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SLOPE HANDLING DESIGN PIHANIN BRIDGE PANDAN SARI VILLAGE HULU SUNGAI SELATAN REGENCY

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ABSTRAK

Jalan menuju arah desa Pandan Sari Kabupaten Hulu Sungai Selatan adalah salah satu infrastruktur penting untuk perekonomian masyarakat di desa pandan sari. Terjadinya longsoran menyebabkan terputusnya jalur transportasi sehingga perlu dilakukan perbaikan, konstruksi yang digunakan untuk mengganti jalan tersebut adalah jembatan *pile slab* karena pelaksanaannya yang cukup mudah dan biaya konstruksinya relatif murah. Jembatan ini memiliki bentang 86 m dengan kelas jembatannya adalah kelas C khusus dengan lebar lalu lintas 5,5 m dan trotoar 0,25 m. Tujuan dari tugas akhir ini adalah untuk mendapatkan rancangan konstruksi yang aman, memenuhi syarat serta ekonomis dalam pembuatannya.

Perancangan ini meliputi perencanaan struktur atas, struktur bawah, dan pondasi jembatan. Dimana pembebanan struktur bangunan atas dan bawah mengacu pada RSNI T-02-2005, Perhitungan pembebanan dibantu dengan menggunakan *software* SAP2000. Perencanaan pelat lantai menggunakan metode *Bittner* dan pelat dianggap sebagai balok selebar 1 m. Sehingga digunakan gaya-gaya terbesar antara kedua metode tersebut. Spesifikasi mutu baja tulangan utama U-32 (*fy* 320 MPa) mutu baja tulangan pembagi dan geser U-24 (*fy* 240 MPa). Pada pelat lantai digunakan beton dengan mutu *fc'* 35 MPa. Sedangkan pada sandaran dan struktur bawah digunakan beton dengan mutu *fc'* 30 MPa). Kemudian dilanjutkan dengan analisis stabilitas lereng terhadap *safety factor* pada kondisi sebelum dan sesudah adanya perkuatan.

Dari hasil perhitungan didapatkan desain pelat lantai 25 cm tulangan utama D19-80 dan tulangan pembagi Ø16-100. Pada pondasi abutment digunakan tiang pancang pabrikasi berupa PC *spun pile* kelas B diameter 30 cm sebanyak 12 buah tiang, untuk pondasi pelat lantai (*pile slab*) sebanyak 4 tiang tiap balok melintang (*voute* 1), dan sebanyak 6 tiang tiap balok melintang (*voute* 2). Diperoleh daya dukung tiang (757,64 kN) > gaya tiang pancang (181,41 kN) dan daya dukung lateral (250,870 kN) > gaya lateral (95,76 kN). SF(*Safety Factor*) yang didapat sebelum adanya perkuatan adalah 0,983 dan sesudah adanya perkuatan didapat 2,684.

Kata kunci: Jembatan, beton bertulang, *pile slab*, abutment, tiang pancang.

ABSTRACT

The road leading to the village of Pandan Sari, Hulu Sungai Selatan Regency, is one of the important infrastructures for the community's economy in the village of Pandan Sari. The occurrence of landslides causes the transportation line to be cut off so that it needs to be repaired, the construction used to replace the road is a slab pile bridge because the implementation is quite easy and the construction costs are relatively cheap. This bridge has a 86 m span with the bridge class is a special class C with a traffic width of 5.5 m and a sidewalk of 0.25 m. The purpose of this final project is to obtain a construction design that is safe, qualified and economical in its manufacture.

This design includes planning the upper structure, lower structure, and bridge foundation. Where the imposition of upper and lower building structures refers to *RSNI* T-02-2005, Calculation of loading is assisted by using SAP2000 software. Floor plate planning uses the Bittner method and the plate is considered as a 1 m wide beam. So that the biggest styles are used between the two methods. Quality specifications of U-32 main reinforcement steel (fy 320 MPa) quality of U-24 divider and shear reinforcement steel (fy 240 MPa). On the slab used concrete with fc '35 MPa quality. Whereas on the back and lower structure concrete is used with fc '30 MPa quality). Then proceed with analysis of slope stability against safety factors in conditions before and after the reinforcement.

