ITASCA
Consultants, s.a.s.

MAXIMUM COMPACTION OF A GRANULAR PACKING OBTAINED BY VERTICAL VIBRATIONS

Purpose(s): Validate the discrete numerical approach to estimate the maximum compaction of a granular packing

Client: LAFARGE - Centre de Recherche

Date: 2005-2007

Location: Saint Quentin Fallavier (Isère)

Partners: None

Project executive manager: Fabian DEDECKER

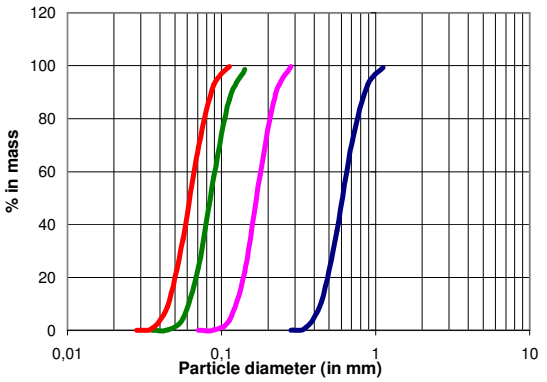
Code(s) used: *PFC3D*

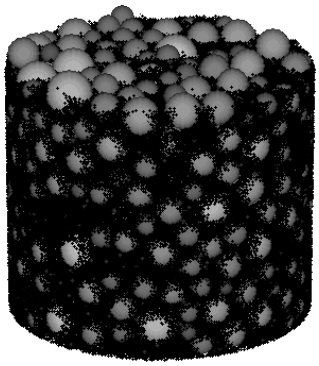
In order to validate the **discrete numerical approach**, ITASCA built a **3D numerical model,** using *PFC3D*, of a "shock test". The "shock test" was performed by applying a **vertical vibration** (successive shocks on a horizontal plane) on a cylindrical cell until a constant volume was reached.

This validation consisted of comparing the measurements of the maximum compaction of a **bi-modal or tri-modal packing** obtained from numerical models to those obtained from laboratory tests.

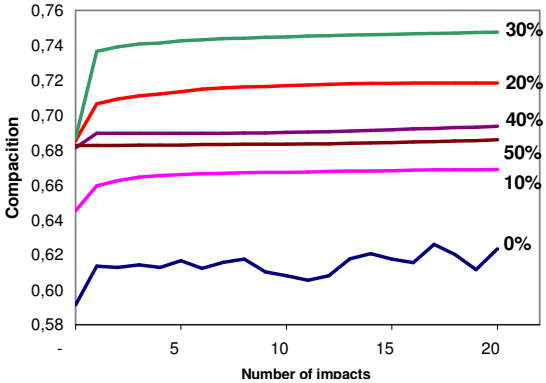
To limit the differences between the numerical and experimental tests, and to compare the results of both directly, **spherical and unbreakable glass balls were used** to perform these tests. The granular mixtures modeled were composed from **one to three granulometric classes.** The **diameter ratio** between the upper class and the lower **varied from 4 to 10**.

Granulometric distribution curve (Lafarge) →





Bi-modal sample (with 30% fine particles, diameter ratio = 10)



Compaction versus number of impacts and % of fine particles in mass (bi-modal packing, diameter ratio = 10) →

KEYWORDS:

- Discrete numerical modeling
- Compaction
- Shock test
- Bi-modal and tri-modal packing

⇨ RESULTS:

- The numerical value of compaction evolves qualitatively as do the experimental results according to the volume and size ratio of particles for both bi-modal and tri-modal packings.
- The first shock efficiently compacts the packing, whereas the next knocks moderately increase the compaction (2% - 3%).
- Twenty shocks are not enough to reach the maximum compaction but allow the maximum to be approached.

LAFARGE now has a new tool, complementary to its experimental tools, for improving the compaction of granular packings and, thus, the mechanical performance of cement/concrete.

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