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ASSESSMENT OF STRUCTURAL STABILITY OF BUILDINGS

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Abstract: After the incident wherein one substation building was collapsed, Management had decided to review the structural safety of 276 nos BRPL premises those were constructed before year 2000. A Govt. approved consultant was hired by BRPL for structural safety audit selected through open bidding process and conducted the structural audit of the selected office buildings.

As per consultant's report, the structure of these buildings do not confirm to various provision of present earthquake resistant design codes like IS 1893-2016; IS 4326-2013; IS13920-2016, while these locations lie in earthquake zone IV. However structure has been constructed with seismic provision prevailing at the time of constructions. The consultant has declared 23 Nos buildings unsafe out of which 29 Nos buildings (EHV Grid) can attain or increase the overall life of the building by Retrofitting works as per their recommendation.

The unsafe declared buildings have been categorized according to the condition of RCC beams, ceiling and columns, those which have loosen their strength with the passage of time and visible rusted reinforcements are making it dangerous which may fail during earthquake and cause harm to human life as well as other expensive assets of the BRPL. The condition of brick walls and roof treatment is also considered for the categorization of unsafe buildings.

Grid buildings in BRPL whose current condition was found critical & serious and declared unsafe for long term use in respect to its safety and stability during earthquake are considered for retrofitting because urgent measures should be taken to make them safe for staff as well as for consumers.

This dissertation project is presented for structural assessment of three nos of sub-station buildings namely.

1. 33KV Tughlakabad Grid located at Air Force MES Colony, Tughlakabad, and New Delhi-110019.
2. 33 KV Masjid Moth Grid located near Chirag Delhi, DTC Bus Stand, New Delhi-110017.
3. 33 KV Bhikaji Cama Place Grid located Near August Kranti Bhawan, Bhikaji Cama Place Complex, New Delhi-110066.

ABSTRACT

After the incident wherein one substation building was collapsed, Management had decided to review the structural safety of 276 nos BRPL premises those were constructed before year 2000. A Govt. approved consultant was hired by BRPL for structural safety audit selected through open bidding process and conducted the structural audit of the selected office buildings.

As per consultant's report, the structure of these buildings do not confirm to various provision of present earthquake resistant design codes like IS 1893-2016; IS 4326-2013; IS13920-2016, while these locations lie in earthquake zone IV. However structure has been constructed with seismic provision prevailing at the time of constructions. The consultant has declared 23 Nos buildings unsafe out of which 29 Nos buildings (EHV Grid) can attain or increase the overall life of the building by Retrofitting works as per their recommendation.

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This dissertation project is presented for structural assessment of three nos of sub-station buildings namely

4. 33KV Tughlakabad Grid located at Air Force MES Colony, Tughlakabad, New Delhi-110019
5. 33 KV Masjid Moth Grid located near Chirag Delhi, DTC Bus Stand, New Delhi-110017 and
6. 33 KV Bhikaji Cama Place Grid located Near August Kranti Bhawan, Bhikaji Cama Place Complex, New Delhi-110066.

CHAPTER – 1

INTRODUCTION

Structural assessment can be initiated, when there has been a change in resistance, such as structural deterioration due to time-depending processes (e.g. corrosion, fatigue) or structural damage by accidental actions. Also when there will be a change in loading (e.g. increased traffic load) or an extension of the design working life. Assessment can also be carried out to analyze the current structural reliability (e.g. for environmental hazards like earthquake or extreme winds and/or waves). The proposed guideline presents a methodological framework of the assessment of existing structures and a summarization of the manifold methods developed in recent years for structural assessment. It is intended to describe the coherency and difference between methods and to provide an understanding and to help practicing engineers finding the suitable assessment procedure depending on the assessment objectives as well as on different boundary conditions.

Assessment of existing structures is becoming a more and more important and frequent engineering task. Continued use of existing structures is of a great significance due to environmental, economic and socio-political assets, growing larger every year. These aspects are particularly relevant to heritage buildings that always constitute a great historical, social and economic value.

The approach to the assessment of existing structures is in many aspects different from that taken in designing the structure of a newly proposed building. The effects of the construction process and subsequent life of the structure, during which it may have undergone alteration, deterioration, misuse, and other changes to its as-built (as-designed) state, must be taken into account.

However, even though the existing structure may be investigated several times, some uncertainty in the basic variables and structural behavior shall always remain. Therefore, similarly as in design of new structures, actual variation in the basic variables describing actions, material properties, geometric data and model uncertainties are taken into account by partial factors or other code provisions.

In general, an existing structure may be subjected to the assessment of its actual reliability in case of:

- Rehabilitation during which new structural members are added to the existing load carrying System;
- Adequacy checking in order to establish whether the existing structure can resist loads associated with the anticipated change in use of the facility, operational changes or extension of its design working life;
- Repair of a building, which has deteriorated due to time dependent environmental effects or which has suffered damage from accidental actions, for example, earthquake;
- Doubts concerning actual reliability of the structure.

Two main principles are usually accepted when assessing existing buildings:

- Currently valid codes for verification of structural reliability should be applied; codes valid in the period when the structure was designed should be used only as guidance documents.

- Actual (estimated) characteristics of structural materials, actions, geometric data and structural behavior should be considered, the original design documentation including drawings should be used as guidance documents only.

The first principle should be applied in order to achieve similar reliability level as in case of newly designed structures, taking only account of economic aspects as indicated below. The second principle should avoid negligence of any structural condition that may affect actual reliability (in favorable or unfavorable way) of a given structure.

Most of the current codes are developed assuming the concept of limit states in conjunction with the partial factor method. In accordance with this method, which is mostly considered here, basic variables are specified by characteristic or representative values.

The following circumstances can lead to starting of assessment:

- Degradation of a structure – faults and defects have appeared in the object
- Change in use
- Extension of the working life of existing structures
- Changes of an object, leading to a change in the load
- Required check of working life
- Extraordinary load of existing structures

CHAPTER-2

LITERATURE REVIEW

2.1 PRINCIPLES OF ASSESSMENT

Two main principles are usually accepted when assessing existing buildings:

- Currently valid codes for verification of structural reliability should be applied codes valid in the period when the structure was designed should be used only as guidance documents.

- Actual (estimated) characteristics of structural materials, actions, geometric data and structural behavior should be considered, the original design documentation including drawings should be used as guidance documents only.

2.2 METHOD OF DATA ACQUISITION

To determine load effects, in most cases of assessment it is necessary to gather information about material and structural properties and dimensions as well as about the previous, current and/or future loading on the structure. Environmental conditions are of physical, chemical or biological nature and can have an effect on material properties.

The main difference between design and assessment is, that in the latter uncertainties can be reduced significantly by site specific data from the real structure. There is a wide range of methods with varying expense and accuracy. The choice of the data acquisition method highly depends on the assessment objective and with that on the assessment procedure. Usually simple methods like the study of documents are applied in the beginning. To reduce uncertainty within higher assessment levels more sophisticated test methods need to be applied. Non-destructive methods are to prefer to destructive methods, whenever this is possible.

Beside the provision of data which describes the current state of the structure, also information about time depending processes like deterioration need to be acquired. This can take place with periodic or permanent measurement (i.e. structural health monitoring).

The results of the data acquisition should be of the same form, to be able to compare data from different methods and to be able to use data in future assessment procedures.

2.3 STUDY OF DOCUMENTS

To review documents from design and construction process as well as inspection and maintenance reports is in general the easiest way of gathering data about the structure to be assessed. It has to be making sure that the surveyed documents are correct. Loads can be usually determined from current loading codes and environmental conditions may be obtained from the site inspection reports.

Resistance properties like material and structural properties and dimension can be obtained from codes, drawings and other design specifications (e.g. static calculations, subsoil condition report), from construction documents (e.g. material delivery documentation) and from reports of earlier inspection and maintenance.

The objective of assessment within structure management is to provide information about the structural state for optimization of the point in time and the extent of inspection, maintenance and repair work (maximum operation effect at minimum costs) and for

prioritization of maintenance and repair work within a stock of structures or parts of a structure. Further on it needs to be achieved to minimize economic losses by disruption of operation of the structure.

The assessment results should be available in a form, useable in the structure's management. It means that input values, calculations and results should be archived for future reference and reassessment. Also the applied assessment routines should be unified within a stock to make results comparable and so to make the right inspection, maintenance and repair decisions.

CHAPTER – 3

METHODOLOGY

A structure consultant has been awarded the work of Carrying out the Structural Audit of various Buildings and Grid stations in BRPL. IN this scheme 29 nos. of Grid sub-station buildings have to be checked for in situ conditional assessment and structural adequacy as per present seismic provision. This dissertation project is presented for three nos of sub-station buildings namely (1). 33KV Tughlakabad Grid located at Air Force MES Colony, Tughlakabad, New Delhi-110019, (2). 33 KV Masjid Moth Grid located near Chirag Delhi, DTC Bus Stand, New Delhi-110017 and (3). 33 KV Bhikaji Cama Place Grid located Near August Kranti Bhawan, Bhikaji Cama Place Complex, New Delhi-110066. The existing structure is RCC framed structure with RCC beams and columns over them to support the slabs. Non Destructive Testing (NDT) testing such as Rebound hammer test (RBH) and Ultra pulse velocity (UPV) has been conducted on existing beams, columns and slabs to assess the strength of the existing reinforced cement concrete and quality of concrete.

3.1 SCOPE OF WORK

The scope of work is to conduct following tests on locations jointly identified by the Structure consultant in association with our team.

a) Visit to Site for assessment of the surface damage of the existing structural Elements like brick walls, beams, slabs, chhajja's and parapet walls by visual inspection & taking photograph of critical structural distress points. The visual inspection has been carried out for the sole aim of identifying the Point of structural distress, exposed reinforcement and Spalling of concrete besides mapping of visible cracks in structural elements with sample digital Photographs.

b) Marking of testing points in drawings for conducting various NDT tests as per scope of work.

c) Conducting following tests

1. Ultrasonic Pulse Velocity Test (UPV)
2. Rebound Hammer Test (RBH)
3. Submission of comprehensive report with conclusion and recommendations.

3.2 BRIEF DESCRIPTION OF THE WORK:

33 KV Grid substations Tughlakabad located at Air Force MES Colony, Tughlakabad, New Delhi-110019, has been constructed in the year 1988, and is a Single Storey RCC framed structure. RCC beams, columns and slabs are provided as structural element to withstand the entire possible load and to resist earthquake load. Dampness and seepage has been observed at some places inside the building. NDT tests have been performed in the locations as marked in the drawings to check the strength and quality of RCC. Based on the results of various NDT tests, the existing quality and strength of RCC are presented in the report. Details of various NDT tests including its procedure and results are presented in the report.

33 KV Masjid Moth Grid located at 33 KV Grid S/STN near Chirag Delhi, DTC Bus Stand, New Delhi-110017 has been constructed in the year 1978, and is a G+1 RCC framed structure. RCC beams, columns and slabs are

provided as structural element to withstand all the possible load and to resist earthquake load. No major distress has been observed at any place inside or outside the building. Building is found to be well maintained. NDT tests have been performed in the locations as marked in the drawings to check the strength and quality of RCC. Based on the results of various NDT tests, the existing quality and strength of RCC are presented in the report. Details of various NDT tests including its procedure and results are presented in the report.

33 KV Bhikaji Cama Place Grid located at 33 KV Sub Station, Near August Kranti Bhawan, Bhikaji Cama Place Complex, New Delhi-110066, has been constructed in the year 1976, and is a G+1 RCC framed structure. RCC beams, columns and slabs are provided as structural element to withstand all the possible load and to resist earthquake load. NDT tests have been performed in the locations as marked in the drawings to check the strength and quality of RCC. Based on the results of various NDT tests, the existing quality and strength of RCC are presented in this report. Details of various NDT tests including its procedure and results are presented in the report

3.3 DETAILS OF NON DESTRUCTIVE TESTS

3.3.1 ULTRASONIC PULSE VELOCITY (UPV) TEST

The test involves measurement of transit time of an ultrasonic pulse generated through the emitter and measured by the collector or by receiver. Since the thickness of the member is known or can be measured, the pulse velocity can be calculated from the simple formula V=L/T.

The test involves measurement of pulse velocity by either direct or semi direct or indirect (surface) transmission method as mentioned in IS 13311 (Part 1): 1992(Reaffirmed 2013). Direct method shall be used as far as possible, since that gives best results. Wherever direct method is not possible due to very high member thickness the semi-direct or indirect methods of testing shall be used. The locations at which test is desired shall be identified by the engineer in-charge before the test, so as to prepare the surface for the test. It is desirable that the transducers shall be directly in contact with concrete whose surface is clean and free from moisture and dust. The reliability of the results might be affected significantly in case readings are taken from plaster and/or rough surfaces. The thickness of the member or the length of shortest direct path within concrete shall be measured before start of the test. Any coupling agent like grease, petroleum jelly etc., shall be applied to the transducers and test surface to remove any entrapped air. The transducers shall then be placed against concrete in a direction depending on mode of transmission. The transit time shall be recorded onto the equipment. Repeated readings of the transit time shall be made until a minimum value is obtained and this should be the recorded value. Based on this, the ultrasonic velocity shall be calculated as described above and is presented inTable-1.

INTERPRETATION OF RESULTS

The interpretation of results has been done on the basis IS: 13311 (Part 1) (Reaffirmed 2013) the standard table of which is reproduced below. The results are tabulated in Table. The method of testing is also mentioned along with specific remarks if any for a particular location. The pulse velocity through concrete usually gives a good indication of its quality. The pulse velocity is also affected by surface preparation, moisture content, temperature, percentage reinforcement etc., among other known factors.

TABLE 3A OF IS: 13311 (Part 1): 1992

PULSE VELOCITY (km/sec)	CONCRETE QUALITY GRADING
Above 4.5 km/sec	Excellent
3.5 - 4.5 km/sec	Good
3.0 - 3.5 km/sec	Medium
Below 3.0 km/sec	Doubtful

TEST LIMITATIONS

Test limitations for UPV testing are mentioned in IS 13311 (Part 1): 1992 (Reaffirmed 2013). To mention it briefly, the results are affected by age of concrete, percentage of reinforcement, method of testing, concrete composition etc. It is to be noted that if correlation is made between UPV values & compressive strength of concrete, then estimated strength may vary from actual strength by +/- 20 percent. Surface probing (Indirect method of UPV) in general gives lower pulse velocity than in case of cross probing (Direct method of UPV) and also depending on number of parameters, the difference could be of the order of about 1 km/sec Velocity as per IS: 13311 Part 1. The results are specific to tested locations only due to heterogenic property of concrete.

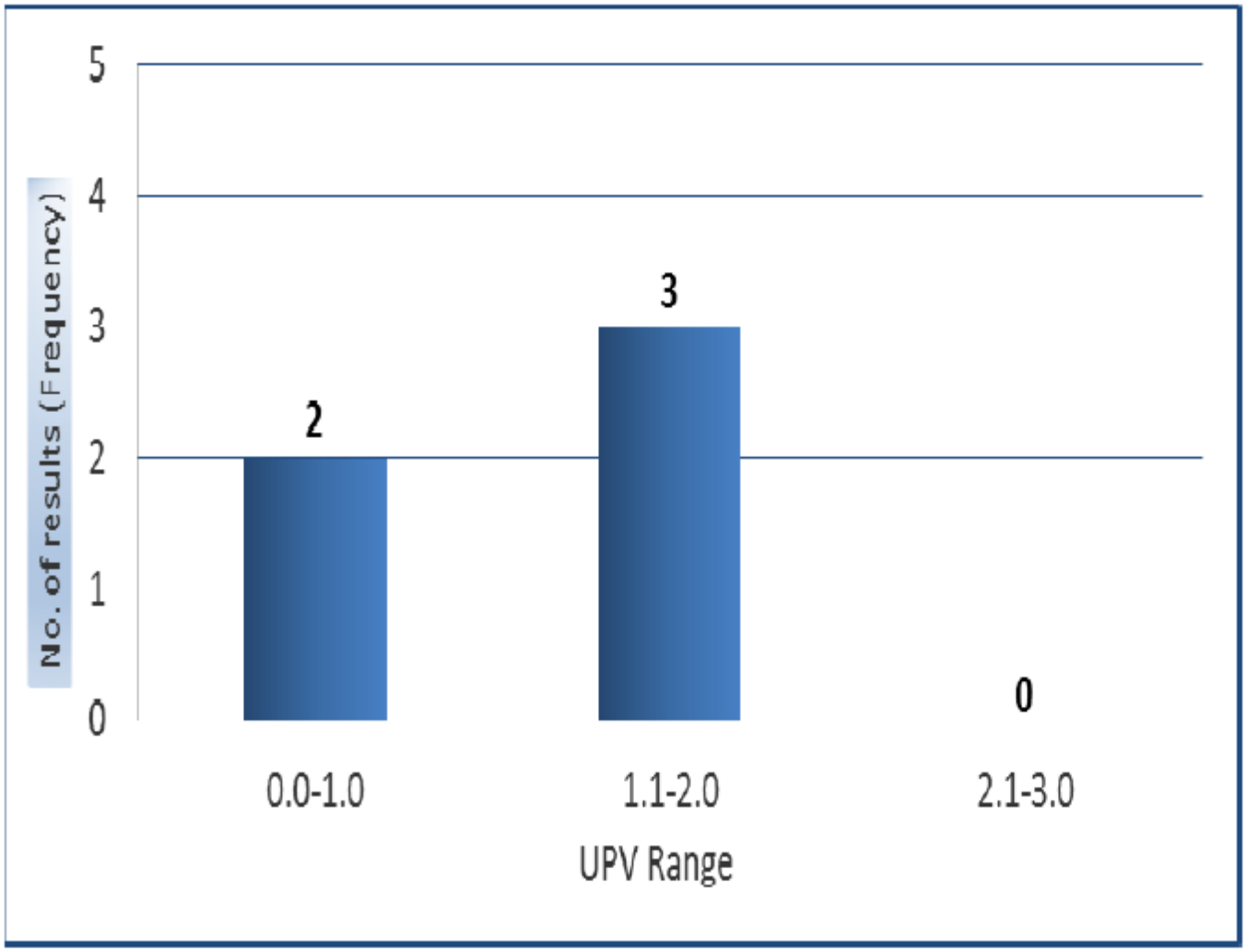
FIG: 1 UPV APPARATUS

ULTRASONIC PULSE VELOCITY TEST DATA

TABLE-3B, 33 KV TUGHLAKBAD GRID

S. No.	Test Location		Type of Method	Pulse Velocity (Km/s)	Quality Of Concrete
	Location	Mark ID			
1	Slab	S/1	Indirect	0.6	Doubtful
2	Beam	B/1	Indirect	0.7	Doubtful
3	Column	C/1	Direct	1.4	Doubtful
4	Beam	B/2	Indirect	1.3	Doubtful
5	Slab	S/2	Indirect	1.3	Doubtful

