A discussion about the rod position in the splitting tensile tests on hollow concrete blocks

Supplementary file

BUILDINGS

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Abstract: Different loading conditions cause different tensile stress patterns in masonry structures. Several studies related to masonry behavior use indirect tensile tests to obtain that value, where the splitting test from ASTM-C-1006 is usually employed. In this paper, an experimental analysis of the tensile strength of hollow concrete blocks is reported. Different locations of the rod from the ASTM-C-1006 splitting test were analyzed. The tensile strength was evaluated in 4 different ways: 1) placing the rod in the transversal-direction over the gross area, 2) in the transversal-direction over the net area, 3) in the longitudinal-direction, and 4) 200 mm from the central region of the block in the longitudinal-direction. The obtained results were compared with the tensile strength values measured from the direct tensile test in the longitudinal-direction. In addition, an axial compressive test was performed to characterize the blocks, and a discussion about the tensile/compression ratio is shown. The experimental results from the splitting tests show that for each configuration setup, the tensile stress is different. The main result was that the splitting test over the net area with the rod positioned in the longitudinal-direction can overestimate the tensile strength more than 21% of the one over the gross area.

Keywords: hollow concrete blocks; tensile strength; splitting tests; masonry.

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Introduction

In this file it can find the direct tensile test report in the x and y direction. The blocks used for current research have a mean compressive strength of 11.62MPa. The file is structured as follow: (1) Compressive strength results, (2) Results from direct tensile test in the x and y direction.

Nomenclature

ε_u	Ultimate strain in compression
ε_0	Strain related to the maximum stress in compression
f'_{Cg}	HCB uniaxial compressive strength over the gross area, MPa
f'_{Cn}	HCB uniaxial compressive strength over the net area, MPa
E_{Cg}	Elastic modulus over the gross area, in compression, MPa
E_{Cn}	Elastic modulus over the net area, in compression, MPa
$ft_{S_{nx}}$	Splitting tensile strength in the x-direction over the net area, MPa
$ft_{S_{gx}}$	Splitting tensile strength in the x-direction over the gross area, MPa
ft_{S_y}	Splitting tensile strength in the y-direction, MPa
$ft_{S_{y-CR}}$	Splitting tensile strength in the y-direction, 200 mm from the central region of the block, MPa
$ft_{S_{(g-n)x}}$	Splitting tensile strength in the x-direction over the gross area using the net area to compute the splitting strength

1. Compressive strength results

30 blocks were tested to achieved its axial compressive behavior, here is the results of each one.

