Up gradation of existing Jakhapura - Daitari line Bridges to Heavy Mineral Loading standard (HMLS) and Regrading of existing line up to a maximum height of 4.03 meters for providing 1 in 150 ruling gradient **under traffic conditions** (case study).

Sr Professional course Track (Course no821)

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Brief History:

Construction of Jakhapura (a station on Howrah – Chennai main line) - Daitari line of 33.15 Kms long was sanctioned in the year 1976-77 as Phase-I of Jakhapura - Daitari- Banspani line and commissioned in the year 1981 as siding to Jakhapura station. Standard of bridge construction of Jakhapura-Daitari line was RBG-1975 (22.5T Axle load).

In the year 1992-93, balance section i.e. from Daitari to Banspani BG Rail line of 152 Kms was sanctioned to connect Daitari with Banspani to facilitate movement of iron ore from Banspani to Paradeep port. To cater for ore transport this new line has been constructed to the standards of HM loading.

So a necessity has arisen to upgrade the old siding from Jakhapura to Daitari from RBG standards to HML standards. In addition even though ruling gradient was 1 in 100 for the siding, at number of location actual gradient found was near about 1 in 80. Thus the locos were failing to haul the rakes between Daitari to Jakhapura. So along with strengthening of bridges regradation of formation for 1 in 150 has been planned and estimates were prepared.

Details of Original proposal of strengthening of bridges and Regrading under total traffic block of 60 days.

According to the initial plan, regrading of existing line involves lifting of track to a maximum extant of 3 meters and lowering upto 1.50 meter. In the lowering portion, an approximate quantity of 10,000 cum of rock requiring blasting was also involved.

Detailed proposals for upgradation of existing bridges in the form of strengthening, rebuilding, extension, replacement of existing slabs etc have been finalized as per the 'L' section.

However before execution it was felt closing the line for 60 days will cause loss of 240 rakes of loading causing huge revenue loss to the railway. In addition to above, existing plants have to be intimated to make alternate arrangement for transportation of iron ore by other means during the period of closure. Further, there may be slippage in completion of work due to failure of any one agency falling in the critical path. So alternate scheme to execute the upgradation work without closure of the line has been developed.

Salient features of proposed scheme and its execution under traffic condition.

(1)Revised 'L' Section of Regrading:
As a first step the regrading has been modified in such a way that entire portion of track proposed for lifting. And lowering of track is completely eliminated. Because lowering of track by blasting & removing rock under traffic is not possible.

In the revised longitudinal section maximum lifting of track is 4.03 meter instead of 3.00 meter as in the earlier proposal. While finalizing the revised 'L' Section care has been taken to keep new formation level equivalent to existing formation level at major bridges.

(2) Bridges: In the proposed portion of Regrading, there are three major bridges and one hundred minor bridges required to be upgraded to Heavy Mineral Loading Standard. Details given below:

Major Bridges

Sl No	Bridge No	Type	Span	Proposed strengthening to H.M.Loading standard
1	388	RCC Slab	3x6.1 m	Replacement of existing RCC slabs with PSC pre-cast slab.
2	417	Steel Girder	3x12.2 m	Rebuilding of bridge with 3 Nos. of 2x4.67 mx4.08m Twin RCC Box
3	449	Early Steel Girder	3x12.2 m	Existing girders replaced with H.M. loading steel girders and substructure and foundation is proposed for strengthening with jacketing.

Minor bridges:

Hume pipes	24 Nos.(0.90 m and 1.20m dia)
Flat slabs	41 Nos (Spans 1.22m, 1.83m, 3.66m & 4.57m.
Flat top siphons.	03 Nos (Span 1.22m)

Following are the different methods chosen for upgrading existing Minor bridges :

