NUMERICAL ANALYSIS of DEFORMATION BASED DESIGN FOR CAISSONS

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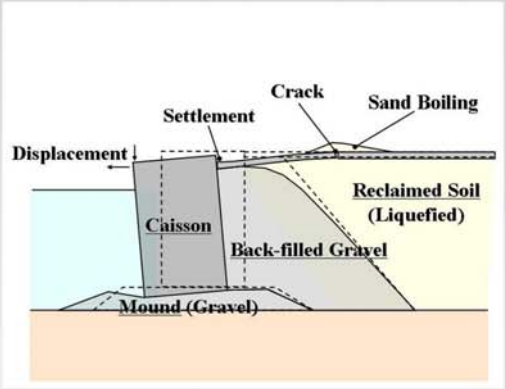
Introduction

Coastal structures are subjected not only to water wave action, but also to other types of environmental loading, such as earthquakes. However, high seismic activity can lead to failures of the structures.

Earthquakes may provide a destructive loading in many areas around the world, and therefore they should be considered for inclusion in the design of coastal structures, especially in areas of high seismicity. Because the failure of the quay walls could cause the handling operation problems.

Failure Modes



Failure modes

Damage on quay wall in Derince Port after Kocaeli Earthquake (1999), in Turkey

Ref: **Hazarika,H., Sugano, T., Kikuchi, Y., Yasuhara,K., Murakami, S., Takeichi, H., Karmokar, K., Kishida, T., and Mitarai, Y.,(2006), Model Shaking Table Test on Seismic Performance of Caisson Quay Wall Reinforced with Protective Cushion**, The Proceedings of The Sixteenth (2006) International Offshore And Polar Engineering Conference, VolumeII, 309-316, San Francisco, California, USA,

Aim

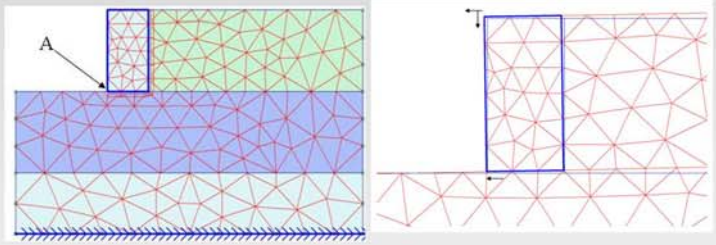
The dynamic behaviour of soil and caissons were investigated by using FEM method and results were compared with experimental results from previous study existed in literature.

A static analysis was performed for simulating the stress conditions before earthquakes

Numerical analysis of dynamic response of caisson quay walls was carried out by using Plaxis V8.2 software that can calculate with FEM.

The Hardening Soil Model (HS) was chosen for modeling of elasto-plastic behavior of material that non-linearly with strain.

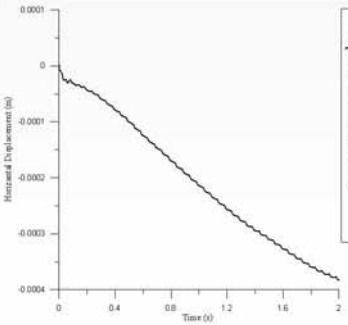
Results of numerical analysis were compared with model shaking table test on caisson walls carried out by Hazarika et al (2006).



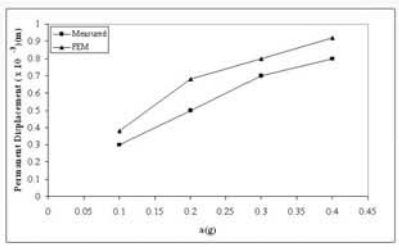
Structural mesh and deformed mesh

Properties of materials

Symbol		Unit	Backfill	foundation	rubble	caission
γ_{unsat}	Unsaturated unit weight	kN/m³	13	17	18	24
γ_{sat}	Saturated unit weight	kN/m³	16	20	20	26
E_{50}^{ref}	Reference secant Young modulus	kN/m²	40000	50000	60000	60000
E_{oed}^{ref}	Reference constraint modulus	kN/m²	40000	50000	59000	59000
E_{ur}^{ref}	Reference unloading-reloading modulus	kN/m²	120000	150000	180000	180000
c	Cohesion	kN/m²	-	-	-	-
ϕ	Shear strength angle	°	40	40	45	45
ψ	Dilatancy angle	°	10	10	10	10
ϑ_{ur}	Poisson rate	-	0.2	0.2	0.2	0.2
P_{ref}	Reference stress	kN/m²	100	100	100	100
m	Power for stress level dependency	-	0.5	0.5	0.5	0.5
K_{0nc}	Earth pressure coefficient at rest	-	0.357	0.331	0.309	0.309
R_f	Failure ratio	-	0.9	0.9	0.9	0.9



Permanent displacement at A point under cyclic action (0.1g)



Measured and computed wall displacements