



ANALYSIS OF THE CAUSES OF THE DECLINE OF THE HIGHWAY (Case Study: Jalan Lettu Karim Kadir, Gandus District)

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Abstract: This research investigates the causes of significant road subsidence observed on Lettu Karim Kadir Street, Gandus District, Palembang City, starting in early 2025. The study addresses the urgent need to identify the technical factors contributing to this subsidence, which has disrupted traffic and indicates potential geotechnical issues in the road's subgrade. The research methodology involves analyzing the mechanical properties of the soil through laboratory testing, including Proctor Standard compaction tests, California Bearing Ratio (CBR) tests (soaked and unsoaked), and consolidation tests. The objectives are to analyze the geotechnical factors causing road subsidence, determine soil parameters at the study site, and provide technical recommendations for road structure repair or improvement. The study is limited to the specified location and focuses on soil properties testing for clay soils, including sieve analysis, specific gravity, Atterberg limits, compaction, CBR, and subgrade testing. The expected benefits include contributing to the scientific literature on geotechnical aspects of road subsidence due to soft soil conditions and providing a technical reference for local government and related agencies in addressing similar issues in the future.

Keywords: Peat Soil, Reinforcement, Woven Geotextile, Shallow Foundation, Bearing Capacity (BCR).

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1. Introduction

Highways are one of the land transportation infrastructures that have a strategic role in supporting the smooth distribution of goods and services. Its existence is very vital in the transportation system, especially in supporting logistics activities and community mobility. In addition, highways also contribute significantly to economic growth and development in an area, because good accessibility can encourage an increase in economic activities and accelerate regional development.

Roads are part of land transportation infrastructure that includes all road elements, including connecting buildings, complementary buildings, and traffic equipment that are above ground level, above water level, underground, or underwater, with the exception of railroads, truck tracks, and cable cars. As a transportation infrastructure, roads have an important role in providing optimal transportation services for the community. The existence of roads greatly supports various daily activities, such as education, trade, work, and other social activities. Therefore, roads

are one of the main elements in supporting the social dynamics and economic growth of a country.

Damage to the road due to traffic activities can generally be observed with the naked eye, especially on the road surface. The damage generally occurs in the road pavement layer and is caused by the load of vehicles crossing it. The level of damage will increase faster if the passing vehicle carries a load that exceeds the limit set in the technical provisions. This damage is generally characterized by the appearance of cracks and holes on the road surface. Efforts to repair the damage are usually carried out through the patching method on the affected part of the road. At the beginning of 2025, there will be a significant road decline phenomenon on Jalan Lettu Karim Kadir, Gandus District, Palembang City, precisely at the coordinates -3.0136916S +104.7141E. This incident had become a public concern because it caused traffic disruptions and showed indications of geotechnical problems in the basic soil structure of the road.



The problem of road decline raises the urgency for research to be carried out to identify the technical cause of the decline. One of the approaches used is through the analysis of the mechanical properties of the soil, including density tests (Proctor Test Standard), soil carrying capacity (CBR Soaked), and consolidation.

In a previous study conducted by Reztya A. (2020) with a study entitled Stabilization of Clay Soil Using Sand and Lime Additives to the Cbr Value, the results of this test were selected with a variation of 10% sand and 2%, 4%, and 6% lime, the CBR value of the original soil without soaking was 5.014% and in the soaking condition of 1.152%. The CBR value of the original soil with the addition of sand and lime was obtained the largest CBR value at 7 days of settling with variations of original soil + 10% sand + 2%, 4% and 6% lime of 12, 195%, 13.324%, and 15.583% and 4-day soaking of 1.716%, 2.529%, and 5.239%. An increase in unsoaked CBR by 210.811% and soaked CBR by 354.902% against the variation of the original soil mixture + 10% sand + 6% lime. The CBR value increases during the addition of lime content and along with the length of the fermentation time.

2. Literature Review

A highway is a means of land transportation designed to connect one region to another. The road structure consists of a layer of pavement, foundation, and subsoil. The stability of the subsoil greatly affects the performance of the road in the long term Mulyono, T. (2004). Land strips on the earth's surface are deliberately made by humans with their shapes, sizes and constructions so that they can be used to channel the traffic of people, animals and vehicles that transport goods from one place to another quickly and easily. (Silvia Sukirman, 1994). Land transportation infrastructure that includes all parts of the road, including complementary buildings and equipment intended for traffic, which is above ground level, below ground and/or water level, and above water level, except for railways, truck roads, and cable roads. According to Law No.38/2004, the definition of road is a road is a land transportation infrastructure that includes all parts of the road, including complementary buildings and their equipment intended for traffic, which are above ground level, below the ground and/or water level, and above the water level, except for railways, truck roads, and cable roads.

