LPD Analysis Instructions

(Updated 2014-03-19 by Jinsol Kim, Amy Patel)

Overview

Lighting power density (LPD) limits are a major part of all current building energy codes that indicate whether a space offers opportunities for energy savings. They set maximums for installed power over a defined area expressed in watts per square foot (W/ft_2).

There are two primary calculation methods for analyzing Lighting Power Density (LPD): **Building Area Method and the Space by Space Method**.

This Revit Add-in allows you to calculate LPD with both methods – using area plans and lighting fixtures placed in the model. The Revit category, "Spaces" and "Rooms", are not used in the context of this add-in. The LPD values are calculated based on Area elements only.

Additionally, we recommend that both calculation methods are used on your project to achieve the most accurate results.

Note: This version is only compatible if the project is in Imperial units. A metric version will be available once we determine both need and calculation requirements.

A video demonstrating the use of this tool can be found here:
http://www.knowledgenet.hok.com/BIM%20Resources/Education/Downloads%20Revit/Revit%20Addin%20-%20LPD%20Calculator/HOK_LPDAnalysisRevit.mp4

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Knowledge Prerequisites

Before using this add-in, the user should have an understanding of the functions utilized for this tool in Revit. These include, but are not limited to:

- Updating parameter values
- Inserting schedules from a file and updating values
- Loading families
- Creating area plans

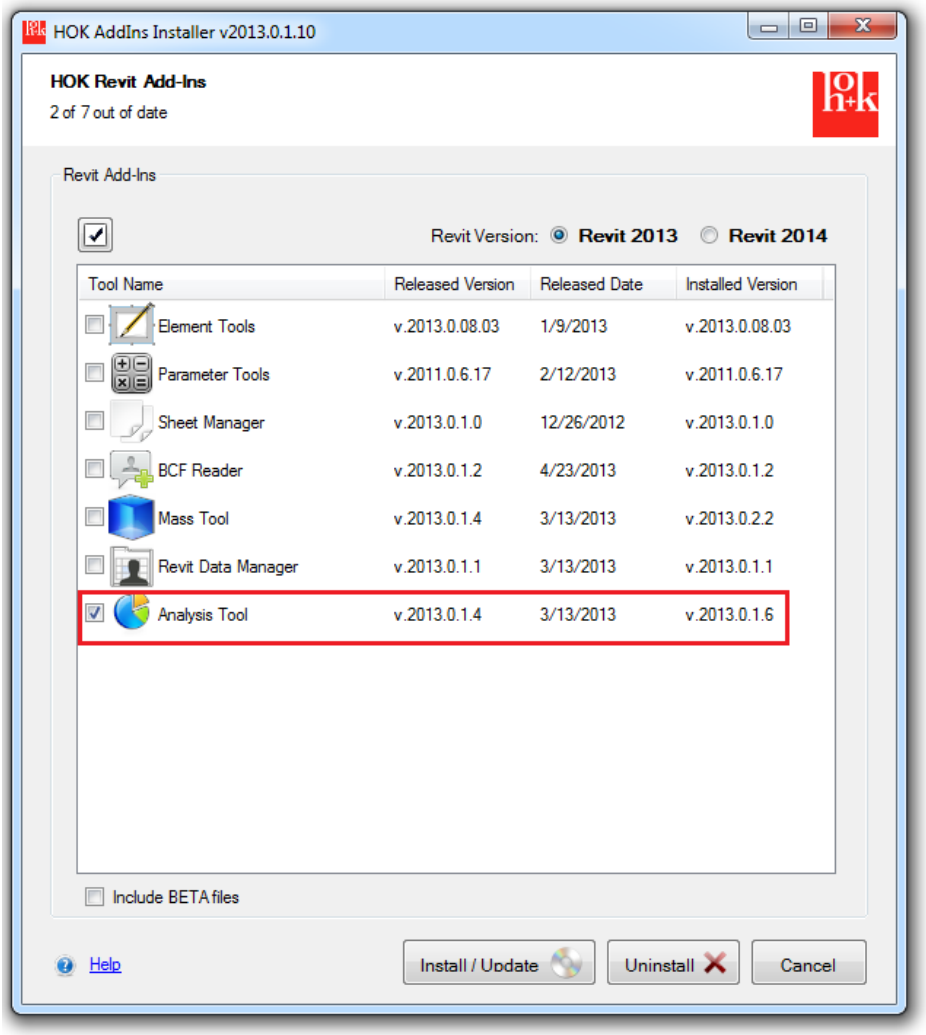
Data Prerequisites

To ensure accurate results, the following data must be included in the Revit model:

- Apparent Load values (type parameter) for each light fixture family placed in the model. These values will be provided by the Lighting Designer or Lighting Specifier on your project.
- Location of where area boundary lines are to be placed based on calculation method. Read further for instructions or contact the Lighting Designer or Lighting Specifier on your project for further information regarding this.

Installation

LPD Analysis exists within the Analysis Tool in the HOK Addins Installer. Make sure you have selected the appropriate version of Revit before installing. Contact your buildingSMART Manager if you need assistance.

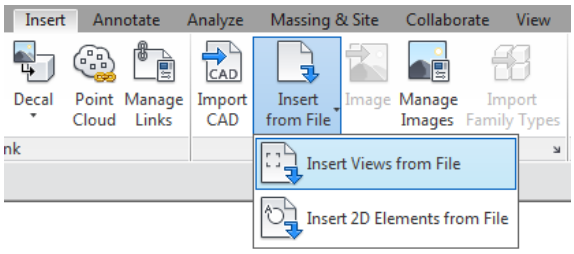


1. Building Area Method

This method calculates LPD by allowing for a whole building power allowance by assigning a common ASHRAE space type for all areas in the project.

