How Do Light ARchitect's Photometric Calculations Compare to that of Luxiflux?

Get Ready to Be Surprised.

A Photometric Calculation Comparison Between Cooper Lighting Solutions' Light ARchitect App and Luxiflux
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Executive Summary
Overview

Light ARchitect is a lighting simulation app created by Cooper Lighting Solutions for use by its agents, architects, specifiers, and any other customers who are involved with lighting design:

- The app enables users to create and visualize lighting designs instantly for exterior projects of virtually any size, from small parking lots to complex sports fields.

- A built-in customized catalog helps users find the right fixture.

- The application is accessible across platform at any time, uses colorful intuitive visuals and tools, and integrates Google Maps to further amplify the visualization of the outcome.

- The app can also be used to collaborate remotely with stakeholders.

Several customer case studies available on the Cooper Lighting Solutions website demonstrate the application's integral role in creating faster, more efficient lighting layouts and in helping to close sales.

Photometric calculations are a cornerstone capability that contributes to Light ARchitect's success. Colorful heatmaps enrich photometric calculation results and simplify decisions with a single glance.

With such a convenient and beneficial tool, the question arises: How definitively accurate is Light ARchitect's photometric calculations algorithm compared to the standardized tools used in the lighting industry?

Prior to this data collection and analysis, no studies had been conducted targeting this topic.

Methodology

For data collection, the comparison is between Light ARchitect and Light Analyst's software Luxiflux.

Luxiflux software is very similar to Light ARchitect; photometric calculations assume surfaces are flat, and access to Cooper Lighting Solutions fixture IES files are hassle-free.

- One fixture configuration type was manipulated and observed at a time while preserving the Light ARchitect default fixture settings in both software.

- Required calculation boundary parameters in Luxiflux were changed to match Light ARchitect.

- Photometric calculation results for both software were recorded then compared using the percentage difference of Light ARchitect to Luxiflux.

Key Findings

- **Light ARchitect photometric calculations algorithm compared to Luxiflux on average differs less than 5% across every calculation type where fixture configurations pertain to mounting height, vertical tilt, arm length, color, and multiple heads configurations.**

- **For optics configuration, the algorithm on average differs less than 3% for average illuminance and average/min illuminance, and less than 10% difference for max illuminance and max/min illuminance.**

Recommendations

- Light ARchitect photometric calculations algorithm is reliably accurate to one industry standard tool.

- The application is completely free, provides both visually appealing and functional services, and proves its significant impact via customer case studies.

- I recommend the application to any user, regardless of expertise, who wishes to design a lighting layout.

Methodology and Results
Tools Used in Data Collection

Tools used in this study include Light ARchitect Satellite View on the browser, accessed at LightARchitectApp.com, and Light Analyst's Luxiflux accessed through Cooper Lighting Solutions' publicly available IES repository.

Luxiflux was chosen as the basis for comparison for several reasons:

- The software is reputable. It's created and supported by Light Analysts, creators of industry standard, illumination engineering software, including AGI32.

- The software offers nearly identical customizable configurations as Light ARchitect. Its photometric calculations assume surfaces are flat just as Light ARchitect does.

Collection Method

- Photometric calculations of the observing manipulated variable were completed on Light ARchitect first and recorded.

- Then, Luxiflux was used, with fixture configurations set to match the fixture configurations used with Light ARchitect.

- Locked fixture settings in Light ARchitect that were not visible in the user interface included light loss factor (0.864) and max to min footcandle ration (capped at 10 to 1 footcandle).

- In the calculation screen of Luxiflux, two photometric values (min and max to min ratio) calculated from Light ARchitect were input into Luxiflux's mandatory calculation boundary parameters.

- The average parameter in Luxiflux was untouched.

- Photometric calculation results from Luxiflux were recorded.

- The average illuminance, max illuminance, average to min illuminance, and max to min illuminance were compared using signed percent difference (Light ARchitect to Luxiflux) to show direction.

- For the overall averaged result of each configuration type, the absolute value of each percent difference was summed, then averaged for each photometric calculation type per data table. **(Table graphics begin on page 6.)**

- When adding a new fixture to Light ARchitect, the default values for fixture configurations were based on the default settings:

  Mounting height: 30 ft
  Vertical Tilt: 0 degrees
  Arm Length: 1ft
  Number of heads: single head

The choice of fixtures for this study was based on several factors.

Optics/Multiple Heads: Gan Galleon was chosen as it contains the most diverse IES files and the most diverse optics. This fixture is ideal for checking most optics in single and multiheaded scenarios.

Mounting Height/Vertical Tilt/Arm Length/Color: Fixtures were chosen based on popularity – the four used most often in successful layouts were selected. To further diversify the data, the two most popular optics types were used by all four fixtures that were chosen.

IES Files: The type of IES file chosen was based on the proximity to 20,000 lumens for each fixture. And 3000K color was selected as it is the most available fixture color across all fixtures.

Results

Overall, Light ARchitect photometric calculations algorithm undercalculated or overcalculated values by less than 5 percent for mounting height, vertical tilt, arm length, color, and multiple fixture heads across each configuration.

The algorithm undercalculated or overcalculated optics by less than 3% for average illuminance and average to min illuminance. The difference is shared across all optics.

The gap is widened to 10% when calculating max illuminance and max to min illuminance. The 10% difference is not equally shared across all optics; optics with excessively skewed shapes, such as SLL starting from the source, result in the largest difference while other optics, such as 5MQ and T2, share the same percent difference as the other photometric values.

If excessively skewed optics were ignored (SLL, SLLHS, SLR and SLRHS) then the average percent difference improves to 5%. This percentage is significantly more relevant to users as the aforementioned optics are rarely used. In contrast, the other 24 optics serve general purposes and have greater usage.

