MOTT MACDONALD

High-speed rail

Designing passenger rail systems that are safe, economical, energy-efficient, and faster than ever

A high-speed response to the need for growth

High Speed 2 passes through the village of Austrey in Warwickshire.

The development of high-speed rail systems is universally considered as a stimulus for economic growth and a sustainable response to population growth, increased travel demand, and transport capacity constraints.

Mott MacDonald is engaged on major high-speed rail projects around the world. We have the depth and breadth of experience to support any aspect of planning, design, engineering, and environmental services required to deliver sustainable rail systems.

Mott MacDonald has had key roles on UK High Speed 1, Taiwan's Taipei to Kaohsiung system, China's expanding network, California's High-Speed Rail project, North India's proposed Corridor 3, and HSL-Zuid in the Netherlands. Building on this portfolio, we have key roles on UK High Speed 2 and Kuala Lumpur to Singapore High Speed Rail.

Our skills in program and project management, conceptual, preliminary, and detailed design, environmental engineering, permitting, and right-of-way acquisition are helping to guide these projects to success. With 16,000 staff members around the world, we can draw on some of the world's leading professionals in transportation project delivery, from planning, design, and funding to construction and asset management.

10 ways our expertise can help you

1.

Solid relationships

Our clients include some of the world's leading transportation authorities and rail and transit companies. You benefit from the trust and understanding built during decades of previous high-speed project experience.

2

Merging old and new

Although modern technological advancements have permeated every part of rail systems, many "traditional" technologies are still in active service. Through our knowledge and experience, we help you successfully integrate existing systems with more advanced high-speed systems.

3

Integrating major systems

On large-scale projects, our requirements-based design approach plus verification and validation activities make sure errors are corrected early, schedules are met, and client costs are minimized.

4

Seeing it in 3D

With BIM and other methods, owners and operators can visualize and modify the project to achieve the outcomes they want. The project team can "build" the project in a virtual environment, rehearsing complex procedures and identifying needs.

5

A range of expertise

Our capabilities encompass every facet of rail and transit, including light rail, subway/metros, commuter rail, and freight rail.

6

Communicating clearly

Our skills in telecommunications and control are matched by our expertise in real-time customer information systems — from design of control centers to technical audits for public address and information displays.

7

Optimizing traction power

Mott MacDonald is prepared to meet the challenges of any electrification system. We use our own TRAIN® software to complete advanced computer simulation and analysis to study and refine our clients' electrification designs.

8

Moving the air

Mott MacDonald is a world leader in tunnel ventilation. Our designers use advanced simulation software to produce real-time depictions of the tunnel environment, then design appropriate, cost-effective solutions.

