FIZYKA BUDOWLI W TEORII I PRAKTYCE
TOM II, 2007

Sekcja Fizyki Budowli KILiW PAN

BUILDING ENVELOPE MADE OF THE TRANSLUCENT INSULATION MATERIAL MONIFLEX

Barbara MATUSIAK

Norwegian University of Science and Technology, Faculty of architecture and Fine Art
Alfred Getz vei 3, NO-7491 Trondheim, e-mail: barbara.matusiak@ntnu.no

Streszczenie: The paper describes a concept of a modern translucent wall and presents light measurements for two variants of outside translucent wall developed by the Pir II architects, Trondheim, and the author. The measurements were done at the daylighting laboratory at NTNU

Słowa kluczowe: Translucent insulation materials, Moniflex, daylight, light transmission.

1. INTRODUCTION

In many centuries the traditional Japanese architecture with its clearly articulated wooden construction and its characteristic translucent paper walls made a strong impression on western architects. Unfortunately, the poesy of the diffuse light created by paper walls was not possible to recreate in the cold and windy north European countries. The usage of translucent insulation materials, as the Moniflex, in combination with clear glass and/or plastic may enable construction of a building envelope that both, protects the building from severe weather conditions and creates a soft grading of luminance's similar to the Japanese paper wall.
Alternative solutions of the building envelope with the Moniflex material were examined in the daylighting laboratory, NTNU [1].

2. WOODEN WALL WITH MONIFLEX

Pir II architects used a translucent insulation material made of thin cellulose based layers, Moniflex, instead of mineral wool in an outside wall of the Mæla School, Skien, photos 1-6. To obtain transparency for light, all layers in the wall have to be translucent. On the inside the canal plastic was used, on the outside a corrugated plastic, the wind cover was translucent as well. The construction is similar to the traditional wooden Norwegian wall, fig. 1.

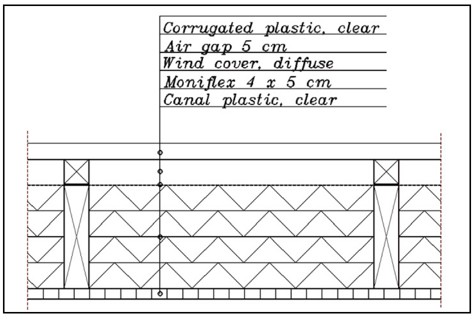

Fig 1. Horizontal section through the translucent wooden wall in the Mæla school, Skien/Norway.

The light transmittance of the Moniflex material was measured in an artificial sky, figure 2. As expected, the transmittance of this material decreases with increased thickness of the material from over 52% for a 5cm thick sample to 17% for 20cm thick.

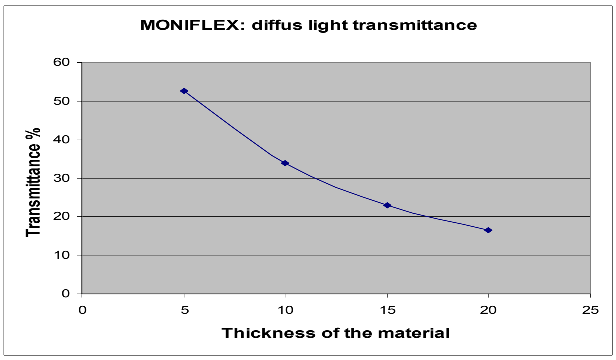

Fig 2. Moniflex, diffuse light transmittance.

The material is quite homogenous, therefore the angle dependent transmittance of the material varies very little for angles 0-45º, figure 3.

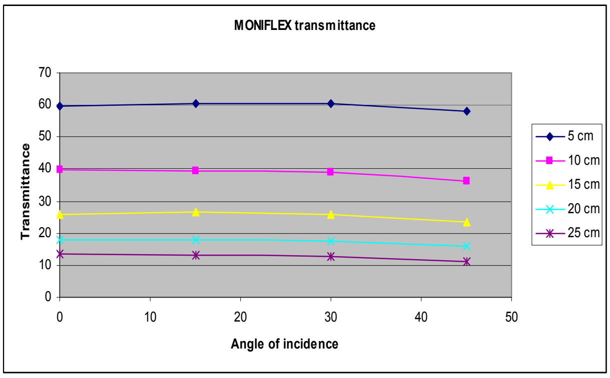

Fig 3. Angle dependent transmittance for different thickness of the Moniflex material.

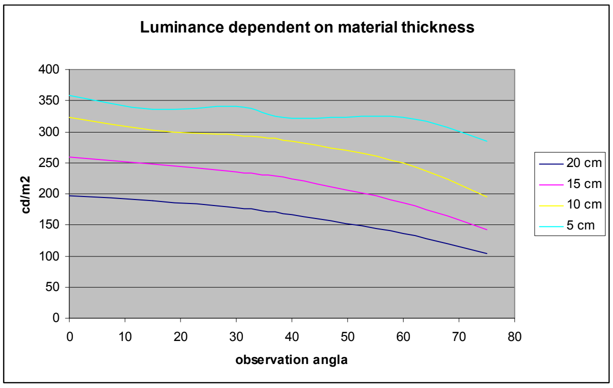

Fig 4. Angle dependent luminance for different thicknesses of the Moniflex material.

