



REGIONAL OFFICE  
RAJASTHAN STATE POLLUTION CONTROL BOARD  
18, Near Pannadhaya Circle, Azad Nagar, Bhilwara.  
Phone/Fax no. 01482-241159, E-Mail ID : rorpcb.bhilwara@gmail.com



No. RPCB/ RO BHL/ NGT (2019)(L-4)/4321

Registered and Email

Date 28/02/2020

The Registrar,

National Green Tribunal,

Principal Bench, New Delhi.

Sub:- Regarding status report of field work done by Expert Committee formed on 22.07.2019 by District Magistrate, Bhilwara in reference to OA No. 288/2019, Bal Kishan Vyas Vs State of Rajasthan.

Ref.:- (i) Order of Hon'ble National Green Tribunal, Principal Bench, New Delhi issued on date 10.10.2019.

(ii) Status report received from District Magistrate vide letter no. 22286 dated 28.02.2020.

Sir,

With reference to above case matter, Hon'ble National Green Tribunal, Principal Bench, New Delhi vide order dated 10.10.2019 has directed District Magistrate, Bhilwara to furnish the report received from the team of experts regarding identification of the root causes behind problems faced by residents of Village - Pur, District - Bhilwara.

In continuation to earlier status report received from District Magistrate, Bhilwara vide letter no. 22009 dated 07.01.2020, The detailed Status Report regarding field work done by Expert Committee, as received from District Magistrate, Bhilwara vide letter dated 28.02.2020 which includes:-

- i) Field work report till 31<sup>st</sup> Jan, 2020 by IIT Roorkee team,
- ii) Work status report dated 28.02.2020 on investigation of cracks in the Pur Village by CSIR-CIMFR, Dhanbad,
- iii) Status report on studies to investigate the reason of cracks development in buildings of Pur Village during 28.01.2020 to 03.02.2020 by CSIR-CBRI, Roorkee, is submitted herewith for kind perusal and necessary directions please.

Yours Sincerely

Encl: - As above.

  
(Mahaveer Mehta)  
Regional Officer,  
RSPCB, Bhilwara

राजस्थान-सरकार

कार्यालय जिला मजिस्ट्रेट, भीलवाडा

क्रमांक : न्याय / 2020 / 22284

दिनांक : 28. 02.2020

प्रेषिति,

क्षेत्रीय अधिकारी,  
राजस्थान राज्य प्रदूषण नियंत्रण मण्डल,  
भीलवाडा

विषय :- प्रार्थना पत्र 288/2019 श्री बालकिशन व्यास बनाम राजस्थान राज्य व अन्य में माननीय न्यायालय राष्ट्रीय हरित अधिकरण, प्रधान पीठ, नई दिल्ली के आदेश की पालना में रिपोर्ट प्रस्तुत करने के संबंध में।

उपर्युक्त विषयान्तर्गत लेख है कि माननीय न्यायालय राष्ट्रीय हरित अधिकरण, प्रधान पीठ, नई दिल्ली के आदेश की पालना में प्रार्थना पत्र 288/2019 श्री बालकिशन व्यास बनाम राजस्थान राज्य व अन्य में रिपोर्ट प्रस्तुत करनी है। प्रकरण में पेशी दिनांक 02.03.2020 नियत है। वर्तमान में उपनगर पुर में सर्वे एजेन्सियों (CIMFR, CBRI and IIT Roorkee) द्वारा किये जा रहे अनुसंधान के क्रम में Principal Scientist & Professor, AcSIR Head PPC & CCC Group CSIR Central Building Research Institute Roorkee के ई-मेल दिनांक 28.02.20 से प्राप्त अद्यतन स्थिति का प्रतिवेदन परिशिष्ट ए पर संलग्न कर भिजवाया जा रहा है।

अतः आपको निर्देश दिये जाते हैं कि विषयक प्रकरण में माननीय न्यायालय राष्ट्रीय हरित अधिकरण, प्रधान पीठ, नई दिल्ली में नियत दिनांक से पूर्व संलग्न रिपोर्ट अनुसार जवाब प्रस्तुत कर पालना से इस कार्यालय को अवगत करावें।

संलग्न:- रिपोर्ट

1. Dr. Brijesh Yadav IITR Roorkee
2. Dr. Harsh K.R Verma Dr. sc CIMFR, CSIR
3. Prady. S.K. Singh Sr. Pr. scic. CSIR Roorkee

21/3/2020  
जिला मजिस्ट्रेट,  
भीलवाडा



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## Status report of Studies to investigate the reasons of cracks development in buildings of Pi



From: Brijesh Yadav

To: dm-bhi-raj@nic.in

Cc: National Informatics Centre (NIC) Shantanu Sarkar Harsh Verma CIMFR MD REYAZUR RAHMAN SK Sin

Status\_Report Pur\_IIT Roorkee.docx (1.6 MB) [Download](#) | [Briefcase](#)

Dear Sir,

The status report of the field work done by team IIT Roorkee is also attached herewith.

Regards,  
Brijesh

Dr. Brijesh Kumar Yadav  
Associate Professor  
Department of Hydrology  
Indian Institute of Technology Roorkee  
Roorkee- 247667  
Uttarakhand  
Email: brijkfhy@iitr.ac.in  
tel +91-1332-284755  
fax +91-1332-285226

## Action Taken so far by Team IIT Roorkee

### **Work done during the 1<sup>st</sup> field trip (November 7-10, 2019)**

A survey team comprised of Dr. Harsha Verma (Principal Scientist CIMFR), Dr. Brijesh Kumar Yadav (Associate Professor, Department of Hydrology), Dr. Pramod Kumar Sharma (Associate Professor, Department of Civil Engineering), Mr. Manik Goel (Research Scholar), Mr. Shubham Tiwari (Research Scholar), Mr. Uttam Singh (Senior Research Scholar), Shri Raj Kumar (Senior Laboratory Technician), and Shri Ashok Kumar (Laboratory Technician) from IIT Roorkee visited the Pur village, Bhilwara and its nearby areas along with the required instruments during November 7-10, 2019 for conducting the field study. Representatives from DM Office, Bhilwara joined the survey team throughout the entire field work.

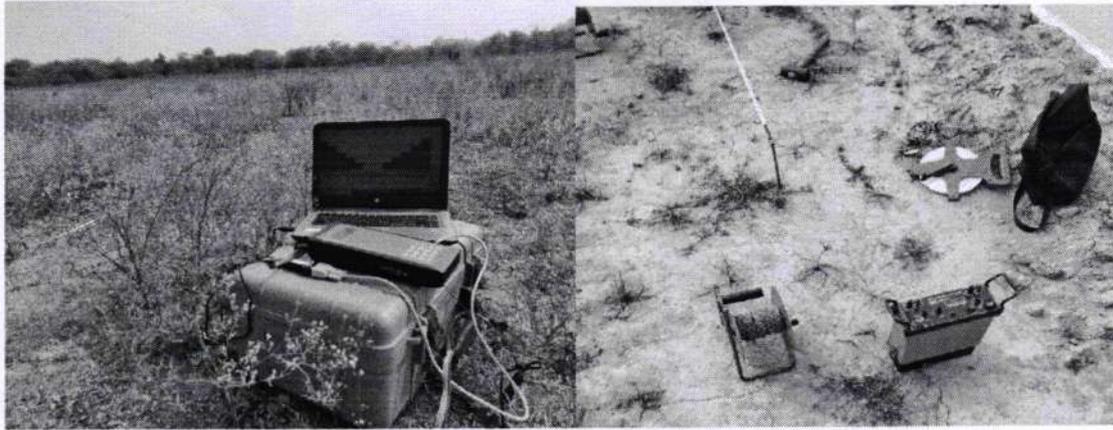
The survey team has carried three major equipment i.e., 1) Earth resistivity meter, 2) sounding terrameter, 3) Ground Magnetic Resonance (GMR) along with multiparameter probe and water table sensor and other their accessories. Some glimpses of the field survey are listed below along with brief working principles of these used equipments in field.

#### **Earth Resistivity Meter**

The earth resistivity meter 4 point light 10W is a high precision instrument for determination of soil resistivity. The electrical resistivity allows determination of the water content in the soil and of the types of soils and rock. It can be applicable to groundwater prospecting, mining, and other environmental investigations. The phase shift between output current and voltage provides information about the induced polarization (IP). The accuracy of the instrument is about 0.1 % with a resolution of max. 100 nV. From the current  $I$ , the voltage  $U$  and a geometric configuration factor the specific electrical resistivity  $\rho$  (Ohm-m) is calculated. In Remote mode (RMT) an external computer will control the instrument. This mode will mainly be useful with active external electrodes. The receiver of the instrument is highly selective and only records voltages at the set frequency. However, noise at the measurement frequency will degrade the quality of the measurement and should be suppressed. Major reasons for noise may include Mains (electric) interferences, magnetic interferences, wind, rain, and mechanical instability of the electrodes.