9

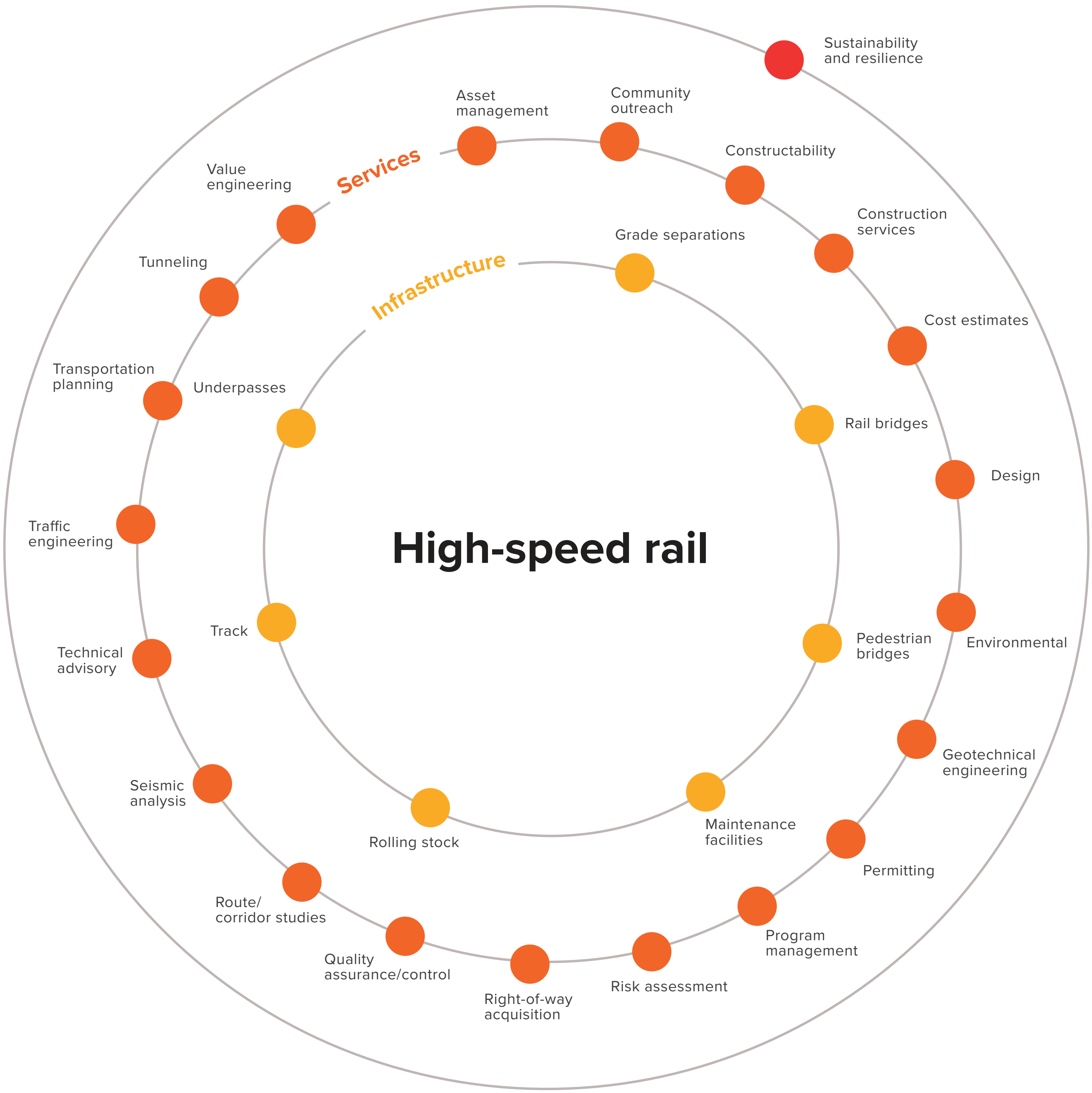
Delivering faster

Schedules can be cut significantly by making design decisions early, using standard elements when possible, resolving complex construction details ahead of time, and producing fabrication and construction drawings directly from the model.

10

Keeping it safe

Our systems engineers have conducted numerous testing and safety certification programs for our clients. These programs are critical to the successful startup and commissioning of a project.

