



WTC2026 ITA-CET Training Course Participant Guide

May 15-16, 2026

École de technologie supérieure – Montréal, Quebec

Building the future - delivering tunnel projects for the next generation

Welcome!

It with great pleasure that we welcome you to the WTC2026 two-day training course, prepared by the Tunnelling Association of Canada (TAC) in partnership with the ITACET Foundation and the ITA-CET Committee. With the theme “Building the future – delivering tunnel projects for the next generation,” the program is designed to give participants the knowledge, context, and confidence to contribute meaningfully to the projects that will define the coming decades.

The 2026 program focuses on four critical areas shaping modern tunnelling:

- **Site investigation and geocharacterization:** understanding the ground is the starting point for every safe and successful tunnel. Sessions will explore investigation strategies, data interpretation, and how early decisions influence project outcomes.
- **Excavation and ground control methodology / selection:** from TBMs to conventional methods, participants will learn how excavation choices are made and how ground behaviour drives design and construction decisions.
- **Contracting and delivery methods:** with project delivery models evolving worldwide, this topic helps participants understand risk allocation, collaboration frameworks, and how procurement shapes technical outcomes.
- **Safety, sustainability, and innovation:** as the industry pushes toward lower-carbon solutions, safer worksites, and the use of Artificial Intelligence (AI), this module highlights emerging technologies and best practices that will define the next generation of projects.

What is ITA-CET?

The ITA Committee on Education and Training (ITA-CET) was created to address one of the tunnelling industry's biggest long-term needs: continuous, high-quality education. Since 2007, ITA-CET has worked to strengthen global training standards and expand access to expert-led learning opportunities. It collaborates closely with the ITACET Foundation, which supports and organizes training initiatives worldwide, connecting students and young professionals with more than 130 lecturers from academia and industry.

At its core, ITA-CET exists because tunnelling is a field where knowledge transfer truly matters. Every project is unique, every ground condition presents new challenges and every innovation requires engineers who understand both the fundamentals and the evolving state of practice. For those in the early stages of our careers, this kind of structured, high-quality education is not just helpful—it's essential.

Benefits of Attending

Tunnelling is no longer just about excavation and lining design. Today's engineers must navigate:

- Complex geotechnical uncertainty
- Rapid advances in mechanized excavation
- Growing expectations for sustainability and resilience
- New contracting and delivery models
- Increasingly interdisciplinary project teams
- Evolving role of tunnel and underground structures in modern cities

Formal education can provide a foundation, but industry-focused training helps practitioners bridge the gap between theory and practice. The two-day training course has been built specifically to do just that.

The benefits go far beyond the technical content:

- Clarity on career paths through exposure to different specialties
- Networking opportunities with peers, mentors, and future employers from around the globe
- Confidence in understanding the language and expectations of the industry
- A head start on the skills needed for complex, multidisciplinary projects

Most importantly, the course creates a sense of community. Whether you're a student, young professional, or a seasoned expert, you'll be joining a global network of people who are passionate about shaping the underground infrastructure of tomorrow.

Logistics

Venue: The course will be held at École de technologie supérieure (ETS) in Pavilion E (see map on next page). The street address is 1220 Notre-Dame Ouest.

Room: Both days will be held in the E-2033 theatre (signage will direct you in Pavilion E).

Transport: ETS can be accessed in several ways:

- **Parking:** Pavilion E has visitor parking spaces available (any time)
- **Public transit:** ÉTS is located close (about a five-minute walk) to the Bonaventure and Lucien-Lallier metro stations (orange line) and Montréal's Gare Centrale train station. Several buses (35, 36, 74, 75, 107, and 715) pass right in front of ÉTS.
- **Active transportation:** in addition to nearby BIXI stations, there are 124 outdoor bike racks available around ÉTS.
- **Walking:** you can also easily walk through the underground network to arrive at ETS. Simply look for signage directing you towards Pavilion E.

Registration: all participants are invited to register at the course venue (E-2033 theatre).

Please bring a valid ID and confirmation of your registration for verification purposes.

Registration will be open at the following times:

- **Thursday May 14:** 2 pm to 6 pm
- **Friday May 15:** 8 am to 9 am

Arrival time: we recommend arriving at no later than 8 am on each day to enjoy breakfast and complete your registration if you are unable to come on May 14.