#### **Sounding Terrameter**

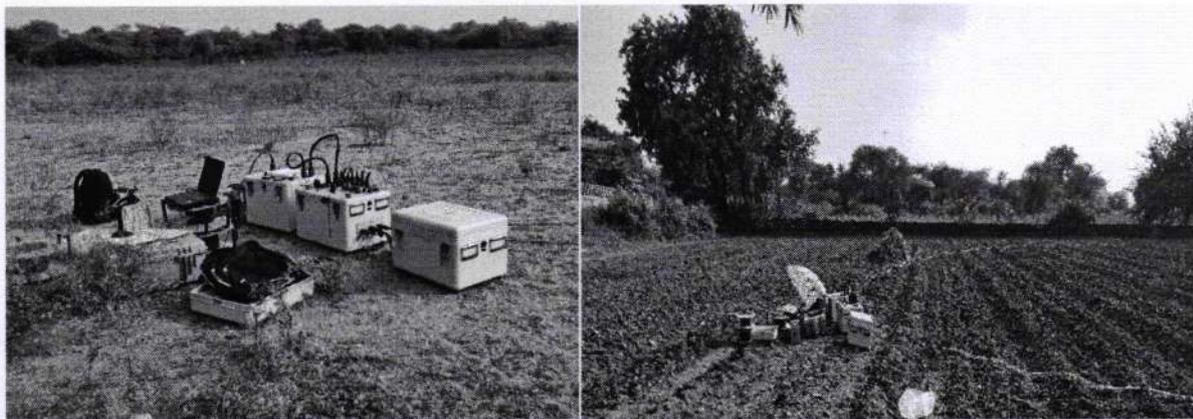
The terrameter used for performing the 1-dimensional Vertical Electrical Soundings (VES) is used for performing geophysical investigations. It works on the principle of measuring resistivity anomaly in the subsurface. It gives the one dimensional geological characterization of the area in terms of apparent electrical resistivity along the survey line.



**Figure 1:** Earth Resistivity meter and terrameter installed in the field

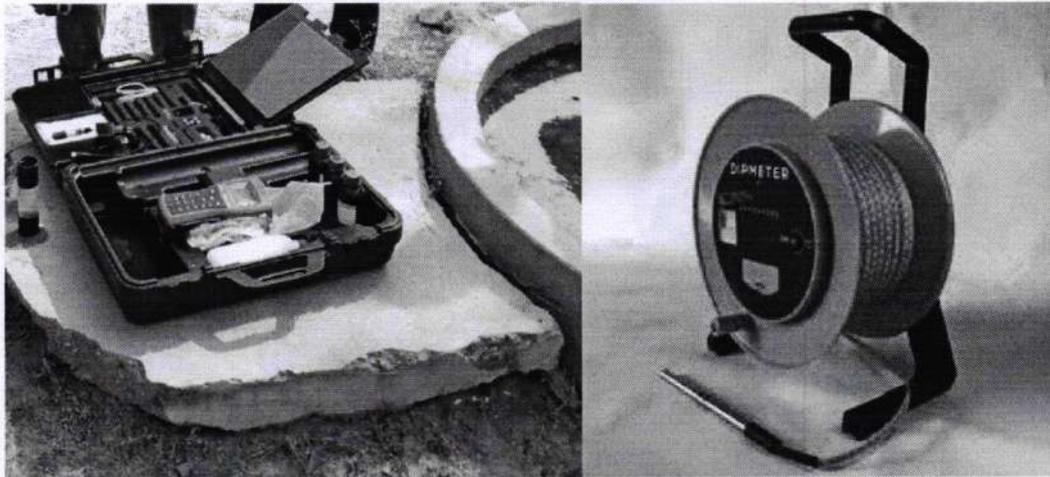
### **Ground Magnetic Resonance (GMR)**

The GMR system directly detects the presence of groundwater utilizing a phenomenon known as proton nuclear magnetic resonance (NMR). Proton NMR is observed when proton spins associated with hydrogen atoms in groundwater are subjected to perturbation in the background magnetic field. In the static magnetic field, the proton spins will preferentially align in the same direction as the field and so form a small magnetic moment. The GMR system provides unambiguous detection of groundwater because the measured signal is generated by hydrogen in fluids. By measuring the NMR properties of the subsurface, GMR provides quantitative images of water content as well as estimates of hydro-geologic parameters, including specific yield and permeability. Using GMR, it is possible to obtain detailed aquifer characterization before ever drilling a well. GMR applications include direct detection of groundwater, non-invasive imaging of groundwater to depths of 100m (Approx.), quantitative determination of water content, estimates of mobile water volume and specific yield, groundwater exploration and well site selection, and vadose zone characterization. Factors like electric and magnetic interferences can affect the accuracy of the GMR.



**Figure 2:** Field setup of ground magnetic resonance (GMR)

#### Some other instruments:



**Figure 4:** Multi-electrode parameter and dipmeter used for in-situ water quality analysis and for groundwater table detection

#### **Work done during the 2<sup>nd</sup> field trip(January 28-31, 2020)**

All the geological and hydrological data collected during the first field visit were analysed in to find existing hydro-geological conditions of the area and possible causes for the building cracks in the region. It was observed that there are some locations in the study area which are more sensitive hydro-geologically, and therefore, more data were collected from these identified locations to make the findings more accurate. Thus, a second field visit was planned for collecting data from 11 additional locations in and around the Pur village. A total of three 2-D electrical soundings, water sampling from seven locations were collected along with the aquifer pumping test during the second field visit. A survey team comprised of Dr. Brijesh Kumar Yadav, Mr. Shubham Tiwari, and Mr. Uttam Singh from IIT Roorkee visited the Pur village during January 28-31, 2020 for completing this field work. **The analytical work related to this field work is in well progress and the draft report of the whole hydrogeological survey shall be submitted soon.**

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### Fwd: Work status report in connection to investigation of cracks in Pur Village



From: Rajendra bhatt DM

To: NIC Bhilwara JUDICIAL SEC. COLLECTORATE, BHILWARA

CIMFR Work Stat...llage Feb-2020.docx (3.9 MB) [Download](#) | [Briefcase](#)

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**From:** "Dr. Harsh Verma" <drharsh77@gmail.com>

**To:** "dm-bhi-rj" <dm-bhi-rj@nic.in>

**Sent:** Friday, February 28, 2020 3:23:22 PM

**Subject:** Work status report in connection to investigation of cracks in Pur Village

Dear Sir

Pls fiend attached herewith work status report of CSIR-CIMFR as requested by you.

CSIR-CBRI and IIT Roorkee Team have also sent you the reports separately

Dr. Harsh Kr. Verma  
Principal Scientist & Head of Section  
CSIR- Central Institute of Mining & Fuel Research (CIMFR),  
CIMFR Research Centre, Bilaspur 495001  
INDIA