HISTOGRAM PLOT OF UPV VALUES FOR 33 KV TUGHLAKBAD GRID



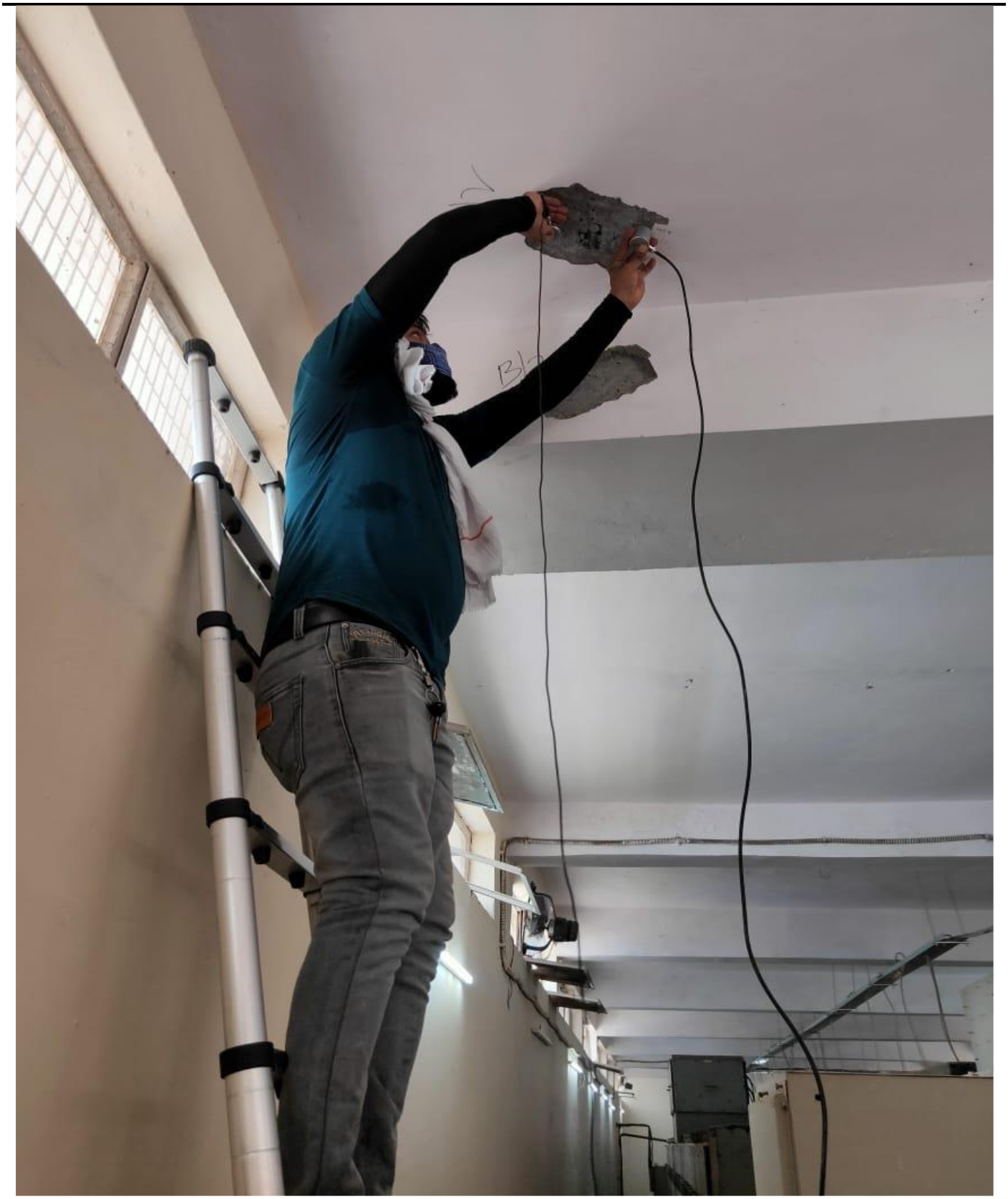


FIG: 2 UPV TEST IMAGES TUGHLAKABAD

TABLE-3C 33 KV MASJID MOTH GRID

S. No.	Test Location		Type of Method	Pulse Velocity (Km/s)	Quality Of Concrete
	Location	Mark ID			
1	Slab	S/1	Indirect	0.6	Doubtful
2	Beam	B/1	Indirect	0.7	Doubtful
3	Column	C/1	Direct	1.4	Doubtful
4	Beam	B/2	Indirect	1.3	Doubtful
5	Slab	S/2	Indirect	1.3	Doubtful

HISTOGRAM PLOT OF UPV VALUES FOR
33 KV MASJID MOTH GRID.

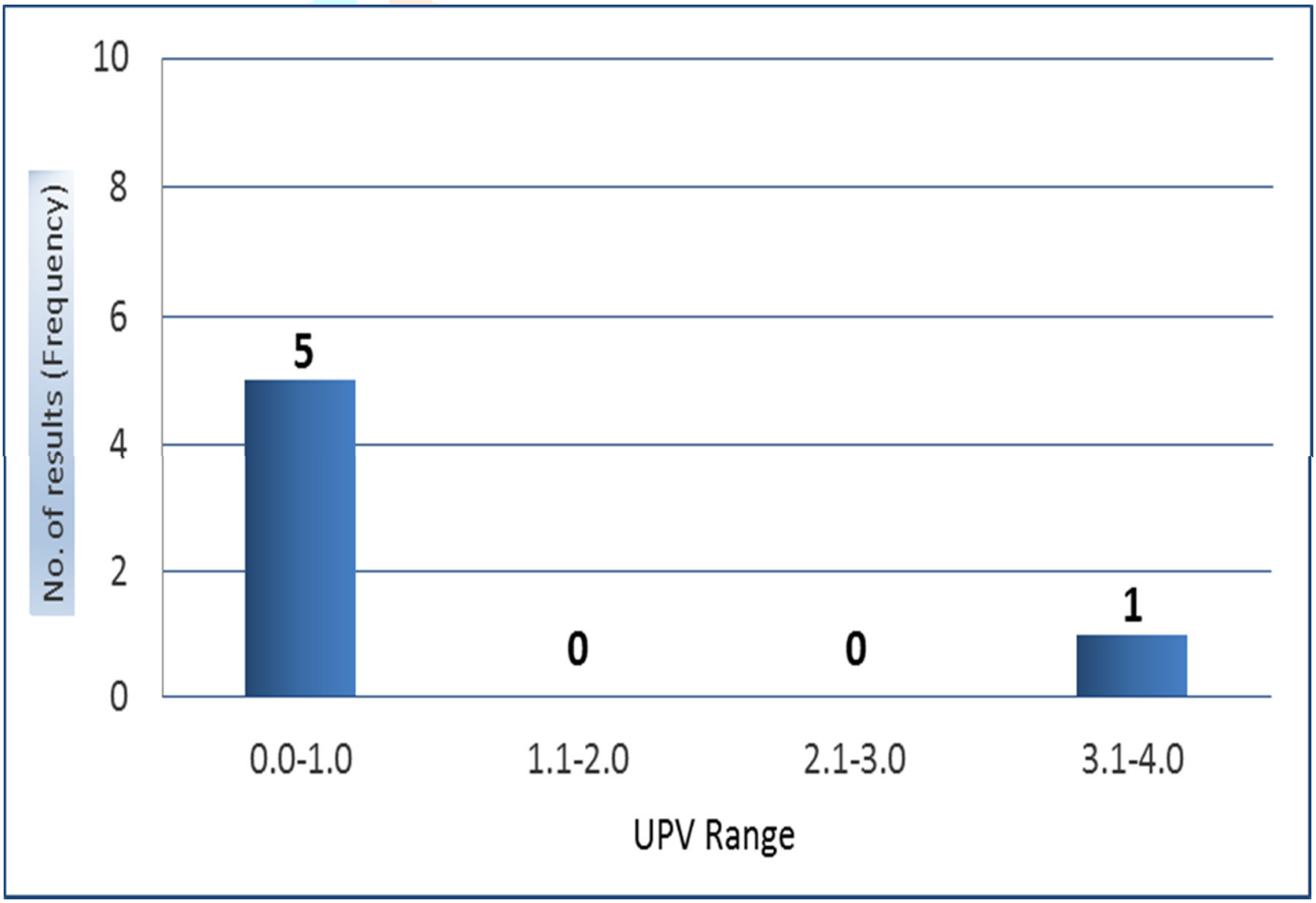


FIG: 3 UPV TEST IN PROGRESS MASJID MOTH GRID

TABLE-3D 33 KV BHIKAJI CAMA PLACE GRID

S. No.	Test Location		Type of Method	Pulse Velocity (Km/s)	Quality Of Concrete
	Location	Mark ID			
1	Slab	S/1	Indirect	0.6	Doubtful
2	Beam	B/1	Indirect	0.7	Doubtful
3	Column	C/1	Direct	1.4	Doubtful
4	Beam	B/2	Indirect	1.3	Doubtful
5	Slab	S/2	Indirect	1.3	Doubtful

HISTOGRAM PLOT OF UPV VALUES FOR
33 KV BHIKAJI CAMA PLACE GRID.

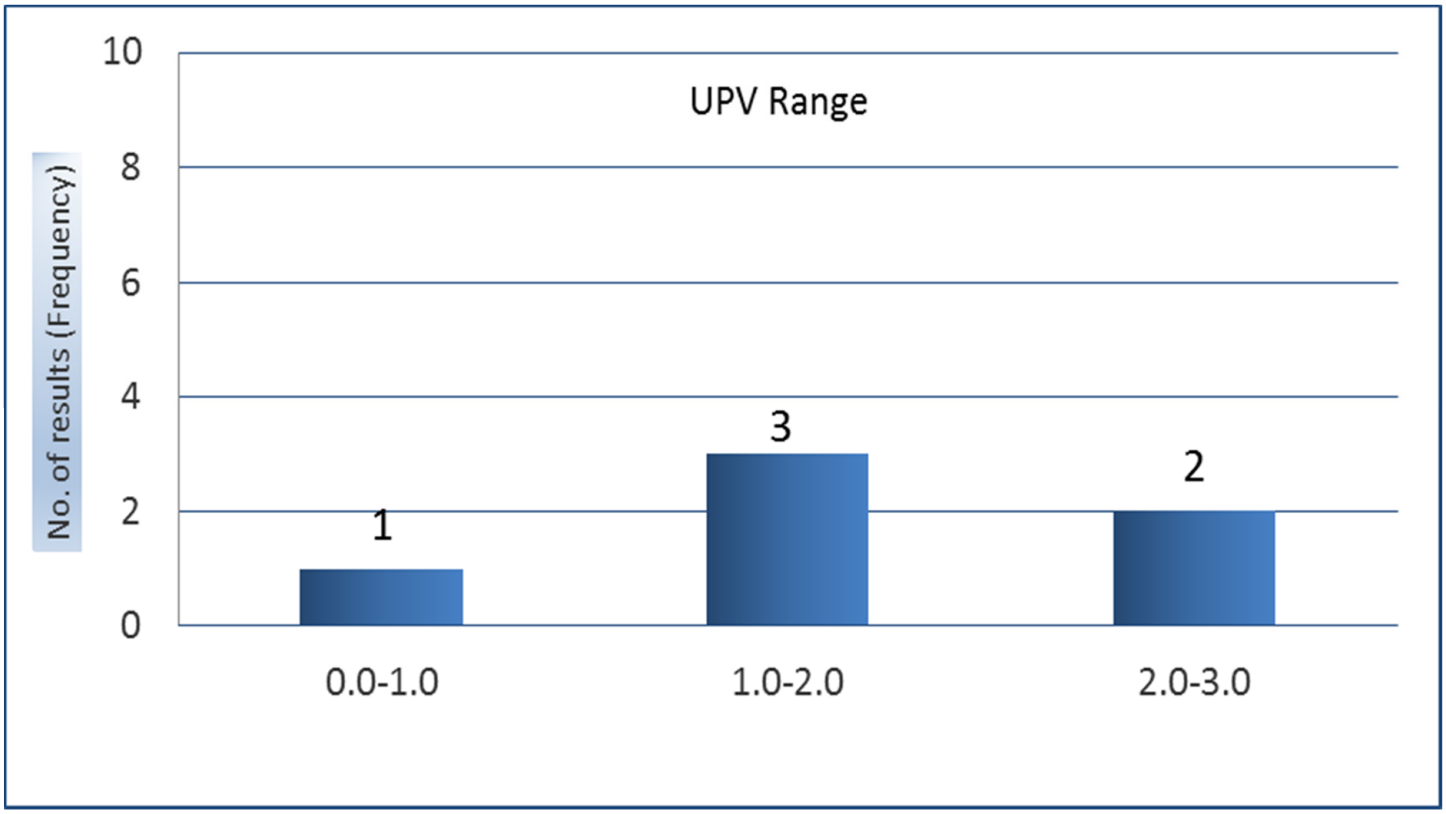


FIG:4 UPV TEST IN PROGRESS BHIKAJI KAMA GRID

3.3.2 REBOUND HAMMER TEST

The basic principal of Rebound hammer working is that when the plunger of rebound hammer is pressed against the surface of the concrete, the spring to control mass rebounds and the extent of such rebound depends upon the surface hardness of concrete. The surface hardness and therefore the rebound indices taken shall be related to the compressive strength of the concrete. The rebound distance is measured along a graduated scale and is designated as the rebound number or rebound Index. The test involves measurement of rebound number or rebound Index by placing rebound hammer at right angles to the surface of the concrete member as mentioned in IS 13311 (Part 2): 1992 (Reaffirmed 2013).

The test shall be conducted around all the points of observation on all accessible faces of the structural element. The point of impact shall be at least 20mm away from any edge or sharp discontinuity. The locations at which test is desired shall be identified by the engineer in-charge before the test, so as to prepare the surface for the test. For testing the selected surface shall be smooth and dry. Concrete surfaces shall be thoroughly cleaned before taking any measurement.

The reliability of the results might be affected significantly in case readings are taken from plaster and/or rough surfaces. The rebound number is affected by factors like type of cement and aggregate, surface preparation, moisture content, age of concrete and extent of carbonation of concrete. As per IS: 13311 (Part 2): 1992 the rebound indices are indicative of compressive strength of concrete to a limited depth from the surface.

INTERPRETATION OF RESULTS

The interpretation of results is evolved with reference to IS: 13311 (Part 2): 1992. The rebound hammer method provides a convenient and rapid indication of the compressive strength of concrete by means of established correlation between the rebound Index and the compressive strength of the concrete.

TEST LIMITATIONS

The test preliminary responds on surface hardness and it is indirect method to assess the strength of concrete. Factors that influence the readings as mentioned in IS: 13311 (Part-2), 1992 (Reaffirmed 2013) are affected by localized hardness, carbonation of concrete, surface smoothness, type of cement, type of the aggregates, moisture content of the concrete, concrete, age of concrete, concrete composition etc. The test results can vary up to +/- 25 % as a limitation of this method of testing. The results are specific to tested locations only due to heterogenic property of concrete.

Fig: REBOUND HAMMER APPARATUS

REBOUND HAMMER –TEST DATA

TABLE-3D 33 KV TUGHLAKBAD GRID

S. NO.	Test Location		Hammer Alignment	Avg. Rebound No.	Equiv. Comp. Strength (N/mm2)	Design Strength
	Location	Mark ID				
1	Slab	S/1	Vertical	33	21.1	Not Available
2	Beam	B/1	Horizontal	32	26.8	
3	Column	C/1	Horizontal	25	16.0	
4	Beam	B/2	Horizontal	25	16.0	
5	Slab	S/2	Vertical	37	27.8	

HISTOGRAM PLOT OF EQUIV. COMP. STRENGTH FROM RBH TEST FOR 33 KV TUGHLAKBAD GRID

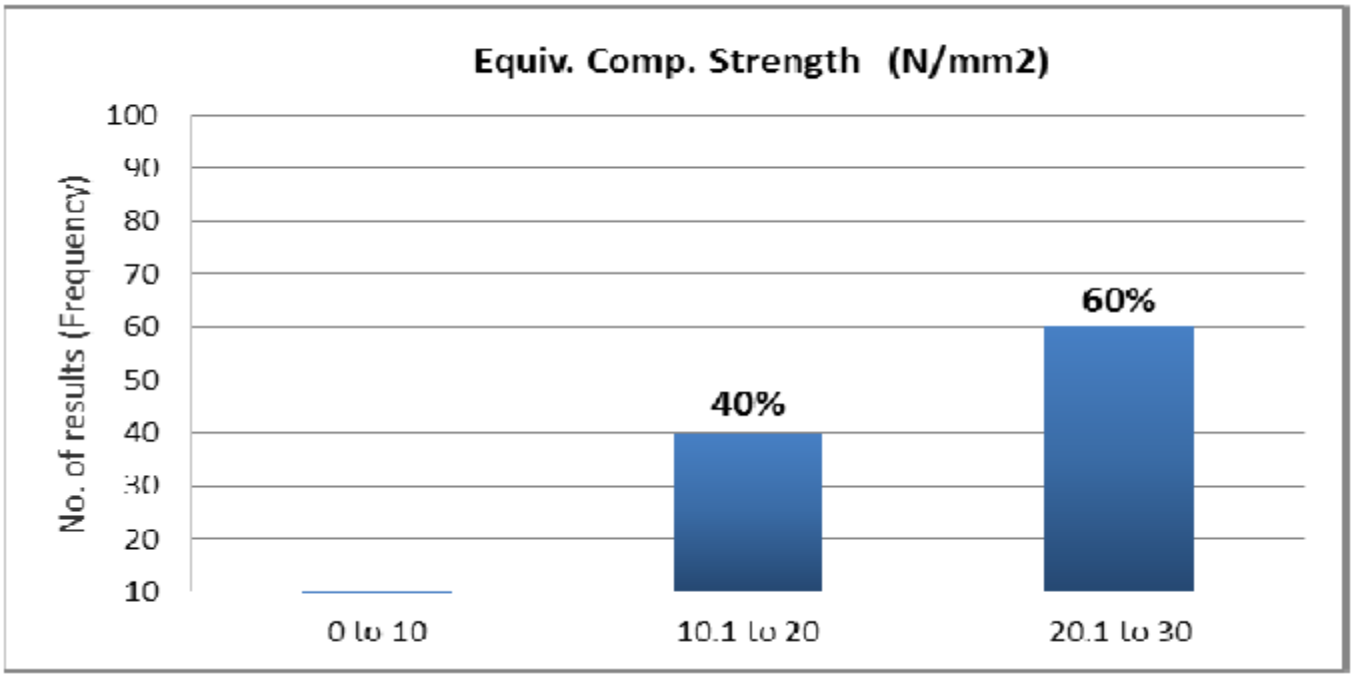


FIG: 5 RBH TEST IMAGES

TABLE-3E 33 KV KV MASJID MOTH GRID

S. NO.	Test Location		Hammer Alignment	Avg. Rebound No.	Equiv. Comp. Strength (N/mm2)	Design Strength
	Location	Mark ID				
1	Ground Floor Beam	GB/1	Horizontal	19	10.0	Not Available
2	Ground Floor Slab	GS/1	Horizontal	19	10.0	
3	Ground Floor Column	GC/1	Horizontal	24	14.8	
4	First Floor Beam	FB/2	Horizontal	16	10.0	
5	First Floor Slab	FS/2	Vertical	16	10.0	
6	First Floor Column	FC/1	Horizontal	20	10.0	

HISTOGRAM PLOT OF EQUIV. COMP. STRENGTH FROM RBH TEST FOR 33 KV MASJID MOTH GRID.

