Tunnels and Trenchless Technologies

HATCH

Why Pick Hatch Tunnels?

Capability
Excellence in all tunnel applications & specialties

Capacity
Over 175 dedicated tunnel specialists

Large Tunnel & Project Experience
Largest rock TBM project in the world

Leader in Innovation
Technical, procurement & delivery

International Recognition
Dozens of awards

Proven Project Delivery
Thousands of kilometers of tunnels

National & Global Presence
Over 55 offices in the US & worldwide

Euclid Creek Tunnel, Cleveland, Ohio: *Hatch was the lead consultant responsible for overall project management and administration, and tunnel design.**

Tunneling the future

Tunnel and Trenchless Technology engineering is one of Hatch's core strength technical specialties. At Hatch, our tunnels practice helps our clients face the toughest challenges through total commitment, professional excellence and innovation.

As an employee-owned, professional services firm, we draw upon our 9,000 staff with experience in over 150 countries to challenge the status quo and create positive change for our clients, our employees, and the communities we serve. With over 30 offices throughout the United States and Canada and an additional 35 offices world-wide, Hatch offers a full-range of services and capability to handle any size project— we are able to scale our effort according to project size, from a small inspection assignment to world-class, multi-billion-dollar transit programs. We offer clients a complete range of engineering services, including planning, design, contract procurement, construction management, program management and operations support.

We have roots in tunnel engineering, beginning with our work on Toronto's subway system in the 1950s. Our steady growth since then means that Hatch has now engineered thousands of miles of tunnels on five continents beneath urban centers, residential areas, mountains and rivers. Whether it is hard rock tunnel boring machines, sequential excavation methods, drill and blast, micro-tunneling, horizontal directional drilling or pressurized face tunnel boring machines in soil, we can specify the most appropriate technology to suit the anticipated ground conditions.

With over 175 dedicated tunnel specialists (engineers, geologists and construction management professionals), we have the capacity, knowledge, experience and the understanding to overcome the challenges associated with new transportation tunnel links, highways through environmentally sensitive areas, major transit expansion programs, water conveyance and sewage facilities and pedestrian tunnels beneath congested urban centers.

Whatever our clients envision, Hatch specialists can design and manage it from concept to completion. With over six decades of business and technical experience in the infrastructure, mining and energy sectors, we know your business and understand that your challenges are changing rapidly. We advocate for integration of tested, new technologies to increase construction efficiencies and we respond quickly with innovative solutions that are smarter and more efficient.

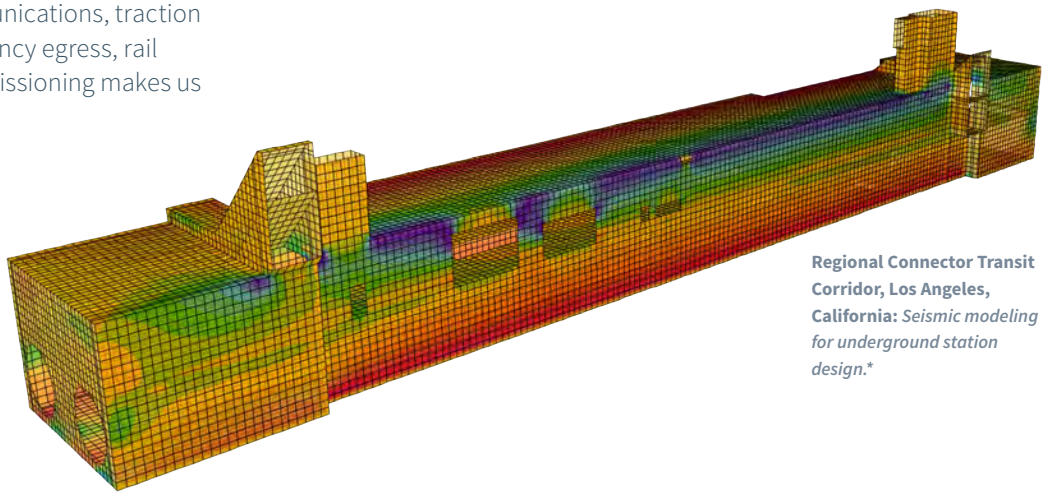
Cover: (Left) Southeast Collector Trunk Sewer, Markham, Ontario: *Hatch provided engineering detailed design, contract preparation and construction management;* **(Right) Eglinton Crosstown LRT, Toronto, Ontario:** *Hatch performed the preliminary and detailed designs of the twin-bored tunnels and services for the AFP components.*

Transit

Transit systems in urban centers and airports require construction underground in a manner that minimizes surface disruption throughout the construction process. Building underground transit facilities such as the Regional Connector in Los Angeles, Beacon Hill Station and Tunnels, Minneapolis Hiawatha LRT, Eglinton Crosstown LRT, Calgary Green Line LRT Project, the Toronto-York Spadina Extension and the Evergreen Line Rapid Transit through urban areas presents many challenges, including variable subsurface conditions, complex rights-of-way and dealing with existing structures and utilities.

