

$\text{eff}.\ Q_{izin} > Q_{kerja}$
$0{,}855 . 1694{,}580 > 1047{,}935$
$1449{,}464\ \text{kN} > 1047{,}935\ \text{kN}$ Ok!

c. Calculating of lateral load

$H_{izin} > H_{kerja}$

$$\frac{64281{,}6}{1{,}5 . 1000} > 6535{,}374$$

$41854{,}40\ \text{kg} > 2757{,}04\ \text{kg}$........ Ok!

Abutment Reinforced of Samurangau Partway

1) Segment I
   Main Reinforced = ØD 19 – 150
   Second Reinforced = ØP12 – 200
2) Segment II
   Main Reinforced = ØD 25 – 125
   Second Reinforced = ØP16 – 150
3) Segment III
   Main Reinforced = ØD 25 – 125
   Second Reinforced = ØP16 – 150
4) Segment IV
   Main Reinforced = ØD 25 – 100
   Second Reinforced = ØP16 – 150
5) Segment V
   Main Reinforced = ØD 25 – 100
   Second Reinforced = ØP16 – 150

Calculating Box Culvert Samurangau

Foundation of Box Culvert
Type = Minipile beton *precast*
Diameter = 0,2 m
Depth = 7,60 m
Mutu baja *fy* = 240 MPa

- Efficient

$$E_{ff} = 1 - \frac{\theta \times ((n-1) \times m + (m-1) \times n)}{90 \times m \times n}$$
$$= 0{,}739$$

- Bearing capacity of pile

$$Q_{izin} = \frac{Q_p}{SF_1} + \frac{Q_s}{SF_2}$$
$$= \frac{38680}{5} + \frac{98462{,}61}{10}$$
$$= 17582{,}26\ \text{kg}$$
$$= 175{,}823\ \text{kN}$$

$\text{eff}.\ Q_{izin} > Q_{kerja}$

$$0{,}739 . 175{,}823 > \frac{2769{,}98}{52}$$

$129{,}946\ \text{kN} > 53{,}269\ \text{kN}$ .... Ok!

c. Analyze of Load and Reinforced

1) Segment I
   Main Reinforced = 2 . ØD 16 – 200
   Second Reinforced = 2 . ØP10 – 200
2) Segment II
   Main Reinforced = 2 . ØD 16 – 200
   Second Reinforced = 2 . ØP10 – 200
3) Segment III dan IV
   Main Reinforced = 2 . ØD 16 – 150
   Second Reinforced = 2 . ØP10 – 200

d. Calculating of Lateral Load

$$H_{izin} > H_{kerja}$$

$$\frac{992000}{1{,}5\,.\,1000} > 6535{,}374$$

661,3 kg $> 247{,}3$ kg.................. Ok!

d. Calculating high of heap (H_{CR})

$$H_{CR} = \frac{C_u\,.\;N_c}{\gamma_{timbunan}}$$

$$= \frac{63{,}7\ kN/m^3\,.\;5{,}14}{17\ kN/m^3}$$

$$= 19{,}26\ m > H_{timbunan} = 5{,}50\ m \qquad Ok$$

5. CLOSING

5.1. Conclusion

1. Using steel truss bridge with a 60 m wide and 7.6 m, Concrete quality for structure used fc '25 MPa, steel quality BJ 51, Birdge patapet using piple steel ø 76.3 mm. Sidewalk planned using quality concrete fc '25 MPa with the main reinforcement 16-150 and second reinforcement 8-250. Slab planed with 0.25 m with concrete quality25 Mpa. Girder planed using WF 450. 300. 11. 18
2. The structure under the direction of the village of Biu using caisson foundations diameter of 3.0 m with a depth of 2.4 by 2 pieces.
3. Under the direction of the village Samurangau structure using pile foundation piling pipe diameter of 0.6 m with a depth of 7.6 as many as 10 pieces.
4. On the structure of the direction of the village used Samurangau box culvert to reduce ground pressure that occurs in abutment with a size of 3.6 mx 3.6 m. Box culvert minipile usingconcrete foundation *precast* with a diameter of 0.2 m depth of 7.6 m for 52 pieces.

5.2. Recommendation

1. In connection bolt anti-rust paint should be done first before being installed in order to awake quality.
2. Should further ground investigation (in this case the drill testing in and N-SPT) in order to obtain more accurate soil data and hard soil depth.
3. At the bottom of the structure toward the village Samurangau box culvert should be used as in the above calculation in order to reduce the ground pressure that occurs

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