

PEMADATAN TANAH DI LAPANGAN

Dr. Ir. Nurly Gofar, MSCE

Field compaction

COMPACTION OF SANDY SOIL

- Measured by relative density (D_r)
- Compaction is normally done in layers
- Moisture control not necessary
- Compact by vibration: Combination of Dynamic compaction (large area) and vibratory compactor (small or narrow area)

Vibratory roller

- Contains a vibrating unit that imparts an up-and-down vibration to the roller as it pulled over the soil
- Effective in compacting granular materials



Pneumatic roller

This type of rollers are also effective for granular material containing small amount of fines



PEMADATAN DALAM *Dynamic compaction rig and pounder*



Field compaction

COMPACTION OF CLAYEY SOIL

- Compaction is normally done in layers
- Moisture content can be
 - **Increased by sprinkling water**
 - **Decreased by aeration**
- The surface of each compacted layer should be scarified by disk plowing to provide for bonding between layers
- Various kind of field compaction equipment:
 - **Tampers**
 - **Rollers**

Smooth wheel roller

- Can cover large areas relatively quickly & with great compacting pressures
- Compacted primarily through static weight



Sheepsfoot roller

- Effective for compacting fine-grained soils



Tampers

- Compact soil by delivering light weight blows
- Limited in scope and compacting ability
- Useful in areas not readily accessible to rollers



Spesifikasi

- Ada dua cara yang digunakan sebagai Spesifikasi Pemadatan
 - Tentukan prosedur dan jumlah lintasan yang harus dikerjakan oleh kontraktor
 - Tentukan berat isi kering minimum yang harus dicapai setelah proses pemadatan di lapangan (lebih umum digunakan). Dalam hal ini berat dan volume tanah harus ditentukan.