1.1 Model Requirements

1. **Insert Schedules**



Use the Insert Views from File command and navigate to either:

V:\RVT2013\HOK Content\Schedules.

V:\RVT2014\HOK Content\HOK Schedules.

Select the **LPD SCHEDULE.rvt** file and insert the following schedules:

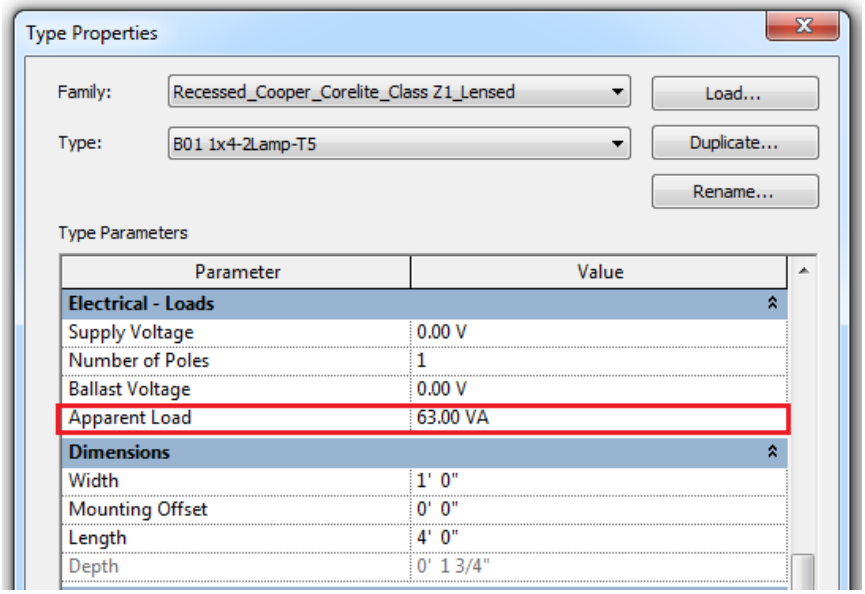
- **LPD (BUILDING AREA METHOD)**
- **ASHRAE 90.1 2007 Allowable LPD (BUILDING AREA METHOD)**
- **LIGHTING FIXTURE APPARENT LOAD**

2. **Load Families**

   Load the **LPD_BuildingAreaMethod_HOK_I.rfa** from either *V:\RVT2013 or RVT2014\HOK Content\HOK Imperial Library\Annotations\Generic Tags.*

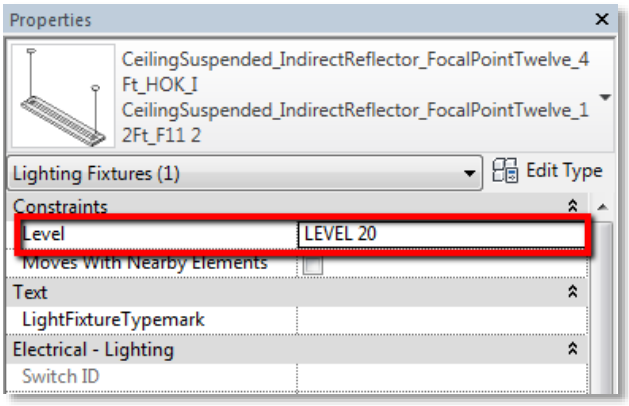
3. **Update Lighting Fixture Parameters**

   Make sure all lighting fixtures placed in the model have the correct value for the *Apparent Load* parameter in the type properties of the family. This parameter should be in Volt Amperes (VA) not Watts (W).



