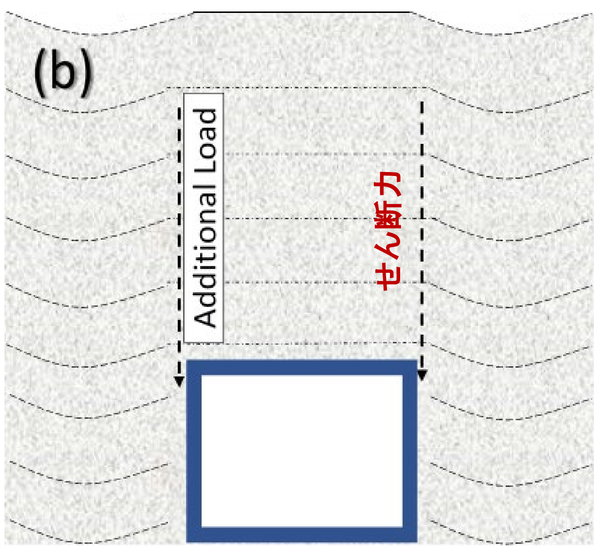
Arching in Trapdoor Model Test & Equivalent DEM Simulations

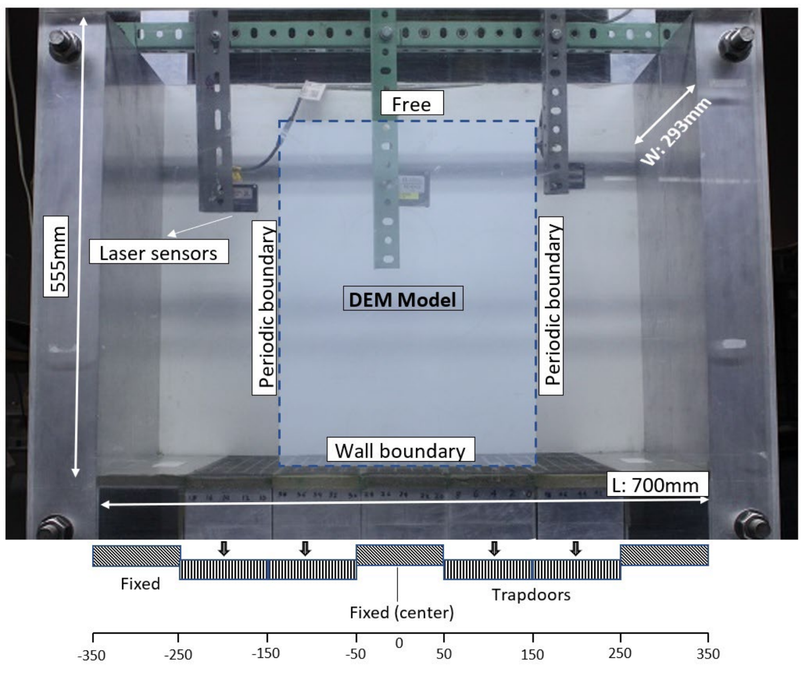
アーチ効果に関する落し戸実験＆個別要素法解析

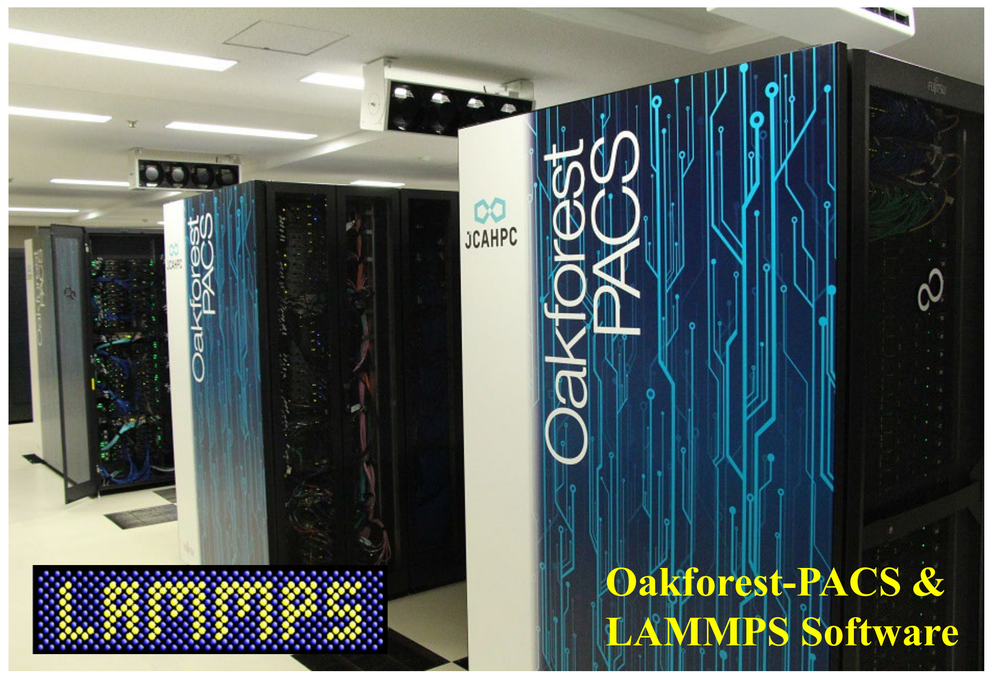
Complex interactions between soil and buried structures have been investigated in this study. A trapdoor test apparatus was used to represent deferential settlement at the base, using Toyoura sand, Kashima river sand and spherical glass beads. Model grounds with different height (H) were prepared, and the side bottom plates were moved downwards to investigate the arch formation. Equivalent numerical simulations using discrete element method (DEM) were performed, and DEM results matched closely with the experimental results. Arching phenomenon was observed with larger ground height for a given width of the lowered plate.