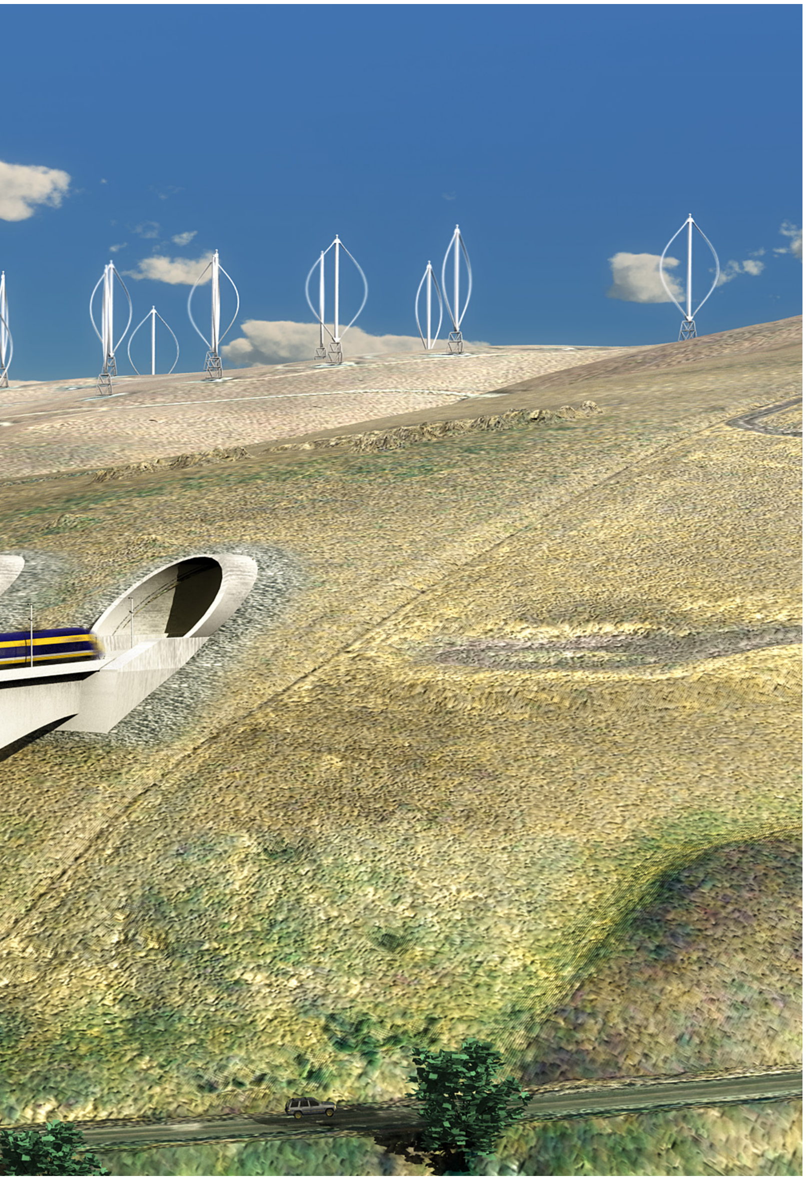

High-speed rail
Services
Infrastructure
Sustainability and resilience
Asset management
Community outreach
Constructability
Construction services
Cost estimates
Design
Environmental
Geotechnical engineering
Permitting
Program management
Risk assessment
Right-of-way acquisition
Quality assurance/control
Route/ corridor studies
Seismic analysis
Technical advisory
Traffic engineering
Transportation planning
Tunneling
Value engineering
Grade separations
Rail bridges
Pedestrian bridges
Maintenance facilities
Rolling stock
Track
Underpasses

High-speed travel in California

Mott MacDonald provided project management, engineering design, and other services for three segments of the California High-Speed Rail route.

2 hours 40 minutes

from San Francisco to Los Angeles



Opportunity

California's proposed high-speed rail system will run from San Francisco to Los Angeles in under 3 hours and at speeds exceeding 200 mph (322 kph). It will operate over 800 miles (1,287 kilometers) of track and will serve as many as 24 stations at cities including Sacramento, Stockton, San Francisco, San Jose, Fresno, Bakersfield, Palmdale, Los Angeles, Anaheim, Riverside, Irvine, and San Diego.

Solution

Mott MacDonald provided project management, engineering design, environmental, permitting, and right-of-way acquisition services for three segments of the system: Fresno to Bakersfield (110 miles or 177 kilometers), Bakersfield to Palmdale (95 miles or 153 kilometers), and Palmdale to Los Angeles (65 miles or 105 kilometers). We provided station area planning services for the cities of Gilroy, Merced, Palo Alto, Norwalk, and for Tulare County, and program management support for the Transbay Terminal in San Francisco. Our expertise in fire and life safety supported the shared corridor alternative between Los Angeles and Anaheim.

We were the engineering designer for the Bakersfield to Palmdale and Palmdale to Los Angeles sections: arguably the most difficult sections of alignment. We developed structural solutions for wide canyon and river crossings, tunneling and ventilation solutions for long and complex tunnel alignments needed to manage railroad profiles, mitigation for sensitive habitats and urban areas, and risk management and innovative engineering in high seismic zones in Southern California.

Outcome

The Central Valley segment is expected to go into service in 2027, and the San Francisco to Bakersfield section in 2029. When the project is complete, a passenger will be able to board an express train in San Francisco and step off the train in Los Angeles 2 hours and 40 minutes later. That's three to four hours less than a driver would need to cover that distance — even without traffic.

Project
California High-Speed Rail

Location
Fresno to Orange County

Client
California High-Speed Rail Authority

Expertise
Project management, preliminary design, environmental engineering, permitting, right-of-way acquisition

Connecting the United Kingdom

Curzon Street Station will be the High Speed 2 terminal in Birmingham.

Opportunity

The United Kingdom's first true high-speed line, HS1 or the Channel Tunnel Rail Link, carries passengers between London, Ashford, and the UK portal of the Channel Tunnel on dedicated high-speed tracks at speeds up to 186 mph (300 kph). As Independent Safety Assessor and Project Representative for the UK government, Mott MacDonald advised on the technical feasibility, implementation, and progress of the design-build project. We later provided full technical support for high-speed intercity regional service operating on the HS1 tracks.

