New Urban Infrastructure

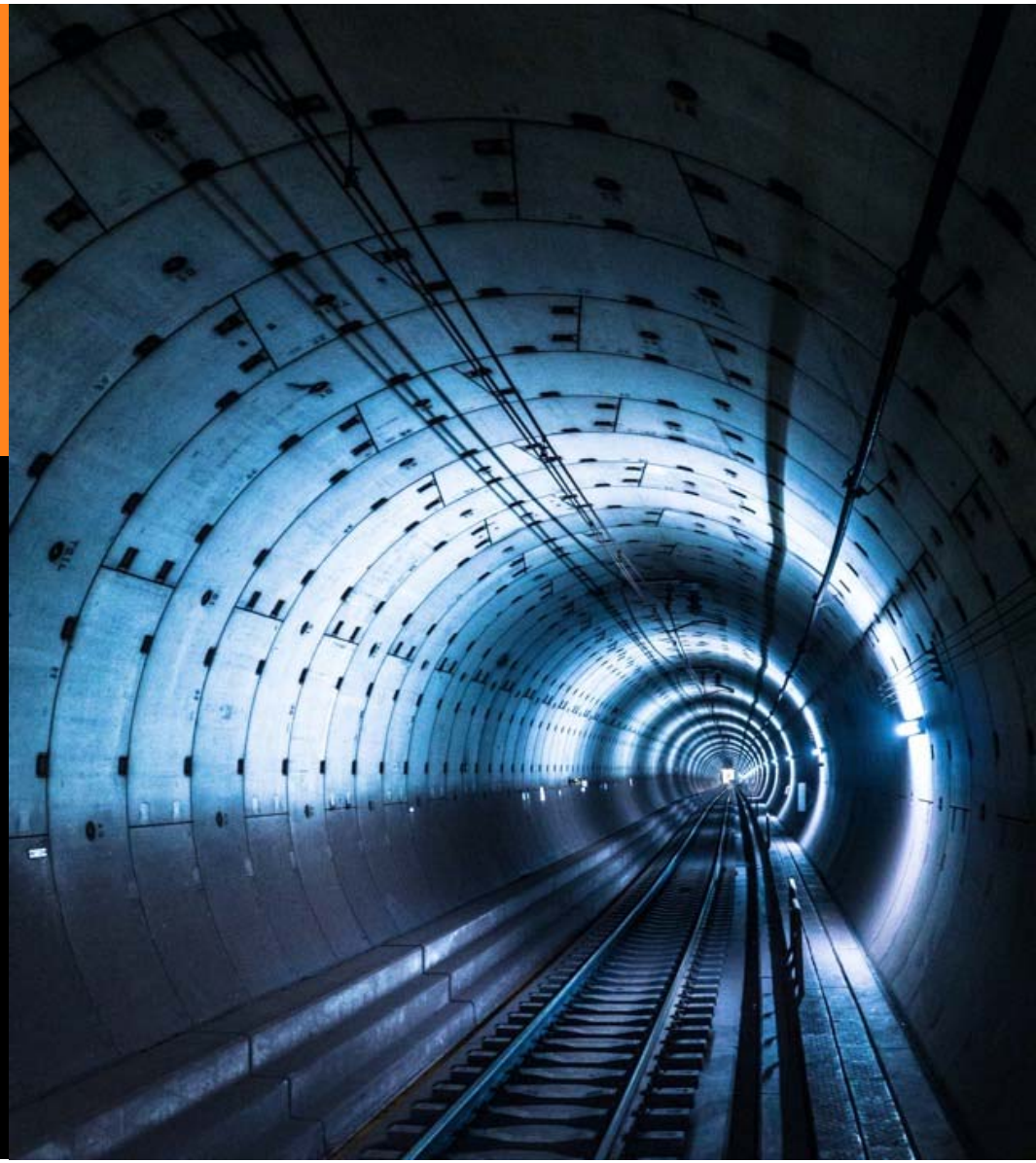
ABOVE OR BELOW GRADE

Underground solutions for city infrastructure; a general discussion.