4. Levels

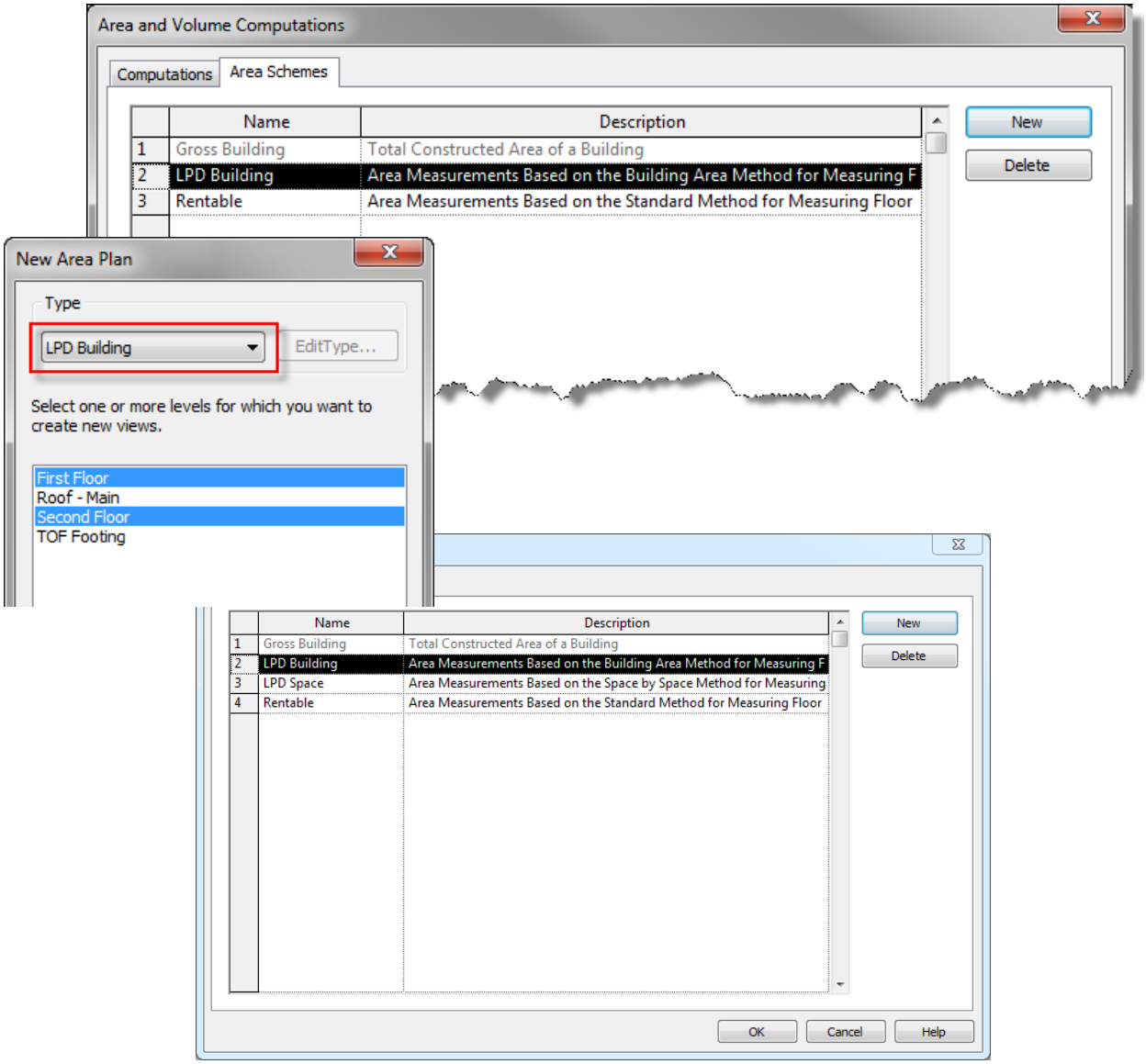
Make sure the light fixtures are assigned to appropriate levels. The LPD Analysis add-in will capture lighting fixtures based on the level with which they are associated. In the Properties palette, verify the Level or Schedule Level parameter in the instance properties of the light fixture family.



5. Create Area Plans on appropriate Area Scheme

Area plans that reflect the appropriate areas to be included in the calculations are to be created under the LPD Building area scheme. This area scheme should be automatically

added to your model if you have inserted the schedules listed in step 1. If the LPD Building area scheme does not exist within your project, click the New button and create it.



Create area plans for the LPD Building area scheme. Add boundary lines based on the calculation rules below. Place Areas, tag and name them.

Area boundary lines should be carefully drawn following the appropriate calculation rules.

For the Building Area Method

i. Determine the gross lighted floor area (square feet) of the building area type. (Do not include unlit shafts within the area boundary).
ii. Draw area boundary lines around the outside of the exterior wall, glazing, etc. for each level. This includes balconies and other projections that are considered

part of the interior space. (Remove any non-illuminated areas like mechanical shafts).

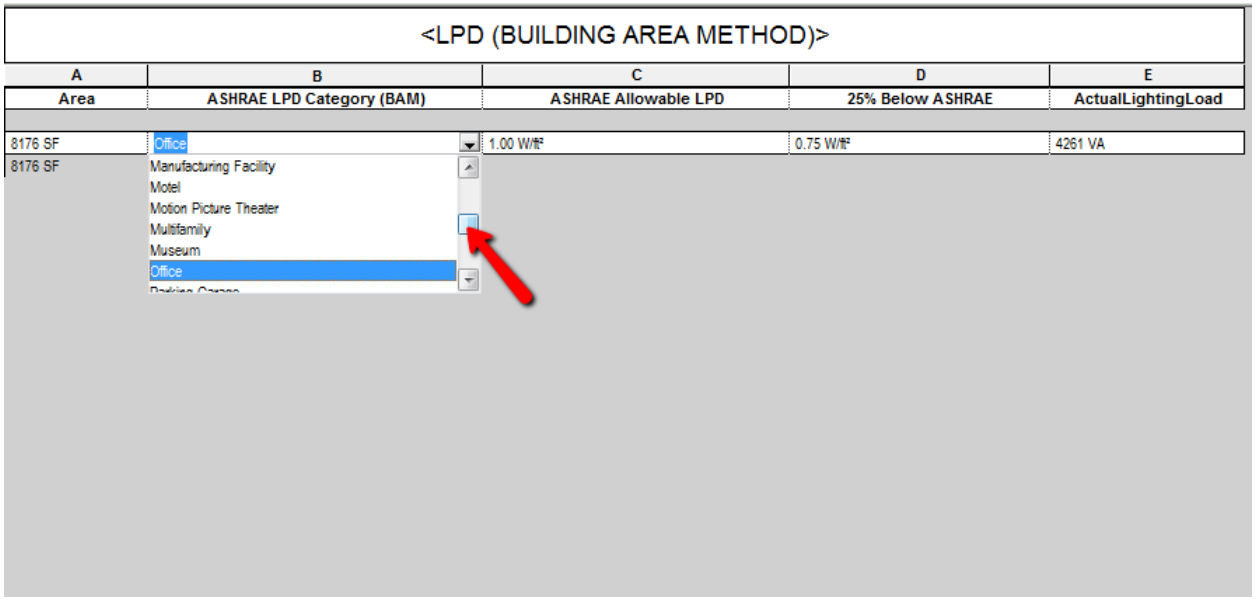
iii. Closets smaller than 20sf may be considered as part of adjacent space type. Closets over 20sf should be identified separately as “active storage”.

iv. Place an area and area tag in the new boundary. Select the new area, and within the properties select the appropriate “ASHRAE LPD Category (BAM)”. These are referenced from ASHRAE 90.1 Table 9.5.1 Lighting Power Densities Using the Building Area Method.