Food: participants will be provided with all meals throughout the day at the course venue. This will include the following on both days (May 15 and 16):

- **Breakfast:** 8 am to 9 am
- **Coffee breaks:** 10:45 am to 11 am, and 3 pm to 3:15 pm
- **Lunch:** 12:30 pm to 1:30 pm

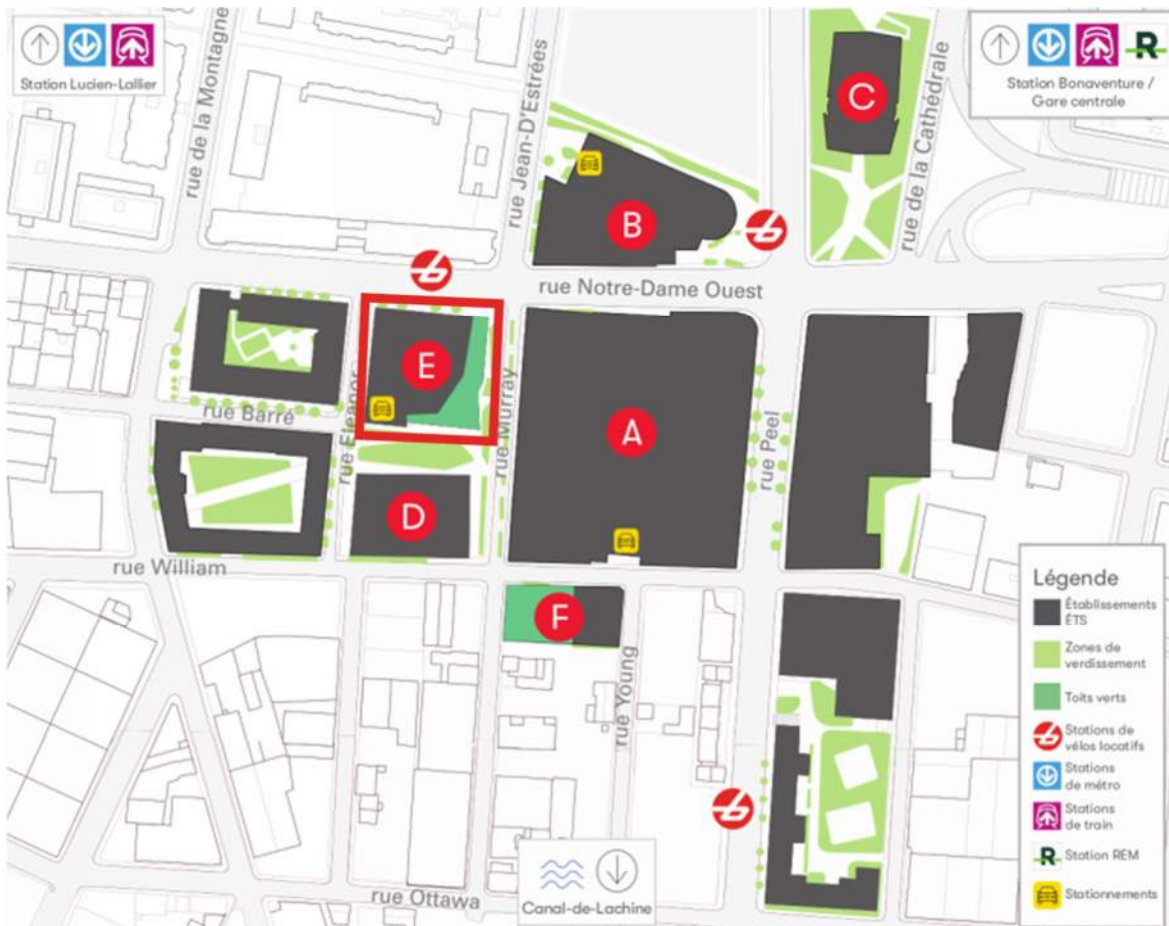
Networking Event: at the end of the first day (May 15), there will be a networking event held including food and drinks. This event is sponsored by Mott MacDonald and the Lovat Foundation. All participants and speakers are invited to this event to stay, chat, and socialize with one another!