Specimen	Max. Load (kN)	(f'_{Cg}) (MPa)	(f'_{Cn}) (MPa)	(E_{Cg}) (MPa)	(E_{Cn}) (MPa)	(ε_0) (mm/mm)	(ε_u) (mm/mm)	μ
B1	380.58	6.69	11.72	2998	5253	0.002190	0.004627	0.043
B2	390.38	6.88	11.96	3059	5318	0.002800	0.005141	0.077
B3	354.33	6.21	10.88	2634	4615	0.002981	0.004426	0.051
B4	356.29	6.24	10.94	3053	5357	0.001642	0.002729	0.087
B5	335.96	5.85	10.39	2500	4438	0.003652	0.004783	0.056
B6	335.96	5.87	10.37	3682	6511	0.001499	0.002238	0.061
B7	408.61	7.16	12.58	3009	5288	0.001937	0.002829	0.070
B8	427.23	7.48	13.21	2983	5264	0.003387	0.005966	0.042
B9	379.25	6.64	11.64	2652	4648	0.003028	0.004851	0.056
B10	366.01	6.44	11.26	2830	4948	0.002796	0.004845	0.052
B11	397.77	6.99	12.29	2313	4068	0.003002	0.004328	0.059
B12	342.38	5.92	10.57	2652	4733	0.002411	0.006243	0.053
B13	408.91	7.17	12.45	3283	5705	0.002657	0.004849	0.030
B14	370.83	6.51	11.32	2907	5056	0.003520	0.005403	0.065
B15	384.10	6.70	11.83	3368	5947	0.003207	0.005780	0.064
B16	343.58	6.02	10.55	2504	4388	0.002592	0.004521	0.053
B17	392.76	6.91	12.03	2969	5174	0.003406	0.005012	0.065
B18	369.71	6.50	11.38	2782	4875	0.003248	0.004818	0.058
B19	333.22	5.83	10.28	2725	4804	0.004560	0.005261	0.064
B20	390.82	6.86	12.04	2749	4828	0.003003	0.004757	0.048
B21	393.85	6.89	12.12	2780	4890	0.002743	0.003390	0.044
B22	357.68	6.26	10.98	2440	4278	0.002138	0.005962	0.071
B23	376.01	6.57	11.55	5521	9703	0.001709	0.004071	0.036
B24	375.84	6.60	11.54	2754	4811	0.002664	0.003242	0.054
B25	385.75	6.81	11.87	2219	3866	0.003158	0.004812	0.069
B26	395.08	6.89	12.20	2501	4430	0.002816	0.003894	0.083
B27	404.94	7.07	12.47	3214	5668	0.002599	0.002854	0.057
B28	435.49	7.66	13.43	5189	9096	0.002028	0.002822	0.069
B29	374.19	6.55	11.55	3653	6435	0.002290	0.003405	0.063
B30	360.46	6.27	11.09	3038	5370	0.002095	0.003601	0.045
Mean	377	6.61	11.62	3032	5326	0.0027	0.0044	0.06
SD	26.23	0.47	0.81	722	1269	0.0007	0.0011	0.015
COV	7%	7%	7%	24%	24%	25%	24%	22%

2. Results of direct tensile test in x and y directions

The direct tensile tests were carried out in the x and y directions (Figure S1a,b). The plates to carried out the test have a length of 230 mm (Figure S1). The direct tests were performed under displacement control ($0.0005\ mm/s = 0.5\ \mu m/s$) [1], with a different set of supporting steel plates for each direction. The description of the direct tensile test and the experimental procedure for reproducing it can be consulted in the references [2, 3]. In current research 30 blocks were tested for each direction x and y. The results are showing in Table S1.

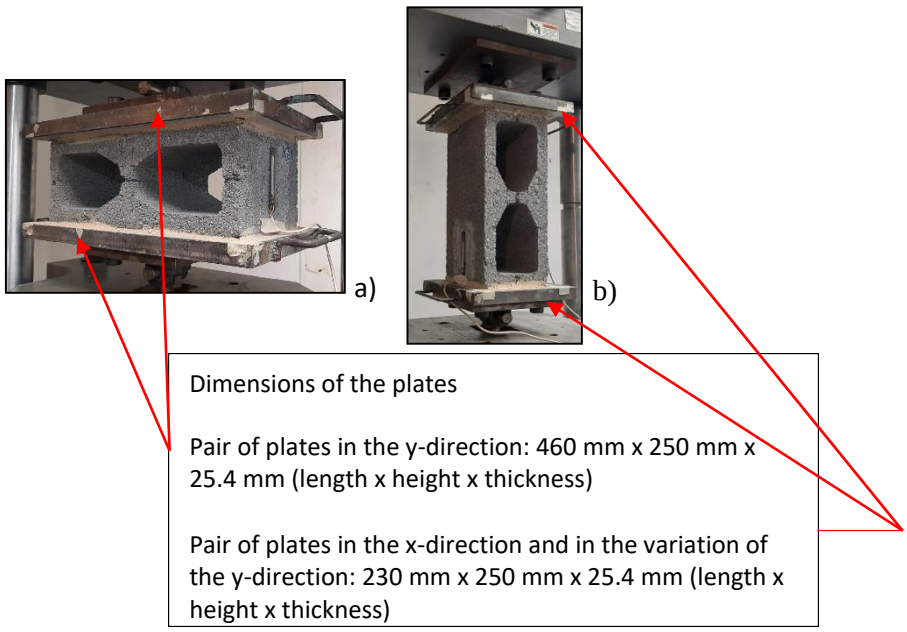

Figure S1. Schematic arrangement and location of the transducers for the direct tensile test in a) y direction, and b) x direction

