high-speed rail
Designing North America’s future today
High-speed rail is recognized as an economic alternative to air travel for short and mid-distance journeys. It also provides fast and efficient intercity service for both commuter and leisure travel.
Hatch Mott MacDonald, in conjunction with Mott MacDonald—one of our parent companies, has a solid reputation of successfully delivering prestigious high-speed rail projects throughout the world. We have an enviable record in railway engineering and are known for consistently providing creative, technically-sound, and cost-effective solutions for our clients.

We provide all aspects of railway engineering—from concept planning, operations modeling, and environmental studies, through detailed design and construction management—for both new and existing lines. We have expertise in:

- Track alignment for design speed
- Bridge dynamics
- Stations
- Tunneling
- Railway tunnel ventilation and railway aerodynamics
- Train control
- Systems and traction power
- Systems certification
- Rolling stock certification
- Safety assessment of railway systems
- Maintenance facilities
- Independent Safety Assessment (ISA)
- Seismic engineering
- Value engineering

Whatever the challenge, Hatch Mott MacDonald/Mott MacDonald have the staff, experience, and technical skills to provide the highest level of expert guidance to our clients. We successfully deliver high-speed rail projects on time and on budget.

We are proud of our involvement in providing over 1,800 miles (2,897 km) of high-speed rail systems worldwide with design speeds ranging from 90 to 217 mph (145 to 349 km/h). Projects include:

- California High-Speed Rail - USA 217 mph (349 km/h)
- Channel Tunnel and Rail Link - UK to France 186 mph (299 km/h)
- Taiwan High-Speed Rail 217 mph (349 km/h)
- Zhengzhou to Xi’an - China 217 mph (349 km/h)
- Netherlands HSL Zuid - Amsterdam to Brussels 186 mph (299 km/h)
- Western Route Upgrades - UK 125 mph (201 km/h)
- Southeast High-Speed Rail - USA 110 mph (177 km/h)
- Hampton Roads High-Speed Rail - USA 110 mph (177 km/h)
- Richmond to Washington, DC - USA 90 mph (145 km/h)
setting the pace for high-speed rail in the U.S.

The first of its kind in the U.S., California High-Speed Rail (CAHSR) will span 800 miles (1,287 km) from San Francisco and Sacramento to San Diego. An express train departing San Francisco will arrive in Los Angeles in 2-1/2 hours — three to four hours less than traveling the same distance by car. Connecting with existing rail, air, and highway networks, the system is projected to transport 100 million passengers per year by 2030.

Hatch Mott MacDonald is providing project management, preliminary design, environmental engineering, permitting, and right-of-way acquisition services for three segments of the CAHSR system.

- The Palmdale to Los Angeles segment crosses three major seismic fault lines, densely populated cities, rivers, and steep mountains, and requires 11 miles (18 km) of tunnels and numerous viaducts.
- Fresno to Palmdale segment — the longest segment of the system at 162 miles (261 km) — will traverse several fault zones, prime farmland, the steep Tehachapi Mountains, and the Mojave Desert.
- Los Angeles to Orange County is a 30-mile (48-km) segment of shared track currently used by both Metrolink and Amtrak.

Hatch Mott MacDonald is also working on two additional high-speed rail projects in California:

- We are program manager for the design, construction, testing, and start-up of the Caltrain Downtown Extension (DTX) — a 1.3-mile (2-km) below-grade rail extension that will bring both high-speed rail (CAHSR) and Caltrain service into San Francisco’s proposed landmark $4.3 billion Transbay Transit Center.
- We are providing consulting services for a proposed Merced County High-Speed Rail Maintenance Facility.

Top & Left: Renderings of proposed California High-Speed Rail Train and the Mission Beach terminal in San Diego, CA (images courtesy of N3CD)
The $13 billion, 214-mile (344-km) Taiwan High-Speed Rail is one of the largest privately-funded transportation projects in the world. With trains running at 217 mph (349 km/h), travel between Taipei and Kaohsiung—Taiwan’s two largest cites—can be accomplished in 90 minutes.

Taiwan High-Speed Rail, which runs through densely populated corridors, was a monumental undertaking with 186 miles (299 km) of tunnels and viaducts, numerous bridges, and ten new stations.

A single control center monitors the entire line and its systems using artificial intelligence and a modern, efficient communications network to manage and supervise all train movements.

Mott MacDonald led the International Railway Engineering Group (IREG) in auditing and spot-checking all design and construction management activity related to the entire high-speed railway system, including permanent way, viaducts and tunnels, signaling, power supply, rolling stock, and stations.
Hatch Mott MacDonald/Mott MacDonald’s involvement with the world-renowned Channel Tunnel—the high-speed rail system connecting England and France—began in 1929 and culminated in 2007 with the completion of the high-speed rail link between Paris and London.

**channel tunnel**

The $6 billion, 67.7-mile-long (109-km-long) Channel Tunnel runs approximately 150 ft (46 m) beneath the English Channel and has been described as the civil engineering project of the century. It is the biggest design/build project in British civil engineering history and was the realization of a 200-year-old dream to connect England and France by rail. We were the principal designer with multidisciplinary responsibility for the tunnels and associated underground structures, coordination of all civil, mechanical, electrical, and trackwork design within the UK tunnels and Folkestone terminal, and the ventilation and aerodynamic systems throughout the entire tunnel. We provided project management, environmental work, route alignment, detailed design, advice on technical feasibility, and safety assessment.

**Channel Tunnel Rail Link**

The $16 billion, 32-mile-long (52-km-long) Channel Tunnel Rail Link—referred to as High Speed 1 (HS1)—establishes high-speed rail between the Channel Tunnel and London. The project involved 40 separate construction contracts covering tunnels, at grade, viaducts and new HSR stations, trackwork, signaling and power supplies, and provides a high-capacity, high-speed route that caters to the needs of high-speed international and commuter services and freight.