From the calculation results obtained 25 cm floor plate design D19-80 main reinforcement and divider reinforcement Ø16-100. In the abutment foundation, used manufacturing poles in the form of PC class B spun pile 30 cm in diameter as many as 12 poles, for 4 slab pile slabs (voute 1), and 6 poles per transverse beam (voute 2)) Obtained bearing capacity (757.64 kN)> pile style (181.41 kN) and lateral carrying capacity (250.870 kN)> lateral force (95.76 kN). SF (Safety Factor) obtained before the reinforcement is 0.983 and after the strengthening is obtained 2.684.
Keywords: Bridge, reinforced concrete, pile slab, abutment, pile.

1. INTRODUCTION

Landslides occurred in the Pihanin bridge area in the direction of Pandan Sari Village. As a result, local residents have to evacuate temporarily and the transportation route for users of motorized vehicles is cut off. It is necessary to increase the road from the road that has experienced a landslide. Of several types such as: Sheet pile, Geogrid, girder bridge selected concrete bridge slab pile structure to reconnect transportation access for motorized vehicle road users.

This design goal is to design a safe, relatively inexpensive slab pile bridge and can function properly and meet technical requirements so that access to transportation can run well.

2. THEORITICAL STUDY

Land data obtained from 3 points::

a) BH-01 Data

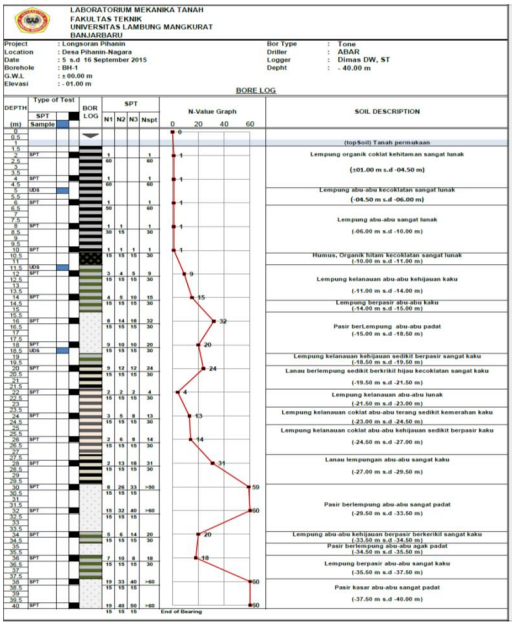

Figure 1. BH01 Data

b) BH-02 Data

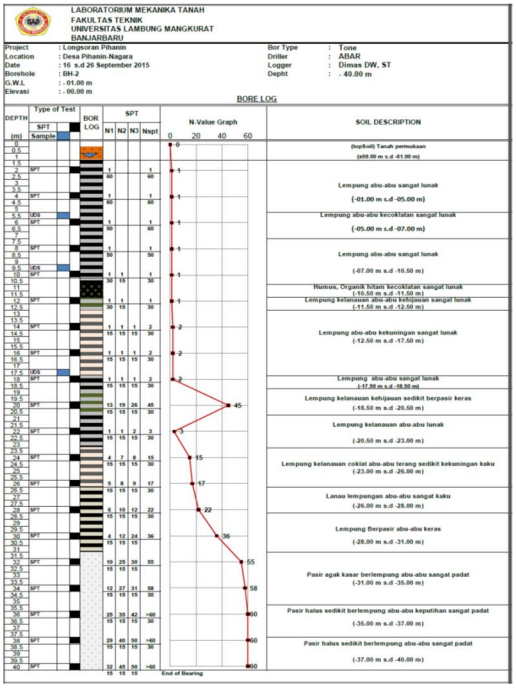

Figure 2. BH02 Data

c) BH-03 Data

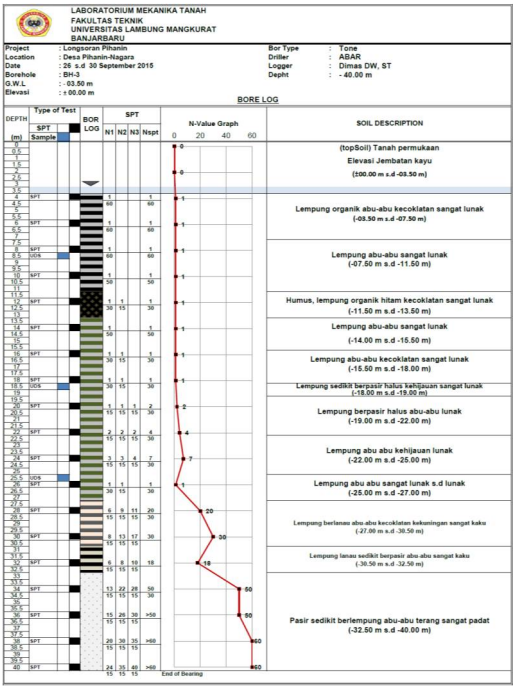

Figure 3. BH03 Data

3. METHOD

a) Determine the Topic of the Discussion

The first step taken in the preparation of this final project is to determine the topic of discussion. The topic of discussion is about designing a slab pile bridge. The location chosen in this design was the handling of the Pihanin mudflow landslide design in the direction of the village of Pandan Sari, Hulu Sungai Selatan District. The location was chosen because it has supporting data such as land data and visual field photos. Besides that, considering the purpose and benefits of the design, that is to facilitate access to the village's transportation.

b) Secondary Data Collection and Primary Data

Secondary data is data obtained indirectly from the source, both oral and written. Secondary data needed in the design this time includes building functions, building dimensions, material data, plan loads, soil data. Land data is needed to design bridge foundations. In planning this slab pile bridge the land data used is the NSPT data carried

