Technology can make infrastructure safer

There is a common thread that binds India's frequent accidents involving railways, roads and bridges, dams and other civil infrastructure: the unrelenting focus on quantity by successive governments has sometimes exacted its cost from quality. The inadequacy of our present infrastructure, however, cannot be an excuse for creating a below-par infrastructure that is in frequent need of repair or upgrades.

In fact, the current government's focus on transforming infrastructure, which includes housing for all and smart cities, presents an unprecedented opportunity to build or upgrade existing urban and civil infrastructure that is world-class in terms of efficiency and safety.

To do so, we need to first reorient our construction goals and commit to performance metrics that emphasize safety, efficiency and longevity of infrastructure projects as much as the speed and time of project completion. Once these metrics are in place, the actual execution is relatively straightforward—with judicious application of specialized technology in constructing or maintaining the infrastructure.

Consider the example of roads, where right grading and compacting (using a road roller) of the surface before and after road construction makes all the difference between producing a road surface that is smooth, wobble-free and lasts for years versus one that is undulated, gets water logged and withers away in the first heavy rain. Advanced machine-control technologies available today allow global positioning system (GPS)-enabled precise and automated control of hydro-mechanical components of construction equipment for highly accurate grading and compacting. Contrast this with manual compacting that involves little precision for the person driving the road roller, and depends solely on his instinct or skill to determine how many times the surface should be rolled. In fact, once the grading and road-rolling equipment is automated and remotely controlled, precise values fed into the system are able to create safer and durable world-class roads.

In case of railway infrastructure, which is in dire need of an upgrade, safety is perhaps an even more critical consideration. Derailments, which in turn are frequently caused by fractures in railway lines, have been responsible for more than half of 586 railway accidents in the last five years, according to a 20 August report in *Hindustan Times*. Today, we have sensors that can continually monitor track movement in real time and raise alerts in case of any cracks or abnormality, thus allowing the signalling room to stop the train and prevent a derailment. When deployed on flood-prone roads and bridges, these sensors can raise alerts to slow down or restrict rail or road traffic—or stop it altogether in case of a grave threat.

Structural monitoring is useful when new metro lines or flyovers are being added in congested areas; but it is more critical in the vicinity of many old or heritage buildings (as is the case in Mumbai today), or in case of dilapidated buildings in seismically active places like in Delhi. Every monsoon, dozens of old or dilapidated buildings collapse in cities across India. Imagine how many lives could be saved if our municipalities mandated the use of structural monitoring systems in buildings older than a prescribed age and evacuate their occupants well in time when the sensors raise an alert?

These monitoring systems typically consist of high resolution strong motion recorders (to detect seismic activity), total stations (electronic/optical instruments used in modern surveying and building construction) and global navigation satellite system (GNSS) receivers feeding data into an advanced monitoring software solution. They can also detect minute changes in a building's structural and position parameters due to tunnelling or digging and can help the authorities ensure

that existing buildings stand their ground unmoved by the vibrations.

For example, in the US, the California Strong Motion Instrumentation Program (CSMIP) records the strong shaking of the ground and structures during earthquakes through a state-wide network of strong motion instruments—California being the most seismically active of all the 50 US states. CSMIP maintains recording instruments at more than 1,150 locations state-wide, including the city halls of Los Angeles, San Francisco and Oakland, and at the State Capitol. A number of high-rises, dams and all major bridges are instrumented. Similar systems monitor buildings, including prestigious landmarks in Australia and New Zealand, including Te Puna o Waiwhetu, Christchurch's main art gallery, which is otherwise designed to withstand earthquakes.

The contrast with India is stark, however, as we have collectively often neglected infrastructure safety. In a majority of projects, safety for the end-user is more of a regulatory afterthought—a list where boxes must be ticked rather than safety being an absolute precondition for design and execution. This needs to change—and the change must come in the form of a national vow for making our civil infrastructure safer for all.

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