

3.4 Compressive Strengths of Masonry Prisms

Introduction

The current situation in relation to the permitted ultimate compressive strength values f'_m in *NZS 4230 Design of reinforced concrete masonry structures* is summarised as follows:

Class A No limit, but values beyond 12 MPa must be confirmed via prism testing. (Supervised construction).

Class B 12 MPa. (Construction observation)

Class C 4 MPa. (No construction observation)

The concept of prism testing (3 units high) was not considered to be a viable control method, but in order to provide designers with some information as to the ultimate compressive strength of masonry, a series of prism tests were carried out (*NZCRA Report SLR 24*).

The New Zealand Concrete Research Association was particularly conscious NOT to have artificially raised the level of the recorded strength through specific laboratory procedures not representative of practical blocklaying and grouting. The results therefore clearly show the previous conservative nature of the Standards document prior to *NZS 4320*.

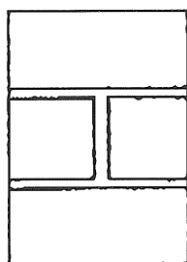
While the results in themselves are probably insufficient in number to form a basis upon which to propose a revised strength appraisal method, they have been passed to the University of Canterbury for inclusion within a new strength evaluation method which is now contained in Appendix B of *NZS 4230*.

It is considered that the results obtained should provide designers with a broad independent assessment of the actual compressive strengths likely to derive from grout filled concrete masonry in the Auckland, Wellington and Christchurch areas.

Summary of Results

Result 1:

Compression tests were carried out on 3 unit high prisms laid up as shown using results 2016 type units.



Result 2:

Three different sources of masonry units were used from Auckland, Wellington and Christchurch.

The mean compressive strengths of the individual masonry blocks from each consignment were measured in accordance with *NZS 3102P:1974*.

The values were:

Auckland	17.1 MPa
Wellington	26.5 MPa
Christchurch	25.6 MPa

Result 3:

Two types of mortar were used - X and Y:

Mix Design	X	Y
Sand/cement (by weight)	3.29	4.92
Water/cement (by weight)	0.83	0.97
Admixture (ml/kg)cement	2.80	2.80
Flow after suction* (% of initial flow)	69.0	51.0
28 day compressive strength**	19.5	16.0
Admixture (ml/kg)cement	2.80	2.80

* As per Clause 23 of *ASTM C91*
 ** As per *NZS 3112:1980 Part 2*

Result 4:

Two types of grouts were used - 17.5 MPa (Type A) and 20 MPa (Type B). Both grouts were proportioned to give spread values of between 490 mm and 510 mm. (*NZS 4210P* spread requirements 450 mm to 530 mm).

Result 5:

108 three high grouted prisms were tested to cover the various combinations of manufacture source, mortars and grout strengths.

The 7 day prism strengths can be summarised as:

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Designation	Individual Prism Strengths (MPa)	Mean Prism Strength (MPa)	7 Day Grout Strength (MPa)	28 Day Grout Strength (MPa)
AXA1	12.3 13.5 13.7	13.2	11.0	18.0
AXA2	11.9 14.0 13.2	13.0	10.5	19.0
AXA3	13.6 12.3 11.8	12.6	11.5	19.5
AXB1	13.7 14.2 12.9	13.6	12.0	20.0
AXB2	14.1 14.3 13.6	14.0	13.0	22.5
AXB3	15.1 13.8 14.4	14.4	12.5	21.0
AYA1	13.2 12.7 13.4	13.1	10.5	16.5
AYA2	13.7 10.8 13.1	12.5	11.0	17.5
AYA3	12.6 12.9 13.3	12.9	9.5	18.0
AYB1	13.0 13.5 14.2	13.6	12.0	21.5
AYB2	13.9 14.5 15.1	14.5	11.5	20.5
AYB3	13.8 15.0 14.7	14.5	13.0	22.5
WXA1	13.2 13.0 13.7	13.3	10.5	18.5
WXA2	13.9 12.7 14.0	13.5	10.0	19.0
WXA3	14.0 14.2 16.7	15.0	11.5	19.5
WXB1	13.2 12.9 13.6	13.2	10.5	19.0
WXB2	11.7 14.3 14.8	13.6	11.0	20.
WXB3	17.4 16.5 16.5	16.8	12.5	21.5

Designation	Individual Prism Strengths (MPa)	Mean Prism Strength (MPa)	7 Day Grout Strength (MPa)	28 Day Grout Strength (MPa)
WYA1	12.9 13.3 12.9	13.0	9.5	17.0
WYA2	13.8 12.8 13.4	13.3	10.5	19.0
WYA3	14.2 13.8 13.6	13.9	10.5	18.0
WYB1	14.6 15.3 13.9	14.6	12.5	22.5
WYB2	14.9 14.9 15.8	15.2	12.0	19.5
WYB3	13.8 14.6 13.3	13.9	11.0	19.5
CXA1	12.7 11.8 13.0	12.5	9.5	17.0
CXA2	16.2 15.7 14.6	15.5	11.5	18.5
CXA3	13.1 13.0 13.9	13.3	11.0	18.5
CXB1	14.2 13.6 13.7	13.8	12.0	20.5
CXB2	15.6 16.2 14.9	15.6	12.5	21.0
CXB3	14.8 13.2 15.1	14.4	12.5	21.5
CYA1	12.9 13.2 13.5	13.2	8.5	15.0
CYA2	13.7 14.3 12.9	13.6	10.0	17.5
CYA3	14.1 13.2 13.7	13.7	11.0	18.5
CYB1	15.6 14.9 15.4	15.3	12.0	20.5
CYB2	14.7 16.6 13.2	14.8	13.0	22.5
CYB3	17.0 16.5 16.7	16.7	13.0	21.0

Each set of prisms is identified as follows:

1. First code letter represents source of masonry units – A = Auckland, W = Wellington, C = Christchurch.
2. Second code letter represents type of mortar – X or Y.
3. Third code letter represents grout type – A or B.
4. Final number is replicate set number.

Note: NZS 3102P has been superseded by AS/NZS 4455, and NZS 4230 was introduced in 2004 replacing DZ 4210 Part B. The prism test results of 1983 remain valid and were used to complete Appendix B of NZS 4230:2004.

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