Wi-fi: free Wi-Fi will be available for all attendees throughout the short course.

Photo: École de technologie supérieure (ETS)



Map: Pavilion E location (red box) – 1220 Notre-Dame Ouest



Industry Sponsors



Mott MacDonald is a global planning, engineering, management and development consultancy working globally. We are regularly cited as one of North America's most prominent tunnel specialist firms, having managed the design and construction phases of some of the most complex infrastructure projects in the region, and around the world, using ingenuity to create lasting value for our clients, project partners, and communities.

Our extensive experience with diverse and technically challenging tunnelling assignments enables us to bring innovative technical solutions, practical knowledge, and valuable lessons learned to both design and construction management roles. We are committed to providing responsive, effective, and cost-efficient service, and have established a reputation for identifying and mitigating risks. Our collaborative approach emphasizes working closely with clients to deliver projects within budget and schedule, while meeting the highest standards of quality.

We have a long history of working in Canada, both as Mott MacDonald (since the 1950s) and as Hatch Mott MacDonald (since the mid-1990s). In 2016, we began operating independently in North America as Mott MacDonald, continuing our reputation as a fully integrated engineering consultant with expertise in studies, planning, design, and construction, project, and program management for tunnels, highways and bridges, rail and transit, and ports and harbour projects.



Lovat Tunnelling Solutions Inc. is an expert in the design, manufacture, application, and operation of Tunnel Boring Machines (TBMs). Renowned for creative problem solving, Lovat Tunnelling Solutions Inc. develops innovative, and practical solutions to complex technical and commercial challenges within the tunnelling industry.

With extensive international experience, Lovat Tunnelling Solutions Inc. brings a strong global perspective to underground infrastructure projects and has consistently builds trust and confidence with colleagues, clients, and teams worldwide. Backed by more than 40 years of international tunnelling expertise, Lovat Tunnelling Solutions Inc. has a deep understanding of global infrastructure demand and the growing use of underground space.

Committed to industry advancement, Lovat Tunnelling Solutions Inc. actively shares knowledge and promotes awareness of the benefits and opportunities offered by modern tunnelling technology.

Programme

Friday May 15, 2026

Item	Start	End	Description	Speaker
Breakfast / Registration / Welcome	8:00 AM	8:45 AM	Registration	-
	8:00 AM	9:00 AM	Breakfast for all attendees	-
	9:00 AM	9:15 AM	Welcome remarks	Connor Langford (Training Course Chair) and Robert Galler (Chair of the ITA-CET Committee)
Site Investigation / Geocharacterization	9:15 AM	10:00 AM	Planning site investigations for tunnel ground characterization and performance prediction	Nick Vlachopoulos (RMC)
	10:00 AM	10:45 AM	From ground to alignment: turning geo-characterization into reliable tunnel design	Giuseppe Gaspari (AECOM)
	10:45 AM	11:00 AM	Coffee Break	-
	11:00 AM	11:45 AM	A sequential, early-stage investigation strategy - focus on investigation needs for the design of underground structures over centennial timescales	Jad Zghondi (Andra)
	11:45 AM	12:30 PM	Panel Discussion: Geocharacterization for Geotechnical Baseline Reports	Randy Essex (Retired) and Brigitte Gagne (EXP)
Lunch	12:30 PM	1:30 PM	Lunch	-
Excavation and ground control methodology / selection	1:30 PM	2:15 PM	From ground investigation to method selection: evaluating mechanized tunnelling solutions	Laurence Delplace (Amberg)
	2:15 PM	3:00 PM	Tunnel design criteria - mechanisms and supports / ground control	Francois Martin and François Laigle (WSP)
	3:00 PM	3:15 PM	Coffee Break	-
	3:15 PM	4:00 PM	Practical lessons from project experience in selecting excavation methods and ground support for tunnels, shafts and caverns worldwide	Luis Pinillos Lorenzana (Mott MacDonald)
	4:00 PM	4:45 PM	Project Example: TBM, D&B, Roadheader - the Blue Line Experience	Patrick Chandonia and Xavier Lacourse-Dontigny (EBC)
Closing	4:45 PM	5:30 PM	Open Q&A with all Speakers	-
Networking Event	5:30 PM	7:30 PM	Networking Event (drinks and appetizers provided)	Mott MacDonald and Lovat Tunnelling Solutions (Industry Sponsors)

