

LEMBAR
HASIL PENILAIAN SEJAWAT SEBIDANG ATAU PEER REVIEW
KARYA ILMIAH : PROSIDING

Judul Artikel : Improvement of Potholes and Rutting Assessment in Surface Distress Index
 Jumlah Penulis : 3 Orang (**Bagus Hario Setiadji***, Djoko Purwanto, YI Wicaksono)
 Status Pengusul : Penulis ke-1
 Identitas Prosiding : a. Judul Prosiding : Advances in Engineering Research, Vol. 193
 Proceedings of the 2nd International Symposium on
 Transportation Studies in Developing Countries
 (ISTSDC 2019)
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Prof. Ir. Ludfi Djakfar, MSCE, Ph.D., IPU.
 NIP. 196407091990021001
 Unit Kerja: Fakultas Teknik Universitas Brawijaya

Semarang, Desember 2021
 Reviewer 2



Prof. Ir. Mochamad Teguh, MSCE, Ph.D
 NIP. 195808051987031001
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Malang, Oktober 2021
 Reviewer I



Prof. Ir. Ludfi Djakfar, MSCE, Ph.D., IPU.
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Yogyakarta, Oktober 2021
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BAGUS HARIO SETIADJI

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Dr. Eng. Ir. Muhammad Isran Ramli, S. T., M.T.




**Dean of Engineering Faculty,
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Dr. Edward Ngii., M.T.

Improvement of Potholes and Rutting Assessment in Surface Distress Index

BH Setiadji, D Purwanto... - ... on *Transportation Studies* ..., 2020 - atlantis-press.com

To monitor and evaluate the functional condition of roads, an easy-to-understand and powerful parameter is important for countries whose road regulators have different capabilities, such as Indonesia. To date, Surface Distress Index (SDI) is still the most popular parameter for assessing the road functional condition in Indonesia, due to its simplicity and easy-to-understand features. However, the index has a lack of accurateness in assessing the damages. In this study, an improvement of the effectiveness of the damage assessment ...

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FACULTY OF ENGINEERING HALU OLEO UNIVERSITY
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“THE INTEGRATION OF THE BASE SYSTEMS FOR ROAD, SEA, RAIL AND AIR TRANSPORTATION TO SUPPORT REGIONAL DEVELOPMENT AND COMMUNITY WELFARE OF DEVELOPING COUNTRIES”

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Development of a Priority Scale in Handling National Road Maintenance in Banten

Novel Ridwan, Leksmono Suryo Putranto

National road should be maintained periodically to keep its performance in a serviceable condition. Banten is a province next to the capital of Indonesia, Jakarta. Therefore, road maintenance in this area must be conducted properly. Banten is one of the areas in Indonesia, in which the national road...

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Characteristics of Weekend Activities in Greater Jakarta

Leksmono Suryo Putranto, Josia Marxalim

After fully occupied with working and other potentially stressful activities during the weekdays, people need to release the burden in themselves. Therefore, hypothetically the type of activities, time to conduct the activities, duration of the activities and the mode of vehicle used to reach the place...

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The Efficiency of a Bus Rapid Transit Utilizing a Passenger Information System

Mudjiastuti Handajani, Andi Kurniawan Nugroho, Harmini

Incredible city transportation utilizing a safe, comfortable, stable, and efficient smart transportation system with modern arrangements has become a necessity. Currently, the transit busses still run on the open road in mixed traffic, which means the arrival times cannot

be anticipated correctly. Furthermore,...

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Analytic Hierarchy Process for Priority Policy on Road Access to Tourist Areas of Berau Regency, East Kalimantan

Rosa Agustaniah, Achmad Wicaksono

Development of favorite tourist destinations in Derawan Island and other places in the southern coastal region of Berau Regency, East Kalimantan, must be supported by the provision of good transportation infrastructure and services to encourage connectivity so that it can increase tourist visits annually...

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Cycle Rickshaw: History and Problems

Imma Widyawati Agustin

Cycle rickshaw is one of the modes of paratransit transportation that has advantages in supporting the sustainability of the transportation system in Klojen District, Malang City. However, the provision of cycle rickshaw that is not in accordance to the needs of the community in Klojen District causes...

