its Engineering Company

ALPINE DEPARTMENT

Brochure

The Department

ITS Alpine was born with the strategic objective of measuring itself in an evolved way with the themes related to hydro-geological, hydraulic and avalanche risk and in general to engineering for the mountains. The technicians of ITS Alpine, also thanks to the experience gained in the mountains and alpine environments, can develop advanced models for the study of all the natural phenomena that every year more and more cause serious damage to the settlements and infrastructure present on the territory, also in relation to the climate change in progress. The same technicians, qualified for rope work, have access to the most challenging places using the most advanced mountaineering techniques and special instruments and means such as drones and helicopters. As well as the study and analysis of the phenomena, ITS Alpine can design and direct the works for defense and security works of the territory.

Services

01 Territory analysis (GIS)

Its Alpine specializes in GIS (Geographical Information System) can analyze the territory from a cartographic perspective, performing data processing of territorial data. Through this analysis it is possible to define the characteristics of the analyzed territory from topographic, morphological, hydraulic, geological etc., perspectives, as well as from the standpoint of critically and constraints.

- Spatial analysis of cartographic data
- Morphological analysis
- Hydrological analysis
- Topographical analysis

02 Geological surveys, insepections, site visits

The technicians of ITS Alpine can access the most difficult locations thanks to their experience in mountains and alpine environments. They use the most advanced alpine techniques (technicians qualified for rope work) and possibly also tools and means such as drones and helicopters. The advantage is that the engineering technicians are on the front-line areas of instability, allowing for an appropriate assessment of all case-specific criticalness. The team is completed by geologist trained in conducting filed geological surveys.

- Technicians qualified in rope work
- Technicians qualified in using SARP (drones) for photographic and topographic surveys
- Geological and geotechnical surveys

03 Monitoring

The department can offer the most modern monitoring techniques in the field of hydro-geological instability. These techniques are very useful in the study of landslides and general gravitational movements but are applicable to any hydro-geological instability. The combination of monitoring and detailed meteorological models allows for the creation of predictive models for sudden phenomena such as floods and debris flow.

- Monitoring of landslide movements in slopes and walls
- Real-time data transmission via air
- Micro-meteorology

04 Numerical Modeling

The technicians of ITS Alpine are trained in using the most advanced commercial tolls for numerical modeling of natural phenomena such as floods and watercourse overflows debris flow, landslides, rockfall and avalanches. One-dimensional and two-dimensional models, with mobile and fixed beds, are used for characterizing the risk and danger in reference to hydro-geological instability phenomena.

- Two-dimensional hydraulic modeling, mobile and fixed bed
- Debris flow modeling and general transport
- Two-dimensional avalanche modeling
- Hydrological modeling

