# DETECTION AND SIZING STUDY OF CRACKS : A CASE STUDY

Jaimin Shah, prasad barve

International Journal of Advance Research in Engineering, Science & Technology(IJAREST),
ISSN(O):2393-9877, ISSN(P): 2394-2444,
Volume 2, Issue 8, August- 2015, Impact Factor: 2.125

# DETECTION AND SIZING STUDY OF CRACKS : A CASE STUDY

**Prasad S. Barve[1], Dr. Lalit S. Thakur[2], Ruchi P. Barve[3], Jaimin K. Shah[4], Neha P. Patel[5],**

[1] Assistant Professor, CIVIL ENGINEERING, Babaria Institute of Technology, prasadbarve20@gmail.com
[2]Associate Professor, CIVIL ENGINEERING, Babaria Institute of Technology, lalitsthakur@yahoo.com
[3]Assistant Engineer, GWSSB, Limkheda, Dahod, ruchibarve17@gmail.com
[4]B.E. final year student, CIVIL ENGINEERING, Babaria Institute of Technology, jaiminshah93567@gmail.com
[5]B.E. final year student, CIVIL ENGINEERING, Babaria Institute of Technology, nehapatel1904@gmail.com

**Abstract:**
*Commonly occurring cracking in structures need investigation for their causes so as to allow engineers to carry out suitable repair and remedial measures. If the concept behind various causes of cracking is understood by engineers, the repair and remedies could be made more effective. To examine the exact causes it is necessary to observe carefully, the location, shape, size, depth, behavior and other characteristics of the cracks, and to collect information about specifications of the job, time of construction and past history of the structure. The first sight of crack is important to be known by the engineer. Structural cracks are the one whose inherent cause lies in either in incorrect design, or faulty construction or overloading and are the one which can endanger the safety of a given structure. On the other hand, the non-structural cracks are the one which have the underlying origin due to moisture or thermal fluctuations, elastic deformation, creep, chemical reaction, or reason related to the foundation soil such as it movement or settlement or unhindered vegetation. Non-structural cracks are mostly due to internally induced stresses in building materials and these generally do not directly result in structural weakening. Non uniform settlement is usually the most problematic, as it leads to structural distortions and therefore not only to serviceability but also ultimate limit states. In this case study, cracks are detected, crack width and depth are measured, and their profile is plotted. It is hoped that the remedial and control measures for repair and prevention of cracks that are suggested in the conclusion, will prove useful and help the engineers to take decisions for quality construction.*
***Keywords****- Cracks; Crack profile; Crack pattern; Remedial measures; Control measures*

## I. INTRODUCTION

Cracks in buildings are common. The first and most common reason of crack development is the stress component exceeding its strength component which can be associated to the externally applied loads (forces) such as dead, live, wind or seismic loads, or foundation settlement or stresses developed internally due to thermal movements, moisture changes and/or chemical action, etc.
Most buildings crack at some time during their service life. The appearance of cracks is a symptom of distress within the fabric of the building. Often the cracking is of little consequence and once it is established as static, simple repair by filling or re-pointing is all that is required. However a crack maybe the first sign of a serious defect which may affect the serviceability or the stability of the building.
Modern structures are comparatively tall and slender, have thin walls, are designed for higher stresses and are constructed speedily. These structures are, therefore, more liable to cracks as compared with old structures which used to be low, had thick walls, were lightly stressed and were built at a slow pace. Moreover, moisture from rain can easily penetrate inside and can spoil the aesthetic view of a modern building having thin walls. Thus, measures for crack control in buildings have assumed much greater significance on account of the emerging trends and advances in construction industry. The appearance of cracks can also affect the value of the building. Therefore correctly assessing the significance of cracks is essential. However it is a far from a simple task and is often a subjective and qualitative exercise. This exercise however need to be done on the basis of plan area, location, length and width basis which required quantitative analysis to be then converted to qualitative analysis as per the importance of the project as per IS specifications or overruled by client specifications. This causes this subject matter to be of contention in view of the present day scenario. The implications of an incorrect assessment can lead to expensive and unnecessary remedial work. In some instances the remedial work may exacerbate the problem resulting in yet further and more extensive cracking.

## II. CRACK TAXONOMY

Cracks could be broadly classified as Structural and Non-Structural. Structural cracks which are due to incorrect design, faulty construction or overloading. Non-structural cracks are mostly due to internally induced stresses in building materials and these generally do not directly result in structural weakening. These are due to penetration of moisture or thermal variation. Cracks may appreciably vary in width from hairline cracks barely visible to the human eye (about 0.01 mm in width) to gaping cracks 5 mm or more in width. Classification of cracks, based on their width is:

- Thin— less than 1 mm in width,
- Medium — 1 to 2 mm in width, and
- Wide — more than 2 mm in width.

Fractures in structural or non structural components also known as cracks can be of unvarying width throughout or may be inconsistent with changing width from one to the other end. Cracks may be straight, toothed, stepped, map pattern or random and may be vertical, horizontal or diagonal. Cracks may be only at the superficial or may extend to deep to varying materials.

