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**MUNICIPAL CORPORATION OF GREATER MUMBAI**

**Report of Technical Investigation Committee**  
**regarding the collapse of Compound wall**  
**at Malad Hill Reservoir on 2.7.2019.**

Report submitted with regards,

To,

Hon. MUNICIPAL COMMISSIONER  
MUNICIPAL CORPORATION OF GREATER MUMBAI  
MAHAPALIKA MARG, MUMBAI – 400 001.

BY

THE TECHNICAL INVESTIGATION COMMITTEE

PROF. G.B.CHAUDHARI  
RETIRED VJTI

SHRI R.B.BAMBALE  
EX.D.M.C.(S.E.), MCGM

SHRI P.R.K.MURTHY  
DIRECTOR METRO MMRDA

SHRI PRAVIN KIDE  
ENGINEER IN CHIEF, MMRDA

PROF. DR. DASAKA S.MURTY  
IIT BOMBAY

PROF. DR. ARGHADEEP LASKAR  
IIT BOMBAY

PROF. DR. JAYADIPTA GHOSH  
IIT BOMBAY

SHRI S.M.BAPAT  
EX. DY.H.E.(CONST.) MCGM

SHRI A.S.TAWADIA  
DMC(SE) & CHAIRMAN  
OF THE COMMITTEE

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# Layout Plan of Malad Hill Reservoir



1. Total length of Compound wall - 2150 mtrs.
2. Size of Side Drain - 0.3m x 0.6m
3. Four Numbers of cross Drains (C1,C2,C3,C4)

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# 1.PREAMBLE

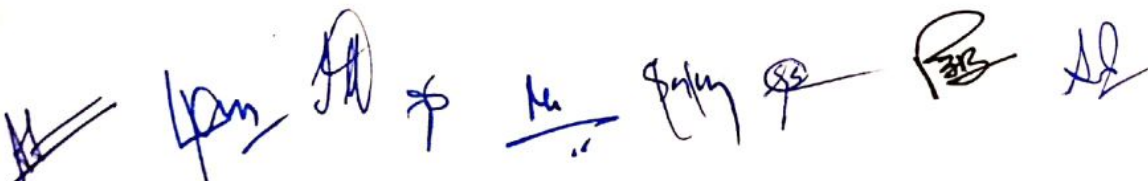
Malad Hill Reservoir is one of the service reservoirs of Mumbai, which mainly caters to the area of Goregaon (East), Malad (East) and Kandivali (East). There was an existing stone masonry compound wall along the periphery of the reservoir plot. This wall was breached at many places by the local hutment dwellers, thereby posing a security threat to this important installation, i.e. Malad Hill water reservoir.

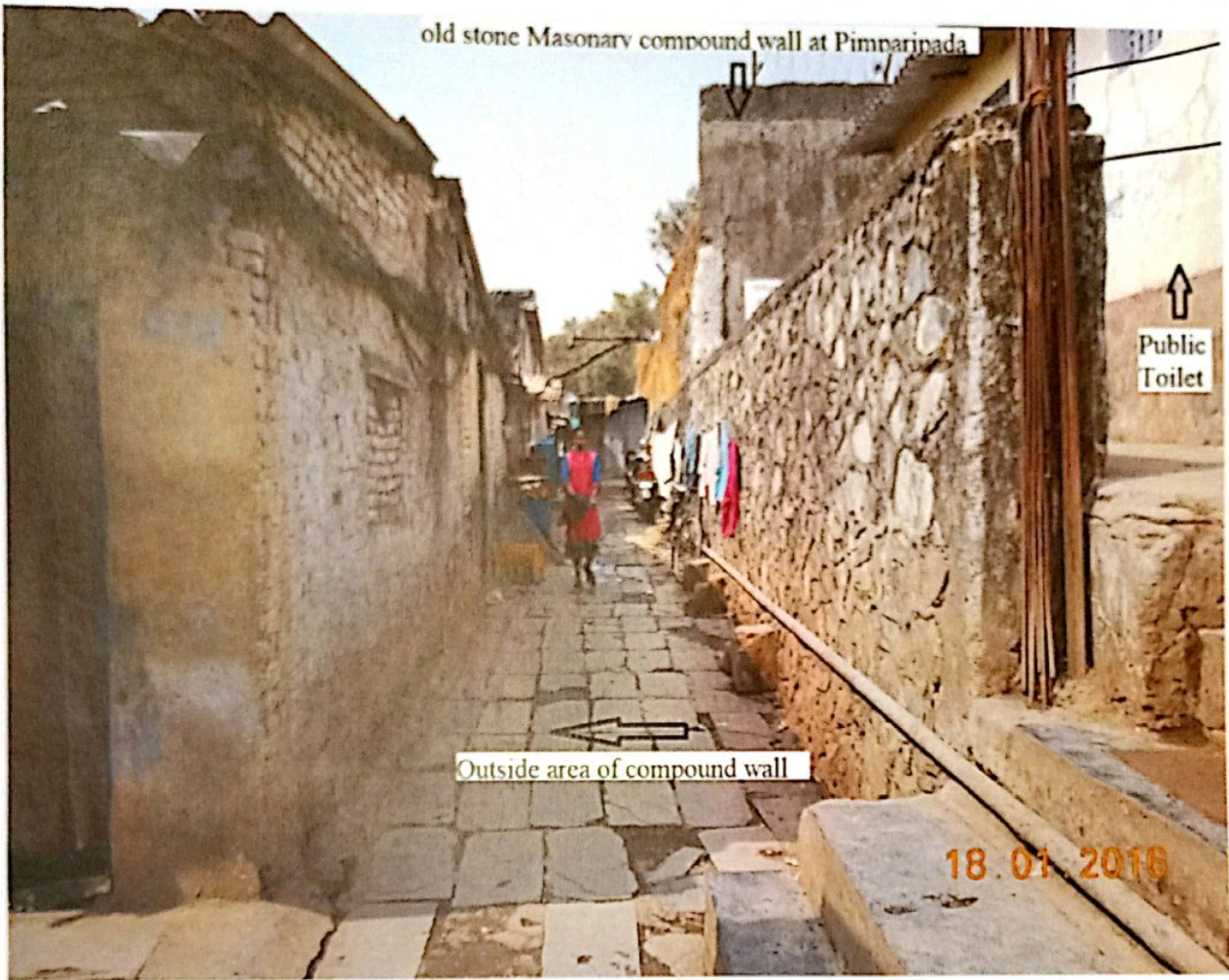
An earlier communication was received from Additional Commissioner of Police, Protection and Security, Mumbai dated 4.4.2014 to construct 10 feet ( 3.0 m ) high compound wall with barbed wire fencing over it to safeguard the Malad Hill Reservoir premises.

Accordingly, the H.E. department had proposed to construct R.C.C. compound wall of 3.3 m ( 11 feet ) height with barbed wire fencing above the wall in the year 2015. The work of construction of R.C.C. compound wall was started in December 2015 and completed in 2017.

Some of the relevant photographs of old stone masonry compound wall and the photographs during the construction of R.C.C compound wall are attached at page 5-13.

\*\*\*\*\*

A series of handwritten signatures in blue ink, including names like 'H', 'Kam', 'AA', 'P', 'M', 'Prady', 'SS', 'RBS', and 'AD'.



old stone Masonary compound wall at Pimnaripada

↑  
Public Toilet

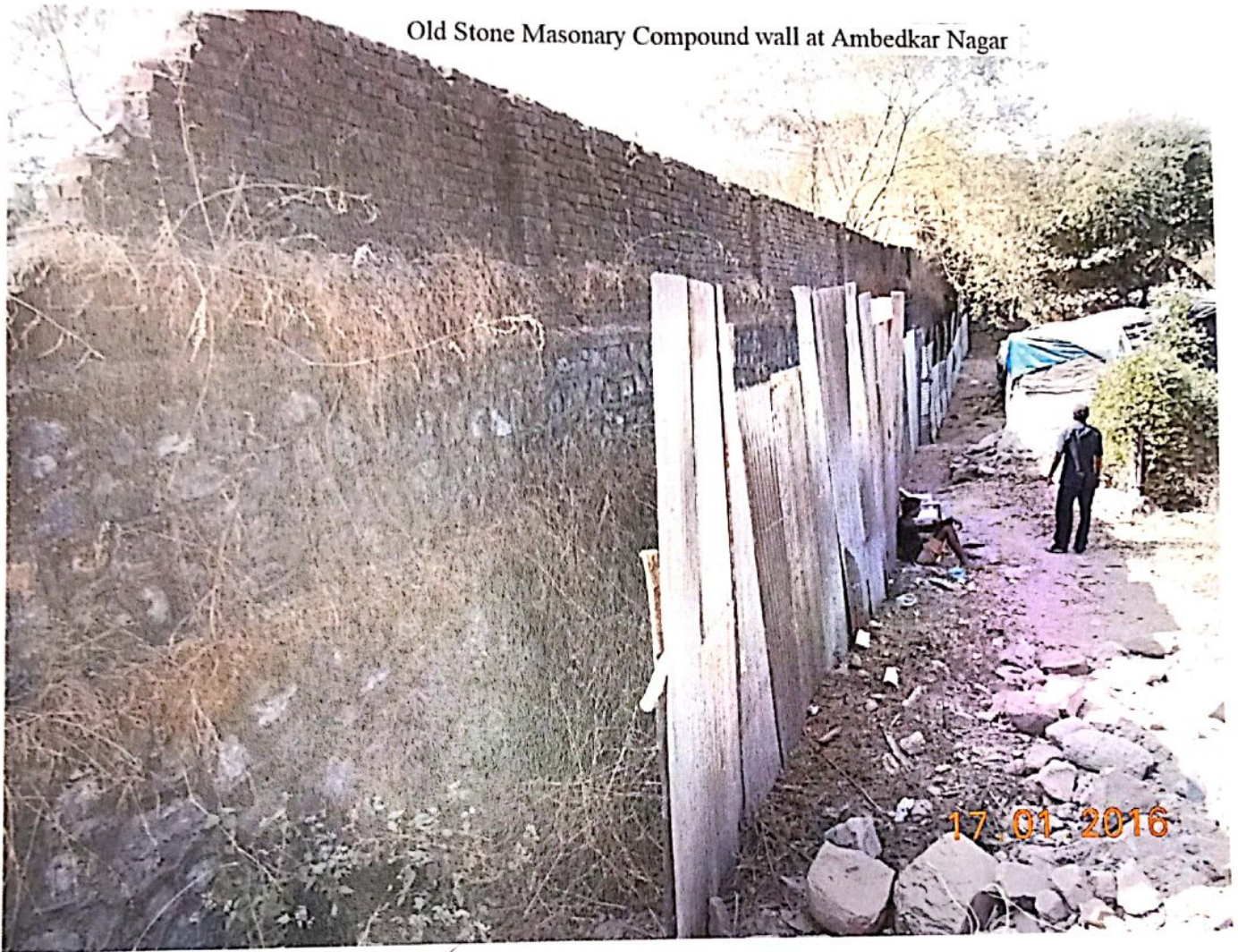
←  
Outside area of compound wall

18.01.2016



Demolition of Old Stone Masonary compound wall at Ambedkar Nagar

Old Stone Masonary Compound wall at Ambedkar Nagar



At      Lpm      SP      SP      SP      SP      SP  
SP

Construction of Inspection track at Malad Hill Reservoir

9  
7

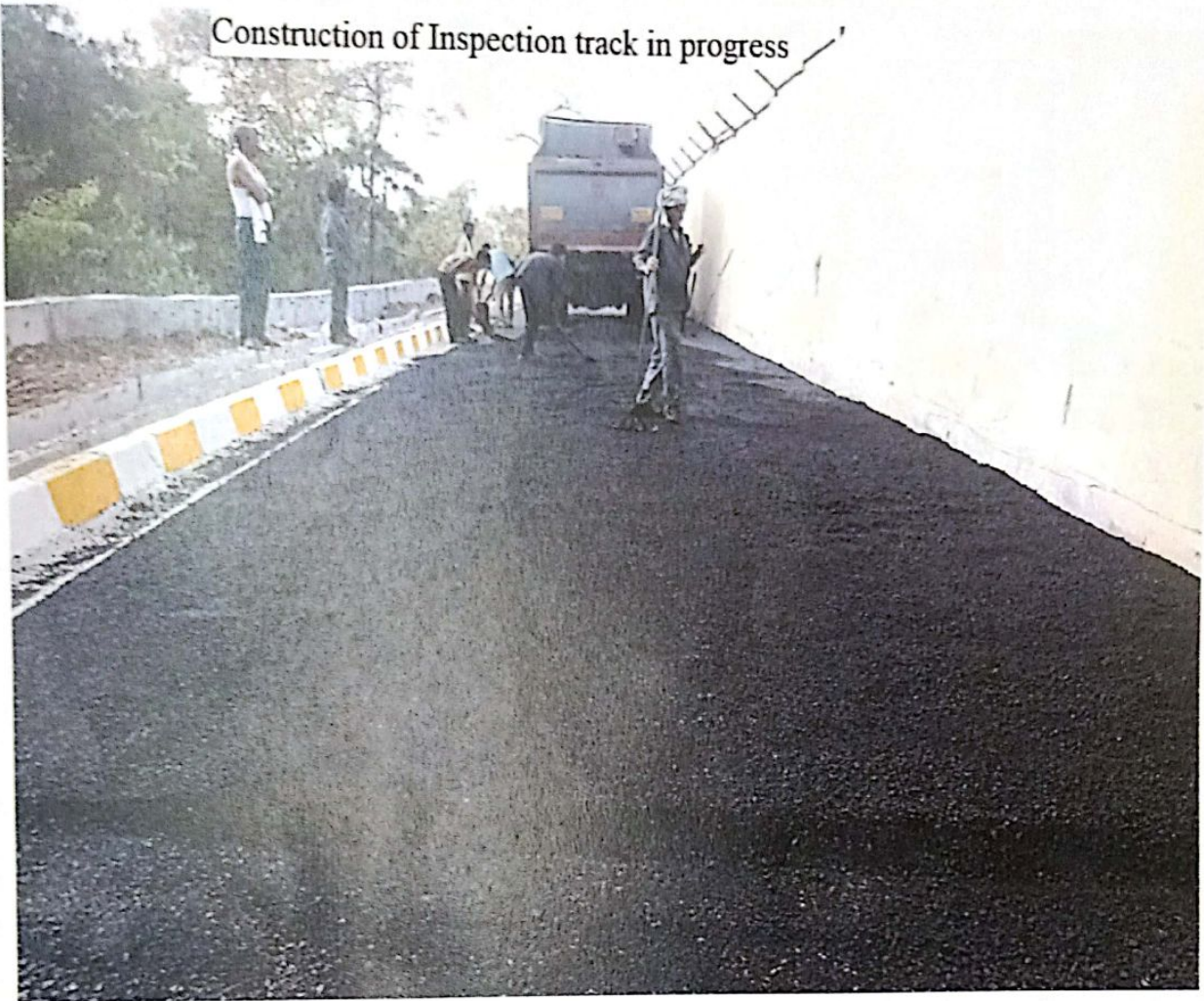


Left  
No  
132

9  
132  
132



Construction of Inspection track in progress



Construction of R.C.C. compound wall in progress



*Handwritten signatures and initials in blue ink:*  
A. 4/11/2019 [Signature] [Initials] [Signature] [Initials] [Signature] [Initials]



