Individual Internship Report

4th year

Follow up of an underground road project

KREATE Sverige AB
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Logo

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Acknowledgements

I would like to express my sincere gratitude to all those who have contributed to making this internship an extremely valuable, educational, and memorable experience. Over these past months, I have not only developed new technical skills but also learned important lessons about teamwork, communication, and problem-solving in a professional environment.

First and foremost, I would like to thank Kreate Sverige AB for giving me the opportunity to join their team and take part in the Lovön underground construction works, a project of exceptional scale and complexity. I am especially grateful to my supervisor, Damian Zagorski, for his continuous guidance, trust, and constructive feedback throughout the internship. His availability and support made this experience both smooth and highly instructive.

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Finally, I would like to thank my housemates Alexis Le Dez et Coline Le Saec, who made my stay much easier and more enjoyable, providing both friendship and advice whenever needed.

This internship has been a truly rewarding stage in my academic journey, strengthening my technical competencies and broadening my understanding of large-scale engineering projects. I am deeply grateful for the trust, collaboration, and enriching exchanges I experienced during my time at Kreate Sverige AB, and I look forward to applying these learnings in my future career.

Introduction

During the fourth year of engineering studies at Polytech, students are required to undertake a 14 to 16-week internship in a professional environment. This internship aims to give us practical exposure to engineering challenges, complementing the theoretical knowledge acquired throughout our studies.

I had the opportunity to complete my internship at Kreate Sverige AB, a Swedish company specializing in rock and concrete engineering, as well as complex underground construction projects. While this field is not directly the core focus of my major, the technical complexity and scale of their operations immediately caught my attention. I was particularly interested in the possibility of taking part in the follow-up and coordination of one of the largest infrastructure projects currently underway in Stockholm**.**

Stockholm is often recognized as the greenest capital in Europe and one of the most environmentally committed cities in the world, is currently undergoing significant infrastructure developments to meet the needs of its growing population. Large-scale projects such as the one I was involved in require careful planning, advanced engineering techniques, and close collaboration between various stakeholders, while also taking into account strict environmental regulations.

This internship offered me the chance not only to observe but also to contribute to different stages of the project, enabling me to develop both my technical skills and my understanding of large-scale project management in a context that combines innovation, sustainability, and engineering excellence.

Company presentation

Kreate Sverige AB, formerly known as BBEAB, is a Swedish company specializing in complex underground construction projects. It was founded in 2013 by Veli and Maria Taatila, who built the company's reputation on its ability to deliver technically demanding works in challenging environments. In 2022, the company became part of the Finnish group Kreate Oyj, a publicly listed company and a major player in the infrastructure sector in Northern Europe. Following this acquisition, BBEAB officially changed its name to Kreate Sverige AB.

Before joining the Kreate Group, BBEAB employed around 50 people and achieved an annual turnover of approximately 120 million SEK. Today, as a subsidiary of Kreate Group Oyj, Kreate Sverige AB continues to expand its activities while maintaining high operational standards. The company is certified under several international benchmarks: ISO 9001 for quality management, ISO 14001 for environmental management, and ISO 45001 for occupational health and safety.

Kreate Sverige AB operates mainly in rock, concrete, ground, and foundation works, with a strong focus on projects that require advanced technical expertise. Most of its activities take place in the Greater Stockholm and Greater Gothenburg regions, but the company also undertakes projects in other parts of Sweden, such as Karlskrona in the south. Its clients are often public sector entities, and the company regularly collaborates with other contractors on large-scale infrastructure projects.

The company values Honesty, Ambition, Humanity, and Simplicity, values that are at the heart of its operations. They guide interactions with clients, partners, and colleagues, while fostering a work environment that balances professionalism with a collaborative and respectful spirit. During my internship, I had the opportunity to witness how these principles are applied daily, both on construction sites and within the office.

The project I am involved in during my internship is particularly significant: it is not only the largest undertaking ever carried out by Kreate Sverige AB but also one of the most ambitious infrastructure projects in Stockholm's history. With a budget of 36 billion SEK (approximately 3.6 billion euros), it represents a major investment for the city and the country. Its scale, complexity, and strategic importance make it a unique opportunity to observe and contribute to modern engineering at the highest level.

Figure 1: Logo of the company KREATE Sverige AB

Presentation of the project

The project is called Förbifart Stockholm or Stockholm Bypass. It is one of Sweden's largest infrastructure projects, designed to improve traffic flow and connectivity in the Stockholm region. The project consists of a new 21-kilometre motorway, of which approximately 18 kilometres will run through tunnels, making it the third longest road tunnels in the world. It will link the southern and northern parts of the city, bypassing the congested central area.

The main objectives of the project are to reduce travel times, increase traffic safety, and improve accessibility for commuters and freight transport, while also alleviating congestion in central Stockholm. In addition, the bypass is expected to contribute to the city's environmental goals by reducing emissions linked to traffic congestion in urban areas.

Construction of Förbifart Stockholm involves complex engineering challenges, including large-scale tunnelling through varied geological conditions, bridge construction, and the integration of advanced traffic management systems. Given the scale and technical demands of the project, it requires close coordination between multiple contractors, engineers, and governmental agencies.

Working on or alongside such a major infrastructure development provides valuable insight into modern engineering practices, project management in large-scale works, and the balance between technical, environmental, and societal considerations in civil engineering.

At completion, this tunnel will the third longest motorway tunnel in the world. It is expected that 140 000 vehicles

The project is managed by Trafikverket, the Swedish Transport Administration, which awarded the contract to Kreate Sverige AB following a public call for tenders. Under this contract, Kreate is responsible for completing the lining works of three ramp tunnels. The construction site is located on Lovön Island, to the west of Stockholm, the capital of Sweden.

During the course of my internship, Kreate successfully secured an additional contract for the lining works of the main tunnels, significantly expanding the scope of the project. This acquisition tripled the overall workload and represented a major opportunity for the company, enabling substantial growth and allowing it to achieve its annual economic objectives ahead of schedule.

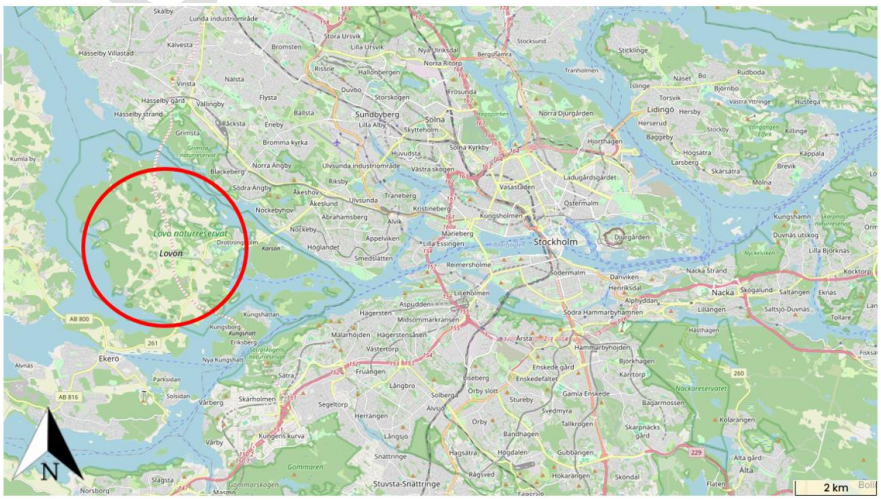


Figure 2: Map showing where is the project is located on a Stockholm map

During my internship, I worked on a project that can be divided into two main parts. The first part focused on widening the existing Ekerövägen road, including the Drottningholm Bridge and the Nockeby Bridge in the West-East direction. The goal was to add an extra lane between Nockeby and Tappström heading toward Ekerö, which helps buses move more smoothly during rush hours and encourages the use of public transportation. This part of the project also involved constructing another tunnel tube next to the Lindö tunnel and building a new openable bridge at Tappström.

Figure 3: Map locating the widening of the bridges included in the project

The second part of the project involved constructing the E4 Stockholm Bypass underground road, including roundabout and ramp tunnels in the North-South direction to improve traffic flow and connectivity. Overall, the project aims to make travel safer, smoother, and more efficient while supporting sustainable transport options.

Figure 4: Förbifart Stockholm (white area) according to a brochure from the Swedish Road Administration 2008 and modelling of the tunnel entrance

The reason Ekerövägen is being rebuilt is that the municipality has grown and developed over many years. As the area has expanded, traffic has increased, and accessibility has become more difficult for road users on the three-lane Ekerövägen. To address this, the road is being widened with an additional lane for public transport during rush hours, which will improve accessibility and make it easier to travel by bus to and from Brommaplan.
Once the E4 Stockholm Bypass opens, residents of Ekerö will also be able to reach the northern and southern parts of Stockholm without passing through Brommaplan. The project passes through areas of great cultural and environmental importance, including the World Heritage Site and nationally listed building Drottningholm, several national interests, nature reserves, water protection zones, and Natura 2000 areas.
The main part of Ekerövägen was expected to be completed in 2024, except for the Drottningholm Bridge and the Nockeby Bridge. The Drottningholm Bridge is planned for completion in 2026, while the widening of the Nockeby Bridge will take place after the E4 Stockholm Bypass opens in 2030.

