APPLICATION OF TRACK MACHINES IN LAYING OF TRACK IN NEW LINE PROJECTS

S K Sapra, Narinder Paul** & Rajinder Singh****

SYNOPSIS

Modern track structure involves heavy track components viz 60 kg PRC sleepers, 60 kg 90UTS/110UTS rails, 300-350mm ballast cushion, handling 20 rail panels, PRC turnouts etc. Whether it is renewal of track or first time laying of track in new line projects, precision and quality control is of utmost importance. The role of track machines becomes relevant in this context as modern track components can not be properly handled manually, quality of laying suffers in case of manual work and deficiencies of alignment, cross-levels/superelevation, versines etc become inherent and give trouble in the long run, need more maintenance input in terms of cost & time and give poor riding comfort. This adversely affects overall economics and life-cycle cost of track structure. Moreover, concrete sleepers with elastic fastenings and higher rail section of upgraded metallurgy need careful handling to prevent undesired stresses affecting durability of track structure. This paper deals with application of track machines (and small track machines) for accurate laying of track in new line, doubling and gauge conversion projects. Few cases of deployment of track machines and small track machines in Jallandhar-Jammutawi Doubling and Qazigund-Baramulla new line Projects have also been referred.

1.0 BACKGROUND

Indian Railway is undergoing through transition phase as far as modernization of track structure and mechanization of track maintenance & track laying is concerned. High speed and dense passenger traffic on one hand and heavy axle load of goods traffic on the other, demand better initial laying, thus requiring less maintenance during service life and ensuring durability of track components. There is stress on reducing manpower for maintenance of P.Way assets and availability of block/ER for maintenance by track machines has also been substantially constrained. It is in this context that greater emphasis is imperative on mechanized initial laying with proper quality control and accurate geometry. Proper quality control in preparation of sub-grade is also possible by mechanized soil compaction methodology.

In construction projects (new lines, gauge conversion and doubling), formation earthwork and blanketing work has been mechanized to large extent by deploying heavy machinery viz high capacity excavators, dozers, dumpers and vibratory compactors including slope compactors along with application of geogrid and geotextiles. However, handling of sleepers and rails is still done manually which results into damage to pre-stress in PRC sleepers, kinks in

*SrDEN/C/Firozpur **ADEN/G/Firozpur ***SSE/P.Way/Jallandhar City

90UTS rails and breakage/damage of PRC sleepers & 90UTS rails due to impact of dropping. Similarly, the irregularities of initial laying persist throughout the service life of the track components. Slow speed of manual track laying and linking in construction projects also becomes a major constraint in commissioning of line. Mechanized track laying is very fast if activities are properly planned and requisite machines are deployed in time.

2.0 VISION 2020 AND CHALLENGES

VISION-2010 proposes to add 25,000 kms of New Lines by 2020. Of this, at least 10,000 kms would be socially desirable lines regardless of their economic viability in the short run. This will, of course, include the completion of the backlog of 11,985 kms of lines already sanctioned. More than 30,000 kms of route would be of double/multiple lines (compared to around 18,000 kms today) and more than 6,000 kms would be quadrupled lines with segregation of passenger and freight services into separate double-line corridors. Maximum speed of passenger trains would be raised from 110 or 130 kmph at present to 160-200 kmph, maximum speed of freight trains would be raised from 60-70 kmph to over 100 kmph. Gauge conversion programme would be completed. The gap between maximum and average speeds of both passenger and freight trains will be minimized. The entire network (barring the hill and heritage railways) would be in Broad Gauge.

The Vision 2020 also envisages the implementation of at least 4 high-speed rail projects to provide bullet train services at 250-350 kmph in each of the four regions of the nation and planning for at least 8 more corridors connecting commercial, tourist and pilgrimage hubs in the country.

Capacity constraints, reliability of assets, safety, slow speeds, technological upgradation and suburban transport are few important keywords in the Vision-2020 document.

