

Technical Note No: 3

Sub: APRRP- Construction of New Roads – Cement Stabilization with High-End machinery instead of conventional provisions- Economical where the subgrade CBR is 5% or more -Report- Reg.

Ref:1) IRC: SP:72-2015: Guidelines for the design of flexible pavements for low volume Rural Roads (First Revision).

2) Soil stabilization with WIRTGEN soil stabilizer WR 240 & Cement Spreader.

1. Pre-requisites for Suitable and Economical Designs:

There are a number of important points to be considered while evolving suitable and economical designs for the low volume rural roads .First and foremost is the aspect of practical implements of the recommended designs within the available resources and level of expertise in rural areas, availability of equipment / plant for construction and maintenance as well as the level of quality control that can be effectively exercised in rural areas. To the extent possible, the use of locally available materials as such or after suitable processing has to be maximized in the larger interest of economy.

2.Present scenario:

At present based on the subgrade strength and Traffic, crust of new road / upgradation road will be designed and provisions are made accordingly in the estimate. The conventional provisions like GSB and WMM as base are proposed even though the metal quarries are too far from the work spot. In some of the Districts the lead of the metal quarries is about 90 Kms particularly in Coastal Districts which leads high construction cost per Km.

For Example, for new road if the subgrade CBR is 5% and Traffic category is T4, the crust required as per IRC:SP:72 is 150 mm GSB and 150 mm WMM. The total quantity of material about 1507 Cum per 1 Km length of road (GSB;729 cum+ 778 Cum WMM) is to be transported from a distance of about 90

kms, so it involves huge cost towards transportation, extensive quarrying and stone processing operations.

The conventional methodology of road construction requires at least two months for 1 Km as it involves of several layers like GSB, WMM & BT one after the other during the construction process. During the entire period of the construction, traffic must either be diverted or restricted causing a huge inconvenience to the daily commuting life of common public.

The conventional road construction requires an approximately of 133 Trips (4 Units) vehicular movement which causes air and noise pollution.

In some cases, rise in the embankment will also noticed due to laying of several layers like GSB, WMM etc. which will cause inundation of nearby houses during rainy season.

3.Proposals: Cement Treated Base:

IRC: SP:72-2015 specified certain crust design charts vide Fig 6 for Cement Treated Bases and Subbases for implementation in Rural Roads.

For Example: If the subgrade CBR is 5% and the Traffic is T4, the crust required is 110 mm CT subbase and 100 mm CT base as against the conventional crust of 300 mm. In this case the available subgrade soil CBR is 5%, the existing soil / Borrowed soil with little modification in terms of grading can be utilized for cement stabilization instead of bringing metal from far away quarries. If necessary, certain thickness with available soil having CBR 5% which satisfies the properties and gradation mentioned below vide Table 7&8 can be used for profile correction /raising the road. By adopting these provisions, the cost per km will be minimized when compared to conventional cost.

The suitability of soils and Gradation for subbase/Base stabilization with cement will be as follows as per IRC: SP: 89- 2010 (Table 7&8).

4.2.2 Requirement for bound sub-bases/bases

Granular materials, gravel, sand, lateritic soils, sandy silty material, crushed slag, crushed concrete, brick metal and kankar, etc. stabilized with either cement or lime-fly ash-cement or lime-fly ash, etc. may be allowed for use as capping layer over weak subgrade, as sub-base and base layer of pavement. The main requirements of stabilized layers for different layers of a pavement structure as indicated above are summarised in **Table 7 and 8**. The gradations indicated in **Table 8** are intended as tentative specifications. Gradation for cement bound materials as per MoRTH specifications can also be adopted. However, thickness of different stabilized layers, selection/choice for adoption of a particular grading and strength requirements of these layers are to be decided on the basis of pavement design and with specific approval of the Engineer-in-Charge.

Table 7 Material Characteristics for Cement Modified Granular Materials

Properties	Specified Value
Liquid Limit (%)	<45
Plasticity Index	<20
Organic content (%)	<2
Total SO ₄ content (%)	0.2
Water absorption of coarse aggregates	<2% (If the is value is >2% the soundness test shall be carried out on the materials delivered to site as per IS 383)
10 percent fines value when tested as per BS 812(III)	≥ 50 kN