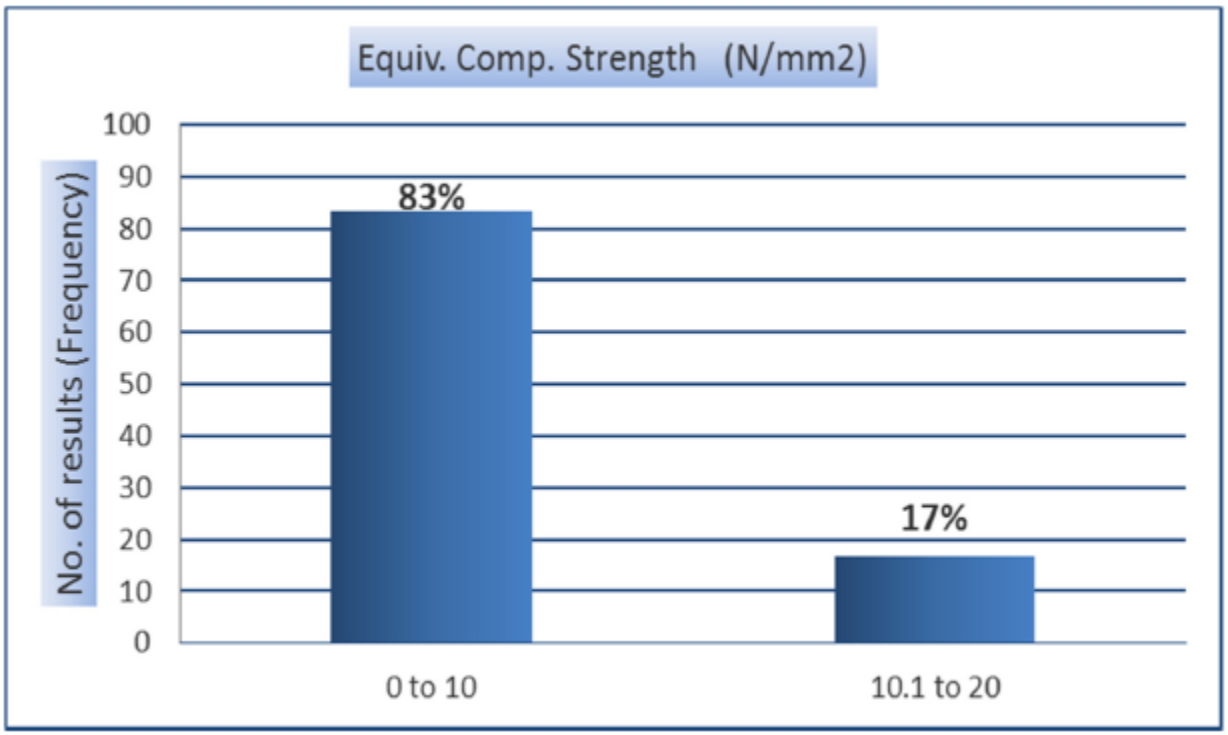


FIG: 6 RBH TEST IN PROGRESS

TABLE-3F 33 kV BHIKAJI CAMA PLACE GRID

S. NO.	Test Location		Hammer Alignment	Avg. Rebound No.	Equiv. Comp. Strength (N/mm2)	Design Strength
	Location	Mark ID				
1	Ground Floor Beam	GB/1	Horizontal	14	10.0	Not Available
2	Ground Floor Column	GC/1	Horizontal	15	10.0	
3	Ground Floor slab	GS/1	Vertical	20	10.0	
4	First Floor Beam	FB/2	Vertical	20	10.0	
5	First Floor Column	FC/2	Vertical	17	10.0	
6	First Floor slab	FS/1	Vertical	20	10.0	

HISTOGRAM PLOT OF REBOUND NO
FOR 66 33 KV BHIKAJI CAMA PLACE GRID.

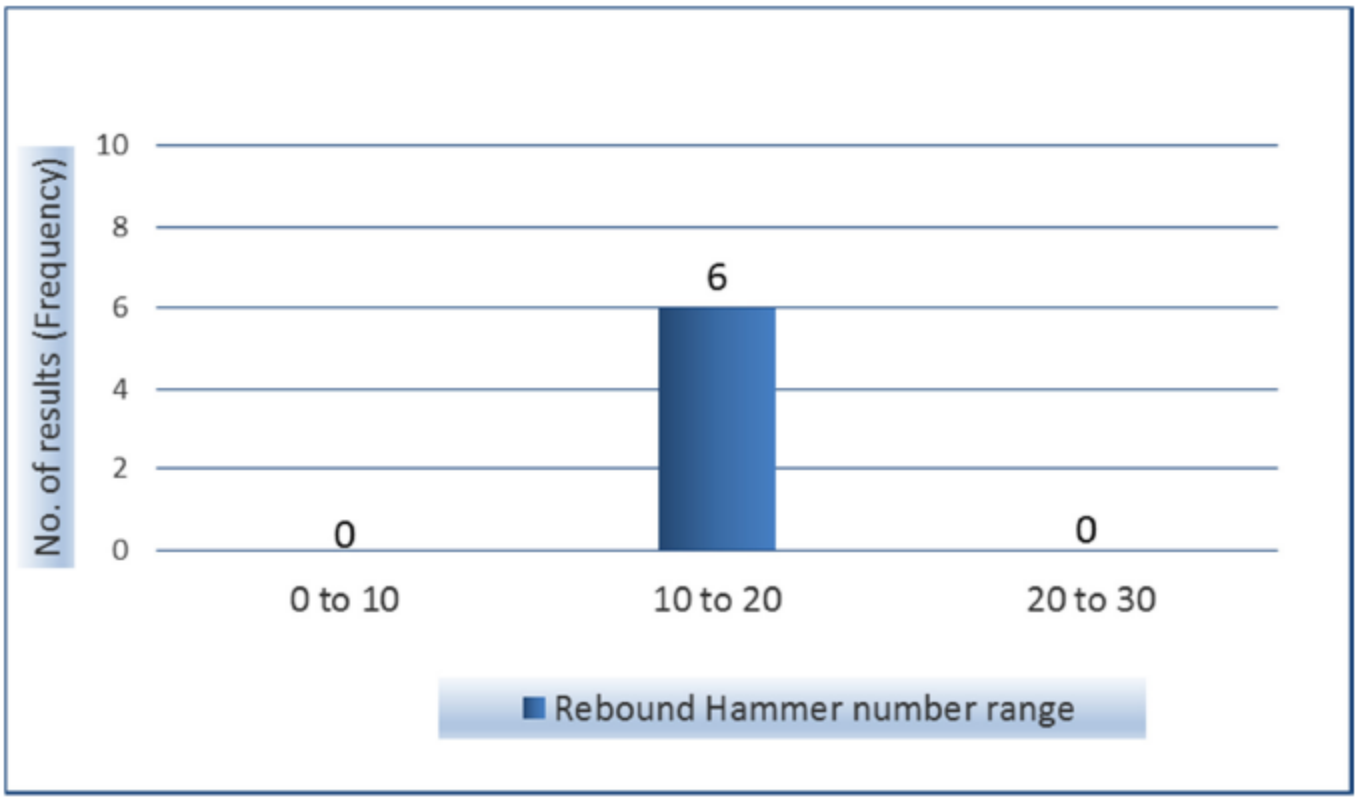


FIG: 7 RBH TEST IN PROGRESS

3.4 RESULTS OF NDT TESTS AND ITS DISCUSSION.

At Tughlakabad grid, a total of 5 points were tested with 2 locations in slab, 2 locations in beam and 1 location in column for UPV/Rebound hammer testing by DIRECT & INDIRECT method. It is observed that UPV reading at all the tested locations are very low and are in doubtful category. It means concrete quality is in very poor condition at all the tested locations and large scale honey combing and voids are present in the concrete which is to be strengthened. However surface concrete strength as indicated by the results of rebound hammer in slabs, columns and beams is found to be in the range of M16 to M27.8 grade of concrete. Whereas designed strength of concrete is not available though it can be assumed to be M20 (1:1.5:3) normally used in the period the construction was done and is since deteriorated.

At Masjid Moth Grid, a total of 6 points were tested with 3 locations in column and 2 locations in beams and 1 location in slab for UPV/Rebound hammer testing by DIRECT & INDIRECT method. It is observed that UPV reading at 5 locations are very low and are in doubtful category and at only 1 location it is showing in medium category. It means concrete quality is in very poor condition at almost all the tested locations and large scale honey combing and voids are present in the concrete which is to be strengthened. However surface concrete strength as indicated by the results of rebound hammer in slabs, columns and beams is found to be M10 & M14.8 grade of concrete. Whereas designed strength of concrete is not available though it can be assumed to be M15 (1:2:4) normally used in the period the construction was done.

At Bhikaji Kama Grid, a total of 6 points were tested with 2 locations in beams and 2 locations in slabs and 2 locations in columns for UPV/Rebound hammer testing by DIRECT & INDIRECT method. It is observed that UPV readings at all 6 locations are in doubtful category. It means at all the locations, concrete quality is in poor condition and large scale honey combing and voids are present and are to be strengthened. However concrete strength in almost all locations as indicated by the results of rebound hammer is found to be M10 grade of concrete. Whereas designed strength of concrete is not available though it can be assumed to be M15 (1:2:4) normally used in the period the construction was done.

3.5 OBSERVATION BASED ON RAPID VISUAL INSPECTION AND NDT TEST

Tughlakabad Grid

Various observations based on site inspection and NDT tests carried out to assess the various structural and services aspects of the structure in relation to its suitability against various safety provision of the NBC of India

and related IS codes are briefly given below.

1. The existing building is single storey RCC framed structure. Beams, Column and slabs are provided as structural element to withstand all the possible load and to resist earthquake load.
2. The beams are approximately 230X500mm in size.
3. The columns are approximately 230X450 mm in size.
4. The concrete quality in slabs, columns and beams are very poor as per the results of the UPV tests & large scale honey combing and voids are present.
5. Dampness and See page has been observed on walls and slabs inside the building.
6. No plinth beam is provided at plinth level as per requirement of IS 4326- 2013.
7. Grade of RCC in slabs, columns and beams is found to be M16 to M27.8 gradeas evaluated through rebound hammer test. However designed strength of concrete is not available though it can be assumed to be M20 (1:1.5:3) normally used in the period the construction was done.

8. The structure has weakened due to age factor and poor quality of RCC casted manually using saline water for construction. Honey combing may be due to inadequate use of vibrator during concreting.
9. The structure do not conform to various provision of present earthquake resistant design codes like IS 1893-2016; IS 4326-2013; IS13920-2016, as it was constructed in 1988.

FIG: 8 SHOWING DAMPNESS & SEEPAGE

Masjid Moth Grid

Various observations based on site inspection and NDT tests carried out to assess the various structural and services aspects of the structure in relation to its suitability against various safety provision of the NBC of India and related IS codes are briefly given below.

1. The existing building is G+1 RCC framed structure. Beams, Column and slabs are provided as structural element to withstand all the possible load and to resist earthquake load.

2. The structure do not conform to various provision of present earthquake resistant design codes like IS 1893-2016; IS 4326-2013; IS13920-2016, as it was constructed in 1978.
3. The beams are approximately 230X600 mm in size.
4. The columns are approximately 450X230 mm in size
5. Building is found to be well maintained and not any distress has been observed at any place inside or outside the building.
6. The concrete quality in slabs, columns and beams are poor as per the results of the UPV tests & large scale honey combing and voids are present.
7. Average surface concrete strength as indicated by the results of rebound hammer tests is found to be M10 & M15 grade.

FIG: 9 SHOWING NO DISTRESS.

Bhikaji Kama Grid

Various observations based on site inspection and preliminary evaluation carried out to assess the various structural and services aspects of the structure in relation to its suitability against various safety provision of the NBC of India and related IS codes are briefly given below.

1. The existing building is G+1 RCC framed structure. RCC beams, columns and slabs are provided as structural element to withstand all the possible load and to resist earthquake load
2. There are visible cracks on the columns, walls and slabs and on the outer walls of the building.
3. The beams are approximately 400X400 mm in size.
4. The columns are approximately 300X350 mm in size.
5. The building was constructed in the year 1976.
6. Dampness & Seepage has been observed on almost every wall inside and outside in the building.
7. No plinth beam/band is provided at plinth level as per requirement of IS 4326-2013.
8. No corner reinforcement is provided in the brick wall as per requirement of IS 4326-2013.
9. Shattering of concrete has been observed on slabs in the building.
10. Seismic provision have not been provided in the above structures & the structure do not conform to various provision of earthquake resistant design codes like IS 1893-2016; IS 4 326-2013; IS13920-2016, and various other provision of IS 456-2000 and IS 1905-1987.
11. Seismic Bands as per IS 4326:2013 are absent in External & Internal Walls.
12. Grade of RCC in slabs and beams are found to be M10 grades as evaluated through rebound hammer test. However designed strength of concrete is not available though it can be assumed to be M15 (1:2:4) normally used in the period the construction was done.
13. The concrete quality in slabs and beams are very poor as per the results of the UPV tests & large scale honey combing and voids are present.
14. There are no Seismic provisions taken in the structure as per requirement of IS 4326:2013.
15. The structure has weakened due to age factor and possibility of poor quality of material used and saline water for construction.

FIG:10 SHOWING CRACKS

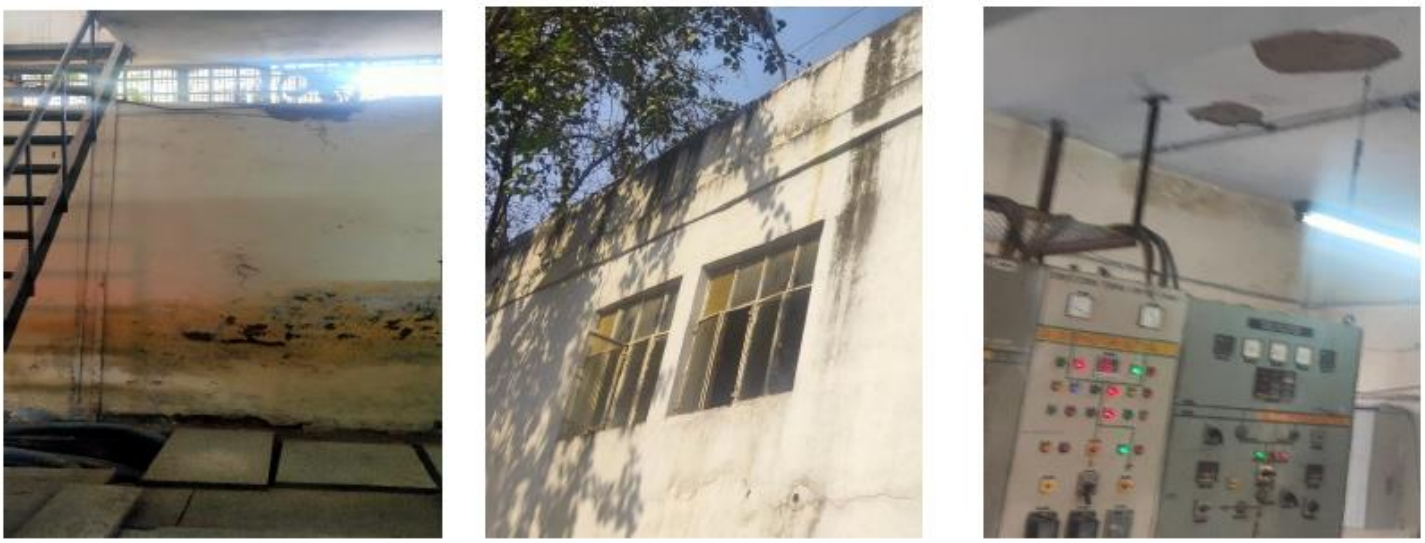


FIG: 11 DAMPNESS & SEEPAGE.

FIG: 12 SHATTERING OF CONCRETE

3.6 CONCLUSION

Tughlakabad Grid

Based on the above observation and recommendation it is concluded that the building do not conform present seismic provisions. However low strength of concrete and honey combing observed is a serious cause of concerned and to be take care of as per the methodology of repair presented in the category RC-I of this report. However only those slabs, columns and beams should be taken first where there are visual distresses. Repair of service pipe line to be taken on priority to prevent further damage to the structure. It is further advised to have a regular mechanism to observe any distress in any structural element which should be got repaired as per the methodology presented in this report. Structure is safe and stable under present normal loading condition with minor structural repair of slabs, columns and beams. However for long term use and its safety and stability during earthquake, seismic provisions as per IS 15988:2013 shall be incorporated and column size to be increased by jacketing with micro concrete.

Masjid Moth Grid

From the above it is concluded that Building is safe and stable under present normal loading condition with minor structural repair of slabs and beams. However for long term use and its safety and stability during earthquake seismic provisions as per IS 15988:2013 shall be incorporated.

CHAPTER-4

RECOMMENDATIONS FOR REPAIR AND RESTORATION

Recommendations have been made to address the observed deficiencies in various components of the structure. The scope of the present study included providing broader recommendations for the repair and restoration of distressed elements in the buildings under reference based on test data.

4.1 Repair Category-RC-I: Restoration of Integrity and Strength of Concrete

It is recommended to undertake epoxy injection grouting for the repair and restoration of RCC structural elements identified to have inadequate in-situ concrete integrity and strength. Therefore all the structural elements like all columns, beams and slabs where unsatisfactory UPV value was noted shall be chosen for grouting. It is believed that presence of voids and pores in the concrete have resulted in unsatisfactory homogeneity, integrity and strength of concrete in these members. Grouting shall restore the Integrity and homogeneity of concrete which shall also ultimately result in enhancement in strength of concrete.

It is recommended to undertake grouting using ultra low viscous, solvent free, high strength epoxy resin. The epoxy grout shall conform to the relevant recommendations of ASTM C 881 [9]. Mechanical packers with non return valve are recommended to be used for grouting. Manufacturer's recommendations shall be followed with respect to application procedure for various other aspects of grouting.

It shall be ensured that the entire volume of concrete in the member under consideration is grouted to the extent possible. The repaired RC elements shall be tested using ultrasonic pulse velocity apparatus in order to verify the improvement in integrity and strength of concrete. While the integrity and homogeneity of concrete shall be considered as satisfactory if a UPV value of more than 3.5 km/s is obtained.

The above mentioned minimum threshold UPV values for meeting in-situ strength of concrete were computed from the strength correlations for beams and columns discussed in previous sections. It is also recommended that the repair executing agency shall undertake UPV testing of all the remaining RC beams and columns and the members found to be deficient with respect to the above mentioned UPV criteria shall be epoxy grouted.

Drawings showing methodology of grouting is provided along with this report.

4.2 Repair Category-RC-II: Jacketing of columns and beams with micro concrete along with or without addition of reinforcement.

All the columns which are inadequate in size and deficient in the load carrying capacity shall be jacketed with reinforcement by micro concrete. Beam where stirrups are exposed shall also be jacketed with micro concrete with addition of longitudinal reinforcement and stirrups. Following procedure shall be adopted under this Repair Category.

1. Before attempting any repair, it shall be ensured that the live loads in the building, expected to be transferred to the member being repaired, shall be the minimum possible. Wherever necessary, temporary props and supports using structural steel sections shall be provided to unload the member being repaired. Generally where the thickness of concrete removal exceeds the 50 mm on each of the two opposite of a member and section reduction in reinforcement is found due to corrosion, temporary unloading with propping is required before attempting any repair. Typical arrangement of unloading a beam by propping the slab on its either side is schematically illustrated in Fig It may be noted that a continuous transfer of load from the level of repair to ground floor or to columns below shall be ensured by placing the props concentrically at every level. On the ground floor the lowest prop shall be supported on firm ground. A local temporary R.C.C base shall be created and the lowest prop shall be firmly attached to the base. Remove plaster and finished all around the columns, and beams to be repaired. In columns, the plaster and the finishes shall be removed from all its four exposed faces along its entire height. Thereafter, using electric/ pneumatic chippers or any other

concrete demolishing toll gently remove cover concrete over the entire affected portion of the structure member under consideration, to expose (corroded) steel reinforcement. It shall be ensured that the removal of cover concrete shall be done to such an extent that the longitudinal reinforcement in the columns stands exposed. It may be noted that in the case of columns, the cover concrete shall be removed from all the four vertical faces. Further, care shall be taken that the concrete shall also be removed from the inside/underside of the bars by under-cutting to a depth of 20 mm below/inside the (longitudinal) reinforcement bars. It shall also be ensured that concrete is completely stripped - off around the full circumference over the full length of the corroded bars, where ever encountered.

2. Ensure that where ever encountered, deteriorated or loosely attached concrete is removed from the member in question till the sound substrate is exposed. It is advised to remove the concrete from the entire height of length of the member in a given storey even if the distress is noticed only a patch. This precaution is advised because experience show that patch repair of corroded R.C.C. remains unsuccessful due to formation of new anodes around the patched concrete and therefore repair of full height/length should be undertaken.

