

Sudan University of Sciences and Technology
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Finite Element Modeling of Reinforcement Concrete Cantilever Beam

النمذجة بالعناصر المحددة للعروضات الخرسانية الكابولية

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Abstract

A cantilever beam is an important structural element that provide less support and efficient use of space in building design . the cantilever beam is rigidly fixed in one end and the other end is hanged in the air . It is essential design elements that provide functional and aesthetic architectural benefits , and require care and ingenuity in their design , erection , assessment , and rehabilitation by structural engineers . This research consists a finite element model to study structural analysis of a reinforced concrete cantilever (RCC) beam , and focuses on defining the special deflection properties , and using carbon fiber reinforced polymer (CFRP) as a strengthening technique for (RCC) beams and learn how to use ABAQUS program to modeling and analysis structural element. For this purpose, a cantilever beam with the only deflection in one direction and various length is used .To use Abaqus program , will compare experimental results which taken from previous study with the FE program (ABAQUS) results to sure the effectiveness and efficiency of the program (ABAQUS) in modeling , for this purpose B1and B2 , show modeling of (RCC) and (RC) beam respectively , the beams was used to sure the efficiency of the program (ABAQUS) in modeling , The comparison show that , Finite element program (ABAQUS) is in good agreement with experimental approach results (which taken from previous study) . After checked the performance of Abaqus program , cantilever beam (B4) at length 3.5m was model . (B4a) RCC beam without CFRP , while (B4b) RCC with externally bonded of CFRP. The beam was used to Comparison of behavior of RCC beam with and without using CFRP and try to reach to length 3.5m to cantilever beam without big deflection . The results of deflection to B4a was (2616mm) while to B4b is (0.05243mm) , and the stress value to B4a was ($2.595e^{10}$ N/mm²) , but B4b show ($6.348e^5$ N/mm²) value of stress . The obtained results indicated that Strenegthing with externally bonded CFRP sheets increases the carrying load and decreases the deflection .

المستخلص

البيم الكابولي عنصر إنشائي مهم ذو قيمة جماليه و وظيفية خاصة ذلك نظرا لإضافته مساحه للمنشأة حرفيا من لاشئ . وهو عبارة عن بيم مثبت من طرف واحد بينما يظل الطرف الآخر حرا في الهواء, وهذا ما يجعله يحتاج لدقه فائقة و براعة تامة في عملية التحليل و التصميم و التنفيذ و التقييم و إعادة التأهيل من قبل المهندس الإنشائي . يحتوى هذا البحث على نمذجة للبيم الكابولي بواسطة برنامج التحليل الانشائي ال **ABAQUS** .

تم التركيز على تعريف و تحليل الانحراف للبيم الكابولي بشكل خاص و ذلك بعد التعرف على البرنامج و كيفية استخدامه كتقنية لنمذجة العناصر الانشائية كما تم استخدام ألياف الكربون المسلح لتحسين السلوك الانشائي للبيم .

لاستخدام البرنامج لابد أولا من التأكد من انه يعطى نتائج مقاربة لنتائج الدراسات المعملية وذلك عن طريق مقارنة نتائجه مع نتائج دراسات سابقة , تم ذلك بنمذجة أبيام بواسطة البرنامج بعد استخلاص خصائصهم من دراسة سابقة و من ثم تم مقارنة النتائج مع النتائج الحقيقية لنفس الدراسة , بعد المقارنة وجد أن النتائج المستخرجة من البرنامج ذات توافق جيد مع نتائج الدراسات السابقة التي تم استخلاص خصائص الابيام منها .

بعد التأكد من جودة النتائج تم عمل نمذجة لبيم كابولي B4 بطول (3.5m) بعد استخلاص خصائصه من دراسة سابقة , النمذجة تمت للبيم للحالتين مع و بدون استخدام ألياف الكربون المسلح , بعد اكمال عملية النمذجة وجد أن قيمة الانحراف للبيم من دون استخدام ألياف الكربون المسلح (2616mm) وقيم الاجهاد ($2.595e^{10} N/mm^2$) , بينما ولفس البيم بعد استخدام ألياف الكربون المسلح أصبحت قيمة الانحراف (0.05243mm) و الاجهاد ($6.348e^5 N/mm^2$)

وكما يتضح من القيم التأثير الكبير على السلوك الانشائي للبيم الكابولي , إن استخدام ألياف الكربون المسلح يعمل على زيادة السعة التحميلية و تقليل الانحراف بشكل كبير و تقليل الانفعال لحديد التسليح .

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Symbols

Abaqus/CAE	: Abaqus / complete abaqus environment
ACI	: American Concrete Institute
AISC	: American Institute of Steel Construction
B & b	: Width
BSI	: British Standards Institution
C _b	: Modification Factor
CFRP	: Carbon Fiber Reinforced polymer
CI	: Concrete Institute
D & d	: Depth
E	: Modulus of Elasticity
EXPR	: Experimental
F _{cu}	: Concrete Compressive Strength
F _y	: Yield Strength of Steel
FEA	: Finite Element Analysis Experimental
GFRP	: Glass Fiber Reinforced Polymer
H & h	: Depth
L	: Length
M	: Bending Moment
MEMS	: Micro Electro Mechanical System
M _{st}	: Microstoks
PNAP	: Practice Notes for Authorized Persons .
RC	: Reinforced Concrete
RCC	: Reinforced Cantilever Concrete
[R]	: References Number
v	: Poisson Ratio
V	: Shear Force

- v : Shear Stress
- B1 : Reinforced Concrete Cantilever Beam
- B2 : Reinforced Concrete Simple Supported Beam
- B2a : B2 Without Carbon Fiber Reinforced Polymer at Load 10KN
- B2b : B2 With & Without Carbon Fiber Reinforced Polymer at Load 71KN
- B2c : B2 with Carbon Fiber Reinforced Polymer at load 100KN
- B3 : Reinforced Concrete Cantilever Beam in Length 2.2m
- B3a : B3 Without Carbon Fiber Reinforced Polymer
- B3b : B3 With Carbon Fiber Reinforced Polymer
- B4 : Reinforced Concrete Cantilever Beam in Length 3.5m
- B4a : B4 Without Carbon Fiber Reinforced Polymer
- B4b : B4 With Carbon Fiber Reinforced Polymer