

GEODETIC DETERMINATION OF EARTH STRAINS IN KOYNA DAM AREA

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Two dimensional strain field induced in Koyna Dam area due to the earthquakes of 1967-68 is deduced from survey data. Figure 1 represents the small scale triangulation network. The strains are deduced from (i) adjusted coordinates, (ii) adjusted angles and (iii) unadjusted observed angles respectively obtained from the triangulation measurements of 1966 and 1969. In the first case the four elements of the strain tensor e_{ij} for any observed line PQ are calculated from the following relationships (1).

$$e_{11} = \frac{(X'_q - X'_p) - (X_q - X_p)}{(X_q - X_p)} ; \quad e_{12} = \frac{(X'_q - X'_p) - (X_q - X_p)}{(Y_q - Y_p)}$$

$$e_{21} = \frac{(Y'_q - Y'_p) - (Y_q - Y_p)}{(X_q - X_p)} ; \quad e_{22} = \frac{(Y'_q - Y'_p) - (Y_q - Y_p)}{(Y_q - Y_p)}$$

where X, Y and X', Y' denote the adjusted coordinates obtained from the first and second surveys respectively. The subscript indicates the point concerned. From these quantities the dilatation Δ and rotation ω are deduced. In the second case the shear components γ_1, γ_2 total shear γ as defined by Frank (2) and azimuth ψ as defined by Savage and Burford (3) are computed from adjusted angles. The values thus obtained are presented trianglewise in Table 1. The values of γ_1, γ_2 and γ are also estimated from unadjusted observed angles by least squares solution and presented along with their probable errors in Table 2.

The analysis leads to the conclusion that the strains consequent to the earthquakes are maximum near the dam axis, the maximum values of dilatation and rotation components being -132 and 64 μ strains respectively. The respective maximum values of γ_1, γ_2 and γ are -68, -34 and 73 μ strains. The mean azimuth value of the maximum tensile axis is N67°E and it agrees with the fault plane solution of Khattri (4).

REFERENCES

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TABLE 1 - VALUES OBTAINED FROM ADJUSTED COORDINATES AND ADJUSTED ANGLES

Triangle	From Adjusted Coordinates		From Adjusted Angles			
	$\Delta (10^{-6})$	$\omega (10^{-6})$	$\gamma_1 (10^{-6})$	$\gamma_2 (10^{-6})$	$\gamma (10^{-6})$	ψ
ABG	-132.382	64.373	-48.649	-34.554	59.672	55°
GBE	3.795	42.508	-68.426	-26.698	73.450	69°
GEH	-3.070	6.558	-48.449	-10.597	49.594	78°
HEF	41.996	-24.036	-43.275	-14.958	45.787	71°
HEC	25.348	-35.450	-50.749	-2.563	50.813	87°
HED	-15.317	+18.201	-31.412	-34.098	46.362	43°
HCD	15.716	-9.601	-57.697	-26.314	63.414	65°
ECD	26.784	-17.478	-61.105	19.195	64.049	72°

TABLE 2 - VALUES OBTAINED FROM UNADJUSTED OBSERVED ANGLES BY LEAST SQUARES SOLUTION

Triangle	$\gamma_1 (10^{-6})$	$\gamma_2 (10^{-6})$	$\gamma (10^{-6})$
ABG	-46.99 ± 1.61	-34.99 ± 1.05	58.58 ± 1.91
GBE	-66.33 ± 1.14	-24.07 ± 1.63	70.56 ± 1.98
GEH	-47.54 ± 1.48	-13.50 ± 1.05	49.42 ± 1.80
HEF	-40.11 ± 1.47	-13.49 ± 1.20	42.32 ± 1.89
HEC	-57.36 ± 3.94	-5.121 ± 1.22	57.58 ± 3.21
HED	-38.37 ± 2.13	-33.07 ± 4.91	50.66 ± 5.35
HCD	-58.35 ± 1.74	-27.19 ± 2.52	64.38 ± 3.06
ECD	-56.57 ± 1.80	-21.56 ± 1.91	60.54 ± 2.63

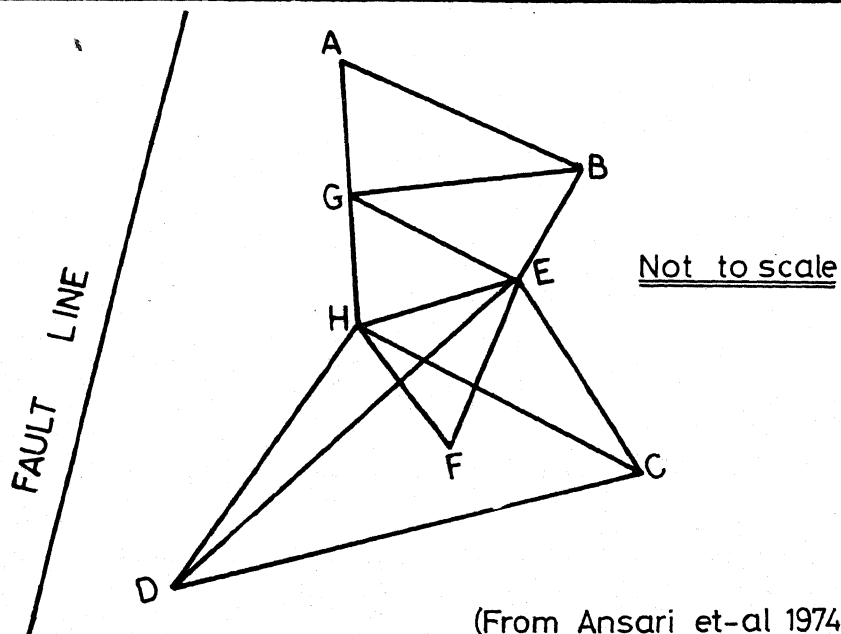


FIG 1

NOTE: Line AB is near the dam axis