

## HydroSurveyor Enables Rapid Indian Railways Bridge Surveys



Shahibaugh Railway Bridge over Sabarmati River, Ahmedabad, India.

### Acoustic Technology Makes Railways Safer

Every day, Indian Railways (IR) carries 23 million travelers and 3 million tonnes of freight on routes covering 95,981 kilometres (km). Maintaining one of the world's largest railway systems—with more than 1,23,500 km of track spanning deserts and jungles, crowded cities and empty landscapes, mountains and coastlines—IR must maintain constant surveillance of the condition of its 1,47,523 bridges to keep its network running.

IR runs more than 13,500 passenger trains daily, from Mail or Express trains chugging at an average speed of 50.6 kilometres per hour to premium passenger trains running 140 to 150 km/h and the flagship Gatiman Express between New Delhi and Jhansi topping out at speeds of 160 km/h. At the same time, more than 9,000 freight trains carry goods that fuel one of the world's most dynamic economies. More than 12,000 locomotives, 2,89,185 wagons and 74,000 coaches keep Asia's largest railway—and the world's second-largest railway under single management—rolling.



**HydroSurveyor-M9**

#### SONTEK:

Founded in 1992 and advancing environmental science in over 100 countries, manufactures affordable, reliable acoustic Doppler instrumentation for water velocity measurement in oceans, rivers, lakes, harbors, estuaries, and laboratories.

Headquarters are located in San Diego, California. SonTek is part of Xylem, Inc., a company that provides monitoring and data collection instrumentation to global water quality, water quantity, and aquaculture markets.

#### ADDITIONAL INFORMATION:

For more information about SonTek visit [SonTek.com](http://SonTek.com), or email SonTek directly at [inquiry@SonTek.com](mailto:inquiry@SonTek.com).



a xylem brand

In a system as crowded and vital as IR's, bridge failure can be catastrophic. The threat is heightened because 37,689 of IR's bridges are more than 100 years old. Though the Ministry of Railways notes that age is not an indicator of soundness, it also points out that a century ago, bridges were designed for lighter loads than they are today. Regardless of the age or even the condition of a bridge, the biggest concerns in bridge safety is scour, the removal of sediment from around bridge abutments and piers caused by swiftly flowing water.

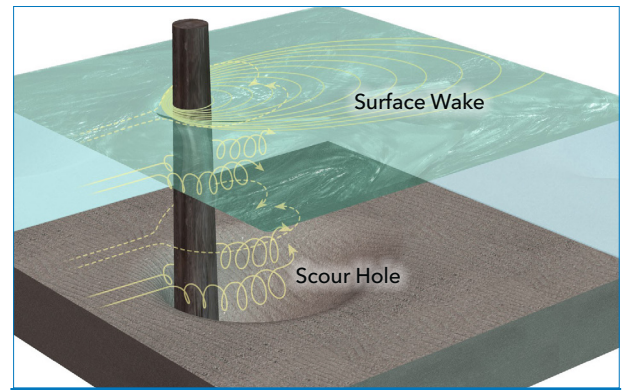
The resulting scour holes can compromise the integrity of the structure. Bridge scour is one of the three main causes of bridge failure (the others being collision and overloading). It has been estimated that 60% of all bridge failures result from scour and other hydraulic-related causes. It is the most common cause of highway or railway bridge failure.

Water normally flows faster around piers and abutments, making them susceptible to local scour. At bridge openings, contraction scour can occur when water accelerates as it flows through an opening that is narrower than the channel upstream from the bridge. Degradation scour occurs both upstream and downstream from a bridge over large areas. Over long periods of time, this can result in lowering of the stream bed and, finally, weakening of the bridge structure.

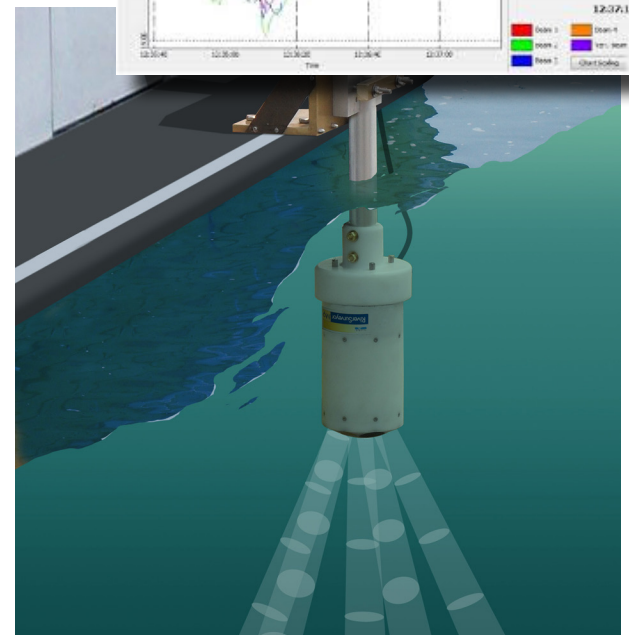
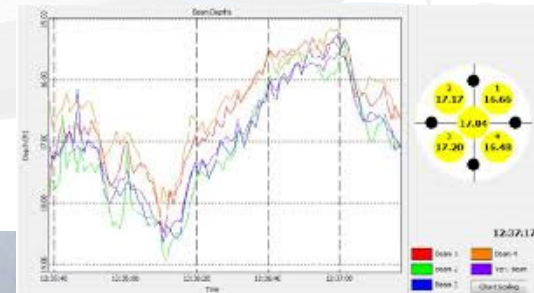
Gathering data on the bridge scour over a period of years is the only way that early warning can be issued to direct measures to strengthen endangered piers and abutments. Bathymetry surveys that measure depth and velocity near the bridge pier are considered the best technique to gather long-term data around the bridge piers.

