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Behavior of Hybrid Reactive Powder Concrete Columns Exposed to Chloride Attack

Mohammed M. Salman **Husain K. Jarallah** **Raed Satar Al-Behadili**
Civil Eng. Dep., Al Mustansiriyah Uni., Baghdad, Iraq
Civil Eng. Dep., Uruk University, Baghdad, Iraq
mmsalman56@yahoo.com khalfdec@uomustansiriyah.edu.iq satarraad@yahoo.com
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Abstract

In this paper, the cross section behavior of reinforced concrete columns made of normal and hybrid reactive powder concrete (hybrid by steel and polypropylene fibers) under concentric and eccentric vertical load was study. The casted columns were cured in two different type tap water for 28 days and chloride water for six months. Chloride salts with concentration was 8341.6 mg/l. Three variables were adopted in the experimental program; concrete type, curing type and the eccentricity of vertical load. Twenty (120x120x1200) mm columns were casted and tested depending on these variables. The different eccentricities were (0, 50,100 and 150) mm and where (e/h) were (0, 0.42, 0.83 and 1.25) respectively from the center of column, the other types of loading are tested the specimens as beam. The experimental results showed increasing in ultimate load capacity and higher chlorides resisting for hybrid reactive powder concrete in comparison with normal concrete in both types of curing (tap and chloride water). Through studying load deflection, test results for Normal Strength Concrete (NSC) and Hybrid Fiber Reactive Powder Concrete (HFRPC) columns that deflection for columns cured in chloride water more than tap water when compared at the same load that also by increase eccentricity leads to an increase in deflection for both cured and The neutral axis depth for HFRPC columns is more than NSC at the same load also when eccentricity increases, the compression zone decreases and neutral axis also decrease by increase eccentricity. These results occur when columns are cured in tap and chloride water.

Keywords: normal strength, hybrid fiber reactive powder concrete, eccentricity, deflection, curing, neutral axis depth.

1 .Introduction

When reinforced concrete subjected to chemical attack or high level of distress, it was found to show deterioration and hence, much research is being carried out to find ways to improve performance of these materials. Towards this HFRPC developed are of considerable practical significance. Many researcher study effect of aggressive environment on load-deflection curve of reactive powder concrete such as. **Abtan, 2013, [1]** studied the behavior of RPC columns subjected to axial load with initial eccentricity. Twelve columns were prepared with 120mm square section at the midsection and were hunched at the ends to apply eccentric loading. The specimens were tested up to failure to determine the effects of the variation of the concrete kind (normal or RPC), presence of steel fibers and longitudinal steel ratio. Experimental data on strength, lateral displacement and failure mode was obtained for each test. The comparative analysis of the experimental results indicated that the use of RPC caused substantial variation in the ultimate strength and failure modes. inclusion of steel fibers in RPC was an effective way to prevent spalling 2of the concrete cover and increase the ductility, as well as, high ratio of longitudinal reinforcement delays the buckling of the columns and increased strength. **Muthuswamy and Thirugnanam, 2014, [2]** studied the structural behavior of hybrid fiber reinforced concrete column made with the combination of steel and glass fibers under axial loading reinforced concrete column. The size of RC Column specimens chosen for experimental study was 150mm diameter and 700mm height. The longitudinal reinforcement consists of 6 numbers of 8mm diameter bars and lateral ties consist of 6mm diameter bars with 100mm spacing. It was observed from the experimental investigation that the behavior of HFRC column was relatively better than conventional reinforced concrete column and steel fiber reinforced concrete column in all respects.

The main objective of the present study is study the effect of external chloride attack on the strength, load-deflection curve and neutral axis depth of hybrid fiber reactive powder concrete (HFRPC) columns and normal strength concrete (NSC) columns subjected to concentric and eccentric loading.

2. Experimental Program

2.1 Details of Tested Columns

A total of 20 columns were investigated by using experimental work. All columns have square cross section with 120 mm. the materials used for the specimens are normal strength concrete (NSC) designed for 25 MPa as by **ACI 318M-14 [3]** and rebars as specified in ASTM A615. The other materials are used HFRPC (reactive powder concrete with steel and polypropylene fibers). All detailing specification for columns as per conditions of ACI 318M-14. The shape and size of the specimens loading arrangement and strain measurement of the test specimens ae given in this paper. The columns were studied the following variables:

1) Type of concrete
2) Curing condition
3) Eccentricity value

Fig. 1 and **Plate 1** show the geometry and reinforcement details of tested

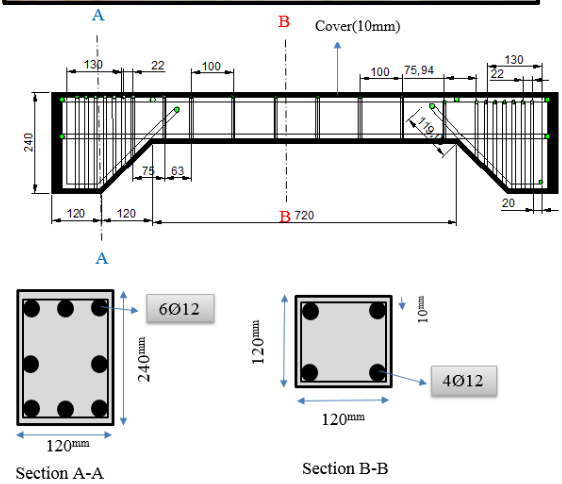


Figure 1: Dimensions and reinforcement details of tested columns

2.2 Materials

2.2.1 Type of concrete

The two types of concrete were used, the first one: hybrid fiber reactive powder concrete (HFRPC) this concrete contains (high content of cement+ fine aggregate, silica fume, superplasticizer (Glenium 51) with water and steel fiber with polypropylene fiber), the secondary was: normal strength concrete (NSC) "conventional concrete" this concrete contains (cement, fine aggregate, coarse aggregate and water).

2.2.2 Steel reinforcement

In all the specimens (Ø12 mm) diameter for steel bars with a nominal yield strength 636 MPa confirming to, **ASTM A615, 2005 [4]**. It was used as main steel with 1% steel reinforcement ratio to confirm minimum reinforcement requirement of ACI 318M-14. The ties were fabricated using (Ø8 mm) diameter for steel. The minimal conditions to be satisfied in terms of hoops spacing (S) proposed in ACI318 for buildings design should satisfy the following condition: S = min. ($16\times Ø_{longtudional}$ or $48\times Ø_{tie}$ or smaller dimension of section). The tensile test was performed achieved by the testing machine SANS (1000 kN), as shown in **Plate 2** and **Table 1,** available at the Materials Laboratory, Faculty of Engineering Mustansiriayah University. The bars were tested to evaluate the yield stress and ultimate stress.

Table 1. Properties of steel bars*

Nominal diameter mm	Length before test(mm) ($l_{No.}$)	Yield stress (Fy) MPa	Ultimate strength (Fu) MPa	Ductility= $(l_{ac.} - l_{No.})/l_{No.}$ %
8.66	50	696	961	9.2
12.15	50	636	818	7.75

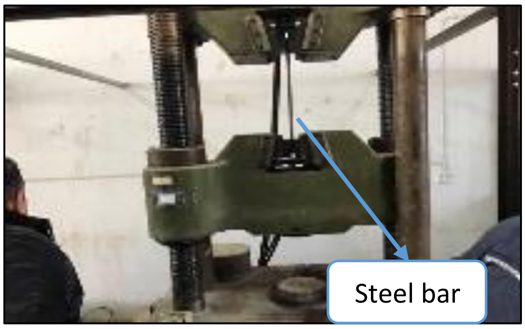


Plate 2. Tensile Machine for Steel Bars Testing

2.2.3 Mix proportion

The ordinary Portland cement was used in the concrete mix of proposition by weight (1:1.5:3) for normal strength concrete (cement: sand: gravel). Reactive powder concrete was used in concrete mix (1:1:0.15) for (cement: sand: silica fume). The steel fibers used in the specimens (straight, density 7800kg/m^3, length 13mm, diameter 0.175mm, aspect ratio 74, tensile strength 2600 MPa). The polypropylene filers used in the specimens (straight, density 910kg/m^3, length 12mm, diameter 0.12mm, aspect ratio 100, tensile strength 450 MPa), **Table 2** more details about material used in mix for this study. Control specimens consisting of (150×300) mm and (100×200) mm cylinders and (100×100×500) mm prisms were also cast with each specimen to determine the compressive and splitting tensile strength, modulus of rupture and modulus of elasticity. The workability was 12cm in this study by using slump test. The mix proportion used in this study depending on the same previous researches **[5], [6] and [7]**

Table 2: Mix proportions of NSC and HFRPC

Concrete Type	NSC	HFRPC
f_c'	26.9	107.07
f_{sp}	1.768	3.253
E_C	27.485	44.499
f_r	4.23	8.25
Cement (C) (kg/m^3)	400	1000
Sand (S) (kg/m^3)	600	1000
Gravel (G) (kg/m^3)	1200	-
Silica Fume (SF%)*(kg/m^3)	-	150 (15)
Super-plasticizer(SP)** Glenium51%	-	6
Water (W) (kg/m^3)	180	200
Water/ cement ratio W/C	0.45	0.2
Steel fiber*** (STF%)	-	0.75
Polypropylene fiber*** (PPF%)	-	0.15
Total fiber volume*** %	-	1.15
Mix proportion by weight	1:1.5:3 Cement : Sand : Gravel	1:1: 0.15 Cement : Sand : Silica fume

* Percent of cement weight.
** Percent of binder (cement and silica fume) weight.
*** Percent of mix volume.

