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Customer P.O.#: 2

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TEST REPORT

LIGHT AVAILABILITY

OTRON THRUFLOW DOCK PANEL

1. INTRODUCTION

Otron requested the assistance of Cambridge Materials Testing Limited (CMTL) to estimate the amount of sunlight which would be available under a 4' x 4' section of dock surfaced with their ThruFlow Flooring System. The amount of available light under the dock is an important factor with regard to the sustainability of plant and animal life under dock structures.

Otron supplied an assembled 4' x 4' dock section for this testing. The section consisted of four ThruFlow panels (12" x 48") fastened to a metal frame.

Two dock surface heights were tested:

- eighteen (18) inches (tested under CMTL Lab. No. 304167-02)
- sixty (60) inches (tested under CMTL Lab. No. 307535-02).

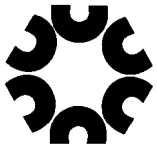
A graph extrapolating the expected light availability over the dock height range of 0 to 60 inches is provided in this report.

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Cambridge Materials Testing Limited

Per *Frank Mansfield* QUALITY ASSURANCE

Per *Derek McGivern* TECHNICIAN



2. BACKGROUND to TEST PROCEDURE

Two routes for sunlight to irradiate the area under a 4' x 4' dock section were considered by CMTL.

Surface Light - light which passed through the slots on surface of dock

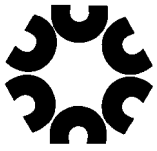
- the slots accounted for a reported 43% of the dock surface
- surface light passed through the slots in the surface of the dock and created a Partially Illuminated Area (PIA) under the dock
- the PIA consisted of illuminated and dark shadow areas corresponding to the Otron ThruFlow panel
- the frame supporting the dock panels created solid bands of frame shadow which occupied part of the area under the dock
- the PIA covered 100% of the area under the dock when the sun was directly overhead (90 degrees) minus the Frame Shadow Area (FSA)
- as the sun moved from 90 degrees to higher or lower incident light angles the PIA cast by the dock surface covered progressively less area under the dock
- the FSA changed with the incident light angle
- eventually at very low and very high incident light angles the PIA and FSA under the dock became zero.

Edge Light - light which strikes the edge plane of the dock

- incident light at sun angles below 90° illuminated the area under the edge of the dock
- the percentage of area illuminated from the side plane increased from zero for incident light close to 90° to 100% for low and high incident angles

3. TEST PROCEDURE

The 4' x 4' dock section was mounted so that the top surface of the dock was 18 inches and so inches above ground level. A 150 watt (120 volt) incandescent light source was sequentially positioned at the following incident light angles: 90, 75, 60, 45, 30, 20 and 10 degrees relative to the mid point of the dock section at ground level. The light source at 90 degrees simulated sunlight at noon. The light source at 0 degrees simulated sunrise or sunset.



3.0 TEST PROCEDURE (CON'D)

At each incident light angle the width of the area under the dock illuminated by Edge Light was measured. This length was used to calculate the **Edge Light Area**. The light intensity in the Edge Light Area was the same with and without the dock in place and was assigned as 100%.

Light Availability due to Edge Light was calculated as Edge Light Area multiplied by the light intensity.

Light passing through the openings in the ThruFlow panel created a Partially Illuminated Area (PIA) under the dock. The PIA was calculated as the total dock area minus the Edge Light Area. The Frame Shadow Area (FSA) was subtracted from the PIA to determine the **Corrected PIA** under the dock.

At each incident light angle a Sekonic Illuminometer (Model 246) light meter was used to measure the light intensity at ground level at the mid point of the dock section with and without the dock in place. The reading with the dock in place was measured as the average between the illuminated and shadow areas.

The reading with the dock in place was divided by the reading without dock to calculate the Light Intensity Ratio. The distance of the light source from the mid point of the dock was kept constant for the measurements at each incident angle.

Light Availability due to Surface Light was calculated as the Corrected PIA multiplied by the average light intensity.

Total Average Light Availability (%) From 0 to 90 Degrees was calculated by adding the Light Availability Due to Edge Light and Light Availability Due to Surface Light and averaging across the 0 to 90 degree incident light range. Actual sunlight would act over a 0 to 180 degree arc but the percent light availability would be identical to the 0 to 90 degree arc.



4. RESULTS

The measurements and calculations for estimating the light availability under the Otron ThruFlow dock panels are summarized in Tables 1 and 2. The averaged light availability measured was:

18" Dock Height	61%
60" Dock Height	84%

A graph extrapolating the expected light availability over the dock height range of 0 to 60 inches is provided below.