Road subsidence or settlement is a vertical movement of soil that occurs due to external loads or changes in soil structure. Drops can be elastic, plastic, or consolidated. In the case of highways, subsidence often occurs due to suboptimal compaction or soft soil conditions Terzaghi et al. (1996), Bowles (1997).

Factors Causing Road Decline

1. Basic soil type (soft clay is very susceptible to long-term consolidation).
2. Low soil carrying capacity (small CBR value).
3. Heavy and repetitive traffic loads.
4. Poor drainage conditions that cause soil saturation

Soil is the earth's surface layer that has a physical role as a place for plant roots to grow, provide support for plant growth, and supply water and nutrients needed by roots. Chemically, soil functions as a storer and provider of nutrients or nutrients, while from a biological perspective, soil acts as a habitat for soil

organisms that play a role in providing nutrients and additives that are beneficial to plants.

Naturally, soil is made up of a mixture of mineral particles that may or may not contain organic matter. These particles can be separated from each other easily through the process of washing using water. Soil comes from the weathering of rocks, which can occur physically or chemically. In addition to being influenced by the nature of the parent rock as a material source, the technical nature of the soil is also influenced by external factors that cause the weathering of the rock.

In the field of Civil Engineering, terms such as gravel, sand, silt, and clay are used to classify soil types. Under natural conditions, soil is often made up of a mixture of two or more types of soil, and sometimes contains organic matter. The name of the land is then followed by the designation of the main types of materials that exist. For example, silty clay refers to soil that is predominantly clay but contains silt. Soil is made up of three main components: air, water, and solid matter. Air generally does not affect the technical properties of the soil, while water greatly affects the technical properties. The empty space between the soil grains can be filled by water, air, or both. If the soil cavity is completely filled with water, the soil is said to be in a saturated state. If the soil cavity is filled partly by air and partly by water, the soil is in a partially saturated state. Dry soil is soil that contains no water at all or has zero moisture content.

Basic soil that has low strength and stability will cause the pavement to easily deform and crack. Soil with poor properties is very uneconomical and unsupportive if used as the basic soil of a civil building construction. Therefore, it is necessary to carry out stabilization to improve the soil both mechanically and chemically. The carrying capacity of the subsoil is influenced by the type of soil, density level, moisture content, drainage conditions, and others. In Indonesia, the carrying capacity of the base soil for the planning of road pavement thickness is determined by *CBR* inspection with a minimum *CBR* value of 6% in accordance with the specifications of the Highway.

California bearing ratio is a continuation of the soil compaction test so that the test is carried out using soil samples that have been compacted with proctoric compaction. This test is intended to determine the CBR value or carrying capacity of the soil at a certain density and moisture content. In other words, the *CBR* price will determine the extent to which the soil can withstand the load of the structure on it.

CBR testing in the laboratory is carried out by *soaked* and *unsoaked* methods or sample sampling. The purpose of the *CBR* test by soaking for 4 days is because it is adjusted to the weather climate in Indonesia which often rains and causes inundation or even flooding, by analogizing the carrying capacity of the soil after flooding with a maximum assumption time of 4 days.

Meanwhile, CBR testing with sample grading aims to provide the time of the chemical reaction process that occurs between soil and added materials. The principle of *CBR* testing is that soil samples are pressed in cylindrical molds with a standard press device in the form of a piston with a penetration speed of 1.27 mm/min.

The soil sample used for the test specimen in the *CBR* test is a soil sample that passes sieve no. 4 and then put into a cylindrical mold with a general diameter of 152 mm and then compacted in 3

layers, each layer is pounded with a standard fist 56 times. The CBR test specimen is placed with a base piece on the penetration machine and a weighted piece on the surface of the test specimen weighing at least 4.5 kg (10 pounds). The penetration indicator watch and the load indicator watch are set so that they show zero. Apply the load regularly so that the penetration speed is close to a speed of 1.27 mm/min. Loading readings were carried out at penetration intervals of 0.025 inches (0.64 mm), until they reached penetrations of 0.5 inches (12.7 mm).

3. Methods and Materials

This research was carried out in the Gandus District Area, Palembang City, South Sumatra Province, precisely on Jalan Lettu Karim Kadir. The sampling location is at the coordinate point - 3.0136S +104.7141E.

