



International Symposium on "Novel Structural Skins: Improving sustainability and efficiency through new structural textile materials and designs"

Sustainability – the art of modern architecture

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Abstract

Over the last 10-15 of years the building industry has been faced with an increasing demand for sustainable solutions. According to Peter Bakker, president and CEO of the World Business Council for Sustainable Development WBCSD, buildings are the largest energy consumers in the world economy, accounting for over one-third of final energy use and approximately 30% of global carbon emissions [1]. These figures do not take into account the energy and carbon emissions due to production of building materials or for logistics and building construction. The demand for both energy and resources is soaring as global construction booms, especially in countries such as China and India. This means that developments in building practice can significantly contribute to tackling climate change and energy use. The use of ETFE foils as a new transparent material substitute for glass provides the potential for not only vast savings in material quantities but simultaneously makes possible a new type of space for living and working. The environmental benefits are presented as results of a comparative study between glass and ETFE solutions on two projects in Germany, Domaquarée in Berlin and Kapuzinergraben in Aachen, based on a life cycle analysis. The social benefits will be presented using the example of Kingsdale School in London and Kuwait Avenues, Kuwait. It will be shown that the introduction of ETFE foil systems in modern architecture will significantly contribute not only to environmental sustainability, but also create economic and social advantages compared to more classic building materials.

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Peer-review under responsibility of the TensiNet Association and the Cost Action TU1303, Vrije Universiteit Brussel

Keywords: LCA; building cladding systems; membrane structures; ETFE; foils; sustainability; environmental; social; economic; comfort

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1. Introduction

The term “sustainability” has been applied extensively to many products and activities in recent years. It is generally considered that there are three distinct sectors in which sustainability can be effected and enhanced.

- environmental sustainability
- economic sustainability and
- social sustainability.

In the case of the building industry there is a strong demand for solutions that provide benefits for all of the three sectors. As global warming has increasingly become one of the main areas of social concern, reduction of energy consumption as well as significant prevention of pollution and damage to the natural environment is recognized as a task of highest priority [2]. As a consequence and in order to provide sufficient well protected living space for a still growing population worldwide the building industry is asked to provide more building space whilst simultaneously using less materials. Additionally a building’s energy consumption during the use phase should be minimized, which is not only a criterion for new buildings but for existing buildings and particularly heritage buildings. These parameters should be taken into account as well in the context of energy efficiency refurbishment.

Special attention has always to be paid to the costs involved in building structures. Environmentally sustainable buildings offend against fundamentals of economic sustainability if cost-efficiency is not taken into account. “Plus-energy-houses” that cannot be afforded by most of the building owners are by no means models for environmental sustainability.

Additionally new buildings as well as refurbishment of buildings have to allow for the altered social demands of multicultural societies. Light and spacious but well protected areas should come along with comfort, energy savings and aesthetics in order to create living spaces where people can meet.

The objective of this paper is to explore the potential of new building cladding systems, ETFE foil membrane systems in particular in comparison to more classic concepts, for instance glazed roof structures.

Special attention has been paid to environmental sustainability by means of a comparative life cycle assessment of two projects that were originally designed with glazed roofs but, due to loading problems, were subsequently realized with a Texlon® ETFE foil cladding system. All materials and their corresponding masses for the cladding system as well as for the primary supporting structure are well known for both the glazed and the ETFE foil solutions. The Life Cycle Assessment (LCA) framework was used to analyze the whole lifetime of the products and their components, from extraction of raw materials to disposal or recycling [3].

2. The projects

2.1. DE Berlin, Domaquarée – building D

In 2004 the architects nps Tchoban Voss GmbH & Co. KG, Hamburg, designed the Domaquarée complex on Alexanderplatz in Berlin which comprises four different buildings A, B, C and D (a four star hotel, an office and retail building, residential apartments, an open passage and the world’s largest indoor saltwater aquarium). The atrium of the office and retail building D is covered by a 1533 m² ETFE roof 33 meters above the floor. Initially the architects designed the roof in glass but because of load problems changed to a Texlon® ETFE system.

For the glass roof, panes of 2700 mm x 1330 mm were specified, supported by a steel structure and a secondary aluminum structure.

The Texlon® roof consists of 14 ETFE cushions with lengths between 36 m and 43 m, and widths between 2.66 m and 3.45 m.

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