Ain Shams University
Faculty of Engineering
Irrigation & Hydraulics Department

Leakage Assessment through Water Distribution Network

A Thesis Submitted for the Partial Fulfillment of the
Doctor of Philosophy
Civil Engineering - Irrigation & Hydraulics [2009]

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Cairo, Egypt
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بسم الله الرحمن الرحيم

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خَلَقَ الْإِنسَانَ. عَلَّمَهُ الْبَيَانَ.

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STATEMENT

This thesis is submitted to the Irrigation and Hydraulics Department, Faculty of Engineering, Ain Shams University in the partial fulfillment of the requirements for the Degree of Doctor of Philosophy in Civil Engineering.

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No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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ABSTRACT

Scarcity of water recourses, pollution, climate change and more construction of cities intensified the need for development of appropriate water management approaches which will aim in keeping a balance between water supply and demand. It is evident that water is becoming a limited recourse in most parts of the world.

The percentage of water lost in pipe network is, in many towns, (40–50%) of the total daily water consumption. Water loss from the pipe network is not constant. It depends on both the water pressure and the network parameters.

Presented herein is a simplified method for estimating the magnitude of leakage and water consumed but not metered in the potable water distribution system of small residential zones (under 1,000 connections). It is assumed that continuous measurements of flow rates and pressures

through the main supply line into a residential service zone are available. The data must have different scenarios (records) in entry water volume and operating pressure to evaluate the reasonable pressure exponent γ (the pressure power which the leakage volume proportional with it) and leakage volume. By applying a significant difference in operating pressure, these scenarios can be reached. The study showed that the change in the entry water volume is equal to the sum of change in leakage due to pressure difference and the change in the consumed flow (if any). By applying the water components balance equation for each scenario, a system of equations will be constructed but these equations function in two unknowns (the pressure exponent γ and the leakage volume). The equations are transformed into linear form and solved using non-linear regression analysis. Usage of this method provides a best fit for estimation of both the pressure exponent γ and the leakage volume. Extended period simulation (EPS) is employed to test these results using a small residential area as a case study. The comparison showed an agreement between the results of non-linear regression and the simulation.

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