FINAL ASSIGNMENT

DESIGN AND CALCULATION OF RAILWAY TUNNEL

Submitted the requirements in completing undergraduate education on Civil Engineerng of Sultan Agung Islamic University

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FAKULTAS TEKNIK JURUSAN TEKNIK SIPIL

UNIVERSITAS ISLAM SULTAN AGUNG

SEMARANG

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FINAL ASSIGNMENT

DESIGN AND CALCULATING OF RAILWAY TUNNEL

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Nomor : 21 / A.2 / SA-T / I/2018

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telah menyelesaikan Tugas Akhir dengan Judul Design and Calculation of Railway Tunnel.
Dengan tahapan sebagai berikut :

No.	Tahapan	Tanggal
1	Penunjukan Dosen Pembimbing	12 Maret 2018
2	Pengumpulan Data	19 Maret 2018
3	Penyusunan Laporan	6 April-14 Agustus 2018
4	Selesai Laporan	16 Agustus 2018
5	Seminar Tugas Akhir	

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DECLARATION

The undersigned below :

Name : 1. Alfiya Arum Lestari (30201403694)
2. Muthia Kharisa Syahlma Nuha (30201403855)

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Hereby declare this our Final Assignment is entitled : **DESIGN AND CALCULATION OF RAILWAY TUNNEL** is a scholary work free from plagiarism. If later there is proven plagiarism from this final assignment, then I am willing to accept sanction in accordance with applicable legislation.

Semarang, September 2018

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ABSTRACT

Railway are constructed in the flat surface, across the river, valley, and mountainous area. In order the train can easily, safely and comfortably move, the track must be as flat as possible. The allowable gradients may be based on the ruling gradient which is the maximum gradient over which a tonnage train can be hauled with one locomotive. In some countries, momentum gradient which is a steeper but shorter gradient may be allowed. This is usually when there is a track gradient is connected to a leveled tangent track that is long enough with no signal between them so that train can build momentum to push through steeper grade than it can be without momentum. Dutch Railway Services allow the maximum gradient 5% or 1 to 200. On that gradient the train considered still able to travel it. If the train should traveled across the highly mountain where the maximum requirement of gradient is impossible to fulfilled, then a tunnel is made to break through the mountain to get the flat gradient of railway. Pay the important of tunnel in the geometry of railway or roadway construction into attention, this final assignment have an objectives : To design and calculation of railway tunnel, To get knowledge on designing and calculating tunnel construction. In this final assignment railway tunnel will be designed and calculated. Of the various types of tunnels, this final assignment will be discuss the railway tunnel as study material. There are two dimensions of tunnels in Indonesia, namely circle tunnels and horseshoe tunnels. The soil type in the tunnel is soft soil because in Indonesia there are many types of soil like that. There are four planning methods in the railroad tunnel, which determine tunnel timing, tunnel width, shear condition, and determine track free space. As for the calculation method using load, check segment, shear force. The results of the calculation of the load on the train tunnel is g = 12.72 kN / m2, in vertical pressure at tunnel crown P1 = 306.12 kN / m2, vertical pressure at tunnel bottom P2 = 346.08 kN / m2, lateral pressure at tunnel crown q1 = 224.3 kN / m2, lateral pressure at tunnel bottom q2 = 368.4 kN / m2. The results of security checks on the tunnel lining in the shear force get results τ = 0.486 MN / m2 <1.1 MN / m2, check bolt τ = 54.8 MN / m2 <150 MN / m2, Sα = 45.5 kN, check of fall W1 = 333.3 kN / m2. It can be concluded that the use of the lining segment in the railroad tunnel, apart from depending on the carrying capacity of the land, also depends on the calculation method used.

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ABSTRAK

Kereta api dibangun di permukaan datar, melintasi sungai, lembah, dan daerah pegunungan. Agar kereta bisa dengan mudah, aman dan nyaman bergerak, lintasan harus selandai mungkin. Gradien yang diijinkan dapat didasarkan pada gradien yang berkuasa yang merupakan gradient maksimum di mana kereta dapat diangkut dengan satu lokomotif. Di beberapa negara, gradien momentum yang lebih curam tetapi gradien yang lebih pendek dapat diizinkan. Ini biasanya ketika ada lintasan yang terhubung ketingkat lintasan yang cukup panjang tanpa ada sinyal di antara mereka bahwa kereta api dapat membangun momentum untuk mendorong melalui kelas dari pada yang bias tanpa momentum. *Dutch Railway Services* memungkinkan gradient maksimum 5% atau 1 hingga 200. Pada gradient itu, kereta dianggap dapat melakukan perjalanan. Jika kereta api harus melakukan perjalanan melintasi gunung yang sangat tinggi di mana persyaratan maksimum gradient tidak mungkin dipenuhi, maka sebuah terowongan dibuat untuk menerobos gunung untuk mendapatkan gradient kereta api datar. Yang terpenting tentang pembangunan terowongan di jalan kereta api atau konstruksi jalan menjadi perhatian, tugas akhir ini memiliki tujuan: Untuk merancang dan menghitung terowongan kereta api. Dalam tugas akhir ini terowongan kereta api akan dirancang dan dihitung. Dari berbagai jenis terowongan, tugas akhir ini akan dibahas di terowongan kereta api sebagai bahan belajar. Ada dua dimensi terowongan di Indonesia, yaitu terowongan lingkaran dan terowongan tapal kuda. Jenis tanah di terowongan adalah tanah lunak karena di Indonesia ada banyak jenis tanah. Ada empat metode perencanaan di terowongan kereta api, yang menentukan waktu terowongan, lebar terowongan, kondisi geser, dan menentukan ruang bebas jalur. Adapun metode perhitungannya menggunakan beban, check segmen, gaya geser. Hasil perhitungan pada terowongan kereta adalah g = 12,72 kN / m2, pada tekanan vertical pada terowongan mahkota P1 = 306,12 kN / m2, tekanan vertikal di bawah terowongan P2 = 346,08 kN / m2, tekanan lateral pada terowongan mahkota q1 = 224,3 kN / m2, tekanan lateral di bawah terowongan q2 = 368,4 kN / m2. Hasil pemeriksaan keamanan pada lapisan terowongan dalam gaya geser mendapatkan hasil τ = 0,486 MN / m2 <1,1 MN / m2, periksa baut τ = 54,8 MN / m2 <150 MN / m2, Sα = 45,5 kN, pengecekan jatuh W1 = 333,3 kN / m2. Dapat disimpulkan bahwa penggunaan lining segment pada terowongan kereta api selain tergantung dari daya dukung tanahnya juga tergantung dari metode perhitungan yang dipergunakan.