Saturday May 16, 2026

Item	Start	End	Description	Speaker
Breakfast / Registration / Welcome	8:00 AM	8:45 AM	Registration	-
	8:00 AM	9:00 AM	Breakfast for all attendees	-
	9:00 AM	9:15 AM	Welcome remarks	Jason Mann (Tunnelling Association of Canada)
Contracting / delivery methods	9:15 AM	10:00 AM	The delivery decision: how procurement models shape underground project outcomes	Andrés Marulanda (Chair of ITA Working Group 3)
	10:00 AM	10:45 AM	Risk informed decision making on large civil infrastructure projects	Connor Langford (Mott MacDonald)
	10:45 AM	11:00 AM	Coffee Break	-
	11:00 AM	11:45 AM	Contract Packaging & Delivery Approaches for VTA's BART Silicon Valley Phase II Extension Project	Ronak Naik and Sarah Wilson (VTA)
	11:45 AM	12:30 PM	Owner Panel: Driving success in project delivery	Will Close (Bechtel), Joe Gildner (Sound Transit), Sarah Wilson (VTA), Hamed Nejad (Gateway)
Lunch	12:30 PM	1:30 PM	Lunch	-
Safety, sustainability and innovation in tunnelling	1:30 PM	2:15 PM	Major rehabilitation of the Montreal Lafontaine Immersed Tube Highway Tunnel – implementation of innovative, resilient and sustainable solutions	Jean Habimana (Hatch)
	2:15 PM	3:00 PM	Sustainability and embodied carbon: opportunities and challenges	Ian Whitehead (ITA Working Group)
	3:00 PM	3:15 PM	Coffee Break	-
	3:15 PM	4:00 PM	Safety during tunnel design, construction and operations	Alastair Smith (Jacobs)
	4:00 PM	4:45 PM	Responsible Machine Learning for tunnelling and rock engineering: case studies, pitfalls, and best practice	Josephine Morgenroth (BGC) and Jonathan Aubertin (ETS)
Closing	4:45 PM	5:30 PM	Open Q&A with all Speakers	-
	5:30 PM	6:00 PM	Certificates available for pick up	-

Detailed Course Program – Friday May 15

Session 1 (9:15 am to 12:30 pm) – Site Investigation / Geocharacterization

Planning site investigations for tunnel ground characterization and performance prediction

Speaker: Dr. Nicholas Vlachopoulos (Geologos Inc. and RMC)

Description: This talk outlines the steps involved in planning site investigation programs for tunnelling projects with the goal of achieving reliable ground characterization and performance prediction. It walks through the process from defining project needs and uncertainty drivers to selecting investigation methods and structuring field and laboratory testing. Drawing on best practices, industry standards, and established guidelines, the presentation emphasizes the key outputs of a well-planned program, including ground models, design parameters, risk identification, and decision ready information that supports tunnel design, construction strategy, and performance management.



From ground to alignment: turning geo-characterization into reliable tunnel design

Speaker: Giuseppe Gaspari (Vice President, Tunnel Practice Growth Leader (Canada, USA, Latin America) AECOM; Chair, ITA-AITES Working Group 20 Global Challenges, Underground Solutions)

Description: This lecture bridges the critical gap between site investigation and practical tunnel design, focusing on how geo-characterization directly informs alignment selection, construction methodology, and risk management.



Drawing on global experience across major transportation and water infrastructure projects, the session explores how geological and geotechnical data evolve from early-stage studies into design decisions that impact cost, schedule, and constructability. Particular emphasis is placed on managing uncertainty, recognizing data limitations, interpreting variability, and translating findings into robust, defensible design approaches.

Through real project examples, the talk illustrates how multi-criteria analysis, risk-based frameworks, and iterative design processes are used to optimize tunnel alignments and construction strategies. It also highlights the role of Geotechnical Baseline Reports (GBRs), stakeholder coordination, and procurement models in shaping outcomes.