Telefax: +91 1332 275998/271315

Email: drharsh77@gmail.com

Mobile: 09412978538

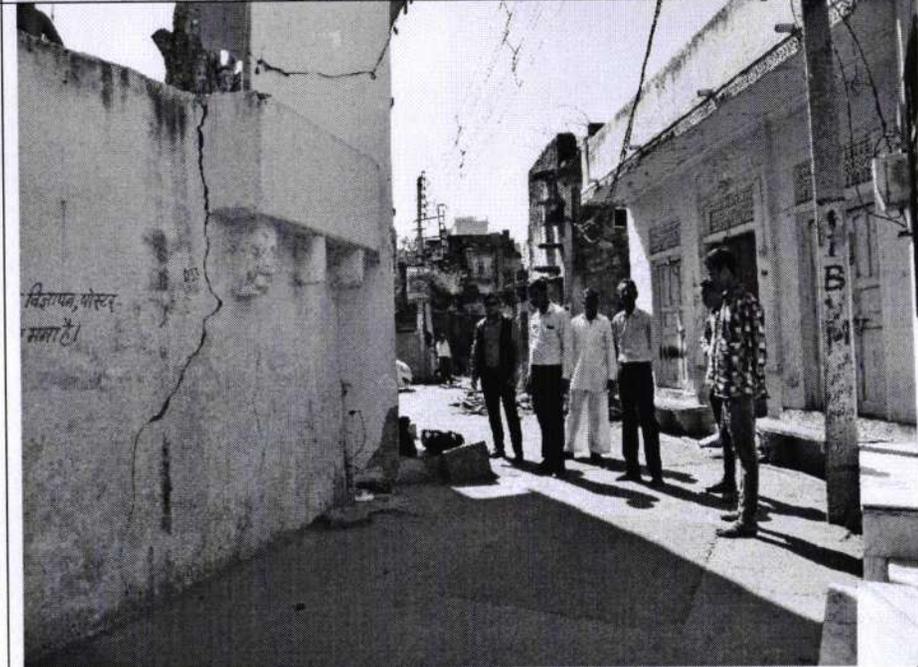
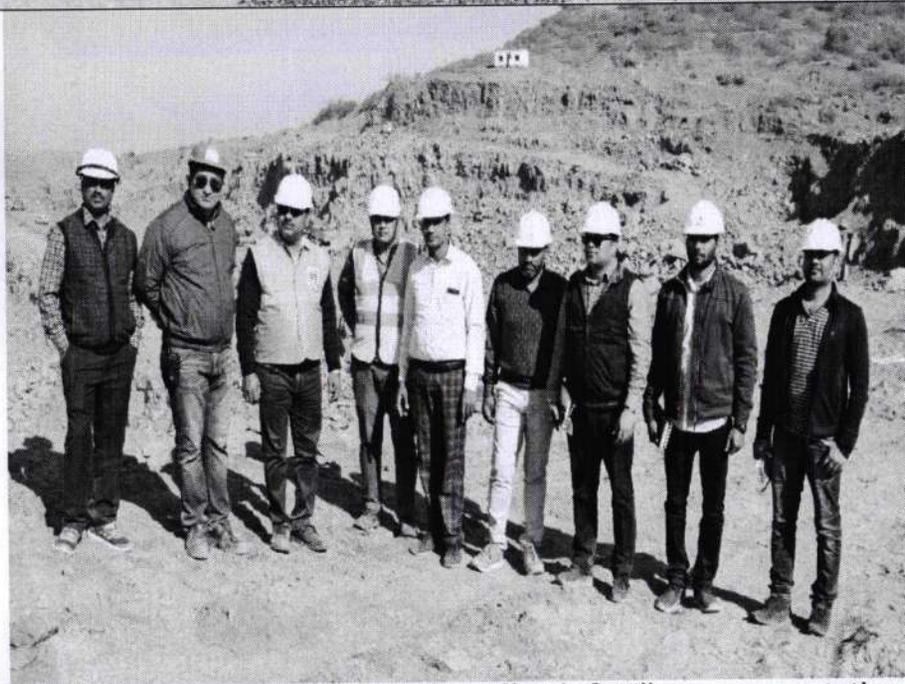
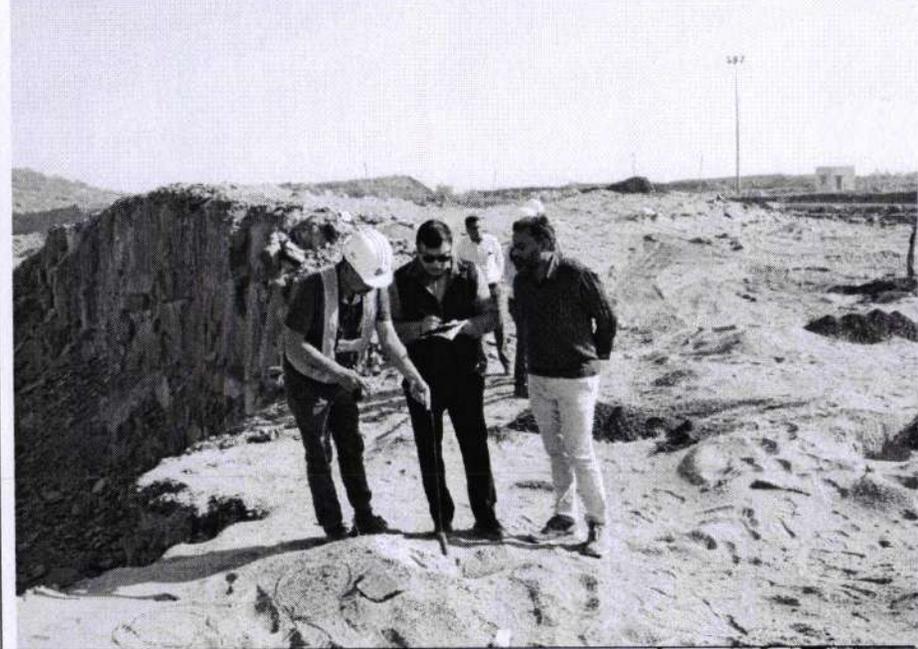
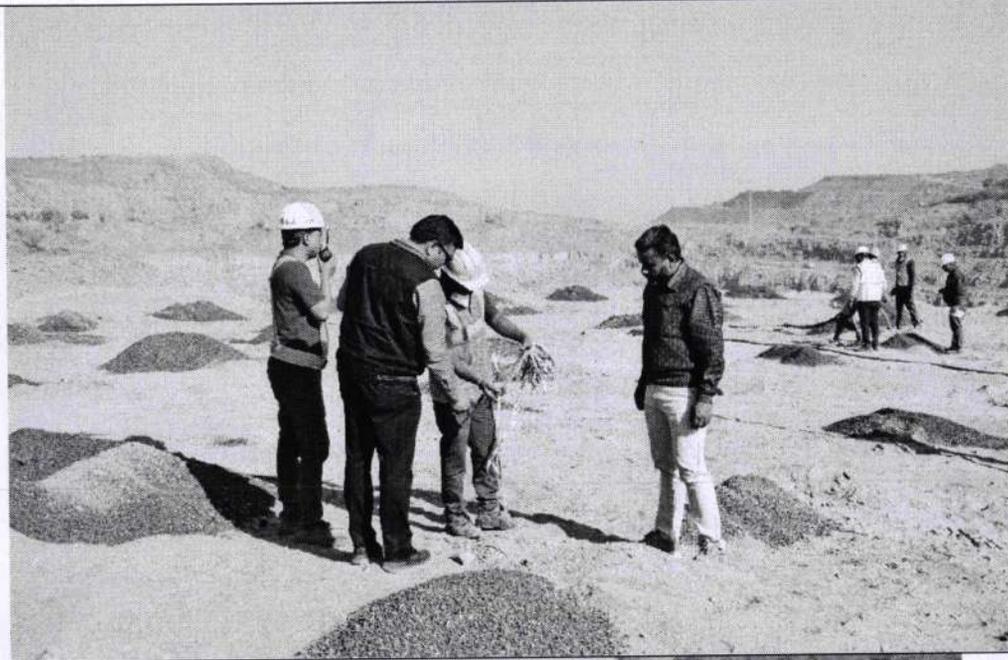
28.02.2020

**Sub: Work Status Report on Investigations of Cracks in the Pur village, Distt. Bhilwara, Rajasthan**

CSIR- Central Institute of Mining and Fuel Research, Dhanbad has been entrusted to carry out scientific investigation for identifying the root causes of cracks in the domestic houses of the Pur Village, Bhilwara together with IIT Roorkee and CSIR-Central Building Research Institute, Roorkee. CSIR-CIMFR will be carrying out blasting experiments in mines to assess damage potential of the blast induced ground vibration in the surrounding mines. IIT Roorkee has been assigned works of sub-surface investigations and its impact of the structures.

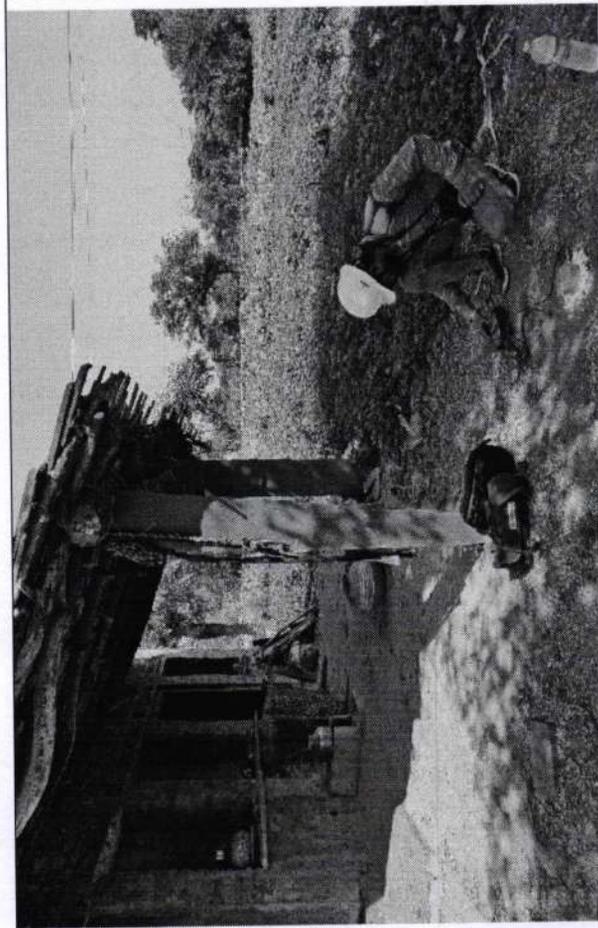
Team of scientists of CSIR- CIMFR have carried following activities

1. Reconnaissance survey of the houses of Pur villages and visual inspection of the crack in the affected housing structures
2. Review of the nearby mine working and mining blasting operations.
3. Review of the earlier investigations in mines and Pur villages
4. CSIR-CIMFR Team have received blasting records since April 2018 to October 2019 from Jindal Iron Ore Mine, Bhilwara. There are more than 500 blast data and associated vibration data. Review of the data has been done. Parameters of approx. 30 blast design have been identified.
5. CSIR-CIMFR Team visited Bhilwara team during 30.01.2020 to 07.02.2020.
6. Team conducted experimental blast in the mines. Altogether seen experimental blast round were completed with varying blast design parameters.
7. Blast vibration monitoring was carried out using four seismographs at different location.
8. Another site visit for the next round of filed investigations have been schedule during 02.03.2020 to 07.02.2020.
9. The study is continued.
10. Images of experimental blasting works out in the last visit of CIMFR Team is presented in the subsequent pages

