

World class tunnel solutions

Comprehensive and innovative services for
underground works

RAMBOLL

Bright ideas.
Sustainable change.



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Creating sustainable connections

Ramboll has 50 years of experience bringing innovative Major Projects to life, such as the iconic Øresund Fixed Link and the upcoming Fehmarnbelt Link—set to become the world's longest combined road and rail immersed tunnel. As a leading engineering, design, and consultancy company, we focus on sustainable solutions across sectors, including tunnel projects worldwide.

Our complete service includes design, engineering, environmental, sustainability, and project and cost management, with specialist services such as lighting, ventilation, fire safety, and M&E engineering. We integrate environmental, social, and economic considerations to ensure sustainable tunnel development.

Owned by the Ramboll Foundation, we are guided by a long-term, independent focus to address climate change, resource scarcity, and inequality. We support clients in building sustainable business models by combining technical expertise with innovation and digital capabilities.

Our global tunnel work emphasises resilient design, climate adaptation, low-carbon materials, lifecycle assessments, and biodiversity protection. We collaborate with stakeholders to ensure integration with surrounding infrastructure, while engaging communities to create local benefits and positive social impact.

Our involvement in tunnel projects globally focuses on several key sustainable initiatives:

- Emphasising resilient design principles to reduce environmental impact, optimizing tunnel layouts and alignments, and enhancing energy efficiency.
- Incorporating climate change considerations, especially in areas prone to natural hazards.
- Using eco-friendly and recyclable materials to reduce the carbon footprint.
- Considering the entire lifecycle of tunnel projects, conducting lifecycle assessments to evaluate environmental impact and carbon emissions.
- Taking a holistic approach, collaborating with stakeholders and urban planners for seamless integration into surrounding infrastructure.
- Mitigating impacts on natural environments and preserving biodiversity through sustainable construction practices and ecological mitigation measures.

- Engaging with local communities and prioritising social impact assessments to contribute positively to the local economy, create employment opportunities, and enhance social well-being.
- Through continued learning, development, and collaboration, we proudly offer the latest sustainable solutions in our tunnel projects

About Ramboll

Ramboll is a global architecture, engineering, and consultancy company founded in Denmark in 1945. With more than 18,000 experts, we deliver expertise and sustainable solutions across sectors including Buildings, Transport, Energy, Environment & Health, Water, Management Consulting, and Architecture & Landscape.

Operating in 35 countries, Ramboll combines deep local insight with a global knowledge base to create sustainable societies and drive positive change for our clients. We call it: Bright Ideas. Sustainable change. Our experts help drive sustainable impact through standalone and multidisciplinary solutions.

As The Partner for Sustainable Change, we enable stakeholders to realise their goals and navigate the transition to a more sustainable future. We leverage our expertise, innovation, and creativity to address the risks and opportunities of sustainable change. By integrating technical expertise, domain knowledge, and digital capabilities, we support clients in driving improvement and developing sustainable business models.

Ramboll participates in the UN Global Compact and aligns with the Paris Agreement through climate targets approved by the Science Based Targets initiative. We continually strive to achieve solutions that make a genuine difference to our clients, end-users, and society at large.

www.amboll.com

Comprehensive tunnel engineering expertise

We provide professional consultancy services within tunnelling and underground works – from major international transport infrastructure for road and rail to small diameter microtunneling works. We bring together tunnel experts with our specialists across all disciplines to deliver fully integrated solutions.

Ramboll's tunnel engineers work on all types of projects, with all levels of complexity. We work on micro to macro-scale projects worldwide.

Grown from our strength in immersed tunnel design on projects such as the Øresund Crossing between Denmark and Sweden over 20 years ago, our tunnel team has developed and delivered all types of tunnels globally, within a wide variety of ground conditions.

Our significant involvement with immersed tunnels from cradle to the grave means that we don't only understand the design and construction of road and rail tunnels, but that we are at the forefront of developing tunnel safety strategies, and risk management of underground spaces.

Throughout the years, our team has grown in size and in skill set and now we also lead design work in sprayed concrete, segment design, hard-rock excavation, micro-tunnelling as well as more traditional cut and cover tunnel works.

Our project portfolio ranges from preconception phases, right through the design and construction, but also historical renovation and remediation. We understand what the design-life of our tunnels means.

While design and construction support is our mainstay, the type of consultancy advice we offer extends far beyond this.

Our understanding of the behaviour of various tunnel structural systems, and their interaction with the surrounding soils or rock means that we can advise on a wide variety of projects to help ensure technical approvals are in place.

Our clients range from public sector to bespoke private clients and construction companies at either end of the project scale.

We bring to all our clients global tunnel expertise tailored to local projects, ensuring a bespoke approach to client requirements, geological nuances, and the often-unique local stakeholders.

