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M. J. Berry and H. S. Hasegawa

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See table of contents

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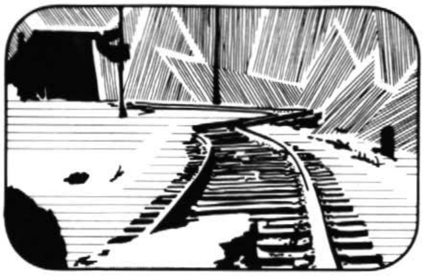

Second Canadian Conference on Earthquake Engineering

M. J. Berry and H. S. Hasegawa
Division of Seismology & Geothermal Studies
Earth Physics Branch
Department of Energy, Mines and Resources
Ottawa, Ontario K1A 0E4

At the First Canadian Conference on Earthquake Engineering, which was held at the University of British Columbia, Vancouver, on May 25-26, 1971, the Canadian National Committee for Earthquake Engineering (CANCEE) decided that a conference with a similar theme should be convened four years hence. One of the primary objectives of the first meeting was to facilitate and stimulate co-operation between engineers and scientists in the field of earthquake engineering through the interchange of views and the results of research. The design engineer would learn of the current research underway in the research laboratories and would thus be in a better position to apply some of the new results to his own work, while the research scientist would be made more aware of the most pressing problems facing the design engineer and, consequently, would be able to redirect his endeavours towards those current problems.

The main topics covered at the 1971 conference were, according to S. Cherry, the Conference Chairman:- (1) seismicity and ground motion (2) soil and soil-structure interaction relative to earthquake problems (3) analysis of structural response to strong seismic ground motion and (4) miscellaneous studies. The format was sufficiently general that it was expected that succeeding conferences would follow the same topics but possibly with different emphasis, depending upon new developments and problems at the time.

The Canadian National Committee for Earthquake Engineering of the National Research Council and the Department of Civil Engineering and Engineering Mechanics of McMaster University jointly sponsored the Second Canadian Conference on Earthquake Engineering on June 5 and 6, 1975, at McMaster University, Hamilton, Ontario. As in Vancouver, the meeting brought together researchers from the universities and government departments and practicing civil engineers to discuss the state-of-the art in earthquake engineering design and practice in Canada. The conference was preceded by a seismic design seminar on June 4, the purpose of which was to outline significant changes in the earthquake load provision in the 1975 National Building Code of Canada (NBC).

The seminar started with A. C. Heidebrecht presenting a review of the basic concepts and definitions in the seismic loading provisions of the NBC and then describing the significant changes incorporated into the 1975 edition of the code. The reasoning behind the changes and their implications were clearly presented. For instance a more physically meaningful parameter, namely acceleration "A", now replaces "R", an integer associated with each seismic zone. Other changes now incorporate more detail into some definitions, e.g., the foundation factor "F", the "K" factor which reflects the type of construction, and torsional moment. In the Special Provisions of the Code (Section 4.1.9.3) the height limitation has been made less restrictive. Engineers were reminded that the natural period "T" of a structure, which appears in the expression for seismic response factor "S", as computed using Code formulae, can be considerably in error. In the next talk, a logical follow-up of the first, W. K. Tso selected buildings with specific shapes and sizes to illustrate numerically the implications of the changes. Several examples were presented to show the comparative effects of wind and earthquake loads on buildings in each of zones 1, 2 and 3.

The afternoon session commenced with A. C. Heidebrecht describing the parameters which control the behavior of structures subjected to strong seismic ground vibrations. For small, intermediate, and large magnitude earthquakes the controlling parameters are stiffness, strength and ductility, respectively. During this presentation and throughout the subsequent Conference seminars, the topic of ductility was more frequently discussed than perhaps any other parameter or subject.

The final presentation of the design seminar was W. K. Tso's overview of the dynamic analysis technique recommended by the 1975 NBC to evaluate a design load for a structure. Procedures to evaluate the design load for a single-degree-of-freedom system and for a multi-storey structure were outlined and supplemented with several examples.

In so far as future revisions to the present NBC are concerned, the general feeling was that caution should be exercised before making changes and that changes should not be made until experimental evidence is strong enough to demand change. From the point of view of the design engineer, it was suggested that some definitions should be modified so as to be more informative. There also appeared to be a generally held view (by the engineers) that the design engineering community as a whole does not have adequate input into the code revision process.

Preceding the technical sessions, J. Penzien of the University of California, Berkeley, gave the keynote address. He emphasized that the design of structures for regions of high seismicity requires a design philosophy which includes both static and dynamic design and a thorough appreciation of the inelastic phenomena which necessarily will be brought into play in the event of a severe earthquake. He emphasized that in such circumstances the uncertainties, both of the ground motion and of the design, are so great that serious consideration must be given to using the probabilistic approach at all phases of the design process in order to be able to make meaningful predictions.