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Urban Transportation: Performance and Problems (Case Study: Route of ABG, CKL, and AT)

Septiana Hariyani, Budi Sugiarto Waloejo, Mahasti Adityasari

ABG, CKL, and AT are public transportation (called angkot) with the longest route in Malang. The length of the routes of ABG, CKL, and AT is 26m, 22Km, and 18Km. This research aims to determine the performance of three public transportation and to provide a new route recommendation. The operational performance...

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The Effect of Commercial Areas and Industrial Zone Improvement on Road Service Levels Between City Surabaya-Sidoarjo

Budi Sugiarto Waloejo

The Regional Government Policy of Surabaya City which prohibits industrial zones outside industrial estates in Surabaya urban areas encourages the growth of new industrial zones in the hinterland area of Surabaya city or Gerbangkertosusilo region, including Gresik Regency, Sidoarjo Regency and Mojokerto...

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Emission Reduction from Transportation Sector Using Carbon Footprint

Christia Meidiana, Deni Agus Setiyono, Noufal Riziqi N Rohman, Adina Khusnudzan Hadid

Sidoarjo urban area is an area with different type of activities, such as settlement, trade, services, government, and also public service such as schools and hospitals. Different type of activities generate high levels of transportation activity resulting in high level of CO2 emissions. The purpose...

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The Influence of the Water Level in the Brake Fluid on the Rate of Increase in Temperature and Boiling Point of the Brake Fluid

Setya Wijayanta, Desvinia Diah, Kurniawan Pambudi, Himly Albab Arifan

The study aims to determine the effect of the water level in brake fluid on the rate of increase in brake fluid temperature and the boiling point of brake fluid. The study used an experimental method to determine the performance of 5 brands of brake fluid. The brands of brake fluid used are Jumbo, Fuso,...

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Calibration and Validation of Walking Behavior Parameter (Case Study: Sky Bridge of Sultan Mahmud Badaruddin II Airport, Palembang)

Siti Raudhatul Fadhilah, Sony Sulaksono Wibowo

A micro-simulation model is a crucial tool in the study of transportation, especially in complex traffic systems that include interactions between components in it. Therefore, the accuracy of the model must be considered by calibrating the parameters used and validating the model with observation data....

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The Relationship Between Trait Anger and Traffic Accident History in Denpasar, Manado, and Padang

Leksmono Suryo Putranto, Rostiana, Annisa Noor Tajudin, Sunu Bagaskara

Trait anger may increase traffic accident risk. In the current research, 9 items of the trait anger scale were translated into Indonesian and used to assess whether the 9 trait anger items were very unfit, unfit, fit very fit with the respondent's personality. Respondents also asked to tell their accident...

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Planning Reactivation Train for Kedungjati – Tuntang Using Google Earth, Global Mapper, and AutoCAD Civil 3D

Dhiya Ayu Nuswanti, Moch. Zusuf Mahendra, Adya Aghastya

Kedungjati - completion road is a railway line that has not been used, and it used to connect between Semarang and Secang, Magelang Regency. In accordance, with the 2011 National Railway Master Plan (RIPNAS), the Directorate General of Railways of the Ministry of Transportation stated that the need for...

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Relationship of Emotional Maturity and Couples Adjustment on the Aircraft Crew

Hendro Prabowo, Maria Chrisnatalia, Ajeng Sekar Lasenda

This research is purposed to examine between emotional maturity and couples-social adjustment on commercial aircraft crew (pilots and flight attendants) with their partners. This research involved 90 respondents (45 couples) with ages ranging from 18 to 62 years old. We use a quantitative method with...

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The Meaning of Membership in Motorcycle Community in the Campus

Hendro Prabowo, M. Ihsan Sulthoni, M. Purwani Dewi

In 2017, there are 113 million motorcycles in Indonesia or 43% of the total population of 264 million. With this amount, of course there are also many motorcycle communities and/ or motorcycle gangs. Many social and psychological studies have been done and found positive aspects of motorcycle communities...

