CERTIFIED DOMINATION IN WATER SUPPLY NETWORKS FOR FIRE SAFETY

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Providing water to the fire protection water supply network is a crucial aspect of the overall fire protection and life safety strategy of an entire community. Currently, as new buildings are emerging, necessary calculations are being performed so that the buildings are complied with fire safety regulations.

Before everything it is important to make sure that the proper amount of water is available to the responding fire department for both suppression of the fire in the building, and protection of any exposed buildings. All water-based fire protection systems need water. Without access to an adequate water supply these systems will not function properly.

We introduce a theoretical model of a water supply network given in the language of graph theory. The model uses the certified dominating sets to focus on placing the water supply issues and hence other, less important parameters are omitted.

A set D of vertices of a graph $G = (V, E)$ is a *dominating set* of G if every vertex in $V - D$ is adjacent to at least one vertex in D. The *domination number* of a graph G, denoted by $\gamma(G)$, is the cardinality of a smallest dominating set of G. A subset $D \subseteq V$ is called a *certified dominating set* of G if D is a dominating set of G, and every vertex in D has either zero or at least two neighbours in $V - D$. The cardinality of a smallest certified dominating set of G is called the *certified domination number* of G, and it is denoted by $\gamma_{\text{cer}}(G)$.

Thanks to the minimum certified dominating sets it is possible to determine where in the environment to place pumping stations and wells to meet, fire safety requirements, while minimising the cost. We assume the cost of installing a pumping station to be approximately 2.5 times that of a well. The objective is to ensure that every location without a water source is connected by a pipe to a pumping station, thereby ensuring that the water pressure requirements of user locations are met. Also, a place with a well should be connected only to places with a well or a pumping station on order to avoid any pressure decreases.

The aforementioned approach would be further reinforced by the presentation of case studies in which cost savings are demonstrated and, simultaneously, compliance with relevant fire safety standards is supported in a different context. Consequently, the new approach must act once more as a practical

tool for urban planners and engineers in promoting a systemic approach to improvements in fire safety infrastructure.

References

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