Index

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 are to be decided on the basis of pavement design and with specific approval of the Engineer-in-Charge.

Properties	Specified Value
Liquid Limit (%)	<45
Plasticity Index	<20
Organic content (%)	<2
Total SO, 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 7 Material Characteristics for Cement Modified Granular Materials

	Grading I	Grading II	Grading III	Grading IV
Sieve size	Grading .	100		100
75.0 mm	100	80-100	100	
53.0 mm	100	00-100		
45.0 mm	\$5-100			95-100
37.5 mm				55-75
26.5 mm		56-90	70-100	
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	-
And and a second se		T .	-	1
0.300 µ	0.8	3-10	3-10	0-10
0.075 µ	land and the second sec	7*/4.5**	3'/1.5"	1.5*/0.75
7 days Unconfined Compressive Strength (MPa) for cement bound materials or 26 days strength for time-fly ash & time-cement-fly ash bound materials	12*/6**	C.44,0	511.0	01

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

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 allomatives

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:

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

				Con	nparative Stat	ement			
S. No /	Conventional Crust with GSB and WMM			Cement S	it Treated Base Spreader, Motor ig 6 of Cement SP:72	Savings with CTB			
Name of the District	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	by using High End machinery Rupees	Remarks
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	Conventional Crust with GSB and WMM			Cement S	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)				_
the District	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	by using High End machinery Rupees	Remarks
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 Ba	ase/ Base	(SOR 19	18-19)	
N o	Index Code	Description	Unit	Quantit y	Rate Rs	Cost Rs	Remark s
6		Cement Treated Soil Sub Base/ Base					
A	RBR - SBBS -6	Construction of Recycli the designed quantity of propelled Cement Spre- drive Recycler, Compa with the motor grader a OMC to achieve the des form a layer of base as Further curing for 7 Day	of cemer ader and cting wi and furth sired und per tecl	nt to the soi d ,, mixing i th 20T Pad her rolling w confined cor	l using tr in place v foot Vibra vith Vibra mpressive	uck mounte vith Four wh atory Roller tory road ro strength a	d self neeled , grading oller at nd to
		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% Water tanker 6 KL	tonn e	21	3900	81900	
		capacity (For Curing)	hour	5	655.2	3276	
		Cost of water	KL			0	

	Hire Charger for Recycler, 20 T Pad Foot Roller and	Sqm	1000	207.7 1	207710	
	Cement Spreader					
	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				287.35	
	(0.21 Cum/ Sqm)					
	Rate Per Sqm (0.225	-				read
		ire Cha	rges for R as approve	ecycler,	Cement Sp	
SI.No	Rate Per Sqm (0.225 Rate analysis for H	ire Cha	rges for R	ecycler,	Cement Sp	
SI.No	Rate Per Sqm (0.225 Rate analysis for H Heavy Pad foot Rolle Name of the	ire Cha r 20 T,	Hire Hire Charges as per SSR 17-	ecycler, d by the	Cement Sp	
	Rate Per Sqm (0.225 Rate analysis for H Heavy Pad foot Rolle Name of the Equipment	ire Cha r 20 T, No	Hire Hire Charges as per SSR 17- 18	ecycler, d by the Per	Cement Sp Committee	
1	Rate Per Sqm (0.225 Rate analysis for H Heavy Pad foot Rolle Name of the Equipment Recycler 20 T Pad Foot	No	Hire Charges as per SSR 17- 18 38658.94	ecycler, d by the Per Per	Cement Sp Committee	
1 2	Rate Per Sqm (0.225 Rate analysis for H Heavy Pad foot Rolle Name of the Equipment Recycler 20 T Pad Foot Roller	No	Hire Charges as per SSR 17- 18 38658.94 14382.25	ecycler, d by the Per Per Per	Cement Sp Committee	

