

FEATURE OF TECHNICAL SERVICE

Subject

Executive Project of Castellanza pitting – Integrated contract works Lot 1 of the Saronno-Malpensa railway – M11. The operation was carried out on the T2 route from km 30+726 and km 32+635 to the municipality of Castellanza (Varese province), and consists of two double-oven tunnels with blind holes and eight inspection and ventilation shafts.

Carried out by

SGAI Srl of E. Forlani & C.

Client

ITINERA S.p.A. (already Grassetto Lavori S.p.A)

Service length

2003

Value of works

€ 30'351'783,82

Categories value

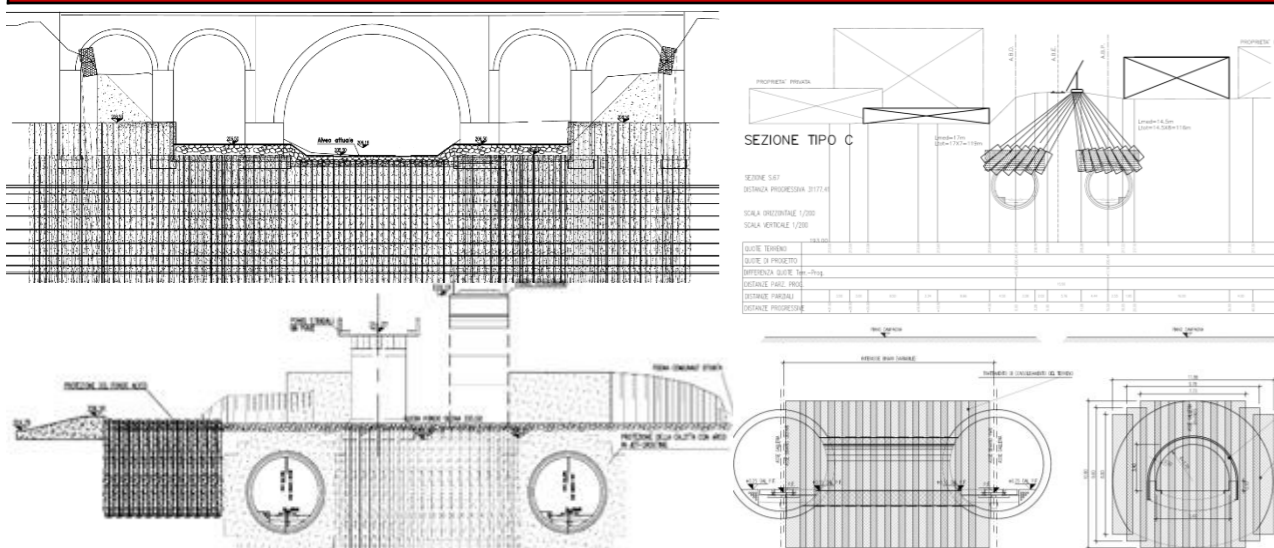
S.05	€ 28'523'090,83
E.17	€ 1'708'479,21
V.02	€ 120'213,78

CASTELLANZA TUNNEL AND SHAFTS - Design issues and their resolution

In view of the evidence of the supplementary geognostic surveys foreseen in the executive project and the considerations outlined in the report «**Relazione sulla scelta della metodologia di scavo meccanizzato**», drawn up by SGAI, the NOT applicability of the EPB, Slurry and Hydroshield system has emerged as the main issue. This problem was solved by supporting the EPB excavation technique by performing **pre-consolidations of the cover cup by injections of cement mixtures performed from the surface** and a partial filling of the excavation chamber (a system also used in the Turin and Milan metro excavations). Given the complex morphology of the territory and at the same time its strong anthropization, it was necessary carry out numerous investigations, modelling and monitoring that allowed to confirm the conditions of the cluster expected, defining more precisely the tenso-deformative framework and the behaviour in act, foreseeing the evolution with the progress of the work. In this way it was possible to define reference thresholds, beyond which to take preventive actions over time to protect adjacent buildings and works.