## 2. COLLAPSE OF COMPOUND WALL AND FORMATION OF TECHNICAL INVESTIGATION COMMITTEE

The area of Malad Hill Reservoir witnessed continuous rainfall from 26.6.2019 to 2.7.2019 and particularly heavy rains on 1.7.2019 and 2.7.2019. As per the data received from Disaster Management Cell of MCGM, the total rainfall recorded for 24 hours is 479.56 mm from 8.00 a.m. on 1.7.2019 to 8.00 a.m. on 2.7.2019. The hourly rainfall recorded from 23.00 hrs to 00.00 hrs midnight on 1.7.2019 was 67.82 mm and 63.26 mm for the period from 00.00 hrs to 01.00 hrs on 2.7.2019.

As per the information received from Fire Brigade Department, the compound wall was reported to have suddenly collapsed at the two locations i.e.

- a) Ambedkar Nagar at 1.01 a.m. on 2.7.2019 and
- b) Pimparipada at 1.40 a.m. on 2.7.2019

An occurrence report was submitted by Ex.Engineer (Civil) Maint./ Deputy Hydraulic Engineer (Maint.) on 02.07.2019 informing about the occurrence of the incident to Hydraulic Engineer /DMC(SE) /Hon.AMC (P) and Hon.M.C.



As per the direction of Hon. M.C., vide No. MGC/F/9638 dated 4.7.2019, a Technical Investigation Committee was constituted to ascertain the causes of collapse of the said compound wall. This Committee comprises of experts from IIT Bombay, Retd. Professor from VJTI, Officers from MMRDA and retired Officers from Municipal Corporation of Greater Mumbai's Hydraulic Engineer Department.

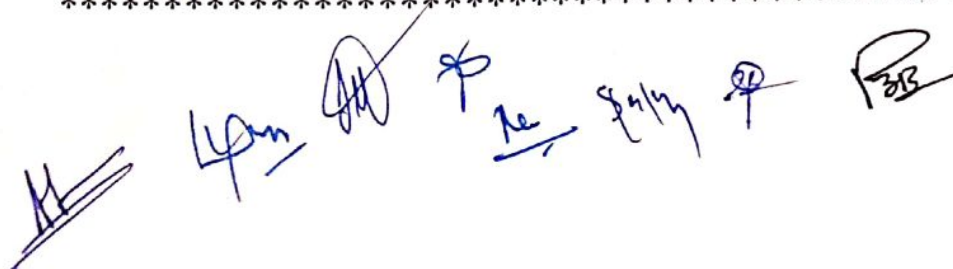
The Committee comprises of the following members :-

1. Shri A.S.Tawadia, Chairman and DMC(SE) MCGM
2. Prof. G.B.Chaudhari, Retired VJTI.
3. Shri R.B.Bambale, EX.D.M.C.(S.E.), MCGM
4. Shri P.R.K.Murthy, Director Metro, MMRDA
5. Shri Pravin Kide, Engineer in Chief, MMRDA
6. Prof. Dr. Dasaka S.Murty, IIT Bombay
7. Prof. Dr. Arghadeep Laskar, IIT Bombay
8. Prof. Dr. Jayadipta Ghosh, IIT Bombay
9. Shri S.M.Bapat, EX.Dy.H.E.(Const.), MCGM

This Committee had conducted its investigation under the chairmanship of DMC (SE) Shri A.S.Tawadia. The scope of the Committee was to find out the causes of collapse of said compound wall.

Some of the relevant photographs and print media report are attached at page 19-29.

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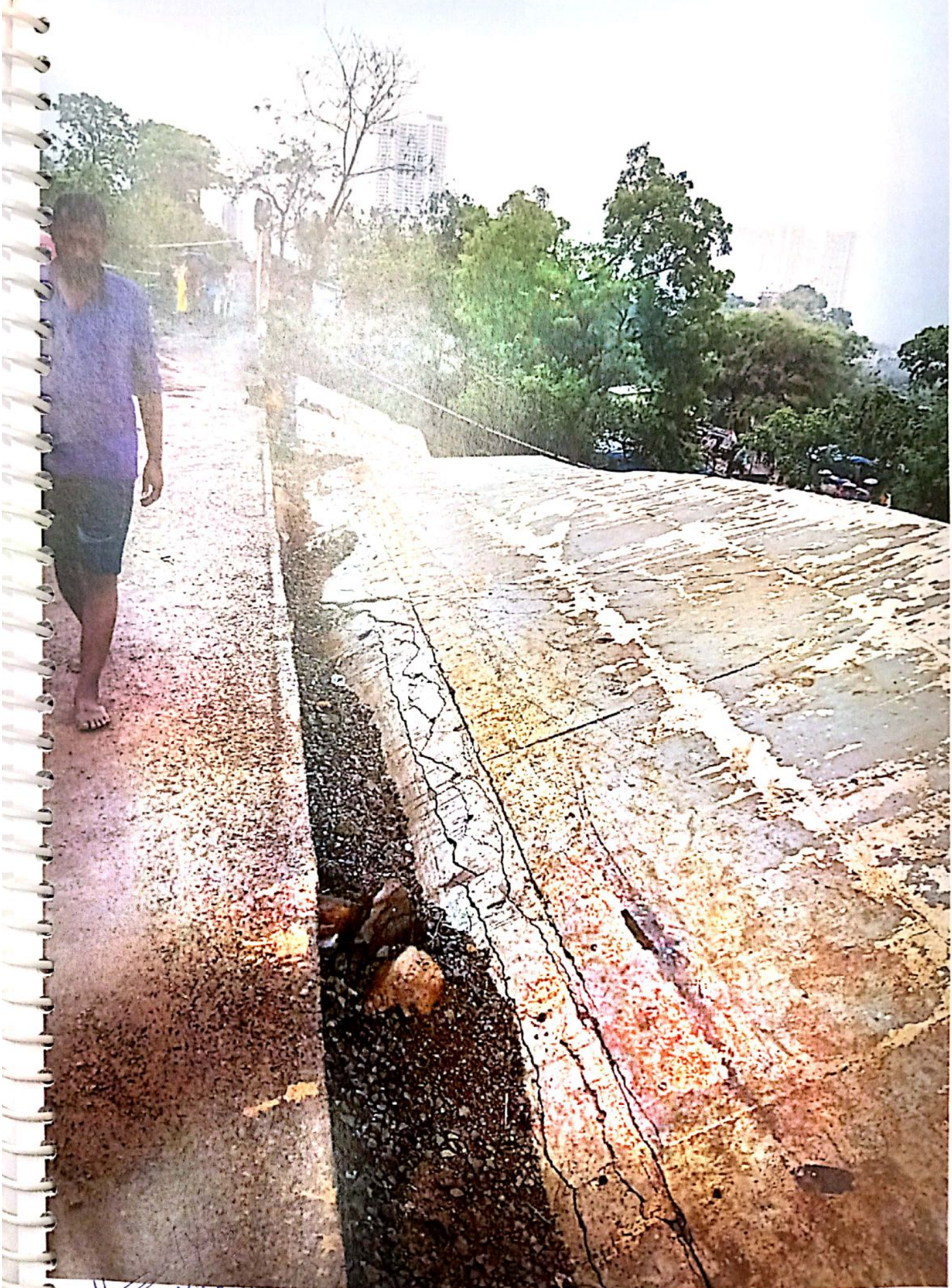


Collapsed compound wall at Ambedkar Nagar



H  
LPM  
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S  
R

Collapsed compound wall at Ambedkar Nagar

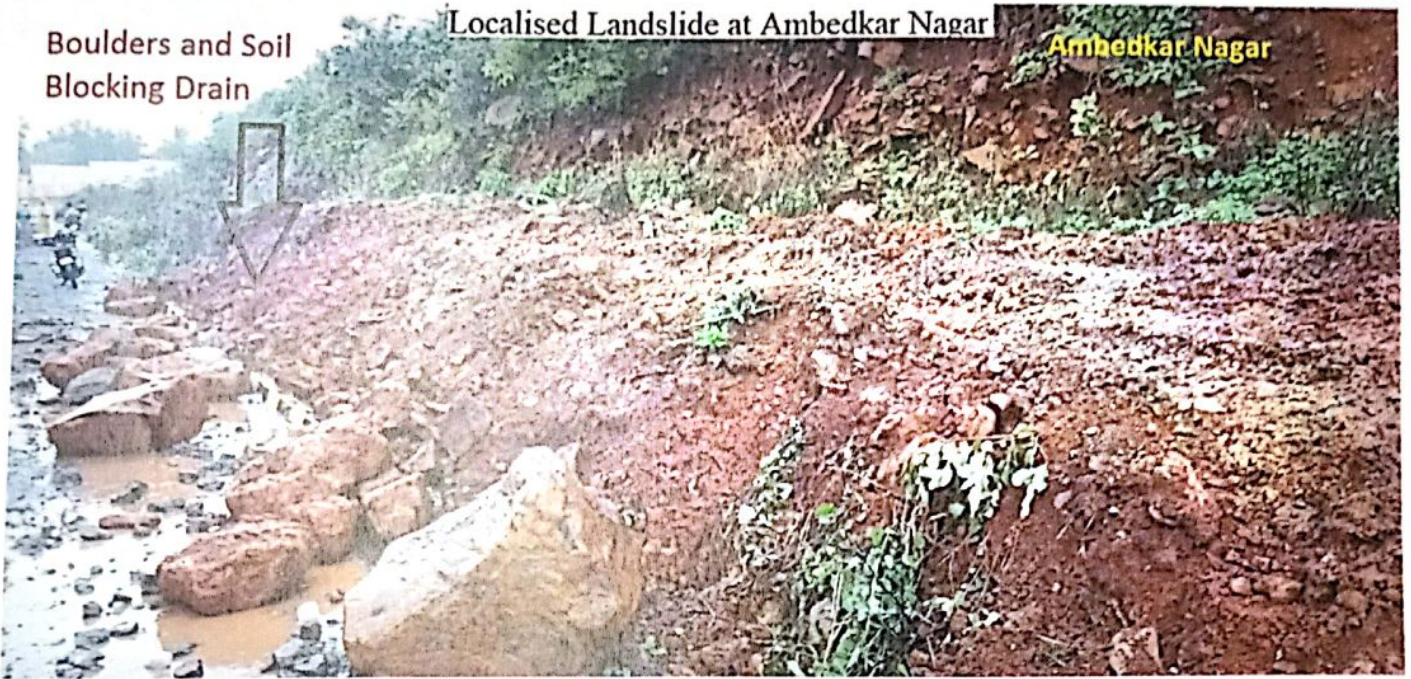


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Boulders and Soil  
Blocking Drain