土と埋設構造物の複雑な相互作用に関する理解を深めるため、不同沈下現象を再現する模型実験装置内にガラスビーズ材料地盤を作成し、落し戸実験を実施しました。様々な地盤高（H）に対し，中央部以外の底板を下方に変位させることでアーチ効果の発現について分析しました．球体粒子で構成される地盤をモデル化し，個別要素法（DEM）解析を実施した結果，実験結果と精度良く一致する結果を得ました．特に地盤高の高い地盤において，顕著なアーチ効果が確認されました．



Increased load on buried structure due to settlement of surrounding soil



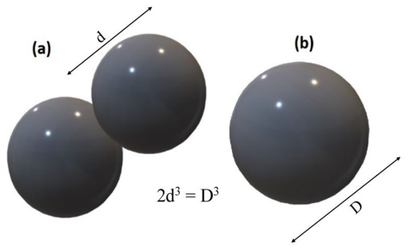


Model Test:
700 mm (X) : 293 mm (Y) : 100-400 mm (H)
Trapdoor width (B): 100 mm
Mean Particle size: 0.203mm (Toyoura)

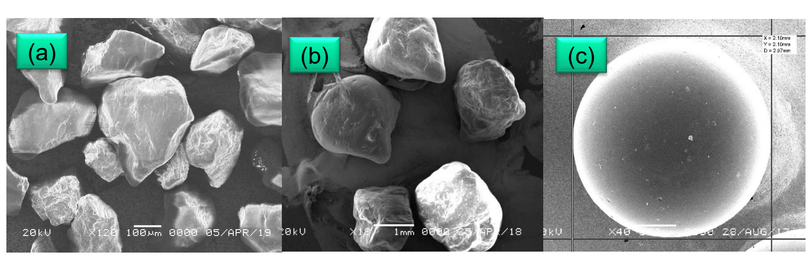
Mean Particle size: 1.72mm (river sand)
1.80mm (glass beads)

DEM Simulations:
300 mm (X) : 40 mm (Y) : 44-521 mm
Trapdoor width (B): 100 mm
Diameter of particle: 1.2 – 2.2 mm

Friction coefficient (μ): 0.35
Young's modulus: 71.6 GPa
Poisson's ratio: 0.23
Specific gravity: 2.5