Bridge type	Where Regrading involved	Where there is no Regrading.
Hume pipes	Existing bridge Hume pipes are NP-4 and fit for Heavy Mineral Loading standard. So planned to extend Bridge on up and down stream with NP-4 Hume pipes and with new return walls.	To raise & strengthen Existing return walls strengthened by jacketing.
Flat slabs	(a) To replace Existing RBG standard slabs with Heavy Mineral Loading Standard slab and extended upstream and down streamside with RCC boxes and new return walls. (b) If discharge permits, placing of RCC Hume pipes in the existing vent way of FT bridge and construction of return walls at end as per revised FL. And to remove Existing slab under traffic block	(a) Replacement of existing RCC slab with PSC precast slab of Heavy Mineral Loading Standard under traffic block. Rising of return walls with proper doweling, jacketing to return walls and combining of footings in between return walls to make it safe against sliding. (b) If discharge permit, construct Box culvert inside existing FT bridge and remove Slabs under traffic block.
Flat top siphons.		Placing of new slab (Heavy Mineral Loading Standard) on existing slab having provision for deflection in between. However existing track to be regraded to accommodate the thickness of new slab and 300mm ballast cushion.

(3) Blanket material for lifting & raising of formation : For lifting of track and raising of formation under traffic conditions, blanket material has been chosen. For this purpose, moorum quarry has been identified and sand has been planned to transport to the location of moorum quarry. Blending has been planned with the help of excavators and transport to site by tippers.

(4) On track lifting jacks: On track lifting jacks have been fabricated in local workshop.

This has been developed by adding few accessories to our well known dip lorry. Main accessories that are added are:

1) Reaction rods, 80mm dia M.S. Rod of 1 m long containing threads through out its length except top 150mm.
2) M.S. Nuts of size 100x100x100mm size fixed inside the channel to facilitate movement of threaded reaction rod. At the end of reaction rod, base plate of size 150x150x10mm thick has been provided for wide base.
3) Scissor chain and hooks have been provided at all four faces for holding the rail during the lifting operation. The scissors chain will hang from 25mm dia tie rods welded to the channels.

Since the equipment made from dip lorry it is easy to handle with four laborers i.e. for placing, taking out of jack from the track and for rotating the handles of the reaction rod for lifting. In one cycle, it was planned to lift the track by 10 cms by placing jacks at every 6th sleeper. While carrying out lifting operation, it is very easy to check the cross level of the track by placing a spirit level on connecting channel.

5) Special packing tools : Special tool, i.e. ordinary crow bar welded with 50x50x10mm plate at the end has been planned to be used for packing the blanket material beneath the PSC sleepers for early permitting the traffic on Regraded portion.

(6) Special machine for spreading of blanket material in lifted portion :

A machine called **'BOBCAT'**(Company name) similar to that of **JCB** has been planned to use for spreading the blanket material after each lift. This is rubber tyred machine operates at very high speed and rotates 360^0 in the small area. One more advantage of this machine is it can easily cross the track.

(7) Extra formation width:
For movement of tippers 3m width required on both sides of PSC sleeper which works out to 8.75m against 6.85m

For reversal of tippers, rollers etc refuses of 7.5x4m have been planned and latter they can be utilized as trolley refuges

(8) Vibromax roller for compaction of blanket material:
Blanket material spread by the side of sleepers for a thickness of 300 mm. on each side have been compacted with vibromax rollers in **heavy compaction mode**. While compacting the blanket material, care has been taken to see that the drum of roller taken near to the sleeper so that, vibrations of roller will reach to soil beneath the track.

Further, **field trial** has also been conducted in regard to compaction with vibromax roller and crow bar compaction.
Details are furnished below.
Dry density of blanket material compacted with vibromax roller = 2.32 Gram per C.C.
Dry density at 30 cm below the compacted level= 2.16 Gram per C.C.
Dry density of blanket materials compacted with crow bar = 2.22 Gram per C.C.
Dry density at 30 cm. below the compacted level= 2.022 Gram per C.C.
As compared above, it is noticed that dry density of blanketing material with Crow bar compaction is less by 4% at top and 2% below 30 cm. level and which is negligible. However on movement of trains the material further getting compacted and desired 98% dry density has been achieved.