			Krishn	a Dist.Nuz	iveedudi	vn SSR: 2017	-18	
N.W: R/F R Krishna Dis		ala	ayam to M	ekala H/W	of Chee	puruGudem (V) of Chatra	i (M) of
			Length	Width	Depth	Total Qty	Rate per	Amount
			Mts	mts	mts	Cum	1 cum	in Rs
material (Gr grader on p compacting density, con materials, la charges etc.	adi rep wit nple bou , co	ng are h s ete ir, o mp	III materi ed surface, mooth whe as per Te conveyance blete for fini 1000	al) (Table 4 mixing by eel roller 80 chnical Spe hire charge shed item o 4.05	400.1A), mix in pla 0-100 kN cification es of mac of work. 0.15	ub-base by pr spreading in u ace method wi / vibratory rol Clause 401 M hinary, but exc 608 cum	iniform layer ith rotavator ler to achiev ORD includin luding GST ar 2294.6 1 cum	s with motor at OMC, and e the desired g cost of all nd Seignorage 1393951
specification Mill), carriag course on a v / Vibratory barricading a Specification	inc e o well Rol and Cla	f m pr ller ma	ling premix nixed mater epared sub 80-100 k aintenance e 406 MOR Seignorag	ing the mat ial by tippe -base and co N weight to of diversion D/ MORTH,	terial with r to site, l ompacting o achieve , etc as po including tc., compl	ed stone aggre water at OMC aying in unifor with smooth the desired er Tables 400.1 overhead charg ete for finished 585	in mechanic m layers in s wheel roller o density inclu L1 & 400.12 a ges & Contrac item of work	al mixer (Pug ub-base/base f 80 to 100kN ding lighting, and Technical tor profit, but
			1000	3.9	0.15		3042.5	1779839
					Total R	Cum	1 cum	3173790
Roller , grad to achieve th	ing ne (ecif	wi des ica	th the moto ired unconf tion Clause	or grader ar fined compr	nd further essive str	Compacting w rolling with Vi ength and to fe er curing for 7	bratory road orm a layer c	roller at OMC of base.as per
			1000	3.9		3900	287.35	1120665
						Sqm	1 Sq.m	
Cost and spr Stabilization						nm thick(New)	•	for
			1000	3.9	0.21	819	245.43	201007
						Cum	1 Cum	
						Total Rs		13,21,672
Note:			SoR: 2	017-18				
Metal Lea	ad			93 Kms				
Selected Ea Lead	rth	ı ((Gravel)	8 Kms				
SubGradeC	BR	: 5	%, T4					
Convention Crust as pe 4		g	Cement	t Treated c	rust as p	er Fig 6		
GSB: 150 m	m		Subbase		110 mm			
WMM :150 n			Base		100 mm			
			5450		100 1111			L