*If you are unclear about the rules for area boundaries, contact the Lighting Designer or Lighting Specifier on your project.

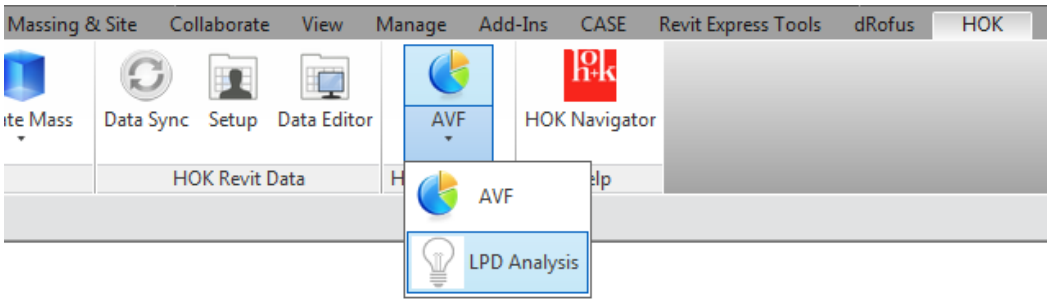
6. Update Schedule

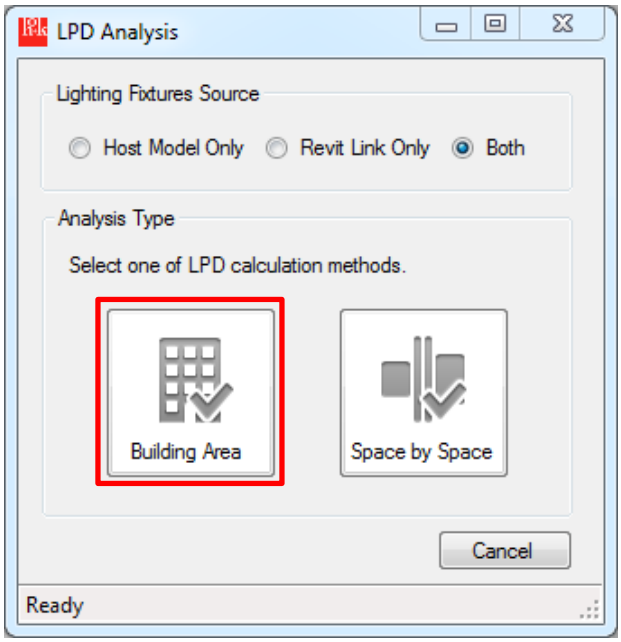
In the **LPD (BUILDING AREA METHOD)** schedule, select the appropriate building type under the ASHRAE LPD Category (BAM) field for each area. Corresponding ASHRAE Allowable LPD values will populate.



1.2 Calculations

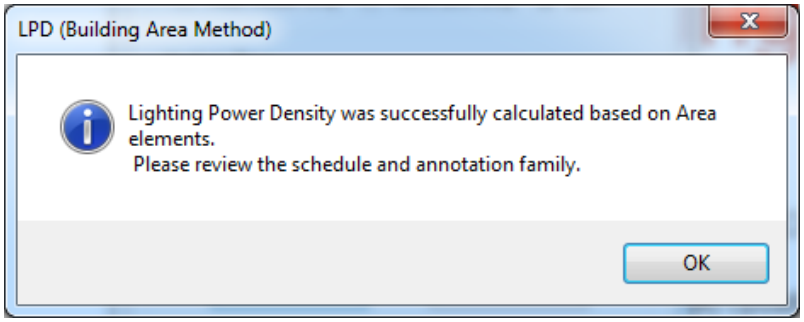
The LPD Analysis command can be found in the HOK Analysis panel under the HOK ribbon in Revit. *HOK tab >> HOK Analysis Panel >> AVF >> LPD Analysis.*





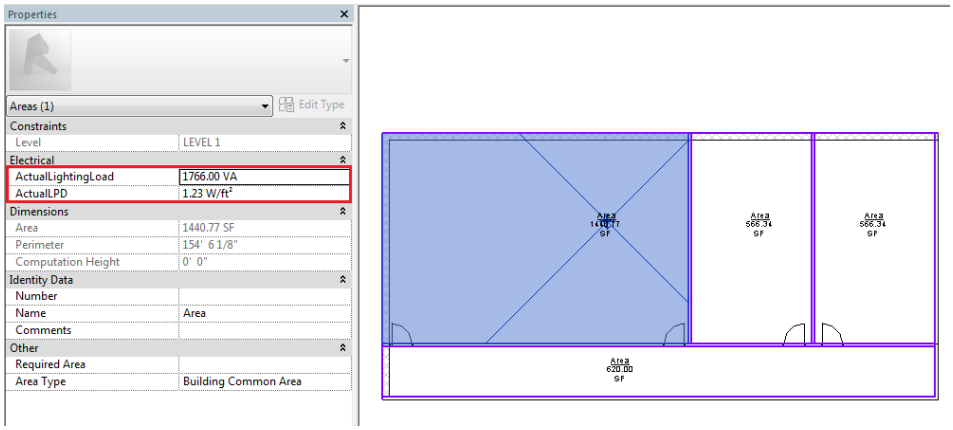
First, choose the source for the lighting fixtures. The add-in can analyze the fixtures in the Host Model Only, in Revit Links Only, or Both. Then select the **Building Area** analysis type. This will calculate the Actual LPD and schedule the areas outlined in the "LPD Building" area plans you have created along with the Apparent Load (VA).