Discussion and Recommendations

Lighting designs created in the free application can be expected to reliably reflect photometric values to one industry-standard tool. The calculated values can be trusted as a project springboard to fulfill any regional standards particular layouts may require. Furthermore, Light ARchitect's user-friendly design empowers all users, regardless of expertise, to create lighting layouts. The intuitive heatmaps simplify decisions to a single glance. To use the tool, minimal effort is required; the need for extra training is nullified.

Now, with tangible evidence regarding the accuracy of photometric calculations, I confidently recommend using the application for kickstarting outdoor lighting projects.

LightARchitect and Luxiflux

Gan Galleon, Optics Comparison
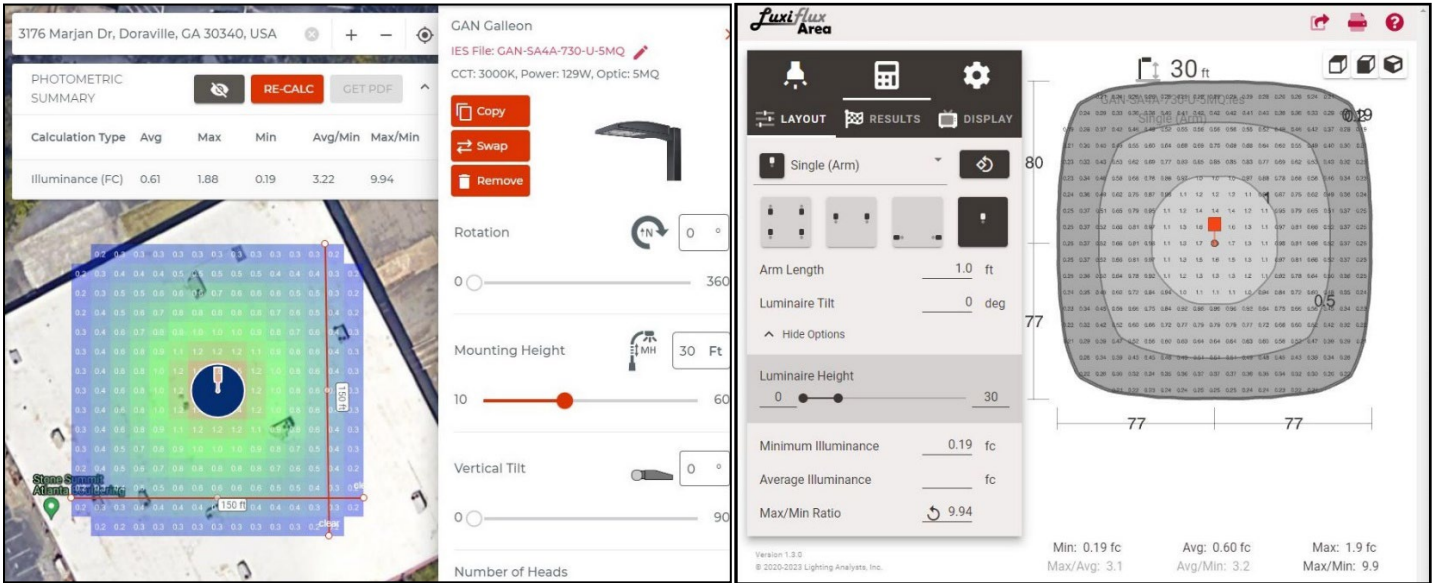
Archeon Large, Multiple Heads Comparison

Table: Absolute Average Percentage Difference

		Configuration Variables					
		Optics	Mounting Height	Vertical Tilt	Arm Length	Color	Number of Heads
Calculation Types	Average	2.583%	1.482%	3.974%	1.064%	1.283%	2.325%
	Max	5.236 %**	3.686%	4.061%	3.104%	3.048%	2.150%
	Average/Min	2.701%	2.132%	2.470%	1.093%	1.386%	1.500%
	Max/Min	5.427 %**	4.060%	4.720%	1.467%	2.538%	1.726%
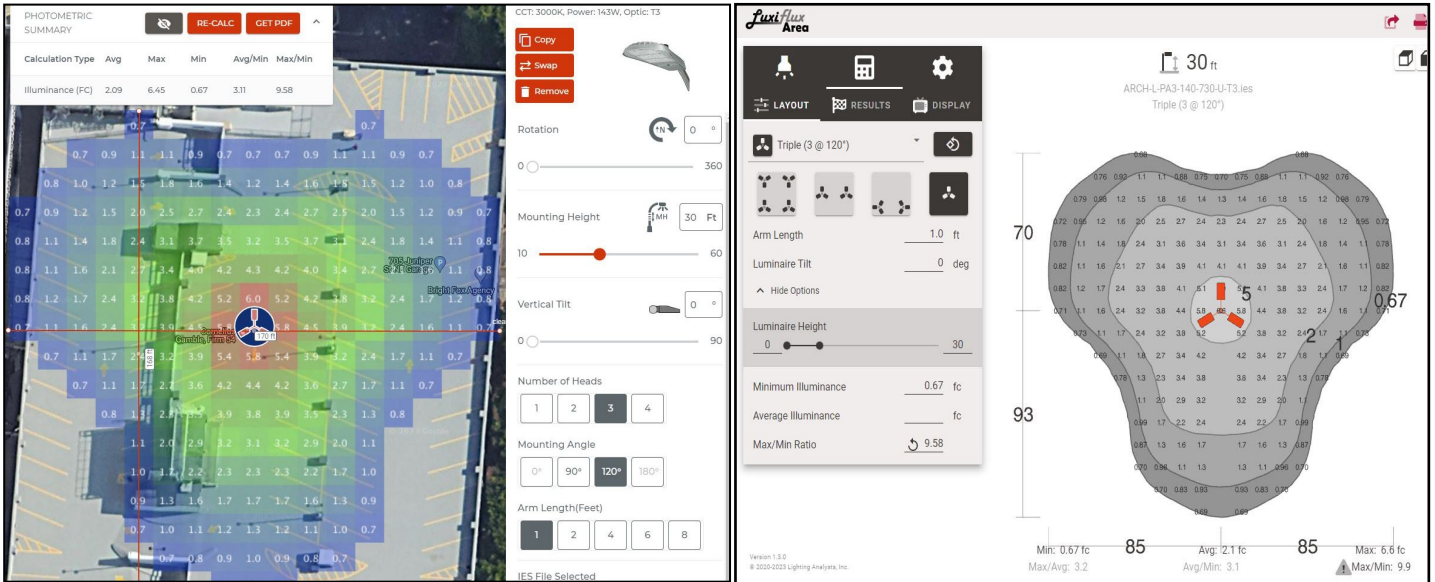
Absolute Average Percentage Difference for Each Calculation Type and Configuration Variables