During my internship, I followed the development of the E4 Stockholm Bypass, a project composed of two underground roads with two lanes each, stretching 21 kilometers, of which 18 kilometers run through tunnels. These tunnels connect to Ekerövägen via two new roundabouts on Lovön Island. Once the bypass opens, Ekerö residents will have two new connections to the mainland—one to the north and one to the south—relieving traffic on Ekerövägen and reducing the impact on the sensitive environment of the Drottningholm World Heritage Site.
In several sections, high-tech safety solutions and advanced technical systems for electricity supply, ventilation, monitoring, and traffic control have already been installed. The E4 Stockholm Bypass is scheduled to open in 2030.

Initially, Kreate Sverige acted as a subcontractor on the project. However, in February, the company signed a contract with the Swedish Transport Administration to carry out the cladding work for ramp tunnels 311, 313, and 314 as part of the Lovön project. This contract, worth SEK 98 million, made Kreate Sverige the main contractor, the largest contract in its history.
During my internship, in June, the company also obtained the contract for the construction of the main tunnels, which further increased the importance and scale of the project. The contract for these sections was worth SEK 75 million. Kreate became responsible for the execution of the works in main tunnel 301, which is about 2 kilometers long, and in main tunnel 302, which is about 4 kilometers long. The type of work to be carried out in the main tunnels is the same as the one done in the ramp tunnels, including drilling, bolting, waterproofing, and installing the wall elements.
With this extension of the project, the workforce had to be increased to match the larger scope of work. The number of workers on site almost doubled, going from 20–25 people to 40–45 people. This change gave me the opportunity to see how quickly a company must adapt when a project grows in size, not only in terms of manpower but also in organization, planning, and logistics.

For me, this meant working on a project that is not only important for traffic and the environment, but also for the development of the company itself. This gave me the chance to see how a big project like this evolves and how a company adapts to new responsibilities.

Kreate Sverige is in charge of building the three ramp tunnels 311, 313 and 314 and of the main tunnels 301 and 302 (see on the figure below).

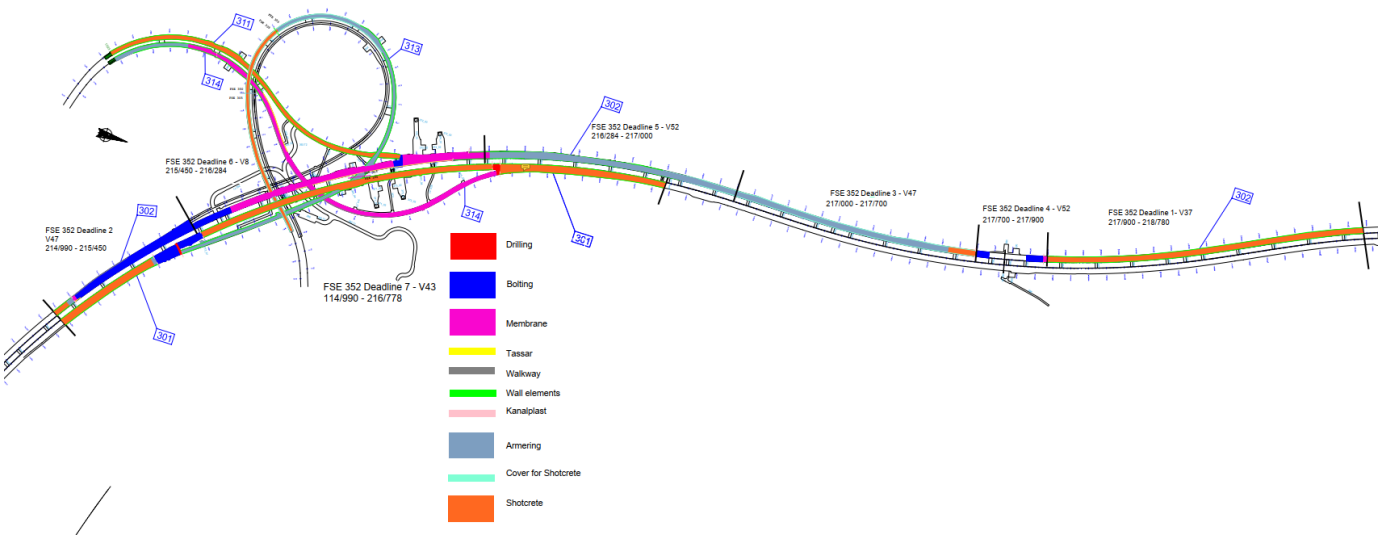


Figure 5: Map of the site representing the work in progress, realised by Valentin Roulaud (11/08/2025) (Full picture available in annexes)

Résumé en français de la présentation du projet

Le projet Förbifart Stockholm ou Stockholm Bypass est l'un des plus grands projets d'infrastructure de Suède. Il s'agit d'une nouvelle autoroute de 21 km, dont 18 km sous tunnel, ce qui en fera le troisième plus long tunnel routier au monde à la fin de sa construction . Son objectif est de fluidifier le trafic, réduire les temps de trajet, améliorer la sécurité routière et limiter la congestion dans le centre de Stockholm, tout en contribuant aux objectifs environnementaux de la ville.
Le projet comprend deux parties principales. L'élargissement de la route d'Ekerövägen, avec la construction d'une nouvelle voie réservée aux bus aux heures de pointe, ainsi que des travaux sur les ponts de Drottningholm (fin prévue en 2026) et de Nockeby (après 2030). Cet aménagement vise à améliorer l'accessibilité pour les habitants d'Ekerö et à réduire l'impact sur le site classé au patrimoine mondial de Drottningholm. Ainsi que la construction du contournement E4, composé de deux tunnels souterrains à deux voies chacun, reliant Ekerövägen à deux nouveaux échangeurs sur l'île de Lovön.
Le projet traverse des zones de grande importance culturelle et environnementale, ce qui rend sa réalisation particulièrement complexe. Des systèmes techniques avancés (ventilation, électricité, sécurité, gestion du trafic) y sont déjà intégrés. L'ouverture du contournement est prévue pour 2030.
Concernant l'entreprise Kreate Sverige AB, elle a d'abord participé en tant que sous-traitant jusqu'en février 2025, avant de signer directement avec la Swedish Transport Administration (Trafikverket) pour les travaux de revêtement des tunnels rampes 311, 313 et 314, un contrat de 98 millions SEK en avril (le plus important de son histoire à ce moment-là). En juin, pendant mon stage, Kreate a obtenu un second contrat de 75 millions SEK pour les tunnels principaux 301 (2 km) et 302 (4 km), élargissant considérablement le projet.
Cette extension a nécessité de presque doubler les effectifs, passant de 20–25 à 40–45 ouvriers. J'ai ainsi pu observer comment une entreprise s'adapte rapidement à l'augmentation de la charge de travail, aussi bien en termes d'organisation que de logistique. Pour moi, ce stage a représenté une expérience unique : participer à un projet majeur pour la mobilité et l'environnement de la région de Stockholm, tout en suivant de près l'évolution et la croissance d'une entreprise grâce à l'obtention de nouveaux marchés.

In order to build such infrastructure, there are several processes to follow (refer to the glossary for the vocabulary)

Our contracts start after the excavation phase, which consists of digging the tunnel using controlled blasting with explosives. The method used in Lovön follows the typical drill and blast technique, where a series of holes are drilled into the rock, filled with carefully measured explosive charges, and detonated in a controlled sequence. After each blast, the loosened rock is removed using loaders and trucks. To limit the impact on the sensitive surroundings of Lovön, especially near Drottningholm, the amount of explosives was drastically reduced and the blasting cycles were shorter. This helped to minimize vibrations on the surface and to protect nearby structures, cultural sites, and the environment.

Once a section of rock was excavated, a first layer of shotcrete (sprayed concrete) was immediately applied onto the tunnel walls and roof. This temporary support layer prevents

potential rockslides and stabilizes the exposed surfaces until permanent support systems, like bolts and final lining, can be installed. The process of excavation was carried out progressively, advancing only a few meters per blast, which made the tunnelling work slower but safer, especially in the complex geology of Lovön where the rock quality can vary significantly.

Steps of the tunnel construction:

Drilling

The first step of our work to drill the holes for the bolt installation. Before the drilling process, the location, the position, the width and the depth of each hole is calculated by engineers considering the profile of the tunnel since it is not a perfectly flat surface. After calculation, the position and depth are marked onto the tunnel. The drilling is realised by a driver and his machine for a meticulous work. The drilling can also be executed using a bigger machine for drilling higher or a hand driller to be more cost efficient when there only few holes.

Figure 6: Photo of a Commando DC130Ri drilling in our ramp tunnel

Bolting

Bolting is the process of installing bolts into pre-drilled holes. The bolts are grouted with quick-setting cement to secure them firmly in place. There are three main types of bolting work.

The first is the installation of membrane bolts, positioned along the roof of the tunnel. These have a diameter of 16 mm, with 12 bolts per tunnel section (20 in the main tunnel), spaced 1.2 meters apart between rows. Their function is to hold the waterproof membrane in place.

Next are the vertical bolts, which also have a diameter of 16 mm. Two are placed on each side of the tunnel every 1.5 meters, and their purpose is to secure the prefabricated wall elements.

Finally, there are the horizontal bolts, which are thicker, 27 mm on the *kulvert side* and 30 mm on the *rock side*. Like the vertical bolts, they are used to hold the wall elements in position, but they are installed horizontally to provide additional structural stability.