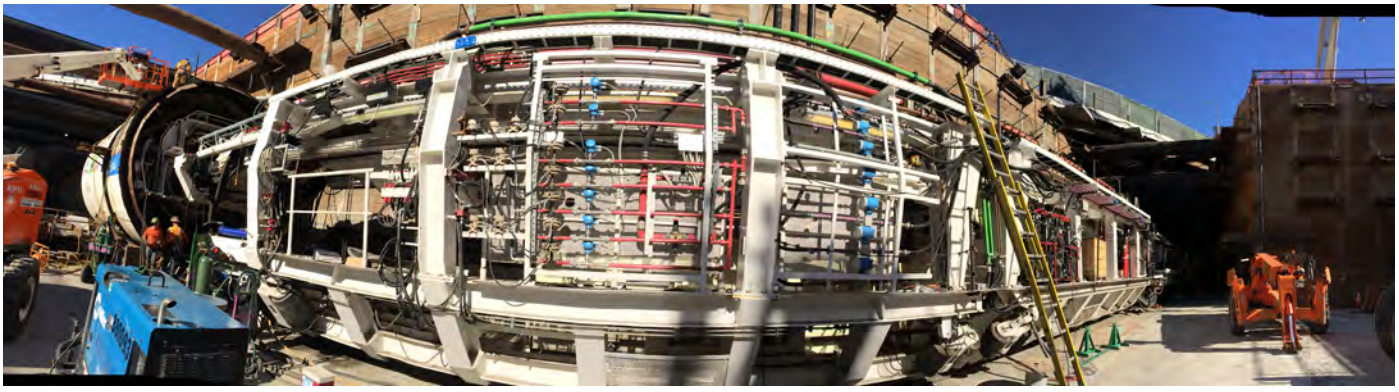
Of critical importance is the need to plan, design, construct, and commission these facilities so that public impacts are minimized. Hatch's ability to offer the necessary geotechnical, structural and practical tunneling skills required of all underground projects, and to complement these skills with extensive skills in the specialist areas of track design, signaling, communications, traction power, ventilation and emergency egress, rail activation, and systems commissioning makes us a true partner for our clients.

Scarborough Subway Extension, Toronto, Ontario: *Large diameter transit tunnel with double track configuration - design implementation in progress on the Scarborough Subway Extension.*



Regional Connector Transit Corridor, Los Angeles, California: *Seismic modeling for underground station design.**

Regional Connector Transit Corridor, Los Angeles, California: *TBM assembly prior to launch. **



King Road/CN Grade Separation, Burlington, Ontario: *Prime consultant responsible for the entire project.*

Rail

Well designed and configured rail systems help move goods, services and passengers efficiently through our cities and urban centers. Rail tunnels require underground construction whether it be a grade separation, rehabilitation of existing infrastructure, or construction of new rail corridors to meet the increasing growth and capacities in rail system needs. Constructing underground rail and facilities presents many challenges, including maintaining existing rail operations, complex grades, alignments and geometries, rights-of-way and dealing with variable subsurface conditions.

Hatch's proven experience working on rail projects such as the Norfolk Southern Heartland Corridor, St. Clair River Tunnel and the King Road Grade Separation projects, along with our ability to efficiently delivery innovative designs allows us to deliver solutions for a wide variety of rail tunnel applications. Hatch's in depth tunnel experience is complemented with extensive skills in the specialist areas of track design, signaling, communications, traction power, ventilation and emergency egress, rail activation, and systems commissioning allowing us to offer unique and cost saving solutions for our clients.

2014 Grand Award

The King Road/CN Grade Separation received several awards for its technical excellence including the "Grand Award" from the American Council of Engineering Companies in 2014.

Outstanding Project of 2014

Beacon Hill Station and Tunnel Project received several awards for its technical excellence including “Outstanding Project of the Year” from the International Federation of Consulting Engineers in 2014.