### 2.1 Principal causes of occurrence of cracks in buildings

- Moisture changes
- Temperature changes
- Elastic deformation

- Creep
- Chemical reaction
- Foundation movement and settlement of soil
- Vegetation
- Weathering
- Permeability of concrete
- Corrosion of reinforcement
- Poor construction practices
- Poor maintenance
- In-discriminate addition and alterations

### 2.2 Cracking in walls

- Expansion cracks
- Cracks above openings
- Hairline cracks in wall
- Cracks in masonry wall
- Cracks in drywall
- Cracks in plaster wall

## III. OBJECTIVES

- Study on causes of crack
- Position of crack
- To study the criticality of major crack
- Specification of active and passive crack
- Studying activity of cracks by measurement of cracks width, opening and crack width test.
- Profiling of crack w.r.t width and depth.
- Remedial measure of crack w.r.t width and depth of cracks

## IV. DETECTION & SIZING STUDY OF CRACKS

The study was conducted at a Residential Building: Tower B, C and G all of which are Ground (Parking) with five floors. Also study of structural drawing for location of hidden beams i.e. slab beams was done. Various data required for case study was collected from site, which was drawn on front elevation of the wall with location, length and crack width. Crack width and depth measurement was done with help of Feeler gauge, and crack profiling and plotting was carried out using AutoCAD. Remedial measures with respect to width and depth of crack were suggested at the end of the work.

### 4.1 Method and Material

**Initial inspection:** This included the physical verification of the surrounding and the adjoining building. It also included noting any minor or major modification however irrelevant they may seem to the physical eye.

**Crack survey.** The second stage of survey included crack survey in which crack width is measured and plotted on drawing of building. Crack measurement was done using feeler gauge.

Methods of measurement:-

- The wall which is in front of door of flat is wall no:-1.
- Then other wall are given number in anticlockwise direction from Wall No:-1.
- Arbitrarily 3 points were considered on the crack of any wall.
- Crack width and depth of 3 points were measured with the help of Feeler gauge and Vernier Caliper.
- X-Y co-ordinates of 3 points were measured with the help of 3meter steel tape.

**Profiling of cracks.** The crack position on wall was noted with help of measure tape, using three points, coordinates of each of these points noted. These cracks were later plotted individually with help of AutoCADD for the actual profiling.

### 4.2 Subsurface investigation report

***Table : 1 Subsurface investigation report***

| Bore hole no. | Depth (m) | No. of SPT | No. of UDS | Water table below GL |
|---|---|---|---|---|
| BH-1 | 7.0 | 4 | 4 | Not met with |
| BH-2 | 7.0 | 4 | 4 | Not met with |

***Table : 2 Sub soil stratification***

| Depth (m) | Description of strata |
|---|---|
| Stratum I: 0.0-0.5 | Blackish silty clay |
| Stratum II: 0.5-7.0 up to depth investigated | Yellowish clayey silt of low to medium. Plasticity with stiff to hard consistency. |

***Table : 3 Safe bearing capacity***

| Type and size of footing (m x m) | Depth (m) | Net Safe Bearing capacity /Pressure | | Net safe Bearing capacity (t/m2) |
|---|---|---|---|---|
| | | Shear Failure Criterion (t/m2) | Settlement Criterion For 50 mm settlement (t/m2) | |
| Square 2.0 x 2.0 | 1.5 | 24.5 | 33.6 | 24.5 |
| | 2.0 | 30.0 | 36.5 | 30.0 |
| Square 3.0 x 3.0 | 1.5 | 27.0 | 20.7 | 27.0 |
| | 2.0 | 32.1 | 22.0 | 32.1 |
| Rectangle 3.0 x 3.0 | 1.5 | 22.6 | 32.5 | 22.6 |
| | 2.0 | 27.7 | 34.6 | 27.7 |

### 4.3 Crack profiling, analysis, results and discussion

#### 4.3.1. Crack Profile of Drawing Hall

***Table : 4 Drawing hall wall 1 (Block G)***

| Flat no | Point | Width (mm) | Depth (mm) | Colour |
|---|---|---|---|---|
| 501 | 1 | 0.7 | 3.2 | White |
| | 2 | 0.7 | 3.2 | |
| | 3 | 0.7 | 3.2 | |

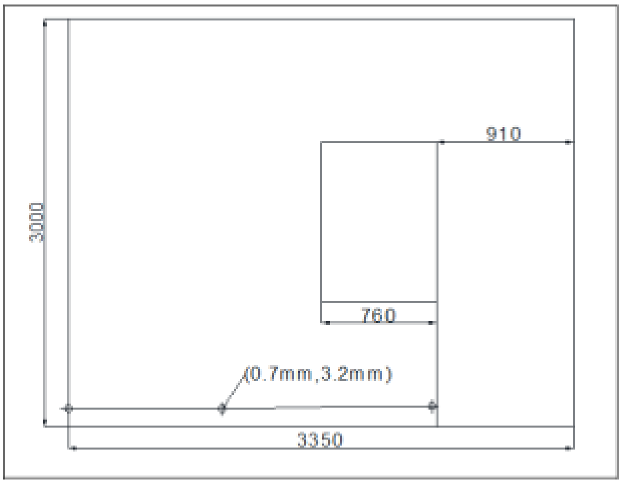


*Figure: 1 Crack Profile for Drawing Hall Wall1*

*Table : 5 Crack Profile for Drawing hall wall 3 (Block G)*

| Flat no | Point | Width (mm) | Depth (mm) | Colour |
|---|---|---|---|---|
| 501 | 1 | 0.02 | 1 | White |
| | 2 | 0.02 | 1 | |
| | 3 | 0.02 | 1 | |
| 503 | 1 | 0.2 | 3.35 | Red |
| | 2 | 0.15 | 3.35 | |
| | 3 | 0.2 | 3.35 | |