**Table 8 Gradation Requirement for Cement Bound Materials for
Base/Sub-bases/Capping Layer**

Sieve size	Grading I	Grading II	Grading III	Grading IV
75.0 mm		100		100
53.0 mm	100	80-100	100	--
45.0 mm	55-100			
37.5 mm			--	95-100
26.5 mm		55-90	70-100	55-75
22.4 mm	60-80			
11.2 mm	40-60			
9.5 mm		35-65	50-80	
4.75 mm	25-40	25-55	40-65	10-30
2.36 mm	15-30	20-40	30-50	-
0.600 μ		-	-	
0.425 μ	8-22	10-35	15-25	-
0.300 μ		-		
0.075 μ	0-8	3-10	3-10	0-10
7 days Unconfined Compressive Strength (MPa) for cement bound materials or 28 days strength for lime-fly ash & lime-cement-fly ash bound materials	12*/6**	7*/4.5**	3*/1.5**	1.5*/0.75**

* Average value of a batch of 5 cubes

** Minimum strength of an individual cube within the batch. For Grading IV the unconfined compressive strength and CBR requirement are equally acceptable alternatives

But in practice even though the Subgrade CBR is equal or more than 5%, the estimates are approved with conventional GSB and WMM which will lead to increase in cost per km due to transportation of metal from far away quarries. For such type of subgrades, it is suggested to adopt Cement stabilization with High - end Machinery which will be economical when compared to conventional provisions.

The other added advantages of using Cement Stabilization with High end machinery are:

- Minimizing the usage of coarse aggregate, reduce air pollution.
- Conservation of Natural resources.
- Less construction time, one Km of road can be laid in a single day or at least in two days.
- Construction Vehicular traffic will be minimized since little quantity of material is required for blending if necessary.
- Road levels will be maintained as it is due to utilization of existing soil for stabilization.
- The finished road will be High strength and Durability when compared to conventional road.
- High ecological advantageous.
- Less energy is consumed overall.
- Cost advantage.

4. Process of Stabilization:

Mix -in-place stabilization: Normally this procedure is adopted in the field at present. In this process the material is stabilized in-situ which requires the stabilizing agent (cement) to be spread before or during the pulverization **manually** and mixing of the soil and stabilizer. This is generally carried out with agricultural machinery is being used for in -situ stabilization.

The Process of in-situ Cement Stabilization with semi mechanized equipment is as follow.



Fig 1. Spreading of construction material



Fig 2. View of Cement bags laying for Stabilized Layer.



Fig 3. View of Cement Spreading



Fig 4. View of Dry mixing with Rotavator



Fig5. View of Water Addition



Fig6. View of Wet Mixing by Rotavator



Fig 7. View of rolling after Grading



Fig 8. View of curing of finished Stabilized layer

As per the experiences in the field it is too difficult to get uniform mixing of soil and cement by using semi mechanized machinery due to which strength of CT Subbase and CT Base will differ from one place to other which results into bad quality of work.

To overcome the above difficulties cement stabilization can be done using High - end machinery such as Recycler for full depth recycling along with Cement spreader and 20T Pad foot vibratory Roller to get uniform mixing and required strength since the machines are sophisticated and controlled by sensors. These machines are now used and proved in Stabil Road Technology works and the results are satisfactory.

The Process of in-situ Cement Stabilization with High- end machinery is as follows.



Fig 1. Spreading of construction material
For stabilized layer



Fig 2. High End Recycler with automation



Fig 3. High End Cement Sreader



Fig 4. Mixing with Recycler at OMC



Fig 5. Rolling with 20T Pad foot Roller



Fig 6. Grading with Grader



Fig 7. Rolling with Vibratory Roller



Fig 8. Curing of finished Stabilized layer.

Hence the above machinery may be used in cement stabilization instead of semi mechanized machinery in construction of Roads where the subgrade CBR is equal to or greater than 5%.

5. Results:

The cost economics are worked out with the rates available in three districts for traffic T4&T5 and subgrade strength of 5% duly comparing with the conventional provisions as per Fig 4 and Cement treated subbases and base as per Fig 6 of IRC: SP:72-2015. In the data 4% of cement was taken for comparison and it will vary as per actual mix design to attain a minimum laboratory 7- day unconfined compressive strength of 3 MPa vide clause 7.2.3 of IRC:SP:72-2015. The details of comparison of Conventional and Cement treated crust are enclosed in **ANNEXURE I**.

As seen from the comparative statement it is evident that the cost per km of CTB is less than the cost per km of conventional crust in all the cases. If the Metal quarries are too far, the savings per Km is much more when compared to the quarries situated nearby.

The cost of saving per km ranges from Rs 3.64 lakhs to Rs 18.52 lakhs depending up on the lead of metal and gravel.