North West PATH Tunnel from Union Station, Toronto, Ontario: *As Prime Consultant, performed preliminary and detailed design including alignment design and provided construction contract administration services.*

Road Tunnels

As the demand for additional highway infrastructure expands, Hatch's capabilities in large-diameter and large-bore tunnels are finding increasing application across North America. Together with our comprehensive civil, structural and transportation engineering expertise, we bring critical knowledge and experience to the early stages of these visible, long-term projects.

Whether the client's project requirements are highway realignment through a rural canyon, a river crossing, or a route beneath a congested urban center, we can help by offering the appropriate construction technologies. Hatch can provide fully integrated teams that cover not only the tunnel design but also traffic and roadwork, fire-life safety, tunnel ventilation, emergency egress and illumination design.

Pedestrian Tunnels

As underground occupied spaces, pedestrian tunnels require a truly integrated multi-discipline approach, in order to provide a safe, accessible and pleasant user experience. By their very nature, pedestrian tunnels tend to be shallow structures, which typically generate conflicts with urban utilities, traffic and buildings, resulting in highly complex projects.

In urban settings, construction of these tunnels can significantly impact day-to-day operation of adjacent buildings and affect prominent stakeholder facilities, requiring effective planning and staging of the works. Hatch's core tunneling strengths are complemented by our in-house capabilities in architectural, mechanical, electrical and fire-life safety disciplines, allowing us to provide a fully integrated in-house service.

(Left Page) Beacon Hill Station and Tunnels, Seattle, Washington: *Lead JV partner responsible for overall project management and controls and detailed design of all tunnels and portals.**

Water Conveyance Tunnels

North America's water supply and distribution system is in a constant state of repair, upgrading and expansion. It is critical that these "lifeline" facilities remain operational for extended periods of time. Hatch's replacement water conveyance systems experience ranges from small diameter pipelines using horizontal direction drilling, to some of the largest and largest diameter machine-bored tunnels for cooling water intakes and electrical power generation. We engineered the Niagara Tunnel that conveys 11,500 MGD (43,200 MLD) of water from upstream of Niagara Falls to the Sir Adam Beck Power Plant – using the largest rock TBM in the world at 47.5 feet (14.5 m) excavated diameter. We have worked with clients on projects that have traversed the most diverse conditions — from pristine mountain areas to active fault crossings, subaqueous crossings beneath rivers, estuaries and oceans and highly developed urban environments.

Elm Road GS Water Intake Tunnel, Oak Creek, Wisconsin: *Hatch was responsible for all engineering, procurement, and construction necessary to provide the Intake Water Tunnel.*

Niagara Power Tunnel, Niagara Falls, Ontario: *As Owner's Representative Hatch developed the concept design and set out the owner's mandatory requirements. (Photo provided courtesy of Ontario Power Generation Inc.)*

Largest Rock TBM

The 14.44 m diameter Robbins open-gripper TBM, christened "Big Becky", excavated 1.7 million m^3 of rock which was transported through the tunnel by conveyor belt and stored on Ontario Prower Generation property. When it was commissioned, Big Becky was the largest hard-rock TBM in the world.

West Area CSO Storage Tunnels and Pumping Station, Atlanta, Georgia: *Primary responsibility for design of the tunnel and shaft linings, including preparation of tunnel and shaft specifications.**

Wastewater and Stormwater Tunnels

North America's aging wastewater infrastructure requires attention to address deterioration, lack of redundancy and insufficient capacity resulting from population growth. With ever increasing environmental considerations and sensitivity, combined and sanitary sewage overflows require complex and costly system improvements.

As hard surfacing associated with development reduces the ground's ability to absorb rainfall, stormwater runoff is becoming an increasing problem. For wastewater, CSO, outfall and storm water collection and conveyance, developments in tunnel design and construction have resulted in a wide-range of successful, sustainable solutions that have been implemented by Hatch. We are currently managing the design of the Ashbridges Bay Treatment Plant Outfall that will convey and disperse 1050 MGD (3923 MLD) of treated effluent into Lake Ontario. This will significantly improve the waterfront quality in the City of Toronto.

No matter what size pipe is required, there is a sustainable underground approach that will provide a cost- effective solution. We are able to provide our clients with the right blend of trenchless, tunnel, shaft, and hydraulic system design expertise to provide well-engineered solutions for the most complex wastewater and stormwater conveyance and storage needs.

Ashbridges Treatment Plant Outfall, Toronto, Ontario: *Prime consultant leading the preliminary and detailed design and construction management.*

Etobicoke Creek Trunk Sanitary Sewer Twinning, Toronto, Ontario: *Etobicoke Creek Trunk : Primary consultant providing preliminary and detailed design of the trunk sewer*

Trenchless Technologies

Trenchless technologies consist of a family of techniques for smaller diameter underground infrastructure implementation, allowing renovation, replacement and new construction with minimal excavation from the ground surface. Whether micro tunnel boring machines (MTBM), horizontal directional drilling (HDD), pipe ramming, jack-and-bore, Hatch has done it successfully. A recent example is the Burbrook Trunk Sewer where Hatch was able to design and specify MTBM methods that succeeded where others had failed.

