Analysis of Rectangular Reinforced Concrete Liquied Tanks by Using Yield Line Theory

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ABSTRACT

In the analysis of rectangular reinforced liquid storage tanks, a method assuming linear-elastic behavior for material can be used, i.e. strip method, moment coefficient method, finite element method, etc. In the analysis of these types of tanks, tank walls can be considered as a slab. In this study tank walls are analyzed as a slab subjected to hydrostatic loading; in the analysis the yield line theory is used because it is more suitable for the linear inelastic behavior of reinforced concrete slabs than the ones based on linear elastic theory. An iterative algorithm based on yield line theory is presented for the design of isotropically reinforced recrangular concrete slabs supported along all four edges. A computer program is coded which predicts the location of yield lines for the slabs depending upon certain parameters. As a result of this prediction, manual design of such slabs can be significantly simplified by the use of coefficient obtained by using the program.

Key Words: Liquid tanks, reinforecd concrete, reinforced slads, yield line

1 INTRODUCTION

The methods based on yield line theory are more suitable for the design of reinforced concrete slabs than the other methods based on the linear elastic theory–strip method, moment coefficient method, etc. Because they consider the realistic behavior of such elements. The behavior of these slabs consists of four stages under increasing loads and can be listed as elastic, cracking, plastic and collapse. In the initial stage the distribution of bending moments are corresponds to the elastic bending moment diagram. When the first crack takes place the second moment of area of the section reduces and this reduction causes redistribution of the bending moment diagram. In the plastic stage, for an under reinforced section, rebars start yielding as loading increases. This yielding spreads along the section where most of the cracks concentrate. These failure lines are known as yield lines. At the final stage, the failure lines spread along the slab and transform it into a collapse mechanism following an infinitesimal increase of the loads. In this stage the failure occurs by crushing the concrete in the compression zone [1-10].

In this study a computer program is presented that is based on an iterative algorithm. The algorithm uses the yield line theory and obtains the ultimate moment per unit length of an isotropically reinforced slab that is subjected to hydrostatic pressure loading. The program also predicts the location of yield lines for slabs supported along all four edges. As a result, manual design of such slabs can be significantly simplified by the use of a coefficient obtained by using the program.