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A Prototype of Track Gauge and Cant Measurement Device for Curved Railroad by Using Microcontroller

Rony Alvin Alfatah, Dwi Samsu Al Musyafa, Wahyu Tamtomo Adi, Septiana Widi Astuti

The purpose of this study is to create a tool for measuring track gauge and cant in the curved railroad with digital systems which can improve railroad maintenance with an automatic recording system for more efficient and easy to use. This tool uses Arduino IDE as an application programming language...

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Design and Load Analysis Toward the Strength of Rim Modification Using SolidWorks Software on Motorcycle as a City Transportation

Yuspian Gunawan, Samhuddin, Fitria Masud, Nanang Endriatno, Muh. Yamin, Muslimin

The purpose of this study was to design and analyze the loading of the modified rim strength (cast wheel type) on the motorcycle. The method used is to use SolidWorks software, loading simulation analysis performed with 3 variations of the rim model and three (3) variations in the number of spoke (8,...

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Freeboard Monitoring System as an Early Warning System on Railroad Bridge with Solar Cell as Resource Energy

Rizky Arief Qurnianto, Adya Aghastya, Christiant Anandhitya Tri Mulyanto, Suwandi

The bridge is a construction that connects paths that are cut off by rivers, ravines, or construction. One of the requirements of the bridge is freeboard. Safety height is the height measured from the water to the lowest bridge construction. The survey results are still a railroad bridge that does not...

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Analysis of Tariff Integration Between MRT and TransJakarta*

Kevin Ginevra Arota Hulu, Andyka Kusuma

The Tariff Integration System is a tariff payment system where users of public transportation make payments only once but can use two or more modes of public transportation. For this study, the modes of transportation reviewed are TransJakarta and MRT. The purpose of this study is to find out the preferences...

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Investigating the Role of Activity-Travel Participation on Daily Travel Satisfaction in Bandung Metropolitan Area

Jeanly Syahputri, Tri Basuki Joewono, Dimas B.E. Dharmowijoyo

Relationship between daily travel satisfaction and individuals' travel behaviour has been explored by the number of studies. However, previous studies were rarely to examine the effect of daily activity in conjunction with travel participation on daily travel participation. Using general descriptive...

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Overcoming Social Impacts on Routine Road Maintenance by Involving Community Participation

Yudi Sekaryadi, Wimpy Santosa, Anastasia Caroline Sutandi

Routine maintenance by involving the community is needed to overcome the social impact of routine road maintenance. Some of the variables that influence this are the level of community participation, budget and material participation, community institutions, road damage, method of implementation, material,...

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Online-Taxi Choice Model Based on Passenger Perception in Indonesia

Tarita Apriliani Sitinjak, Ludfi Djakfar, Ahmad Wicaksono

Malang, and Surabaya are two cities in East Java Province, Indonesia with day-population more than 1 million and have experienced daily traffic congestions because of the over usage of private vehicle. This study aim is to find the modal choice model for shifting the passenger from conventional-taxi...

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Performance of Urban Infrastructure: Road User Satisfaction Index in Satellite City

Resdiansyah, Tri Nugraha Adikesuma, Fredy Jhon Philip.S, Nailah Nahdiyah

The rapid growth of Satellite City in South Tangerang will directly impact road infrastructure and environmental conditions. The purpose of this paper is to investigate the performance of existing road infrastructure. The study was to gain the perception of road users regarding various elements of satellite...

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Dynamic System Modeling in the Selection of Regency Road Pavement Construction Types

A R Indra Tjahjani, Nuryani Tinumbia, Wita Meutia

The selection of pavement construction type is influenced by several factors, such as technical conditions, economic conditions and conditions in the area. These factors have different criteria in each region, resulting in a different selection of road pavement. This paper aims to model the most suitable...

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Evaluation of Side Friction in IHCM for Highway Two Lanes Two Ways

Najid

IHCM (Indonesia Highway Capacity Manual) was issued and came into force in 1997. After 20 years there has been a change in traffic from the number and composition, as well as the traffic regulation policy. As a result of this, the determination of IHCM's road capacity is often incorrect. Therefore it...