out by the LAB. Soil Mechanics, University of Lambung Mangkurat. From the soil data there are parameters that can be used to calculate the bearing capacity of the foundation, namely the N value and laboratory data. NSPT data is usually presented in boring logs like the attached picture. Primary data is data obtained directly.

c) Technical Data of Pile Slab Bridge

The structure of the slab pile bridge is divided into upper buildings and lower buildings. The upper building is all buildings that are not directly related to the land for example slabs. While the lower building is a building that is directly related to the land such as abutments. The structural material used in the upper buildings and buildings under the Pihanin bridge are reinforced concrete. According to the 2010 Technical Revision 2 nd Specifications on bridges, the quality of concrete used for building up is K-350 while for buildings under K-300.

d) Preliminary Design

The dimensions of the bridge follow the class of road that passes through the bridge. In this Final Project, a special Class C bridge is chosen because the planned vehicle that will pass is a Public Vehicle. Preliminary bridge designs include; building width, slab thickness, sidewalk width.

e) Upper Structure Loading

After determining the preliminary design of the bridge, the next step is to determine the loading of the upper structure. The load includes; dead load, additional dead load, live load T, live load D. These expenses are calculated in accordance with the applicable provisions according to RSNI T-02-2005.

f) Calculation of Upper Structure Reinforcement

The styles obtained from the calculation of loading are then used to calculate the reinforcement in the slab, reinforcement of the backrest, and reinforcement of the transverse beam. For slabs and transverse beams using reinforced concrete casted in a place with K-350 quality. Whereas on the back using reinforced concrete casted in place with the quality of the K-300.

g) Lower structure loading

The loading of the lower structure includes dead load, additional dead load, soil pressure on the wall both normal and earthquake conditions, life load, brake force / longitudinal force, friction force on the placement, wind load, earthquake force. These expenses are calculated in accordance with the applicable provisions according to RSNI T-02-2005.

