

## PERFORMANCE OF MULTIPLE STRUCTURAL RESPONSE RECORDERS IN INDIA

P.N. AGRAWAL<sup>I</sup>

The idea of installation at one site of number of self recording & simplified pendulum devices (Seismoscopes) with different period and damping combinations to permit recording of maximum relative response for a range of structures, has been introduced in India. Multiple structural Response Recorder (MSRR) is the name given to a combination of six pendulums with period of 0.40, 0.75 and 1.25 sec; and each with 5% & 10% of critical damping (1). The instrument is shown in Fig 1. During the last one decade the number of MSRR installations in India have gradually been doubled to their present number of 68 and the distribution is shown in Fig 2. During this period seven earthquakes as given in Table I have been registered. Total number of records obtained is 80 & the range of resulting relative velocity response ( $S_v$ ) values for 10% of critical damping are also given in Table I. The first field test for the instruments in India was provided by the October 29, 1968 earthquake in Koyna region which was recorded both-by MSRR and accelerograph. The comparison of shape and size of the MSRR records to the plots of two dimensional computed response from accelerogram was notable, particularly in view of the low level of recording (2). The July 29, 1970 earthquake on Burma-India Border region is the most extensively recorded event (3). Forty four records from ten different sites spread over 300 km long region have been obtained. The variation in  $S_v$  from seven sites at different distances and azimuth's from the epicentre are compared in Fig 3. The November 6, 1975 event which occurred very close to Roorkee was recorded on MSRR and the results are shown in Fig 4. The expected variation in the response values has been recorded. Even the strike of the fault planes suggested on the basis of these records have been found consistent with the results of the fault plane solution obtained using seismological data for two of the earthquakes recorded. This certainly is an extraordinary performance of a sparsely distributed network of simple devices needing small efforts and investment. Also it is very conveniently possible to select and prepare a site; and install and calibrate the MSRR in a period of about two days. However, there is still scope of improvement in the instrument with regard to its damping characteristics. The instrument in its present form itself is recommended for application in similar studies and can be considered as complementary to the accelerograph installations.

1. Agrawal, P.N.,(1970), 'Structural Response Results from October 29, 1968 Earthquake in the Koyna-Pophali Region', Bull. Seismo. Soc. Am., Vol. 60, No. 1, pp. 76-88.
2. Chandrasekaran, A.R. & P.N. Agrawal,(1970), 'Strong Motion Data From October 29, 1968, Koyna Earthquake', Bull. Indian Soc. Earth. Tech., Vol. VII, No. 3, pp. 153-157.
3. Agrawal, P.N., (1972), 'Structural Response Results during July 29, 1970 Earthquake in Burma India Border Region', Bull. Seismo. Soc. Am., Vol.62, No. 1, pp. 101-114.