Localised Landslide at Ambedkar Nagar

Ambedkar Nagar



Cross Drain at Pimparipada , Malad Hill Reservoir

Cross Drain



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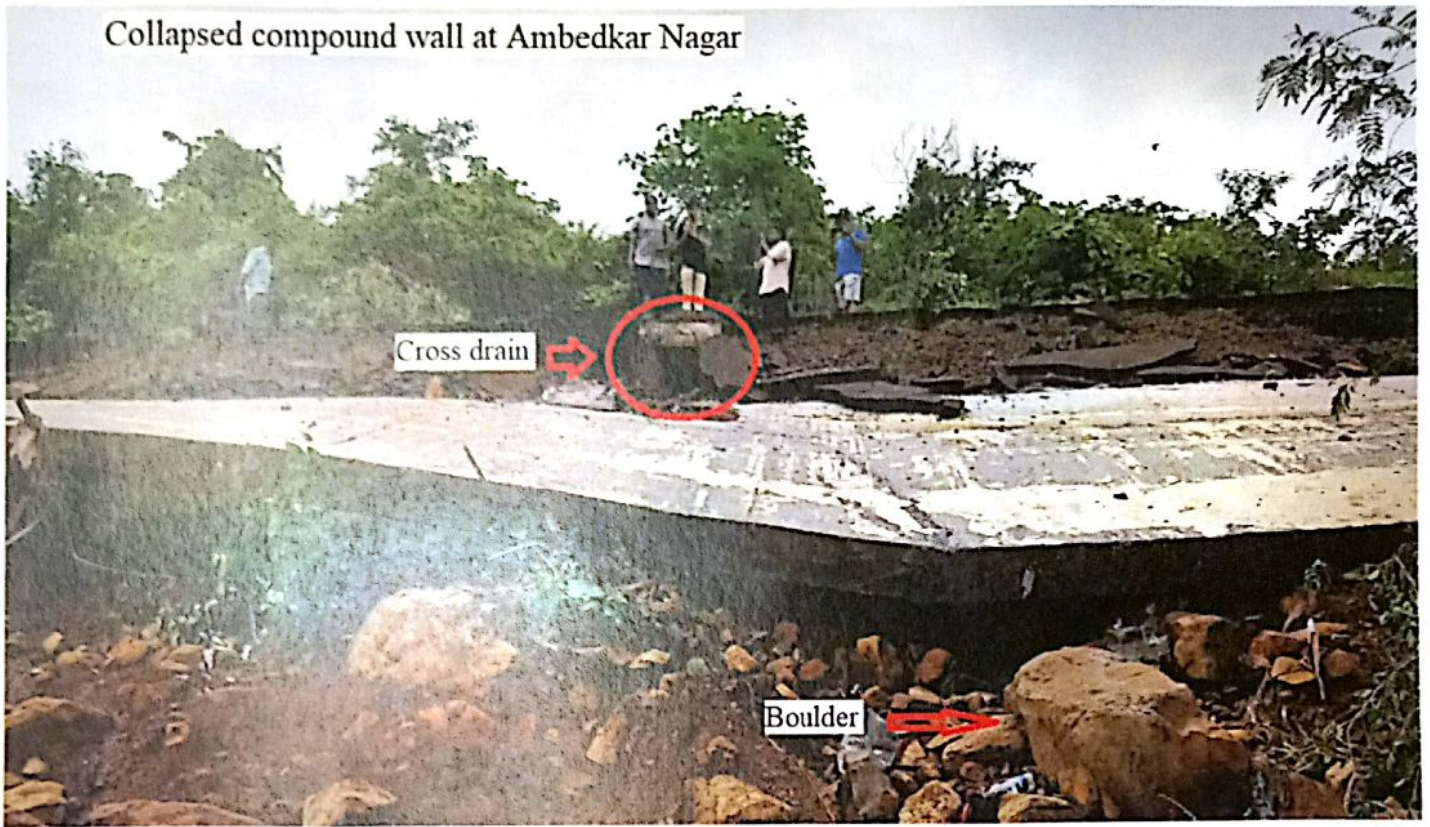
Collapsed compound wall at Ambedkar Nagar



*[Handwritten signatures and marks in blue ink]*



Collapsed compound wall at Ambedkar Nagar



Cross drain

Boulder



Ambedkar Nagar

Localised Landslide at Ambedkar Nagar

Boulders and Soil

Boulder

Soil

Boulder


*[Handwritten signatures and initials]*



### 3. INVESTIGATION METHODOLOGY

The Technical Investigation Committee conducted its first site visit and meeting on 07.07.2019. During the meeting, the Committee decided to carry out the investigation in the following manner :-

- 1) To study the documents / test reports relevant to the work of compound wall.
- 2) To obtain the rainfall data from Disaster Management Cell of MCGM.
- 3) To obtain satellite images of the premises from National Remote Sensing Centre, Hyderabad to ascertain the status of accumulation of water near the wall sections just before their collapse.
- 4) To expose the foundation to ascertain if there was any evidence of scouring beneath the foundation of wall.
- 5) To extract cores from the RCC compound wall to ascertain the quality of the work and to test the cores either in Material Testing Laboratory of MCGM or in any prestigious Educational Institutions, such as VJTI or IIT Bombay.



- 6) To carry out a Drone Survey of the entire plot to obtain the contour of the plot and to ascertain the catchment area.
- 7) To review various designs / calculations as submitted by the consultant appointed for the work.
- 8) To have more site visits, if required.

Some of the relevant photographs are attached at page 35-45.

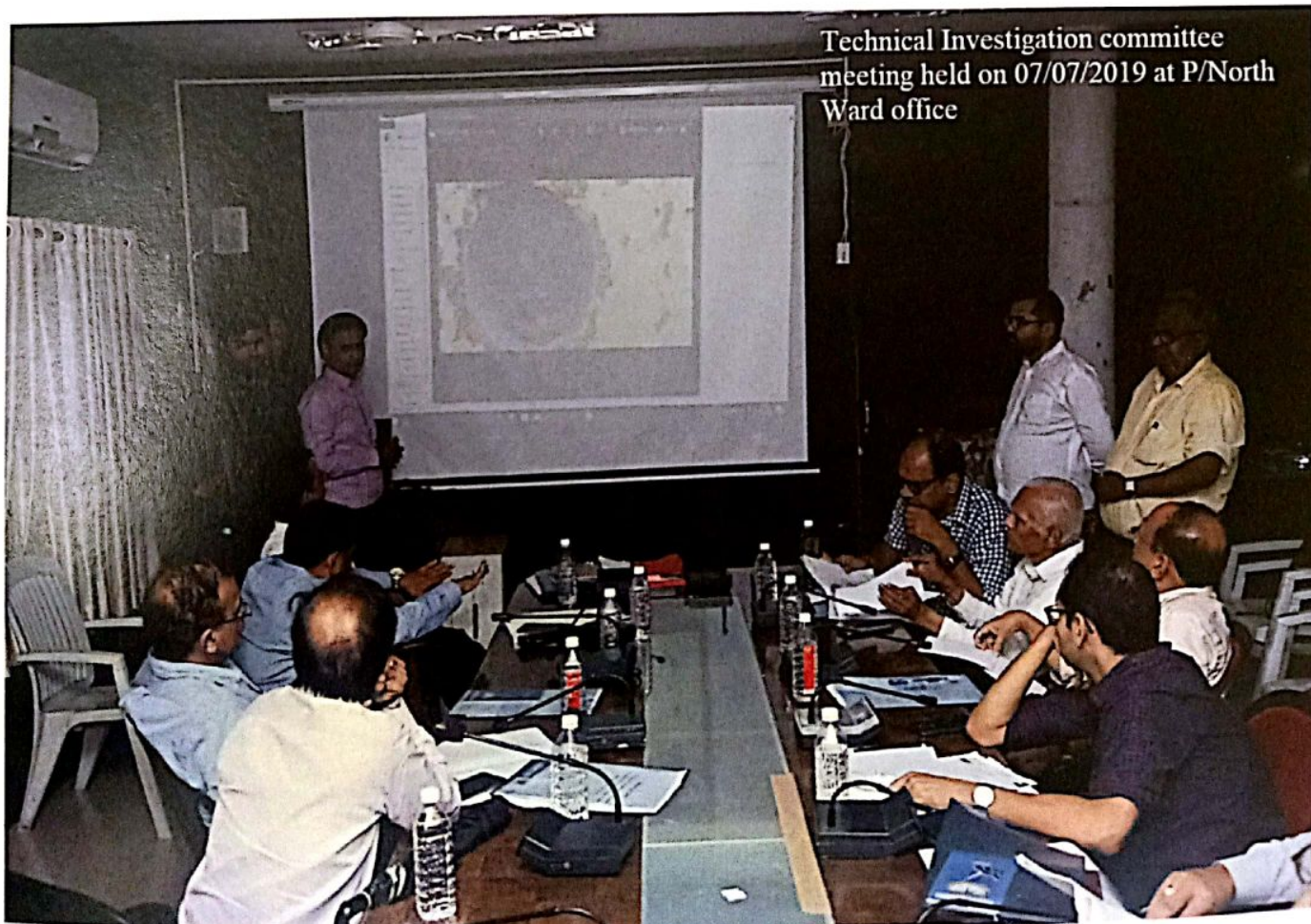
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*H* *Yan* *Je* *P* *July* *P* *P* *AL*  
*Na*

Technical Investigation committee meeting held on 07/07/2019 at Malad Hill Reservoir

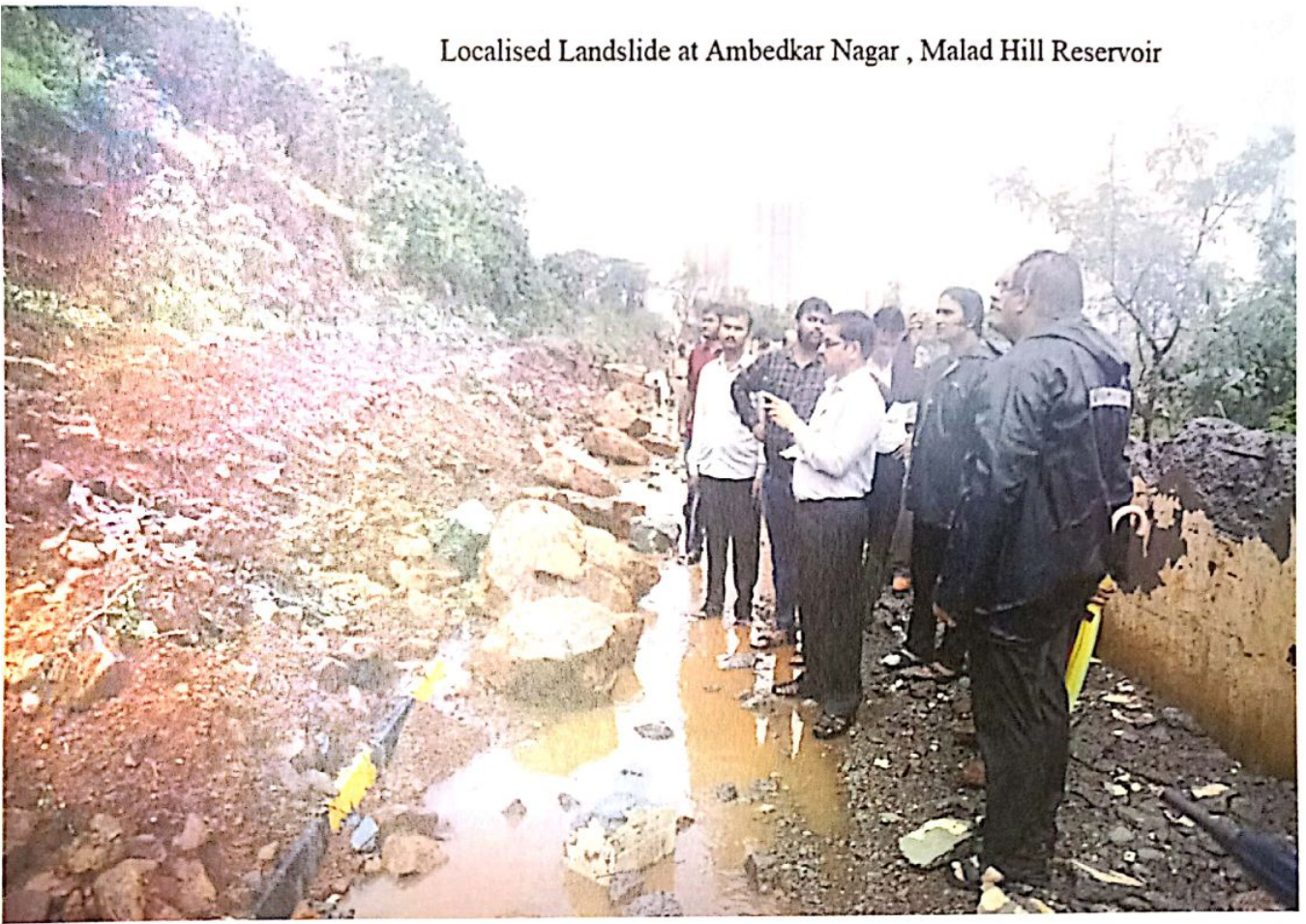


Technical Investigation committee meeting held on 07/07/2019 at P/North Ward office