High Speed 2 (HS2) is a proposed Y-shaped rail network that will be built in two phases. A 140-mile (225-kilometer) line between London and Birmingham will be constructed by 2026, including a connection to Europe via HS1 and the Channel Tunnel. Phase 2, opening in 2033, will extend the service northwards to the cities of Manchester and Leeds.

Speeds up to

186 mph

(300 kph)

Solution

For Phase 1 of HS2, we prepared preliminary engineering design for the urban London tunnels section and Old Oak Common Station intermodal/regional rail station. As part of a consortium, we carried out environmental surveys for the London metropolitan area and the rural southern section of the route, covering Buckinghamshire, Hertfordshire, Oxfordshire, and Northamptonshire. We identified and confirmed all property interests, engaging extensively with property owners, councils, charities, residents' associations, land agents, and lawyers.

For Phase 2, we developed the alternative analysis and station options for the Birmingham to Manchester line, working in close collaboration with HS2's environmental teams. We analyzed alternatives for the Birmingham to Leeds leg of the Y.

Top: The Delta Junction in Birmingham is the most complex portion of the project.

Bottom: Lymm Bridgewater Canal.

Outcome

HS2 is the most significant transport infrastructure project in the UK since the motorways were built in the 1950s and 1960s. It will reduce travel time between major population centers, connecting the country's regions and economic growth through regeneration and job creation. The benefits of HS2 will extend far beyond cities that have their own high-speed stations.

Project
High Speed 2

Location
United Kingdom

Client
HS2 Ltd.

Expertise
High-speed rail engineering, design, environmental services, right-of-way

90 minutes from Kuala Lumpur to Singapore

Passengers can leave Kuala Lumpur (top) and arrive in Singapore (opposite) in only 90 minutes.

Opportunity
In 2013, the prime ministers of Malaysia and Singapore agreed to build a high-speed rail link between their countries. The goal was to facilitate seamless travel between their capital cities, enhance business connections, and bring the people of both countries closer together.

Project
Kuala Lumpur-Singapore High-Speed Rail

Location
Malaysia, Singapore

Client
Land Transport Authority, MyHSR

Expertise
Project management, procurement and technical advice, safety standards, tender documentation

$5 billion

increase in Malaysia's GDP

Solution

In 2017, a consortium including Mott MacDonald was awarded a contract to provide project management, procurement, and technical advice for the project team of Singapore's Land Transport Authority (LTA) and the Malaysian corporation MyHSR. With our partners, we brought together specialists from six countries to create a strong local integrated team.

The technical team led by Mott MacDonald has advised on engineering safety and regulatory requirements, operating speed, system capacity, and journey time. We have worked closely with MyHSR and LTA to develop system-neutral specifications and concept designs for rolling stock and systems procurement. We have provided technical advice on fire and life safety, interface and stakeholder management, system assurance, operational concept, and cross-border coordination and regulatory alignment.

During our two-year contract, our team has delivered recommended safety standards, validated ridership studies, modeled operational scenarios to determine capacity and service patterns, managed the interface between seven design organizations, and established overarching standards for all parties to follow.

Outcome

According to MyHSR, the rail line will link two of Southeast Asia's "most vibrant and fast-growing economic engines." When completed in 2026, service will run every 30 minutes, reducing travel time from about four hours by car to 90 minutes. The line will extend for 217 miles (350 kilometers), with seven stops in Malaysia and one in Singapore. By 2060, the government of Malaysia estimates it will boost the country's GDP by $5 billion through socioeconomic development along the alignment.

Service every

30 minutes

Supporting economic growth in Taiwan

Opportunity
In the second half of the twentieth century, Taiwan's economy grew so quickly that its western transport corridor, including highways, conventional rail, and air traffic systems, became saturated and an obstacle to further economic growth. A new high-speed rail line was first suggested in the 1970s, with informal planning getting underway in the 1980s.

Trains reach top speeds of 186 mph (300 kph) and are accessible to almost 90% of Taiwan's population.

Project
Taiwan High Speed Rail

Location
Taiwan

Client
Taiwan High Speed Rail Corporation

Expertise
Asset management, safety, site engineering

2,000
engineers from 20 countries

Solution

As part of an international joint venture, Mott MacDonald led the International Railway Engineering Group (IREG) through all stages of design and construction over a six-year schedule, acting as independent checking and site engineer. At the time, this was among the world's largest privately funded transport projects. The route was 217 miles (350 kilometers) in length, had 168 miles (270 kilometers) of bridges and viaducts, 18 miles (45 kilometers) of tunnels, and 19 miles (30 kilometers) of earthworks. The system operates using Shinkansen vehicles using an electrified traction power system, and has three depots and two maintenance bases.