**SLL, SLLHS, SLR, SLRHS optics not included. If including said optics, difference increases to 9.196% for Max, 9.547% for Max/Min

Appendix
Data Tables

Table 1: Optics

Comparing Illuminance Calculation for Different Optics

Optics	LightARchitect Reults (FC)					LuxiFlux Results (FC)					Percent Difference of LightARchitect/LuxiFlux			
	Average	Max	Min	Average/Min	Max/Min	Average	Max	Min	Average/Min	Max/Min	Average	Max	Average/Min	Max/Min
5MQ	0.61	1.88	0.19	3.22	9.94	0.6	1.9	0.19	3.2	9.9	1.666667	-1.05263	0.625	0.40404
5NQ	0.87	2.05	0.22	3.94	9.26	0.91	2.1	0.22	4.1	9.4	-4.3956	-2.38095	-3.902439024	-1.48936
5WQ	0.76	2.49	0.25	3.04	9.91	0.62	1.8	0.25	2.5	7	22.58065	38.33333	21.6	41.57143
AFL, HSS	1.84	3.85	0.4	4.59	9.61	1.9	4.6	0.4	4.7	11	-3.15789	-16.3043	-2.340425532	-12.6364
AFL	1.81	4.1	0.42	4.32	9.8	1.8	5.2	0.42	4.3	12	0.555556	-21.1538	0.465116279	-18.3333
RW	0.72	1.98	0.2	3.64	9.93	0.73	2	0.2	3.6	9.8	-1.36986	-1	1.111111111	1.326531
SL2, HSS	1.02	3.21	0.32	3.15	9.92	0.99	3.1	0.32	3.1	9.5	3.030303	3.548387	1.612903226	4.421053
SL2	1	3.59	0.36	2.77	9.91	1	3.5	0.37	2.7	9.6	0	2.571429	2.592592593	3.229167
SL3, HSS	1.03	3.65	0.37	2.78	9.8	1	4.4	0.37	2.8	12	3	-17.0455	-0.714285714	-18.3333
SL3	1.08	4.31	0.44	2.46	9.78	1.1	4.4	0.44	2.4	9.9	-1.81818	-2.04545	2.5	-1.21212
SL4, HSS	0.75	2.26	0.24	3.05	9.24	0.75	2.6	0.24	3.1	11	0	-13.0769	-1.612903226	-16
SL4	0.77	2.61	0.26	2.94	9.97	0.74	2.8	0.24	3.1	12	4.054054	-6.78571	-5.161290323	-16.9167
SLL, HSS	1.27	3.65	0.37	3.41	9.78	1.3	5.2	0.37	3.5	14	-2.30769	-29.8077	-2.571428571	-30.1429
SLL	1.27	3.97	0.4	3.16	9.93	1.3	5.5	0.4	3.2	14	-2.30769	-27.8182	-1.25	-29.0714
SLR, HSS	1.24	3.49	0.35	3.53	9.95	1.3	5.1	0.35	3.6	15	-4.61538	-31.5686	-1.944444444	-33.6667
SLR	1.26	3.93	0.4	3.17	9.85	1.3	5.3	0.4	3.2	13	-3.07692	-25.8491	-0.9375	-24.2308
T2, HSS	0.82	2.16	0.22	3.74	9.88	0.85	2.2	0.22	3.8	9.8	-3.52941	-1.81818	-1.578947368	0.816327
T2	0.88	2.6	0.26	3.38	9.99	0.89	2.7	0.26	3.4	10	-1.1236	-3.7037	-0.588235294	-0.1
T2R, HSS	1.39	3.96	0.4	3.46	9.9	1.4	4	0.4	3.6	9.9	-0.71429	-1	-3.888888889	0
T2R	1.38	4.15	0.42	3.27	9.87	1.4	4.1	0.42	3.4	9.8	-1.42857	1.219512	-3.823529412	0.714286
T3, HSS	0.75	1.84	0.18	4.09	10	0.75	1.8	0.18	4.2	10	0	2.222222	-2.619047619	0
T3	0.85	2.31	0.23	3.64	9.92	0.85	2.3	0.23	3.7	10	0	0.434783	-1.621621622	-0.8
T3R, HSS	0.84	2.49	0.25	3.34	9.91	0.83	2.5	0.25	3.3	9.8	1.204819	-0.4	1.212121212	1.122449
T3R	0.92	2.94	0.29	3.11	9.98	0.89	2.9	0.29	3.1	10	3.370787	1.37931	0.322580645	-0.2
T4FT, HSS	0.62	1.94	0.2	3.18	9.96	0.62	1.9	0.2	3	9.2	0	2.105263	6	8.26087
T4FT	0.75	2.65	0.27	2.77	9.77	0.75	2.7	0.27	2.8	9.8	0	-1.85185	-1.071428571	-0.30612
T4W, HSS	0.64	1.7	0.17	3.72	9.92	0.63	1.7	0.17	3.7	10	1.587302	0	0.540540541	-0.8
T4W	0.71	2.02	0.2	3.45	9.88	0.7	2	0.2	3.5	10	1.428571	1	-1.428571429	-1.2

