# Abrasion Test Using Los Angeles Machine

- Toughness is the percent loss of material from an aggregate blend during the Los Angeles Abrasion test
- The aim of abrasion test using Los Angeles machine is to measure aggregate resistance to degradation due to mechanical action.
- Examples of Mechanical Actions:
  - During stockpiling,
  - During placing,
  - During mixing,
  - During compaction,
  - During service, by traffic.

- This test covers a procedure for testing aggregates up to 1.5 in. (37.5 mm) in size.
- The standard L.A. abrasion test subjects a coarse aggregate sample (retained on the No. 12 sieve) to abrasion in a rotating steel drum containing a specified number of steel spheres.
- Number of spheres is determined according the gradation of the sample.
- After being subjected to the rotating drum, the aggregate that is retained on a No. 12 sieve is weighed.
- The Los Angeles abrasion loss is the difference between the original and final mass of the sample is expressed as a percentage of the original mass after washing off the No. 12 (1.70 mm) screen.

Calculate loss percentage.

$$Loss\ \% = \frac{Original\ Weight - Weight\ Retained\ on\ Sieve\#12}{Original\ Weight} \times 100$$


Standards:

- Rotational speed = 30 rpm
- Number of revolutions = 500 revolution
- Typical test values range from 10% for extremely hard rocks (e.g. basalt) to 60% for soft rocks (e.g. limestone).
- Maximum loss of 40% for surface courses or 50% for base courses.

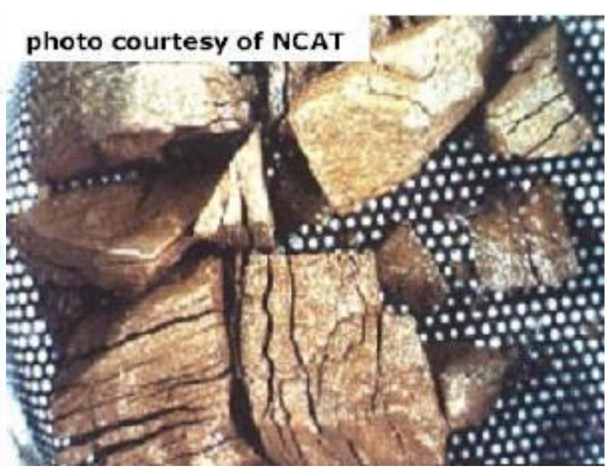
- An abrasion loss value of 40 indicates that 40% of the original sample passed through the No. 12 sieve and 60% of the original sample retained.
- The higher abrasion loss value the weaker the aggregate.
- Aggregates not adequately resistant to abrasion and polishing may cause premature structural failure and/or a loss of skid resistance.
- Furthermore, poor resistance to abrasion can produce excessive dust during HMA production resulting in possible environmental problems as well as mixture control problems.

# Soundness test

- Soundness is the percent loss of material from an aggregate blend during the sodium or magnesium sulfate soundness test.
- The aim of sulfate soundness test is to measure aggregate resistance to disintegration due to chemical action.
- Examples of Chemical Actions:
  - Polluted rain.
  - Water runoff.
  - Ground water.

- The soundness test is a durability test.

- The soundness test repeatedly submerges an aggregate sample in a sodium sulfate or magnesium sulfate solution.
- This process causes salt crystals to form in the aggregate's water permeable pores.
- The formation of these crystals creates internal forces that apply pressure on aggregate pores and tend to break the aggregate.



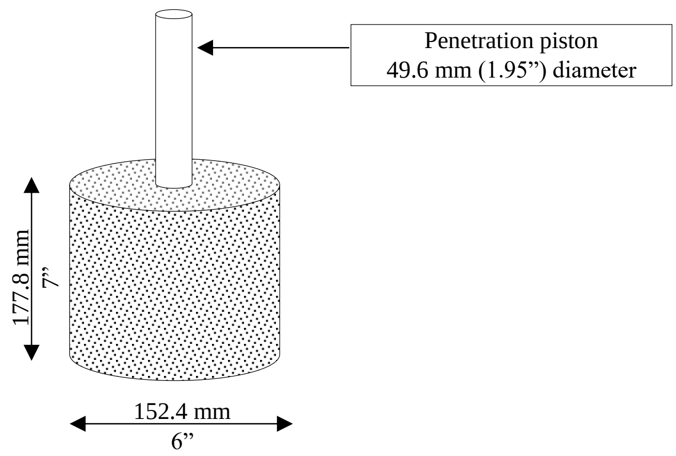
- A quantitative measurement is applied to determine percentage loss of material.
- A qualitative measurement is applied to determine percentage loss of quality.

$$Loss\ \% = \frac{mass\ before\ the\ test - mass\ after\ the\ test}{mass\ before\ the\ test} \times 100$$

- Standards:
  - At least five cycles.
  - Maximum loss 12% when sodium sulfate is used.
  - Maximum loss 18% when magnesium sulfate is used.