3.0 SOCIO-ECONOMIC SCENARIO

Manual laying and maintenance of heavy track structure is neither feasible nor desirable due to changing socio-economic scenario also. Manual work is time consuming and is of poor quality affecting service life of the track. Track-related activities are strenuous, hazardous, unsafe and in-compatible with the emerging social trends. Manual handling of heavy track components sometimes leads to injuries including fatalities to the labour. With enhanced literacy level and rise in technical trade-education standards in the country, available manpower is better oriented for handling track machines and small track machines for efficient and quality laying and maintenance. Suitable blend of mechanization and manual working for select activities is therefore need of the hour.

4.0 APPLICATION OF SMALL TRACK MACHINES IN INITIAL LAYING

Selection of suitable machine (or combination of machines), trained manpower (including technical supervision), proper maintenance set-up (at the level of SSE/P.Way & at Division/Depot level) and documentation of laying parameters are important while deploying Small Track Machines for initial track laying. Following activities of track laying & linking in new line/gauge conversion/doubling projects can be executed using Small Track Machines:

Sl	Activity	Small Track Machine	Remarks
1	Pairing & butting edges on cess	Power-driven rail-hauling system	Also used for hauling heavy material during laying of track.
2	PRC sleeper spacing	Hydraulic sleeper spacer	
3	Rail joint welding, trimming and profile grinding	(i) Rail creep adjuster (ii) Power-driven Weld Trimmer (iii) Rail weld profile grinder	Weld Trimmer helps in trimming of left-over material of the weld.
4	Destressing of LWR	Hydraulic Rail Tensor	Used for Tensioning of rail during destressing at temperature less than T_d
5	Rail cutting, drilling & chamfering	(i) Abrasive Rail Cutter (ii) Abrasive Rail Cutting Wheel (ii) Rail Cutting Machine (Saw Type) (iv) Rail Drilling Machine (v) Chamfering Kit	
6	PRC sleeper unloading	Jib crane	
7	Lifting & Slewing of track	Tralis (Track Lifting cum Slewing Device)	Used for correction of alignment of track/turnout and for re-alignment of curve
8	Bending & De-kinking of rails	Hydraulic Rail Bender (Jim-Crow)	Used for flat-bottom rails.
9	De-hogging of dipped joints before welding	Hydraulic Rail Joint Straighter	Useful for improving longitudinal profile of rail.
10	Data-base of continuous temperature record	Continuous Rail Thermometer	Used for continuously displaying rail temperature, storing data at pre-set interval and printing the same.

5.0 APPLICATION OF ON-TRACK MACHINES FOR INITIAL LAYING

Two major factors responsible for good inherent quality of track, are profile of the rail and profile of the surrounding ballast bed. Rail should be straight and ballast bed should be free from longitudinal and cross level faults, as far as possible. Both these parameters need special attention at the time of track construction.

MECHANIZATION IN CONSTRUCTION OF TRACK

Track machines are the most important part of the modern track. With the growth of traffic and adoption of heavier track structure, use of the track machines is indispensable to achieve high quality work efficiently.

MAJOR CONCTITUENTS OF TRACK WORK

Once the subgrade has been prepared to the prescribed standard, further track work constitutes of the following elements:

- (i) Procurement and placement of stone ballast in layers of appropriate thickness. Provision of sub-ballast / blanket forms part of substructure.
- (ii) Transport, handling and placement of concrete sleepers at appropriate places.
- (iii) Transport, handling, laying and fastening of rails in coordinated manner.
- (iv) Lifting, leveling, lining and tamping of track (first round).
- (v) Inserting additional ballast in track from stacks on cess or through ballast DMT.
- (vi) Lifting, leveling, lining and tamping of track (second round).
- (vii) Further addition of ballast to make correct ballast profile.
- (viii) Welding of rails into long/continuous welded rails, followed by de-stressing of rails.
- (ix) Final round of tamping.

MECHANIZED TRACK CONSTRUCTION

Various methods of mechanized track construction have been adopted by track construction organizations around the world depending upon the local conditions/construction environment such as:

(a) Volume/magnitude of the work
(b) Availability of skilled manpower
(c) Desired quality standards
(d) Available track laying equipment

On Indian Railway, most of the track construction work has been carried out using simple road-based equipments. Only after the track is manually laid, ON-

Track tamping machines, borrowed from Open Line organization, are deployed for giving final rounds of tamping. In this method, inspite of the deployment of tamping machines, there is a considerable degree of compromise on the quality of track produced.

