THE INDIAN EXPRESS

The Big Picture

SATURDAY, MAY 9, 2026

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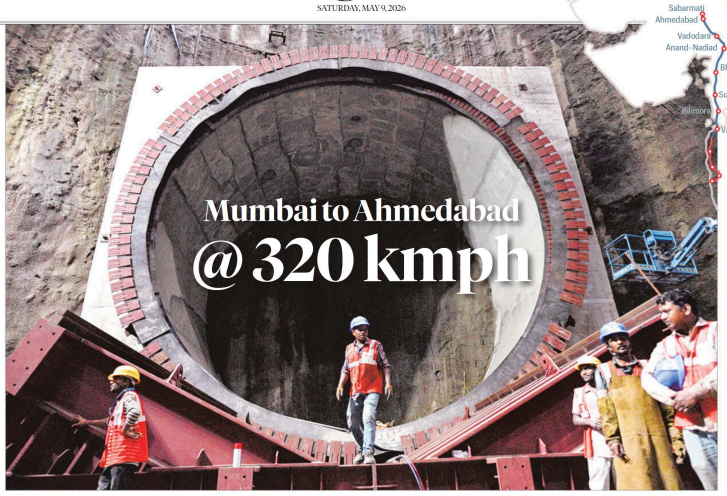
21 km (including a 7-km undersea tunnel beneath the Thane creek)

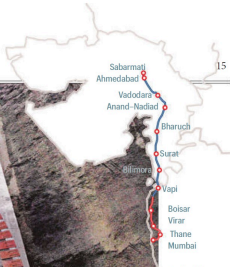
8 Mountain tunnels

28 Steel bridges

25 River bridges



Mumbai to Ahmedabad @ 320 kmph



Bullet lines

Apart from Mumbai-Ahmedabad, the government has announced seven other high-speed networks

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- Pune-Hyderabad
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Viaducts that fly over high-rises, 53 steel and river bridges, a 7-km undersea tunnel, and machines that can move mountains. DHEERAJ MISHRA and photographer SANKHADEEP BANERJEE travelled along the 508-km bullet train route, from Ahmedabad to Mumbai, to map the scale of one of India's biggest infrastructure projects

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Almost a decade after Prime Minister Narendra Modi laid the foundation stone for the bullet train project in September 2017, the country's high-speed dreams are finally taking shape in the form of the 508-km Mumbai-Ahmedabad corridor.

The government hopes to build seven other lines, spanning 4,000 km, at a cost of Rs 16 lakh crore. The Rs 1.98-lakh-crore Mumbai-Ahmedabad line has Japan as its primary partner. As part of the initial deal signed in 2017, Japan was to supply its famed Shinkansens. However, amid growing "uncertainties", sources said, India has already started building its own bullet trains at a BEML plant in Bengaluru.

After multiple delays, the Mumbai-Ahmedabad High Speed Rail corridor is expected to be operational by 2029. The first of the stretches, the 48 km from Surat to Billimora, is scheduled to be completed by August 2027.

Over the Sabarmati

Overlooking the quiet flow of the Sabarmati is a 480-metre-long viaduct (bridges on which elevated railway lines or roads run). Over 90%, or 465.38 km, of the high-speed network's 508-km-long tracks will run on viaducts such as these, at heights of over 20 metres from the ground, making a journey in the bullet train a ride through the skies.

A senior officer of the National High Speed Rail Corporation Limited (NHSRCL), the government organisation responsible for building and managing the high-speed rail corridors, said that unlike in European countries, the bullet train's tracks had to be elevated for safety reasons. "We could not have run the bullet train on the surface. People and animals cross the railway line. Even on the railway's broad gauge lines, where trains can go up to 160 kmph, barricades are installed on either side of the tracks. Here, in the case of the bullet train, we are talking of speeds of 300 kmph and upwards," the officer said.

The under-construction viaduct at Sabarmati river, which leads to one of the terminal points of the railway line, overlooks three other bridges. The closest is an old railway bridge, its tightly spaced piers (the columns or pillars that support a viaduct) reminiscent of an earlier era of rail construction.