Spherical and non spherical particles in DEM



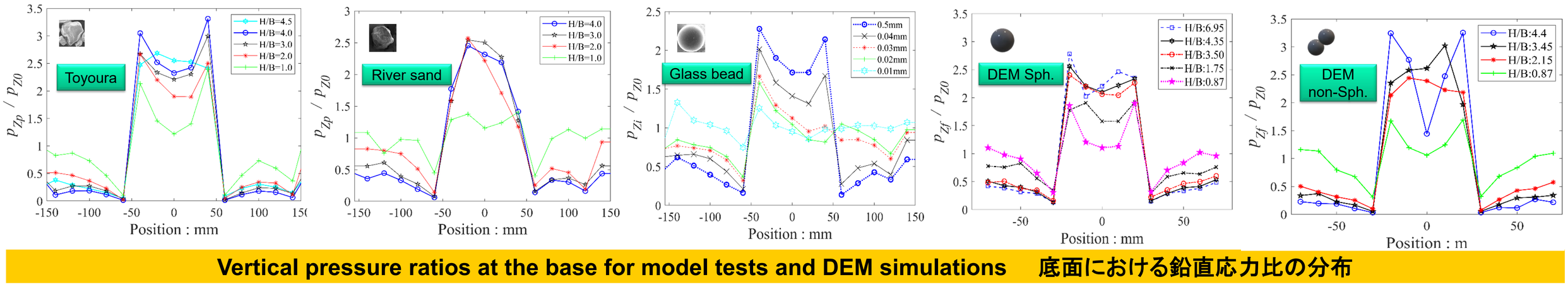
SEM images of (a) Toyoura sand (b) Kashima river sand (c) glass beads