Method of execution of regrading work:

Following Preliminary works were completed before commencement of regrading

(a) Earth work in formation for widening:

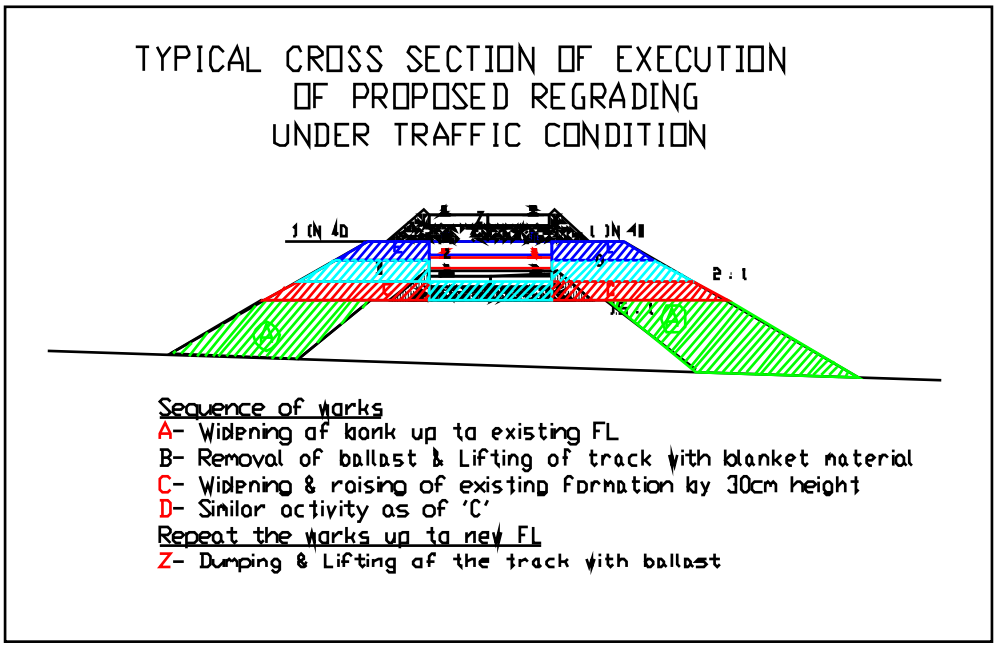
1) Existing formation has been widened to the required width up to top of existing sleeper level after benching of existing bank slopes.
2) Required blanketing material such as moorum and sand has been collected and blended in advance and kept ready for lifting and widening of formation in stages 30cm each (as shown in enclosed sketch).

(b) Bridges :

1) RCC Hume pipes as per requirement have been cast and transported to particular location of each bridge.
2) Precast PSC slabs/RCC slabs as per requirement have been cast and transported to particular location of each bridge.
3) Existing, RC Hume pipe bridges where there is no regrading involved; needs only rising of head wall and jacketting to return walls has been taken up and completed independently.
4) Existing RC Hume pipe bridges need extension on account of the regrading have been commenced from the foundation of return walls and after arrival of RC Hume pipes at site of work the same have been fixed and return walls sub structure have been completed.
5) For bridges needs replacement of slab, the same has been completed with proper capacity road cranes by taking traffic block of 3 to 4 hours each immediately after arrival of precast slabs to site of work. Jacketing work to return walls/abutments and combining of footings wherever required have been completed simultaneously.
6) Wherever site condition permits to provide RCC box in the vent way of existing F.T Bridge, and if the cost of strengthening work (Replacement of slab jacketing work and combining of footings) is more than construction of RCC new box; the same have been taken up simultaneously and completed.
7) In case of RCC F.T bridges where there is regrading, such bridges have been strengthened by replacing existing slabs with HM Loading standard slabs duly designed for surcharge, and construction of RCC boxes with Return walls on Up and down stream sides to cater for regrading. Jacketing if any required for existing abutment needs to be checked on account of surcharge.
8) If flood discharge permits, locations where regarding involved at F.T bridges has also been rebuilt by placing R.C.C. Hume pipes in ventway of existing bridge covering the length required as per revised regrading

level. Subsequently, existing R.C.C. slab have been removed under traffic block and gap have been filled up with moorum blanket.

9) Entire bridge rehabilitation work shall be completed prior to commencement of regrading work under traffic condition.



(C) Regrading work(please sea above shown cross section).

Imposed 15Km speed restriction with caution order stop dead if required.