Uji Pemadatan di lapangan

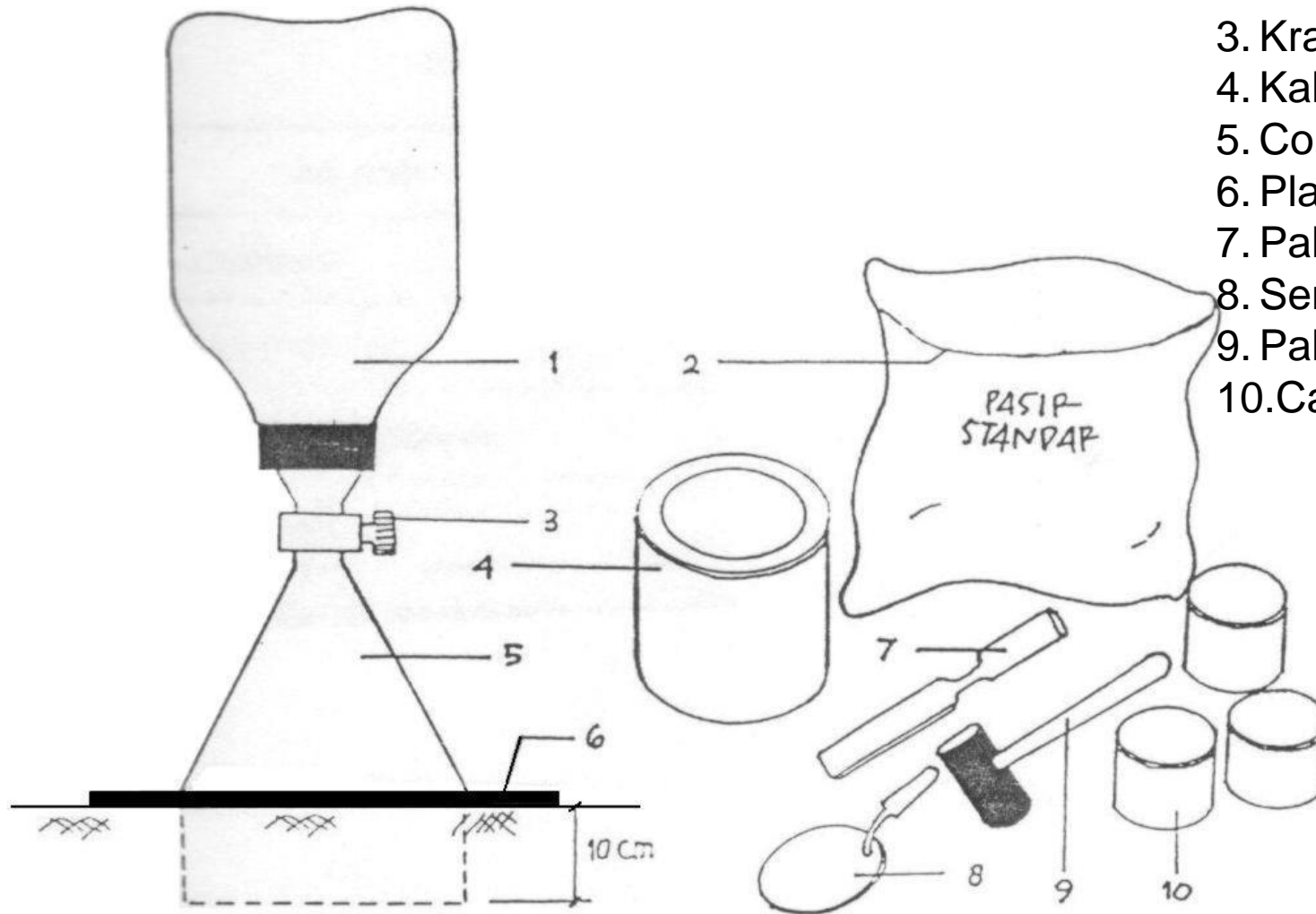
Densiti/Berat jenis

- Sand Cone
- Rubber Balloon Test
- Nuclear methods (hazardous, very costly)

Kadar Air

- Speedy moisture tester
- Membakar dengan Metanol (menggoreng)
- Metode hidrometer alkohol

Sand-cone apparatus



Keterangan gambar

1. Botol sand cone
2. Pasir standar
3. Kran corong
4. Kaleng lapangan
5. Corong sand cone
6. Plat sand cone
7. Pahat
8. Sendok
9. Palu karet
10. Cawan

Example

- During construction of a soil embankment, a sand-cone-in-place unit weight test was performed in the field
- The following data were obtained
 - Weight of sand used to fill test hole & funnel of sand-cone device = 867 g
 - Weight of sand to fill funnel = 319 g

Example (cont'd)

- The following data were obtained (cont'd)
 - Unit weight of sand = 1.538 g/cm^3
 - Weight of wet soil from test hole = 747 g
 - Moisture content of soil from test hole = 13.7%
- Determine the dry unit weight of the compacted soil

Solution

Weight of sand used in test hole

= Weight of sand to fill test hole & funnel – weight of sand to fill funnel

$$= 867 \text{ g} - 319 \text{ g} = 548 \text{ g}$$

$$\text{volume of test hole} = \frac{548 \text{ g}}{1538 \text{ g/cm}^3} = 356 \text{ cm}^3$$

$$\text{wet unit weight of soil in - place} = \frac{747 \text{ g}}{356 \text{ cm}^3} = 2.1 \text{ g/cm}^3 = 21 \text{ kN/m}^3$$

From eqn 4.1,

$$\gamma_d = \frac{\gamma}{1 + w}$$

$$\gamma_d = \frac{21 \text{ kN/m}^3}{1 + 0.137} = 18.4 \text{ kN/m}^3$$

Field control of compaction

- After a fill layer of soil has been compacted, test is usually performed to determine if the maximum lab dry unit weight has been achieved
- A common practice is to specify the required percentage of compaction
- Some practical considerations to note
 - Soil may be of different characteristics if taken from different pits
 - Degree of compaction may not be uniform throughout

Field control of compaction

- To ensure that required field unit weight is achieved by field compaction, a specifications contract between owner & contractor is prepared
- The contract includes:
 - Required percentage (%) of compaction
 - Min number of field unit weight tests required
 - Max thickness of loose fits prior to compaction
 - Method to obtain dry unit weight & in-place unit weight

