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STRONG MOTION DATA FROM OCTOBER 29, 1968 KOYNA EARTHQUAKE

A.R. Chandrasekaran*, Member **and P.N. Agrawal**** Member

INTRODUCTION

The destructive earthquake on the West Coast of India near the Koyna hydro-electric Project in Maharashtra state which occured on December 11, 1967 had yielded a usable accelerogram. Subsequently, during the sequence of aftershocks, the accelerographs in the region have been triggered several times, but only that recorded during the earthquake of October 29, 1968 (magnitude 5.2) had appreciable amplitudes. During this earthquake, structural response data was also obtained from the Structural Response Recorders. Thus the event provided a field test on the utility of these simplified devices for collection of structural response data for the first time in India. The structural response results from the relevant (N 35° E) component of October 29, 1968 accelerogram have been compared with the results from Structural Response Recorders. The broad features of two dimensional plots of the computed response in horizontal plane derived from the accelerogram have been compared with records obtained from these simplified devices.

THE ACCELEROGRAM

A photo-stat copy of the accelerogram of October 29. 1968 was obtained through the kind courtesy of Dr. S. K. Guha of Central Water and Power Research Station, Poona. This was enlarged six times. The tracing prepared from the enlargement was used and is given in Fig. 1. For all the three components, the digitization of amplitude at peak

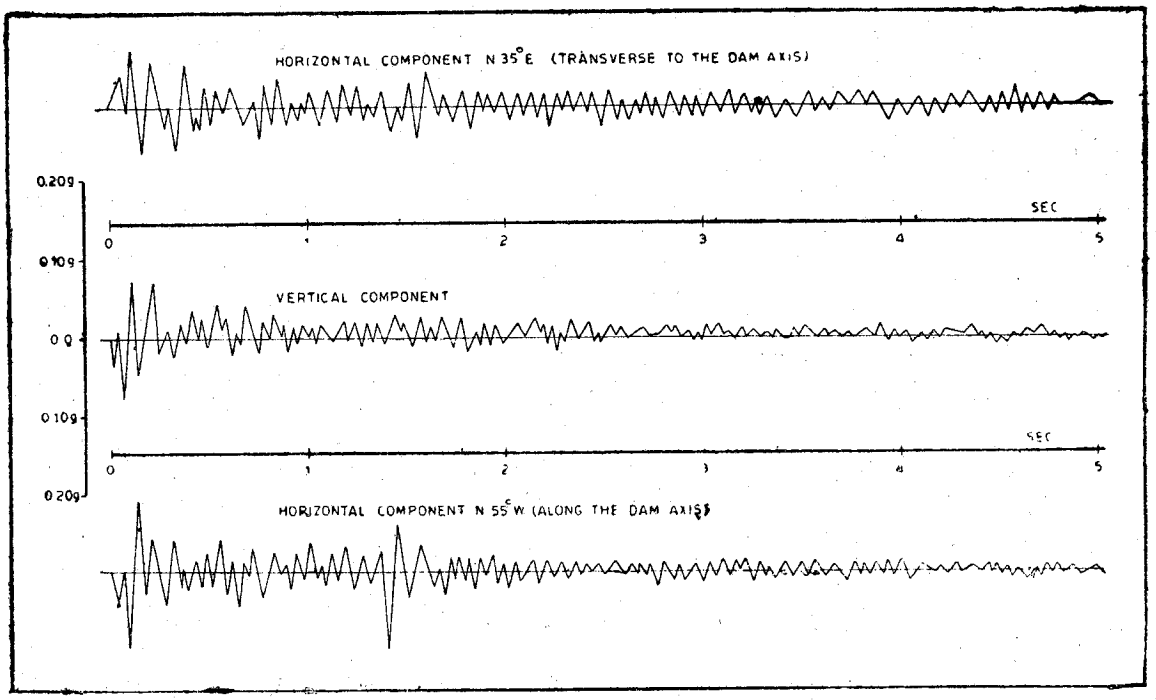

Fig. 1. Accelerogram of October 29, 1968 Koyna Earthquake.

* Professor of Structural Dynamics, School of Research and Training in Earthquake Engineering, University of Roorkee, Roorkee,

** School of Research and Training in Earthquake Engineering, University of Roorkee, Roorkee.

and trough of each wave was carried out for first four seconds. These details of digitization have been included here to indicate the possible source of additional inaccuracies compared to a normal case where original accelerograms are available for use. The base line has been located to give minimum mean square computed ground velocity at the end of each trace.

