THE CANADIAN SPECIFICATION FOR PRECAST CONCRETE PAVERS

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SUMMARY

The Canadian specification for 'BLOCK PAVING' has been written around a de-icing salt freeze-thaw test designed to insure satisfactory performance of pavers under severe Winter conditions. A minimum compressive strength is also specified. It is the manufacturer's responsibility to arrange for sampling and testing periodically, with the record of test results being made available to prospective purchasers.

A specification for use in Canada must satisfy our severe climatic conditions. The most critical situation occurs in the Spring of each year when the sub-base is still frozen, thus preventing drainage through the base material, while freezing takes place at night, thawing during the daytime. Pavers can be expected to undergo a number of cycles each year in a salt solution under these conditions. A paver must have sound aggregate, a strong cement paste and proper compaction if it is to perform well under these conditions.

The strength of the salt solution does not seem to be too important, provided that the concentration is less than 10%. M. Levitt's results In 1974 (Table 1) show that the most aggressive sodium chloride solutions are between 0.3 and 1.02, but a 3% solution is generally used in Canadian laboratories, and so the Canadian specification has adopted the 3% concentration (1). Consideration was given to only testing the durability characteristics of the top of the stone, but it is felt that a user is entitled to expect satisfactory performance from the full stone. Figure 1 shows the top of a paver which was replaced, in die sidewalk of a Canadian city after 5 years. Figure 2 shows the underside of the same stone. Immersing a full paver in a 3% NaCl solution and then cycling the container in freeze-thaw duplicates the most severe natural condition and insures adequate durability of cement paste, aggregates and compaction. The paver in Figures 1 and 2 did not have proper compaction of the bottom part of the stone, probably as a result of incomplete filling of the mould.

The de-icing salt test calls for 50 cycles of freezing and thawing. This will take 10 weeks to complete on the basis of one cycle per day, five days per week. Adequate age and maturity of the cement paste at the start of the test is a necessity, and a curing procedure is specified. Twenty-eight days is the usual age at which de-icing salt tests are started In North America. Table 2 shows the scaling loss at 50 cycles for eight different brands of North American cements, as tested by the Ontario Ministry of Trans-

Table 1: Surface scaling, loss - g/cm ^{2}
50 cycles in NaCl
Age at start of test - 7 Months

Concentration of NaCl	Individual	Average
10%	0.02	
	0.03	0.04
	0.07	
3%	0.06	
	0.03	0.05
	0.06	
1%	0.11	
	0.13	0.15
	0.23	
0.3%	0.13	
	0.19	0.16
	0.16	
0.1%	0.14	
	0.09	0.13
	0.17	



Figure 1: Five year old paver - surface.

portation and Communications according to ASTH C.672-74T, freezing and thawing In a 3% NaGl solution (2). This shows that the durability and maturity chracterlstics of ceaents di f fer.

Table 3 shows weight loss as a percentage of the original paver after 50 cycles of freeze-thaw in a 3% NaCl solution for pavers sampled from the same batch, but with cycling starting after 28 days and 60 days. The result confirms that some cements are immature at 28 days, but the committee writing the specification felt that additional delay in starting the test would not be justified. In addition, the allowable maximum loss of IX with Che cycling starting at 28 days would have to be reduced if the stone is allowed to mature further.

Table 2: Surface scaling, loss - g/cm^2
50 cycles in 3% NaCl

Brand of Cement	Individual	Average
A	0.0616	
	0.0198	
	0.0392	0.0404
	0.0411	
B	0.0177	
	0.0258	
	0.0674	0.0450
	0.0689	
C	0.0678	
	0.0324	
	0.0322	0.0428
	0.0386	
D	0.0174	
	0.0191	
	0.0283	0.0233
	0.0278	
E	0.0409	
	0.0429	
	0.0294	0.0360
	0.0308	
F	0.0511	
	0.0394	
	0.1039	0.0623
	0.0547	
G	0.0201	
	0.0260	
	0.0252	0.0223
	0.0178	
H	0.0131	
	0.0150	
	0.0201	0.0161
	0.0160	