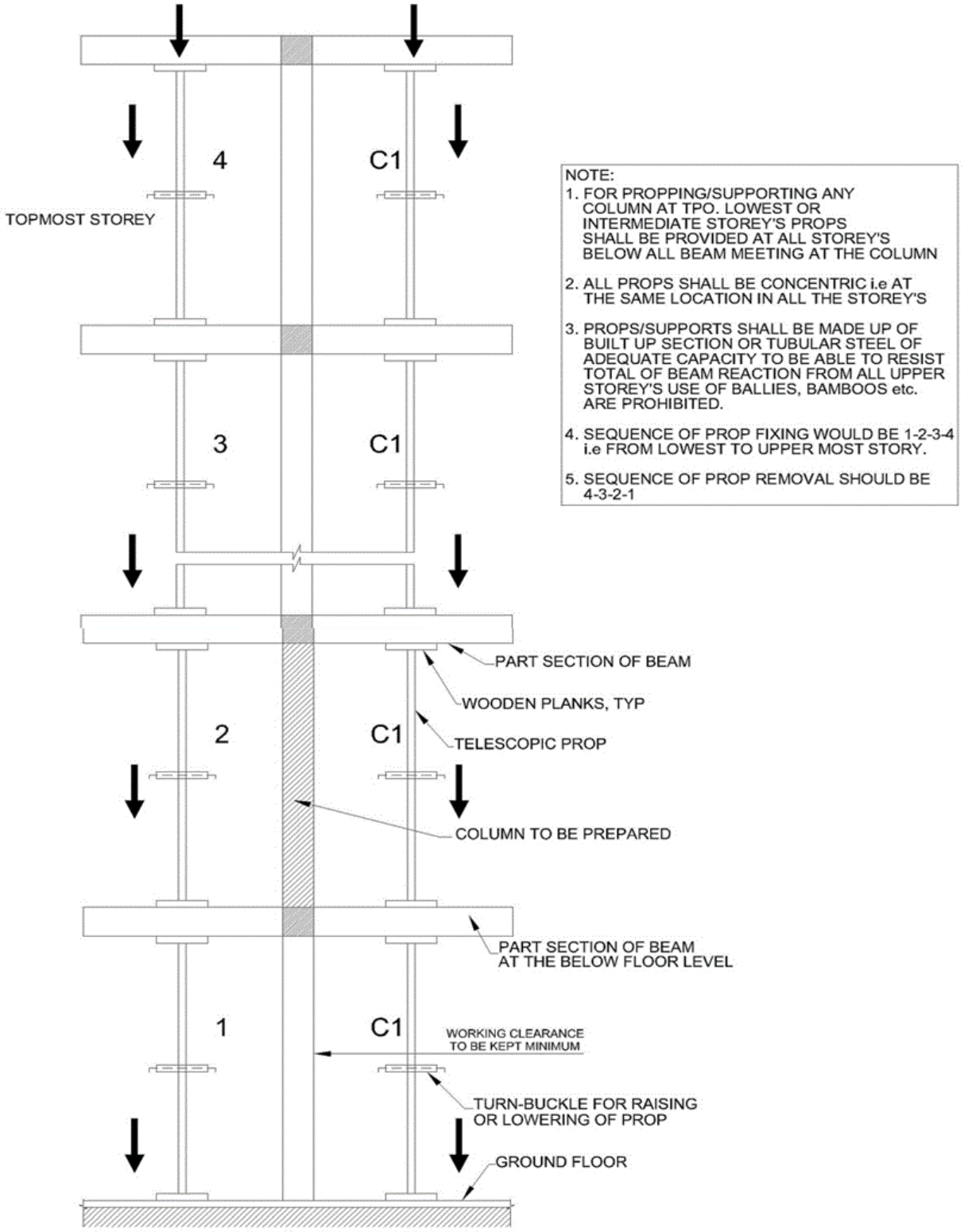


FIG: 10 TYPICAL ARRANGEMENT OF PROPPING FOR RELIEVING A COLUMN OF ITS AXIAL LOAD.

3. Clean the exposed concrete substrate by using wire brushes and/or sand blasting. Water jet may also be used. Remove rust (if any) from all around the surface along the length of the corroded steel reinforcement, using hand tools like chisel, hammers, wire brushes, abrading cloth/paper etc.

4. Upon removal of the cover concrete and rust from the corroded rebars/longitudinal bars, in the columns (if and where ever encountered) shall be inspected for loss in their section. Both longitudinal and lateral steel shall be inspected. If section reduction is less than 25% for one corroded bar and 20% for two more bars, no repair of reinforcement is required. If section reduction is found to be more than above mentioned limits then the member shall be repaired with addition of longitudinal bars as per drawings attached with this report. The additional reinforcement shall be rebar with HILTI chemical and lateral ties shall be provided before concreting. A structural drawings showing the methodology is attached with this report.

4.3 Repair Category-RC-III: Repair of slabs by shotcreting

The surface of the slab shall be chipped till the existing reinforcement is observed. The surface of the existing concrete and reinforcement shall be cleaned by wire brush. Damaged reinforcement shall be removed and additional reinforcement shall be added as per requirement by HILTI rebar. Welded wire fabrics shall be put in place. Shotcreting/guniting shall be done with 1:4 cement sand mortar. Alternatively it can also be repaired with polymer modified mortar.

4.4 Repair Category-RC-IV: Seismic Belts at plinth level

Plinth band shall be provided at plinth level as shown in structure drawings. The following mesh reinforcement is recommended to be used on both sides of the walls binded together with bolts. Mesh of gauge 10 with 8 wires in vertical direction spaced at 25mm in a belt width of 200mm or mesh of gauge 13 with wires @25 mm in a belt width of 250mm may be used.

4.5 BOQ Based on Recommendation of Repairing

ESTIMATE BASED ON DSR 2021 RATES						
SUBJECT		**Retrofitting works at gird sub station building Tughlakabad**				
S.No	Ref.	Description of item	Unit	Rate	Qty.	Amount
1	15.2.1	Demolishing cement concrete manually/ by mechanical means including disposal of material within 50 metres lead as per direction of engineer in charge. Nominal concrete: 1:3:6 or richer mix (i/c equivalent design mix)	Cum	2007.10	41.94	84177.77
2	15.7.4	Demolishing brick work manually/ by mechanical means including stacking of serviceable material and disposal of unserviceable material within 50 metres lead as per direction of Engineer-in-charge. In cement mortar	Cum	1698.45	29.06	49356.96
3	15.25	Dismantling stone slab flooring laid in cement mortar including stacking of serviceable material and disposal of unserviceable material within 50 metres lead.	Sqm	219.75	279.59	61439.90
4	15.27	Demolishing mud phaska in terracing and disposal of material within 50 metres lead.	Cum	753.75	105.32	79384.95
5	2.8.1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil anddisposal of surplus excavated soil as directed, within a lead of 50 m. All kinds of soil	Cum	286.85	291.81	83705.70

6	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.	Cum	253.95	233.45	59284.63
7	2.27	Supplying and filling in plinth with sand under floors, including watering, ramming, consolidating and dressing complete.	Cum	2161.20	17.90	38685.48
8	BRPL	Repairs to plaster of thickness 12 mm to 20 mm in patches of area 2.5 sq. metres and under, including cutting the patch in proper shape, raking out joints and preparing and plastering the surface of the walls complete, including disposal of rubbish to the dumping ground within 50 metres lead: With cement mortar 1:4 (1 cement : 4 coarse sand)	Sqm	230.00	30.00	6900.00
9	4.1.8	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering- All work upto plinth level 1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size)	CUM	6326.05	27.96	176876.36
10	4.17	Making plinth protection 50mm thick of cement concrete 1:3:6 (1 cement : 3 coarse sand (zone-III) derived from natural sources : 6 graded stone aggregate 20 mm nominal size derived from natural sources) over 75mm thick bed of dry brick ballast 40 mm nominal size, well rammed and consolidated and grouted with fine sand, including necessary excavation, levelling & dressing & finishing the top smooth.	SQM	681.65	27.50	18745.38
11	11.3.1	Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate) finished with a floating coat of neat cement including cement slurry, but excluding the cost of nosing of steps etc. complete. 40 mm thick with 20 mm nominal size stone aggregate	Sqm	545.00	127.28	69367.60
12	6.1.2	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in foundation and plinth in cement mortar 1:6 (1 cement : 6 coarse sand)	CUM	6658.25	8.38	55796.14
13	6.4.2	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in superstructure above plinth level up to floor V level in all shapes and sizes in : Cement mortar 1:4 (1 cement : 4 coarse sand)	CUM	8288.35	23.43	194196.04
14	5.9.5	Centring and shuttering including strutting, propping etc. and removal of form for Lintels, beams, plinth beams, girders, bressumers and cantilevers.	SQM	608.35	254.81	155013.66
15	5.9.6	Centring and shuttering including strutting, propping etc. and removal of form for: Columns, Pillars, Piers, Abutments, Posts and Struts	SQM	804.25	268.74	216134.15

16	5.9.3	Centring and shuttering including strutting, propping etc. and removal of form for: Suspended floors, roofs, landings, balconies and access platform	SQM	766.55	246.24	188755.27
17	5.22.6	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete. Thermo-Mechanically Treated bars of grade Fe-500D or more.	KG	89.65	6282.00	563181.30
18	15.56	Dismantling old plaster or skirting, raking out joints and cleaning the surface for plaster including disposal of rubbish to the dumping ground within 50 metres lead.	Sqm	45.05	89.91	4050.45
19	13.4.1	12 mm cement plaster of mix 1:4 (1 cement: 4 coarse sand)	Sqm	307.25	83.12	25538.62
20	13.2.1	15 mm cement plaster on rough side of single or half brick wall of mix: 1:4 (1 cement: 4 fine sand)	Sqm	339.70	59.15	20093.26
21	13.91	Removing dry or oil bound distemper water proofing cement paint and the like by scrapping, sand papering and preparing the surface smooth including necessary repairs to scratches etc. complete.	Sqm	20.85	658.97	13739.52
22	13.8	Providing and applying white cement based putty of average thickness 1 mm, of approved brand and manufacturer, over the plastered wall surface to prepare the surface even and smooth complete.	sqm	123.85	801.24	99233.57
23	13.41.1	Distempering with oil bound washable distemper of approved brand and manufacture to give an even shade. New work (two or more coats) over and including water thinnable priming coat with cement primer	Sqm	162.55	113.91	18516.07
24	13.98.1	Wall painting with plastic emulsion paint of approved brand and manufacture to give an even shade: One or more coats on old work	sqm	90.85	658.02	59781.12
25	13.46.1	Finishing walls with Acrylic Smooth exterior paint of required shade: New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @2.20kg/10 sqm).	Sqm	166.85	1033.15	172381.08
26	13.111.1	Finishing walls with Acrylic Smooth exterior paint of required shade: Old work (Two or more coats applied @ 1.67 ltr/ 10 sqm) on existing cement paint surface.	Sqm	111.60	268.27	29938.93
27	13.99.1	Painting with synthetic enamel paint of approved brand and manufacture to give an even shade one or more coats on old work.	SQM	86.55	69.37	6003.97
28	13.61.1	Painting with synthetic enamel paint of approved brand and manufacture to give an even shade. Two or more coats on new work.	Sqm	131.45	114.44	15043.14
29	10.1	Structural steel work in single section fixed with or without connecting plate including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete.	KG	93.05	100.48	9349.66
30	10.22	Welding by gas or electric plant including transportation of plant at site etc. complete	Cm	3.40	140.00	476.00

31	AR. 142	P/F MS chequred plate i/c cutting, straightening, rounding of edges, making lifting arrangment & fixing by welding to M.S angle frame etc.	Kg	81.00	204.82	16590.42
32	16.53	Providing and fixing concertina coil fencing with punched tape concertina coil 600 mm dia 10 metre openable length (total length 90 m), having 50 nos rounds per 6 metre length, upto 3 m height of wall with existing angle iron 'Y' shaped placed 2.4 m or 3.00 m apart and with 9 horizontal R.B.T. reinforced barbed wire, stud tied withG.I. staples and G.I. clips to retain horizontal, including necessary bolts or G.I. barbed wire tied to angle iron, all complete as per direction of Engineer-in-charge, with reinforced barbed tape(R.B.T.) / Spring core (2.5mm thick) wire of high tensile strength of 165 kg/ sq.mmwith tape (0.52 mm thick) and weight 43.478 gm/ metre (cost of M.S.angle, C.C. blocks shall be paid separately).	M	303.65	160.00	48584.00
33	WO 2356 2098	Dismantling of PVC flooring of area up to 100 sqm by scraping/streching/cutting with necessary tools includig disposal of rubbish upto 50 m lead.	LS	1500.00	1.00	1500.00
34	WO 2356 2098	Providing and laying epoxy flooring by cleaning existing floor, laying epoxy base and epoxy paint 2mm Thick	Sqm	600.00	53.28	31968.00
35	WO 2356 2098	Providiing & applying demarkation line up to 10 cm width of approved colour with epoxy paint all complete as per direction of engineer incharge.	M	33.60	31.90	1071.84
36	14.4.1	Making the opening in brick masonry including dismantling in floor or walls by cutting masonry and making good the damages to walls, flooring and jambs complete, to match existing surface i/c disposal of mulba/ rubbish to the nearest municipal dumping ground, all complete as per direction of Engineer-in-Charge. For door/ window/ clerestory window	Ea	1046.95	8.00	8375.60
37	14.5.1	Renewing glass panes, with putty and nails wherever necessary including racking out the old putty: Float glass panes of thickness 5.50 mm	Sqm	941.95	14.06	13243.82
38	21.1.1.2	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS:733 and IS:1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing/panelling, C.P.brass/stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-	KG	466.30	19.50	9092.85

		charge. (Glazing, panelling and dash fasteners to be paid for separately): For Fixed portion. Powder coated aluminium (minimum thickness of powder coating 50 micron)				
39	21.1.2.2	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size including necessary filling up the gaps at junctions ie. at top , bottom and sides with required EDPM rubber/neoprene gasket etc . Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing/panelling, C.P. brass/stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing panelling and dash fasteners to be paid for separately.) For shutters of doors, windows & ventilators including providing and fixing hinges/pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber/ neoprene gasket required (Fittings shall be paid for separately.) Powder coated aluminium (minimum thickness of powder coating 50 micron)	KG	564.80	23.40	13216.32
40	21.2.1	Providing and fixing 12 mm thick prelaminated particle board flat pressed three layer or graded wood particle board confirming to IS: 12823 Grade I Type II, in panelling fixed in aluminium doors, windows shutters and partition frames with C.P brass/ stainless steel screws etc. complete as per architectural drawings and directions of engineer-in-charge. Pre-laminated particle board with decorative lamination on one side and balancing lamination on other side.	Sqm	965.10	1.65	1592.42
41	21.3.2	Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge . (Cost of aluminium snap beading shall be paid in basic item). With float glass panes of 5 mm thickness (weight not less than 12.50 kg/sqm)	Sqm	1325.55	2.25	2982.49
42	9.97.3	Providing and fixing aluminium tower bolts ISI marked anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade with necessary screws etc. complete:	EA	90.80	2.00	181.60

		200x10 mm				
43	9.100.1	Providing and fixing aluminium handles ISI marked anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade with necessary screws etc. complete: 125 mm	EA	60.05	5.00	300.25
44	9.101.2	Providing and fixing aluminium hanging floor door stopper ISI marked anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour and shade with necessary screws etc complete. Twin rubber stopper	EA	62.25	1.00	62.25
45	9.96.1	Providing and fixing aluminium sliding door bolts ISI marked anodised (anodic coating not less than gradeAC 10 as per IS:1868) transparent or dyed to required colour and shade with nuts and screws etc. complete: 300x16 mm	EA	260.30	1.00	260.30
46	BRPL	Repair to steel door/windows by welding the broken window hinges, members etc. for its smooth operation (The cost of any new material i/c the hinges if required will be paid separately.	Ea	199.00	4.00	796.00
47	17.18.1	Providing and fixing P.V.C. low level flushing cistern with manually controlled device (handle lever) conforming to IS : 7231, with all fittings and fixtures complete. 10 litre capacity - White.	Ea	1023.05	1.00	1023.05
48	18.49.1	Providing and fixing C.P. brass bib cock of approved quality conforming to IS: 8931: 15 mm nominal bore.	EA	434.20	6.00	2605.20
49	15.53.1	Providing and fixing C.P. brass angle valve for basin mixer and gyser points of approved quality conforming to IS:8931 a) 15 mm nominal bore : 15 mm nominal bore	EA	500.35	4.00	2001.40
50	18.74.1	Providing and fixing unplasticised P.V.C. connection pipe with PTMT Nuts, collar and bush of approved quality and colour.15 mm nominal bore with 30cm length	Ea	85.50	3.00	256.50
51	15.23.1	Dismantling tile work in floors and roofs laid in cement mortar including stacking material within 50 metres lead:For thickness of tiles 10 mm to 25 mm	Sqm	60.50	45.13	2730.37
52	8.31	Providing and fixing Ist quality ceramic glazed wall tiles conforming to IS : 15622 (thickness to be specified by the manufacturer) of approved make in all colours, shade except burgundy, bottle green , black of any size as approved by Enigineer-in-Charge in skirting, risers of steps and dados over 12 mm thick bed of Cement Mortar 1:3 (1 Cement : 3 Coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm including pointing in white cement mixed with pigment of matching shade complete.	Sqm	1063.45	22.42	23842.55

53	BRPL	Providing and fixing 10 mm thick acid and/or alkali resistant tiles of approved make and colour using acid and/or alkali resisting mortar bedding, and joints filled with acid and/or alkali resisting cement as per IS : 4457, complete as per the direction of Engineer-in- Charge. In dado/skirting on 12 mm thick mortar 1:4 (1 acid proof cement : 4 coarse sand)	SQM	1275.00	8.75	11156.25
54	9.84	Providing and fixing aluminium extruded section body tubular type universal hydraulic door closer (having brand logo with ISI, IS : 3564 embosed on the body, door weight upto 36 kg to 80 kg and door width from 701 mm to 1000 mm) with double speed adjustment with necessary accessories and screws etc. complete.	EA	856.30	1.00	856.30
55	BRPL	Disposal of surplus earth by mechanical transport loading, unloading and stacking etc complete for all leads and lifts,	Cum	215.00	15.00	3225.00
56	10.2	Providing and fixing bolts including nuts and washers complete.	Kg	140.15	159.04	22289.46
57	11.41.2	Providing and laying vitrified floor tiles in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS: 15622, of approved make, in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand), jointing with grey cement slurry @ 3.3 kg/ sqm including grouting the joints with white cement and matching pigments etc., complete. Size of Tile 600x600 mm	Sqm	1416.65	127.75	180977.04
58	12.22	Making khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1 m x1 m x 400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges and making and finishing the outlet complete.	Ea	266.60	10.00	2666.00
59	22.7.1	Providing and laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc consisting of following operations: a) Applying a slurry coat of neat cement using 2.75 kg/sqm of cement admixed with water proofing compound conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment. b) Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand) admixed with	Sqm	1522.95	300.93	458301.34

		water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs. c) After two days of proper curing applying a second coat of cement slurry using 2.75 kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge. d) Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300 mm square 3 mm deep. e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test.“All above operations to be done in order and as directed and specified by the Engineer-in-Charge : With average thickness of 120 mm and minimum thickness at khurra as 65 mm.				
60	24.2	Providing and fixing double scaffolding system (cup lock type) on the exterior side of building/structure, upto 25 metre height, above ground level, including additional rows of scaffolding in stepped manner as per requirement of site, made with 40mm dia M.S. tube, placed 1.5 metre centre to centre, horizontal & vertical tubes joint with cup & lock system with M.S. Tubes, M.S. tube challis, M.S. clamps and staircase system in the scaffolding for working platform etc. and maintaining it in a serviceable condition for execution of work of cleaning and/ or pointing and/ or applying chemical and removing it thereafter. The scaffolding system shall be stiffened with bracings, runners, connecting with the building etc, wherever required, if feasible, for inspection of work at required locations with essential safety features for the workmen etc., complete as per directions and approval of Engineer-in-charge. Note:- (1) The elevational area of the scaffolding shall be measured for payment purpose. (2) The payment will be made once only for execution of all items for such works.	Sqm	285.00	1220.06	347717.10