After the completion of the LPD calculation, you will see this message indicating the LPD was successfully calculated:



1.3 Results

Once the LPD calculation is complete, select the area elements to inspect the values for Actual Lighting Load and Actual LPD.



Place the **LPD_ BuildingAreaMethod_HOK_I** annotation family in the area plan or on a sheet to report the results.

This generic annotation family will report the ASHRAE allowable and actual lighting loads, area, actual LPD, target reduction and the final % LPD reduction.

LIGHTING POWER DENSITY SUMMARY
BUILDING AREA METHOD

ASHRAE LPD CATEGORY:	
ASHRAE ALLOWABLE LPD:	0.00 W/ft²
HOK AIA 2030 TARGET LPD REDUCTION:	0.00 W/ft²
ACTUAL LIGHTING LOAD:	0 VA
AREA:	0.00 SF
ACTUAL LPD:	0.00 W/ft²
% REDUCTION:	0.00%

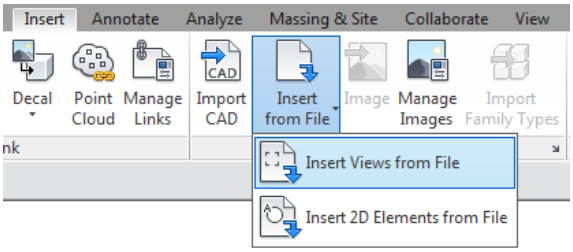
LPD CALCULATED BY:
LIGHTING SPECIFIER:

2. Space by Space Method

This method will be used when there is not a common ASHRAE space type within the building. It assigns an allowance for individual spaces with different use types.

2.1 Model Requirements

1. Insert Schedules



Use the Insert Views from File command and navigate to either:

V:\RVT2013\HOK Content\Schedules

V:\RVT2014\HOK Content\HOK Schedules

Select the file **LPD SCHEDULE.rvt** and insert the following schedules:

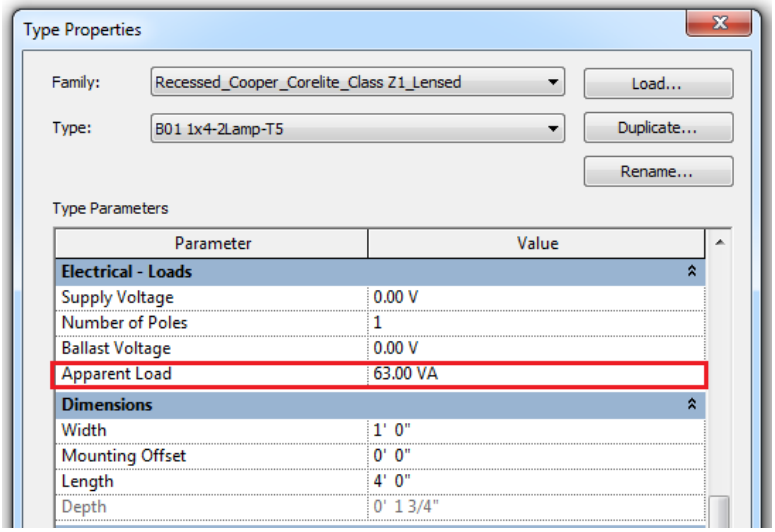
- **LPD (SPACE BY SPACE METHOD)**
- **ASHRAE 90.1 2007 Allowable LPD (SPACE BY SPACE METHOD)**
- **LIGHTING FIXTURE APPARENT LOAD**

2. Load Families

Load the **LPD_SpaceBySpaceMethod_HOK_I.rfa** from *V:\RVT2013 or RVT2014\HOK Content\HOK Imperial Library\Annotations\Generic Tags.*

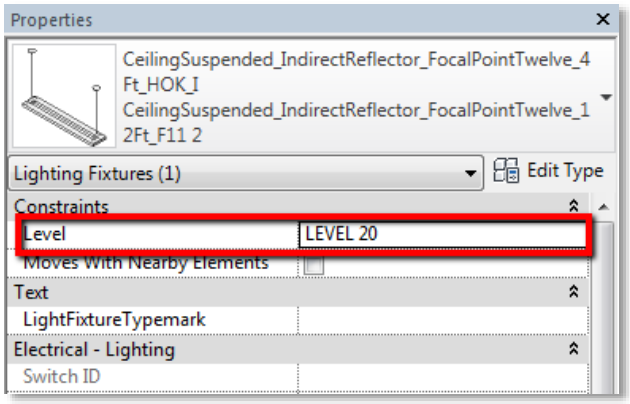
3. Update Lighting Fixture Parameters

Make sure all lighting fixtures placed in the model have the correct value for the *Apparent Load* parameter in the type properties of the family. This parameter should be in Volt Amperes (VA) not Watts (W).