The main problems arose at the River Olona, where the tunnel crosses the riverbed reaching the values of maximum deepening and minimum cover. In order to contain the longitudinal slopes of the two binary, and to ensure the stability of the covering ground above the cap, the self-sustaining test of the excavation was carried out, which revealed the need to make a jet grouting crown 2.00m thick. The construction of the by-passes between the two tubes, took place at the end of tunnel excavation works, after consolidation of the soil by injections. The injection was carried out before the passage of TBM, this to ensure a minimum disturbance to the ground during the excavation of the twin-tube of the railway, and to obtain a kind of “grouted” between the consolidated soil and the injection of sealing the pieces. The excavation is carried out using traditional methods, using centinatures and spritz beton, all-section digging and cladding with reinforced concrete.

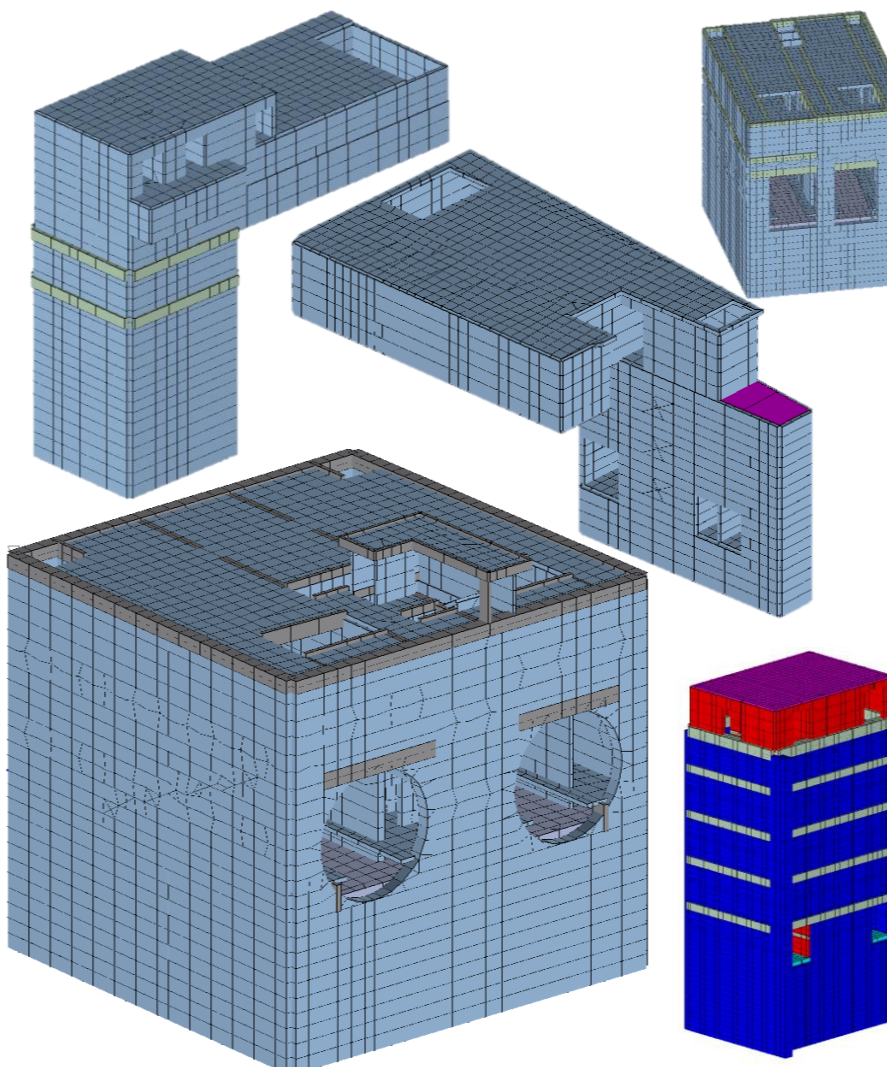
CASTELLANZA TUNNEL – Underpass of Olona river – profile, sections and details



