DERLEME MAKALE
(Rewiev Article)

Example of Textile Structures Used in the Shading: Zippered Curtain

Gölgelendirme Sisteminde Kullanılan Tekstil Yapılarına Örnek: Fermuarlı Perde

Alime Aslı İlleez[1],
Orcid: 0000-0001-9760-246X

Gülşah Pamuk[2],
Orcid: 0000-0002-9358-2331

[1]Asst.Prof.Dr., Ege University, Emel Akın Vocational High School, İzmir, Turkey

[2]Assoc.Prof.Dr., Ege University, Emel Akın Vocational High School, İzmir, Turkey

Sorumlu Yazar (Corresponding Author):
Alime Aslı İlleez
alime.asli.illeez@ege.edu.tr

Alınış (Received): 08.09.2021 **Kabul Tarihi (Accepted):** 15.09.2021

ABSTRACT

The sun, which is the main source of life on Earth, creates some uncomfortable conditions in summer due to its scorching effect. Exposure of the interior of a building to direct sun is only desirable in some building type, such as residences, during the heating season, and in all other structures (such as homes, workplaces or hospitals). For this reason, air conditioning systems or shading systems that prevent heating from the beginning are needed to cool our homes in summer. It is calculated that, on average, 52% of the cooling load needed to cool a house with air conditioning in our country is caused by glass heat gain. For this reason, considering that glass surfaces are used more in new architectural structures, more effective shading systems should be used.

Shading systems in building is divided into two as internal and external systems. Accordingly, sun shading curtain systems are applied in order to allow the passage of these harmful lights in the buildings or especially in front of the windows as desired. One of the textile surfaces used for this propose is the curtain system with zipper. Zippered curtain works like a motorized blind system, but its main components are aluminum, motor and technical textile fabric. This product is specially designed to protect a place from the extreme heat of the sun, wind, cold and create an ideal indoor climate. The zippered curtain system protects the house from damage by reducing the effect of the wind in winter months, while helping to prevent overheating by preventing unwanted heat from entering inside, while at the same time providing optimum light and heat penetration. This provides great savings in cooling and heating in summer and heating in winter.

Keywords:
Zippered curtain, Technical textile, Cooling system, Energy

ÖZ

Dünya'daki yaşamın ana kaynağı olan güneş, yaz aylarında kavurucu etkisi nedeniyle bazı rahatsız edici koşullar oluşturmaktadır. Bir binanın iç kısmının doğrudan güneşe maruz kalması sadece ısıtma sezonu sırasında konutlar gibi bazı yapı tiplerinde arzu edilir diğer türlü bütün yapılarda (evlerde, işyeri ya da hastaneler gibi) arzu edilmez. Bu nedenle yazın evlerimizin soğutulabilmesi için klima sistemine veya ısınmayı baştan önleyici gölgelendirme sistemlerine ihtiyaç duyulmaktadır. Ülkemizde bir evin klimayla soğutulması için ihtiyaç duyulan soğutma yükünün ortalama % 52'sinin cam ısı kazancından kaynaklandığı hesaplanmaktadır. Bu nedenle özellikle yeni mimari yapılarda cam yüzeylerin daha fazla kullanıldığı da göz önünde bulundurulursa, daha etkin gölgelendirme sistemlerinin kullanılması gerekmektedir.

Binalarda gölgelendirme sistemi iç ve dış sistemler olmak üzere ikiye ayırmaktadır. Buna göre binaların veya özellikle pencere önlerinin bu zararlı ışıklara istenilen şeklide geçit verilebilmesi için güneş kırıcı perde sistemleri uygulanır. Bu amaçla kullanılan tekstil yüzeylerinden biri de fermuarla perde sistemidir. Fermuarlı perde, motorlu panjur sistemi gibi çalışan ancak ana bileşenleri alüminyum, motor ve teknik tekstil kumaşıdır. Bu ürün, bir yeri güneşin aşırı sıcaklığından, rüzgardan, soğuktan korumak ve ideal bir iç mekan iklimi yaratmak için özel olarak tasarlanmıştır. Fermuarlı perde sistemi, kış aylarında rüzgarın etkisini azaltarak evi hasardan korurken, bir yandan istenmeyen ısının içeri girmesini engelleyerek aşırı ısınmayı önlemeye yardımcı olurken, aynı zamanda optimum ışık ve ısı penetrasyonunu sağlar. Bu, yazın soğutma ve ısıtmada, kışın ısıtmada büyük tasarruf sağlar.

