CONCLUSIONS

1. HSC shows a larger strain-rate-sensitivity in compression than NSC as far as the peak stress and the strain are concerned, whereas in tension, both concretes show a similar strain-rate-sensitivity.

2. The experimental observations can be explained on the basis of a basic mechanism of the strain-rate-sensitivity (mainly the Stefan effect).

3. The long-term strength of HSC does not correspond to the so called 'critical stress' related to the maximum volume strain. It seems to be reasonable to consider the beginning of cracking inside the concrete as the critical point, which is shown by a significant increase of Poisson's ratio. According to the experimental analysis, the long-term strength of HSC is about 80% of its short-term strength.

ACKNOWLEDGEMENTS

The research project was made possible by the financial support of the Dutch Centre for Civil Engineering Research and Codes (CUR), the Professor Bakkerfonds and MEBIN. Mr. A. van Rhijn and Mr. F. Schilperoort, member of the technical staff of the Stevin Laboratory, are gratefully acknowledged.

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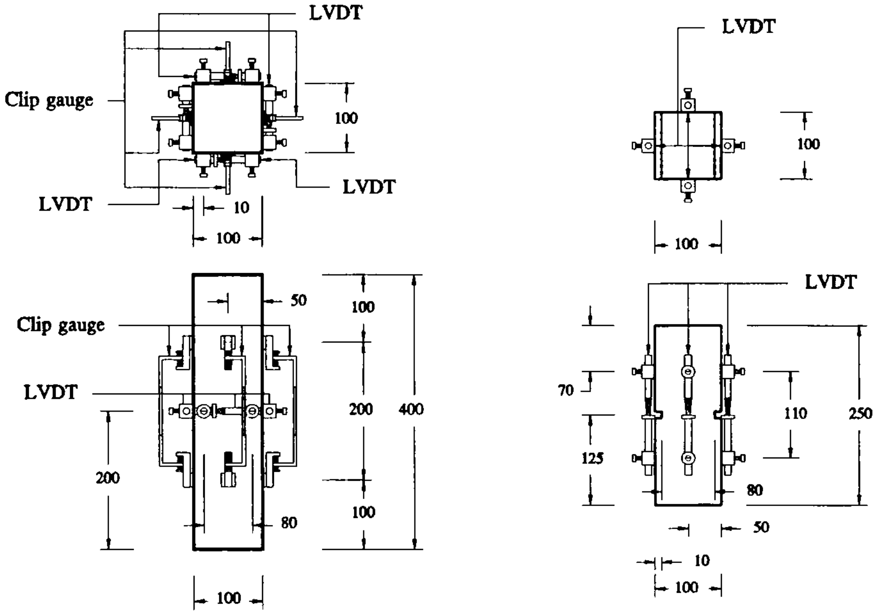
TABLE 1 — MIX PROPORTIONS FOR HSC AND NSC

Mixture	Unit	HSC	NSC	Note
Cement	kg/m^3	475	360	ENCI Portland Cement Class C
Silica fume	kg/m^3	25	0	dry powder
W/(C+SF)		0.30	0.50	Water/(Cement+Silica Fume)
Aggregate	kg/m^3	1796	1816	total weight of aggregate
0 - 4 mm 4 - 16 mm	kg/m^3 kg/m^3	718 1078	726 1090	Fine aggregate Coarse aggregate
Superplasticizer	%	*****	*****	percentage of weight of cement
lignosulfonate lignosulfonate Naphtalene	% % %	0.2 0.6 2.2-2.5	0.2 (40% solid)	with a little Na-gluconate without Na-gluconate
Air content	%	1	1	*****
Cube strength (28 days) 150×150×150 mm	N/mm^2	113.8	42.3	Cube strength is determined at a constant loading rate of 13.5 KN/s
	SD	4.1	1.4	
Prism strength (28 days) 100×100×400 mm	N/mm^2	100	29.4	Prismatic strength is determined at a constant longitudinal strain rate of 7.3 × 10^{-6} s^{-1}
	SD	3.3	1.4	

TABLE 2 — STATISTICAL ANALYSIS OF MECHANICAL PROPERTIES OF HSC AND NSC IN UNIAXIAL COMPRESSIVE TESTS AT VARIOUS STRAIN RATES

