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EVIDENCES OF 12TH-13TH CENTURY EARTHQUAKE AND RELATED SEISMOTECTONICS, BARSUR AREA, DISTT. BASTAR, MADHYA PRADESH

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INTRODUCTION

The village of Barsur (19°07′: 81°18′) lies 27 km. north of Gidam (Fig. 1) and is spectacular due to the wide spread ruins. It is locally known that the place was at its zenith during the Nagbansi rule in the 11th century A.D. and had 147 temples and 147 tanks. The only remains of this ancient rich civilisation, can be seen in the form of a few rickety temples, heaps of rubble, some beautifully preserved statues and sculpture and outline of dry and silted tanks. The Archaeological Survey of India is understood to have salvaged a part of the stone sculptures found in the area, some of which were obtained while ploughing the fields. The magnificent structure of the Battisa temple though dilapidated still exists in the area (Fig. 2). The other fairly well preserved structure is known as Mama-Bhanja-Ka tample. A elegant statue of Lord Ganesh 2 to 2.5m high and about 5m in girth is further maintained under a new constructed roof in the area.

EVIDENCES OF EARTHQUAKE DEVASTATION

Barsur temples were compact lofty temples without any enclosure wall and architecturally resemble the Khajuraho temples of 10th century A.D. The construction is made by granite blocks set without any mortar. In the vicinity of the temples, the granitic bedrock lies at shallow depth of about 5m, as could be seen in the excavated tank sections and is overlain by alluvial silt and laterite deposits.

The structure of the Battisa temple which is one of the best preserved temples amongst the ruins has a twin Sanctum (garbha-griha), a common rectangular courtyard, and in all 32 pillars. The area being severely hit by an earthquake shock is very well exhibited in the nature of the temple ruins. Some of the critical features recorded are:

1. The temple dome has fallen on the western side, with sanctum structure tilted towards West. The rock slabs forming the basal portion of the Sanctum walls show a relative horizontal displacement of about 10cm towards east with reference to the upper portions.
2. Rotation in some of the pillars by as much as 30° from their original position.
3. The base of one of the pillars forming the courtyard has been displaced towards east, causing tilt and collapse.
4. The slabs on the parapet of the courtyard are horizontally displaced by about 5 cm. towards east with tensional openings in the parapet wall.
5. The plinth of the temple is buckled in the shape of a double curve along the north-south axis, on the northern face of temple, where a maximum estimated differential settlement of about 30cm. is observed in a length of 25cm. of the plinth. However, along the north-south axis on the eastern face of the temple, a gentle curve is apparent with the uplifted central section and outward tilt towards the corners. In general, the foundation of the temples show a wavy appearance.

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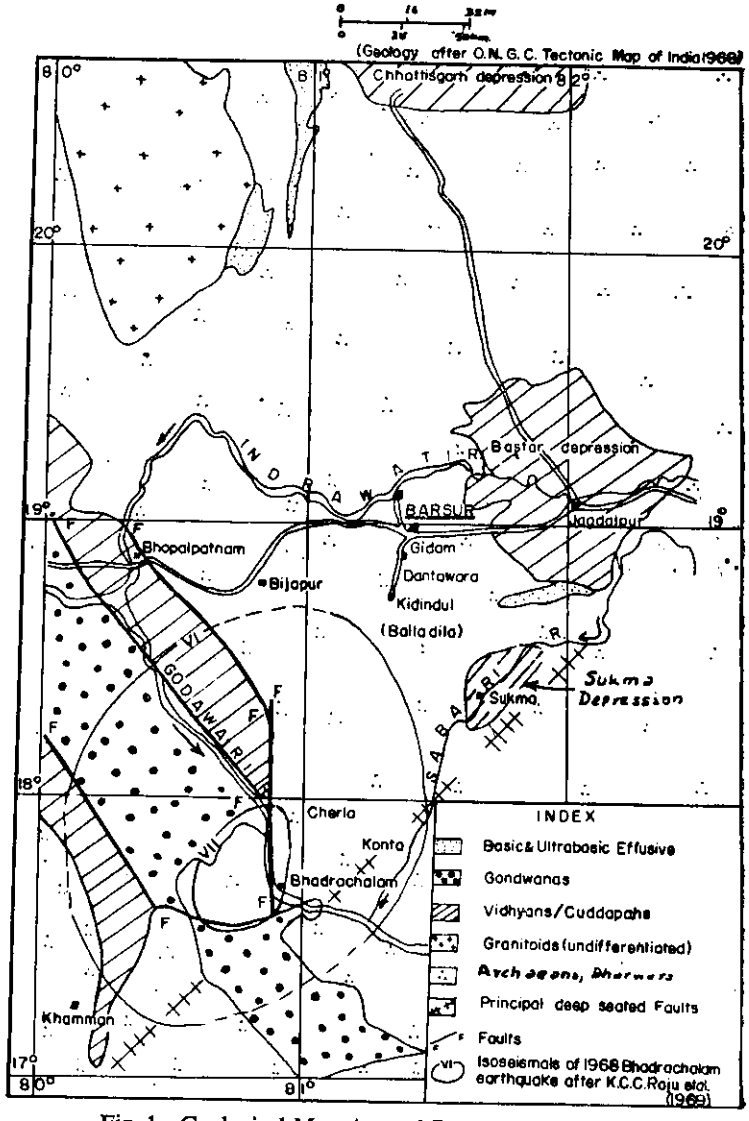

Fig. 1—Geological Map Around Barsur Bastar (M.P.)

