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THE EFFECT AND INFLUENCE OF FIRE ON THE REINFORCEMENT AVAILABLE IN R.C.C STRUCTURES

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ABSTRACT

As we all know, the risk of large fires and fire disasters in buildings is growing every day. As a result, assessing, rehabilitating, and repairing buildings that have been destroyed by fire has become a topic of interest. The most important possible danger to the majority of RCC structures is fire. Concrete is the most extensively utilized building material in today's globe. As a result, making concrete fire resistant has become a hot topic among academics. Several scholars from various countries have conducted studies on this subject. In this field, research and development activities are ongoing, and other disciplines are also attempting to study the subject. The truth of real-life issues is presented, giving us a genuine sense of the subject. We will be acquainted with the absolute strategy for the restoration of structures that have been damaged by fire as a result of this study. Also, express a specific assessment and processes by using NDT and a recovery strategy. To determine the impact of fire on reinforcing steel bars, we conducted tests on six samples, each of which was heated to temperatures of 150°, 350°, 650°, and 950° centigrade. After heating, all samples are swiftly cooled in water by quenching, as well as under conventional air-cooling conditions. The qualities of the samples were seen to alter (mechanically) using a universal testing machine (UTM), and grain size and grain structure were analyzed using a scanning electron microscope (SEM), which is referred to as a microscopic study. We infer that more than half of RC structures that have been destroyed by fire may be repaired. As the temperature rises, the material's mechanical qualities deteriorate. The qualities of the composing components, steel, and concrete, are tested at extreme temperatures to analyze the building under fire circumstances. Steel and concrete undergo changes in strength, physical characteristics, and stiffness as a result of heating, and some are repairable while others are not after cooling. When subjected to temperatures exceeding 950°C, the ductility of the reinforcing bars was seen to be diminished when quickly cooled by water. The temperature has little influence on ductility in a bar that is chilled under typical air conditions. Heating the reinforcing bars may change the mechanical characteristics without affecting the chemical composition.

Keywords: Reinforcement, Heat, Ductility, Tensile And Compressive Strength, Concrete, U.T.M Testing Machine, And Quenching.

I. INTRODUCTION

Building fires are becoming more common these days, and the restoration and rehabilitation of fire-damaged structures have become a subject of study and research. Many resources have been dedicated to doing a study on these linked topics. Building a building that can be used again after it has been damaged by fire is a discipline that the civil engineering community is very concerned about. We are well aware that fire causes devastation in terms of loss of life, families, and livelihoods. The "Authoritative Approach" is mostly used in structural design for fire safety. The Authoritative Approach was created about a century ago and incorporates fire resistance evaluation of buildings. Of course, fresh studies modify the statistics, but it is still cautious. IS 1642:1989 (7) and IS 456: 2000 (8) both provide recommendations that follow the tried-and-true prescriptive method. With the introduction of the performance-based design method in the second part of the 1990s, a paradigm change in fire safety engineering occurred. The performance-based strategy has been proposed by George Faller (3) of Arup Fire. Based on the time equivalent notion, his study proposes a public presentation-based technique for estimating fire resistance needs. A mapping of fire load, compartment linings, and ventilation conditions is a comparable computation. The firefighting duration is estimated and then adjusted to take into consideration the likelihood of a flame, structural collapse, and the impacts of an automated suppression system.

Objective of study

1. The goal of this project is to investigate the effects of fire on reinforcing bars that have been heated to different degrees, quenched in water, and then cooled to ambient temperature.

2. using a Universal Testing Machine, investigate the distinctive variations in the mechanical characteristics of the bars.

3. using a scanning electron microscope (SEM), examine the microstructure of the bars.

II. LITERATURE REVIEW

Asif USMANI, Ian A.FLETCHER, Stephen WELCH, José L. TORERO, Richard O. CARVEL Steel's behavior in a fire is better known than concrete's, and its strength at a given temperature can be anticipated with considerable accuracy. Higher temperatures cause the steel to expand much more than the concrete, and if temperatures on the order of 700°C are reached, the steel reinforcement's load-bearing capability will be decreased to around 20% of its design value. Riley, Msc. A new system for assessing fire-damaged buildings might be developed. Sir William Halcrow and Partners (Sir William Halcrow and Partners) (Sir William Halcrow and Partners) (S Under increased temperatures, the bond behavior of fiber reinforced concrete and 20-mm reinforcing steel rebar was investigated.

