VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

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PREDICTION OF ACCIDENTAL ACTIONS LIKELY TO OCCUR ON BUILDING STRUCTURES

AN APPROACH BASED ON STOCHASTIC SIMULATION

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This book deals with problems of structural design for accidental actions. It has been written primarily to provide information on predicting accidental actions and assessing damage from them by means of a stochastic simulation. Both prediction and damage assessment are based on methods of the quantitative risk assessment.

The book has been written with the needs of two types of readers in mind: graduate students and Doctorate candidates studying structural engineering as well as researchers and engineers taking interest in assessing safety of structures and insuring against accidents.

Alphabetical list of reviewers:

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CONTENTS

PREFACE

Hazardous and abnormal loads are an important, sometimes crucial, problem for the designers of many structures used as components of major infrastructures. Abnormal loads are typically induced during natural disasters and man-made accidents. And these are almost weekly, if not daily, phenomena if considered on a world-wide scale. If considered on a nation-wide scale, disasters involving some damage to structures are suffered almost every year. However, on the scale of a particular plant, transportation system, or offshore platform, abnormal loads are rare and usually difficult-to-predict phenomena. Accidents involving failures of structures and damage to large objects of mechanical engineering are well-known for their catastrophic consequences. The names of Piper Alpha oil platform and Flixborough works became almost “standard” examples of tragic disasters which involved structural failures due to abnormal actions.

Considerable uncertainties and commonly occurring scarcity of data on abnormal loads constitute a significant obstacle to a reliable design of structures for such loads. The problem of uncertainties and data scarcity can hardly be tackled thoroughly and consistently by applying deterministic methods which prevail in the present-day structural design. Many of deterministic design codes and standards used in Europe call the abnormal loads “accidental actions”. This term is somewhat wider than “Abnormal load”. It will be used in the subsequent text to denote any abnormal mechanical and thermal action which can be induced during natural disaster and man-made accident. Clearly, the deterministic approach can give some answers to the question, how to predict accidental actions and assess damage from them. However, the temptation to model accidental actions by the same methodological means as the loads acting on structures during normal service conditions can be misleading.

It can turn out in many cases that data for specifying characteristic or design intensity of accidental action are insufficient, not fully relevant or even absent at all. In some cases the engineer will simply be forced to judge what can be the characteristics of a potential acci-

dental action. Even if some statistical data will be collected by investigating a specific accidental action, the amount of this data can be insufficient to process it by standard means of classical statistics. In addition, the engineer may also have the feeling that the knowledge expressed by this data could be complemented by other forms of knowledge on the accidental action under study. Thus the need to deal with accidental actions can raise questions about an intelligent use of different sources of information about the physical phenomena which can escalate into occurrence of an accidental action and cause damage to the exposed structure.

Aim of the book

The phenomenon of accidental actions has been under investigation for a long time and the number of publications on this subject is considerable. However, the author of this book, when he/she started to take an interest in the problem of accidental actions, encountered a paradoxical situation. The general impression the author got from the publications related to accidental actions is that this area of structural engineering is highly fragmented and insufficiently specific. One can state that there are a lot of general discussions on accidental actions. However, the number of practical recipes, how to predict them by keeping in mind the complicated problems of uncertainty and data scarcity, remain few in number.

The aim of this book is to provide a discussion on specific methodological aspects of predicting accidental actions in the design of the structures which can be subjected to them. This discussion seeks to systematise methodological tools potentially suitable for solving the problems of uncertainty and data scarcity which are almost inseparable attributes of accidental actions. The main idea of the book was to apply extensively methods of quantitative risk assessment to predicting accidental actions. These methods are not a panacea capable of "curing all illnesses" related to accidental actions; however, they allow to deal with limited information on accidental actions in a consistent way.