Sub: Guidelines for Design/Construction of formation on Indian Railway track

Ref: Railway Board’s letter No. 2011/CE-II/Form/Spec. dated 14.10.15

Guidelines for design/construction of formation for Indian Railways is mostly covered in the following two documents:


Since all new formations are to be constructed for 25t axle load, therefore provisions regarding design of formation contained in GE: G-1 were superseded by those in GE: G-0014.

It is noticed that difficulties are being experienced in the field in adopting these Guidelines as some of the provisions of aforesaid two documents are overlapping. Moreover necessity was felt to simplify the provisions of formation design with special emphasis on the blanket layer due to difficulties experienced by field officials. Accordingly, attempt has been made to rationalise the design of formation keeping in view the economy & safety.

In view of above, provisions on design of formation have been formulated based on international practices and the same have been approved by Railway Board with the stipulation that “Chief Administrative Officers/Con shall finally decide the requirement of Blanket layer keeping the subgrade characteristics, etc. in view”.

A copy of approved guidelines is enclosed herewith for adoption in new works/projects. The basic instructions (other than those contained in enclosed guidelines) detailed in aforesaid two documents (GE: G-1 and GE: G-0014) shall continue to apply.

Copy to EDCE(P)/Railway Board for information please.
Guidelines for Design/ construction of formation on Indian Railway track

1.0 The formation is the platform upon which the track structure is constructed. Its main function is to provide a stable foundation for the subballast and ballast layers. As the influence of the traffic induced stresses extends considerably beyond the depth of the ballast, the subgrade is a very important substructure component having significant influence on track performance and maintenance. Replacement/rehabilitation of track formation in service has serious repercussion on traffic and is very costly. Therefore it is necessary that adequately strong formation is built in new constructions to avoid need for rehabilitation in future for the foreseeable/planned traffic needs. Proper formation design and quality control during construction is key for providing stable formation for anticipated traffic needs.

2.0 Soil Exploration for formation design:

2.1 As formation design will primarily depend upon the type of soil being used in construction, it is essential the soil exploration is done properly for soil classification and assessment of bearing capacity as laid down in RDSO Guidelines GE: G-1 para 3.0. The results of soil exploration shall be reviewed and finally approved at the level of CAO/Con as this will be the basis of further design.

2.2 The soil classification shall be done as per IS: 1498. To formulate the thicknesses of formation layers, various soil groups have been combined together to simplify the classification based on %age fines, in Table-1 below:

<table>
<thead>
<tr>
<th>Soil Group</th>
<th>Soil Sub Group</th>
<th>Description w.r.t. %age Fines (size &lt; 75 micron)</th>
<th>Equivalent soil group as per IS classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>Soil containing fines &lt; 12%</td>
<td>GW, SW, GW-GM, SW-SM</td>
</tr>
<tr>
<td>B</td>
<td>B1</td>
<td>Soil containing fines &lt; 12%</td>
<td>GP, SP, GW-GC, GP-GM, GP-GC, SP-SM, SP-SC, SW-SC</td>
</tr>
<tr>
<td>B</td>
<td>B2</td>
<td>Soil containing fines from 12% to 50%</td>
<td>GM, GC, SM, SC, GM-GC, SM-SC</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>Soil containing fines &gt; 50%</td>
<td>CL, ML, CL-ML, CL, MI</td>
</tr>
</tbody>
</table>

3.0 Requirement of Blanket Layer:

3.1 The provision of blanket layer shall not be needed when formation/ earth fill embankment have:

(i) Rocky beds except those, which are very susceptible to weathering e.g. rocks consisting of shales and other soft rocks, which become muddy after coming into contact with water

(ii) Soil of GW, SW, GW-GM, SW-SM type

(iii) Soils conforming to specifications given in Para 4 below.
The provision of separate Blanket layer shall not be necessary when Coarse granular, well graded ($Cu>7$, $Cc$ between 1 and 3) soil/quarry dust/crushed stones material of 300 mm thickness is laid as top layer.

3.2 For other conditions, the system of layered construction of embankment consisting of prepared subgrade shall normally be followed. The Prepared sub-grade should normally consist of good quality soils with fines less than 12% (A or B1).

3.3 **Thickness of Prepared subgrade and Blanket Layer:**

<table>
<thead>
<tr>
<th>Embankment Fill /Soil Group</th>
<th>Prepared Subgrade</th>
<th>Thickness (mm)</th>
<th>Thickness of Blanket Layer (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Not Required</td>
<td>NIL</td>
<td>NIL</td>
</tr>
<tr>
<td>B (B1/B2)</td>
<td>A</td>
<td>500</td>
<td>NIL</td>
</tr>
<tr>
<td></td>
<td>B1 (Fines &lt; 12%)</td>
<td>350</td>
<td>150</td>
</tr>
<tr>
<td>C</td>
<td>A</td>
<td>500</td>
<td>Nil</td>
</tr>
<tr>
<td></td>
<td>B1 (Fines &lt; 12%)</td>
<td>500</td>
<td>150</td>
</tr>
</tbody>
</table>

The level of compaction of various layers of formation shall be ensured as defined in guidelines issued by RDSO.

3.3.1 In case good quality soils with fines less than 12% (A or B1), are not available for preparation of subgrade economically, soils having fines between 12% to 50% (B2) can be used over embankment fill of soil group C. In such cases, the thickness of blanket layer over prepared subgrade of 500 mm thickness shall be kept as 250 mm. The thickness of blanket layer can be reduced to 150 mm by use of Geotextile in consultation with RDSO.

3.3.2 In case, the prepared subgrade is not considered on economic considerations and use of other types of soil not covered by above clauses is required, Railways may approach RDSO for getting guidance on deciding blanket thickness depth.

3.3.3 Use of Geosynthetics (Geo textile/ Geo grids) shall be considered at places where it is economical to use it in combination with blanket as it reduces the requirement of thickness of blanket. Use and selection of Geosynthetics should be done in consultation with RDSO.

3.4 Selection of top layers for design of formation as well as for blanket material as given in above Paras and further deviations from these provisions can be finally decided on techno-economic considerations by CAO(Con.) after recording the reasons.
4.0 **Specification of Blanket Material:**

4.1 The material for blanket layer over prepared sub-grade should be well graded granular material. The following specifications shall be ensured at the time of laying:

(i) Cu > 7 and Ce between 1 and 3
(ii) Fines (passing 75 microns): 3% to 10 %.
(iii) Minimum required Soaked CBR value 25 of the blanket material compacted at 100% of MDD.

4.2 These values can generally be obtained by following the gradation as given in GE. G-0014.