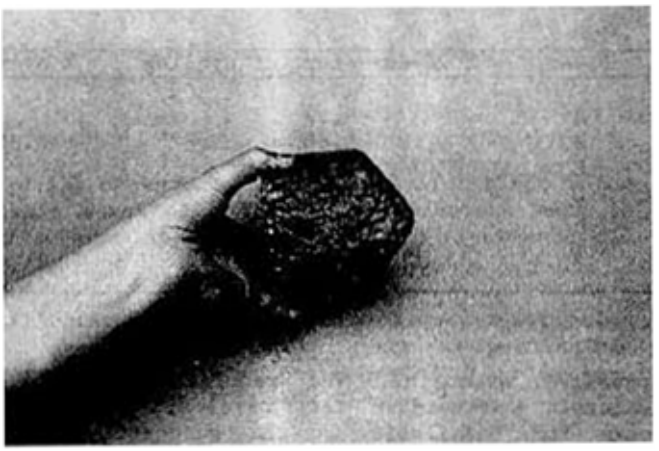

Figure 2: Five year old paver - underside.

A compression test has been included in the specification as a guide to cement content and the strength of the cement paste. A problem was to decide on the method of test. It appears that if half stones are tested, the compressive strength will be 16% higher than for cubes; full stones ±37% higher depending upon shape. There are not many Canadian laboratories capable of testing full stones, and with the variety of shapes produced in Canada, standardization on one of the them as a basis for test would not be realistic. Testing on half stones would also require specifying the shape which is to be cut in half. The Canadian specification requires that the average strength at 28 days shall not be less than 50 MPa based upon the average of five cube specimens cut from five full-sized pavers, and that no single test shall fall below 45 MPa. Testing of full pavers is allowed where the equipment is available, providing that the ratio between full stones of the particular shape and cubes has been established.

Dimensions of pavers shall not differ from those agreed between purchaser and manufacturer by more than ±1.6 mm for length and width, ±3.2 mm for height.

Tire specification requires that the manufacturer shall sample every 20,000 m^2 of production, every two months when in production or when he makes any change In his production process, mix design, cement or aggregate supply, which ever happens first. From each sampling of the manufacturer's production line, pavers shall be moist-cured for 14 days, after which they arc air-dried for 12 days. The specimens for de-icing salt freeze-thaw testing are oven-dried to constant weight for 24 hours before immersion in the 3% solution, cycling to start at 28 days. At this age, cubes are cut and tested for com-

Table 3: Pavers taken from the same production sampling, moist-cured for 14 days, followed by air-drying. Freeze-thaw cycling in a 3% NaCl was started at 28 days and at 60 days. The weight of scaled material after 50 cycles is shown as a percentage of the original dry weight of the paver.
Maximum weight loss allowed by standards - 1% with the freeze-thaw cycling to start at 2 days.

Paver	% 28-day start of cycling	% Average	% 60-day start of cycling	% Average
A	0.59			
B	0.86	0.63		
C	0.44			
D			0.06	
E			0.12	0.08
F			0.07	

pressive strength. The manufacturer shall maintain a record of test results, and shall make this available to the purchaser upon request. The purchaser may wish to sample and test at his own expense to verify the manufacturer's results, but the de-icing salt test requires 14 weeks, and so the pavers will have been put down and be in use before the results are available. An appendix suggests that sampling be done by a concrete testing laboratory, and recommends the method, but it is not a mandatory part of the specification.

There is no test limit for absorption o. abrasion loss. The committee could not find a relationship between durability and absorption, nor have there been problems with excessive wear caused by abrasion.

The Canadian Standard will be published in 1984 under the code CSA #A.231.2M.

REFERENCES

(1) Levitt, M. Correspondence - British Precast Concrete Research Unit.

(2) Ontario Ministry of Transportation and Communications, Durability of Concrete by Brand of Cement.