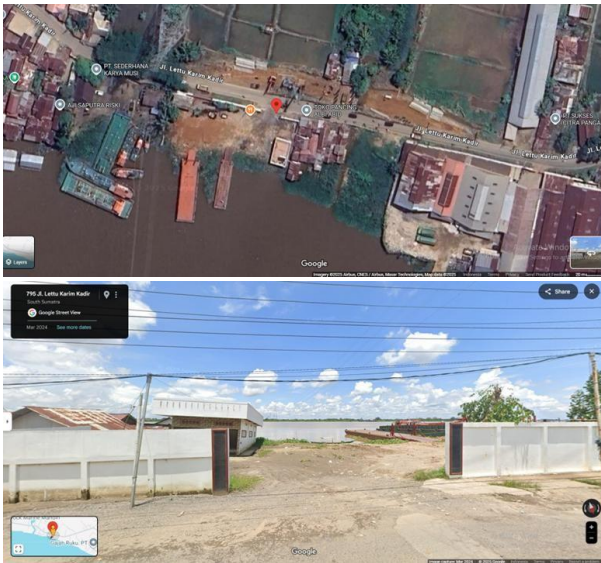


Figure 3.1 Sampling Location



Figure 3.2 Research Location When River Water Overflows After Rain



Figure 3.3 Existing Conditions of Research Sites

The location of this research is in a riverside area which is considered suitable as an object of research. Based on Figure 3.4, it shows the condition of existing soils that have the characteristics of

soil with low carrying capacity. This can be seen as a decrease in the road surface that has deformed, damage in the form of holes, landslides, and puddles that appear in the rainy season.

Geotechnically, these conditions indicate that the subsoil at the research site has water saturation and medium to high plasticity due to the dominance of materials in the form of clay or silt. The scattered characteristics cause problems with the stability of the road pavement and the shallow podation of the surrounding buildings.

The *California Bearing Ratio* (CBR) method was chosen because it is one of the field and laboratory tests that is able to determine the carrying capacity of the soil against traffic loads, as well as being the basis for determining the thickness of the road pavement layer. Considering that roads in this area are intensively used by two-wheeled vehicles to heavy vehicles, CBR value data is needed to evaluate the ability of the ground soil to withstand dynamic loads. In addition, the results of this study will make an important contribution to efforts to improve and plan road infrastructure in riverbank areas, where soft soil and water saturation problems are often found. Thus, the selection of this location is not only relevant from the technical side, but also significant from the academic side to support geotechnical studies related to the carrying capacity of the soil in the environment with these conditions.

This research was carried out from April to July 2025. This activity includes literature study and data collection, survey of existing conditions, soil sampling at several points, documentation, and testing of soil samples at the Soil and Concrete Mechanical Testing Laboratory, Research in the Laboratory, Soil Mechanics.

The type of research used in this study is experimental research with a quantitative approach. This approach aims to obtain a comprehensive picture of soil characteristics and carrying capacity based on the results of the *California Bearing Ratio* (CBR) test.

This research was carried out systematically starting from soil sampling and testing index properties. After the entire series of tests is carried out, the test results data will be obtained.

Soil sampling was carried out to obtain soil materials that could represent the condition of the soil layer on Jalan Lettu Karim Kadir, Gandus District, Palembang. Soil samples were taken from a distance of ± 1 to 20m from the landslide road at a depth of ± 60 cm from the ground level.

The type of sample taken is *disturbed sample*, which is a sample used to test soil characteristics in the laboratory such as moisture content, specific gravity, *Atterberg* limit to CBR testing.

Sampling was carried out using simple tools in the form of hoes, sacks and box containers as storage places for the samples taken. The sample is then labeled so that the sample is not swapped.

4. Results and Discussion

Sampling was carried out in July 2025, the soil was taken and the depth was ± 30 cm from the original soil surface Sample testing in this study was carried out at the Soil and Concrete Mechanical Testing Laboratory, Research in the Laboratory, Soil

Mechanics, Jl. LR Polytechnic. Perkutut No. 9 Bukit Lama, Ilir Barat District 1, Palembang City.

Soil samples were taken from 2 (two) locations on Jalan Lettu Karim Kadir, Gandus District, Palembang City. The first sample (a) was taken at a distance of ± 20 m from the highway and ± 1 m from the riverbank (see the orange line in Figure 4.2) when the river conditions were at high tide, and the second sample was taken at a distance of ± 5 m from the edge of the highway (see the yellow line in Figure 4.1).



