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Titolo articolo: Resilience assessment of a twin-tube motorway tunnel in the event of a traffic accident or fire in a tube.

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Abstract: We have developed a traffic simulation model to quantitatively assess the resilience of a twin-tube motorway tunnel in the event of traffic accident or fire occurring within a tube. The motorway section containing the tunnel was investigated for different possible scenarios including its partial or complete closure. The functionality of the road infrastructure, in the case of an accident in one of the two tubes (each tube presents two lanes with unidirectional traffic under ordinary conditions), was assumed to be recovered both by using the remaining undisrupted lane of the tube interested by the disruptive event (only one lane is closed) and reorganizing the traffic flow by utilizing the adjacent tube for bi-directional traffic (both lanes are closed). The effects of an alternative itinerary individualized in the corresponding open road network were also examined. The level of functionality of the system during the period in which the tube is partially or completely closed was computed as the ratio between the average travel time required to reach a given destination from a specific origin before and after the occurrence of the disruptive event. The resilience metrics were assumed to be resilience loss, recovery speed, and resilience index. The best scenario was found to be the partial closure of the tube in contrast to the complete one. However, in order to contain the negative effects on the functionality of the motorway section due to the complete closure of the tube, it is worth highlighting how the traffic by-pass before the entrance portal of the closed tube should be open in a very short time by the tunnel management team to allow for the quick use of the adjacent tube for bi-directional traffic. An additional improvement, with reference exclusively to passenger cars traveling through the adjacent unblocked tube, might be obtained by activating the variable message signs, located at a sufficient distance from the motorway junction before the entrance portal of the closed tube, in order to suggest an alternative route to heavy good vehicles (HGVs) only. Whereas, when the alternative itinerary is used by all vehicles traveling towards the blocked tube (i.e., both passenger cars and HGVs), this redirectioning of the motorway traffic flow was found to be characterized by an excessive travel time, with it therefore not being advisable. The results obtained might be useful as a decision-making support tool aimed at improving the resilience of twin-tube tunnels.

Keywords: Resilience; Road tunnels; Traffic accident; Traffic simulation models; Travel and delay times; Recovery strategies.

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