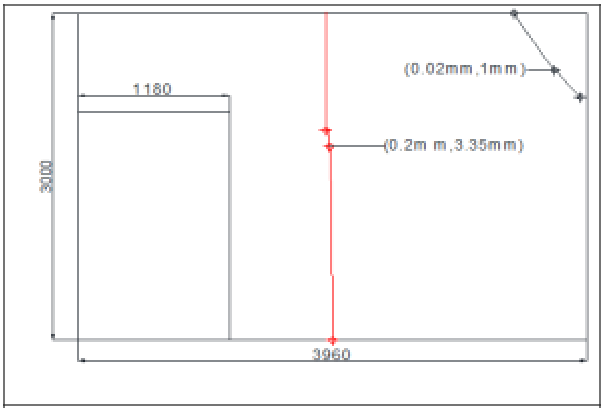


*Figure: 2 Crack Profile for Drawing Hall Wall 3*

*Table: 6 Drawing Hall Wall 2 & 4(Block G & C)*

| Block G | | | | |
|---|---|---|---|---|
| Flat no. | Point | Width (mm) | Depth (mm) | Colour |
| 502 | 1 | 0.35 | 5 | White |
| | 2 | 0.35 | 5 | |
| | 2 | 0.35 | 5 | |
| 503 | 1 | 0.7 | 6.7 | Red |
| | 2 | 0.7 | 6.7 | |
| | 3 | 0.7 | 6.7 | |
| Block C | | | | |
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 402 | 1 | 0.25 | 7.5 | Yellow |
| | 2 | 0.4 | 7.5 | |
| | 3 | 0.02 | 7.5 | |

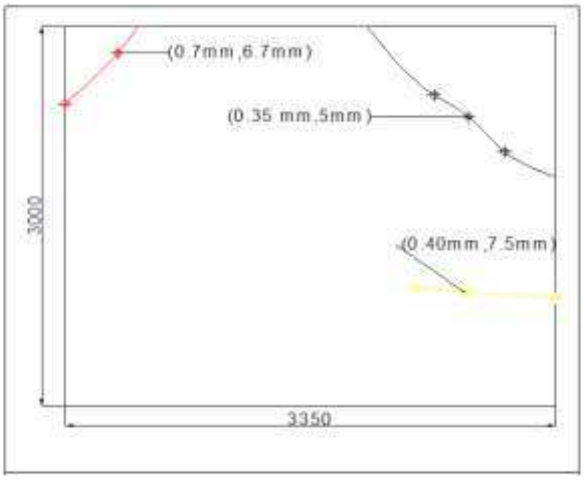


*Figure: 3 Crack Profile Drawing hall wall 2 & 4*

Conclusion from Crack Profile data of Drawing hall walls:-
Type –

- Thin Crack
- Non- structural
- Vertical ,
- random
- horizontal in pattern

Width – 0.5 to 1 mm
Probable Cause – Improper curing, moisture content, temperature variation, expansion in brick work.

**4.3.2. Crack Profile data for Kitchen walls.**
No cracks have been observed in the wall 1 of kitchen.

*Table: 7 Kitchen Wall 3 (Block B)*

| Flat no | Point | Width (mm) | Depth (mm) | Colour |
|---|---|---|---|---|
| 504 | 1 | 0.03 | 3 | White |
| | 2 | 0.03 | 3 | |
| | 3 | 0.03 | 3 | |

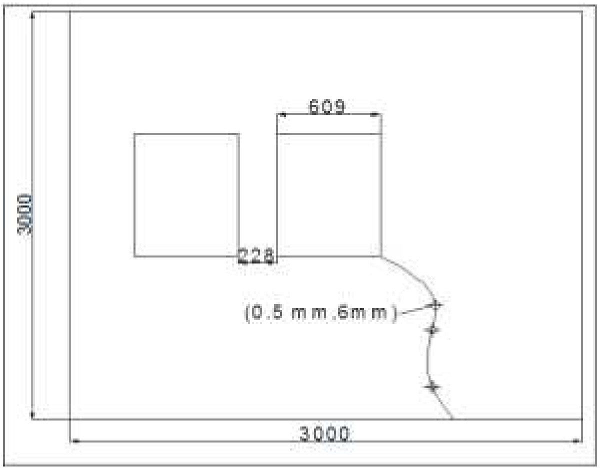


*Figure: 4 Crack profile for Kitchen wall 3*

*Table 8 : Kitchen wall 2 (Block B)*

| Flat no. | Point | Width (mm) | Depth (mm) | Colour |
|---|---|---|---|---|
| 504 | 1 | 0.03 | 3 | White |
| | 2 | 0.03 | 3 | |
| | 3 | 0.03 | 3 | |