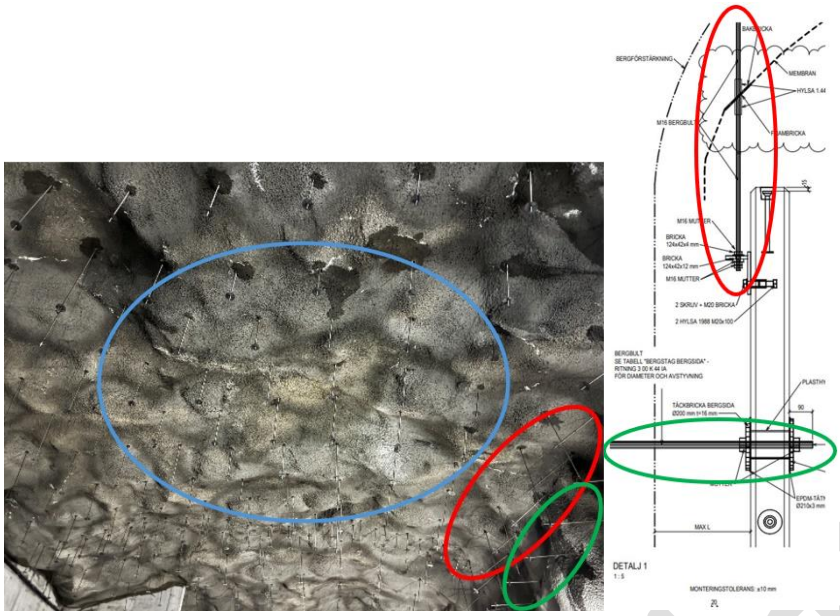


Figure 7: Scheme and photo explaining the position of the different bolts (Membrane bolts in blue, Vertical bolts in red, Horizontal bolts in green)

A few days after installation, the bolts undergo a pull-out test to verify their grip on the tunnel wall and ensure the strength and reliability of the installation.

Membrane

The membrane is specially developed for waterproofing the tunnels and rock cavities in combination with shotcrete. It is also used for technical rooms and escape routes connected to tunnels. The membrane has extra protection against ignition and meets requirements according to class E with. Its installation requires to use the membrane bolts previously installed as anchor points.

Figure 8: Photo of the membrane set in the ramp tunnel

After the membrane is installed, the vertical and horizontal bolts are extended to prepare them for supporting the prefabricated wall elements.

Tassar

Tassars are the concrete structures that can be either prefabricated off-site or cast directly on-site by our team. Their purpose is to serve as a stable base for the installation of the tunnel wall elements. Each tassar must be carefully moulded to the required dimensions, reinforced with steel rebar to ensure structural strength, and then cast onto the rock surface to provide a solid and durable foundation. This process ensures that the wall elements are securely anchored, contributing to the overall stability and safety of the tunnel structure.

Figure 9: Photo of prefabricated tassar

Wall elements

Wall elements are large prefabricated concrete structures, each measuring 5 meters in height and 3 meters in width. On the rock side, they are securely positioned on the tassars, while on the kulvert side, they are installed against the walkway to maintain alignment and support. Their stability is reinforced by the previously installed horizontal and vertical bolts, which anchor the walls firmly to the tunnel structure and ensure they can withstand the pressures from surrounding rock and soil.

The installation process uses a suction machine, allowing precise handling and positioning of these heavy elements while minimizing risks to workers and reducing installation time. The decision to use prefabricated walls was made to increase efficiency, save time, and improve quality, as the walls are manufactured under controlled conditions off-site and then transported and installed rapidly on-site.

Additionally, the use of prefabricated walls reduces the amount of on-site concrete work, which is particularly advantageous in a tunnel environment where space is limited and safety is a priority. This method also helps maintain consistent quality, as each wall element is produced according to strict specifications.

Figure 10: photo of the wall setting

Reinforcement and kanalplast

Following the installation of the wall elements, the next step is the placement of the kanalplast. This is a plastic protective layer that is fixed on top of the walls with construction tape in order to ensure proper waterproofing and to protect the surface during the spraying of shotcrete.
Before the shotcrete application, distansring (green plastic spacers, 13 cm thick) are positioned. Their role is to indicate precisely the thickness of shotcrete that needs to be applied. By setting this reference, workers can control the spraying process and guarantee a uniform and safe layer of concrete on the tunnel walls and roof.
Afterwards comes the armering, or reinforcement stage. This consists of placing metallic meshes onto the roof of the tunnel, which will later be embedded in the shotcrete to improve the overall strength and stability of the lining. A specialized machine equipped with a magnet is used for this operation: the magnet can be activated or deactivated to pick up and position the heavy metallic meshes accurately. This method not only increases efficiency but also improves safety by reducing manual handling of the reinforcement elements.

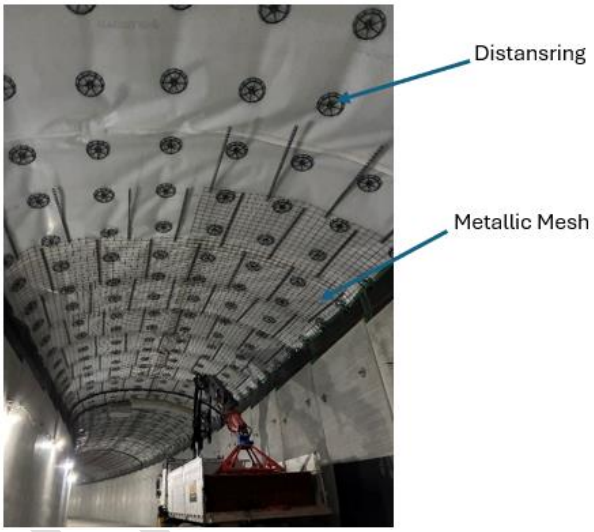


Figure 11: photo of the armering installation with the machine

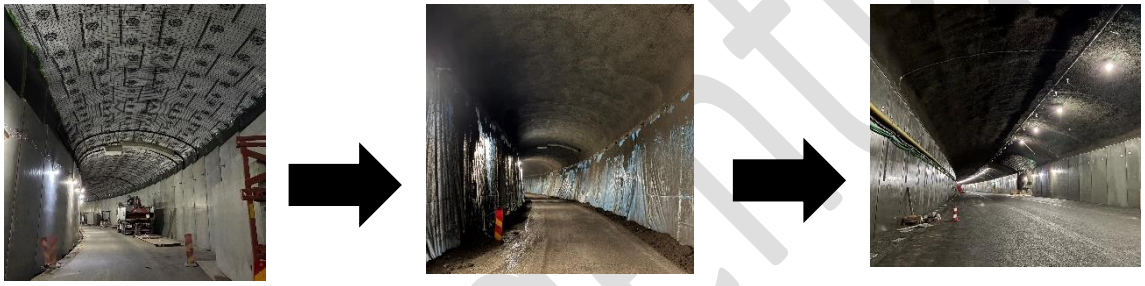
After the reinforcement is installed, plastic foils are installed to cover the walls as a preparation for shotcrete to keep them clean.

Shotcrete

Shotcrete is the final step of our work in the project is a type of concrete or mortar applied at high speed onto a surface using a pressurised hose, generally with compressed air. This method has the advantage of adhering easily to almost any surface, including irregular or vertical walls, and allows for quick application. These qualities make it ideal for temporary or permanent support work, particularly in tunnel construction. The shotcrete aims to cover the roof of the tunnel.

Figure 12: photo of a tunnel roof during the shotcrete (not finished)

Finally, once the shotcrete done, the tunnel should be cleaned and the plastic foils removed. The tunnel is now ready for an inspection withs the clients.



Before the shotcrete After shotcrete After cleaning

Figure 12: Photos illustrating the shotcrete before and after

Later on, other companies have to install the ventilation, the electricity, prepare the emergency exits to the security norms and the safety signs for the future users.

Résumé des techniques utilisées en français

Le travail commence par le forage des trous destinés aux boulons, dont la position, la profondeur et le diamètre sont calculés par les ingénieurs en fonction du profil irrégulier du tunnel. Le forage peut être réalisé avec différentes machines selon la hauteur ou le nombre de trous à percer.

Le boulonnage consiste à insérer et sceller les boulons avec un ciment à prise rapide. On distingue trois types:

- Boulons de membrane (16 mm), fixés au plafond pour maintenir la membrane d'étanchéité.
- Boulons verticaux (16 mm), sur les côtés, pour fixer les éléments de murs préfabriqués.

- Boulons horizontaux (27 mm côté kulvert, 30 mm côté rock), pour renforcer et stabiliser les murs.

Après leur pose, les boulons sont soumis à un test d'arrachement pour vérifier leur tenue. La membrane, résistante au feu et conçue pour l'étanchéité des tunnels, est fixée aux boulons prévus à cet effet. Les boulons verticaux et horizontaux sont ensuite prolongés pour recevoir les murs.

Les tassars sont des socles en béton, soit préfabriqués, soit coulés sur place, servant de base aux murs. Renforcés avec des armatures, ils sont fixés sur la roche pour garantir stabilité et durabilité.

Les murs préfabriqués en béton (5 m × 3 m) sont posés sur les tassars côté roche et contre le passage piéton côté kulvert. Leur installation, assurée par une machine à ventouse, permet précision et rapidité. Ce choix de murs préfabriqués améliore la qualité, réduit le temps de chantier et limite les travaux de bétonnage sur place, ce qui est un atout dans l'espace restreint du tunnel.