Manual handling of heavy track components is not only hazardous for the labour but track components also get damaged, particularly the concrete sleepers and high UTS long rails develop undesired stresses. Following paragraphs deliberate on the two methods of Mechanized Track Construction. In the first method, simple track machines which can be transported by road from one construction site to another are used. Second method makes use of complete track laying trains (similar to PQRS) which carry out track laying operations, all automatically.

MECHANIZED TRACK CONSTRUCTION USING SIMPLE TRACK MACHINES

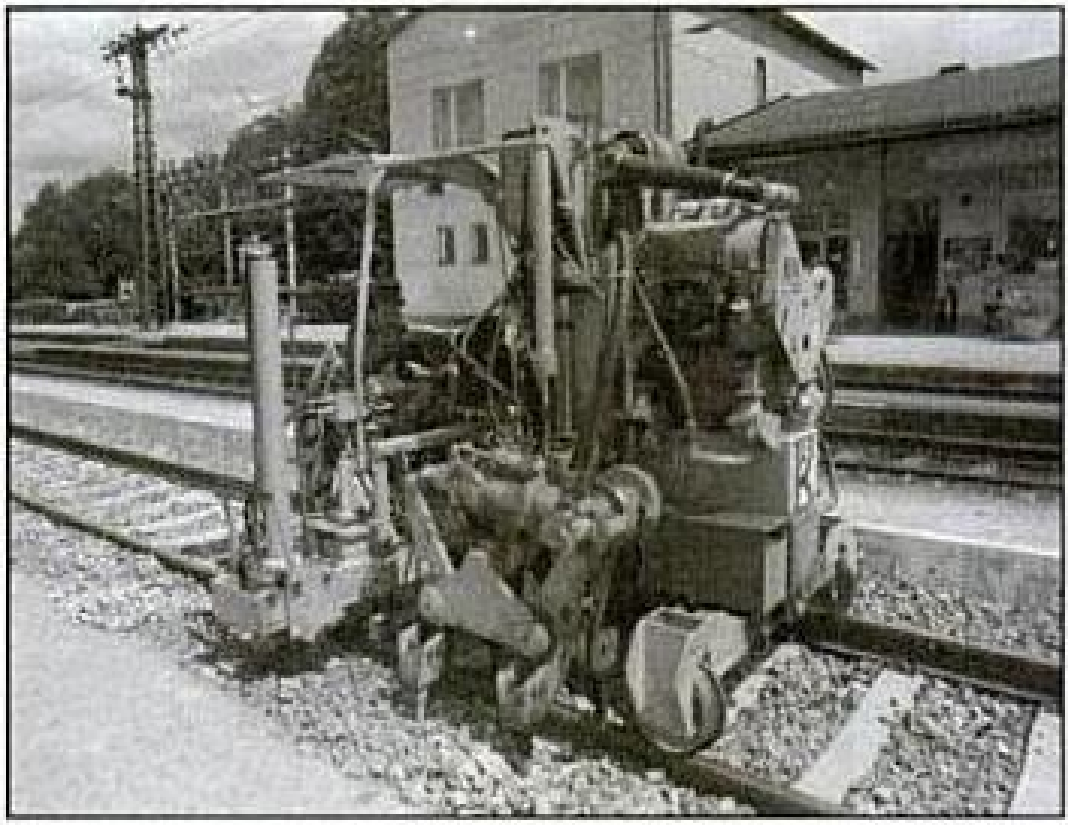

Fig 1: Self-loading tamping machine Plasser 08-275 zw (weight 30t)

- First round of tamping is given after spreading ballast, placing sleepers and laying/linking rails.
- Deficiency of ballast is then made up and second round of tamping is carried out. Additional ballast is inserted to make up shortage due to lifting and tamping.

- Once the sleepers are well consolidated, welding of rails into long rail lengths can be done using Mobile Flush Butt Welding plants/Alumino Thermit Welding. This is followed by de-stressing of rails. At this stage, a third round of tamping can be given if required.
- For obtaining correct ballast profile, a ballast profiling machine can be used.
- Final round of tamping is then given. After this tamping operation, the track should be fit enough for regular operation.