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Walking Distance Perception in Jakarta MRT Station Area*

Alfaizs Vi Afkara, Andyka Kusuma

The interest of the community, especially MRT users to walk at the beginning or end of the journey to the MRT station is relatively low. The purpose of this study was to recognize the effect of changed preference attributes that affect the likelihood and distance of someone who will choose to walk compared...

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Identification of Factors Influencing the Evacuation Walking Speed in Padang, Indonesia

Yosritzal, H Putra, B M Kemal, Erick Mas, Purnawan

This paper aims to identify factors influencing the walking speed of evacuees by conducting an evacuation drill in Padang, West Sumatera, Indonesia. A number of 18 volunteers and 6 observers, were gathered in an evacuation experiment on 3 routes with 5 segments each. The chosen routes are almost equal...

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Efficiency Analysis of Commuter Line Stations (Case study: Tebet Station to Cilebut Station, Indonesia)

Aisyah Nur Jannah, Imam Muthohar, Danang Parikesit

Railway transportation is one of the most commonly used to commute by citizen of Jabodetabek (Jakarta-Bogor-Depok-Tangerang-Bekasi). The train station is part of the railroad infrastructure, including the Jabodetabek area which also has a large number of stations. In this case, the station needs its...

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The Probability Prediction Model of Motorcyclist Accident Against IRSMS and AIS from the Police Department, East Java (A Case Study in Kediri Regency and Surabaya City)

Muhammad Zainul Arifin, Achmad Wicaksono

According to traffic accident data collected by the East Java Police Department through IRSMS and AIS portal in 2018, the number of accidents tended to incline from 2015 to 2017. The objective of this research focusing on Kediri and Surabaya area is finding the characteristic of motorcycle riders in...

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The Effectiveness of Speed Limit Sign and Marking as the Speed Management Devices

Febrina Rachmatika Andini, Naomi Srie Kusumastutie, Edi Purwanto, Pipit Rusmandani, Lovvina Arida Yusup

Lemah Abang - Bandungan Road is an accident-prone area with high speed characteristics. In fact, there is no speed management devices available. Therefore, it is necessary to implement speed management devices with their simulations to reduce the vehicle speed. There were 2 types of devices simulated,...

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Ferhat Januar Rediat Supriana, Martha Leni Siregar, Ellen Sophie Wulan Tangkudung, Andyka Kusuma

The Odd-Even Number Policy intended to limit the DKI Jakarta Provincial Government has implemented vehicle traffic. Since its first implementation in 2016, this policy has undergone several changes, such as the number of roads and active duration. The purpose of this study is to analyze and evaluate...

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John Bosco Niyomukiza, Sri Prabandiyani Retno Wardani, Bagus Hario Setiadji

Subgrade strength is the main factor in determining the required thickness of any pavement. Therefore, the properties of a pavement subgrade materials must be determined, as they can predict the service life of a pavement. This paper examines the deviation of strength attained by sawdust and lime stabilized...

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Improvement of Potholes and Rutting Assessment in Surface Distress Index*

Bagus Hario Setiadji, Djoko Purwanto, Y I Wicaksono

To monitor and evaluate the functional condition of roads, an easy-to-understand and powerful parameter is important for countries whose road regulators have different capabilities, such as Indonesia. To date, Surface Distress Index (SDI) is still the most popular parameter for assessing the road functional...

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Hitapriya Suprayitno

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Performance Analysis of Road Segment and Level Crossing (JPL) 340 KM 158+795 as Access to Adisutjipto International Airport of Yogyakarta

Dian M. Setiawan, Noor Mahmudah, Rizqo Hainun Sully

Roads and rail tracks are land transportation infrastructures that play an essential role in supporting human activities both as passenger and goods transport. One of the problems of land transportation in Indonesia is a large number of level crossings between road and rail track. These level crossings...