Nevertheless, the luminance of the material measured on the opposite side to the artificial sun decreases considerably with observation angle, figure 4. In 5 cm thin material sample the light rays are scattered into different directions creating high luminance spots.

The total light transmittance of the translucent Mæla School wall was also measured. The result varies from 12% for 1-15º incidence angles to 9% for 45º. It is somewhat disappointing result if we compare it to the light transmittance of building glass, 60-80%, but if we consider that this construction has a U-value comparable to the opaque wall insulated with 15cm mineral wool, the result is very encouraging.

The translucent wall should not be used instead of windows, but as something between a wall and a window; as it was done in our school example.

A precise calculation of daylight level was carried out for this school building to find the minimum glass area necessary to satisfy the requirement of minimum 2% daylight factor in all education areas and working places for the personnel. The architects used the minimum glass area during the facade design process. Additionally, they wanted to give a nice outside view for the users and to create a special architectural character of the building, both on the outside and on the inside, see photos 1-6.

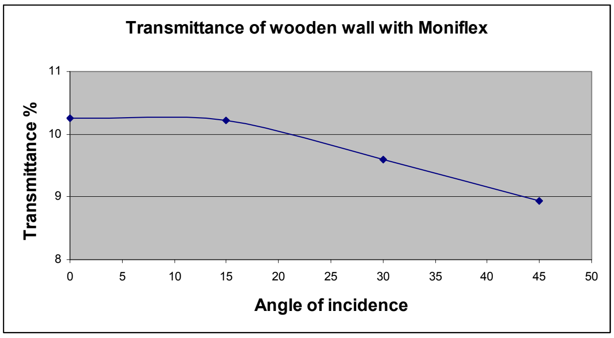

Fig 5. Angle dependent transmittance of the translucent wall at the Mæla school, measured in daylighting laboratory using the artificial sun.

Photo 1. Translucent moniflex wall under construction seen from inside, overcast sky. 20 cm moniflex in the midfield; translucent wind cover in the adjacent sections.

Photo 2. Moniflex wall under construction, overcast sky. The man at the middle holds a 5cm thick moniflex sheet.

Photo 3. Moniflex wall inside, clear sky and sun.

Photo 4. Translucent moniflex wall seen from outside, two types of window detail; for open able window to the left, for fixed window to the right, overcast sky.

Photo 5. Moniflex walls on two parallel education wings, the nicest view toward the somewhat distant rural landscape.

Photo 6. Moniflex wall outside, clear sky.

3. GLASS BLOCK WALL WITH MONIFLEX

The Moniflex material can be also used as a thermal insulation of walls made of glass blocks. Moniflex can be placed on the inside, covered by a diffusion tight glass- or plastic layer or on the outside of the glass block layer in a construction similar to the Mæla school wall. Figure 6 shows the transmittance of the wall made of 200 x 200 x 80 mm clear glass blocks insulated with Moniflex, but without any additional layers, for different thicknesses of the material.

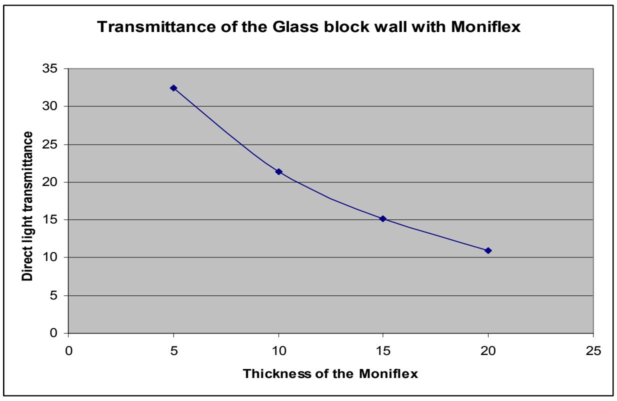

Fig 6. Transmittance of the wall made of 200 x 200 x 80 mm clear glass blocks insulated with Moniflex.

4. CONCLUSION AND DISCUSSION

The transmittance of the Mæla school wall depends on the angle of observation and is only about 10%. Anyway, the mean daylight level is high enough in classrooms because of the large area of the wall and a contribution from few smaller windows with clear glass.
Photos 1-6 show the school building under construction. We believe that this school building will be liked by students and teachers and that the translucent wall will be a reason for a special connection to this special building.
The glass block wall with the moniflex material may be an interesting alternative to the Mæla school wall. The glass block layer transmits a little less light than the canal plastic because of the opaque joints, but may suit better to some room types and be regarded as nicer.
The concept of a translucent envelope made of translucent insulation materials can be used for roofs as well. In a climate with dominating overcast sky conditions with zenith luminance three times higher than luminance on the horizon any daylighting opening on the roof is much more effective than a daylighting opening having the same size but situated in walls. Therefore the usage of any translucent insulation material in the roof opening should be even more cost effective.

References
[1] Matusiak B., Arnesen. H. *The limits of the mirror box concept as an overcast sky simulator* Lighting Research and Technology 4 (2005) 313-327
All photos were taken by Ogmund Sørli, Pir II architects, Trondheim.