Après la pose des parois, une couche de *kanalplast* est fixée pour assurer l'étanchéité et protéger les surfaces. Des distansrings de 13 cm permettent de contrôler l'épaisseur du béton projeté. Ensuite, des treillis métalliques sont installés au plafond à l'aide d'une machine aimantée pour renforcer la structure. Enfin, le *shotcrete* est appliqué à haute pression sur le toit du tunnel, avant le nettoyage et l'inspection finale avec le client.

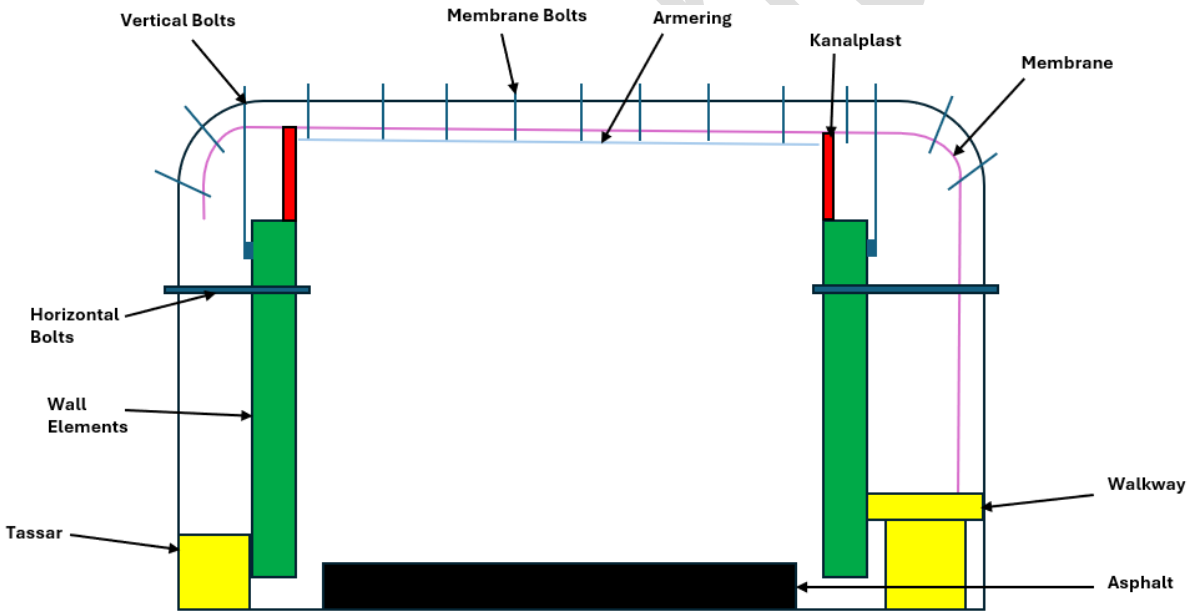


Figure 13: Scheme illustrating the position of elements in a section of the tunnel

Missions' presentation

During my internship, my role was to support the site manager in all activities related to the coordination and follow-up of the project. This gave me the opportunity to be involved in a wide variety of tasks, ranging from technical monitoring to organizational and economic responsibilities.

At the beginning of the internship, I focused on studying the contracts, detailed plans, schedules, and project documentation. This initial phase allowed me to gain a clear understanding of the project from both a technical and financial perspective.

From the second week onwards, I was responsible for monitoring the weekly progress of the tunnel works. Every Monday, I carried out inspections inside the tunnel to check the sections completed by our workers. Based on these observations, I updated Excel files to calculate the pace of work and compare it with the planned schedules. To make the progress easier to visualize, I created tunnel maps showing the different ongoing tasks. These documents were compiled into a weekly report, which I prepared and presented during the Tuesday production meetings with the office staff and sent to the client.

Another important part of my role was the management of materials on site. I carried out a full inventory of all materials stored in the tunnel, which were spread across three storage areas. I organized these areas so that essential materials remained accessible at all times, even if one area had to be closed. To keep track, I created a detailed file listing the available materials, their quantities, and the pace of consumption. This helped me calculate the required stock levels and define the frequency of orders, ensuring that the construction site always had sufficient supplies.

In addition to monitoring materials, I was also involved in various economic and technical analyses. I compared suppliers' offers, negotiated prices, and assessed the performance of different machines that could be purchased for the project. I also prepared files calculating the costs of specific on-site activities. This work helped the company to evaluate which activities were the most cost-effective and where efficiency could be improved by reallocating resources.

In June, I contributed to the preparation of a tender launched by Trafikverket for works in the main tunnel. I accompanied the CEO of Kreate on a site visit, where I recorded all the required works in detail. Based on this visit, I created a detailed map linking each element to specific tunnel sections, which supported the preparation of a realistic and competitive offer.

Another task I was responsible for was the management of daily work protocols. These reports, filled in by employees, record the tasks completed, quantities installed, and any difficulties encountered. While they were originally managed on paper, I was tasked with implementing a digital version. After receiving training on the new system, I designed and tested the digital protocols, made corrections, and then supported the workers in using the new tool. Within two weeks, the digital system was fully operational, saving considerable time and improving the accuracy of data collection.

Safety was also an important part of my responsibilities. Like all employees, I first had to attend a safety training and obtain the necessary certification to work on site. Afterwards, I was responsible for booking safety introductions for new employees and making sure safety rules were followed in the tunnel. I also participated every Wednesday in a "safety round" with the client's safety manager and our foremen, where we checked compliance with safety regulations and suggested possible improvements.

Finally, I contributed to the environmental monitoring of materials used on the project. For each product, suppliers are required to provide detailed data sheets including composition, origin, and environmental certifications. By analysing these documents, I verified compliance with Swedish and European regulations and ensured that materials respected sustainability and safety standards. This process was part of the company's effort to reduce its environmental footprint while maintaining high construction quality.

Presentation of the mission course

The main goal of my internship was to assist the site manager with all his tasks related to the follow-up and coordination of a major construction project. The missions assigned to me were varied and required a wide range of technical and organizational skills.
During the first weeks of my internship, I was tasked with reading contracts, studying detailed plans, reviewing schedules, and analysing project documentation in order to gain a complete understanding of the project from both a technical and economic perspective. Starting from my second week, I was given the responsibility of monitoring the weekly progress of the tunnel works. Every Monday morning, I went down into the tunnel to record the sections completed by our employees during the previous week. Using this data, I carried out calculations in various Excel files to determine the pace of work and assess whether it matched our planned timelines.
To make the progress more visual and accessible, I created updated tunnel maps gathering all the different ongoing tasks. These documents were compiled into a weekly report, which I prepared and presented during the weekly production meeting. This meeting held every Tuesday with all office staff (including foremen, project engineers, and the head site engineer), gave me the opportunity to present my maps and detailed data files, as well as to send the finalized report to our clients.

During my internship, I was responsible for managing the materials on site. My main task was to carry out a complete inventory of all the material stocks stored inside the tunnel. These materials were distributed across three different storage areas, which I organised in such a way that each area contained a bit of everything. This ensured that, even if one storage area had to be closed for a few days, the teams could still access the essential materials without interrupting the work.
To stay organised, I created a detailed file listing all the available materials, including the number of pieces for each item. I also monitored the pace at which the materials were being used in order to estimate future needs. This allowed me to calculate both the quantities required and the frequency of orders, ensuring that stock levels remained sufficient and that the site could run smoothly without delays.

In addition to my monitoring and reporting duties, I was assigned to deliver various documents and analyses to my manager. This included negotiating with different suppliers to obtain the most competitive prices, comparing their offers, and evaluating the capacities of different machines that could be purchased for the project. I also prepared files detailing the cost of each on-site activity, with the aim of establishing a precise project budget. This analysis helped identify which activities were the most cost-effective and where additional workforce allocation could improve efficiency and reduce expenses.

In June, our client Trafikverket launched a call for tenders for works in the main tunnel. This represented a strategic opportunity for Kreate to significantly expand the scope of its main project and further strengthen its position in the market. To prepare our offer, I accompanied the CEO of Kreate on a site inspection of the main tunnel. During the visit, I carefully noted all the works required in order to determine a realistic and competitive price proposal for Trafikverket. Following this, I created a detailed map aligning each identified element with the corresponding sections of the tunnel.

Another important part of my responsibilities was to manage and register work protocols in our database. A protocol is a daily report filled in by employees, indicating the tasks performed, the quantities installed, and any issues encountered. Initially, these protocols were managed on paper and later transcribed into Excel. However, I was tasked with implementing a digital system to replace the paper version entirely. After completing a training session on the new application, I created the online equivalents of our existing protocols using the available tools. Several rounds of corrections were required to fix bugs and optimize usability. Once finalized, the HR department sent an email to all site workers, after which I personally visited the tunnel to assist employees with registration and provide training on how to use the digital protocols. Within two weeks, the system was fully operational, and it has since allowed us to save significant time and improve data accuracy.