3800

The number of Ramboll transport and infrastructure specialists worldwide



Image: Øresund Fixed Link from the air

Immersed tunnels

Ramboll possesses the knowledge and experience within all relevant technical fields related to immersed tunnels, for all stages from the early studies and planning to the detailed design. We also assist our clients with construction follow-up, supervision, independent checking, and maintenance.

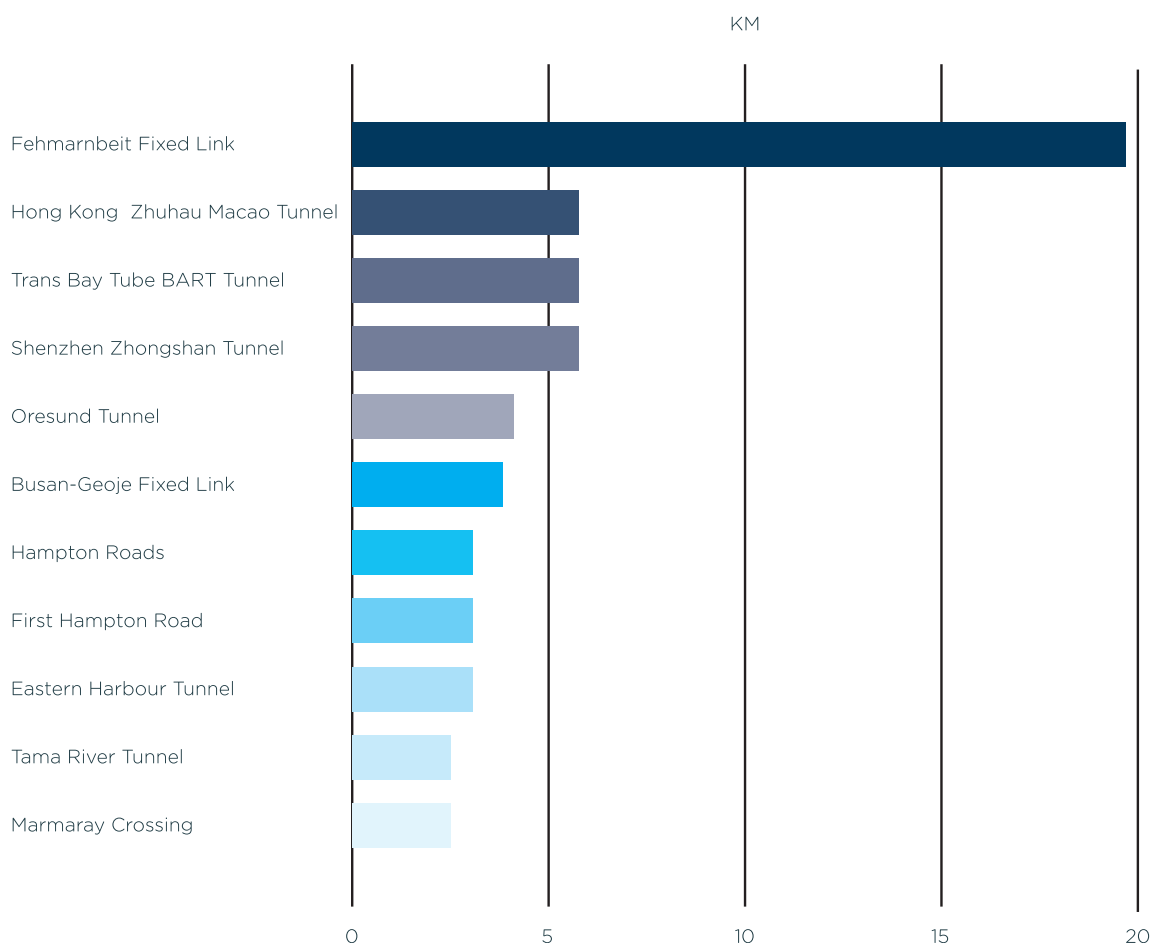
Designing immersed tunnels require close coordination between the structural design, ground engineering, and the design of tunnel installations.

Ramboll provides highly skilled structural engineers who work closely together with our tunnel installation and services specialists.

We recognise the importance and need for minimising and optimising space requirements for installations to keep the total construction costs low. However, it is equally important to provide the necessary space for the efficient future operation and maintenance of the tunnel. Our experience from the operation and maintenance of Danish tunnels, has given us a unique insight into this area.

Furthermore, the need for implementing state-of-the-art safety concepts and well-planned escape routes is evident.

Ramboll has specialists in ventilation, fire-fighting systems, drainage, power supply and distribution domain. Our experience and services also cover control and management systems, passenger flow simulations, emergency escape simulations, traffic management, and Intelligent Transport Systems (ITS), tunnel lighting, IMT etc. For transport projects, we can complement our skills with our specialists in highway and rail to provide a full-service offering.



