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Analysis of the Potential of Soil Shrinking Building on the West Primary Channel Existing Embeddies in Rentang Irrigation Area with Method Free Swelling Test

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Abstract**—** *Expansive soil is soil that expands and shrinks easily so that it often causes problems for civil building construction, for example causing cracked and corrugated irrigation channel lining pairs. West Primary Channel Irrigation Area Range, Indramayu Regency, West Java Province. The 30 km-long West Primary Canal is a technical irrigation canal that is still original, a soil channel with many existing embankments cracked and sliding. The research data used in this study is data obtained from a survey on the West primary canal construction project in the Rentang irrigation area (Package LMS 03) Rentang Irrigation Modernization Project (RIMP) located in Indramayu Regency, West Java Province. The soil sampling from existing canals is attached in the project map as figure-2. Basically, the existing soil sampling should be taken with a Hand Auger from depth 0.5 to 1mandthe interval of soil sampling reach around 500 m. In case the soil type changes, the interval must be shorter. The soil sampling that has been taken using a hand auger must be put in a plastic bag so that the optimum water content in the site field can be maintained. The results of the analysis showed the percentage index of soil swelling and shrinkage in the medium category and high category with the percentage of soil having a swelling soil percentage of 5 - 20%. and high above 20% on the BT 68- BT 69 with a value of 27.78%.*

Keywords**—** *Swelling, clay ekspansif, free swelling test, percent swelling.*

I. INTRODUCTION

The soil condition of the existing embankment of the West Primary channel in the Irrigation Area Physically in the field after an inventory survey of the condition of the existing embankment was carried out, it was found that at several points the soil condition of the existing embankment was damaged, such as sliding and cracking of the soil on the existing embankment, especially the top embankment and sloope of the existing embankment[1]. in a wet section and there are several construction buildings at several points damaged, cracks occur from here, it cannot be concluded that the soil condition was expansivebefore laboratory tests, therefore prior to construction the installation of Lining Precastconcrete Block 1x1x0.07 needs to be carried out a soil investigation, especially soil shrinkage swellingtest with the free swelling soil method.

Expanded soil or also called expansive soil,is soil that has the characteristics of large shrinkage, expands in the rainy season and shrinks in the dry season. The amount of development or shrinkage is uneven from one point to another, causing or causing the formation of unstable soil structures(differential movement) [1].

Expansive soil is a type of soil that easily changes in volume due to changes in water content in the soil pores. The water content in the soil pores increases, the volume of the soil expands, while if the soil water content decreases, the soil will shrink[2].The characteristics of this expansive clay tend to cause damage to civil infrastructure. Radyanand Hwa (2000) stated that the reaction of expansiveclay depends on the water content in the soil. Soils achieve a large swelling pressure for a small initial water content, while for soils with a large moisture content they will achieve a low swelling pressure[3].

Soil Shrinkage Factor

The swelling and shrinkage behavior of expansive clay is very complex and influenced by many factors. The influencing factors can be dividedinto 2 categories, namely the effect of expansive clay properties and the effect of environmental conditions on the expansive clay properties [4].

Inflate Percentage and InflatedPressure

Mr Simokura, an experienced soil engineer from Nippon Koei headquarters With long-standing studies of swelling in many countries, it is proposedto follow the standard evaluation for swelling of thesoil, based on the sample studies of India and Deltamas [5].

$$Ps = \frac{Hs - Hi}{Hi} \times 100\%$$

where,
Hi = Initial height of specimen
Hs = Swelling height of specimen

II. METHOD

Research Site

In the West Primary Canal Irrigation Modernization Project, the Span Irrigation Area which has a channel length of about 30 km. which channel is from the ground channel, as for the handling on the left and right slope sides, Precast or precast concrete with a size of 1x1x0.07 m will be installed. The research data used in this study were obtained from the results of 3.2 points with an interval of 500 m, as shown in (Fig. 1) below the location of the research points.

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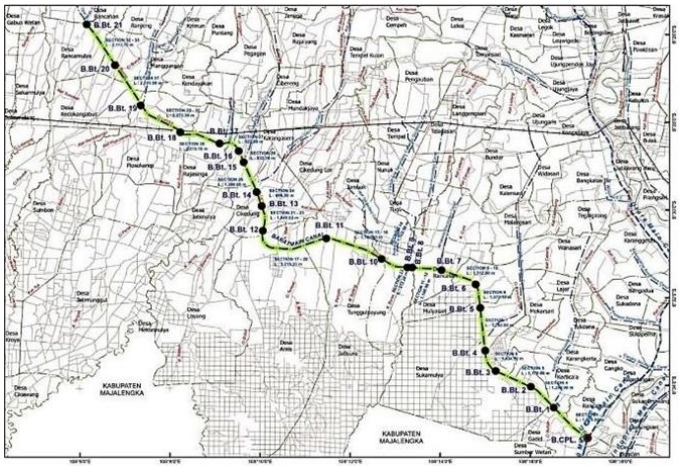

Fig. 1. Map of the Western Mains

Method of Collecting Data

The research data used in this study are data obtained from survey results on the LMS 03 Range Package development project.