An important secondary aspect of my internship was ensuring safety on site, both in the tunnel and within the office premises. Upon my arrival, I attended a mandatory safety introduction covering potential risks associated with tunnel work and the appropriate behaviour to adopt in case of emergency. This was followed by an online quiz assessing knowledge of safety rules and best practices. Successfully passing this test granted me a safety certificate, which is a prerequisite for working on the construction site. All employees, whether working underground or in administrative roles, are required to undergo this training and certification. Part of my responsibilities included booking safety introduction sessions for new employees to ensure they were properly informed and compliant with safety regulations. In addition, whenever I was working in the tunnel, I had to monitor activities to ensure that no unsafe behaviours were taking place.
Every Wednesday, I participated in a “safety round” alongside the client’s chief of safety and our foremen. This consisted of walking through the tunnel to verify compliance with safety rules and discussing possible improvements in site safety. These rounds also provided an opportunity to exchange information about the project’s progress and to coordinate efforts between different teams.
Furthermore, we request detailed data sheets from all our suppliers for every material we purchase. These documents provide essential information such as composition, origin, production methods, and environmental certifications. By analysing these data sheets, we can assess the environmental footprint of each product, including its recyclability, potential emissions, and compliance with safety and sustainability standards. This process ensures that the materials used in the project respect not only the Swedish environmental regulations but also broader European and international norms. It is part of our commitment to responsible construction practices, aiming to minimize ecological impact while maintaining high technical and quality standards.

Résumé en français des missions

Au cours de mon stage, j'ai assisté mon chef de chantier dans le suivi et la coordination du projet, ce qui m'a permis de participer à des missions variées, à la fois techniques, organisationnelles et économiques.

Dans un premier temps, j'ai étudié les contrats, les plans, les plannings et la documentation du projet afin d'acquérir une compréhension globale, tant sur le plan technique que financier.

Dès la deuxième semaine, j'ai pris en charge le suivi hebdomadaire de l'avancement des travaux dans le tunnel. Chaque lundi, je descendais sur le chantier pour constater les sections réalisées, puis je mettais à jour des fichiers Excel afin de calculer le rythme de production et de le comparer aux prévisions. Pour rendre ces informations plus accessibles, j'ai également élaboré des cartes du tunnel et rédigé un rapport hebdomadaire, présenté en réunion de production et transmis au client.

J'ai aussi eu la responsabilité de gérer les stocks de matériaux. J'ai effectué un inventaire complet, réparti sur trois zones de stockage que j'ai organisées pour garantir un accès permanent aux fournitures essentielles. J'ai créé un fichier de suivi recensant les quantités disponibles, le rythme de consommation et les besoins futurs, ce qui a permis d'anticiper les commandes et d'éviter toute rupture de stock.

En parallèle, j'ai participé à plusieurs analyses économiques et techniques, comme la comparaison et la négociation avec les fournisseurs, l'évaluation de machines à acquérir, et le calcul des coûts d'activités sur le chantier afin d'identifier les postes les plus rentables et les gains possibles en efficacité.

En juin, j'ai contribué à la préparation d'un appel d'offres lancé par Trafikverket pour les travaux dans le tunnel principal. J'ai accompagné le directeur général lors d'une visite de site, recensé les travaux nécessaires et réalisé une carte détaillée, afin d'établir une proposition réaliste et compétitive.

Une autre mission importante concernait la digitalisation des protocoles de chantier. Ces rapports quotidiens, d'abord remplis sur papier, ont été transformés en version numérique grâce à l'outil que j'ai mis en place. Après plusieurs tests et corrections, j'ai formé les ouvriers à son utilisation. Ce système, rapidement adopté, a permis de gagner du temps et d'améliorer la précision des données.

La sécurité a également occupé une place centrale dans mes missions. Après avoir suivi la formation obligatoire et obtenu ma certification, j'ai organisé les introductions sécurité pour les nouveaux arrivants, surveillé le respect des règles dans le tunnel et participé chaque semaine à une « ronde sécurité » en compagnie du responsable sécurité du client et des chefs d'équipe.

Enfin, j'ai contribué au suivi environnemental en analysant les fiches techniques des matériaux fournis (composition, origine, certifications). Cette démarche garantissait le respect des normes suédoises et européennes et s'inscrivait dans la volonté de limiter l'impact écologique du projet.

Presentation of mission deliverables

Throughout my internship, I was required to produce a wide range of deliverables such as weekly progress reports, tunnel advancement maps, stock management files, digital protocols, economic analyses, and supplier comparisons. These documents played a central role in supporting the site management and client communication, while also ensuring the smooth coordination of the construction works.
Nevertheless, these deliverables are not included in this internship report. The first reason is confidentiality: the Förbifart Stockholm project involves sensitive technical, financial, and contractual information that cannot be shared outside the company. The second reason is related to file size: the total volume of data produced exceeds 35 gigabytes, consisting of detailed technical drawings, Excel databases, Dalux files, and internal reports, which makes it impractical to attach them in full. A final limitation concerns the language: a significant part of the deliverables was written in Swedish, the working language on site, which would make them difficult to use or interpret in the context of this report.
For these reasons, I have chosen not to reproduce the original deliverables here. Instead, I provide in this report synthetic summaries and detailed descriptions of the tasks I carried out and the methods I applied. This approach allows the reader to understand both the nature and the scope of my work, while respecting the confidentiality, practicality, and linguistic constraints of the project.

Reflective feedback

During my 16-week internship at Kreate Sverige AB, I worked closely with a site manager on the Lovön underground construction, part of the Förbifart Stockholm project. My role involved a wide variety of tasks, from progress monitoring to supplier negotiations, as well as implementing new digital tools for site management. This experience gave me the opportunity to immerse myself in the operational reality of a large-scale infrastructure project.

To complete my assignments, I applied a structured approach combining data collection and analysis through the weekly tunnel inspections to monitor progress, measuring sections completed, and updating Excel tracking files. The use of digital tools, creating visual maps of the tunnel's progress, digitising paper-based work protocols into an application (Dalux), testing and optimising the system before deployment. And finally, Communication methods by preparing and presenting reports in weekly production meetings and liaising with suppliers to compare prices and negotiate purchase conditions.

The reports and visuals I produced improved the communication between the site team and our client, allowing for clearer discussions on progress and priorities. The digitalisation of protocols significantly reduced processing time and improved traceability. However, some delays occurred during the implementation phase due to technical issues, which impacted the speed at which the system could be fully operational.

To further optimise these processes, I believe it would be beneficial to provide a rapid training for workers and engineers in the use of the new tool to limit errors and therefore manual

corrections by engineers. Moreover, the database could be automated to avoid the double entry and then reduce the potential errors.

This internship confirmed my interest in project management within complex and constrained environments. I developed strong skills in planning, interdisciplinary communication, and process digitalisation, which I aim to apply in future positions as a works engineer or project manager in the infrastructure sector.

On a more personal point of view, my supervisor always encouraged me to think independently. He asked me to collect the necessary information, analyse it, and make my own decisions before presenting the results to him. This approach gave me the opportunity to develop my autonomy and problem-solving skills, while also learning to take responsibility for my work. Once I had prepared my files, he would then review them with me, providing constructive feedback to improve the quality of my output.
He also advised me to prepare my files and visuals as if I were trying to 'sell' them. In other words, I had to make them clear, attractive, and convincing, keeping in mind the reader's perspective. This pushed me to consider not only the technical accuracy of my work but also how it would be perceived and understood by others. By doing so, I learned to improve the efficiency and impact of my documents, ensuring they could be used effectively in discussions with both colleagues and clients.

Challenges faced and solutions found

Of course, I encountered some difficulties throughout this journey, since the project was focused on a very different field from what we studied in class, being much more related to civil engineering. I had to start almost from scratch, doing research, reading documentation, asking questions, and listening carefully to the advice I received. Step by step, I managed to adapt, and I even started to share knowledge with new colleagues.
Another challenge was the language barrier. Although I had learned some basic Swedish beforehand to communicate more effectively, I still had difficulties with the Estonian and Polish workers. To overcome this, I learned how to greet them in their own languages to create a connection, and then we communicated using simple English or sometimes translation tools. Later, we organised the teams so that at least one person in each group could communicate in English, which made things much easier.
By the end of June, during the national holiday called Midsommar, everyone went on leave for three days, and I was asked to handle the project on my own. Of course, my manager and colleagues were still reachable if needed, but I took it as a personal challenge: managing the workers and their potential problems, communicating with clients when required, doing the inventory, and checking the protocols. This was quite a stressful moment, but it was also when I learned the most, and I gained a lot of confidence from this experience. I was very thankful for the trust my manager placed in me.
Later, throughout the month of July, most of the office staff went on holidays again, which gave me more autonomy in managing the project. We were working with a reduced workforce in the office while the number of tunnel workers kept increasing. It was also during this period that we implemented the online protocols through Dalux. This phase was challenging, but production was going well and was even ahead of schedule. The application was finally

working properly, and I was praised by both my site manager and the company's CEO for my efforts.

Skills developed

Here is a summary table of the skills I believe I developed the most during this internship, based on the skills framework provided by Polytech.

