Mechanization in construction of track adopted by France Railway

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Synopsis: - This paper deals with complete methodology & machineries used in the mechanized construction of railway track right from formation to stabilization of railway track by fully mechanized means.

1.0 Introduction: -

While the railway is a product or a consequence of the industrial revolution, it is also one of its causes. It is the railway that made it easy to transport goods over long distances and made possible the large concentrations of population in industrial cities through the development of trams and metros.

The railways are an efficient alternative to cars and lorries and a means of reducing congestion at the entry of major cities. They are an efficient means of transport.

Railway structure

A railway consists of rails which are laid on sleepers that are embedded in ballast or concrete on top of a sub grade. Points and crossings, consisting of rails and machined parts, allow trains to move from one track to another.

2.0 Construction of New Double Line by mechanized means:-

When new lines are constructed they must meet requirements as regards speed, safety and comfort. In addition, precisely defined techniques are employed.

Although it might appear very straightforward, the construction of a railway track requires the most advanced technology and construction and maintenance uses sophisticated equipment.

2.1 Construction of the Formation:-

Earthworks began to be mechanized in the nineteenth century with the use of steam engines to tow excavators or the first locomotives to pull dumpers. Subsequently, machinery has been evolving all the time in line with technical developments.

As a result of this process of development, we now have shovels, bulldozers, trucks, and loaders that can weigh up to 100 tonnes with an output of 600 horsepower. They can load a 40 tonne dumper in 4 bucket scoops and are as maneuverable as a car. These machines make full use of modern computer technology for operation and control. The performance of this equipment is nowadays key to the success of a construction project both with respect to speed and cost limitation: seconds count in earthworks.

To illustrate how equipment has developed, in the 19th century it took 7 years to build 30 km of railway that involved moving 6 million m^3 of soil. Today, motorway works on the same scale can be completed in 2 years.

2.1.1 Machineries used in Earthwork in cutting:-

(i) The hydraulic shovel

This machine was invented by the French firm "Poclain" about forty years ago and has completely replaced the cable shovel for earthworks.
Since its invention it has been the subject of constant technical improvements. It is reliable, able to move large volumes of soil and the automatic choice when scrapers cannot be used.

(ii) The scraper

The scraper is an earth moving machine used in soft soil. The scraper is an earthmoving machine used for soft soil.

When it can be used this is the ideal piece of earthmoving machinery as it loads, transports and spreads material. Unfortunately it cannot be used to transport materials over long distances because of heating of the tyres. It cannot be used on rocky ground either as this causes excessive wear. It takes between 30 seconds and one minute for the scraper to load itself.

A scraper
Tracteur = Tractor, Ejecteur = Ejector, Benne = Body, Porte = Gate, Tampon de pousée = Push plate

(iii) Rock drills

These are used to drill into solid rock either to place charges for blasting purposes or to take core samples.

Drilling unit can drill holes with a diameter of between 100 and 150 mm
This machine consists of a track-mounted frame that carries the engine and hydraulic power unit, the dust collector and the boom on which is mounted the rail with the drill and the bar loader. This is known as a surface drill. This track-mounted machine is completely independent

When extremely straight holes are required it is necessary to use a bottom of hole drill. This is powered by compressed air from the machine's compressor that is delivered by tubes.

Perforator hydraulique = hydraulic rock drill
Glassiere = rail
Capteur de poussières = dust collector
Taillant = cutting head

Hydraulic drilling for 115 mm holes

2.1.1 Machineries used in Earthwork in bank or filling :-

(i) Wheel loader and track loader

Wheel loaders and track loaders are used to load the vehicles that transport materials or to move materials over short distances

(ii) Dumpers

These machines are used when transport distances are long in combination with a shovel that can load them in four bucket scoops.

A Caterpillar 773 rigid dumper being loaded. Maximum payload: 50 tonnes. Gross weight: 100 tonnes.