David N. Bilow et al. (4) presents a description of the complicated behavior of buildings in fire, as well as the simplified procedures that have been used effectively for many years to design concrete structures that can survive the impacts of major flames. Following the September 11th attacks on the World Trade Center, interest in the construction of fire-resistant social institutions skyrocketed. S. C. Chakrabarti et al. (5) carried out a large-scale study to determine the concrete's residual efficacy after it was poured. Up to 500°C, it maintains a high-intensity level, and, after approximately a year, it regains 90% of its lost strength. (The hypothesis that fire-damaged concrete regains some strength overtime is not widely accepted.) Concrete spalling begins as the temperature rises more.

Fig 1: Spalling of Concrete in different Types of Structures

III. METHODOLOGY

In the Investigation Sri TMT bars of a diameter of 12mm were used as test specimens. A total of 20 bars were cut to a length of 30 cm. Now, five specimens were evaluated for mechanical characteristics using UTM before being heated in a standard environment and the results were collated. Each of the 10 specimens was heated for an hour in the electric furnace at 100°, 300°, 600°, 900°C, and 1000°C without any intervention. After heating, five of the ten samples at each temperature were quenched in cold water for quick cooling and the other five were set aside for normal cooling at ambient temperature. These specimens were then subjected to UTM testing for mechanical characteristics.

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IV. RESULT AND DISCUSSION

4.1 UTM Analysis

Table 1: Result for rapid cooling conditions

S.No	Temperature °C	UltimateLoad	Elongation (%)
1	25 (Room temp.)	67.1	28.3
2	100	66.1	15
3	300	65.5	30
4	600	68.4	23.3
5	900	78.3	11.6
6	1000	82.4	11.8

Table 2: Result for ordinary cooling condition

S.No	Temperature °C	Ultimate Load	Elongation (%)
1	25 (Room temp.)	67.1	28.3
2	100	66.5	30.2
3	300	63.7	28.3
4	600	64.3	27.4
5	900	65.5	26.6
6	1000	66.4	26.2