C3 Manage a project	**C3.1 Organize the project (roles / tasks / objectives / budget / deadlines / risks)** **C3.2 Participate in, manage, animate the project team (stimulate innovation / methodology)** **C3.3 Write clear and readable communication materials** **C3.4 Communicate with all stakeholders, including in English** **C3.5 Manage project progress and risks (indicators)** **C3.7 Capitalize on the experiences acquired from a completed project (sustainability, quality approach, continuous improvement)**
TC.A Work in team	**A.1 Be part of the team** **A.2 Respect common codes and values** **A.3 Manage conflict situations** **A.4 Know how to evolve in an international work team**
TC.B Communicate	**B.1 Interact effectively with the various departments of the company** **B.2 Communicate for transmission purposes (project closure, training)** **B.3 Communicate in order to convince internal and external interlocutors B.4 Communicate easily both orally and in writing in French** **B.5 Communicate easily both orally and in writing in English**
TC.C Learn to learn	**C.1 Identify your skills development needs**
TC.D Adopt positive leadership practices	**D.1 Get involved in the proposed projects and activities** **D.2 Work independently** **D.3 Be proactive**
TC.E Take into account the dimension of Corporate Social Responsibility	**E.1 Integrate Occupational Health and Safety into the management of its activities and the conduct of its projects** **E.2 Integrating Social Responsibility into the management of its activities and the conduct of its projects E.3 Thinking about its practices in such a way as to avoid any form of discrimination or exclusion** **E.4 Participate in industrial and social changes**

Beyond the skills highlighted in the table, I also developed several other competencies throughout my internship.

I gained a solid understanding of tunnel construction methods, including bolting, shotcrete application, reinforcement, and waterproofing. I learned to read and interpret technical plans, cross-sections, and project documents, which allowed me to better understand how construction work is planned and executed. I also deepened my knowledge of construction materials, including steel, concrete, technical plastics, and membranes, and their specific properties. Moreover, I became familiar with safety and environmental standards, including regulations related to protected areas such as Natura 2000, and I acquired basic knowledge in quality management and compliance control of works.

I developed the ability to plan and monitor the progress of construction work, manage stock and materials (inventory management), and coordinate effectively with different trades and subcontractors. I learned to make quick decisions on site while considering time and budget constraints, which improved my efficiency and ability to respond to unexpected situations.

My internship allowed me to practice negotiation with suppliers to optimize costs and deadlines. I also learned to communicate clearly with a variety of stakeholders, including engineers, workers, clients, and authorities. Writing reports and presenting information in a clear and understandable way for non-specialists was another skill I developed, as well as the ability to argue a point and “sell” a project effectively.

I strengthened my autonomy and initiative, learned to manage stress while working under pressure, and became more adaptable to technical or organizational challenges. Finally, I developed a strong sense of rigor in following procedures and regulatory requirements, which is essential for safe and efficient tunnel construction.

Conclusion

This internship has been a decisive and enriching step in my academic and professional journey. Over the course of sixteen weeks, I was able to immerse myself in the reality of a large-scale infrastructure project, experiencing firsthand the challenges and responsibilities that come with it. Unlike the projects and workshops at Polytech, which are mainly focused on problem identification and the search for technical solutions, here I had the opportunity to confront the practical side: the execution, the follow-up, and the day-to-day management of operations. This complementarity between theory and practice gave real meaning to my studies and allowed me to put into perspective the role of an engineer in the field.

One of the most valuable lessons I learned was the importance of autonomy and initiative. My supervisor consistently encouraged me to think for myself, collect information, make decisions, and take responsibility for their outcomes. This trust pushed me to go further, to approach each task from the reader's or client's perspective, and to ensure that my reports, visuals, and presentations were not only technically accurate but also clear and convincing. This mindset will undoubtedly remain with me throughout my career.

I also realised that being an engineer is not limited to technical skills such as calculations, drawings, or construction methods. It also requires strong communication and negotiation abilities. On one side, I had to deal with suppliers, compare prices, and negotiate the best possible conditions. On the other side, I learned how essential it is to present and "sell" the project convincingly to clients and stakeholders, using arguments that highlight progress, justify choices, and build trust. These experiences showed me that the success of a project depends just as much on interpersonal and managerial skills as on technical expertise.
Another key aspect of this internship was the exposure to a highly demanding environment. Working on the Förbifart Stockholm project meant dealing with strict deadlines, complex logistics, and the constant risk that mistakes could lead to costly consequences. This context taught me to adapt quickly, to learn fast, and to make confident decisions under pressure. I also discovered the importance of teamwork in a multicultural environment, where communication and cooperation were essential to overcome language barriers and ensure smooth progress on site.

Beyond the technical and organisational skills I developed, such as understanding tunnel construction methods, managing inventories, or implementing digital tools. I also grew on a personal level. I learned to manage stress, to remain rigorous even under time pressure, and to approach each challenge as an opportunity to progress. I feel that this internship has not only improved my professional skills but also shaped my character, giving me more confidence in my ability to take responsibility and handle complex situations.

In conclusion, this experience has confirmed my motivation to pursue a career in engineering. It equipped me with concrete skills in both the technical and managerial aspects of the profession, strengthened my adaptability, and gave me a clearer vision of the responsibilities and expectations tied to the role of an engineer. Above all, it reassured me of my choice and gave me the determination to continue on this path, ready to take on future challenges with both confidence and ambition.

Glossary

Bolting: Bolting, or *boulonnage* in French, is the second stage of our project and involves inserting bolts approximately 1.50 meters long into the previously drilled holes. The 16 mm diameter bolts are placed at the locations designated for membrane bolts and vertical bolts. Meanwhile, 27 mm diameter bolts are installed on the *kulvert side*, and 30 mm diameter bolts are installed on the Berg side.

Membrane: The membrane is a large, strong, and waterproof plastic sheet. Its installation in the tunnel is intended to prevent and stop water leaks.

Tassar: *Tassar* is a Swedish word referring to the concrete structure on which the tunnel walls are placed. Since the walls are 3 meters wide, the tassar are spaced 3 meters apart.

Wall Elements: The prefabricated walls are concrete structures that serve as the tunnel's walls. These structures are 5 meters high and 3 meters wide. They are installed on the tassar on the Berg side and alongside the pedestrian path.
Kanalplast: Kanalplast is a Swedish term for a plastic sheet installed above the walls together with mineral wool. Its purpose is to protect the walls, and the area behind them, from shotcrete projections.

Reinforcement: Reinforcement consists of installing steel mesh on the tunnel ceiling, which works together with the shotcrete to distribute pressure forces and spread the load. It also improves the adhesion of the shotcrete, as the mesh serves as a support for the concrete to grip and hold the sprayed concrete in place.

Shotcrete: Shotcrete, or sprayed concrete, is a type of concrete or mortar applied at high speed onto a surface using a pressurised hose, generally with compressed air. Its advantage is that it adheres easily to almost any surface, even irregular or vertical ones, and can be applied quickly. This makes it ideal for temporary or permanent support work, particularly in tunnel construction.

Kulvert side: Kulvert side is a Swedish term referring to the side of the tunnel where the pedestrian corridor is located, between the prefabricated walls and the tunnel lining. This corridor is used by staff to carry out maintenance work. It is associated with 27 mm diameter bolts.

Rock side: Rock side, also called Berg side in Swedish, refers to the other side of the tunnel where the prefabricated walls are placed directly against the tunnel walls without any additional space. It is associated with 30 mm diameter bolts.

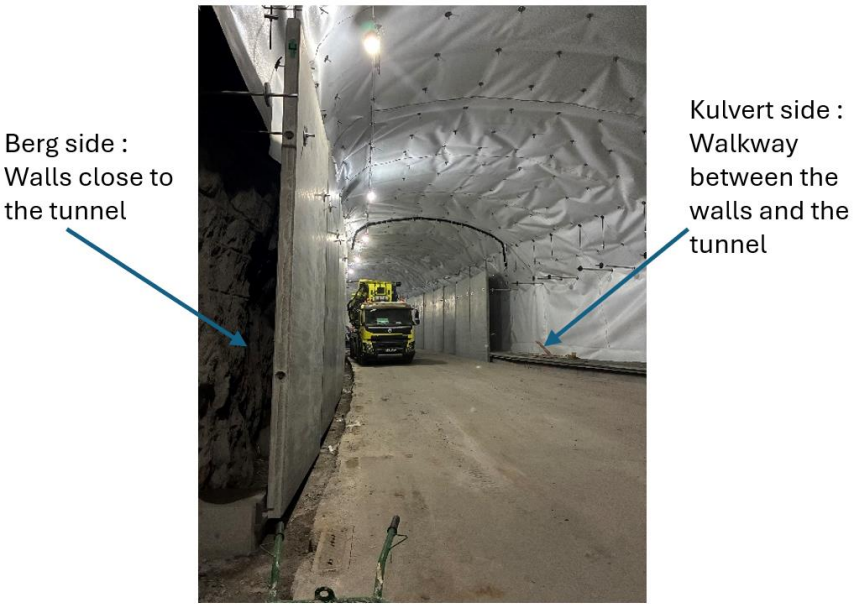


Figure 14: illustration of the tunnel sides Berg side and Kulvert side

Glossaire en Français

Bolting : Le Bolting ou Boulonnage en français, est la seconde étape de notre projet et consiste à insérer des vis d'environ 1,50 mètres dans les trous précédemment forés. Les bolts de 16 mm de diamètre sont placés aux emplacements prévus pour les membranes bolts et les verticales bolts. Tandis, les bolts de 27 mm de diamètre sont installés kulvert side et ceux de 30 mm de diamètre sont installés Berg side.

Membrane : La membrane désigne une large bâche de plastique résistante et imperméable. Son installation dans le tunnel vise à prévenir et empêcher les fuites d'eau.