Sample Fixture: Gan Galleon
IES File Type: SA4A-730-U-[Optics]

Configurations on Both Tools:
- Mount Height: 30 ft
- Vertical Tilt: 0 Degree
- Head Configurations: Numbers: 1; Angle between: 0 Degree
- Arm Length: 1 ft
- Light Loss Factor: 0.864

Parameters for Luxiflux Calculation that Depend on LightARchitect Results:
- Minimum Illuminance
- Max/Min Ratio

Important Note: Ability of Luxiflux Zonal to accruately produce the paramenter's Max/Min Ratio affects all other values. Generally, more deviation from parameter settings leads to greater percent difference values.

Light ARchitect's photometric calculations algorithm differs less than 3-5% on average compared to Luxiflux.

Table 2: Mounting Height

Comparing Illuminance Calculation for Different Mounting Heights

Fixture	Specs	Mounting Height (ft)	LightARchitect Reults (FC)					LuxiFlux Results (FC)					Percent Difference of LightARchitect/LuxiFlux			
			Average	Max	Min	Average/Min	Max/Min	Average	Max	Min	Average/Min	Max/Min	Average	Max	Average/Min	Max/Min
Gan Galleon	5MQ	20	1.32	4.22	0.45	2.95	9.42	1.4	4.2	0.45	3.1	9.4	-5.71429	0.47619	-4.838709677	0.212766
		40	0.34	1.01	0.1	3.36	10	0.33	1.1	0.1	3.3	11	3.030303	-8.18182	1.818181818	-9.09091
		60	0.2	0.46	0.1	1.95	4.59	0.2	0.47	0.2	2	4.7	0	-2.12766	-2.5	-2.34043
	T3	20	2	5.29	0.53	3.74	9.92	1.9	5.3	0.53	3.6	9.9	5.263158	-0.18868	3.888888889	0.20202
		40	0.48	1.31	0.13	3.68	9.98	0.48	1.3	0.13	3.7	10	0	0.769231	-0.540540541	-0.2
		60	0.26	0.58	0.1	2.64	5.83	0.26	0.59	0.1	2.6	5.9	0	-1.69492	1.538461538	-1.18644
Archeon Large	5WQ*	20	1.02	3.73	0.37	2.73	9.95	1	3.8	0.37	2.8	10	2	-1.84211	-2.5	-0.5
		40	0.27	0.85	0.1	2.66	8.44	0.27	0.93	0.1	2.7	9.3	0	-8.60215	-1.481481481	-9.24731
		60	0.17	0.4	0.1	1.72	3.95	0.17	0.42	0.1	1.7	4.2	0	-4.7619	1.176470588	-5.95238
	T3	20	1.86	5.03	0.5	3.69	9.97	1.9	5.6	0.5	3.8	11	-2.10526	-10.1786	-2.894736842	-9.36364
		40	0.48	1.32	0.13	3.59	9.89	0.48	1.4	0.13	3.7	11	0	-5.71429	-2.972972973	-10.0909
		60	0.27	0.58	0.1	2.69	5.79	0.27	0.62	0.1	2.7	6.2	0	-6.45161	-0.37037037	-6.6129
USSL LED	T5*	20	0.92	2.36	0.27	3.46	8.86	0.95	2.4	0.27	3.5	8.8	-3.15789	-1.66667	-1.142857143	0.681818
		40	0.28	0.59	0.1	2.74	5.77	0.28	0.59	0.1	2.8	5.9	0	0	-2.142857143	-2.20339
		60	0.17	0.26	0.1	1.7	2.63	0.17	0.27	0.1	1.7	2.7	0	-3.7037	0	-2.59259
	T3	20	1.9	5.21	0.56	3.43	9.38	2	5.9	0.56	3.6	11	-5	-11.6949	-4.722222222	-14.7273
		40	0.51	1.43	0.14	3.5	9.9	0.5	1.5	0.14	3.6	11	2	-4.66667	-2.777777778	-10
		60	0.27	0.66	0.1	2.69	6.48	0.27	0.65	0.1	2.7	6.5	0	1.538462	-0.37037037	-0.30769
Nav Navion	5MQ	20	1.36	4.34	0.46	2.95	9.42	1.4	4.4	0.46	3.1	9.5	-2.85714	-1.36364	-4.838709677	-0.84211
		40	0.35	1.04	0.1	3.36	10	0.34	1.1	0.1	3.4	11	2.941176	-5.45455	-1.176470588	-9.09091
		60	0.2	0.47	0.1	1.97	4.74	0.2	0.48	0.1	2	4.8	0	-2.08333	-1.5	-1.25
	T3	20	2.03	5.37	0.54	3.74	9.92	2	5.3	0.54	3.6	9.9	1.5	1.320755	3.888888889	0.20202
		40	0.49	1.33	0.13	3.68	9.98	0.49	1.3	0.13	3.7	10	0	2.307692	-0.540540541	-0.2
		60	0.27	0.59	0.1	2.64	5.88	0.27	0.6	0.1	2.6	5.9	0	-1.66667	1.538461538	-0.33898