Anahtar Kelimeler:
Fermuarlı perde, Teknik tekstil, Soğutma sistemi, Enerji

How to cite: İlleez, A.A., Pamuk, G., (2021). "Example of Textile Structures Used in The Shading System: Zippered Curtain", TJFMD, 2021, 3 (3): 119-130
Kaynak gösterimi: İlleez, A.A., Pamuk, G., (2021). "Gölgelendirne Sisteminde Kullanılan Tekstil Yapılarına Örnek: Fermuarlı Perde", TJFMD, 2021, 3 (3): 119-130

I. INTRODUCTION

Traditional roles of shading systems; to increase thermal and visual comfor and provide privacy by reducing overheating and glare. Shading devices can perform one role or all three. Shading systems in building is divided into two as internal and external systems. Accordingly, sun shading curtain systems are applied in order to allow the passage of these harmful lights in the buildings or especially in front of the windows as desired (Bulgurcu, Küçük, Özer, 2014).

Technical textiles have been defined as textile materials and products manufactured primarily for their technical and performance properties, rather than for their aesthetic or decorative characteristics (Nhargava and Shivankar, 2015). In the building sector, there is a growing interest in the technical textiles, in particular as components for facades and also as potential replacements for the current options that seek energy efficiency through mass (Aliprandi, Monticelli, Zanelli, 2015). In the last decades the European Community has developed an energetic strategy that more and more takes into account the indissoluble link between energetic politics, environmental changes and environment's protection. In this context should be considered that the building sector is one of the key consumers of energy in Europe and World where energy use in buildings has seen overall a rising trend over the past 20 years (Heyse et All., 2015).

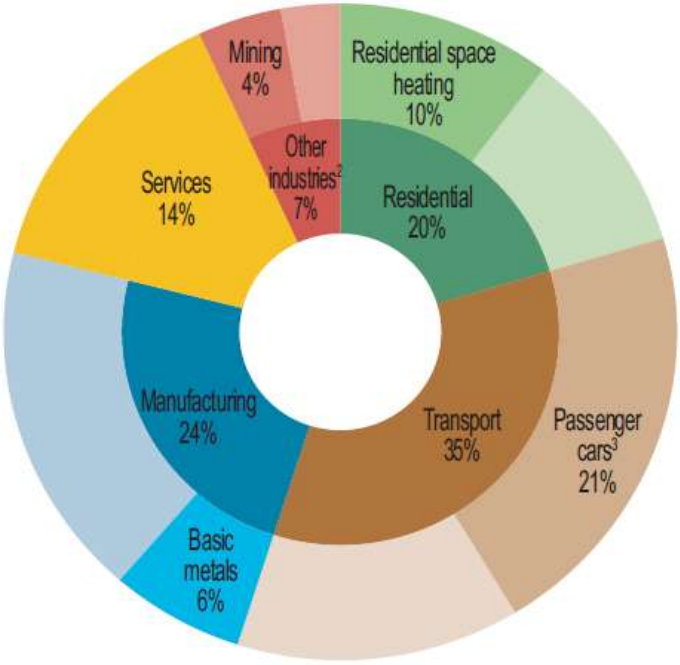
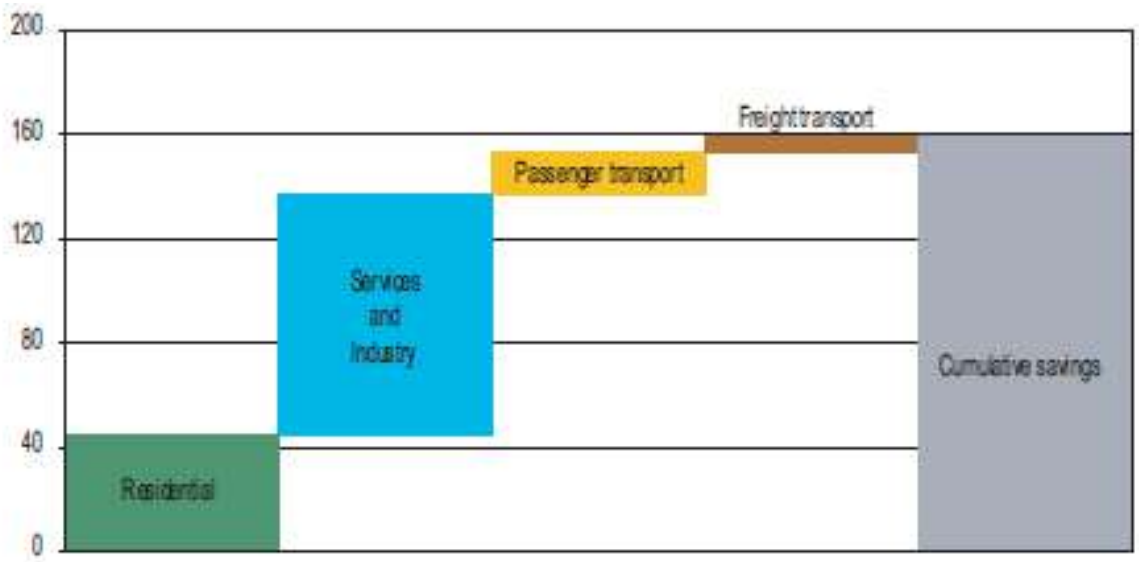