The Hire charges adopted for the above High-End machinery in the preparation of data for CTB are based on the rates approved by the Technical Committee formed by the Govt for finalization of Stable Road Technology.

5. Conclusions:

a) Based on the economics and strength criteria it is better to adopt Cement Treated Base using High - End machinery for stabilization as against the conventional provisions where the subgrade soil CBR is 5% and more and the borrowed soil/ Gravel which satisfies the codal requirements as per IRC:SP:89-2010 to minimize the cost per Km.

b) This technology may be adopted for the districts for New Construction of Roads where the metal quarries are too far, i.e above 30 Kms after analyzing the cost economics compared to conventional provisions case by case in future estimates under all grants.

Encl: 1. Annexure I
2. Data for CTB with High end machinery
3. Details of data of 3 Districts.
4. Fig 6: Pavement design catalogues for Cement Treated Bases and Sub-Bases.

Design engineer

PMC.APRRP

Annexure -I

Comparative Statement									
S. No / Name of the District	Conventional Crust with GSB and WMM			Cement Treated Base using Written Recycler, Cement Spreader, Motor Grader and 20 T Pad foot roller (Fig 6 of Cement treated Bases as per IRC: SP:72-2015)				Savings with CTB by using High End machinery Rupees	Remarks
	Subgrad e CBR & Traffic Category	Crust as per IRC	Cost in Rupees	Subgrad e CBR & Traffic Category	Crust required as per IRC: SP:72-2015	Crust proposed for Stabilizatio n	Cost in Rupees		
1) WG Dist. (Eluru Divn)	1.CBR:5% & T4	GSB: 150 mm WMM: 150 mm	19,90,482	5% & T4	210 mm (110 mm thick CT subbase and 100 mm Thick CT base)	210 mm thick New material	15,82,114	4,08,368	210 mm thick barrowed material (New) including cost and spreading.
	2.CBR: 5%, T5	GSB: 175 mm WMM : 150 mm	21,26,511	5% & T5	225 mm (125 mm thick CT subbase and 100 mm Thick CT base)	225 mm thick New material	16,95,142	4,31,369	Metal: 29 kms, SE/Gravel: 31 Kms.

S. No / Name of the District	Conventional Crust with GSB and WMM			Cement Treated Base using Written Recycler, Cement Spreader, Motor Grader and 20 T Pad foot roller (Fig 6 of Cement treated Bases as per IRC: SP:72-2015)				Savings with CTB by using High End machinery Rupees	Remarks
	Subgrad e CBR & Traffic Category	Crust as per IRC	Cost in Rupees	Subgrad e CBR & Traffic Category	Crust required as per IRC: SP:72-2015	Crust proposed for Stabilizatio n	Cost in Rupees		
2) Krishna Dist. (Nuziveed u Div.) SSR : 17- 18	CBR: 5%, T4	GSB: 150 mm WMM: 150 mm	31,73,790 (Metal: 93 Km)	5% & T4	210 mm (110 mm thick CT subbase and 100 mm Thick CT base)	210 mm (New material Selected Earth/ Gravel)	13,21,672 (SE/Gravel :8 km)	18,52,118	210 mm thick barrowed material (New)including cost and spreading.
3) Srikakula m Dist. SSR : 18- 19.	CBR: 5%, T5	GSB: 175 mm WMM : 150 mm	17,64,472 (Metal : 12 Km)	CBR: 5%, T5	225 mm (125 mm thick CT subbase and 100 mm Thick CT base)	225 mm thick New material	14,00,100 (SE/Gravel :5 km)	3,64,372	225 mm thick barrowed material (New)including cost and spreading

