Данные табл. 2 показывают, что при постоянном расходе цемента соотношение между фракциями, (в том числе введение керамзитового песка) оказывает значительное влияние на прочность. Пластификатор сульфитно-дрожжевая бражка. ЛСТ введена для снижения вязкости цементной суспензии с целью создания условий для более глубокого ее проникновения в поры заполнителя. Наибольшую прочность показали образцы, изготовленные из заполнителя, прошедшие вакуум-обработку при перемешивании. (R_{bt}=2,44 Мпа). Сравнение данных табл. 2 и табл. 1 показывает, что применение вакуум-обработки позволило практически достичь прочности, рассчитанной теоретически.

Исследование структуры бетона было проведено на аншлифах из фрагментов разрушенных при испытаниях образцов. Петрографические исследования показали, что зерна пористого заполнителя после вакуум-обработки окружены плотной оболочкой новообразований толщиной 0,05-0,1 мм. Характер разрушения бетона соответствует типу 3, т.е. прочность керамзита, растворной части и контактной зоны равны. Повышение прочности при растяжении конструкционного керамзитобетона до 2,4 Мпа позволяет расширить область применения керамзитобетона, используя его для конструкций, испытывающих изгибающие и растягивающие напряжения.

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EFFECT OF THE SHEAR AND BENDING ON THE HOLLOW CONCRETE BEAMS MANUFACTURED BY VIBRO-VACUUM

Introduction

Concrete cylinders with hollow section of different purpose are characterized by the extensive application. These sections are used for the various fields such that in buildings, hall reinforced concrete bridge piers, offshore structure and towers [1]. For example, in modern building where utility ducts and pipe are being accommodated below floor beams in the space above the false ceiling, the use of non-prismatic beam with a recess would allow these ducts to pass through the beam, eliminating a significant amount of dead space [2-4]. This would reduce the height of story, leading to substantial savings in the materials and construction costs. Hollow section is often adopted in order to increase flexural rigidity and reduce the self-weight of beam. However, there is possibility that RC members with a hollow section may not have enough plastic deformation capacity and energy dissipation since it is generally difficult to ensure effective confinement of the concrete and the thinner web causes the deterioration of shear resistance of the members. So for ensuring reliable operation of this type of structures throughout the entire lifetime is associated with maintaining their integrity under various load conditions. In the present study was used the vibro-vaccum for increasing the strength of concrete beams.

As early as in the 30s of the previous century vacuum compaction of concrete mixes has been used successfully in the construction of buildings and structures of mass concrete [5, 6, 7, 8]. In practice, back at that time the advantages of vacuum compaction of concrete mixes in monolithic structures had already been convincingly proved. The main ones are the following: increase in labor productivity; reduction of the period of construction of buildings or individual structures; significant reduction in metal consumption (material consumption) by formwork; energy savings; reduction of specific consumption of cement; significant improvement in concrete quality.

Although, extensive work has been done on the advantages of vibro-vacuum compaction of concrete mixes in monolithic structures, little or no work has been previously reported on the effect of the shear and bending on the hollow concrete beams manufactured by vibro-vacuum.

Significant Study:

This research project is an attempt to evaluate the behavior of reinforced concrete beams with different section (solid or hollow), examined hollow (shape and casting method), deflection, strains and failure mode under concentrated static load. In mainly to help get equivalents hollow beams manufactured by vibro-vacuum and by vibration that give same capacity of solid beam sections [1, 6].

Materials and Methods:

The mix proportions of one cubic meter are obtained by series test of trial mixes [9]. The final adopted mix designs are shown in Table (1). The adopted mix these mixers give average standard of 28 days compressive strength of concrete fc' about 25 to 27 MPa.

Table 1 - Mix proportions for (1 m^3) of concrete.