Vijay Rebera, Deputy Chief Project Manager at the site, said that before the seven piers of the viaduct were built, engineers had to build piles (deep foundations to support heavy bridge loads) underwater. "For every pier, we have to cast 16 piles under the Sabarmati. This is one of the most difficult projects I have ever worked on. The bullet train itself will be light, but since it will have to travel at such high speeds, other dynamic forces such as air resistance, vibrations, and centrifugal forces will come into play. So the bridge has to be really strong," he says.

A few kilometers from the Sabarmati viaduct is a steel bridge being built over a road bridge. The structure, 80 metres long, is one of 28 steel bridges planned along the corridor. The bridge has seismic stoppers installed at its piers to help it withstand earthquakes. More than 36,000 bolts hold the structure together.

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Inside a Surat slab factory

At a 14-acre factory in Kim, Surat, Arkin Yadav, a site worker from Uttar Pradesh, fixes his digital depth caliper to one side of a 4.5-tonne track slab to measure its thickness. The track slab is the bed on which the high-speed rails will rest. The machine reads 191 mm. Perfect, so he marks "OK" on its surface.

Even a minor variation would have made it redundant. The factory was set up in September 2023 to manufacture track slabs, one of two such facilities in Gujarat, for the Vapi-Vadodara stretch of the bullet train. At peak capacity, the facility can cast 120 track slabs a day. The Vapi-Vadodara stretch will need 96,000 track slabs, of which the Kim factory has supplied 36,000 so far.

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It's a partnership that's evident at the HSR Depot in Surat-Niyol, nearly 30 km away. The depot is where the high-speed coaches will come for routine inspections once the project takes off.

Two engineers from Japan, Hokutu and Nake Mura, are at the facility to train Indian engineers to operate a wheel lathe machine.

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"The machine was originally designed by the Germans, then the Japanese learned from them. Now we are passing the knowledge on to India," he says.

In the making of the bullet train are technological advances of the kind India has rarely witnessed before. Over a century after the British laid railway lines, using hard labour to lay thousands of kilometres of tracks, these high-speed lines are being put together by machines that tower over the landscape.

Enter Maharashtra

As the project enters Maharashtra, the landscape changes. In Basantwadi village, an Adivasi belt in Palghar district, the high-speed line cuts through the foothills of the Sahyadris. Tunnels replace viaducts and engineering becomes more complex.

Around 26.22 km (5.16%) of the 508-km high-speed line runs through tunnels. Of this, 21 km is in Mumbai and includes India's first 7-km undersea tunnel that runs beneath the Thane creek.

Engineers of L&T working at Tunnel No. 6, a 380-metre-long mountain tunnel at Basantwadi, say the geological composition of the area — young basalt rock, mixed with layers of soil — makes excavation difficult and unpredictable. Work on the tunnel started in January 2025 and breakthrough was achieved in 350 days.

"The maximum overburden — the thickness of rock above the tunnel — is just 20 meters. For nearly 250 meters of the stretch, it drops to less than 14 metres, making the excavation very difficult. For the first time, we have an automatic, real-time monitoring system that tells us in advance if there is any possibility of tunnel collapse," he says.

Deen Dayal Mathuria, project director of L&T at the site, said the tunnel, with a horseshoe-shaped opening, will have a hood at the entrance. "At high speeds, a train entering a tunnel creates a powerful pressure wave and generates a loud, explosive sound. The entrance hood helps release this pressure gradually and reduce the noise," he says.

Nearly 20 km from the tunnel, in Gowana village, Palghar district, a massive launching gantry is at work, picking 980-tonne girders, each 40 metres long, and placing them into position. One after another, these segments come together to form the viaduct or bridge, the spine on which the train will run.

At the centre of this operation is the girder transporter — a 400-tonne, 216-wheel carrier. It moves slowly, much like the Hunter-Killer machines in the *Terminator*, but with far gentler intent, as it carries girders from the casting yard, 2 km away, and shifts them to the launching gantry. The launching of a single girder takes about an hour.

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21-km tunnel in Mumbai

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The tunnel cuts through the Parsik hills. In some sections, the thickness of the rocks above the tunnel was 160 metres, but elsewhere, it would drop to as little as 20 metres. At one particularly sensitive point, officials said, only 4 metres separated the tunnel from the pipelines above.

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"For this 21-km tunnel, we mapped over 600 buildings overground to document existing cracks. Before carrying out the blasting, instruments such as crackmeters, tiltmeters, and seismometers were installed across nearly 50 buildings. At most, there was a slight vibration during the blasting process, like what you feel standing on a bridge," said a senior NHSRCL engineer.