The session reflects current industry challenges, including increasing project complexity, urban constraints, and the need for resilient and sustainable infrastructure. Attendees will gain practical insights into best practices for integrating geo-data into decision-making, improving reliability in design, and reducing downstream construction risks.

This presentation is tailored for young professionals, owners, and engineers seeking to better connect subsurface understanding with successful project delivery in modern tunnelling.

A sequential, early-stage investigation strategy - focus on investigation needs for the design of underground structures over centennial timescales

Speaker: Jad Zghondi (Andra)

Description: Cigéo, is the French deep geological disposal facility for radioactive high-level and intermediate-level long-lived waste. Disposal structures, as well as connecting and operational drifts are designed to meet a range of safety and industrial performance criteria throughout the lifetime of the facility (up to a centennial timescales), incorporating specific requirements related to reversibility and retrievability. Cigéo is located at a mid-depth level (approximately 500 meters) within the Callovo-Oxfordian (COx) claystone formation. The COx offers highly favorable conditions for the containment of radioactive waste, characterized by a very low hydraulic conductivity, a low molecular diffusion, and a strong capacity for radionuclide retention.



Since the 1990s, a progressive approach, initially driven by safety guidance and later by both safety and design requirement, started with sample characterization, surface investigation, and the construction of an underground research laboratory. Starting 2006, the program has increasingly focused on technological and scientific demonstrations, following a step-by-step approach to address the various underground disposal components (drifts, seals, disposal cells, etc.). The talk will focus on the drift investigation program that supports Cigéo design, enabling it to closely reflect real conditions in terms of hydromechanical behaviour and construction feasibility, while meeting safety and design requirements.

Panel Discussion: Geocharacterization for Geotechnical Baseline Reports

Speakers: Randall J. Essex, PE, GE (R J Essex LLC) and Brigitte Gagné, géo., M.Sc. (EXP)

Description: Geotechnical Baseline Reports (GBRs) were developed to help avoid and resolve disputes associated with unanticipated subsurface conditions. Before the advent of GBRs in the late 1970s, Owners provided site characterization data reports to the bidders, and required them to make their own interpretations in developing their fixed-price bids. The data was usually an incomplete description of what would be encountered and where. Claims ensued and litigation spiraled. GBRs were developed to reduce/eliminate the rampant increase in costly and time-consuming legal battles.

The primary focus of a GBR is on project construction. “Baselines” are presented that describe: (1) physical properties relevant to construction processes; and (2) how the ground should be expected to behave for certain construction methods and methods. The GBR should seek to describe likely risks evident from sources other than the available data. The GBR is a Contract Document that is binding on both parties.

Design-related matters should be addressed in a separate document for information only.

The talk will address the most recent of three ASCE guideline publications on GBR preparation and application (2022) and recommendations on content, length, graphics, and who should be engaged during authorship. Good and bad lessons learned will be presented as well as case histories.



Session 2 (1:30 pm to 4 pm) – Excavation and ground control methodology / selection

From ground investigation to method selection: evaluating mechanized tunnelling solutions

Speaker: Laurence Delplace (CEO, Amberg Engineering GmbH)

Description: The selection of an appropriate excavation method is a key step in the planning of underground infrastructure. Today, engineers can rely on a wide range of mechanized tunnelling solutions, from small-diameter trenchless techniques such as Horizontal Directional Drilling (HDD) and microtunnelling to large-diameter Tunnel Boring Machines (TBMs). Each technology has its own field of application, advantages and limitations, and the decision process must carefully consider geological conditions, project constraints and construction risks.



This lecture presents a structured approach to evaluating mechanized tunnelling solutions, starting from the fundamental role of geological and geotechnical investigations. Ground conditions, groundwater regime, overburden, alignment geometry and environmental constraints all influence the feasibility and performance of different excavation methods.

Using TBM tunnelling as a central reference, the presentation highlights how the principles of mechanized excavation apply across different technologies, while also outlining the typical application ranges of HDD, microtunnelling and conventional tunnelling methods. Through selected project examples, the lecture illustrates how investigation results can be translated into informed engineering decisions and how uncertainties associated with underground construction can be effectively managed during the method selection process.