(iii)The bulldozer

Bulldozers are used for ripping, banking up soil, pushing scrapers and for leveling and creating slopes.

For earthworks, bulldozers with a power in excess of 300 HP are used for ripping, banking up soil and pushing scrapers.Machines of less than 300 HP are considered as support machines and used for levelling and creating slopes.

A bulldozer banking up soil (Lame = blade, Ripper = ripper)

(iv) The grader

Earthworks contractors use graders with a power of more than 150 HP. The precision with which the driver controls grading is extremely important as the grader is the last machine to be used on the structure.

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(v) Compactors

For earthworks, fills must be stabilized. This is done using compactors. Soil may be moist, dry, clayey or stoney and this determines the best type of compactor to be used.

Smooth vibrating roller motorized compactor
Versatile, easy to use on different types of terrain and material, highly mobile.Particularly used for compacting the base of layers and materials of all types.

Single drum vibrating sheep foot compactor
Sheep foot compactors are used on mobile cohesive soil (clayey).In order to improve the performance of this type of compactor some models have vibrating drums which increases the compaction energy

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2.2 Laying the first track

A new line consists of two tracks.

The **1st track** is supplied with equipment from a temporary track.
The **2nd track** is laid adjacent to the first and is supplied with equipment from the first.

Laying the temporary track with a Rubber tyred gantry

Sleeper laying gantry travelling on the new track

2.3 Setting out railways

The track must be accurately positioned on the site
Laying the first track: setting out
Prior to any construction work the track must be accurately positioned on the site. Topographic surveys performed by surveyors are required for this.

2.4 Constructing the temporary track

Laying the first track: construction of a temporary track
The temporary track consists of 18 metre track panels laid end to end.
It is installed where one of the permanent tracks is to be positioned and is used to deliver rails and sleepers. This method prevents damage to the existing formation. It also means the rails and sleepers can be discharged in the immediate proximity of their ultimate position, which reduces the risk of the new equipment being damaged on the site.
The temporary track is gradually replaced by the permanent track.

Laying a temporary track using a rubber tyred gantry

2.5 Delivery of rails

Laying the 1st track: Delivering the rails
The 80 metre rails are electrically welded in a workshop and delivered to the worksite in 400 metre lengths by trains that can carry 12,000 meters of rail (i.e. 6km of track).
The photo on the left shows the 400 metre rails being unloaded from the end of the train. The photo on the right shows slings attached to the rails for unloading


Delivery of rails

2.6 Unloading sleepers

The temporary track is lifted in panels using gantries and loaded onto the wagons of the train that delivers the new sleepers .


Sleeper delivery train **Long rails being used as a crane way**

2.7 Fixing the rails

The long welded rails which have been used as a crane way are installed on the sleepers using rail laying machines


Concrete sleeper layer **Machine for installing rail fastenings on the sleepers**

2.8 Thermit welding

The 400 metre rail lengths which are fixed on the sleepers are placed end to end and Thermit welded

Left, pouring the weld metal. Centre: the weld before trimming. Right: the trimmed weld before grinding

2.9 Laying the second rail

Once the 1st track is completed it is used to discharge the rails and sleepers for the 2nd track onto the formation

Top: the 1st track is used to deliver the rails and sleepers for the 2nd track –

Bottom: unloading the sleepers onto the formation and installing the rails on the sleepers

2.10 Unloading long rails

Unloading long welded rails onto the formation.

2.11 Delivery of sleepers

Laying the 2nd track: Delivering sleepers onto the platform

The sleepers are unloaded using a crawler excavator that runs between the two rails that have already been discharged onto the formation. This machine is equipped with an articulated sleeper lifting beam that lays every other sleeper

Sleeper lifting beam Discharging Sleepers onto the platform

Laying alternate sleepers with the lifting beam

2.12 Fixing LWR

Fixing Long Welded Rails to the sleepers.
Laying the 2nd track: Fixing LWR to the sleepers :-The unloaded LWRs are installed on the sleepers by a self-propelled rail laying machine.
The fastenings that have been spread along the formation are screwed or clipped into place using powered tools.