In a session focussing on seismic ground motions, W. G. Milne continued the theme in describing the current research underway at the Department of Energy, Mines and Resources (EMR) in the estimation of seismic risk and in the formulation of a new seismic risk map for Canada. H. S. Hasegawa explained the relationship between Fourier amplitude spectrum of ground motion and the seismic waves generated by nearby earthquakes. He showed the contribution to the Fourier amplitude spectrum made by "direct" shear waves, complex crustal reverberations due to local soil conditions, and surface waves. W. K. Tso and B. P. Guru described their research on artificially generated earthquake records and pointed out the uncertainties associated with published response spectra They again emphasized that a complete dynamic analysis is sometimes required for complex structures and that the static design criteria alone quite often prove to be inadequate. The importance of the duration of strong seismic ground motion was stressed. G. P. Nair and J. J. Emery outlined a method for computing the spatial variation in seismic ground motion and showed the results of applying this to a soil-pile model.

The session entitled "Risk Analysis and Geotechnical Problems" started with C. G. Duff presenting a simplified, deterministic method for evaluating the structural response of nuclear power plant components to a simulated seismic ground signal. This was followed by D. L. Anderson, R. G. Charlwood and C. B. Chapman outlining their seismic risk analysis of nuclear power plants. They showed the importance of considering common mode failures when determining seismically initiated system failure probabilities. Also, in assessing system failure probabilities of the order of 10^{-6} they showed that the input with the highest sensitivity is the probability distribution of large magnitude earthquakes and the component failure probabilities. W. D. L. Finn and P. M. Byrne stated that the settlement of cohesionless soils as a result of strong seismic ground motion result from volume compaction, and that this is due almost exclusively to dynamic shear strains resulting from the horizontal component of ground acceleration. The important parameters of the sand and of the ground motion in effecting settlement were described. J. J. Emery and C. D. Thompson outlined seismic design consdierations for gravity retaining structures and recommended a technique for designing special types of these in earthquake-prone areas. W. E. Saul presented a detailed theoretical account of a simulated structure subjected to a strong seismic ground motion; special emphasis was placed on the role of damping on the structural response. J. G. Beliveau outlined his method for identifying the significant parameters of a structure subjected to strong seismic ground motion. W. K. Tso and R. Bergmann presented a complete time history of the response of an asymmetrical high rise building and compared the values obtained by various techniques with those derived using the 1975 NBC requirements. The session ended with K. Whitham, the Chairman of the previous session, cautioning the audience about the use of unstable parameters such as peak ground acceleration in seismic risk analysis; in particular, with reference to the extreme value technique used to generate the seismic risk map of Canada, he warned that extrapolating to return periods much beyond the length of the data base can easily lead to unrealistic predictions.

The second day of conference seminars was primarily devoted to research and practice in the design of structures to withstand strong seismic ground vibrations. T Pauley of New Zealand, presented an invited lecture in the form of a state-of-the-art report on the design of shear walls for seismic areas This was followed by a session devoted to the behavior of concrete structures. Four papers were presented describing the behavior of such structures to vibratory motion and considerable discussion was generated on the question of ductility in such structures. B. Bresler and V. V. Bertero discussed the influence of high strain rate and cyclic loading, while N. M. Hawkins. D. Mitchell and S. N. Hanna discussed the beneficial effects of shear reinforcement in flat plate structures. W. K. Tso. A. Rutenberg and A. C. Heidebrecht continued with the theme of cyclic loading. V. V. Bertero and H. Kamil brought the meeting back to its starting point with a paper entitled "Nonlinear Seismic Design of Multistory Frames". The session concluded with V. V. Bertero stating emphatically that one of the important parameters that earthquake design engineers require for their predicted ground motion input is the maximum sustained (or integrated) acceleration level and not peak ground acceleration. Thus it would appear that the integrated acceleration level, which has the dimensions of velocity, in conjunction with the duration (number of cycles) of smaller amplitude phases with an average period close to the resonant period of the structure, are the significant ground motion parameters in so far as the design of structures to withstand strong seismic ground vibrations is concerned.

The Fifth Technical Session was devoted to problems associated with design codes. J. H. Rainer of NRC presented a simplified analysis and parametric study of dynamic structure - ground interaction, which was logically followed by a paper by M. Suko and P. F. Adams in which they presented a simplified method for calculating the fundamental natural period of tall structures. A. C. Heidebrecht concluded the session by presenting recent work on the dynamic evaluation of overturning moments, much of which had been presented the previous day at the design seminar.