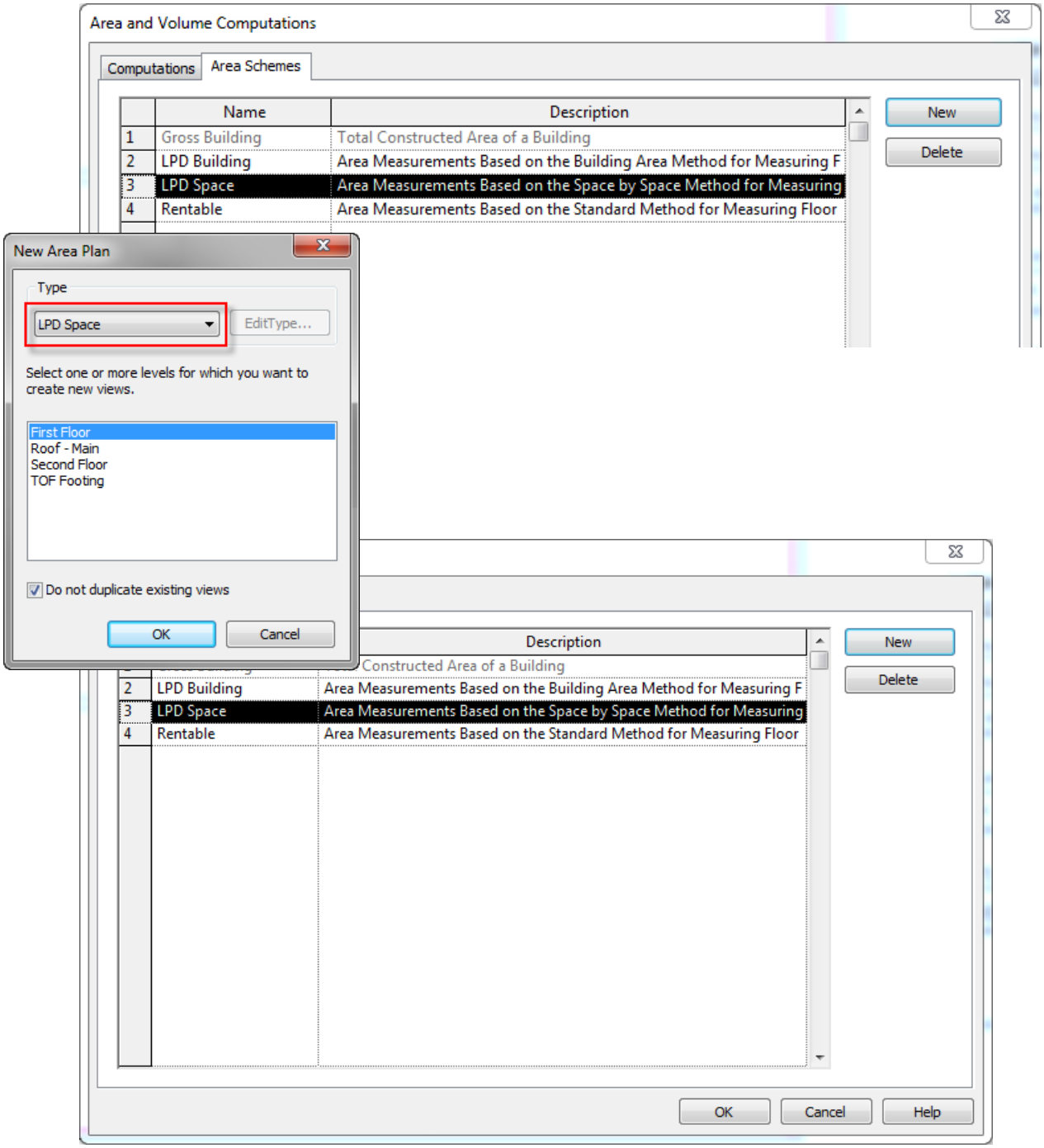
4. Levels

Make sure the light fixtures are assigned to appropriate levels. The LPD Analysis add-in will calculate lighting fixtures based on the level with which they are associated. In the Properties palette, verify the Level or Schedule Level parameter in the instance properties of the light fixture family.



5. Create Area Plans on appropriate Area Scheme

Area plans that reflect the appropriate areas to be included in the calculations are to be created under the LPD Space area scheme. This area scheme should be automatically added to your model if you have inserted the schedules listed in step 1. If the LPD Building area scheme does not exist within your project, click the New button and create it.



Create area plans for the LPD Space Area Scheme. Add boundary lines based on the calculation rules below. Place Areas, tag and name them.

Area boundary lines should be carefully drawn following the appropriate calculation rules.

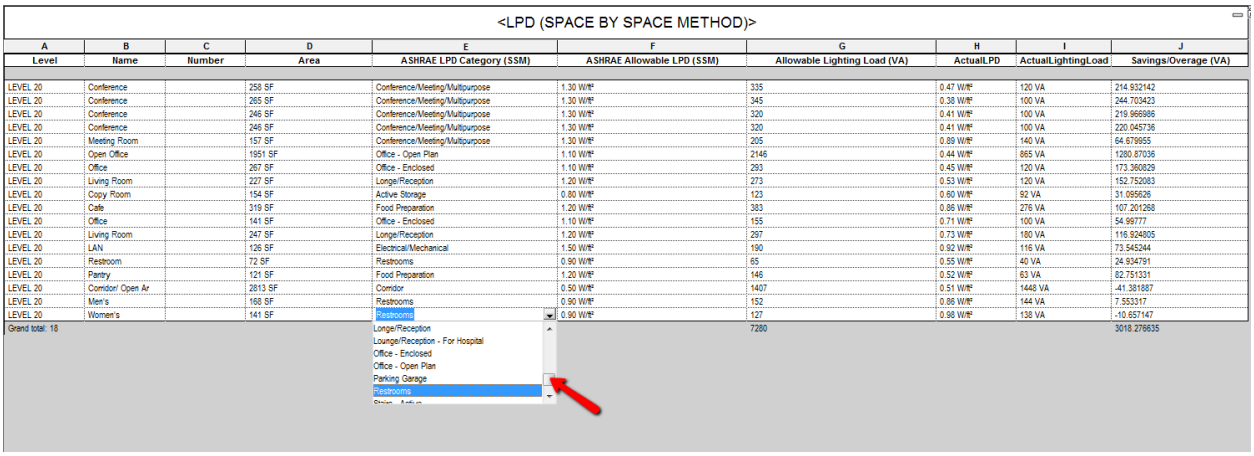
For the Space-by-Space Method:

i. Determine the gross lighted floor area (square feet) of the space type. (Do not include unlit shafts within the area boundary).
ii. Draw area boundary lines on the outside of the perimeter wall, and to the center of the interior partition wall. Include floor area balconies or other projections that are considered part of the interior space. (Remove any non-illuminated areas like mechanical shafts)
iii. Closets smaller than 20sf may be considered as part of adjacent space type. Closets over 20sf should be identified separately as "active storage".
v. Place Areas in the new boundaries, place an Area tag in each new area. For each new area, select the appropriate “ASHRAE LPD Category (SSM)” within the properties. These are referenced from ASHRAE 90.1 Table 9.5.1 Lighting Power Densities Using the Space-by-Space Method.

*If you are unclear about this, contact the Lighting Designer or Lighting Specifier on your project.

6. Update Schedule

In the **LPD (SPACE BY SPACE METHOD)** schedule, select the appropriate space types under the ASHRAE LPD Category (SSM) field. Corresponding ASHRAE Allowable LPD values will populate.



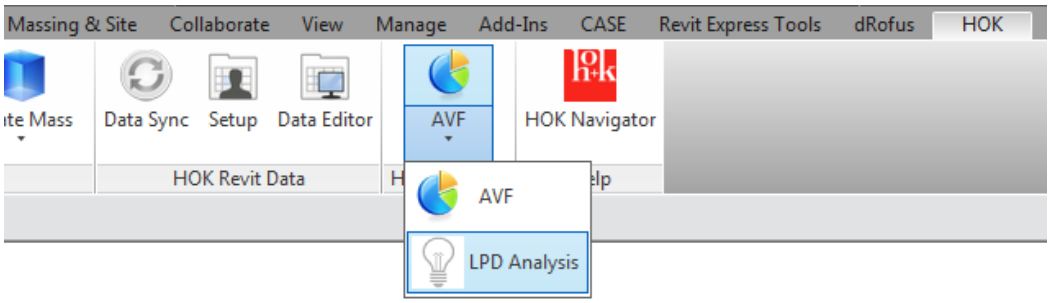
<LPD (SPACE BY SPACE METHOD)>

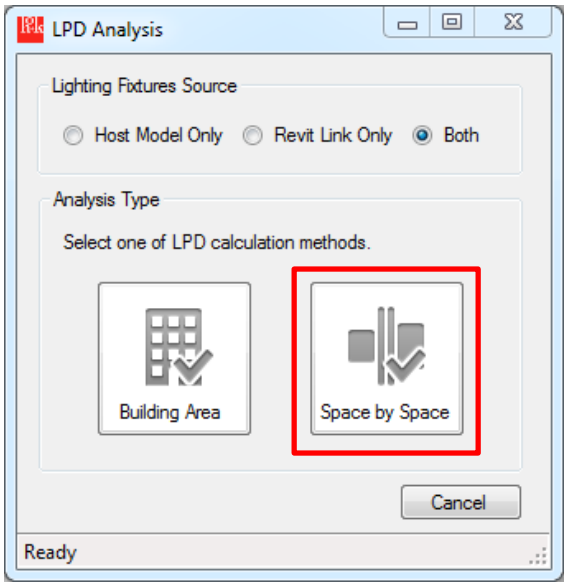
A	B	C	D	E	F	G	H	I	J
Level	Name	Number	Area	ASHRAE LPD Category (SSM)	ASHRAE Allowable LPD (SSM)	Allowable Lighting Load (VA)	ActualLPD	ActualLightingLoad	Savings/Overage (VA)
LEVEL 20	Conference		258 SF	Conference/Meeting/Multipurpose	1.30 W/ft²	335	0.47 W/ft²	120 VA	214.932142
LEVEL 20	Conference		265 SF	Conference/Meeting/Multipurpose	1.30 W/ft²	345	0.38 W/ft²	100 VA	244.703423
LEVEL 20	Conference		246 SF	Conference/Meeting/Multipurpose	1.30 W/ft²	320	0.41 W/ft²	100 VA	219.966986
LEVEL 20	Conference		246 SF	Conference/Meeting/Multipurpose	1.30 W/ft²	320	0.41 W/ft²	100 VA	220.045736
LEVEL 20	Meeting Room		157 SF	Conference/Meeting/Multipurpose	1.30 W/ft²	205	0.89 W/ft²	140 VA	64.679955
LEVEL 20	Open Office		1951 SF	Office - Open Plan	1.10 W/ft²	2146	0.44 W/ft²	865 VA	1280.87036
LEVEL 20	Office		267 SF	Office - Enclosed	1.10 W/ft²	293	0.45 W/ft²	120 VA	173.360829
LEVEL 20	Living Room		227 SF	Lounge/Reception	1.20 W/ft²	273	0.53 W/ft²	120 VA	152.752083
LEVEL 20	Copy Room		154 SF	Active Storage	0.80 W/ft²	123	0.60 W/ft²	92 VA	31.095626
LEVEL 20	Cafe		319 SF	Food Preparation	1.20 W/ft²	383	0.86 W/ft²	276 VA	107.201268
LEVEL 20	Office		141 SF	Office - Enclosed	1.10 W/ft²	155	0.71 W/ft²	100 VA	54.99777
LEVEL 20	Living Room		247 SF	Lounge/Reception	1.20 W/ft²	297	0.73 W/ft²	180 VA	116.924805
LEVEL 20	LAN		126 SF	Electrical/Mechanical	1.50 W/ft²	190	0.92 W/ft²	116 VA	73.545244
LEVEL 20	Restroom		72 SF	Restrooms	0.90 W/ft²	65	0.55 W/ft²	40 VA	24.934791
LEVEL 20	Pantry		121 SF	Food Preparation	1.20 W/ft²	148	0.52 W/ft²	63 VA	82.751331
LEVEL 20	Corridor/ Open Air		2813 SF	Corridor	0.50 W/ft²	1407	0.51 W/ft²	1448 VA	-41.381887
LEVEL 20	Men's		168 SF	Restrooms	0.90 W/ft²	152	0.86 W/ft²	144 VA	7.553317
LEVEL 20	Women's		141 SF	Restrooms	0.90 W/ft²	127	0.98 W/ft²	138 VA	-10.657147
Grand total: 18						7280			3018.276635