Tassar : Tassar est un mot suédois désignant la structure de béton contre laquelle les murs sont posés. Les murs étant large de 3 mètres, les tassars sont donc espacés de 3 mètres.

Wall Elements : Les murs préfabriqués sont des structures de béton servant de murs au tunnel. Ces structures mesurent 5 mètres de haut pour 3 mètres de large. Ils sont installés sur les tassar en Berg side et contre le chemin piéton en

Kanalplast : Le Kanalplast est un mot suédois pour une plaque de plastique montée au-dessus des murs avec de la laine de roche. Leur but est de protéger les murs et ce qu'il y a derrière des projections de shotcrete.

Reinforcement : Le renforcement consiste à poser des mailles de fer au plafond du tunnel qui travaille avec le shotcrete pour repartir les forces de pression et aide à repartir cette charge. Il sert également à améliorer l'adhérence du shotcrete, les treillis servant de supports au béton pour l'accroche et la tenue du shotcrete.

Shotcrete : Shotcrete ou béton projeté est un béton ou un mortier que l'on projette à grande vitesse sur une surface à l'aide d'un tuyau sous pression, généralement avec de l'air comprimé. L'avantage du béton projeté est qu'il adhère facilement à presque toutes les surfaces, même irrégulières ou verticales, et qu'il peut être appliqué rapidement, ce qui le rend idéal pour des travaux de soutènement temporaire ou permanent, notamment en construction de tunnels.

Kulvert side : Le kulvert side est un mot suédois pour le côté du tunnel ou le couloir piéton est situé entre les murs préfabriqués et les parois du tunnel. Ce couloir sert aux employés pour réaliser des maintenances. Associé aux bolts de 27 mm de diamètre. (Voir Figure numéro 14 ci-dessus)

Rock side : Le Rock side aussi appelé Berg side en suédois désigne l'autre cote du tunnel ou les murs préfabriqués sont directement pose contre les murs sans espace supplémentaires. Associé aux bolts de 30 mm de diamètre. (Voir Figure numéro 14 ci-dessus)

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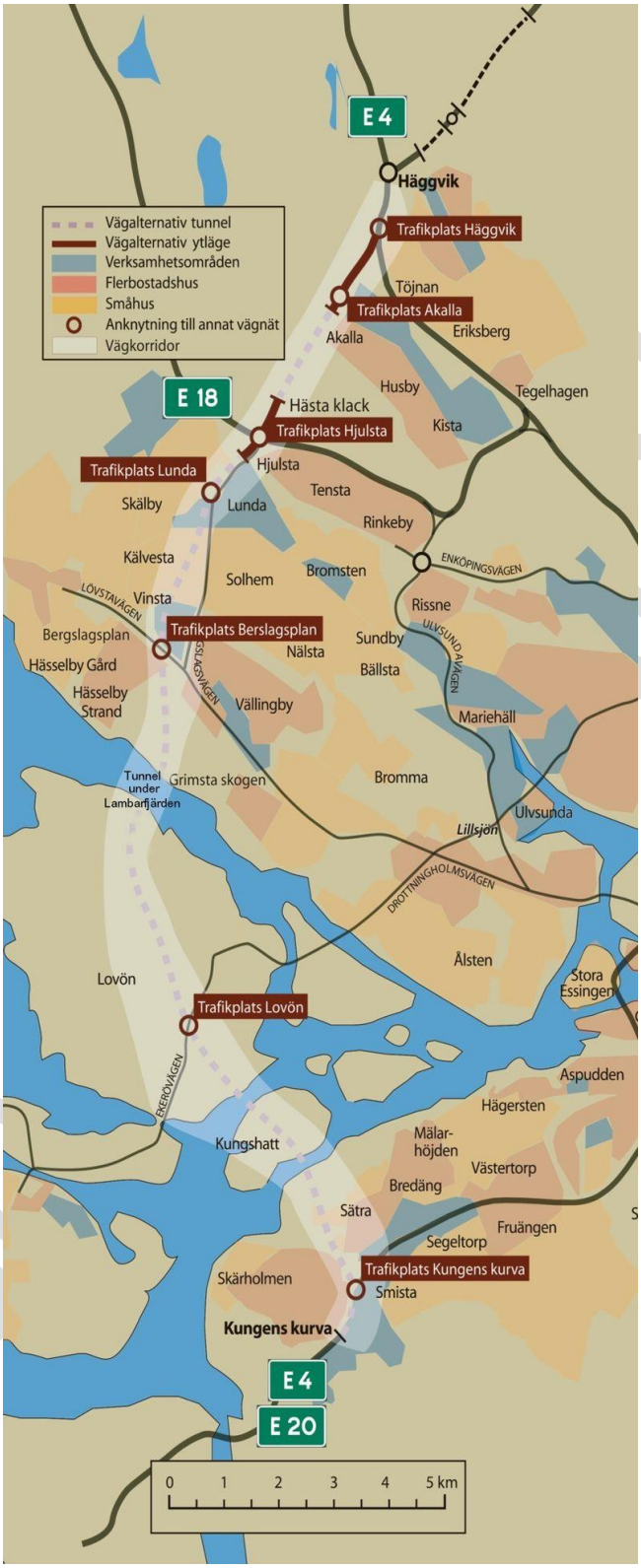
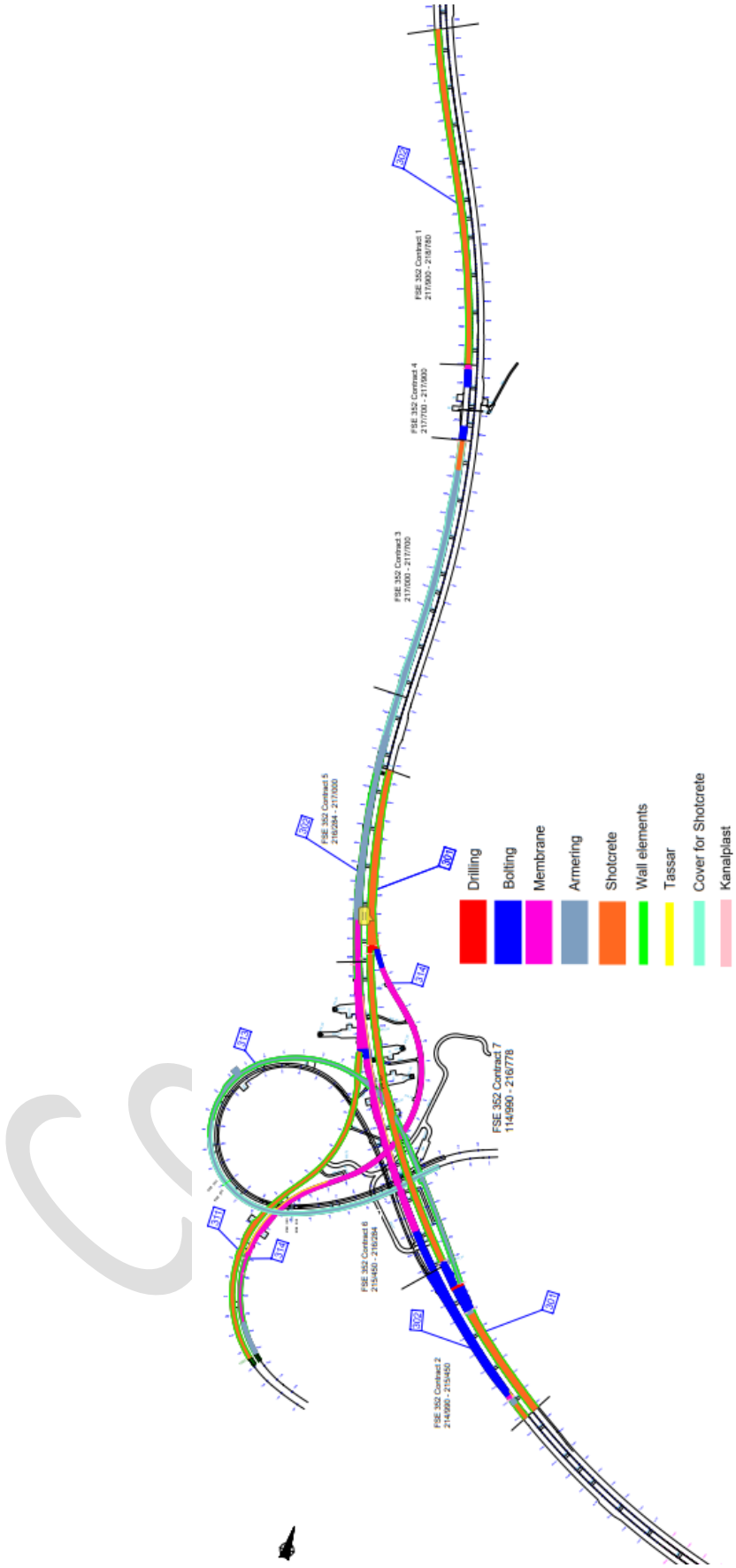
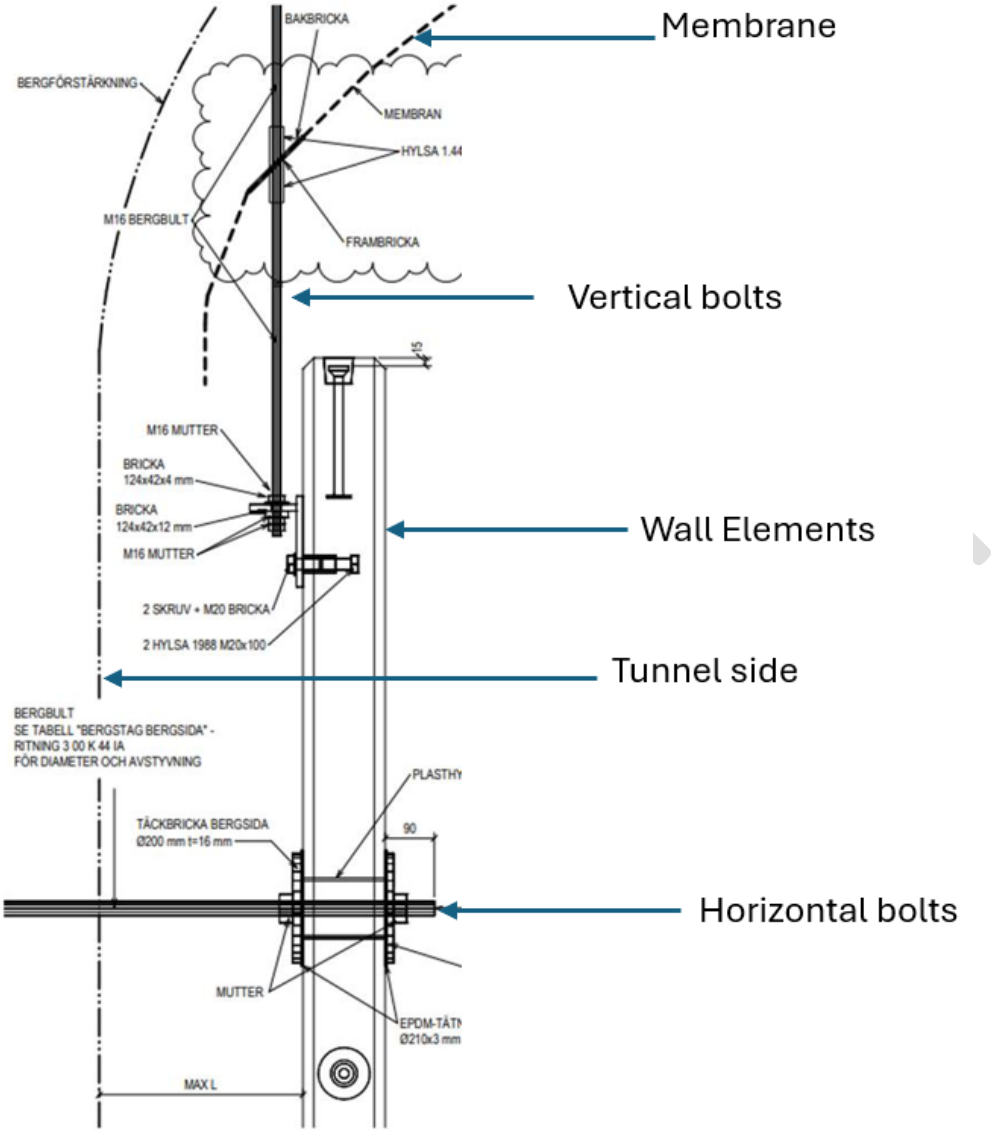
Annexes:



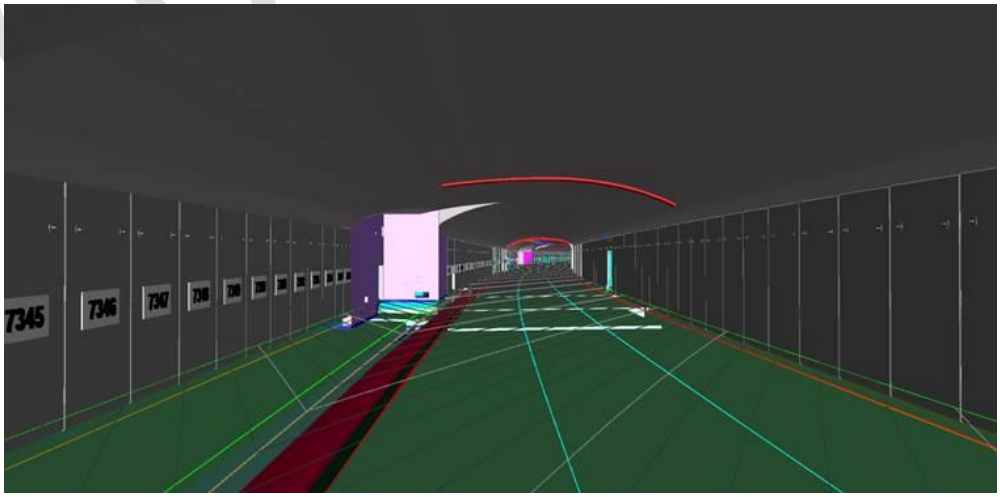
Annexe 1: Förbifart Stockholm (white area) according to a brochure from the Swedish Road Administration 2008 (full size)



Annexe 2: Map of the site representing the work in progress, realised by Valentin Roulaud (11/08/2025) (Full size)



Annexe 3: Scheme of membrane, wall elements and vertical and horizontal bolts position once installed (Based on a drawing provided by the clients)



Annexe 4: 3D model of the tunnel's insides

KREATE

Egenkontroll
FORMARBETE TASSAR

Projektnummer: ***31004***
Projektnamn: ***FSE350 Lovön***

ARBETSSTYRKA *Workforce*	TUNNEL *Tunnel*	SEKTION FRÅN *Section from*	SEKTION TILL *Section to*	DATUM *Date*	PROTOKOLL NR *Protocol no*

	JA / *Yes*	NEJ / *No*	st/ *pcs*
Gjord formarbete för tassar? *Tassar formwork done?*			
Armeringsjärn enligt ritningar 310K44NA, 300K44LF ? *Reinforcement according to drawings 310K44NA, 300K44LF?*			
Antal *Amount*			

FORMARBETE OPI

	JA / *Yes*	NEJ / *No*	meter/ *meter*
Gjord formarbete för OPI? *OPI formwork done?*			
Armeringsjärn enligt ritningar 300K9802 ? *Reinforcement according to drawings 300K9802?*			
Distans *Distance*			

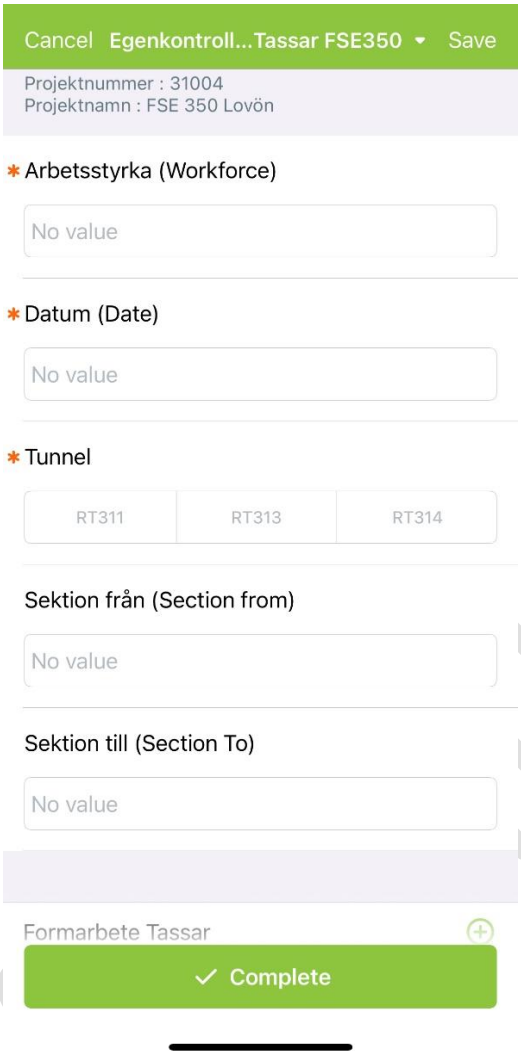
Kommentarer/Comments:

Arbetsledarens underskrift, datum / Foremans signature, date:

.....

www.kreate.fi/sv

Annexe 5: Example of protocols that the tunnel workers should fill, realised by Valentin Roulaud (26/06/2025) (Paper Version)



Annexe 6: Same protocol realised by Valentin Roulaud (17/07/2025) (Dalux Application Version)

POLYTECH TOURS
35 ALLÉE FERDINAND DE LESSEPS
37200 TOURS

Valentin Roulaud
2024-2025

Follow up on an underground road project
Field experience on Sweden's largest infrastructure project

Résumé : Lors de mon stage chez Kreate Sverige AB, j'ai participé à la gestion et au suivi du projet sur le site de Lovön, dans le cadre du Förbifart Stockholm. Mes missions incluaient l'inventaire et le calcul des besoins en matériaux, la préparation et le suivi des plannings, ainsi que la gestion des commandes et la négociation avec les fournisseurs. J'ai également assuré le suivi budgétaire, réalisé des inspections hebdomadaires sur le chantier et veillé au respect des règles de sécurité dans le tunnel et les zones de production. Enfin, j'ai contribué à la transition numérique des protocoles en mettant en place et en configurant l'application Dalux, tout en formant le personnel à son utilisation.

Mots Clés : Project follow up, Underground work, Rock engineering, Concrete Engineering, Sweden

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