Example

- Soil from a borrow pit to be used for construction of an embankment gave the following laboratory results when subjected to the Standard Proctor Test
 - Max dry unit weight = 18.6 kN/m^3
- Optimum moisture content = 12.5% The contractor, during construction of the soil embankment, achieved the following
 - γ_d reached by compaction = 18.5 kN/m^3
 - Actual water content = 13.7%
- Determine % of compaction achieved by contractor

Solution

% of compaction achieved

$$\begin{aligned} &= \frac{\text{in - place dry unit weight}}{\text{max lab dry unit weight}} \times 100 \\ &= \frac{18.5}{18.6} \times 100 = 98.9\% \end{aligned}$$

Example

- A borrow pit's soil is being used as earth fill at a construction project
- The in-situ dry unit weight of the borrow pit soil was determined to be 17.18 kN/m^3
- The soil at the construction site is to be compacted to a dry unit weight of 18.90 kN/m^3
- The construction project requires $15,000 \text{ m}^3$ of compacted soil fill
- Determine the volume of soil to be excavated from the borrow pit to provide the necessary volume of compacted fill

Solution

- Total dry weight required to furnish the compacted fill
= total dry weight of soil required to be excavated
from the borrow pit
 $= (18.90 \text{ kN/m}^3) (15,000 \text{ m}^3) = 283,500 \text{ kN}$
- Volume of soil required to be obtained from the borrow pit

$$= \frac{283,500}{17.18} = 16,500 \text{ m}^3$$

Bearing capacity

- Compaction process also increases the shear strength of soil and therefore the bearing capacity....
- The improvement is usually measured by CBR test

CBR test



1. Put the Mold with compacted sample at the required optimum water content (95% max dry unit weight) on CBR apparatus
2. Turn the crank until the pedestal move up for 0.1 " and 0.2"
3. Read the dial gage
4. Use formula to calculate the CBR

TEST REPORT

Data known from Modified Proctor test;

