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DAYLIGHTING FOR MUSEUM, A GOOD CHOICE?

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ABSTRACT
Too often, people in charge of preventive conservation consider daylight as a danger, which should be eliminated. On the other hand, many architects want to use natural light without restriction, being unaware of the principles of preventive conservation. In most countries, natural light is largely available and represents an alternative or a complement to electric light. This paper describes the methods and tools to use natural light.

INTRODUCTION
For producing painted art works, the artists from the northern hemisphere, always preferred the light coming from the north. It is a stable light, without direct sun radiations. We will take this light as a reference for our work. Although free of direct sunlight, this light is potentially harmful because of its spectral characterized by a content energetic radiations (UV, short visible wavelengths).

A lighting project based on daylight should keep this fact in mind.

LIGHTING PROJECT
The control of light should permit to use its qualities while eliminating its defects. The project should take into account the sensitivity to light of the objects to be exposed. In fact the lighting project is a major part of scenography in which the exposed objects illustrate the exhibition theme. Moreover, it is necessary that visitors, whatever their age, can profit from all the necessary reading. This is not simple, but it is what makes the specificity of the job. A daylight project will thus include a general lighting, or a local directed lighting and, exceptionally, a focused lighting.

MEANS
To obtain a good lighting, it is necessary to know all the characteristics of the light entering in the building. The first point is to know the qualities of the glazings on the openings. It could be necessary to add a filtering for ultraviolet radiations or a solar protection. If so, it will be necessary to propose an adequate glazing in the case of a new project or a protective film in the case of a rehabilitation. A great choice of glazings exists as well as films of protection (one will refer to the bibliography presented).

The second point to be studied is the quantity of light distributed in the room. It can be evaluated by the method of the "daylight factor". This method needs to know the minimum of daylight in a given place of the room, and evaluates the complement in electric lighting.

In our case it is possible to calculate that, over one year, or over the duration of the exhibition, the illumination does not endanger the presented objects. The daylight factor is the ratio of the illuminance of a given plane exposed to the light received directly from a sky of known luminance distribution, with the illuminance of a horizontal plane exposed to an unobstructed hemisphere of this sky. The contribution of direct sunlight to both illuminances is excluded. An annual illuminance is available by the weather agency of each country. For Europe, an Internet site gives all this information (satel-light.com). In order to predict the quantity of

daylight received by the objects, it is necessary to measure, at the same time, the illumination outside and inside. This can be done with two lux-meters operated by two teams, connected by radio or telephone. This being particularly complicated, I asked for a metrological company to produce a compact apparatus in two parts connected by radio, and easy to handle by only one person: the DF-meter [fig. 1].

Fig. 1. The DFmeter CIMLUX (Cimel)

APPLICATION

Exhibition of graphic documents in a palace of XVIIIth century, the castle of the King of Rome in Rambouillet, near Paris.

On last summer was planned an exhibition of "goose game" a very popular game until the first half of the XXth century. This game includes an illustrated plate and as many tokens as players. Plates, printed on a paper medium of average quality, are very sensitive to light [fig. 2]. The plates are presented vertically under glazed frameworks, fixed on the walls. Current electric lighting is composed of projectors on rails, fixed under the cornices.

The site of projectors not being correct, lighting is source of visual noises such of the embarrassing reflexions and of dazzle. It is for this reason that the curator asked for assistance.

In less than two months, without teams, in an administrative context it is impossible to carry out a new installation of electric lighting. I thus propose to rely on lighting by daylight.

The curator in charge of the exhibition was first very surprise because usually daylight is forbidden when exposing graphic documents. However after my detailed explanation on the cautions to be taken (UV elimination, decrease of the colour temperature, use of interior shutters, and finally training of the staff), the curator gave his agreement.

The exhibition took place in four rooms north/west. Nine windows, equipped with interior shutters, permit the lighting of all spaces by daylight. [fig. 3].

Fig. 2. The goose game plate

Fig. 3. North side of the palace

We carried out a series of measurements of the daylight factor in the rooms and obtained the following values: from 1.5 to 2 near the windows, to 0.7 between the windows and from 1 to 1.5 on the perpendicular walls.

The annual amount of exposure for this type of document lies between 15 Klxh/y and 150 Klxh/y. Considering that the exhibition will last three months (July, August and September, from14.00 to 18.00 pm, 5 days per week), and that the quantity of external diffuse light in released on the site will be about 6 Mlxh, we fixed the total dose at 75 Klxh. [fig.4].

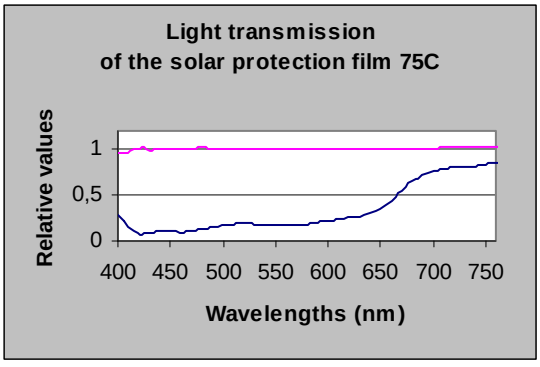

Fig. 4. Light transmission curve of the SS75C

We deduce that if the windows are equipped with a solar protective film [fig.5] with a transmission of 25 %, the daylight factor is at maximum 0.5%.

