TECHNICAL REPORT

ISO/TR 12930

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Seismic design examples based on ISO 23469

Exemples de dimensionnement basés sur l'ISO 23469

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 98, *Bases for design of structures*, sous-comité SC 3, *Loads, forces and other actions*.

Introduction

ISO 23469:2005 provides guidelines to be observed by experienced practicing engineers and code writers when specifying seismic actions in the design of geotechnical works. It might not be so easy for code writers and practitioners to utilize ISO 23469, because that it offers advanced philosophy and general framework of seismic design. The purpose of this Technical Report (TR) is to provide seismic design examples based on ISO 23469 for demonstrating how to utilize ISO 23469 in actual seismic designs to the code writers and the practitioners. The implementation of ISO 23469 will secure the rationality of seismic safety evaluation of the infrastructures in the world, and this TR aims at promoting the implementation.

ISO 23469 is essentially a guideline itself. Therefore, this TR should contain not explicit guidelines but design examples without using the term 'guideline'. Thus, this TR is expected to demonstrate the utilization of ISO 23469 by providing design examples with detailed explanation from the viewpoint of conformity with ISO 23469 for a kind of guidance rather than to provide the detailed recommendation of specific methodologies.

Through the development of this Technical Report, it is concluded that ISO 23469 has been and is going to be an essential and useful guideline of seismic design of geotechnical works for experienced practicing engineers and code writers.

Seismic design examples based on ISO 23469

1 Scope

This Technical Report provides seismic design examples for geotechnical works based on ISO 23469:2005 in order to demonstrate how to use this ISO standard. The design examples are intended to provide guidance to experienced practicing engineers and code writers. Geotechnical works include buried structures (e.g. buried tunnels, box culverts, pipelines, and underground storage facilities), foundations (e.g. shallow and deep foundations, and underground diaphragm walls), retaining walls (e.g. soil retaining and quay walls), pile-supported wharves and piers, earth structures (e.g. earth and rock fill dams and embankments), gravity dams, tanks, landfill and waste sites.

ISO 23469 addresses important issues for seismic actions for designing geotechnical works, including effects of site-specific response, ground displacement, soil-structure interaction and liquefaction, in a systematic manner within a consistent framework. This International Standard presents a full range of methods for the analysis of geotechnical works, ranging from simple to sophisticated, from which experienced practicing engineers can choose the most appropriate option for evaluating their performance. Therefore, this Technical Report includes well-chosen design examples that consider these important issues and covering in a balanced way the wide range of the methods of analysis and the types of model which can be used to evaluate seismic actions of geotechnical works.

2 Purpose and policy of collecting design examples

2.1 Purpose of collecting well-chosen examples

This Technical Report aims at collecting design examples that are basically conformable with ISO 23469. They are expected to be design examples dealing with important things need to be covered in ISO 23469 from the point of view of performance-based design approach. This TR should be well-balanced in included design examples;

— Focusing evaluation of reference earthquake ground motions with detailed description as a common issue.

— Having combination of simplified and detailed analyses.

— Based on simplified equivalent static analysis and detailed analysis for retaining walls, buried structures or earth structures.

— Focusing consideration of soil displacements for pile foundations and buried structures.

— Focusing evaluation of effects of liquefaction for retaining walls, earth structures, pile foundations.

— Focusing consideration of spatial variation in the ground motions for long bridges, buried structures, or dams.

— Based on site specific dynamic response by 1-D analysis.

— Based on detailed dynamic analysis by 2-D or 3-D analysis.

2.2 Concept and policy of choosing and composing

To realize the prescribed purpose of this TR, the basic concept of it is targeting to cover major distinguishing and important issues of IS23469 by all the design examples contained in this TR. Thus, the following points are another requirement for choosing and composing design examples.

— Design examples written with cares for readers in terms of conformity with requirement and recommendation in ISO 23469

— The TR should consist of several well-chosen design examples which cover the key issues of the ISO 23469 with well balance between them.

— The TR is anticipated to be well balanced among Japan, Northern America, and Europe.

— For description of manuscript, each design example is requested to

— Be cared in terms of conformity with requirement and recommendation in ISO 23469

— Have stress on methodology recommended by WG

— Be within 20 pages for a complete example and 8 pages for a sub-example basically

2.3 Development and result

After discussing the policy of collecting and choosing design examples, WG10 also had developed an expected table of contents from arguments through three Working Group meetings held in 2006 and correspondence with consideration of design practice situation in member's countries and regions. After registration of NP12825 in the end of this year, the WG10 repeatedly requested all the WG members and participants of the meetings to provide possible design examples for this Technical Report. The table of contents of the TR of design examples was almost fixed and the drafting persons for the examples were assigned in 2008 through more four WG meetings; eight examples for the first stage of specifying seismic action were expected to be prepared by three persons from Japan and one from Turkey and 28 examples for the second were hopefully to be prepared by 17 persons from Japan, three from USA, one from Greece, and one from Italy.

This NP was officially approved with the submission, in 2008, of the first Working Draft of TR12825 containing six examples, but the NWI was subsequently re-numbered as 12930 from an administrative reason. The third and final Working Draft of TR12930, which was developed through another three meetings in two years for waiting design examples to be offered from countries other than Japan was submitted to TC98/SC3 in the end of 2010 then accepted as a Draft Technical Report with a request of addition of description for a few points. The last two year period was mainly aimed at collecting examples from countries excepting Japan. Notwithstanding the total number of attendees in thirteen WG meetings is 87 and they came from Japan, USA, Greece, France, Poland, Canada, Turkey, Italy, South Africa, Germany, Morocco, Romania, and Russia (in order of total number of attendees), only prescribed persons were merely expected. Probably because that the preparing a manuscript is a tough job with few personal incentive; i.e. a completely volunteer work.

2.4 General conclusion of TR12930 obtained through its development

Eventually seven examples for the first stage and 15 examples for the second stage were successfully collected from thirteen persons consisting of eleven from Japan, one from USA, and one from Greece. The total number of the 22 well-chosen design examples can almost cover major distinguishing and important issues of IS23469 as targeting at the beginning. Through the process of preparing and editing the drafts, it was clarified that IS23469 is useful for evaluation, assessment and review in the seismic design. Furthermore, it was demonstrated that assessment for conformity with IS23469 in can be conducted in terms of provisional sentences according to Clause 3 of this TR. Thus, it is concluded that IS23469 has been and is going to be an essential and useful guideline of seismic design of geotechnical works for experienced practicing engineers and code writers.