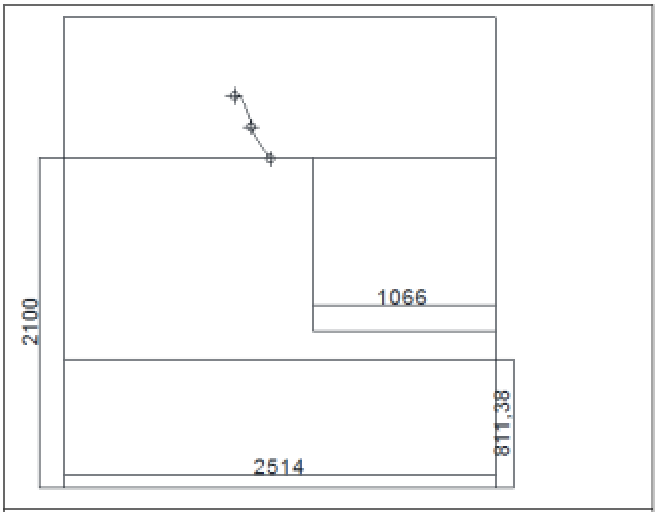


***Figure: 5 Crack profile for Kitchen wall 2 (Block B)***

***Table: 9 Kitchen wall 4 (Block G, C and B)***

| Block G | | | | |
|---|---|---|---|---|
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 501 | 1 | 1 | 7.25 | White |
| | 2 | 1 | 7.25 | |
| | 3 | 1 | 7.25 | |
| 503 | 1 | 0.2 | 3 | Red |
| | 2 | 0.15 | 3 | |
| | 3 | 0.2 | 3 | |
| Block C | | | | |
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 303 | 1 | 0.2 | 4 | Yellow |
| | 2 | 0.2 | 4 | |
| | 3 | 0.2 | 4 | |
| Block B | | | | |
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 504 | 1 | 0.75 | 6.25 | Blue |
| | 2 | 0.75 | 6.25 | |
| | 3 | 0.75 | 6.25 | |
| 502 | 1 | 1 | 9.1 | Violet |
| | 2 | 1 | 9.1 | |
| | 3 | 1 | 9.1 | |

Conclusion from Crack Profile data of Kitchen Walls:-
Type –

- Thin crack
- Non structural
- random in pattern

Width – Below 1 mm
Probable Cause – Thermal variation, Moisture change, overloading

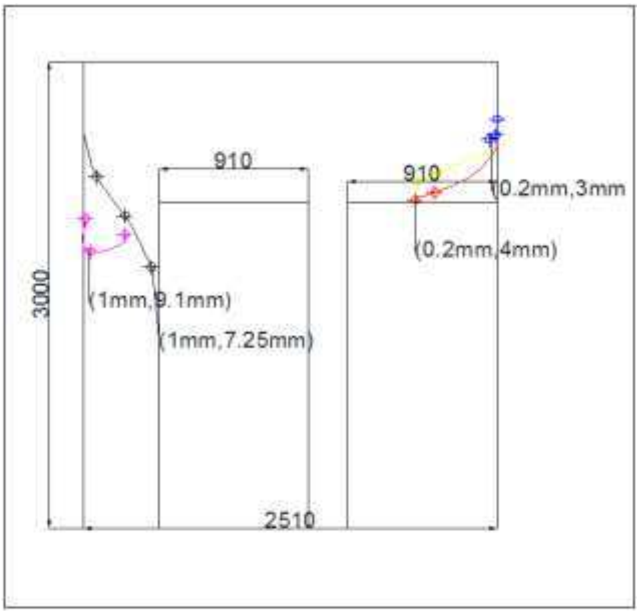


***Figure: 6 Crack profile for Kitchen Wall 4 (Block G, C & B)***

**4.3.3. Crack profile data for Bedroom walls.**

No cracks were found in bedroom wall 2 and 4

***Table: 10 Bedroom wall 3 (Block C, G and B)***

| Block C | | | | |
|---|---|---|---|---|
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 404 | 1 | 0.5 | 3.32 | White |
| | 2 | 0.5 | 3.32 | |
| | 3 | 0.5 | 3.32 | |
| 402 | 1 | 0.2 | 4.4 | Red |
| | 2 | 0.3 | 4.4 | |
| | 3 | 0.5 | 4.4 | |
| Block G | | | | |
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 501 | 1 | 0.3 | 0.23 | Blue |
| | 2 | 0.5 | 0.23 | |
| | 3 | 0.3 | 0.23 | |
| 502 | 1 | 0.3 | 5.6 | Violet |
| | 2 | 0.5 | 5.6 | |
| | 3 | 0.5 | 5.6 | |
| Block B | | | | |
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 502 | 1 | 1 | 9.2 | Yellow |
| | 2 | 0.7 | 9.2 | |
| | 3 | 1 | 9.2 | |

