THE STRENGTH OF CONCRETE PAVING BLOCKS

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As we have seen in the inquiry on Specifications and Standards for Concrete Paving Blocks there are a lot of differences in the way the strength of the concrete is measured in the different countries:
- compressive strength
- flexural strength
- splitting strength.

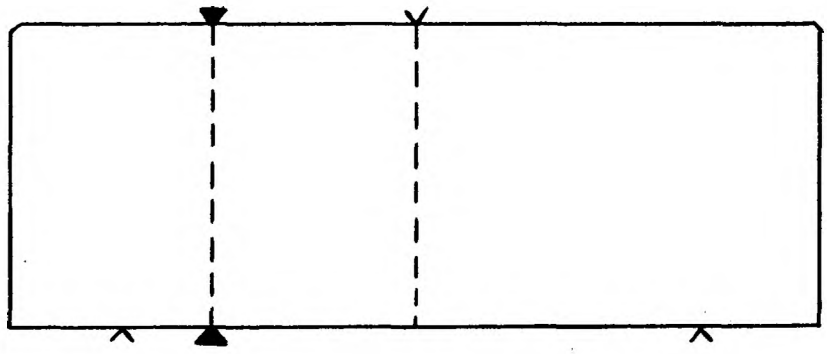
Within the group of standards that use the compressive strength we see differences in the shape and the dimensions of the test-units:
- full block including chamfers
- full block excluding chamfers
- cubes cut from the blocks
- cylinders cut from the blocks.

It may be clear that it is not possible to compare all these different specified levels of strength. This can be considered as a disadvantage for a good and fruitful communication.
Besides that there are some other disadvantages, related to the method of testing, such as:
- a too small number of units in the sample to obtain reliable data
- high costs of preparation of the sample
- the methods of testing the compressive strength and the flexural strength are rather dependent on the shape of the test-unit and its thickness; the splitting strength seems to be less dependent on the shape or dimensions of the units.

Regarding strength there are 2 bases for its specification:
- structural strength which is related to the traffic loads
- durability which is related to climat conditions and to the contact pressures of the traffic.

As structural design was the main theme in the Conference, it would be wise to stipulate the same strength conditions or at least comparable strength levels.

In The Netherlands we specify the characteristic flexural strength in the national standard NEN 7000 as 5.9 MPa.
In our laboratory in Amsterdam we have done some work to investigate the relation between flexural strength and splitting strength. For this purpose we took 8 samples consisting of 15 units each of normal sized rectangular blocks with a thickness of 80 mm. The blocks were from one factory and of slightly different ages.
The flexural strength σ_{fs} was measured according to the Dutch national standard. Next the splitting strength σ_{ss} was determined on one of the halves of each block; thus we got pairs of values of the flexural and the splitting strength. It must be noted that in the splitting test the load is applied in the cross-direction (figure 1).
A positive correlation could be showed within the 120 pairs as well as between the means of 7 out of 8 samples. The regression lines of the 120 pairs as well as the regression lines of the 8 samples are shown in figure 2.



^ 3-point-bending test

▲ splitting test

n = 120 pairs

$\bar{\sigma}_{fs}$ = 7.50 MPa $\qquad$ $\bar{\sigma}_{ss}$ = 5.23 MPa

s_{fs} = 0.65 MPa $\qquad$ s_{ss} = 0.50 MPa

v_{fs} = 8.67% $\qquad$ v_{fs} = 9.56%

Figure 1. Results 3-point-bending test and splitting test.

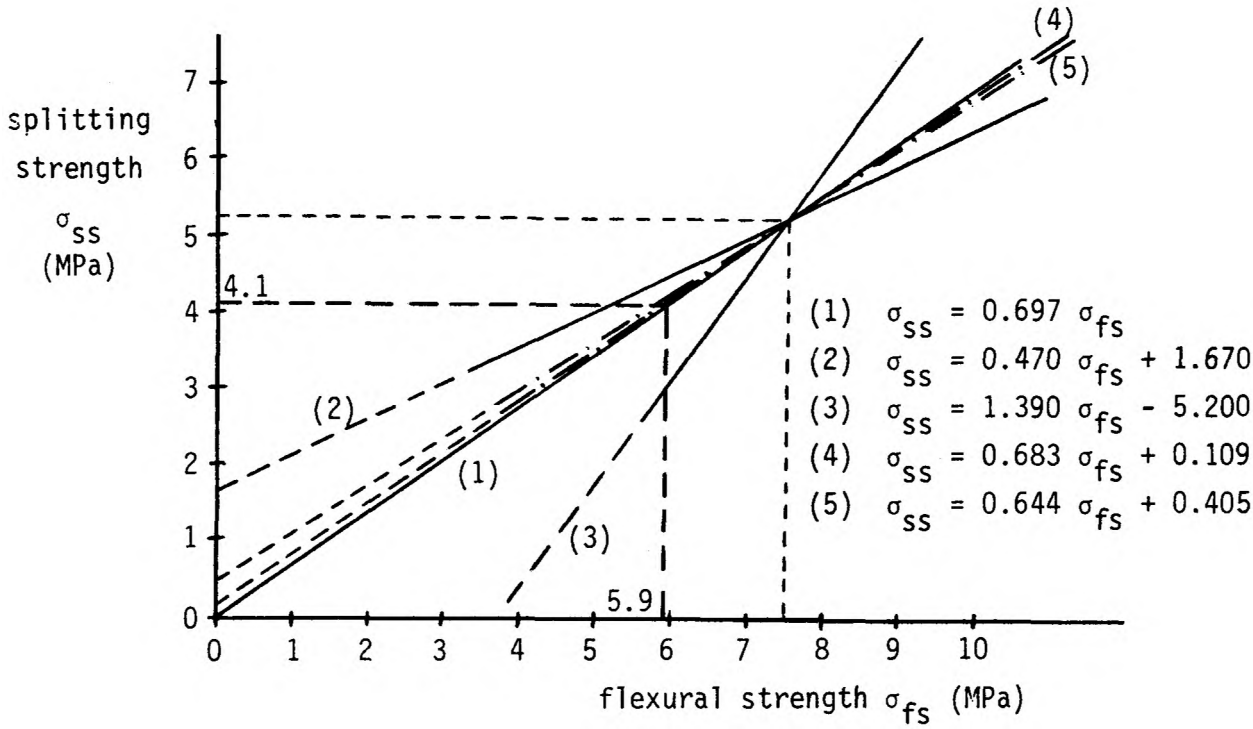


Figure 2. Correlation between splitting strength and flexural strength.

It may be clear that the best correlation will show a line going through the origin. From the measured data was found:

$\sigma_{ss} = 0.697\ \sigma_{fs}$

Some trials with non-linear regression didn't show better fitting.

Based on this investigation we could specify the splitting strength as 4.1 MPa instead of the flexural strength as 5.9 MPa on the same confidence level.

It is suggested that some research efforts should be done in different countries in the next few years, to investigate the correlation between the different methods of measuring the compressive strength and flexural strength at one side and the splitting strength at the other side. The results could be reported to the Third International Conference, supposed a third conference to be there.
If we can reach agreement on the correlations we could also strive for uniformity in the specification of strength.