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Experimental Study on Seismic Behavior of Recycled Concrete Grill Walls with Axial Compression Ratio

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Abstract. Through the seismic behavior of 4 pieces of concrete grill wall by pseudo- static test, the test sample destruction shape, the skeleton curves under to the different wall material and the different axial compression ratio, consuming energy ability, the ductility coefficient were conducted the contrast research. The experiment indicates the test sample under the level reciprocation load and the axial action of force, destruction shape main perform for cutting destruction; After wall dehiscence, the rigidity rate of descent is quick, after achieving the ultimate load, the rigidity drop flatten out, the wall has the good ductility. By enhancing the axial compression ratio, it may enhance the wall the ductility, to consume energy the coefficient; the walls contained recycled concrete aggregate has good energy dissipation and seismic performance;

Introduce

The concrete grill wall is a new structure system, with the merits of heat preservation, load-bearing, light weight, etc, meets our country wall reform requirement. The Harbin Engineering University recognized the wall formally to be similar to the whole small aperture shearing force wall, analyzed through the experiment and the finite element software to this kind of wall, may receive the supporting capacity formula computation according to the present standard[1]; The Tsinghua University indicated that this wall may satisfy 7-stored building of shearing bearing capacity and the story drift request under the small earthquake[1]; China Building Science Research Institute thought this kind of wall may constitute below 6-stored building[1]; The Taiyuan University of Technology has contrasted this kind of wall and the ordinary wall earthquake resistance performance, thought that this system has the enough intensity and rigidity, the supporting capacity may satisfy small earthquake request[2,3]; The Shenyang jianzhu University analyzed the earthquake resistance performance under the different axial compressed ratio and different shear span ratio, proposed a formula of bearing capacity in shearing[1,4].

The current home to recycled concrete components' research mainly forcing on the beam, the column, the node, the frame, but are few regarding the recycled concrete wall's reach[5,6], the author thought that it's necessity to strengthen the research of the recycled concrete wall. It is not only to provide the reach and utility value, adding the recycled concrete to the concrete grill wall, but also conforms to the tendency of wall reforming.

Experiment Design

Experiment Materials and Wall Parameter The experiment uses the C20 concrete that the laboratory abandoned, after man-power broken processing, selected the grain diameter to take the coarse aggregate in the 5~30mm continuous grading, and uses to it stone enveloped with cement

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processing[7], then maintains for 28 days under the nature conditions, the processed coarse aggregates and the natural coarse aggregates take this experimental according to 1:1 proportion mix the coarse aggregates. The available value of the actual concrete cubic anti-pressure is 22.5MPa.

In order to better carry on the experiment contrast, we had designed two pieces of similar size wall with Zhu J. W. of Shenyang Jianzhu University. The test sample serial numbers respectively were RCSW1, RCSW2, and the parameters were indicated in figure 1. The axial compression ratio of RCSW1 and QZ-2 is 0.15, and the axial compression ratio of RCSW2 and QZ-4 is 0.22.

Experiment Procedures Pseudo-static loading device was adopted. As shown in figure 2. Vertical load adopted two 60t hydraulic jacks, the horizontal load uses the 50t electro-hydraulic servo device of American MTS produced , exerted the horizontal load and the vertical load exerted through L shape upstand beam to the top of concrete wall.

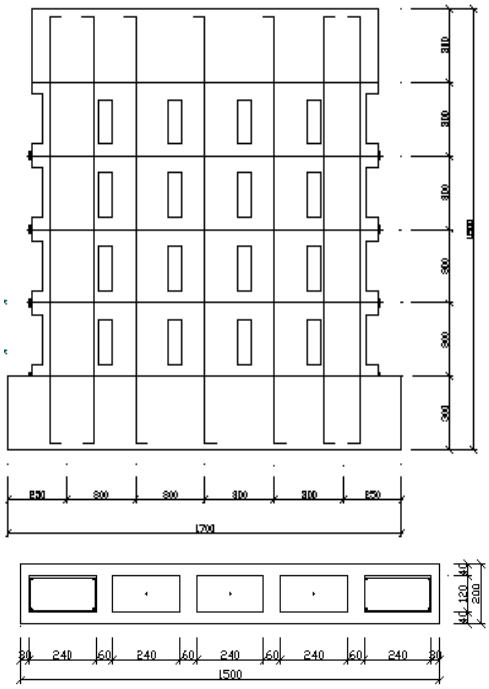

Fig. 1 Details of Concrete Wall

Fig. 2 Experimental Load Installation Picture

First, the computation vertical load was exerted, and maintained in the testing invariable, then exerted the horizontal load from the computation dehiscence load 30%, took 20KN as the grading progressive load, each level on rollers one time, until the sample dehisce; After dehiscence, cracks displacement moved 2 time of upward increasing, each time load 2 circulations, dropped until the horizontal load to 85% of the ultimate load, the experiment ended[8].

