LAND PAC

BS 2010/006

BENEFIT STATEMENT

Case Analysis

eliminating the need for excavation and compacting in thin layers

MARKET SECTOR

Infrastructure Development; Power Industry

APPLICATION

Deep In-situ Compaction, Thick Lift Compaction & Certification

PROJECT PHASE

Design Phase

PROJECT and GEOLOGICAL REVIEW

LOCALITY

The coal stockyard is basically situated north of the main power station infrastructure, about 6km south west of the existing Matimba Power Station and 8km south of Exarro's Grootgeluk Coal Mine.

VEGETATION

The majority of the site is covered in dense Savannah bush., which is to be fully removed prior to the process on impact compaction.

CLIMATE

The climatic conditions of the area are characterised as semi arid with very hot summers and mild winters, with a mean annual rainfall of approximately 550mm and a mean daily maximum temperature of close to 30 degrees Celcius.

TOPOGRAPHY

The area is question is situated across a pediment adjacent to the Waterberg Mountains and as such is characterised by low undulating relief. Regionally the Waterberg Mountains form the largest topographical feature rising about 200mm from plains surrounding Lephalale.

COMPACTION

Impact compaction is the process whereby a high load is applied to the material which needs to be compacted by a falling weight. The load pulses that are caused by the impact cause shock waves in the material to a considerable depth and also in the horizontal direction. The compaction of cohesive, fine material depends largely on the moisture content, the plasticity and the particle size distribution. The shear strength of the material depends on its cohesion.

The fine soil particles have a large specific surface area and therefore a high water absorption capacity. The compactability is dependent on the moisture content and the plasticity of the gravel and it generally has to be well controlled during the compaction process.

Although it is sometimes recommended that the moisture content should be lower than optimum, practice has shown that because of the high forces which are applied by the impact roller, it is more effective than other types of rollers during the compaction of material of which the moisture content is higher than optimum in a sandy type of material.

TYPICAL SOIL PROFILE

0.00m – 0.50m	Dry, yellowish brown, loose to medium dense, pinhole voided, silty SAND with fine angular quartz gravel and roots. TOPSOIL consisting of HILLWASH.
0.50m – 1.00m	Dry, yellowish brown, dense to very dense with depth, pinhole voided, silty SAND with fine quartz gravel. HILLWASH OR dry to slightly moist, yellowish brown to mottled olive brown and orange, very stiff, fissured, clayey SAND with fine angular quartz gravel. HILLWASH.
1.00m – 1.50 m	Dry to slightly moist, yellowish to reddish brown speckled black, dense to very dense with depth, intact, sandy sub-rounded to rounded quartz GRAVEL and COBBLES set in matrix of silty sand. PEBBLE MARKER. The layer is often ferruginized with ferricrete nodules common throughout the layer.
1.50m – 1.60m	Reddish brown, completely to highly weathered, coarse grained, very soft rock ferruginized CONGLOMERITIC QUARTZITE comprising rounded to sub-rounded quartz gravel and cobbles set in sandstone matrix. Matrix supported. MOGALAKWENA FORMATION. WATERBERG GROUP.
1.50m+	Near refusal to refusal by CAT 320 LME tracked excavator on material as described above.
1.)	No groundwater encountered.
2.)	Undisturbed and disturbed samples retrieved.

CONSTRUCTION PLAN

The Cut and Fill programme was planned for conventional methods, requiring the material to be compacted in 150mm layers. The geotechnical recommendation was also to have the top 1m removed and brought back to level also in 150mm layers.

The area in question was in the region of 600,000m2 with a maximum lift of 2m but generally contained to 500mm.

TRIAL PROGRAMME

A complete trial was conducted both on the in-situ and fill material. The trial was performed with a 25kJ Impact Compactor with a testing regime that includes the Continuous Impact Response (CIR), settlement, plate load testing, density testing (at different depths), penetration testing and soil sampling.

The trial was basically used to establish the level of improvement and to establish the optimum number of passes required with the impact compaction plant in order to achieve the required density specification. The trial also allowed for the establishment of control limits to be used with the CIR for quality control and certification and at the same time reducing the testing regime that would have been employed on site during the construction phase.

FINAL CONSTRUTION METHODOLOGY

The proposal detailed below basically eliminates the need for excavating 500-2000mm of material and compacting it back in conventional layers. The following methodology was proposed:

Description	In Situ Compaction	500-750mm Layer Thickness	750-1200mm Layer Thickness
Impact Compaction Plant	25 kJ 3-sided roller	25 kJ 3-sided roller	25 kJ 3-sided roller
Number of passes	30 (minimum) Optimum number of passes will be established following a detailed trial on the actual material on site.	15-20 (minimum) Optimum number of passes will be established following a detailed trial on the actual material on site.	30-40 (minimum) Optimum number of passes will be established following a detailed trial on the actual material on site.
Watering	Every 10th pass if dry.	Every 10th pass if dry.	Every 10th pass if dry.
Post Impact Compaction	Level the undulations and vibro compact only if it is the final surface.	Level the undulations and vibro compact on final layer only.	Level the undulations and vibro compact on final layer only.