The conference concluded with a panel discussion on the relationships between research and design practice in the field of earthquake engineering. During this discussion and, indeed, throughout the meeting, the dichotomy between the practicing civil engineer and the academic became clear. In essence, it is the difference between the deterministic and the probabilistic approach to the problem of designing structures to withstand strong seismic ground motion. The researcher is forced by his studies to the realization of the uncertainties associated, first with the prediction of ground motion, secondly, with the ground structure interaction and, thirdly, with the response of the structure itself to input vibratory ground motion. On the other hand, by the nature of his job, the civil engineer is forced to make decisions at every step of the design process. These decisions are obviously simplified when definite numbers are available, and thus he naturally prefers the deterministic approach.

There was a repeated request by the practicing design engineer for the research-oriented scientist and engineer to follow through with their research until tabulated results can be presented that are of simple, practical value. It was pointed out, however, that one of the difficulties in implementing this urgent request is a lack of sufficient funds and/or manpower. As a first step in tackling the problem, it was suggested that a meeting between practicing design engineers and research-oriented engineers should be arranged with the explicit purpose of selecting certain problems of immediate importance upon which more research should be focussed.

It is probably fair to say that, even where agreement could not be reached, the Conference resulted in a better appreciation of the different points of view held by the different professional groups involved in this business - the seismologists, the civil engineers and others. The researcher became more aware of the difficulties facing the design engineer, whereas he, in turn, was forced to become increasingly appreciative of the statistical nature of earthquake occurrences, our uncertainties in correlating all seismicity in Canada with tectonic features and associated seismic phenomena. It is also clear that not all the uncertainties are seismological - there is reason for considerable engineering dispute on the safety factors introduced by ductility and other factors in many designs and codes.

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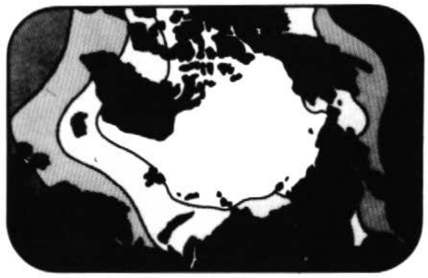

The Thermal Regime of Glaciers and Ice Sheets

E. D. Waddington
Dept. of Geophysics and Astronomy
University of British Columbia
Vancouver, B.C. V6T 1W5

Introduction

This international symposium held at Simon Fraser University, April 8 to 11, 1975, was initiated by the National Research Council of Canada Subcommittee on Glaciers and was organized in cooperation with the Department of Geography at Simon Fraser University. The interdisciplinary nature of glaciology was evident from the wide range of research reports. The papers discussed topics from paleoclimatology to the design of high resolution thermometers. Advances in data acquisition, in knowledge of ice physics, and in computing power enabled participants to report research on major problems, including quantitative numerical models of ice sheet buildup and surging and isotopic studies of world climate changes over the past 10000 years.

There appears to be growing interest among glaciologists in presenting glacier research to the public, as indicated by several educational films prepared by some of the participants. R. Kuchera's film *Processes in Front of a Glacier* used time-lapse photography to illustrate motion and erosion at the terminus of the Athabasca Glacier. G. K. C. Clarke's film *Glacier!* described a field project to measure temperature profiles in a surging glacier in the Yukon, and a film by M. M. Miller displayed the opportunities for student summer research with the Juneau Icefields Research Program in Alaska.

The only field trip of the conference was an evening of downhill skiing at nearby Grouse Mountain.

Technical Sessions

Past surface temperatures and climate changes are being derived from the analysis of present temperature-depth profiles, and from O^{18}/O^{16} oxygen isotope ratio-depth profiles in the ice sheets of Greenland and Antarctica. An invited paper by G. de Q. Robin discussed the anbiguities in both methods, and showed that the results are compatible, when effects due to ice transport are small, or can be calculated.

T. Hughes discussed the possibility of convection and diapiric uplift of warm basal ice into the cold overlying ice sheet in areas where the basal ice is uncoupled from the bedrock, such as over subglacial lakes. In the discussion that followed, the validity of using a Reynolds number stability criterion for thin dykes and sills was questioned. These proposed diapiric sills have not been convincingly identified in radar reflection records.

A paper by H. J. Zwally reported on passive microwave measurements of near surface ice temperatures with radiometers on the Nimbus-5 satellite. With continued observations and improved knowledge of the emissivity properties of snow, he hopes to obtain accurate mean annual surface temperatures over large areas of the ice caps.

The paper which provoked the most spirited discussion at the symposium was given by K. Philberth, who proposed that radioactive wastes from fission power generation be stored in an ice sheet in Greenland or Antarctica. The containers, heated by their radioactive contents, would melt their way down to a predetermined level in the ice at a rate controlled by the amount of radioactive material inside. This would prevent the containers reaching the bedrock with the possible release of the radioactive contents. Because the ice in the proposed areas is cold, any leakage should always be imprisoned in frozen material, even if a container should rupture. After one century, the proposed containers would radiate insufficient heat to melt the surrounding ice and their descent would stop. Dumping the containers at an ice divide, where the ice velocity is nearly zero would minimize the danger of the containers being