h) Load Combination

The loads that have been calculated in the previous step are then combined with certain combinations according to the guidelines for loading RSNI T-02-2005.

i) Calculation of the carrying capacity of the pole

After the calculation of the structure is complete, then the next step goes to the calculation of the bearing capacity of the axial load capacity (vertical) as well as the carrying capacity of the lateral load (horizontal). calculated bearing capacity and foundation dimensions. Piles using round concrete piles (spun pile) produced by PT. Wika concrete. If the carrying capacity of the pole meets, then the next step.

j) Calculation of Group Pole Efficiency

Calculation of the carrying capacity of the pole in the previous step produces a single pole support, for a transverse beam area, a single pole is used while the abutment area is used for group poles. Poles that are single-handed are of course different in bearing capacity with poles that are placed in groups. Therefore, it is calculated the group pole efficiency with various methods including the Converse Labbare method.

k) Calculation of Abutment Reinforcement

After the carrying capacity and efficiency of the group pole have been calculated then the next step is to calculate the reinforcement in the abutment which is first divided into several parts according to the direction of the force in order to facilitate the calculation of technical mechanics. Abutments using reinforced concrete material casted in a place with K-300 quality.

l) Calculation of Plates Step

After the calculation of abutment reinforcement is complete, then calculate the load acting on the stepping plate. The stepping plate is made of reinforced concrete with the quality of the K-300 which is casted in place so it needs an analysis in the calculation of reinforcement.

m) Wing Wall Calculation (Wing Wall)

The wing wall serves to hold the soil from the oprit so as not to slide sideways. Wing wall is made of reinforced concrete with K-300 quality which is associated with the abutment side so that a reinforcement calculation analysis is needed.

n) Shop drawing

After all planning activities are complete, the final design is obtained. The results of the calculation of reinforcement and preliminary designs are then poured into the work drawings using Autocad 2007 software. Includes images of the situation, looks, pieces and details of reinforcement which will then be used as reference images in the field.

4. RESULT AND DISCUSSION

The bridge structure used is pile slab with 86 m bridge span, 6 m bridge width where the traffic width is 5.5 m and the curb width is 0.25 m.

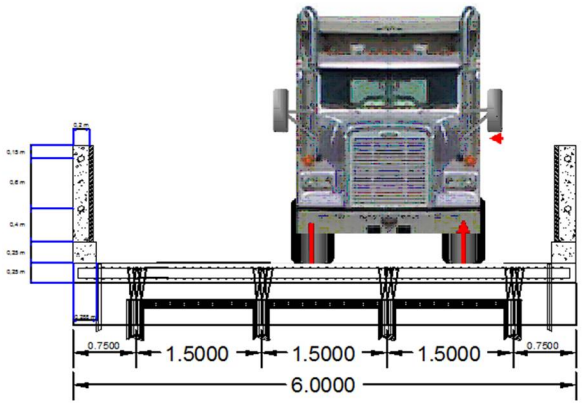

Figure 4. Crossing the bridge

The quality of concrete for the upper structure is K-350, the quality of the concrete backrest and the concrete quality of the lower structure is K-300, the quality of the U-32

main reinforcement steel (fy 320 Mpa), the quality of steel U-24 divider and shear reinforcement (fy 240 Mpa).

Dimensions and reinforcement used in the upper part of the structure are:

1. Backrest using the main reinforcement 4 Ø12, while the reinforcement reinforcement Ø12 - 250 with a blanket thickness of 20 cm.