2.3 Type of Curing

In order to study the influence of the two types of the curing in structural behavior for HFRPC and NSC columns were used. These type were tap water curing and chloride water curing are used tap and chloride water. Curing was carried out for 28 days for NSC and HFRPC in tap water for group A. In chloride, curing was carried out for 6 months for NSC and HFRPC for group B in order to get high disintegration with the exposure time. **Table 3.** show that.

Table 3: Columns details

Group No.	Column* Designations	Eccentricity (mm)	Type of concrete	Type of curing
A	N1E0	0	Normal Strength Concrete	Tap Water
	N2E50	50		
	N3E100	100		
	N4E150	150		
	N5EB	beam		
	H1E0	0	Hybrid Reactive Powder Concrete	
	H2E50	50		
	H3E100	100		
	H4E150	150		
	H5EB	beam		
B	NC1E0	0	Normal Strength Concrete	Chloride Water (8341.6 mg/l)
	NC2E50	50		
	NC3E100	100		
	NC4E150	150		
	NC5EB	Beam		
	HC1E0	0	Hybrid Reactive Powder Concrete	
	HC2E50	50		
	HC3E100	100		
	HC4E150	150		
	HC5EB	Beam		

2.4 Preparation of the saline solution

One of the principal problems of concrete durability is the external attack of sulfate and chloride salts, especially those present in soil and underground water in the southern parts of Iraq and other parts of the world. In this study the salt used in preparing the solution is pure soudiom chloride (NaCl) is added up equal to 3.5% from weight water used in chloride curing (3.5% from weight water used in tank chloride water), this percentage is hardest environment in which concrete is exposed as per ACI 318-14. **Plate 3** shows sample from chloride used in this study also **Plate 4, 5** show type of curing. for tap water the chloride concentration was 14.99 mg/l (Plate 4) while in chloride water the concentration of chloride was 8341.6 mg/l after application ratio 3.5% from weight of water (Plate 5).


Plate 3: Chloride Used in Test

Plate 4: Curing of specimens in tap water

Plate 5: Curing of specimens in chloride water

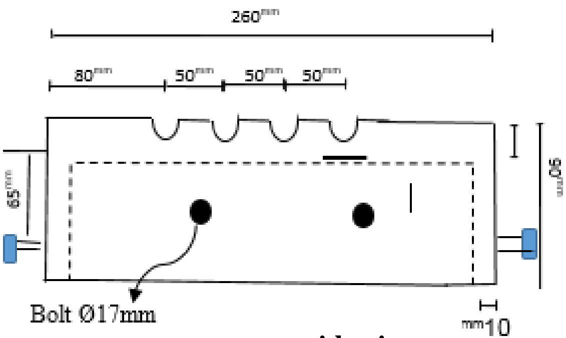
2.5 Testing of concrete column

2.5.1 Eccentricity values

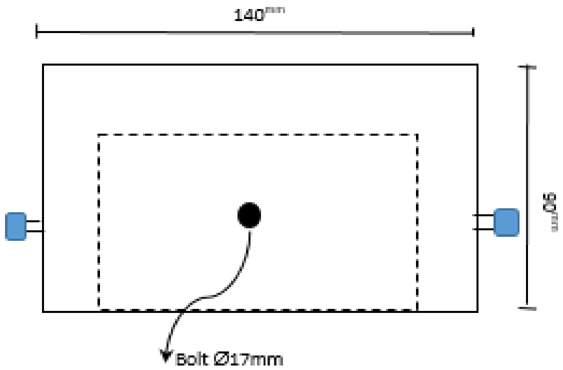
The columns were tested under concentric and eccentric axial loads using hydraulic universal testing machine (MFL). The position of load was variable with five values of eccentricity. The first position was with no eccentricity, so the column was subjected to axial load only with zero eccentricity (e=0), the other values of eccentricity were (50,100 and 150 mm) from the center of column while the last column was tested as a beam to obtain infinity value for eccentricity (e=∞).

2.5.2 Loading caps

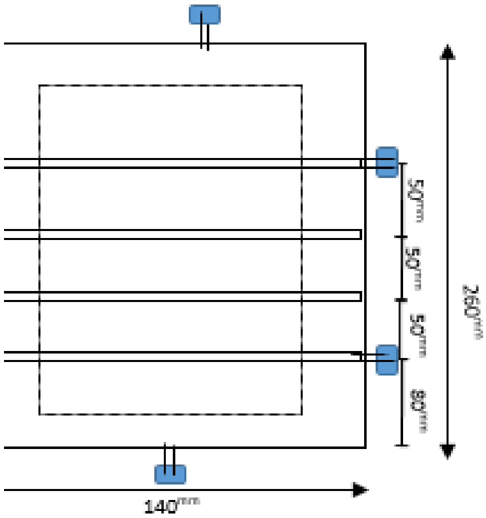
The loading cap was rectangular section (140×260mm) and thickness 40mm.Consisted of four eccentrics. The eccentric load was applied on the loading cap via a wedge plate that was located into the 0 mm, 50mm, 100mm, 150mm channels, respectively. The loading caps were prepared of high strength steel and each end of the columns was covered with loading cap. **Plate 6** shows cap loading.



a-side view



b-front view



c-top view

Plate 6: Cap Loading details

2.5.3 Strain measurement

Strains are measured to determine the degree and behavior of section against the applied stresses. The use of devices with high accuracy is required to calculate th(e = (0, 50, 100, 150) the steel and concrete. Two types of strain gauges were used, the first type for steel reinforcement (FLA-5-23-3L) produced by TML company and the second for concrete (PL-60) produced by TML company. Data logger type (TML/ TC-32K) was used to measure the strains in steel reinforcements and concrete. It is an automatic, multichannel, scanning data logger for reading strain gages and transducers. The strain gages were fixed in two different locations, the first one was fixed in main reinforcement in mid of column length at tension zone, while the second one was settled on compression face of concrete in mid length of concrete.

2.5.4 Loading Applied

The load was increased gradually and in every 10 kN step for HFRPC and 5 kN for NSC, the order of the sample is shown in **Plate 7.** The mid span deflection is recorded at each 10 KN for HFRPC and 5 k N for NSC load increment. The load is applied via a hydraulic jack. The schematic diagrams for the column and beam is shown in **Fig. 2 and 3.**

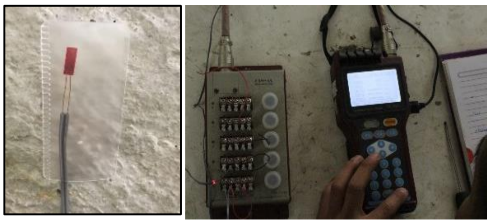


Plate 7: Strain and data logger used in the test

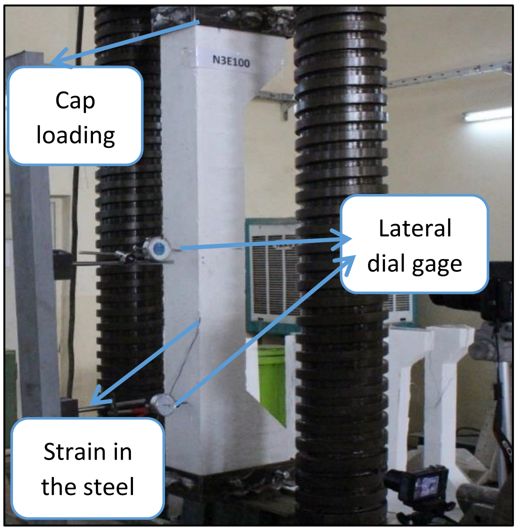


Plate 7: Test setup

3. Results and discussion

3.1 Load-deflection behavior

The experimental load-displacement curves obtained for the tested columns are shown in **Fig.4 to 9.** The load deflection curves of the specimens define the axial deflection which is measured by the actuator deflection gauge and the deflection was obtained from the mid height dial gauge. It can be noticed that all specimens have undergone four stages of behavior during the entire loading process. In the first stage, linear behavior of the load-deflection response is evident. This stage covers the region up to the first cracking load. Within this stage the materials are still elastic and no cracks occur in the specimens. In the second stage, vertical cracks (normal to the longitudinal axis) are initiated in the tension face of the specimens. Those cracks are developed as the load increases, causing a shift of neutral axis location towards the compression face of the columns.

