4.2 Sample Preparation

4.2.1 General. For soils containing particles not susceptible to crushing, one sample is required for test and it can be used several times after progressively increasing the amount of water.

For soils containing particles which are susceptible to crushing it is necessary to prepare separate batches of soil at different moisture contents. Consequently, a much larger sample is required. It may be necessary to carry out a trial compaction to determine whether the soil is susceptible to crushing.

For stiff, cohesive soils, suggested methods are to shred the soil so that it could pass through a 5 mm test sieve, or to chop it into pieces, e.g. to pass a 20 mm sieve.

4.2.2 Preliminary assessment of soil. An assessment of the soil is required in order to determine which method of compaction should be used and the sample size required.

The first assessment is to decide if the soil is susceptible to crushing, i.e. whether it contains weak particles which will crush during compaction with a 2.5 kg rammer. If sufficient sample is available it is preferable to use a method which assumes that the soil susceptible to crushing.

The second assessment is to decide the approximate percentages (to an accuracy of ±5%) by mass of particles passing the 20 mm and 37.5 mm sieves. Having determined the approximate percentages passing the 37.5 mm and 20 mm sieves, the compaction test sample can be assigned to one of six grading zones. These are numbered 1 to 5 and (x) and defined in Table 4.2.1.
Table 4.2.1 Summary of sample preparation methods

<table>
<thead>
<tr>
<th>Grading zone</th>
<th>Minimum percentage passing test sieves</th>
<th>Preparation procedure Table reference</th>
<th>Minimum mass of prepared soil required</th>
<th>Type of mould</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(a)</td>
<td>(b)</td>
<td></td>
</tr>
<tr>
<td>20 mm</td>
<td>37.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>95</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>70</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>70</td>
<td>95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>70</td>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(X)</td>
<td>Less</td>
<td>Less</td>
<td>(Tests not applicable)</td>
<td></td>
</tr>
</tbody>
</table>

(a) Soil particles not susceptible to crushing during compaction.
(b) Soil particles susceptible to crushing during compaction.
1L = one-litre compaction mould.
CBR = CBR mould.

Table 4.2.1 also gives the method of sample preparation, the minimum mass of soil required and the type of mould to be used for the compaction test.

4.2.3 Preparation procedure. The procedure to be adopted depends on the grading zone into which the sample falls (see Table 4.2.1) and whether the soil is susceptible to crushing.

The procedures are given hereafter in a series of tables, detailed as follows;

a) Table 4.2.2. Using 1L compaction mould for soils not susceptible to crushing. Grading Zones : 1 and 2.
b) Table 4.2.3. Using 1L compaction mould for soils susceptible to crushing. Grading Zones : 1 and 2.
c) Table 4.2.4. Using CBR compaction mould for soils not susceptible to crushing. Grading Zones : 3, 4 and 5.
d) Table 4.2.5. Using CBR compaction mould for soils susceptible to crushing. Grading Zones : 3, 4 and 5.
Table 4.2.2 Sample preparation procedure Using 1L mould Soils not susceptible to crushing

<table>
<thead>
<tr>
<th>Grading zone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. % passing 37.5 mm = 100%</td>
<td>Min. % passing 37.5 mm = 100%</td>
<td>Min. % passing 37.5 mm = 95%</td>
<td>Min. % passing 37.5 mm = 95%</td>
<td>Min. % passing 37.5 mm = 90%</td>
<td>Min. % passing 37.5 mm = 90%</td>
</tr>
<tr>
<td>Min. % passing 20mm = 100%</td>
<td>Min. % passing 20mm = 100%</td>
<td>Min. % passing 20mm = 70%</td>
<td>Min. % passing 20mm = 70%</td>
<td>Min. % passing 20mm = 70%</td>
<td>Min. % passing 20mm = 70%</td>
</tr>
</tbody>
</table>

If soil is too wet to process, air or oven dry at not more than 50°C.

Avoid drying completely.

Gently break aggregation of soil.

Determine moisture content. Weigh to 0.1% by mass the whole sample and record the mass.