Data For CTB

Cement Treated Soil Sub Base/ Base (SOR 1918-19)							
No	Index Code	Description	Unit	Quantity	Rate Rs	Cost Rs	Remarks
6		Cement Treated Soil Sub Base/ Base					
A	RBR - SBBS -6	Construction of Recycling granular material (In situ), pulverising, adding the designed quantity of cement to the soil using truck mounted self propelled Cement Spreader and ,, mixing in place with Four wheeled drive Recycler , Compacting with 20T Pad foot Vibratory Roller , grading with the motor grader and further rolling with Vibratory road roller at OMC to achieve the desired unconfined compressive strength and to form a layer of base as per technical Specification Clause 404 MORD and Further curing for 7 Days.					
		Unit = cum					
		Taking output = 300 cum (525 tonnes)					
		For 4 per cent quantity of cement by weight of soil					
		a) Labour					
		Mate	day				
		Mazdoor skilled	day	2.48	400	992	
		Mazdoor	day	10	400	4000	
		Add MA on Labour		0		0	
		b) Machinery					
		Hydraulic Excavator 0.9 cum bucket capacity	hour	5	2791.6	13958	
		Tipper 5.5 Cum	hour	14	950.3	13304.2	
		Moter grader 110 HP @50cum per hour	hour	6	2748	16488	
		Three wheel 80-100 KN Static roller @70 Cum per Hour	hour	4.3		0	
		OR					
		Vibratory roller 8 - 10 KN @60 Cum per Hour	hour	6	2736.2	16417.2	
		Tractor with Rotavator and blade @ 25 cum per hour	hour	12		0	
		Water tanker 6 KL capacity	hour	5	655.2	3276	
		c) Material					
		Cement at Site @ 4%	tonne	21	3900	81900	
		Water tanker 6 KL capacity (For Curing)	hour	5	655.2	3276	
		Cost of water	KL			0	

		Hire Charger for Recycler, 20 T Pad Foot Roller and Cement Spreader	Sqm	1000	207.7 1	207710	
		d &e) Overheads & Contractors Profit				49193.9 1	
		Cost for 300 cum = a+b+c+d+e				410515. 3	
		Rate per cum= (a+b+c+d+e)/300				1368.38	
		Rate Per Sqm (0.3 Cum/ Sqm)				410.52	
		Rate Per Sqm (0.21 Cum/ Sqm)				287.35	
		Rate Per Sqm (0.225 Cum/ Sqm): Rs 307.88					
		Rate analysis for Hire Charges for Recycler, Cement Spreader, Heavy Pad foot Roller 20 T, as approved by the Committee					
	Sl.No	Name of the Equipment	No	Hire Charges as per SSR 17-18			
	1	Recycler	1	38658.94	Per Hour		
	2	20 T Pad Foot Roller	1	14382.25	Per Hour		
	3	Cement Spreader	1	19659.71	Per Hour		
		Total		72700.9	Per Hour		
		Per 1 Sqm: 72700.90/350: Rs 207.71 (Taking output as 350Sqm per hour)					
		-					

Krishna Dist.Nuziveedudivn SSR: 2017-18								
N.W: R/F Ramalayam to Mekala H/W of CheepuruGudem (V) of Chatrai (M) of Krishna Dist								
			Length	Width	Depth	Total Qty	Rate per	Amount
			Mts	mts	mts	Cum	1 cum	in Rs
Conventional : T4 :Construction of granular sub-base by providing well graded HBG material (Grading III material) (Table 400.1A), spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with smooth wheel roller 80-100 kN / vibratory roller to achieve the desired density, complete as per Technical Specification Clause 401 MORD including cost of all materials, labour, conveyance, hire charges of machinery, but excluding GST and Seignorage charges etc., complete for finished item of work.								
			1000	4.05	0.15	608	2294.6	1393951
						cum	1 cum	
Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the material with water at OMC in mechanical mixer (Pug Mill), carriage of mixed material by tipper to site, laying in uniform layers in sub-base/base course on a well prepared sub-base and compacting with smooth wheel roller of 80 to 100kN / Vibratory Roller 80-100 kN weight to achieve the desired density including lighting, barricading and maintenance of diversion, etc as per Tables 400.11 & 400.12 and Technical Specification Clause 406 MORD/ MORTH, including overhead charges & Contractor profit, but excluding GST and Seignorage charges etc., complete for finished item of work.								
			1000	3.9	0.15	585	3042.5	1779839
						Cum	1 cum	
					Total Rs			3173790
Construction of Recyding granular material (In situ), pulverising, adding the designed quantity of cement to the soil using truck mounted self propelled Cement Spreader and ,, mixing in place with Four wheeled drive Recycler , Compacting with 20T Pad foot Vibratory Roller , grading with the motor grader and further rolling with Vibratory road roller at OMC to achieve the desired unconfined compressive strength and to form a layer of base.as per technical Specification Clause 404 MORD and Further curing for 7 Days.(Cement Treated Base)210 mm thick. T4								
			1000	3.9		3900	287.35	1120665
						Sqm	1 Sq.m	
Cost and spreading of Selected Earth/Gravel 210 mm thick(New) is considered for Stabilization including cost and spreading.								
			1000	3.9	0.21	819	245.43	201007
						Cum	1 Cum	
					Total Rs			13,21,672
Note:			SoR: 2017-18					
Metal Lead			93 Kms					
Selected Earth (Gravel) Lead			8 Kms					
SubGradeCBR: 5%, T4								
Conventional Crust as per Fig 4		Cement Treated crust as per Fig 6						
GSB: 150 mm		Subbase		110 mm				
WMM :150 mm		Base		100 mm				