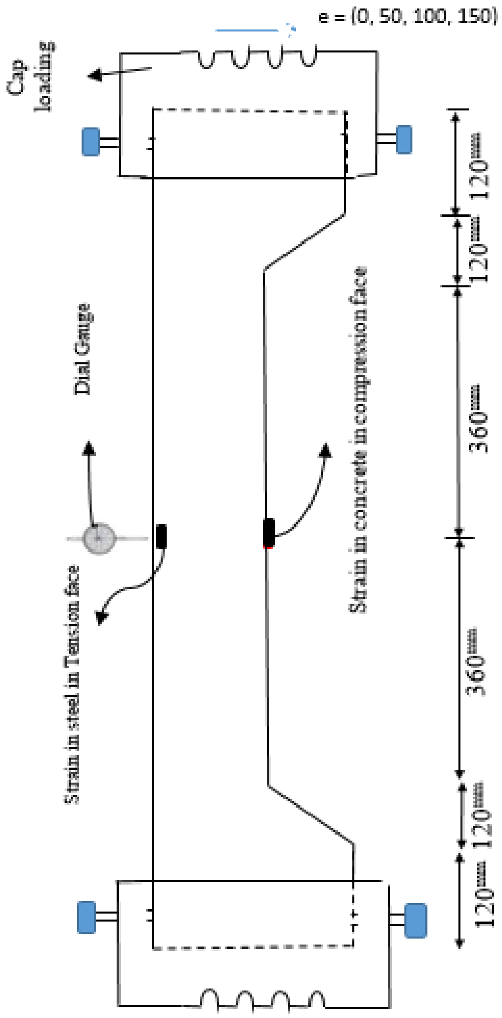


Figure 2: testing column diagram

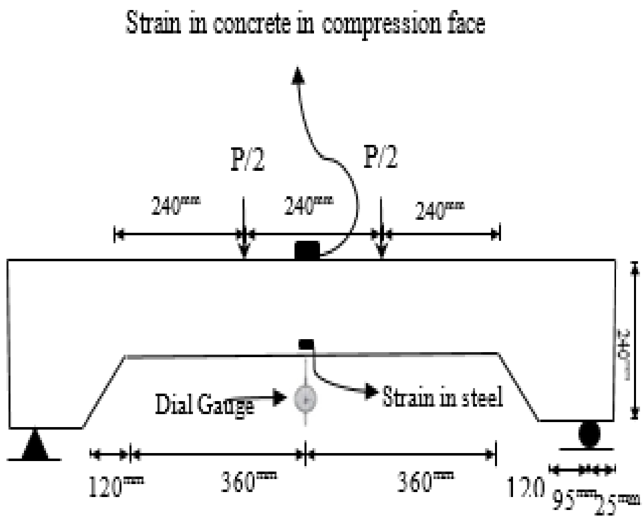


Figure 3: testing beam diagram

Accordingly, a continuous reduction in the moment of inertia of the cracked section occurs as the load increases. The curve changes from linearity to nonlinearity because at this stage the rate of increase in deflection with respect to load continuously increases as the load is increased. In the third stage, as the applied load approaches its ultimate value, the rate of increase in deflection is substantially exceeding the rate of increase in the value of applied load. Finally, the fourth stage shows the descending phase of the load-deflection curve. In this stage the deflection increases as the load constant. for safety reasons the dial gauge is removed from the specimens when the maximum allowable displacement has been recorded, after which the loading process was continued until the failure of the columns. In the fallowing sections, the effect of variable parameters on the load-deflection response will be studied.

3.1.1 Effect of Type of Curing on Load-Deflection Curve

Fig. 4 and 5, show the effect of type curing on normal strength concrete columns. These figures indicate that, in comparison between deflection for columns cured in chloride water and columns cured in tap water at the same load it can be noted that, deflection for columns cured in chloride is large than column cured in tap water when comparing at same load. In other words, high deflection appears with small capacity for columns cured in chloride water, and low deflection appears with high capacity for columns cured in tap water. Also, **Fig. 6** shows the effect of type curing on load-deflection curves for hybrid fiber reactive powder concrete columns. It can be observed from **Fig. 6** that there is little difference in deflection in comparison between columns cured in chloride water and columns cured in tap water. The load-deflection behavior in this study is identical with load-deflection obtained from pervious researchers who studied effect of harsh environment on reinforced concrete beams under bending such as **[8] and [9].**

3.1.2 Effect of Type of Concrete on Load-Deflection Curve

Fig. 6 and 7, show the effect of type of concrete at the same curing condition. It is observed from these figures that, the general stages of curve behavior are the same in normal and hybrid fiber reactive powder concrete columns, but the difference is in ductile behavior between them, where deflection for NSC columns is more than the HFRPC columns in comparison between them at the same load.

3.1.3 Effect of Eccentricity on Load-Deflection Curve

Fig. 8 and 9, show the effect the eccentricity at the same curing condition. It is observed from these figures that, the general stages of curve behavior are the same in normal and hybrid fiber reactive powder concrete columns, but the difference in the deflection, where deflection increase by increase of the eccentricity in NSC and HFRPC.

More details about values of load and deflection wass shown in **Table 4.**

3.2 Variation of neutral axis depth

The experimental neutral axis depth, c, of the tested columns is given from the experimentally measured strain. The variation of the ratio of c to the effective depth of the section, d, shown in **Fig.** from **10** to **13**, it can be noted from these figures that, c/d decreases with the increase in load for all columns when cracks occur neutral axis shifts upward and c/d value drops but some of specimens (N1E0 and H1E0) are constant c/d because the specimens all compression zone only so theN2E50 c/d increase with increase in load, three parameters are affected on variation of c/d with load including:

3.2.1 Effect of type of curing on variation of neutral axis depth

Fig. 10 and 11, indicates the effect of type of curing on variation of c/d with load. From these figures it is noted that c/d for NSC columns in chloride water is lower than c/d in tap water, these results are attributed to deterioration of NSC when subjected to chloride attack. This attack causes an increase in tension zone and a decrease in compression zone due to the increase in crack width and strain when columns are cured in chloride. on the other hand, it is noted that, c/d for HFRPC columns when cured in chloride water approach and lower than c/d for HFRPC columns when cured in tap water because chloride attack on hybrid fiber reactive powder concrete is very little.

3.2.2 Effect of type of concrete on variation of neutral axis depth

It can be noted from **Fig. 12 and 13** that, neutral axis depth for (N1E0 and H1E0) are same behavior because the section works the compression zone only (axial loading).

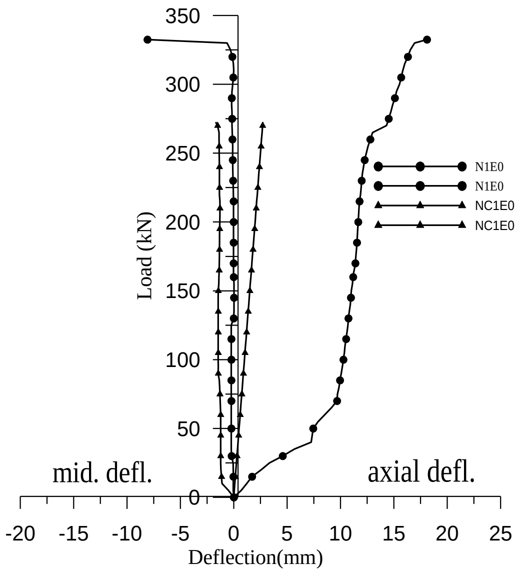
The other specimens HFRPC columns are more than neutral axis depth for NSC column.

The specimens (N5EB and H5EB) are NSC columns are more than neutral axis depth for HFRPC column. HFRPC columns are uncracked and when load is increased the NSC columns fail and HFRPC continue to carry load without cracks. Also, it is noted that, neutral axis for HFRPC columns shifts up toward where appear cracks.

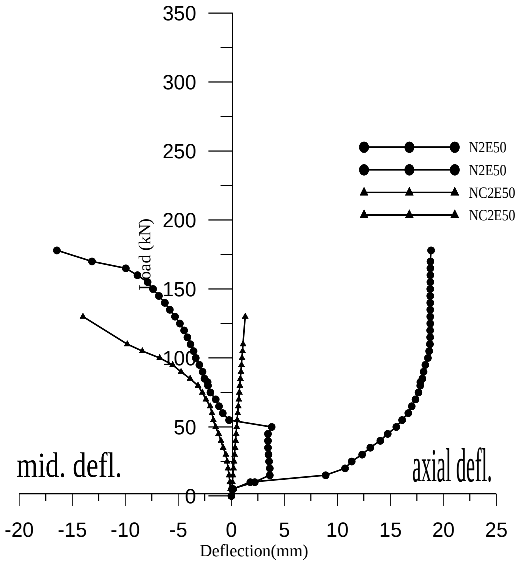
3.2.3 Effect of eccentricity on variation of neutral axis depth

From **Fig. 10, 11, 12 and 13,** noted that, neutral axis depth for HRPC and NSC decrease by increase the eccentricities, the specimens (N1E0 and H1E0) are constant c/d with loading.

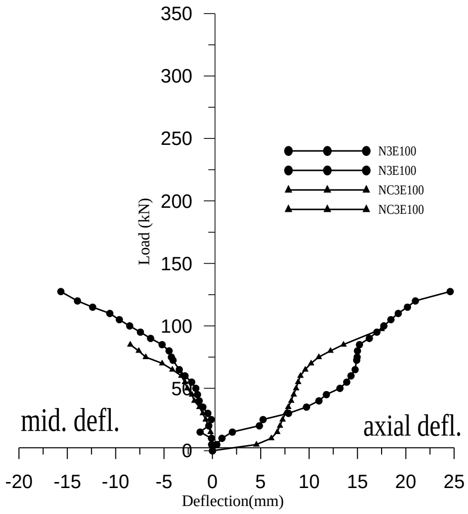
The other specimens are decreases c/d with loading by increase the eccentricities