Table 1. Largest end uses of energy by sector in IEA, 2014 (IEA, 2017)
Çizge 1. *IEA'da sektöre göre enerjinin en büyük son kullanımları, 2014*



Source: adapted from the *IEA Energy Efficiency Market Report, 2016*, based on *IEA Energy Efficiency Indicators (database), 2016*.

Table 2. Estimated cumulative energy savings by sector in IEA, 2000-15 (EJ) (IEA, 2017)
Çizge 2. *IEA'da sektöre göre tahmini kümülatif enerji tasarrufu, 2000-15 (EJ)*

Their construction technology is marked by the usage of massive materials, heavy, characterized by high thicknesses, both for the newly constructed building's interventions that for the already existent building's interventions. But the current tendencies show that the lifestyles are changing and new materials are becoming more and more important in the conservative world of the constructions.

Among these materials, the textiles are taking over more and more market shares. They have been used for many years mainly as waterproof membranes and traditional wallpapers, while recently they are becoming more often the key component of innovative textile facades, shading systems and even components for the aesthetic and thermal retrofitting, thanks to flexibility, lightness, thinness and aesthetic qualities (Aliprandi, Monticelli, Zanelli, 2015).

II. ZIPPERED OUTDOOR CURTAINS

Zippered curtains are products used in buildings and working like a motorized roller shutter system. Main components are aluminum, motor and technical textile fabric. The zippered curtain is especially an exterior facade system. It is also possible to use interior facade system. Zipper is worn on the both side of the fabric with special fabric weld machine. These zipper teeth also move in a specially designed plastic canal. The zipper and its teeth move in the rail, while the plastic channel is in the direction of the slide. The plastic rail is placed in the aluminum profile which also carrying the box and the whole system. The zippered system keeps the fabric taut and smooth, but above all, so the system gains the ability of resisting strong winds. The system is capable of withstanding winds blowing with the velocity of up to 145 km/ h. Over 50 km/h means storms and hurricane (AVZ).

