The IES Photometric File Format

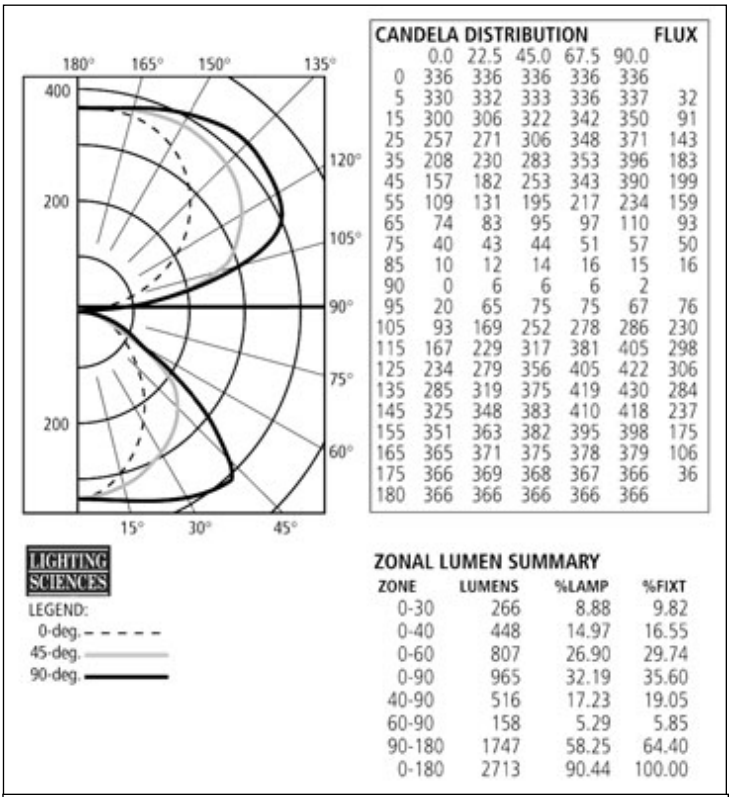
Scott J. Brown

Audience and Scope

This document is designed to introduce 3rd and 4th year Architectural Engineering students to the standard IES photometric file format for light fixtures. The reader is expected to have a basic understanding of photometry and 3D modeling in architectural applications.

Photometry

All luminaires distribute light in different ways. A “photometric distribution" is the dataset that describes the intensity of light emitted from a luminaire as a function of the horizontal and vertical angles from the viewing location to the light source.



CANDELA DISTRIBUTION

	0.0	22.5	45.0	67.5	90.0	FLUX
0	336	336	336	336	336	
5	330	332	333	336	337	32
15	300	306	322	342	350	91
25	257	271	306	348	371	143
35	208	230	283	353	396	183
45	157	182	253	343	390	199
55	109	131	195	217	234	159
65	74	83	95	97	110	93
75	40	43	44	51	57	50
85	10	12	14	16	15	16
90	0	6	6	6	2	
95	20	65	75	75	67	76
105	93	169	252	278	286	230
115	167	229	317	381	405	298
125	234	279	356	405	422	306
135	285	319	375	419	430	284
145	325	348	383	410	418	237
155	351	363	382	395	398	175
165	365	371	375	378	379	106
175	366	369	368	367	366	36
180	366	366	366	366	366	

ZONAL LUMEN SUMMARY

ZONE	LUMENS	%LAMP	%FIXT
0-30	266	8.88	9.82
0-40	448	14.97	16.55
0-60	807	26.90	29.74
0-90	965	32.19	35.60
40-90	516	17.23	19.05
60-90	158	5.29	5.85
90-180	1747	58.25	64.40
0-180	2713	90.44	100.00

Example of a direct/indirect, bilaterally symmetric photometric distribution.

Traditionally, manufacturers have published this information in product catalogues, using a distribution graph and table, as shown on the right. However, with the advent of lighting calculation software, a digital format for this data was invented: the IES photometric file.

IES Format

An IES photometric file is a photometric distribution that is computer-readable. It contains only a series of numbers separated by tabs (or spaces). Roman characters included in the file will not be readable by any lighting software, but can be used to create comments. Below is an annotated example of an IES photometric file, explaining what each number represents. Note that most photometric files are not so legibly formatted - it is up to the reader to count the data-points off and determine where the borders between metadata, angles, and illuminance values lie.