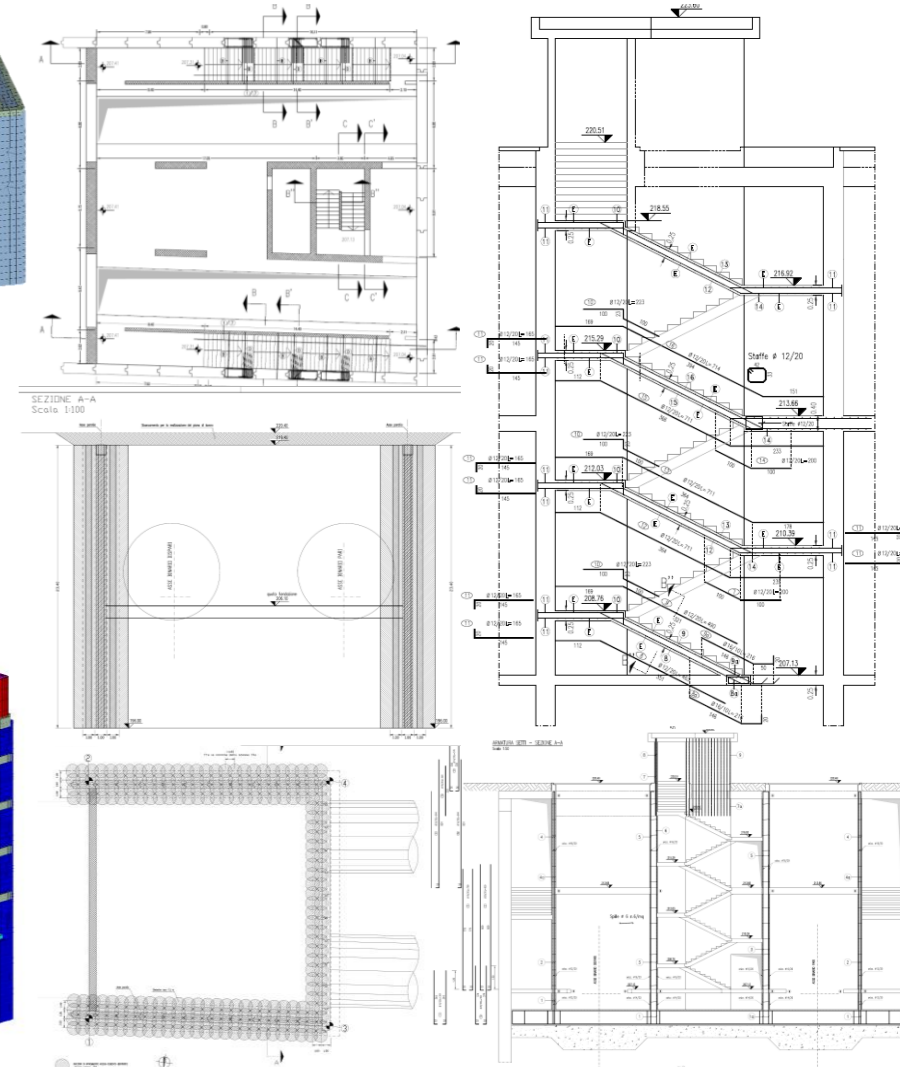
CASTELLANZA TUNNEL AND SHAFTS - Computational aspects - Simulation, results and checks

The analysis and study of the static and dynamic behavior of the different shafts and artefacts was conducted by simulating the structure with three-dimensional finite element numerical model, solved with calculation code PARATIE 6.0 (CeAS) and proSAP (2.S.i. Software and engineering services). The study of the tenso-deformative framework was conducted by simulating the interaction of the ground-structure with finished numerical models in both 2D and 3D using the PLAXIS software.