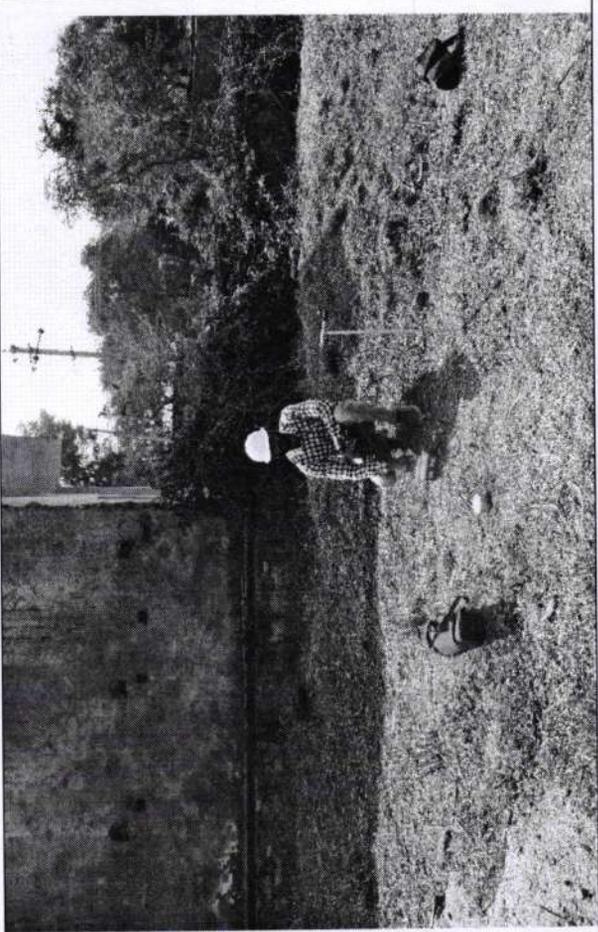


CSIR-CIMFR Team with Jindal Saw(p)Ltd officials & Village representatives

Vibration Monitoring @Laxmi bada Temple, Pur Village



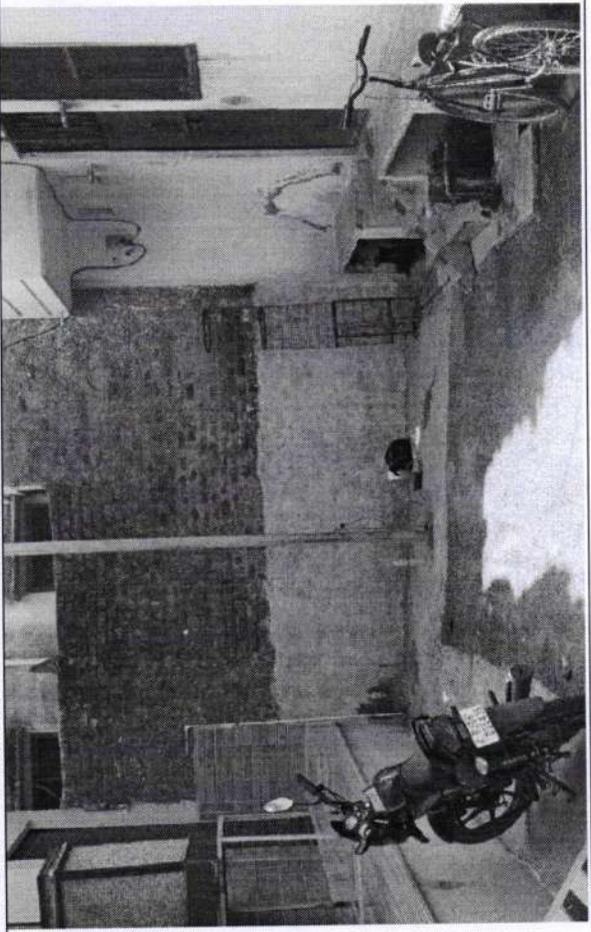
Location-1: Micromate UM12744, Dist.(m): 1286; 1248



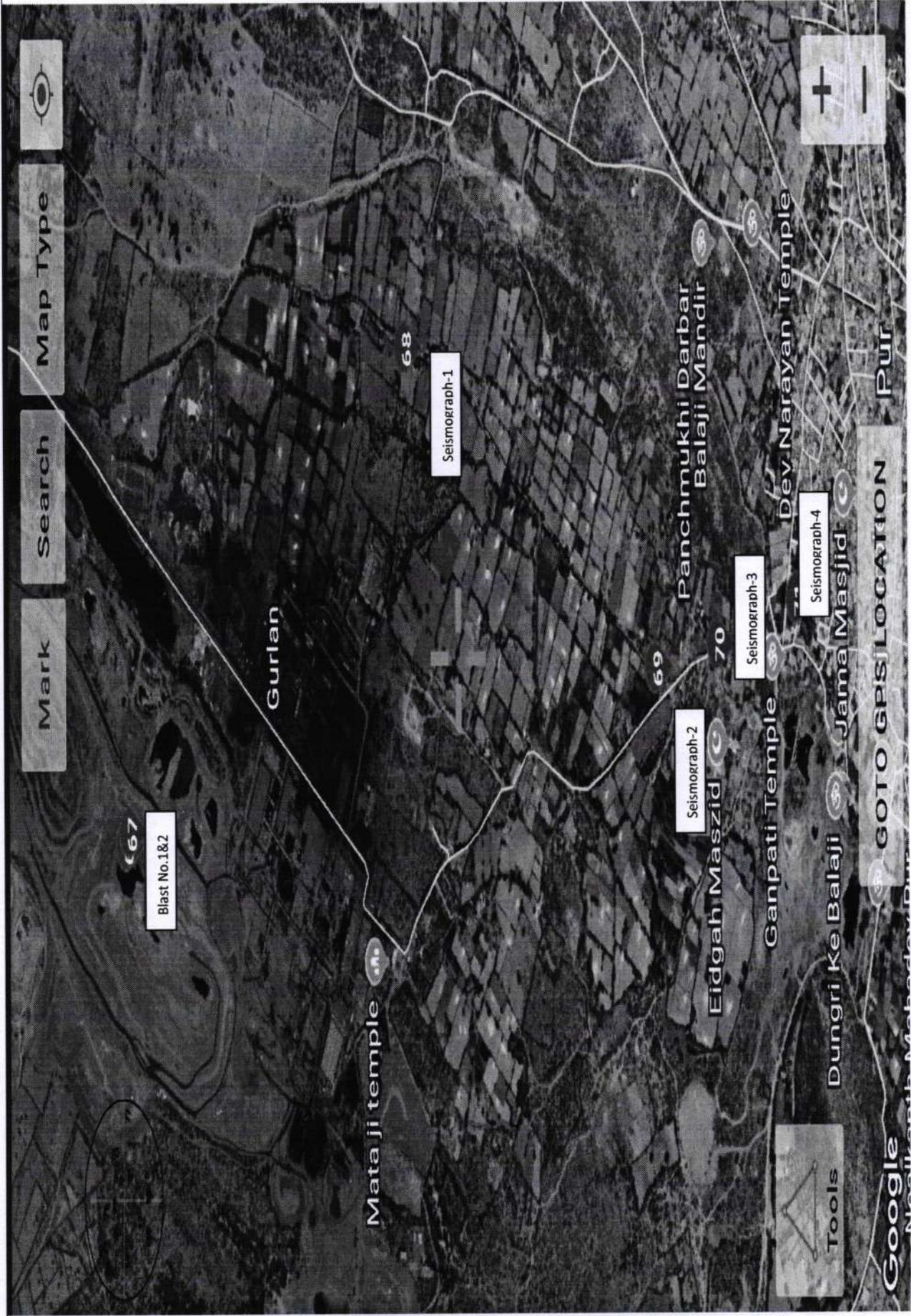
Location-2: Minimate Plus Dist. (m): 2020;1986



Location-3: Minimate Blaster, Jindal Rd Hanuman Temple, Dist.(m): 2256;  
2221



Location-4: Micromate UM12452, Inside Village, Infront of House No. 4949&  
4950, Dist.(m):2562; 2527



**Blast Location: 66-Blast 1; 67-Blast 2**  
**Vibration Monitoring Location: 68- ; 69- ; 70-Hanuman Temple, 71-Inside Village, Infront of House no.4949 & 4950**

## STATUS REPORT

1	Name of work	<b>Studies to investigate the reasons of cracks development in buildings of Pur village, Bhilwara, Rajasthan</b>
2	Institute	<b>CSIR-Central Building Research Institute, Roorkee</b>
3	Site	Pur Village, Bhilwara, Rajasthan
4	Date of visit	28 <sup>th</sup> January 2020 to 3 <sup>rd</sup> February 2020
5	Type of work	Condition assessment of various buildings and monitoring of cracks in building
6	Status of work	<ul style="list-style-type: none"> <li>• Condition assessment of 55 buildings of Pur Village, Bhilwara has been carried out in respect to typology of buildings, structural systems, construction materials, mapping of structural and non-structural cracks, other observations. The identified buildings were marked for monitoring at different locations in Pur village.</li> <li>• During studies, the cracks and other distresses in buildings were properly marked. The plan drawings of each buildings under distressed were prepared.</li> <li>• The monitoring of cracks in buildings were carried out after installation of Demec gauges at different locations in the building.</li> <li>• Till date, about 216 locations were marked for crack monitoring. Readings were taken. It is expected to installation of more locations for crack monitoring.</li> <li>• Width of wider cracks were measured by Digital Vernier caliper</li> </ul>
7	Observations	<ul style="list-style-type: none"> <li>• The building stocks in Pur village were commonly found non-engineered with stone masonry wall having thickness varying from 0.35m -0.45 m.</li> <li>• The majority of the houses in the village were of G+1 structures or single storied.</li> <li>• Kota stone is used as flooring in the most of houses.</li> <li>• Foundation of buildings were found made with stone masonry with varying depth of about 1.0 m- 2.5 m. At a few places it was even deeper.</li> <li>• The roof slabs were made of sand stone slab and steel girders. A few houses also used wooden beams and l-</li> </ul>