Irrigation Modernization Project (RIMP) which is located in Indramayu Regency, West JavaProvince.

The steps for taking data or samples are as follows:

1. Take a soil sample from the existing canal (attached to the project map as shown in figure 2),
2. Basically, existing soil samples should be taken with HandAuger from 0.5 to 1m,

Fig. 2. HandAuger

3. Basically, Soil sampling interval can be 500m. If the soil type changes, the interval should be shorter,
4. Soil samples that have been taken using a hand auger must be put in a plastic bag so that the optimum water content of the field is maintained.
5. Take three samples for each sample point tobe tested,
6. Keep records and pictures of sampling and test results,
7. In addition, prepare a survey report including the preliminary survey conducted.

Data Analysis Method

1. *Adjustment of soil water content:*

Take a soil sample from the target location (shown in the attachment of the project map), and adjust the soil moisture content until it is close to theoptimal moisture content or plastic limit. If the moisture content meets these conditions, the soil will not stick to the hands even after pugging.

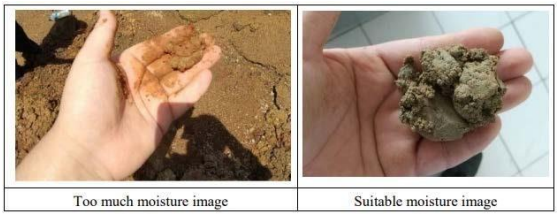

Fig 3. Moisture content

2. *Make a sample of the test soil with a compacted and uniform thickness (3cm) in a beaker:*
   - Make samples 3 cm deep, layer by layer, maximum each layer is 1 cm thick,
   - Compaction of the well in each layer with wooden sticks (2 cm in diameter), filling thespace and air in the placed soil with about 25 to 30 times of compaction,
   - After filling more than 3 cm, trim and level the top surface of the soil specimen to a thickness of 3 cm and also wipe clean the glass around it. (It is recommended to prepare three specimens for each sampling location),
   - Mark the beginning with 3 cm of tape.

Fig. 4. Moisture content

3. *Pouring water and checking the height of the specimen:*
   - Pour water slowly into the glass,
   - Take soil swelling measurements, basically after 1 hour, 2 hours, 24 hours and take photos.

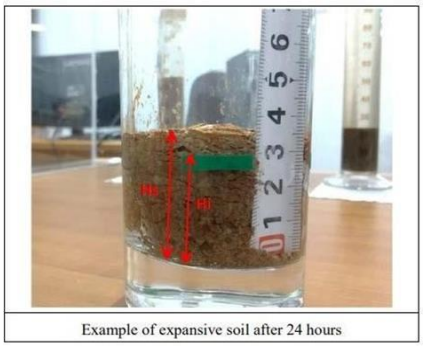

Fig. 5. Example of expansive soil

4. *Calculation of land development rate:*
   - Measurement after 24 hours.
   - Swelling Percentage = 100 (%)

TABLE 1. Percentage of Expansion

Evaluation	Percentage of Expansion (%)
Low	0-5
Middle	5-20
High	20-50
Very High	>50

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III. Result and Discussion

The Result in this research collected in table 2.