Topics

+ **Uses**
+ **Benefits**
+ **Innovations**
+ **Infrastructure Choices**

Prepared by the Benefits of Going Underground Committee of the Underground Construction Association a Division of the Society of Mining Engineers.



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USES

Examples of surface infrastructure that can go underground.

RAPID TRANSIT DELIVERING:

Rider Comfort

Reliable Commutes

Year-round Operability

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Subway and Railroad Tunnels

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TRAFFIC ROUTES PROVIDING:

Reduced neighborhood impact

Controlled service conditions

More efficient traffic flow

USES 1

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Road Tunnels

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PORTLAND OREGON

A new tunnel network keeps waterways clean.

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Sewer Tunnels

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WASHINGTON DC

Tunnels will control overflows and flooding.

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Combined Sewer Overflow Tunnels

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Tunnels are resilient structures for hosting critical service networks for water, wastewater, gas, power communications, etc.

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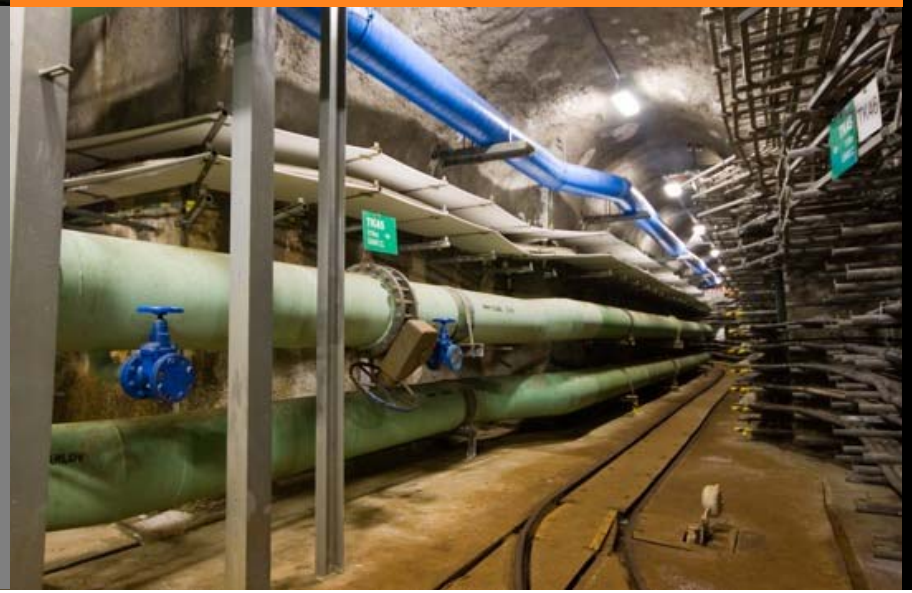
Utility Tunnels

"Future generations of New Yorkers will have the clean and reliable supply of drinking water essential for our growing city."

- Mayor Michael R. Bloomberg



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Many types of facilities can be housed underground.

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Other Uses for Underground Space

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BENEFITS

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Connecting Communities

Tunnels provide safe and efficient alignments under natural barriers and constructed areas.

Improving transit and network connections.

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Tunnels reduce city congestion and improve the urban environment for pedestrians and bikers.

Providing drivers with shorter, faster travel options. Improved circulation and added capacity.

