CERIS : Civil Engineering Research and Innovation for Sustainability

Transient response of water distribution networks: numerical and laboratory tests

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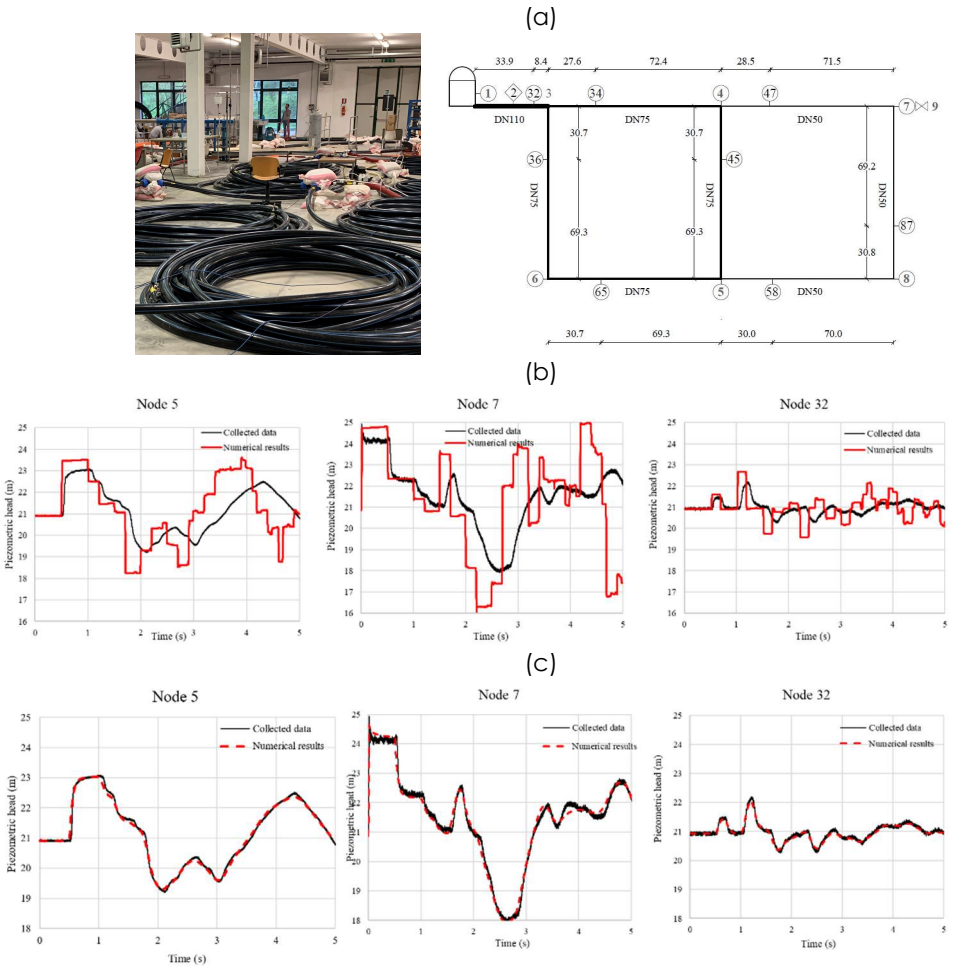
Summary

The aim of this research project is to analyze the dynamic response of a pressure pipe network to transients caused by a change in water consumption in both intact and damaged conditions. To this end, at the Water Engineering Laboratory (WEL) of the University of Perugia, Italy, a wide experimental campaign has been carried out in a polymeric pipe network with two loops. To emphasize the dynamic response of the system, transients due to the complete closure of end-users, located at the downstream end of a service line, have been considered. The tests, and the successive analysis carried out by means of a Lagrangian Model, allow studying the mechanism of interaction of pressure waves with the network components and examining the effect of the network topology, the location of the transient generation point and the entity of the water consumption variation, as well as the combined effect of simultaneous active users. Finally, numerical simulations of pressurized pipe systems in unsteady state conditions have been carried out, by considering both unsteady friction and pipe wall viscoelasticity, and the pipes with and without leaks. A calibration procedure has been established and an excellent agreement has been obtained. This experimental research is of the utmost importance for water utility managers since lessons learnt allow to identify the potential reasons for the high frequency of occurrence and severity of faults in some parts of WDNs apparently "similar" to other parts where damages are less frequent and severe.

Keywords

Hydraulic transients, network, experimental tests, numerical analysis, viscoelasticity.



Hydraulic transient solver calibration in a viscoelastic pipe network: (a) pipe rig photo and schematic; (b) measured and numerically calculated transient pressures using a classic elastic solver; (c) measured and numerically calculated transient pressures using a viscoelastic calibrated solver.