THE HOLOPHANE DAYLIGHT FACTOR ATTACHMENT

The Holophane Daylight Factor Attachment is a device which enables measurements to be made of the daylight factor at any point in a room.

"Daylight Factor" is defined as the ratio of the actual illumination on a horizontal surface within a room to the illumination which would be given if walls, ceiling and other obstructions were removed and light were received from an unobstructed, uniform hemisphere of sky.

The Holophane Daylight Factor Attachment consists of a small cubical enclosure, the lower surface of which is arranged for reception of the photo-voltaic cell, whilst the upper surface carries an iris diaphragm with an index moving over a calibrated scale which reads the daylight factor directly. The range of the scale is ·05% to 1·25%.

To use the Attachment, an illumination measurement should first be taken with the test surface horizontal at the point in the interior of the building which is to be investigated, taking care that no artificial light reaches the test surface, and that there are no uncontrolled shadows on the surface. Secondly, the photo-voltaic cell should be placed in the Daylight Factor Attachment, which should be set on a window ledge with the aperture directed towards an unobstructed portion of the sky, preferably towards that part of the sky which contributed most to the illumination at the test point; the diaphragm should then be adjusted until the reading on the indicator is the same as before, and the daylight factor can then be read as a percentage on the direct reading scale.

To obtain satisfactory results, it is essential that the two measurements should be made under identical conditions of daylight; they should, therefore, be made in quick succession and, as far as possible, the day chosen for the test should be a normal one, the sky being preferably slightly overcast with cloud to a constant extent, but free from fog. Direct sunlight must not reach the photo-voltaic cell for either measurement.

If it is desired to increase the range of the daylight factor scale, different ranges of the photometer may be used for the interior and exterior measurements. If, for example, the range chosen for the interior measurements is 0 to 15-lm/ft², and that for the exterior measurement is 0 to 150-lm/ft², the percentage daylight factor as read on the scale must be divided by 10, *i.e.* 0·005% to 0·12%.

The Daylight Factor Attachment can be used for measuring the average luminance of a large surface in the same way as the Stray-Light Shield described on page eleven, the conversion formula being:

$$\underset{\text{(ft. lamberts)}}{\text{Luminance of surface}} = \frac{100\%}{\text{Scale setting}} \times \underset{\text{(lm/sq. ft.)}}{\text{Photometer reading}}$$

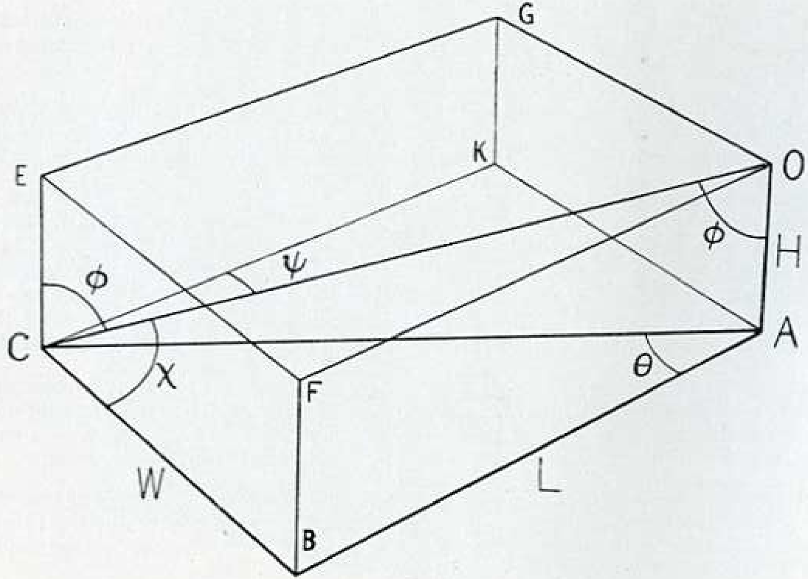

Fig. 6

FORMULÆ FOR MEASUREMENTS OF ILLUMINATION AND INTENSITY

Fig. 6 shows the distances and angles involved, the source of light being at O and the test surface at C.

H	Height of light source above working plane.
L	Length in plan from light source to test point.
W	Width in plan from light source to test point.
D	Distance in plan from light source to test point.
R	Slope distance from light source to test point.
θ (theta)	Angle in horizontal plane.
φ (phi)	Angle in vertical plane and angle of incidence on horizontal plane.
χ (chi)	Angle of incidence on vertical surface at C, in plane CEGK.
ψ (psi)	Angle of incidence on vertical surface at C, in plane BCEF.
I	Intensity of light source in the direction towards the test point.
E	Illumination at test point by direct light from source.
E_H	Illumination on horizontal plane.
E_V	Illumination on vertical plane directed towards light source.
E_N	Illumination on plane normal to light rays from source.
E_s	Illumination on vertical surface in plane CEGK.
E_e	Illumination on vertical surface in plane BCEF.

