

Energy & Low-Income Tropical Housing – ELITH Working Paper EWP IIB-8-5

Crushing strength of mortarless masonry

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Introduction

In July 2016, as part of other experiments conducted at NHBRA Dar es Salaam, compressive strength test was also performed for standard Tanzanian ISSBs. Testing was carried out for single block (300*150*100mm) and 2*2 prisms of ISSB blocks. The main objective of experiment was to find the compressive strength of single ISSBs and to compare the compressive strength of single block with those of block prisms.

Experimental Setup and Results

The test was performed using a Compression Testing Machine as shown in Figure 1. The crushing force was applied through a levelling device and via a wooden frame intended to spread the force evenly over the (non-interlock) bearing surface at the top of each block.

ISSB blocks (**soil:cement ratio of 10 and cured for over 14 days after ejection from mould**) were selected from the existing stock and cleaned before testing. ISSB **heights** were measured from both sides at a point midway along each block. Those blocks having a difference of >1mm between the two measurements were rejected as being of too-low geometrical quality. The same technique was used in other experiments to avoid using high-taper blocks.



Figure 1: Compression Testing Machine



Figure 2: ISSB Used for Compression Testing

5 sample of single block and 5 samples of prisms were tested. At the top of block a wooden frame is used to provide smooth contact surface for testing as shown in Figure 3.



**Figure 3:
Setting of
sample in
testing
machine**



The result of each sample is detailed in the table below; figure 4 shows the failure of prism.



Figure 4: Crushing failure of sample

Sample No	Sample Size	Load Applied (Ton)	Loaded Area	Compressive Stress (MPa)
1	1 block	5	0.045	1.11
2	1 block	7.8	0.045	1.73
3	1 block	7.8	0.045	1.73
4	1 block	7.9	0.045	1.76
5	1 block	7	0.045	1.56
		Sample	Mean	1.69
		Sample	CoV	0.17
Sample No	Sample Size	Load Applied(Ton)	Loaded Area	Compressive Stress (MPa)
1	Prism	9	0.09	1.00
2	Prism	8	0.09	0.89
3	Prism	8.5	0.09	0.94
4	Prism	8	0.09	0.89
5	Prism	8	0.09	0.89
		Sample	Mean	0.92
		Sample	CoV	0.052

Table 1: Result of Compressive stress for Single Block and Prism

The coefficient of variation (CoV) is that within each sample of 5. The COV of the mean values about the population mean would be smaller (by factor 0.44)

Discussion of finding and their implications:

1. If we compare the compressive strength of a single block with that of a prism, it appears that average compressive strength of the prism is 54% lower. We suspect this is due to imperfect block-to-block contact.
2. For a single block, the average compressive stress was found 1.69Mpa. The formation pressure to mould each block was applied manually and not measured, but after discussion with experienced people it was estimated at about 1.5 MPa which is 15% higher than the experimental value for crushing strength.
3. The sample size appears large enough (CoV of sample mean about population mean is under 10%)
4. A further experiment comparing a say 3-brick column with a single brick but with a more elastic 'frame' between loading platen and block surface is desirable.