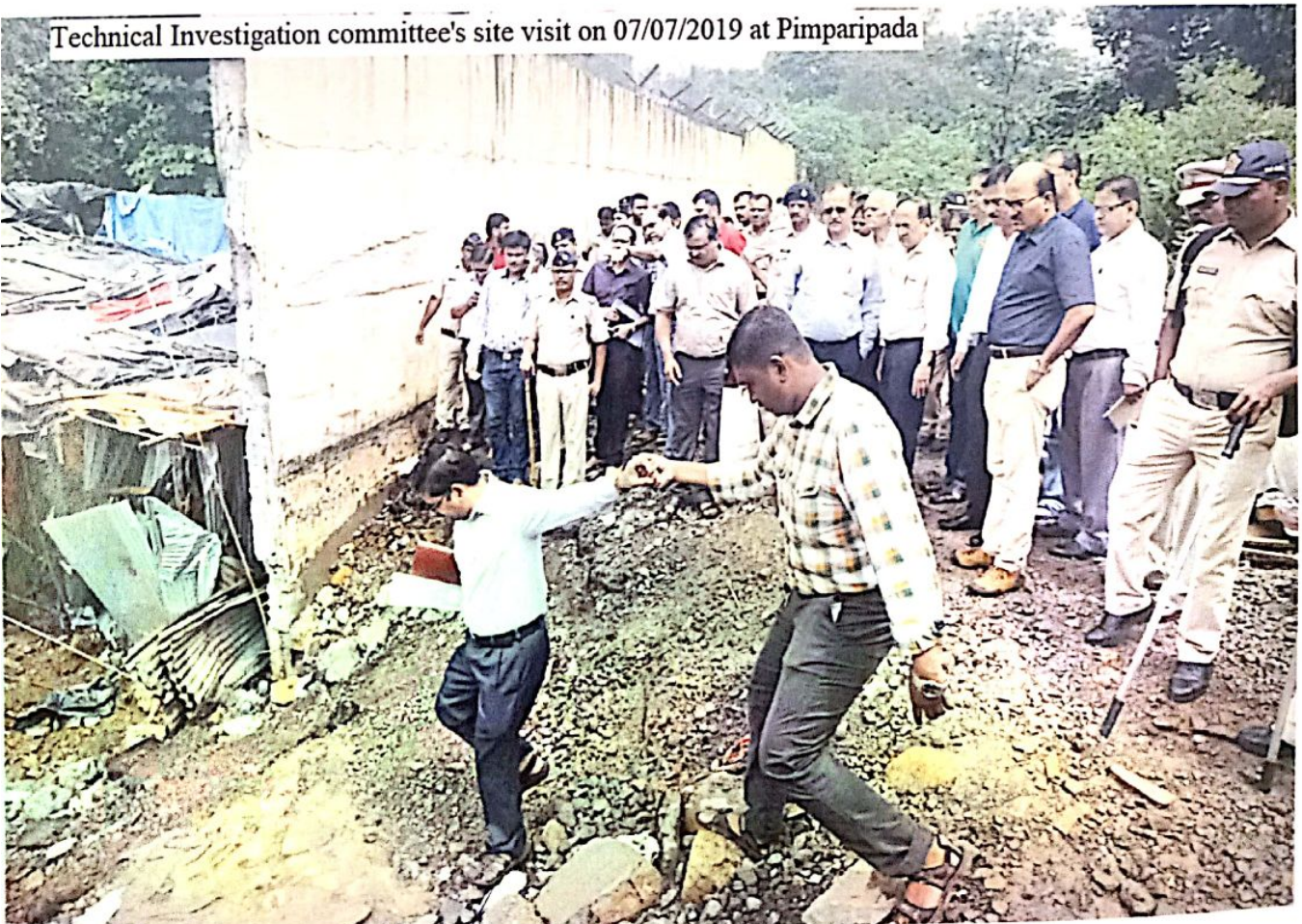


H Lpm GAD P Ne 22 Pm P RB AE

Localised Landslide at Ambedkar Nagar , Malad Hill Reservoir



Technical Investigation committee's site visit on 07/07/2019 at Pimparipada



*[Handwritten signatures and initials in blue ink]*

View from downstream side of collapsed wall at Pimparipada

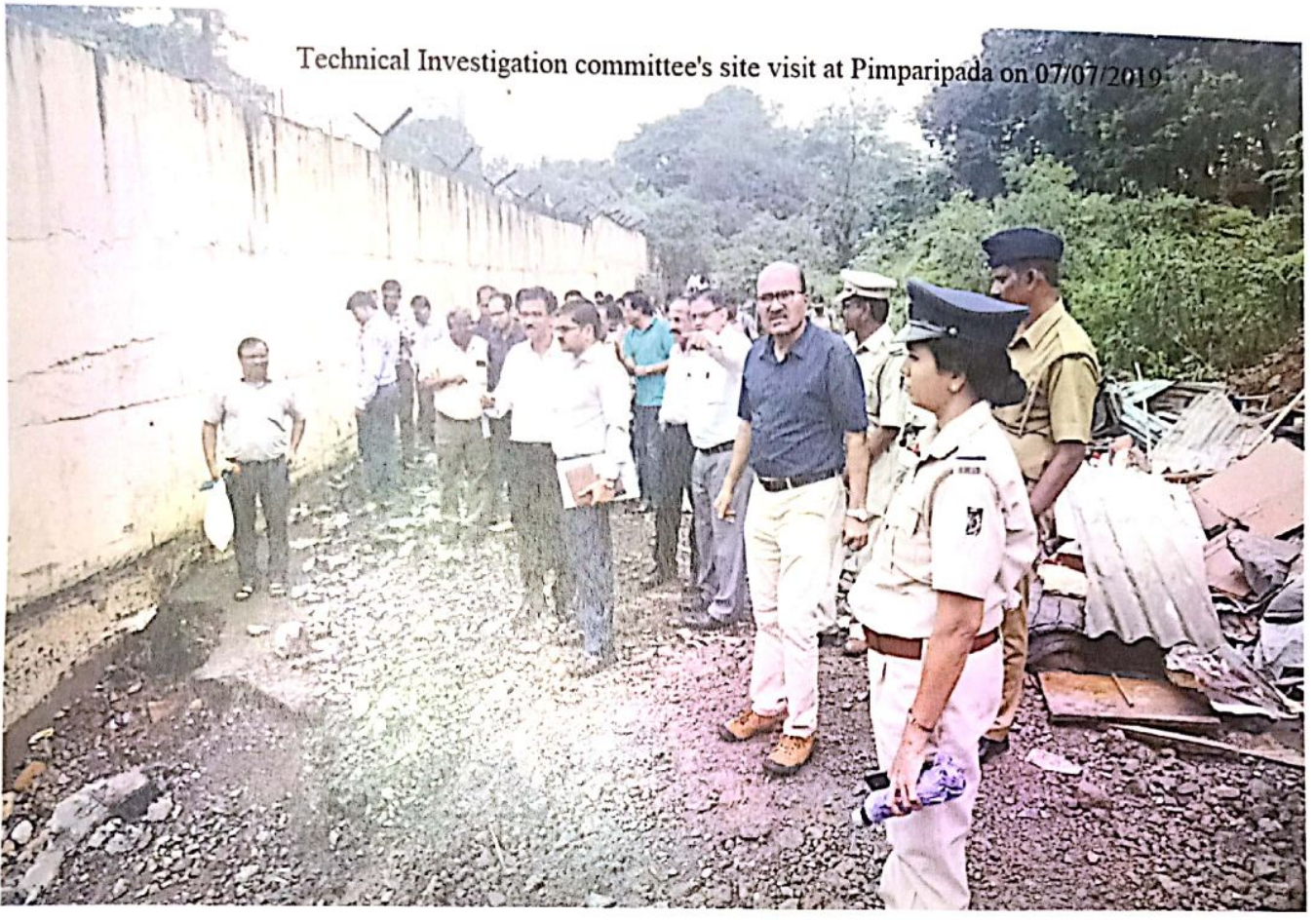


Technical Investigation committee's site visit at Pimparipada on 07/07/2019



*[Handwritten signatures and initials in blue ink]*

Technical Investigation committee's site visit at Pimparipada on 07/07/2019



Technical Investigation committee's site visit at Pimparipada on 07/07/2019



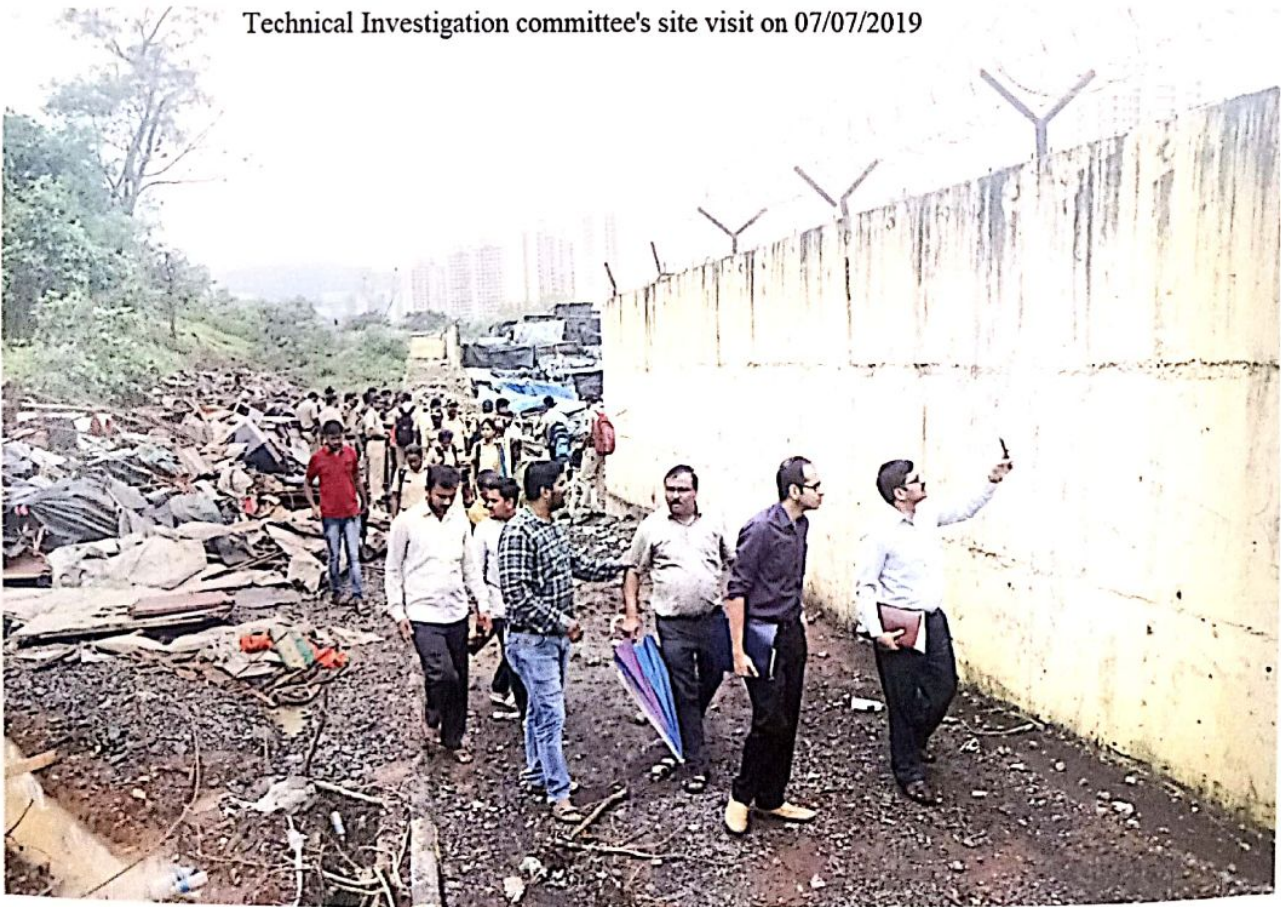
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Technical Investigation committee's site visit on 07/07/2019

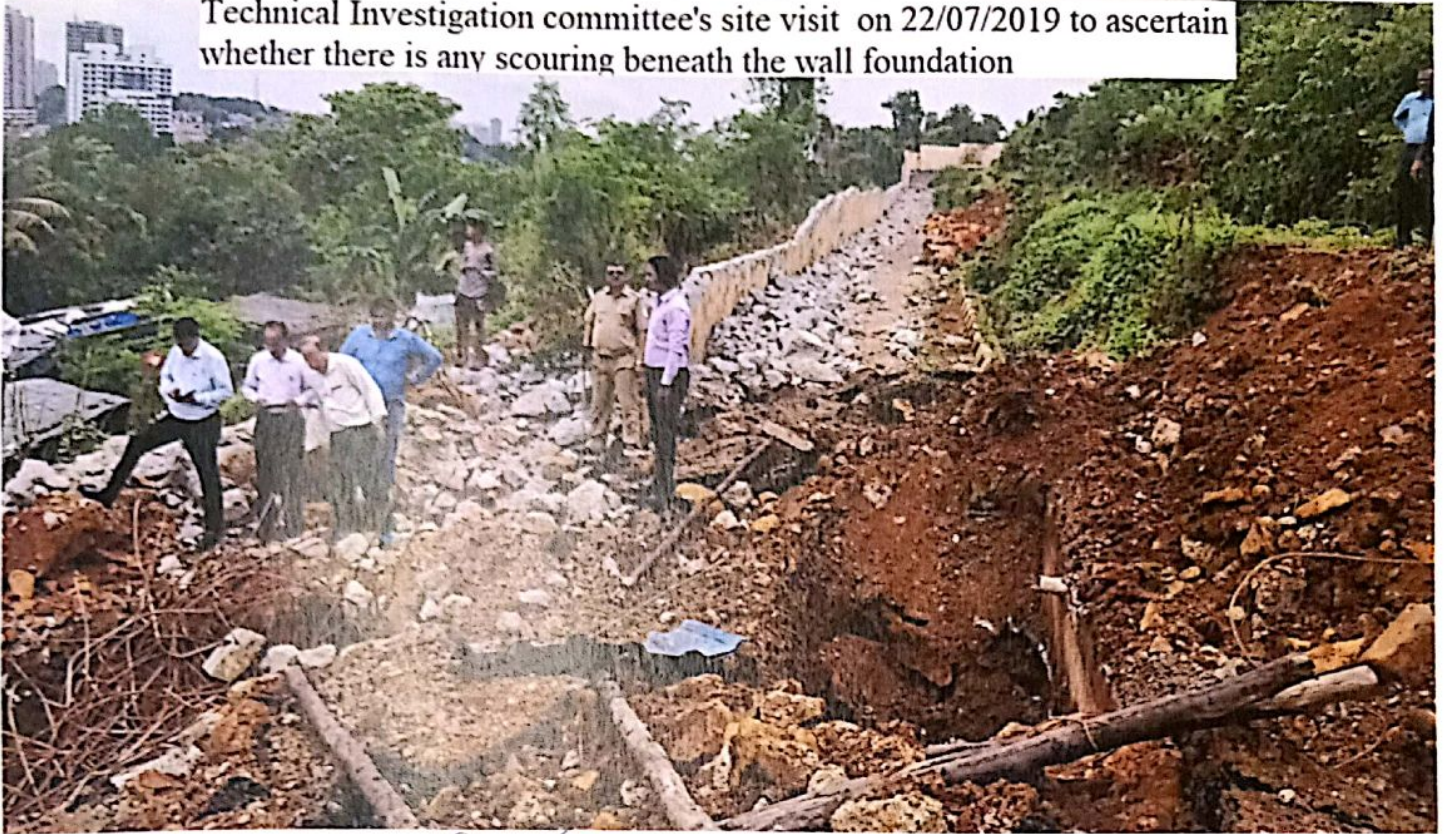


Technical Investigation committee's site visit on 07/07/2019



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Technical Investigation committee's site visit on 22/07/2019 to ascertain whether there is any scouring beneath the wall foundation



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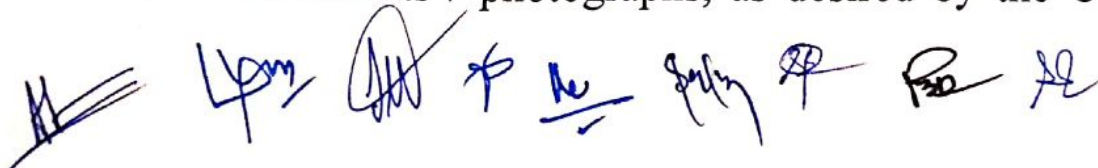
## 4. Field work & material sample collection

The Technical Investigation Committee visited the site on three occasions.

