B-39

PROPOSED USE CTB FOR WIDENING ROAD CONSTRUCTION IN STA 7+820 TO 8+062

(Including JICT Road Internal Arrangement)

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Abstract :
The use of cement has been widely used for several improvements soil properties, soil properties would be better used as a material for subgrade, subbase and basecourse material. In the case of widening and addition of elevation of the road surface in JICT (STA 7+820 until 8+062) , where Concrete Treated Base (CTB) has been used in road construction basecourse existing, need to be assessed basecourse type that will be used in the widening and the addition of the elevation of the road. In the following article we try to explain the benefits of the use of cement, especially to find a solution in determining basecourse material.

Keywords : *Concrete Treated Base (CTB), Base course*

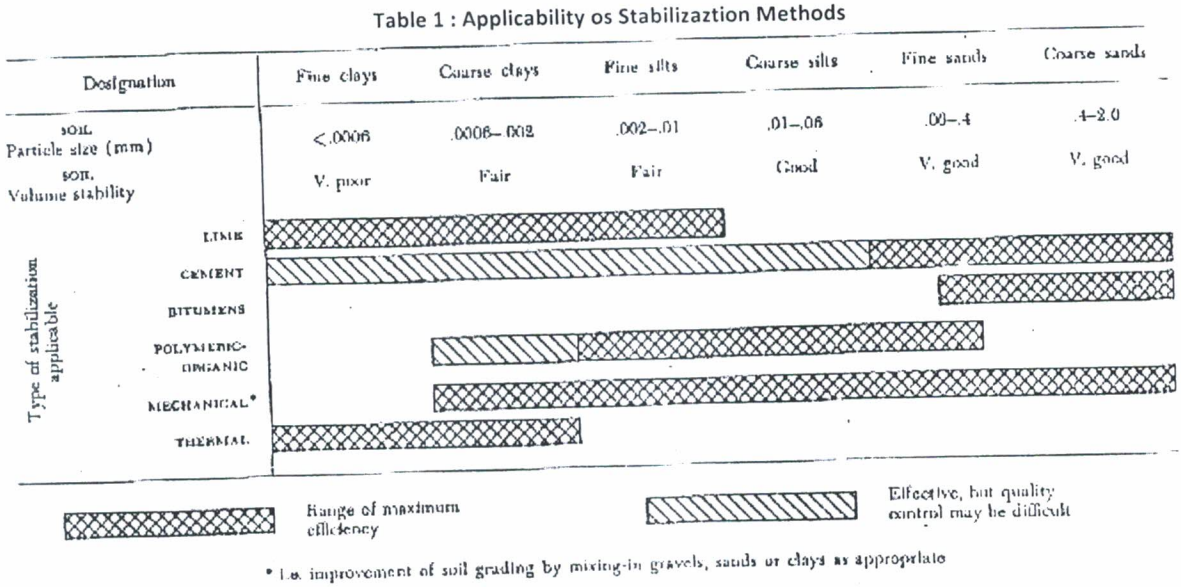
1. APPLICABILITY OF SOIL STABILIZATION METHODS

Application of soil stabilization methods depends on two main things, grained size distribution of soil and material stabilization(cement, lime, bitumens, etc)

It is perhaps appropriate to note , whilst discusing stabilization methods generally, the comparable range of application of these methods. Thus is done in Table 1. it will be seen that reasonable justification exists for such generalization as " use lime for clays and cement for sands ", but no less care should be exercised when stabilizing than with any other construction technique.

In table1, it cemen utilization for soil stabilization materials can be used for all types of soil, but it gets better results when used for soil with coarse gradation (granular soil).

Table 1 : Applicability os Stabilizaztion Methods



* I.e. improvement of soil grading by mixing-in gravels, sands or clays as appropriate

2. CEMENT STABILIZATION

When a material or combination of materials with adequate mechanical stability cannot be obtained, or where enhanced strength or resistance to water softening is required , and it may be advisable to consider stabilization by the addition of cement.