01. Removed the ballast from shoulders and crib and lead the same and screened & stacked near the proposed toe. Transported the blanket material and stacked on the widened portion of bank.
02. Filled the blanket material in crib, shoulder portion and packed the existing track with the available blanket material on the widened portion of formation.
03. Lifted the existing track with specially fabricated **on track lifting jacks** by 30cm in three steps of 10 cm each with blanketing material available at widened portion of formation. Filled the blanket material in the lifted portion of track up to top of sleeper level mechanically by using **bobcat** and pack the track with special packing tools and allow the traffic.
04. Gradual slope has been provided on either side of lifted track before closing of lifting operation.
05. On completion of layer further blanketing material brought to the side of track to take up next 30 cm lift.
06. works mentioned above at sl no. 3 to 5 have been repeated till the formation level reached to the desired regrading level.

07. On reaching the final level track has been dismantled for a length of 130m (10 panel rail lengths) and consolidated the formation with vibro max roller and relinked the track in traffic block of 4-5 hours.
08. Screened ballast dumped back on to the final formation.
09. track has been lifted by final 30cm to give cushion of ballast available by the side of track.
10. Required packing have been taken up and increased the speed to sectional speed.
11. Completed the misc. works such as (1) Full ballasting of track, packing, alignment, boxing of ballast, (2) Completion of works at level crossings such as rail post fencing, fixing indication boards, (3) Fixing of Km/Gradient posts, curve boards, W/L boards and marking of HFL, DL for the bridges and construction of inspection steps at bridges, fixing of bridge tablets etc, (4) Providing pitching, turfing, side drain in cutting, (5) Stacking of released slabs and other useable materials, (6) Raising the speed to normal

Site Details:

1) Out of 33.15 Km length of Jakhapura-Daitari Line upgradation and regrading, 1st Phase work has been taken up in between Km.12.50 to 33.15 (20.65 Kms) and completed successfully by awarding four contracts.
2) In the 1st phase work, Maximum regrading (lifting) of 4.03 m is involved in between Km.16.30 to 18.85 Km. In the above said portion of 2.55 kms., there are total 10 bridges involved for up-gradation to HM loading standard.
3) The following machineries were deployed for lifting of track of Max. height 4.03m.
    i) Excavators : 2 nos. (One for loading of sand at river bed and another for blending and loading of moorum and sand at Moorum quarry.)
    ii) **Bobcat – 1 Nos**.(Loader) for spreading of blanket material after lifting of 30 cm height.
    iii) 10 tyred 15 cum capacity Trucks (TATA-HYVA): 6 Nos. (daytime for transporting of blanket material and night time for carrying of sand from river).
    iv) Two Dozers
    v) Vibromax rollers – 2 nos.
    vi) Water tankers – 2 nos.
    vii) **On track special lifting Jacks** – 10 nos.
    viii) Packing tools (special Crow bars) – 50 nos.
    ix) Wooden chalks – 50 nos.
    x) Skilled labourers for lifting –50 nos.
4) With the help of above said men and machinery we have achieved a daily progress of 250m length of 30 cm. lifting.
5) After completion of all preliminary works, track-lifting work involving maximum height of 4.03m (Average height 2.425m.) located in a length of 2550 m. has been successfully completed in a period of 4 months including ballast cushioning.

Conclusion:

(1) New proposal of execution of regrading and upgradation of bridges to HM loading standard under traffic condition without closure of line for 60 days resulted in a saving of **approximately 20 crores** (earning of 240 rakes of Iron ore loading at an approx. cost of 8 lakhs per rake)
(2) Deployment of on track lifting jacks and bobcat are the key machineries for completing the track lifting work in four months under traffic condition.
(3) Extra formation width of 90 cm. at top (45cm each side) provided for the movement of tippers for transportation of blanket material, ballast and other machineries such as water tankers, vibromax rollers, dozers etc. has helped in speedy completion. This extra width will be useful for future purpose.
(4) In core portion i.e. for sleeper width, other alternative is also possible to use sand instead of blanket material with proper drainage pipes to reduce the cost. Due to usage of sand, effort required for packing of sleepers can be avoided.
(5) In doublings and triplings, regrading of existing lines is unavoidable due to extension of yard limits. Such regradings can be done under traffic condition with the help of above said method and which will avoid construction of diversions and stage workings to carryout regrading work, resulting huge savings in expenditure and valuable time.

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