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PERFORMANCE OF THE TUNNEL LINING SUBJECTED TO DECOMPRESSION EFFECTS ON VERY SOFT CLAY

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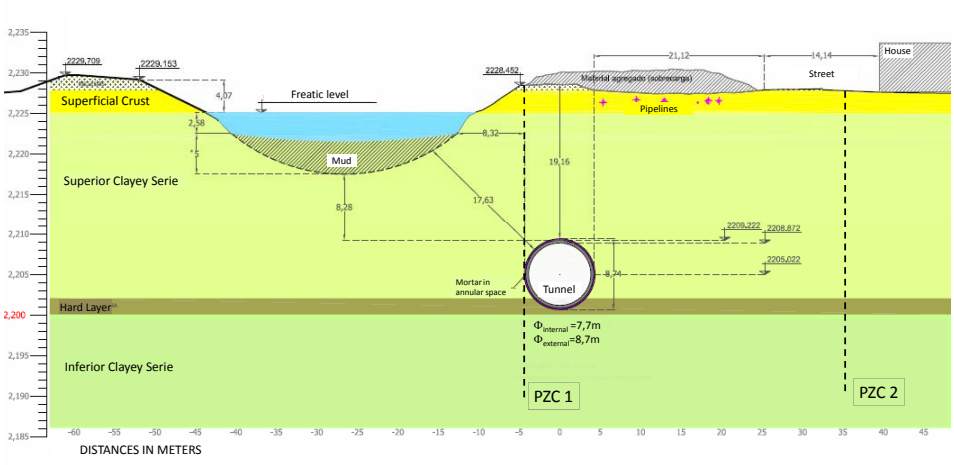
OBJETIVE: To evaluate the effects on tunnel of the unloading induced by dredging surface channels located on cracked clayey deposits.

INTRODUCTION

The **Túnel Emisor Oriente** (TEO) will be the new drainage system for **Mexico City**. It is located to the North of the city and it is a circular tunnel 62km long, of **7m inner diameter**, set at variable **depths between 30 and 155m**. It crosses all types of soils along 97% of its length, from very soft to hard, with the rest of the length crossing volcanic rock. For its construction, **Earth Pressure Balance (EPB) tunnel boring machines** are used, with a primary lining formed by dowels rings with sections 0.35 and 0.40m thick. Almost the entire tunnel is under the groundwater level, with **pore pressures of up to 0.8MPa**. The project's first trajectory, approximately 8km long, is located at a zone of **very compressible clays** with low shear resistance, with **water content in the order of 300%**, running parallel to a surface channel.

A particular aspect is when this tunnel crosses under the channel, here important primary lining deformations have occurred. This anomalous behavior of the tunnel has been caused by a diversity of factors, among which stand out the **channel's dredging** and the **presence of intense fracturing** at the zone of that channel.



GEOTECHNICAL CONDITIONS

Superficial Crust (0 to 3m). It is a stratum formed by interspersions of sandy silts and hard silty sands, and on occasions fills up to 2m thick.

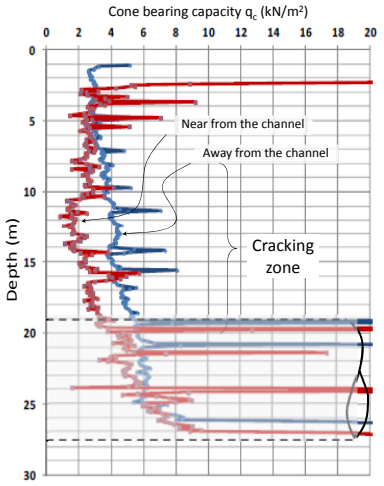
Superior Clayey Serie (3 to 26m). These are clays and silts of high plasticity with thin lenses of volcanic ash and sandy silts.

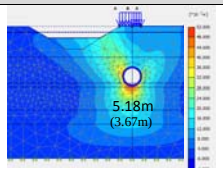
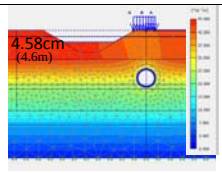
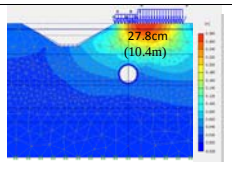
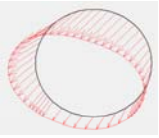
Hard Layer (26 to 28 m). These are interspersions of sandy silts and silty sands (tunnel is located at the inferior part of the Superior Clayey Series resting on the Hard Layer).

Inferior Clayey Serie (28 to 42m). It is a very compressible clayey deposit.

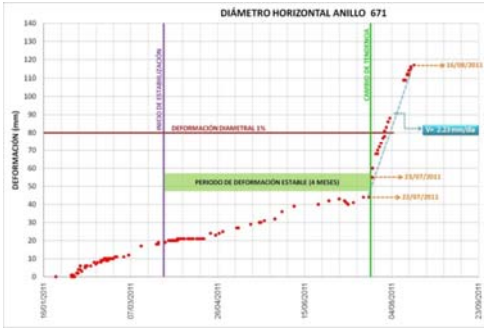
The groundwater level is located at 3m depth, and the pore pressure measured at the tunnel's axis is u_{axis}=145kN/m² (65kN/m² less than the hydrostatic pressure).

NUMERICAL MODELING



STAGE	Displacements (m)	Horizontal divergence of dowels (cm)
Tunnelling		3.9 (2) 
Decreasing pore pressure during 6 monts		0.2(0.2) 
Desazolve y sobrecarga		4.5(2.1) 
TOTAL		**8.6 (4.3)**

DEFORMATIONAL BEHAVIOR



CONCLUSIONS

One of the main effects of superficial unloading on soft soils is the generation of cracking, which in turn causes a reduction of the soil's shear resistance and the geostatic horizontal stress (confining stress reduction of the tunnel lining), and an increase in the soil's deformability. These factors make tunneling difficult in soft soils, mainly regarding aspects of the application of pressures at the excavating front and injection at the point of contact between soil and ring lining.