INNOVATIVE FASTER CONSTRUCTION PRACTICES IN NORTHEAST FRONTIER RAILWAY

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Synopsis:

Indian Railways with track length more than 63000 Km is spread across length and breadth of our country. However considering the requirement of growing population, it is highly desirable to enhance carrying capacity on rail route to fulfil the target of the vision 2020 including target of connecting all the state capital of Northeast with Broad Gauge Rail route. On the basis of demand of faster communication, it is required to construct new Railway line and convert the existing MG track to BG track on large scale and construct double line in area having single line track. To achieve this task, all attempt has to be made to adopt innovative new techniques to meet the target within a short period of time. This practice will be helpful to complete the project within the stipulated time and thus it will fulfil the target of laying of proposed track as planned. Indian Railways is having target of laying 25000 Km Newline, 4000 Km conversion of MG to BG and 30000 Km doubling and to achieve this task in shorter period of time it is required to innovate new technique, modify existing work practice so as to cut short execution time and fulfil the target of laying of track as planned.

Introduction:

N.F. Railway is executing many large projects which cover 2493.01 Km of gauge conversion, 282.66 Km of doubling, 1734.83 Km of new line construction. Out of this 1099.9 Km of Gauge Conversion, 36.52 Km of Doubling, 72.5 Km of New line are completed in the past upto 31st March 2015. In N.F. Railway there are many challenges like short working season, hostile working environment, non-availability of skilled manpower, shortage of Raw material, inaccessibility to work site, difficult terrain. In such scenario it is required to innovate faster construction methods. Few of the innovative practices used for different projects are described below.

(1)EARTHWORK DISPOSAL BY CONVEYER BELT SYSTEM

Brief

The volume of earthwork involved in hilly terrain is much more in shorter stretch of land. There are cutting on one side of hill slope at many location as well as at many locations the alignment is passing through ridge and cutting involved is upto height of 20 to 40 metre. At location where there is bulk earthwork in cutting is involved. It is essential to plan innovative method for cutting & disposal of earth.

Using Tippers for disposal of Earth

For Earthwork carrying for embankment or disposal of excess earth in cutting, generally a number of tippers are used depending upon the quantity, lead to dumping or carrying. The basic principal to move earth away from the alignment in cutting or into the alignment in filling.

Limitation of Tippers

1. Many number of tippers required there by increasing the capital cost and running cost.
2. Manpower required is huge
3. More the Manpower more the overheads

In order overcome above limitation it is planned to dispose the earth by conveyer belt system

Advantages of Using Conveyor Systems for disposal of earth

1. Flexible conveyor easily shifted in and out of operation depending on the transfer length requirement.
2. Adjustable height discharge for more accurate target feeding.
3. Tyre mounted conveyor, can be easily moved around.
4. Minimum maintenance required for conveyor system.
5. Can operate continuously round the clock.
6. Involvement of human labour is much less hence except operator other manpower is not required, this increases output achieved per day. Work can be executed round the clock.
7. Precious fuel required for disposing the earth with help of dumpers is saved.
8. The system is environment friendly as less diesel polluting engines are required.

Details of Method adopted

In New line construction of Bairabi-Sairang project at chainage Km 7.250 the alignment is passing over ridge hill and cutting of 30 metre height is involved where bulk amount of cut spoil can be dumped on valley slope. At this location a bulk material carrying conveyer system is developed. The system consist of conveyer belt mounted on frame with movable tyre with each unit length of 24.5 metre of different heights. The system consists of single hopper type system where earth cutting machine excavator cut the soil and pour into hopper which is attached with conveyer belt this soil is conveyed through different belt and disposed off at distance of 100 metre away from cutting area. At site two excavators were used for feeding of cut spoil into this hopper, where one excavator is cutting 150 Cum/hrs and with two excavators the progress achieved is 300 Cum/hrs. By adopting this system progress achieved is 6000 Cum/day at the location and work of 4.5 lakh cum could be done within 2.5 months time.

Cost comparison in tipper and conveyer belt system

The Cost Factor for 500 Cu / Hr for a lead of 250 Meters		
Description	**Tipper**	**Conveyor**
Excavators (No.s)	3	1
Tippers (No.s)	6	0
Generator (100 Kva) (No.s)	0	1
Capital Cost (Rs.)	3.0 Crs	1.0 Crs
Man Power Requirement (No.s)	20	5
Carrying Cost Per Cu.(Rs.)	12	1
Total Diesel Consumed/Hr	64	23

Operational Dimension of the Conveyor system deployed.

