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A Review–Crack Diagnosis for Stone Masonry Building

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Abstract: ***Structural cracks are common in all types of buildings. To ensure the long life of the construction, engineers often have to look at their causes and carry out appropriate repairs and remedial measures. For repairs and remedies to be effective, it is essential that the engineer has a good understanding of different causes of cracks. To investigate the causes, it is necessary to carefully observe the location, shape, size, depth, behavior and other characteristics of the cracks and to collect information about the job's specifications and the time of construction. It is also necessary for the engineer to keep track of when the cracks first stand out. This article discusses how visual inspection of cracks can be useful to identify and categorize them with respect to different parameters by taking a case study of an institutional building.***
Keywords: cracks, contraction, structural failure, stresses, joints

I. INTRODUCTION AND BACKGROUND STUDY

Modern structures are relatively long and slender, have thin walls, are designed for higher stresses and are built at a rapid pace. These structures are therefore more susceptible to cracking compared to old structures that used to be low, had thick walls, were slightly stressed and were built at a slow pace. In addition, moisture from rain can easily reach the inside and spoil the finish of a modern building with thin walls. For example, measures for the control of cracks in buildings have become much more important due to current building trends. (Shetty, 2005) Cracks in buildings are common. A construction component develops cracks when the tension in the component exceeds its strength. Stress in a building component can be caused by externally exerted forces such as death, life, wind or seismic loads, or foundation deposition or it can be induced internally due to thermal variations, moisture changes, chemical action, etc. Cracks can generally be caused to be classified as structural and non-structural. Structural cracks due to improper design, defective construction or overload and non-structural cracks are usually due to internally induced stresses in building materials and generally do not directly lead to structural weakening. These are the result of penetration of moisture or thermal variation. Cracks can vary considerably in width from very thin hair cracks that are barely visible to the naked eye (about 0.01 mm wide) to gaping cracks of 5 mm or more in width. A well-known classification of cracks, based on their width, is: (a) a thickness of less than 1 mm, (b) medium - from 1 to 2 mm wide and (c) wide - more than 2 mm wide. Cracks can be uniform everywhere or on one side narrow, with the other gradually becoming wider. Cracks can be straight, toothed, stepped, card pattern or random and can be vertical, horizontal or diagonal. Cracks can only occur on the surface or can extend to more than one layer of material. (Gambhir, 2005)

II. TYPES OF CRACKS

The magnitude of the risk caused by a crack can be characterized in terms of direction and dimensions. Cracks can be horizontal, vertical, diagonal or random.

1) Horizontal crack horizontal slit or crack that zigzag angle of 45 degrees, reason for this zigzag shape can be serious, such as foundation shift or water damage. Serious tears usually require immediate attention and may include a reconstruction to prevent further damage.
2) Vertical crack while vertical cracking begins at the intersection where the wall and ceiling meet, it indicates that it developed when the foundation came down after construction. Vertical cracks run in the same direction as plasterboard.
3) Staircase in a staircase A staircase stair looks like a staircase and runs over the wall in both vertical and horizontal direction. The continuous pattern usually follows the stone line or the stone block and can be seen in unfinished basements as a result of the settling of the ground below the middle of the wall. For the repair of such cracks, the soil test and the core test are recommended to prevent the likely damage to the building.

4) Doors and windows It is a way to test the severity of a wall crack in the wall by checking the swinging of the doors and windows during the opening and closing of the interior doors and to evaluate whether the door is obstructed. If so, make sure that the obstruction is not due to the recent paintwork, defective material if you find that nothing hinders the swinging movement of the door, it can be a sign of a moderate or severe foundation of the door. foundation and can result in wall cracks. According to Real Estate, sticky doors indicate that the frame is contorted by a sliding house. If you see a visible opening at the top of a sticky door where it touches the door frame and you see light shining, it can also signal a serious settlement problem, often resulting in jagged, horizontal cracks on nearby walls.

5) Visible nails inspect the area around the crack on the wall and search for nail heads or screw heads that may be visible on the surface of the wall. The nail or screw may not have damaged the plasterboard, but is probably pulled away from the wooden pin underneath. This phenomenon is often known as "nail boobs" or "nail popping" and can be a sign of structural problems. Nagelpops are often associated with more severe wall cracks and often signal a significant plasterboard movement.

