Tunnel Bridge

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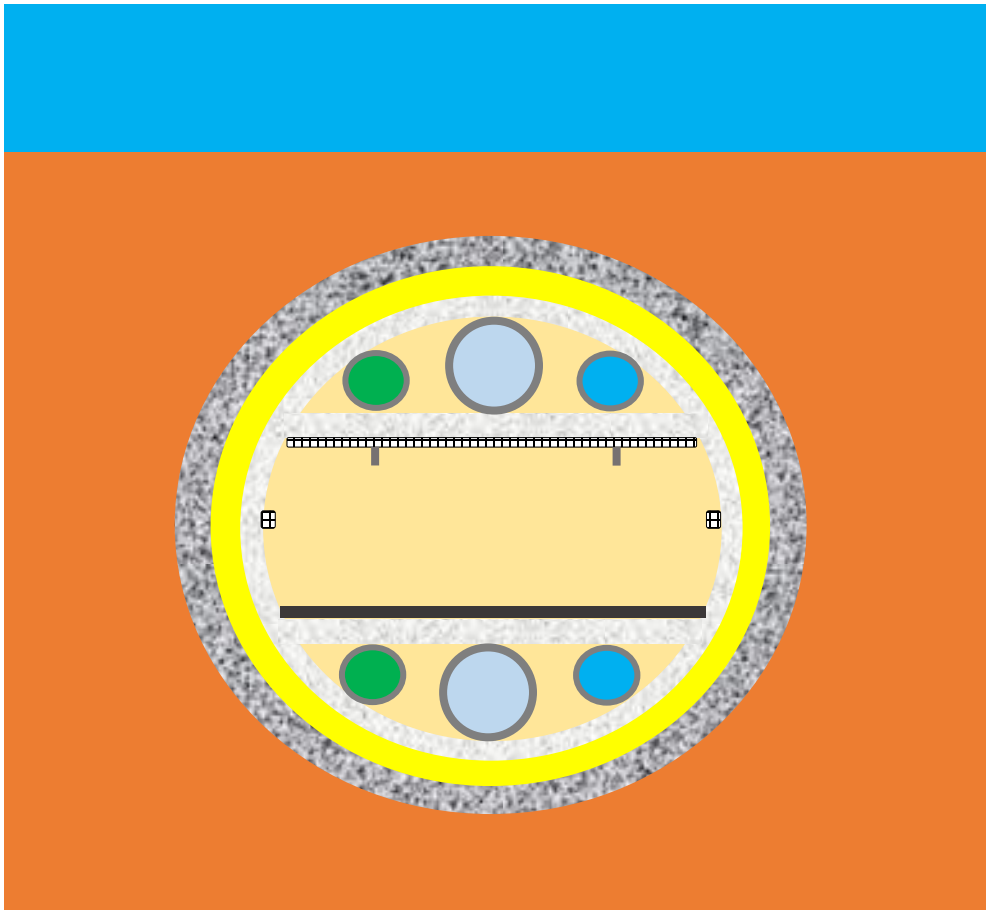
Tunnel Under Rivers with Greater Permanence, Economy, and Safety than Building Bridges



River Tunnel Cross-Section

Cylindrical Reinforced Concrete Under Uniform Temperature & Compressive Loading
Concrete Tunnel is Encased in Water-Proof Rubber Sleeve to Permanently Exclude Moisture
River Tunnel is Deployed Below Water Table. Must Be Waterproof.
Sealed Tunnel Package is Securely Set in Stabilizing Crushed Gravel
Thread Fail-Safe (Redundant) Services Through Utility Space Above & Below Central Traffic Corridor
Fail-Safe (Redundant) LED Surface-Mount Lighting on Ceiling & Walls of Traffic Corridor
Lighting is Color-Coded and Digitized to Parallel Recommended Vehicle Speed
Each Vehicle Lane Has Dual Embedded Center Wires for Automating Accident-Free Passage
Cams, Mics, PAs, Gas Sensors, & Ceiling Rail Aid Traffic-Maintenance-Emergency Management

Tunnel Bridge

Longitudinal Schema

Expect Tunnel Bridge Length 2X River Width for Gradual Descent and Ascent
Entry Structure Conveniently Situates
Fans • Pumps • Utilities • Emergency Vehicles • Communications • Control Room • Staff
Emergency Function of Entry Structure
Redirect Floodwaters Potentially Entering Tunnel
Evacuate Water Entering Tunnel Via Accidental Wall Penetration
Emergency Room for Medical Care of Injured Tunnel Travelers
Ceiling Rail Lifts Vehicle & Injured from Jam Accident, Transports Overhead To Entrance
"Emergency Air Lift" "Rescue Helicopter" "Life Line" "Rescue One" "Space Walk"

Key Comparisons of Tunnels & Bridge

Attribute	River Bridges	Advantage	River Tunnels
Material of Construction	Painted Steel	Tunnel	Sealed Concrete
Primary Stress	Tension	Tunnel	Compression
Character of Stress	Cyclical	Tunnel	Constant
Jointure	Rivets (Numerous Stress-Risers)	Tunnel	No Expansion Joint Need
Temperature Environment	Extreme Temperature Variation	Tunnel	Nearly Constant Temperature
Corrosion Environment	Moisture, Road Salt	Tunnel	Always Dry
Weather	Full Exposure to Wind & Weather	Tunnel	Shielded from Wind & Weather
Resonance Failure	Wind & Traffic Vulnerability	Tunnel	None
Maintenance	Periodic Blasting & Painting Regular Mechanical Testing	Tunnel	Periodically Scrub Tunnel Walls
Failure Rate	10X to 100X more than Tunnels	Tunnel	1% to 10% of Bridge Rate
Cost to Build	$70 Million/Lane Mile	Bridge	$150 Million/Lane Mile
Energy to Operate	None	Bridge	Light & Ventilation*
River Landscape Effect	Adds or Detracts from Nature	Tunnel	Nature Remains Unobscured

***GES is developing RiverPower technology that might supply River Tunnels with free hydropower*