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INTERNATIONAL CENTRE FOR MECHANICAL SCIENCES

COURSES AND LECTURES - No. 332

EVALUATION OF GLOBAL BEARING CAPACITIES OF STRUCTURES

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PREFACE

This book collects the lectures given at CISM during June 1992, devoted to the evaluation of global bearing capacities of structures. The course aimed at presenting a unified frame for yield design, limit analysis and optimal design theories.

After a brief introduction on the basic results and the general comments on the validity of cach theory from the practical point of view, typical and illustrative applications in various domains are given, in order to point out their versatility.

Based upon simple arguments of convex analysis, the theory of yield design makes possible to determine the global bearing capacities of a structure from the sole knowledge of the local strength of the constitutive materials.

Soil mechanics problems are considered, such as stability analysis of reinforced structures, where classical limit analysis cannot be considered as adequate. Efficient methods have been derived from the theory of yield design, some of them making use also of the theory of homogenization.

On a different scale, composite materials with long fibers as reinforcement are considered with the purpose of determining their strength capacities. Interesting results have been obtained through this approach, in good agreement with experiments.

In the second part of the book the "classical" limit analysis theory is presented and it is underlined how its use makes it possible to determine the global bearing capacities of a class of structure, on the basis of the local strength and the plastic associated flow rule of the

constituent material. Structural mechanics problems are considered, such as the limit state of steel structures or reinforced concrete plates and shells, where classical limit analysis can be fully applied. Efficient methods are derived from the combined use of limit analysis and convex analysis theories.

In the third part a general formulation of optimal design theory is proposed. Particular emphasis is given to this method as a tool making it possible to determine the best distribution of the employed material in a structure, with a given layout, to achieve a minimum total weight at prescribed limit plastic load or buckling load. In such a way, optimal design problems can be conceived as inverse problems in comparison to the yield design and limit analysis formulation.

Finally some optimal design problems for structures with given layout and prescribed elastic compliance are presented. The aim of these contributions is to point out some analogies existing between some plastic and elastic problems. Also, opportunity is taken for proposing some numerical applications.

The unifying frame in which yield design, limit analysis and optimal design theories have been presented is intended to be a clarifying reasoning tool leading to various new relevant developments, the necessity of experiments being of course the ultimate and unavoidable validation test.

Giannantonio Sacchi Landriani

Jean Salençon

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