Operation Dimension of the Each Tyre Mounted Conveyor	
Carrying Capacity	500 Cu/Hr
Belt Width	800 mm
Type of Structure	Garland Type
Speed of Belt	100 m / minute
Travel Length of each conveyor	24 m
Max height of Lift	10 m
Horse Power (Kwh)	15 Hp
Max Size of Lump	30 cm

Excavator dumping earth in hopper

Carriage of disposable earth on slope

Diposal of cut spoil by conveyer belt system

(2)Mechanised production,blending & laying of blanketing materials:

Blanket is a layer of specified coarse, granular material of designed thickness provided over full width of formation between subgrade and ballast. In new line construction from Agartala –Sabroom section the alignment is passing through low lying plain area and low hills where bearing capacity of soil is low. In this section it was required to provide the blanket layer as per RDSO specification. Use of geo-synthetics is also considered at places where it is economical to use in combination with blanket as it reduces the requirement of thickness of blanket. It is also particularly planned as availability of blanket material is scarce.

Functions of Blanket Layer:

It reduces traffic-induced stresses to a tolerable limit on the top of subgrade, thereby, prevents subgrade failures under adverse critical conditions of rainfall, drainage, track maintenance and traffic loadings. It prevents penetration of ballast into the subgrade and also prevents upward migration of fine particles from subgrade into the ballast under adverse critical conditions during service. It facilitates drainage of surface water and reduces moisture variations in subgrade, thereby reducing track maintenance problems. It prevents

mud pumping by separating the ballast and subgrade soil. Thus, accumulation of negative pore water pressure in the soil mass is avoided which is responsible for mud pumping.

Provision of Blanket Material:

The blanket material as per standard specification are to be provided by Producing blanket material from naturally available raw material at a plant.To achieve the specified standards blanket material is obtained by Mechanical mixing of more than one natural or mechanically produced granular soil material in tentatively predefined ratio in order to get final product of desired properties.

Mechanised production:

As there was non-availability of natural blanket material it was decided to blend different material and to produce blanket material as per desired specification.

Blending Methodology:

- Blanket material was obtained by proper blending of two or more soils or in combination with soils and crushed material like stone chips and quarry dust.
- Blending of both natural and crushed materials in a pre decided ratio was adopted.
- Theoretical and laboratory trials are taken in order to establish the desirable ratio of the blending materials.

Methodology of blending trials were as below:

- Identification of the usable materials/soils.
- Taking equal weight of the soils for sieve analysis.
- Writing down the weight retained at each sieving stage for all the soils.
- Apportion up of percentage component to each soil and working out a theoretical mix.
- Drawing particle size distribution curve of the mix to find out desirability of gradation.
- If not successful, makeing another trial, and so on.

VIEW OF STORAGE BIN

Types of mechanical blender used:

Pug mill type blenders:For continuous production of mix in large quantities, pug mill blender was used.

The pug mill blender consists of:

- Four bin aggregate unit
- Pug mill mixer unit.
- Water tank and metering system
- Conveyor belts
- Storage silos
- Automation and controls

Blending of Blanket material at Agartala-Sabroom section

Transportation and laying of blanketing materials:

The blanket material was transported wet after mixing water in order to achieve OMC, in tippers for direct unloading on formation.

BLANKET MATERIAL BEING LOADED INTO TRUCK

Laying,spreading and compaction.

- The blanket material was spreaded with a tractor mounted grader and a paverfinisher in layers of uniform thickness, before allowing compaction.
- Compaction to specified levels was carried out through a number of passes of vibratory rollers of 100-120 kN static weight or equivalent capacity. A combination of vibrating rolling initially and static finishing rolling was established through trials. Speed of roller was not exceed 5 km/hr.
- Proper control of moisture was achieved to optimize the compaction effort. Optimum moisture content was established through Modified Proctor Apparatus.
- Rolling was carried out in layers of not more than 300 mm each, following the same camber profile as provided in the subgrade layer and was maintained up to the top layer.
- No provision for uncompacted portion was made on the edges of embankment. The sides was hand rammed with a suitable rammer.