Stress concentration ratio for buried structure

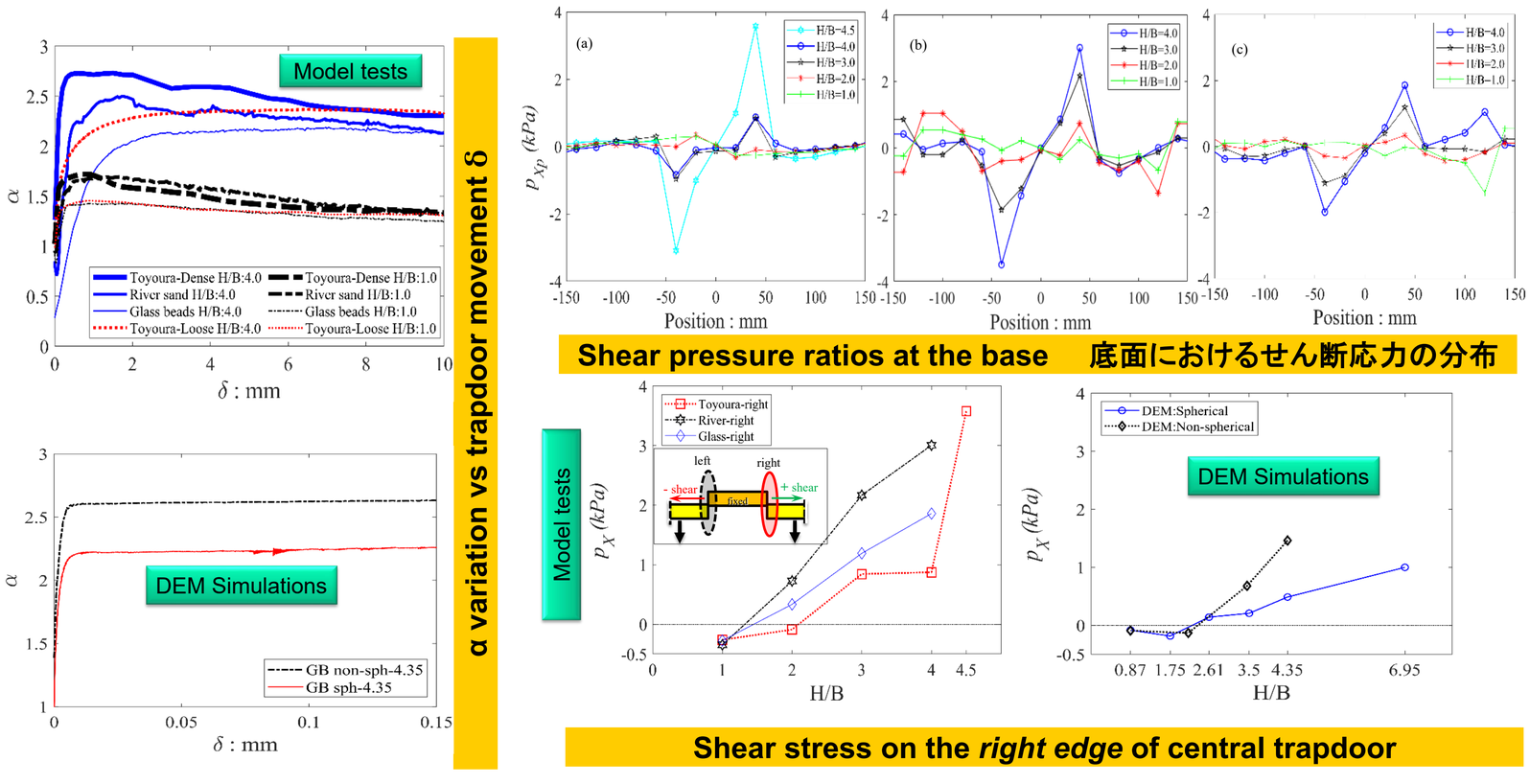
$$\alpha = \frac{P_z c}{P_z o}$$

地中構造物に対する応力集中度

$P_z c$ = Mean vertical pressure on the central plate 中央底板の応力
$P_z o$ = Mean vertical pressure on all the plates 全底板の応力

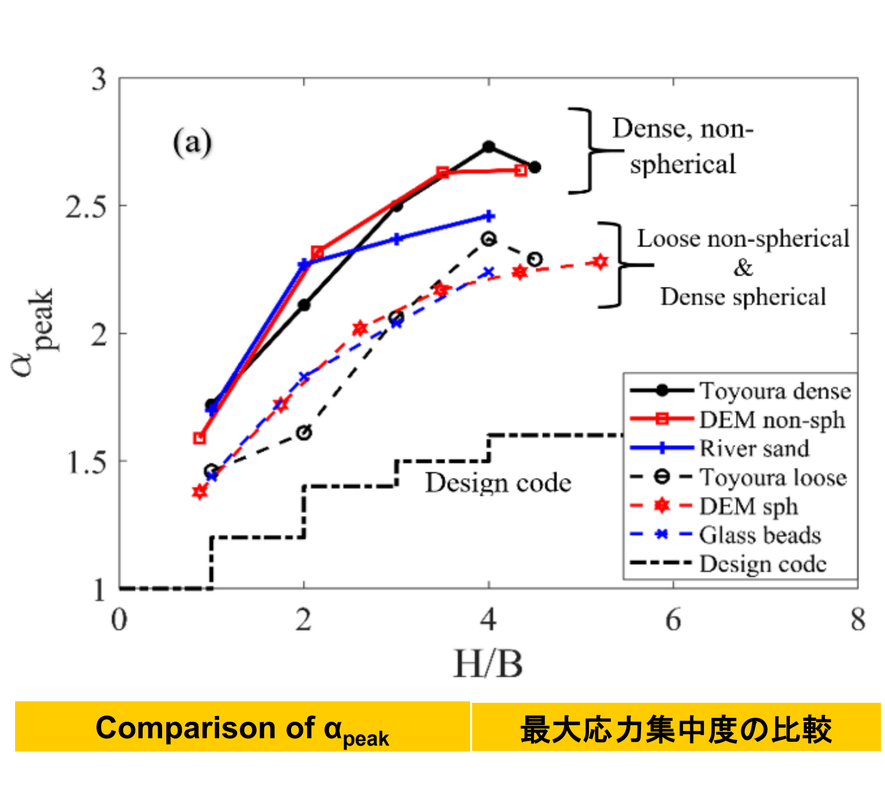


Vertical pressure ratios at the base for model tests and DEM simulations　底面における鉛直応力比の分布



Shear pressure ratios at the base　底面におけるせん断応力の分布

Shear stress on the *right edge* of central trapdoor



Comparison of α_{peak}　**最大応力集中度の比較**

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