			Dist				
				-			
			Materia	l (Table:-	400-1) /	A for Gr	ading-III
RBR- SBBS- 1-A iii	HBG material (Grading spreading in uniform lay surface, mixing by mix OMC, and compacting wi / vibratory roller to achi as per Technical Specific cost of all materials, lal machinery, but excluding						
	Taking out put = 300						
2)							
a)		davi	24	400	060		
	· · · ·	-					
		uay	0	400			
	Add for MA @		0	4160			
b)	-		0	4100	0		
5)	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)							
	sub-base material						
	66 per cent (metal)	cum	237.6	1003.2	.1		
	per cent (Stone dust)	cum	122.4	683.66	98		
		KI	18	0	0		
	sub base for 300 cum				354750 .3		
	sub base cum				1182.5		
			arges &	0.14			
	Rate per cum			Rs.	1343.5		ļ
	Granular Material RBR- SBBS-	Granular Sub-Base with Well Gr Material (CBR Value minimum 2Construction of granular HBG material (Grading spreading in uniform lay surface, mixing by mix OMC, and compacting wi / vibratory roller to achi as per Technical Specific cost of all materials, lat machinery, but excluding complete for finished iter1-A iiiTaking out put = 300 cuma)Laboura)LabourMazdoor (Skilled)Mazdoor (Un-Skilled)b)MachineryVibratory Roller 80-100 KN @10cum per hourTractor with rotavator @ 25 cum per hourTractor with grader @ 25 cum per hourYater tanker 6kl capacityc)MaterialCoarse graded granular sub-base materialCost of materials9.5 mm to 4.75 mm @ 66 per cent (metal)2.36 mm below @ 34 per cent (Stone dust)Cost of waterBasic rate of Granular sub base for 300 cumBasic rate of Granular sub base cumAdd 13.615% for Overh Contractors profit (excl.	Granular Sub-Base with Well Graded I Material (CBR Value minimum 20) RBR- SBBS- 1-A iii Construction of granular sub-bas HBG material (Grading III spreading in uniform layers with surface, mixing by mix in place OMC, and compacting with smood / vibratory roller to achieve the as per Technical Specification (cost of all materials, labour, com machinery, but excluding GST a complete for finished item of word Taking out put = 300 cum a) Labour a) Labour Mazdoor (Skilled) day Mazdoor (Un-Skilled) day Mazdoor (Un-Skilled) day Machinery Vibratory Roller 80-100 KN @10cum per hour Tractor with rotavator @ 25 cum per hour hour Tractor with grader @ 25 cum per hour hour Water tanker 6kl capacity hour Coarse graded granular sub-base material cum Cost of materials 9,5 mm to 4.75 mm @ 66 per cent (metal) cum 2.36 mm below @ 34 per cent (Stone dust) cum Cost of water Kl Basic rate of Granular sub base for 300 cum basic rate of Granular sub base cum Add 13.615% for Overhead cha Contractors profit (excl. GST)	Granular Sub-Base with Well Graded Material Material (CBR Value minimum 20) Construction of granular sub-base by put BG material (Grading III material spreading in uniform layers with motor surface, mixing by mix in place method OMC, and compacting with smooth whe / vibratory roller to achieve the desire as per Technical Specification Clause 4 cost of all materials, labour, conveyan machinery, but excluding GST and Seign complete for finished item of work. Taking out put = 300 cum	Granular Sub-Base with Well Graded Material (Table:-Material (CBR Value minimum 20) Refresting (CBR Value minimum 20) Construction of granular sub-base by providing with BG material (Grading III material) (Table spreading in uniform layers with motor grader on surface, mixing by mix in place method with rol OMC, and compacting with smooth wheel roller & / vibratory roller to achieve the desired density, as per Technical Specification Clause 401 MODC cost of all materials, labour, conveyance, hire of machinery, but excluding GST and Seignorage charcomplete for finished item of work. Taking out put = 300 cum Taking out put = 300 (um a) Labour 400 Mazdoor (Skilled) day 2.4 400 Mazdoor (Skilled) day 8 400 Mazdoor (Un-Skilled) day 8 400 Mazdoor (Un-Skilled) day 8 400 Machinery 0 4160 4160 b) Machinery 12 423.6 Tractor with rotavator hour 12 423.6 Coarse graded granular sub-base material 655.2 2 Coarse graded granular sub-base material 12 635.2 C) Material 12.4 683.66 Cost of materials 12 655.2	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 outform 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 Image: Comment of Mazdoor (Skilled) Image: Comment of Mazdoor (Skilled) Image: Comment of Mazdoor (Un-Skilled) a) Labour Image: Comment of Mazdoor (Un-Skilled) Image: Comment of Mazdoor (Un-Skilled) Image: Comment of Mazdoor (Un-Skilled) Madd for MA @ Image: Comment of Mazdoor (Un-Skilled) Image: Comment of Mazdoor (Un-Skilled) Image: Comment of Mazdoor (Un-Skilled) Madd for MA @ Image: Comment of Moure Mathies (Comment of Mazdoor (Un-Skilled) Image: Comment of Moure Mathies (Comment of Moure Mathies (Comment of Mazdoor (Un-Skilled) Image: Comment of Moure Mathies (Comment of Moure Mathies (Comment of Mazdoor (Un-Skilled) Material Image: Comment of Moure Mathies (Comment of Mazdoor (Un-Skilled) Image: Comment of Moure Mathies (Comment of Mazdoor (Un-Skilled) Image: Comment of Mazdoor (Un-Skilled) Material Image: Comment of Mazdoor (Un-Skilled) Im	Granular Sub-Base with Well Graded Material (Table: 400- 1) A for Gr. Material (CER 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 Imaterial (Gradual Second Conveyance, hire charges of machinery, but excluding GST and Seignorage charges etc., complete for finished item of work. Taking out put = 300 cum Mazdoor (Skilled) day 8 400 960 Mazdoor (Skilled) day 8 400 3200 Imaterial (Gradual Second Secon