TABLE 2. Expansive Soil Test Result

Date	Location (BT)	Nos.	Swelling(cm)	Average (%)	Judgement
09/01/2021	3-4 (R)	1	06.45	06.45	Middle
	8-9 (R)	1	04.17	04.17	Low
	18-19 (R)	1	0	0	Low
		2	0		
		3	0		
	29-30 (R)	1	0	05.54	Middle
		2	03.03		
		3	13.33		
	39-40 (R)	1	03.03	01.01	Low
		2	0		
		3	0		
	49-50 (R)	1	13.33	0,395138889	Middle
		2	03.33		
		3	10		
	68-69 (L)	1	33.33.00	27.78	
		2	0,7131944		
		3	33.33.00		
	77-78 (L)	1	10	11.11	Middle
		2	10		
		3	13.33		
29/03/2021	89-90 (L)	1	0	00.00	Low
		2	0		
		3	0		
	118-119 (L)	1	13.33	11.11	Middle
		2	0,2965278		
		3	13.33		
	128-129 (L)	1	0	00.00	Low
		2	0		
		3	0		
	138-139 (L)	1	03.33	0,295833333	Middle
		2	03.33		
		3	13.33		
	148-149 (L)	1	0	00.00	Low
		2	0		
		3	0		
	164-165 (L)	1	0,2965278	0,395138889	Middle
		2	13.33		
		3	0,2965278		
30/03/2021	175-176 (L)	1	0,2965278	05.56	Middle
		2	10		
		3	0		
	184-185 (L)	1	0	00.00	Low
		2	0		
		3	0		
25/01/2021	191-192 (R)	1	05.13	05.13	Middle
30/03/2021	201-202 (L)	1	0,2965278	03.33	Low
		2	03.33		
		3	0		
	212-213 (R)	1	03.03	03.03	Low
25/01/2021	215-216 (R)	1	0,1430556	0,143055556	Low
	219-220 (R)	1	0	00.00	Low
23/01/2021	222-223 (L)	1	0	00.00	Low
		2	0		
12/03/2021	225-226 (R)	1	14.28	15.39	Middle
		2	15.21		
		3	0,7131944		
23/01/2021	228-229 (R)	1	0,2965278	0,296527778	Middle
	233-234 (R)	1	0,2965278	0,296527778	Middle
25/01/2021	239-240 (R)	1	03.33	0,088194444	Low
		2	0		
30/03/2021	247-248 (R)	1	03.33	04.44	Low
		2	0,2965278		
		3	03.33		
	253-254 (L)	1	05.13	05.13	Middle
25/01/2021	257-258 (L)	1	02.44	02.44	Low
30/03/2021	266-267 (L)	1	13.33	0,345833333	Middle
		2	10		
		3	0		
	276-277 (L)	1	24	0,44375	Middle
		2	0,1486111		
		3	03.03		
09/01/2021	282-283 (L)	1	0	00.00	Low
		2	0		
	293-294 (L)	1	10		Middle
		2	13.33		
30/03/2021		3	10	11.11	
	303-304 (R)	1	0		Low
		2	0		
		3	03.33	01.11	
	315-316 (R)	1	03.33		Middle
		2	10		
31/03/2021		3	0,2965278	0,296527778	
	324-325 (R)	1	03.33	01.11	Low
		2	0		
		3	0		
25/01/2021	331-332 (L)	1	02.56	02.56	Low
	342-343 (R)	1	0	0,296527778	Middle
		2	13.33		
		3	0,2965278		
	352-353 (L)	1	0	03.33	Low
		2	0,2965278		
		3	03.33		
	364-365 (L)	1	0,2965278	03.33	Low
31/03/2021		2	0		
		3	03.33		
	375-376 (R)	1	0,2965278	0,296527778	Middle
		2	10		
		3	03.33		
	387-388 (L)	1	10	13.33	Middle
		2	26.67		
		3	03.33		
09/01/2021	397-398 (L)	1	02.56	12.07	Middle
		2	0,2118056		
		3	29		
30/03/2021	406-407 (L)	1	0	00.00	Low
		2	0		
		3	0		
09/01/2021	416-417 (L)	1	02.07	0,225694444	Low
		2	0,3902778		
		3	03.03		
	425-426 (R)	1	0,7131944	15.56	Middle
		2	26.67		
		3	03.33		
	437-438 (L)	1	20	14.44	Middle
		2	0		
		3	23.33		
	447-448 (R)	1	10	10.00	Middle
		2	10		

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		3	10		
01/04/2021		1	0		
	457-458 (R)	2	0	00.00	Low
		3	0		
		1	10		
	467-468 (L)	2	10	11.11	Middle
		3	13.33		
		1	03.33		
	477-478 (R)	2	03.33	03.33	Low
		3	03.33		
27/01/2021	488-489 (R)	1	0,7131944	0,713194444	Middle
		1	03.33		
01/04/2021	494-495 (L)	2	03.33	04.44	Low
		3	0,2965278		
	500-501 (R)	1	0,1486111	0,148611111	Low
	510-511 (R)	1	0	00.00	Low
27/01/2021	515-516 (R)	1	0	00.00	Low
	520-521 (R)	1	0,2576389	0,257638889	Middle
	521-522 (R)	1	0,5111111	0,511111111	Middle
		1	0		
	526-527 (L)	2	0	00.00	Low
		3	0		
		1	03.33		
	538-539 (L)	2	0	01.11	Low
		3	0		
02/04/2021		1	03.33		
	547-548 (R)	2	0	01.11	Low
		3	0		
		1	10		
	556-557 (L)	2	0,2965278	0,395138889	Middle
		3	10		
27/01/2021	562-563 (R)	1	08.57	08.57	Middle
		1	10		
02/04/2021	574-575 (L)	2	0	05.56	Middle
		3	0,2965278		
	583-584 (R)	1	0,2576389	0,257638889	Middle
27/01/2021					
	588-589 (R)	1	0,2576389	0,257638889	Middle
		1	0		
02/04/2021	595-596 (R)	2	0	00.00	Low
		3	0		
27/01/2021	604-605 (R)	1	07.05	07.50	Middle

From the results of the study it can be concluded that:

1. Existing soil of West Primary Channel Embankment the Span irrigation area in Indramayu district, based on the results of the investigation and the criteria of experts described in the Literature Review, is an active and expansive clay soil and is indicated to have great development potential.
2. Based on the Free Swelling Test method, it was concluded that the clay on the Existing Embankment of the West Primary Canal in the Span Irrigation Area is a soil with small, medium to high development potential.
3. Based on the results of the investigation, which land is indicated to have medium and high soil development potential with 3 categories
4. Small category with a percentage of 0-5% which category does not need special handling of existing soil during construction. The medium category with a percentage of soil that has a swelling soil percentage of5-20% is recommended for handling with mortar and concrete block for the embankment before installing precast concrete block or precast lining on the channel sloop in wet cross section position, peeling the existing soil of the embankment with a thickness of 1 m in the top layer of the embankment and wet section sloop and replaced with new fill soil from the borrow area that has been determined and compactedand then spread mortar before installing Precast Lining

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