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Travel Behavior Research in Indonesia: Its Role to Improve National Welfare

Leksmono Suryo Putranto

Research on travel behaviour, growing quite rapidly recently both in terms of numbers and scopes. Some of them were regarding Indonesian cases. By understanding deeply the characteristics of human travel, we will be able to provide travel facilities and modes appropriately. This paper was prepared to...

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Toward Sustainability: Green Road Construction in Indonesia

Susanti Djalante, Hiroyuki Oneyama, La Ode Muhamad Nurrahmad Arsyad

Road construction projects can affect directly to the degradation of the environment for causing emission, pollution, and congestion. Green road rating is the tool to measure the performance of green practices and the level of greenness on road construction projects. However, the implementation of the...

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Sea Transportation Network Development of the Liukang Tangayya Islands

Chairunnisa Mappangara, Syamsul Asri, Lukman Bochari, M. Rizal Firmansyah

One of the archipelago subdistrict in the Pangkep Regency is Liukang Tangayya District with an area of 11,960 km² which consists of approximately 55 large and small islands. Connectivity between regions can be improved by providing adequate and reliable transportation facilities and infrastructure, as...

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Investigating the Role of Activity-Travel Participation on Daily Travel Satisfaction in Bandung Metropolitan Area

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Abstract—Relationship between daily travel satisfaction and individuals' travel behaviour has been explored by the number of studies. However, previous studies were rarely to examine the effect of daily activity in conjunction with travel participation on daily travel participation. Using general descriptive analysis, this present study expanded its focus on travel and satisfaction by investigating the role and its interconnected aspects of activity-travel participation and daily travel satisfaction in Bandung. The result showed that different levels of daily travel satisfaction may influence the potential activity-travel time-use.

Keywords: *activity-travel participation, daily travel satisfaction, travel behavior*

I. INTRODUCTION

Travel behaviour implies the concept of a 'trip' as the main unit of conventional measurement and analysis [1]. However, how the way an individual decides a single trip or daily trip is shaped by how the way an individual plan and schedules the daily activities, with whom and with what object the person needs to meet, in where the activities are undertaken, and what regulation shape the activities and travels. It means that a travel decision is an effect of complex interdependencies among planned/scheduled and undertaken activities, interdependencies between activities and travels itself, the possibility of activity locations around the individuals, and the shape of regulation. Recently, the activity-based human approach is utilized to replace this simplistic approach to travel behaviour [2] Understanding how people define and decide their daily activity-travel participation can help to provide insight understanding and insight proposed policies to achieve a particular goal. Understanding people continuous path through space and time whereby how people perform activities and travels, with whom, what objects and in which location she/he meets, and what regulation influences their daily life, reveals what policy that can or cannot achieve a particular goal. Individuals' decision-making process is complex as a result of the complex interaction of people's constraints, needs, and possible resources through time and space [3, 4, 5].

Travel is the activity that reports low emotional well-being [6, 7, 4]. Therefore, researchers try to find a way how to improve the travel satisfaction or travel experience. Undertaking a particular type of passive leisure such as online and/or offline socializing shows a better impact on

travel satisfaction [8, 9, 10]. Friman et al. [11] investigated the daily travel experience using cross-sectional observations explained by socio-demographic and travel mode variables. However, Friman et al. [11] did not include other spatiotemporal variables such as the time-use and activity participation and built environment conditions as the predictors of daily travel experience. This study tries to fill the research gap on how the influence of various spatiotemporal variables on daily travel satisfaction. The focus on satisfaction with travel and daily routines is relevant both from a viewpoint of the implications of policies for well-being, but also since travel that is experienced as more satisfactory is more likely to be sustained over longer period [12].

II. LITERATURE REVIEW

Studies of travel satisfaction have recently received increasing attention in the field of transportation [13]. Early work in the area of satisfaction suggested that satisfaction was a result of proceeding from the evaluation based on consumer's expectations of the service/product and the experience [14]. The study of travel satisfaction based on travellers' judgment (e.g Friman [11], Ettema [12], Ye & Titheridge [13]) has only recently been discussed in transportation research [15]. For example, Ettema et al. [16] built a theoretical framework introducing subjective well-being (SWB) as a concept that complements other methods of assessing how people evaluate transportation services.

