

## **FINAL ASSIGNMENT**

### **DESIGN AND CALCULATION OF RAILWAY TUNNEL**

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



**ALFIYA ARUM LESTARI**

**30.2014.03.694**

**MUETHIA KHARISA S.N.**

**30.2014.03.855**

**FAKULTAS TEKNIK JURUSAN TEKNIK SIPIL**

**UNIVERSITAS ISLAM SULTAN AGUNG**

**SEMARANG**

**2018**



**YAYASAN BADAN WAKAF SULTAN AGUNG**

**UNIVERSITAS ISLAM SULTAN AGUNG**

**FAKULTAS TEKNIK**

Jalan Raya Kaligawe KM. 4 Po. BOX 1054 Telp. (024) 6583584 Ext. 507 Semarang 50112

**APPROVAL PAGE  
FINAL ASSIGNMENT**

**DESIGN AND CALCULATING OF RAILWAY TUNNEL**

**By:**



**ALFIYA ARUM LESTARI**  
NIM :30201403694



**MUETHIA KHARISA SYAHLMA NUHA**  
NIM : 30201403855

Have been approved at August , 2018

Supervisor

Co - Supervisor

Ir. M. Faiqun Ni'am, MT., Ph.D

Ir.Gatot Rusbintardjo,M.R.Eng MSc.,Ph.D

Approved By,  
Head of Civil Engineering Department, Engineering Faculty, UNISSULA



Api Sentani, ST.,M.Sc



**YAYASAN BADAN WAKAF SULTAN AGUNG  
UNIVERSITAS ISLAM SULTAN AGUNG (UNISSULA)**

**FAKULTAS TEKNIK**

Jalan Raya Kaligawe KM. 4 Po. BOX 1054 Telp (024)6583584 Ext 507 Semarang 50112

**BERITA ACARA BIMBINGAN TUGAS AKHIR**

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

Pada hari ini, tanggal 16 Agustus 2018 berdasarkan Surat Keputusan Ketua Jurusan Universitas Islam Sultan Agung (UNISSULA) Semarang perihal penunjukan Dosen Pembimbing I dan Dosen Pembimbing II :

- |    |                  |   |                                            |
|----|------------------|---|--------------------------------------------|
| 1. | Nama             | : | Ir. M. Faiqun Ni'am, MT., Ph.D             |
|    | Jabatan Akademik | : | Lektor                                     |
|    | Jabatan          | : | Dosen Pembimbing I                         |
| 2. | Nama             | : | Ir. H. Gatot Rusbintardjo, M.R,Eng,Sc,Ph.D |
|    | Jabatan Akademik | : | Lektor                                     |
|    | Jabatan          | : | Dosen Pembimbing II                        |

Dengan ini menyatakan bahwa mahasiswa yang tersebut dibawah ini telah menyelesaikan bimbingan Tugas Akhir/Skripsi :

- |    |         |   |                              |
|----|---------|---|------------------------------|
| 1. | Nama    | : | Alfiya Arum Lestari          |
|    | Nim     | : | 30201403694                  |
|    | Jurusan | : | Teknik Sipil                 |
| 2. | Nama    | : | Muethia Kharisa Syahlma Nuha |
|    | Nim     | : | 30201403855                  |
|    | Jurusan | : | Teknik Sipil                 |

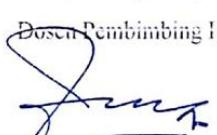
telah menyelesaikan Tugas Akhir dengan Judul Design and Calculation of Railway Tunnel.

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	

Demikian Berita Acara Bimbingan Tugas Akhir ini dibuat untuk diketahui dan dipergunakan seperlunya oleh pihak – pihak yang berkepentingan.

Dosen Pembimbing I



Ir. M. Faiqun Ni'am, MT., Ph.D

Dosen Pembimbing II



Ir. H. Gatot Rusbintardjo, M.R,Eng,Sc,Ph.D



Mengetahui,

Ketua Jurusan Teknik Sipil  
FAKULTAS TEKNIK UNISSULA

Muethia Sentani, ST., MSc.