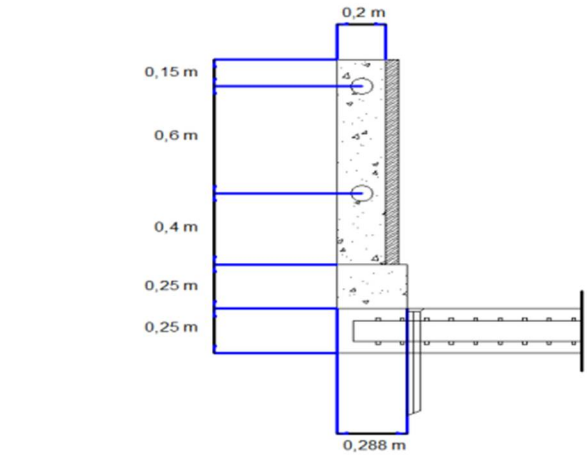

Figure 5. Backrest

2. M_{max} that works on the floor plate as big as:

Table 2. Moment Results

Metode	Momen Tumpuan (kNm)	Momen Lapangan (kNm)
Bittner	-	40,8713
Pelat dianggap balok	-124.5658	130.1618

3. Thickness of 25 cm floor plate, main reinforcement support and field D19 - 80, while pedestal divider and Ø16 - 100 field. And 40 cm concrete blanket thickness.

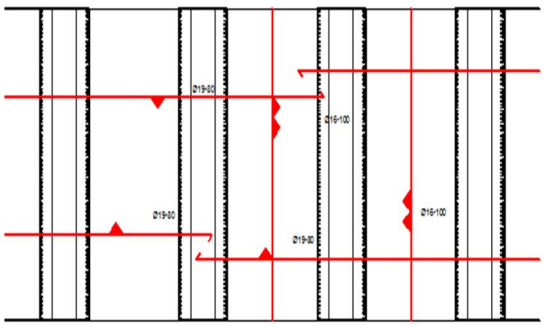

Figure 6. Floor Plate Reinforcement

Control of plate deflection δ_{maks} = 0,004047) ≤ δ_{ijin} = 0,01667... (ok!)

4. The Voute 1 segment using the SAP2000 version 14 application obtained Mmax and Vmax which work on transverse beams obtained the greatest value on:
   a. Moment of support = -102,9583 kN.m
   b. Field moment = 85,8641 kN.m
   c. Style of latitude = 240,512 kN
5. The dimensions of the transverse beam (voute 1) are 0.4 m, the side length is 1.4 m and the bottom side is 0.7 m. The main reinforcement is pedestal and field 4Ø16 - 100 and 6Ø16 - 80, while the reinforcement of sengkag in areas that need shear reinforcement Ø12 - 100 with distance X1 = 322 mm. Shear reinforcement in sufficient area shear reinforcement Ø12 - 100 with distance X2 = 214 mm. Thick concrete blanket 40 cm.

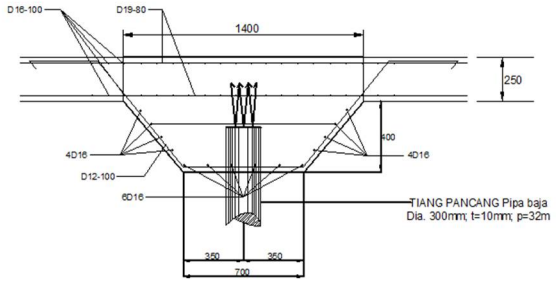

Figure 7. Voute 1

6. Voute 2 segment using the SAP2000 version 14 application is obtained by Mmax and Vmax which works on transverse beams with the greatest value on:
   a. Moment of support = -104,4015 kN.m
   b. Field moment = 92,6492 kN.m
   c. Style of latitude = 236,641 kN
7. The dimensions of the transverse beam (voute 2) are 0.4 m high, the top side length is 2.3 m and the lower side length is 1.6 m. The main reinforcement is pedestal and field 4Ø16 - 100 and 13Ø16 - 80, while stirrup reinforcement in areas that need shear reinforcement Ø12 - 100 with distance X1 = 315 mm.. Shear reinforcement in sufficient area shear reinforcement Ø12 - 100 with distance X_2 = 217.5 mm. Thick concrete blanket 40 cm.

