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NEW DISPLACEMENT THEOREM AND METHODOLOGY FOR THE EFFICIENT DESIGN OF FLEXURAL GRIDS AND DOUBLE LAYER TRUSSES

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Grigorian M[1], Maalek S[2] and Heristchian M[3]

Abstract: While Allowable stress is still the predominant design methodology for flexural and double layer articulated grids and similar structures under service conditions, Performance control (PC) could further enhance their functional uses up to plastic limit states. PC is a recently developed, observation based, design process that aims at rational and efficient selection of structural elements rather than investigating their usefulness through iterative processes. The proposed methodology is ideally suited for preliminary design as well as capacity analysis purposes. It lends itself well to manual, spreadsheet as well as electronic computations. The basic notion behind PC is that structural response is mainly a function of design and detailing, rather than numerical computations. The design concept uses pre-selected target displacements and failure mechanisms as key control objectives. The current contribution presents a general technique for the estimation of maximum plastic displacements of twistless, orthotropic, space frames of regular formation, simply supported along the sides of a parallelogram, and subjected to monotonically increasing uniform distribution of normal nodal forces. In the interim a new application for the uniqueness theorem has also been discussed. The applications of the proposed solutions have been illustrated through a number of generic examples.

Key words: Flexural grillages**,** double layer space trusses, performance control, plastic design, Load sharing concept, Uniqueness theorem, displacements at incipient failure.

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1 Introduction

The elastoplastic plastic response of flexural grillages and Double layer trusses (DLT) has been the subject of several analytical and experimental studies since the early 1950s. The pioneering efforts in these fields are due to, among others, Heyman (1952, 1953), Stevens (1961, 1968), Hongladaromp et Al. (1968), Wah (1969), Grigorian (1971, 1972, 1973a) and Saka and Heki (1971, 1975). More definitive treatments have also been reported, among others, by Grigorian (1973a, b, 1975), Marsh

[1] Ph.D., SE. MGA Structural Engineering Consultants Inc. Glendale, CA. US.
[2] Ph.D., Division of civil Engineering, faculty of Engineering, University of Tehran, Iran
[3] Ph.D., Faculty of Engineering, Islamic Azad University, Tehran Iran.