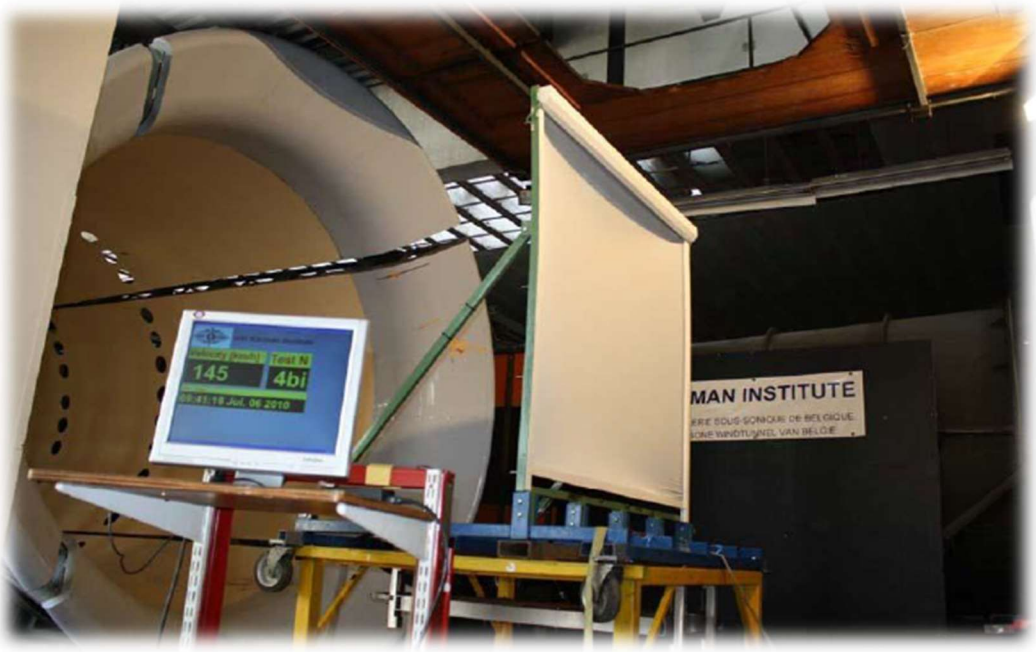


Figure 1. Test 04bis Solid Screen 95 2.000x2.000 mm at 145 km/h 90^0 (AVZ).
Resim 1. *145 km/sa 90°'de Test 04bis Katı Ekran 95 2.000x2.000 mm*

The box ensures that the wrapped fabric does not get dirty or look bad. Also fabric has the ability to clean itself and protect itself against mold, moss, and algae. Inside the box is a bore with a tube motor on one side and on the other side of the roller bearing, the fabric is wrapped on this bore. On the underside of the fabric there is a weight in the aluminum profile.

The curtain closes with the motor turning and weight pulling down. The surface of the facade is opened with the motor winding in the other direction.

Figure 2. Different colors of zipperd curtains (www.sergeferrari.com)
Resim 2. *Fermuarlı perdelerin farklı renkleri*

The main part of course is the fabric earned a lot of features. Fabric is mostly woven by poliester or fiberglass yarn and it is coated with special plastics.

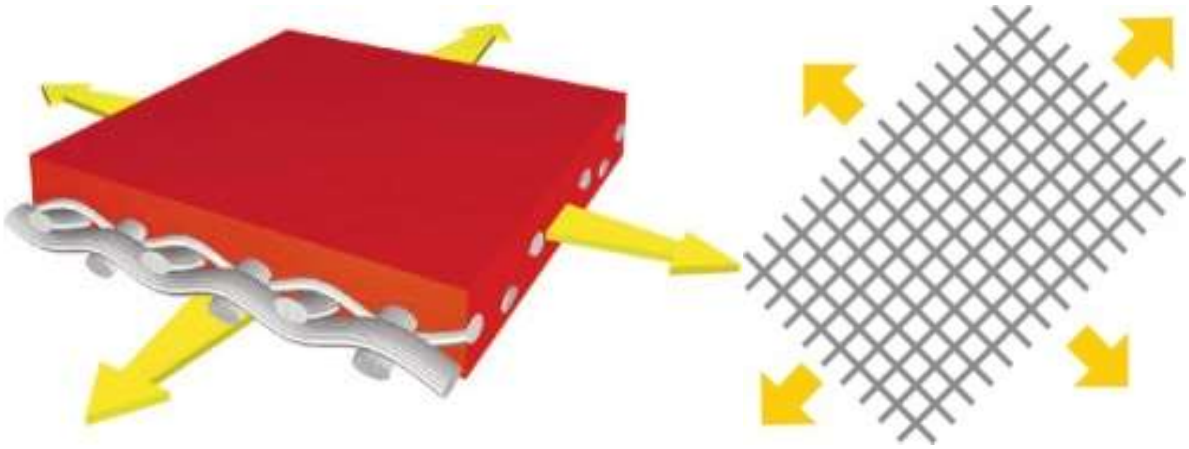


Figure 3. Précontraint® Textiles (www.sergeferrari.com)
Resim 3. *Précontraint® Tekstiller*

III. SOLAR PROTECTION–THERMAL AND OPTICAL PERFORMANCE OF FABRICS

Solar radiation is always partially transmitted through, absorbed or reflected by the fabric. The sum of all 3 equals 100.