Trenchless technologies offer tremendous advantages for the construction and rehabilitation of water, wastewater, energy, communications and industrial infrastructure by minimizing public inconvenience and surface disruption. Often, trenchless technologies are the only practical solutions for the construction or rehabilitation of infrastructure in environmentally sensitive areas, congested urban areas, or other areas otherwise not amenable to traditional construction techniques.

Whether Hatch is completing condition assessments, rehabilitating to extend useful life, or constructing new infrastructure, we have the staff for the job. Our distinguished experts, who are recognized locally and globally, provide a wealth of trenchless knowledge. Hatch leverages that experience and knowledge to deliver customized solutions for our clients' unique needs.

West End Trunk Line, Chester County, Pennsylvania: *Designers for the tunnel**

*Denotes projects with substantial work by Hatch; contracted as Hatch Mott MacDonald Joint Venture

Hatch Tunnels - Areas of Expertise

Tunnel Applications
Rail & Transit
Road & Highway
Water
Hydro-Electric
Wastewater & CSO
Intakes & Outfalls
Pipelines
Pedestrian
Lake Tap

Planning
Cost & Schedule Estimating
Tunnel Feasibility Studies
Economic Evaluations
Major Investment Studies
Corridor Analysis

Tunnel Design
Hard & Soft Rock
Soft Ground
Sub-aqueous
Cut-and-Cover

Project Delivery
Contract Documents
Design-Bid-Build
Design-Build
Contractor Design
Public-Private-Partnerships (P3)
Owner's P3 oversight

Construction Management
Contract Administration
Resident Engineering
Inspection
Claim Resolution
Payment Review
Safety

Program Management
Program Delivery
Project Controls
Document Management
Configuration Management
Contract Packaging

Tunnel Excavation Methods
Main Beam and Shielded Rock TBMs
EPB & Slurry Soft Ground TBMs
Roadheaders
Sequential Excavation Methods
Drill & Blast
Conventional & Hand Excavation

Trenchless Technologies
Microtunnel Boring Machines
Horizontal Directional Drilling
Jack & Bore
Pipe Ramming
Open Shield Pipe Jacking

Deep Excavations & Shafts
Soldier Piles & Lagging
Secant Piles
Slurry Diaphragm Walls
Liner Plate & Ribs
Soil Nailing
Raise Boring
Shaft Drilling
Steel Ribs & Lagging
Sinking Caisson
Steel Casing
Cast-in-Place Concrete Lining
Pre-Cast Concrete Segmental Lining
Steel Shaft Liner

Geotechnical Characterization
Geotechnical Baseline Reports
Geology & Hydrogeology
Investigation & Assessment

Numerical Modeling of Ground
Structure Interaction
2-D & 3-D Modeling
Dynamic
FLAC, Phase2, Staad

Instrumentation & Monitoring
Conventional & Linear Survey
MPBX, Tapex, Inclinometer
Electronic Data Collection
LIDAR

Seismic
Seismic Hazard Assessment
Design Ground Motions
Fault Hazard Assessment
Fault Crossings
Liquefaction Potential

Rock Support Design
Shotcrete
Rock Bolts
Steel Mesh
Lattice Girders & Ribs
Spiles & Canopy Tubes

Tunnel Lining Design
Pre-Cast Concrete Segmental
Cast-in-Place Concrete
Shotcrete
Steel Liner Plate & Ribs
Steel Tunnel Liner

Ground Improvement
Jet Grouting
Compensation Grouting
Permeation Grouting
Ground Freezing
Dewatering
Compaction Grouting

Settlement Prediction & Mitigation
Building & Utility Damage Assessment
Monitoring Programs
Pre-Construction Condition Surveys
Pre- & Post-Tunneling Mitigation

Fire Life Safety Analyses
Code Compliance
Exit Analyses
Fire Modeling
Ventilation

Rehabilitation
Condition Surveys
Corrosion & Design Life Assessment
Remediation Design
Emergency Repairs
Systems Restoration

Let's work together to meet the specific needs of your project!

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Hatch has served clients for over 60 years and has project experience in more than 150 countries around the world. With 9,000 people in over 55 offices, Hatch has more than $35 billion in projects currently under management.

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