Formulæ

$$\tan\theta = W / L$$
$$D = L / \cos\theta = \sqrt{L^2 + W^2}$$
$$\tan\varphi = D / H = L / H.\cos\theta$$
$$R = L / \cos\theta.\sin\varphi = H / \cos\varphi = \sqrt{L^2 + W^2 + H^2}$$
$$\cos\chi = W / R = \sin\theta.\sin\varphi$$
$$\cos\psi = L / R = \cos\theta.\sin\varphi$$
$$E_N = I / R^2 = I.\cos^2\varphi / H^2$$
$$E_H = E_N\cos\varphi = I.\cos^3\varphi / H^2 = E_N\cos\varphi$$
$$E_V = E_N\sin\varphi = I.\cos^2\varphi.\sin\varphi / H^2 = E_N\sin\varphi$$
$$E_s = E_V\sin\theta = I.\cos^2\varphi.\sin\varphi\sin\theta / H^2 = E_N\cos\chi$$
$$E_e = E_V\cos\theta = I.\cos^2\varphi.\sin\varphi\cos\theta / H^2 = E_N\cos\psi$$

If the distances are measured in feet and the intensity in candelas, the illuminations will be given in lumens per square foot (or foot-candles).

The above formulæ apply only to the direct light from the source to the test point and do not make any allowance for diffused or scattered light.

φ	cos φ	$\cos^3\varphi$	tan φ	φ	cos φ	$\cos^3\varphi$	tan φ	φ	cos φ	$\cos^3\varphi$	tan φ
0°	1·000	1·000	·0000	30°	·866	·650	·5774	60°	·500	·125	1·732
1°	1·000	1·000	·0175	31°	·857	·630	·6009	61°	·485	·114	1·804
2°	·999	·998	·0349	32°	·848	·610	·6249	62°	·469	·103	1·881
3°	·999	·996	·0524	33°	·839	·590	·6494	63°	·454	·0936	1·963
4°	·998	·993	·0699	34°	·829	·570	·6745	64°	·438	·0842	2·050
5°	·996	·989	·0875	35°	·819	·550	·7002	65°	·423	·0755	2·144
6°	·995	·984	·1051	36°	·809	·530	·7265	66°	·407	·0673	2·246
7°	·993	·978	·1228	37°	·799	·509	·7536	67°	·391	·0597	2·356
8°	·990	·971	·1405	38°	·788	·489	·7813	68°	·375	·0526	2·475
9°	·988	·964	·1584	39°	·777	·469	·8098	69°	·358	·0460	2·605
10°	·985	·955	·1763	40°	·766	·450	·8391	70°	·342	·0400	2·747
11°	·982	·946	·1944	41°	·755	·430	·8693	71°	·326	·0345	2·904
12°	·978	·936	·2126	42°	·743	·410	·9004	72°	·309	·0295	3·078
13°	·974	·925	·2309	43°	·731	·391	·9325	73°	·292	·0250	3·271
14°	·970	·913	·2493	44°	·719	·372	·9657	74°	·276	·0209	3·487
15°	·966	·901	·2679	45°	·707	·354	1·000	75°	·259	·0173	3·732
16°	·961	·888	·2867	46°	·695	·335	1·035	76°	·242	·0142	4·011
17°	·956	·875	·3057	47°	·682	·317	1·072	77°	·225	·0114	4·331
18°	·951	·860	·3249	48°	·669	·300	1·111	78°	·208	·00899	4·705
19°	·946	·845	·3443	49°	·656	·282	1·150	79°	·191	·00695	5·145
20°	·940	·830	·3640	50°	·643	·266	1·192	80°	·174	·00524	5·671
21°	·934	·814	·3839	51°	·629	·249	1·235	81°	·156	·00383	6·314
22°	·927	·797	·4040	52°	·616	·233	1·280	82°	·139	·00270	7·115
23°	·921	·780	·4245	53°	·602	·218	1·327	83°	·122	·00181	8·144
24°	·914	·762	·4452	54°	·588	·203	1·376	84°	·105	·00114	9·514
25°	·906	·744	·4663	55°	·574	·189	1·428	85°	·0872	·00066	11·430
26°	·899	·726	·4877	56°	·559	·175	1·482	86°	·0698	·00030	14·301
27°	·891	·707	·5095	57°	·545	·162	1·540	87°	·0523	·00010	19·081
28°	·883	·688	·5317	58°	·530	·149	1·600	88°	·0349	·00000	28·636
29°	·875	·669	·5543	59°	·515	·137	1·664	89°	·0175	·00000	57·290

This table gives the values of cos φ, $\cos^3\varphi$ and tan φ for 1° intervals from 0° to 89°. The values of sin φ, $\sin^3\varphi$ and cot φ may be obtained by reading the table at the angle (90° — φ). Thus:

$$\sin\varphi = \cos(90° - \varphi)$$