

## Flexible Foundation of Stacker Reclaimer in soft soil– an Optimized Solution

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“Stacker Reclaimer” is used for stacking and reclaiming of raw materials in the stockyard of various industrial Plants. Stacker Reclaimer moves on rails and it is very important to restrict the differential settlement in between the rails for smooth movement of the equipment. The task of restricting the settlement within tolerable limit is more challenging when soil layer beneath the formation level is poor & soft (clayey silt/ silty clay). In such case open foundation usually is not a viable solution and pile foundation is preferred. Total length of foundation being quite high (600 to 900 m) and piles being costly, adoption of flexible foundation can save both cost and construction time. Flexible foundation system for stacker reclaimer has been engineered by TCE in a Power Plant Project which is under successful operation.

Stacker reclaimer is the equipment for raw material handling & management in Steel, Power, Cement and many other Plants. Stockpile of material is built to augment feeding when regular supply of the same is suspended. Stacker Reclaimer is mounted on wheels which travel on rails over a long stretch of stacking bed depending on the requirement. A typical elevation of stacker reclaimer equipment is shown in figure 1. To ensure flexibility in the foundation and uniform load distribution within the permissible bearing pressure, the rails are placed on sleepers resting on ballast. The soft soil below the ballast is replaced with sand to a calculated depth with adequate drainage system and strengthened with Geogrid/ Geotextiles. To adopt flexible type of foundation system for stacker reclaimer, prior to the above, it is essential to improve the design parameters e.g. net safe bearing capacity, settlement of the underlying soil strata by ground improvement techniques. Several methods of ground improvement are used such as stone column, deep soil mixing, and consolidation by preloading. The sleepers, ballast, sand layer strengthened by Geogrid/ Geotextiles along with drainage system, all together, constitute an elastic medium imparting flexibility to the foundation system.

The Project is located on a river bank in the eastern India where the soil is predominantly clayey silt/ sandy silt/ silty clay (“N” value mostly 3 to 12) upto a depth of around 40 m below the natural level. Under the circumstances the sub-soil being ‘soft’ with low bearing capacity and susceptible to high settlement, rigid foundation on piles became necessary to support the stacker reclaimer rails. As per the design requirements, around 750 numbers of 450 mm diameter piles were required. Estimated cost and time of construction of piles were found to be 17,150 ₹ per m<sup>2</sup> and 5 months respectively. In order to tide over such high cost and time constraints flexible type of foundation system was decided to be constructed. Out of several methods, ground improvement by preloading was used. In this method soft layer was consolidated by applying surcharge load on surface to squeeze out the water trapped in soil. In order to help water to escape at surface, pre-fabricated vertical drains (PVD) were installed in grid pattern through full depth of soft strata. Preloading was done by dumping earth up to designed thickness (earth surcharge) and was maintained for pre-determined period (Fig 2). A single layer of geotextile was placed on the compacted sub grade above which graded sand was filled

in layers and compacted. A drainage system aligning both longitudinally and transversely was laid in the sand layer. The drainage system consisted of perforated HDPE pipes encased with jhama bricks which were again wrapped by geotextile. A layer of geotextile was placed above the sand layer and a layer of geogrid was placed thereupon. Stone ballast (40 mm & down) was laid in two layers with geogrid at mid height and compacted thoroughly. Sleepers with transverse ties were placed thereon and the rails were fixed on the sleepers. The layout and cross section of the foundation system as described above are shown in Fig 3 and Fig 4 respectively. Major part of the initial settlement on account of the stored material in the stock pile is taken care by the preloading and PVD system constructed at the beginning. The ballast and the geogrid disperse the wheel load evenly to the subgrade and reduce the possibility of differential settlement. Additionally the sleepers are firmly held in position by means of mild steel cross ties transversely (Fig 4). It is experienced that during initial phase of the equipment operation, the rail gets settled to some extent on account of closing of inter aggregate gaps in the ballast due to wheel load of the Stacker Reclaimer. This is put back to original level by filling additional ballast material in the affected locations and the total system gets stabilized in due course. The flexible foundation saves around 50 – 60 % of cost compared to rigid pile foundation but the time of construction is about 20 – 40 % more due to preloading.