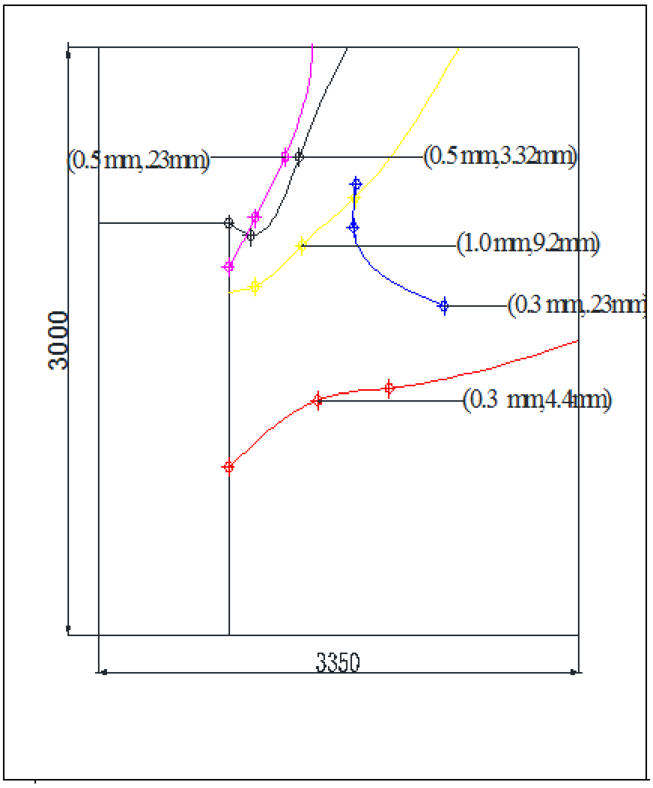


*Figure : 7 Crack profile for Bedroom wall 3*

Conclusion from Crack Profile data of bedroom walls:-

Type –

- thin crack
- Non- structural
- Random in pattern

Width – below 1 mm

- Probable cause – Temperature change, moisture content, improper curing, speedy construction.

**4.3.4. Crack profile data for Master Bedroom walls.**

*Table: 11 Master Bedroom wall 1 (Block C and B)*

| Block C | | | | |
|---|---|---|---|---|
| Flat no | Point | Width (mm) | Depth (mm ) | Colour |
| 402 | 1 | 0.3 | 5 | White |
| | 2 | 0.3 | 5 | |
| | 3 | 0.3 | 5 | |
| Block B | | | | |
| Flat no | Point | Width (mm) | Depth | Colour |
| 504 | 1 | 0.75 | 8 | Yellow |
| | 2 | 0.5 | 8 | |
| | 3 | 0.75 | 8 | |

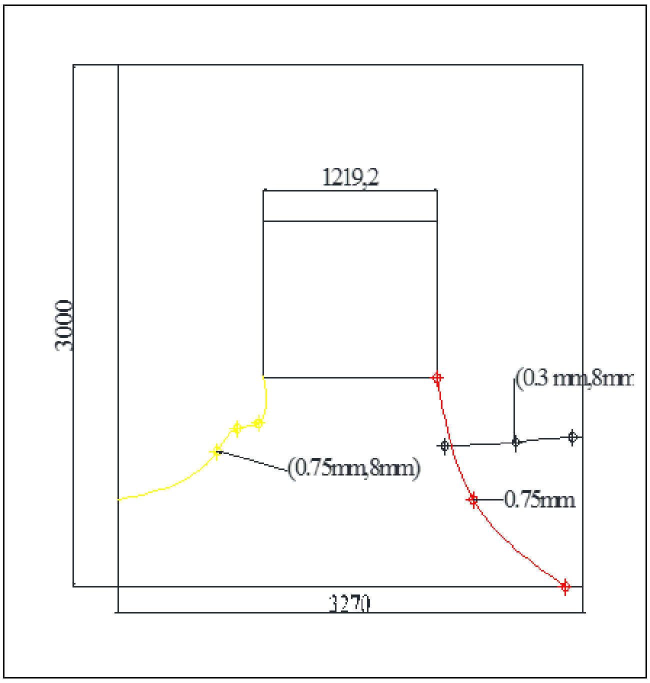


*Figure: 8 Crack profile for Master bedroom wall 1*

*Table: 12 Master Bedroom Wall 3 (Block C and B)*

| Block C | | | | |
|---|---|---|---|---|
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 402 | 1 | 0.2 | 3 | White |
| | 2 | 0.2 | 3 | |
| | 3 | 0.2 | 3 | |
| 203 | 1 | 0.5 | 4.5 | Red |
| | 2 | 0.5 | 4.5 | |
| | 3 | 0.5 | 4.5 | |
| Block B | | | | |
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 504 | 1 | 0.25 | 3.58 | Yellow |
| | 2 | 0.25 | 3.58 | |
| | 3 | 0.25 | 3.58 | |
| 502 | 1 | 1 | 9.1 | Blue |
| | 2 | 1 | 9.1 | |
| | 3 | 1 | 9.1 | |