The project ends at Bandra Kurla Complex (BKC), the only underground station of the project. The worksite is a gigantic cavern, like a part of the earth has been gouged out. Outside, the multi-storeyed buildings of the business district seem diminished, resembling a child's LEGO set.

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(Top) At Vikhroli in Mumbai, one of the many tunnels through which the Mumbai-Ahmedabad high-speed line will pass; work on at the Ahmedabad station of the bullet train

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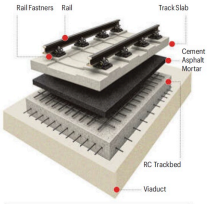

Length of high-speed networks (in km)

China	50,000
Spain	3,993
Japan	3,147
France	2,760
Germany	1,631
India*	508*

*UNDER CONSTRUCTION
(SOURCE: INTERNATIONAL UNION OF RAILWAYS)

NHSRCL
National High Speed Rail Corporation Ltd.

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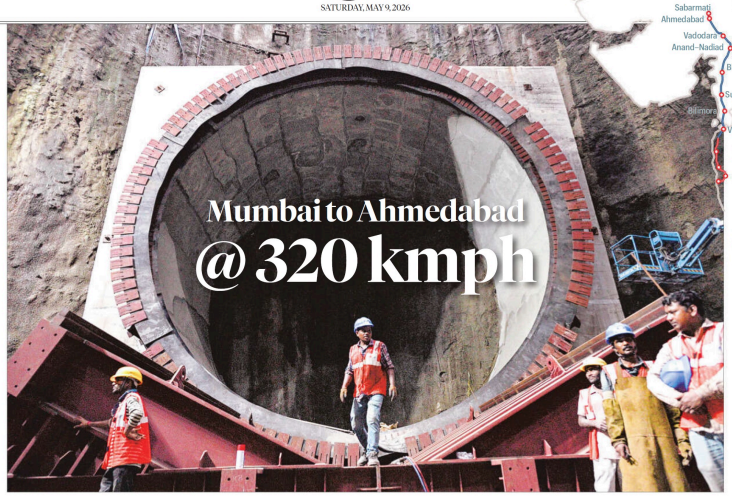

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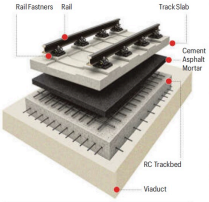

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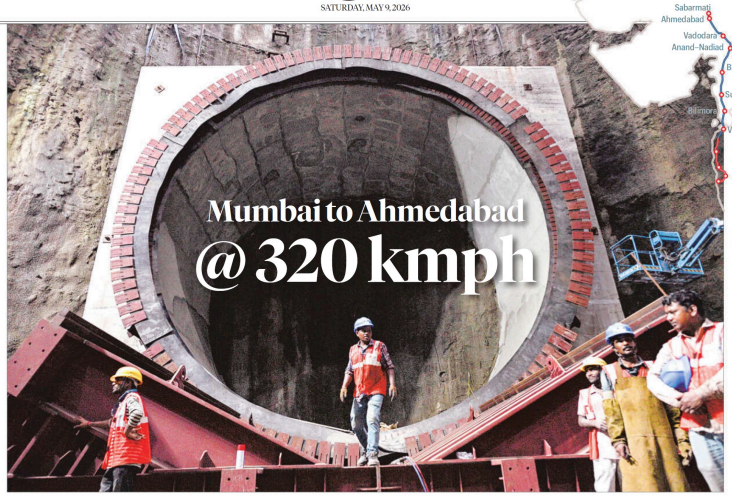

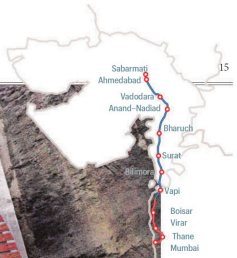

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Over the Sabarmati

Overlooking the quiet flow of the Sabarmati is a 480-metre-long viaduct (bridges on which elevated railway lines or roads run). Over 90%, or 465.38 km, of the high-speed network's 508-km-long tracks will run on viaducts such as these, at heights of over 20 metres from the ground, making a journey in the bullet train a ride through the skies.