Cement (kg/m^3)	Sand (kg/m^3)	Gravel (kg/m^3)	Water/ Cement ratio	Water (kg/m^3)
420	630	1260	0.5	210

In industrial practice a result is known that the application of vibro-vacuum treatment of concrete mixes when forming precast products and erecting structures of monolithic concrete allows eliminating the problem of water consumption by concrete aggregates and, accordingly, considerably improving the quality of concrete (e.g., in terms of strength, frost resistance, etc.) [8]. Simultaneous application of vibration action significantly increases the efficiency of concrete mix compaction [6], [7]. On this basis, we proposed a new method for the manufacture of hollow beams by vibro-vacuum technology.

This method allows the acquisition by concrete of positive properties: intense rise in strength during the initial period of hardening, reducing the time for thermal treatment of products, reduction in metal consumption by processing equipment, etc. The degree of concrete mix compaction depends on the frequency and amplitude of vibrator, as well as on the duration of vibration.

Beams Details: three beams with details shown in Table 2 were designed, fabricated and tested up to failure. All beams are simple support, a one beam was solid a two beams with hollow section.

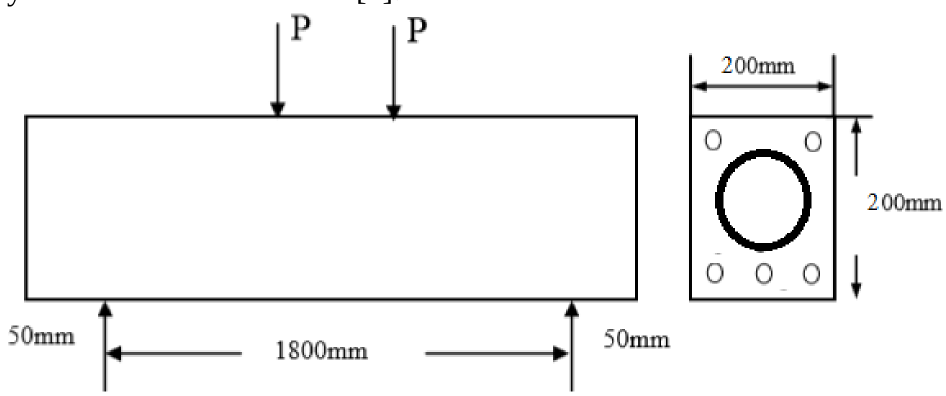

Fig.1. Schematic representation of hollow R.C. Beams Sections.

Table 2 - Details of R.C. Solid and hollow Beams Specimens.

Beam type	Bottom Reinforcing	Top Reinforcing	Stirrups Reinforcing	Hollow size mm	Hollow shape
B1	3Ø12	2Ø10	Ø4 @150	------	-------
B2	3Ø12	2Ø10	Ø4 @150	100	circle
B3	3Ø12	2Ø10	Ø4 @150	100	circle

Table 3 - Properties of Steel Reinforcement [10].

Nominal Diameter (mm)	Measured Diameter (mm)	As (mm^2)	Yield Tensile Strength fy (MPa)	Ultimate Strength fu (MPa)
4	4.13	13.39	395	480
10	9.88	76.67	421	520
12	12.2	116.89	480	570

Table 4 - Compressive Strength of Concrete Cylinder (28 days) [11]

Sample No.	Diameter (mm)	Load, (KN)	Compressive Strength fc, (MPa)	Average Strength (MPa)
1	150	450	26	28
2	150	520	30	28
3	150	480	28	28

Instrumentation and Testing Procedure:

After complete the curing of beams (i.e. after the resin is final curing), the specimen is placed in position, and load was applied at the compression fiber of beam as shown in Figure 3. The load was applied as two concentrated points load and increased gradually at increments of (5 KN). The deflections were measured at center of specimens at each load increments using Digital dial gauge of accuracy of (0.01). The strain in concrete also measured at center of top and bottom fiber at three locations of distance (60mm) between demec points as shown in Figure.(3). Test was carried and continued till failure. Failure mode and crack patterns were recorded. A schematic representation and photographs of the test setup (and instrumentation) are shown in Figure.(3).