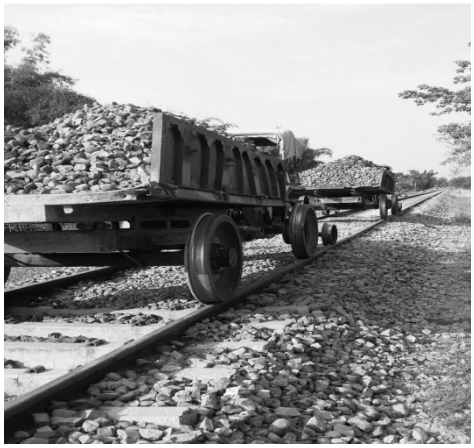
Spreading of Blanket over Geosynthetic in Agartala-Sabroom Project

(3) Ballast spreading on track by Mechanical means:

Spreading of Ballast in long stretches where cess supply can not be taken and site is not accessible by road is time consuming process.In many sections of N F Railway there is problem of road accessibility to site of work as well as ballast availability of rake ballast is megare.In such section at many isolated location along the track mini depots are created nearby the LCs for loading, leading and dumping using Rail Lorries with shorter lead.However training out of of this huge quantity of ballast by manual means and spreading onto the track is time consuming and becomes critical activity.To move ballast along the track and to quickly spread it out in section few innovations are made in Katakhal-Bairabi and Kumarghat-Agartala section of N F Railway.

(a) On Track Tractor-Trolley arrangement:

For spreading of ballast on track, a Road tractor has been modified after removing the tyre and mounting it on rails by fixing modified rail wheels. It is used for carrying ballast on the track and unloaded by tipping. Tractor trolley has also been modified with flanged wheels. The flanged wheels were get prepared from Jalandhar which are best suited for "Messy" Make tractors. This assembly has a hydraulic system which lift the trolley from one end and thus unload the ballast on track. Capacity of this tractor-trolley assembly is approx 3 cum ballast. This arrangement is boon for the places where no other machines can be utilised due to inaccessibility.



Use of tractor trolly in Katakhal – Bairabi G C Project

Use of tractor trolly in Kumarghat –Agartala Project

(b) In house Material Lorrey: This assembly has been prepared in-house to lead and spread the ballast along the track by pulling and pushing manually. Two dip lorry's are joined and then from all around, wooden bats are provided to make a box type of structure which encased the ballast and check to roll it out. This assembly has approximate 1.5 cum ballast and manually operated. This is a very cheap arrangement to spread the ballast up to lead distance of 1km.

(4) Use of Dual gauge sleeper in Gauge Conversion Project

There are many Gauge Conversion Projects under execution in N F Railway. In such project Earth work for widening of existing embankment and extension of minor Bridge to suit BG standard can be executed during normal MG train running on track.However the MG track structure can be changed only after taking Block, removing existing MG structure and placing new BG track over the widened formation. In order to reduce workload and time period of Mega Block it has been planned in many section like Katihar –Barsoi, patches in LMG-SCL and Katakhal –Bairabi section that to useDual gauge sleeper in gauge conversion projects. In this method Dual gauge sleepers were introduced in between existing MG sleepers by interlacing of dual gauge sleeper. Interlacing of sleeper was done by lifting the existing sleepers and inserting dual gauge sleeper during traffic block. In first stage every 5th MG sleeper is replaced with dual gauge sleeper, in next stage every 3rd sleeper is replaced with dual gauge sleeper and finally all the sleepers of meter gauge were replaced by dual gauge sleeper before taking mega block. The sleepers were inserted in stages so as to reduce time of traffic block. In Mega Block only changing the position of Rail from MG seat to BG seat was involved which can be done in short time. By adopting this method time of mega block can be reduced by at least 3 to 4 month.

Section in N F Railway where Dual Gauge Sleeper were used

1.Katihar – Barsoi

2. Lumding –Silchar(in patches)

3.Badarpur-Kumarghat

4.Arunachal – Jiribam

5.Katakhal - Bairabi

During Interlacing of sleeper and Lifting of track following care was taken:

- Lifting of track was done to elimination minor sags, which develop during interlacing of sleepers.
- After correcting minor sags lifting was done to accommodate ballast thickness by fixing Correct level pegs at suitable intervals.

- One-time lift was never exceeded 75 mm. at a time so as to allow proper consolidation. The operation should be repeated until the required level is attained when the track should be finally ballasted, through packed and boxed, the cess being made up to proper level.
- Lifting was commenced from the downhill end carried out in the direction of rising grade, care was taken not to exceed the easement grade.
- While lifting track under bridges and overhead structures and in tunnels it was ensured that there is no infringement of standard dimensions.
- In case of curves, the inner rail was made to the correct level and grade and then raising of the outer rail to give the required super elevation was done, care being taken to see that the cant gradient is within the permissible limit.

MG Track Laid on Dual gauge sleeper in Katakhal-Bairabi section

BG track laid on Dual Gauge Sleeper in Katakhal-Bairabi section

(5) Use of PQRS track machine for lying of track:

PQRS is short form of **Plasser's Quick Relaying System** is a semi-mechanised system for track renewal and the PQRS machines operate with four self-propelled cranes, which are capable of loading into and unloading from BFRs loads up to nine tonnes and lifting of 13-meter long pre-fabricated panel with PSC sleepers. In this system speed along with better quality in the track laying works can be maintained.

