Simplified Method for Safety Assessment on Corroded Municipal Drainage Culvert and Its Engineering Application

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Abstract: It is a serious challenge to estimate the safety and ultimate bearing capacity of a corroded large-span drainage culvert. In this paper, a simplified computational model based on matrix displacement method is established. Within the framework of concrete structure principles and structural mechanics, both the ultimate strength and flexural stiffness reduction of key sections are considered in this model. This simplified model can greatly reduce the computational cost and is readily applicable to engineering practice. Its validity and availability have been verified by finite element analysis with a damage-plasticity coupled concrete constitutive model and physical experiments. Then it was applied to three surveyed sections of Shanghai South Line, where the residual thickness of ceiling and service environment such as cover depth and traffic intensity were available through field survey data. A detailed parameter sensitivity analysis was performed on internal factors including culvert span, ceiling thickness and concrete strength, and external factors including cover depth, lateral unloading and traffic loads, to evaluate their effect on culvert safety. On this basis, some economic and feasible reinforcement and protection strategies for the damaged culvert were discussed.