WG Dist								
	N.W: R/F Tadimetta to Chikkala of Chagallu (M) of WG Dist							
4	Granular Sub-Base with Well Graded Material (Table:- 400- 1) A for Grading-III Material (CBR Value minimum 20)							
	RBR-SBBS-1-A iii	Construction of granular sub-base by providing well graded HBG material (Grading III material) (Table 400.1A), spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with smooth wheel roller 80-100 kN / vibratory roller to achieve the desired density, complete as per Technical Specification Clause 401 MORD including cost of all materials, labour, conveyance, hire charges of machinery, but excluding GST and Seignorage charges etc., complete for finished item of work.						
		Taking out put = 300 cum						
	a)	Labour						
		Mazdoor (Skilled)	day	2.4	400	960		
		Mazdoor (Un-Skilled)	day	8	400	3200		
						4160		
		Add for MA @		0	4160	0		
	b)	Machinery						
		Vibratory Roller 80-100 KN @10cum per hour	hour	6	2736.2	16417.2		
		Tractor with rotavator @ 25 cum per hour	hour	12	423.6	5083.2		
		Tractor with grader @ 25 cum per hour	hour	12	423.6	5083.2		
		Water tanker 6kl capacity	hour	3	655.2	1965.6		
	c)	Material						
		Coarse graded granular sub-base material						
		Cost of materials						
		9.5 mm to 4.75 mm @ 66 per cent (metal)	cum	237.6	1003.2	238361.1		
		2.36 mm below @ 34 per cent (Stone dust)	cum	122.4	683.66	83679.98		
		Cost of water	Kl	18	0	0		
		Basic rate of Granular sub base for 300 cum				354750.3		
		Basic rate of Granular sub base cum				1182.5		
		Add 13.615% for Overhead charges & Contractors profit (excl. GST)			0.14	161		
						1343.5		
		Rate per cum			Rs.	1343.5		

5		Wet Mix Macadam					
	RBR-SBBS-11	Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the material with water at OMC in mechanical mixer (Pug Mill), carriage of mixed material by tipper to site, laying in uniform layers in sub-base/base course on a well prepared sub-base and compacting with smooth wheel roller of 80 to 100kN / Vibratory Roller 80-100 kN weight to achieve the desired density including lighting, barricading and maintenance of diversion, etc as per Tables 400.11 & 400.12 and Technical Specification Clause 406 MORD/MORTH, including overhead charges & Contractor profit, but excluding GST and Seignorage charges etc., complete for finished item of work.					
		By Mechanical Means with 1 km lead					
		By Mechanical Means					
	A	Rural Works					
		Taking out put = 100 cum					
	a)	Labour					
		Dresser (skilled) for alignment	day	8	440	3520	
		Mazdoor (Skilled)	day	2.4	400	960	
		Add for MA @		0	4480	0	
	b)	Machinery					
		Front end loader 1 cum capacity	hour	4	1594.7	6378.8	
		Wet mix plant (Pug Mill)	hour	4	1679.7	6718.8	
		Tipper or dumper (10 t) Capacity	hour	5	950.3	4751.5	
		Tractor with grador @ 25 cum capacity	hour	4	423.6	1694.4	
		Vibratory Roller 80-100 KN @60cum per hour	hour	1.67	2736.2	4569.45	
		Water tanker 6kl capacity	hour	1.33	655.2	871.42	
	c)	Material					
		Coarse aggregate 45 to 22.4 mm using M/C metal @ 30% (Average of 40-45 mm, 25-27mm & 19-22mm metal)	cum	39.9	1419.08	56621.16	
		Aggregates 22.4mm to 2.36mm using M/c metal @ 40% (Average of 19-22mm,12-14mm,	cum	53.2	1190.19	63317.9	