CONTINUOUS IMPACT RESPONSE (CIR) MEASURING SYSTEM

The Continuous Impact Response system employs an accelerometer, which is fitted to axle that links the two masses. Deceleration is measured on a continuous basis and peak deceleration with each impact is recorded. While the material is still in a loose state most of the initial compaction energy will lead to plastic deformation of the soil. At this stage, the soil has a soft response to the load applied and low decelerations of the compaction masses are measured.

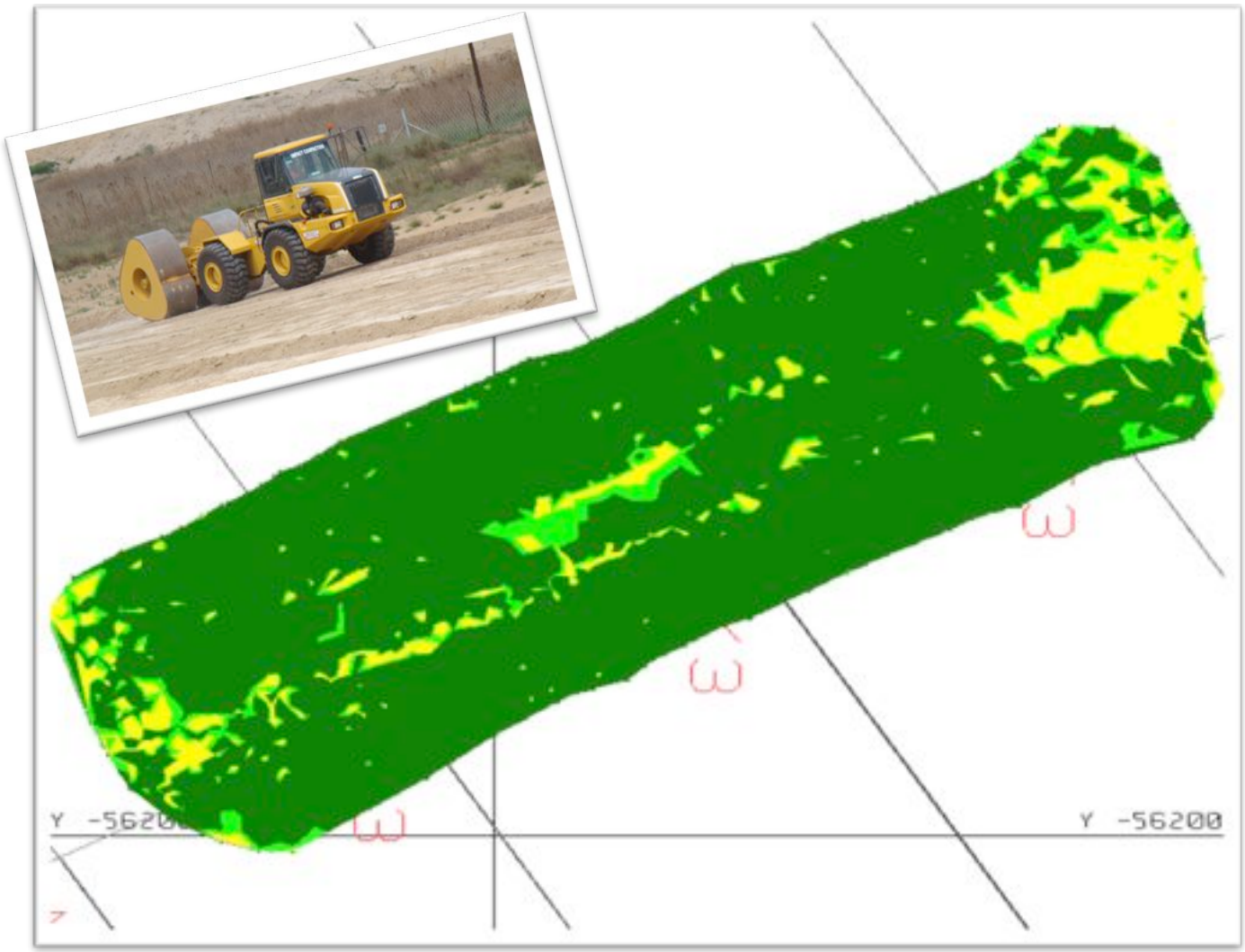
Correlations are developed for the CIR during the trial section, following the analysis of the general testing results achieved. From the correlations, colour coded limits are established

and CIR plots can be generated, providing the customer with an indication of whether a certain CBR value is generally achieved over the entire site.

Established CIR Codes/Limits

Col	Dec	Density	Col	Dec	Density
	< 8.4	< 90 %		9.8 - 13	95 - 100 %
	8.4 - 9.8	90 - 95 %		> 13	> 100%

Typical Plotted Section: 750mm layer thickness treated as per proposed methodology.



SUMMARY

- Eliminating the need to excavate to depth and recompact in conventional layer thicknesses.
- Superior subgrade strength.
- Certification using CIR – increased verification accuracy.
- Reduction in conventional testing regime – reduced amount of tests, personnel requirement and waiting periods for results.
- Construction time savings.
- Substantial cost savings.