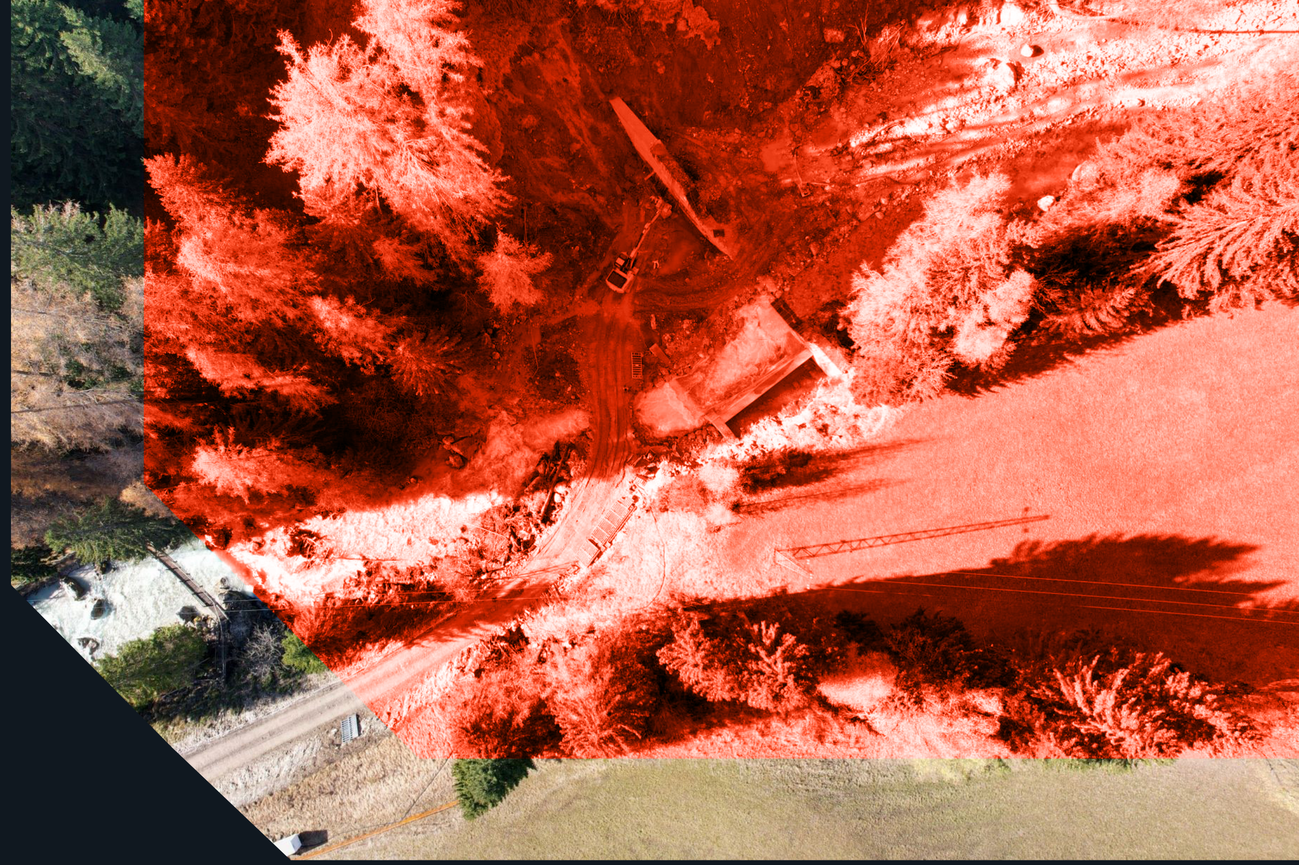
05 Design

The close collaboration among the various departments of ITS enables the definition of the past project solutions from all perspectives, such as structural efficiency, landscape integration, effectiveness against the event to be countered and durability. Continuous updating of techniques allows for the incorporation of cutting-edge solutions, favoring naturalistic engineering where possible.

- Hydraulic design
- Special foundation design
- Design of defense works against landslides, avalanches and floods
- Design of defense against debris flow

06 Environmental Assessment

ITS Alpine can provide engineering services in the field of environmental assessment such as EIA (Environmental Impact Assessment), SEA (Strategic Environmental Assessment), Environmental Incidence Assessment, landscape reports, etc. These assessments are crucial to project approval: a multidisciplinary approach is the only way to describe all the facets that characterized a project from the competencies, coordinating the various professionals of ITS and, if necessary, external consultants.



Our Projects

Debris Flow in Valsesia

Arrangement of the Pianale river and the Nono stream to protect the town of Camasco

The Towns of Corte and Costa di Camasco, on the event on October the 2 and 3 2020, were swept up by debris flow generated by the detachment of a mass of more than 5000 m3.

The project therefore aimed to achieved two main objectives:

• The mitigation of the hydro-geological risk resulting mainly from detrimental flows affecting Nono stream and the Pianale stream, with the inclusion of works to protect the population of the valley towns of Camasco di Varallo;

• The restoration of the hydraulic functionality of some sections of the Pianale stream and the Lavina stream near the Corte and Costa localities.

Regarding to the first point, the interventions upstream of the town were identified such as to contain the largest amount of volume moved by casting and in particular:
no. 4 flexible barriers in the mountain stretch, and no.1 comb filter pan in the middle of the basin, taking advantage of a natural storage area to create the necessary space, immediately upstream of the work. In addition, an alert system consisting of a meteorological station was designed with data transmission and comparison of the data against the alert, risk and alarm thresholds defined for the site of interest.

Regarding to the second point, the interventions focused both on the restoration of existing works and on the inclusion of new works in the bed. The latter were chosen in continuity with the existing works in order to increase the overall hydraulic functionality of the bed, not only deriving from the mere insertion of a new work but considering its combination of effects.

Location:	Piedmont, Italy
Client:	Municipality of Varallo
Year:	2023- Ongoing
Services amount:	1.300.000,00 €
Categories:	-
Services provided:	Preliminary, definitive and executive design. Work supervision, coordination in design and execution phases

Risk of rockfall in Val D'Adige

Works to protect the main road in Val D'Adige from rockfall

The intervention area and the entire neighborhood area, characterized by vertical walls, is subject to landslide phenomena that affect, within a few meters as the crown, the provincial road of the Val d'Adige and the cycle path that runs in parallel between it and the Adige River.

