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INVESTIGATION OF FACTORS AFFECTING THE STRENGTH OF CONCRETE PIPES

By

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The thesis submitted to the Department of Civil Engineering of the University of Moratuwa in partial fulfillment of the requirements for the Degree of Master of Engineering in Structural Engineering Design.

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Abstract

In a developing country like Sri Lanka, it is very important to develop infrastructure facilities to provide facilities to the investors. In this context special emphasis should be drawn towards the road development sector since highway road projects play a major role in infrastructure development.

In the construction of highways, number of water streams have to be crossed and the surface runoffs along the highways are also to be properly directed. In Irrigation projects also the water conveyors are to be provided from the water sources to the desired crop fields. For these requirements in road sector as well as in irrigation schemes, concrete pipes are widely used as a cheap option.

In highway projects, for the storm water lines, high strength concrete pipes are used. Those pipes should be able to carry heavy traffic loads as well as embankment loads while providing non interrupted water drainage path. Mainly in urban areas with limited space, high strength concrete pipes are being widely used as water paths diverting surface runoff to the drainage canals. As an example, in the recent past within Colombo urban area, major road development projects were carried out. The surface runoff and water from either side of road had to be diverted to the open channels through concrete pipes. Therefore it is very important to provide durable and strong concrete pipes.

When the pipe manufacturing industry is considered, it is found that manufacturing process is not developed systematically for concrete pipe production. Still the process in Sri Lanka is in primitive level compared to the techniques used in other countries. There are no proper manufacturing details available for the production of structurally sound concrete pipes in Sri Lanka.

On the other hand, from the results of previously carried out pipe tests, it was clearly seen that most of the large diameter pipes (specially when diameters are more than 600mm) were failed to satisfy the strength requirements

specified in (SLS 452:1979) Sri Lankan specification for NP3 concrete pipes with respect to three edge bearing test. Large number of concrete pipes were rejected due to the repetitive strength failures. Lot of material and time had been wasted due to strength failure and caused the delays in construction projects.

Therefore the investigation of influential parameters on the strength of concrete pipes is necessary for the industry to improve pipe manufacturing process to produce strong concrete pipes economically.

In this regard, initially the literature review and site survey were carried out and secondly the analysis of concrete pipes was carried out using PROKON software. Based on the results of the numerical analysis for the large diameter concrete pipes the key parameters to the strength of pipes were investigated. The effects of pipe wall thickness, amount of reinforcement as well as the influence of concrete grades were identified as key factors to the strength of concrete pipes.

From the results it was found that the use of higher concrete grade does not make substantial effect on the strength of concrete pipes. The circumferential reinforcement and the pipe wall thickness are the main parameters which influence the strength of concrete pipes.

Further, the reinforcement requirement for most commonly used large diameter pipes with various pipe wall thicknesses were calculated and presented in this report.

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DECLARATION

I, Kulasiri Kuruppu Nanayakkara, hereby declare that the content of this thesis is the original work carried out by me. Whenever others' work is included in this thesis, it is appropriately acknowledged as a reference.

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