Essentially, the studies of travel satisfaction would provide useful detailed information for a broad range of policy decisions [17] and support urban planners to create transport strategies that improve subjective well-being or helping transportation providers to their service provision evaluation [15]. For example, it has been recognized that time pressure is a significant factor affecting travel satisfaction and, for that reason, some recommendations such as changing the opening hours of facilities and public transportation nodes might have an impact on travel satisfaction [12]. Moreover, early study of time and space prism concept [3] has discussed time pressure as one of three individuals' time and space constraints (capability, coupling, and authority). Hagerstand [3] defined coupling constraints as individuals' limitations to certain decisions to be in a specific place in a specific time. This concept also

Identification of Factors Influencing the Evacuation Walking Speed in Padang, Indonesia

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Abstract—This paper aims to identify factors influencing the walking speed of evacuees by conducting an evacuation drill in Padang, West Sumatera, Indonesia. A number of 18 volunteers and 6 observers, were gathered in an evacuation experiment on 3 routes with 5 segments each. The chosen routes are almost equal in terms of distance, but different in terms of the number of turning points. The experiment comprises of three cases in terms of the complexity of the route. These cases represent a simple, a medium and a complex route based on the number of turning points. The volunteers were asked to move, as if in an evacuation, to a particular place which was assumed to be a shelter. The observers were placed at some particular waypoints to record the time when an evacuee passes their location. The distance between the observers was measured using a manual distance meter. This study found that the average walking speed during the evacuation was 1.69 m/s. In addition, walking speed varied by age, gender, and walking distance. This finding significantly has an effect on the estimations of the coverage area of tsunami shelters. The data collection method is one of the novelties of this research. In this study, the walking speed was observed through an evacuation drill from a location to a shelter of 1.5 km away, whilst most of the previous studies estimate the walking speed based on an observation of a group of pedestrians crossing a road.

Keywords: *tsunami, evacuation, walking speed, evacuation drill, Padang*

I. INTRODUCTION

Padang is the capital of West Sumatera Province, Indonesia. Located close to the Ring of Fire in the west part of Sumatera Island. Padang has a substantial tsunami hazard potential, as reported by various authors such as [1], [2], [3], and [4]. The population of the city was about 914.968 in 2016 [5], and about half of them are living in the tsunami-vulnerable area [6]. Many massive earthquakes had hit the area, and some of those had triggered significant tsunamis to the west coastal area of Sumatera Island and nearest islands such as Mentawai and Nias Islands. Previously, on February 10, 1797, and November 24, 1833, tsunami was reported with a respectively 5 m and 3-4 m inundation high of tsunami [3]. Padang is predicted to face up to 15 m tsunami inundation shortly [7], [8], [9], [3]. McCloskey reported that

an accumulation of a vast seismic moment deficit since 1797 and 1833 at the megathrust [3].

In order to reduce the disaster risk, the Indonesian government has been developing tsunami early warning systems, increasing the capacity of tsunami evacuation routes, building new or retrofitting existing buildings for temporary evacuation sites, and educating people about tsunami and evacuation [9], [10]. Given the complexity of the preparation and limited time and budget available, the Major of Padang was calling any contribution from the universities and experts (Personal communication, April 19, 2016). This paper is one of our contributions to answer the call.

This paper presents an observation of walking speed of evacuees during an experiment of tsunami evacuation in Padang. The objective of the study is to investigate the effects of the characteristics of the evacuation route and characteristics of evacuees on the evacuation walking speed. In particular, turning points in evacuation routes and age of evacuees. It is more valuable to measure the evacuation time with a much larger group of participants, however, in this area, it is difficult to invite people to do evacuation drill. It used to be at least once a year, the community-wide tsunami drill being organized by the government. However, in recent days, not so many people engage in the drill. Therefore, a limited evacuation drill should be organized to obtain the required data. This study is the extension of our previous study published in [6], which observed the walking speed of the evacuees in a simple evacuation route (case 1 in this paper). Here, two more routes with different characteristics were added together with nine additional volunteers.