COMPARISON OF RESULTS FROM THE RECORDS OF STRUCTURAL RESPONSE RECORDER AND ACCELEROGRAPH.

Multiple Structural Response Recorder (pendulum periods 1.25, 0.75 and 0 40 seconds) was installed in the Seismological Observatory on the downstream side of the Koyna Dam. The Accelerograph was also installed in the body of the dam at foundation level. These two locations are closely spaced so as to permit the comparison of the results obtained.

The direction of the maximum relative displacement response (S_d) as recorded on Structural Response Recorder (SRR) records was almost transverse to the dam axis and therefore only one of the two horizontal component (N 35°E) recorded by the accelerograph in that direction was used for computations of S_d values for comparison. The plot of S_d versus period obtained through the relevant accelerograph trace is given in Figure 2. The values obtained through SRR records are also marked. The spectrum values as interpreted from the records are in general agreement with those computed from accelcrogram if it is kept in mind that the damping in the instrument is non-linear with amplitude and the damping values specified in the earlier report[1] are nominal. Also, there are great uncertainties in the determination of effective damping at such small amplitudes of recording due to increased contribution of dry friction. The results from the records of 0.75 sec period pendulums of the SRR compare very favourably with theoretical results. The records of 0.4 sec. pendulum indicate higher response. The 1.25 second period recorder gave lower response results due to higher damping. This has been the general experience with 1.25 second recorder pointing to inadequacy of its design.

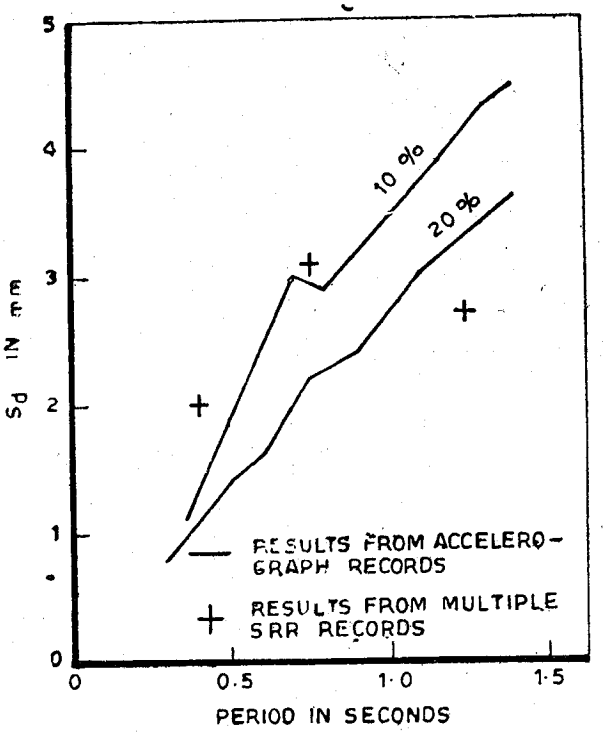

Fig. 2. Plot of maximum relative displacement response versus period for the horizontal component in N 35° E direction of the accelerogram alongwith SRR data.

COMPUTED RESPONSE IN HORIZONTAL PLANE

From the two horizontal components of the October accelerogram, the time-wise relative displacement response of a single degree of freedom oscillators having 0.40 to 0.75 second periods and each with 10, 20 and 40 percent of critical damping combinations have been computed[2]. Their two dimensional plots are given in Figure 3. Reduction of all these plots to the same scale and equal to that of SRR records was not felt necessary since the intention was only to compare the broad features and shape of the two.