61	26.28.2	Chipping of unsound/weak concrete material from slabs, beams, columns etc. with manual Chisel and/ or by standard power driven percussion type or of approved make including tapering of all edges, making square shoulders of cavities including cleaning the exposed concrete surface and reinforcement with wire brushes etc. and disposal of debris for all lead and lifts all complete as per direction of Engineer-In-Charge. - 50mm average thickness	Sqm	211.55	523.55	110757.00
62	26.31.1	Providing, mixing and applying bonding coat of approved adhesive on chipped portion of RCC as per specifications and direction of Engineer-In-charge complete in all respect. SBR Polymer (@10% of cement weight) modified cementitious bond coat @ 2.2 kg cement per sqm of surface area mixed with specified proportion of approved polymer	Sqm	117.75	523.55	61648.01
63	26.32.1	Providing, mixing and applying SBR polymer (of approved make) modified Cement mortar in proportion of 1:4 (1 cement: 4 graded coarse sand with polymer minimum 2% by wt. of cement used) as per specifications and directions of Engineer-in-charge. Note: Measurement and payment: The pre-measurement of thickness shall be done just after the surface preparation is completed and Payment under this item shall be made only after proper wet curing has been done and surface has been satisfactorily evaluated by sounding / tapping with a blunt metal instrument and/or the 75mm size cube crushing strength at the end of 28 days to be not less than 30 N/Sqmm2). 12 mm average thickness.	Sqm	333.00	116.14	38674.62
64	26.39	Providing and inserting 12mm dia galvanised steel injection nipple in honey comb area and along crack line including drilling of holes of required diametre (20mm to 30mm) up to depth from 30mm to 80mm at required spacing and making the hole & crack dust free by blowing compressed air, sealing the distance between injection nipple with adhesive chemical of approved make and allow it to cure complete as per direction of Engineer-In-Charge.	Sqm	202.70	5059.98	1025657.95
65	26.35.3	Providing and injecting approved grout in proportion recommended by the manufacturer into cracks/honey-comb area of concrete/ masonry by suitable gun/pump at required pressure including cutting of nipples after curing etc. complete as per directions of Engineer-in-Charge. (The payment shall be made on the basis of actual weight of approved grout injected.) Epoxy injection grout in concrete/RCC work of approved make	Kg	793.25	202.40	160553.80

66	NS	Providing and fixing 3 mm dia (Gauge 10) stainless steel wire fabric mesh of grade SS 304 with spacing 25 mm x 25 mm in longitudenal and transverse direction to be fixed & firmly anchored to the surface of Brick masonary , stone masonary or concrete by means of stainless steel shear key or bolts including the cost of labour, tool & plants etc. complete as required for fixing as per direction of Engineer-in-charge. (Drilling of holes & shear key or bolt shall be paid seperately.)	Sqm	1404.00	87.12	122316.48
67	NS	Drilling suitable holes in reinforced/plain cement concrete/brick masonry/CC block masonry/stone masonry with power driven drill machine in RCC beams, lintels, columns and slabs to introduce steel bars for anchoring wire mesh including fixing the steel bars in position using epoxy resin anchor grout of approved make but excluding the cost of reinforcement, all complete as per direction of Engineer-In-Charge. upto and including 12 mm dia for depth above 200 mm upto 300 mm	Ea	90.00	24.00	2160.00
68	NS	Clean the surface and remove any dust, unsound material, from reinforcement etc Roughen the surface and remove any laitance by light scrubbing. The concrete surfaces shall be thoroughly cleaned with wire brushes/cleaning brushes. Cleaning the existing reinforcement with wire brushes and cleaning burshes application of rust remover Rebakleen RR @ 0.25 Ltr/10sqm. Application of Nitozinc rich Primer @ 5 Sqm/Ltr after 24 hrs.	Sqm	245.00	523.55	128269.75
69	NS	Providing and placing in position micro-concrete which shall be cement based pre packed single component chloride free non shrink free flow self compacting ready to use after mixing water in specified proportion obtained from approve manufacturer as per specification and direction of Engineer-in-charge. (Payment under this item shall be made only after proper wet curing has been done and surface has been satisfactorily evaluated by sounding / tapping with a blunt metal instrument) self flowing non shrink micro concrete, Grade as per drawing.	Cum	52880.00	52.35	2768268.00
70	15.6	Disposal of building rubbish / malba / similar unserviceable, dismantled or waste materials by mechanical means, including loading, transporting, unloading to approved municipal dumping ground or as approved by Engineer-in-charge, beyond 50 m initial lead, for all leads including all lifts involved.	CUM	219.35	20.00	4387.00
ELECTRICAL ITEMS	0	0	0	0.00	0.00	0.00

71	BRPL	Point wiring in PVC conduit, with modular type switch : Wiring for light point fan point exhaust fan point call bell point with 1.5 sq.mm FR PVC insulated copper conductor single core cable in surface / recessed PVC conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm. FR PVC insulated copper conductor single core cable etc as required. Group B	PNT	413.00	15.00	6195.00
72	BRPL	Point wiring in PVC conduit, with modular type switch : Wiring for light point fan point exhaust fan point call bell point with 1.5 sq.mm FR PVC insulated copper conductor single core cable in surface / recessed PVC conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm. FR PVC insulated copper conductor single core cable etc as required. Group C	PNT	504.00	15.00	7560.00
73	BRPL	Circuit/sub-main wiring in PVC conduit : Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of PVC insulated copper conductor, single core cable in surface/ recessed PVC conduit as required-2 X 2.5 sq. mm + I X 2.5 sq. mm earth wire	M	115.00	60.00	6900.00
74	BRPL	Circuit/sub-main wiring in PVC conduit : Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of PVC insulated copper conductor, single core cable in surface/ recessed PVC conduit as required-2 X 4 sq. mm + 1 X 4 sq. mm earth wire	M	132.00	40.00	5280.00
75	BRPL	S / F light plug point modular type accessories : Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 amps modular socket outlet and 5/6 amps modular switch, connection. painting etc. as required. (For light plugs to be used in non residential buildings).	Ea	260.00	5.00	1300.00
76	BRPL	S/F power plug point modular type accessories : Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 6 pin 15 / 16 & 5 / 6 amps modular socket outlet and 15 / 1 6 amps modular switch, connection, painting etc. as required.	Ea	349.00	10.00	3490.00
77	BRPL	S / F 'C' series, SP MCB : Supplying and fixing 5 amps to 32 amps rating, 240 volts, 'C' series, miniature circuit breaker, suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required-Single Pole	Ea	130.00	6.00	780.00
78	BRPL	Providing and fixing, Testing & commissioning of 450mm dia heavy duty Exhaust Fan with louver of approved make.(crompton greaves)	Ea	3305.00	8.00	26440.00

79	BRPL	Providing and fixing ceiling fan 48" of crompton make with five stage Electronic fan regulator of anchor make.	Ea	1742.00	6.00	10452.00
80	BRPL	Providing and fixing Exhaust Fan of size 12" of crompton approved make.	Ea	1586.00	2.00	3172.00
81	BRPL	P/F/T/C of PHILIPS make Stellar Bright LED Tube Light 20 W with Batten complete job.	Ea	530.00	20.00	10600.00
82	BRPL	Removing of fluorescent fitting from surface and re-Installation after testing and commissioning etc. complete (The cost is inclusive of rewiring of the fittings if required, labour screws rawl plug but excluding the cost of fluorescent tube rod, Starters.	Ea	63.00	10.00	630.00
83	BRPL	Dismantling / removing damaged / unservicable PVC insulated / fire resistant Aluminium / Copper conductor cables size upto 10 sqmm. from existing wooden battens / casing, caping / steel / PVC conduits or in mixture of all, including removal of wooden battens / casing, caping and disposal of the materials from the site, the cost of Aluminium / Copper so recieved is to be supplied in scrap store complete as per direction of Engineer-In-Charge.	LS	670.00	2.00	1340.00
84	BRPL	Supplying and fixing following way, horizontal type three pole and neutral, sheet steel, MCB distribution board, 415 volts, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB/RCCB/Isolator). 6 way (4 + 18), Double door.	ea	1829.00	1.00	1829.00
85	BRPL	Supplying and fixing following rating, Four pole, 415 volts, MCB in the existing MCB DB complete with connection, testing and commishioning etc. as required 63 amps	Ea	501.00	2.00	1002.00
		AMOUNT				**8294274.98**

SUBJECT : **Retro Fitting Work at 33 KV Grid Sub Station Masjid Moth**

S. No.	Ref.	Description of Item	Unit	Rate	Quantity	Amount
1	15.2.1	Demolishing cement concrete manually/ by mechanical means including disposal of material within 50 metres lead as per direction of Engineer - in - charge. Nominal concrete 1:3:6 or richer mix (i/c equivalent design mix)	Cum	2,007.10	22.00	44,156.00

2	15.7.4	Demolishing brick work manually/ by mechanical means including stacking of serviceable material and disposal of unserviceable material within 50 metres lead as per direction of Engineer-in-charge. In cement mortar	Cum	1,698.45	26.00	44,160.00
3	15.25	Dismantling stone slab flooring laid in cement mortar including stacking of serviceable material and disposal of unserviceable material within 50 metres lead.	Sqm	219.75	145.00	31,864.00
4	15.27	Demolishing mud phaska in terracing and disposal of material within 50 metres lead.	Cum	753.75	60.00	45,225.00
5	15.56	Dismantling old plaster or skirting raking out joints and cleaning the surface for plaster including disposal of rubbish to the dumping ground within 50 metres lead.	Sqm	45.05	89.00	4,009.00
6	2.8.1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil anddisposal of surplus excavated soil as directed, within a lead of 50 m. All kinds of soil	Cum	286.85	153.00	43,888.00
7	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.	Cum	253.95	154.00	39,108.00
8	4.1.8	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size)	Cum	6,326.05	15.00	94,891.00
9	5.9	Centering and shuttering including strutting, propping etc. and removal of form for:				
	5.9.5	a) Lintels, beams, plinth beams, girders, bressumers and cantilevers	Sqm	608.35	111.00	67,527.00
	5.9.6	b) Columns, Pillars, Piers, Abutments, Posts and Struts	Sqm	804.25	226.00	181,761.00
	5.9.3	c) Suspended floors, roofs, landings, balconies and access platform	Sqm	766.55	130.00	99,652.00
10	5.22.6	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete above plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.	Kg	89.65	4,056.00	363,620.00
11	6.1.2	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in foundation and plinth in: Cement mortar 1:6 (1 cement : 6 coarse sand)	Cum	6,658.25	5.00	33,291.00
12	6.4.2	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in superstructure above plinth level up to floor V level in all shapes and sizes in : Cement mortar 1:6 (1 cement : 6 coarse sand)	Cum	8,288.35	21.00	174,055.00
13	10.20	Providing and fixing bolts including nuts and washers complete.	Kg	140.15	85.00	11,913.00

14	11.3.1	Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate) finished with a floating coat of neat cement, including cement slurry, but excluding the cost of nosing of steps etc. complete.	Sqm	545.00	77.00	41,965.00
		a) 40 mm thick with 20 mm nominal size stone aggregate				
15	16.88	Providing and laying vitrified floor tiles in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS: 15622, of approved make, in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand), jointing with grey cement slurry @ 3.3 kg/ sqm including grouting the joints with white cement and matching pigments etc., complete.	Sqm	1,866.20	50.00	93,310.00
		a) Size of Tile 600x600 mm				
16	12.22	Making khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1 m x1 m x 400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges and making and finishing the outlet complete.	Each	266.60	8.00	2,133.00
17	13.1.1	12 mm cement plaster of mix : 1:6 (1 cement: 6 fine sand)	Sqm	294.85	152.00	44,817.00
18	13.2.1	15 mm cement plaster on the rough side of single or half brick wall of mix : 1:6 (1 cement: 6 fine sand)	Sqm	339.70	102.00	34,649.00
19	13.60	Wall painting with acrylic emulsion paint of approved brand and manufacture to give an even shade :	Sqm	137.85	176.00	24,262.00
	13.60.1	a) Two or more coats on new work				
20	13.80	Providing and applying white cement based putty of average thickness 1 mm, of approved brand and manufacturer, over the plastered wall surface to prepare the surface even and smooth complete.	Sqm	123.85	176.00	21,798.00
21	13.46	Finishing walls with Acrylic Smooth exterior paint of required shade :	Sqm	166.85	76.00	12,681.00
	13.46.1	a) New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm)				
22	22.7.1	Providing and laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc consisting of following operations:	Sqm	1,522.95	169.00	257,379.00
		a) Applying a slurry coat of neat cement using 2.75 kg/sqm of cement admixed with water proofing compound conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment.				

		b) Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs.				
		c) After two days of proper curing applying a second coat of cement slurry using 2.75 kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge.				
		d) Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300 mm square 3 mm deep.				
		e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test.“All above operations to be done in order and as directed and specified by the Engineer-in-Charge :				
		With average thickness of 120 mm and minimum thickness at khurra as 65 mm.				
23	24.2	Providing and fixing double scaffolding system (cup lock type) on the exterior side of building/structure, upto 25 metre height, above ground level, including additional rows of scaffolding in stepped manner as per requirement of site, made with 40mm dia M.S. tube, placed 1.5 metre centre to centre, horizontal & vertical tubes joint with cup & lock system with M.S. Tubes, M.S. tube challis, M.S. clamps and staircase system in the scaffolding for working platform etc. and maintaining it in a serviceable condition for execution of work of cleaning and/ or pointing and/ or applying chemical and removing it thereafter. The scaffolding system shall be stiffened with bracings, runners, connecting with the building etc, wherever required, if feasible, for inspection of work at required locations with essential safety features for the workmen etc., complete as per directions and approval of Engineer-in-charge.	Sqm	285.00	1,113.00	317,205.00
		Note:- (1) The elevational area of the scaffolding shall be measured for payment purpose. (2) The payment will be made once only for execution of all items for such works.				

24	26.28.2	Chipping of unsound/weak concrete material from slabs, beams, columns etc. with manual Chisel and/ or by standard power driven percussion type or of approved make including tapering of all edges, making square shoulders of cavities including cleaning the exposed concrete surface and reinforcement with wire brushes etc. and disposal of debris for all lead and lifts all complete as per direction of Engineer-In-Charge. - 50mm average thickness	Sqm	211.55	337.00	71,292.00
25	26.31.1	Providing, mixing and applying bonding coat of approved adhesive on chipped portion of RCC as per specifications and direction of Engineer-In-charge complete in all respect.SBR Polymer (@10% of cement weight) modified cementitious bond coat @ 2.2 kg cement per sqm of surface area mixed with specified proportion of approved polymer	Sqm	17.75	337.00	5,982.00
26	26.32.1	Providing, mixing and applying SBR polymer (of approved make) modified Cement mortar in proportion of 1:4 (1 cement: 4 graded coarse sand with polymer minimum 2% by wt. of cement used) as per specifications and directions of Engineer-in-charge. **Note:** Measurement and payment: The pre-measurement of thickness shall be done just after the surface preparation is completed and Payment under this item shall be made only after proper wet curing has been done and surface has been satisfactorily evaluated by sounding / tapping with a blunt metal instrument and/or the 75mm size cube crushing strength at the end of 28 days to be not less than 30 N/Sqmm2). 12 mm average thickness	Sqm	333.00	62.00	20,646.00
27	26.39	Providing and inserting 12mm dia galvanised steel injection nipple in honey comb area and along crack line including drilling of holes of required diametre (20mm to 30mm) up to depth from 30mm to 80mm at required spacing and making the hole & crack dust free by blowing compressed air, sealing the distance between injection nipple with adhesive chemical of approved make and allow it to cure complete as per direction of Engineer-In-Charge.	Each	202.70	4,366.00	884,988.00
28	26.35	Providing and injecting approved grout in proportion recommended by the manufacturer into cracks/honey-comb area of concrete/ masonry by suitable gun/pump at required pressure including cutting of nipples after curing etc. complete as per directions of Engineer-in-Charge.	Kg	793.25	175.00	138,819.00
		(The payment shall be made on the basis of actual weight of approved grout injected.)				
	26.35.3	Epoxy injection grout in concrete/RCC work of approved make				

29	NS	Clean the surface and remove any dust, unsound material, from reinforcement etc Roughen the surface and remove any laitance by light scrubbing. The concrete surfaces shall be thoroughly cleaned with wire brushes/cleaning brushes. Cleaning the existing reinforcement with wire brushes and cleaning burshes application of rust remover Rebakleen RR @ 0.25 Ltr/10sqm. Application of Nitozinc rich Primer @ 5 Sqm/Ltr after 24 hrs.	Sqm	245.40	337.00	82,700.00
30	NS	Providing and placing in position micro-concrete which shall be cement based pre packed single component chloride free non shrink free flow self compacting ready to use after mixing water in specified proportion obtained from approve manufacturer as per specification and direction of Engineer-in-charge. (Payment under this item shall be made only after proper wet curing has been done and surface has been satisfactorily evaluated by sounding / tapping with a blunt metal instrument) self flowing non shrink micro concrete, Grade as per drawing.	Cum	52,880.00	33.80	1,787,344.00
31	NS	Providing and fixing 3 mm dia (Gauge 10) stainless steel wire fabric mesh of grade SS 304 with spacing 25 mm x 25 mm in longitudenal and transverse direction to be fixed & firmly anchored to the surface of Brick masonary , stone masonary or concrete by means of stainless steel shear key or bolts including the cost of labour, tool & plants etc. complete as required for fixing as per direction of Engineer-in-charge. (Drilling of holes & shear key or bolt shall be paid seperately.)	Sqm	1,404.00	47.00	65,988.00
32	NS	Drilling suitable holes in reinforced/plain cement concrete/brick masonry/CC block masonry/stone masonry with power driven drill machine in RCC beams, lintels, columns and slabs to introduce steel bars for anchoring wire mesh including fixing the steel bars in position using epoxy resin anchor grout of approved make but excluding the cost of reinforcement, all complete as per direction of Engineer-In-Charge.	Each	90.00	526.00	47,340.00
		(i) upto and including 12 mm dia for depth above 200 mm upto 300 mm				
33	NS	Reinforcement welding to existing reinforcement	Each	27.00	150.00	4,050.00
34	NS	Fixing of rebar with hilti RE 500 V3 chemical				
	(i)	Diameter 10mm, depth 100 mm	Each	252.00	25.00	6,300.00
	(ii)	Diameter 12mm, depth 120 mm	Each	329.00	25.00	8,225.00
	(iii)	Diameter 16mm, depth 160 mm	Each	557.00	25.00	13,925.00
	(iv)	Diameter 20mm, depth 200 mm	Each	946.00	25.00	23,650.00
36	BRPL	Removal of sapling of trees from roof of s/stn by removing mud phaska of roof treatment and relaying the mud phaska as per existing level upto 2 sqm i/c disposal of malba from roof etc. complete	EA	263	10.00	2,630.00

37	14.18.1	Flush pointing with cement mortar 1:3 (1 cement : 3 fine sand) mixed with 2% of integral water proofing compound by weight of cement for flat tile bricks on top of mud phaska : With F.P.S. brick tiles	SQM	114.70	168.18	19,290.25
38	13.2.1	15 mm cement plaster on rough side of single or half brick wall of mix 1:4 (1 cement : 4 fine sand)	SQM	339.70	81.13	27,559.86
39	13.1.1	12 mm cement plaster of mix 1:4 (1 cement : 4 fine sand)	Sqm	294.85	104.35	30,767.60
40	13.41.1	Distempering with oil bound washable distemper of approved brand and manufacture to give an even shade. New work (two or more coats) over and including water thinnable priming coat with cement primer	CUM	162.55	1328.49	215,946.05
41	13.46.1	Finishing walls with Acrylic Smooth exterior paint of required shade: New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @2.20kg/10 sqm).	Sqm	166.85	592.12	98,795.22
42	13.80	Providing and applying white cement based putty of average thickness 1 mm, of approved brand and manufacturer, over the plastered wall surface to prepare the surface even and smooth complete.	sqm	123.85	2972.00	368,082.20
43	13.61.1	Painting with synthetic enamel paint of approved brand and manufacture to give an even shade :Two or more coats on new work	SQM	131.45	198.81	26,133.57
44	17.31	Providing and fixing 600x450 mm beveled edge mirror of superior glass (of approved quality) complete with 6 mm thick hard board ground fixed to wooden cleats with C.P. brass screws and washers complete.	SQM	1411.15	1.35	1,905.05
45	1.18	Disposal of moorum/building rubbish/ malba/ similar unserviceable, dismantled or waste material by mechanical transport including loading, transporting, unloading to approved municipal dumping ground for lead upto 10 km for all lifts, complete as per directions of Engineer-in-charge.	CUM	411.30	9.75	4,010.18
46	17.28.1 .1	Providing and fixing P.V.C. waste pipe for sink or wash basin including P.V.C. waste fittings complete. flexible pipe 32 mm dia.	Ea	90.95	4.00	363.80
47	18.58.1 .1	Providing and fixing PTMT (An Engineeing thermoplastic) grating of approved quality, colour and make (Prayag or equivalent) circular type 100 mm nominal dia	EA	33.20	4.00	132.80
48	18.49.1	Providing and fixing C.P. brass bib cock of approved quality conforming to IS: 8931: 15 mm nominal bore.	EA	434.20	5.00	2,171.00
49	18.53.1	Providing and fixing C.P. brass angle valve for basin mixer and geyser points of approved quality conforming to IS:8931, 15mm nominal bore	EA	500.35	4.00	2,001.40
50	18.21.1 .1	Providing and fixing uplasticised PVC connection pipe with brass unions: 45 cm length, 15 mm NB	Ea	74.80	4.00	299.20