Due to the stepped morphology of the slope under study, the fall trajectories assessed because of the rock fall pattern showed significant heights (even over 20 m on the vertical form the country floor). A bulkhead tunnel of about 150 m was therefore built to protect the most vulnerable stretch of the road, while the remaining stretch of the project saw the installation if about 550 m of bulkhead barriers on the slope.

The gallery consists of main portal to protect the road and a cantilevered shelf for the protection of the cycle path that runs alongside. The barriers, on the other hand, have a nominal height of 7 m for an energy capacity of 5000 kJ.

A key aspect in this design was the interference with several elements, including a high voltage power line, the sliding in the tunnel (below the slope) of the Biffis canal, and the presence of the medieval Castle of Corvara, on which first a dedicated archeological investigation and then an intervention of cleaning and restoration on the wall structures were carried out.

In addition, the presence of Natura 200 areas has imposed particular attention on the aspects of environmental mitigation and landscape insertion of the works, as well as the drafting of a specific VIncA report.

The construction of the tunnel was constrained by the need of the client to ensure the passage of vehicular traffic. For this purpose, a temporary one-way alternative road has been provided.

Location:	Veneto, Italy
Client:	Province of Verona
Year:	2022 - Ongoing
Services amount:	7.000.000,00 €
Categories:	S.04, S.05
Services provided:	Definitive and executive design, coordination in design and execution phases, work supervision

Boite stream in Cortina d'Ampezzo

Intervention for the arrangement of the Boite stream bed

Following the assignment of Construction Management of the works in question, after carried out a series of inspection to verify the current state of the art, there were substantial differences with the hypotheses underlying the executive project. It was highlighted how the flood events that occurred in the years following the design, have severely accentuated the erosion of downstream of the existing bridle, reaching almost the tax share of the foundation of the same and creating a circumvention of the wing in the right river eroding the bank, undermining the stability of the work.
For this reason, a variant appraisal was carried out for the consolidation of the bridle, through the construction of a sub-foundation curb and the remaking of the wing by increasing the denting on the side, together with the construction of threshold and fifth walls for the connection of the latter with the bridle.
To complete the intervention, it was planned to pave the bottom for the control of the underfoot at the base of the bridle, and of the cliffs in cyclopean massifs upstream and downstream of the works. For the construction of the planned intervention, the access of the mechanical means saw the need to build a reclamation box made of inert material to overcome awns interposed of an old municipal dirt road that was in fact totally grassed. An ultimately, the access to the bed takes place with the overcoming of a small stretch of privately owned slope reclaimed with inert material.

Location:	Veneto, Italy
Client:	Veneto Region
Year:	2021 - 2022
Services amount:	350.000,00 €
Categories:	D.02
Services provided:	Work supervision, expert report for variations and safety coordination during execution

Landslides “Saviane” and “Teno-Ribego” in Alpago

Possible obstruction of the Valturcana stream

The intervention area is located along the riverbed of the Valturcana stream, in the municipality of Alpago. The design was carried out in two excerpts, each of which focused on a landslide that insists on the stream threatening its obstruction: Saviane landslide, of about 3.5 ha, and Teno-Ribego landslide, of about 14 ha. The works, for both sections, had the objective both of restoring the hydraulic functionality of the riverbed of the Valturcana stream, and the cleaning and re-profiling of the landslide slopes to guarantee a preferential route to the runoff of meteoric water towards the planned surface drainages, which will allow it to be removed and discharge into the Valturcana stream. The interventions in the riverbed were partly devoted to the restoration of the existing artifacts, mostly closed bridle of the Fascist era with historical value, special design measures had to be followed to restore the original stone cladding.

River interventions were then supplemented with new works, such as cliffs and slabs in boulders for the protection against erosion, but also the insertion of two new bridles made by laying “umbrella” single anchor structure. The two rows of umbrellas were located at the foot of the Teno-Ribego landslide to stabilize the bed but also as a garrison at the foot of the landslide and weight it down.

The choice of single-anchor technology was born from construction needs, because, due to the difficult accessibility of the places, the construction of a classic concrete bridle was not technically and economically advantageous.