Tunnel design criteria - mechanisms and supports / ground control

Speakers: François Martin (WSP Canada) and François Laigle (Setec-terrasol)

Description: This presentation introduces the fundamental criteria for tunnelling design, emphasizing the interaction between ground and structure. It explains how excavation induces deformations and how support installation timing and sequence influences stress release, settlements and stability.



The presentation outlines different stability conditions depending on the ground's natural

capacity and the structural support system, distinguishing between hyperstatic, isostatic, and hypostatic behaviors. It then introduces the Limit States Approaches for tunnels, dividing criteria into Serviceability Limit States (SLS) - with displacements and deformations - and Ultimate Limit States (ULS) - focused on global stability and failure mechanisms.

ULS concepts are presented for both soils and rocks, covering classical classifications, typical failure modes, and corresponding support principles such as shotcrete, bolts, steel sets, face support, pre-support and ground improvement.

Finally, the presentation contrasts local and global design approaches, showing how support interacts with the rock mass to control convergence, maintain stability, and prevent both localized block falls and global collapses.

Practical lessons from project experience in selecting excavation methods and ground support for tunnels, shafts and caverns worldwide

Speaker: Luis M Pinillos Lorenzana (Mott MacDonald and AETOS board member)

Description: This lecture presents practical lessons drawn from project experience in the selection of excavation methods, ground control approaches and support systems for tunnels, shafts and caverns in a range of geological and project settings worldwide. It will show how methodology selection is influenced by the interaction between ground conditions, geology, groundwater, environmental constraints, project purpose, geometry, constructability and site context.

Using a consistent comparison framework, the talk will explain how different projects balanced design requirements and construction constraints to arrive at safe, efficient and buildable solutions. The examples will cover a range of excavation approaches, including TBMs, drill and blast, raiseboring, VSMs, shafts and cavern excavation methods, highlighting the reasoning behind each choice.



The lecture will also briefly present the achieved outcomes and indicative average production rates from the examples shown, so that the audience can relate methodology selection not only to technical suitability, but also to delivery performance. The overall aim is to provide a clear and practical way of thinking that helps engineers make better-informed decisions when selecting excavation and ground support strategies for underground works.

Project Example: TBM, D&B, Roadheader - the Blue Line Experience

Speakers: Patrick Chandonia, ing., M. Sc. (Project Director, EBC)

Description: Mobilité Bleue Horizon (MBH), the consortium awarded the main contract for the extension of Montréal's Blue Line, is responsible for delivering the tunnel and underground works of this major urban transit expansion.



Designed to integrate seamlessly into densely built neighborhoods, the Blue Line Project (PLB) traverses highly developed areas and seeks to harmonize with the communities it serves. This approach is reflected in its commitment to meeting the expectations of citizens and users, while striving to foster a healthy coexistence with surrounding communities.

To support these objectives, Mobilité Bleue Horizon, a partnership between EBC, Pomerleau, and Spie Batignolles, has adopted a range of excavation methods selected according to geological conditions, location, and environmental constraints. Drill and Blast is employed in confined areas where flexibility and cost efficiency are critical, although it requires careful vibration control. The Rocksplitter method is used in sensitive urban zones to minimize noise and disturbance. Roadheaders are applied in areas with variable geometries, enabling continuous excavation with reduced vibration. For long, uniform tunnel sections, a 9.7 m diameter Tunnel Boring Machine (TBM) provides a highly efficient solution.

Detailed Course Program – Saturday May 16

Session 3 (9:15 am to 12:30 pm) – Contracting / delivery methods

The delivery decision: how procurement models shape underground project outcomes

Speaker: Dr. Andrés Marulanda E. (Managing Director INGETEC, Animateur ITA WG 3- Contractual Practices)

Description: This presentation explains how procurement and delivery models critically shape the outcomes of underground infrastructure projects, particularly tunnels, where uncertainty and risk are inherently high. It emphasizes that no single procurement model fits all situations, and that selecting the appropriate strategy must be based on project-specific factors such as risk profile, market conditions, stakeholder capabilities, and financing constraints.

A central theme is the importance of risk allocation, especially regarding subsurface (geotechnical) conditions—the primary source of uncertainty in tunneling. The presentation argues that risks should be assigned to the party best able to manage them, noting that improper allocation leads to disputes, cost overruns, and delays. It highlights that owners should retain ground-related risks, while contractors should manage performance-related risks.

