The continuously bonded tunnel lining system based on sprayed concrete and sprayed waterproofing membrane (sprayed concrete lining, SCL) represents fundamentally different system properties compared to traditional and commonly used tunnel lining systems. This lining system has been investigated as a waterproof and permanent lining option for road and rail tunnels in Norway, and a possible cost-effective alternative to tunnels lined with cast-in-place concrete. The study was highly multidisciplinary covering the fields of rock mechanics, hydrogeology, concrete technology, building physics and polymer technology.

In principle a continuously bonded lining system will be exposed to the boundary conditions posed by ground loads, the groundwater and the tunnel climate with seasonal variations between warm summers and winters with freezing. Risks of different degrading mechanisms will be discussed.

In its basic form there are no thermally insulating or hydraulically draining layers. This means that the lining structure is undrained. Hence, the particular structural feature, compared to the traditional drained tunnel lining systems, is that there are no mechanically diving layers or parts. Therefore, in addition to the monolithic mechanical property, thermal and hygric continuity from the rock-concrete interface through the lining structure to the lining surface pose the important system properties of the SCL.

The waterproofing membrane is located between two layers of sprayed concrete and bonds to either of the interfaces with the concrete. Extensive laboratory testing of the concrete and membrane materials as well as field investigations of the in-situ moisture condition suggest that the lining structure is waterproof and vapor permeable, allowing a certain amount of water to migrate through the lining in the form of vapor. Important properties of the sprayed concrete and membrane materials were found to be vapor permeability and hygroscopicity.

The mechanical performance of the membrane show consistent tensile bonding strengths measured in-situ in the lining in the range of 1.1-1.5 MPa. Results from laboratory testing show that the membrane will resist the shear loads and tensile elongation over the cracks in the concrete which it receives in the lining. The moisture content profiles found in the tested linings suggest a number of favorable effects which can substantiate a low risk of several degrading mechanisms. One main conclusion of the conducted investigations is that the SCL system for permanent tunnel linings exhibit favorable properties and is suitable for permanent use in rail and road tunnels under certain conditions.