# California Bearing Ratio Test for Aggregate and Soil

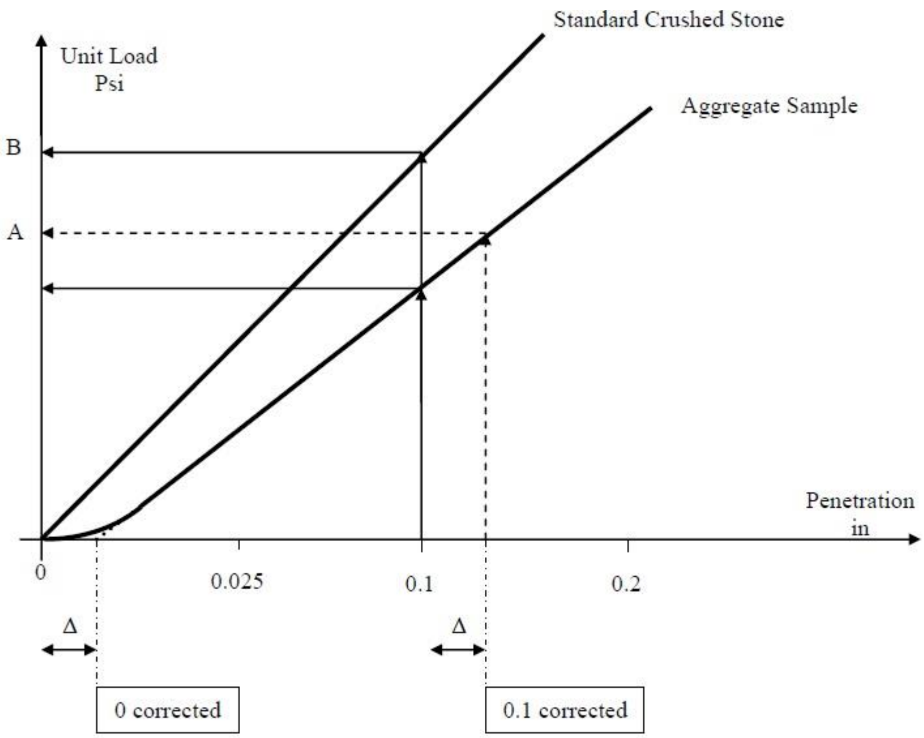
- California Bearing Ratio (CBR) test is a simple strength test that compares the bearing capacity of a material with that of a well-graded crushed stone.
- A high quality crushed stone material should have a CBR @ 100%.
- The basic CBR test involves applying load to a small penetration piston at a rate of 0.05″ per minute and recording the total load at penetrations ranging from 0.025" up to 0.3"




- Sample should be compacted at optimum water content, $w_{\circ}$.
- The sample should be compacted in five equal layers, each subjected to 10 blows of a 10-lb (4 .5-kg) hammer at 18 in. (457 mm) drop.

- CBR is used in thickness design.

- For any layer, if it has a low CBR, the above layer shall has a larger thickness so it can reduce the load concentration.




Values obtained are inserted into the following equations to obtain a CBR value:

$$CBR\%_{0.1} = \frac{unit\ load\ at\ 0.1''\ penetration\ for\ the\ sample}{unit\ load\ at\ 0.1''\ penetration\ for\ standard\ crushed\ stone\ (1000\ Psi)} \times 100$$

$$CBR\%_{0.2} = \frac{unit\ load\ at\ 0.2''\ penetration\ for\ the\ sample}{unit\ load\ at\ 0.2''\ penetration\ for\ standard\ crushed\ stone\ (1500\ Psi)} \times 100$$

- If Soil A has a CBR of 50% and Soil B has a CBR of 70% that means Soil B has a higher strength than Soil A.

- Recent test used is Resilient Modulus; MR, which is a modulus of elasticity of a material, resulted from dividing the stress by the strain.