We were appointed Independent Safety Assessor and as part of a joint venture, the Project Representative for the UK Government advising on technical feasibility, implementation, and progress of the design/build project.

**awards**

The projects received numerous national and international awards, including two from the British Construction Industry Awards (BCIA):

- In 1994 the Channel Tunnel project was awarded *Outstanding Feat of Civil Engineering*
- In 2007 the Channel Tunnel Rail Link project won a *High Commendation Award*
Hatch Mott MacDonald/Mott MacDonald undertakes track alignment design for conventional high-speed and tilting trains modeling the space requirements for any type of rolling stock to optimize clearances to neighboring structures. Whether the track is ballasted or ballastless, we provide trackform and track foundation design to ensure high levels of passenger comfort, reliability and availability, and minimal maintenance downtime. Long-term performance of the trackform and rolling stock interaction behavior are modeled using our in-house software. This process ensures track lifetime and maintenance requirements can be predicted with a high level of certainty. Our proprietary software provides dynamic analysis of track and structures so the design solution minimizes noise and ground-born vibrations in suburban areas.

High-speed trains can cause excessive levels of vibration and resonance within bridges causing the ballast to become unstable and unable to provide firm support to the track. Our software tools enable the rapid dynamic analysis of bridges, taking account of the high frequency acceptance limit, effect of wheel condition on bridges, and trackform response.

We use our proprietary software to assess high-speed trains in tunnels including aerodynamics, pressure pulses, tunnel cooling, emergency and normal ventilation. Our software assesses air flows and temperatures together with smoke dispersion and control in the event of fire and air pollution in underground railway systems. These programs are vital for optimization of the design of ventilation shafts, determination of ventilation requirements, and investigation of all other facets of the system’s performance for high-speed trains. They are extremely effective in establishing the geometric configuration of tunnels, the implications of trains operating at high speeds and the aerodynamic design requirements, for rolling stock at high speeds.

Analysis results enable system optimizations and capital cost savings for the client. We have expertise in tunnel transient pressure alleviation studies, computational fluid dynamics, the study of train induced pressure pulse and slipstream effects, and the effects of cross winds on high-speed train stability.

Our rolling stock team is comprised of specialists from manufacturing, maintenance, and operating industries who bring a diverse range of experience, particularly in rolling stock tilting mechanisms. We provide complete support to clients throughout the entire procurement process for new-build rolling stock for high-speed lines, from initial development and funding negotiations through contract specification, design review, and commissioning.

Properly engineered systems are fundamental to both the demonstration of safety and the reliable operation of a high-speed rail service. Our proven capability using standardized processes and techniques enables us to capture project objectives effectively and translate these into clear system requirements and solutions.
key services
Amtrak negotiations
asset management
bid preparation and evaluation
capacity analysis/network modeling
capital cost analyses
capital replacement planning
compliance reviews
conceptual design
condition surveys
contract and construction
corridor upgrades
cost estimating and scheduling
DBFO participation
design and design management
due diligence and peer reviews
electrification studies
environmental assessments
equipment procurement
feasibility studies
financial modeling
grant preparation
host railroad negotiations (UP, BNSF, CSX, NS, CN)
ispection
load flow studies and analyses
major investment studies
management
modeling
noise and vibration analyses
operation mobilization
operational reviews
owner's engineer
owner's representative
passenger flow/emergency evacuation
simulation
planning
plans and specifications
preliminary/final design
program/project management
project management oversight (PMO)
rail activation and start-up
regulatory issues and permitting
relay coordination studies
risk/threat vulnerability analyses
route selection studies
safety assurance and certification
scope, cost and schedule
security plans
state safety oversight
systems integration
track configurations and inspections
training
transportation planning
vehicle and technology evaluations
ventilation studies
warranty administration

other key services
bid services
bridge load rating
constructability reviews
environmental mitigation
fatigue and fracture critical analysis
peer reviews
risk management and mitigation
safety improvements
seismic analysis, design and retrofit
condition inspection
value engineering

areas of expertise

rail infrastructure
ballasted
capacity improvements
direct fixation track
embedded track
emergency egress
mainline
maintenance and storage facilities
park and ride facilities
track and guideway
train layover
utility protection, relocation
yards and terminals

bridges & structures
engineered structures
grade separations (highway, rail, pedestrian)
station and passenger facilities
tunnels and underground facilities
ventilation

rail systems
at grade/level crossing active warning
systems
automated train control systems (ATCS)
automatic block signaling (ABS)
block design and simulation
centralized traffic control systems (CTC)
communication based train control (CBTC)
dark territory control systems
microprocessor-based and relay-based
signaling systems
vital control systems
yard control systems

wayside systems
dragging equipment detectors
hot box detectors
slide fences
snow clearing devices
solar powered systems
switch machines

traction power systems
AC and DC substations
corrosion/stay current control and mitigation
EMI and RFI analyses
load flow analyses and simulations
overhead contact systems
safety certification
systems integration
testing and commissioning
third rail systems

communications systems
AEI readers
alarm and intrusion detection systems
closed circuit TV
fiber optic networks
IT networks
operation control centers
passenger information systems
public address, intercom
radio systems (VHF, UHF, microwave, GPS)
supervisory control and data acquisition (SCADA)
telephone systems

ventilation
CFD modeling
emergency response plans
environmental monitoring and control systems
fire safety and evacuation simulations (STEPS)
microprocessor based automated control systems
ventilation systems designs (NFPA 130)

vibration and noise mitigation
control centers
data warehousing
environmental studies
facility operations
GIS applications

Please contact us to discuss your high-speed rail needs or for additional information.

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