The walking speed during an evacuation is one of the most critical variables in developing evacuation plans [11], [12], [13]. Many studies have been aimed to estimate the walking speed in case of disaster evacuation, but almost all of the studies estimate is based on an observation of pedestrians at a crosswalk which is short in distance and not in evacuation cases [14]. In our study, the distance, duration, and route were set to be equal to the real situation; therefore this is one of the contributions of our study to the literature.

Improvement of Potholes and Rutting Assessment in Surface Distress Index*

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Abstract—To monitor and evaluate the functional condition of roads, an easy-to-understand and powerful parameter is important for countries whose road regulators have different capabilities, such as Indonesia. To date, Surface Distress Index (SDI) is still the most popular parameter for assessing the road functional condition in Indonesia, due to its simplicity and easy-to-understand features. However, the index has a lack of accurateness in assessing the damages. In this study, an improvement of the effectiveness of the damage assessment equation in SDI, especially for pothole and rutting damages, was carried out to increase the accuracy of the SDI in evaluating the functional conditions of the road. For this purpose, the damage assessment equations in the proposed SDI were developed based on the deduct values from Pavement Condition Index (PCI) that adjusted to the maximum value of the damage contribution for both types of distress. This study produces findings that the equations developed could produce more sensitive and consistent SDI values at different distress densities and levels of severity than that of the existing one.

Keywords: *functional condition, Surface Distress Index, potholes, rutting*

I. INTRODUCTION

Evaluation of road functional condition is one type of evaluation that has to be carried out routinely to ensure it is always in good condition. Especially for evaluating flexible pavement condition based on damage data, at present, there are several single-index used to reflect the overall road surface conditions based on the accumulation of road damage occurred, such as Pavement Condition Index (PCI) [1, 2], Surface Distress Index (SDI) [3], and Road Condition Index (RCI) [4].

Of the three indices, SDI is the most popular index and is used at different levels of the highway authority. SDI is more preferable because it only evaluates three main road damages, that is, cracking, potholes and rutting, making it easier for surveyors in the field to carry out data collection. However, the simplicity of SDI also has drawback, such as, the lack of detail in the properties of the distresses, where SDI only consists of the density and severity level of one type of cracking, the number of potholes without any differences in density and severity level of potholes, and the average depth of rutting.

On the other hand, PCI is recognized by AASHTO [5] as the most comprehensive functional condition index in the world due to it covers 19 types of road damage, and this makes the index can accurately evaluate road pavement

condition. However, with so many types of distress that have to be identified, this causes the measurement process to become too complex and requires experienced people in the field, making it difficult to be implemented especially for a low-level highway authority.

To overcome this, Setiadji et al. [6] have conducted preliminary research to empower SDI, instead of PCI, by increasing the ability of SDI in assessing crack damage. The accuracy of SDI in assessing the distress was improved by adding crack damage assessment equations, from only one equation in the existing SDI becomes 7 equations in the proposed SDI. This improvement made SDI could better recognize different crack damages, and be able to minimize the errors in crack damage recognition by a maximum of 6.25%.

Based on Setiadji et al. [6], the improvement of the proposed SDI was continued in this study by increasing the accuracy of damage assessment of two other distresses in SDI, i.e. potholes and rutting. Therefore, this study aims to develop new potholes and rutting damage assessment equations in SDI to improve the accuracy of SDI in evaluating road functional condition.

II. INDICES OF ROAD FUNCTIONAL CONDITION

In this section, the two most popular indices used in Indonesia, SDI and PCI, that elaborating the two distresses, i.e. potholes and rutting, are presented.