Taking into account that the staff can close the interior shutters during the opening hours, in rooms free of visitors, the real total amount of exposure will be even weaker [fig. 6].

To check the reliability of the estimated value of exposure we have placed several dosimeters of the type “LightCheck Ultra”, notably in showcases, the most critical locations. This dosimeter is constituted of a layer of material sensitive to light deposited on a substrate. The color change during the exhibition time turning from dark blue to mallow for a bright illimination of about 50 Klxh. For a dose of 100 Klxh it became pink.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
10-11	8.4	12.0	17.5	19.5	23.4	23.8	23.6	20.0	16.4	12.8	10.9	7.8
11-12	11.4	14.9	20.3	22.9	27.3	27.6	27.1	23.0	20.0	16.1	13.6	10.6
14-15	11.1	15.6	19.7	27.4	30.4	31.9	31.8	28.2	24.0	18.8	11.9	9.6
15-16	8.2	12.7	17.4	24.8	29.6	30.4	30.5	26.0	22.4	16.5	8.2	6.2
16-17	4.4	9.0	14.2	22.4	27.3	27.5	28.4	24.0	18.9	12.5	3.5	2.0
17-18	0.5	3.6	9.3	18.3	22.7	23.8	23.8	20.5	15.1	8.3	0.2	0.0

9300 Klx.h

Fig. 5. Satelight data

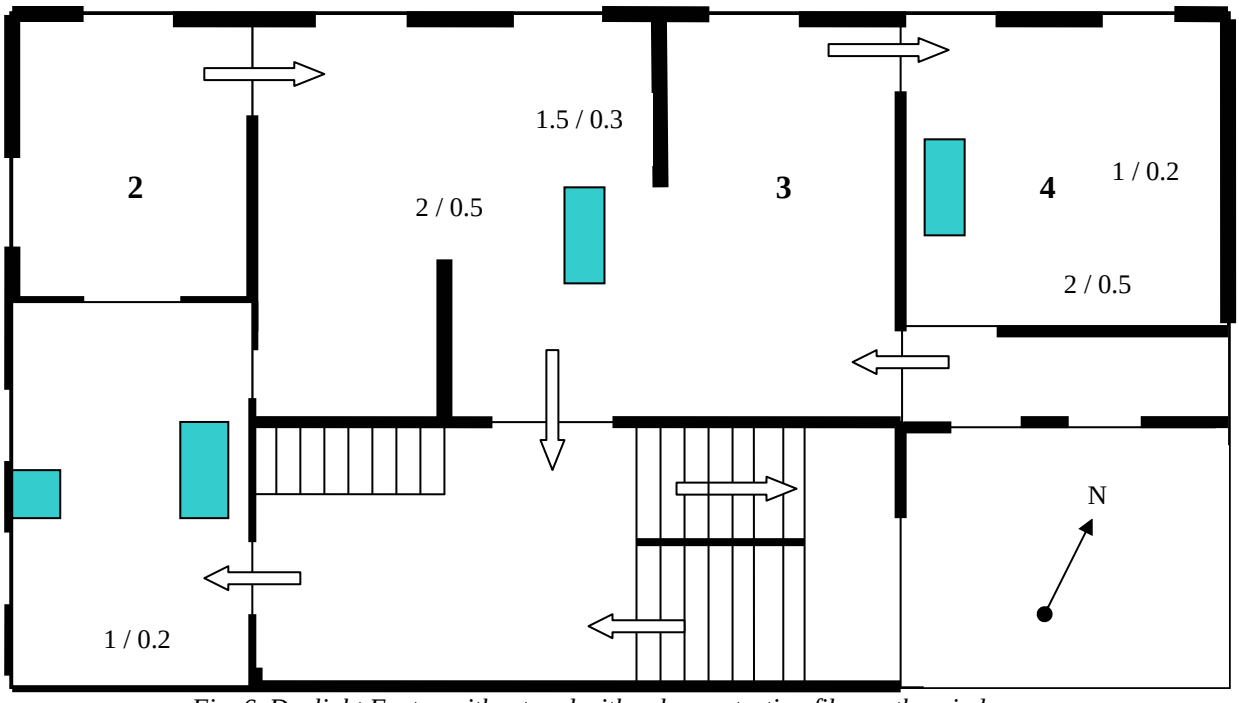

Fig. 6. Daylight Factor without and with solar protection film on the windows

CONCLUSION

This example shows that it is possible to use natural light, under the condition of controlling it with a dedicated device. These control could also be simple, like putting on windows curtains, blinds and shutters handled by the staff. People working in museums should be aware of these problems, with a good knowledge of protective materials and a minimum of methods of control. The DF-meter, allowing the measurement of the daylight factor, seems to be a new essential tool for planning and diagnostic at the disposal of preventive conservation actors.

MATERIALS LIST

1. Daylight factor meter CimLux 210: CIMEL Electronique, 172, rue de Charonne, 75011 Paris, 331 43 48 62 61, www.cimel.fr
2. Solar protection film, Bronze 75C, Solar Screen Hanita: Vitrages France International, 3, rue d'Herblay, 95480 Pierrelaye, 331 30 37 71 02
3. LightCheck Ultra: ATLANTIS FRANCE, 51, rue de la Chapelle, 39160 Noisy-le-Grand, 331 48 15 51 51. www.atlantis-france.com.

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