BENEFITS

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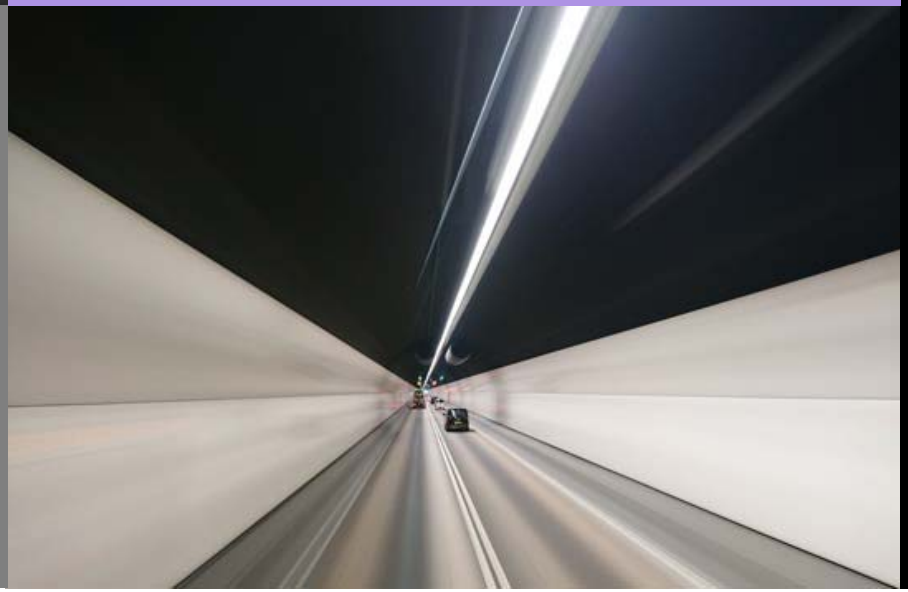
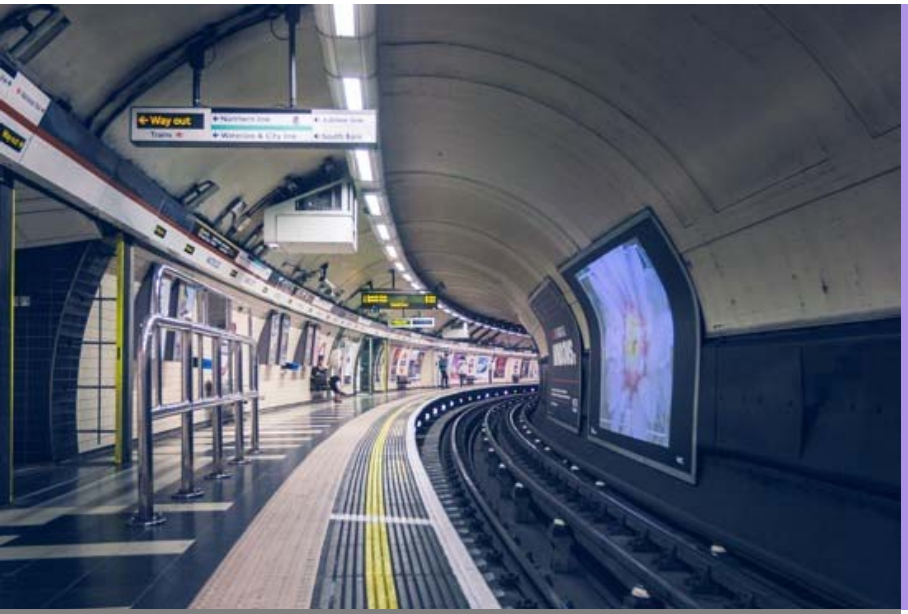
Relieving street-level gridlock





Underground mass transit offers city travelers efficient commutes and inter-modal transfer.

Predictable transit times in a congested footprint. Cities with subways want more subway.

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Mobilizing the People

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Revitalizing the City

Replacing aging infrastructure with an underground alternative can return surface space to the citizens.

Preserving the integrity of heritage structures.

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Tunnels maintain green space and limit land takes.

Subsurface sites offer sustainable, energy efficiency models.