51	12.22	Making khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20mm nominal size) over P.V.C. sheet 1mx 1mx400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement rounding the edges and making and finishing the outlet complete.	Ea	266.60	5.00	1,333.00
52	14.5.2	Renewing glass panes, with putty and nails wherever necessary including racking out the old putty: Float glass panes of thickness 5 mm (weight not less than 12.5kg/sqm)	Sqm	1245.15	21.33	26,559.05
		Electrical work				
53	BRPL	Point wiring in PVC conduit, with modular type switch : Wiring for light point! fan point! exhaust fan point! call bell point with 1.5 sq.mm FR PVC insulated copper conductor single core cable in surface / recessed PVC conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm. FR PVC insulated copper conductor single core cable etc as required.Group B	Point	413.00	30.00	12,390.00
54	BRPL	Point wiring in PVC conduit, with modular type switch : Wiring for light point! fan point! exhaust fan point! call bell point with 1.5 sq.mm FR PVC insulated copper conductor single core cable in surface / recessed PVC conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm. FR PVC insulated copper conductor single core cable etc as required.Group C	Point	504.00	30.00	15,120.00
55	BRPL	Circuit! sub-main wiring in PVC conduit : Wiring for circuit submain wiring alongwith earth wire with the following sizes of PVC insulated copper conductor, single core cable in surface/ recessed PVC conduit as required 2 X 2.5 sq. mm + I X 2.5 sq. mm earth wire	Metre	115.00	100.00	11,500.00
56	BRPL	Circuit! sub-main wiring in PVC conduit : Wiring for circuit submain wiring alongwith earth wire with the following sizes of PVC insulated copper conductor, single core cable in surface/ recessed PVC conduit as required 2 X 4 sq. mm + I X 4 sq. mm earth wire	Metre	132.00	40.00	5,280.00
57	BRPL	S / F light plug point modular type accessories : Supplying and .fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 amps modular socket outlet and 5/6 amps modular switch, connection. painting etc. as required. (For light plugs to be used in non residential buildings).	Each.	260.00	18.00	4,680.00
58	BRPL	S / F power plug point modular type accessories : Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and .fixing 6 pin 15 / 16 & 5 / 6 amps modular socket outlet and 15 / 1 6 amps modular switch, connection, painting etc. as required.	Each.	349.00	25.00	8,725.00

59	BRPL	S / F 'C' series. SP MCB : Supplying and fixing 5 amps to 32 amps rating, 240 volts. 'C' series, miniature circuit breaker suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required. : Single pole	Each.	130.00	10.00	1,300.00
60	BRPL	Providing and fixing Testing & commissioning of 450mm dia heavy duty Exhaust Fan with louver of approved make.(crompton greaves)	Each	3305.00	15.00	49,575.00
61	BRPL	Providing and fixing Exhaust Fan of size 12" of crompton approved make.	Ea	1586.00	2.00	3,172.00
62	BRPL	Providing and fixing ceiling fan 48" of crompton make with five stage Electronic fan regulator of anchor make.	Ea	1742.00	6.00	10,452.00
63	BRPL	P/F/T/C of PHILIPS make Stellar Bright LED Tube Light 20 W with Batten complete job.	Each	530.00	35.00	18,550.00
64	BRPL	Dismantling / removing damaged / unserviceable PVC insulated / fire resistant Aluminum / Copper conductor cables size unto 10 sqmm. from existing wooden battens / casing, capping / steel / PVC conduits or in mixture of all, including removal of wooden battnes / casing, caping and disposal of the the materials from the site. The Aluminiun / Copper so recieved is to be returned to scrap store complete as per direction of Engineer-In-Charge.(For buildings having area up to 5000 SFT)	LS	670.00	2.00	1,340.00
65	BRPL	Supplying and fixing following way, horizontal type three pole and neutral, sheet steel, MCB distribution board, 415 volts, on surface/ recess, complete with bar, earth bar, din bar, interconnections, powder painted tinned copper bus bar, neutral bus including earthing etc. as required. (But without MCB/ RCCB/Isolator): 6 way(4+18) double door	each	990.00	2.00	1,980.00
		AMOUNT				**6,262,612.23**

SUBJECT		**Retrofitting work at 33kv grid S/stn Bhikaji kama Place**				
S. No	**Ref.**	**Description of item**	**Unit**	**Rate**	**Qty.**	**Amount**
1	15.2.1	Demolishing cement concrete manually/ by mechanical means including disposal of material within 50 metres lead as per direction of engineer in charge. Nominal concrete: 1:3:6 or richer mix (i/c equivalent design mix)	Cum	2007.10	23.11	46384.08
2	15.7.4	Demolishing brick work manually/ by mechanical means including stacking of serviceable material and disposal of unserviceable material within 50 metres lead as per direction of Engineer-in-charge. In cement mortar	Cum	1698.45	20.40	34648.38
3	15.25	Dismantling stone slab flooring laid in cement mortar including stacking of serviceable material and disposal of unserviceable material within 50 metres lead.	Sqm	219.75	149.29	32806.48
4	15.27	Demolishing mud phaska in terracing and disposal of material within 50 metres lead.	Cum	753.75	75.60	56983.50

5	2.8.1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil anddisposal of surplus excavated soil as directed, within a lead of 50 m. All kinds of soil	Cum	286.85	133.81	38383.40
6	2.25	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.	Cum	253.95	133.81	33981.05
7	2.27	Supplying and filling in plinth with sand under floors, including watering, ramming, consolidating and dressing complete.	Cum	2161.20	9.13	19731.76
8	6.1.2	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in foundation and plinth in cement mortar 1:6 (1 cement : 6 coarse sand)	CUM	6658.25	5.24	34889.23
9	6.4.1	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in superstructure above plinth level up to floor V level in all shapes and sizes in : Cement mortar 1:4 (1 cement : 4 coarse sand)	Cum	8512.10	15.16	129043.44
10	4.1.8	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering- All work upto plinth level 1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size)	CUM	6326.05	21.76	137654.85
11	4.1.3	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering- All work upto plinth level 1:2:4 (1 Cement : 2 Coarse Sand : 4 Graded stone agg. 20 mm nominal size)	CUM	7365.15	4.17	30712.68
12	11.3.1	Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate) finished with a floating coat of neat cement including cement slurry, but excluding the cost of nosing of steps etc. complete. 40 mm thick with 20 mm nominal size stone aggregate	Sqm	545.00	125.24	68255.80
13	5.9.5	Centering and shuttering including strutting, propping etc. and removal of form for: Lintels, beams, plinth beams, girders, bressumers and cantilevers	Sqm	608.35	365.61	222418.84
14	5.9.6	Centring and shuttering including strutting, propping etc. and removal of form work for Columns, piers, abutments, pillars, posts and struts	SQM	804.25	187.20	150555.60

15	5.9.3	Centring and shuttering including strutting, propping etc. and removal of form work for Suspended floors, roofs, landings, balconies and access platform	SQM	766.55	72.00	55191.60
16	5.22.6	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete. Thermo-Mechanically Treated bars of grade Fe-500D or more.	KG	89.65	6633.60	594702.24
17	15.23.1	Dismantling tile work in floors and roofs laid in cement mortar including stacking material within 50 metres lead:For thickness of tiles 10 mm to 25 mm	Sqm	60.50	32.40	1960.20
18	11.38	Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer), of 1st quality conforming to IS : 15622, of approved make, in all colours, shades, except White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick bed of cement mortar 1:4 (1 Cement : 4 Coarse sand), jointing with grey cement slurry @ 3.3 kg/ sq.m including pointing the joints with white cement and matching pigments etc., complete.	Sqm	1107.05	17.70	19594.79
19	8.31	Providing and fixing Ist quality ceramic glazed wall tiles conforming to IS : 15622 (thickness to be specified by the manufacturer) of approved make in all colours, shade except burgundy, bottle green, black of any size as approved by Enigineer-in-Charge in skirting, risers of steps and dados over 12 mm thick bed of Cement Mortar 1:3 (1 Cement : 3 Coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm including pointing in white cement mixed with pigment of matching shade complete.	Sqm	1063.45	65.10	69230.60
20	11.41.2	Providing and laying vitrified floor tiles in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS: 15622, of approved make, in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand), jointing with grey cement slurry @ 3.3 kg/ sqm including grouting the joints with white cement and matching pigments etc., complete. Size of Tile 600x600 mm	Sqm	1416.65	62.44	88455.63

21	12.22	Making khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1 m x1 m x 400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges and making and finishing the outlet complete.	Ea	266.60	7.00	1866.20
22	13.33.1	Pointing on stone work with cement mortar 1:3 (1 cement : 3 fine sand) : Flush/ Ruled pointing	Sqm	319.35	102.80	32829.18
23	14.1.2	Repairs to plaster of thickness 12 mm to 20 mm in patches of area 2.5 sq.meters and under, including cutting the patch in proper shape, raking out joints and preparing and plastering the surface of the walls complete, including disposal of rubbish to the dumping ground, all complete as per direction of Engineer-in-Charge. With cement mortar 1:4 (1cement: 4 coarse sand)	Sqm	478.00	20.00	9560.00
24	13.4.1	12 mm cement plaster of mix 1:4 (1 cement: 4 coarse sand)	Sqm	307.25	105.40	32384.15
25	13.2.1	15 mm cement plaster on rough side of single or half brick wall of mix: 1:4 (1 cement: 4 fine sand)	Sqm	339.70	70.27	23870.72
26	13.91	Removing dry or oil bound distemper water proofing cement paint and the like by scrapping, sand papering and preparing the surface smooth including necessary repairs to scratches etc. complete.	Sqm	20.85	1176.73	24534.82
27	13.8	Providing and applying white cement based putty of average thickness 1 mm, of approved brand and manufacturer, over the plastered wall surface to prepare the surface even and smooth complete.	sqm	123.85	1352.40	167494.74
28	13.41.1	Distempering with oil bound washable distemper of approved brand and manufacture to give an even shade. New work (two or more coats) over and including water thinnable priming coat with cement primer	SQM	162.55	1299.70	211266.24
29	13.46.1	Finishing walls with Acrylic Smooth exterior paint of required shade: New work (Two or more coat applied @ 1.67 ltr/10 sqm over and including priming coat of exterior primer applied @2.20kg/10 sqm).	Sqm	168.85	1104.47	186489.76
30	13.99.1	Painting with synthetic enamel paint of approved brand and manufacture to give an even shade one or more coats on old work.	SQM	86.55	158.12	13685.29
31	15.12.1	Dismantling doors, windows and clerestory windows (steel or wood) shutter including chowkhats, architrave, holdfasts etc. complete and stacking within 50 metres lead: Of area 3 sq. metres and below	Ea	302.70	28.00	8475.60

32	15.12.2	Dismantling doors, windows and clerestory windows (steel or wood) shutter including chowkhats, architrave, holdfasts etc. complete and stacking within 50 metres lead: Of area beyond 3 sq. metres	Ea	414.55	2.00	829.10
33	21.1.1.2	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS:733 and IS:1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing/panelling, C.P.brass/stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, panelling and dash fasteners to be paid for separately): For Fixed portion. Powder coated aluminium (minimum thickness of powder coating 50 micron)	KG	466.30	379.45	176937.54
34	21.1.2.2	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size including necessary filling up the gaps at junctions ie. at top , bottom and sides with required EDPM rubber/neoprene gasket etc . Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing/panelling, C.P. brass/stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing panelling and dash fasteners to be paid for separately.) For shutters of doors, windows & ventilators including providing and fixing hinges/pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber/ neoprene gasket required (Fittings shall be paid for separately.) Powder coated aluminium (minimum thickness of powder coating 50 micron)	KG	564.80	364.36	205790.53
35	9.101.2	Providing and fixing aluminium hanging floor door stopper ISI marked anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour and shade with necessary screws etc complete. Twin rubber stopper	EA	62.25	12.00	747.00

36	9.96.2	Providing and fixing aluminium sliding door bolts ISI marked anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade with nuts and screws etc. complete : 250x16 mm	EA	234.90	6.00	1409.40
37	9.97.2	Providing and fixing aluminium tower bolts ISI marked anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade with necessary screws etc. complete: 250x10 mm	EA	104.40	46.00	4802.40
38	9.100.1	Providing and fixing aluminium handles ISI marked anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade with necessary screws etc. complete: 125 mm	EA	60.05	46.00	2762.30
39	21.2.2	Providing and fixing 12 mm thick prelaminated particle board flat pressed three layer or graded wood partilce board confirming to IS 12823 Grade I, Type II in panelling fixed in aluminium doors, windows shutters and partition frames with C.P. brass / stainless steel screws etc. complete as per architectural drawings and directions of engineer-in-charge. Prelaminated particle board with decorative lamination on both sides.	SQM	951.05	26.34	25050.66
40	21.3.2	Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge . (Cost of aluminium snap beading shall be paid in basic item). With float glass panes of 5 mm thickness (weight not less than 12.50 kg/sqm)	SQM	1325.55	56.78	75264.73
41	21.15.3	Providing fixing aluminium casement windows fastener of required length for aluminium windows with necessary screws etc. complete. Polyester powder coated minimum thickness 50 micron aluminium.	Each	78.25	40.00	3130.00
42	17.31	Providing and fixing 600x450 mm beveled edge mirror of superior glass (of approved quality) complete with 6 mm thick hard board ground fixed to wooden cleats with C.P. brass screws and washers complete.	SQM	1411.15	0.90	1270.04
43	BRPL W.O. 2356 2412	Providing and laying epoxy flooring by cleaning existing floor, laying epoxy base and epoxy paint 2mm Thick	Sqm	600.00	154.15	92490.00
44	BRPL W.O. 2356 2412	Providiing & applying demarkation line up to 10 cm width of approved colour with epoxy paint all complete as per direction of engineer incharge.	M	33.60	74.80	2513.28

45	15.6	Disposal of building rubbish / malba / similar unserviceable, dismantled or waste materials by mechanical means, including loading, transporting, unloading to approved municipal dumping ground or as approved by Engineer-in-charge, beyond 50 m initial lead, for all leads including all lifts involved.	CUM	219.35	38.11	8359.43
46	17.28.2.1	Providing and fixing P.V.C. waste pipe for sink or wash basin including P.V.C. waste fittings complete. flexible pipe 32 mm dia.	Ea	104.35	4.00	417.40
47	BRPL 522	P/F of CP jali of appd design and shape: 100 mm dia.	Ea	81.00	4.00	324.00
48	18.52.1	Providing and fixing C.P. brass stop cock (concealed) of standard design and of approved make conforming to IS:8931: 15 mm nominal bore.	EA	594.75	2.00	1189.50
49	18.49.1	Providing and fixing C.P. brass bib cock of approved quality conforming to IS: 8931: 15 mm nominal bore.	EA	434.20	3.00	1302.60
50	18.7.1	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge.Internal work - Exposed on wall : 15 mm nominal dia Pipes	M	255.90	5.00	1279.50
51	18.7.2	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge.Internal work - Exposed on wall : 20 mm nominal outer dia Pipes.	M	325.10	5.00	1625.50
52	18.50.1	Providing and fixing C.P. brass long nose bib cock of approved quality conforming to IS standards and weighing not less than 810 gms : 15 mm nominal bore.	EA	715.05	2.00	1430.10
53	14.4.1	Making the opening in brick masonry including dismantling in floor or walls by cutting masonry and making good the damages to walls, flooring and jambs complete, to match existing surface i/c disposal of mulba/ rubbish to the nearest municipal dumping ground, allcomplete as per direction of Engineer-in-Charge. For door/ window/ clerestory window	Ea	1046.95	6.00	6281.70

54	BRPL 143	Repairing of rolling shutter / rolling grills by oiling , greasing of moving / sliding parts, lowering down the shutter for necessary repair like setting right the alignment, replacing any number of old, damaged ends locks straightening of bent up shaft, tightening of spring, welding of any number of springs, welding of any numbers of broken flats, hold fasts sliding bolts / handles etc. wherever required including re-errecting the rolling shutter / rolling grill in position, fixing of top cover properly and providing and fixing new wooden gitties, nails / screws and nuts and bolts etc. as required.	EA	934.00	4.00	3736.00
55	10.2	Providing and fixing bolts including nuts and washers complete.	Kg	140.15	150.72	21123.41
56	22.7.1	Providing and laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc consisting of following operations: a) Applying a slurry coat of neat cement using 2.75 kg/sqm of cement admixed with water proofing compound conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment. b) Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs. c) After two days of proper curing applying a second coat of cement slurry using 2.75 kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge. d) Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300 mm square 3 mm deep. e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test.“All above operations to be done in order and as directed and specified by the	Sqm	1522.95	216.02	328987.66

		Engineer-in-Charge : With average thickness of 120 mm and minimum thickness at khurra as 65 mm.				
57	24.2	Providing and fixing double scaffolding system (cup lock type) on the exterior side of building/structure, upto 25 metre height, above ground level, including additional rows of scaffolding in stepped manner as per requirement of site, made with 40mm dia M.S. tube, placed 1.5 metre centre to centre, horizontal & vertical tubes joint with cup & lock system with M.S. Tubes, M.S. tube challis, M.S. clamps and staircase system in the scaffolding for working platform etc. and maintaining it in a serviceable condition for execution of work of cleaning and/ or pointing and/ or applying chemical and removing it thereafter. The scaffolding system shall be stiffened with bracings, runners, connecting with the building etc, wherever required, if feasible, for inspection of work at required locations with essential safety features for the workmen etc., complete as per directions and approval of Engineer-in-charge. Note:- (1) The elevational area of the scaffolding shall be measured for payment purpose. (2) The payment will be made once only for execution of all items for such works.	Sqm	285.00	1779.84	507254.40

58	26.28.2	Chipping of unsound/weak concrete material from slabs, beams, columns etc. with manual Chisel and/ or by standard power driven percussion type or of approved make including tapering of all edges, making square shoulders of cavities including cleaning the exposed concrete surface and reinforcement with wire brushes etc. and disposal of debris for all lead and lifts all complete as per direction of Engineer-In-Charge. - 50mm average thickness	Sqm	211.55	552.81	116946.96
59	26.31.1	Providing, mixing and applying bonding coat of approved adhesive on chipped portion of RCC as per specifications and direction of Engineer-In-charge complete in all respect. SBR Polymer (@10% of cement weight) modified cementitious bond coat @ 2.2 kg cement per sqm of surface area mixed with specified proportion of approved polymer	Sqm	117.75	552.81	65093.38
60	26.32.1	Providing, mixing and applying SBR polymer (of approved make) modified Cement mortar in proportion of 1:4 (1 cement: 4 graded coarse sand with polymer minimum 2% by wt. of cement used) as per specifications and directions of Engineer-in-charge. Note: Measurement and payment: The pre-measurement of thickness shall be done just after the surface preparation is completed and Payment under this item shall be made only after proper wet curing has been done and surface has been satisfactorily evaluated by sounding / tapping with a blunt metal instrument and/or the 75mm size cube crushing strength at the end of 28 days to be not less than 30 N/Sqmm2). 12 mm average thickness.	Sqm	333.00	77.62	25847.46
61	26.39	Providing and inserting 12mm dia galvanised steel injection nipple in honey comb area and along crack line including drilling of holes of required diametre (20mm to 30mm) up to depth from 30mm to 80mm at required spacing and making the hole & crack dust free by blowing compressed air, sealing the distance between injection nipple with adhesive chemical of approved make and allow it to cure complete as per direction of Engineer-In-Charge.	Sqm	202.70	5788.33	1173294.49