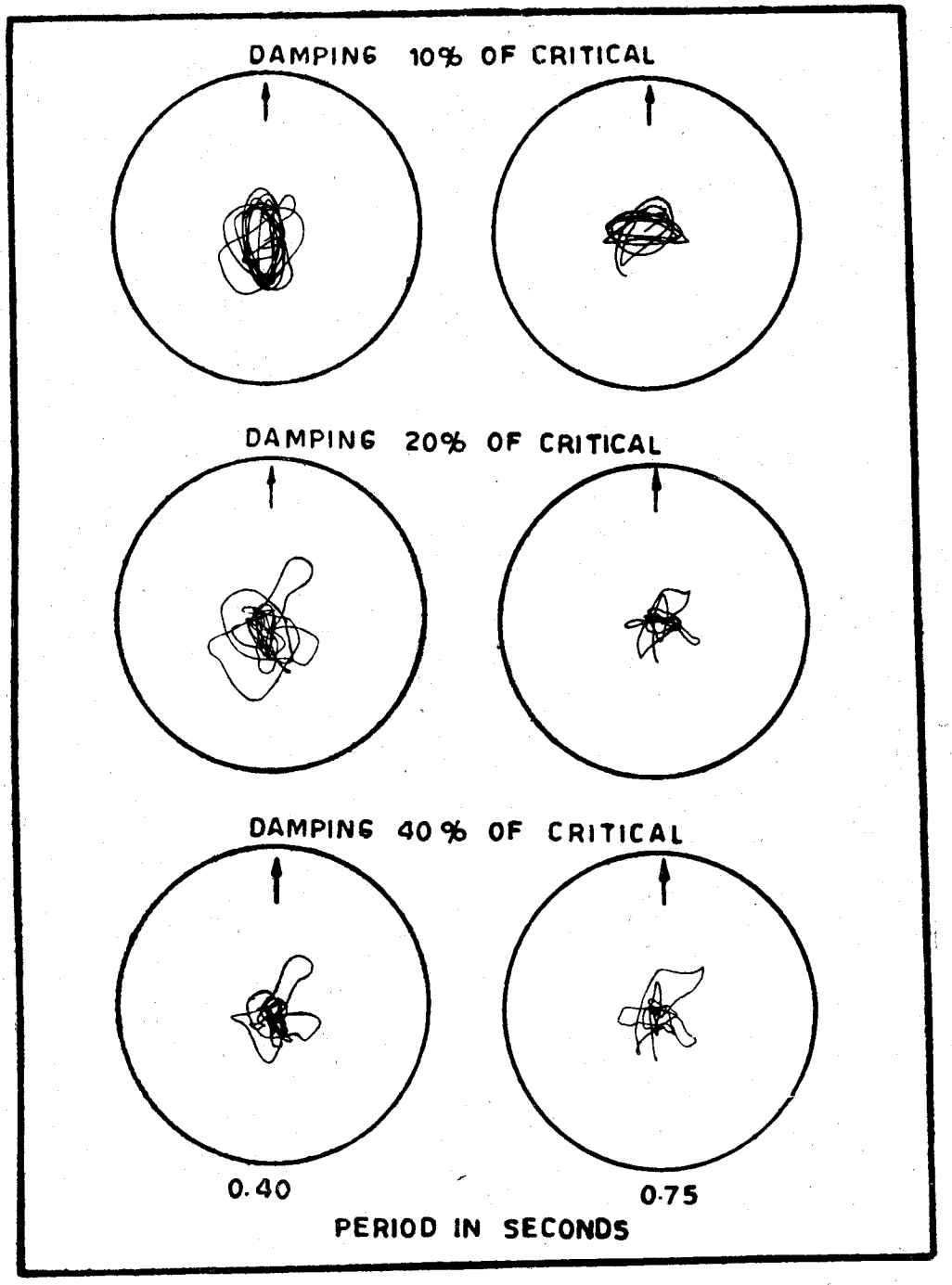

Fig. 3. Two dimensional plots of relative displacement response in horizontal plane of single degree of freedom viscous damped oscillators of 0.40 and 0.75 second period each with 10, 20 and 40 percent of critical damping computed from the accelerogram of October 29, 1968 Koyna earthquake (Arrows pointing to the north).

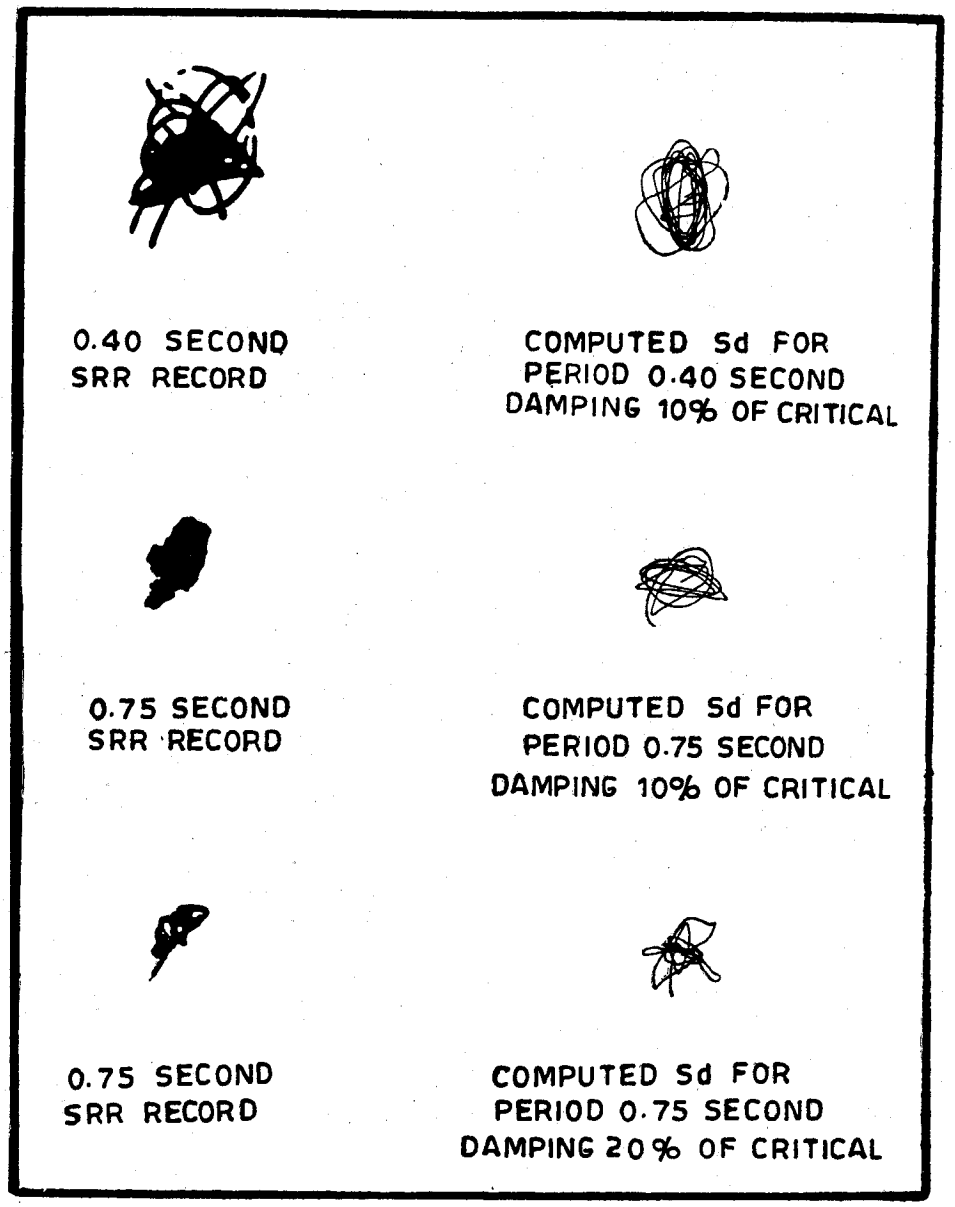

Fig. 4. Comparison of two dimensional computed relative displacement response plots and corresponding SRR records.

These computed results correspond to linear damping whereas the instruments are non-linearly damped. Even then, the direction of maximum computed response was same as recorded by the SRR. The SRR records and the computed plots which showed some broad similarities of features, have been given side by side in Figure 4. The comparison shows that the record of 0 75 second instrument has a better similarity from that of 0.40 second instrument. However, this comparison was not made for 1.25 second instrument since there was a large discrepency in S_d values itself.

CONCLUSIONS

From the comparison of results of the Structural Response Recorder to that of Accelerograph the utility of these simplified devices is very clearly evidenced. The plot of computed displacement response in horizontal plane and the SRR records show only broad similarity of features as would be expected in view of the non linear damping characteristics of these devices and due to the low level of recording. The comparison of results also brings out the fact the instrument design is most suited for 0.75 second period recorder.

It would be desirable if the simplified instruments have linear damping so that an exact comparison of results can be made with those obtained from accelerographs.

ACKNOWLEDGEMENT

The photo-stat copy of the October 29, 1968 accelerograph used was obtained through the kind courtesy of Dr. S.K. Guha of Central Water and Power Research Station, Khadagwasla, Poona.

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