Left: A Rail laying machine. Right; Bolting rail fastenings using a rail screwing machine

2.13 Ballasting

Laying Ballast
Once the tracks have been laid on the platform the ballast is discharged by ballast hoppers and installed under the sleepers

2.14 Tamping machine

The 09-3X tamping machine is used for raising, straightening, leveling and tamping track. The machine has a satellite enabling it to tamp three sleepers simultaneously. This is a continuous tamping machine that propels itself slowly forward as the tamping unit moves underneath, thus achieving a high working rate

2.15 Dynamic Stabilization

This is performed by a dynamic stabilizer

Close up of the stabilization unit **close up of the stabilization unit**

2.16 Finishing works

Finishing work is required once the track has been leveled.

B**allast grader giving the ballast is final profile**

Machineries used in the Track Linking

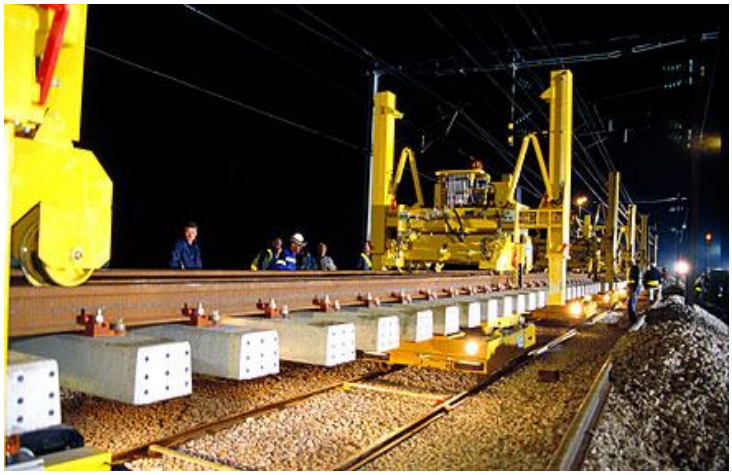
(i) Cranes

Single jib and twin jib cranes:
These are self-propelled machines fitted with one or two hydraulic cranes that are used to handle track panels or points and crossings. These cranes have sufficient torque to lift 45 T/m and 72 T/m .

They can either be mounted on track (in the case of worksites with a double track) and used to transport rails, track panels, points and crossings, or in depots, on sidings (to load and unload worksite materials).

Installing a set of points with a twin jib crane

(ii) Machine for renewing points and crossings



Laying points from along the axis of the track

This type of equipment has the following features:

- Ability to handle track panels or points and crossings without deforming them.
- Movement of the equipment is radio controlled and monitored in the three planes
- Each gantry/buggy combination is able to handle a 20 tonne load

Machine for renewing and laying points and crossings:

This is a set of completely independent machines which lays pre-assembled points or crossings in one or more sections depending on its length. This machine loads and unloads the points or crossings, moves them laterally or longitudinally, installs them (on existing or new track). The system's versatility means that it can be used during track replacement works.

On the photo above a set of points is transported by radio-controlled buggies. In this photo the buggies are travelling on an additional crane way. The gantries, which are resting on top of the track panel, will be used to lay the points once the crane way has been removed.

3.0 Conclusion:-

(i) In the Indian Railways new track is constructed mainly by manual labour assisted by machines but on France railway the it is done mainly by the machines assisted by manual labours .Due to heavy structure , ,the labour is not able to handle it properly , therefore now time has come to adopt the mechanized means for construction of new railway track on Indian Railways.

(ii) Mechanized construction of the track not only ensures the best quality as well as fast construction.

(iii) Now a days with the globalization, the import of the latest machineries is very easy and there are certain firms on Indian Railways which can definitely use these machineries in construction of railway track.