62	26.35.3	Providing and injecting approved grout in proportion recommended by the manufacturer into cracks/honey-comb area of concrete/ masonry by suitable gun/pump at required pressure including cutting of nipples after curing etc. complete as per directions of Engineer-in-Charge. (The payment shall be made on the basis of actual weight of approved grout injected.) Epoxy injection grout in concrete/RCC work of approved make	Kg	793.25	231.53	183661.17
63	NS	Providing and fixing 3 mm dia (Gauge 10) stainless steel wire fabric mesh of grade SS 304 with spacing 25 mm x 25 mm in longitudenal and transverse direction to be fixed & firmly anchored to the surface of Brick masonary , stone masonary or concrete by means of stainless steel shear key or bolts including the cost of labour, tool & plants etc. complete as required for fixing as per direction of Engineer-in-charge. (Drilling of holes & shear key or bolt shall be paid seperately.)	Sqm	1404.00	58.22	81740.88
64	NS	Drilling suitable holes in reinforced/plain cement concrete/brick masonry/CC block masonry/stone masonry with power driven drill machine in RCC beams, lintels, columns and slabs to introduce steel bars for anchoring wire mesh including fixing the steel bars in position using epoxy resin anchor grout of approved make but excluding the cost of reinforcement, all complete as per direction of Engineer-In-Charge. upto and including 12 mm dia for depth above 200 mm upto 300 mm	Ea	90.00	628.00	56520.00
65	NS	Clean the surface and remove any dust, unsound material, from reinforcement etc Roughen the surface and remove any laitance by light scrubbing. The concrete surfaces shall be thoroughly cleaned with wire brushes/cleaning brushes. Cleaning the existing reinforcement with wire brushes and cleaning burshes application of rust remover Rebakleen RR @ 0.25 Ltr/10sqm. Application of Nitozinc rich Primer @ 5 Sqm/Ltr after 24 hrs.	Sqm	245.00	552.81	135438.45

66	NS	Providing and placing in position micro-concrete which shall be cement based pre packed single component chloride free non shrink free flow self compacting ready to use after mixing water in specified proportion obtained from approve manufacturer as per specification and direction of Engineer-in-charge. (Payment under this item shall be made only after proper wet curing has been done and surface has been satisfactorily evaluated by sounding / tapping with a blunt metal instrument) self flowing non shrink micro concrete, Grade as per drawing.	Cum	52880.00	55.28	2923206.40
67	BRPL	Recovery on account of disposal of : AS IS WHERE IS bases after demolishing of the damaged unserviceable steel members / sheet etc. of different size from the site as per direction of Engineer-In-Charge.	Kg	-23.00	250.00	0.00
68	BRPL W.O. 2356 5107	Point wiring in PVC conduit, with modular type switch : Wiring for light point! fan point! exhaust fan point! call bell point with 1.5 sq.mm FR PVC insulated copper conductor single core cable in surface / recessed PVC conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm. FR PVC insulated copper conductor single core cable etc as required.Group B	Point	413.00	15.00	6195.00
69	BRPL W.O. 2356 5107	Point wiring in PVC conduit, with modular type switch : Wiring for light point! fan point! exhaust fan point! call bell point with 1.5 sq.mm FR PVC insulated copper conductor single core cable in surface / recessed PVC conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm. FR PVC insulated copper conductor single core cable etc as required.Group C	Point	504.00	30.00	15120.00
70	BRPL W.O. 2356 5107	Circuit! sub-main wiring in PVC conduit : Wiring for circuit submain wiring alongwith earth wire with the following sizes of PVC insulated copper conductor, single core cable in surface/ recessed PVC conduit as required 2 X 2.5 sq. mm + I X 2.5 sq. mm earth wire	Mtr	115.00	35.00	4025.00
71	BRPL W.O. 2356 5107	Circuit! sub-main wiring in PVC conduit : Wiring for circuit submain wiring alongwith earth wire with the following sizes of PVC insulated copper conductor, single core cable in surface/ recessed PVC conduit as required 2 X 4 sq. mm + I X 4 sq. mm earth wire	Mtr	132.00	15.00	1980.00

72	BRPL W.O. 2356 5107	S / F light plug point modular type accessories : Supplying and .fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 amps modular socket outlet and 5/6 amps modular switch, connection. painting etc. as required. (For light plugs to be used in non residential buildings).	Ea	260.00	8.00	2080.00
73	BRPL W.O. 2356 5107	S / F power plug point modular type accessories : Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and .fixing 6 pin 15 / 16 & 5 / 6 amps modular socket outlet and 15 / 1 6 amps modular switch, connection, painting etc. as required.	Each.	349.00	10.00	3490.00
74	BRPL W.O. 2356 5107	S / F 'C' series. SP MCB : Supplying and fixing 5 amps to 32 amps rating, 240 volts. 'C' series, miniature circuit breaker suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required. : Single pole	Each.	130.00	6.00	780.00
75	BRPL W.O. 2356 5107	Providing and fixing Testing & commissioning of 450mm dia heavy duty Exhaust Fan with louver of approved make.(crompton greaves)	Each	3305.00	6.00	19830.00
76	BRPL W.O. 2356 5107	Providing and fixing ceiling fan 48" of crompton make with five stage Electronic fan regulator of anchor make.	Ea	1742.00	6.00	10452.00
77	BRPL W.O. 2356 5107	Providing and fixing Exhaust Fan of size 12" of approved make.	Each	1586.00	2.00	3172.00
78	BRPL W.O. 2356 5107	Providing & fixing of philips make stellar bright LED TUBE LIGHT 20W with batten complete job	Each	530.00	30.00	15900.00
79	BRPL W.O. 2356 5107	Removing of fluorescent fitting from surface and re-Installation after testing and commissioningetc. complete (The cost is inclusive of rewiring of the fittings if required, labour screws rawl plug but excluding the cost of fluorescent tube rod, Starters.	Each.	63.00	25.00	1575.00

80	BRPL W.O. 2356 5107	Dismantling / removing damaged / unserviceable PVC insulated / fire resistant Aluminum / Copper conductor cables size unto 10 sqmm. from existing wooden battens / casing, capping / steel / PVC conduits or in mixture of all, including removal of wooden battnes / casing, caping and disposal of the the materials from the site. The Aluminiun / Copper so recieved is to be returned to scrap store complete as per direction of Engineer-In-Charge.(For buildings having area up to 5000 SFT)	LS	670.00	1.00	670.00
81	BRPL W.O. 2356 5107	Supplying and fixing following way, horizontal type three pole and neutral, sheet steel, MCB distribution board, 415 volts, on surface/ recess, complete with bar, earth bar, din bar, interconnections, powder painted tinned copper bus bar, neutral bus including earthing etc. as required. (But without MCB/ RCCB/Isolator): 6 way(4+18) double door	each	1829.00	1.00	1829.00
82	BRPL W.O. 2356 5107	Supplying and fixing following rating, four pole, 415 volts, isolator in the existing MCB DB complete with connections, testing and commissioning etc. as required. 63Amp	each	501.00	2.00	1002.00
83	BRPL W.O. 2356 5107	Supplying and fixing 63 AmpS, TP, 10KA, 415 volts, MCB of approved make in the existing MCB DB complete with connections, testing and commissioning etc.	each	1144.00	1.00	1144.00
		Amount				**8905342.16**

CHAPTER – 5

RESULT AND CONCLUSIONS

1. Seismic provisions have to be provided as given under repair categories.

2. Concrete strength to be improved to M15 by injection grouting in beams and slabs.

3. Service Pipeline to be replaced or repaired.

4. Water proofing to be done on terrace.

On the basis of the observations and tests, it is concluded that structural health of the building is found to be unsatisfactory due to low UPV values and noncompliance of seismic provisions as per IS 1893:2016 in the building. Injection grouting shall be done immediately to improve UPV values and regain strength and to fill the voids. UPV tests should be repeated after grouting to check the values and insure proper grouting. Non-structural repair such as repair/replacement of damaged service pipe line, Roof treatment, re plastering of damaged plaster and painting shall be carried out as routine work for safety and stability of the structure. However, for long term use and its safety and stability during earthquake seismic provisions as per IS 15988:2013 shall be incorporated as recommended in this report.

CHAPTER-6

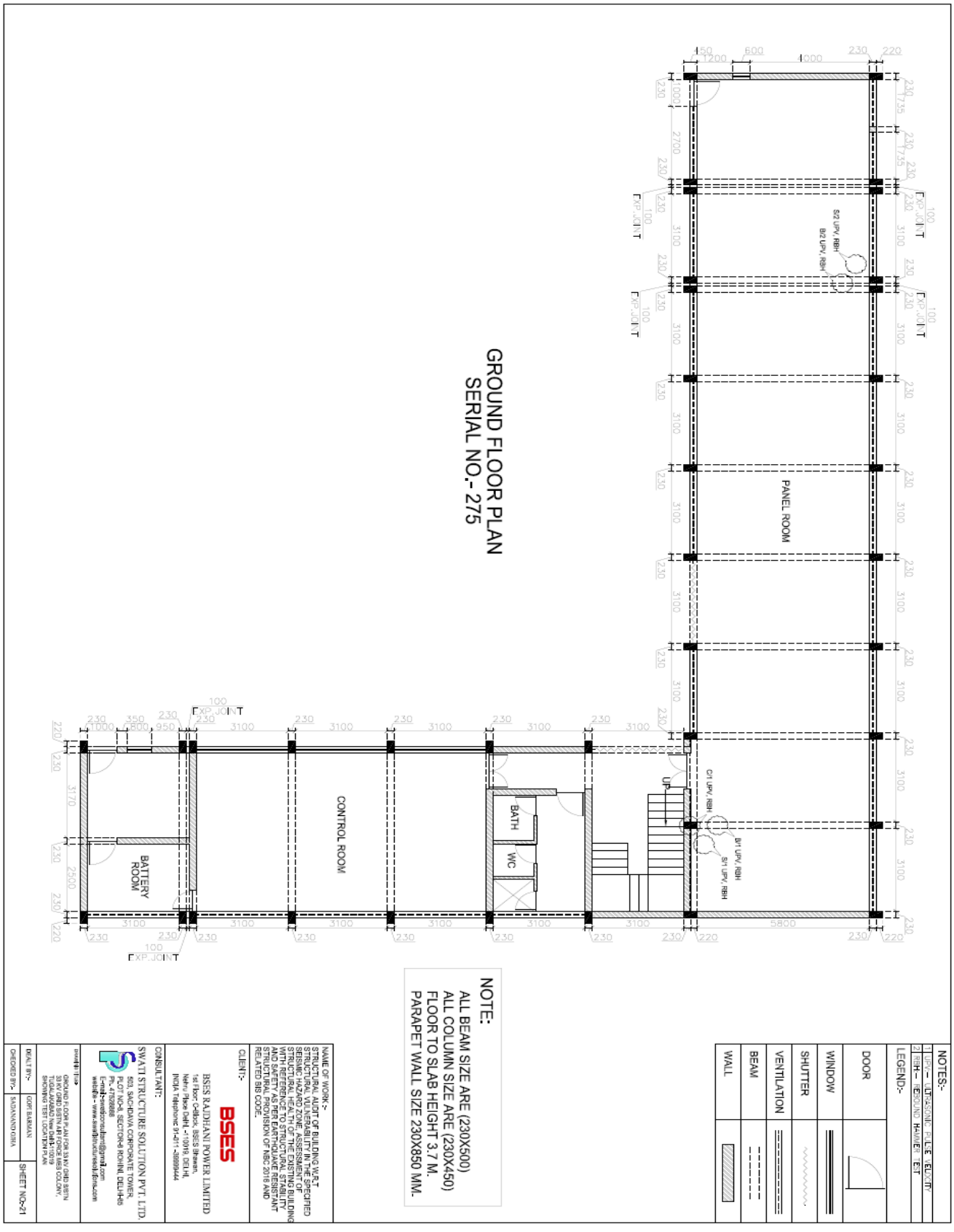
REFERENCES

1. F08a Guideline for the Assessment of Existing Structures "SAMCO". SAMCO final report 2006
Dir. u. Prof. Dr. W. Rücker, Dipl.-Ing. F. Hille, Dipl.-Ing. R. Rohrmann
Federal Institute of Materials Research and Testing (BAM), Division VII.2 Buildings and Structures
Unter den Eichen 87, 12205 Berlin, Germany

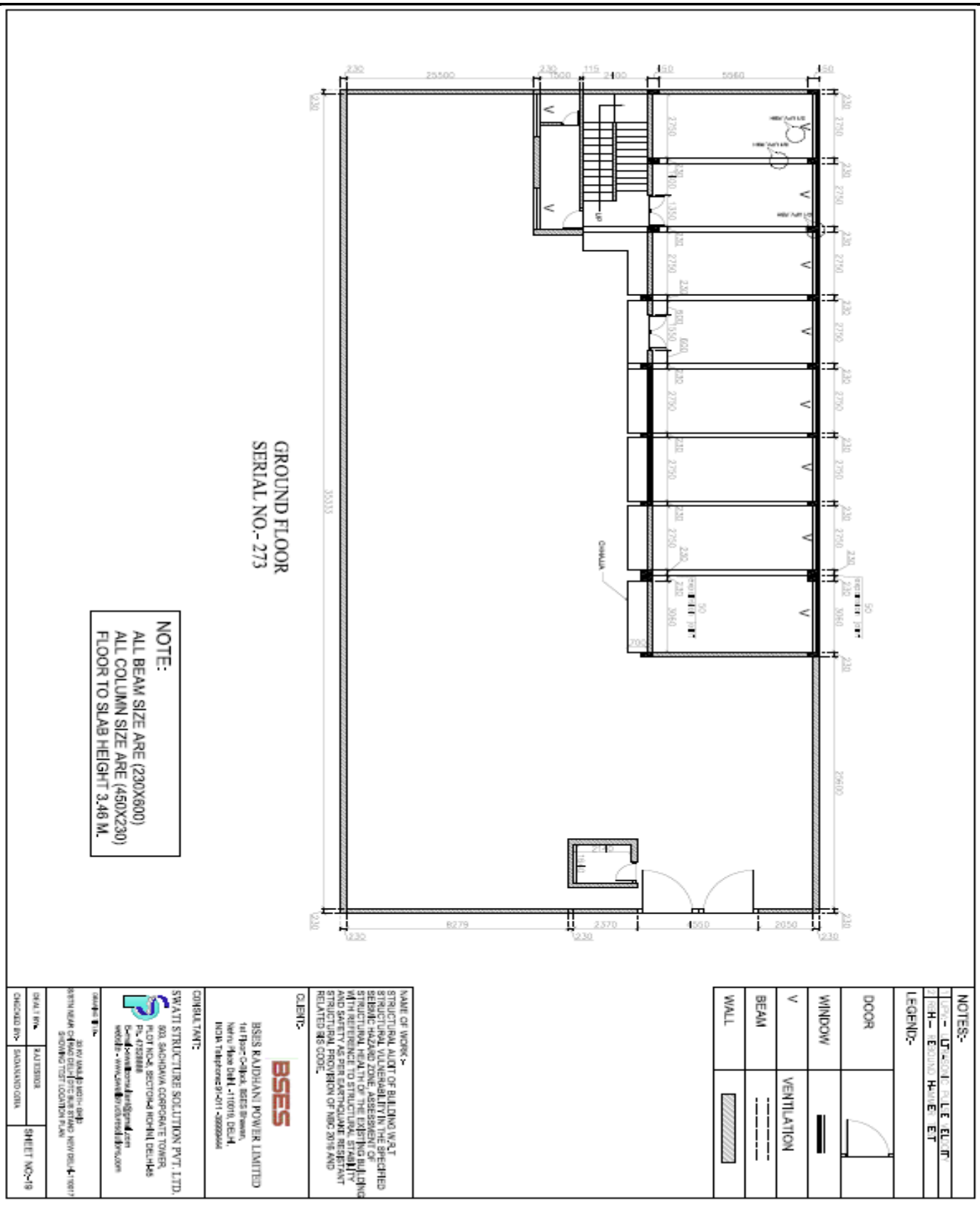
2. BASICS FOR ASSESSMENT OF EXISTING STRUCTURES.
Writers: Milan Holický, Vladislava Návarová, Roman Gottfried, Michal Kronika, Jana Marková, Miroslav Sýkora, Karel Jung
Editors: Milan Holický, Klokner Institute, Czech Technical University in Prague, Czech Republic
Published by: Klokner Institute, Czech Technical University in Prague, Šolínova 7, 166 08 Prague 6, Czech Republic