The document reviews traditional and alternative delivery models, including Design-Bid-Build and Design-Build, and introduces modern approaches such as collaborative contracting and the FIDIC Emerald Book, specifically developed for underground works. Key tools like Geotechnical Baseline Reports (GBRs) are presented as essential for defining risk, enabling fair compensation mechanisms, and improving project predictability.

Ultimately, the presentation advocates for flexible, well-structured contracts, aligned with procurement strategy, to manage uncertainty effectively, enhance collaboration, and improve project success.



Risk informed decision making on large civil infrastructure projects

Speaker: Dr. Connor Langford, P.Eng. (Earth Structures Group Lead, Mott MacDonald)

Description: Over the last few decades, structured approaches to risk management have become more commonplace for large civil infrastructure projects. This transition has been shepherded by advancements in risk tools that make them more approachable/easier to use (such as Monte Carlo simulations) as well as a general improvement in knowledge surrounding the benefits of risk management to the industry. As a result of this, many owners have formally incorporated risk management into approval processes, whereby a project cannot move to the next stage of design until a certain threshold of risk understanding is demonstrated.



These changes have been incredibly beneficial for project planning, particularly in the era of “mega projects” where a reliable project estimate is the bottom line against which both stakeholder and public trust is measured. As the use of risk tools continues to grow in the industry, it is worth pausing and remembering why we started down this road in the first place. It was not to develop bigger and more complex risk registers, or fancier Monte Carlo simulation results, but rather so project teams can gain a better understanding of threats and opportunities in order to make informed decisions to improve project outcomes.

This talk will provide an overview of how we develop and apply a risk management approach, including a summary of key tools that can be used at various stages of a project to drive decision making. This will be illustrated using several case studies in Canada and the United States.

Contract Packaging & Delivery Approaches for VTA’s BART Silicon Valley Phase II Extension Project

Speakers: Sarah Wilson (Construction Director, Santa Clara VTA, BART Silicon Valley Program) and Sonak Naik (Capital Project Coordinator, Santa Clara VTA, BART Silicon Valley Program)

Description: Santa Clara Valley Transportation Authority (VTA) is extending Bay Area Rapid Transit (BART) heavy rail service through downtown San José, CA through delivery of VTA’s BART Silicon Valley Phase II Extension (BSVII) Project. Presenters will provide an overview of this megaproject



including technical background, current efforts underway, and approaches the owner has taken on contract packaging and delivery methods. This will

include an inside look at the BSVII Project's tunnel Contract Package, one of the most complex urban tunneling efforts delivered through a Progressive Design-Build (PDB) model. Attendees will explore how the owner navigated different stages of this Contract Package including the initial Stage 1 phase through design development and the commercial negotiation process along with authorization of early construction work to maintain project schedule. In addition, VTA will provide insight on considerations for other delivery models currently being evaluated for other project scope including heavy civil construction, stations, any systems work.



Owner Panel: Driving success in project delivery

Speakers: Joseph Gildner (Chief Engineer, Sound Transit), Hamed S Nejad, P.E. (Chief Engineer, Gateway Development Commission), Will Close (Bechtel), and Sarah Wilson (Construction Director, Santa Clara VTA)

Description: This session brings together a distinguished panel of owners and executive leaders behind North America's most complex and high-stakes infrastructure projects. As the industry shifts away from traditional contracting methods, these experts will delve into the practical realities of Collaborative Delivery Models.

Panelists represent both owner and contractor perspectives and will provide a "behind-the-scenes" look at the planning and implementation phases of multi-billion dollar developments. The discussion will move beyond theoretical benefits to examine the specific cultural and structural shifts required to align teams toward a common goal.



Session 4 (1:30 pm to 4 pm) – Safety, sustainability and innovation in tunnelling

Major rehabilitation of the Montreal Lafontaine Immersed Tube Highway Tunnel – implementation of innovative, resilient and sustainable solutions

Speaker: Jean Habimana, PhD, PEng (Global Director of Tunnelling – Hatch)



Description: The La Fontaine Tunnel in Montreal, Quebec is currently undergoing major structural rehabilitation work and systems upgrade work to comply with current codes, standards and best practices in fire life safety and to extend its lifespan of this 55-year-old immersed tube tunnel for at least another 40 years. The tunnel, which was primarily built using prefabricated sections, was inaugurated on March 11, 1967. To this day, it remains one of the largest prestressed concrete structures in the world.