$T_s + R_s + A_s = 100\%$ of solar energy.

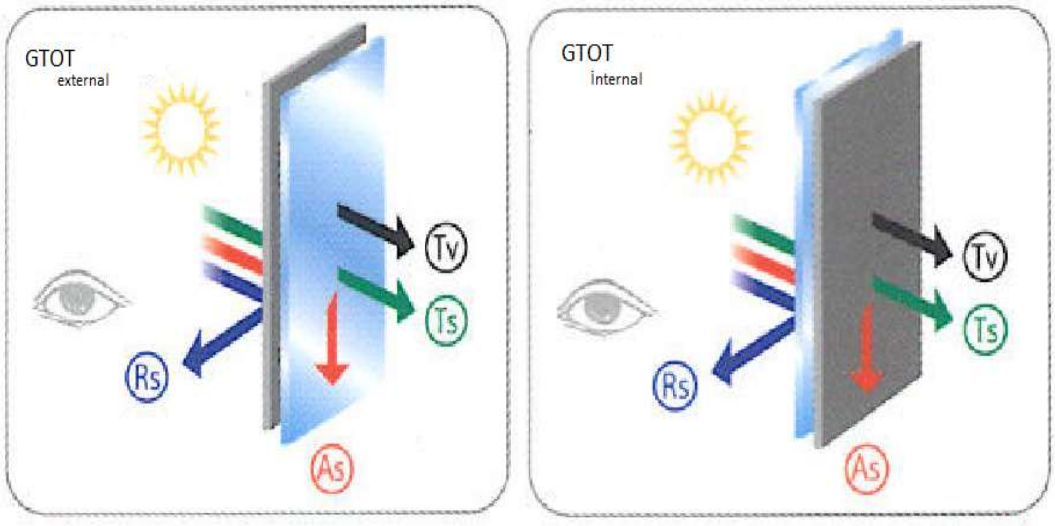


Figure 4. Blind and glazing property of curtains (Recasens, 2021)
Resim 4. *Perdelerin stor ve sırlama özelliği*

According to several studies, an office exposed to a temperature of 25°C to 30°C leads to a 2 % loss in productivity (Atmaca and Yiğit, 2009). This figure can be as high as 10% when the temperature exceeds 30°C. The solar factor determines the percentage of solar energy entering a room through the blinds and the glazing. It is called GTOT according to the EN 14501 standard (transmittance of solar energy) an it is expressed by an index of 0 to 1. The

closer the fabric's index is to 0, the more efficient it is in terms of protecting against the heat (EN 14501).

External blinds offer better thermal protection than internal blinds because the solar radiation, which is partly absorbed (A_s) by the fabric before reaching the glazing, is reflected outwards (sunscreen-mermet.com, 2021).

Figure 5. Thermal protection of external and internal blinds (sunscreen-mermet.com, 2021)
Resim 5. *Dış ve iç jaluzilerin termal koruması*

Dark colours protect better against the heat than light colours because they absorb more solar energy (lower T_s). Conversely, light colours are more efficient indoors. They absorb less heat (lower A_s) and reflect it more (R_s) than dark colours.

The emissivity of a material is its ability to re-emit the energy received through conduction (heat/cold). A fabric with a low level of emissivity will limit the effect of inward radiation by limiting how cold it feels in winter and how hot it feels in summer. The energy emitted through this reflection is kept inside so reducing air conditioning and heating consumption which in turn helps reduce energy consumption (sunscreen-mermet.com, 2021).

Figure 6. Solar and light properties (EN 14501) (www.sergeferrari.com)
Resim 6. *Solar ve ışık özellikleri*

Thermal Factors:

Solar Transmittance is the proportion of solar energy transmitted through the fabric. A low percentage means the fabric performs well at reducing solar energy.