Riffle/quarter to about 6 kg passing 20 mm.

Remove and weigh to 0.1% by mass the material retained on 20 mm sieve. Discard the material.

Calculate additional water required for 1st compaction point, e.g. sandy and gravelly soils start at 4%-6%, for cohesive soils start at 8%-10% below plastic limit.

1L mould not suitable for this soil grading

1L mould not suitable for this soil grading

1L mould not suitable for this soil grading

Add required water and mix thoroughly.

Store mixed material in sealed container for minimum 24 h before compaction (particularly for cohesive soils).

Note: Care should be taken in drying samples which may suffer irreversible changes as a result.

Add required water and mix thoroughly.

Store mixed material in sealed container for minimum 24 h before compaction (particularly for cohesive soils).

Note: Care should be taken in drying samples which may suffer irreversible changes as a result.

Note: As an alternative, the whole sample could be compacted in a CBR mould. In this case, material retained on 20 mm is not discarded.
Table 4.2.3 Sample preparation procedure Using 1L mould Soils not susceptible to crushing

<table>
<thead>
<tr>
<th>Grading zone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. % passing 37.5 mm = 100% Min. % passing 20mm = 100%</td>
<td>Min. % passing 37.5 mm = 100% Min. % passing 20mm = 95%</td>
<td>Min. % passing 37.5 mm = 100% Min. % passing 20mm = 70%</td>
<td>Min. % passing 37.5 mm = 95% Min. % passing 20mm = 70%</td>
<td>Min. % passing 37.5 mm = 90% Min. % passing 20mm = 70%</td>
<td></td>
</tr>
</tbody>
</table>

If soil is too wet to process, air or oven dry at not more than 50°C. Avoid drying completely.

Gently break aggregations of soil.

Determine moisture content. Weigh to 0.1% by mass the whole sample and record the mass.

Riffle/quarter sample into 5 or more representative samples, each of about 2.5 kg.

Remove and weigh to 0.1% by mass the material retained on 20 mm sieve. Discard the material.

Determine moisture content. Add required water and mix thoroughly (see individual test methods). Increments of 1%-2% are appropriate for sandy and gravelly soils, and of 2%-4% for cohesive soils.

Riffle/quarter sample into 5 or more representative samples, each of about 2.5 kg.

1L mould not suitable for this soil grading

Store mixed material in sealed container for minimum 24 h before compaction (particularly for cohesive soils).

Add required water and mix thoroughly (see individual test methods). Increments of 1%-2% are appropriate for sandy and gravelly soils, and of 2%-4% for cohesive soils.

Store mixed material in sealed container for minimum 24 h before compaction (particularly for cohesive soils).

Note: Care should be taken in drying samples which may suffer irreversible changes as a result.

Note: As an alternative, the whole sample could be compacted in a CBR mould. In this case, material retained on 20 mm is not discarded.
Table 4.2.4 Sample preparation procedure Using CBR mould | Soils not susceptible to crushing

<table>
<thead>
<tr>
<th>Grading zone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. % passing 37.5 mm = 100%</td>
<td>Min. % passing 37.5 mm = 100%</td>
<td>Min. % passing 37.5 mm = 100%</td>
<td>Min. % passing 37.5 mm = 95%</td>
<td>Min. % passing 37.5 mm = 90%</td>
<td>Min. % passing 37.5 mm = 90%</td>
</tr>
<tr>
<td>Min. % passing 20mm = 100%</td>
<td>Min. % passing 20mm = 95%</td>
<td>Min. % passing 20mm = 70%</td>
<td>Min. % passing 20mm = 70%</td>
<td>Min. % passing 20mm = 70%</td>
<td></td>
</tr>
</tbody>
</table>

If soil is too wet to process, air or oven dry at not more than 50°C. Avoid drying completely.

Gently break aggregation of soil.

Riffle/quarter to about 15 kg.

Remove and weigh the material retained on 37.5 mm. Discard this material.

Determine moisture content.

Add required water and mix thoroughly.

Store mixed material in sealed container for minimum 24 h before compaction (particularly for cohesive soils).