G/S (No. of samples)	$d\varepsilon_1 / dt$ ($\times 10^{-6}$ s^{-1})	Statistic item	ε_{vmax} ($\times 10^{-3}$)		$\sigma_{mvs}/\sigma_{max}$	
			HSC	NSC	HSC	NSC
R1 (3)	6.250	average	1.514	0.389	0.960	0.810
		SD	0.021	0.036	0.017	0.056
R2 (2)	2.500	average	1.438	0.426	0.957	0.926
		SD	0.011	0.029	0.006	0.048
R3 (2)	0.430	average	1.356	0.447	0.943	0.952
		SD	0.063	0.042	0.057	0.037
R4 (2)	0.190	average	1.431	0.387	0.942	0.865
		SD	0.000	0.009	0.012	0.058
R5 (2)	0.020	average	1.469	0.456	0.922	0.761
		SD	0.062	0.031	0.009	0.028
R6 (2)	0.010	average	1.485	0.410	0.928	0.874
		SD	0.045	0.006	0.013	0.080

ε_{vmax} means the maximum volume strain.
σ_{mvs} means the stress at the maximum volume strain.



(a) (b)

Fig. 1—Setup of measurements for: a) compressive tests; and b) tensile tests

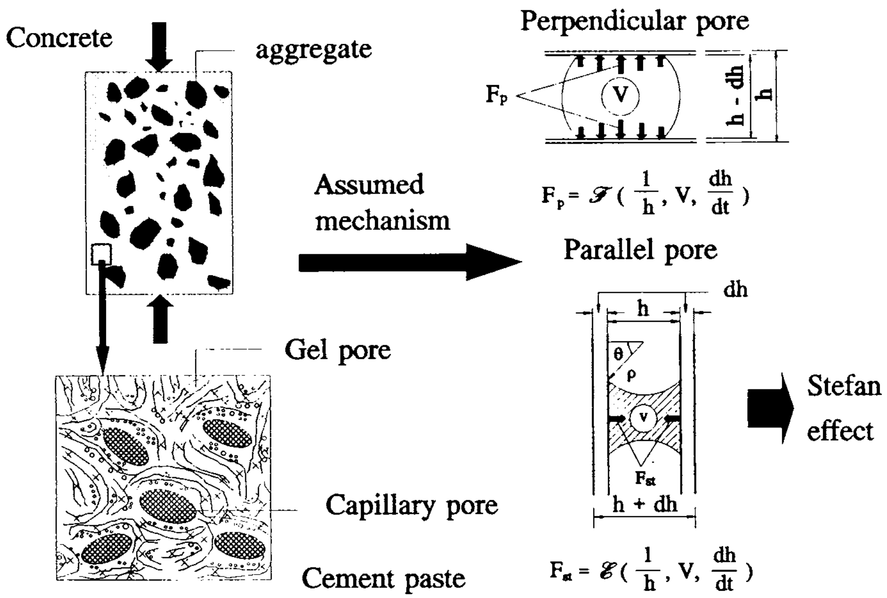


Fig. 2—Basic mechanism of strain-rate sensitivity

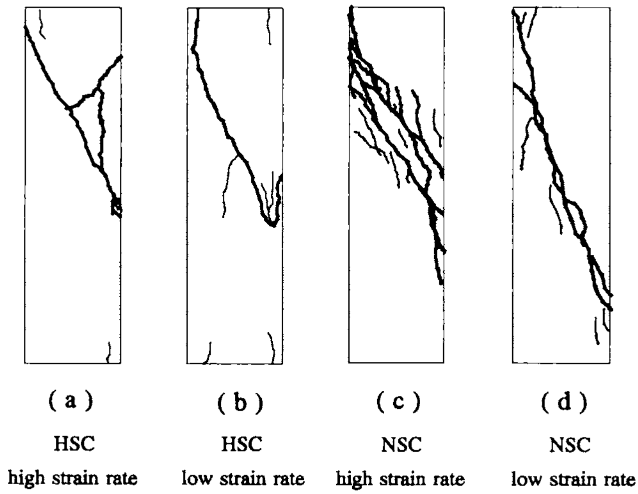


Fig. 3—Typical failure modes

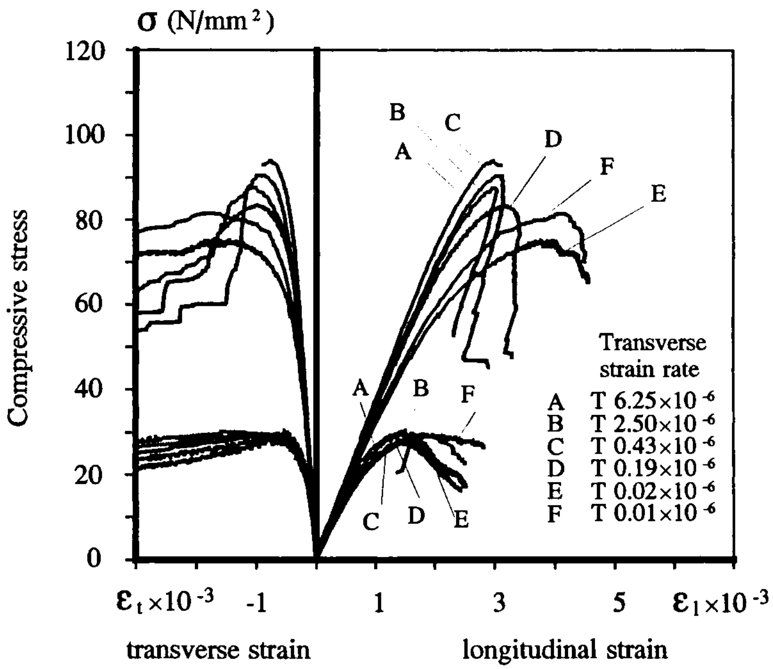


Fig. 4—Stress-strain curves for HSC and NSC in uniaxial compressive tests at various transverse strain rates

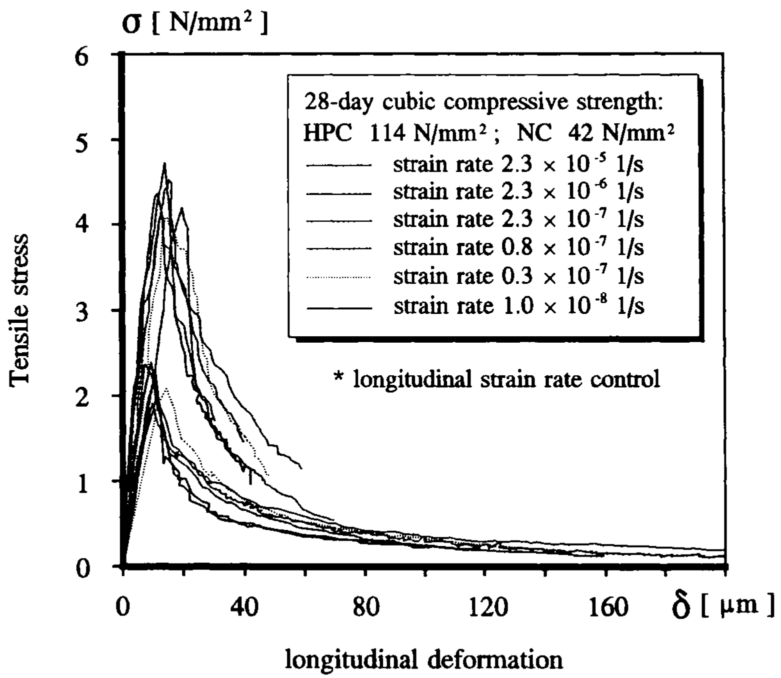


Fig. 5—Stress-deformation curves for HSC and NSC in uniaxial tensile tests at various longitudinal strain rates