In many section of N F

Railway where Dual gauge sleeper are not used in track in pre block period the time required for lying of BG track during Mega Block is very high. Lying of track by manual means is cumbersome and time consuming and problem get compounded due to non-availability of skilled manpower on large scale. In such section it has been planned to use mechanised means such as PQRS for track laying so as to complete the work in short time.

In following Section PQRS track machine was extensively used for track laying:

(a)Katihar-Barsoi section

For better output and working of PQRS following works were carried out before start of work:

- All the longitudinal level and preparation of long section was completed before Mega block.
- Initial and final profile marked on the drawings.
- Quantity of ballast assessed and stacking of ballast was made near the possible locations.

- Site survey and selection of base Depot done well in advance.
- Wherever required formation treatment was done.
- All the ballast from crib and shoulder was removed.
- Fabrication of new panel with old rails was proceeded before mega-block.
- All the obstruction was removed temporarily.

Activities involved for lying sleeper during mega -block:

- Auxiliary track with dynamic gauge of 3.4 m was laid with CST-9 and on wodden block @ 2 m spacing for movement of Portal cranes.
- PQRS rake formed at base depo was proceeded to site for laying.
- Existing track was cut down into panels.
- After lifting up of old panel levelling of ballast was done on which new panel from BFR,s was placed.
- After laying of new panel packing of track was done.

Use of PQRS for lying of track in kumarghat-Agartala section

(6) Use of T-28 track machine for laying of Turnouts

T-28 is a point and crossing changing/laying machine manufactured by M/S Ameca of Italy for laying of turnouts on PSC sleepers. It consists of 2 nos. self-propelled Portal crane, 2sets of motorized/non-motorized rail trollies and jib crane. The portal crane permits adjustment of span and height and can be worked on crawler chains.

In normal maintenance of track due to space and time constrain to insert assembly of long fan shaped sleeper of point and crossing T-28 is used. However in N F Railway construction due to huge work load during block period T-28 machine is used extensively in many project. Its use has facilitated faster and quality construction as manual insertion is time consuming and require lot of adjustments.

Projects where T-28 was extensively used are:

(a) kumarghat- Agartala section-50 to 60 turnouts were inserted

(b) Katihar Yard - 250 no. of turnouts were inserted.

(c) Katihar – Barsoi section- 70 to 80 turnouts were inserted

Considering the time and space constrain whole work of laying point and crossing by T-28 was planned before Mega block and the entire work to be executed was by T-28 was split into two categories:

(i) Work to be executed before the Mega block.

(ii) Work to be executed during the mega block.

(i) Work to be executed before Mega block.

(a) New turnouts set was assembled with complete fittings at suitable location near the work site so as to avoid any infringement to other work.

(b) All required sleeper are stacked near the site location in sequence manner so as to avoid unnecessary delay in handling heavy P&C sleepers.

(c) All required signalling work which can be done in assembled turnouts was done.

(d) All required survey and measurements of geometry, marking of reference point like SRJ,ANC,etc are marked at site.

(e) Approach track was lifted with provision of proper ramp so as to provide matched profile.

(f) Usually point like shifting SRJ point required new foundation was casted for rodding arrangement for point operation.

(ii) Work which was executed during mega block.

(a) Existing turnouts was dismantled.

(b) Ballast bed was screened and levelled properly to accommodate extra dimensions of Fan -shaped PSC sleepers.

(c) Shifting of new turnout's assembly with portal and placing to near possible location where it has to be laid. So, that only longitudinal movement is balance.

(d) After preparation of bed the whole assembly was laid in position.

(e) Visible kinks, if any was eliminated and ballast was put back and one round packing done.

(f) All measurements of the turnouts to be checked and rectified if disturbed during laying.

(g) Ballasting & 3 round packing.

(h) Segregating and stacking released P-way materials.

Lying of Point and crossing at Kumarghat – Agartala section

Conclusion: To reduce construction time in any engineering project is the top most priority of any project executing department. N.F. Railway with on-going large construction project is best suited for adopting new innovative method of construction. The earthwork disposal by conveyer belt, mechanised blending & mixing and spreading of blanketing material, spreading of ballast on track by mechanical means, use of dual gauge sleeper and laying of track & Point & Crossing by mechanical means saves execution time, it is economical and helps a lot in executing work in targeted period in difficult circumstances of N.F. Railway.