The HydroSurveyor-M9 system from SonTek, a Xylem brand, is an instrument/technology that Indian Railway has employed to rapidly measure bathymetry data along with velocity data. The HydroSurveyor is a multi-frequency acoustic Doppler current profiling system (ADCP) equipped with nine acoustic beams, five of which are used to survey at any one time; four slanted beams provide a velocity profile from up to 128 cells as well as measure depth, and then there is a vertical beam with an 80m range which measures the depth directly below the system. The HydroSurveyor thus provides a detailed profile of velocity with depth as well as providing a detailed bathymetric map that can identify scour holes. A moving boat survey is conducted using the HydroSurveyor to measure the velocity around the piers and surveys from 100 meters upstream and downstream of the piers provide the data for studies on the changes occurring pre and post monsoon season.

The monsoon season occurs in parts of India from June to September, and several changes occur during the monsoon due to high velocity of water carrying heavy sediment loads.



Flood events on rivers can cause erosion of the soil around a bridge foundation. This process is referred to as bridge scour. Over time, scour can cause dangerous foundation instability and is the leading cause of bridge failure.



The HydroSurveyor-M9 can be deployed via a floating platform, such as the SonTek HydroboardII, or boat mounted as you see in this example.

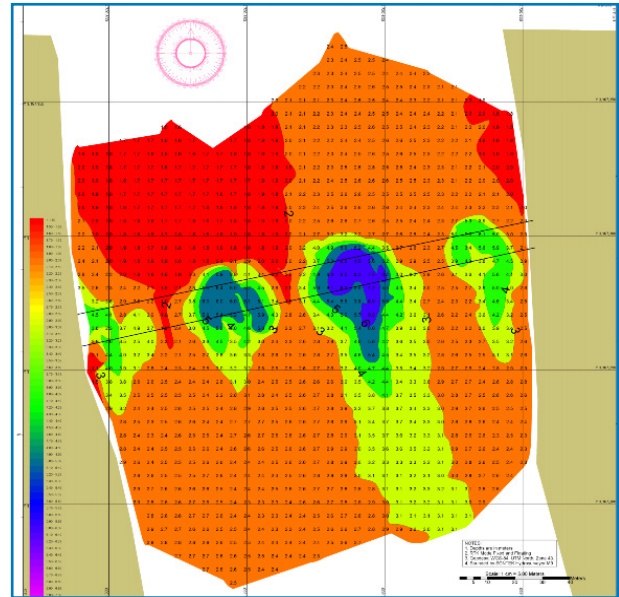
The HydroSurveyor system's slanted beams are mounted at a 25 degree off-axis angle, providing a 50 degree 'swath' for the depth measurement. This means that the time spent "driving" the boat is minimized in comparison with single beam instruments. The HydroSurveyor also incorporates built-in navigation, and compensation for speed of sound and integrated RTK GPS positioning.

Rajiv Bhatia, a SonTek Application Specialist at Xylem Analytics, says "the HydroSurveyor is unique because it is the only product on the market that is able to make real-time corrections for thermoclines, saline stratification and the effects of boat pitch and roll." User-friendly software provides a central recording and processing platform that enables users to develop bathymetric maps and velocity maps, using properly gridded data points—a function that is automated and fully embedded in the software.

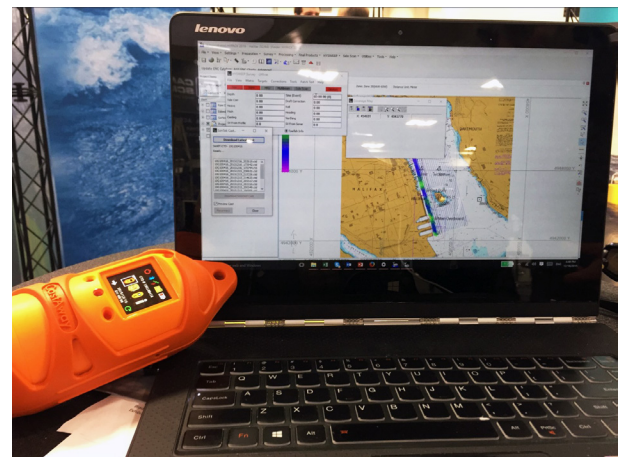
The HydroSurveyor can be easily deployed in the water with a HydroBoard-II floating platform, towed by a user supplied boat, or remotely using a rope from a bridge. The instrument is also capable of measuring discharge and cross section area from one bank to the other.

Bathymetric survey data is recorded on HYPACK software that integrates all the data and then can be processed into various products in 3D graphical formats and tabular formats for further assessment.

The technology is extremely helpful for Indian Railway engineers to study the changes occurring on the bridge piers before and after the monsoon season, helping keep millions of IR passengers and millions of tonnes of freight moving quickly and safely.



A bridge survey along the piers with depth data.



The HydroSurveyor-M9 is powered by HYPACK, which now includes new sound speed interpolation by position and time with the SonTek CastAway-CTD. Simply cast and click and sound speed data will automatically import via Bluetooth.

**Request a DEMO!**

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