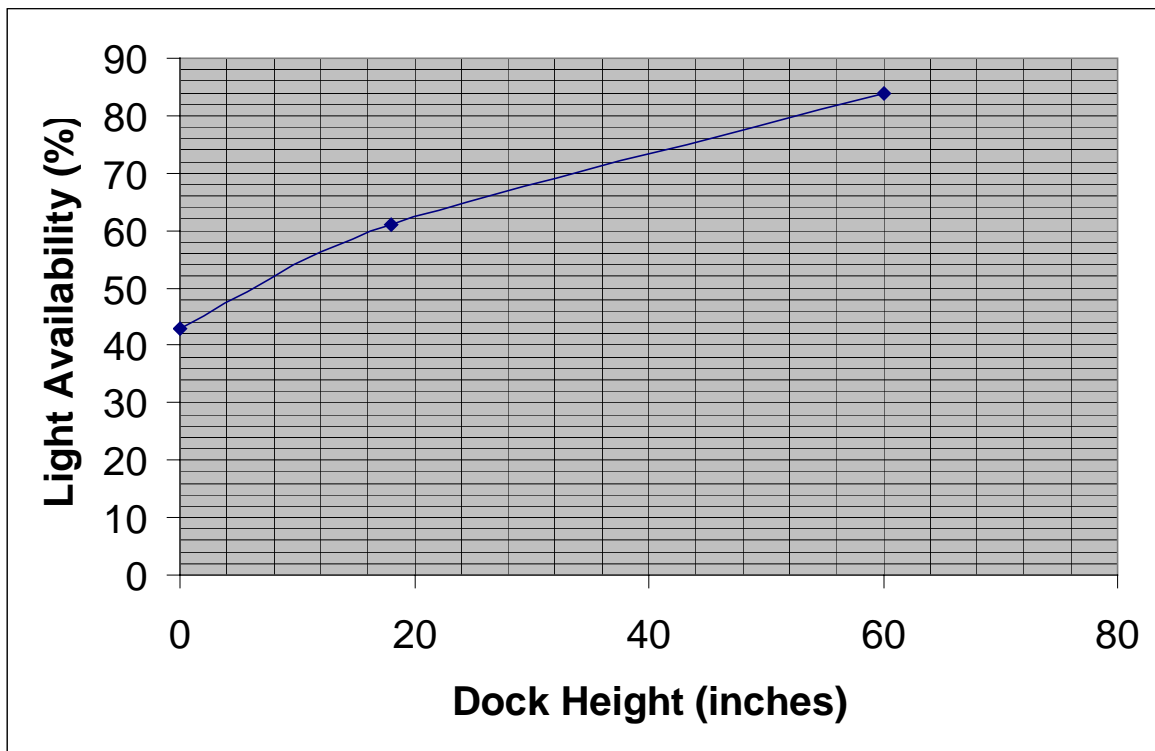




Table 1
**Light Availability – Otron Thruflow Panel
18 inch dock height**

Incident Light Angle	0	10	20	30	45	60	75	90
<u>Surface Light</u>								
Partially Illuminated Area (%)	0	0	0	42	73	89	97	100
Frame Shadow Area (%)				8	21	22	12	6
Corrected Partially Illuminated Area				34	52	66	85	94
Light Intensity								
Light Intensity (Lx)- without dock				160	380	410	440	220
Light Intensity (Lx) - with dock				40	140	160	180	100
Light Intensity Ratio				25	37	39	41	45
<u>Light Availability due to Surface Light (%)</u>	0	0	0	8	19	26	35	43
<u>Edge Light</u>								
Edge Illumination (inches)	48.0	48.0	48.0	28.0	13.0	5.5	1.4	0.0
Edge Illumination (%)	100	100	100	58	27	11	3	0
<u>Light Availability due to Edge Light (%)</u>	100	100	100	67	46	37	38	43
Total Average Light Availability (%), 0 - 90°	61%							



Table 1
**Light Availability – Otron Thruflow Panel
5 foot dock height**

Incident Light Angle	Angle of Incidence (degrees) of Light Source							
	0	10	20	30	45	60	75	90
Surface Light								
Total Grid Shadow Area (%)	0	0	0	0	0	10	74	100
Zero Light Area- frame effect				0	0	3	9	6
Partially Illuminated Area - ThruFlow panel effect				0	0	8	65	94
Partially Illuminated Area								
Light Intensity (Lx)- without dock						115	340	310
Light Intensity (Lx) - with dock						60	115	115
Light Intensity Ratio						52	34	37
Light Intensity Ratio x Partially Illuminated Area						4	22	35
Edge Light								
Edge Illumination (inches)	48.0	48.0	48.0	48.0	48.0	39.5	12.5	0.0
Edge Illumination (%)	100	100	100	100	100	82	26	0
Light Availability (%)	100	100	100	100	100	86	48	35

Average Light Availability, 0 - 90°, 5 Foot Dock Height - 84 %



Figure 1 – Schematic of Test Procedure for Light Availability