A senior officer of the National High Speed Rail Corporation Limited (NHSRCL), the government organisation responsible for building and managing the high-speed rail corridors, said that unlike in European countries, the bullet train's tracks had to be elevated for safety reasons. "We could not have run the bullet train on the surface. People and animals cross the railway line. Even on the railway's broad gauge lines, where trains can go up to 160 kmph, barricades are installed on either side of the tracks. Here, in the case of the bullet train, we are talking of speeds of 300 kmph and upwards," the officer said.

The under-construction viaduct at Sabarmati river, which leads to one of the terminal points of the railway line, overlooks three other bridges. The closest is an old railway bridge, its tightly spaced piers (the columns or pillars that support a viaduct) reminiscent of an earlier era of rail construction.

Vilay Behera, Deputy Chief Project Manager at the site, said that before the seven piers of the viaduct were built, engineers had to build piles (deep foundations to support heavy bridge loads) underwater. "For every pier, we have to cast 16 piles under the Sabarmati. This is one of the most difficult projects I have ever worked on. The bullet train itself will be light, but since it will have to travel at such high speeds, other dynamic forces such as air resistance, vibrations, and centrifugal forces will come into play. So the bridge has to be really strong," he says.

A few kilometers from the Sabarmati viaduct is a steel bridge being built over a road bridge. The structure, 80 metres long, is one of 28 steel bridges planned along the corridor. The bridge has seismic stoppers installed at its piers to help it withstand earthquakes. More than 36,000 bolts hold the structure together.

While Japan moved directly from metre gauge (a narrow gauge in Japanese standard) to high-speed networks, India took the longer route, moving from narrow and metre gauge to broad gauge (maximum speeds of 160 kmph) that now form over 97% of the rail network. The next step, high-speed, took years to take off.

Inside a Surat slab factory

At a 14-acre factory in Kim, Surat, Arjun Yadav, a site worker from Uttar Pradesh, fixes his digital depth caliper to one side of a 4.5-tonne track slab to measure its thickness. The track slab is the bed on which the high-speed rails will rest. The machine reads 191 mm. Perfect, so he marks "OK" on its surface.

Even a minor variation would have made it redundant. The factory was set up in September 2023 to manufacture track slabs, one of two such facilities in Gujarat, for the Vapi-Vadodara stretch of the bullet train. At peak capacity, the facility can cast 120 track slabs a day. The Vapi-Vadodara stretch will need 96,000 track slabs, of which the Kim factory has supplied 36,000 so far.

Sanchit Garg, overall in-charge and joint general manager of IRCON, said 16 engineers had arrived from Japan to train engineers at the Kim facility.

It's a partnership that's evident at the HSR Depot in Surat-Nhyol, nearly 30 km away. The depot is where the high-speed coaches will come for routine inspections once the project takes off.

Two engineers from Japan, Hokutu and Nake Mura, are at the facility to train Indian engineers to operate a wheel lathe machine.

Hokutu, who has previously worked on Joetsu Shinkansen, explains that the bullet train's steel wheels wear out from repeated contact with the tracks at high speeds. The wheel lathe machine restores the wheel's shape by shaving off a very thin outer layer of metal, a process called reprofiling. "A new wheel starts with a diameter of 860 mm. Every reprofiling makes it smaller, but once it reaches 790 mm, the wheel can no longer be used," he says.

"The machine was originally designed by the Germans, then the Japanese learned from them. Now we are passing the knowledge on to India," he says.

In the making of the bullet train are technological advances of the kind India has rarely witnessed before. Over a century after the British laid railway lines, using hard labour to lay thousands of kilometres of tracks, these high-speed lines are being put together by machines that tower over the landscape.

Enter Maharashtra

As the project enters Maharashtra, the landscape changes. In Basantwadi village, an Adivasi belt in Palghar district, the high-speed line cuts through the foothills of the Sahyadris. Tunnels replace viaducts and engineering becomes more complex.

Around 26.22 km (5.16%) of the 508-km high-speed line runs through tunnels. Of this, 21 km is in Mumbai and includes India's first 7-km undersea tunnel that runs beneath the Thane creek.

Engineers of L&T working at Tunnel No. 6, a 380-metre-long mountain tunnel at Basantwadi, say the geological composition of the area — young basalt rock, mixed with layers of soil — makes excavation difficult and unpredictable. Work on the tunnel started in January 2025 and breakthrough was achieved in 380 days.