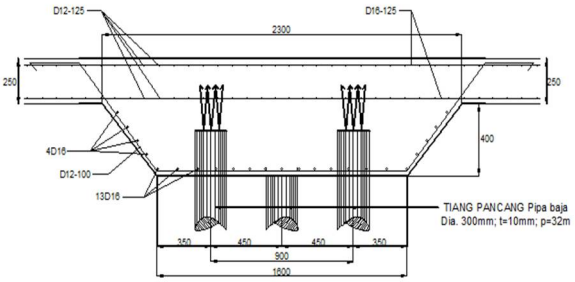

Figure. 8 Voute 2

Dimensions and reinforcement used in the lower part of the structure are :

1. The structure under the bridge is an abutment with the following dimensions:
   a. Width = 3.75 m
   b. Length = 6 m
   c. Height = 3 m

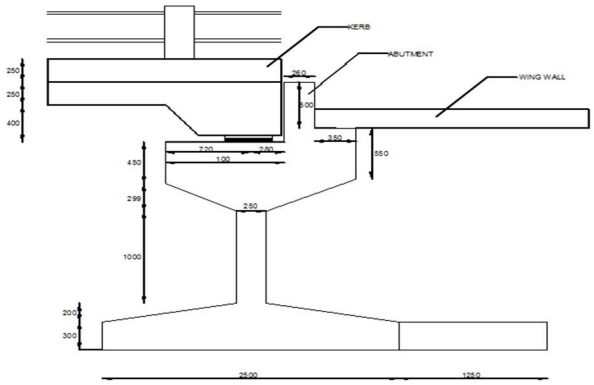

Figure 9. *Abutment*

2. From some combinations the maximum conditions are obtained:
   a. Vertical (V) = 1724,45 kN
   b. Horizontal (H) = 1028,12 kN
   c. Moment (M) = 1508,42 kN.m
3. The results of the calculation of forces on the stake are obtained:
   a. Max vertikal force = 1724,45 kN
   b. Max horizontal force = 1028,12 kN
   c. Max axial force =1508,42 kN.m
4. The type of foundation used:
   a. Abutments using PC B class 30 diameter spun pile piles.
   b. The beam across the pile slab uses PC spun pile class B diameter 30 cm with a pole length of 38 m.
5. Based on the results of the calculation of the soil investigation using a machine drill / N-SPT, the carrying capacity of the foundation permits was obtained by the Meyerhof method (1956):
   a. BH01 = 757,642 kN
   b. BH02 = 733,025 kN
   c. BH03 = 633,601 kN
6. Control of the strength of the pile material:
   a. BH–01=757,642kN > 181,41kN (ok!)
   b. BH–02=733,025kN > 181,41kN (ok!)
   c. BH–03=633,601kN > 181,41kN (ok!)
7. Control safe conditions for abutments to lateral forces :

a. BH–01=250,870kN > 95,76kN (ok!)
b. BH–02=247,800kN > 95,76kN (ok!)
c. BH–03=247,764kN > 95,76kN (ok!)

8. Using the Converse Labarre method, the calculation of group pole efficiency is 82.20%.
9. Control the safe conditions of abutment towards vertical forces:
   P_{netto}=547,3935kN>P_{kerja}181,41 kN(ok!)
10. In the calculation of abutments obtained reinforcement as follows:
    a. Breast wall uses reinforcement D19-150 and Ø12-150
    b. Backwall below uses D19-100 and Ø16-300 reinforcement
    c. The upper backwall uses D19-100 and Ø16-300 reinforcement
    d. Corbel uses D19-50 reinforcement, Ø16-100, and Ø12-200
    e. Pile cap uses D19-150 and Ø16-300 reinforcement
11. In the calculation of the step plate, the calculation of the main reinforcement Ø16-150 and divider reinforcement Ø10-200 are obtained with a 40 cm concrete blanket thickness.
12. In the calculation of the wing wall, the main reinforcement calculations D19-150 were obtained, divider reinforcement Ø16 - 300, with 40mm concrete blanket thickness.