The world's longest immersed tunnels

Ramboll led the design of the Fehmarnbelt and Øresund tunnels, two of the world's top five longest immersed tunnels.



Image: Visualisation of the work harbour and tunnel factory for the Fehmarnbelt. Credits: Femern A/S

Bored Tunnels

Advances in Tunnel Boring Machine (TBM) technologies and the expansion of urban areas are driving the adoption of bored tunnel construction for both transport and utilities globally. Today's machines enable larger diameter tunnels to be constructed more efficiently and safely, with minimal impact on the existing conditions

In urban areas, where there are often many constraints at or near the surface from buildings, infrastructure, and utilities – tunnels constructed using tunnel boring machines are an efficient, safe and cost-effective option for a range of soft and hard ground conditions.

Ramboll has experience in the delivery of bored tunnel projects across a range of diameters and in varying ground conditions – from major rail and metro systems to smaller utility tunnels.

Our team size and range of skills allow us to provide expertise for the design and construction of both the tunnels themselves, but also the wider system and operational aspects.

Our designers have expertise in the design of segmental linings for tunnels and smaller diameter pipejacking projects.

Understanding the entire construction process of TBM tunnels means we can provide cutting-edge advice to our clients ensuring that bored tunnel projects are planned and developed in the most efficient way.

Alignment planning, construction site set-up and logistics, tunnel boring strategy, and power and water consumption are just some of the aspects we have advised on.

By understanding the wider projects goals, we help our clients ensure that the more complex technical aspects of bored tunnel projects such as structural interfaces, as well as the more highly repetitive aspects such as lining installations, are managed in the most efficient way in terms of cost, programme and sustainability.



Image: Baltic Pipeline TBM launch

Credits: Gaz Systems



Mined tunnels in rock

From our company's origins in Scandinavia, we have developed a strong history of involvement in rock tunnelling projects. With a wider variety of techniques being used to excavate rock, our tunnelling team, has the know-how to ensure the appropriate and efficient use of structural systems and water ingress management systems that work seamlessly with the end purpose of the tunnel works.

Our experience in the Scandinavian market, with its wide-ranging geological conditions, means that we are familiar with both drill-and-blast methods, plus the use of road headers, and with more delicate wire-cutting techniques.

We have significant expertise in rock mechanics and numerical modelling that enables us to develop cost-efficient solutions that, together with our geological and hydrogeological teams, make good use of the prevailing geology.

Working in hard rock, we have developed essential skills including techniques to manage high water pressures, and high inflow volumes - so our team's tool kits of various ground treatment options such as grouting, and ground-freezing are often called upon.

Our broad knowledge and experience of lining systems including extensively working with sprayed concrete lining, rock-bolting methods, and cast in situ permanent linings mean that we can advise on complex rock tunnelling projects.



Image: Construction phase of Holmestrand Station



Image: Visualisation of Håga station. Credits: Abako arkitektkontor

Safety Installations

Fire & Life Safety in tunnels including the emergency services is a major concern for the public and for the authorities. Ramboll offers a holistic, risk-driven approach to the design of safety features. Based on continuous Operational Risk Analysis through the design phases, it is ensured that the project's overall risk threshold limit is not exceeded.

Fire and emergency situations are amongst the greatest concerns of the travelling public, emergency services and authorities when entering a tunnel. Is the tunnel 'safe' and can the tunnel deal with an emergency 'safely'?

Ramboll understands these key questions and in response, our team of world class Engineers offer a holistic, pragmatic and risk driven approach to the design and inclusion of safety features. Taken in isolation, a fire extinguisher or similar safety feature alone, does not make a tunnel safe. A holistic view of the risks, escape routes, fire doors, emergency access, lighting and so on needs to be coordinated and appropriately considered. Ramboll experts do this based on Operational Risk Analysis (ORA). This is a continuous process that is used through the design phases to ensure that the project's overall risk threshold limit is not exceeded.

Ramboll always carries out the ORA process with full transparency and in co-operation with clients, authorities, and emergency services. Through the ORA approach Ramboll is able to challenge existing standards and recommendations. Without compromising the required level of safety, Ramboll finds alternative solutions to achieve a level of safety for the tunnel that satisfies the societal requirements – in the simplest, most sustainable and most cost-effective manner, pragmatic and holistic design.

What is special about Ramboll designers is that ORA is based on real-life experiences from our experts using their experience, comparable existing tunnels and other confined spaces combined with advanced simulations of smoke propagation and occupant flow.

The risk driven process is relevant for new projects but specifically for refurbishment projects the advantages of a risk driven process are evident. Physical restraints in such projects may render it impossible to reach a contemporary level of safety and the task is rather to implement realistic and effective safety features.