		9.5-11.20mm,5-7mm & 2.36-5mm metal)						
		Fine aggregate/crushed sand 2.36 mm to 75 micron @ 30%	cum	39.9	683.66	27278.03		
		Cost of water	Kl	8	0	0		
		Basic rate of WMM for 100 Cum				176681.5		
		Basic rate of WMM per Cum				1766.81		
	e)	Add 13.615% for overs head charges & Contractors profit (excl. GST)			0.14	240.55		
						2007.36		
		Rate per cum			Rs.	2007.36		
		Conventional : T4 : Construction of granular sub-base by providing well graded HBG material (Grading III material) (Table 400.1A), spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with smooth wheel roller 80-100 kN / vibratory roller to achieve the desired density, complete as per Technical Specification Clause 401 MORD including cost of all materials, labour, conveyance, hire charges of machinery, but excluding GST and Seignorage charges etc., complete for finished item of work.						
		1000 x 4.05x 0.15 = 607.5x1343.50			816176			
		Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the material with water at OMC in mechanical mixer (Pug Mill), carriage of mixed material by tipper to site, laying in uniform layers in sub-base/base course on a well prepared sub-base and compacting with smooth wheel roller of 80 to 100kN / Vibratory Roller 80-100 kN weight to achieve the desired density including lighting, barricading and maintenance of diversion, etc as per Tables 400.11 & 400.12 and Technical Specification Clause 406 MORD/ MORTH, including overhead charges & Contractor profit, but excluding GST and Seignorage charges etc., complete for finished item of work.						
		1000 x 3.90x 0.15 = 585 Cum x 2007.36 =			1174306			
			Total Rs		19,90,482			

		Construction of Recycling granular material (In situ), pulverising, adding the designed quantity of cement to the soil using truck mounted self propelled Cement Spreader and ,, mixing in place with Four wheeled drive Recycler , Compacting with 20T Pad foot Vibratory Roller , grading with the motor grader and further rolling with Vibratory road roller at OMC to achieve the desired unconfined compressive strength and to form a layer of base.as per technical Specification Clause 404 MORD and Further curing for 7 Days. (Cement Treated Base) 210 mm thick Stabilization, T4						
		1000 x 3.90 = 3900 Sqm x287.35 =		1120665				
			1 Sqm					
		Cost and spreading of Selected Earth / Gravel 210 mm thick(New) for Stabilization Total crust as per Cement Stabilization Chart : 210 mm) including cost and spreading						
		1000x3.9x0.210= 819 cum x 563.43/1Cum		461449				
			Total Rs	1582114				
		Note:	SoR	2018-19				
		Metal Lead	29 Kms					
		Selected Earth(Gravel) Lead	31 Kms					
		Sub Grade CBR : 5%, T4						
		Conventional Crust as per Fig 4	Cement treated Crust as per Fig 6					
		GSB: 150 mm	CT subbase	110 mm				
		WMM : 150 mm	Base	100 mm				
		300 mm		210 mm				
Conventional : T5 : Construction of granular sub-base by providing well graded HBG material (Grading III material) (Table 400.1A), spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with smooth wheel roller 80-100 kN / vibratory roller to achieve the desired density, complete as per Technical Specification Clause 401 MORD including cost of all materials, labour, conveyance, hire charges of machinery, but excluding GST and Seignorage charges etc., complete for finished item of work.								
			1000	4.05	0.175	708.75	1343.5	952205.6
						cum	1 cum	

Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the material with water at OMC in mechanical mixer (Pug Mill), carriage of mixed material by tipper to site, laying in uniform layers in sub-base/base course on a well prepared sub-base and compacting with smooth wheel roller of 80 to 100kN / Vibratory Roller 80-100 kN weight to achieve the desired density including lighting, barricading and maintenance of diversion, etc as per Tables 400.11 & 400.12 and Technical Specification Clause 406 MORD/ MORTH, including overhead charges & Contractor profit, but excluding GST and Seignorage charges etc., complete for finished item of work.								
			100 0	3.9	0.15	585	2007.4	1174306
						Cum	1 Cum	
					Total Rs			2126511
Construction of Recycling granular material (In situ), pulverising, adding the designed quantity of cement to the soil using truck mounted self propelled Cement Spreader and ,, mixing in place with Four wheeled drive Recycler , Compacting with 20T Pad foot Vibratory Roller , grading with the motor grader and further rolling with Vibratory road roller at OMC to achieve the desired unconfined compressive strength and to form a layer of base.as per technical Specification Clause 404 MORD and Further curing for 7 Days. (Cement Treated Base) 225 mm thick stabilization, T5								
			100 0	3.9		3900	307.88	1200732
						Sq.m	1 Sq.m	
Cost and spreading of Selected Earth / Gravel suitable for cement stabilization as per code 225 mm thick(New) including cost and spreading.								
			100 0	3.9	0.225	877.5	563.43	494410
						Cum	1 Cum	
					Total Rs			1695142
Note:			SoR	2018-19				
Metal Lead				29 Kms				
Selected Earth (Gravel) Lead				31 Kms				
Sub Grade CBR: 5%, T5								
Conventional Crust as per Fig 4			Cement Stabilization Crust as per Fig 6					
GSB 175 mm			CT Sub base	125 mm				
WMM: 150 mm			CT Base	100 mm				