MECHANIZED TRACK CONSTRUCTION USING CONTINUOUS ACTION TRACK LAYING MACHINE

- Modern high capacity track laying machines have following important features:
    - It can place the sleepers automatically at a specified spacing.
    - It carries the rails and can unload them on the track-less area ahead of the machine.
    - During travel from one work site to another, the equipment is conveniently placed on standard Railway flat-bed wagons.

    - Main component of the machine is “Laying Machine”. During work, the front of the laying machine runs on the crawler track and the rear end is supported on the transport wagon.

In present scenario & organizational set-up, Track Machines are controlled by Open Line organization and Annual Deployment Programme of On-Track Machines largely envisages and deliberates requirement of maintenance only. There have though been few innovations in new line and doubling projects on Firozpur Division as described under:

(i) **Qazigund-Baramulla new BG Standalone section**: This is part of prestigious Udhampur-Srinagar-Baramulla new Broad Gauge Rail Line Project. However at present, the link is not fully commissioned and only standalone section between Qazigund-Baramulla (117 kms) is operational. Two ON-Track machines were deployed during laying of track in this section (the machines were transported to Kashmir valley on road trailers) through intervening mountainous terrain:

(a) WST (DUO): This machine helped in achieving excellent track geometry in most difficult working conditions.
(b) MPT: MPT was used for tamping of turnouts and attending slacks.
(c) UNIMAT: Used for tamping of turnouts.
(d) BRM: Ballast profiles were achieved using BRM.

After commissioning of Qazigund-Baramulla section, MPT is held back, for spot attention of the track including turnouts. MPT is also used for leading small rails required for welding in case of rail/weld fractures.

(ii) **Jallandhar-Jammutawi Doubling:** Following ON-Track machines have been used on this project:

- **(a) UNIMAT:** The machine has been widely used for tamping of newly laid turnouts on this Project. Deployment of UNIMAT has tremendously helped in expeditious commissioning of NI working.
- **(b) WST:** WST has been very useful in handling the track. Multiple rounds of tamping have helped in achieving good riding and early raising of speed to normal.
- **(c) UTV:** This has helped in organizing the section by stacking released/scattered material at nominated place.
- **(d) DTS:** Volumetric compaction of ballast by lateral oscillations, results into more close re-arrangement of ballast particles, without any damage. The ballast should however be laid in layers for more effective compaction.

Other projects (e.g. Abohar-Fazilka new BG line) have used Mobile Flash Welding Machines to make long/continuous welded rails in new sections.

Fig 2: Relaying of track by PQRS

6.0 CONTRACT MATTERS

6.1 RELATED TO DEPLOYMENT OF ON-TRACK MACHINES

Various ancillary works requiring deployment of manpower have to be outsourced in order to reduce pressure on departmental resources which are already scant with Construction Organization.

6.2 RELATED TO LAYING OF TRACK

Tender should be designed to provide application of high quality track laying machines. This is possible if size of the tender package is kept reasonably high (contrary to present practice of dividing the work into small sections) so as to motivate contractors to invest into high capacity and high output laying machines. The magnitude of contract scope has to be substantially large to justify investment of huge capital by contractor for deployment of track laying machines. This however, involves policy directions.

7.0 IMPLICATIONS OF DEFICIENT FORMATION & INITIAL TRACK LAYING

7.1 During construction, utmost care is required for providing an even and undisturbed top of formation. Any unevenness in the subgrade will cause maintenance problems afterwards, due to “memory” of the track.
7.2 Quality of initial track laying is the prime most factor determining maintenance requirement of the track during its service life, riding quality and life (durability) of various track components.
7.3 Poor quality of formation leads to excessive consumption of track ballast during service phase. This is because of puncturing of ballast into poor subgrade.

8.0 CONCLUSION: Deployment of Small Track Machines, ON-Track Machines, suitably trained manpower, adequate technical supervision is most important to ensure proper quality control of track laying in new lines/gauge conversion/doubling projects. It A policy is required for making large size track laying contracts to invite good contracting parties and to motivate them to invest in high capacity, quality output track laying machines. The challenges of VISION-2020 can be met by following innovative strategies, deviating from orthodox trends.