5			W	et Mix M	1 acadam]	
	RBR- SBBS- 11	Providing, laying, spread aggregate to wet mix premixing the material mixer (Pug Mill), carriage laying in uniform layers prepared sub-base and roller of 80 to 100kN / Vi achieve the desired dem and maintenance of dive 400.12 and Technical MORTH, including overhe excluding GST and Seign 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	1419.0 8	56621.1 6	
		Aggregates 22.4mm to 2.36mm using M/c metal @ 40% (Average of 19-22mm,12-14mm,	cum	53.2	1190.1 9	63317.9	

		r	1	1		
	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	27278.0 3	
	Cost of water	KI	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 h & Contractors profit (excl		arges	0.14	240.55	
					2007.36	
	Rate per cum			Rs.	2007.36	
	providing well graded HE (Table 400.1A), spreadi grader on prepared surfa with rotavator at OMC, a roller 80-100 kN / vibra density, complete as per MORD including cost of hire charges of mach Seignorage charges etc., 1000 x 4.05x 0.15 = 607	ng in ce, mix nd com tory ro Techni all mat inery, comple	uniform king by r npacting oller to a cal Spec erials, la but ex te for fir	layers w nix in plac with smo achieve th ification C abour, cor ccluding	ith motor ce method oth wheel ne desired clause 401 nveyance, GST and	
	Providing, laying, spread aggregate to wet mix premixing the material mixer (Pug Mill), carriage laying in uniform layers prepared sub-base and roller of 80 to 100kN / Vi achieve the desired dens and maintenance of dive 400.12 and Technical S MORTH, including overhe excluding GST and Seign finished item of work.	macac with wa of mixe in sub- compa bratory sity inc rsion, o Specific ad chan norage	dam spe ater at (ed mater base/bas acting v Roller 8 cluding li etc as pe cation C rges & C charges	ecification OMC in m rial by tipp se course with smoo 0-100 kN ighting, b er Tables Clause 40 ontractor	including ber to site, on a well oth wheel weight to arricading 400.11 & 6 MORD/ profit, but	
	1000 x 3.90x 0.15		5 Cum x 07.36 =	117	4306	
			Fotal Rs	19,9	0,482	

		Construction of Recycl pulverising, adding the d soil using truck mounted and ,, mixing in place w Compacting with 20T Pad the motor grader and fur roller at OMC to achieve the strength and to form a Specification Clause 404 Days. (Cement Treat Stabilization, T4 1000 x 3.90 = 3900 Squ	esigned self p vith Fou foot Vi urther he desi a layer MORD	d quanti propelled ur wheel bratory l rolling w red unco of bas and Fu Base) 7.35 =	ty of cement d Cement S ed drive R Roller, grad with Vibrate onfined com se.as per f rther curin	nt to the Spreader ecycler , ding with ory road pressive technical ng for 7 thick		
		Cost and spreading of S thick(New) for Stabiliz Stabilization Chart : 210	ation T	otal cru	ist as per	Cement		
		1000x3.9x.0.210= 819 cum x 563.43/1Cum			4614	149		
			Tot	al Rs	158	2114		
		Note:	SoR	2018-1	9			
		Metal Lead	29 Kn	ns				
		Selected Earth(Gravel) Lead	31 Kn	ns				
		Sub Grade CBR : 5%, T4 Conventional Crust as per Fig 4		ent treat r Fig 6	ed Crust			
		GSB: 150 mm	CT subb ase	110 m	m			
		WMM : 150 mm	Bas e	100 m	m			
		300 mm		210 m	m			
(Grad prepa smoo per conv	ding III ared surf oth whee Technica reyance,	al : T5 :Construction of gra material) (Table 400.1A), face, mixing by mix in place I roller 80-100 kN / vibrat I Specification Clause 40 hire charges of machinar finished item of work.	sprea e metho ory roll 01 MC	ding in od with r ler to ac)RD incl	uniform la otavator a hieve the c uding cost	yers with t OMC, ar lesired de t of all	n motor nd compa ensity, co material	grader on acting with omplete as s, labour,
			0	05	0.1/5			552205.0
						cum	1 cum	