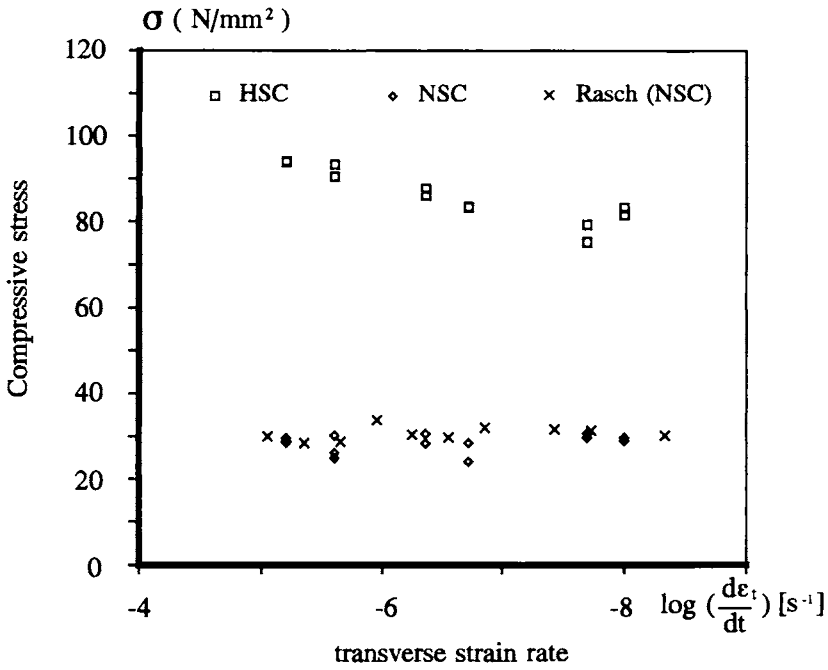


Fig. 6—Peak stresses versus transverse strain rates for HSC and NSC in uniaxial compressive tests

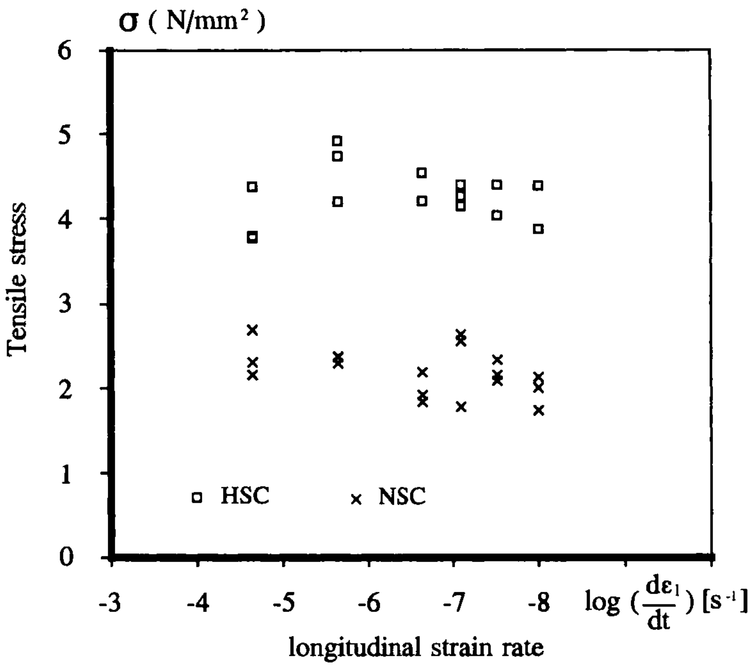


Fig. 7—Peak stresses versus longitudinal strain rates for HSC and NSC in uniaxial tensile tests

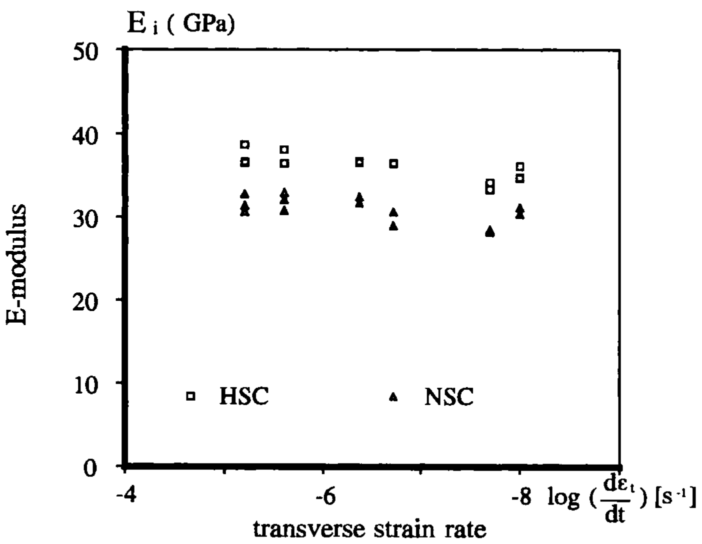


Fig. 8—Initial *E*-modulus versus transverse strain rate