اجندة طالب الدراسات العليا

اسم الطالبة : إكرام أمين سعيد

التخصص: هندسة مواد بناء

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أسماء لجنة المناقشة:

١. أ. د. شاكر أحمد صالح رئيساً
٢. أ. د. غالب محسن حبيب عضواً
٣. أ. م. د. علي حميد عزيز عضواً
٤. أ. م. د. إقبال نعيم كوركيس عضواً
٥. أ. م. د. معن سلمان حسن عضواً
٦. أ. د. رياض صالح المهيدي عضواً ومشرفاً
٧. أ. د. طارق صالح هادي عضواً ومشرفاً
٨. أ. م. د. باسل صلاح مهدي عضواً ومشرفاً

اسم المقوم العلمي: د. أحمد سلطان علي

اسم المقوم اللغوي: يقظان رضا مهدي

عنوان البحث للرسالة او الاطروحة:

"Flexural Performance of Reinforced Concrete Beams Strengthened with Near-Surface Mounted Carbon Fiber Reinforced Polymer Laminates and Bars under Elevated Temperature"

عناوين البحوث المستلة:

1- **"Flexural Performance of Near Surface Mounted CFRP Strengthening Reinforced Concrete Beams Using Cement-Based Adhesives at Elevated Temperatures"**
2- **"Behaviour of RC Beams Strengthened with NSM-CFRP Laminates and Bars**
3- **"Finite Element modelling of Reinforced Concrete Beams Strengthened with Near Surface Mounted Carbon Fibre Reinforced Polymer Laminates and cement-based adhesive"**

تقدير المناقشة: جيد جداً عالي

صورة المناقشة

Abstract **مستخلص البحث**

Near surface mounted (NSM) technique recently has been used for concrete structures strengthening with FRP. It is considered as a promising technique in retrofitting and strengthening RC structures in both shear and flexure loading system. Researches available up to now are focusing foremost on overall member behavior. Furthermore, current researches also are focusing on different parameters that have effect on NSM laminate or NSM bars bond performance. However, few research have focused on how NSM FRP are affected when exposed to high temperature. An experimental program was carried out on a total fifteen large scale RC beams to investigate the behavior of unstrengthened and strengthened beams when subjected to high temperature conditions. Twelve of the beams were strengthened with NSM-FRP laminates and bars where strips include both smooth and rough FRP strips and the remaining three beams where unstrengthened to be referred to as control beams when analyzing the tests results. The experimental program subject the strengthened beams to high temperature degrees up to 600 ˚C in electric furnace and observe changes after beams been heated.

The effect of using cement-based adhesive, two different NSM CFRP laminate surfaces, and two different NSM CFRP configurations (bars and strips) were studied. Furthermore, investigate involvement of insulation system (plasterboard) for protection the beams under heat exposure. A photo imaging instrumentation technique (photogrammetry) is applied to record strains value on specimens and compared with the conventional instrumentation techniques.

Results showed that the reinforced concrete beams strengthened with NSM CFRP retained 100% of their unstrengthened ultimate load and about 82% - 61% of their unheated strengthened ultimate load after heat exposure, although the CFRP temperature exceeded the glass transition temperature of each CFRP type. This means that keeping the temperature below CFRP's glass transition temperature to attain the endurance of structural high temperature is not needed. This is due to good performance of the cement-based adhesive achieved at 600˚C and the good protection provided to the CFRP through embedment in the grooves. Moreover, the plasterboards provided excellent protection and decreased the CFRP temperature of about 42-24%. The insulated beams behaved as good as that of strengthened beams prior to expose to 600˚C.

Advanced non-linear finite element analyzing software (ATENA) was used for modeling the tested beams and compared against experimental test results.

Diameter of CFRP bars, CFRP laminates number and concrete compressive strength parameters effects on ultimate load capacity and behavior of NSM CFRP strengthened beam in both ambient and elevated temperatures were assessed by carrying out a parametric study.

Finite element modeling accuracy was confirmed by the results obtained which were satisfactory when compared with the experimental results.

CFRP bars diameter, CFRP laminated number and concrete compressive strength moderately influence NSM CFRP performance of the strengthened beams in both elevated temperature and ambient circumstances and this was concluded based on the parametric study results.