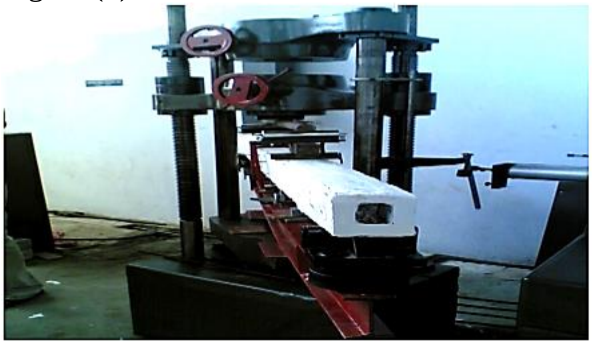

Fig. 2. Testing Machine and Sample.

Experimental Results: The test results of all specimens based on load carrying capacity, deflection, and strain and crack pattern. The comparisons are shown in the following:

First Crack and Ultimate Load: Table 5, show the hollow section decrease in load capacity and increase in corresponding deflection for the same properties, also when used hollow beams manufactured by vibro-vacuum give more load capacity and decrease in deflection.

Table 5 - Fist Crack, Ultimate Load and deflections.

Beam No.	First Crack Load KN	Ultimate Load, KN	Deflection mm	Failure mode
B1	30	70	7.1	shear
B2	15	50	12	shear
B3	15	35	10	shear

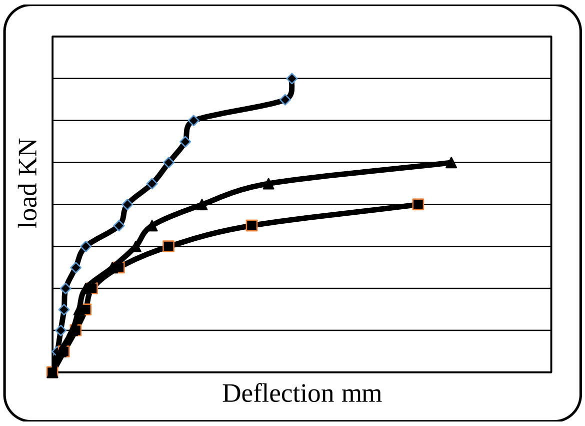

Fig.3. Load deflection of all Beams. 1-solid beam, 2- hollow concrete beams manufactured by vibro-vacuum, 3- hollow beam manufactured by vibration.

Crack Patterns: It is clear that in all beams the hollow beams cracked at significantly lower loads than the solid ones. This indicates that the concrete core in the solid beams participates in increasing the cracking load. In general, the larger the applied loading relative to applied points loads, the larger the difference in the cracking loads as shown in Figure 4.

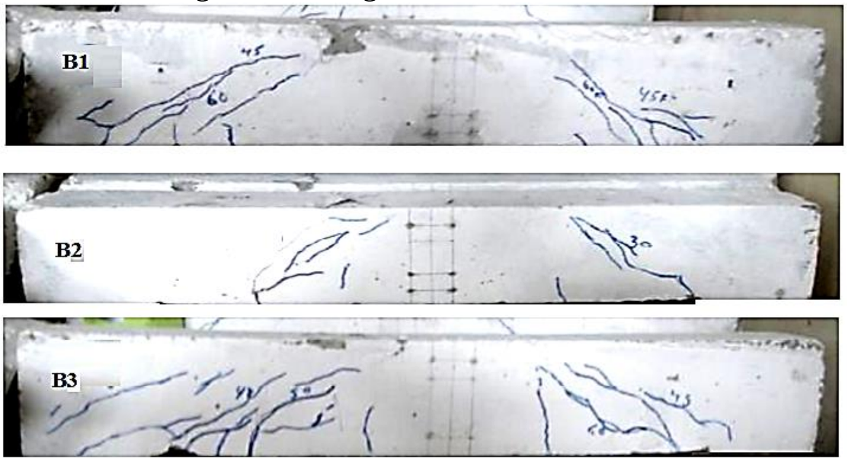

Fig. 4. Crack Pattern of Tested Beam.