		ving, spreading a including premixi							
		e of mixed materi							
		ell prepared sub-							
		Roller 80-100 kN							
		nd maintenance of							
		Clause 406 MORE							
		Γ and Seignorage							prone, bue
excludin			enargee	100	3.9	0.15	585	2007.4	1174306
				0	5.5	0.15	303		
							Cum	1 Cum	
						Total Re			2126511
						i otar rte			
Constr	uction	of Docycing grap	ular mate	rial (In	citu) p	luoricing	adding th		
		of Recycing grant							
		the soil using tru							
		our wheeled drive the motor grader							
		inconfined compr							
		Clause 404 MORD							
		abilization, T5		Lifer Cu	ining tor	7 Days. (Lement I	leateu b	ase) 225
				100	3.9		3900	307.88	1200732
				0	5.9		3900	507.00	1200752
				0			Sq.m	1 Sq.m	
Castan									
		ading of Selected w) including cost a			suitable i	or cement	stabilizat	ion as pei	r code 225
				100	3.9	0.225	877.5	563.43	494410
				0					
							Cum	1 Cum	
						Total Re	5		1695142
Note:				SoR	2018-	19			
Metal I	Lead				29 Km	IS			
Selecte	ed Eai	th (Gravel) Lea	d		31 Km	S			
		BR: 5%, T5							
Conve	ntiona	ll Crust as per F	ig 4		ent Stal t as per	bilization Fig 6			
		5B 175 mm							
GSB 17	75 mm			CT Sub base	125 m				

Sri	Srikakulam Dist, N.W : CHR Road to G.SigadamRS via Niddam&Addonampeta.								
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							
	RBR-								
4	SBBS-								
	1-A iii	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 machinary, 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		10	122.6	5000.0			
		cum per hour	hour	12	423.6	5083.2			
		Water tanker 6kl	hour	3	655.2	1965.6			
	c)	capacity Material	noui	5	055.2	1905.0			
	C)	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	KI	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			
		(31)			0.14	129.22			
						10/0.5	$\left \right $		
		Rate per cum			Rs.	1078.3			
	I	1	L	1	1	1	1]		

		Wei	t Mix Macad	lam			
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					
	7.	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	KI	8	0	0	
		Basic rate of WMM for 100 Cum				150490	

		Basic rate of WMM per Cum				1504.9			
		Add 13.615% for over				100 119			
		head charges &							
	e)	Contractors profit (excl.			0.14	204.89			
		GST)							
						1709.79			
		Rate per cum			Rs.	1709.79			
	Conventional : T5 : Construction of granular sub-base by providing well graded HBG								
		Grading III material) (Table 4							
l.		grader on prepared surface, mixing by mix in place method with rotavator at OMC, and							
l.		ng with smooth wheel roller 80							
1		omplete as per Technical Spec , labour, conveyance, hire cha							
		je charges etc., complete for f			excluding	GST and			
	1000	4.05	0.175	708.8	1078	764245			
	1000		51275	cum	1 cum				
	Providing, laying, spreading and compacting graded stone aggregate to wet mix macada								
l.	specification including premixing the material with water at OMC in mechanical mixer (Pug								
		iage of mixed material by tipp							
		a well prepared sub-base a							
		/ibratory Roller 80-100 kN wei							
		ig and maintenance of diversion							
		ion Clause 406 MORD/ MORT					rofit,		
	1000	ding GST and Seignorage char 3.9		585	1710	1000227			
	1000	5.9	Total Rs	202	176447				
	Construct	l ion of Recycing granular ma		itu) pulve		_	ianod		
		of cement to the soil using tru							
		place with Four wheeled drive							
	Roller, gi	rading with the motor grader a	and further r	olling with	Vibratory	road roller at	OMĊ		
		e the desired unconfined comp							
		Specification Clause 404 MOR		er curing for	r 7 Days.	(Cement Tre	ated		
	-	5 mm thick Stabilization, T	1		1				
	1000	3.9	3900	307.88		1200732			
			Sq.m	1 Sq.m			<u> </u>		
						<u> </u>			
I		Earth/ Gravel (New) suitable			as per co	ode including			
		(Total Crust as per Cement s			222.2	100269	<u> </u>		
	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						
		e CBR : 5%, T5	Cement Tr						
	GSB	175 mm	Subbase	125 mr					
	WMM	150 mm	Base	100 mr	n I				

Enclosure 4:

