BEFORE THE NATIONAL GREEN TRIBUNAL
SOUTHERN ZONE, CHENNAI (SZ)
ORIGINAL APPLICATION NO.120 OF 2024

IN THE MATTER

Suo-Motu ...Applicant(s)

- Vs-

Irrigation and command Area
Development (CAD)
Through its Engineer in chief,
Siddipet District, Telangana ...Respondent(s)

ADDITIONAL REPORT FILED BY THE IRRIGATION DEPARTMENT-R4

Place: Chennai

Date: 4.02.2025

Mrs. H. Yasmeen Ali,
Standing counsel for 4nd Respondent

BEFORE THE NATIONAL GREEN TRIBUNAL,
SOUTHERN ZONE, CHENNAI

Original Application No.120 of 2024
[Earlier O.A. No.151 of 2024 (PB)]

Suo Motu

.... Applicant

-Vs-

Irrigation & Command Area Development (CAD)
Through its Engineer in Chief, Siddipet District, Telangana

.... Respondents

Report filed by the Irrigation & Command Area Development (CAD) Department-R-4

Report as per the order of National Green Tribunal, Chennai dated:26.11.2024

1. **Why the Seismic Study was not conducted before the commencement of the Project when the project also included an unsafe zone?**

It is to submit that, Earthquake-prone regions of the country have been identified on the basis of level of seismicity, the Bureau of Indian Standards (BIS) has grouped the country into four seismic zones viz. zones V, IV, III and II. Zone V expects the highest level of seismicity whereas Zone II is associated with the lowest level of seismicity (Enclosed as Annexure-1). The Sri Komaravelli Mallannasagar Reservoir in Telangana falls under Seismic Zone-II which is the safest zone in the country as per the level of seismicity.

Before formation of the Sri Komaravelli Mallannasagar Reservoir while approving the design and drawings, as per the suggestion of Chief Engineer, Central Designs Organization, Hyderabad, the Executive Engineer, Irrigation Division No.6, Gajwel has addressed the Director, Council of Scientific and Industrial Research (CSIR)- National Geophysical Research Institute (NGRI), Hyderabad for conducting the site-specific seismic studies pertaining to Sri Komaravelli Mallanna Sagar Reservoir. Subsequently, the Chief Scientist, National Geophysical Research Institute, Hyderabad along with his team visited the site and conducted Ground Penetration Radar studies. As per the results, the Chief Scientist, National Geophysical Research Institute has submitted a Preliminary Seismo-tectonic and Ground Penetration Radar studies Appraisal (Overview) around Mallanna Sagar dated:23.08.2018 (Enclosed as Annexure-2).

Further, the National Geophysical Research Institute has reported that it has carried out Ground Penetration Radar survey at site and as per the latitude and longitude of the location (aa' @ N-17°57.451', E-78°47.915'; 65m length and bb' @ N 17°57.469', E-78° 47.942'; 68 m length) it

falls nearby Full Reservoir Level at +557.000m and away from the bund alignment of the Sri Komaravelli Mallannasagar reservoir, where the ground level is almost +557.000m. The water column at the location where Ground Penetration Radar survey conducted by National Geophysical Research Institute is zero for the reservoir full capacity of 50 thousand Million Cubic feet (TMC) at +557.000m.

Subsequently, during the design of earth bund, basic horizontal seismic coefficients (α_o=0.02 as per Table-2 of I.S:1893-1984) is considered and designed accordingly by Chief Engineer, Central Designs Organization, Hyderabad. Factor of safety obtained for steady seepage (1.11) and sudden draw down (1.0) conditions are more than required value of 1.0. The design and drawings were approved and formation of reservoir has been executed asper approved drawings and specifications.

Further, Government constituted a technical committee vide G.O.Rt.No.49 I&CAD (Proj-IV) Dept Dated:28.01.2021 to resolve technical issues related to Designs, Stability analysis, Vetting of Designs pertaining to Sri Komaravelli Mallanna Sagar Reservoir.

The Scientist (Geo-Technical Expert) from Central Water and Power Research Station, Pune, member of the committee has inspected the Sri Komaravelli Mallannasagar Reservoir site. Three cross sections of the dam were analysed viz. Section-1 of Height 59.60 m at Km.15.600 (maximum height section), Section-II of Height 51.00 m from Km.18.625 to Km.19.925 and Section-III of Height 49.00 m from Km.16.300 to Km.16.700.

After detailed analysis, a detailed report on "Geotechnical studies for seepage and stability analysis of zoned earth dam of Mallanna Sagar reservoir" have been furnished. In the report, the Section.10.0 Conclusions and Recommendation point 'c' states that "Results of stability analysis indicate that all three cross-sections are safe from slope stability point of view" and point 'd' states that "Pseudo-static earthquake analysis indicates that all three sections are safe for steady seepage and reservoir full conditions" (Enclosed as Annexure-3).

Further, National Geophysical Research Institute, Hyderabad vide their letter dated:29.04.2024 (Enclosed as Annexure-4) have opined and recommended to carry out the continuous seismic monitoring of the reservoir as per Central Water Commission guidelines.

National Geophysical Research Institute, Hyderabad has submitted a detailed proposal (Enclosed as Annexure-5) for Supplying and Installation of recommended seismic instruments for monitoring the seismic activity of Sri Komaravelli Mallanna Sagar Reservoir and requested for payment for Rs.534.325 Lakhs. The Government vide Memo No.4113/Proj.IV/A1/2024 Dt:26.11.2024 (Enclosed as Annexure-6) has accorded the permission to deposit the necessary funds to CSIR-NGRI, Hyderabad. Subsequently, for depositing the necessary funds to CSIR-NGRI,

Hyderabad the bill is prepared and submitted to Government vide Token No.2523655479 dated:08.01.2025 for payment.

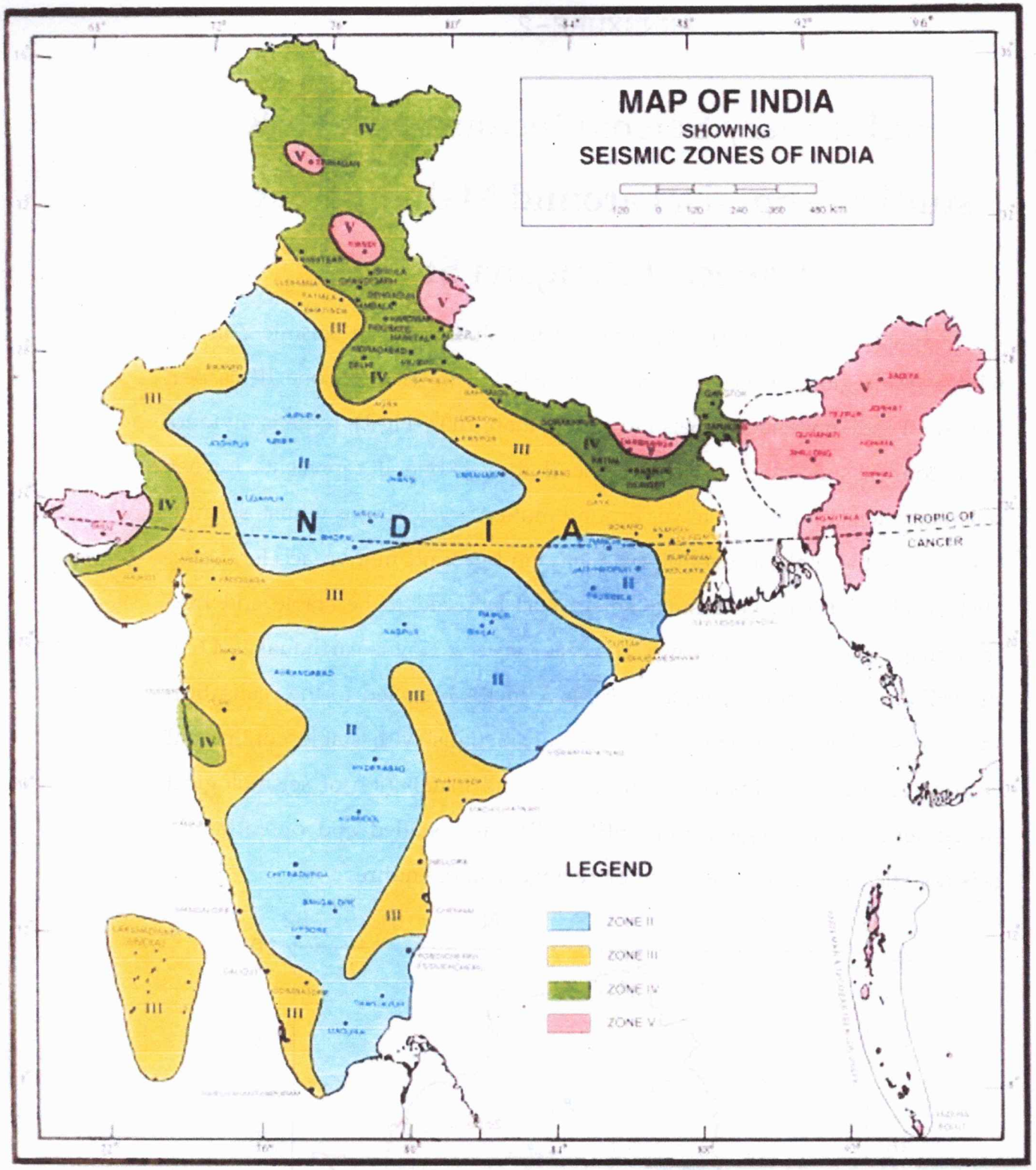
The Seismic monitoring, Delineation of seismically active faults/ lineaments and Determination of Peak Ground Acceleration (PGA) levels of the dam structure during the occurrence of near field earthquakes will be carried out by National Geophysical Research Institute, Hyderabad after payment of the necessary funds.

2. **Preparation of Emergency Action (EAP)**

The Preparation of Emergency Action Plan (EAP) for Sri Komaravelli Mallannasagar Reservoir has been entrusted to Central Water & Power Research Station (CWPRS), Pune and required fee has also been remitted. The collection of data by CWPRS, Pune for preparation of EAP has been started and the report will be submitted by March-2025.

This is submitted for your kind favour of information and perusal. The case is listed on 06.02.2025.

Executive Engineer I&CAD Dept
Irrigation Division No.6
Gajwel



NOTE : Towns falling at the boundary of zones demarcation line between two zones shall be considered in High Zone.

Preliminary Seismo-tectonic and GPR studies Appraisal around Mallanna Sagar Project, Telangana State

Telangana state in southern peninsular shield falls in Seismic Zone II with a few regions of north eastern districts fall in seismic zone III as per Bureau of Indian Standards Seismic zoning map, 2002 (Fig 1). India is divided in to four seismic zones namely zone II to V. Zone II represents lowest seismicity level and hence, lower ground motion accelerations whilst, seismic zone V has the highest level of seismicity and ground motion accelerations. Historically southern Peninsular shield was believed to be stable and free from major earthquakes however, the occurrence of Koyna earthquake M 6.3, in 1967 and the Latur earthquake of M6.3, in 1993 has led to the realisation that the southern Peninsular shield is conspicuous with stable continental region earthquakes. This led to the design and installation of seismological instruments in this region and CSIR-NGRI has installed and operating 16 seismological stations in the states of Telangana and Andhra.

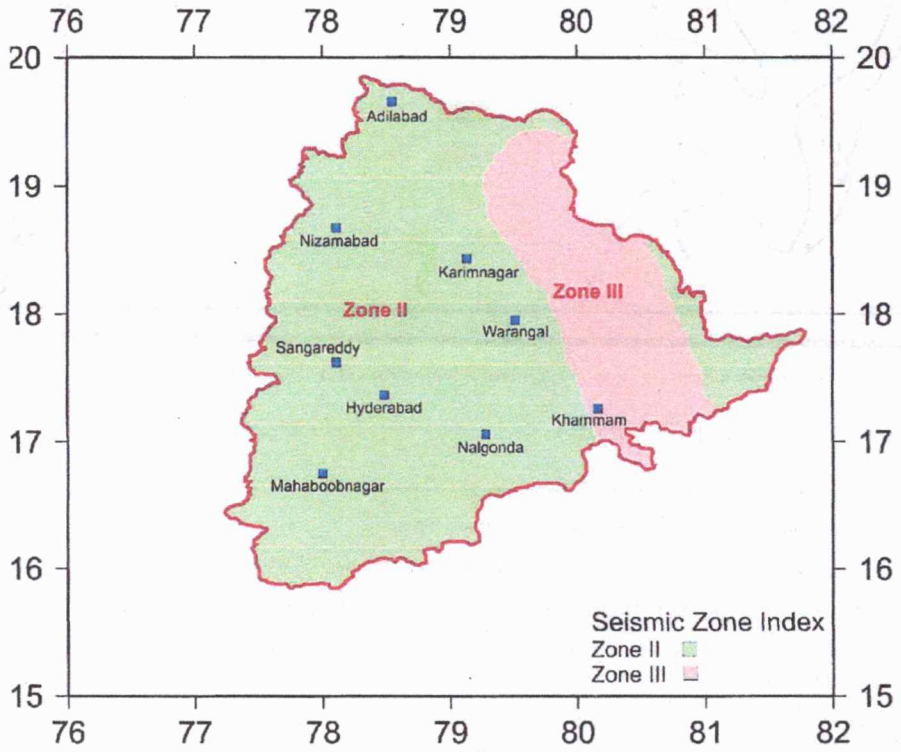


Figure 1 Seismic Zone Map of Telangana

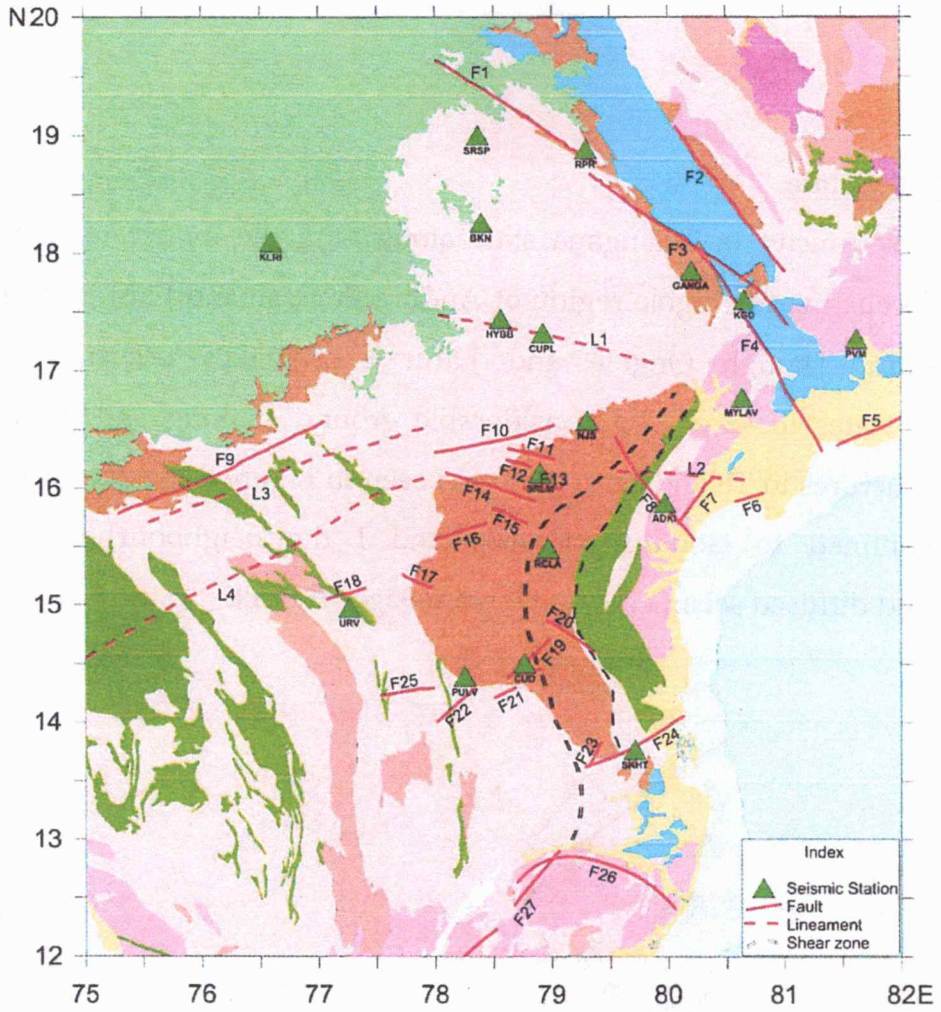


Figure 2 Major faults/Lineaments in Telangana and Andhra Pradesh as per the SEISAT 2000 and locations of seismological stations

Major tectonic features in and around the state:

The major tectonic feature in Telangana is the Godavari graben as shown in Figure 2. The graben forms the north eastern boundary and is linearly trending in the NW-SE direction about 350 km in length and 40 km width. Majority of the lineaments are of Archean age that can be basically characterized into two distinct sets: (1) NW–SE trend, predominantly found in the main basin, and (2) NE-SW trend, in the South eastern part of the valley. The major faults adjoining the rift are the Kadam fault (KF), Kinnerasani–Godavari fault (KGF), Kolleru-lake fault and the Godavari valley fault (GVF) (Figure 2). The green triangles are the seismological stations operating and about 7 of them are operating in Telangana.

Seismicity in the state

Recent seismicity in Telangana state along with the moderate sized earthquakes occurring in Ongole region of Andhra Pradesh and Latur region of Maharashtra. Though Ongole and Latur earthquakes occurred in neighbouring states these caused considerable ground shaking and minor damage to structures in Telangana region. As seen in Figure 3 the seismicity is mainly confined to Godavari Graben and I the neighbourhood of Hyderabad and diffused seismicity near Sriram Sagar Project.

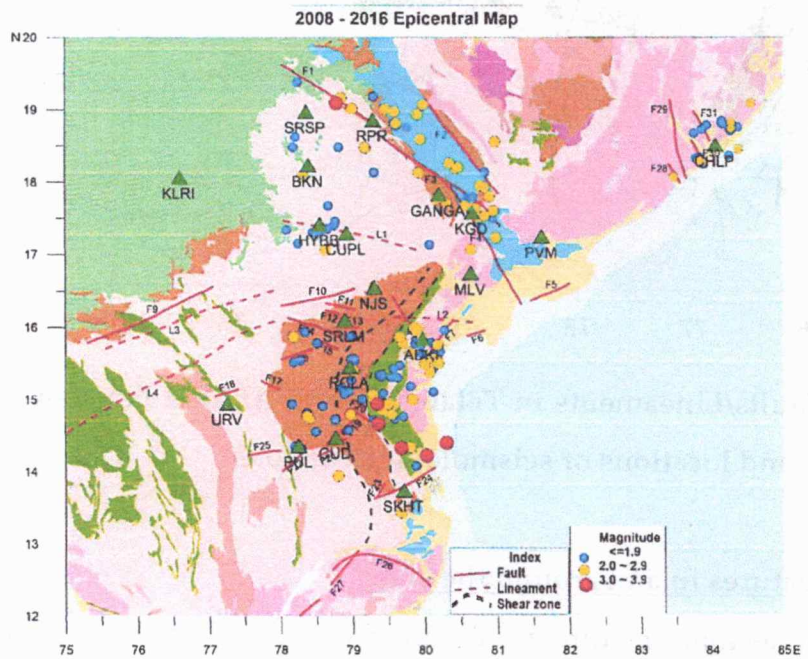


Figure 3 Seismicity map of Telangana and Andhra Pradesh

In the year 1969, moderate earthquake with magnitude 5.7 struck **Bhadrachalam** region in Khammam district as shown in Figure 4. This earthquake was felt in the entire south India Peninsular shield and there were reports of damage to structures in the epicentral region. The iso-seismal map is presented in Figure 5 clearly shows that the Mallanna Sagar Project is located along the Intensity VI contour. The Bhadrachalam earthquake occurred at a distance of about 200 km from Mallanna Sagar Project site.

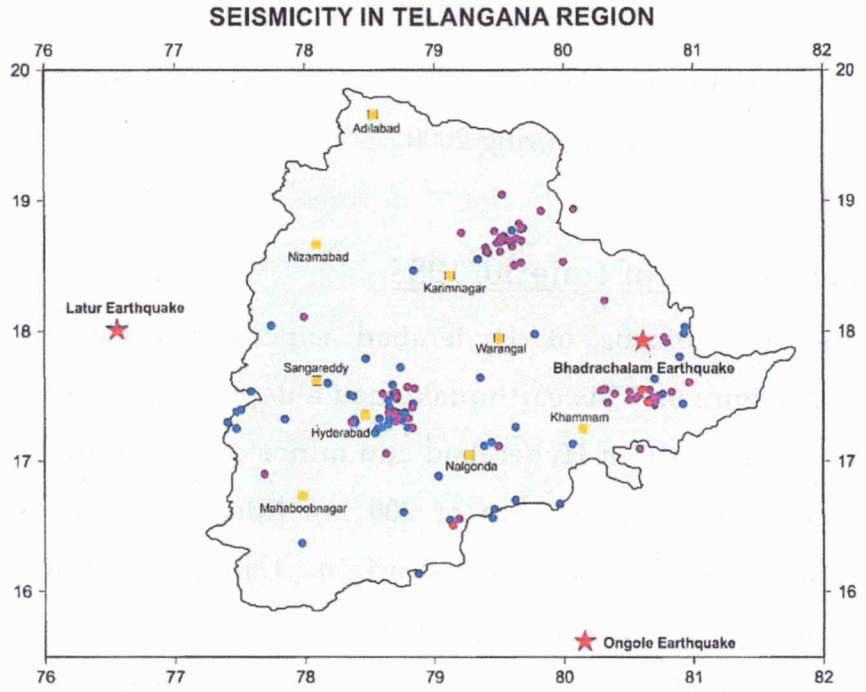


Figure 4 Major earthquake locations around the Mallanna Sagar Project

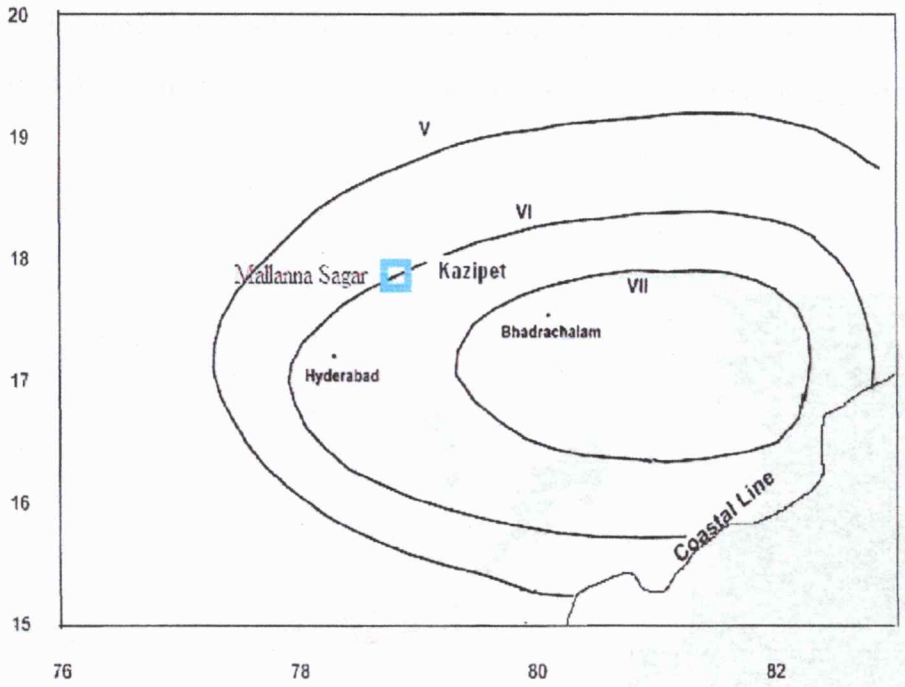


Figure 5 Isoseismal Map of 1969 Badhrachalam earthquake

There other source region is Hyderabad which has reported episodes of swarm activity during the years 1982, 1994, 1995, 1998, 2000 and 2010. Largest swarm activity was in the vicinity of Gandipet reservoir area during 1982 with M 3.5 being the maximum magnitude earthquake. Swarm activities have also been reported from Jubilee hills and Vanasthalipuram of

Hyderabad. Largest magnitude tremor among this swarm sequences is 2.6 which occurred in Jubilee Hills during 2000.

Medchal Earthquake of June 30, 1983

Medchal area in suburbs of Hyderabad experienced earthquake of magnitude 4.9 (Figure 6). This earthquake had a depth of more than 15 km and was felt significantly in Hyderabad and minor cracks in the buildings have been reported. Upto distance of 200 km this earthquake was felt significantly because of its deep seated origin. Using three stations data from Hyderabad, Srisailam and Nagarjuna Sagar operated by CSIR-NGRI, the epicentre is located to the NE of the International Seismological centre epicentre. This epicentre distance of this earthquake is about 20 km from the Mallanna Sagar Project site and could be located on either of the two lineaments/faults which are east-west and north west-south east trending.

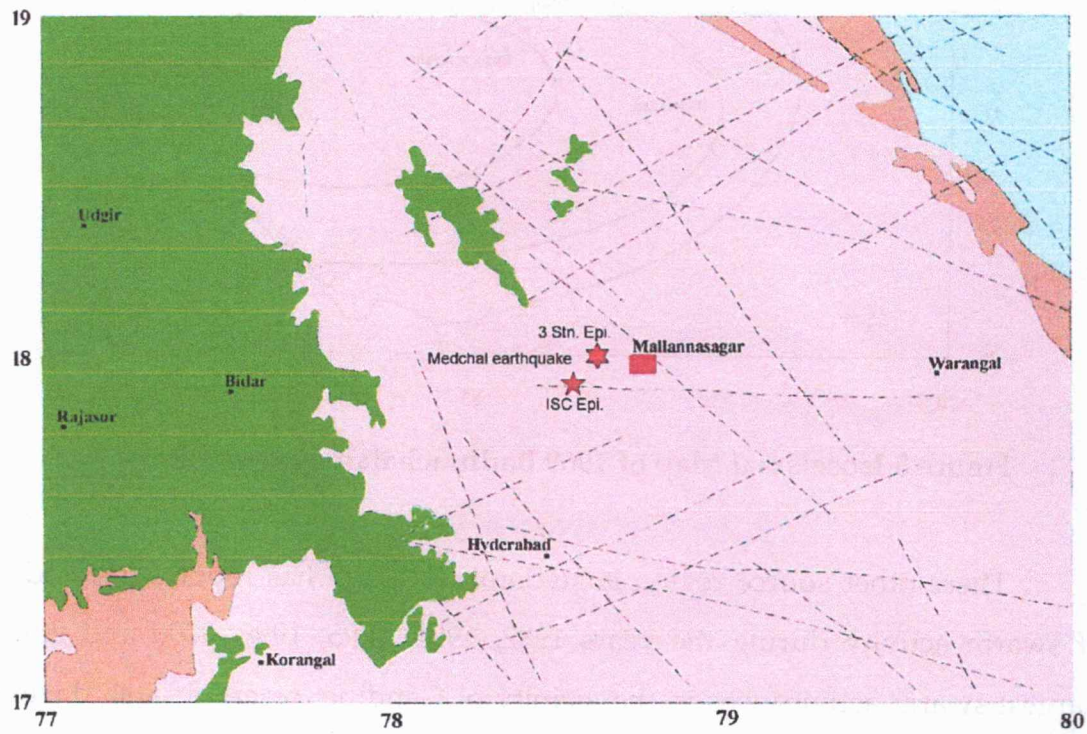


Figure 6 Epicentre location of the 1983 earthquake close to Mallanna Sagar Project

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Prominent source regions:

In the year 1967, moderate earthquake with magnitude 5.4 struck Ongole region in Andhra Pradesh. The epicentral region of this earthquake is Located at ~ 300 km from the Mallanna Sagar project site

On September 29, 1993 a major earthquake of Magnitude 6.3 occurred in Latur, Maharastra state. Even though this earthquake occurred in neighbouring state the actual distance of the source region of this is in close distance to Zahirabad surrounding villages (~100 km). The Latur earthquake occurred at a distance of about 240 km to Mallanna Sagar Project site. This earthquake caused lots of damage to structures in epicentral region and also felt strongly in bordering districts Telangana. The seismic activity in this region continued for few years.

Apart from this natural earthquake activity along the Godavari Graben in coal mines most of the reported activity is artificial mine blast activity. Over all there are about 9 seismic stations installed in Telangana region to monitor the seismic activity in continuous mode. They are situated at Rampur, Kothagudem, Gangavaram, Sriram Sagar, Nagarjuna Sagar, Choutuppal, Bikanoor and Hyderabad. Among the above, Hyderabad seismological observatory is the permanent observatory, being operated in world standards since 1967.

Keeping in view of the above historical seismicity status of the region, An earthquake of magnitude 5 or more on Richter scale is likely to cause damage to non engineered structures and property. A level of loss of life or damage to property depends on place and depth of earthquake occurrence. Hence any installations planned should be in standards least to withstand to the levels of respective ground shaking.

Preliminary results of GPR survey across the fault zone

A field survey, to identify the shallow subsurface fault features, was carried out by NGRI team near project site (Figure 7). The area and location for the study were finalized after consulting the site engineer. The Ground

Penetration Radar (GPR) survey at the site was conducted on 17th of January, 2018 with the site engineer. The field pattern and outcrop suggest the area constitute of granite with 3 different phases of dyke emplacement. At the studied section, a ENE-WSW trending fault has displaced the NNW-SSE trending dyke by ~240 m with dextral strike slip disposition on the surface. The fault suggests strike-slip deformation possibly during ENE-WSW trending dyke emplacement during (?) early to mid-Proterozoic period. The GPR survey was conducted to map the shallow subsurface signature of the fault and the profiles are planned along the geomorphic expression of the fault (Figure 7 A).

In order to map the fault features, GPR profiles needed to be placed orthogonally to the fault, which was not possible due to poor accessibility of the rugged uneven terrain. A total 7 GPR 2D profiles with lengths ranging from 25m to 80m, were acquired following the possible accessible route. For this survey, the 200 MHz GPR antenna, having capability of mapping high resolution shallow subsurface, up to a depth of 5m, is deployed. The GPR data is acquired in 'distance mode' with the distance calibrated wheel perimeter. The signal gain was kept in auto mode and the frequency range was set by assigning a low pass and a high pass filter to get the desired signals. The dielectric value of the upper layer was assigned and the total depth of penetration was set to 5m. The acquired raw data was processed using the specialized software at CSIR-NGRI. The processing steps constitute the Auto Peak-Time shift, Background removal (to remove all the horizontal coherent noises using Full pass background removal), FIR (to increase the signal-noise ratio, low pass (=400) and high pass (=35) filters have been applied), Gain (max is 76 is applied in order to reduce the fluctuation of amplitude of traces) to obtain the preliminary results (Figure 7 B, C).

The preliminary results from two profiles at oblique angles (almost orthogonal) with the fault, marked as **aa'** (N17°57.451', E078°47.915': 65m length) and **bb'** (N17°57.469', E078°47.942': 68m length) are presented (Fig B, C). The preliminary shallow subsurface (~5 m) imaging by GPR suggests the

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top soil / regolith in the area largely constitute of granite boulders and its weathering product extends for 50-60cm and at places has voids in surveyed sections (Fig. B, C). The top 3 m constitute of weathered granite and largely remain undisturbed except in 2-3 m wide fault zone, where the topsoil and rocks (weathered and fresh at depth) are disturbed by shearing. Since the host rock is massive granite, which does not have lithological layering, no lateral contrast is observed nor any dominant vertical component of deformation along the fault could be deciphered. Though, the top soil and weathered zone show downward perturbation along the fault zone. The preliminary data clearly suggests; it is a deep seated vertical fault with significant strike slip motion. The rocks in the fault zone are highly sheared and fractured. Further, there is at least three sets of dominant lineaments with distinct geomorphic signatures are observed in the region. To characterize their effect on shallow subsurface and understand their mutual relationship, it will be appropriate to conduct detailed survey with planned profile orientations. The same is proposed for future work for the region.

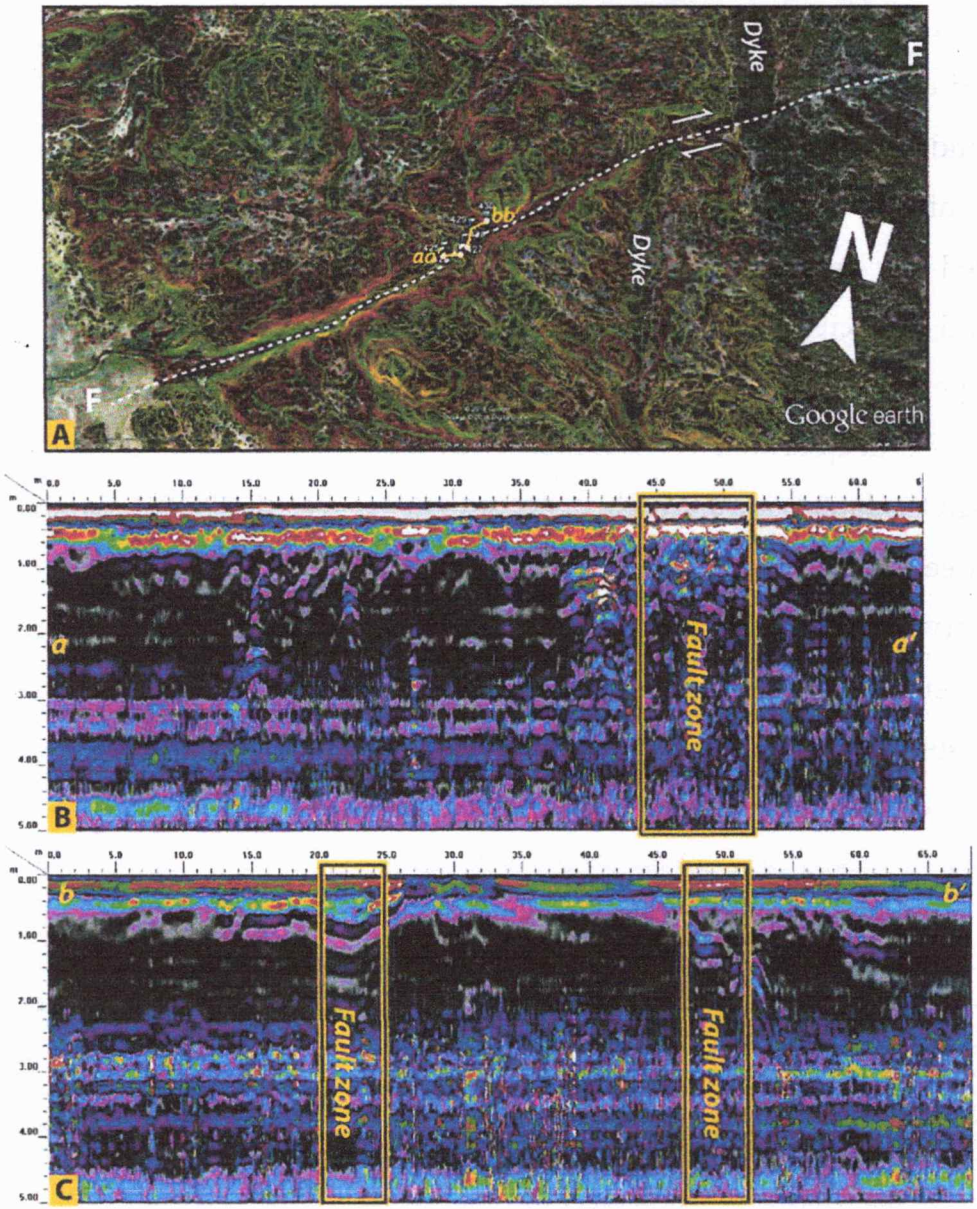

Figure 7. (A) Google image of study site overlaid with the 1 m contour interval marking the location of ENE-WSW trending fault that displace the NNW-SSE trending dyke by ~240 m. Multiple 2D GPR line survey was carried out as per the suggestions of site engineers. Note the location of 2-D profiles aa′ & bb′. (B, C) The preliminary results of two lines **aa′** and **bb′** clearly show ~2-4 m thick disturbed zone along the fault in respective profiles.

Symposium on Earthquake Effects on Plant and Equipment: Dec. 1984

Medchal, Andhra Pradesh Earthquake of June 30, 1983

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Assistant Director, National Geophysical Research Institute, Hyderabad.

R.K. Chadha
National Geophysical Research Institute, Hyderabad.

ABSTRACT

The paper describes the seismic effects of Medchal, Andhra Pradesh earthquake of June 30 1983. This earthquake is of scientific and general interest as it occurred in the middle of peninsular shield and caused cracks in some buildings in Hyderabad.

The magnitude of the earthquake is estimated to be 4.5 from the recorded duration at Hyderabad seismograph station of NGRI. The maximum intensity is assigned to be V. The area with this intensity is 30 km x 20 km, elongated in N-S direction and stretching about 20 to 50 km north of Hyderabad. The computer located epicentre with near stations data lies within this area at a distance of 30 km from Hyderabad and depth is computed to be 40 km. The earthquake was felt for about 20 sec in the meizoseismal area and 10 sec in Hyderabad. Within the meizoseismal area, intensity was higher in the northern and southern ends. There was less damage in the central part. In higher intensity area, tiles fell down in many houses, many houses developed cracks, one mud wall collapsed and at four places favourably placed rocks were displaced. These effects are described in detail. We also describe the isoseismals and known local geology. The cause of the earthquake is also visualized.

INTRODUCTION

The Medchal earthquake of June 30, 1983 caused general alarm in the twin cities of Hyderabad and Secunderabad as this earthquake is the first earthquake occurring in this area in the living memory. List of historical earthquakes in this area is given in Table I. The 1983 earthquake is of lesser intensity than the one in 1876. The intensity assigned for the 1983 earthquake is V in M.M.Scale. Though the earthquake is of moderate intensity it has aroused interest of scientific community as it occurred in the centre of the Peninsular Shield of India. In this paper we describe the effects of earthquake and mention about the source parameters, local geology and cause of the earthquake. Technical aspects of these investigations are described elsewhere (Rastogi and Chadha, 1984).

INTENSITY SURVEY

Initially, the purpose of the field study was to delineate the meizoseismal area. Analysis of Hyderabad seismograms indicated the epicentre to be about 30 km WNW of the seismic station and reports came in for more damage in the area 20 to 50 km north of Hyderabad (seismic station is in the eastern end of the city). Hence, survey for meizoseismal area was made in this area. The mode of survey was to interrogate as many number of persons possible in a particular area about their feelings and evidences regarding the temporary and permanent effects on objects/buildings. The strategy adopted was to estimate the intensity at a particular place and to approach the area with highest intensity. Once the meizoseismal area was delineated, the boundaries of intensities V/IV, IV/III and III/II (M.M.Scale) were estimated along certain roads leading out of the meizoseismal area (Figure 1 and 2). During the surveys the following points were observed.

1. The earthquake was felt in twin cities of Hyderabad and the area in the north with intensity IV and more.
2. There was no serious damage to any structure/building anywhere.
3. Damage was more in the area 20 to 50 km north of Hyderabad. This area lies east of N.H. 7 between Medchal and Shamirpet in the south to Tupran in the north. This area was assigned an intensity V.
4. Though intensity V is observed in a large area as shown in Figure 1, there was no clear-cut eye or an area of higher intensity. This suggests some depth of the focus. The depth calculated from isoseismals is 31-34 km. In fact, damage was rather more in the northern and southern parts of the meizoseismal area and lesser in the central part. This is due to the vertical approach of seismic waves immediately above the focus. This is corroborated by the felt report in the central area. The centre of the meizoseismal area is near Kakunda village (Figure 1). Here, a jolt or 'thud' from below was felt, and there were only minor cracks developed in some walls.

5. It was possible to draw isoseismal V clearly and others roughly. Isoseismals IV and III were drawn on very few observations and isoseismal II based on newspaper reports as well as personal communications.

6. There was clear indication of the isoseismal lines V and IV having an elliptical shape with major axis along N-S direction.

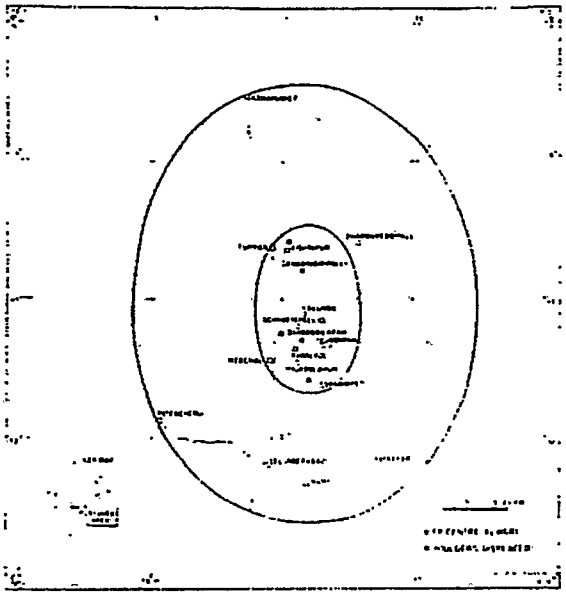


Fig.1 Isoseismal V and IV.

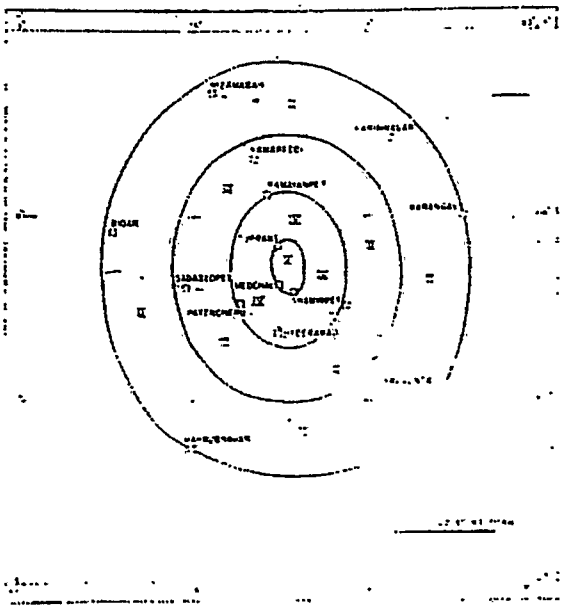


Fig.2 Isoseismal I to II for Medchal Earthquake

MACROSEISMIC EFFECTS

The earthquake of 30th June, 1983 was felt for about 20 seconds in the meizoseismal area and about 10 seconds in twin cities of Hyderabad and Secunderabad.

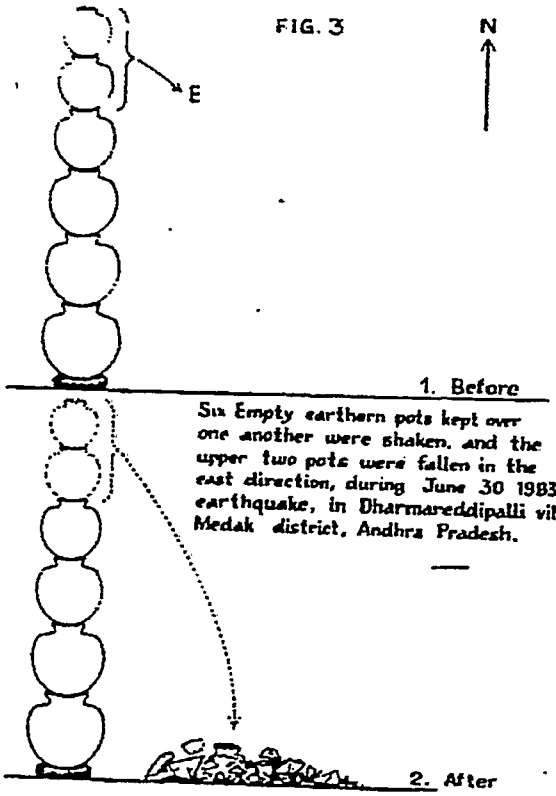
The earthquake was accompanied by loud sound variously described as thunder, passing of an aeroplane, moving of heavy trucks, rumbling and underground explosion. In the meizoseismal area, the most prominent sound was described as a thunder in the peripheral area and as explosion in the centre. In the intensity IV area the sound was mostly described as that of passing of heavy trucks or booming of an aeroplane. The sound was not much as compared to that in the meizoseismal area.

At a place around Kakunda near the centre of intensity V area people felt a jolt from below and were slightly pushed up. In the extreme south of meizoseismal area also near Raja Bolaram Tanda, people felt a jolt from below and a person felt that his lunch plate was thrown upwards.

Utensils kept in the racks and tiles were thrown down at many places in the V intensity area. A corner of tiled roof collapsed near Kishtapur in the north and a portion of tiled roof along with the mud wall near Bandamallaram in the south . At Dharmareddipalli, two out of 6 stacked earthen pots fell down and broke to pieces (Figure 3). In the southern portion of the meizoseismal area at Shamirpet and Yadavaram and in the north at Ananthagiripalli and Kishtapur, huge boulders, placed favourably were rolled down due to this earthquake (Figures 4 and 5).

Observations at the individual places in the meizoseismal area are as follows. In the northern part of meizoseismal area near Kishtapur, huge chuncks of rocks, favourably placed were displaced. Large sound of explosion type was heard in the area. Cracks were developed in the walls and in a house a corner of the tiled roof was collapsed. Just south of Yacharam, near Anantagiripalli, some boulders were displaced and also explosion like sound was heard. Cracks in the walls and roofs are very frequent in this area. Just outside the meizoseismal area near Dharamareddipalli and Gajwel in the east, the sound was of a passing heavy vehicle. In the centre of the meizoseismal area near Kakunda, a thud from below was felt, and there were only minor cracks developed in some walls. Near Bandamallaram, just south of Kakunda, a corner of tiled roof and portion of the mud wall of a house was collapsed. Utensils were thrown out from the racks. Near Vehhavyapalli, (in the centre of Meizoseismal area) thunder sound was heard from west. Tiles were fallen and utensils were thrown out of the racks. In Dasarlapalli also in the centre of meizoseismal area) large thunder sound was heard. Towards south of the meizoseismal area, in Yadavaram boulders were rolled down. Large sound as of a passing aeroplane was felt and a jolt from below was felt by some people. Roofs of many houses were cracked. In Biwalkol, in the south, sound from west was heard. In the extreme south of meizoseismal area, near Raja Bolaram

landa, people felt a jolt from below and plates were thrown upwards. In the south west of meizoseismal area, i.e., near Medchal, rumbling sound was heard with rattling of utensils. Minor cracks were developed.



Six Empty earthern pots kept over one another were shaken, and the upper two pots were fallen in the east direction, during June 30 1983, earthquake, in Dharmareddipalli village, Medak district, Andhra Pradesh.

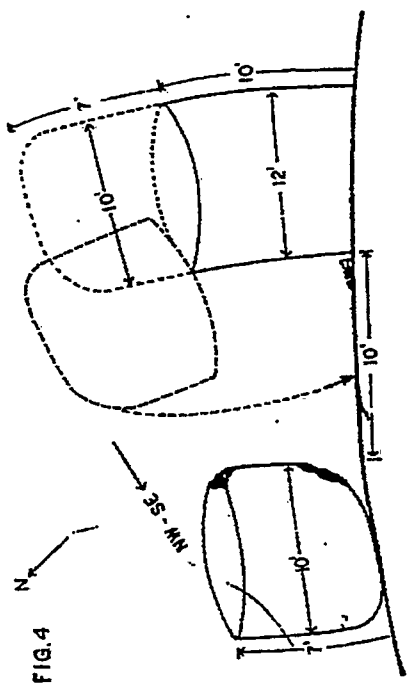
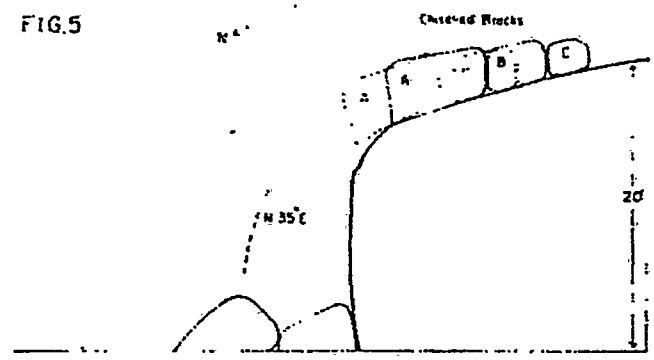


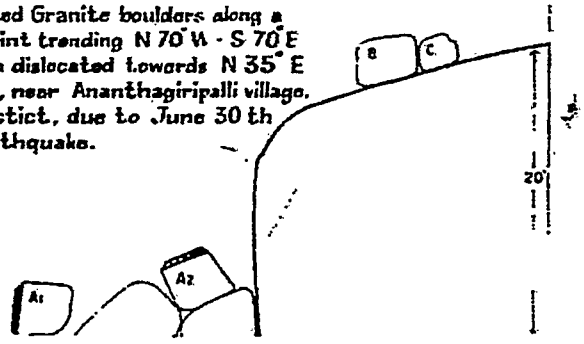
FIG.4

A Granite boulder resting on another boulder along a pre-existing joint, fallen upside down, near Kishtapur village, Medak district, due to June 30, 1983 earthquake

FIG.5



Pre-jointed Granite boulders along a vertical joint trending N 70° W - S 70° E have been dislocated towards N 35° E direction, near Ananthagiripalli village, Medak distict, due to June 30 th 1983 earthquake.



In many areas of intensity IV, like Ramavanpet, Secunderabad and Hyderabad shaking was felt prominently. Few buildings developed hair-line cracks in Hyderabad including those of the NGRI (Figures 6 to 8) and Board of Intermediate Education at Vampalli. In these two buildings cracks are between pillars and walls, beams and walls and sometimes at the junction of two walls. A wall of one house under construction in Lalapet developed crack in the middle.

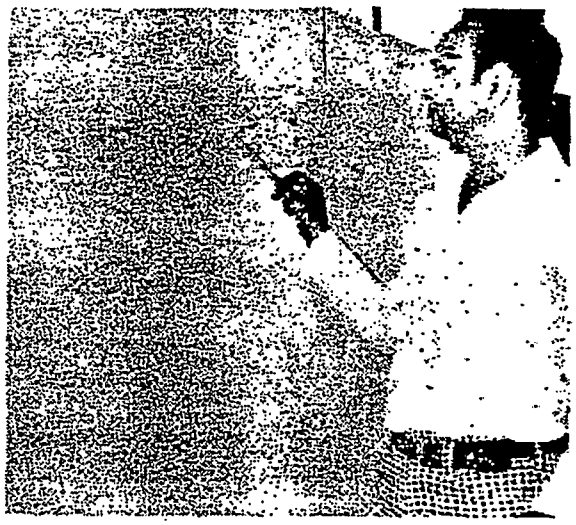


Fig.6 Cracks developed in the wall of ground floor canteen of NGRI, due to June 30 earthquake.

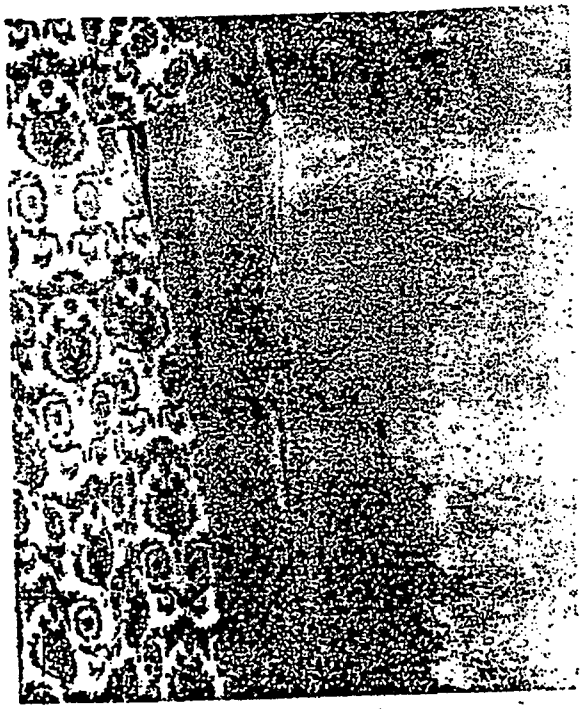


Fig.7 Crack developed at the contact of two adjacent walls in the second floor dining hall of NGRI, due to June 30, earthquake.

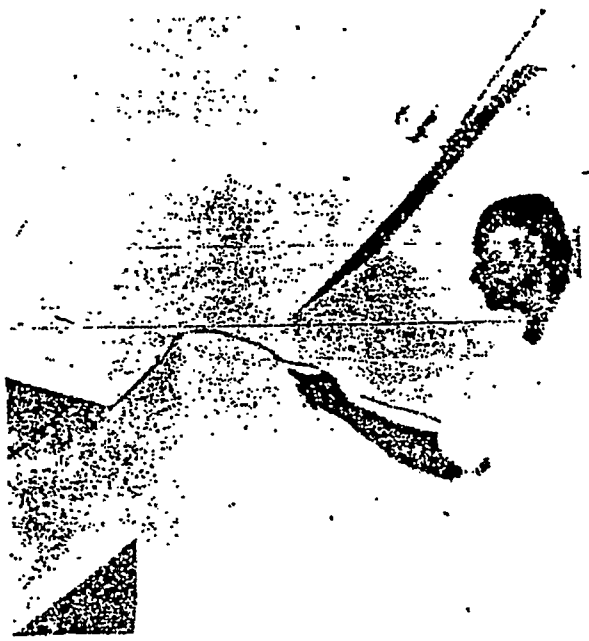


Fig.8 Cracks developed along the contact of beam and wall in NGRI library due to June 30, 1983 earthquake.

Direction of approach of earthquake waves or sound as noticed by persons at different places is shown in Figure 9. South of Tupran majority of the people reported west to east direction, while north of Tupran the reported direction was usually southwest to northeast.

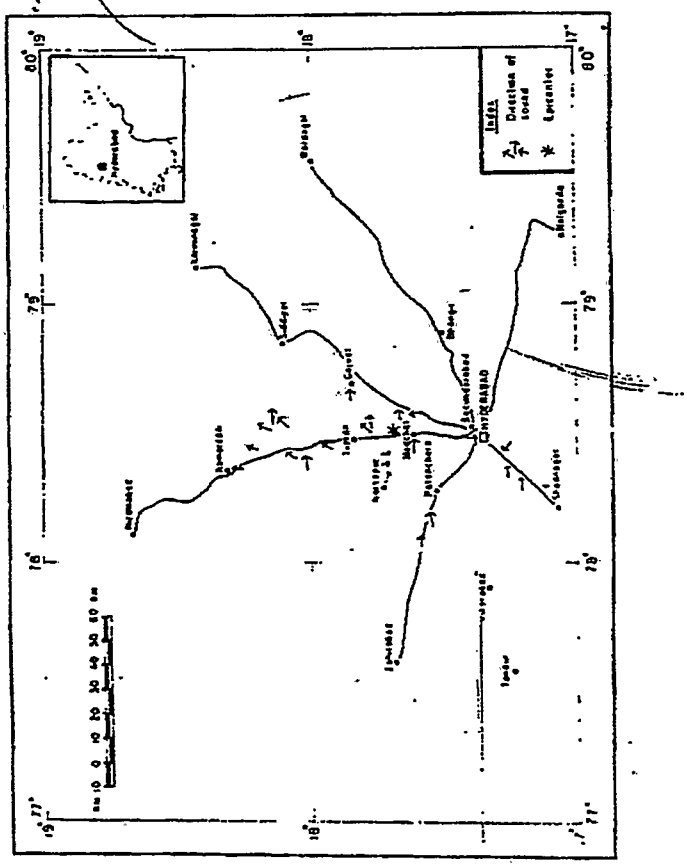


Fig.9 Direction of approach of sound or earthquake waves.

SOURCE PARAMETERS

The epicenter of the Medchal earthquake of June 30, 1983 determined by using the near seismic stations data is 17° 41'N, 78° 30'E. This epicentre is near the centre of the meizoseismal area. Depth is of the order of 30 km. Seismogram portions showing this earthquake at different near stations are shown in Figures 10 to 13. As described earlier intensity is V on M.M.Scale. Magnitude of the earthquake is estimated to be 4.5. The epicentres determined by IMD and ISS using distant stations are far off from the meizoseismal area. The magnitude determined by IMD at New Delhi station is an over estimate.

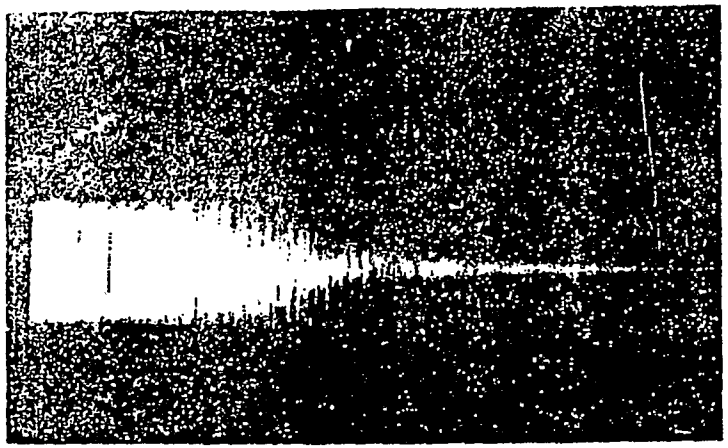


Fig.11 June 30, 1983 earthquake as recorded at Nagarjunasagar. Seismograph deployed is portacorder, and S 500 Seismometer

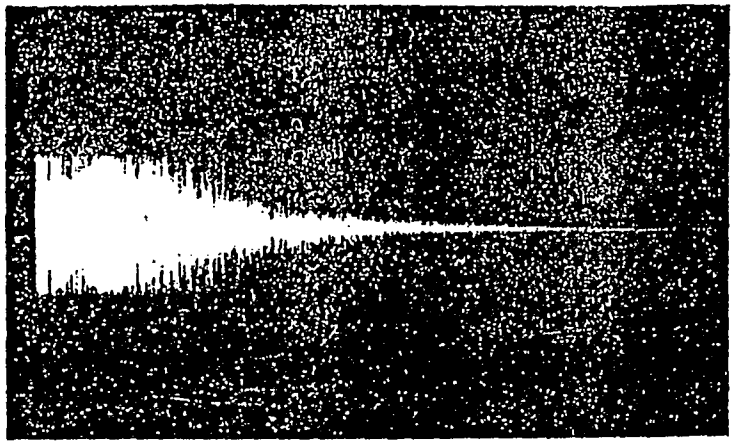


Fig.10 June 30, 1983 earthquake as recorded at Srisailam Seismograph deployed is portacorder, and S 500 Seismometer.

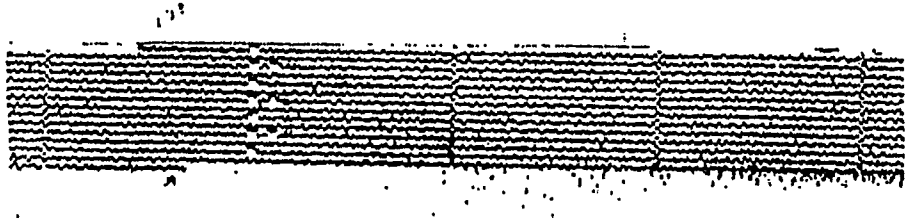


Fig.12 June 30, 1983 earthquake as recorded at Hyderabad short period Benioff seismograph, vertical component.

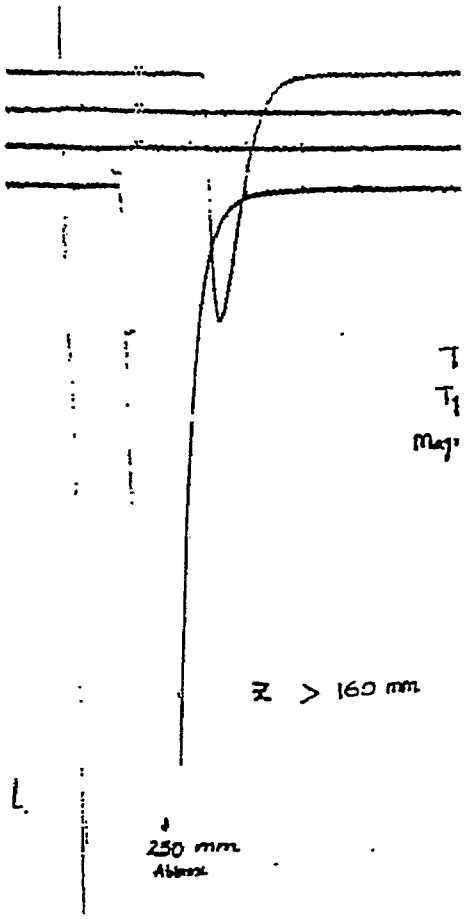


Fig.13 June 30, 1983 earthquake as recorded at Hyderabad vertical component long-period Press-Ewing seismograph.

LOCAL GEOLOGY AND CAUSE OF THE EARTHQUAKE

The country rocks in the area are Archean granites and gneisses. These rocks are intruded by dolerite dykes, pegmatite, aplite and quartz veins. The most predominant directions of the dykes are NE-SW and N-S. From the lineament map prepared by GSI, the lineaments passing through the meizoseismal area are as follows. One NE-SW trending megalineament passes through Medchal. One small lineament parallel to it passes through the centre of the meizoseismal area where it meets a small E-W trending lineament. The ground check of these lineaments has not been done. Any of these lineaments could be the zone of weakness along which the present earthquake has occurred The present earthquake is a part of regional seismicity and is of tectonic origin. The small stresses, due to northward movement of the Indian continent, slowly accumulate. When these stresses exceed elastic limit, the earth blocks adjust themselves to equilibrium along zones of weakness (Chandra, 1977).

CONCLUSION

The Medchal earthquake of 30th June 1983 was of intensity V on M.M.Scale and Ms magnitude 4.5. Intensity V area is 530 sq.km. The earthquake was felt in an area of 450,00 sq.km. Felt duration in meizoseismal area was about 20 sec and in twin cities of Hyderabad and Secunderabad about 10 sec. There was no serious damage anywhere. In view of this earthquake and intensity VI earthquake in 1876, seismic coefficient in this area may have to be revised.

ACKNOWLEDGEMENTS

The authors are thankful to India Meteorological Department and Bhabha Atomic Research Centre for providing their data. M/s. Indra Mohan, C.V.R. Rao and Md. Khamruddin helped in intensity survey. Mr.S.C.Bhatia obtained the computer location. The authors are grateful to Prof. V.K.Gaur, Director, NGRI for his keen interest and guidance in this study. Mr.K.Ramana Rao assisted in typing this manuscript.

REFERENCES

1. Chandra,U. (1977) "Earthquakes of Peninsular India - A seismotectonic study", Bull.Seism.Soc.Am. 67, 1387-1413.

2. Rastogi, B.K. and Chadha, R.K. (1984), "Source Parameters of the Medchal, Andhra Pradesh Earthquake of June 30, 1983", Communicated to Mausam.

TABLE I

HISTORICAL EARTHQUAKES NEAR HYDERABAD

Date	Place	Description of Earthquake	Magnitude/ Intensity	Source
1843 Mar 12	Hyderabad	Shock felt around Hyderabad	IV	Oldham, 1883
1876 Oct/Nov.	Secunderabad	Felt throughout the city caused general alarm, glass panes broken in some of the houses, a number of sparrows found dead after the earthquake; Baracks in cantonment area were more or less in an oscillating condition during a period of 55-60 secs. Effects in different areas ranged from being thrown out of bed to as if being rocked in a cradle. Punkah wires jingled, doors and windows shook, parrots screamed, dogs barked and men woke up by the rolling and loud noise accompanying the earthquake ; some private bunglows in and out of cantonment were damaged, but no large scale destruction or loss of life.	VI	TOI 7.11.76

[TOI : Times of India]

ANNEXURE-3

Tel: 020–24103444, 24103387
Fax: 020-24381004

e-mail: rsrgp@rediffmail.com
Website: www.cwprs.gov.in

Government of India
Ministry of Jal Shakti
Department of Water Resources, River Development & Ganga Rejuvenation
Central Water & Power Research Station
Khadakwasla, Pune 411024

No. CWPRS/F&S/GE-II(Soil)/1-Mallanasagar/2022/ 71

Date : 01/04/2022

Shri B. Hari Ram,
Engineer-in-Chief (Irrigation)
Irrigation and CAD Department (I & CAD)
Gajwel,
Siddipet - 502278

Sub : Technical Report on "Geotechnical studies for seepage and stability analysis of zoned earth dam of Mallannasagar reservoir, Telangana"

Ref : 1) CWPRS cost estimate submitted vide No. TC/2021/344 dated 22/06/2021
2) Your letter No. EE/Irrg/D6/Gajwel/DB/2020-21/395 dated 12/08/2021

Sir,

With reference to above, Technical Report No. 6008 dated March, 2022 on "Geotechnical studies for seepage and stability analysis of zoned earth dam of Mallannasagar reservoir, Telangana" is enclosed herewith in duplicate. Kindly acknowledge receipt of the same.

As a part of CWPRS commitment to continuous improvement, we would appreciate your assessment on how we have performed in conducting the studies. It is requested to kindly fill and submit the attached **Feedback Form**.

Thanking you,

Yours sincerely,

Encl : As above

(Dr. R. G. Patil)
Scientist 'E'

Government of India
Ministry of Jal Shakti
Department of Water Resources,
River Development and
Ganga Rejuvenation

सत्यमेव जयते

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास
और गंगा संरक्षण विभाग

TECHNICAL REPORT NO. 6008

GEOTECHNICAL SEEPAGE AND STABILITY STUDIES FOR ZONED EARTH DAM OF MALLANNASAGAR RESERVOIR, TELANGANA

March, 2022

केन्द्रीय जल और विद्युत अनुसंधान शाला, पुणे
CENTRAL WATER AND POWER RESEARCH STATION, PUNE

Dr. R. S. Kankara
Director

GOVERNMENT OF INDIA
MINISTRY OF JAL SHAKTI
DEPARTMENT OF WATER RESOURCES, RIVER DEVELOPMENT AND GANGA REJUVENATION

CENTRAL WATER AND POWER RESEARCH STATION
KHADAKWASLA, PUNE 411024

GEOTECHNICAL ENGINEERING – II (SOIL)

TECHNICAL REPORT NO. : 6008
March 2022

GEOTECHNICAL SEEPAGE AND STABILITY STUDIES FOR ZONED EARTH DAM OF MALLANNASAGAR RESERVOIR, TELANGANA

Dr. R. S. Kankara
DIRECTOR

REPORT DOCUMENTATION SHEET

Technical Report No. 6008 **Month : March, 2022**

Title: GEOTECHNICAL SEEPAGE AND STABILITY STUDIES FOR ZONED EARTH DAM OF MALLANNASAGAR RESERVOIR, TELANGANA

Officers responsible for conducting the studies

Smt. J. S. Edlabadkar, Scientist 'C', Dr. (Smt.) Tanusree Samanta, Scientist 'B', Shri A. D. Khot and Smt. S. S. Waghmare, Research Assistants

Dr. R. G. Patil, Scientist 'E' was in-charge of Geotechnical Engineering-II (Soil) division during conducting the studies and preparation of report.

Name and address of organization conducting the studies

Foundations and Structures Laboratory
Central Water and Power Research Station, Pune – 411024, India

Name and address of authority sponsoring the studies

Shri B. Hari Ram, Engineer-in-chief (Irrigation)
Irrigation and CAD Department (I & CAD)
Gajwel, Siddipet District

Synopsis

The Irrigation & CAD department, Government of Telangana has taken up execution of Kaleshwaram lift irrigation project to cater to irrigation and drinking water needs of drought prone areas in Telangana. The Kaleshwaram project envisages construction of various barrages, storage reservoirs, pump houses and canal network system. Sri Komuravelli Mallannasagar is one of the storage reservoirs with 50 TMC feet capacity. The reservoir is being created by constructing a multi-zoned earth dam of length 22.6 km and maximum height of about 60 m. To expedite the construction of reservoir, total length of the earth bund is divided into four reaches. Considering size and importance of the reservoir, the Engineer-in-Chief, Irrigation & CAD Department, Gajwel, Siddipet requested CWPRS to conduct geotechnical seepage and stability studies for the earth dam.

Three cross-sections of the dam were analyzed viz. **Section I** in Reach III of Ht. 59.6 m (at Ch. 15.6 km, maximum height section), **Section II** in Reach IV of Ht. 51.0 m (Ch.18.625 km to Ch.19.925 km, tank bed portion) and **Revised section III** in Reach III of Ht. 49.0 m (Ch. 16.3 km to 16.7 km, hillock portion). Seepage analysis using software PLAXIS 2D for steady state condition was conducted to establish phreatic line, seepage discharge, pore pressures and hydraulic heads in various zones of the dam. Transient state seepage analysis was conducted to establish phreatic line for drawdown condition simulating drawdown rate of 0.5 m/day.

Results indicated that total seepage discharge (dam body + foundation) works out to be 0.6667 m^3/day/m, 0.1497 m^3/day/m and 0.6269 m^3/day/m for cross-sections 'I', 'II' and 'III' respectively. It was observed that seepage quantity through foundation was 67.6% to 82.4% of total discharge. For cross-section 'I' and 'III', discharge values were more than the specified lower permissible limit of 0.4 m^3/day/m but less than the specified higher limit of 0.8 m^3/day/m . For cross-section 'II' the discharge was less than lower permissible limit of 0.4 m^3/day/m. It was recommended to undertake appropriate remedial measures for foundation seepage if still lower permissible values are decided upon by project authorities.

Results of slope stability analysis indicated that all three dam cross-sections were safe with Factor of Safety (FS) values more than required values of 1.5 for steady seepage and 1.3 for sudden drawdown conditions as per IS 7894:1975. Pseudo-static analysis for earthquake condition indicated that the dam is safe with FS more than required value of 1.0 for conditions of steady seepage and full reservoir. It was recommended to design zone-I on upstream and downstream sides as transition zone. It was also suggested to install adequate monitoring devices viz. piezometers, 'V' notch weirs, etc on the dam sections along with appropriate drainage arrangements as per relevant IS codes. Regular dam monitoring and maintenance as per CWC guidelines was suggested.

Key words: Earth dam, Multi zoned, Seepage, Slope stability, Pseudo-static

CONTENTS

of safety from slope stability analyses are summarized in Table 13. All three sections are found to be safe from slope stability point of view for steady seepage and drawdown conditions for drawdown rate of 0.5 m/day.

Table 12: Results of seepage analysis

Section	Seepage discharge (m^3/day/m)			Pore pressure[$] (kPa)	Hydraulic head (m)	
	Dam body	Foundation	Total		Maximum	Minimum[#]
I	0.1172	0.5495	0.6667	-378.534	54.4	1.235
II	0.0484	0.1012	0.1497	-576.585	45.8	0.833
Revised 'III'	0.1167	0.5102	0.6269	-470.418	46.3	14.374

$ *In foundation below upstream toe near dam base*

\# *In horizontal filter near downstream toe of hearting*

Table 13: Factor of safety values

Section	Static		Pseudo-static	
	Steady seepage (downstream)	Sudden drawdown (upstream) with rate 0.5 m/day	Steady seepage (downstream)	Reservoir full (upstream)
I	1.55	1.55	1.21	1.43
II	1.56	1.41	1.25	1.38
Revised 'III'	1.64	1.41	1.33	1.36

10.0 CONCLUSIONS AND RECOMMENDATIONS

Two dimensional seepage analysis using software PLAXIS 2D and limit equilibrium slope stability analysis using Bishop's slip circle method is conducted for multi-zoned earth dam sections viz. section 'I' at Ch. 15.6 km; section 'II' (tank bed portion) and revised section 'III' (hillock portion) of Mallannasagar reservoir. Aim of the study is to determine safety of the dam sections from seepage and stability point of view and recommend suitable remedial measures if required. Conclusions of the studies and recommendations are presented below.

a) Results of seepage analysis indicate that total seepage discharge (dam body + foundation) is 0.6667 m^3/day/m, 0.1497 m^3/day/m and 0.6269 m^3/day/m for dam sections 'I', 'II' and revised section 'III' respectively. Results also indicate that major percentage of seepage discharge is through foundation.

b) The current BIS standards do not indicate any value of permissible seepage through earth dam. However, according to "Handbook of Geotechnical investigations and design tables"

by Burt Look [Ref. (iv)], the permissible seepage through earth dam of height more than 40 m should be ideally less than 0.4 m^3/day/m and in any case not more than 0.8 m^3/day/m. For all the sections of Mallannasagar dam the total discharge values are less than the upper permissible limit of 0.8 m^3/day/m; but for section 'I' and revised section 'III' the discharge value is more than lower permissible value of 0.4 m^3/day/m. As purpose of the project is to store water by lift irrigation, water loss through seepage is undesirable. Project authorities may take a call on permissible seepage discharge values and remedial measures for seepage prevention if required may be taken up depending upon on-site seepage measurement values.

c) Results of stability analysis indicate that all three dam cross-sections are safe from slope stability point of view for static loading, with FS more than required values of 1.5 for steady seepage and 1.3 for sudden drawdown condition as per IS 7894:1975. The rate of drawdown adopted in analysis is 0.5 m/day as provided by project authorities. The factor of safety may decrease further for faster rate of drawdown.

d) Pseudo-static earthquake analysis indicates that all three dam sections are safe for steady seepage and reservoir full conditions with factor of safety more than required value of 1.0.

e) As the dam sections comprise of three zones of different soil types, it is recommended that zone 1 (SC) on upstream side be designed as transition zone for zone 2 (CI) and zone 3 (SM). Gradation of zone 1 should be such that gradual change in size of particles occurs. Similarly, zone 1 on downstream side should be designed as transition zone in between filter media and downstream casing zone 3. This will prevent erosion of soil particles due to seepage flow thus avoiding clogging, creation of voids, piping, etc.

f) It is suggested to install adequate monitoring devices viz. piezometers, 'V' notch weirs, etc. on all the three dam sections along with appropriate drainage arrangements designed as per IS 7356 (Part 2)-2003 [Ref. (iii)] and IS 9429-1999 [Ref. (v)]. Variation in pore pressures and seepage discharge with respect to reservoir water level be monitored periodically and any change in values be noted. The values from instrumentation could be compared with design values as obtained in the present studies. Any discrepancy in the values should be noted, cause of the same be found out and acted upon as per requirement.

Annexure - IV

सी एस आई आर - राष्ट्रीय भूभौतिकीय अनुसंधान संस्थान
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)
पो.ब. सं. 724 उप्पल रोड़, हैदराबाद-500 007, तेलंगाणा, भारत
CSIR - NATIONAL GEOPHYSICAL RESEARCH INSTITUTE
(Council of Scientific & Industrial Research)
Post Bag # 724, Uppal Road, Hyderabad - 500 007, T.S., INDIA

ANNEXURE-4

डॉ. प्रकाश कुमार, एफ एन ए एससी
निदेशक
Dr. Prakash Kumar, FNASc
Director

February 29, 2024

To

The Engineer-in Chief
2nd Floor, Integrated Office Complex
Sangapoor Road, Gajwel,
Siddipet District 502278

DEE

Sub: Kaleshwaram Project – Formation of Sri Komaravelli Mallanna Sagar Reservoir- Seismic study -Reg.

Ref: Lr. No. SE/IC/GJL/DCE/DEE-4/AEE-1/SKMS/2023-24/369 dated 21-2-2024

Dear Sir,

AEE

With reference to the letter cited, it is recommended to carry out continuous seismic monitoring of the reservoir as per CWC guidelines. CSIR-NGRI has submitted a detailed proposal to Mallanna Sagar Reservoir authorities in this regard.

In addition, it is also recommended to carry out a seismic safety audit of the structure by a team of Civil Engineering / Structural Engineering experts.

Best Regards,

(Dr. Prakash Kumar)
डॉ. प्रकाश कुमार - निदेशक
Dr. Prakash Kumar - Director
सी एस आई आर - राष्ट्रीय भूभौतिकीय अनुसंधान संस्थान
CSIR - National Geophysical Research Institute
उप्पल रोड, हैदराबाद - 500 007, तेलंगाणा, भारत
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[P.T.O]

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वेब साइट / Web site: www.ngri.org.in
ई-मेल / E mail : director@ngri.res.in
pk.ngri.csir@gmail.com

ANNEXURE-5

PROFORMA FOR APPROVAL OF CONTRACT R&D PROJECT

1. Project

a) Title : **Seismic Monitoring of Sri Komaravelli Mallanna Sagar Reservoir, Telangana**

b) Number & Accounting Code :

c) Type (Sponsored/Collaborative/Grant-in-aid) :

2. Client / Customer

a) Name and Address	The Executive Engineer, Irrigation Division No.6, Gajwel, Siddipet District. Telangana PIN 502278
b) Category* (Type & size) (*Govt.Dept./Agency/Voluntary/ Cooperative Agency, Research Organization, Foreign Firm/Agency, Public/Private Sector, Large/Medium/ Small / Cottage Unit)	Govt. Dept
c) Status	New
d) If it is 'repeat', please provide a brief statement of past experience	NA

3. Objectives, Scope and Duration of the project :

Objectives: Seismic Monitoring of Sri Komaravelli Mallanna Sagar Reservoir, Telangana

Scope

- Monitoring of Seismicity of the region
- Delineation of seismically active faults/lineaments
- Determination of Peak Ground Acceleration (PGA) levels of the dam structure during the occurrence of near field earthquakes.

Duration: No. of Years:	Date of Start	Date of Completion
5 years	Date of work order	

4. Does the activity fall within the approved research areas of the laboratory:	Yes (Seismology)

5. Present state of knowledge available with lab in the area including IPR position:

- CSIR-NGRI is a pioneering institute in seismic monitoring of Dams.
- It is operating seismic Networks around Koyna-Warna Reservoirs in Maharashtra for the past five decades.
- It also operating seismic stations at Nagarjunasagar, Srisailam and Sriramsagar reservoirs in

1

Andhra Pradesh and Telangana states, since 1981.

- An aftershock study was carried out by installing a four-station seismic network around Pulichintala Reservoir after an M4.6 magnitude earthquake that occurred on January 26, 2020 near the Pulichintala reservoir, felt in Andhra Pradesh and Telangana states.
- CSIR-NGRI operates a seismic network with 15 seismic stations in Andhra Pradesh and Telangana States to monitor the regional seismicity.
- CSIR-NGRI is monitoring the Dhamni and Bhatsa Dams in Maharashtra by installing four Strong Motion Accelerographs in Dhamni dam and Six Strong Motion Accelerographs in Bhatsa dam. These are continuously operated from November 2019. In addition to that, a five station Broadband Seismograph network is continuously operated to monitor seismicity in the Palghar region from January 2019 onwards.
- An aftershock study was carried out by installing a five-station seismic network after the M4.5 magnitude earthquake that occurred on June 20, 1988 near Idukki reservoir in Kerala state.
- A digital seismograph was procured for Kerala State Electricity Board for installation at Idukki dam and also training on the operation of the seismograph and seismic data analysis was provided in 2001.
- CSIR-NGRI is carrying out seismic monitoring of Periyar, Sholayar and Mettur dams maintained by Tamil Nadu Water Resources Department (TNWRD) and 16 other dams maintained by Tamilnadu Generation and Distribution Company (TANGEDCO) through a network of five Broadband Seismographs and twenty-eight Strong Motion Accelerographs in the dam structures in Tamilnadu state.
- CSIR-NGRI also operates more than ten different seismic networks comprising more than 200 seismic stations under various projects in India.

6. Specify the S&T inputs being provided by client:

a) Programme of work with phasing, milestones and deliverables envisaged from CSIR-NGRI:	1. Procurement of Broadband Seismographs and Strong Motion Accelerographs. 2. Site preparation 3. Installation of one Broadband Seismograph (BBS) in the Dam premises and three more seismographs around the reservoir. 4. Installation of three Strong Motion Accelerographs (SMA) in the Earth bund structure and one in the free field. 5. Operation and Maintenance of seismological instruments. 6. Seismological Data collection. 7. Operation and maintenance of Central Recording Station at CSIR-NGRI, Hyderabad. 8. Monitoring the state of health of the seismic network periodically 9. Seismic Data Processing and Interpretation 10. Submission of preliminary earthquake report of significant events. 11. Submission of Annual event report.

b) Vesting of Intellectual Property Rights:	Lies with CSIR-NGRI

7. Project Team (S& T Staff) :

Name	Designation	PL / Co-PL / Member
i. Er. R. Vijayaraghavan	Chief Scientist	Project Leader
ii. Dr. M. Shekar	Principal Scientist	Co-Project Leader
iii. Dr. Nitin Sharma	Scientist	Member
iv. Dr. Pavan Kumar	Scientist	Member
v. Dr. G Suresh	Senior Tech. Officer (1)	Member
vi. Dr. D. Srinivas	Senior Tech. Officer (1)	Member

8. Financial Aspects

Particulars	Cost (₹. in Lakhs)
Project cost (five years period) (The project cost includes Manpower, TA /DA for field staff, Field expenses, Consumables, Laboratory share and Project Fee as per CSIR Guidelines)	**285.126**
GST 18%	**51.323**
Capital cost (The capital cost includes Field Seismic Equipment (five Broadband Seismographs, four Strong Motion Accelerographs and accessories) to be installed in and around Mallanna Sagar Reservoir and Data Processing and Storage Equipment to be installed at CSIR-NGRI, Hyderabad and Procurement and handling charges 5% as listed in Annexure I	**197.876**
Total cost	**534.325**

Schedule of payments to be received: (Link the payments receivable to deliverables, specify the deliverables, vis-à-vis time frame and the amount of installment receivable from client)	Amount to be paid by Demand Draft / RTGS 1. Along with the work order- 25% of the project cost + GST + Capital cost 2. After submission of 1st Annual Event Report – 15 % of the project cost + GST 3. After submission of 2nd Annual Event Report – 15 % of the project cost + GST 4. After submission of 3rd Annual Event Report – 15 % of the project cost + GST 5. After submission of 4th Annual Event Report – 15 % of the

	project cost + GST 6. After submission of 5th Annual Event Report – 15 % of the project cost + GST

- If any concession is provided on Project Fee, a note of justification may be enclosed.

9. Utilization of Intellectual Property / Knowledgebase generated :

Licensing :	
a) Exclusive/Non-Exclusive	
b) Period	
c) Envisaged Fee/Charges	
i. Lumpsum (instalments, amount, time, mode)	
ii. Recurring royalty (Period and basis)	

Remarks :

Project Leader	MLP-PL	BDG	CoFA/FAO

DECISION OF COMPETENT AUTHORITY
Director / Management Council / DG, CSIR

Copy to:	1. Project Leader	2. CoA / AO
	3. CoFA / FAO	4. BDG&PME
	5. CoSP/SPO	6. Director

Annexure-I

Seismic Monitoring of Sri Komaravelli Mallanna Sagar Reservoir

Part A. Cost estimate of Field seismological equipment

Sl.No	Item	Quantity	Unit cost (₹.in Lakhs)	Total cost (₹. in Lakhs)
Imported				
1.	Broadband Seismometer	5 Nos.	11.00	55.000
2.	Data Acquisition System	5 Nos.	6.00	30.000
3.	Strong Motion Accelerograph	4 Nos.	6.00	24.000
Indigenous				
4.	Battery (12V-100AH)	56 Nos.	0.10	5.600
5.	Solar Panel 100W	16 Nos.	0.10	1.600
6.	Solar charge controller 20A	20 Nos.	0.10	2.000
7.	Power supply / Battery charger	20 Nos.	0.20	4.000
8.	Cellular Modem	8 Nos.	0.30	2.400
9.	Data Charges	60 months	0.05	3.000
10.	Consumables	1 Lot	2.00	2.000
			Total	129.600
			GST 18%	23.328
Customs Duty + Freight + Insurance (approx.) 15% for Imported Items Sl. Nos.1 to 3				16.350
			Total A	**169.278**

Note: The cost of the field seismological equipment to be installed in and around the Mallanna sagar Reservoir. It is proposed to install one Broadband seismograph in the dam premises and three more Broadband seismographs around Mallanna sagar Reservoir (one spare unit) and also three strong motion accelerographs in the dam structure and one strong motion accelerograph at the free field site.

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Part B. Cost estimate of Data Processing and Storage equipment

Sl.No	Item	Quantity	Unit cost (₹.in Lakhs)	Total cost (₹. in Lakhs)
Indigenous				
1.	Data Retrieval computer (Laptop computer)	1 No.	2.00	2.000
2.	Data Analysis computer (Desktop computer)	1 No.	2.00	2.000
3.	Data Analysis computer (Workstation computer)	1 No.	4.00	4.000
4.	Printer	1 No.	0.75	0.750
5.	External Storage media	10 Nos.	0.15	1.500
6.	Data Storage (NAS server)	1 No.	6.00	6.000
			Total	16.250
			GST 18%	2.925
			Total B	**19.175**

Note: The cost of the Data Processing and Data storage equipment to be installed at CSIR-NGRI.

Total (A+B)	**188.453**
Procurement and handling charges 5%	**9.423**
Total Capital cost	**197.876**

ANNEXURE-6

GOVERNMENT OF TELANGANA
IRRIGATION & CAD (PROJECTS-IV) DEPARTMENT

Memo.No.4113/Proproj.IV/A1/2024 **Dated: 26-11-2024**

Sub: I& CAD Department – Kaleshwaram Project – "Formation of Sri Komaravelli Mallanna Sagar Reservoir with a Capacity of 50 TMC – Formation of Earth Bund with all associated components for Reach-4 from Km 16.700 to Km 22.900 along with its structures and adjoining with Reach-3 at Km 16.700 and saddle bund of 1.600 Km Length" – Permission for depositing the required funds towards seismic monitoring of Sri Komaravelli Mallanna Sagar Reservoir by CSIR-NCRI – Accorded.

Ref: From the Engineer-in-Chief (General), Hyderabad, Letter No. ENC(G) / Dy.ENC(G)/DCB KB/OT6/AEE15/SKMS, Dated:25.05.2024.

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Under the circumstances reported by the Engineer-in-Chief (General), Hyderabad in the reference cited, Government after careful examination of the proposal hereby accord permission to the Engineer-in-Chief (General), Hyderabad, to deposit an amount of Rs.534.325 Lakhs as per the payment schedule to CSIR-NGRI, Hyderabad towards Seismic Monitoring of Sri Komaravelli Mallanna Sagar Reservoir for a period of five years by CSIR-NGRI as per the preliminary report of Chief scientist, CSIR-NGRI from balance available provision of Rs.639.5763 Lakhs in sanctioned estimate of Sri Komaravelli Mallanna Sagar Reach-4

2. This Memo., issues with the concurrence of Finance (WP) Department vide their U.O.No.2591716/171/WP/A1/2024, Dt:24-09-2024

RAHUL BOJJA
SECRETARY TO GOVERNMENT

To
The Engineer-in-Chief (General), Hyderabad.
Copy to:
SF/SC

// FORWARDED : : BY ORDER //

SECTION OFFICER