Location:	Veneto, Italy
Client:	Veneto Region
Year:	2022 - 2023 (1st stage), 2023 - Ongoing (2nd stage)
Services amount:	1.100.000,00 € (350’000 € 1st stage, 750’000 € 2nd stage)
Categories:	D.02
Services provided:	Final and executive design, construction supervision, coordination during design and execution phase

Debris flow in the Agordino zone

Construction of a cycle bridge over the Gavon stream

The Gavon stream, a tributary of the Biois stream, is one of the main waterways affecting the municipality of Falcade (Belluno Province). The bridge replaces an existing bridge, which collapsed due to extraordinary meteoric events (VAIA) that occurred in late October 2018.

The new work, in addition to restoring the continuity of the cycle-pedestrian route that develops sideways the Biois stream, will improve the hydraulic conditions for the of flood events and frequent debris flows that affect the Gavon stream. The main source of danger is in fact represented by the development of debris flows, especially for the damage to the structure of the bridge (the floods, both of Gavon and Biois, despite causing flooding, do not involve inhabited centers). For the correct design of the new bridge, a hydrological analysis, and a hydraulic modeling of the water catchment area of the Gavon stream were carried out.

The hydrological study of the water catchment area carried out in order to estimate the liquid flow rates necessary for the design of the cycle bridge and analyze the behavior of a debris flow onto Gavon stream, considering the return time of 50 years, Both a two-dimensional hydraulic modeling of the Gavon-Biois confluence and a modeling of the debris carting with specific WEEZARD software (WEbgis modElling and hazard Assessment for the mountain flows) were performed, based on a biphasic model with various motion and moving bottom.

Location:	Veneto, Italy
Client:	Municipality of Falcade
Year:	2020 - 2022
Services amount:	350.000,00 €
Categories:	D.02, S.04
Services provided:	Definitive-executive design, work supervision, safety coordination in the design and execution phases

Hydro-geological risk on Ripa Road

Arrangement of the “Ripa Road” Lots 2, 3, and 4

The Ripa Road is between the riverbed of Magra River and the slope that lead down to Vezzano Ligure in the Province of La Spezia. This slope is characterized by a widespread hydro-geological instability that manifests itself in the form of landslides of various kinds: surface landslides, small flows and rockfall.
From the result of the rockfall modeling, the project interventions have been defined: the barrier tunnel is placed to defend the road at the most critical sections, in which safety cannot be guaranteed by works on the side; in the other sections, on the other hand, it is planned to build barriers against the slope, positioned to optimize the quantity. On the rock face, overlooking the road, there is the inspection and maintenance of the existing in-adherent networks, as well as the integration of the same where they are missing at the level of construction, a temporary bypass road was designed and would allow the works to be carried out without interference with the traffic and at the same time always guarantee the double direction of traffic.
The valley edge of the road represents the limit of the Regional Natural Park of Montemarcello-Magra-Vara, which in this case coincides with the riverbed of the Magra River. Particular attention was paid to the aspects of landscape insertion and environmental sustainability of the works, sharing the choices with the park body and to the design if the bypass road, albeit temporary, to be built obligatorily in the riverbed. At the end of the works this area will be restored, creating a wetland area that recreates a natural environment typical of the area, thus improving it comperes to its current state.

Location:	Liguria, Italy
Client:	I.R.E Spa
Year:	2018 - 2022
Services amount:	4.300.000,00 €
Categories:	S.05, S.03, D.02, V.02
Services provided:	Final and executive design, construction management, safety coordination during design and execution

Ornella valley streams

Transversal and longitudinal forestry hydraulic works to protect the town of Col d'Ornella