## DECLARATION

The undersigned below :

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

Department : Civil Engineering

Hereby declare this our Final Assignment is entitled : **DESIGN AND CALCULATION OF RAILWAY TUNNEL** is a scholarly 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

By :

Editor I



Alfiya Arum Lestari

Editor II



Muethia Kharisa Syahlma Nuha

Approved :

Supervisor



Ir. M. Faiqun Ni'am, MT., Ph.D

Co – Supervisor



Ir. Gatot Rusbintarjo, M.R.Eng.Sc., Ph.D

## 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  $g = 12.72 \text{ kN} / \text{m}^2$ , in vertical pressure at tunnel crown  $P_1 = 306.12 \text{ kN} / \text{m}^2$ , vertical pressure at tunnel bottom  $P_2 = 346.08 \text{ kN} / \text{m}^2$ , lateral pressure at tunnel crown  $q_1 = 224.3 \text{ kN} / \text{m}^2$ , lateral pressure at tunnel bottom  $q_2 = 368.4 \text{ kN} / \text{m}^2$ . The results of security checks on the tunnel lining in the shear force get results  $\tau = 0.486 \text{ MN} / \text{m}^2 < 1.1 \text{ MN} / \text{m}^2$ , check bolt  $\tau = 54.8 \text{ MN} / \text{m}^2 < 150 \text{ MN} / \text{m}^2$ ,  $S_\alpha = 45.5 \text{ kN}$ , check of fall  $W_1 = 333.3 \text{ kN} / \text{m}^2$ . 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.

## 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 diangkat 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  $g = 12,72 \text{ kN} / \text{m}^2$ , pada tekanan vertical pada terowongan mahkota  $P_1 = 306,12 \text{ kN} / \text{m}^2$ , tekanan vertikal di bawah terowongan  $P_2 = 346,08 \text{ kN} / \text{m}^2$ , tekanan lateral pada terowongan mahkota  $q_1 = 224,3 \text{ kN} / \text{m}^2$ , tekanan lateral di bawah terowongan  $q_2 = 368,4 \text{ kN} / \text{m}^2$ . Hasil pemeriksaan keamanan pada lapisan terowongan dalam gaya geser mendapatkan hasil  $\tau = 0,486 \text{ MN} / \text{m}^2 < 1,1 \text{ MN} / \text{m}^2$ , periksa baut  $\tau = 54,8 \text{ MN} / \text{m}^2 < 150 \text{ MN} / \text{m}^2$ ,  $S_\alpha = 45,5 \text{ kN}$ , pengecekan jatuh  $W_1 = 333,3 \text{ kN} / \text{m}^2$ . Dapat disimpulkan bahwa penggunaan lining segment pada terowongan kereta api selain tergantung dari daya dukung tanahnya juga tergantung dari metode perhitungan yang dipergunakan.

## 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)- إِلَّا وَفِي الْجَزَاءِ يُجْرَاهُ ثُمَّ - (٤٠)- يُرَى سَوْفَ سَعْيَهُ وَأَنَّ - (٣٩)- سَعَى مَا إِلَّا لِلْإِنْسَانِ لَيْسَ وَأَنَّ  
“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)

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

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Alhamdulillahirabbil'alamin, Innalhamdalillah nahmaduhu wa nasta'iynuhu. Upon Ridho and Rahmat Allah Subhana wa Ta'ala this final assignment report can be completed.

In preparing this report, I was contact with many people, researches, academicians, and practitioners. They have contributed towards my understanding and thoughts. In particular, i wish to express my sincere appreciation to my main study supervisor, Ir. M. Faiqun Ni'am, MT., Ph.D or for his encourages, guidance, criticism, and friendship. I an also very thankful to my Co – supervisor, Ir. H. Gatot Rusbintardjo,M.R.Eng.,MSc.,Ph.D., for his guidance, advice and motivation. Without their continued support and interest, this final assignment report would not have been the same as presented here.

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Very special thanks are given to my beloved parents, my father Susila and my mother Indah, their patience, prayers and understanding during this study were always a blessing. Also my sister Nurul anda my brother Yoga who always give me support and pray.

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Semarang, August 2018

Alfiya Arum Lestari

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Muethia Kharisa Syahlma Nuha