"The maximum overburden — the thickness of rock above the tunnel — is just 20 meters. For nearly 250 meters of the stretch, it drops to less than 14 metres, making the excavation very difficult. For the first time, we have an automatic, real-time monitoring system that tells us in advance if there is any possibility of tunnel collapse," he says.

Deen Dayal Matharia, project director of L&T at the site, said the tunnel, with a horseshoe-shaped opening, will have a hood at the entrance. "At high speeds, a train entering a tunnel creates a powerful pressure wave and generates a loud, explosive sound. The entrance hood helps release this pressure gradually and reduce the noise," he says.

Nearly 20 km from the tunnel, in Gowana village, Palghar district, a massive launching gantry is at work, picking 980-tonne girders, each 40 metres long, and placing them into position. One after another, these segments come together to form the viaduct or bridge, the spine on which the train will run.

At the centre of this operation is the girder transporter — a 400-tonne, 216-wheel carrier. It moves slowly, much like the Hunter-Killer machines in the *Terminator*, but with far gentler intent, as it carries girders from the casting yard, 2 km away, and shifts them to the launching gantry. The launching of a single girder takes about an hour.

From his house in Gowana, a village of around 6,000, Sachin Pardi can see the blue launching gantry. "*Mar jaayenge, lekin kabhi iss train mein nahi baith paayenge* (We will die, but may never get to ride this train), I have to be born again to sit in the train," smiles Pardi, a paddy farmer.

Work on the viaduct continues through the night. With it, the hum of machinery and a siren that goes out loud intermittently before every new activity. "There is a lot of noise. It is very difficult for us to sleep," he says.

Work on the viaduct continues through the night. With it, the hum of machinery and a siren that goes out intermittently

21-km tunnel in Mumbai

At Shilphata in Mumbai, the tunnel passes beneath critical urban infrastructure — two major water pipelines and a 610-mm gas pipeline.

The tunnel cuts through the Parsik hills. In some sections, the thickness of the rocks above the tunnel was 160 metres, but elsewhere, it would drop to as little as 20 metres. At one particularly sensitive point, officials said, only 4 metres separated the tunnel from the pipelines above.

"An error in excavating the tunnel could have damaged these pipelines. Here, the excavation had to be carried out manually," says Krishan Singh, Deputy Chief Project Manager at the site.

"For this 21-km tunnel, we mapped over 600 buildings overground to document existing cracks. Before carrying out the blasting, instruments such as crackmeters, tiltmeters, and seismometers were installed across nearly 50 buildings. At most, there was a slight vibration during the blasting process, like what you feel standing on a bridge," said a senior NHSRCL engineer.

The project ends at Bandra Kurla Complex (BKC), the only underground station of the project. The worksite is a gigantic cavern, like a part of the earth has been gouged out. Outside, the multi-storeyed buildings of the business district seem diminished, resembling a child's LEGO set.

At Mumbai, India's railway story comes full circle. It was in Mumbai that the country's first passenger train ran between Bori Bunder (present-day Chhatrapati Shivaji Maharaj Terminus) and Tannah (now Thane) in 1853. The city will now host the terminus of India's first high-speed train.

(Top) At Vikhroli in Mumbai, one of the many tunnels through which the Mumbai-Ahmedabad high-speed line will pass; work on at the Ahmedabad station of the bullet train

508 km Mumbai-Ahmedabad corridor | **1.98 lakh cr** Estimated cost

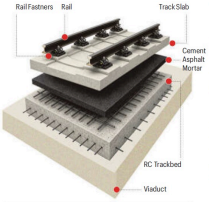
Mumbai to Ahmedabad: Travel time

BULLET TRAIN	VANDE BHARAT	BY FLIGHT	BY ROAD
1 hour 58 minutes	5 hour 40 minutes	1 hour 30 minutes	9 hours

SPECIAL TRACKS

The Mumbai–Ahmedabad High-Speed Rail Corridor adopts the Japanese "J-slab" ballastless track system. It does not use loose stones (ballast) like traditional railway tracks. Instead, the rails are fixed on a solid concrete structure (slab), similar to what Japan's Shinkansen uses

A typical J-slab track has four key layers/components:



Length of high-speed networks (in km)