* No 5MQ optics available, next closest chosen

IES Specifics:
Gan Galleon:	SA4A-730-U-
Archeon L:	PA3-140-730-U-
USSL LED:	C02-D-U-
Nav Navion:	SA4A-730-U-

Sample Fixture: Top 3 Fixtures Used
IES File Type: [Refer to Comment]

Configurations on Both Tools:
- Mount Height: [Refer to Table]
- Vertical Tilt: 0 Degree
- Head Configurations: Numbers: 1; Angle between: 0 Degree
- Arm Length: 1 ft
- Light Loss Factor: 0.864

Parameters for Luxiflux Calculation that Depend on LightARchitect Results:
- Minimum Illuminance
- Max/Min Ratio

Important Note: Ability of Luxiflux Zonal to accruately produce the paramenter's Max/Min Ratio affects all other values. Generally, more deviation from parameter settings leads to greater percent difference values.

Comment Regarding IES choice: About 20,000 lumens each, 3000K, Same Optics except where noted.

Light ARchitect's photometric calculations algorithm differs less than 2-4% on average compared to Luxiflux.

Table 3: Vertical Tilts

Fixture	Specs	Vertical Tilt	LightARchitect Reults (FC)					LuxiFlux Results (FC)					Percent Difference of LightARchitect/LuxiFlux				Sample Fixture:		Top 3 Fixtures Used
			Average	Max	Min	Average/Min	Max/Min	Average	Max	Min	Average/Min	Max/Min	Average	Max	Average/Min	Max/Min	IES File Type:		[Refer to Comment]
Gan Galleon	5MQ	15	0.7	1.88	0.2	3.47	9.37	0.68	1.9	0.2	3.4	9.3	2.941176	-1.05263	2.058823529	0.752688	Mount Height:		30 ft
		30	1.04	2.85	0.29	3.53	9.71	1	3.1	0.29	3.4	11	4	-8.06452	3.823529412	-11.7273			
		45	1.45	4.27	0.44	3.29	9.69	1.4	4.3	0.44	3.2	9.8	3.571429	-0.69767	2.8125	-1.12245	Vertical Tilt:		[Refer to Table]
	T3	15	0.62	2.15	0.22	2.82	9.77	0.63	2.1	0.22	2.9	9.7	-1.5873	2.380952	-2.75862069	0.721649	Head	Numbers:	1
		30	0.52	1.95	0.2	2.66	9.9	0.52	1.9	0.2	2.6	9.5	0	2.631579	2.307692308	4.210526	Configur ations:	Angle between:	0 Degree
		45	0.37	1.34	0.13	2.73	10	0.36	1.4	0.13	2.7	11	2.777778	-4.28571	1.111111111	-9.09091	Arm Length		1 ft
Archeon Large	5WQ*	15	0.54	1.63	0.16	3.32	9.99	0.54	1.6	0.16	3.4	10	0	1.875	-2.352941176	-0.1			
		30	0.96	2.91	0.3	3.16	9.56	0.7	2.9	0.3	3.2	9.5	37.14286	0.344828	-1.25	0.631579	Light Loss Factor:		0.864
		45	1.32	4.41	0.45	2.9	9.71	1.4	4.5	0.45	3.1	10	-5.71429	-2	-6.451612903	-2.9	Parameters for Luxiflux Calculation that Depend on LightARchitect Results:		Minimum Illuminance
	T3	15	0.69	2.59	0.26	2.62	9.8	0.69	2.5	0.26	2.6	9.7	0	3.6	0.769230769	1.030928			
		30	0.56	2.32	0.23	2.38	9.91	0.55	2.3	0.23	2.4	10	1.818182	0.869565	-0.833333333	-0.9			
		45	0.45	1.81	0.18	2.46	9.99	0.45	1.8	0.18	2.5	10	0	0.555556	-1.6	-0.1			Max/Min Ratio
USSL LED	T5*	15	0.57	1.89	0.19	2.98	9.79	0.54	1.9	0.19	3	10	5.555556	-0.52632	-0.666666667	-2.1			
		30	0.98	3.36	0.34	2.9	9.98	1	3.3	0.34	2.9	9.7	-2	1.818182	0	2.886598			
		45	1.4	4.95	0.51	2.76	9.78	1.5	4.8	0.51	2.9	9.5	-6.66667	3.125	-4.827586207	2.947368	Important Note: Ability of Luxiflux Zonal to accruately produce the paramenter's Max/Min Ratio affects all other values. Generally, more deviation from parameter settings leads to greater percent difference values.		
	T3	15	0.7	2.16	0.22	3.11	9.64	0.69	2.2	0.22	3.1	10	1.449275	-1.81818	0.322580645	-3.6			
		30	0.54	1.84	0.19	2.88	9.78	0.55	1.7	0.19	2.9	8.9	-1.81818	8.235294	-0.689655172	9.88764			
		45	0.48	1.84	0.19	2.58	9.85	0.48	1.3	0.19	2.5	6.6	0	41.53846	3.2	49.24242			
Nav Navion	5MQ	15	0.72	1.94	0.21	3.47	9.37	0.71	1.9	0.21	3.4	9.1	1.408451	2.105263	2.058823529	2.967033	Comment Regarding IES choice: About 20,000 lumens each, 3000K, Same Optics except where noted.		
		30	1.07	2.94	0.3	3.53	9.71	1	3.1	0.3	3.4	10	7	-5.16129	3.823529412	-2.9			
		45	1.49	4.4	0.45	3.29	9.69	1.4	4.4	0.45	3.1	9.8	6.428571	0	6.129032258	-1.12245			
	T3	15	0.63	2.18	0.22	2.82	9.77	0.64	2.2	0.22	2.9	9.9	-1.5625	-0.90909	-2.75862069	-1.31313			
		30	0.53	1.98	0.2	2.66	9.9	0.52	2	0.2	2.6	9.8	1.923077	-1	2.307692308	1.020408			
		45	0.37	1.36	0.14	2.73	10	0.37	1.4	0.14	2.6	10	0	-2.85714	5	0			

Comparing Illuminance Calculation for Different Vertical Tilts

* No 5MQ optics available, next closest chosen

IES Specifics:	
Gan Galleon:	SA4A-730-U-
Archeon L:	PA3-140-730-U-
USSL LED:	C02-D-U-
Nav Navion:	SA4A-730-U-

Light ARchitect's photometric calculations algorithm differs less than 2-5% on average compared to Luxiflux.