		<p>Section for providing support to stone slabs.</p> <ul style="list-style-type: none"> <li>• Recent buildings were found constructed with R.C.C roof slab and brick masonry. In few places both stone masonry and brick masonry were observed along with R.C.C. roof slab and stone slab where new construction was done over/along the old structure.</li> <li>• The diagonal cracks were predominantly observed in walls etc. The cracks were also found between wall joints, surface floors, ceiling, skirting and walls.</li> <li>• Floor stone slabs were dislocated at a few places causing gaps between stones, which makes the surface uneven.</li> <li>• Most of cracks in walls were diagonal in nature and at some places cracks were propagated from floor to wall and then to ceiling.</li> <li>• Water leakage problem from cracked underground water tank in various houses were also observed.</li> </ul>
8	Future	<ul style="list-style-type: none"> <li>• The geotechnical investigations will be carried out at minimum 4 identified locations to assess the properties of soil and geophysical studies. The processing to carryout tests has been finalized and expected to start at the earliest after selection of appropriate agency.</li> <li>• The monitoring of cracks will be carried out for next six months.</li> </ul>

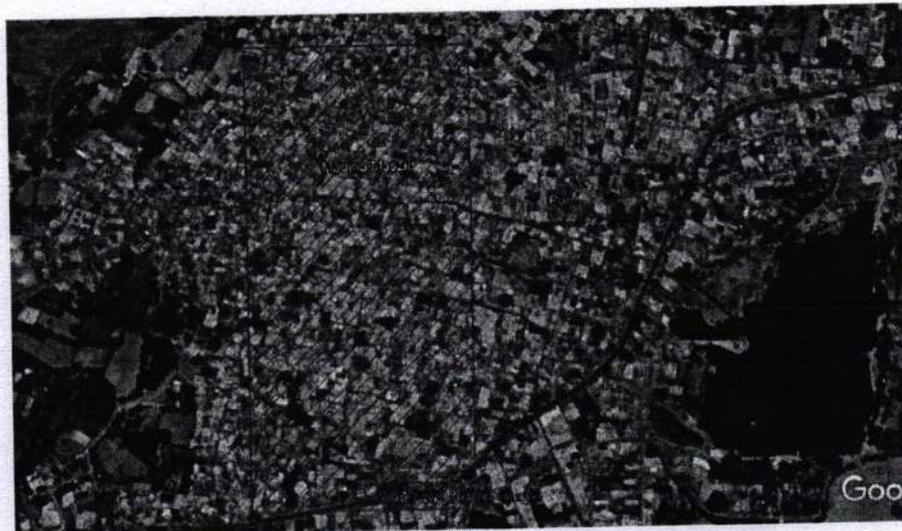


Fig 1. Sattellite image of Pur village and hashed red colour showing area covered in this phase

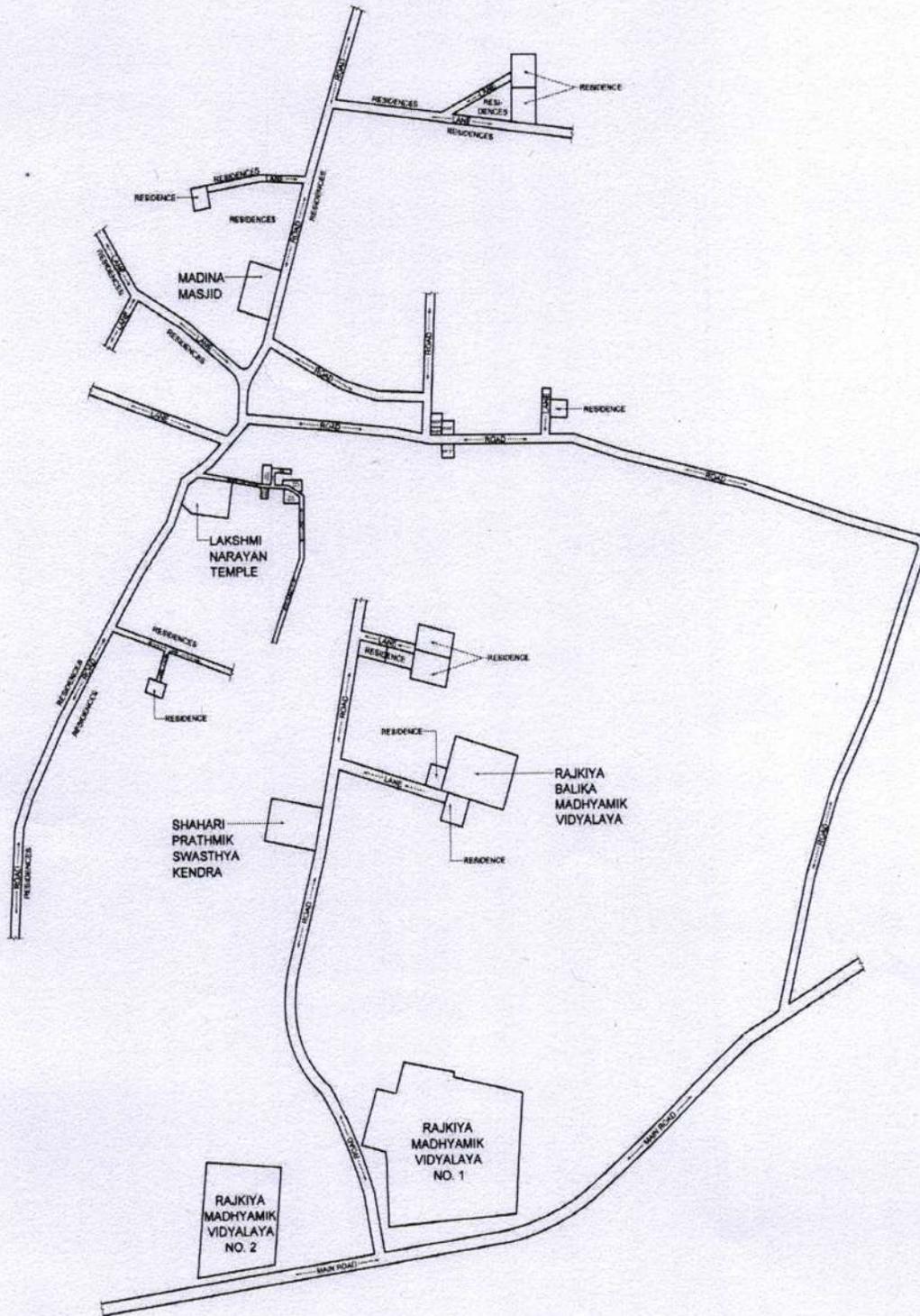


Fig 2. Key Plan of Pur village

**House no. 2249**

**Visual Observations:**

- No. of Stories built : G+1
- Occupancy: Zero (Building is not in living condition)
- Ground floor of building was built in year 1990 and First floor was built in year 2015
- Major structural cracks observed in building occurring diagonally as shown in fig 5 and 6.
- Some cracks propagating from floor to walls.
- Joints of wall got opened as shown in fig 4
- First Floor ceiling got damaged (Stone chipping out from the first floor roof) as shown in fig 3
- Diagonal cracks observed on parapet as shown in fig 2
- Overhang of building also damaged as shown in fig 2

Building type	Foundation type	Masonry type	Flooring	Roof type	Area
Load bearing structure	Stone masonry	Stone masonry	marble	Flat girder	126 sqm