Maximum dry density = 2.204 gm /cc

O.M.C = 8 %

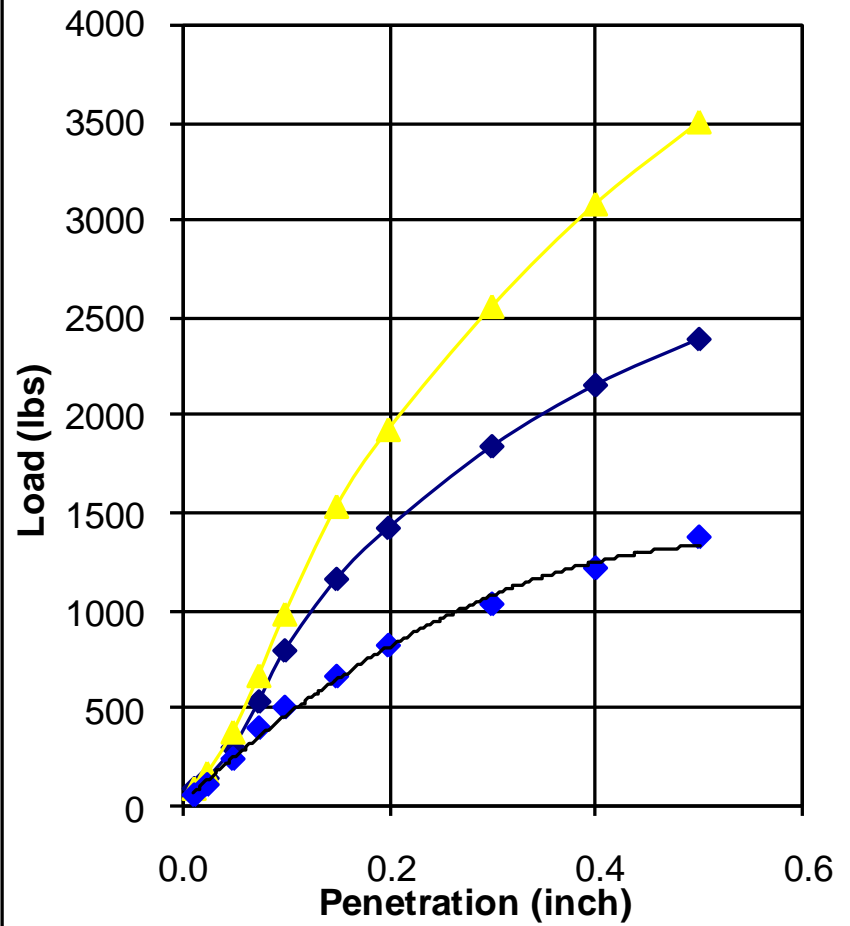
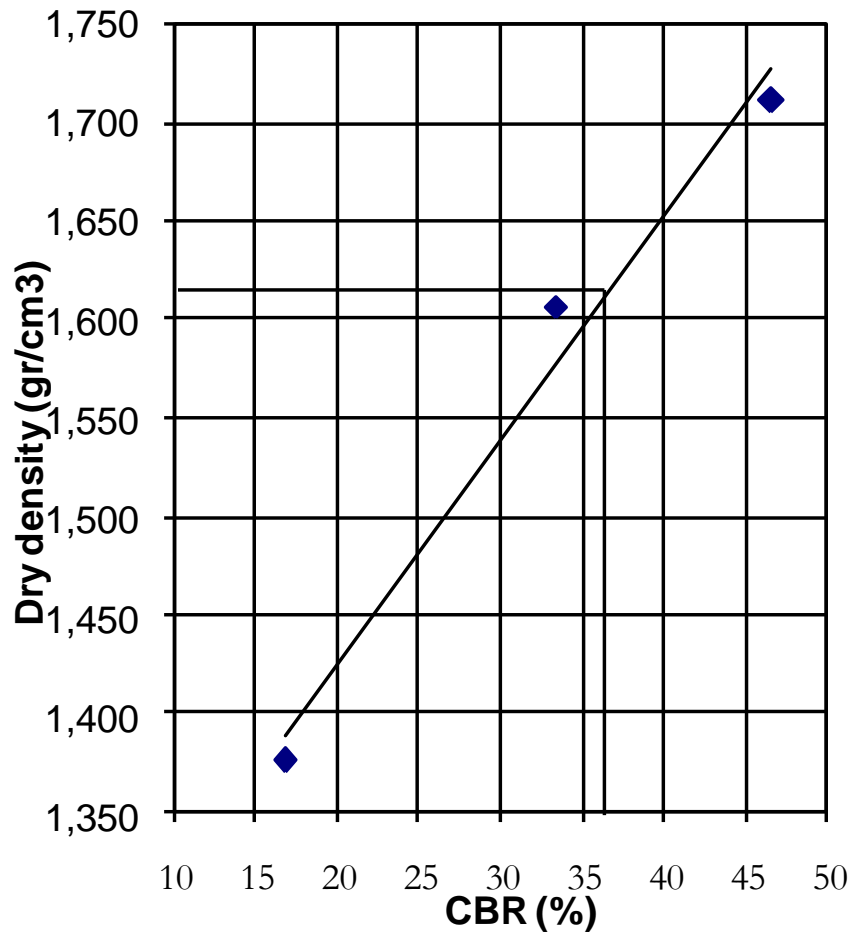
DRY DENSITY AND CBR DATA FOR 10 BLOWS

MOISTURE CONTENT		DRY DENSITY	
Container #	B 10	Weight of the mould (g)	7383
Weight of Container (g)	95.5	Wt.of mould + Compacted soil (g)	11842
Wt. of cont + Wet soil (g)	888.6	Volume of the mould cm ³	2110
Wt. Of cont + Dry soil (g)	832.4	Bulk Unit Wt. (g/cc)	2.11
Moisture Content (%)	7.63	Dry Unit Wt. (g/cc)	1.96

CBR TEST DATA

PENETRATION (in)	PROVING RING DIAL READING	PISTON LOAD (lb)	AREA OF PISTON (in ²)	PENETRATION STRESS (psi)
0	0	0	3	0
0.025	5.5	112.25	3	37.42
0.05	11	225.52	3	75.17
0.075	14.4	293.07	3	97.69
0.1	17	346.95	3	115.65
0.125	19.8	404.1	3	134.7
0.15	22	449	3	149.67
0.175	23.8	485.74	3	161.91
0.2	24.7	504.1	3	168.03
0.3	30.2	616.35	3	205.45
0.4	32	653.09	3	217.7
0.5	35	714.32	3	238.11