Srikakulam Dist, N.W : CHR Road to G.SigadamRS via Niddam&Addonampeta.							
4	RBR-SBBS-1-A iii	Granular Sub-Base with Well Graded Material (Table:- 400- 1) A for Grading-III Material (CBR Value minimum 20)					
		Construction of granular sub-base by providing well graded HBG material (Grading III material) (Table 400.1A), spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with smooth wheel roller 80-100 kN / vibratory roller to achieve the desired density, complete as per Technical Specification Clause 401 MORD including cost of all materials, labour, conveyance, hire charges of machinery, but excluding GST and Seignorage charges etc., complete for finished item of work.					
		Taking out put = 300 cum					
	a)	Labour					
		Mazdoor (Skilled)	day	2.4	400	960	
		Mazdoor (Un-Skilled)	day	8	400	3200	
						4160	
		Add for MA @20%		0	4160	0	
	b)	Machinery					
		Vibratory Roller 80-100 KN @10cum per hour	hour	6	2736	16417.2	
		Tractor with rotavator @ 25 cum per hour	hour	12	423.6	5083.2	
		Tractor with grader @ 25 cum per hour	hour	12	423.6	5083.2	
		Water tanker 6kl capacity	hour	3	655.2	1965.6	
	c)	Material					
		Coarse graded granular sub-base material					
		Cost of materials					
		9.5 mm to 4.75 mm @ 66 per cent	cum	237.6	808.7	192143	
		2.36 mm below @ 34 per cent	cum	122.4	489.1	59870.7	
		Cost of water	Kl	18	0	0	
		Basic rate of Granular sub base for 300 cum				284723	
		Basic rate of Granular sub base cum				949.08	
		Add 13.615% for Over head charges & Contractors profit (excl. GST)			0.14	129.22	
						1078.3	
		Rate per cum			Rs.	1078.3	

Wet Mix Macadam							
5	RBR-SBBS-11	Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the material with water at OMC in mechanical mixer (Pug Mill), carriage of mixed material by tipper to site, laying in uniform layers in sub-base/base course on a well prepared sub-base and compacting with smooth wheel roller of 80 to 100kN / Vibratory Roller 80-100 kN weight to achieve the desired density including lighting, barricading and maintenance of diversion, etc as per Tables 400.11 & 400.12 and Technical Specification Clause 406 MORD/ MORTH, including overhead charges & Contractor profit, but excluding GST and Seignorage charges etc., complete for finished item of work.					
		By Mechanical Means with 1 km lead					
		By Mechanical Means					
	A	Rural Works					
		Taking out put = 100 cum					
	a)	Labour					
		Dresser (skilled) for alignment	day	8	400	3200	
		Mazdoor (Skilled)	day	2.4	400	960	
						4160	
		Add for MA @20%		0	4160	0	
	b)	Machinery					
		Front end loader 1 cum capacity	hour	4	1595	6378.8	
		Wet mix plant (Pug Mill)	hour	4	1680	6718.8	
		Tipper or dumper (10 t) Capacity	hour	5	950.3	4751.5	
		Tractor with grador @ 25 cum capacity	hour	4	423.6	1694.4	
		Vibratory Roller 80-100 KN @60cum per hour	hour	1.67	2736	4569.45	
		Water tanker 6kl capacity	hour	1.33	655.2	871.42	
	c)	Material					
		Coarse aggregate 45 to 22.4 mm using M/C metal @ 30%(Average of 40-45 mm, 25-27mm & 19-22mm metal)	cum	39.9	1225	48859.8	
		Aggregates 22.4mm to 2.36mm using M/c metal @ 40%(Average of 19-22mm,12-14mm, 9.5-11.20mm,5-7mm & 2.36-5mm metal)	cum	53.2	995.7	52969.4	
		Fine aggregate/crushed sand 2.36 mm to 75 micron @ 30%	cum	39.9	489.1	19516.7	
		Cost of water	Kl	8	0	0	
		Basic rate of WMM for 100 Cum				150490	