Cement stabilization is widely used for road construction . The technique of cement stabilization involves breaking up (pulverizing) the soil, adding the cement, usually by spreading on the surface of the loose soil, mixing the cement with the soil than watering and compacting until minimum 95% from the maximum dry density in laboratory compaction test.

The additional of even small quantities of cement, up to 2 percent, will modify the properties of gthe soil, whereas large amounts will radically after the properties. a clean gravel with 5 to 10 percent of cement will behave almost like concrete, and indeed may often be referred to as "lean" or "rolled" concrete.

3. SOME REFERENCE SOIL STABILIZATION WITH CEMENT

As the main reference is the use of Cement on existing conditions at the site JICT the CTB layer, by mixing cement with aggregate and water, as thick as 90 cm. Test Californoa bearing ratio (CBR) field has been done on the surface of the CTB to the results CBR value greater than 140%. However, because the work is already done for so long (over 10 years) then we do not get data on the percentage of usage of cement. But the soil is used in the form of granular soil (Gravelly Sand).

Here is the result of other references on cement stabilization :

Table 2 : Typical Properties of Soil Cement Stabilization

Soil Type	Strength (range of kgf/cm² (kN/m²))	E Value kgf/cm² (kN/m²)	CBR [a]	Permeability cm/sec	Thermal Expansion in /in/°C	Volume Change [b]	Comments	Use
Well graded gravel sand clay, sands or gravels	28-105 (400-1500) and more Ratio of wet/dry strength 1.1.3	7.21 x 10³ (1.3 x 10⁶)	More than 600	High Decreased by cement 1.5 x 10⁻³ unstabilized 1.8 x 10⁻⁴ stabilized		Very small loss than 1% (Concrete 0.1%)	Too strong Wide spaced with cracks Suitable for bituminous stabilization	Base for heavy traffic
Silty sandy, sandy clays, sand and gravel	17-35 (250-500)	7 x 10³ (1 x 10⁶)	600	High Decreased by cement		Small	Good material	Base for heavy traffic
Silty sandy clays, poorly graded sands	7-17 (100-250)	3.5-7 x 10³ (5 x 10⁵ 1 x 10⁶)	200	5 x 10⁻⁴ unstabilized 0.1 x 10⁻⁴ stabilized	10 x 10⁻⁶ 7 x 10⁻⁶		Compaction difficulties in sands	Sub-base for light traffic
Silts, silty clays, very poorly graded soils	3.5-10.5 (50-150)	Less than 3.5 x 10³ (Less than 5 x 10⁵)	Up to 100	Low Increased by cement		Moderate		Low grade sub base
Heavy clays organic and subsoils, rich clays	1 - <7 (<100) Ratio of wet/dry strength 1.3	Up to 1.4 x 10³ (Up to 2 x 10⁵)	Up to 50	Very low (10^{-7}) Increased by cement (10^{-5})	10 x 10⁻⁶	High >4% May be increased by cement	Extensive difficulty in mixing Use of lime could be beneficial Special treatment for organic and sulphate soils	possibly for upgrading subgrades

NOTES

[a] Strength given as approximate figure for 7 days cure at constant temperature and moisture content appropriate economic cement content density and moisture content levels. Ratio of U.C.S. to flexure about 4:1 in sand, 3:1 in subsoil. Ratio of U.C.S. to I.T.S. about 10:1.

[b] Static flexure tests. Ratio of static to dynamic values about 1:1. Poissons ratio ranges from 0.1 to 0.3

[c] Approximate figures for mixes with 7 days U.C.S. of 250 psi (accepted U.C.S. for base construction)