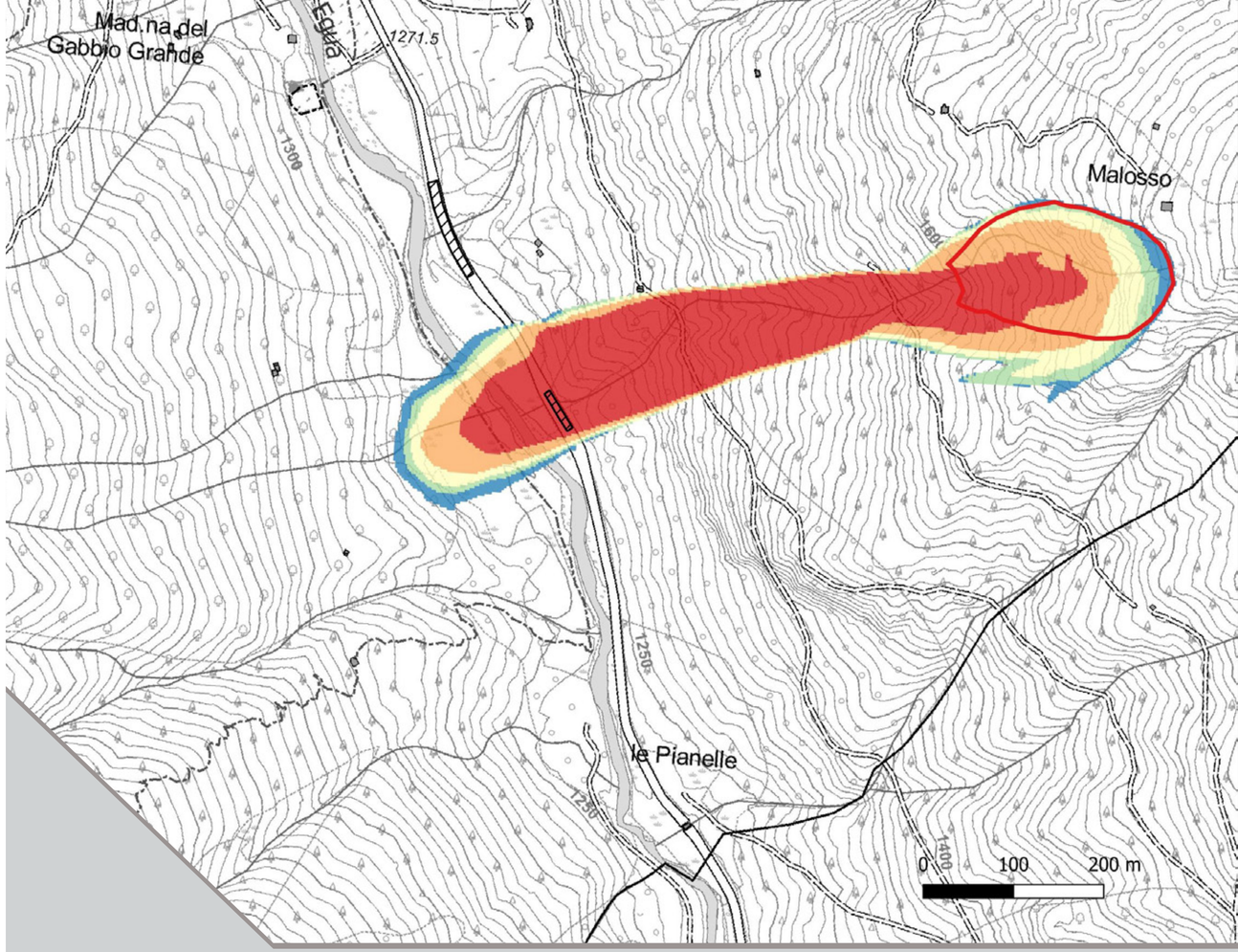
The project pursued the dual objective of restoring the both hydraulic functionality of the D'Ornella stream basin and the municipal-forestry viability, compromised because of the "Vaia" storm: the passage of the flood has in fact resulted in both the collapse of banks of works and slopes, but also of the crossing bridges of the stream.
The design therefore provided for the realization of works compatible with exceptional flood events. Alongside those closely connected with the road, there are, therefore, interventions for the accommodation, stabilization and restoration of bedsides and slopes such as to allow the passage of the flows safely and to increase the real safety of the roads and the inhabitants of Col D'Ornella and surroundings.
The campaign of surveys and inspections carried out was of fundamental importance.
The survey was carried pout by means of aerophotogrammetry, integrated by GPS, to ensure coverage over the entire work area, particularly extended by including an entire landslide slope on which natural engineering works have been designed (weirs and gutters made of timber-stone) to contain the hydro-geological mess and for optimal landscape insertion. Geological and geomorphological surveys have seen the execution of HVSR seismic survey and passive seismic surveys lines, to locate the rocky bedrock below the foundations of the new bridges under design.
The estimate of the project flow rates, considering the different closing sections, was determined by applying hydrological modeling through HEC-HMS software.
They were then verified, considering a two-hundred-year return, both the hydraulic francs to the new bridges and the bed river works, such as cliffs, thresholds, and bridles.