We were also appointed to develop a comprehensive asset management strategy for the rail line's civil infrastructure. Construction of the system took more than six years, drawing on the work of more than 2,000 engineers from 20 countries and more than 20,000 foreign and domestic workers.

90%

of population served

Outcome

Taiwan High Speed Rail runs over a route length of 217 miles (350 kilometers) along the west coast of Taiwan, from the capital Taipei to the city of Kaohsiung. Trains reach top speeds of 186 mph (300 kph) and are accessible to almost 90% of Taiwan's population. Because most of the intermediate stations are outside the cities served, transfer options such as free shuttle buses, conventional rail, and metros have been developed.

The rail line opened in 2007, and by December 2016 more than 400 million passengers had used it. With our help, Taiwan High Speed Rail Corporation has the necessary assurance that its civil infrastructure is being maintained in a safe condition for use by the operator.

By 2015, China had the world's longest high-speed rail network.

Project
Daxi PDL Section, Hefu PDL Anhui Section, Hefu PDL Min'gan Section, and Hukun PDL

Location
People's Republic of China

Client
Chinese Ministry of Railway

Expertise
Construction management, quality management, site supervision

Keeping China at the forefront of high-speed rail

Opportunity

For many years, high-speed rail has been one of China's top infrastructure investment priorities. China's expansion of high-speed rail is managed entirely by the Chinese Ministry of Railway, which since 2006 has embarked on an ambitious new construction plan.

By 2015, China had the world's longest high-speed rail network, totaling more than 12,036 miles (19,370 kilometers) — more than the rest of the world combined. This expansion is set to continue so that China will have over 16,000 miles (25,750 kilometers) of high-speed rail line by 2020.

Solution

Mott MacDonald has been closely involved with the construction of four separate projects: the Daxi PDL Section, Hefu PDL Anhui Section, Hefu PDL Min'gan Section, and Hukun PDL. Each of these has design speeds between 156 mph (250 kph) and 220 mph (350 kph). Based on site, our staff provided quality management and site supervision services throughout the construction schedule and over a combined route length of 250 miles (400 kilometers).

Outcome

The development of high-speed rail in China will expedite the mass movement of population from rural areas to urban centers and will expand economic opportunities, free up existing lines for freight capacity, and increase employment. Construction of the Beijing-Shanghai line alone employed about 100,000 workers and engineers.

Writing in 2014, Chris Hale of the University of Melbourne said, "Within just a few years, China's 2400 km north-south spine will be linked by a giant rail network, with Hong Kong on one end, Beijing at the other, and hundreds of millions of people in between."

China has been able to build and operate high-speed rail at less cost than European countries, and as of 2014 a ticket from Shenzhen to Guangzhou cost less than $6. Chinese companies have built high-speed lines in Turkey and Venezuela, with discussions underway to build projects in Brazil, Russia, Poland, and Saudi Arabia.

Realizing a vision for speed in India

In its Vision 2020, Indian Railways proposed the development of 1,250 route miles (2,000 kilometers) of high-speed rail corridors.

Project
India high-speed rail, Corridor 3

Location
Delhi to Kolkata

Client
Ministry of Railways

Expertise
Rail systems, rolling stock, track and structural design, travel demand forecasting, cost estimating and economic analysis

Opportunity

India has one of the world's most extensive rail networks, with over 40,000 route miles, over 7,000 stations, 833 tons of freight each year, and almost 7 billion passengers. India's Ministry of Railways is one of the world's largest employers with more than 1.4 million staff.

Economic growth has brought increased ridership. The Indian government recognized the need for energy-efficient and sustainable intercity transportation to meet this demand. In its Vision 2020, Indian Railways proposed a National High-Speed Rail Authority and the development of 1,250 route miles (2,000 kilometers) of high-speed rail corridors. Six corridors were identified.

Solution

Mott MacDonald was appointed to study Corridor 3, Delhi to Patna and Kolkata, and to advise India's Ministry of Railways on the technical feasibility, cost, and economic benefits. We used a team based in Delhi and brought together international expertise in high-speed rail, economics, and project delivery.