[d] Coefficient for concrete 3 to 8 x 10^{-6}, bitumen 8 x 10^{-6}

[e] Only very limited data

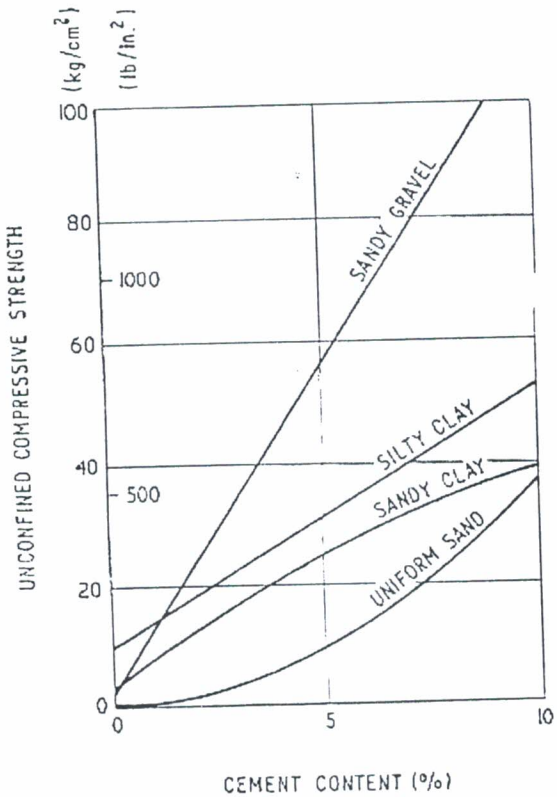


Figure 1 : Effect of cement content on strength for various soil stabilized with ordinary Portland Cement (PC) and cured for 7 days at 25^{0}C, contant moisture content (after Metcalf)

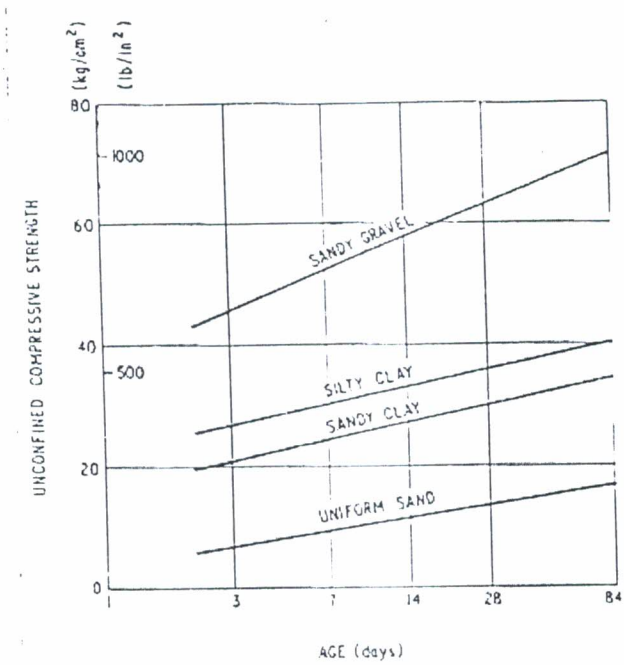


Figure 2 : Effect of age o strength of various soil stabilized with 5 % cement (after Metcalf)

Table 3 : Cement Content for various soil types for pavement construction

Soil Type	Cement Requirement (per cent)
Fine crushed rock	½- 2 [1]
Well graded sandy clay gravels	2- 4
Well graded sand	2- 4
Poorly graded sand	4- 5 [2]
Sandy clay	4- 6
Silty clay	6- 8
Heavy clay	8-12
Very heavy clay	12-15 [3]
Organic soils	10-15 [4]

[1] Used as a construction expedient to aid "set up" on compaction, to reduce sensitivity to compaction moisture content and prevent ravelling under construction traffic.

[2] Compaction may be very difficult, and segregation of the cement may occur.

[3] Mixing may be very difficult — pretreatment with lime may help.

[4] Pretreatment with lime or addition of 2 per cent calcium chloride may help.