Location:	Veneto, Italy
Client:	Veneto Region
Year:	2020 - 2022
Services amount:	550.000,00 €
Categories:	D.02, S.03
Services provided:	Final and executive design, construction management, safety coordination during design and execution

Avalanche risk in Val Sermenza

Interventions to defend the fall of avalanches on the slopes above the town and the main road- Maria Luisa

The intervention area is located on a stretch of the road by the avalanche that descends along the "Maria Luisa" gully, as well as the phenomenon of the fall of boulders.
The design included the construction of an avalanche guard tunnel of about 65 m, rockfall barriers for a length of about 70 m several hydraulic works for the management of the water coming from the slope to sizing the gallery, the nivological and avalanche study of the slope was drawn up. In particular, the analysis followed several phases, including cartographic analysis, in situ inspections, the acquisition and examination of photographic material, the acquisition and analysis of climate data of the area, dynamic modeling with RAMMS software developed by the WSL-SLF in Davos and the return of results with avalanche area, maximum deposit height, dynamic pressures and snow speed. Starting from the result obtained from the modeling and assigning a different degree of priority to the interventions, the intervention trait was identified. Similarly, the optimal design solution was chosen from the rockfall modeling, namely in this case the installation of 30 m of barriers with an absorption capacity of 1000 kJ and 40 m at 1500 kJ, respectively 3.5 and 4 m high.
Finally, the design also took into the account the landscape mitigation aspects. In particular, the valley wall of the gallery, being the inly one visible, will be made of exposed reinforced concrete, using specific formwork to have an excellent surface finish, and the inertia of the gallery cover will be performed to minimize the visual impact, to better integrate with the surrounding landscape.



Location:	Piedmont, Italy
Client:	Municipality of Carcoforo
Year:	2021 - 2023
Services amount:	850.000,00 €
Categories:	S.05, D.02, V.03
Services provided:	Technical and economic feasibility studies, final and executive design, safety coordination during design

Hydro-geological instability in Longarone

Performance and functional improvement work of the road between the Castellavazzo junction and the Termine tunnel entrance

The present project of rectification and planimetric improvement of "Alemagna" road, halfway between the Piave River and the slope above it, was also an opportunity to secure the road from hydro-geological disruption phenomena. Afterwards the execution of the topographical surveys, the geological investigations, from the point of view of the rockfall and the criticality of hydro-geological risk, the following interventions were designed: barrier-mass in several rows and with different energy absorption capacities; systematic nailing of rock walls close to the road; installation of double-twist nets, coupled to a regular mesh of steel ropes for the cortical reinforcement of the rock walls.

As the geological surveys carried out at the final stage were considered insufficient, a supplementary survey campaign was carried out. The plan provided for the execution of no.2 MASW type seismic prospecting, no.11 refractive seismic prospecting, no.14 electrical tomography surveys and no.13 H/V surveys. A new geomechanical survey was also carried out to characterize the rock walls above the road and thus define the extent and danger scenarios, as well as the geotechnical model of the rock cluster. The rockfall study was also integrated, investigating further critical sections. The simulations were carried out with Rocscience's Rockfall software, which allows to simulate the rockfall in 2D. In total, 4 sections of barriers were installed for a length of 330 m. The cortical strengthening was performed on a wall of about 2500 square meters.

Location:	Veneto, Italy
Client:	ANAS Spa
Year:	2019
Services amount:	18.000.000,00 €
Categories:	S.05, S.04, D.02, V.02
Services provided:	Executive design, safety coordination during design

Avalanche risk at Falzarego Pass

Intervention for avalanche risk mitigation with an extension of the avalanche shelter tunnel at Falzarego Pass

The project includes the construction of two sections of an avalanche shelter tunnel: one downstream of the two existing ones, and the other one connecting them. The slope has a gradient of around 40°-45° and it is particularly articulated both in its morphological development, with narrow and steep gullies, and in the presence of disarticulated rocky material, which due the freeze-thaw cycle, affects the roadbed even in summer. T

he tunnel's structure consists of a series of adjacent reinforced concrete frames placed at 2.50-meter spacing, with valley pillars of variable increasing section towards the top, rectangular mountain pillars, and a beam connecting their tops. Given the location of the work, particular attention was paid to the work's construction. The site was divided into four work sections to operate limited sites, at least for the more delicate phases of digging the foundations and casting them, as well as 3-meter-high wall section that allows for partial filling to secure the slope before proceeding with the same operations in the subsequent sections.

Moreover, it was not possible to completely close the traffic road, except for a short periods and specific hours: therefore, a site plan was devised that allows for operation on external tracks, both valley and mountain side, to limit the traffic interference as much as possible and facilitate the movement of excavated material to be relocated behind the avalanche shelter structure.

Location:	Veneto, Italy
Client:	Veneto Strade Spa
Year:	2014 - 2015
Services amount:	850.000,00 €
Categories:	S.05
Services provided:	Operational management and site inspection

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