During the risk driven process design alternatives will be evaluated against each other with regards to risks and valuable insight will be gained as to where the important risks are in the design and how they can be mitigated.

Mechanical, Electrical and Plumbing (MEP) installations is a vital part of the safety measures – and also important for the health and well-being of maintenance staff, tunnel users and physical assets. Ramboll offers expert knowledge within all the MEP disciplines relevant for road and rail tunnel projects in both design, construction, and operation phases.

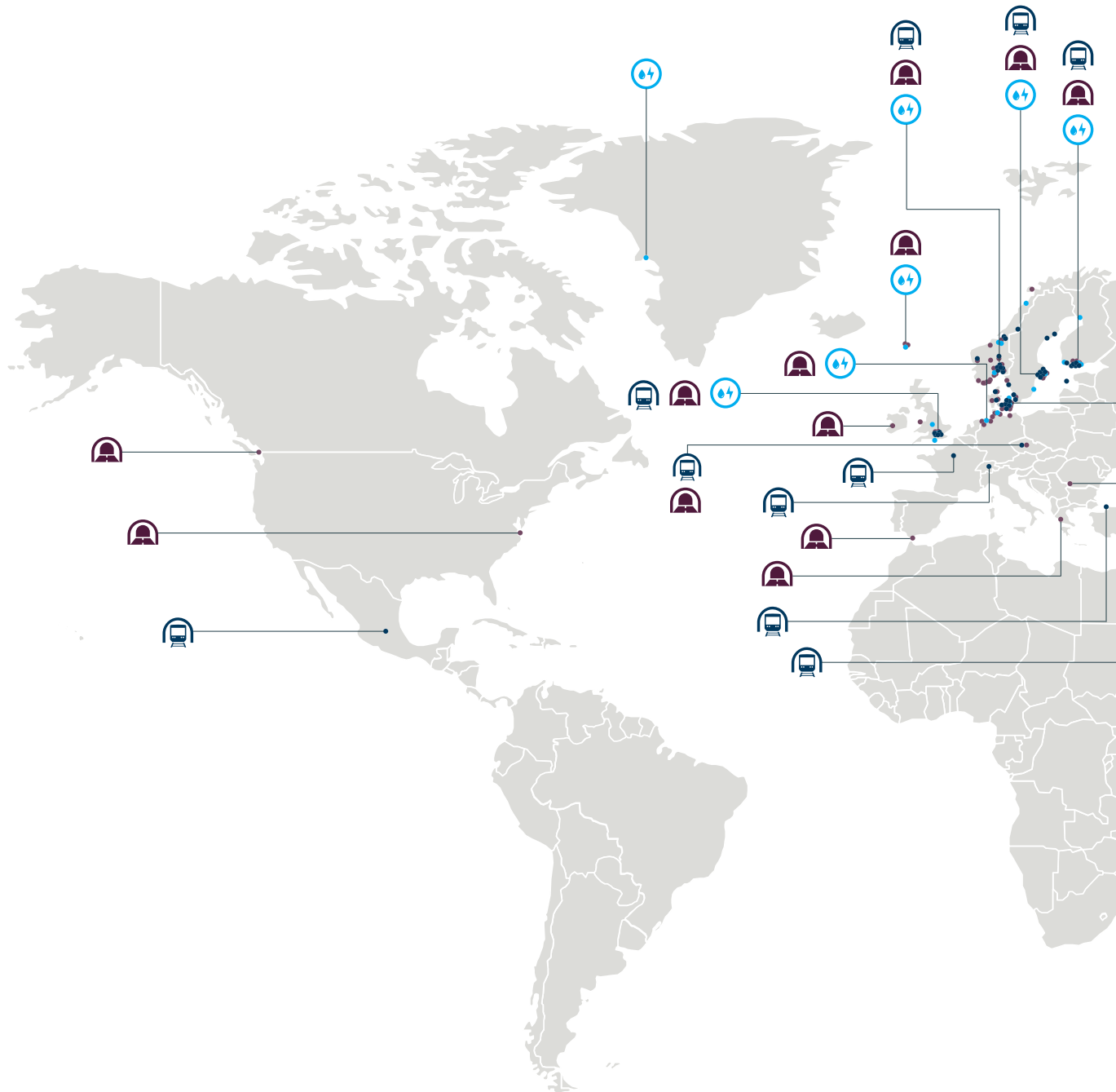
Further to this, Ramboll offers design expertise within complementary systems e.g. road and railway design as well as road and rail traffic management including signaling and ITS systems.



Tunnel designs around the world

[illegible]

Global experience local knowledge



-  Metro or rail tunnel
-  Road tunnel
-  Utility tunnel

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Read more