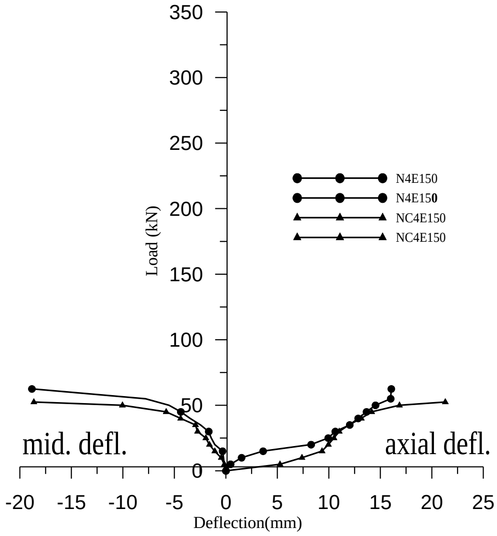
a-load-deflection for first specimen



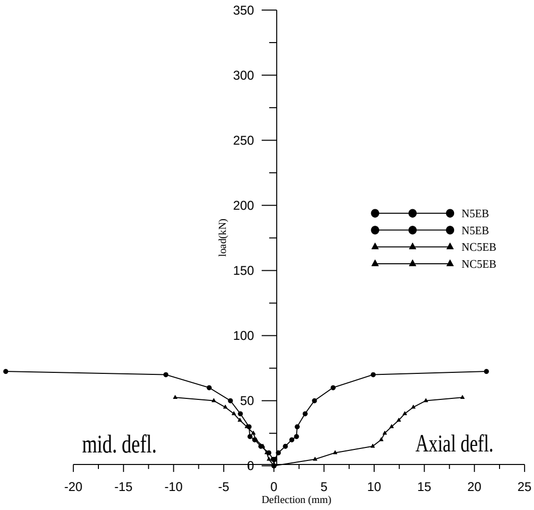
b-load-deflection for second specimen



c-load-deflection for third specimen

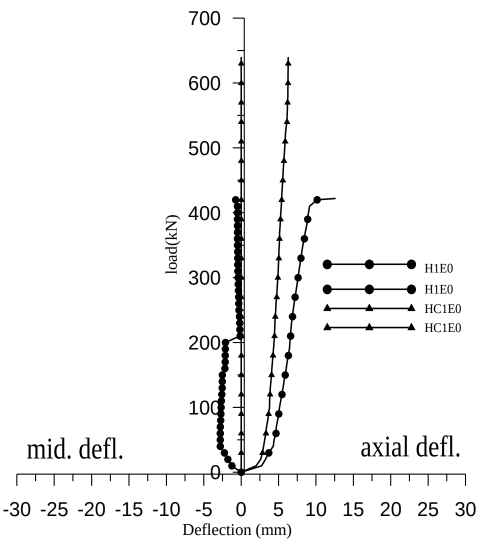


d-load-deflection for forth specimen

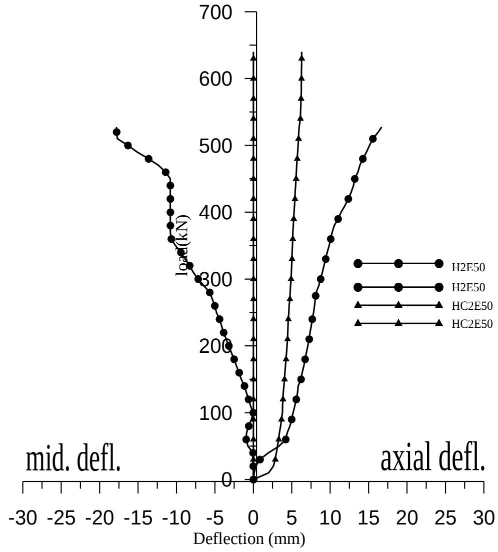


e-load-deflection for fifth specimen

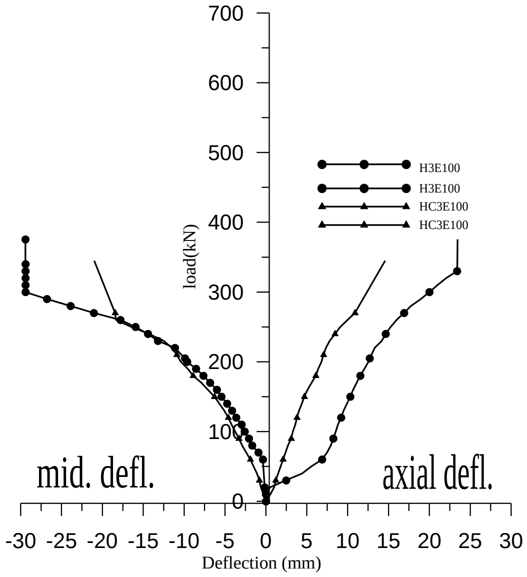
Figure 4: Effect of type of curing on load-deflection curve for NSC columns



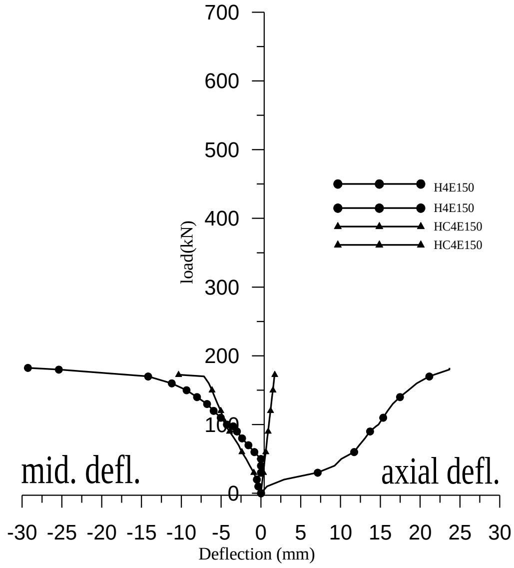
a-load-deflection for first specimen



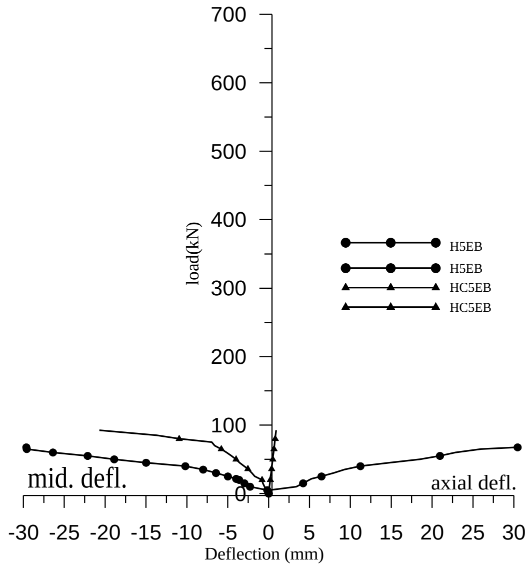
b-load-deflection for second specimen



c-load-deflection for third specimen

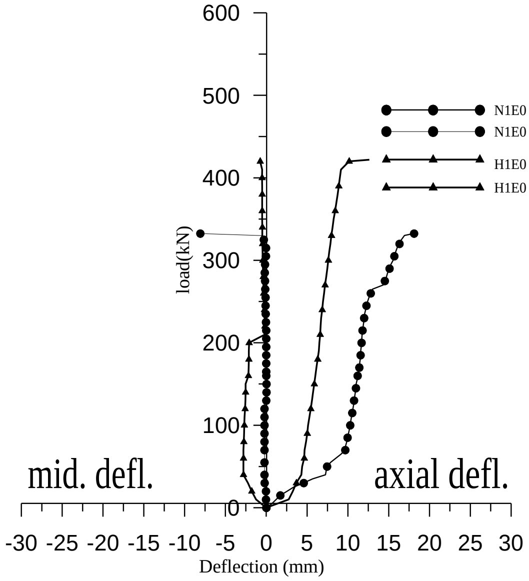


d-load-deflection for forth specimen

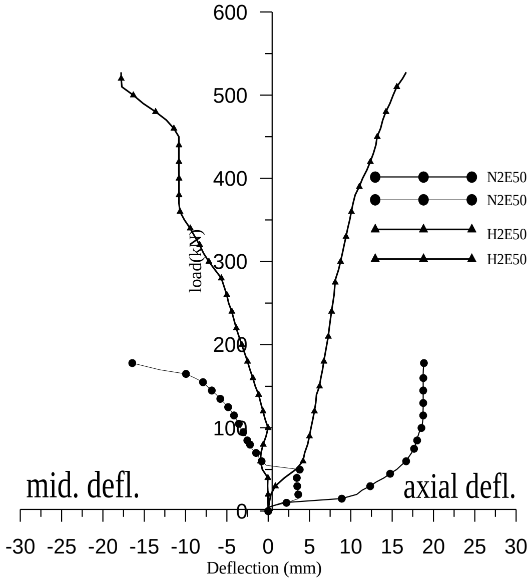


e-load-deflection for fifth specimen

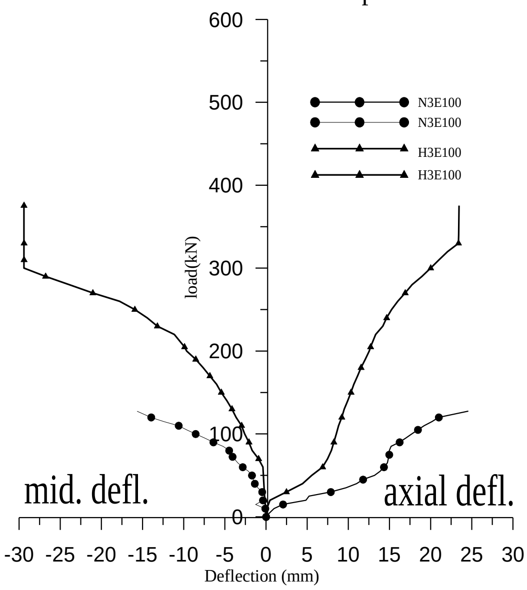
Figure 5: Effect of type of curing on load-deflection curve for HFRPC columns