III. METHODOLOGY

To achieve the goal and the objective, a qualitative approach is used in this study because more unknown and unexpected extra information can be obtained through a conversation with experienced professional respondents. All defects were observed by visual observation. The defects were recorded using a digital camera and the data is recorded manually. An important and authoritative method for collecting information in the field. The purpose of the interview is to gather information from someone with first-hand knowledge.

IV. PRINCIPAL CAUSES OF OCCURRENCE OF CRACKS IN BUILDINGS

A. Moisture changes
B. Thermal variations
C. Elastic deformation
D. Creep
E. Chemical reaction
F. Foundation movement and settlement of soil
G. Vegetation.

V. LITERATURE REVIEW

1) Kishor Kunal et. Al (2014) concluded that some precautionary measures could be tackled during the construction process itself. Any lack of attention may lead to damage to the building in the future, which may also lead to the failure of the structure. Cracks can occur for various reasons, as discussed earlier. The occurrence of cracks can not be stopped, but specific measures can be taken to limit them and reduce their level and impact.

2) Rishabh Pathak el. al. (2015) He noted that the structure is subject to various loads and real-time environmental conditions leading to different types of cracks and requiring specific rehabilitation for the usability of the building.

3) Ankush Jain et. al. (2015) He noted that the possible causes of cracks can be controlled if sufficient account is taken of building material and technique to be used. If we concentrate on the main causes of cracks in our building and take their preventive measures initially, we can minimize the problem of cracks in our structure.

4) D. Kumar et. al. (2016) He concluded that Microbial technology has proven to be better than many conventional technologies because of the environmentally friendly nature, self-healing properties and the increase in the durability of various building materials. The other methods for repairing cracks increase the crack width later by the presence of moisture in newly laid concrete. Thus, this method of crack repair reduces the possibility of further cracking. The work of various researchers has improved our understanding of the possibilities and limitations of biotechnological applications on building materials. Improvement of compressive strength, reduction of permeability, water absorption and enhanced corrosion has been observed in various cementitious and stone materials. Cementing according to this method is very simple and convenient for use. This will soon form the basis for high-quality structures that are cost-effective and environmentally friendly, but more work is needed to improve the feasibility of this technology, both from an economic and a practical point of view.

5) N.S.N Anwar et. al. (2016) found that microwave imaging techniques have a high potential to be applied to defect detection of cement-based materials. The achieved resolution of $\lambda / 14$ allows detection of cracks of only 5 mm. Such a resolution enables detection of crack in the early stage of development.

6) Rajveer Singh Narwaria et. al. (2017) concluded that if good care and supervision is followed, the formation of cracks can be prevented and if the formation still occurs, appropriate measures can be taken according to the tears to treat them. Epoxy-based resins are such resins if they are used properly for treating cracks, then an epoxy treatment should be good as compared to the damaged parts.

7) Yogesh N. Sonawane et. al. (2018) His research provides insight into types of cracks, causes of cracks and the occurrence of cracks. Various techniques for the treatment of cracks are discussed in this study. We can summarize that while it is not viable to insure against cracking, attempts can be made to minimize the development of cracks. And also, not every type of crack requires the same level of attention. The likely causes of cracks can be checked if sufficient attention is paid to building material and the technique to be used. In case of existing cracks, after detailed examination and analysis of crack parameters, the most suitable correction method must be used for effective and efficient repair of cracks.

VI. PROBLEM STATEMENT

Many buildings and civil constructions are made of reinforced concrete or cement-based materials. These structures are designed to transport certain quantities of cargo under certain circumstances and for a specific period. Exposure to the environment and loads are ways in which deterioration and damage are caused in a functioning civil structure or cement-based materials during maintenance. For example, a structure may deteriorate when it is loaded with more than what it was originally designed for. This gradual deterioration and damage of the material usually appear in the form of a slit or other deviations. The anomaly poses a major threat to all civil structures; it is very dangerous and has caused a lot of destruction and damage. Even small cracks that look insignificant can grow and eventually lead to serious structural failures. Whatever the origin of these cracks is, either micro- or macro-naturally, the side-effects of such a defect affect not only the structural properties of such buildings but also their mechanical behavior, integrity and permeability properties. Therefore, when cracks occur, the actual strength of such structures would be reduced. In addition to manual inspection that is not effective and time-consuming, various non-destructive evaluation techniques have been used for crack detection such as ultrasonic technique, vibration technique and stress-based technique; However, some of the sensors used are too large or have poor resolution. A high resolution microwave imaging technique with ultra-wideband signal is detected when detecting millimeter scale cracks.

