Summary

The present study deals with membrane shells subjected exclusively to tensile stresses and constructed of thin sheet metal (with a thickness between 0.3mm and approx. 3mm); such membranes may be regarded as descendants of tents and balloons. They combine the advantages of metallic construction materials with the special features of membrane constructions.

A complete inventory of projects and experimental constructions already implemented employing sheet metal membranes under tensile stress shows on the one hand how extensive the range of worthwhile applications is, and makes it evident on the other, that the metal membrane as a load-bearing structure is still in the early days of development.

The main obstacles to its development thus far have been manufacturing problems associated with the use of sheet metal. These problems are discussed in detail, as are known methods of production. Proceeding from the realization that the serious problems of shaping can be solved especially elegantly by exploiting the plastic deformability of the sheet metal, the construction method of the "form-finding load case" is elaborated upon and submitted for acceptance as a standard concept.

The basic idea of this method, which was known and applied in the case of the shallow spherical dome, lies in the reshaping of a simple, basically flat surface into the desired membranous shape. It was expanded to a sound and broadened concept mainly on the basis of experiments.

For verification of the idea of the shaping load case on a small scale, a modeling technique was developed that contains all the necessary production and measuring elements for experiments with sheet metal models. Numerous model studies indicate that a wide variety of load-bearing forms of different shapes are feasible.

The shaping procedures are studied both on the basis of measurement models as well as with the aid of comparative computer analysis. For the latter - after clarification of the theoretical background - a model for the calculation of axially symmetrical configurations was derived. This allows the iterative determination of stretching, tension, and meridional coordinates as functions both of the materials and of the shaping loads.

One main objective of the study is to help legitimize the metal membrane as a load-bearing structure by giving it a comprehensive portrayal. Another is to stimulate further development of a construction method in a manner relevant to construction engineering by elaborating the arguments for it. Some fundamental questions have been clarified in the process, especially with regard to practicability. Without a doubt, gaps of a less fundamental nature remain to be closed by future work.