

## ANNEX E: AIR-PERMEABILITY ON THE STRUCTURE

### E.1 Scope

The following sections specify a non-destructive method for the determination, on the structure, of the air-permeability of a concrete complying with standard SN EN 206-1. The air-permeability permits to derive information on the durability of the concrete cover.

### E.2 References

None

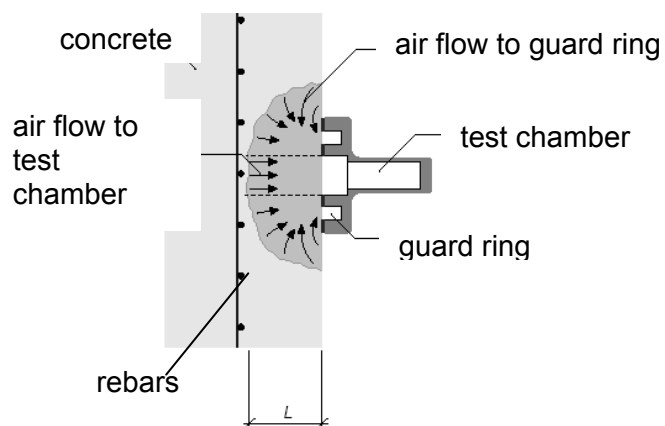
### E.3 Definitions

$k$  Coefficient of air-permeability, abbreviated as Air-permeability [ $m^2$ ]

### E.4 Principle

A depression is created by means of a vacuum pump in a test chamber and in a surrounding guard chamber, both of which are open against the concrete surface. Afterwards, the connection between the test chamber and the pump is hermetically closed. During the duration of the test, the pressure in the guard chamber is managed so as to keep it always equal to that of the test chamber. The pressure rise in the test chamber, induced by the flow of air through the concrete, is measured as a function of time. The Air-permeability is calculated in function of the variation of pressure with time and of other characteristic values.

Figure 2: Principle of the test



### **E.5 Testing Equipment (see Section 4.4)<sup>4</sup>**

- Test chamber with an open circular face of 50 mm diameter, surrounded by an external chamber that function as guard-ring
- Manometer measuring the depression with a precision of  $\leq 1$  mbar
- Vacuum pump capable of generation a depression  $< 50$  mbar
- Stopwatch with a precision  $\leq 1$  second

### **E.6 Preparation of the Test Surface**

- The concrete surface shall be smooth enough for the depression to generate adhesion of the test chamber and that no air flow exists between the chamber and the concrete surface. If this is not the case, the concrete surface should be polished as lightly as possible
- Place the test chamber on surface that is representative of the concrete to be tested
- The selected test surface of the concrete cover must be sufficiently dry to avoid interference with the measurement

### **E.7 Execution**

Place the test chamber on the concrete surface and evacuate the air by means of the vacuum pump until the depression reaches the desired value. Interrupt the evacuation of air from the test chamber and record the rise of its pressure with time.

For each surface of a concrete element to be tested conduct at least 3 measurements in different places.

If possible, the moisture of the concrete should be measured at the same place where the air-permeability was tested. This can be done, for example, through the electrical resistivity of the concrete or by determining the humidity in a conveniently sealed drilled cavity.

### **E.8 Test Result**

The air-permeability  $k$  is calculated in function of the recorded data (pressure rise, test duration, other characteristics values required). The test result will have the form  $X, Y \cdot 10^{-Z} \text{ m}^2$ ; for instance  $5,4 \cdot 10^{-17} \text{ m}^2$ .

### **E.9 Test Report**

The test report should contain the following data:

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<sup>4</sup> Torrent R. und Frenzer G., "Studie über Methoden zur Messung und Beurteilung der Kennwerte des Überdeckungsbetons auf der Baustelle", Bericht 516, Bundesamt für Strassenbau, Bern, 1995.

- details of the construction element and of the measurement points, such as cracks, honeycombing, large surface voids, etc.
- in case of a surface preparation treatment (polishing, for instance) the justification of the procedure applied
- air temperature, meteorological conditions and number of days since the construction element has last been wet
- method used to measure the moisture of concrete and the value recorded
- detailed values of the air-permeability measurement
- if necessary the air-permeability values corrected in function of moisture
- in the case of reporting the mean of a series of readings, an indication on how the mean value was calculated
- any special circumstance during the test

### **E.10 Precision**

Laboratory tests on specimens of 22 concretes with w/c ratios in the range 0.26 – 0.69 yielded a coefficient of variation of 6.6%. [Torrent R. und Ebensperger L., "Studie über Methoden zur Messung und Beurteilung der Kennwerte des Überdeckungsbetons auf der Baustelle", Bericht 506, Bundesamt für Strassenbau, Bern, 1993.]