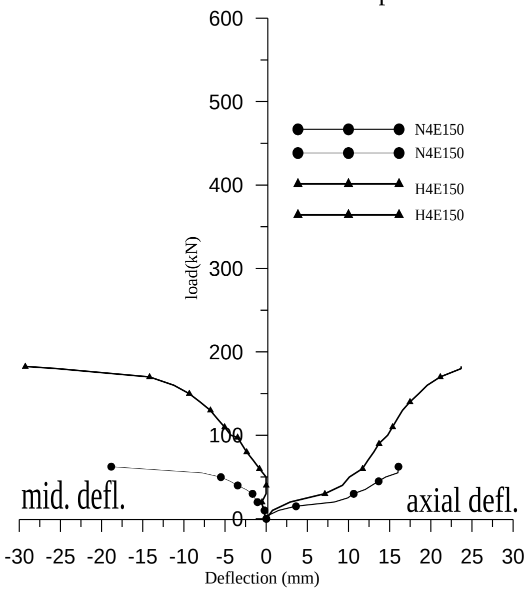
a-load-deflection for first specimen



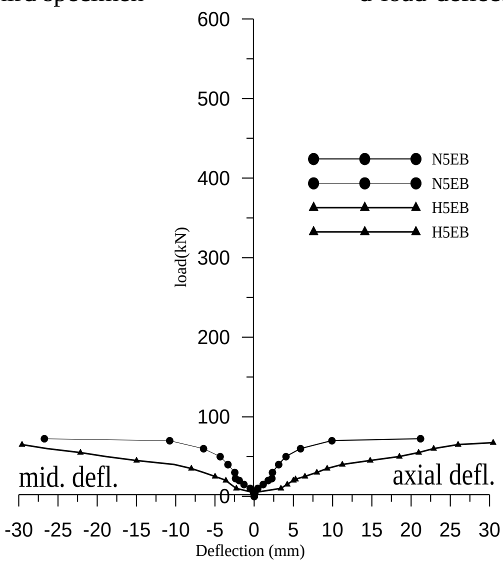
b-load-deflection for second specimen



c-load-deflection for third specimen

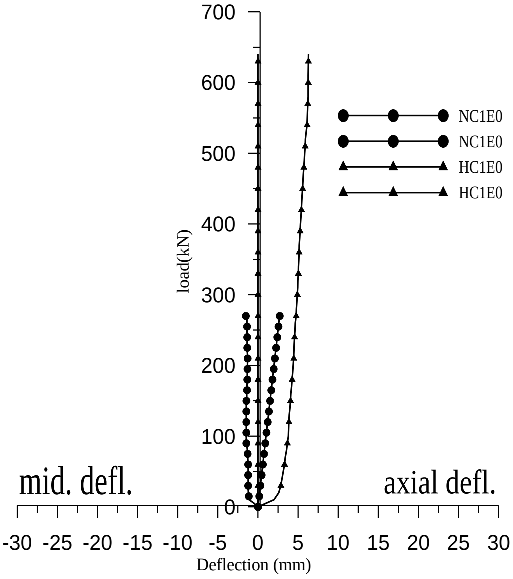


d-load-deflection for forth specimen

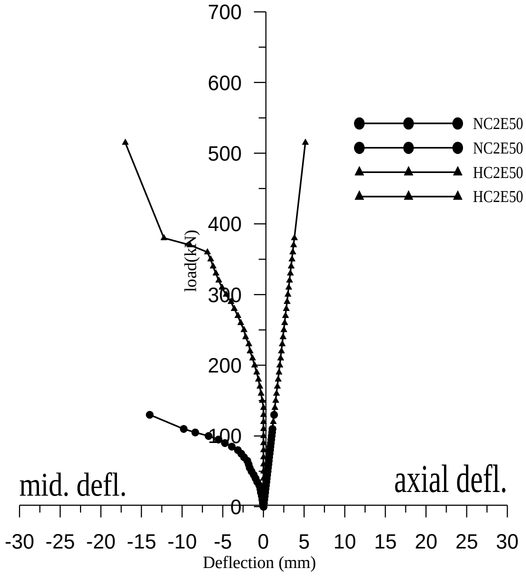


e-load-deflection for fifth specimen

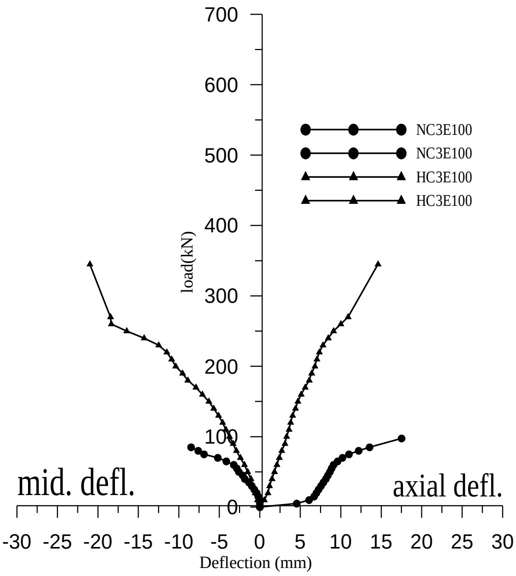
Figure 6: Effect of type of concrete on load- deflection curve when curing in tap water



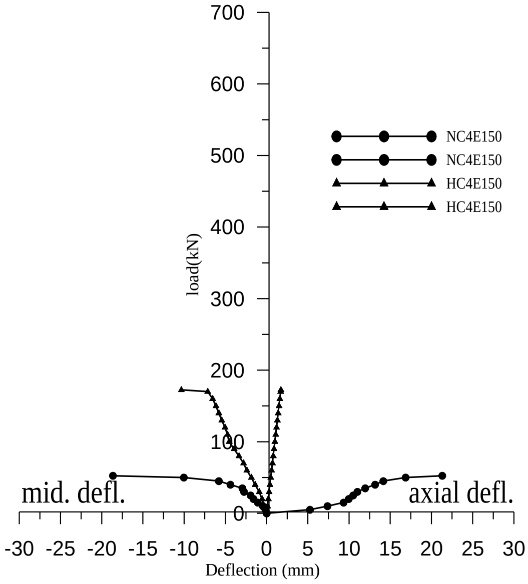
a-load-deflection for first specimen



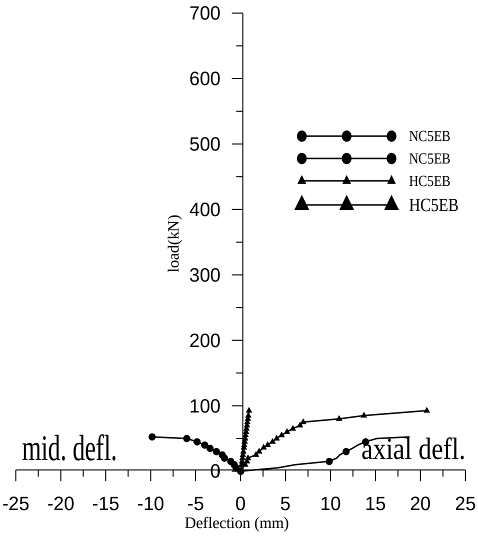
b-load-deflection for second specimen



c-load-deflection for third specimen



d-load-deflection for forth specimen



e-load-deflection for fifth specimen

Figure 7: Effect of type of concrete on load-deflection curve when curing in chloride water

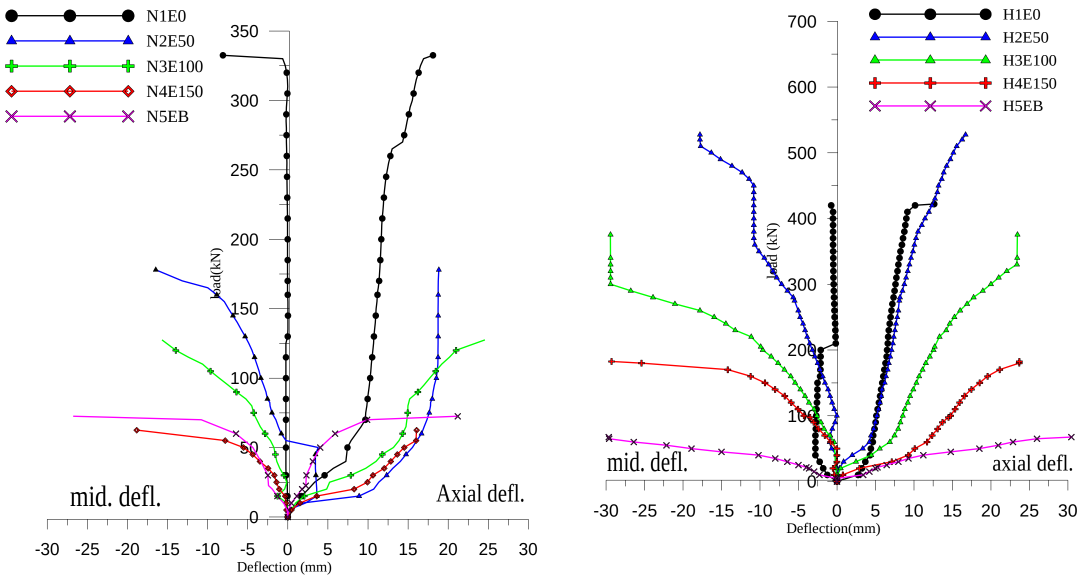


Figure 8: Effect of eccentricity on load-deflection curve when curing s in tap water