		Basic rate of WMM per Cum				1504.9	
	e)	Add 13.615% for over head charges & Contractors profit (excl. GST)			0.14	204.89	
						1709.79	
		Rate per cum			Rs.	1709.79	
Conventional : T5 : Construction of granular sub-base by providing well graded HBG material (Grading III material) (Table 400.1A), spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with smooth wheel roller 80-100 kN / vibratory roller to achieve the desired density, complete as per Technical Specification Clause 401 MORD including cost of all materials, labour, conveyance, hire charges of machinery, but excluding GST and Seignorage charges etc., complete for finished item of work.							
	1000	4.05	0.175	708.8	1078	764245	
				cum	1 cum		
Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the material with water at OMC in mechanical mixer (Pug Mill), carriage of mixed material by tipper to site, laying in uniform layers in sub-base/base course on a well prepared sub-base and compacting with smooth wheel roller of 80 to 100kN / Vibratory Roller 80-100 kN weight to achieve the desired density including lighting, barricading and maintenance of diversion, etc as per Tables 400.11 & 400.12 and Technical Specification Clause 406 MORD/ MORTH, including overhead charges & Contractor profit, but excluding GST and Seignorage charges etc., complete for finished item of work.							
	1000	3.9	0.15	585	1710	1000227	
			Total Rs		1764472		
Construction of Recyding granular material (In situ), pulverising, adding the designed quantity of cement to the soil using truck mounted self propelled Cement Spreader and ,, mixing in place with Four wheeled drive Recycler , Compacting with 20T Pad foot Vibratory Roller , grading with the motor grader and further rolling with Vibratory road roller at OMC to achieve the desired unconfined compressive strength and to form a layer of base.as per technical Specification Clause 404 MORD and Further curing for 7 Days. (Cement Treated Base) 225 mm thick Stabilization, T5							
	1000	3.9	3900	307.88		1200732	
			Sq.m	1 Sq.m			
Selected Earth/ Gravel (New) suitable for Cement stabilization as per code including Spreading (Total Crust as per Cement stabilization : 225 mm)							
	1000	3.9	0.225	877.5	227.2	199368	
				cum	1 cum		
			Total Rs		14,00,100		
	Note:						
	SSR	2018-19					
	Gravel/Selected Earth		5 Kms				
	Metal		12 Kms				
Subgrade CBR : 5%, T5			Cement Treated				
	GSB	175 mm	Subbase	125 mm			
	WMM	150 mm	Base	100 mm			

Enclosure 4:

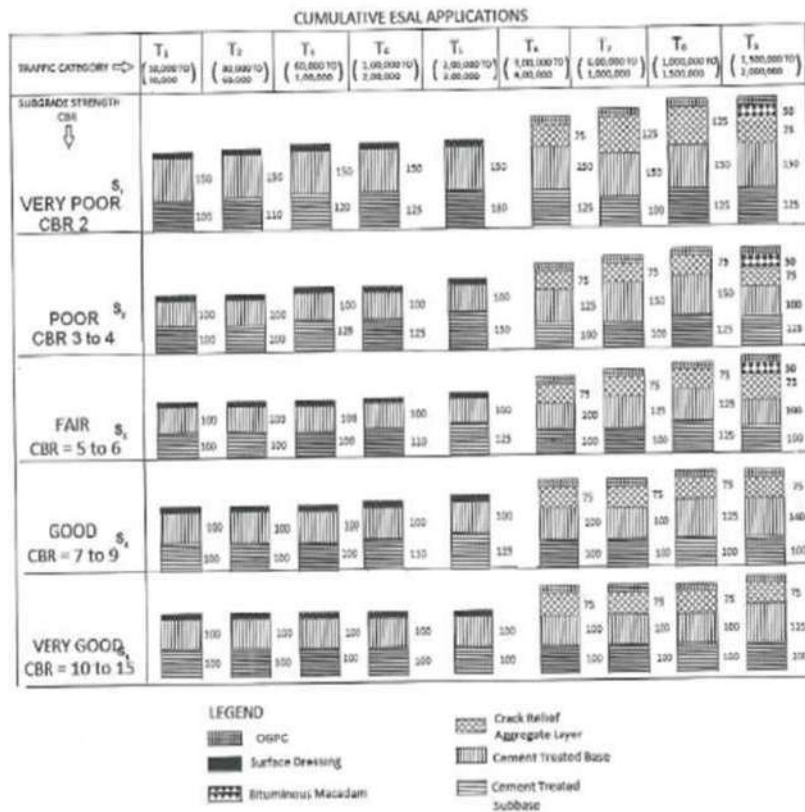


Fig. 6 Pavement Design Catalogues for Cement Treated Bases and Sub-Bases

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