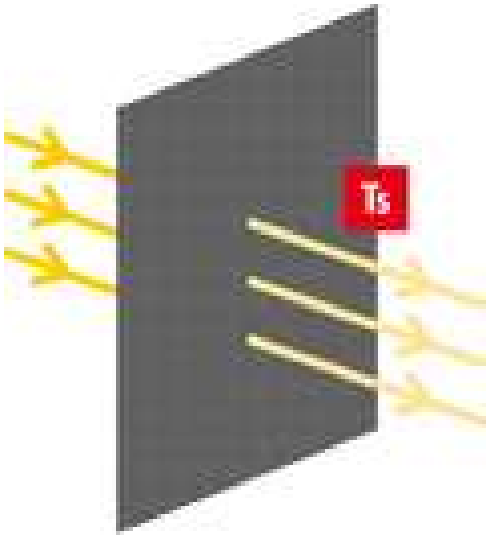


Figure 7. Solar transmittance (sunscreen-mermet.com, 2021)
Resim 7. Solar geçirgenlik

Solar Reflectance: Proportion of solar radiation reflected by the fabric. A high percentage means the fabric performs well at reflecting solar energy.

Figure 8. Solar reflectance (sunscreen-mermet.com, 2021)
Resim 8. *Solar yansıma*

Solar Absorptance is the proportion of solar radiation absorbed by the fabric. A low percentage means the fabric absorbs little solar energy (sunscreen-mermet.com, 2021).

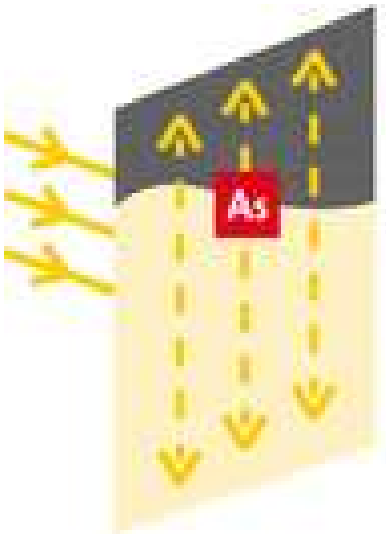


Figure 9. Solar Absorptance (sunscreen-mermet.com, 2021).
Resim 9. *Solar absorpsiyon*

Total solar factor – G_{tot}:

Percentage of solar energy which is actually penetrates into a room through the blind and glazing. A low value means good thermal performance. G_{tot} solar factor is determined for 4 standardized glazing as defined in Annex A of EN 14501 standard. The base glazing is C (thermal transmission factor of the glazing alone U = 1,2 W/m²K – solar factor of the glazing alone gv = 0,59) (sunscreen-mermet.com, 2021).

Visual Management – Visual Comfort

Dark colours offer better transparency and enhanced glare control. On the contrary, the lighter colours diffuse more natural light (sunscreen-mermet.com, 2021).

Openness Factor (OF) = T_{vnn}: Relative area of the openings in the fabric (hole). It is considered as independent of the colour. For fabrics with the same weave, it should be measured using the darkest colour in the range.

Figure 10. Openness factor (sunscreen-mermet.com, 2021).
Resim 10. *Açıklık faktörü*

Visible Light transmittance (T_{vnh}) : Total percentage of light radiated through the fabric over a wavelength of 380 to 780 nm (nanometers), called the visible spectrum (total illumination) (sunscreen-mermet.com, 2021).

Visible light reflectance (R_{vnh}): Proportion of light reflected by the fabric (sunscreen-mermet.com, 2021).

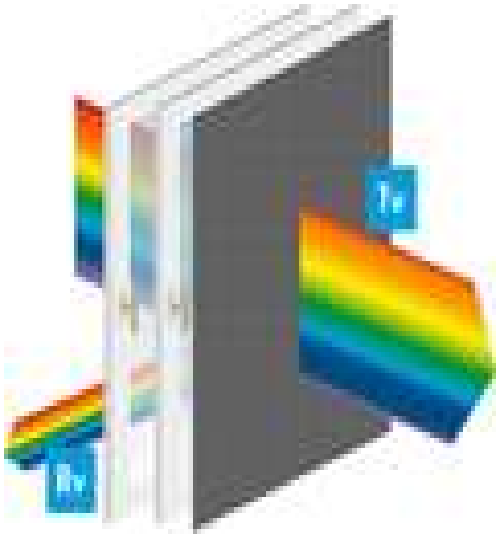


Figure 11. Visible light reflectance (sunscreen-mermet.com, 2021)
Resim 11. *Görünür ışık yansıması*

Diffuse transmission factor (T_{dif}):

Correlation of the two factors

$T_{dif} = T_v - OF$.