The first site visit was arranged on 7.7.2019 and it was an exhaustive visit. The members inspected both the locations of collapse of wall and the site constraints, etc. and observed the following :-

- a. The pattern of failure of wall.
- b. The partial blockage of storm water drains provided along the inspection track, due to localised land sliding.
- c. The condition and size of drains provided at site
- d. The provided weep holes were found to be blocked at certain locations by the slum dwellers residing on the other side of the compound wall.
- e. Total length of compound wall – 2.15 km and four cross drains in existence at site having size of
  - i. C1 0.45 X 0.6 m
  - ii. C2 0.45 X 0.6 m
  - iii. C3 1.2 m X 0.6 m
  - iv. C4 1.7 m X 0.6 m

After the site visit, the Committee had a discussion in the Conference Hall of P/North ward office where the site staff had arranged powerpoint presentation of the incident and then handed over the documents / photographs, as desired by the Committee.



The Committee then instructed MCGM to carry out the following :-

- a) To extract the concrete cores from the existing compound wall to understand the quality of concrete of compound wall.
- b) To carry out Drone survey to ascertain the catchment details and contour map of the area.

Further the Committee decided to visit the site again, if required.

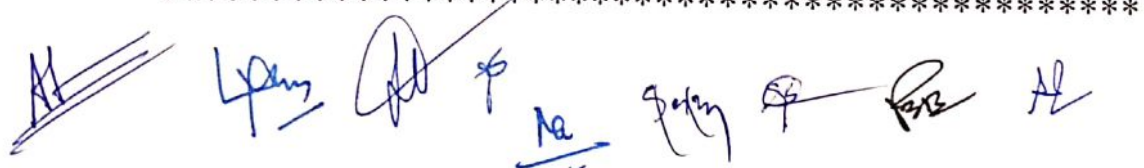
The second site visit was held on 18.7.2019 when the core extracting team was also present at site. Prof.G.B.Chaudhari explained about the precautionary measures to be taken while extracting the cores. Then the Committee finalised the locations for extracting the cores and it was decided to extract total 16 number of cores of 100 mm dia. and 6 number of cores of 150 mm dia. These cores were extracted from the existing compound wall on either side of the collapsed stretches. The photographs were taken during extraction of cores and attached at page 53-61.

The third site visit was arranged on 22.7.2019. As desired by the Committee members, the site staff had exposed the wall

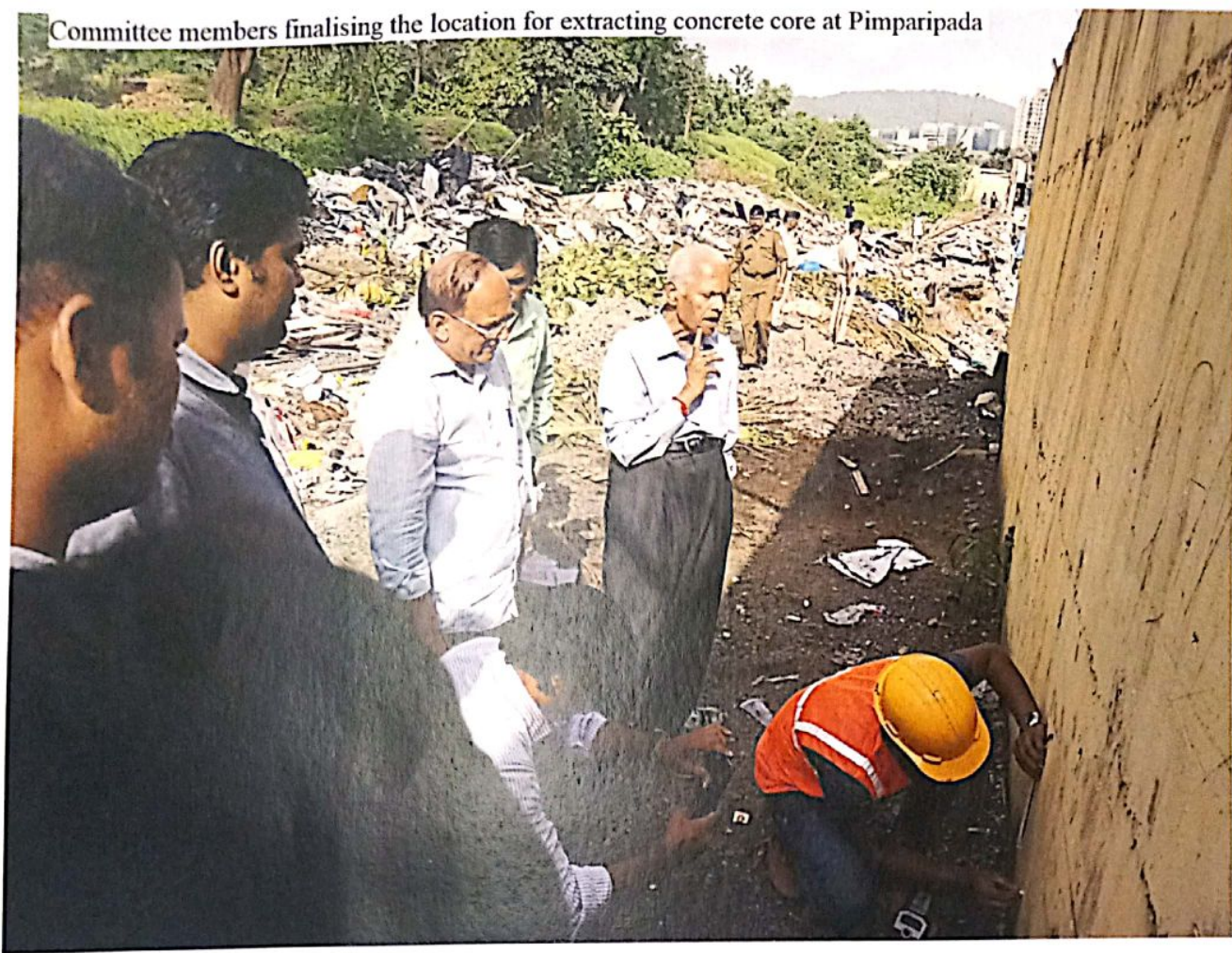
A series of handwritten signatures in blue ink, including names like 'L.P.M.', 'G.B.', 'K.P.', 'S.K.', 'Sulim', 'R.B.', and 'A.C.', along with a crossed-out signature on the left.

foundation at both the locations and it was observed that there was no scouring beneath the foundation. Then the Committee members witnessed all the cores properly stacked in the MCGM office at Malad Hill Reservoir. Prof. G.B.Chaudhari then suggested to send these cores to IIT Bombay for testing and further informed that he would like to be present during the testing of these cores.

Some of the relevant photographs are attached at page 63-67.

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Committee members finalising the location for extracting concrete core at Pimparipada



Finalisation of Concrete core location by avoiding existing reinforcement at Ambedkar Nagar



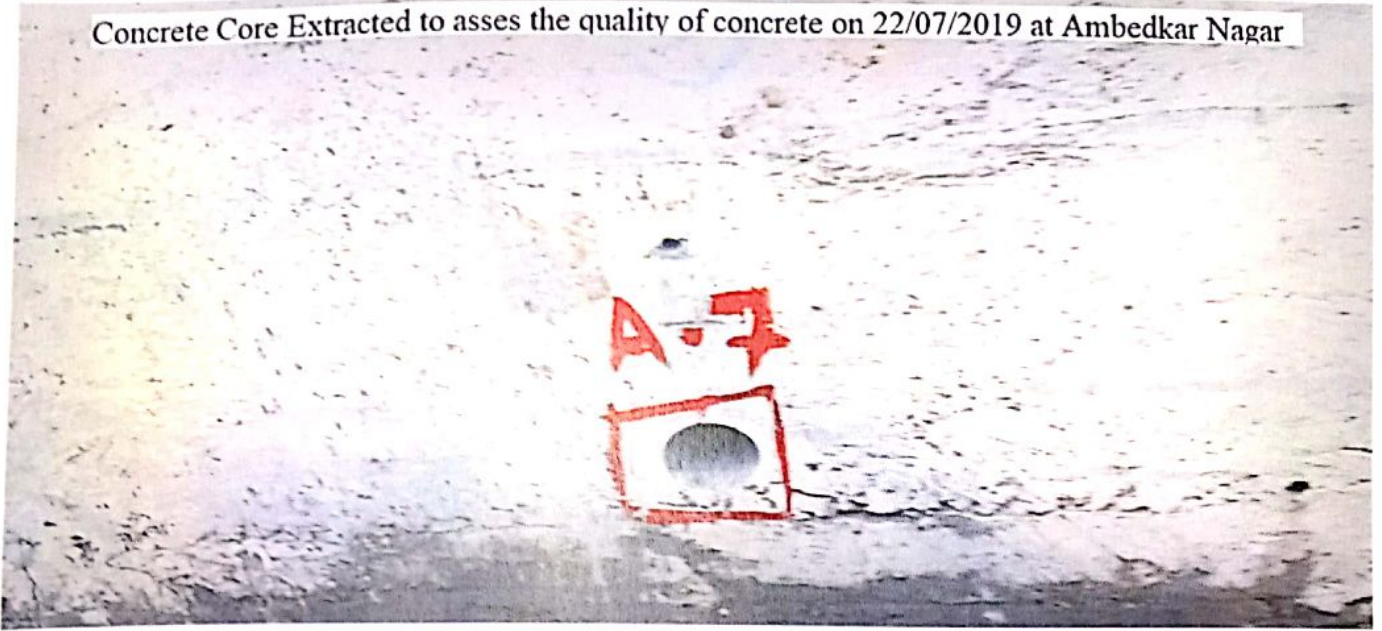
Handwritten signatures and initials in blue ink, including 'H', 'Lam', 'G', 'K', 'M', 'S', 'P', 'R', and 'A'.

Committee member Finalising the location for extracting concrete core at Pimparipada



*[Handwritten signatures and initials in blue ink]*

Concrete Core Extracted to asses the quality of concrete on 22/07/2019 at Ambedkar Nagar



Extraction of Concrete core at Pimparipada



*[Handwritten signatures and initials in blue ink]*



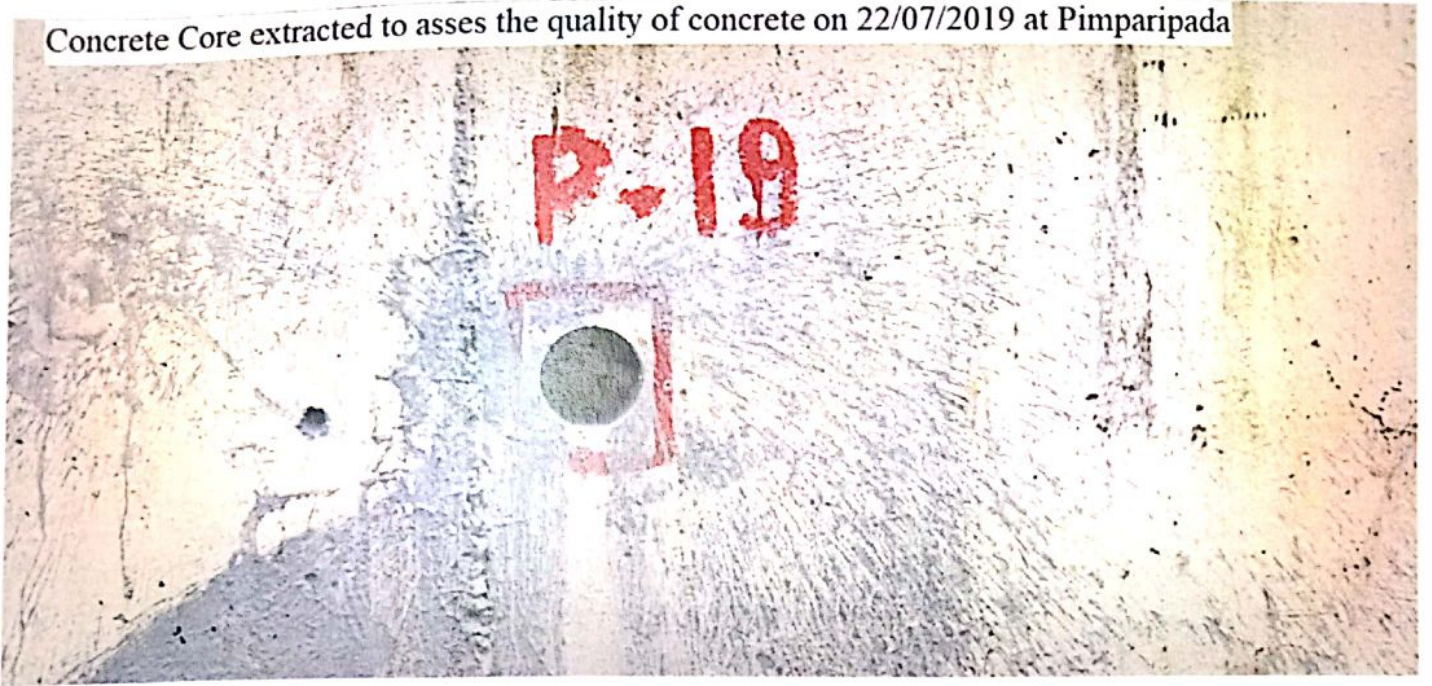


Extraction of Concrete core in progress at Pimparipada



*[Handwritten signatures and initials in blue ink]*

Concrete Core extracted to assess the quality of concrete on 22/07/2019 at Pimparipada