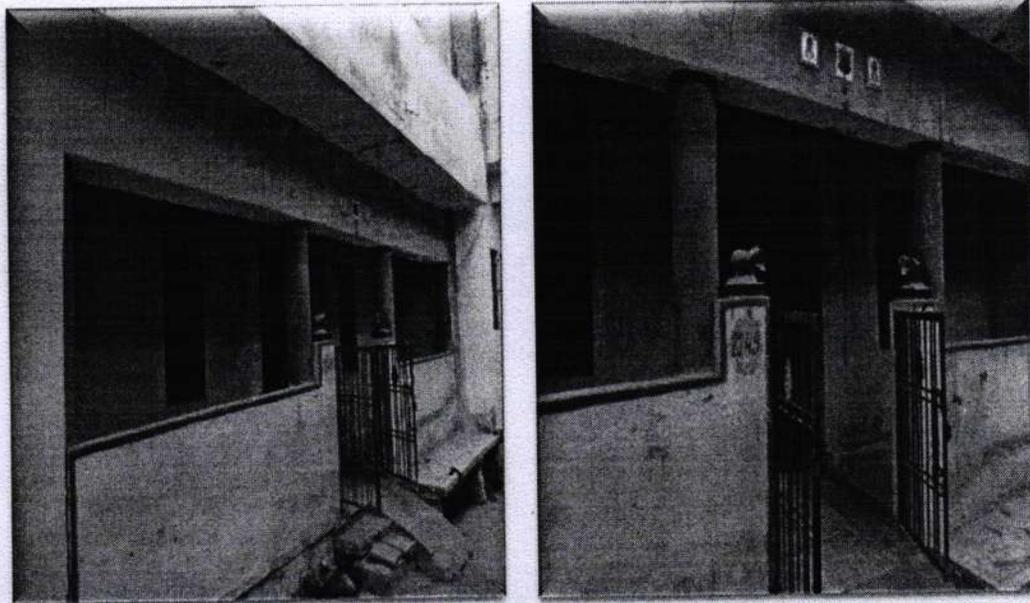


Fig 3. House no. 2249

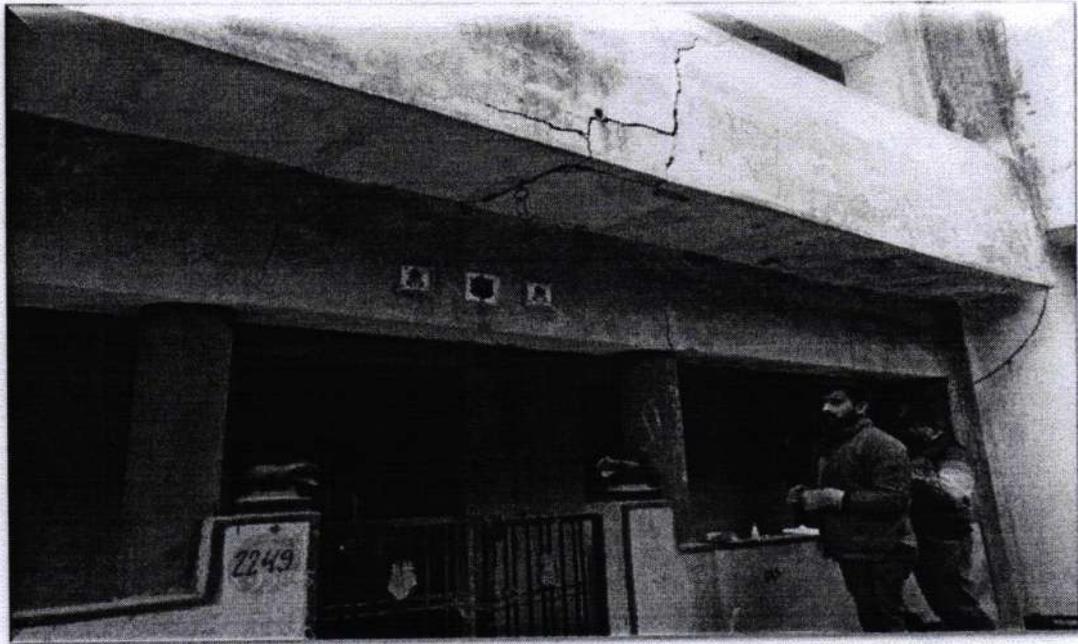


Fig 4. Damaged parapet and overhang

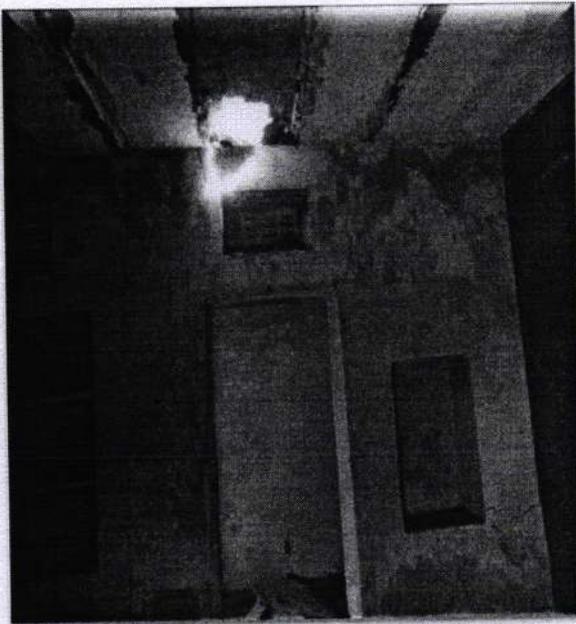


Fig 5. Damaged First floor ceiling



Fig 6. Opened wall joints

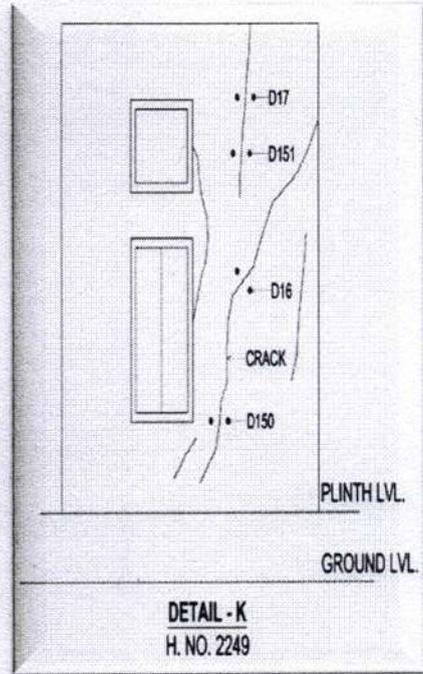
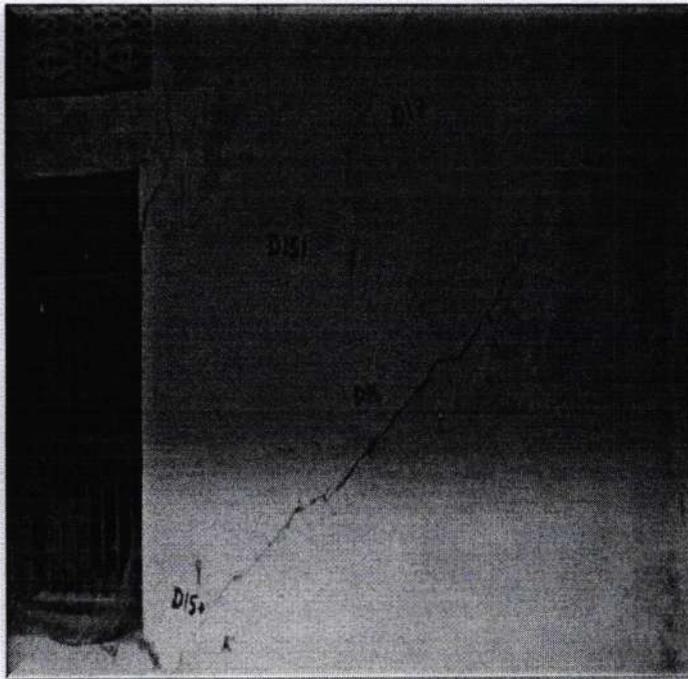


Fig 7. Diagonal cracks in walls with marking with installed studs (outside)

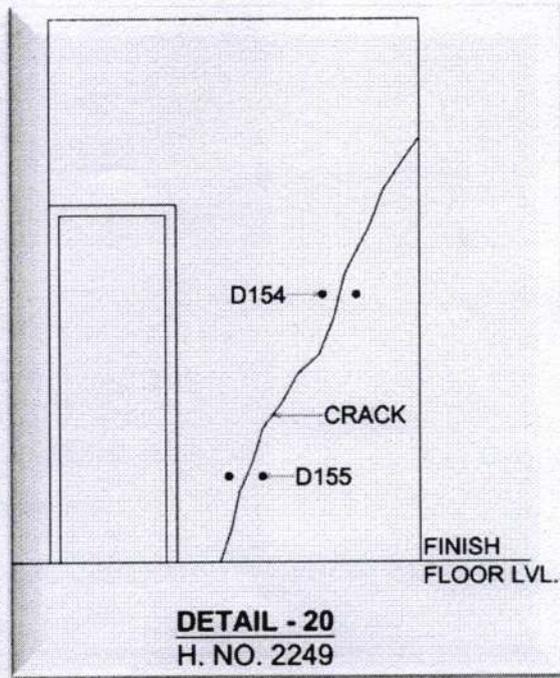
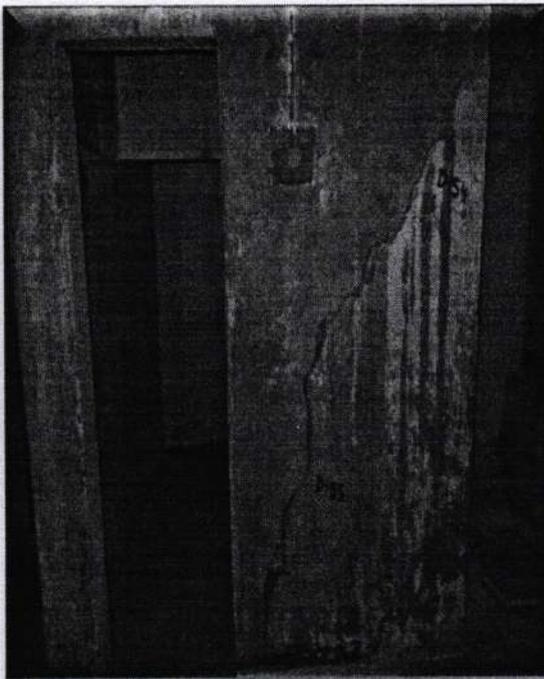