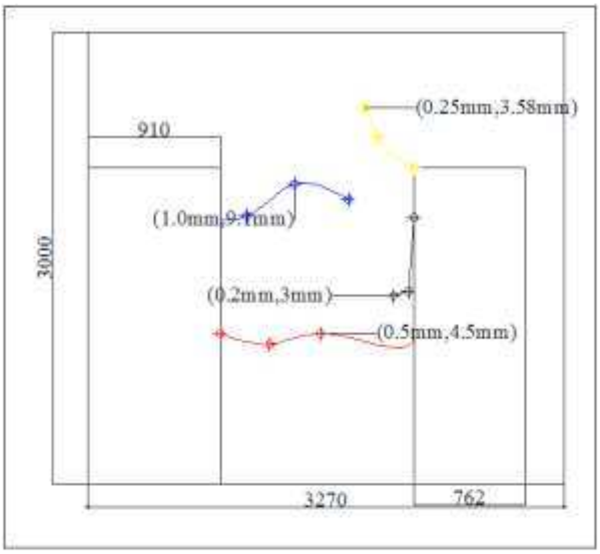


*Figure: 9 Crack profile for Master Bedroom Wall 3*

***Table: 13 Master Bedroom wall 2 (Block G and B)***

| Block G | | | | |
|---|---|---|---|---|
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 503 | 1 | 0.15 | 4.2 | White |
| | 2 | 0.2 | 4.2 | |
| | 3 | 0.2 | 4.2 | |
| Block B | | | | |
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 501 | 1 | 0.25 | 5.3 | Red |
| | 2 | 0.5 | 5.3 | |
| | 3 | 0.5 | 5.3 | |

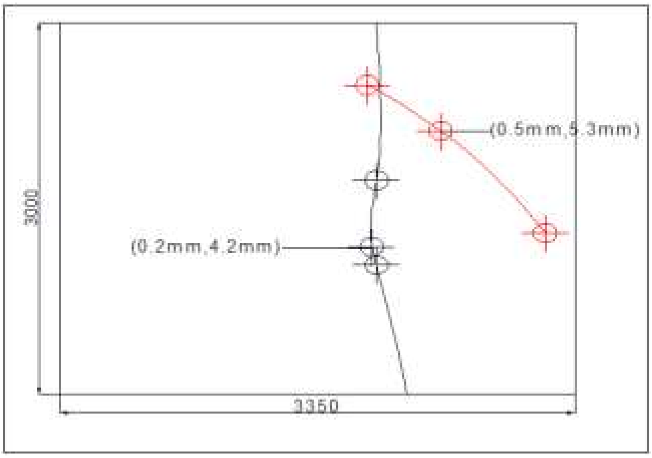


***Figure: 10 Crack profile for Master Bedroom wall 2***

***Table: 14 Master bedroom wall 4 (Block G)***

| Block G | | | | |
|---|---|---|---|---|
| Flat no | Point | Width (mm) | Depth (mm) | Colour |
| 503 | 1 | 0.7 | 6.7 | White |
| | 2 | 0.7 | 6.7 | |
| | 3 | 0.7 | 6.7 | |
| 502 | 1 | 0.3 | 4.2 | Red |
| | 2 | 0.3 | 4.2 | |
| | 3 | 0.3 | 4.2 | |

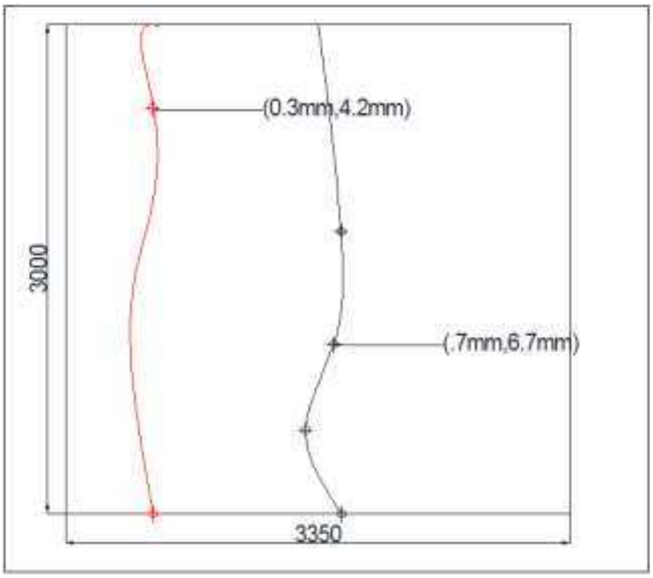


***Figure : 11 Crack profile for Master bedroom wall 4***

Conclusion from Crack Profile data of Master bedroom walls :-

**Type** –

- Non- structural
- thin crack
- Vertical
- random in pattern

**Width** – Below 1 mm

**Probable cause** – Temperature variation, moisture change, expansion in brickwork

**4.3.5. Crack profile data for common and attached toilets.** Walls of attach toilet and common toilet have wall tiles up to slab height therefore no cracking pattern has been observe.

## V. CONCLUSION

- The entire major crack in wall seems to be starting from the corners of openings or joints of wall and slab.
- Crack depth observed throughout study is never greater than 10mm, therefore cracks seem to be plaster cracks.
- Cracks in master bedroom wall 3 block B, bedroom wall 3 block B and kitchen wall 4 block B of flat 502 appears to be the deepest and widest.
- Flat 502 needs detailed investigation of cracks since all wide and deepest crack are found on level 5 block B.