Note: Care should be taken in drying samples which may suffer irreversible changes as a result.
### Table 4.2.5 Sample preparation procedure Using CBR mould Soils not susceptible to crushing

<table>
<thead>
<tr>
<th>Grading zone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. % passing 37.5 mm = 100% Min. % passing 20mm = 100%</td>
<td>Min. % passing 37.5 mm = 100% Min. % passing 20mm = 70%</td>
<td>Min. % passing 37.5 mm = 95% Min. % passing 20mm = 70%</td>
<td>Min. % passing 37.5 mm = 90% Min. % passing 20mm = 70%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Soils of this grading are usually compacted in 1L moulds, except when CBR tests are to be carried out.

If soil is too wet to process, air or oven dry at not more than 50°C. Avoid drying completely.

Gently break aggregation of soil.

Riffle/quarter sample into 5 or more representative samples each of about 6 kg.

Remove and weigh the material retained on 37.5 mm. Discard this material.

Replace this material by the same quantity of material of similar characteristics which passes 37.5 mm and is retained on 20 mm.

Add required water and mix thoroughly (see individual test methods). Increments of 1%-2% are appropriate for sandy and gravelly soils, and of 2%-4% for cohesive soils.

Determine moisture content.

Riffle/quarter sample into 5 or more representative samples each of about 6 kg.

Riffle/quarter sample into 5 or more representative samples each of about 6 kg.

Store mixed material in sealed container for minimum 24 h before compaction (particularly for cohesive soils)

Add required water and mix thoroughly (see individual test methods). Increments of 1%-2% are appropriate for sandy and gravelly soils, and of 2%-4% for cohesive soils.

Determine moisture content.

Add required water and mix thoroughly (see individual test methods). Increments of 1%-2% are appropriate for sandy and gravelly soils, and of 2%-4% for cohesive soils.

Note: Care should be taken in drying samples which may suffer irreversible changes as a result.

Store mixed material in sealed container for minimum 24 h before compaction (particularly for cohesive soils)

Note: Care should be taken in drying samples which may suffer irreversible changes as a result.

Note: Care should be taken in drying samples which may suffer irreversible changes as a result.

Note: Care should be taken in drying samples which may suffer irreversible changes as a result.
4.2.4 Modifying soil moisture content. When carrying out compaction tests it may be necessary to change the moisture content of the soil, either to a lower value, or to a higher value. The required calculations are:

a) To decrease the moisture content from a value of $x\%$ to a value of $y\%$, the mass of water required to be lost is:

$$ \frac{x - y}{100 + x} \times M \text{ grams} $$

where, $M$ is the mass of the wet soil

b) To increase the moisture content from a value of $x\%$ to a value of $z\%$, the mass of water to be added is:

$$ \frac{z - x}{100 + x} \times M \text{ grams} $$

4.3 Standard Compaction using 2.5 kg Rammer

4.3.1 Scope. This test method determines the optimum moisture content and maximum dry density of a soil when compacted into a mould in three layers using a 2.5 kg rammer falling through a height of 300 mm. In this method, 1L mould is used for soils passing 20 mm sieve and CBR mould is used for soils containing not more than 30% by mass of material on the 20 mm sieve which may include some particles retained on the 37.5 mm sieve.

4.3.2 Apparatus. The following general apparatus is required for the test:

a) 2.5 kg compaction rammer (see Figure 4.3.1).
b) Sieves of 20 mm and 37.5 mm, with receiver.
c) Spatula or palette knife.
d) Straight edge, e.g. a steel strip about 300 mm long, 25 mm wide, and 3 mm thick, with one beveled edge.
e) Sample tray of plastics or corrosion-resistant metal with sides, e.g. about 80 mm deep.
f) Apparatus for the determination of moisture content.
g) Scoop.
h) Additionally for test using 1L mould: a compaction mould similar to the one shown in Figure 4.3.2; a balance readable to 1 g.
i) Additionally for test using CBR mould: a compaction mould similar to the one shown in Figure 4.3.3; a balance readable to 5 g.