Table 4: Arm Length

Fixture	Specs	Arm Length (ft)	LightARchitect Reults (FC)					LuxiFlux Results (FC)					Percent Difference of LightARchitect/LuxiFlux				Sample Fixture:		Top 3 Fixtures Used
			Average	Max	Min	Average/Min	Max/Min	Average	Max	Min	Average/Min	Max/Min	Average	Max	Average/Min	Max/Min	IES File Type:		[Refer to Comment]
Gan Galleon	5MQ	2	0.61	1.87	0.19	3.25	9.98	0.6	1.9	0.19	3.2	9.9	1.666667	-1.57895	1.5625	0.808081	Mount Height:		30 ft
		4	0.6	1.82	0.19	3.15	9.56	0.6	1.9	0.19	3.2	9.9	0	-4.21053	-1.5625	-3.43434			
		8	0.61	1.87	0.19	3.25	9.98	0.6	1.9	0.19	3.2	9.9	1.666667	-1.57895	1.5625	0.808081	Vertical Tilt:		0 Degree
	T3	2	0.85	2.28	0.23	3.67	9.88	0.85	2.3	0.23	3.7	10	0	-0.86957	-0.810810811	-1.2	Head	Numbers:	1
		4	0.86	2.32	0.24	3.61	9.71	0.87	2.3	0.24	3.6	9.7	-1.14943	0.869565	0.277777778	0.103093	Configur ations:	Angle between:	0 Degree
		8	0.86	2.34	0.24	3.6	9.84	0.87	2.3	0.24	3.6	9.7	-1.14943	1.73913	0	1.443299	Arm Length		[Refer to Table]
Archeon Large	5WQ*	2	0.46	1.64	0.17	2.76	9.92	0.46	1.6	0.17	2.7	9.6	0	2.5	2.222222222	3.333333			
		4	0.45	1.56	0.16	2.83	9.95	0.45	1.7	0.16	2.8	10	0	-8.23529	1.071428571	-0.5	Light Loss Factor:		0.864
		8	0.46	1.64	0.17	2.76	9.92	0.46	1.7	0.17	2.7	9.8	0	-3.52941	2.222222222	1.22449	Parameters for Luxiflux Calculation that Depend on LightARchitect Results:		Minimum Illuminance
	T3	2	0.86	2.24	0.23	3.71	9.67	0.86	2.4	0.23	3.7	10	0	-6.66667	0.27027027	-3.3			
		4	0.88	2.42	0.24	3.65	9.98	0.87	2.5	0.24	3.6	10	1.149425	-3.2	1.388888889	-0.2			
		8	0.85	2.36	0.24	3.59	9.95	0.87	2.4	0.24	3.6	10	-2.29885	-1.66667	-0.277777778	-0.5			Max/Min Ratio
USSL LED	T5*	2	0.4	1.04	0.1	3.81	9.95	0.39	1	0.1	3.9	10	2.564103	4	-2.307692308	-0.5			
		4	0.4	1.03	0.1	3.83	9.94	0.39	1	0.1	3.9	10	2.564103	3	-1.794871795	-0.6			
		8	0.4	1.04	0.1	3.81	9.95	0.39	1	0.1	3.9	10	2.564103	4	-2.307692308	-0.5	Important Note: Ability of Luxiflux Zonal to accruately produce the paramenter's Max/Min Ratio affects all other values. Generally, more deviation from parameter settings leads to greater percent difference values.		
	T3	2	0.86	2.31	0.23	3.7	9.92	0.85	2.6	0.23	3.7	11	1.176471	-11.1538	0	-9.81818			
		4	0.89	2.48	0.25	3.59	9.98	0.89	2.6	0.25	3.6	10	0	-4.61538	-0.277777778	-0.2			
		8	0.88	2.57	0.26	3.42	9.91	0.92	2.6	0.27	3.4	9.7	-4.34783	-1.15385	0.588235294	2.164948			
Nav Navion	5MQ	2	0.63	1.92	0.19	3.25	9.98	0.62	1.9	0.19	3.3	10	1.612903	1.052632	-1.515151515	-0.2	Comment Regarding IES choice: About 20,000 lumens each, 3000K, Same Optics except where noted.		
		4	0.62	1.87	0.2	3.15	9.56	0.62	1.9	0.2	3.1	9.7	0	-1.57895	1.612903226	-1.4433			
		8	0.63	1.92	0.19	3.25	9.98	0.62	1.9	0.19	3.3	10	1.612903	1.052632	-1.515151515	-0.2			
	T3	2	0.86	2.32	0.23	3.67	9.88	0.86	2.4	0.23	3.7	10	0	-3.33333	-0.810810811	-1.2			
		4	0.88	2.36	0.24	3.61	9.71	0.88	2.4	0.24	3.6	9.8	0	-1.66667	0.277777778	-0.91837			
		8	0.87	2.37	0.24	3.6	9.84	0.87	2.4	0.24	3.6	9.9	0	-1.25	0	-0.60606			

Comparing Illuminance Calculation for Different Arm Length

* No 5MQ optics available, next closest chosen

IES Specifics:	
Gan Galleon:	SA4A-730-U-
Archeon L:	PA3-140-730-U-
USSL LED:	C02-D-U-
Nav Navion:	SA4A-730-U-

Light ARchitect's photometric calculations algorithm differs less than 1-3% on average compared to Luxiflux.