Probable reasons for the cracks for these could be :

- Material Non uniformity
- Speed of work
- Insufficient or intermittent curing during last phase
- of construction
- Through this cannot be considered to be full proof. Further non-destructive testing may be carried out to point out the exact cause.

## VI. SUGGESTED REMEDIAL, CONTROL AND PREVENTIVE MEASURES

### 5.1 Remedial measures

The basic intention of taking up crack aim of crack patching up is to achieve the mentioned objectives, using suitable repair method and materials:

- Restore and/or increase strength of cracked components
- Restore and/or increase stiffness of cracked components
- Enhance functional performance of the structural members
- Prevent ingress of moisture
- Improve the aesthetics of the surface of concrete
- Improve durability; and prevent development of a corrosive environment at the reinforcement.

Material used for repair of non-structural dormant crack should rigid in nature. Cementitious, polymer modified cementitious grouts of acrylic, styrene-acrylic and styrene-butadiene can be used for wider cracks. However polyester and epoxy resins should be used for injection of dormant cracks. For active cracks, flexible type of material of polysulphide or polyurethane should be used. Before repair of any non-structural cracks the following factors have to be considered :

- Nature of the crack: passive or active;
- Present width and depth of the crack;
- Determination of pressure extent required to seal a given crack and the side of such pressure exertion;
- Whether or not, aesthetic as factor should be taken into consideration.

**5.1.1. Method of Repair of Passive cracks.** Passive cracks may range in width from 0.05 mm or less, to 6 mm or more. Based on crack width and depth, repair material and method is to be deicide. The fine cracks are repaired by low viscous epoxy resin and other synthetic resin by injecting. Injection method can be used to repair wide cracks which on vertical wall. Cracks on horizontal surface can be repaired by injection or by crack filling using gravity. In passive cracks, where there is no need of structural repair, can be repaired by widening the crack along the external face and filling and sealing it with a suitable joint sealer. This is a common method to prevent penetration of water into cracked areas. The method is suitable for sealing both fine pattern cracks and wide crack. Various materials are used such as including epoxies, urethanes, silicones, polysulphides, asphaltic materials and polymer mortars. The crack is routed out, cleaned and flushed out before the sealant is placed. It should be ensured that the crack is filled completely.

**5.1.2. Use of cementitious grout.** It is used for repair of wide cracks. It is a mixture of cementitious material and water that is proportioned to produce a proper consistency. Cement-based grouts are available in a wide range of consistencies; therefore, the methods of application are different for different material. This type of material do not require skilled worker or special equipment to apply, safe to handle and economical. These materials tend to have similar properties to the parent concrete and mortar, and have the ability to undergo autogenous healing due to subsequent hydration of cementitious materials at fracture surfaces. The main disadvantage is that this material shrinks. These are not suitable for structural repairs of active cracks. For application of cementitious grouts generally, some form of routing and surface preparation, such as removal of loose debris are needed. Grouts are generally to be mixed to a proper consistency by using a drill and proper mixer, and the consistency may be adjusted thereafter. Application should be done by hand troweling or dry packing into vertical and overhead cracks to fill all pores and voids .Finally, a suitable coating to be applied on the repaired surfaces.

**5.1.3. Use of Epoxy resin grout.** This is most common polymer material used for crack repairs. It should be less viscous and should have low surface tension, so that the resin penetrates into fine cracks easily under gravity, and there is no need of injecting it under pressure. The viscosity must be less than 200 centipoise (cps). It is efficiently used to repair horizontal concrete elements such as bridge and parking decks, floor slabs, plaza decks, and similar surfaces. The cracks should be cleaned with compressed air to make them free from dust. If required some routing may be required to facilitate pouring of resin. Use of water should be avoided to clean the cracks because if it is not dried for 24 hours and remains moist, the flow of resin might get obstructed by the moisture present inside the crack. The resin has to be mixed in a bucket with a proper mixer.

**5.2 Control and preventive measures**

**5.2.1. Measures for controlling shrinkage cracks.**

- Authorities recommend storage of bricks for minimum period of 1 week to 2 weeks after removing them from kilns, to avoid cracks in brickwork due to initial expansion.
- Shrinkage cracks in masonry could be minimized by avoiding use of rich cement mortar in masonry and by delaying plaster work till masonry has dried after proper curing and has undergone most of its initial shrinkage.
- Precast tiles should be used in case of terrazzo flooring
- Temperature reinforcement is used to control shrinkage cracks in structural concrete. This reinforcement is intended to control shrinkage as well as temperature effect in concrete and is more effective if bars are small in diameter and are thus closely spaced, so that, only thin cracks which are less perceptible, occur.
- To minimize shrinkage cracks in rendering/plastering, mortar for plaster should not be richer than what is necessary from consideration of resistance to abrasion and durability.

