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Methods of improving the track formation of existing lines

Méthodes d'amélioration de la plate-forme de lignes existantes

Verfahren zur Verbesserung des Planums auf vorhandenen Strecken



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Summary

The first part of this leaflet deals with civil engineering means of improving the track formation on existing lines.

The second part describes the various working methods.

The third part evaluates these working methods in respect of operating and civil engineering conditions, staff and machine cost, performance and quality of work.

Diagnosing the need for improvement of track formation, also the selection and dimensioning of the materials to be incorporated, are dealt with in *UIC Leaflet 719*.

With a strict interpretation of the diagnosis, improvement of the formation is often necessary only for relatively short sections of line. However, it should be noted that, for reasons of uniformity and to prevent problems at transition points, short untreated sections between two improved sections should be avoided.

1 - Civil engineering methods of improving the formation

The working methods described in this leaflet represent various civil engineering means of improving the track formation.

1.1 - Formation Improvement (FI) by means of a formation protective layer (PL) of mineral substances (formation sand and gravel)

Formation improvement by laying formation sand and gravel is the most frequently-used method.

The layer directly beneath the ballast is removed and replaced by formation sand and gravel.

The formation sand and gravel here fulfils four functions:

- filter stability (preventing the formation material from penetrating the ballast and vice-versa),
- drainage of surface water,
- improving load-bearing ability,
- increasing frost-resistance.

1.2 - Formation improvement with formation sand and gravel (FSG) and geotextiles

The thickness of the protective layer, in particular, can be reduced by the use of geotextiles, which decreases the quantity of materials to be laid and excavated (see *report D 117/RP 28* - see Bibliography - [page 24](#)).

1.3 - Formation improvement by laying treated materials

If no mineral mix conforming to *UIC Leaflet 719, Fig. 2* ([see Bibliography - page 24](#)) is available then coarse-grained material, which must be treated, can also be used. Two methods have proved successful in long-term trials (FS).

1.3.1 - Cement-treated limestone material

Use of crushed limestone material, treated with cement "misto cementato" as a protective layer between formation and ballast.

Formation improvement with "misto cementato" has been used by the FS in long-term trials (over 20 years) with great success. The crushed limestone should conform to the grading curve of *UIC Leaflet 719*.

The proportion of cement (PZ 35) is roughly 3 to 4 % and the water content is 6 % (percentages by weight).

1.3.2 - Asphalted (bitumenized) conglomerate

Grain-size distribution should conform to the specifications of *UIC Leaflet 719*.

The proportion of bitumen by weight is roughly 5 %.

1.4 - Creation of frost-resistance by laying of thermal insulation sheets

To provide frost resistance, thermal insulation sheets (e.g. of extruded foamed polystyrol) are laid between ballast and formation. Other materials, such as old sleepers, may also be used in place of such sheets.

2 - Description of methods

The civil engineering means of improving the formation outlined in point 1 - page 2 are now described in detail.

2.1 - Formation Improvement with formation sand and gravel (FSG)

FSG is currently laid by the IM using the working methods described in points 2.1.1, 2.1.2 and 2.1.3 - page 5.

2.1.1 - Laying of FSG by earthmoving machinery in short sections of less than 100 m

After the track has been lifted, the ballast and formation material are excavated with the aid of earthmoving machinery. If the excavated material cannot be laid at the side, it is loaded on to wagons on the adjacent track or on to lorries.

If neither of these options is available, intermediate trackside storage will be necessary. When the track is restored, the material can then be loaded on to wagons.

The FSG and ballast are similarly unloaded from an adjacent track or from lorries. Here too, the material can be held in intermediate storage before track removal.

Once the materials have been laid and compacted, work commences on the track.

Filling-in, tamping, lining and welding complete the work.

On double-track lines where a greater thickness of FSG (more than 50 cm) is laid, the length of working sections is limited by the stability of the adjacent track.

Appendix A - page 11 shows the flow chart for formation improvement in short sections.

2.1.2 - Laying of FSG by earthmoving machinery in longer sections, exceeding 100 m

In principle, the working method is identical to that described under point 2.1.1, but with the longer sections it is more economical to undertake track lifting and replacement using high-speed track relaying machines.

Because of the larger quantities of material to be removed and laid (~ 1 000 m³ for 120 m FI), this method is best applied to double-track lines, with use of the adjacent track.

Appendix B - page 12 shows the flow chart for formation improvement in longer sections.

2.1.3 - Laying of FSG by tracklaying machines

With this working method, it is possible to install a layer of FSG without track removal and replacement. If the track is removed and relaid, a better quality of finished work is achieved.

The method may be broken down into the following stages:

- total excavation by ballast screening machine in several passes as required. The excavated material is partially stored alongside or loaded (e.g. to MFS 40 units),
- levelling of the formation,
- if a geotextile is being laid the track is lifted, the geotextile placed in position, and the track replaced,
- FSG unloaded from self-discharge wagons and distributed to the necessary level by a ballast regulator with suitably-adjusted levelling equipment,
- lifting of the track panel by tamping and lining machine (SRM) and compaction of the FSG beneath the sleepers (enlarged tamping pick),
- FSG compacted in the sleeper cribs by special crib consolidator, and in the cesses by vibrator roller,
- ballast discharged from self-discharge wagons and spread; track lifted, tamped, lined and rewelded.

Preparatory work to be carried out includes:

- raising the ballast shoulders, so that the BRM covers the complete ballast cross-section,
- lowering of the cess, to ensure trouble-free drainage of the formation.

If the track is removed and relaid, it is possible to produce a FSG surface with a perfect horizontal and longitudinal profile, which can then be compacted to the required standard using a vibrator roller.

Appendix C - page 13 shows the flow chart for FI using a tracklaying machine.

2.1.4 - Formation improvement using ballast screening machines (BRM)

Formation improvement by ballast screening machine makes possible the laying of a protective covering (PFC) of formation sand and gravel to a max. depth of 20 cm and a width of 3,80 m at the same time as the old track is lifted. This method is used primarily when protective improvement of the formation is necessary (for increased line speeds, axle loadings). Avoid cutting into the old, compacted track formation if possible.

The PFC is laid beneath the raised track panel without track lifting and replacement. This method does not require use of the adjacent track.

The use of this method requires a clean ballast bed, otherwise the ballast should be screened before FI.