Table 5: Colors

Comparing Illuminance Calculation for Different Colors

Fixture	Specs	Color (K)	LightARchitect Reults (FC)					LuxiFlux Results (FC)					Percent Difference of LightARchitect/LuxiFlux			
			Average	Max	Min	Average/Min	Max/Min	Average	Max	Min	Average/Min	Max/Min	Average	Max	Average/Min	Max/Min
Gan Galleon	5MQ	3000	0.61	1.88	0.19	3.22	9.94	0.6	1.9	0.19	3.2	9.9	1.666667	-1.05263	0.625	0.40404
		4000	0.67	2.06	0.21	3.22	9.94	0.66	2.1	0.21	3.2	9.8	1.515152	-1.90476	0.625	1.428571
		5000	Not Availabe in LightARchitect													
	T3	3000	0.85	2.31	0.23	3.64	9.92	0.85	2.3	0.23	3.7	10	0	0.434783	-1.621621622	-0.8
		4000	0.93	2.53	0.26	3.64	9.92	0.94	2.6	0.26	3.6	9.9	-1.06383	-2.69231	1.111111111	0.20202
		5000	Not Availabe in LightARchitect													
Archeon Large	5WQ*	3000	0.45	1.67	0.17	2.73	10	0.46	1.7	0.17	2.7	9.7	-2.17391	-1.76471	1.111111111	3.092784
		4000	0.5	1.83	0.18	2.73	10	0.5	1.8	0.18	2.8	10	0	1.666667	-2.5	0
		5000	Not Availabe in LightARchitect													
	T3	3000	0.85	2.24	0.23	3.69	9.75	0.85	2.5	0.23	3.7	11	0	-10.4	-0.27027027	-11.3636
		4000	0.93	2.46	0.25	3.69	9.75	0.93	2.7	0.25	3.7	11	0	-8.88889	-0.27027027	-11.3636
		5000	Not Availabe in LightARchitect													
USSL LED	T5*	3000	0.4	1.05	0.11	3.77	9.94	0.41	1	0.11	3.7	9.5	-2.43902	5	1.891891892	4.631579
		4000	0.41	1.07	0.11	3.77	9.94	0.41	1.1	0.11	3.8	9.7	0	-2.72727	-0.789473684	2.474227
		5000	0.41	1.09	0.11	3.77	9.94	0.42	1.1	0.11	3.8	9.8	-2.38095	-0.90909	-0.789473684	1.428571
	T3	3000	0.91	2.5	0.26	3.58	9.79	0.9	2.6	0.26	3.4	10	1.111111	-3.84615	5.294117647	-2.1
		4000	0.93	2.54	0.26	3.58	9.79	0.91	2.6	0.26	3.5	10	2.197802	-2.30769	2.285714286	-2.1
		5000	0.95	2.59	0.26	3.58	9.79	0.92	2.7	0.26	3.5	10	3.26087	-4.07407	2.285714286	-2.1
Nav Navion	5MQ	3000	0.63	1.94	0.19	3.22	9.94	0.62	1.9	0.19	3.2	10	1.612903	2.105263	0.625	-0.6
		4000	0.69	2.13	0.21	3.22	9.94	0.68	2.1	0.21	3.2	10	1.470588	1.428571	0.625	-0.6
		5000	Not Availabe in LightARchitect													
	T3	3000	0.86	2.34	0.24	3.64	9.92	0.87	2.4	0.24	3.6	9.9	-1.14943	-2.5	1.111111111	0.20202
		4000	0.94	2.57	0.26	3.64	9.92	0.95	2.6	0.26	3.6	10	-1.05263	-1.15385	1.111111111	-0.8
		5000	Not Availabe in LightARchitect													

* No 5MQ optics available, next closest chosen

IES Specifics:	
Gan Galleon:	SA4A-7[3/4/5]0-U-
Archeon L:	PA3-140-7[3/4/5]0-U-
USSL LED:	C02-D-U-
Nav Navion:	SA4A-7[3/4/5]0-U-

Sample Fixture: Top 3 Fixtures Used
IES File Type: [Refer to Comment]
Configurations on Both Tools:
- Mount Height: 30 ft
- Vertical Tilt: 0 Degree
- Head Configuration: Numbers: 1, Angle between: 0 Degree
- Arm Length: 1 ft

Light Loss Factor: 0.864
Parameters for Luxiflux Calculation that Depend on LightARchitect Results: Minimum Illuminance, Max/Min Ratio

Important Note: Ability of Luxiflux Zonal to accruately produce the paramenter's Max/Min Ratio affects all other values. Generally, more deviation from parameter settings leads to greater percent difference values.

Comment Regarding IES choice: About the same lumens for each color across chosen fixtures, Same Optics except where noted.

Light ARchitect's photometric calculations algorithm differs less than 1-3% on average compared to Luxiflux.

