Study On The Stress-strain Full Curves Of Waste Glass Powder Concrete

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Keywords:Waste glass concrete; Stress-strain full curve; Best color waste glass powder

Abstract:Design level C30 ,Water cement ratio 0.5, Sand rate 36%, Glass powder content 15%, Glass particle size by milling 35min, Waste glass powder mixed with two kinds of color, brown and green. Plus a baseline group of three groups and each group of six, a total of eighteen. Strain gauge affixed to the sides of the prismatic concrete test block stress - strain full curve.

Introduction:

The rise and fall of stress - strain curves of concrete under compressive stress are the main characteristics of the basic compression[1],[2].It has far-reaching significance to explore the differences of stress - strain curves of concrete under compressive stress between ordinary concrete and glass concrete under the same conditions and the optimal color glass concrete between brown, colorless and green.

Test material

Cement: P·II42.5 made by Hengyang Shao Feng

Waste glass powder: Ball milling machine to clean, dry, brown, green two kinds of waste glass grinding 35min;

Sand: Medium sand, density 2.63g/cm³, particle size in 0.25mm - 0.50mm;

Pebble The density of 2.65g/cm³, the particle size is less than or equal to 25mm, natural gravel.

experiment scheme

No.	Glass powder content	Calculation of water cement ratio	Sand rate	Glass particle size
1	0	0.5	36%	35min
2	15% (Brown)	0.5	36%	35min
3	15% (Green)	0.5	36%	35min

Baseline groups are three prisms of 150 × 150 × 300mm, there are six prisms of brown, green waste glass powder concrete. Baseline groups plus are reference groups of three groups each of three standard curing room curing 28d. After curing 28d wiped out from the curing chamber installed strain gauges on good cross and longitudinal directions, respectively, both on the waste

glass powder concrete prism, a simple first strain gauge measuring point sandpaper remove surface grease, rust.

In the electric hydraulic servo valve controlled by a rigid testing machine, such as strain rate loading[3]. First force to control the electro-hydraulic servo press, the maximum compressive strength of the prism, 20%, 40%, 30%, 50%, 60%, 70%, 80%, 10% of the load speed, the first 20%, 30%, 40% by 3kN/s speed of loading, 80% to 80% by 0.5MPa/s, when the maximum force of the prism to displacement control, the speed of the electro-hydraulic servo press is 0.05 mm/min.

experimental results and discussion

Analysis of the stress-strain full curves of waste glass powder concrete

Concrete stress - strain tests conducted in two phases single-step control: 10% of the first phase of the prism maximum compressive strength, 20%, 30%, 40%, 50%, 60%, 70%, 80% PTO controlled electro-hydraulic servo machine; the second stage in 80% of the maximum force reached the compressive strength of the measured displacement and displacement add a note of every 0.1mm electro-hydraulic servo controlled machine, the stress - strain curve .

Under the same test conditions of stress measured not add glass frit - strain as shown in Table 3.1 and Table 3.2

Table 1 test results of stress and strain in the first stage of ordinary concrete

Force (kN)	Longitudinal strain			Lateral strain			Displ- acement	Stress (MPa)
	Longitu- dinal strain1	Longitu- dinal strain2	Mean value	Lateral strain1	Lateral strain2	Mean value		
Initial value	0	0	0	0	300	150		0
3kN	1	-8	-3.5	-2	-25	-13.5		0.133
48kN	-46	-104	-75	1	-30	-14.5		2.133
96kN	-104	-202	-153	11	-85	-37		4.267
144kN	-176	-304	-240	18	50	34		6.400
192kN	-259	-406	-332.5	26	65	45.5		8.533
240kN	-350	-511	-430.5	33	45	39		10.667
288kN	-459	-626	-542.5	38	60	49		12.800
336kN	-577	-750	-663.5	44	65	54.5		14.933
384kN	-724	-911	-817.5	45	70	57.5	1.41mm	17.067

Table 2 Stress and strain test results of the second stage of ordinary concrete

Initial value	Longitudinal strain			Lateral strain			Force(kN)	Stress (MPa)
	Longitudinal strain1	Longitudinal strain2	Mean value	Lateral strain1	Lateral strain2	Mean value		
1.61mm	-1059	-1289	-1174	38	126	82	460.66kN	20.474
1.71mm	-1322	-1601	-1461.5	887	1820	1353.5	479.65kN	21.802
1.81mm	-1710	-1961	-1835.5	2583	2900	2741.5	460.10kN	20.449
1.91mm	-2342	-2093	-2217.5	5238	3980	4609	346.20kN	15.387
2.01mm	-2009	-1754	-1881.5	6450	5400	5925	264.20kN	11.742
2.11mm	-1928	-1584	-1756	7211	8250	7730.5	235.10kN	10.449

Stress strain curve of concrete with 15% brown glass powder

Brown glass doped with 15% of concrete stress - strain test results shown in Table 3.3 and Table 3.4

Table 3 brown glass powder doped with 15% of the first stage of concrete stress - strain results