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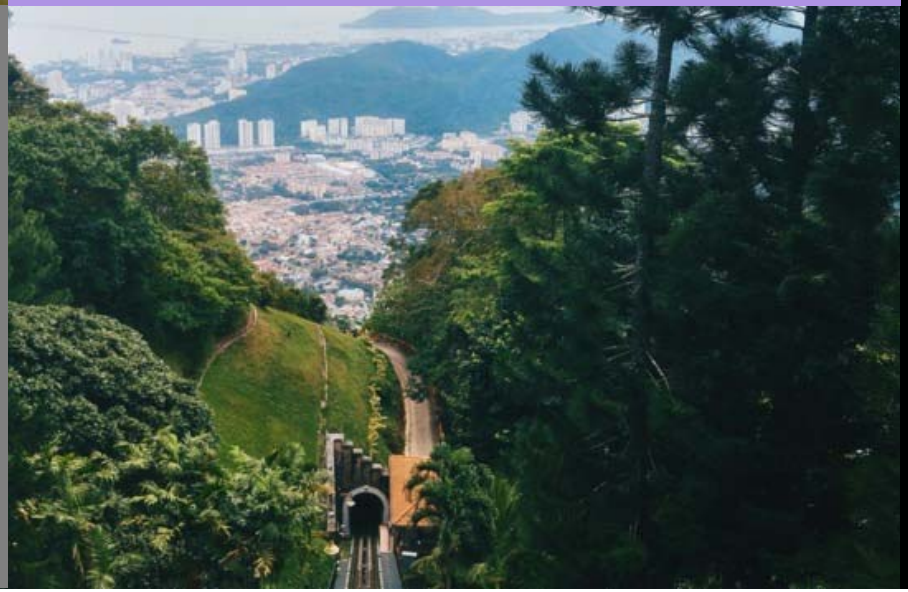
Protecting the Environment



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Surface construction disrupts city business, damages adjoining structures and pollutes.

Tunnel work minimizes neighborhood impacts.

Maximum Tunneling = Minimum Disturbance

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Minimizing Construction Disruption

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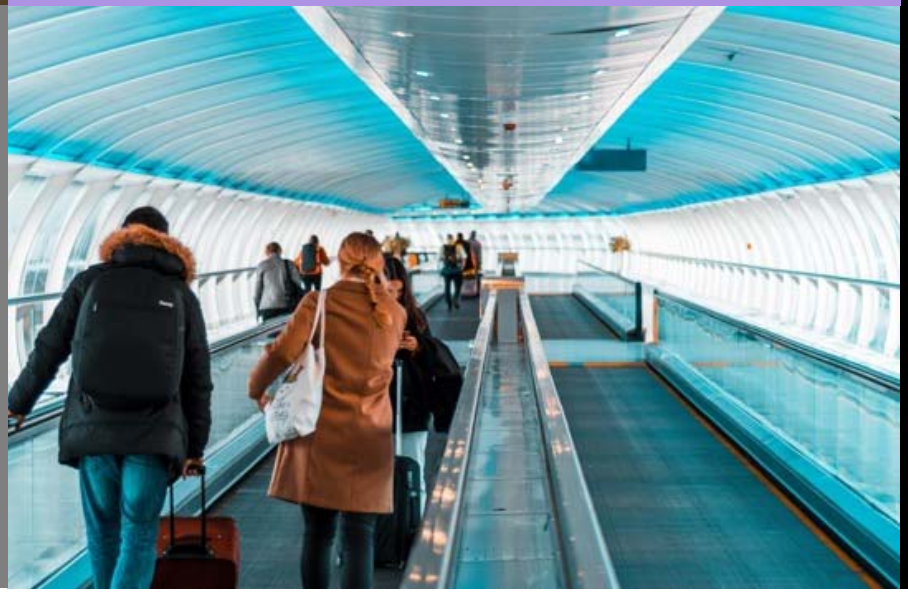
Planning for a Better City

Siting new infrastructure underground offers urban planners opportunities for high density development.

Delivering sustainable solutions that reduce sprawl and generate new residential and business revenue.



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INNOVATIONS

Ground support systems reliably stabilize a wide range of adverse construction conditions.

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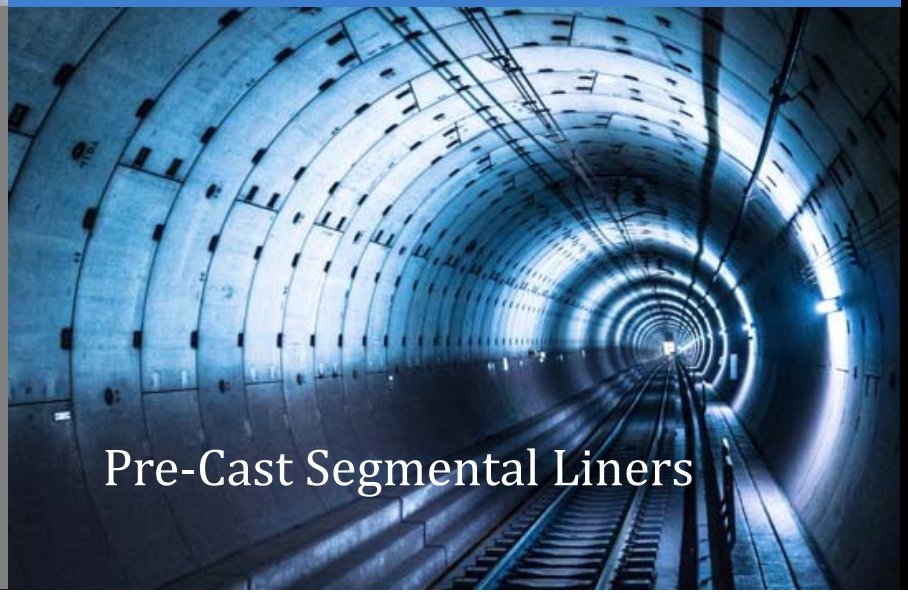
Ground Stabilization Methods



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Tunnel Boring Machines (TBM's) and one-pass liners deliver dry tunnel subject to high external water pressures.

A tunnel is no longer a structure that "leaks."

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Groundwater Control Methods

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TBM advance rates over one mile per month have been achieved under favorable ground conditions.

TBM technology is proven over a wide range of ground conditions and excavated diameters.

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TBM-System Performance

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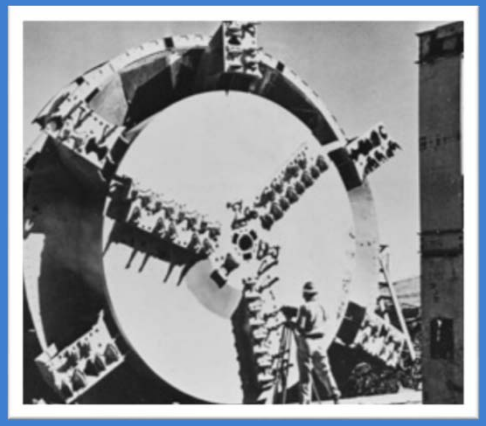
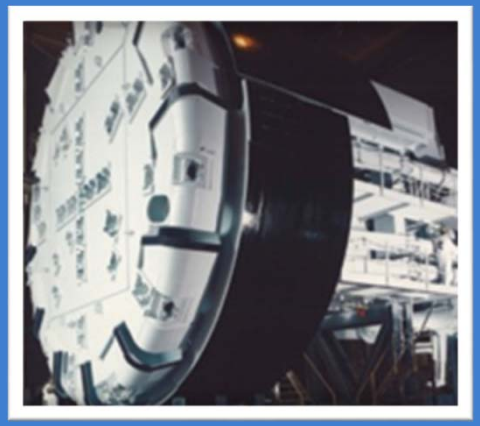
Examples of Large Diameter TBM Projects



Oahe Dam Tunnel / South Dakota



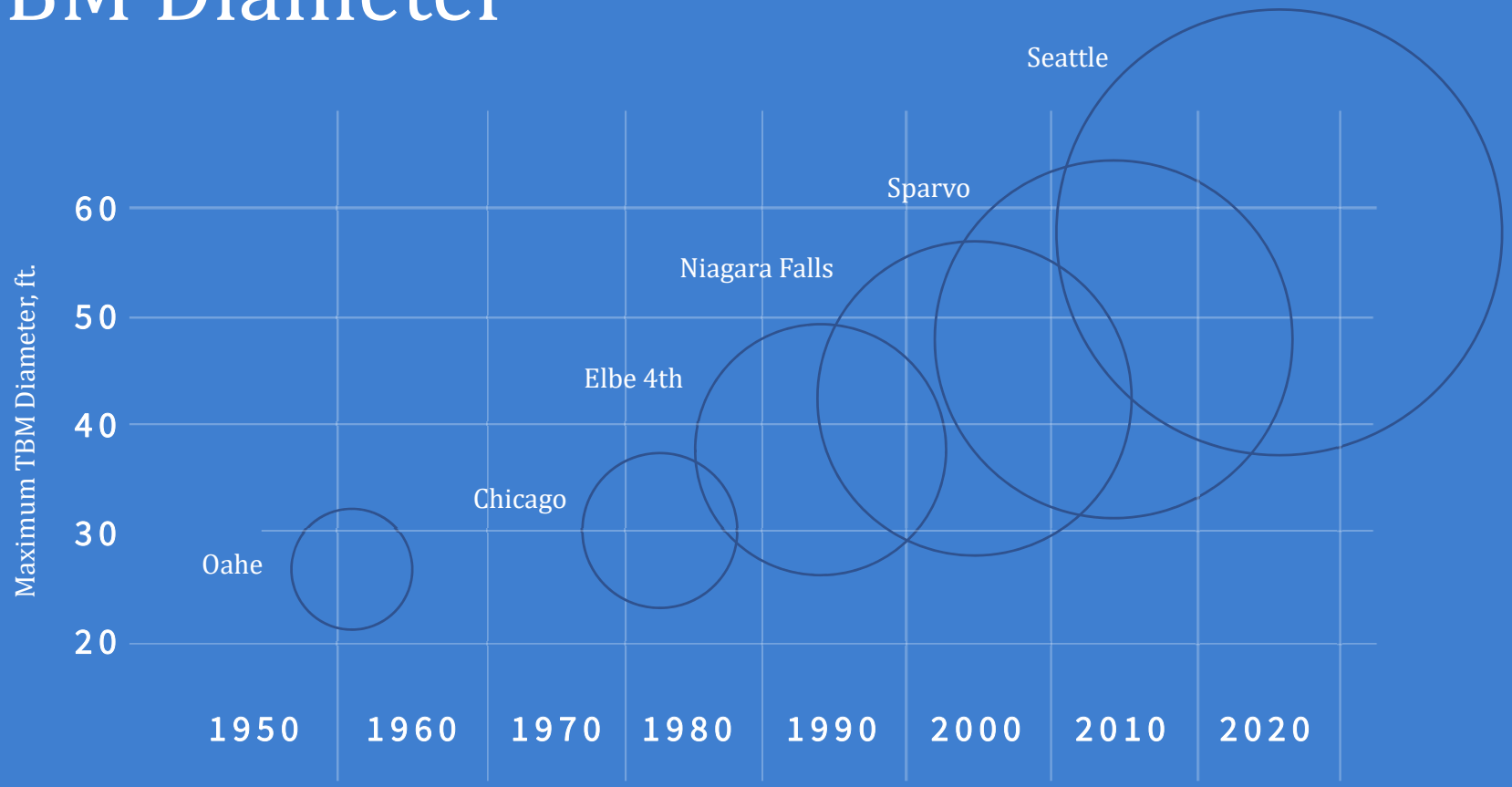
Tunnel & Reservoir Plan / Chicago

Elbe River 4th Road Tunnel

Niagra Pressure Tunnel Canada

Sparvo Road Tunnel, Italy

Increments in Maximum TBM Diameter



Built in 1904 / Still in regular service

TBM advance rates over one mile per month have been achieved under favorable ground conditions.

TBM technology is proven over a wide range of ground conditions and excavated diameters.

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Underground Structures are Long-Lived

Built in 1945 / To be replaced by a tunnel

Improved Contract Practices

New tunnel contract guidelines facilitate better management of underground risks; increasing confidence in the procurement process and construction outcome.

"A Code of Practice for Risk Management of Tunnel Works."
International Tunneling Insurance Group, 2nd Edition 2012

"Geotechnical Baseline Reports for Construction."
American Society of Civil Engineers, 2007

"Recommended Contract Practices for Underground Construction."
Society of Mining Engineers, 2008

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INFRASTRUCTURE CHOICES

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The Community's Choice

For Users:
More efficient, comfortable commutes.

For Residents:
Space returned to civic use.

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The Operator's Choice

Well-controlled operating environment.

Reliable, cost-competitive solutions to many contemporary urban infrastructure problems.

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The Builder's Choice

Methods are robust and outcomes predictable.

The number and size of tunnel contracts let in the US is increasing.