It is indicated as T_{vndif} for the aspects of glare and shape recognition (outward visibility / night privacy). A low figure shows a better visual comfort. However, for natural light control, it is indicated as T_{vdifh}. It is used to ascertain a fabric's light diffusion capacity. A high figure means more natural light (sunscreen-mermet.com, 2021).

Tv = Tvnh = Tvnn + Tvndif

Glare Control

Natural light, which is variable, constitutes an important factor for well-being. Consequently, it should be managed properly in order to avoid glare, which is an intense source of eye fatigue, particularly on computer screens (sunscreen-mermet.com, 2021).

As is the case with heat, visual comfort guarantees the efficiency of employees while they work and forms the subject of regulations* setting their work conditions.

Factors enabling glare control to be measured are the **optical factors T_v or TL** (Visual transmission) and **OF** (Openness factor)

All fabric weaves are effective for controlling glare. They must be chosen based on the global geographic location and the layout of the buildings. Solar protection fabric enables the window's level of luminance to be controlled (natural light diffused in the room) and a reduction in disturbing light & dark contrasts within the field of vision. Depending on its colour, a solar protection fabric can become a light source if sunlight strikes it directly.

An example of the level of luminance of surfaces according to standard NF X 35-103:

– Acceptable within a field of = 16 to 150 Cd/m²

– On the edge of the field of vision = 5 to 500 Cd/m²

– For your information, a sheet of paper = 100 Cd/m², a computer screen = 50 Cd/m²

Dark fabric provides better control of glare because it diffuses less light (sunscreen-mermet.com, 2021).

Figure 12. Some applications of zippered curtains
Resim 12. *Fermuarlı perdelerin bazı uygulamaları*

Energy Savings

In a house of 100 m^2, the heat recovery capacity is about 6 kW, 55% of which is occurring by glass and transparent surfaces. Thanks to this system it is possible to reduce the energy consumption of the heat gain or cooling systems by 55%. This means a savings of for about 12% of total consumption in Turkey having 20 million houses.

With the other words 12 billion kWh energy can be saved in a year and so will be able to contribute significantly to the environment and economy (Atmaca and Yiğit, 2009).

IV. CONCLUSION

As a result, beside energy savings this product protects the place from excessive heat of the sun, from the wind, from the cold, provides privacy without sacrificing sight, creates natural light and air suited to the place, and an ideal indoor climate.

This product as a technical textiles have also high aesthetic or decorative characteristics, besides their technical and performance properties.

REFERENCES

Aliprandi S., Monticelli C., Zanelli A., (2015). "Technical textiles and thin insulation materials new scenarios for the energetic retrofitting", *Energy Procedia*, vol. 78, pp. 501-506

Atmaca İ. and Yiğit A., (2009). "Isıl konfor ile ilgili mevcut standartlar ve konfor parametrelerinin çeşitli modeler ile incelenmesi, IX. Ulusal Tesisat Mühendisliği Kongresi, 06-09 Mayıs

AVZ, Specification of Solar Screen 85, https://www.avz.nl/en/downloads/2868/solidscreen-85-en.pdf

Bulgurcu, H., Küçük, M., Özer, C., (2014). "Bina Gölgelendirme Sistemleri ile Binalarda Enerji Verimliliği", 2. Ulusal İklimlendirme Soğutma Eğitimi Sempozyumu ve Sergisi, p. 623-636

Heyse P., Buyle G., Walendy B., Beccarelli P., Loriga G., Zangani D., Tempesti A., (2015). "Multitexco-high performance smart multifunctional technical textiles for the construction sector", *Procedia Engineering*, vol. 114, pp. 11-17

IEA, (2017). Key World Energy Statistics, International Energy Agency, pp.44, www.iea.org

Nhargava N., Shivankar V., (2015). "Technical Textiles-Growth Potential and Prospects in India", International Journal on Textile Engineering and Processess, Vol. 1(2), pp. 16-19

Recasens, (2021). www.recasens.com/en/producto/recscreen

Serge Ferrari, Composite Textiles&Membranes Catalogue, Ferrari Architecture, Serge Ferrari Group, www.sergeferrari.com

sunscreen-mermet.com, (2021). Solar Protection-Thermal and Optical Performance of Fabrics, Mermet Sun Control Textiles, Mermet Sunscreen, http://www.sunscreen-mermet.com/technical-support/solar-protection-thermal-and-optical-performance-of-fabrics.html#visual-management-visual-comfort