

TYPICAL SPECIFICATION

IN SITU TREATMENT OF SOIL BY MEANS OF IMPACT COMPACTION

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1.0 SCOPE

This is a Particular Specification and covers the in situ treatment of soil by means of impact compaction.

2.0 IMPACT COMPACTION PLANT

A 25 kJ 3-sided impact compactor will be utilized for the in-situ treatment of soil. The rating of the impact compactors shall be determined by measuring the energy expended per fall of the compactor and shall be calculated by multiplying the mass of the rotating drums, by the lift and by the gravitational constant.

The compactor shall be towed by a 4-wheel drive tractor of sufficient engine power (not less than 200 Kilowatts) and of sufficient capacity to maintain an optimal compactor towing speed (10 – 12 km/hr) on a maximum uphill gradient of 5%. All equipment shall be maintained in good working order.

3.0 DEFINITION OF AN IMPACT COMPACTOR PASS

A “pass” for the dual drum 25kJ, 3-sided impact compactor is defined as two runs of the compactor over a 4 metre wide lane such that one drum of the compactor during its second run travels in the middle of the inter-drum space created by the first run of the compactor. Overlapping of drum paths in two consecutive runs (i.e. in one pass) will not be permitted.

4.0 SETTING OUT

The area to be treated with impact compaction shall be as defined in the drawings. The contractor shall control the compaction operations by employing appropriate setting out markers to ensure that all areas designated for impact compaction receive the specified number of impact compactor passes.

5.0 PREPARATION AND MAINTENANCE OF COMPACTING SURFACE

Compaction shall be carried out as soon as possible after clearing and grubbing operations to exploit any moisture available in in-situ material, which will facilitate the compaction process.

Water shall be applied in sufficient quantities to the surface as compaction proceeds to prevent the crumbling of the surface, to promote efficient compaction and to contain dust.

The area being impact compacted shall be lightly graded by means of a grader unit fitted to the back of the impact roller, to maintain a good operating surface for the compactor, to level out surface undulations and to prevent the formation of deep "footprints" of the compactor. Alternatively, the Contractor may use a grader to lightly grade the surface.

6.0 IMPACT COMPACTION TRIALS

Before commencement of the full-scale impact compaction works, compaction trials shall be carried out on a representative section, identified by the Engineer, of at least 40m in length. The impact compactor turning circles shall lie outside the trial section and sufficient length shall be allowed for to ensure that the compactor compacts at optimum speed. The width of the trial section shall be 4m.

The objective of these trials is to determine the number of passes to be applied and to confirm the adequacy of the Contractor's plant and methodology to achieve a relative improvement in the in-situ soil bearing characteristics of the in-situ soil. Table 1 details the testing required during the trials:

Table 1: Trial Testing Required

Test	No	Pass						
		0	10	20	30	40	50	60
Settlement, 20m length at 1m intervals, every 5 passes	1	x	x	x	x	x	x	x
DCP at Ch10,20,30 (2m DCP length)	3	x	x	x	x	x	x	x
Density testing (0-900mm) at Ch 10,20,30	6	x		x		x		x
Plate load test	1					x		
Continuous Impact Response	1	x	x	x	x	x	x	x
Maximum dry density and optimum moisture	4							x
Foundation indicator	1							x
Soaked CBR	1							x

The target compaction state shall be based on the number of passes, which results in soil substantially attaining its near elastic state condition. The target coverage required will be determined by means of the settlement results and shall be presented to the Engineer for approval. The Engineer shall approve or reject the recommendation within one working day as to ensure that compaction operations are not held back. A trial report shall furthermore be compiled by the Contractor and submitted to the Engineer after all laboratory results have been received.

7.0 **COMPACTION**

(1) General

Impact compaction must be carried out before services, drainage pipes or culverts are installed. Adequate supervision shall be provided and undertaken by the Contractor to ensure that the specified method of compaction is strictly adhered to.

(2) Variation in Compactive Effort

For tender purposes, 30 passes shall be used to achieve the required improvement.

Should more or less passes be ordered, adjustment in compensation to the Contractor shall be made either as an additional payment to the Contractor in respect of the increased number of passes or as a reduction in payment in respect of a reduced number of passes.

(3) Vibration monitoring

Should there be structures within a 20m radius of where compaction takes place, vibration monitoring shall be done. It is the Contractor's responsibility to ensure that the vibration levels (Peak Particle Velocity (PPV)) are kept below a limit of 25mm/s.

Should a cut-off trench be required to mitigate the vibrations, the Contractor will be paid separately.

(4) Recording Procedure

The impact compaction work carried out shall be recorded each day in the Compaction Record Book. The Compaction Record Book shall make provision for the recording of:

- The date on which any compaction was carried out.
- The area and section on which the compaction was carried out.
- The lane on which the compaction was carried out.
- The number of passes at which the compaction on those lanes commenced and ended on that day – inclusive (e.g. 6-15).
- The number of passes carried out on that day on that lane (e.g. 10).
- The width of the area being compacted.
- The length of the area being compacted.
- The square metre passes compacted on that day (i.e. the area compacted x the number of passes).
- The record book shall be presented to the Engineer on a daily basis for his verification of the information recorded.

8.0 **QUALITY CONTROL PROCEDURE**

The following quality control procedure shall be followed:

(1) Continuous Impact Response Measurements

The Continuous Impact Response measurement system shall monitor and record the deceleration of the rotating drum of an impact compactor at impact and shall automatically correlate this data with the geographical position of the compactor as determined by a GPS receiver. These measurements shall be recorded during the first three as well as at the last three passes.

