

Basic principles

As far as structural mechanics is concerned, the PLEXIGLAS® Soundstop sheets used in noise reduction barriers are flat surface structures that are supported along their edges to suit the structural circumstances. The PLEXIGLAS® Soundstop sheets are supported at the sides on uprights and, in the case of three-sided mounting, on the bottom edge, in the case of four-sided mounting, also on the top edge. The mounting of PLEXIGLAS® Soundstop generally comprises not only support of the sheets along their normal plane, but also prevention of rotation of the sheet edges.

The support conditions have a significant impact on the structural behaviour of flat structures. Because of the relatively high degree of deformability of plastics – in comparison to metallic materials – linear plate theory is generally inadequate for structural analysis of sheets of PLEXIGLAS® Soundstop.

For flat structures that are subject to significant deformation, it is necessary in the structural analysis of the so-called “large deformations” to take account of the relationship between the distortions and the deformations in the basic structural equations.

In the structural calculation for noise reduction sheets made of PLEXIGLAS® Soundstop exposed to wind load, it is necessary to take account of so-called “large deformations”. This is possible by means of the finite element analysis, using the finite element program MARC.

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Behaviour of material:

The structural analysis of PLEXIGLAS® Soundstop sheets exposed to wind loads is based on linear elastic behaviour of the materials, for which the short-term elastic modulus is used. This assumption is based on the experience that the wind load at levels close to the ground can fundamentally be regarded as a short-term load as far as the mechanical properties of PLEXIGLAS® Soundstop are concerned, both in terms of gusting and average wind speed.

Load condition:

In accordance with ZTV-Lsw 06 and EN 1794, the wind load is to be regarded as a load that is evenly distributed over the surface of the barrier in a horizontal direction and is considered static. It can affect the barrier on either side alternately.

Unless otherwise specified, the wind loads should be taken from the relevant standards (national wind load map).

Support conditions:

The structural analysis for noise sheets made of PLEXIGLAS® Soundstop is carried out on the assumption that the sheets are fixed loosely on three or four sides. The following conditions apply to loose fixing:

- support in line with the plane of the sheet
- edge of the sheet cannot be rotated
- edge of the sheet can move in the plane of the sheet

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Evidence required:

The structural analysis for PLEXIGLAS® Soundstop sheets must include the following evidence in relation to serviceability and load bearing capacity:

- stress analysis for 1 x wind load
- deformation analysis for 1 x wind load
- load bearing capacity analysis for 1.75 x wind load

The results of the structural analysis for PLEXIGLAS® Soundstop sheets are presented in characteristic diagrams for the specified sheet geometries, wind loads and mounting conditions. With the aid of these characteristic diagrams, the analyses required can be carried out very easily, without complex calculations.

The characteristic diagrams show for a given sheet geometry with three or four-sided loose fixing and at a specific wind load both the anticipated maximum deflection of the sheet transversely to its plane and the stress in the sheet.

EN1794 and ZTV-Lsw 06 define a maximum permitted deflection of 50 mm for vertical noise barrier elements.