Concluding Discussion

Two hollow cross section beams were tested. Solid and hollow (Circle) beams subjected to two points concentrated load. The experimental work involved in this study was mainly to evaluate the effectiveness of hollow beams manufactured by vibro-vacuum. Based on the experimental results, in terms of load-carrying capacity and strains in concrete, obtained from tests on hollow concrete beams manufactured by vibro-vacuum, it can be concluded that:

1. The (hollow beam manufactured by vibration) contribute at decrease of load carrying capacity by about (53%) and increased in deflections and strain by about (40% and 25%) respectively compared with solid beams. For same properties. Also the (hollow beams manufactured by vibro-vacuum) that same function of hollow beam manufactured by vibration but led to decrease in load carrying capacity by about (17%) and increased in deflection and strain by about (33% and 21%) respectively.

2. At two cases of hollow sections the increases in shear reinforcement led's to increases in load capacity by about (30%) and decrease in deflections by (24%).

3. Hollow beams manufactured by vibro-vacuum give more enhancement by about (56%) compared with hollow beam manufactured by vibration.

4. Crack are concentrated near support of hollow beams manufactured by vibro-vacuum to formulated shear failure due to vibro-vacuum give more strength at this location to prevent failure of flexural.

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РАЗРАБОТКА ОДНОВАЛЬНОГО ВИБРАЦИОННОГО СМЕСИТЕЛЯ БЕТОНА

Введение. Бетоносмесители принудительного действия широко используются в строительном производстве для приготовления бетонных смесей и растворов. Используются роторные [1], одновальные [2, 3] и двухвальные бетоносмесители принудительного действия [4]. Одновальные бетоносмесители принудительного действия [2], предназначены для приготовления пластичных и жестких цементобетонных смесей. Они сочетают в себе высокую эффективность и простоту конструкции. Энергоемкость одновальных бетоносмесителей принудительного действия [2] отвечает требованиям стандарта [5] и имеет на 30 – 40% меньшую энергоемкость, чем двухвальные бетоносмесителей принудительного действия. Современное производство требует создания бетоносмесительного оборудования с малой энергоемкостью. Эти машины должны обеспечивать эффективное приготовление жестких бетонных смесей. Снижения энергоемкости и повышения эффективности процесса приготовления можно достичь путем использования вибрационного воздействия на бетонную смесь в процессе её приготовления через корпус смесителя [6], в транспортирующем в зону перемешивания вибролотке [7] или через встроенную в корпус смесителя вибрационную заслонку [8]. Эти вибрационные смесители снабжены вибровозбудителями направленных [6] или круговых колебаний [7, 8]. Они обеспечивают приготовление жестких бетонных смесей, но требуют дополнительной защиты электропривода от вредных вибрационных воздействий, передаваемых от вибрирующих механизмов. Дальнейшего снижения энергоемкости и упрощения конструкции одновальных смесителей принудительного действия [2, 8], предназначенных для приготовления жестких и сверхжестких бетонных смесей можно достичь путем внедрения в технологический процесс перемешивания вибрационного воздействия на бетонную смесь, создаваемого крутильными колебаниями виброзаслонки [9].

Цель и задачи. Исследование и разработка одновального лопастного бетоносмесителя принудительного действия, снабженного вибрационным устройством и обладающего малой энергоемкостью.

Результаты исследования. На рис. 1 и 2 представлен вибрационный смеситель бетона, который включает корпус 1 с загрузочным 2 и выгрузочным, закрытым заслонкой 3, отверстиями и центральный лопастной вал 4, смонтированный в подшипниковых опорах 5, вынесенных за пределы области перемешивания. На лопастном валу 4 смонтированы центральные 6 и пе-