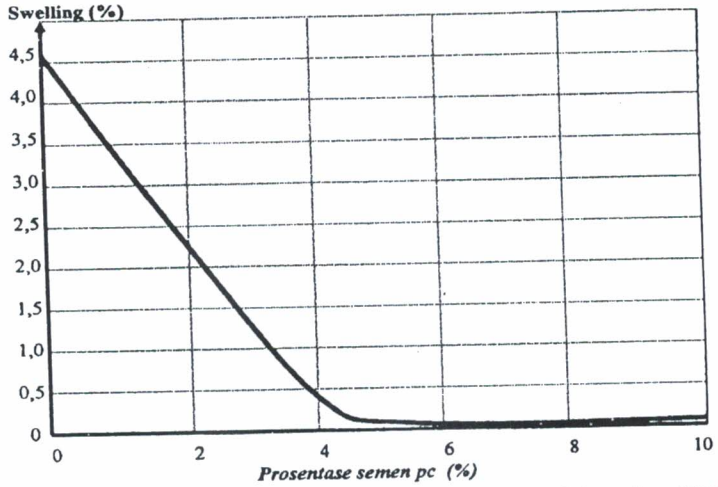


Figure 3 : Effect PC for decreasing swelling in Losari Clay (after Idrus 1990)

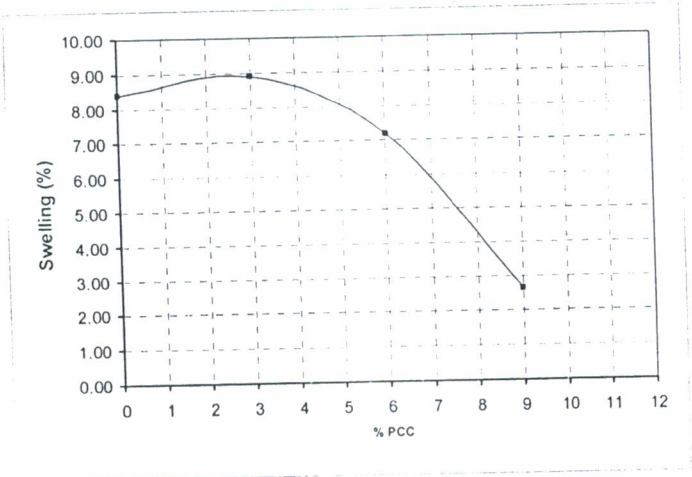


Figure 4 : Swelling effect on using PC in Deltamas/ Cikarang Clay (after idrus 2006)

4. DESIGN EXISTING ROAD

Design of existing roads in the area JICT (STA 7 +820 to 8 +062) can be seen in Figure 5 below:

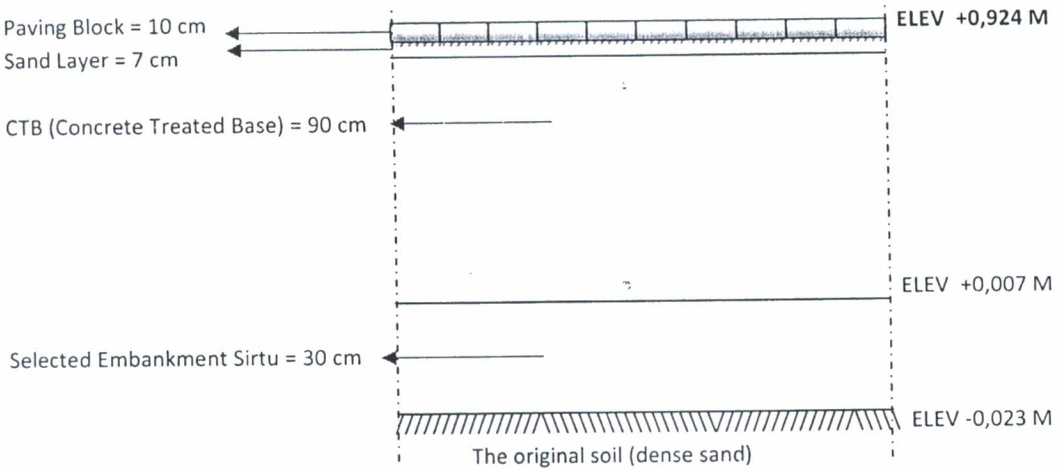


Figure 5 : The existing road construction in STA 7+820 JICT

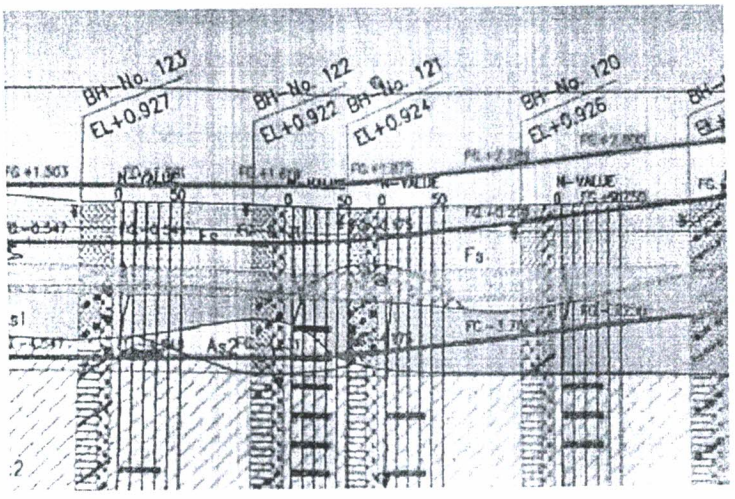


Figure 6 : Sub Soil Condition around STA 7+820

Sub-Soil Description .

- From existing ground to -4,00 meter depth , it is silty sand or sand with dense to very dense consistency
- From -4,00 meter to -6,00 meter, it is silty sand with medium consistency

4. SUGGESTED USING BASE COURSE WITH CTB.(CONCLUTION)

In the case of widening of existing roads in the STA and +820 to 8 +062, we recommend using the same base course with the existing base course using Conctere Treated Base (CTB) of at least 90 cm thick. The reason is that in order to obtain the same behavior on a layer of base course while receiving the vehicle load.

To create a layer of CTB in this case, to consider some of the following:

- Selected sub-base material (aggregate), a Gravelly sand (gravel)
- The use of portland cement by a certain percentage. In this case, we recommend using 8% cement by weight of dry aggregate used
- The implementation method of mixing aggregate with cement in the field
- The addition of water (if required) and compaction.
- Perform compaction layer by layer (30 cm / layer), up to 90 cm thickness CTB.
- Perform quality controle in the field CBR test a few days after the compaction from the field.
- After CTB thickness is reached (90 cm), above given Lean Concrete Wet 10 cm, then use the plastic polyethene 120 μ coating.
- After a layer of plastic polyethene 120 μ, then rigid concrete pavement with 35 cm thick and 5 cm above the coated asphalt surfacing layer.

Drawing road construction suggested the following:

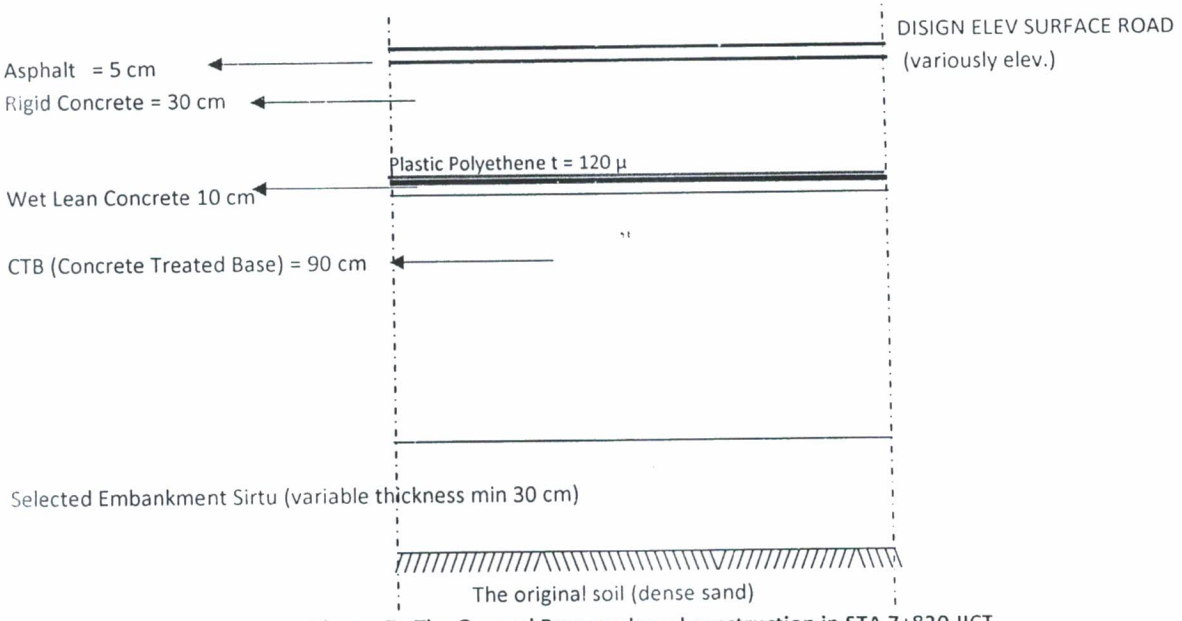


Figure 7 : The General Proposed road construction in STA 7+820 JICT

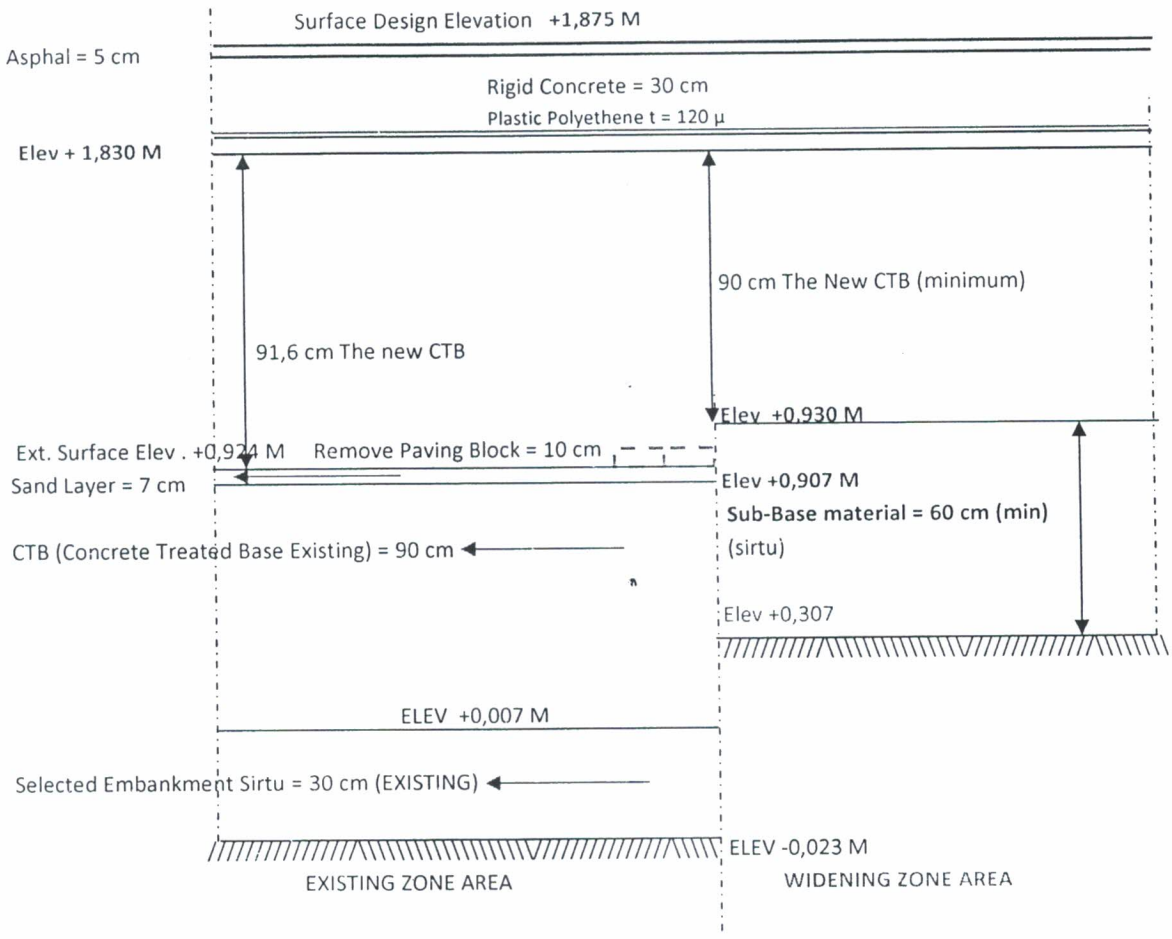


Figure 8 : The Proposed Road Construction in STA 7+820 JICT

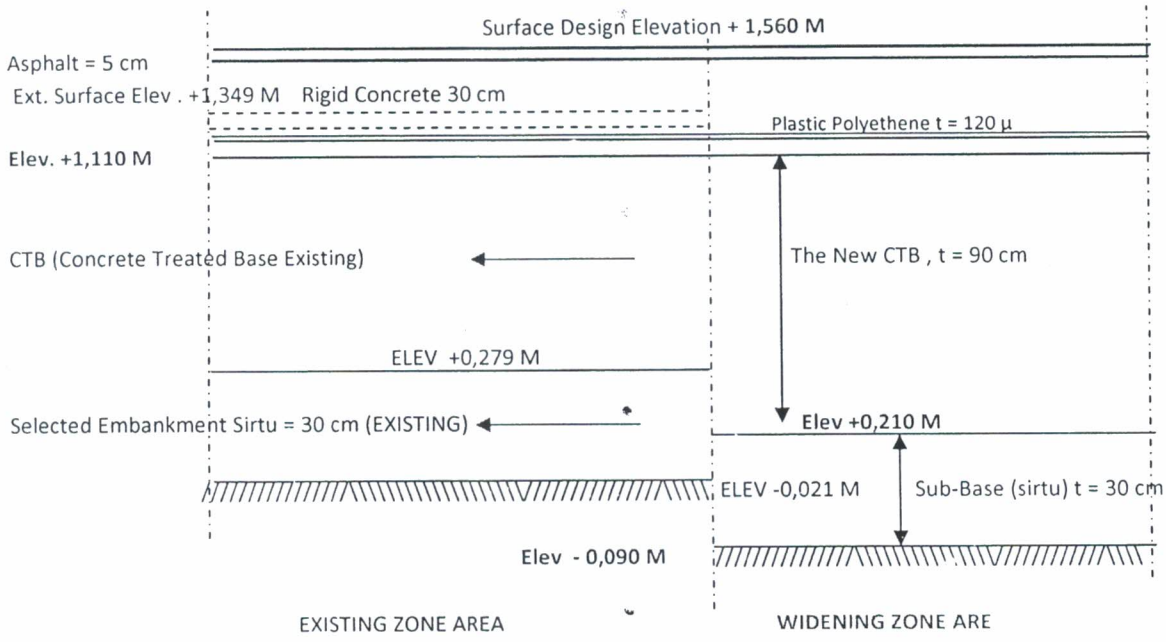


Figure 9 : The Proposed Road Construction in STA 8+000 JICT

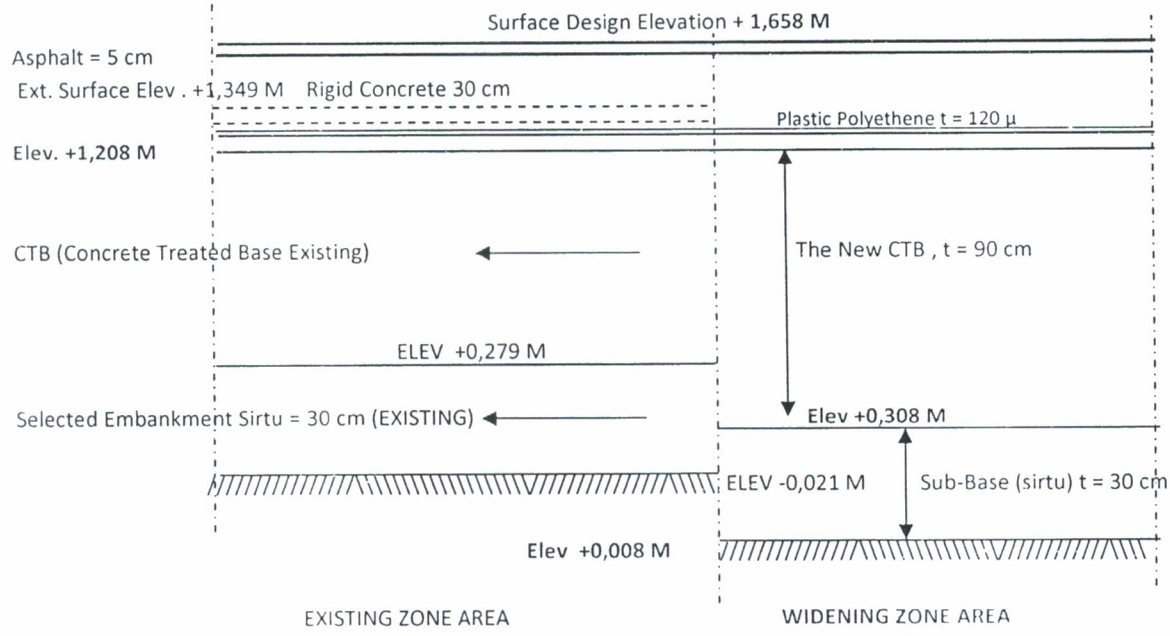


Figure 10 : The Proposed Road Construction in STA 8+060 JICT

4.1. ANALYSIS OF THE USE OF PERCENTAGE OF CEMENT

As explained earlier in this paper, that almost any type of soil can be stabilized with cement. Cement will greatly affect the changes in soil properties. But more effective if the soil used is granular soil, such as sub-base material (gravelly sand).

The percentage of cement to be used, should be done first conducted research in the laboratory. From these studies the use of cement will be obtained in accordance with the percentage of usage needs.