Lounge/Reception
Lounge/Reception - For Hospital
Office - Enclosed
Office - Open Plan
Parking Garage
Restrooms

2.2 Calculation

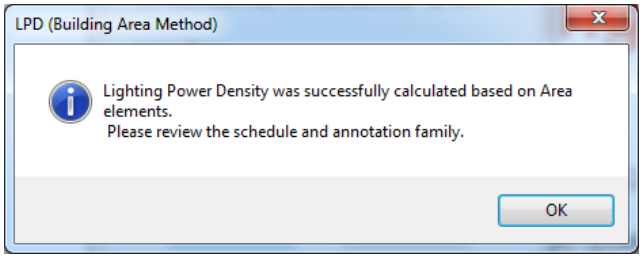
The LPD Analysis command can be found in the HOK Analysis panel under the HOK ribbon in Revit. *HOK tab >> HOK Analysis Panel >> AVF >> LPD Analysis.*





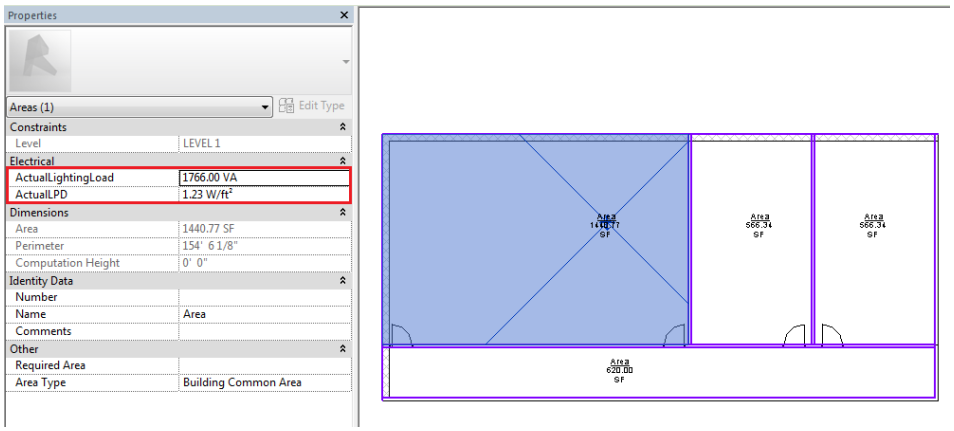
First, choose the source for the lighting fixtures. The add-in can analyze the fixtures in the Host Model Only, in Revit Links Only, or Both. Then select the **Space by Space** analysis type. This will calculate the Actual LPD and schedule the areas outlined in the LPD area plans you have created along with the Apparent Load (VA).

After the completion of the LPD calculation, you will see this message indicating the LPD was successfully calculated:



2.3 Results

Once the LPD calculation is complete, select the area elements to inspect the values for Actual Lighting Load and Actual LPD in the Properties palette.



Place the **LPD_ SpacebySpaceMethod _HOK_I** annotation family on the area plan or on a sheet to report the results.

This generic annotation family will report the total allowable and actual lighting loads, area, actual LPD, total savings and the final % LPD reduction.

LIGHTING POWER DENSITY SUMMARY
SPACE BY SPACE METHOD

TOTAL ALLOWABLE LIGHTING LOAD:[1]	0 VA
TOTAL ACTUAL LIGHTING LOAD:[2]	0 VA
TOTAL SAVINGS/OVERAGE:	0 VA
AREA:	0.00 SF
ACTUAL LPD:	0.00 W/ft²
% REDUCTION:	0.00%

LPD CALCULATED BY:
LIGHTING SPECIFIER:

FOOTNOTES:
1. "TOTAL ALLOWABLE LIGHTING LOAD" from LPD Space By Space method schedule.
2. "TOTAL ACTUAL LIGHTING LOAD" from All Lighting Fixtures of the project.