**5.2.2. Measures for controlling cracks due to thermal variations.**

- Wherever feasible, provision should be made in the design and construction of structures for unrestrained movement of parts, by introducing movement joints of various types, namely, expansion joints, control joints and slip joints.
- Even when joints for movement are provided in various parts of a structure, some amount of restraint to movement due to bond, friction and shear is unavoidable. Concrete, being strong in compression, can stand expansion but, being weak in tension, it tends to develop cracks due to contraction and shrinkage, unless it is provided with adequate reinforcement for this purpose. Members in question could thus develop cracks on account of contraction and shrinkage in the latter direction. It is, therefore, necessary to provide some reinforcement called 'temperature reinforcement" in that direction.
- Over flat roof slabs, a layer of some insulating material or some other material having good heat insulation capacity, preferably along with a high reflectivity finish, should be provided so as to reduce heat load on the roof slab.
- In case of massive concrete structures, rise in temperature due to heat of hydration of cement should be controlled.

**5.2.3. Measures for prevention of cracks due to creep.**
Though it may not be possible to eliminate cracking altogether, following measures will considerably help in

minimization of cracks due to elastic strain, creep and shrinkage:

- Use concrete which has low shrinkage and low slump.
- Do not adopt a very fast pace of construction.
- Do not provide brickwork over a flexural RCC member (beam or slab) before removal of centring, and allow a time interval of at least 2 weeks between removal of centring and construction of partition or panel wall over it.
- When brick masonry is to be laid abutting an RCC column, defer brickwork as much as possible.
- When RCC and brickwork occur in combination and are to be plastered over, allow sufficient time (at least one month) to RCC and- brickwork to undergo initial shrinkage and creep before taking up plaster work. Also, either provide a groove in the plaster at the junction or fix a 10 cm wide strip of metal mesh or lathing over the junction to act as reinforcement for the plaster.
- In case of RCC members which are liable to deflect appreciably under load, for example, cantilevered beams and slabs, removal of centring and imposition of load should be deferred as much as possible (at least one month) so that concrete attains sufficient strength, before it bears the load.

**5.2.4. General measures for chemical attack.**

- In case of structural concrete in foundation, if sulphate content in soil exceeds 0.2 percent or in ground water exceed 300 ppm, use very dense concrete and either increase richness of mix to 1:1/5:3 or use sulphate resisting Portland cement/super-sulphated cement or adopt a combination of the two methods depending upon the sulphate content of the soil.
- For superstructure masonry, avoid use of bricks containing too much of soluble sulphates (more than 1 percent in exposed situations, such as parapets, free standing walls and masonry in contact with damp soil as in foundation and retaining walls; and more than 3 percent in case of walls in less exposed locations) and if use of such bricks cannot be avoided, use rich cement mortar (1:1/2:4.5 or 1:1/4 :3) for masonry as well as plaster or use special cements and take all possible precautions to prevent dampness in masonry.
- To prevent cracking due to corrosion in reinforcement and premature deterioration, it is desirable to specify concrete of richer mix (say 1:1/5:3) for thin sections in exposed locations and to take special care about grading, slump, compaction and curing of concrete.

Based on crack width and depth, causes of cracks have been diagnosed, due to which the cracks have occurred in the structure and suitable remedial measures, which are feasible, have been suggested. There are so many structures which have failed due to occurrence of cracks and these failures have caused a huge loss of life and property. So if cracks are identified, suitable remedial measures must be taken as soon as possible.

## REFERENCES

[1] SP:25-1984, “Handbook on Causes and Prevention of Cracks in Buildings”, “Bureau Of Indian Standards, New Delhi, 1984.
[2] M.S. Shetty, “Concrete Technology”, S Chand Publications, New Delhi.
[3] Suresh Chandra Pattanaik, “Causes, Evaluation and Repair of Cracks in Concrete Structures”, Paper published in the Proceedings of National Seminar held at Institution of Engineers, Bhubaneswar, Odisha from 16-17 July, 2011 on “Recent Advances in Civil Engineering.
[4] Fikiri Fredrick Magafu, Wu Li, “Causes of Cracks on Structures in Ngara-Tanzania”, Published Online December 2010 (http://www.scirp.org/journal/eng).
[5] Kishor Kunal & Namesh Killemsetty, “Study on control of cracks in a Structure through Visual Identification & Inspection”, IOSR journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 11, Issue 5 Ver. VI (Sep-Oct. 2014), PP 64-72.
[6] Roger W. Johnson, “The significance of cracks in low-rise buildings”, Chartered Civil and Structural Engineer and Surveyor.
[7] Syed Mohd Mehndi, Prof. Meraj Ahmad Khan & Prof. Sabih Ahmad (Guide), “Causes and Evaluation of Cracks in Concrete structures”, International Journal of Technical Research and Applications, Volume 2, Issue 5 (Sep-Oct 2014), PP. 29-33.
[8] Ehiorobo J.O, Izinyon O. C and Ogirigbo R.O., “Measurement and Documentation for Structural Integrity Assessment of In-Service Building at Risk”, Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 4(5): 763-767© Scholarlink Research Institute Journals, 2013(ISSN: 2141-7016).
[9] http://theconstructor.org
[10] http://www.ehow.com
[11] http://colleged.info
[12] http://www.drfixitinstitute.com
[13] http://www.dreamghar.com