Fig 8. Diagonal cracks in walls with marking with installed studs (Inside)

**House no. 2245**

- No. of Stories built : G+1
- Occupancy: 2
- Building constructed in 1980 and renovates in 2008
- Building is supported on temporary structure (Shoring) as shown in fig 8
- Diagonal cracks observed in walls of the building as shown in fig 11 and 12
- Horizontal cracks observed in ceiling
- Major cracks observed near the joints of walls
- Crack propagates from walls to roof as shown in fig 10
- Stones in slab slides and gap is clearly visible between stones
- Gap between wall and skirting is observed
- Walls joint got opened and separated from each other as shown in fig 9

Building type	Foundation type	Masonry type	Flooring	Roof type	Area
Load bearing structure	Stone masonry	Stone masonry	marble	Flat girder	145 sqm



Fig 9. House no. 2245

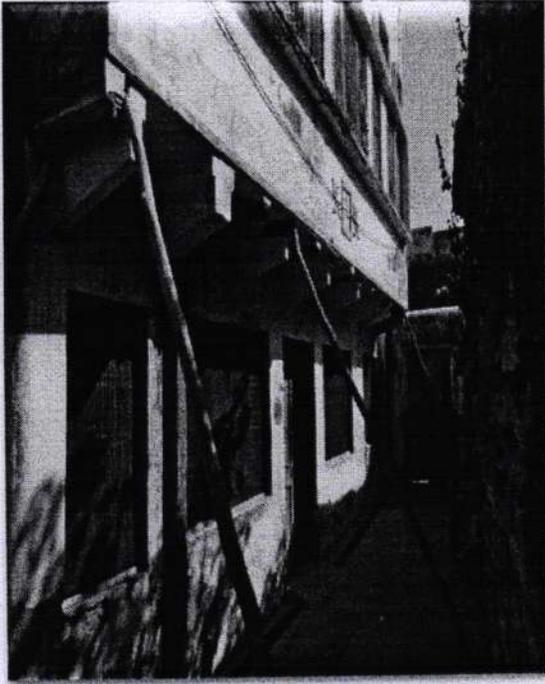


Fig 10. Temporary support (Shoring)



Fig 11. Opened Wall joints



Fig 12. Horizontal cracks in ceiling

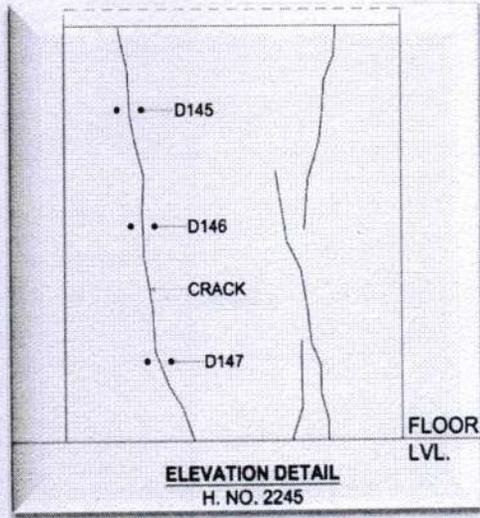


Fig 13. Diagonal cracks in wall with installed demic points

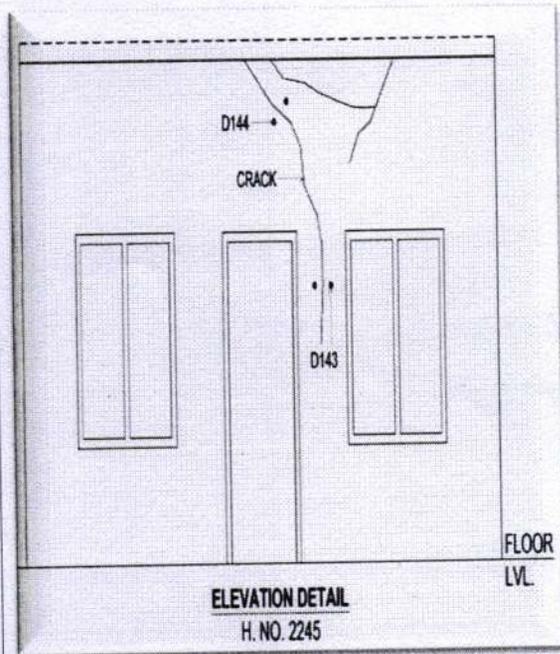
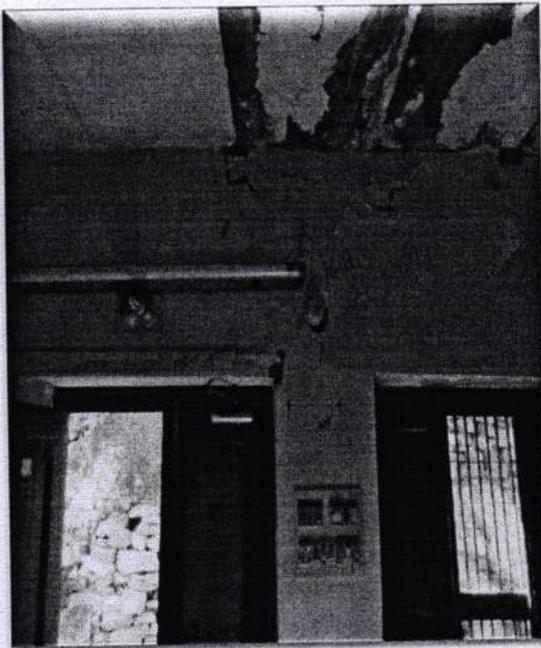


Fig 14. Diagonal cracks in wall with installed demic points

House no. 1353

Visual Observation:

- No. of stories built: G+1
- Occupancy: 3 people (Building is not living condition)
- Ground floor building was built in year 1990 (30 years old) and First floor was built in year 2010
- Major structural cracks ceiling to wall as shown in fig 15
- Diagonal & vertical cracks observed in wall of the building as shown in fig 15
- Horizontal cracks observed in Ceiling.
- Cracks in walls propagates into floor and ceiling as shown in fig 15
- Joints of walls got opened as shown in fig 14

Building type	Foundation type	Masonry type	Flooring	Roof type	Area
Load bearing structure	Stone masonry	Stone masonry	Cement flooring	Flat girder	45 Sq. m.