Our study identified preferred alignments over the 625-mile (1,000-kilometer) corridor between Delhi and Patna, and analyzed station location alternatives in the cities of Mathura, Agra, Kanpur, Lucknow, Varanasi, and Patna. We undertook preliminary engineering design to address multiple crossings of the Ganges and the need for an elevated guideway along much of the alignment.

We also provided recommendations for rolling stock and systems, determined operating speeds and travel time, undertook ridership demand analysis and cost estimates, and advised on the likely economic benefits. Our final report included recommendations on project funding and project execution.

Outcome

According to the Indian government, high-speed rail will bring the time and cost of transportation down, making them the lowest in the world. Goods and people that used to take three days to transport can be moved in three hours.

High-speed rail will make Indian exports and manufacturing more cost-competitive, benefit the suppliers of manufacturing components, accelerate scientific research, integrate regions more strongly, and increase employment.

From Dresden to Prague in 50 minutes

Opportunity

According to the European Union, “The current line between Dresden and Prague traces an undulating route through the environmentally significant Elbe valley, and has been subject to flooding in the recent past. It is expected to reach capacity in the coming years as passenger and freight volumes increase.” The EU refers to the rail link as “one of the most serious future bottlenecks” in the region’s rail network.

An EU report calls the improvement of the line one of the most important railway projects in Central Europe, saying, “It is a vital part of the Orient/East-Med Corridor of the Trans-European Transport Network, which connects the North and Baltic Sea ports and economic centers in Southeast Europe.”

60%+

reduction in travel time

Solution

Mott MacDonald was appointed by Správa Železniční Dopravní Cesty to carry out two studies for a new cross-border railway line that will connect Dresden in Germany to Prague in the Czech Republic. The new railway will be a part of the Trans European Transport Network's Orient/East-Med core corridor and the first section of the Czech Republic's future high-speed rail network. Using electric traction, it will pass through the Ore mountains, avoiding railway congestion through the Elbe valley — a popular tourist region.

With our project partners, we have undertaken geotechnical investigations, environmental impact assessments for the alignment options, technical investigation for major bridges and long tunnels, a preliminary economic evaluation, an implementation plan, publicity services, and a review of Czech, German, and European legal procedures.

Outcome

The new line is expected to reduce travel time from Dresden to Prague from 2 hours and 15 minutes to only 50 minutes. It will reduce noise and traffic pollution in the Elbe River and provide a connection to the Czech Republic that is protected from flooding.

The portion of the route between the German-Czech border and Prague will run along an existing highway, reducing the environmental impact. Freight trains will continue to use the existing double-track lines, increasing freight capacity.

The rail line takes passengers from Dresden (top), through the Ore Mountains (middle), to Prague (right).

Project
Dresden-Prague high-speed rail line

Location
Germany, Czech Republic

Client
Správa Železniční Dopravní Cesty

Expertise
High-speed rail systems, civil engineering, tunneling, geotechnical services

Project
HSL-Zuid

Location
Netherlands

Client
Infraspeed and Rijkswaterstaat

Expertise
Design, risk assessment,
cost estimates

Northbound trains terminate at Amsterdam's Central Station.

Faster, safer travel from Holland to Belgium

Opportunity

HSL-Zuid (High Speed Rail South) was developed to provide faster and more efficient travel between the Netherlands and Belgium. Opening in 2009, the high-speed line runs 78 miles (125 kilometers) from Amsterdam to the Belgian border, with a branch line to Breda.

Solution

Mott MacDonald was closely involved with HSL-Zuid from the early design phases through construction, an independent safety assessment, and validation of track design. We worked closely with Infraspeed, the consortium commissioned to design and construct the rail systems, to identify a track form suitable for operation at 155 mph (250 kph). A key requirement was to identify a track form solution that required minimal maintenance.

The Rheda 2000 track system was chosen for its performance on other high-speed rail systems, notably in Germany. To avoid unpredictable and uneven settlement of the track near the Belgian border, Mott MacDonald carried out a design review, whole life cost, and risk assessment of proposed alternative track forms.

Outcome

Since the system opened, an increasing number of trains have been added to HSL-Zuid. To ensure the safety of passengers, we worked with Holland Rail Consult (now Movares) to carry out an independent safety assessment of the track systems. A key issue was to verify that lessons learned following the Eschede derailment in Germany were taken into account.

Opening opportunities
with connected thinking.

**For more information, write to
americas@mottmac.com or call 800.832.3272.**

mottmac.com