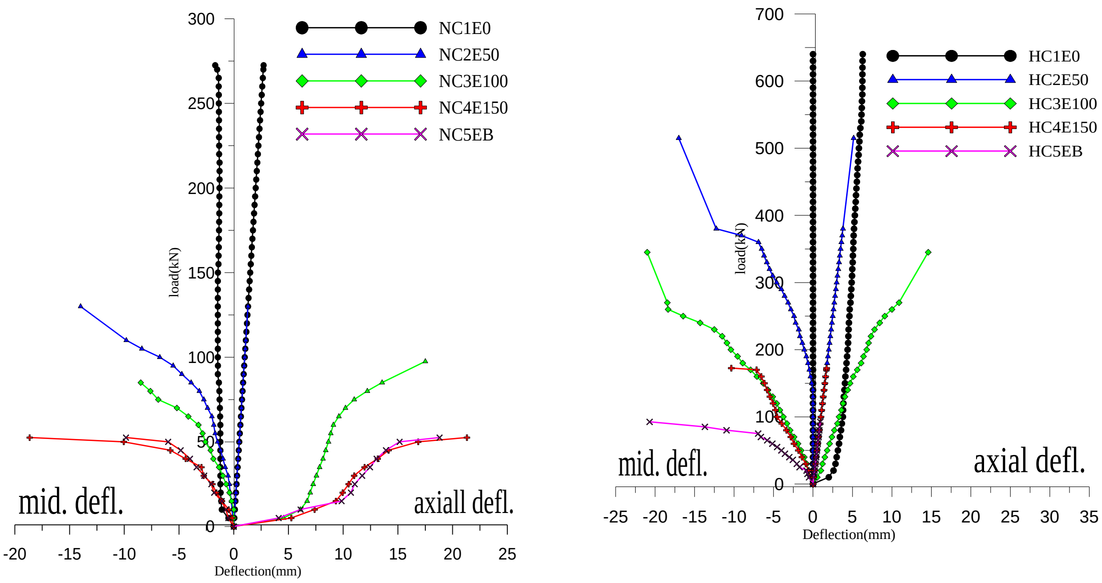
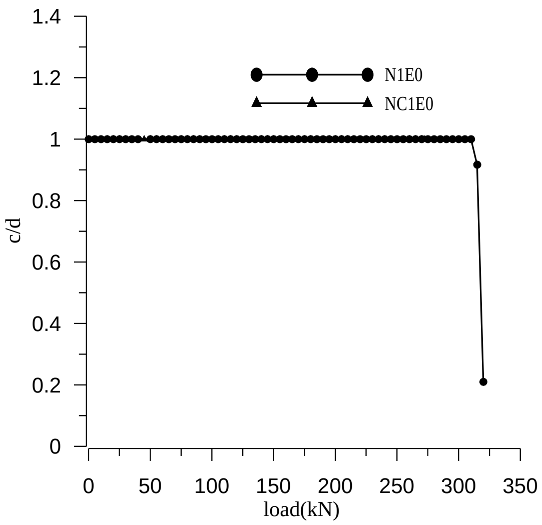


Figure 9: Effect of eccentricity on load-deflection curve when curing s in chloride water

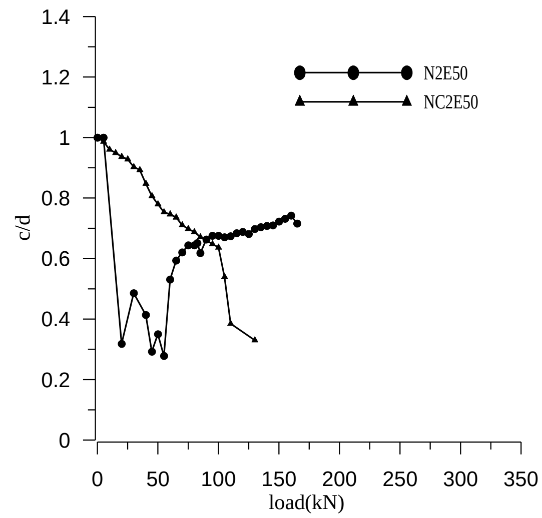
Table 4: Summary of Experimental Results of Structural test

Results For Normal Strength Concrete (NSC)									
Type of Curing	The column designation	First crack stage			Ultimate stage			Ratio	
		P_{cr} (kN)	M_{cr} (P_{cr}×e)	Δ_{cr} (mm	P_u (kN)	M_u (P_u×e)	Δ_u (mm)	$\frac{P_{cr}}{P_u}$ %	$\frac{\Delta_{cr}}{\Delta_u}$ %
Tap water curing	N1E0	162.5	0	-0.02	332.5	0	8.09	48.8	-0.24
	N2E50	82.5	4.13	2.24	178	8.9	16.48	46.3	13.5
	N3E100	72.5	7.25	4.08	127.5	12.8	15.68	56.8	26
	N4E150	25	3.75	14.1	62.5	9.4	18.84	40	74.8
	N5EB	22.5	4.8	2.39	72.5	15.6	26.75	31	8.9
chloride water curing	NC1E0	105	0	-1.46	272.5	0	-1.7	38.5	85.8
	NC2E50	60	3	1.83	130	6.5	14	46.1	13.1
	NC3E100	55	5.5	2.85	97.5	9.8	11	56.4	25.9
	NC4E150	20	3	1.6	52.5	7.9	18.65	38.1	8.6
	NC5EB	17.5	4.62	1.8	52.5	14.5	9.85	33.3	18.2
Results For Hybrid Fiber Reactive Powder Concrete (HFRPC)									
Type of	The column`s	First crack stage			Ultimate stage			Ratio	

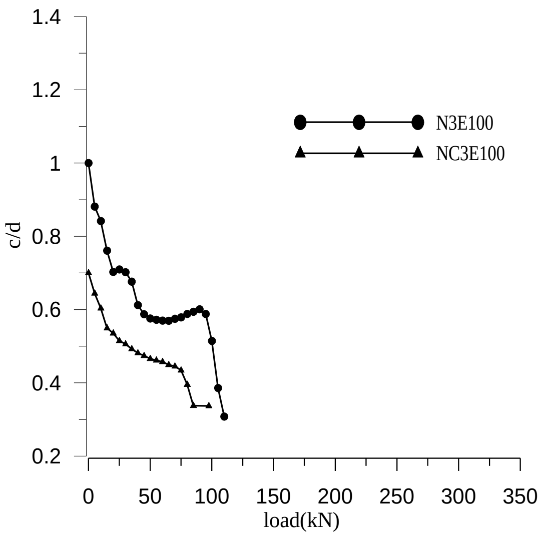
Curing	Name	P_{cr} (kN)	M_{cr} (P_{cr}×e)	Δ_{cr} (mm	P_u (kN)	M_u (P_u×e)	Δ_u (mm)	$\frac{P_{cr}}{P_u}$ %	$\frac{\Delta_{cr}}{\Delta_u}$ %
Tap water curing	H1E0	200	0	-0.24	655	0	0.51	30.5	-47
	H2E50	275	13.8	5.51	527	26.4	17.8	52.1	30.9
	H3E100	205	20.5	9.91	375.5	37.6	29.42	54.5	33.6
	H4E150	97.5	14.6	3.94	182.5	27.4	29.28	53.4	13.4
	H5EB	21.5	3.76	3.98	67.5	11.3	29.65	31.8	13.4
Chloride water curing	HC1E0	210	0	-0.14	645	0	-	32.5	-
	HC2E50	220	11	1.65	515	25.8	17	42.7	9.7
	HC3E100	190	19	9.55	345	34.5	21	55.1	45.4
	HC4E150	90	13.5	3.95	172.5	25.8	10.35	52.1	38.1
	HC5EB	36	7.74	2.55	92.5	19.9	20.7	38.9	12.3