Fig 15. House no. 1353

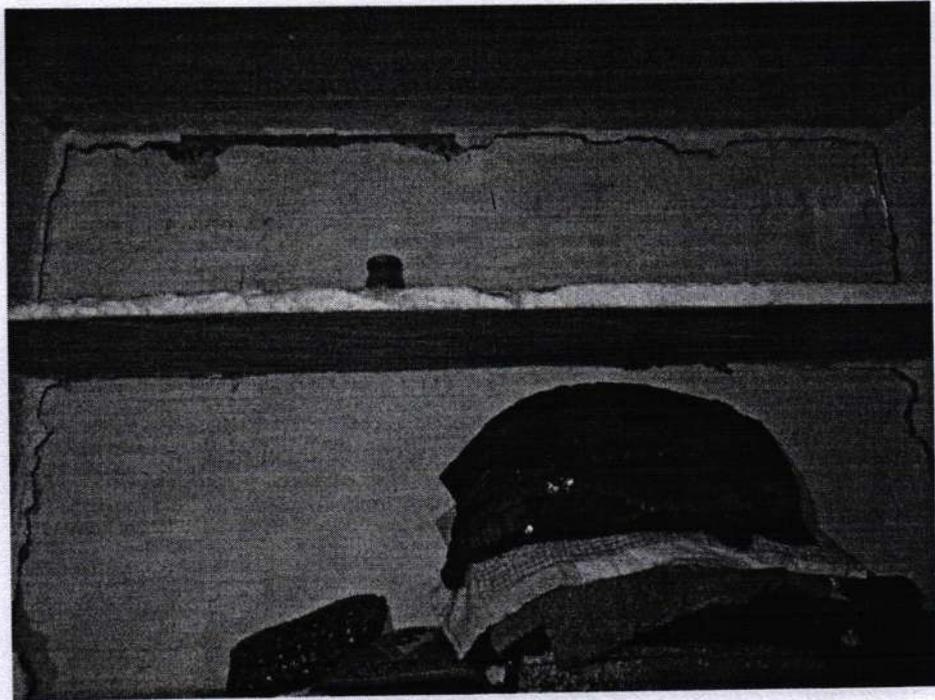


Fig 16. Opened joints of wall

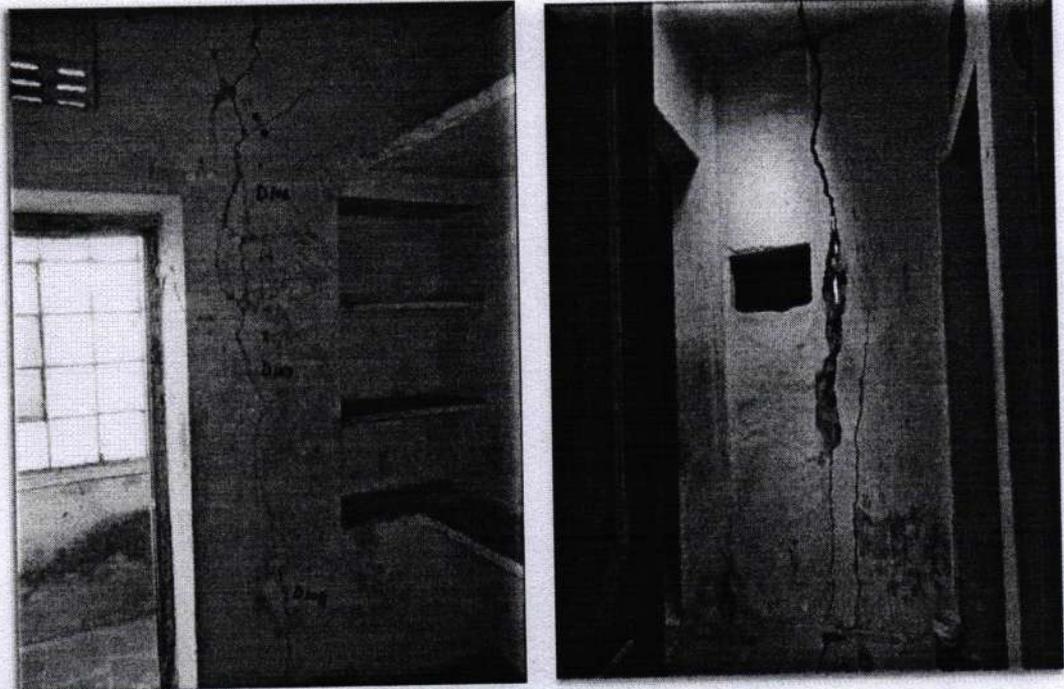


Fig 17. structural cracks on ceiling to wall

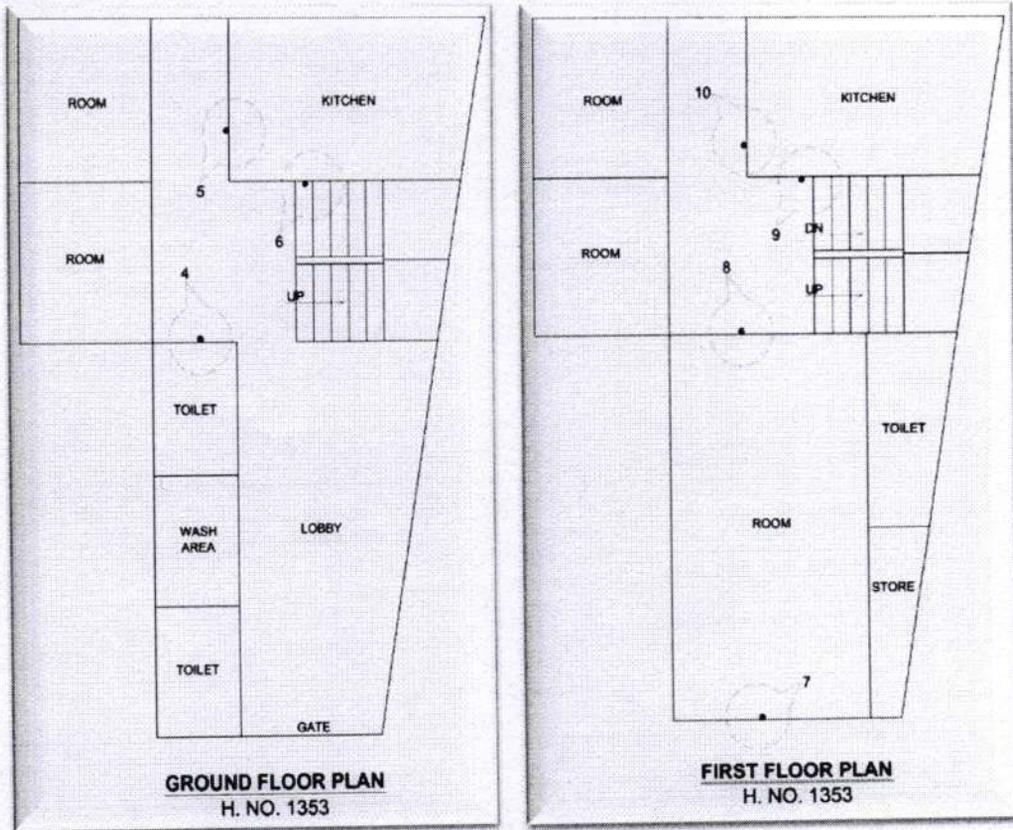


Fig 18. Floor plans

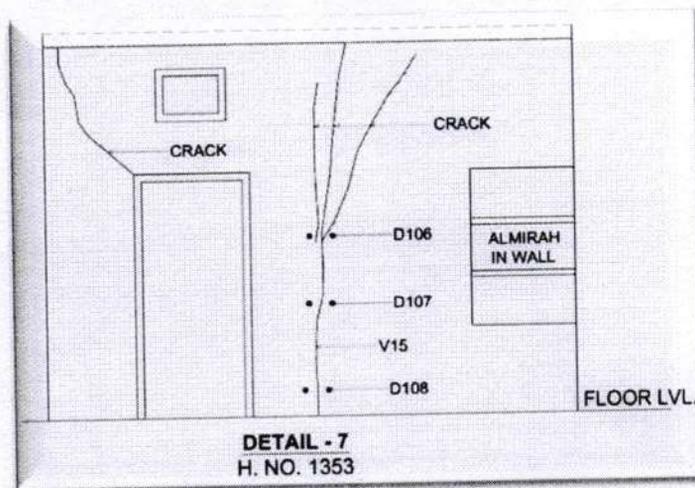


Fig 19. Detailing of Diagonal & vertical cracks observed in wall of the building.

**Location of Demic points at various places in Pur village, Bhilwara**

Sr no.	Demic Points	Location
1	D1, D2, D3, D188, D189	School-2
2	D4, D5	School-1
3	D6, D6, D7, D8, D9, D10, D190, D191, D192	Village general hospital
4	D11, D208, D209	Girls School
5	D12, D13	House no. 2835
6	D14	House no. 2836
7	D15, D16, D17, D18, D19, D20	House no.2249
8	D21, D22	House no. 2251
9	D23, D24, D25, D26, D27, D28, D29, D30, D31, D32, D33, D34, D35, D184, D185, D186, D187	Laxmi Narayan temple
10	D36	House no. 1936
11	D37, D38,39	House no. 1952
12	D40, D41, D42, D43,D45, D46	House no. 1956
13	D44	House no. 1962
14	D47	House no. 1970
15	D48	House no. 1982
16	D49	House no. 2213
17	D50, D51	House no. 2377
18	D52	House no. 2489
19	D53, D54, D55	House no. 2490
20	D56, D57	House no. 2669
21	D58	House no. 2491
22	D59, D60	House no. 2496
23	D61	House no. 2492
24	D62, D64	House no. 2502
25	D63	House no. 2505
26	D66, D67, D68, D69	Shop no. 1100
27	D70, D71, D72	House no. 1095
28	D73	House no. 1089
29	D74	House no. 1092
30	D75, D76	House no. 1093
31	D77, D78, D79, D80, D81	House no. 841
32	D82, D83	House no. 1064
33	D84, D85	House no. 1066
34	D86, D87	House no. 1068
35	D88, D89	House no. 1077
36	D90	House no. 1073

37	D91, D92, D93	House no. 1067
38	D94	House no. 1079
39	D95, D96	House no. 878
40	D97, D98, D99	House no. 882
41	D100, D101	House no. 1095
42	D102, D103, D104, D105, D106, D107, D108, D109	House no. 1353
43	D110, D111, D112, D113, D114	House no. 1372
44	D115, D116	House no. 1375
45	D117	House no. 1378
46	D118, D119	Shop no. 1582
47	D120, D121	Shop no. 1581
48	D122	Shop no. 1635
49	D123	House no. 1567
50	D124, D125, D126	House no. 112
51	D127	House no. 1126
52	D128	House no. 1122
53	D129	House no. 1132
54	D130	House no. 1135
55	D131, D132, D133	House no. 1141
56	D134, D134, D135, D136, D137, D138, D139, D140, D141, D142	Madina masjid
57	D143, D144, D145, D146, D147, D148	House no. 2245
58	D149, D150, D151, D152, D153, D153, D154, D155, D156, D157	House no. 2249
59	D158, D159, D160, D161, D162, D163, D164, D165, D166, D167	House no. 2248
60	D168, D169, D170, D171, D172	House no. 2235
61	D173, D174, D175, D176, D177	House no. 2234
62	D178, D179	House no. 2237
63	D180, D181, D182, D183	House no. 2826
64	D193, D194, D195, D196, D197, D198, D199, D200	House no. 2822
65	D201, D202, D203, D204, D205	House no. 2823
66	D206, D207	House no. 2835
67	D210, D211, D212, D213, D214, D215	House no. 2324
68	D216	House no. 1374

*AS Bings*

