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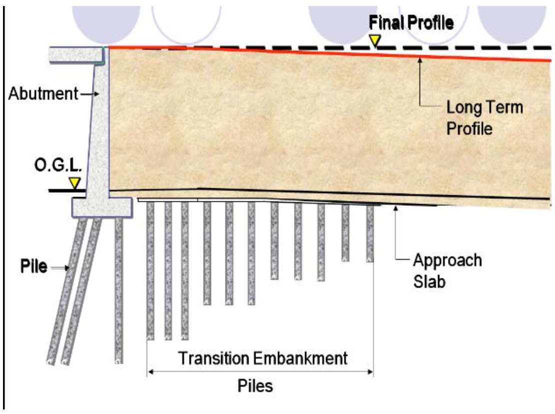
Northern Double Track

The construction of the Double Track from Alor Setar to Padang Renggas (about 200km) in the northern part of Peninsular Malaysia commenced in 2007. As the Double Track transverses from north to south, the subsoil consists of various types of soil ranging from soft alluvium deposit to dense residual soil. In general, the thickness of the soft alluvium deposits is about 15m to 20m with an undrained shear strength of 10kPa to 15kPa for the top 3m.

The geometrical tolerance of Double Track is very stringent with designed speeds of 180km/hour and 90km/hour for passenger train and freight train respectively. In view of this, the ground treatments for the railway embankment are designed to meet the stringent performance requirements of differential settlement of not more than10 mm over a chord length of 10m and settlement of not more than 25mm within 6 months after completion. Ground treatment techniques such as excavate & replace (E&R), temporary surcharge, with prefabricated vertical drain (PVD), basal reinforcement, stone column and piled embankment are designed to meet the above-mentioned stringent performance requirements. In addition, dynamic effect checks are vital to determine the safe configuration of the railway embankment in order to prevent excessive subgrade deformation and failures due to repetitive axle load.

Temporary surcharge

Significant differential settlements at bridge approach are still common along highways and railways in Malaysia. Bridge abutments over soft deposits are normally supported by precast concrete piles, usually driven to set at a firmer layer. The long term settlement of the abutments is hence negligible. The embankment adjacent to abutments would settle due to consolidation settlement of the subsoil under the embankment load. Consequently, this creates a significant differential settlement between bridge abutment and bridge approaches without piles. In view of this, piled embankment with different lengths as transition area is utilised to provide smooth profile between bridge abutment (rigid structure with piles) and approach embankment area (without piles).

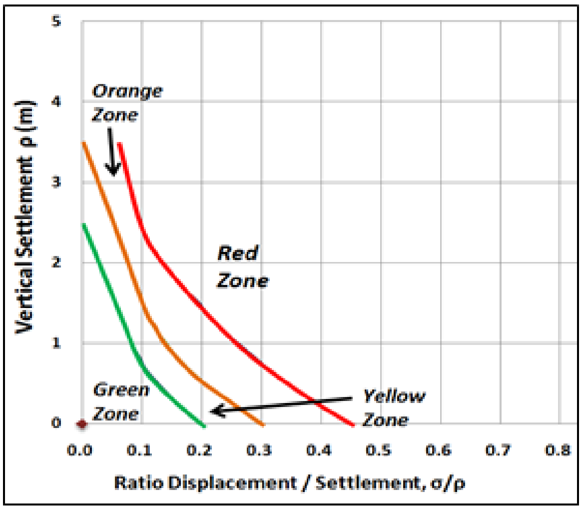


Piled embankment with transition piles

The installations of PVD are carried out by using static or hydraulic rig. The machine is generally fitted with a structural frame (drain mast) and a mandrel that designed to the required depth. The structural frame is as high as the designed PVD length. In view of this, the installation of PVD cannot be carried under headroom constraint due to areas such as underneath existing pylons. Therefore, conventional sand drains are adopted as a replacement for PVD. The installations of sand drains are carried out using borehole drilling machines.

As the proposed Double Track is to be built within the current ROW, which is near to the existing live track, the construction of the railway embankment needs to be carried out with extra care to ensure the safety of the existing live track. This is different from highway projects which are always built in rural area. Therefore, assessments of existing track conditions are carried out as a risk management measure prior to the commencement of construction works, thus allowing the contractor to take necessary actions based on the risk levels; classified into four (4) risk categories namely Low Risk, Moderate Risk, Significant Risk and High Risk.

Many literatures reported failures of embankments constructed over soft clay are closely related to the magnitude and history of the deformations which took place before failure. Therefore the information obtained from field instrumentations measurements can be used to ensure the safe construction of embankments. Displacement markers (that are relatively cost effective compared to inclinometer) are utilised extensively to monitor the lateral movements of the constructed embankments. With reference to the lateral movements and settlements (recorded from settlement gauge), the stability of the constructed embankment is monitored based on a "modified" Matsuo stability plot as shown below.



Embankment stability check during filing