Test Phenomena

The test sample presented the shear failure characteristic under the repeated horizontal loading function, along with the increase of the horizontal load, the test sample first presented the diagonal 45 degrees slight crack in coupling beam place, and progressive assumed ring-like; immediately changed the displacement to control, along with the increase of the displacement, the annulus progressive extends, and presented the overlapping X cracking in the annulus region center, and followed the tall and slender crack to extend to the grill type column; The wall apex displacement continued to increase, the wall acclivity crack wide band enlightened and is accompanied by the concrete unceasingly the flaking phenomenon. Finally the horizontal load dropped to the 85% of ultimate load, test sample destruction.

Experimental Results and Analysis

The Load Capacity The bearing capacity and displacement of each specimen were listed in table 1.

It can be seen two points from table 1:

(1).Under the condition of the same axial compression ratio, it's possible to be delay the dehiscence, to suppress the crack the development, to enhance the wall dehiscence load, adding the recycled aggressive.

(2).Under the condition of the same materials, along with the axial pressure to enlighten, the dehiscence load, yield load and the ultimate load correspondingly enhanced.

Table 1The comparison of experimental bearing capacity and displacement

Sample	Load orientation	Dehiscence		Yield		Limit		Ductility Factor
		Load (kN)	Displace-ment (mm)	Load (kN)	Displace-ment (mm)	Load (kN)	Displace-ment (mm)	
QZ-2	Negative	140	0.53	296.6	3.66	232.5	5.67	1.55
	Positive	132	0.56	276.8	3.12	245.1	3.64	1.17
	Average	136	0.55	286.7	3.39	238.8	4.66	1.36
QZ-4	Negative	142	0.55	306.4	4.44	306.3	5.1	1.45
	Positive	140	0.61	309.7	3.3	262.2	7.1	2.15
	Average	141	0.58	308.05	3.87	284.25	6.1	1.8
RCSW1	Negative	131.27	0.36	306.21	2.22	265.41	4.41	3.32
	Positive	178.76	0.45	331.27	2.12	283.49	3.86	2.99
	Average	155.02	0.41	318.74	2.17	274.45	4.14	3.16
RCSW2	Negative	157.25	0.94	332.67	3.79	283.72	5.37	1.42
	Positive	177.55	0.59	375.23	3.29	320.4	4.82	1.47
	Average	167.4	0.77	353.95	3.54	302.06	5.10	1.45

Skeleton Curves The skeleton curve has reflected the rigidity changed characteristic of the wall "the dehiscence- yield- destruction". This article used the normalized skeleton curve; the broken line inflation points express the wall dehiscence, the yield and the destruction turning points separately. It can be seen from figure 3 that the dehiscence load was small, after the dehiscence, the load will still rise, when after achieving the yield load, the curve started to drop, the supporting capacity and the rigidity presented the degenerated phenomenon; when the load drops to 85% of ultimate load, the wall still had certain bearing capacity and distortion ability.

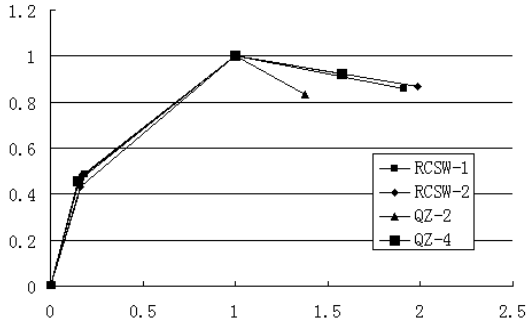

Fig. 3 Normalized Skeleton Curves

Ductility Coefficient and Energy Dissipation The displacement ductility coefficient μ usually used limited displacement and the yield displacement ratio to express, $\mu=u_u/u_y$. The equivalent viscous damping ratio ζ_{eq} is an important symbol of the structure consuming energy size. The damping ratio is bigger, the test sample consumes energy ability to be better. The test sample ductility, dissipative coefficient and energy dissipation and the equivalent viscous damping ratio was shown in table 2.

Table 2 The ductility coefficient and dissipative coefficient

Sample	QZ-2	QZ-4	RCSW1	RCSW2
μ	1.36	1.8	3.16	1.45
φ	0.436	0.74	0.581	0.507
ζ_{eq}	0.069	0.0755	0.093	0.081

Conclusion

(1) The destruction shape of test sample main performance for shearing broken under level reciprocation and axial action of force. The initial destruction displacement of the walls mainly indicate coupling beam places, along with the increase of horizontal displacement, the wall presents the obvious X shape crack, finally the wall bottom and top presented the diagonal crack, assumes 45 degrees approximately, the core areas concretes squash, test sample destroyed.

(2) Containing recycled concrete aggregate walls had good energy dissipation and aseismic performance; After wall dehiscence, the rigidity rate of descent is quick, after achieving the ultimate load, the rigidity drop flatten out, the walls still have good ductility.

(3) It can enhance the ductility of the wall, increases its distortion ability and enhances the earthquake resistance performance, the dissipative coefficient and energy dissipation and the equivalent viscous damping ratio also correspondingly increasing.

(4) It can be delay the delay the dehiscence, enhances the wall limit supporting capacity, and suppresses the crack the development.

Acknowledgments

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