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MOTTO

(Alfiya Arum Lestari)

“Dan janganlah kau berputus asa dari rahmat Allah. Sesungguhnya tidaklah seseorang berputus asa kecuali orang – orang yang kafir”

(QS. Yusuf : 87)

-(٤١)– الْأَوْفَى الْجَزَاء يُجْزَاهُ ثُمَّ -(٤٠)– يُرَى سَوْفَ سَعْيَهُ وَأَنَّ -(٣٩)– سَعَى مَا إِلَّا لِلْإِنسَانِ لَّيْسَ وَأَن

“Dan bahwa manusia hanya memperoleh apa yang telah diusahakannya, dan sesungguhnya usahanya itu kelak akan diperlihatkan (kepadanya), kemudian akan diberi balasan kepadanya dengan balasan yang paling sempurna.”

(QS An-Najm 39-41)

“Barang siapa yang menginginkan dunia maka wajiblah ia memiliki ilmunya dan barang siapa yang ingin (selamat&bahagia) diakhirat maka wajiblah ia memiliki ilmunya pula dan barang siapa yang menginginkan kedua-duanya maka wajiblah ia memiliki ilmu kedua-duanya pula”

(HR. Bukhori Muslim)

(Muethia Kharisa SN)

“Behold along with the difficulty there is relief. Therefore when you're done (do something else). And hope to the Lord.

(QS. Al Insyirah : 6-8)

“Everything went well even though everything seems to go wrong at all if you are honest with yourself. Instead, everything is not good for you even if everything looks right, if you are not honest with yourself”.

(Mahatma Gandhi)

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“I dedicated this final assignment to the knowledge of airport and runway engineering as my worship to Allah SWT”

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Semarang, August 2018

Alfiya Arum Lestari

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Semarang, August 2018

Muethia Kharisa Syahlma Nuha

`

TABLE OF CONTENTS

`

CHAPTER 3 DESIGN AND METHODOLOGY

`

`

CHAPTER 4 DESIGN AND CALCULATION

CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS

`

LIST OF TABLE

`

LIST OF FIGURE

`

ABBREVIATIONS

T = Thickness

A = Area

E = Modulus of elasticity

I = Moment of inertia of area

EI = Flexural rigidity

M = Moment

N = Axial force

S = Shearing force

D = Diameter of lining

Ro = Outer radius

Rc = Radius of controid

Ri = Inner radius of the lining

γ = Weight of soil

γ' = Submerged unit weight of soil

γ_w = Unit weight of water

γ_c = Unit weight of concrete

H = Overburden

$\gamma_w \times H_w$ = Groundwater pressure at crown of lining

P_o = Surcharge

W = Weight of lining per meter in longitudinal direction

p_g = Dead Load

P_{el} = Vertical earth pressure at crown of lining

P_{w1} = Vertical water pressure at crown of lining

q_{e1} = Horizontal earth pressure at crown of lining

q_{w1} = Horizontal water pressure at crown of lining

P_{e2} = Vertical earth pressure at bottom of lining

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P_{w2} = Vertical water pressure at bottom of lining

q_{e2} = Horizontal earth pressure at bottom of lining.

q_{w2} = Horizontal water pressure at bottom of lining

p_w = Water pressure.

Λ = Coefficient of lateral earth pressure.

k = Coefficient of subgrade reaction.

δ = Displacement of lining.

p_k = Subgrade reaction/la reaction/Bettung.

C = Cohesion of soil / La cohesion du sol / Kohaesionvom Boden.

$\emptyset$ = Angle of internal friction of soil.

f'_{ck} = Nominal strength ofConcrete (Characteristic Compressive Strength of Concrete)

f_y = Yield strength of steel

E_s = Modulus of elasticity of steel