---

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

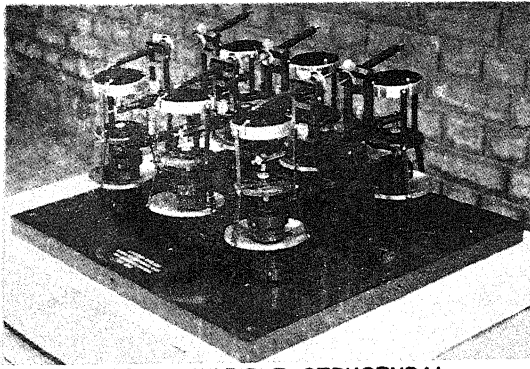


FIG. 1 - MULTIPLE STRUCTURAL RESPONSE RECORDER

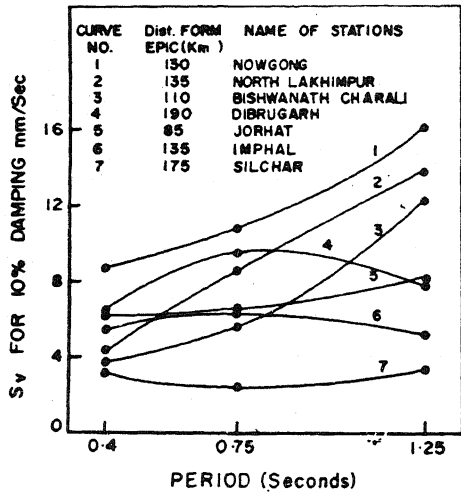


FIG. 3 - COMPARISON OF VELOCITY RESPONSE RESULTS DURING THE JULY 29, 1970 EARTHQUAKE IN BURMA-INDIA BORDER REGION

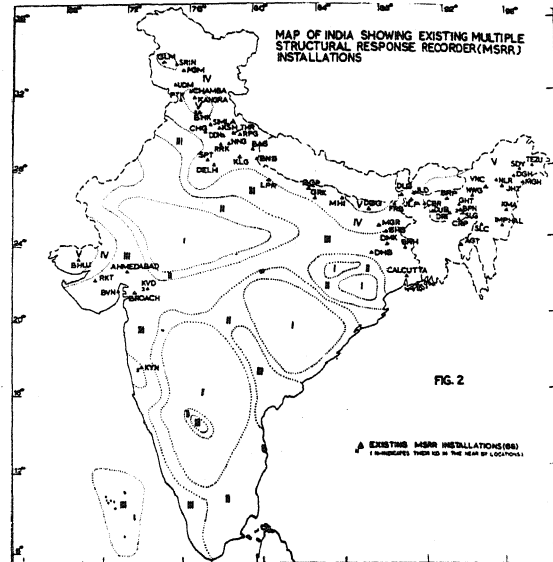


FIG. 2

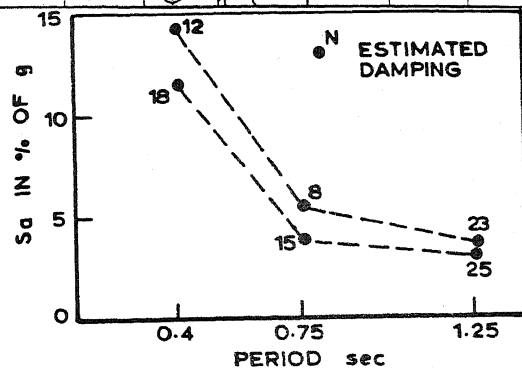


FIG. 4 - VARIATION IN RESPONSE RECORDED AT ROORKEE - NOV. 6, 1975 EARTHQUAKE

TABLE I - EARTHQUAKES RECORDED BY MULTIPLE STRUCTURAL RESPONSE RECORDERS IN INDIA						
DATE & LOCATION OF EARTHQUAKE	MAG.	PLACE OF RECORDING DIST.* OF EPIC. KM.	No. of RECORDS	S <sub>y</sub> FOR 10% DAMPING PERIOD		cm/sec
				S <sub>y</sub> (range)		
6.6.66 36.32°N 71.16°E	6.3	Gulmarg, Srinagar 370 400	04	0.75 1.25	3.57 5.31	- 3.35
27.6.66 29.8°N 80.7°E	6.1	Bageshwar, Banbasa 125 125	03	0.40 0.75 1.25	11.35 4.15 1.36	9.43 1.79 0.71
29.10.68 17.4°N 73.75°E*	5.2	Koyna, Pophali 5 5	12	0.40 0.75 1.25	3.44 3.17 4.07	3.23 2.77 1.91
27.6.69 17.4°N 73.75°E*	4.2	Koyna, Pophali 5 5	06	0.40 0.75	0.99 0.65	0.65 0.49
29.7.70 26.0°N 95.4°E	6.5	Agartala, Biswanath- 350 110 Charali, Chapakhowa 275 Dibrugarh, Imphal 190 135 Jorhat, Marghrita 85 220 Nowgong, North- 130 Lakhimpur, Silchar 135 175	44	0.40 0.75 1.25	1.14 1.19 1.71	0.30 0.24 0.33
6.11.75 29.8°N 78.3°E*	4.7	Roorkee 5	06	0.40 0.75 1.25	10.35 5.65 10.65	9.64 5.30 9.29

\* These are only approximate