Tunnels: Inspection, Asset Management, and Rehabilitation
Tunnel management is a cyclical process that includes NTIS inspections and life safety evaluations, prioritizing and implementing improvements, then starting the process again.

Gannett Fleming played a key role in the development of the National Tunnel Inspection Standards (NTIS) and is recognized for our experience in tunnel inspection, rehabilitation, and maintenance management.

Aging Infrastructure

In the U.S., 65 percent of the roadway tunnels are more than 50 years old and in need of upgrading to improve their condition, meet current life safety standards, increase energy efficiency, and reduce maintenance. At the same time, today’s tunnel owners are faced with increasingly limited funding to maintain and preserve their tunnels and associated systems. Gannett Fleming’s tunnel professionals offer experience in the design, rehabilitation, inspection, and management of tunnel systems. We can assist tunnel owners across the full lifecycle of their tunnels, from inspections and evaluations, to capital planning, rehabilitation design, and maintenance management.
Gannett Fleming has played a major role in the development of national guidelines for the inspection, maintenance, and rehabilitation of tunnels.

**Tunnel Inspection and Evaluation**

In order to ensure the safety of the nearly 500 highway tunnels throughout the U.S., the Federal Highway Administration (FHWA) released the National Tunnel Inspection Standards (NTIS), which establishes national, uniform standards for the inspections of all tunnels on public roads. The new standards require maintenance of tunnel inventory, tunnel inspections every two years, and reporting to FHWA. Gannett Fleming played a major role in the development of the NTIS, as the initial author of the *OneDOT Highway and Rail Transit Tunnel Inspection Manual* (HRTTIM), and contributing author for the *Tunnel Operations, Maintenance, Inspection, and Evaluation Manual* (TOMIE Manual).

Because the majority of tunnels were constructed more than 50 years ago, their systems do not meet current standards for ventilation, traffic control, and life safety and emergency response as recommended by the National Fire Protection Association (NFPA) 502 Standard. Aging equipment also can benefit from upgrades to improve energy efficiency and reduce maintenance. Gannett Fleming’s engineers perform equipment condition inspections and testing, and in-depth inspections of subcomponents, such as bearings, relays, and motors. We conduct life safety evaluations and make recommendations for improving safety in the event of fire, as well as improvements focused on reducing energy usage and system maintenance.

Gannett Fleming has specialized experience in all of the disciplines required to perform in-depth inspections of tunnels, including mechanical and electrical systems and lighting. Since 1985, we have inspected major highway tunnels across the U.S. Our structural, civil, mechanical, and electrical inspectors are Nationally Certified Tunnel Inspectors (NCTI) certified to lead tunnel inspection teams for all tunnel systems and elements.
Our knowledge of system maintenance requirements and our system commissioning experience comes from serving many agencies across the U.S.

**Tunnel Asset Management**

The biennial inspections required by the NTIS, particularly for tunnel systems, afford agencies an opportunity to better manage tunnel assets. Gannett Fleming developed the original tunnel management system (TMS) for the FHWA, creating a computerized database to store tunnel condition information and facilitate the prioritization of repairs. Since then, we have utilized the TMS for tunnel owners across the country, helping them remain compliant with NTIS.

To proactively manage tunnel maintenance, we have implemented computerized maintenance management systems (CMMS) for clients. Combined with the TMS, a CMMS provides full capability to a tunnel owner for condition evaluations, maintenance, and repairs.

Gannett Fleming’s thought leadership in tunnel management includes the development of a guide for tunnel owners to prioritize tunnel improvements. NCHRP Report 816 *Guide for the Preservation of Highway Tunnel Systems* provides a user-friendly metric to assist owners in prioritizing improvements, establishing capital plans, and determining needed staffing. Using the information from tunnel inspections and life safety evaluations, Gannett Fleming can assist owners with proactively managing their tunnel assets.
The Fort Pitt Tunnel rehabilitation received six awards, including the Outstanding Highway Engineering Award from the American Society of Highway Engineers, Pittsburgh section.

Renovations to the Squirrel Hill Tunnel in Pittsburgh, Pa., earned the National Engineering Excellence Award from the American Council of Engineering Companies.

Tunnel Rehabilitation Experience

For a tunnel rehabilitation to be successful, the cause of deterioration must be eliminated or controlled. In underground structures, problems are often the result of water infiltration. Gannett Fleming performs leakage investigations and develops remediation measures to reduce further deterioration within tunnels. Our teams have executed complete rehabilitation projects involving walls, ceilings, roadway, and drainage improvements. We have evaluated and designed waterproofing systems that include liners, grouting, and traditional leak repair methods.

Implementing rehabilitation work typically requires tunnel closures or lane closures, but maintaining vehicular traffic is critical. Gannett Fleming works with each agency to develop needed traffic control plans and design construction phasing to meet operational requirements.

Highway tunnels have extensive ventilation and lighting systems that require regular maintenance. Gannett Fleming has provided rehabilitation design for highway tunnels to meet the requirements of NFPA 502 for life safety and Illuminating Engineering Society of North America (IESNA) Recommended Practice for Tunnel Lighting RP-22. Our rehabilitation experience includes ventilation system design, life safety systems, lighting systems, traffic control, signage, and control systems.
Specialized Knowledge and Expertise

In addition to HRTTIM, TMS, and TOMIE, Gannett Fleming has completed other tunnel studies and prepared guidelines for the Transportation Research Board (TRB), FHWA, and FTA (OneDOT), and the American Association of State Highway and Transportation Officials (AASHTO):

- OneDOT Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual
- NCHRP 20-07 Task 261 Best Practices for Implementing Quality Control and Quality Assurance for Tunnel Inspection
- NCHRP 20-07 Task 276 Guidelines for Rehabilitation of Existing Highway and Rail Transit Tunnels
- NCHRP 20-59 Emergency Exit Signs and Marking Systems for Highway Tunnels (led by Texas A&M Transportation Institute; Gannett Fleming contributor)

Services

- In-depth and routine inspection per NTIS
- NFPA 502 fire life safety evaluation and design
- Rehabilitation studies and design
- Geotechnical evaluation
- Mechanical ventilation design
- Tunnel and underpass illumination design per IESNA RP-22
- Electrical power distribution and control system
- Emergency and uninterruptible power systems
- Tunnel drainage
- Security and access control
- Intelligent Transportation Systems (ITS)
- Geospatial Information Systems (GIS)
- Implementation of Computerized Maintenance Management System (CMMS), Enterprise Asset Management System (EAM), and system integration
- Implementation of Tunnel Management System (TMS)
- Geophysical testing
- Traffic control
- Roadway design
- Lifecycle cost analysis.
Tunnel Systems Design
• Ventilation and smoke control
• Emergency Response Plan
• Variable Frequency Drive (VFD) conversions
• Programmable Logic Controller (PLC)-based tunnel control
• Electrical surge protection
• Fire standpipe design
• Lane signals
• ITS and motorist egress signage
• Temperature monitoring
• Carbon monoxide and NOx monitoring
• Fire detection and alarm
• Emergency communications
• Traffic speed and volume measurement
• Closed circuit television (CCTV)
• Over-height vehicle detection, warning, and traffic control
• Centralized control, data collection, and report generation
• Flammable and combustible liquid.

Tunnel Lighting Design
• Day and nighttime lighting
• Tunnel threshold, transition zones, and exit zone lighting for daytime visual adaptation
• Roadway lighting approaching the tunnel for nighttime visual adaptation
• Automatic lighting controls
• Emergency egress and exit lighting
• Lighting system supervisory control
• Economic analysis of alternative light sources and luminaries.
Gannett Fleming is a global infrastructure firm that provides planning, design, technology, and construction services for a diverse range of markets and disciplines. With 2,000 highly qualified individuals across a global network of 60 offices, we are united in our passion to deliver excellence. We have played a part in shaping infrastructure and improving communities in more than 65 countries, specializing in transportation, earth science, water, power, geospatial, and facility-related projects.

Founded in 1915, we embrace sustainability and innovation in our projects and internal activities, achieving results while being responsible stewards of our environment. Our culture of service, ingenuity, and responsiveness empowers us to fulfill our key mission: make our clients successful.

Gannett Fleming is consistently ranked in the top 10 percent on Engineering News-Record’s Top 500 Design Firms list.