Fig -1 Stacker reclaimer equipment



Fig – 2 Preloading by earth surcharge

LONGITUDINAL DRAINS  
(TYP)

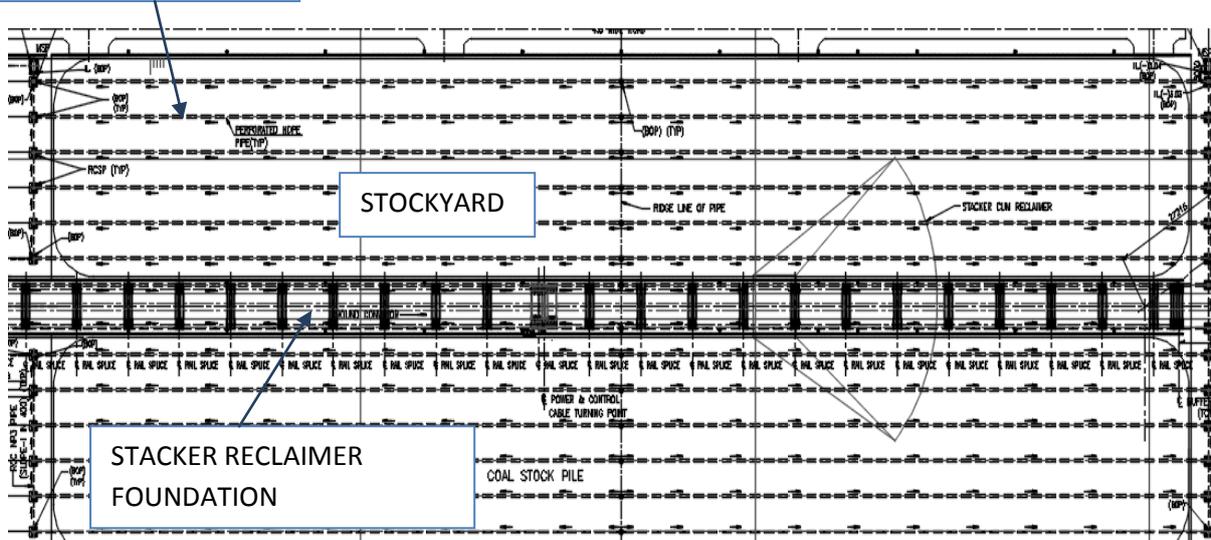


Fig – 3 Stacker Reclaimer Foundation Plan along with stockyard drainage

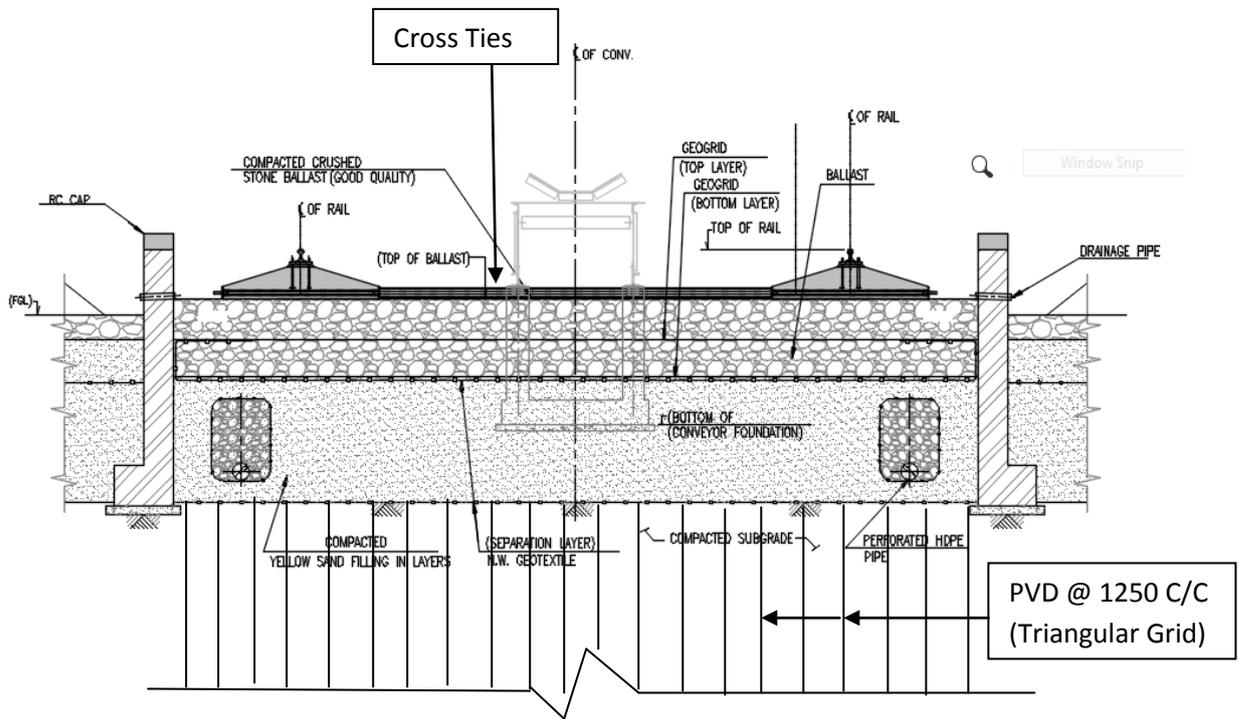


Fig- 4 Typical cross section of flexible foundation system



Fig – 5 Stacker reclaimer supported on flexible foundation