A. Surface Distress Index (SDI)

SDI is an index of road functional condition which use is regulated in the Road Condition Survey Guide. [3]. SDI only consists of three types of road distress, namely cracking, potholes and rutting. These three types of distress contribute differently to SDI, depending on the ratio of damage area to the area being evaluated (or called as density). The index represents a cumulative contribution of damage caused by the three types of distress for distance 100 m long. For potholes and rutting, the damage assessment equations are as follows.

a) SDI_3 as a function of total area and average width of crack (SDI_2)

$$SDI_3 = SDI_2, \text{ if there are no potholes} \quad (1)$$

$$SDI_3 = SDI_2 + 15, \text{ if the total number of potholes is less than 10 per km}$$

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Performance Analysis of Road Segment and Level Crossing (JPL) 340 KM 158+795 as Access to Adisutjipto International Airport of Yogyakarta

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Abstract—Roads and rail tracks are land transportation infrastructures that play an essential role in supporting human activities both as passenger and goods transport. One of the problems of land transportation in Indonesia is a large number of level crossings between road and rail track. These level crossings are generally operated semi-automatically, and their operation significantly affects vehicle traffic on the road. This study not only aims to identify traffic parameters on the road and the completeness of the level crossing safety infrastructure but also to analyze the performance of the access road to the Adisutjipto International Airport of Yogyakarta, which intersects with the level crossing of the 340 KM 158+795 JPL. The results of the study showed that the traffic flow from the South to the North section was 1484.5 pcu/day, while from the South to the North section was 808.5 pcu/day. Moreover, the average traffic delay was 100.3 seconds with the longest vehicle queue length from the North to the South section was 118 m, while from the South to the North section was 48 m. Lastly, it was concluded that an increase in traffic density of 1 pcu/km would cause a decrease in vehicle speed by 0.1999 km/hour.

Keywords: delays, level crossings, road performance, traffic density, traffic volume, vehicle queues length

I. INTRODUCTION

Road and rail transportation are the main modes of land transportation that are needed by service users because these modes are fundamental to support human activities both as a passenger and for goods transportation. Reference [1] states that roads are land transportation infrastructure that includes all parts of the road, including complimentary structure and device intended for traffic, which are above ground, below ground and water, and above the water surface, except rail track, lorries, and cable access.

Based on [2], the level crossing requirements are:

1. The interval between two consecutive train arrivals is at least 30 minutes.
2. The road that intersecting with the rail track is a road that categorized as class III.
3. The distance between two consecutive level crossings is not less than 800 meters.
4. It is located on the straight section of the rail track and the road.
5. There is a 60 cm flat surface measured from the outer side of the rail track.

6. The crossing width for a single lane is a maximum of 7 meters.
7. The intersection angle between the rail track and the road must be 90°, and the length of the straight section must be at least 150 meters from the rail track centerline.

Reference [3] states that the following lists are the infrastructure lists that must be equipped in road systems that intersecting with a level crossing:

1. Warning sign.
2. Prohibition sign.
3. Road markings.
4. Rumble strips.
5. Median on a 2-lane 2-way road.
6. Red light signals and sound signals.
7. Crossing gate.

According to [4], there are three main variables used to analyze traffic flow, namely speed, volume, and density. Reference [5] and [6] state that traffic flows that use research methods in the form of dynamic traffic management can be utilized to improve the safety of level crossing areas by manipulating traffic signs that can be controlled to display the speed mode of vehicle traffic flow, together with the closing time of the rail track crossing.

One of the problems of transportation in Indonesia is the level crossing between the road and the rail track. In Indonesia, the intersection between these two types of transportation infrastructure has been operated semi-automatically using a crossing gate. Although it has been performed in a semi-automatic method, the level crossing performance is still very influential on traffic on the road. According to [7], the risk assessment of level crossing is considered as a challenging task, and accidents at European level crossing account for about more than 30% of the entire railway collisions and led to more than 300 deaths every year. In Lithuania, there were 83 accidents at railway level crossings, or 14.4% from a total of 576 traffic accidents occurred in the infrastructure of JSC “Lithuanian Railways” from 2010 to 2016. The traffic accidents at Lithuanian level crossings caused 21 deaths and 19 heavy injuries, i.e., three deaths or injuries per year [8]. Moreover, as stated by [9], a crash between trains and motorized vehicles led most to level crossing accidents, while the risky behavior of motorists is