Every photometric file begins with metadata about the luminaire. These thirteen numbers represent:

- the number 1
- the rated lumens of the fixture, or the number -1 if absolute photometry is used
- multiplying factor (typically 1)
- the number of vertical angles
- the number of horizontal angles
- the number 1
- unit-type: 1 for feet, 2 for meters
- x dimension
- y dimension
- z dimension
- the number 1
- the number 1
- luminaire wattage

```
1  -1  1  73  5  1  1  0.13  3.79  0.33  1  1  27.5

0  2.5  5  7.5  10  12.5  15  17.5  20  22.5  25  27.5  30
32.5  35  37.5  40  42.5  45  47.5  50  52.5  55  57.5  60
62.5  65  67.5  70  72.5  75  77.5  80  82.5  85  87.5  90
92.5  95  97.5  100  102.5  105  107.5  110  112.5  115
117.5  120  122.5  125  127.5  130  132.5  135  137.5  140
142.5  145  147.5  150  152.5  155  157.5  160  162.5  165
167.5  170  172.5  175  177.5  180

0  22.5  45  67.5  90

256  251  250  249  247  245  241  237  232  225  218  210
201  192  182  171  160  150  138  126  115  103  92  82
72  63  55  47  40  34  29  24  20  16  12  8  5  4  4  4
4  4  4  3  3  3  3  3  3  2  3  2  2  2  1  1  1  1  1
1  1  0  0  0  0  0  0  0  0  0  0  0  0

256  255  250  247  244  240  236  231  224  216  208  198
189  179  169  159  149  140  132  123  116  108  101  96
90  84  79  74  70  66  61  57  54  50  46  42  38  36  34
32  30  28  26  25  23  21  20  18  16  15  14  11  9  8
5  3  2  1  1  1  1  0  0  0  0  0  0  0  0  0  0  0  0

256  253  250  248  244  238  230  223  214  205  196  188
180  172  166  159  154  148  144  139  134  130  124  120
116  111  106  102  98  93  89  84  80  76  70  66  62  59
56  54  52  50  48  46  44  42  40  38  36  34  32  30  28
25  23  20  18  14  12  9  6  3  1  0  0  0  0  0  0  0
0  0  0

256  251  248  246  240  232  224  215  207  199  192  186
182  177  173  169  165  162  158  154  150  145  140  136
130  126  121  116  110  105  100  95  90  85  80  74  70
67  64  62  60  58  56  54  52  50  48  47  45  43  41  39
37  34  32  29  26  24  20  18  14  11  7  4  1  0  0  0
0  0  0  0  0

256  250  248  245  238  230  221  212  204  198  192  187
183  180  176  172  169  166  162  158  154  149  144  140
134  128  123  118  112  107  102  96  91  86  80  74  70
68  66  62  60  58  57  55  54  52  50  48  46  45  44  41
39  36  34  31  29  26  23  20  17  13  10  6  2  0  0  0
0  0  0  0  0
```

Following the metadata is the series of vertical angles in the photometric web. This file contains data for all of these 73 vertical angles.

Next, the horizontal angles are listed.

Finally, the photometric data is grouped first by horizontal angle. Each of these numbers in the first group represents the intensity of light at 0ºH, and increasing vertical degrees (0ºV, 2.5ºV, … 177.5ºV, 180ºV).

This group represents the intensity at 22.5ºH.

These numbers represent intensity values at 12.5ºV, and 45ºH, 67.6ºH, and 90ºH respectively. Can you see why?

Answer in comment

Limitations

All photometric calculations are incorrect - there are only large or small degrees of inaccuracy. The most obvious way a photometric file can be inaccurate through insufficient data: a file containing intensity data for 10 vertical angles will be much less accurate than a file containing intensity data for 73 vertical angles. Good designers check their photometric files before determining whether they are precise enough to be used in a calculation.

Another form of error is inherent to modern photometry. All photometric calculations currently devised rely on the assumption that every source emits light from a point. While this assumption may closely resemble real, physical photometry for certain sources (namely filament lamps without housings), it is still only an approximation of reality. The degree of inaccuracy this approximation causes depends heavily on the layout of the 3D model being used to generate lighting calculations. In general, placing a line-source (e.g. florescent strip-light) closer to the calculation plane results in a less accurate calculation. The IES recommends using the Five-To-One Rule: the distance between a line-source and the calculation plane should be at least five times the distance of the source's longest dimension.

Conclusion

Computers have made lighting calculations faster, cheaper, and more accurate than they have ever been. However, computer calculations are beginning to give many designers a false sense of security in the accuracy of their own calculations, resulting in unpredictable energy models, and dissatisfied clients. Understanding the IES photometric file format will empower designers to evaluate the photometric data that they receive from manufacturers and develop a comprehensive awareness of the limitations of lighting calculation software.