Force (kN)	Longitudinal strain			Lateral strain			Displacement	Stress (MPa)
	Longitudinal strain1	Longitudinal strain2	Mean value	Lateral strain1	Lateral strain2	Mean value		
Initial value	0	0	0	0	300	150		0
3kN	1	-8	-3.5	-2	-25	-13.5		0.133
48kN	-46	-104	-75	1	-30	-14.5		2.133
96kN	-104	-202	-153	11	-85	-37		4.267
144kN	-176	-304	-240	18	50	34		6.400
192kN	-259	-406	-332.5	26	65	45.5		8.533
240kN	-350	-511	-430.5	33	45	39		10.667
288kN	-459	-626	-542.5	38	60	49		12.800
336kN	-577	-750	-663.5	44	65	54.5		14.933
384kN	-724	-911	-817.5	45	70	57.5	1.41mm	17.067

Table 4 brown glass powder doped with 15% the second phase of concrete stress - strain results

Initial value	Longitudinal strain			Lateral strain			Force (kN)	Stress (MPa)
	Longitudinal strain1	Longitudinal strain2	Mean value	Lateral strain1	Lateral strain2	Mean value		
1.61mm	-1059	-1289	-1174	38	126	82	460.66kN	20.474
1.71mm	-1322	-1601	-1461.5	887	1820	1353.5	479.65kN	21.802
1.81mm	-1710	-1961	-1835.5	2583	2900	2741.5	460.10kN	20.449
1.91mm	-2342	-2093	-2217.5	5238	3980	4609	346.20kN	15.387
2.01mm	-2009	-1754	-1881.5	6450	5400	5925	264.20kN	11.742
2.11mm	-1928	-1584	-1756	7211	8250	7730.5	235.10kN	10.449

The stress-strain curves of 15% green glass powder concrete

The test results of the stress strain of 15% green glass powder concrete are as follows: table 3.5 and table 3.6

Table 5 The test results of the first stage stress strain of 15% green glass powder

Force (kN)	Longitudinal strain			Lateral strain			Displacement	Stress (MPa)
	Longitudinal strain1	Longitudinal strain2	Mean value	Lateral strain1	Lateral strain 2	Mean value		
41.4kN	-84	-57	-70.5	3	36	19.5		1.84
82.8kN	-165	-106	-135.5	13	52	32.5		3.68
124.2kN	-245	-153	-199	28	67	47.5		5.52
165.6kN	-327	-218	-272.5	35	68	51.5		7.36
207kN	-404	-296	-350	43	76	59.5		9.2
248.4kN	-494	-401	-447.5	42	91	66.5		11.04
289.8kN	-616	-528	-572	28	85	56.5		12.938
331.2kN	-755	-665	-710	20	100	60	0.91mm	14.72

Table 6 Test results of the second phase of the 15% stage of the mixed with the green glasspowder

Initial value	Longitudinal strain			Lateral strain			Force(kN)	Stress (MPa)
	Longitudinal strain1	Longitudinal strain2	Mean value	Lateral strain1	Lateral strain2	Mean value		
1.21	-1402	-1180	-1291	143	490	316.5	435.59kN	19.36
1.31	-1702	-1381	-1541.5	548	1069	808.5	447.92kN	19.908
1.41	-1998	-1649	-1823.5	1735	3001	2368	450.47kN	20.021
1.51	-2370	-1819	-2094.5	2977	3649	3313	440.30kN	19.569
1.61	-2749	-1982	-2365.5	4341	4760	4550.5	420.10kN	18.671
1.71	-2695	-2021	-2358	7033	5277	6155	362.10kN	16.093
1.81	-2500	-1818	-2159	9985	5328	7656.5	329.70kN	14.653
1.91	-2384	-1649	-2016.5	12384	5363	8873.5	302.60kN	13.449
2.01	-2267	-1462	-1864.5	14170	5402	9786	276.10kN	12.271
2.11	-2230	-1356	-1793	16043	5265	10654	264.60kN	11.76

Conclusion

Baseline groups and waste glass powder concrete vertical and horizontal stress - strain curve as shown in Figure 4.1 and 4.2

Fig 1 longitudinal stress-strain relations

Fig 2 transverse stress-strain relation

By the graph we can see that the longitudinal compressive stress value of normal concrete under the same condition is the maximum and minimum strain but the difference is not more than 5Mpa; two, when the maximum longitudinal stress value of concrete compressive failure of concrete is increased, the absolute value of normal concrete stress is larger than that of the normal concrete[4]. Two kinds of waste glass powder concrete stress drop absolute value than the absolute value of the strain decreased absolute value is less than a certain ductility damage, so the maximum stress value of waste glass powder concrete performance is better than ordinary concrete. The reason may be the glass powder into the still friction between the strip surface roughness and sand, stone more; three, the stress-strain curve of concrete segment increased at the same strain stress ratio of two kinds of waste glass powder concrete stress value, decline of two kinds of waste glass powder in concrete shows better ductility, deformation to absorb more energy, so the stress value is not a sharp decline[5]; four, concrete of two different colors of the waste glass powder stress-strain curve is basically the same, the same longitudinal strain under stress is almost the same with only slight differences, that is to say the glass in concrete in five, in the concrete not much difference between stability; the same stress of different colors under two kinds of waste glass powder from the longitudinal strain to bottom is 15% Brown waste glass powder concrete, 15% green waste glass powder concrete; six, brown, green and brown two kinds of waste glass powder in concrete the maximum bearing capacity of concrete waste glass powder;Consistent with lateral strain;

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