In the District Gazetteer of Chattisgarh (1922) the Barsur temples are reported to be of 1109A.D. In the area an old temple known as Mama-Bhanja-Ka-Mandir with a fairly high dome exists and does not show any evidence of damage due to an earthquake. This temples is locally known to be a later construction, in the 13th century A.D. It can, therefore, be surmised that the catastrophic earthquake of Barsur occurred sometime in the 12th or 13th century A.D.

ASSESSMENT OF THE PARAMETERS OF THE EARTHQUAKE

From the affects of the earthquake discussed earlier it is evident that the area experienced an earthquake of intensity between VIII & IX of the Modified Mercalli Scale.

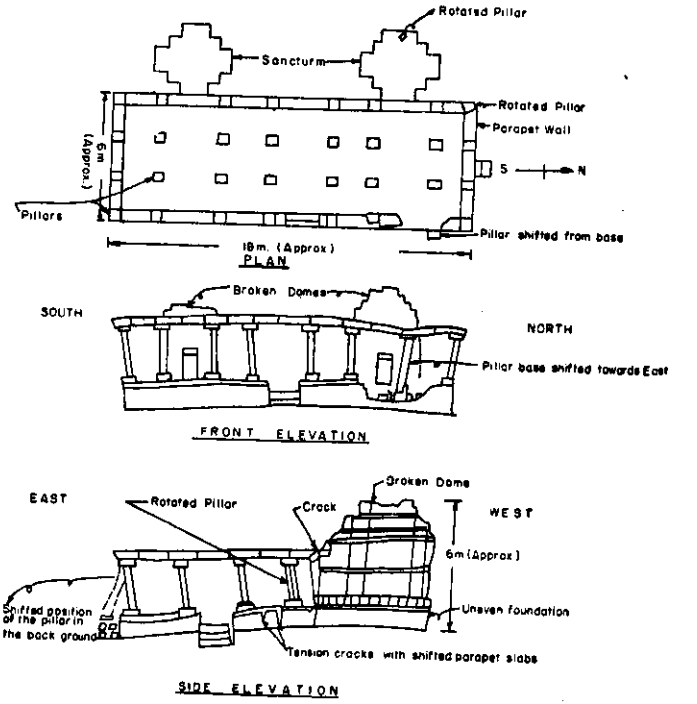

Fig. 2—Sketch Showing Earthquake Damage to Battisa Temple, Barsur (M.P.)

On the basis of tilt and failure of the structures it is observed that those which were under the effect of inertia the displacement is always in a westerly direction, whereas in the lower blocks of the pillars, walls and slabs which could move under the influence of the force of propagation of the earthquake wave, have shifted towards east. Considering this evidence, it is surmised that the seismic forces had hit the area from a westerly direction.

Utilising empirical formula (Gutenberg & Richter, 1942) for maximum intensity zone $M=1.3+0.6\times I$ (where M is Richter magnitude and I is maximum intensity of an earthquake), the possible magnitude of the earthquake with an epicentre at Barsur should have been between 6.1 and 6.7. The magnitude of the earthquake would have been higher if the epicenter as interpreted, lay farther towards west.

DISCUSSION ON THE SEISMO-TECTONICS OF THE AREA

Barsur area is located on Archaean formations which form the basement for Cuddapah as well as Gondwana formations. Crookshank (1963) geologically mapped the Cuddapah formations which unconformably overlie the Archaean granites and gneisses, in the Chattisgarh, Bastar and Sukma depression lying towards North, East and South of Barsur area respectively. He considered the difference in level between these depression being due to subsequent earth movements. The Archaean rocks in general have been traversed by effusive basic and ultrabasic rock trending in N-S and E-W directions. The Gondwana basin which lies about 100 km. south-west of Barsur, in the Godawari rift valley, trends in a NW-SE direction.

The published tectonic map of India by Oil and Natural Gas Commission, 1968

has indicated a NE–SW trending deep seated fault passing through Bhadrachelam, south of Barsur area. In addition a NW–SE trending fault has also been shown within the Godawari basin. Raju *et al* (1969) has further postulated a N–S trending fault along river Godawari between Bhadrachelam and Cherla and has also indicated presence of a number a N–S and E–W trending faults in the Godawari Basin; a feature which fairly confirms with the pattern of effusive basic and ultrabasic rock occurring within the Archacans.

Minor earthquakes are reported to have occurred in Bhadrachelam town in 1956 and again in July 1968. On 13th April, 1969 an earthquake of intensity VII and magnitude 6.5 occurred in the area and was reported to have its epicentre 35 km. WNW of Bhadrachelam (Raju, *et al* 1969). It has in general been interpreted that the seismic activity in the area is related to N–S faults occurring along the Godawari Basin. The N–S axis of weakness has also been reported in the basement below the Deccan trap and has been considered to be responsible for the koyna earthquake of 11th Dec., 1967 having a magnitude of 6.5. Geological Survey of India (1968) Though no record of earthquake activity in the Barsur area is available, it is of significance to note that Barsur area lies in the direction of longer axis of the isoseismals of Bhadrachelam earthquake of 1969.

With the data in hand, it is rather difficult to pin-point the plane of weakness which caused the Barsur earthquake. However, considering the tectonic set up, the earthquake could be related to activity along any of the faults lying west of Barsur around the Godawari Rift Valley.

According to seismic zoning map published by Indian Standards Institution, the Barsur area falls in seismic zone I. However, in view of the foregoing observations of a major catastrophic earthquake having occurred during historical times, the area is considered to be seismically active and the feature should be taken into account in the design of civil structures. In the absence of instrumental data on microtremors any continued activity along the faults occurring in the area is however, not known.

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