ABSTRACT

During the last years, there was a strong need to repair and strengthen the concrete structures. There was also increase in using the modern techniques such as fiber-reinforced olymers (FRP) in repairing and strengthening concrete structure due to their several desirable attributes, such as resistance to corrosion, high strength – to – weight ratio, in addition to easy handling, quick application, minimum alteration to dimensions and more need of maintenances.

However, a major concern about the use of FRP in strengthening applications is the effect of high temperature, which has a damaging effect on polymer resins, and therefore there is a possibility of total loss of the FRP strengthening in case of fire. Exposing the "GFRP" system to an elevated temperature higher than that of the (tg) of the resin, the resin burns which leads to falling of "GFRP" from the beam, and thus loss of the strengthening system.

The present research work aims to study the effect of high temperature on the structural behavior of reinforced concrete beams strengthened with FRP laminates. The various studied variables are degree of temperature, duration of exposure to high temperature and type of protective coating material. The aim of the research is to study the effectiveness of different coating layers in protection of FRP strengthened beams and therefore to suggest the most efficient protective coating material.

The structural behavior of RC beams was investigated by carrying out 4- point loading till failure to evaluate residual strength of such beams after exposure to high temperature.

The experimental program consisted of two phases. Phase one consists of testing of 81 cubes, protected by different coating materials under variable degrees of high temperature to determine the effect of high temperature on the compressive strength of concrete and different materials for coatings. Phase two consists of 36 beams, some beams were tested to study the effect of high temperature on reinforced concrete beams whether they are strengthened or unstrengthened by GFRP, while other beams were tested under variable degrees of temperature, strengthened with GFRP and protected with different types of coating materials to evaluate the most effective protecting coating materials.

The results of experimental work showed that concrete cubes subjected to temperature of 600^{o}C for two hours, lost 80% of compressive strength. Also reinforced concrete beams subjected to temperature of 600^{o}C for two hours, lost 65% of failure load. Reinforced concrete beams strengthened with (GFRP), the strength is increased by (16%) from the unstrengthened beams.

The coating materials, which consist of double coating system [Ceramic fiber + Perlite plaster or Vermiculite plaster or OPC plaster or Aswan clay)], give a better protection for (GFRP) system during exposure to a temperature of 600°C for 2 hours. Inanition it can effectively contribute to reduce heat transfer and thus provide higher fire rating and increase load carrying capacity of the structural member. Since, higher level of capacity can be achieved by ceramic fiber blanket, more if is perlite mortar added, compared to the other types. Further enhancement is also achieved.