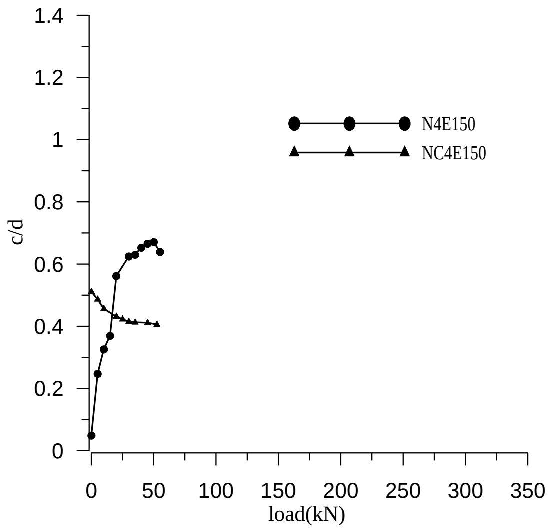
a-neutral axis-load for first specimen



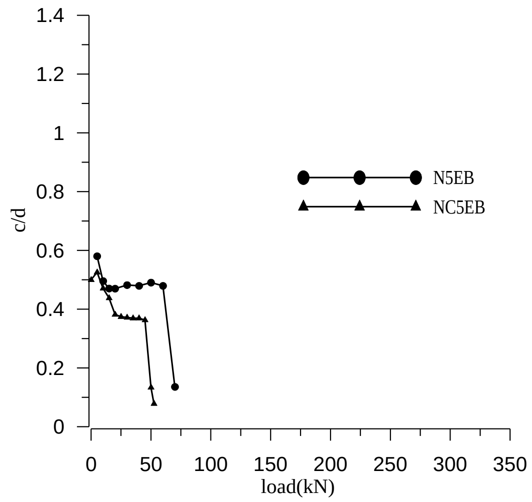
b-neutral axis-load for second specimen



c-neutral axis-load for third specimen

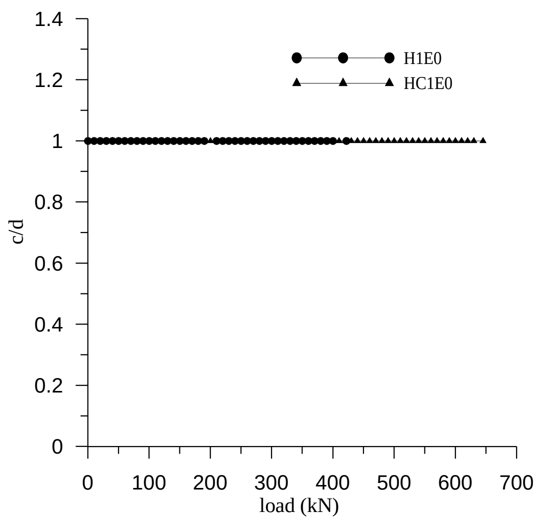


d-neutral axis-load for forth specimen

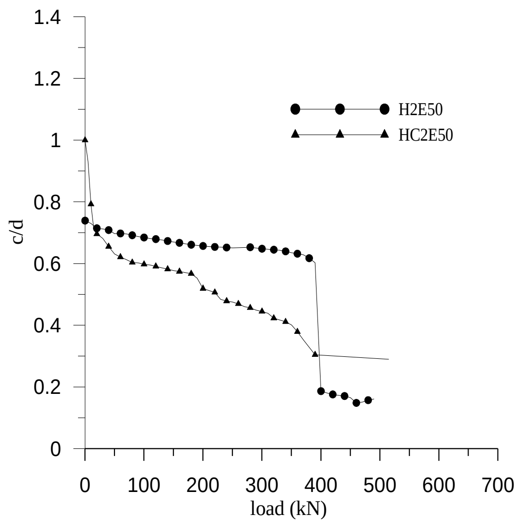


e-neutral axis-load for fifth specimen

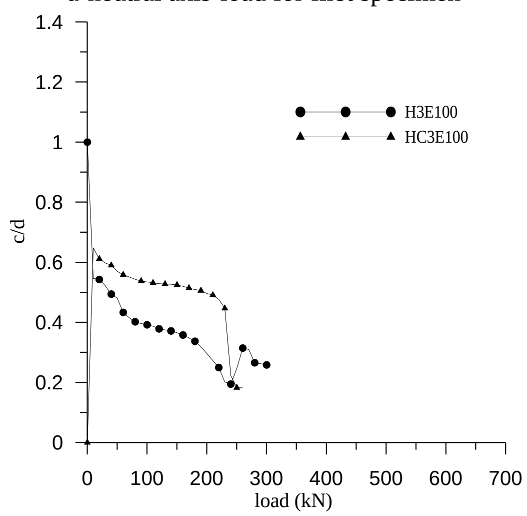
Figure 10: Effect of type of curing on neutral axis depth in NSC columns



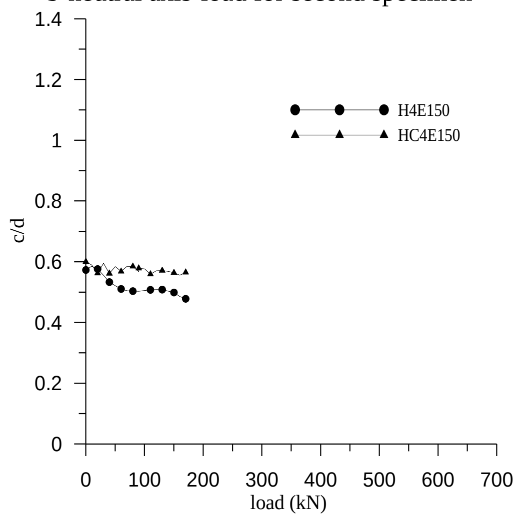
a-neutral axis-load for first specimen



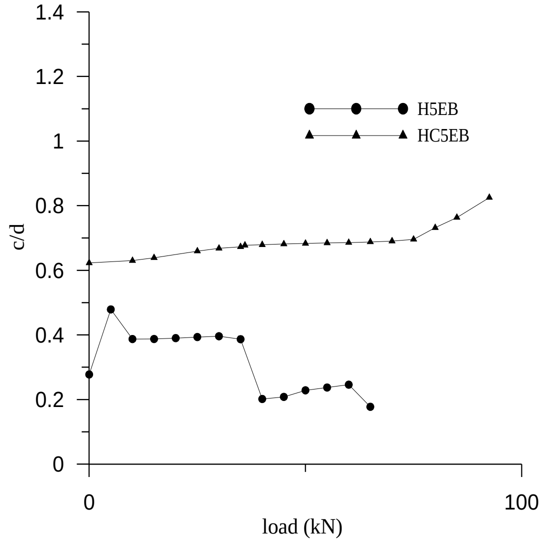
b-neutral axis-load for second specimen



c-neutral axis-load for third specimen

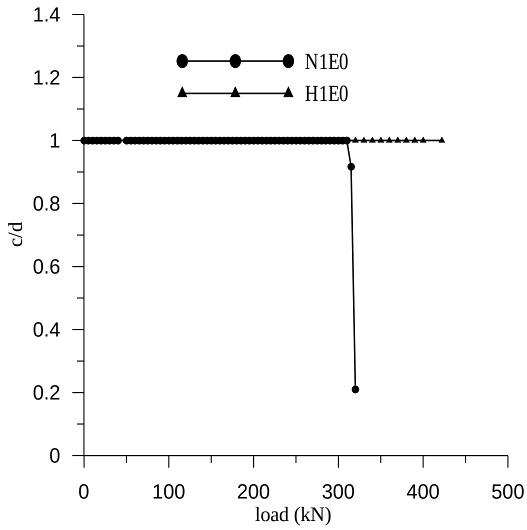


d-neutral axis-load for forth specimen

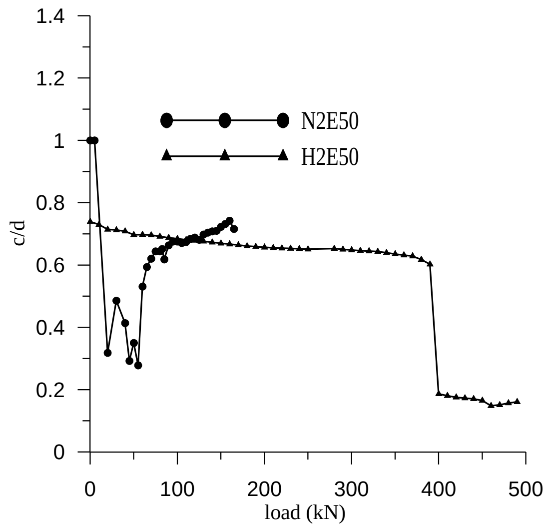


e-neutral axis-load for fifth specimen

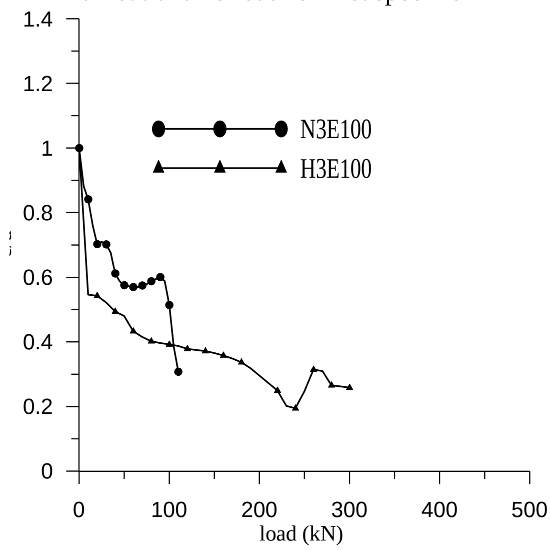
Figure 11: Effect of type of curing on neutral axis depth in HFRPC