Table 6: Number of Heads

Comparing Illuminance Calculation for Different Number of Heads

Optics	Head Configs*	LightARchitect Reults (FC)					LuxiFlux Results (FC)					Percent Difference of LightARchitect/LuxiFlux			
		Average	Max	Min	Average/Min	Max/Min	Average	Max	Min	Average/Min	Max/Min	Average	Max	Average/Min	Max/Min
5MQ	2h / 180	1.22	3.76	0.39	3.15	9.72	1.2	3.7	0.39	3.1	9.6	1.666667	1.621622	1.612903226	1.25
	3h / 90	1.83	5.64	0.58	3.17	9.79	1.8	5.6	0.58	3.1	9.7	1.666667	0.714286	2.258064516	0.927835
	3h / 120	1.79	5.64	0.57	3.12	9.83	1.8	5.6	0.57	3.2	9.9	-0.55556	0.714286	-2.5	-0.70707
	4h / 90	2.44	7.52	0.78	3.12	9.62	2.4	7.5	0.78	3.1	9.6	1.666667	0.266667	0.64516129	0.208333
T2	2h / 180	1.3	3.98	0.41	3.2	9.82	1.3	4.1	0.41	3.1	9.9	0	-2.92683	3.225806452	-0.80808
	3h / 90	2.02	6.29	0.68	2.96	9.23	2.1	6.7	0.68	3	9.9	-3.80952	-6.1194	-1.333333333	-6.76768
	3h / 120	2.09	6.83	0.69	3.02	9.86	2.1	6.7	0.69	3	9.7	-0.47619	1.940299	0.666666667	1.649485
	4h / 90	2.46	7.49	0.77	3.17	9.66	2.6	8.1	0.77	3.3	10	-5.38462	-7.53086	-3.939393939	-3.4
T2R	2h / 180	1.81	4.8	0.52	3.51	9.31	1.9	5	0.52	3.6	9.6	-4.73684	-4	-2.5	-3.02083
	3h / 90	2.95	8.62	0.9	3.26	9.53	3	8.8	0.9	3.3	9.7	-1.66667	-2.04545	-1.212121212	-1.75258
	3h / 120	2.98	7.8	0.79	3.76	9.84	3	8	0.79	3.7	10	-0.66667	-2.5	1.621621622	-1.6
	4h / 90	3.44	9.57	0.96	3.58	9.95	3.6	9.9	0.96	3.7	10	-4.44444	-3.33333	-3.243243243	-0.5
T3	2h / 180	1.32	4.31	0.45	2.94	9.6	1.4	4.3	0.45	3	9.6	-5.71429	0.232558	-2	0
	3h / 90	2.04	6.56	0.66	3.09	9.96	2	6.5	0.66	3.1	9.9	2	0.923077	-0.322580645	0.606061
	3h / 120	2.06	6.46	0.65	3.18	9.95	2.1	6.5	0.66	3.1	9.8	-1.90476	-0.61538	2.580645161	1.530612
	4h / 90	2.74	8.62	0.99	2.76	8.67	2.8	8.6	0.99	2.8	8.7	-2.14286	0.232558	-1.428571429	-0.34483
T3R	2h / 180	1.55	5.89	0.6	2.6	9.84	1.5	5.8	0.6	2.6	9.7	3.333333	1.551724	0	1.443299
	3h / 90	2.45	8.83	0.93	2.64	9.53	2.4	8.7	0.93	2.6	9.4	2.083333	1.494253	1.538461538	1.382979
	3h / 120	2.37	8.83	0.89	2.67	9.93	2.3	8.7	0.89	2.6	9.8	3.043478	1.494253	2.692307692	1.326531
	4h / 90	3.05	11.77	1.18	2.59	9.96	3.1	12	1.2	2.6	9.8	-1.6129	-1.91667	-0.384615385	1.632653
T4FT	2h / 180	1.34	5.3	0.53	2.5	9.92	1.3	5.3	0.53	2.5	10	3.076923	0	0	-0.8
	3h / 90	2.08	7.95	0.8	2.62	9.99	2.1	8	0.8	2.6	10	-0.95238	-0.625	0.769230769	-0.1
	3h / 120	2.14	7.95	0.8	2.68	9.98	2.1	8	0.8	2.7	10	1.904762	-0.625	-0.740740741	-0.2
	4h / 90	2.76	10.6	1.13	2.45	9.41	2.8	11	1.1	2.5	9.4	-1.42857	-3.63636	-2	0.106383
T4W	2h / 180	1.08	3.6	0.36	2.98	9.92	1.1	3.8	0.36	3	11	-1.81818	-5.26316	-0.666666667	-9.81818
	3h / 90	1.65	5.28	0.53	3.08	9.87	1.6	5.4	0.53	3.1	10	3.125	-2.22222	-0.64516129	-1.3
	3h / 120	1.69	5.35	0.56	3.02	9.55	1.7	5.4	0.56	3	9.7	-0.58824	-0.92593	0.666666667	-1.54639
	4h / 90	2.12	6.86	0.71	2.98	9.64	2.2	7.2	0.71	3	10	-3.63636	-4.72222	-0.666666667	-3.6

Configs*: Head Configuration values are as follow: _h / _ means _ # of Heads at _ Degrees between heads

Sample Fixture: Gan Galleon
IES File Type: SA4A-730-U-[Chart]
Configurations on Both Tools:
- Mount Height: 30 ft
- Vertical Tilt: 0 Degree
- Head Configurations: Numbers: [Refer to Chart], Angle between: [Refer to Chart]
- Arm Length: 1 ft

Light Loss Factor: 0.864
Parameters for Luxiflux Calculation that Depend on LightARchitect Results: Minimum Illuminance, Max/Min Ratio

Important Note: Ability of Luxiflux Zona to accruately produce the paramenter's Max/Min Ratio affects all other values. Generally, more deviation from parameter settings leads to greater percent difference values.

Light ARchitect's photometric calculations algorithm differs less than 2% on average compared to Luxiflux.