More contractors compete for more work.

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Underground alignments improve infrastructure operation and create more livable cityscapes.

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Underground: A Win:Win Solution

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CITIES ARE RUNNING OUT OF SPACE

Time to Go Underground

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Arup
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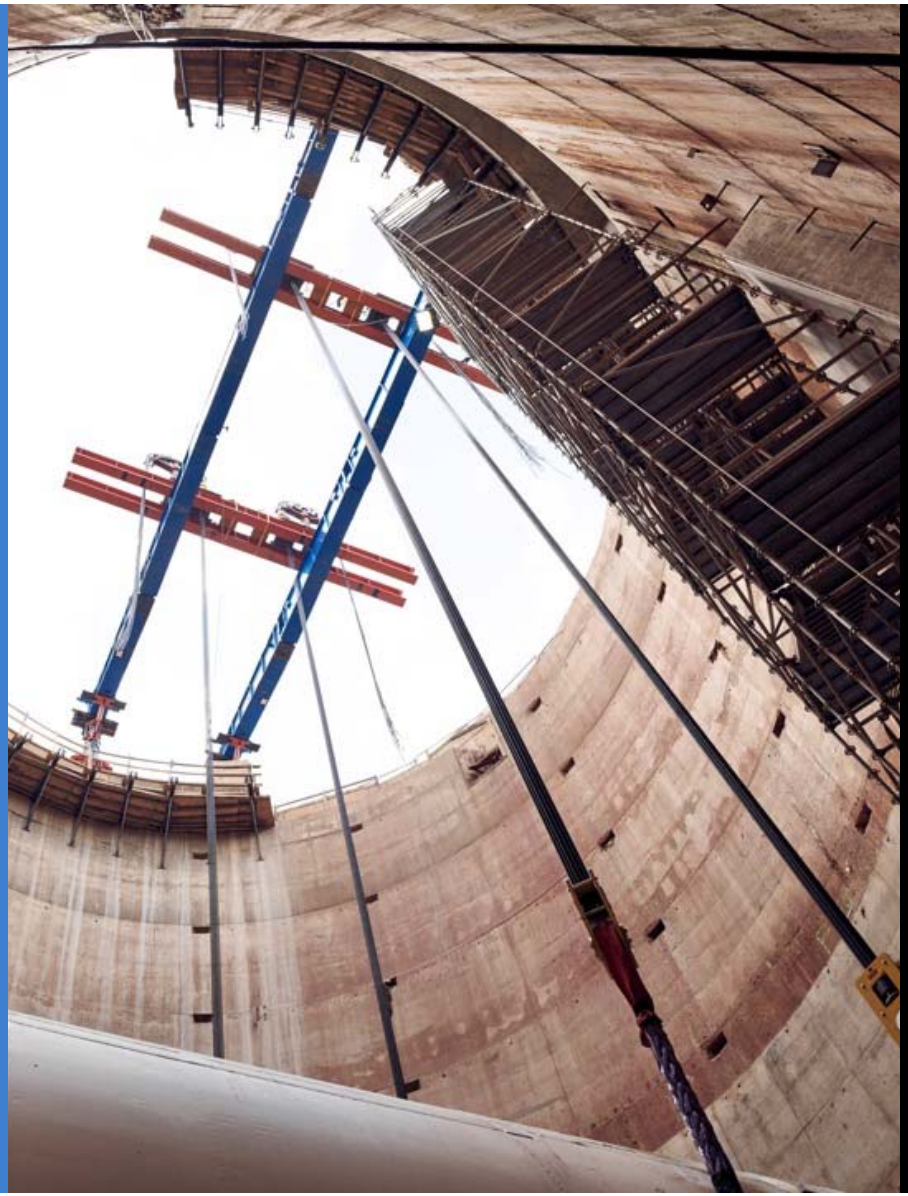
About UCA

UNDERGROUND CONSTRUCTION ASSOCIATION

UCA represents the underground construction industry; Owners, Contractors, Designers, Manufacturers, Suppliers, and others with an interest in underground construction.

UCA serves its members by advocating the responsible and cost-effective use of underground structures to improve the value and sustainability of public space.



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