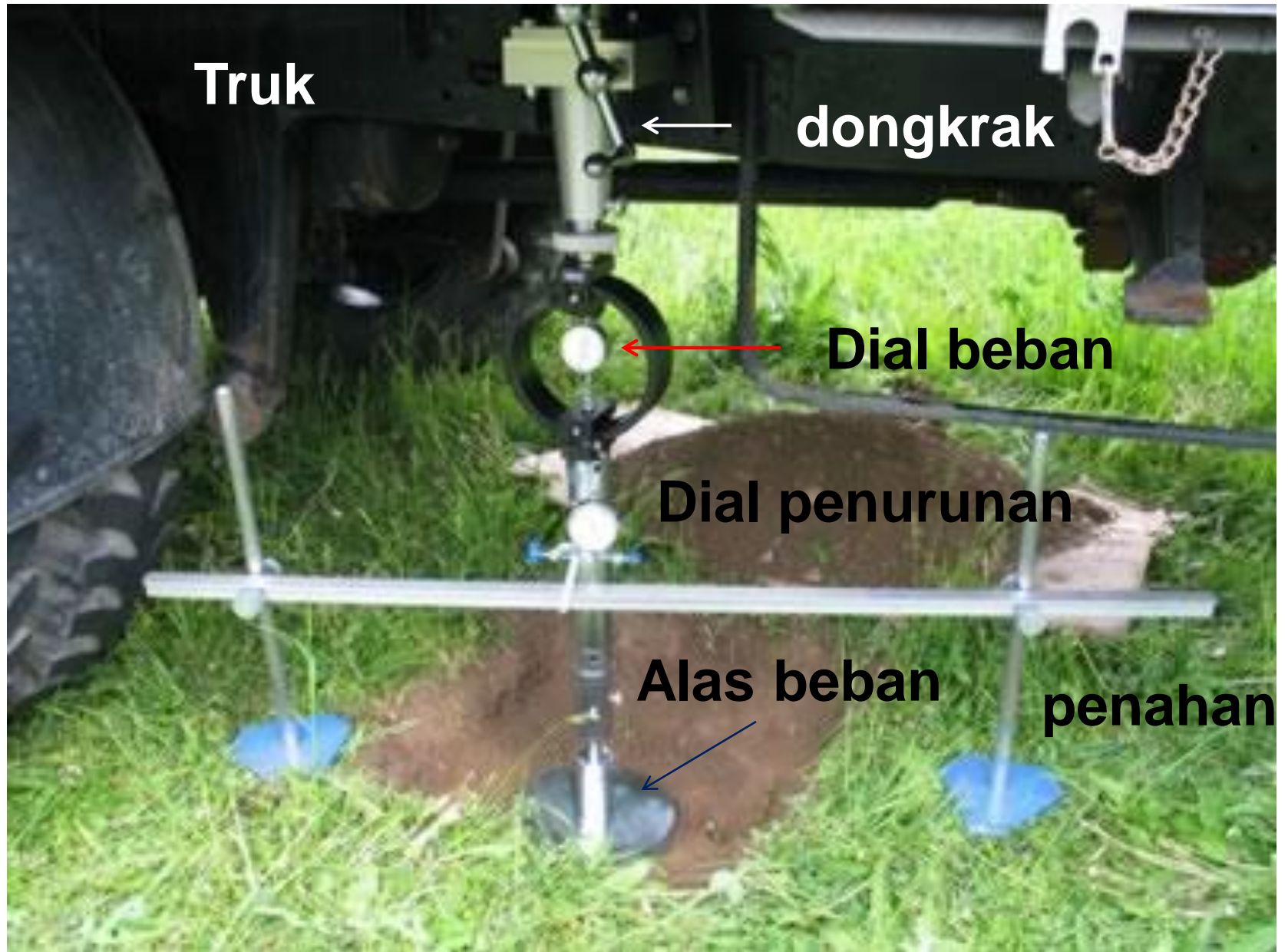
CBR test results



CBR Unsoaked & CBR Soaked

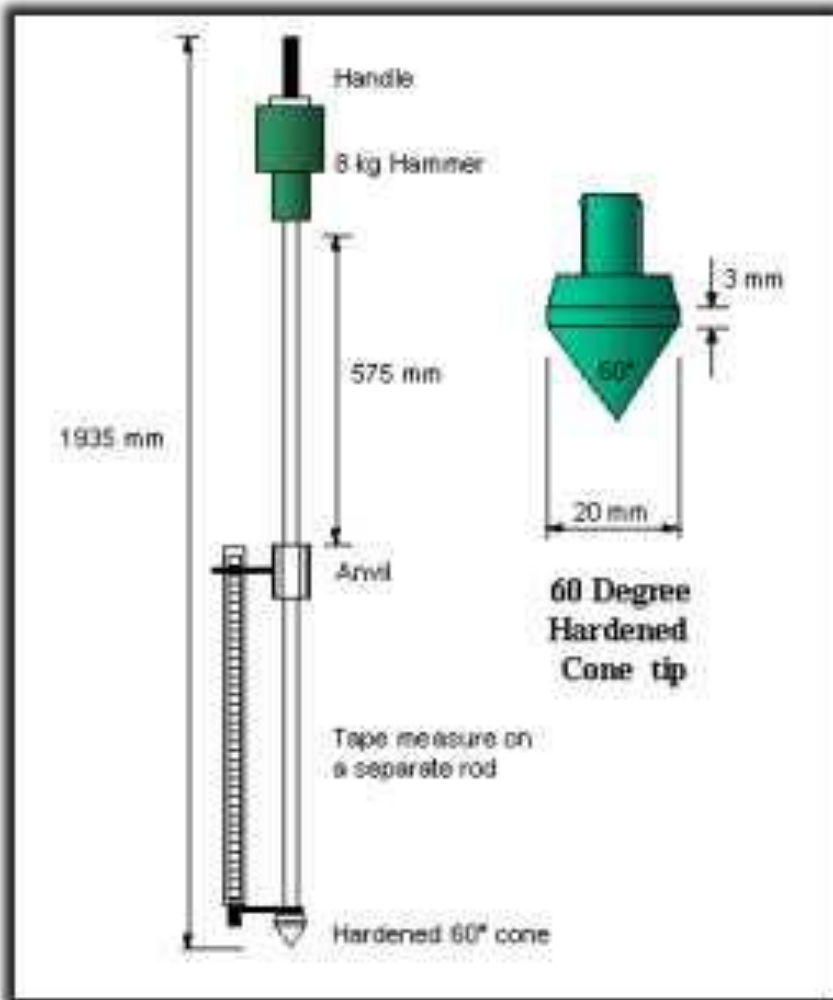
- For CBR unsoaked, test is done at dry condition (right after compaction)
- For CBR soaked, test is done after the mold (filled with compacted soil) is soaked in water for 4 x 24 hour.
- Settlement was measured every 24 hour to evaluate the effect of water on soil

Field CBR test



- Suatu plat dengan ukuran diameter 30 cm diletakkan di atas tanah sebagai penahan tiang yang dilatitkan tepat di pusat lingkaran tersebut. Suatu beban surcharge seberat 15 kg diletakkan di atas pelat beban. Kemudian dial gage di pasang di tiang untuk mengukur penetrasi yang diukur terhadap datum yang dibebani 4kg. Kemudian dial di set ke nol.
- Beban di aplikasikan dngan menggunakan dongkrak dengan kecepatan penetrasi 1.25 mm/menit. Beban dibaca pada penetrasi 0,0.5, 1, 1.5, 2, 2.5, 3, 4, 5, .5, 10 dan 12.5mm.
- Kemudian beban di plot terhadap penetrasi. Kemudian CBR dhitung seperti prosedur pengujian CBRdi laboratorium.

Field CBR test, dynamic cone penetrometer (DCP)



1. Take Zero Reading of DCP
2. The drop weight is then raised to its maximum height and released. The readings are taken with each blow of the weight.
3. If the penetration rate is below 20 mm/blow, the frequency of readings may be decreased
4. Penetration depth less than 1 mm and exceeding 20 blows is considered as refusal.
5. Upon reaching the desired depth or refusal, the instrument is withdrawn.
6. Calculate CBR

Thanks for your
attention

