Weathering-induced ageing strength modification factors for PET-PVC-fabrics

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Abstract

The design process of tension fabric structures must consider changes of the material properties due to long-term exposure to the environment. In line with the harmonized view of the Ultimate Limit State verification which is currently developed in the framework of a novel European design standard for membrane structures, a strength modification factor considering ageing effects is proposed to describe the deterioration arising from environmental impacts. The objective of this paper is to broaden the data basis for the long-term behaviour of a typical structural membrane made of PET-PVC material for environmental impacts. In this way, an overview about different data achieved from two practical applications and experimental artificial weathering tests is presented for the destructive effect of weathering on tensile strength of coated woven fabrics. Finally, related weathering-induced ageing modification factors are derived.

Keywords: Tension membrane structures; architectural PET-PVC fabric; weathering-induced ageing strength modification factor; artificial weathering

1 Introduction

Tension membrane structures have been utilized prominently in many architectural designs. Textiles of membrane structures are composed of woven, laid, or knitted yarns with laminated and coated coverage systems. Polyvinyl chloride-coated woven polyethylene terephthalate (PET-PVC) fabric is one common type of multi-component coated fabric owing to its compatibility of cost, quality, and functional parameters.

Membrane fabrics as exterior building materials are exposed to outdoor weathering conditions and degrade over time. Acceptance of membrane fabrics for an outdoor application depends upon their weatherability, whereas the degradation of their mechanical properties by weathering effects should be considered in the design process.

The most appropriate exposure conditions for simulating weathering are tests which precisely mimic the service environment. Therefore, the exposure period should be equal to the service life of the materials which is not appropriate for products with a long service life. In this way, natural weathering, natural and artificial accelerated weathering, and weathering by practical applications can be employed for simulating weathering impacts. Florida with hot and humid subtropical climate and Arizona with severe hot and dry desert climate are mainly utilized as reference geographical benchmarks for natural weathering studies.

In this contribution, first, the implementation of weathering impacts into the design of tension fabric structures in form of a weathering-induced ageing strength modification factor is explained. Second, an overview about different data achieved from two practical applications and experimental artificial weathering tests is presented as a step to enlarge the data basis related to the destructive