But in some references, that to get a high California Bearing ratio (CBR) after mixing with cement, then the percentage of cement in general, at least 4% and a maximum of 12%. If the percentage of cement consumption more than 12%, then it is no longer efficient.
For that we recommend persentage use of cement used to create a layer of Cement Treated Base (CTB) is 8% of the dry weight of aggregate used.
Type of cement used is type 2, which is commonly used for building purposes.

4.2. SUGGESTIONS

we suggest to carry out the work CTB in field, should be performed by an experienced practitioner using the usual equipment for working on site soil stabilization. There is a special machine to mix aggregate with cement and compacting the field with a maximum thickness of 30 cm on each layer.

4.3. CALCULATION PERCENTAGE USE OF CEMENT :

For example : for 1 (one) truck with 24 ton of selected sub-base copurse (sirtu) with water content (approximately) is w= 20%. Using 8% of cement

How much cement is required ?
Dry weight of agregate is = Wdry = (W soil) / (1-w)
= (24.000)/(1,20) = 20.000 kg
Cement needed = 0,08 x 20.000 kg = 1.600 kg.
If per zak cement is 50 kg, the total zak cement needed = 1.600/50 = 32 zak of cement
The type of cement required is Portland Cement Type II (two) .

Reference :

1. Soil Stabilization , Principles and Practise, O.G Ingles , JB Metcalf, Butterworth,1972.
2. Stabilized Earth Roads, A. Kezdi, Elsevier Scientific Publishing Company, 1979.
3. Stabilisasi Lempung Expansive dengan SCMT Methods, Festival Soil Stabilization with PC, Idrus Muhammad, 2006.