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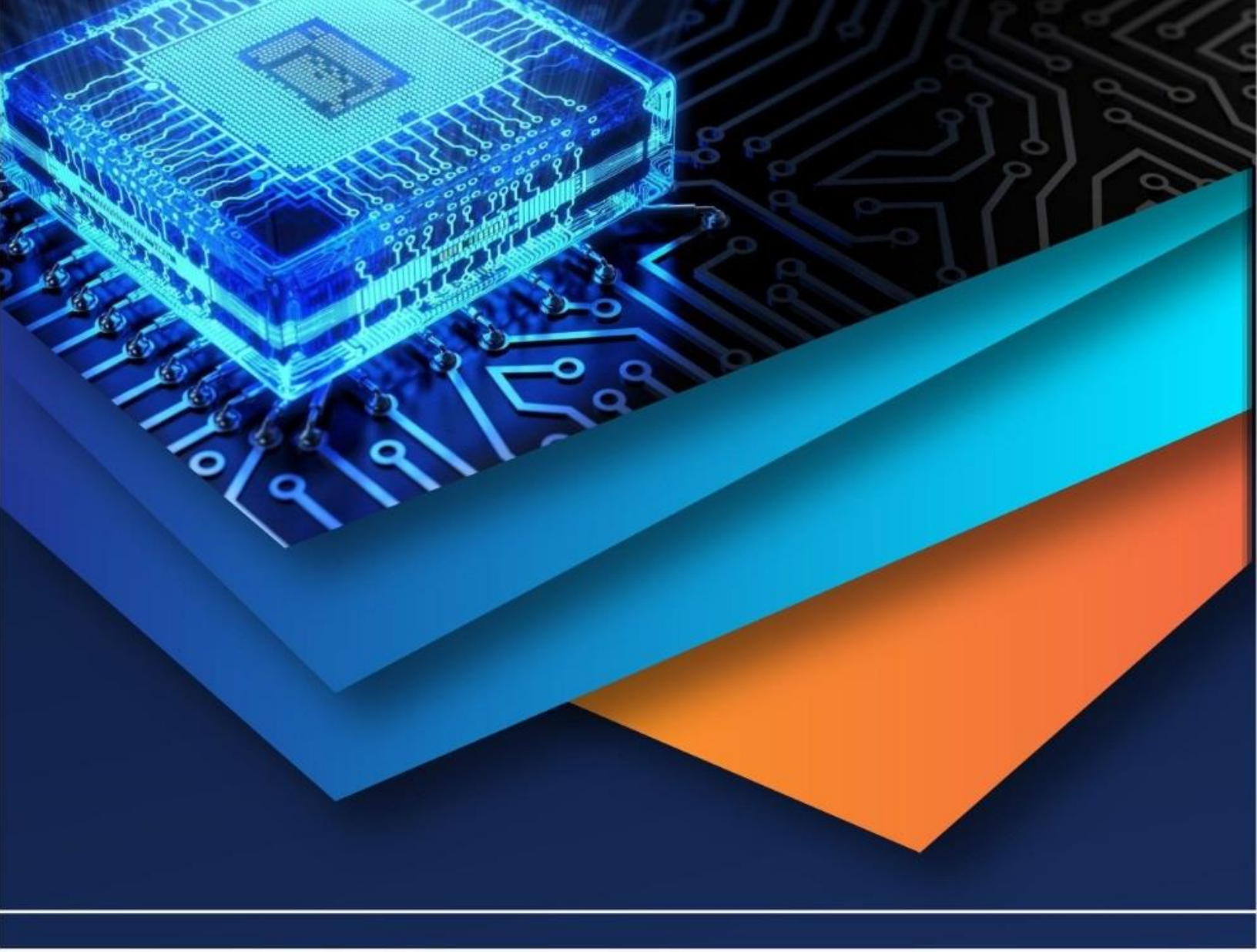

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