Concrete cores stacked at Control room, Malad Hill Reservoir

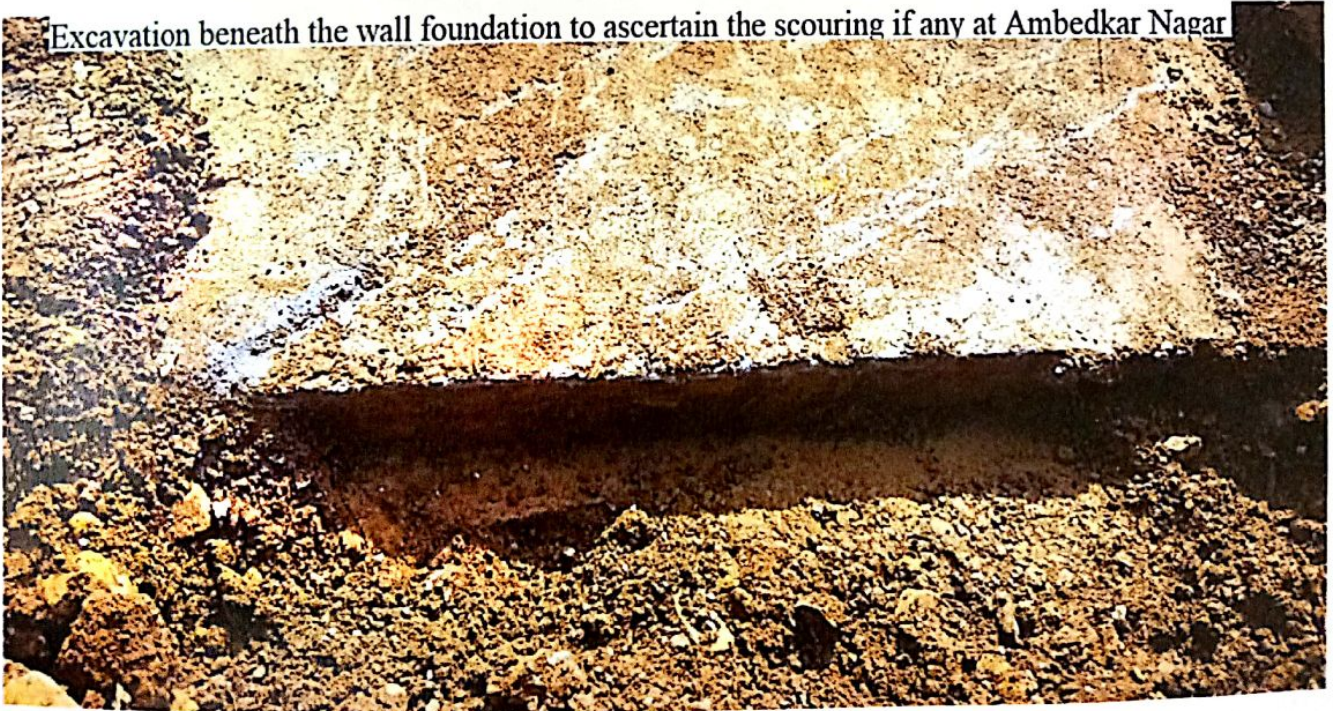


*[Handwritten signatures and initials in blue ink]*

Excavation beneath the wall foundation to ascertain the scouring if any at Ambedkar Nagar



Excavation beneath the wall foundation to ascertain the scouring if any at Ambedkar Nagar



*Handwritten notes in blue ink:*  
H  
Lpm  
AW \*  
the  
Spm \*  
R32  
AL

Excavation beneath the wall foundation to ascertain the scouring if any at Pimripada



H/ 4m, (A) \* 6.00m \* 1.2m 2

Excavation beneath the wall foundation to ascertain the scouring if any at Pimpripada



H / 4 / 20 / 12 / 12 / 12 / 12

## 5. DRONE SURVEY

As desired by the Technical Investigation Committee, MCGM appointed the consultant M/s.Pednekar and Associates to carry out the drone survey of the premises to ascertain the various parameters such as total catchment area, contour levels of the plot and quantity of water accumulated at these two locations just before the collapse of the wall.

Accordingly, the consultant had carried out the drone survey and submitted various data as regards to the total area of the plot, catchment area, ground levels and probable quantity of water accumulated behind the wall just before the wall collapse.

During the meeting held on 26.7.2019, the Consultant M/s.Pednekar & Associates explained the details arrived from the drone survey. Shri Bambale instructed the consultant to submit the details of water accumulated in the plot with respect to the intensity of rainfall. Accordingly, M/s. Pednekar & Associates submitted the details to the Committee.

The layout plan and contour map of the plot are attached as at page 71-73 respectively.

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**Legend**

Collapsed Wall

Wall

**Orthomosaic**

**RGB**

Red: Band\_1

Green: Band\_2

Blue: Band\_3

0 25 50 100 150 200 250 Meters

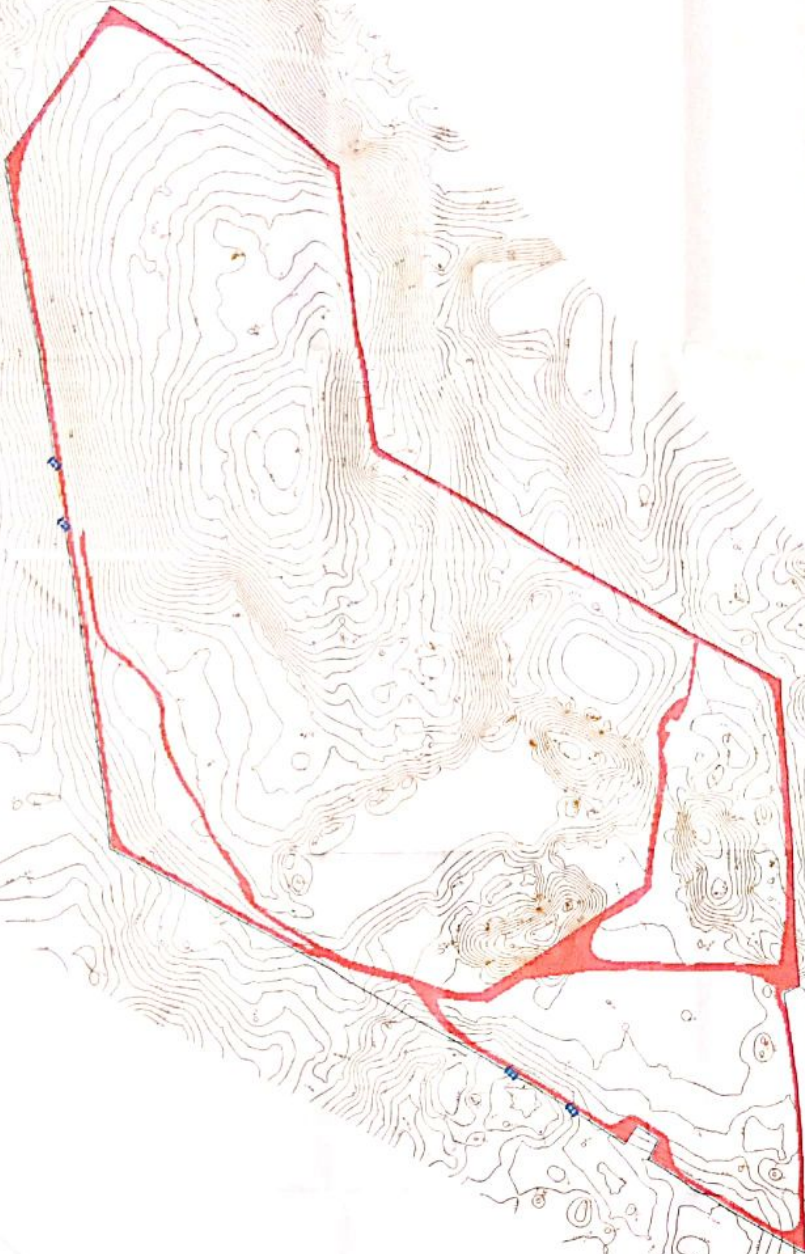
0 0.125 0.25 0.5 Kilometers

Orthomosaic of the site representing Wall (thick red line) and fallen wall ( black pinned)





# Mumbai Malad Wall Analysis

*Handwritten notes and signatures in the bottom left corner.*

NORTH



**Legend**

-  Levels
-  Road
-  Collapsed wall (38m)
-  Wall

**Note :-**

- 1) Datum- WGS1984
- 2) Projection- UTM zone 43N
- 3) All measurement in meter
- 4) Levels at 1m interval
- 5) Contour at 1m interval

TITLE : TOPOGRAPHY MAP LAYOUT FOR MALAD WALL SURVEY-MUMBAI

SUBJECT: DRAWING SHOWING THE CONTOUR AND LEVELS

SCALE	JOB NO	DRAWING NO	REV
1:1			

*Handwritten signature and notes in Devanagari script.*

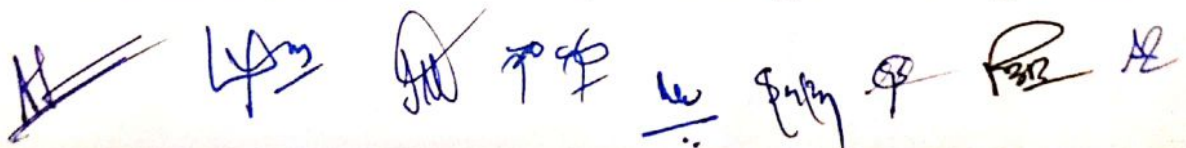


## 6. REVIEW OF THE DESIGN OF THE CONSULTANT M/S.H.M.RAJE

As per tender condition, the contractual agency M/s.Omkar Engineers and Contractors had appointed the consultant M/s. H.M.Raje, for the design of storm water drains, cross drains and R.C.C. compound wall. The design calculations as submitted by the consultant M/s.H.M. Raje, appointed by the contractor of the work, were reviewed by the committee. The committee has observed as under: -

### 1) The Compound Wall:-

From the design calculations of the wall, it is observed that the wall is designed as retaining wall below the ground level and as compound wall above the ground level. It is observed that the retaining wall is designed considering the saturated soil condition only. However, it is necessary to consider the surcharge load and submerged condition of the soil i.e. water upto top of inspection track which was not taken into consideration. As per geotechnical design calculations, the wall is likely to fail against sliding under



submerged condition i.e. the water level upto top of inspection track. However, the compound wall is structurally safe under the same condition. Further, it fails in flexure for water column upto 3.3 m height, i.e. water level upto top of compound wall. However, from the functional requirement, the wall is not expected to take the water pressure of 3.3m height above the inspection track i.e. upto top of compound wall.

**2) Storm water Drains along the Inspection Track :-**

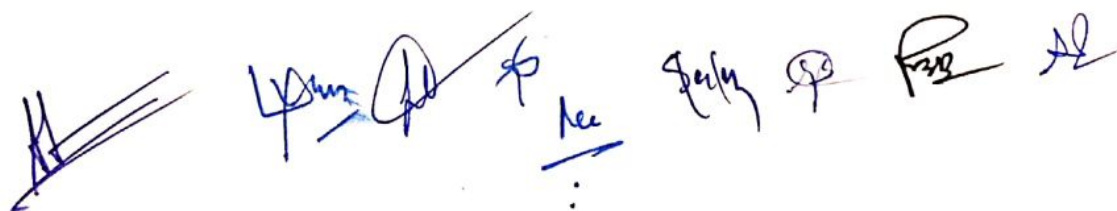
The size /section of the SWD was worked out by the Consultant using rational method. The formula for calculating the discharge (Q) is

$Q = 0.278 CIA$ , where

C = Coefficient of run-off

I = Intensity of rainfall in mm/hr.

A = Catchment area in sq.km.



While designing, the consultant has considered the following values for different parameters :-

C = Coefficient of run-off = 1.00

I = Intensity of rainfall in mm/hr. =  $\frac{50 \text{ mm/hr}}{1000}$   
( it got converted to m/hr )

A = Catchment area in sq.km. A = 10 m x 3 m  
= 30 sq.m

( catchment area considered was in sq.m instead of sq.km )

From the calculations, it was observed that the values considered for different parameters like catchment area, intensity of rainfall were inappropriate. Also, the calculations had multiple arithmetical errors.

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## 7. Key observations from the Data collected (Cores and Drone Survey)

### A) Drone Survey

M/s.Pednekar & Associates has carried out the Drone Survey and given the details such as

- a) The contour map of entire plot.
- b) The plan showing the water streams as per the topography of the plot.
- c) The catchment area of these two locations, i.e.
  - i) Pimparipada - 43199.80 sq.m.
  - ii) Ambedkar Nagar - 8111.00 sq.m.
- d) The water accumulated at these two locations by considering the water upto top of compound wall -
  - i. Pimparipada -194.62 Cu.m. covering 7271.06 sq.m. area.
  - ii. Ambedkar Nagar -138.87Cu.m. covering 4015.52 sq.m. area.

