Session Summary

by

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The second sub-committee consists of 50 papers on the Analysis of Structural Response and Instruments. Because of time limitation, only 30 of these papers were read at the conference, while the rest had their outlines introduced in the session summary.

When the papers are placed into groups according to their contents they become as follows:

The great majority concern the question of resistance against earthquakes of buildings. 14 theses presented by J. I. Bustamante et al., R. I. Skinner et al., M. Ifrim, R. L. Jennings et al., F. Neumann, W. T. Thomson, T. Tajime, T. Taniguchi, I. Toriumi et al., H. Sandi, A. G. Nazarov et al., M. Derleres and S. Gershanik et al., have carried out detailed theoretical calculations on the elastic vibrations of buildings.

Most of them discuss the shear vibration, torsional vibration and transient vibrations of shear beam type structures on the basis of strong motion records obtained in the past.

Some discuss the influence that walls and the elastic properties of the foundations have on building vibrations.

As for the methods of theoretical calculations, the method of using normal coordinates and the numerical method by use of computers are used.

The vibration research on structures naturally goes from elastic vibration to non-elastic vibration, and 9 papers presented by G. W. Housner, J. A. Blume, G. V. Berg et al., L. S. Jacobsen, J. Penzien, N. M. Newmark et al., R. Tanabashi, T. Kobori et al. and N. Ando discuss the questions of maximum amplitude of non-linear elasto-plastic vibration and of vibration attenuation. In these cases, practically all the theses have utilized an analog computer or a digital computer.

In elasto-plastic vibration, energy dissipation becomes very great, and there are many which conclude that the vibration stress does not reach such a large value as to be measured by elasticity computation. There are others which go further and discuss plastic collapse.

Instead of discussing vibration of structures on the basis of strong motion records obtained in the past, there are theses which

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consider earthquake motions as random phenomena and treat problems statistically. 3 theses given by H. Tajimi, M. F. Barstein and V. V. Bolotin deal with this problem.

The recent outstanding advances in computing machines have made the calculation of statistics and response very easy, but very active research is being carried out on calculating machines to be used especially for earthquake engineering calculations.

5 papers presented by G. N. Bycroft, R. A. Morris et al., E. Shima et al., R. Takahashi (Non-linear Analyzer Committee) and D. E. Hudson et al., indicate new methods of using calculating machines. Some are linear type and others are non-linear one.

2 theses by E. Shima et al. and A. Z. Kats are papers concerned with measurement of earthquake shocks and the strain caused by such shocks.

As outlined above, the theoretical calculations on building vibrations are being studied from both the elastic and non-elastic standpoints. On the other hand, however, in order to verify this or in order to obtain new information or to decide concretely the coefficient which has been assumed in theoretical formulas, actual measurement of building vibrations is being actively carried out. 7 papers submitted by L. Zeevaert, J. A. Blume et al., D. E. Hudson, R. W. Binder et al., M. Takeuchi et al., H. Kobayashi and H. Ishizaki et al., handle this problem.

Of these, some are tests for artificially vibrating buildings, while others are measurements of earthquakes in structures. As a major result of such actual measurements, the concrete information on damping coefficients of buildings can be listed.

Besides the above, there are those discussing tests on models. These are the theses by E. Lauletta et al. and K. Muto et al.

The theses introduced above concern the earthquake-resistance of buildings, but there are 9 papers submitted concerning the effect of earthquakes on dams, bridge piers, suspension bridges, quay walls, etc.

In other words, the paper from H. Goto and K. Kaneta is concerned with bridge piers, while 3 theses read by I. Konishi, K. Kubo and M. Ito are about theoretical calculations concerning suspension bridges. The article submitted by S. Hayashi and N. Miyajima concerns actual measurements of quay wall vibrations, while 2 papers presented by N. N. Ambraseys and S. Okamoto et al., are about theoretical and actual test research on earth dams and arch dams, respectively. 2 theses read by R. W. Clough and S. Kotsubo handle the effect of water on the vibrations of underwater structures.

Since these structures differ in character on many points from buildings, the effect on them of earthquakes naturally is different, but the methods used for research differ very little from those used for buildings.

In other words, the analytical method or numerical method using calculators are used for estimating seismic stress in structures and the results of calculations are compared with those of the measurements of earthquake vibrations of actual structures and with the results of vibration tests with actual structures or models.

At the Berkeley Meeting in 1956, there were reported only 11 theses on the Analysis of Structural Response, but this time there are about five times as many papers being read. Through reading these 50 papers, it is possible to learn about the remarkable advances made in this field in the past four years.