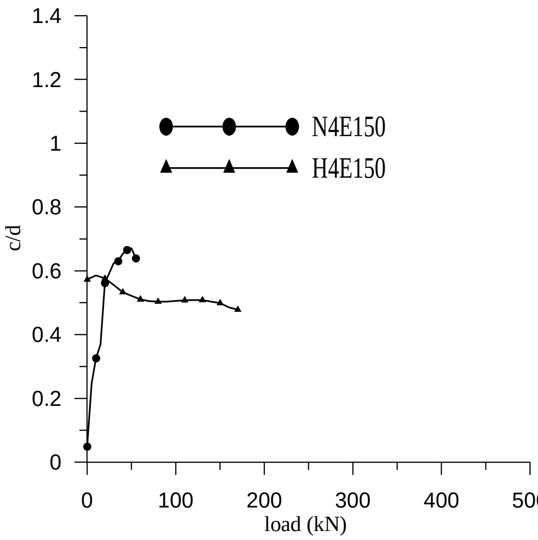
a-neutral axis-load for first specimen



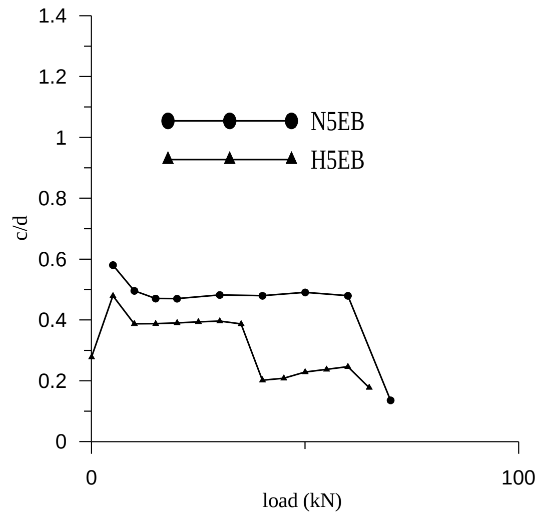
b-neutral axis-load for second specimen



c-neutral axis-load for third specimen

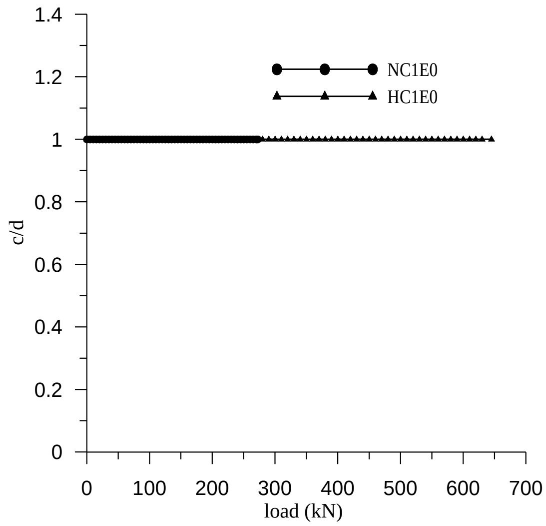


d-neutral axis-load for forth specimen

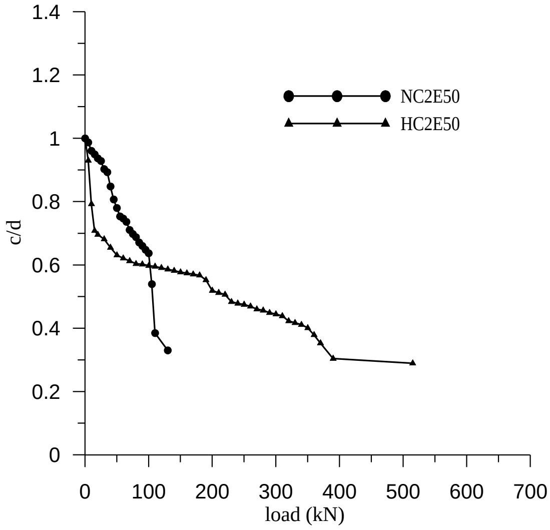


e-neutral axis-load for fifth specimen

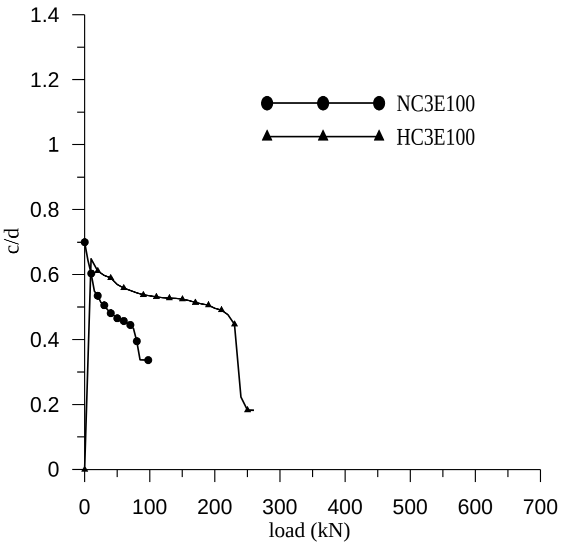
Figure 12: Effect of type of concrete on neutral axis depth in tap water



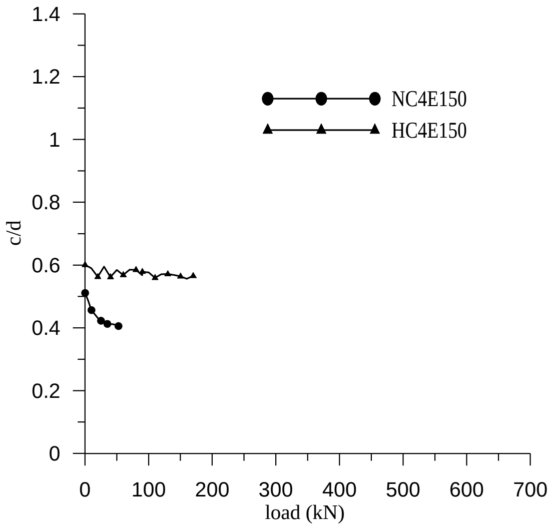
a-neutral axis-load for first specimen



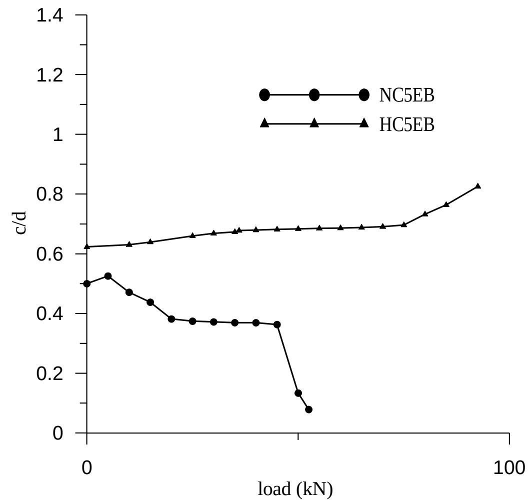
b-neutral axis-load for second specimen



c-neutral axis-load for third specimen



d-neutral axis-load for forth specimen



e-neutral axis-load for fifth specimen

Figure 13: Effect of type of concrete on neutral axis depth in chloride water

4. Conclusions

1- Test results, for NSC and HFRPC columns show deflection for columns cured in chloride water more than tap water when compared at the same load by percentage (75, 14, 40, 12.5 and 52) % for NSC while HFRPC (20, 9.5, 30, 66 and 45) %.

2- when curing in tap or chloride water, deflection for NSC columns is more than HFRPC columns when compared at the same load by percentage (75, 14.2, 33.3 and 8.3) % for tap while the chloride water (60, 14.3, 50 and 70) %.

3- the increase in eccentricity leads to an increase in deflection when cured in tap or chloride water for NSC and HFRPC columns.

4- The neutral axis depth for columns cured in chloride water is lower than columns cured in tap water (neutral axis moves down towards the compressed face when cured in chloride water) by percentage (0, 133, 33.3, 50 and 20) % for NSC while HFRPC (0, 50, 66.6) %.

5- The neutral axis depth for HFRPC columns is more than NSC at the same load by percentage (0, 7.1, 50, 48 and 45) %.

6- The experimental results show that when eccentricity increases, the compression zone decreases and neutral axis also decrease by increase eccentricity. these results occur when columns are cured in tap and chloride water

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تصرف الاعمدة ذات الخرسانة الفعاله المهجنة المعرضة لهجوم الكلورايد

محمد مصلح سلمان
قسم الهندسة المدنية
الجامعة المستنصرية
بغداد- العراق

حسين خلف جارالله
قسم الهندسة المدنية
الجامعة المستنصرية
بغداد- العراق

رائد ستار ورور
قسم الهندسة المدنية
جامعة اوروك الاهلية
بغداد- العراق

الخلاصة

في هذا البحث تم دراسة تصرف المقاطع للاعمدة الخرسانية المسلحة والمصنوعة من نوعين من الخرسانة العادية وذات المساحيق الفعالة والمهجنة بالالياف (steel and polypropylene fiber) تحت تأثير الحمل المحوري واللامحوري ، تم صب الاعمدة ومعالجتها في نوعين مختلفين الاولى في المياه العادية ولمدة 28 يوم والثانية في المياه الكلوريدية ولمدة 6 اشهر و بتركيز (8341.6 ملغم\لتر) . يتضمن الجانب العملي ثلاث متغيرات هي نوع الخرسانة ونوع المعالجة ونوع التحميل، حيث تم صب وفحص 20 عمود خرساني بابعاد (120 × 120) ملم وبارتفاع 1200 ملم. في الفحص تم تسليط ثلاث انواع من الحمل وهي الحمل المحوري واللامحوري وهي (0، 50، 100، 150) ملم ونسبة (e/h) (0 ,0.42 ، 0.83 و 1.25) من سنتر العمود والحمل الاخير هو فحص النموذج كعتبة.

اظهرت النتائج العملية زيادة في الحمل والمقاومة في كلا المعالجة العادية والكلوريدية للخرسانة المهجنة مقارنة بالخرسانة العادية من خلال الحصول على منحنيات القوى-الانفعال، نتائج الفحص للخرسانة العادية والمهجنة ومن خلال الرسوم تم استنتاج بأن الانفعال للخرسانة العادية والمهجنة عند معالجتها في المياه الكلوريدية هي اكثر من الانفعال لنفس الخرسانة عند معالجتها في المياه العادية. وكذلك بزيادة اللامحورية يزداد التشوه للخرسانة. وبنت النتائج بأن عمق المنطقة الانضغاطية للخرسانة ذات المساحيق الفعاله والمهجنة بالالياف هي اكثر من الخرسانة العادية عند نفس الحمل وكذلك بزيادة اللامحورية فان منطقة الانضغاط تقل وعمق المنطقة كذلك يقل وهذه النتائج تنطبق على كلا المعالجتين العادية والكلوريدية.