The above values are arrived at by adopting water shed analysis.

- e) The plan showing the extent of area covered by the water at the time of spilling over the compound wall i.e. at a height of 3.3 m.

The details were discussed by the Committee and on enquiry regarding the hydrological details, the consultant



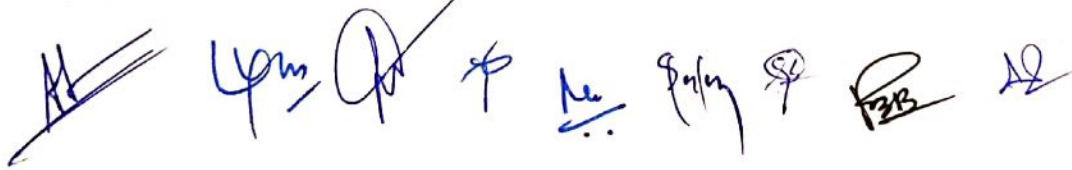
informed that he is unable to furnish the hydrological details / data.

**B) Concrete Cores**

To assess the strength of concrete, 16 number of 100 mm dia and 6 number of 150 mm dia concrete cores were extracted from existing wall on either side of the collapsed stretches. These cores were sent to IIT Bombay for testing. The 100 mm dia cores were tested and all the 16 cores were found to have strength higher than the design strength of M25 Grade concrete. A copy of the report received from IIT Bombay is attached as at pg. 85-95. With regard to the 150 mm dia. cores, Prof. Dr. Salman, IIT Bombay (Lab incharge) has informed that due to unavailability of required machinery, 150 mm dia. cores could not be tested at IIT Bombay.

The Committee felt that since the test results of all the 16 number of 100 mm dia. cores were found higher than the design strength of M25 concrete used to construct the wall, the testing of 150 mm dia. concrete cores is not considered to be necessary.

\*\*\*\*\*



RE: Testing of concrete cores extracted from the wall at Malad Hill Reservoir.

From: Salman (msalman@civil.iitb.ac.in)  
To: dmcsemcgm@yahoo.com  
Cc: hod@civil.iitb.ac.in  
Date: Wednesday, August 21, 2019, 05:17 PM GMT+5:30

Dear Sir

Please find the core test results attached for your review. We shall send you a signed copy upon your confirmation of the same.

Kind regards

Muhammad Salman  
Assistant Professor  
Department of Civil Engineering  
Indian Institute of Technology Bombay  
Powai, Mumbai – 400 076  
Ph: (+91) 22 2576 9306

From: Dy.Municipal Commr. (Special Engineering) <dmcsemcgm@yahoo.com>  
Sent: Monday, 19 August, 2019 14:57  
To: Salman <msalman@civil.iitb.ac.in>  
Cc: Head of the Department <hod@civil.iitb.ac.in>  
Subject: Re: Testing of concrete cores extracted from the wall at Malad Hill Reservoir.

This has a reference to your e-mail dt.19.08.2019 wherein it is informed that the testing of 150 mm dia concrete cores is not possible.

In this regard this is to inform you that, the report of collapse of wall is to be finalised at the earliest as such it is requested to forward the test results of 100 mm dia concrete cores. It is further requested to handover the six number of 150 mm dia of cores to Shri. Kshirsagar, Executive Engineer from MCGM

Regards,





**Indian Institute of Technology Bombay**  
**Department of Civil Engineering**  
Powai, Mumbai - 400 076 (India)  
Phone: (+91-22) - 2576 9306  
Fax: (+91-22) - 2572 3480, 2576 7302  
Email: msalman@iitb.ac.in

**Dr. Muhammad Salman**  
**Assistant Professor**

---

Date: 21/08/2019

Executive Engineer  
Water Works (Civil) Maintenance  
Municipal Corporation of Greater Mumbai  
Hydraulic Engineering Department  
1<sup>st</sup> Floor, Ghatkopar Water Works Yard  
L. B. S. Marg, Ghatkopar (West)  
Mumbai 400 086

Dear Sir

Please find enclosed the concrete core test results as provided by you. The cores were prepared as per IS 516. The testing was done in accordance with IS 456. The strains were obtained by using strain gauges (two 90 mm strain gauges pasted diagonally opposite on each core).

The criteria for acceptance of cores tests can be confirmed form IS 456:2000 clause 17.4.3.

Please feel free to contact in case of queries.

Kind regards

Muhammad Salman



**Dr. Muhammad Salman**  
 Assistant Professor

Email: msalman@iitb.ac.in

Table 1: Compressive strength of the cores

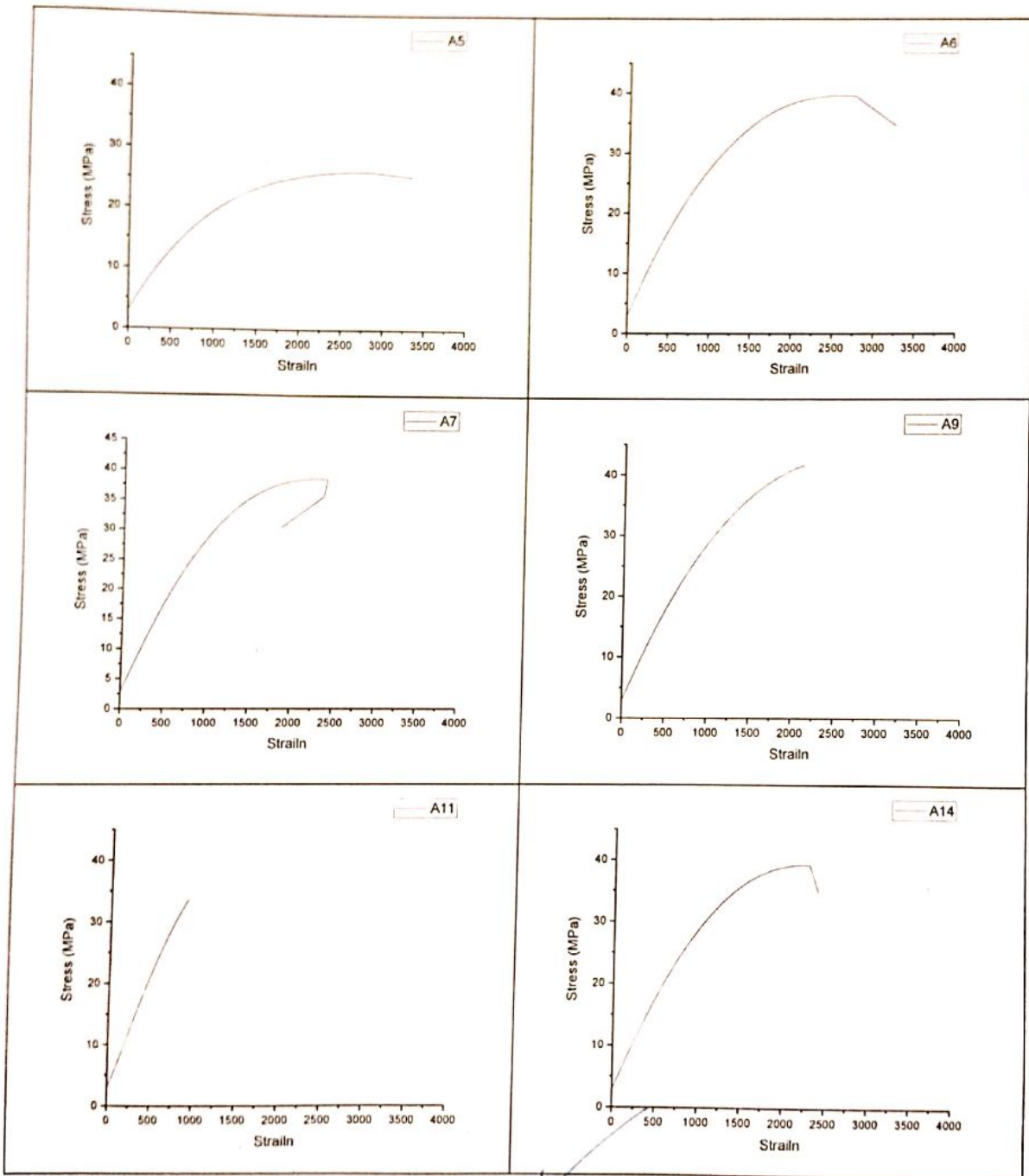
ID Mark	Diameter (mm)	Height (mm)	H/D	SSD Density (kg/m <sup>3</sup> )	Correction Factor	Load (kN)	Comp. Strength (MPa)	Corrected Comp. Strength (MPa)	Eq. Cube Strength (MPa)	MOE (MPa)
A5	94	189	2.02	2312	1	182.6	26.4	26.4	33.0	14687.1
A6	94	190	2.02	2475	1	276.6	39.8	39.8	49.8	24006.1
A7	94	191	2.03	2480	1	268.8	38.7	38.7	48.4	26002.7
A9	94	191	2.03	2485	1	292.2	42.2	42.2	52.81	29002.9
A11	94	189	2.01	2437	1	282.2	40.4	40.4	50.5	34693.2
A14	94	191	2.04	2480	1	271.4	39.2	39.2	49.0	28947.0
A18	94	191	2.03	2470	1	279.2	40.0	40.0	50.1	29545.4
A20	94	191	2.04	2490	1	274.9	39.7	39.7	49.7	51236.3
P1	94	191	2.02	2438	1	266.2	38.2	38.2	47.7	26458.0
P2	95	190	2.00	2438	1	252.3	35.7	35.7	44.6	28091.4
P6	94	190	2.02	2311	1	144.6	20.9	20.9	26.2	17563.3
P8	94	191	2.03	2478	1	278.9	40.0	40.0	50.0	28061.1
P14	94	192	2.04	2479	1	278.3	40.2	40.2	50.3	27593.2
P16	94	189	2.01	2466	1	267.4	38.5	38.5	48.2	27905.4
P19	94	189	2.00	2444	1	271.7	39.0	39.0	48.8	28381.9
P20	94	190	2.02	2478	1	274.3	39.6	39.6	49.5	28939.1
								Average	46.8	28194.6
								Standard deviation	7.0	7737.8





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Email: msalman@iitb.ac.in

Dr. Muhammad Salman  
Assistant Professor



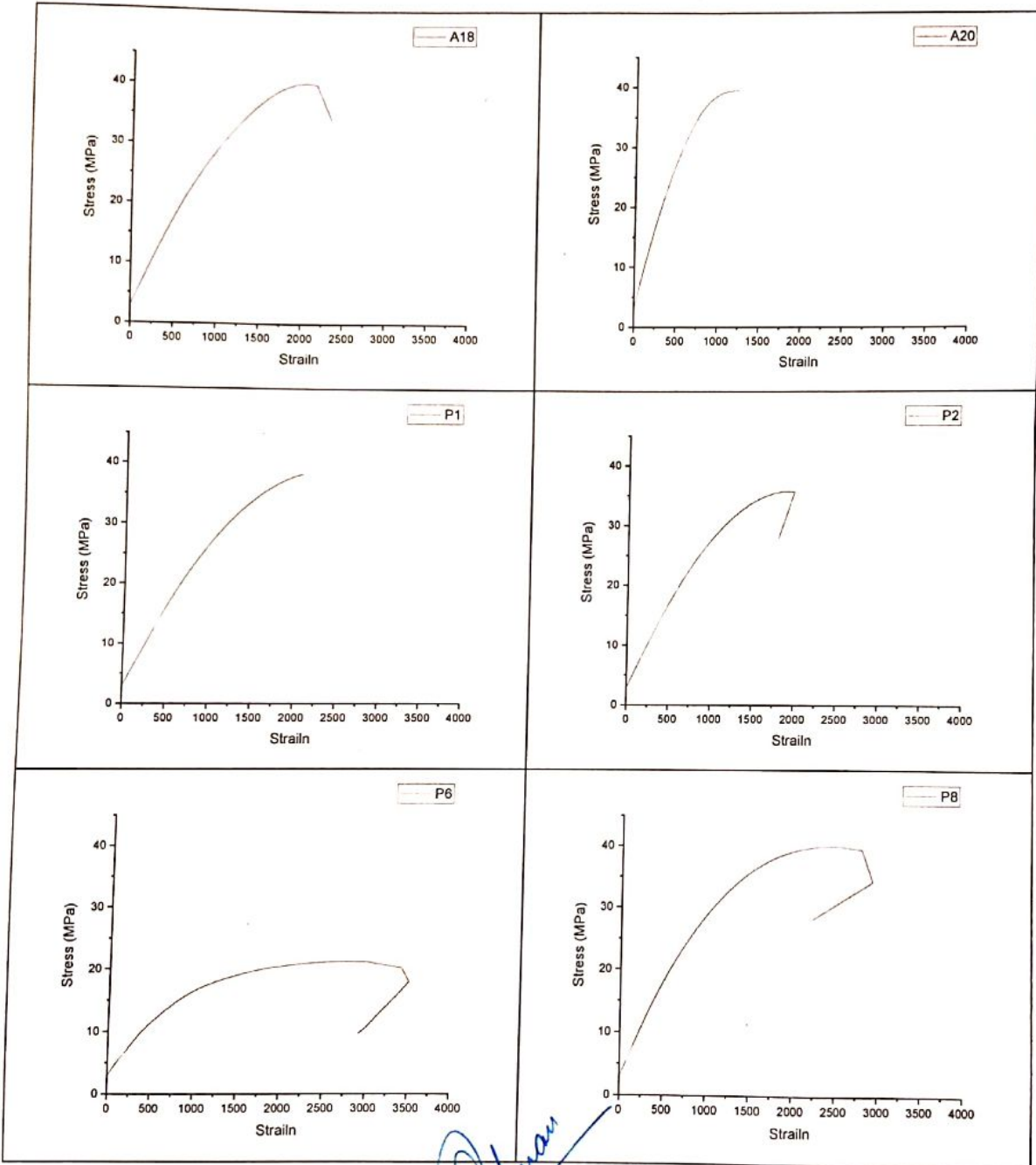
Handwritten signatures and initials in blue ink:

- MS
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Assistant Professor

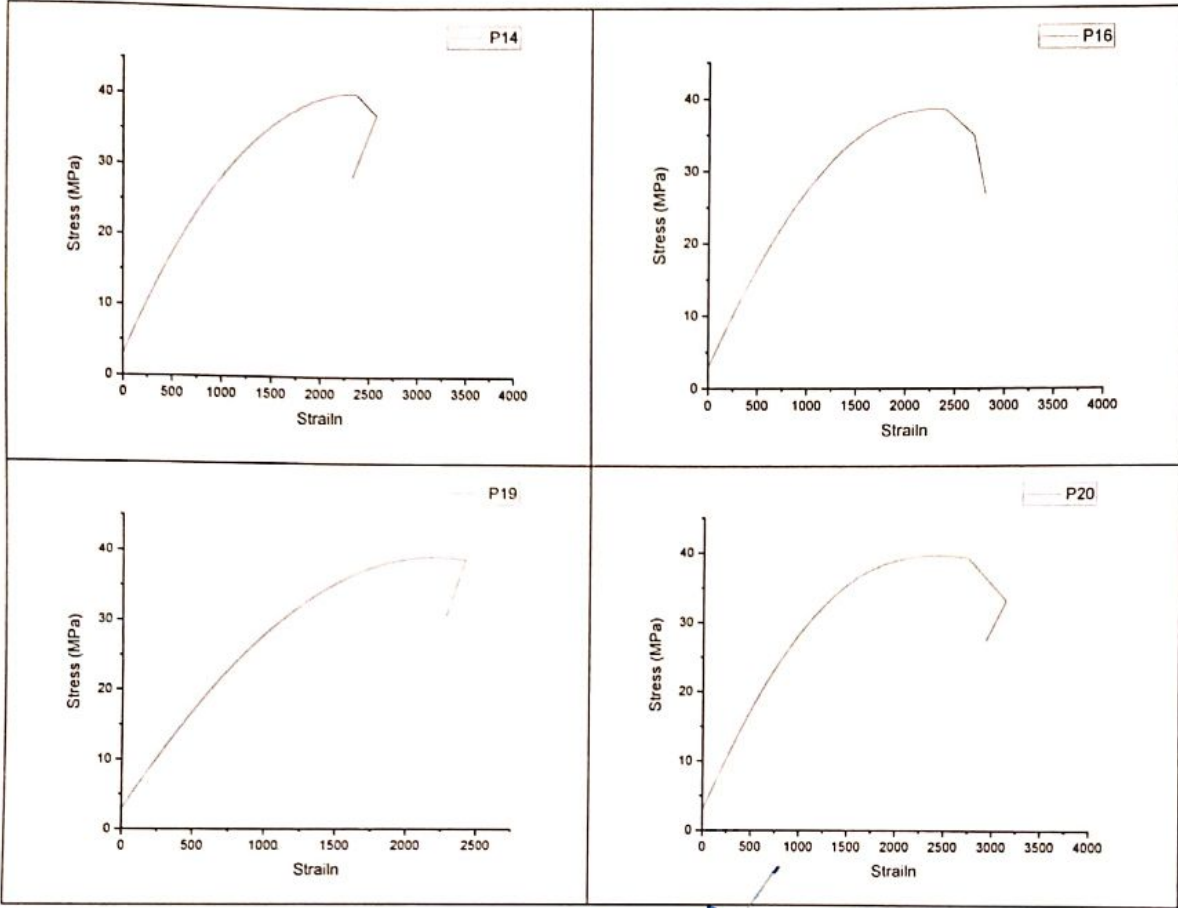


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Assistant Professor



*Handwritten signatures and initials in blue ink:*  
MS (left), LP (left), [Signature] (center), [Signature] (right), [Signature] (right), [Signature] (right), [Signature] (right), [Signature] (right).

## 8. SUMMARY & CONCLUSIONS

Based on the above said information, observations and study, the following conclusions are drawn :-

1. Due to continuous rainfall since 26.7.2019 and further heavy downpour of 479.56 mm in 24 hours i.e. from 8.00 a.m. on 1.7.2019 to 8.00 a.m. on 2.7.2019, the water level rose upto and above the height of compound wall ( 3.3 m) at these two locations resulting into the sudden collapse of the compound wall, as the said compound wall was not functionally expected to withstand such water pressure.
2. The intensity of rainfall recorded was 67.82 mm between 23.00 hrs. to 24.00 hrs. on 01.07.2019 and 63.26 mm between 00.00 hrs to 01.00 hrs on 02.07.2019. The intensity of rainfall considered by the consultant for the design of storm water drains was 50 mm/hr as per the then policy prevailing in MCGM.

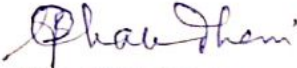


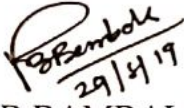
3. The existing side drains were inadequate to drain out the water from the continuous and heavy rainfall that had occurred during the above mentioned period. Additionally, the localised landslide caused partial blockage of drains worsening the situation further.
4. In the design calculations of SWD furnished by the Consultant, it is observed that inappropriate units and values for various parameters such as catchment area, intensity of rainfall were considered. Also, some arithmetical errors in calculations are observed.
5. From the design calculations of the wall, it is observed that it is designed as retaining wall below the ground level without considering the surcharge load and submerged condition of the soil upto the top of inspection track.
6. The concrete cores were tested at IIT Bombay and the results ( concrete strength ) are found satisfactory which indicate that the quality of concrete meets the required design strength of M25 Grade concrete used for the construction of compound wall.




7. The provided weep holes were found blocked at certain locations by the slum dwellers residing on the downstream of the compound wall.

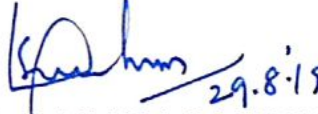
Considering the above facts, the Committee is of the opinion that there are multiple causes / reasons as mentioned above for the collapse of the wall.


  
 PROF. G.B. CHAUDHARI  
 RETD VJTI


  
 SHRI R.B. BAMBALE,  
 EX.D.M.C.(S.E.), MCGM


  
 SHRI P.R.K. MURTHY  
 DIRECTOR METRO, MMRDA

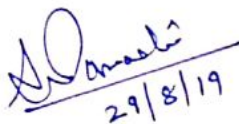
  
 SHRI PRAVIN KIDE  
 ENGINEER IN CHIEF, MMRDA

  
 PROF. DR. DASA S. MURTY  
 IIT BOMBAY

  
 PROF. DR. ARGHADEEP LASKAR  
 IIT BOMBAY


  
 PROF. DR. JAYADIPTA GHOSH  
 IIT BOMBAY

  
 SHRI S.M. BARJAT  
 EX.DY.H.E.(CONST.) MCGM

  
 (A.S. Tawadia )  
 D.M.C.(S.E.) &  
 The Chairman of Committee

## 9. RECOMMENDATIONS

1. At Malad Hill Reservoir site, on the upstream side of the storm water drain, the slope should be properly stabilized to avoid any localised landslide.
2. The topography of the plots / properties owned by the MCGM shall be ascertained by the concerned department and if required, slope stabilization shall be carried out to avoid any mishap.
3. The MCGM empanelled Consultant appointed for any work shall be solely responsible for all the design parameters / design aspects and calculations submitted by him/her to the Engineer-in-charge of the work. Further, a condition to that effect shall be incorporated in the respective tender documents. Also, for critical structures and structures on hilly area, the design submitted by the consultant shall be vetted by any prestigious educational institute, such as VJTI, SPCE or IIT Bombay.



- 4. It is recommended to have a proper Storm Water Drainage system beyond the reservoir plot to be connected to the nearest nalla for proper discharge of surface water.
- 5. Proper inspection and periodical maintenance preferably before monsoon and after monsoon shall be carried out by the concerned department.

*G.B. Chaudhari*  
 PROF. G.B.CHAUDHARI  
 RETD VJTI

*R.B. Bamble*  
 29/8/19  
 SHRI R.B.BAMBALE  
 EX.D.M.C.(S.E.), MCGM

*P.R.K. Murthy*  
 29/8/19  
 SHRI P.R.K.MURTHY  
 DIRECTOR METRO MMRDA

*P. Pravin Kide*  
 SHRI PRAVIN KIDE  
 ENGINEER IN CHIEF, MMRDA

*D. Dasaka S. Murty*  
 29.8.19  
 PROF. DR. DASAKA S.MURTY  
 IIT BOMBAY

*A. Arghadeep Laskar*  
 29/8/19  
 PROF. DR. ARGHADEEP LASKAR  
 IIT BOMBAY

*Jayadipta Ghosh*  
 29/08/2019  
 PROF. DR. JAYADIPTA GHOSH  
 IIT BOMBAY

*S.M. Bapat*  
 29/8/19  
 SHRI S.M.BAPAT,  
 EX.DY.H.E.(CONST.) MCGM

*A.S. Tawadia*  
 29/8/19  
 (A.S.Tawadia )  
 D.M.C.(S.E. )&  
 The Chairman of Committee



## 10. ACKNOWLEDGEMENT

The Technical Investigation Committee is grateful to Hon.Municipal Commissioner of MCGM for entrusting this assignment.

The Committee visited the site on three occasions to gather the first hand information and deliberated for about two months on the various issues and aspects before it could give final shape to this report.

The Committee acknowledges the assistance rendered by the staff of Maintenance Section of Hydraulic Engineer.

This Committee appreciates the co-operation extended by the authorities of IIT Bombay for core testing.

We also appreciate the co-operation extended by M/s.Pednekar and Associates for carrying out Drone survey.



The Committee wishes to place on record the assistance given by Sr.Inspector of Police, Kurar village Police Station and Security department of MCGM at Malad Hill Reservoir.

*A.S. Tawadia*  
29/8/19

(A.S.Tawadia )  
D.M.C.(S.E.)  
&

The Chairman of Committee

\*\*\*\*\*

*[Handwritten signatures and initials]*

C-8056

MUNICIPAL CORPORATION OF GREATER MUMBAI

2354/OD 29th  
No.DMC/SE/ dated August, 2019

Sub.: Report of Technical Investigation Committee regarding the collapse of Compound wall at Malad Hill Reservoir.

On 2<sup>nd</sup> July, 2019, early in the morning, the part portion of compound wall was collapsed at two locations i.e. Pimparipada and Ambedkar Nagar at Malad Hill Reservoir. Dy.H.E.(Maint.) had submitted occurrence report to D.M.C.(S.E.)/ Hon.A.M.C.(P)/ Hon.M.C. on 3<sup>rd</sup> July, 2019.

By the directions of Hon.M.C., a Technical Investigation Committee comprising of experts from IIT Bombay, VJTI, MMRDA and retired MCGM Engineers under the Chairmanship of D.M.C.(S.E.) was constituted. The Committee visited the site on several times and conducted number of meetings to find out the causes of collapse of compound wall. On going through all the Technical details such as drone survey, testing of concrete cores extracted from the existing concrete compound wall, the existing storm water drain network at the site, the Committee has prepared a Technical Investigation Report and the same is submitted herewith for Hon.A.M.C.(P)/ Hon.M.C.'s perusal please.

Submitted please.

*A.S. Tawadia*  
29/8/19  
(A.S.Tawadia)  
D.M.C.(S.E.)  
&

The Chairman of Committee

(Shri Pravin Darade)  
Hon.A.M.C.(P) sir,

(Shri Praveen Pardeshi)  
Hon.M.C. (sir)  
Sir,

*see. Is institute preventive steps for all compound walls, specially those located abutting human habitation and on hilly slopes or nullah boundaries*  
*Praveen Pardeshi*  
Municipal Commissioner  
A.M.C.(P)

बृहन्मुंबई महानगर पालिका  
 नगरीय आयुक्त (प्रकल्प)  
 चाचे कार्यालय  
 29 AUG 2019  
 क्र. अति. आ./प्रकल्प/2448

29/08/2019

IC-8056

बृहन्मुंबई महानगरपालिका  
 आयुक्तांचे कार्यालय  
 26 SEP 2019  
 समय ११, १२, १३, १४  
 १५, १६, १७, १८  
 क्रमांक MGU/F/500

26/9/19

Please issue circular for taking care of all <sup>existing</sup> compound walls so  
 DMC (SE) - per instr. of Hon. MC in and  
 Do structural audit of all existing compound walls & do the  
 strengthening if required to avoid such incidences in future

AMC/P/2448  
 Date - 07/10/2019  
 7/10/2019  
 A. M. C. (P)

DMC (SE) -

HE -

EE (PIDMC (SE))

Please put-up Draft  
 circular and guidelines  
 for preventive steps  
 as decided by Hon. MC/MC  
 A part  
 9/9/19  
 DMC (SE)

The draft circular is submitted  
~~herewith~~ in a separate file for  
 perusal and approval please vide  
 no. DMC/SE/3036/dt 19.10.2019.

DMC (SE)  
 Sir,

Seen  
 Record  
 19/10/19  
 DMC (SE)

EE (PIDMC (SE))