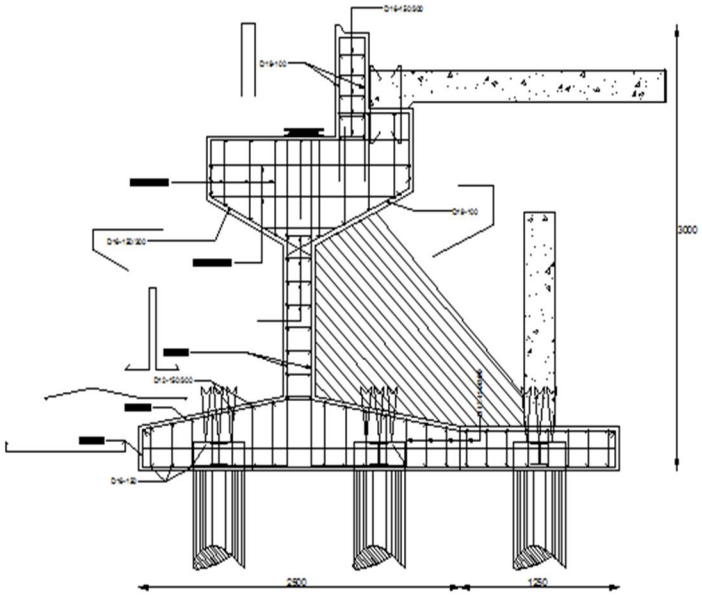

Figure 10. Abutment Reinforcement

CONCLUSION

The structure design is safe so that it matches the initial planning goals and meets the technical requirements so that access to transportation can be reused.

REFERENCES

Anonim, 2010. *Pedoman Penulisan Karya Ilmiah*. Universitas Lambung Mangkurat. Banjarbaru

Arifin, Yulian F, dkk, 2016. *Peraturan dan Pedoman Penulisan Tugas Akhir*. Universitas Lambung Mangkurat. Banjarbaru

Badan Standardisasi Nasional. 2005. *Peraturan Pembebanan Untuk Jembatan RSNI T-02-2005*. Bandung

Das, Braja M. 1999. *Principles of Foundation, 4th edition.* PWS Kent

Direktorat Jenderal Cipta Karya, Departemen PU. (1979). *Peraturan Beton Bertulang Indonesia 1971 Cetakan ke 7.* Yayasan Lembaga Penyelidikan Masalah Bangunan. Bandung

FT unlam, Laboratorium Komputasi. 2013. *Modul Pelatihan SAP 2000 Versi 14*. Universitas Lambung Mangkurat. Banjarbaru

Hardiyatmo, Hary C, 2006. *Teknik fondasi 2.* Cetakan ke-3. Beta offset. Yogyakarta.

Hardiyatmo, Hary C, 2010. *Teknik fondasi.* Bagian 2. Gadjah Mada University Press. Yogyakarta.

Presiden Republik Indonesia. (1993). *Peraturan Pemerintah (PP) Tentang Prasarana dan Lalu Lintas Jalan No. 43 Tahun 1993.*

Rahardjo, P.P. (2005). *Manual Pondasi Tiang Edisi 3.* Geotechnical Engineering Center. Universitas Katolik Parahyangan. Bandung

Standar Nasional Indonesia. (2002). Tata Cara Perhitungan Struktur Beton Untuk Bangunan Gedung. SNI 03-2847-2002. Bandung

Sutarman, E, 2009. *Konsep dan Aplikasi Mekanika Tanah*. Andi. Yogyakarta

Tjitradi, Darmansyah. (2008). Struktur Beton Bertulang II. Universitas Lambung Mangkurat Press. Banjarmasin