The paper discusses design consideration of ongoing works that include structural analyses to evaluate repair strategies for the post-tensioned reinforced caissons, the scheme to repair two leaky joints between caissons, the design of passive fire protection that involved in situ and real scale laboratory tests, and other tunnel systems upgrades.

The presentation will showcase a series of pioneering tests that were carried out in situ and laboratory as well as cutting-edge tools and technologies that were used to come up with innovative solutions that are being successfully implemented to give this critical infrastructure a new life and modernize its operation while improving passenger comfort.

Sustainability and embodied carbon: opportunities and challenges

Speaker: Ian Whitehead (Decarbonizing Tunnels Lead – North America, Mott MacDonald)



Description: This talk will cover a range of sustainability considerations that apply to tunnelling projects, including when to consider sustainability, the use of sustainability rating systems, how to assess and reduce the embodied carbon associated with tunnel construction, and beneficial reuse of tunnel muck.

Sustainability rating systems, such as Envision, are a useful tool to help project teams improve the sustainability of projects across a wide range of criteria. The instructor will share his experience as an Envision Sustainability

Professional. This includes using Envision at the early stages of projects to identify sustainability opportunities, and preparing documentation for the verification process once the design is complete.

Underground construction projects typically use large quantities of concrete, steel and fuel. These all contribute to the upfront carbon emissions or embodied carbon of the project. However, because the quantities are large, the opportunity to reduce them is also. This talk will cover the basics of how to calculate embodied carbon, then address some of the tunnel specific considerations like annular grouting and ground treatment, providing practical opportunities to reduce carbon emissions.

Links to a range of useful resources will be provided to enable participants to consider sustainability in their projects or in academic study.

Safety during tunnel design, construction and operations

Speaker: Alastair Smith BSc CEng MICE (Chief Engineer Tunnelling Europe, Jacobs)

Description: This lecture examines the evolution of safety in design and construction in the tunnelling industry with a look at how over the past 40 years regulation, risk management, cultural and behavioural changes have led to an order of magnitude improvement in the Tunnel Industry Safety Record.



Over this period tunnelling has gone from an acceptance of high risk high accidents as almost inevitable, with one of the worst safety records within the construction sector; to a Zero Harm driven approach achieving better safety outcomes than many other construction sectors. The current best practice of the tunnel industry approach is illustrated with the implementation of de5ign, “five in design” approach developed by Jacobs and applied on the C1-Align Contract on the HS2 project in the UK. De5ign combines emerging best practice from adherence to global HSE in Design legislation, with guidance from academic research, the United Nations, the World Health Organization and the International Labour Organization, into a behavioural HSE in Design Management framework.

Responsible Machine Learning for tunnelling and rock engineering: case studies, pitfalls, and best practice

Speakers: Dr. Jonathan Aubertin (Professor at École de technologie supérieure), Dr. Josephine Morgenroth (Senior Geotechnical Engineer at BGC Engineering)

Description: Machine learning is increasingly finding its way into tunnelling and underground rock engineering, yet the difference between success and disappointment often comes down to how the work is framed and how the data is handled. This talk explores what responsible ML practice looks like in a field where data can be sparse, noisy or unevenly distributed, and where engineering judgement remains essential.

We will provide a brief orientation to machine learning and how it differs from other forms of artificial intelligence, setting realistic expectations for what these tools can and cannot do in tunnelling applications. A series of case studies will be used to illustrate how ML has been used to support underground design and analysis, highlighting situations where the method added clarity and others where limitations in the data reduced its value. These examples provide a grounded view of the practical challenges engineers face when applying ML to complex projects. We will also present lessons learned from ML projects in tunnelling and underground rock engineering. The focus will be on assessing data quality, understanding the consequences of insufficient or overly noisy datasets, selecting appropriate data splitting strategies, and knowing when expert help is required. Throughout, the message is consistent: ML can be powerful, but only when its results are interpreted through sound engineering judgement.