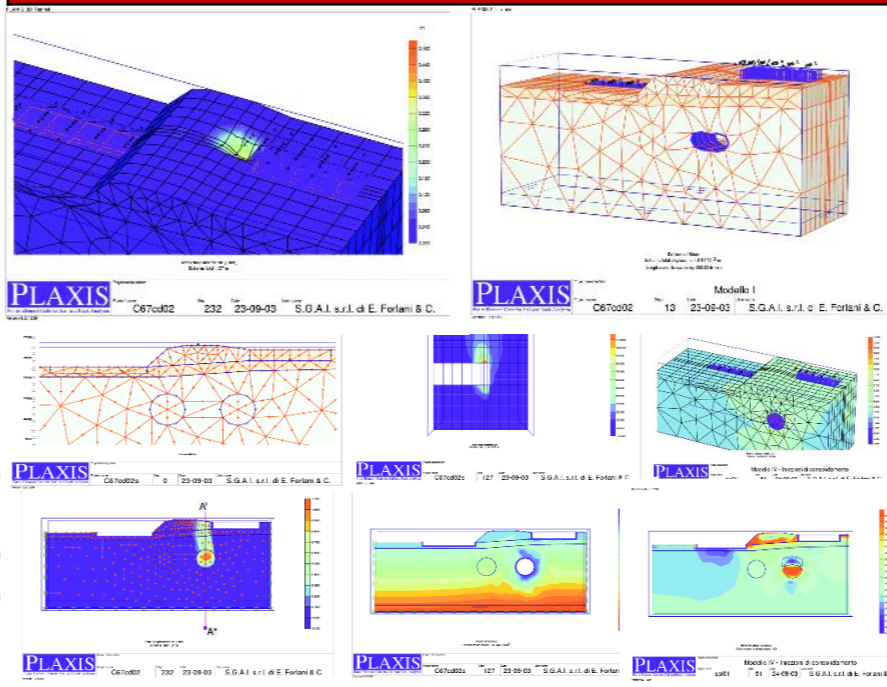
VENTILATION SHAFTS Numerical model



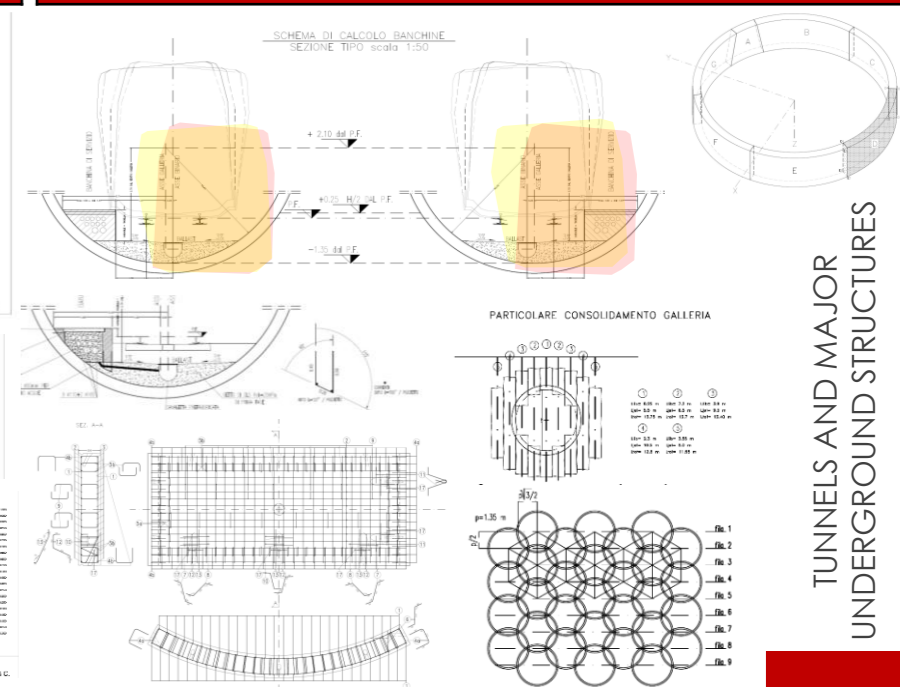
VENTILATION SHAFTS Carpenteria e armature e dettagli



CASTELLANZA TUNNEL – Checks and analysis of consolidations



CASTELLANZA TUNNEL – Carpentry, steel reinforcement and details



TUNNELS AND MAJOR UNDERGROUND STRUCTURES