ANNEXURE-A

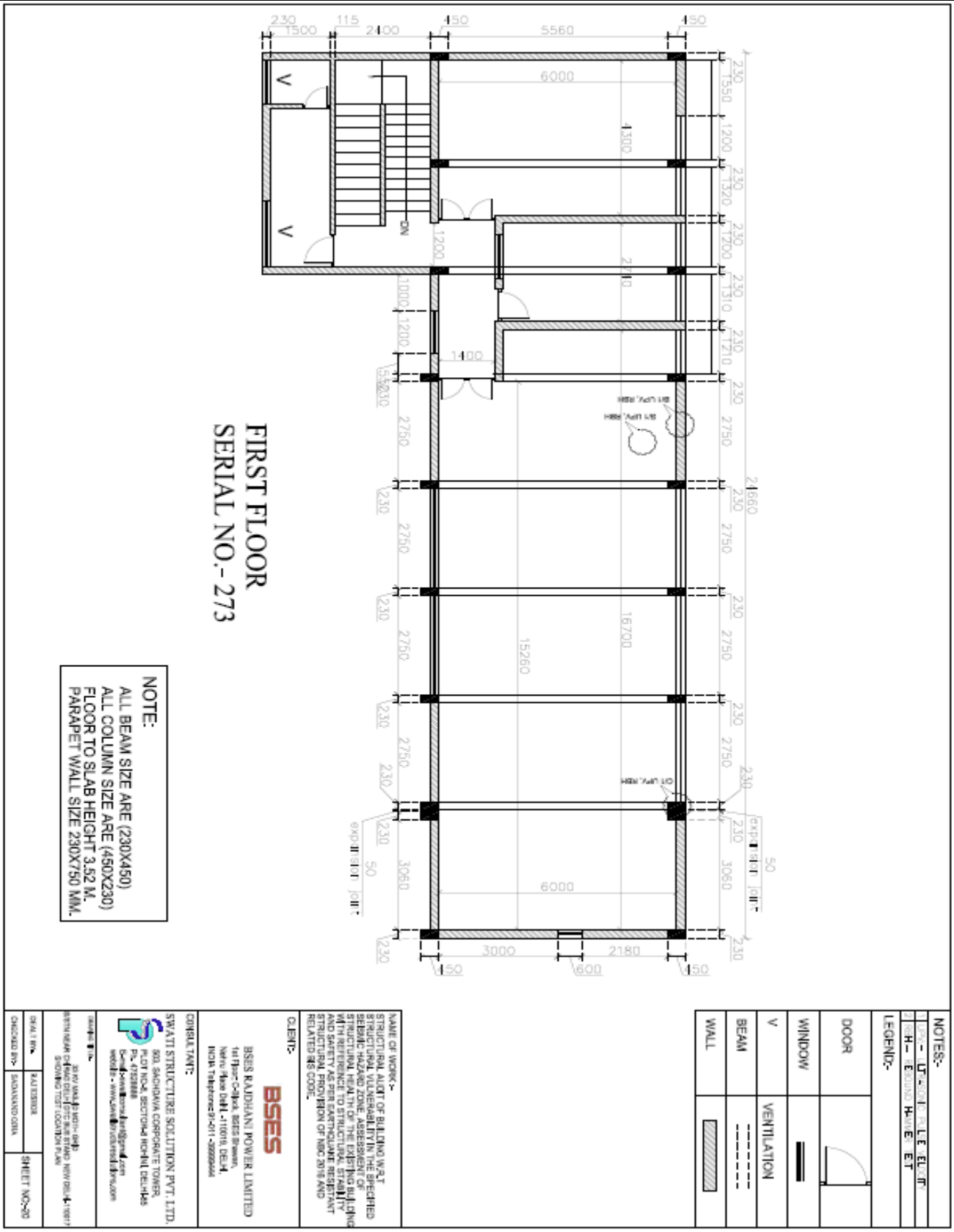
DRAWINGS SHOWING TEST LOCATIONS



Tughlakabad Grid



Masjid Moth Grid



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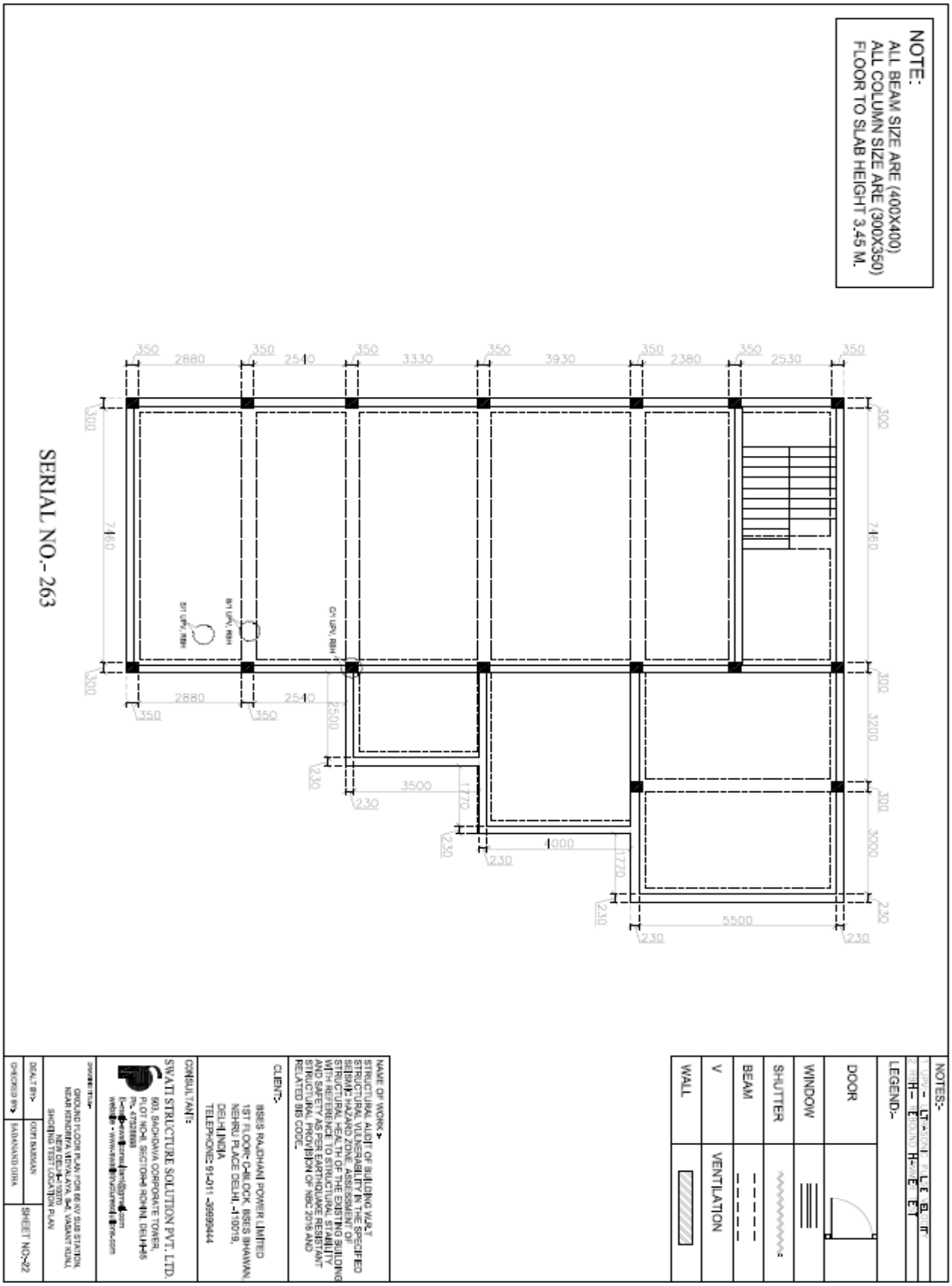
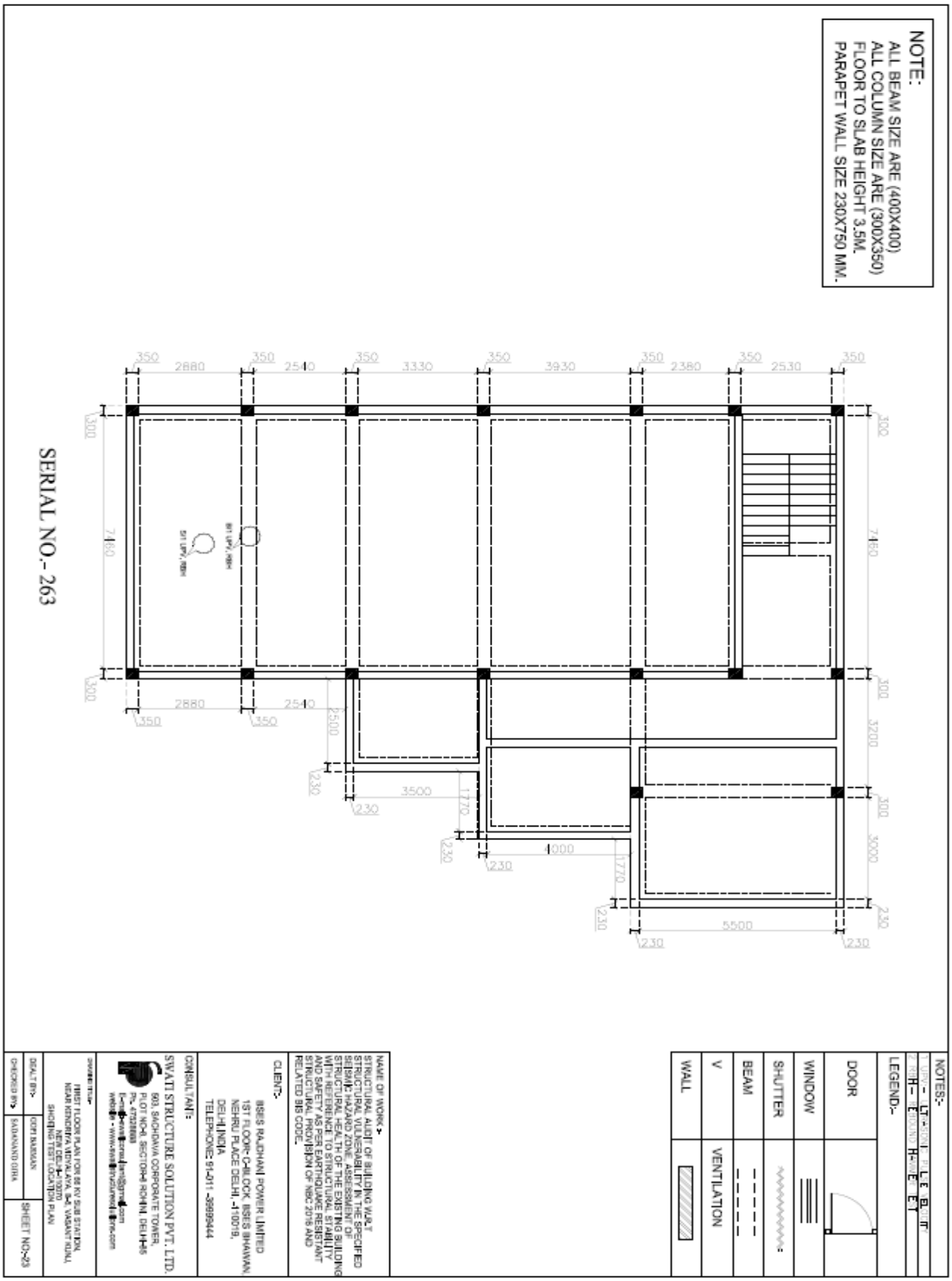


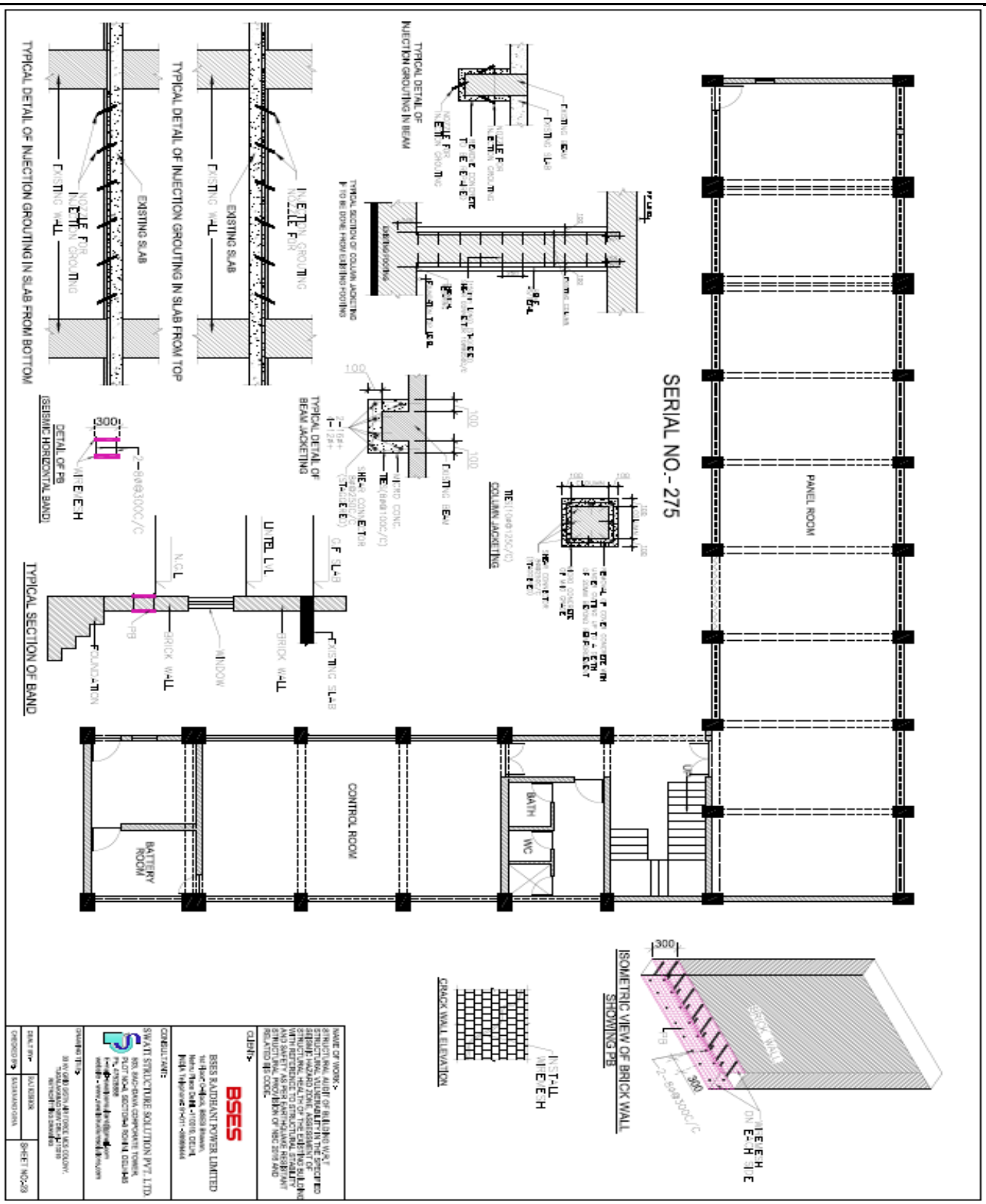
Bhikaji Kama Grid



Bhikaji Kama Grid

ANNEXURE-B

DRAWINGS



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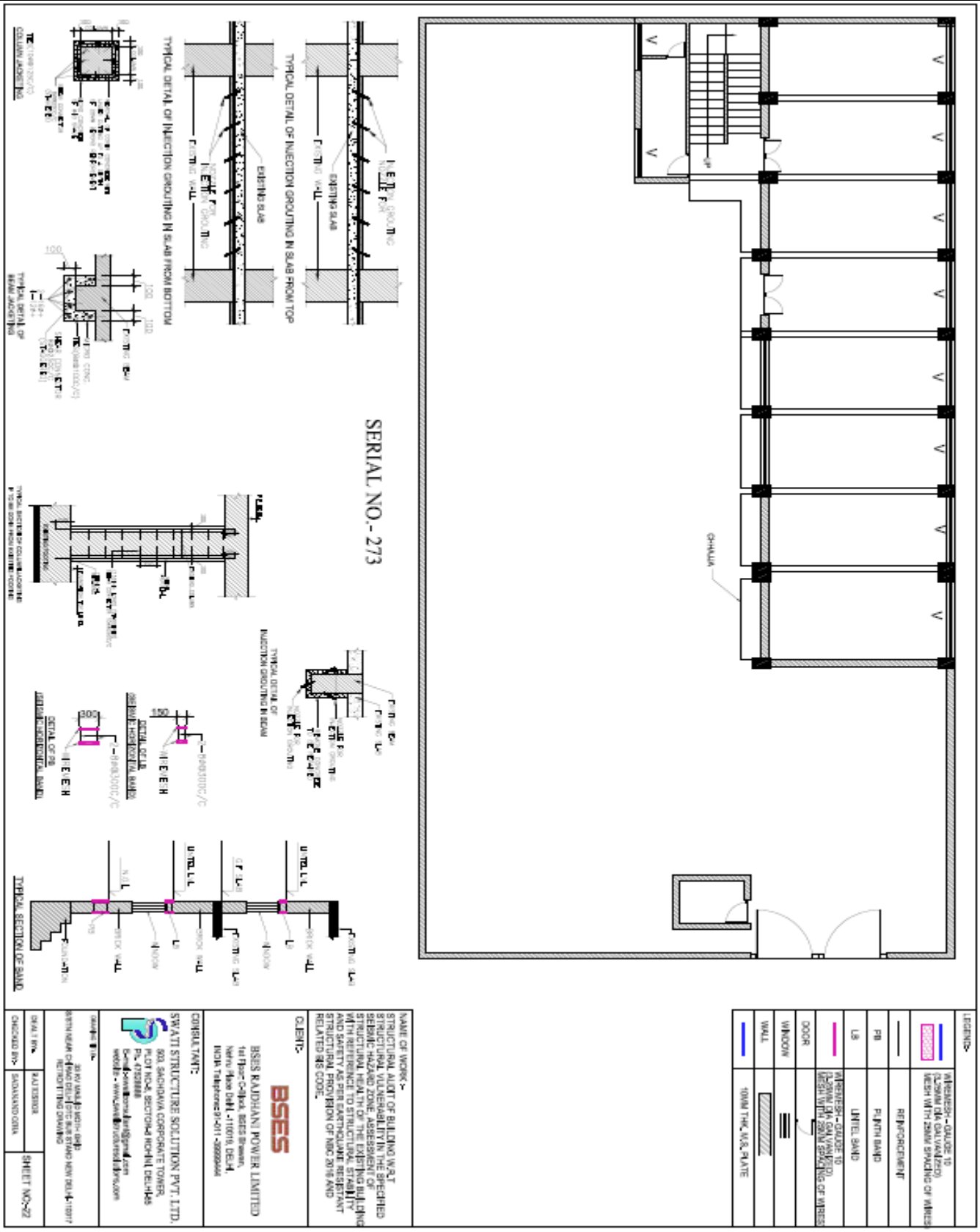

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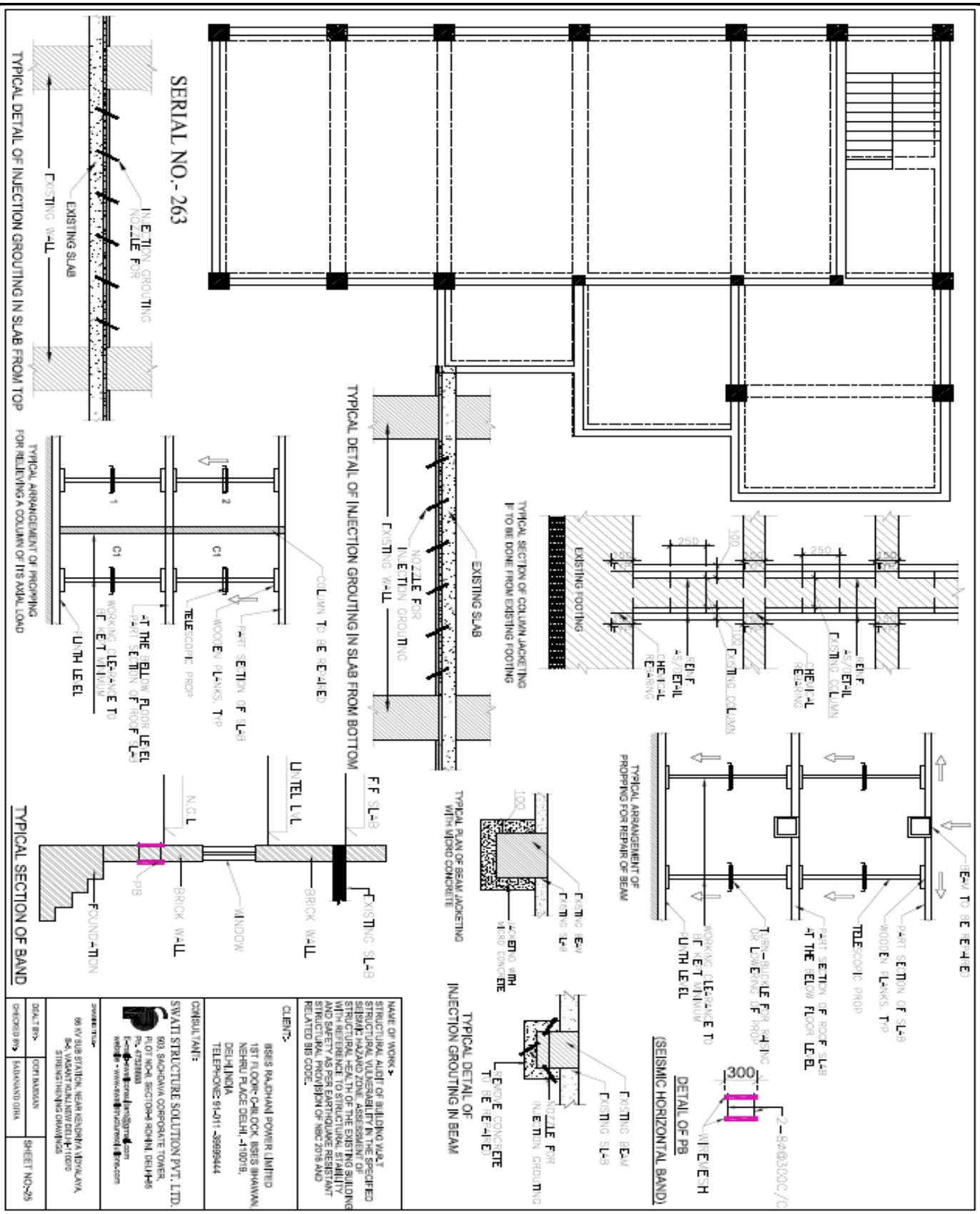

Bhikaji Kama Grid