Table S1. Results of the direct tensile test (the elastic modulus were evaluated using the secant modulus at 5% to 35% of the ultimate strength).

x-direction						
	Ft_{D_x} (kN)	$ft_{D_{gx}}$ (MPa)	$ft_{D_{nx}}$ (MPa)	$\varepsilon_{tDx,U}$ (με)	$Et_{D_{gx}}$ (MPa)	$Et_{D_{nx}}$ (MPa)
Mean	8.93	0.316	0.90	41.20	7811	22187
SD	1.31	0.05	0.13	10.79	2054	5834
COV	15%	15%	15%	26%	26%	26%
y-direction						
	Ft_{D_y} (kN)	$ft_{D_{gy}}$ (MPa)	$ft_{D_{ny}}$ (MPa)	$\varepsilon_{tDy,U}$ (με)	$Et_{D_{gy}}$ (MPa)	$Et_{D_{ny}}$ (MPa)
Mean	8.59	0.111	0.543	8.72	10723	52336
SD	0.98	0.01	0.06	1.56	2452	11969
COV	11%	11%	11%	18%	23%	23%

In Figure S2 the principal failure obtained from the direct tensile tests are shown.

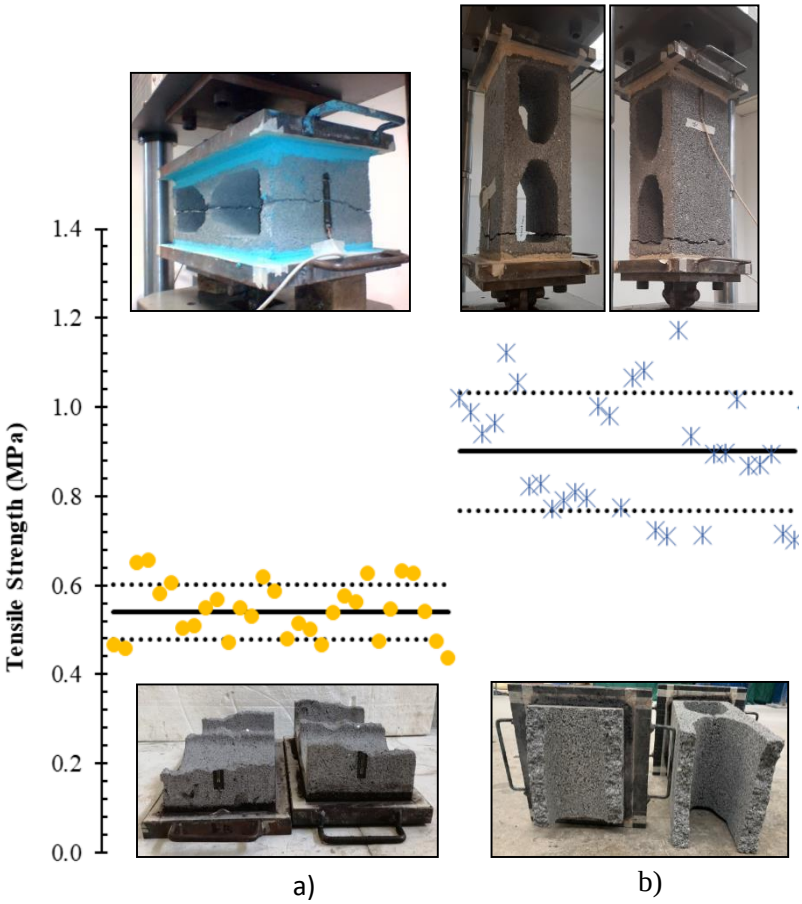

Figure S2. Failure mode from direct tensile tests: a) y-direction, and b) x-direction

References

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