(Source: Personal Documentation, 2025)

Figure 4.1. Soil Sampling Locations



(Source: Personal Documentation, 2025)

Figure 4.3. First Sampling Location (a)



(Source: Personal Documentation, 2025)

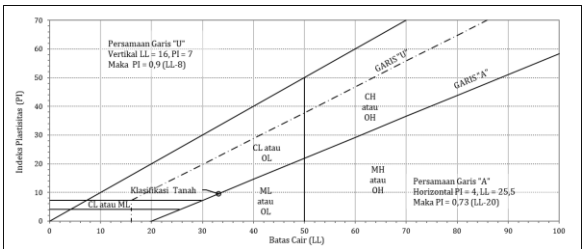
Figure 4.4. Second Sampling Location (b)

In this study, properties and mechanical tests were carried out on each soil sample taken. The test parameters include soil moisture content testing, soil specific gravity, sieve pass percentage No.200, Atterberg limit (liquid limit, plastic limit, and plasticity index), and Proctor standard compaction test (OMC and γ_d max). In addition to testing the properties of soil samples, CBR testing was also carried out in unsoaked and soaked conditions at a penetration of 2.5 mm.

Table 4.1 Summary of Test Results

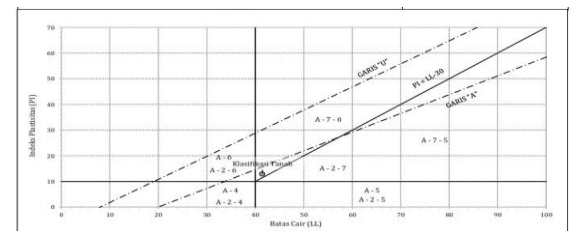
Yes	Types of Testing	Unit	Sample a	Sample b
1	Moisture Content (ω)	%	28,52	34,66
2	Specific Gravity (Gs)	-	2,55	2,62
3	Filter Analysis (% Pass No.200)	%	34,10	73,06
4	Liquid Limit (LL)	%	33,14	41,46
5	Plastic Limit (PL)	%	23,55	28,62
6	Plasticity Index (PI)	%	9,59	12,84
7	OMC (Optimum Moisture Content)	%	23,89	28,25
8	γ_d max (Maximum Dry Density)	gr/cm ³	1,56	1,46
9	CBR Unsoaked	%	21,26	11,74
11	CBR Soaked	%	7,34	5,18

(Source: Research Results, 2025)



(Source: Research Results, 2025)

Figure 4.8 Chart of Casagrande Plasticity Sample A According to USCS



(Source: Research Results, 2025)

Figure 4.10 AASHTO Plasticity Diagram

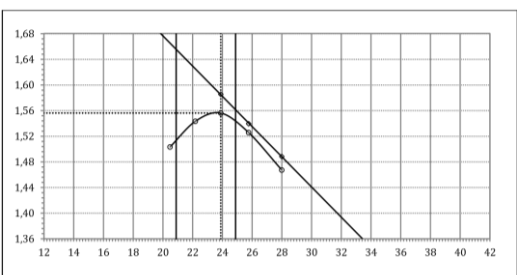


Figure 4.12 Sample Compaction Curve A

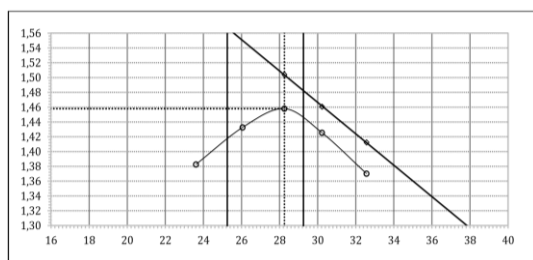


Figure 4.12 Sample Compaction Curve A

5. Conclusion

- a. The results of the unsoaked CBR test in sample b showed values of 7.76% from 10 x punches, 19.97% from 30 x punches, and 23.03% from 65 x punches at 2.5 mm and 5.00 mm penetrations, while sample a showed CBR values of 9.80% from 10 x punches, 30.77% from 30 x punches, and 50.30% from 65 x punches at 2.5 mm and 5.00 mm penetrations. Based on the results, the *unsoaked CBR value* is included in the good category for basic soil materials. And the results of the development potential test in soil sample b were obtained with a value of 1.18 and in sample a a value was obtained with a value of 0.72.

The results of the CBR test on the *soaked condition* in sample b showed a CBR result value of 2.23% from 10 x punches, 8.54% from 30 x punches, and 11.92% from 65 x punches at penetrations of 2.5 mm and 5.00 mm. Meanwhile, sample a showed a CBR value of 1.79% from 10 x punches, 9.25% from 30 x punches, and 17.44% from 65 x punches at penetrations of 2.5 mm and 5.00 mm.

- b. Based on the dominant factors of land subsidence and the results of laboratory tests on soil samples on Jalan Lettu Kadir Karim, there are several efforts such as lime/cement stabilization, PVD, *Preloading*, geotextiles, and *fly ash*.

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