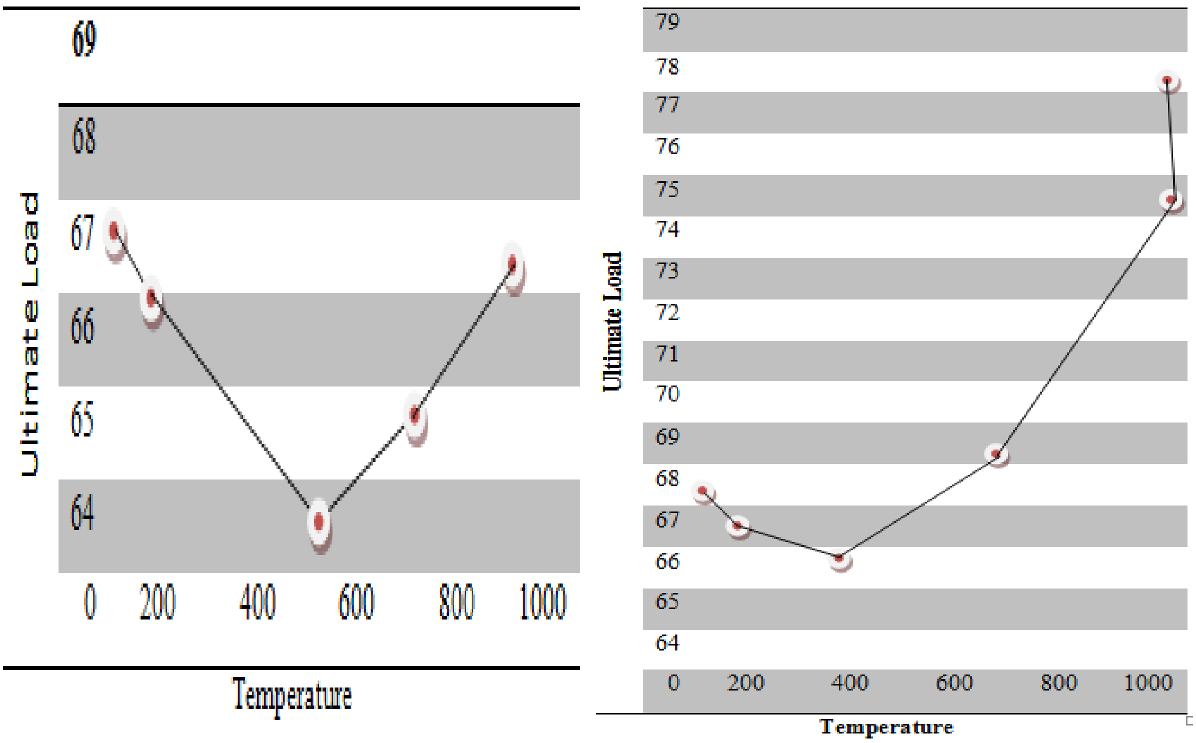

Fig 2: Graph between Temperature and ultimate Load databased Table 1 and Table 2

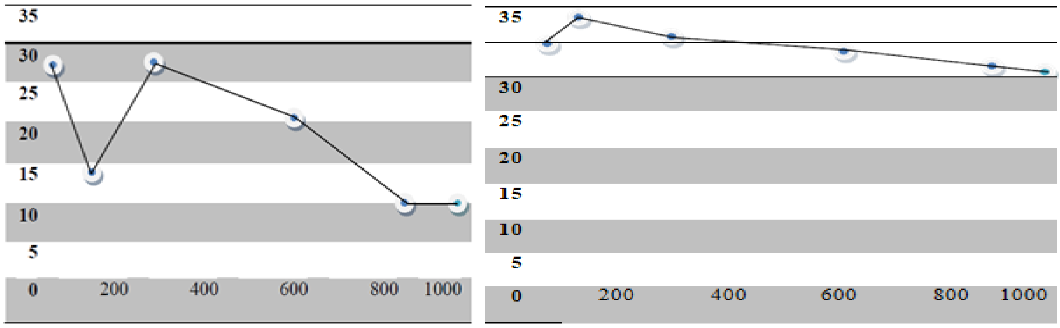

Fig 3: Graph between Temperature and Elongation databased Table 1 and Table 2

4.2 SEM Analysis

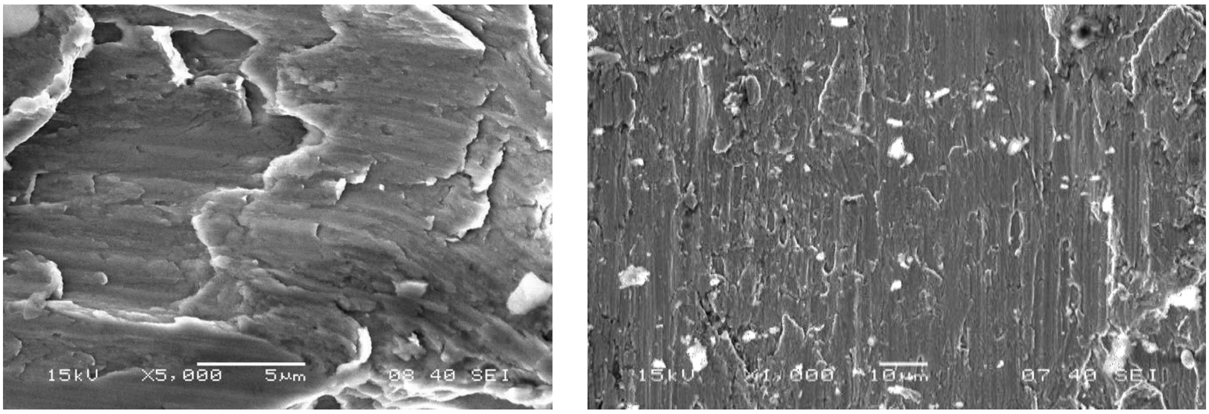

Fig 4: 150° C normally cooled at 5° C and 10° C

V. CONCLUSION

- The behavior of reinforcement bars heated to temperatures of 150°C, 350°C, 650°C, and 950°C, cooled rapidly by process quenching, and also at normal cooling in ambient temperature, was investigated, and we found that rapid cooling after heating to a high temperature of 950 °C reduced the ductility of the bar.
- Tensile strength testing using a Universal Testing Machine revealed distinctive changes in the mechanical characteristics of the bars, including an increase in ultimate load and a drop in percentage elongation of the specimen, indicating a considerable loss in ductility.
- Scanning Electron Microscope (SEM) analysis of the microstructure of the bars also reveals that the microstructure of highly heated specimens alters without changing the chemical composition, which would have a detrimental influence on the structure.

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