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Statistical Analysis of Distress Management in Existing Buildings

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Abstract

Weak workmanship, structural defects, lack of care, atmospheric impact, and natural calamities are all causes of building distress. As a result, periodic repair and restoration of a concrete structure are needed to prolong its life and maintain structural integrity during its design life. Since the number and severity of distress are proportional to the building's age. The distressed structure should be brought to required strength by retrofitting and re-habilitation so it may be put to service without imperiling its utility and safety.

Keywords

Concrete, Cracks, Statistical Analysis, Distress

1. Introduction

Buildings deteriorates over time as a result of moisture, atmospheric and thermal weathering is subjected to additional stresses as a result of different types of loading. Reinforced cement concrete is one of the most durable building materials available to humans, and because of its low cost, it can be used in large quantities while still remaining a viable choice. Owing to fatigue and atmospheric weathering, reinforced cement concrete, despite being extremely durable, begins to develop cracks as the structure ages. Cracks may be broadly categorized as: structural and non-structural cracks. A survey conducted where several buildings were studied for distresses in them (especially structural cracks) and building age was noted along with the number of cracks, severity of cracks, crack width, their frequency, and other parameters. Statistical analysis is done on collected data that gave a unique conclusion about the relation between crack width, age of building, and their frequency.

2. Literature Review

Nation Council of Cement and Building Materials, Hyderabad published a case study on "DISTRESS EVALUATION OF STRUCTURES". This study states that Many reinforced concretes. (RCC)structures suffered from durability distress over a 15-year period, according to case studies published in the literature. External signs include concrete cracking and spalling, as well as corrosion of reinforcement. The primary cause of the issue is water and/or aggressive chemicals penetrating structures during their service life. Carbonation, chloride ingress, alkali-silica reaction, leaching, freeze-thaw and sulphate attack are the identified natural causes of deterioration. Neglecting routine maintenance will result in more preventive maintenance and ignoring preventive maintenance will result in more significant maintenance.

3. Methodology

The methodology which will be followed during this report will be firstly to conduct a survey of buildings that are 40 to 50 years old. After choosing the 50 buildings of above age, they are examined for the cracks, their frequency and probable cause. Since structural cracks are more dangerous for buildings than nonstructural cracks. The data collected is restricted to structural cracks and further statistically analyzing data, to find mean width of cracks, their frequency, standard deviation of crack width and their relation with each other.

Instrument Used to measure crack width - Crack width Ruler

Buildings examined- 50 in numbers

Locality of buildings - Sultanpur, Varanasi, Lucknow

Age of buildings – 40 to 50 years old (by year 2020)

4. Observations

The number of houses along with the examined structural crack width and their overall frequency is given as below:

Table 1. Data of cracks and width of houses

No. Of houses	Crack Width (x mm)	No. Of cracks
5	3	6
8	3.1	9
12	3.15	12
15	3.2	17
18	3.3	22
27	3.5	31
26	3.6	30
16	3.8	19
6	4	8
4	4.15	4
2	4.2	2

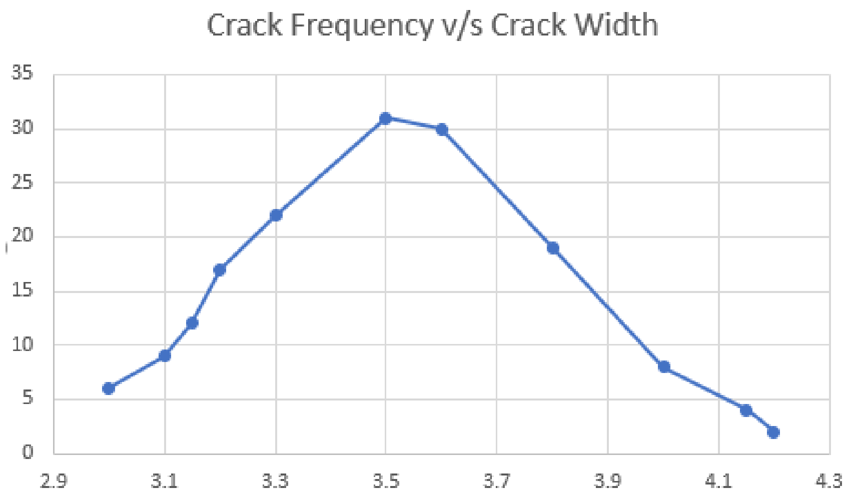

Figure 1. Data related to crack frequency v/s crack width

5. Statistical Analysis

Though the buildings chosen are random, still we see that the frequency of cracks of almost mean width is maximum and then decreasing. Further finding normal distribution of crack width without considering the frequency of cracks gives and plotting the graph gives unique result:

Table 2. Normal distribution of crack width

Crack Width (x mm)	Normal distribution
3	0.415
3.1	0.537
3.15	0.600
3.2	0.661
3.3	0.772
3.5	0.901
3.6	0.901
3.8	0.772
4	0.537
4.15	0.358
4.2	0.304
Mean	3.55
Std Deviation	0.44

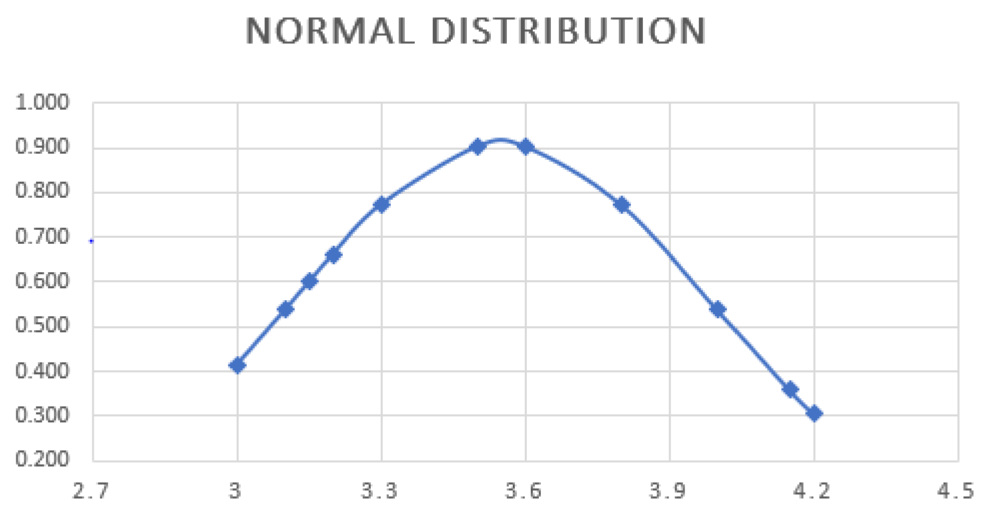

Figure 2. Normal distribution graph

6. Conclusion

When the crack frequency v/s crack width graph is plotted we observe that graph first increases reach maximum value and then decreases. On the other hand, if we do not consider the frequency of cracks but only crack width in general and draw normal distribution, we get a roughly bell-shaped graph (which is almost same as obtained graph in above condition considering frequency), with mean width=3.55 mm. Which indicates that if a building is roughly is roughly 40-50 years old, the maximum chances of structural cracks of crack width 3.55mm exists.

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