The data shall be presented to the Engineer in raw and in triangulated Autocad or Modelmaker formats. Raw data shall be presented in the fields of date, time, Y, X, and G (deceleration). Back

calculation and interpretation of the results to determine the relative weak areas shall be included in the report.

(2) Dynamic Cone Penetration (DCP) Tests

2m DCP testing shall be conducted before compaction commences and after it is completed. The testing shall be done on a 25m grid and standard method TMH 6:1984 method ST6.

DCP testing shall furthermore be done in areas shown to be relative weak as indicated by the Continuous Impact Response measurement system.

(3) Relative density testing

Density testing shall be done according to TMH1: A10 after compaction has been completed. Density positions shall be tested to depths of 0-300mm and 300-600mm on a 50m grid. Moisture corrections shall be done according to TMH1:A17. Sufficient modified AASHTO dry density samples shall be sampled and tested in order to determine the relative density.

(4) Soaked CBR tests

Soaked CBR samples (TMH 1) shall be taken in relatively weak areas as indicated by the Continuous Impact Response measurement system.

(5) Plate load tests

Plate load tests shall be done with a 450mm diameter rigid circular plate in stress increments of 0, 45.4, 0, 45.4, 90.9, 136.3, 181.8, 227.2, 272.7, 318.1, 363.5, 409.0, 454.4 & 0 kPa. Settlement results shall be recorded with three settlement gauges at 30s, 1min, 2min, 4min, 8min & 16min. All plate loads shall be done 400mm below the natural ground surface under soaked conditions. Each plate load test pit shall be soaked for at least 12 hours in advance. Plate loads shall be done for every 750m² compacted.

(6) Project report

A project report shall be presented to the Engineer detailing the tests results obtained during compaction operations.”

9.0 MEASUREMENT AND PAYMENT

<u>Item</u>	<u>Unit</u>
9.1 Establishment and of impact compaction equipment, personnel and ancillary equipment necessary to complete impact compaction operations	lump sum

The tendered lump sum shall include full compensation for establishing and de-establishing the impact compactors, tow- tractors, personnel and ancillary equipment necessary to complete impact compaction operations. The amount tendered in item 9.1 will be payable upon completion of the impact compaction operations.

<u>Item</u>	<u>Unit</u>
9.2 Compaction of in-situ soil with 30 passes by means of a 3-sided 25kJ Impact Compactor	m²

The unit of measurement shall be the square meter of in-situ soil compacted in accordance with the provisions of this specification. The quantity will be computed in accordance with the authorized dimensions of the area to be treated. The quantity shall be based on a tender coverage of 30 passes.

The tendered rates shall include full compensation for grading and watering the surface as required, impact rolling the soil by the number of passes as approved by the Engineer and for any interruptions to the work necessitated by the taking of control tests.

The average settlement induced by the impact compactor as recorded during the trial shall be taken as the average settlement over the entire site. The Contractor shall be reimbursed for importing material under SABS1200DM Item 8.3.3.

The Contractor shall be reimbursed for roadbed preparation under SABS1200DM Item 8.3.3.

<u>Item</u>	<u>Unit</u>
9.3 Variations in the compaction of the in-situ soil applicable to item 9.2	m²-pass

The unit of measurement for the increased or decreased number of impact compactor passes shall be the square metre pass and shall be computed by multiplying the surface area in square metres of the soil compacted by the number of 4 metre wide compactor passes. For clarity, a lane 100m long and 4m wide given one pass, i.e. 2 runs of a 3 or 5-sided impact compactor, will be measured as 400m²-pass.

The quantity shall be calculated by multiplying the area in square metres to which the variation applies by the increase or decrease in number of compactor passes.

<u>Item</u>	<u>Unit</u>
9.4 Impact compaction trial section	no

The unit measurement shall be number of completed trial sections as described in clause PA06.

The tendered rate shall include full compensation for constructing the trial section as specified.

<u>Item</u>	<u>Unit</u>
9.5 Continuous impact response measurements	m²

The unit measurement shall be the square metre of compacted area as measured under item 9.2. The work shall be performed as described in clause 8.0.

The tendered rate shall include the cost of procuring, furnishing, installing operating and maintaining all additional equipment to enable the electronic monitoring of the deceleration as detailed above. The cost of processing, back calculating and providing the information to the Engineer (in report format) including all consumables, software and other incidental costs incurred is to be included in the tendered rates.

<u>Item</u>	<u>Unit</u>
9.6 Dynamic cone penetration tests	no

The unit measurement shall be the number of DCP tests done as described in clause 8.0.

The tendered rate shall include full compensation for transportation of the test team, setting out of test positions, conducting testing, recording and processing the test values and presenting the test results to the Engineer in report format.

<u>Item</u>	<u>Unit</u>
9.7 Relative density tests	no

The unit measurement shall be the number of relative density tests done as described in clause 8.0.

The tendered rate shall include full compensation for transportation of the test team, setting out of test positions, conducting testing (including maximum dry density tests), recording and processing the test values and presenting the test results to the Engineer in report format.

<u>Item</u>	<u>Unit</u>
9.8 Soaked CBR tests	no

The unit measurement shall be the number of soaked CBR tests done as described in clause 8.0.

The tendered rate shall include full compensation for transportation of the test team, setting out of test positions, conducting testing, recording and processing the test values and presenting the test results to the Engineer in report format.”

<u>Item</u>	<u>Unit</u>
9.9 Plate load tests	no

The unit measurement shall be the number of plate load tests done as described in clause 8.0.

The tendered rate shall include full compensation for transportation of the test team, setting out of test positions, conducting testing, recording and processing the test values and presenting the test results to the Engineer in report format.