

Lighting Power Density (LPD) Public User's Manual

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1 LPD Applications

1.1 Background

This software provides a comprehensive source for understanding the lighting models underlying the commercial lighting power limits developed in ASHRAE/IESNA 90.1-2004.

The software is intended for use by building code commissions and other interested practitioners. Increased understanding of the lighting models will promote reliance on the lighting power density (LPD) limits as the basis for state energy code lighting requirements and the advancement of lighting, quality and more energy efficient lighting design.

The methodology used by the software calculates lighting power allowances for building spaces and whole buildings. It models lighting design assumptions from a consensus of lighting design professionals for each of the space types used in 90.1-2004, using currently available efficient lamp/ballast/fixture data, and illuminance values from IESNA illuminance recommendations (IESNA Lighting Handbook, 9th edition). In this way, the needs of the occupants are taken into account and energy-efficient design is promoted through the resulting LPD's.

Since lighting accounts for a large portion of energy consumption of a building, significant energy savings are possible if lighting power limits are included in building energy codes. This software has been developed to aid building code commissions in developing energy codes for commercial buildings and it incorporates currently available lighting product characteristics, light loss factors, building construction data and professional design experience.

1.2 How LPD Values are calculated

The process for determining the lighting power density (LPD) values in watts/square foot is a linear calculation with user inputs or default values at various points.

The program makes the following assumptions about each space type in order to calculate the space type LPD:

1. The percentage of the space dedicated to task lighting, and the percentage dedicated to general lighting.
2. The illumination levels for both the task lighting and the general lighting. The program uses published IESNA recommended footcandles for this assumption where applicable.
3. A Room Cavity Ratio for the space.

Space by Space Path

- Input manufacturers lighting fixture data [coefficient of utilization (CU) for three room cavity ratios (RCRs)].
- Calculate CU for the fixture type which is calculated by an average of the CU's of each individual fixture that exists within the type.
- Input characteristic data including lamp lumen depreciation, luminaire dirt depreciation, room surface depreciation and lumen efficacies in the fixture type data database.
- Calculate Total Efficiency Factor (TEF) values from CU, light loss factors (LLF), and luminous efficacies (LE) for each RCR condition. $TEF = CU * LLF * LE$
- Create models with user inputs for each space type including space and building type descriptions, general and task light levels [footcandles (fc)], percentage of space for general and task lighting, fixture type inputs (up to 3) with descriptions and average CU data, percentage of lighting provided by each system, the expected RCR for that space, and model number.
- Calculate LPD for the three RCR values for each model described above but display only the one associated with the expected RCR.

The program makes use of up to three lighting fixture types for each space selected from a library of lighting fixtures. It then calculates the LPD for the space using the equation below.

$$LPD = (\text{Average Weighted Illuminance} * \% \text{ of light from fixture type 1} / TEF \text{ for fixture type 1}) + (\text{Average Weighted Illuminance} * \% \text{ of light from fixture type 2} / TEF \text{ for fixture type 2}) + (\text{Average Weighted Illuminance} * \% \text{ of light from fixture type 3} / TEF \text{ for fixture type 3})$$

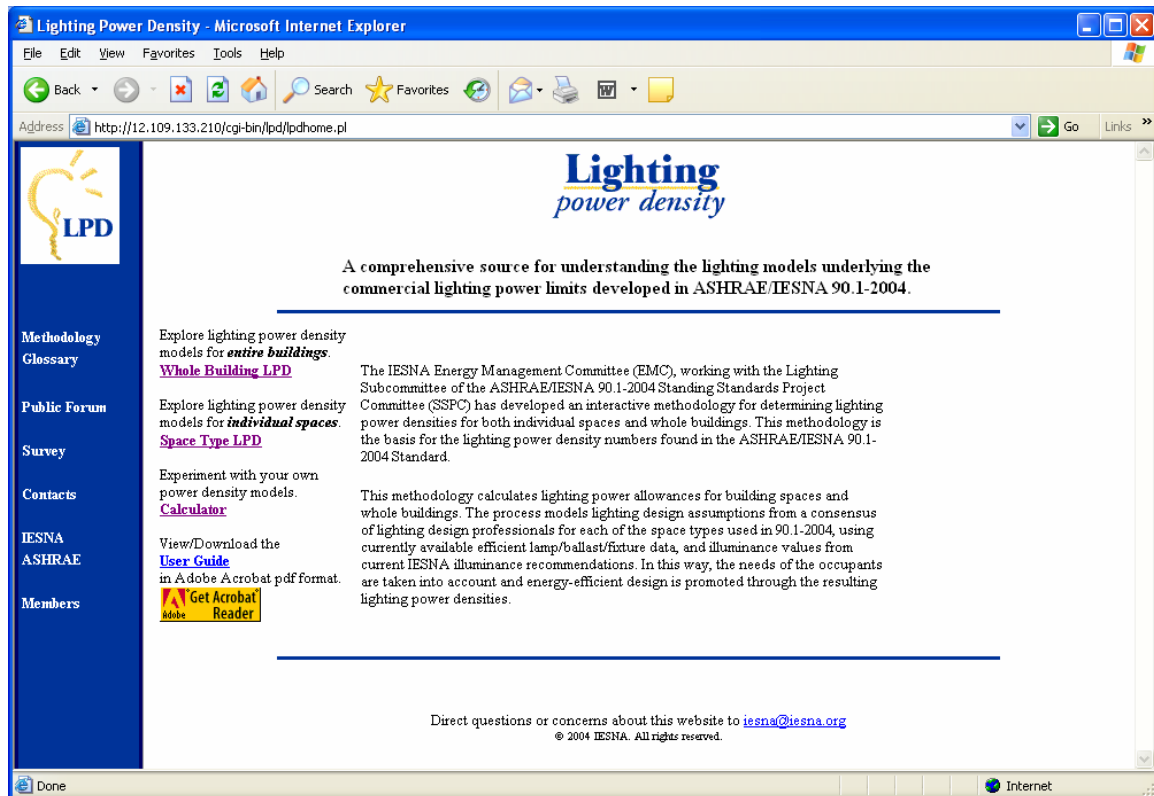
Whole Building Path

In addition to the steps above, the following is also done:

- Input/change building space square footage and/or percentage data for entire buildings with descriptions of space types linked to space by space LPD values.

- Apply space type LPD values to whole building space types using the space type square footage percentages to weight an overall LPD for that specific building.
- Average the LPDs for all similar buildings to derive a typical whole building LPD.
- Include whole building LPDs with the space type LPDs in the main LPD table.

2 Public Module



• Figure 2-1 LPD Main Page

This path allows anyone with Internet access to browse the lighting power density (LPD) values from IESNA illuminance recommendations (IESNA Lighting Handbook, 9th edition). The software uses drill-down functionality, which is the ability to click on a building or space LPD value and view the inputs (fixture data, loss factors and lumen efficacy, model light levels, space percentages, and fixture type choices) that are used in calculating the LPD for that space or building type. Within this area, a user may begin at the building category level and view any of the whole building models within the category and then choose to explore the space types within the building. The calculator section allows the user to experiment with his or her own power density models.

A user may also begin directly at the space type model level, selecting a particular space from the list of all space types. Once at the space type level, fixture types used in the model can be viewed, as well as the characteristics of the individual fixtures that make up the fixture type.

This page also contains the following links on the left border:

- Methodology - Energy standards used to develop Lighting Power Density.
- Glossary – List of definitions of terms used in the program. See also Section 3.
- Public Forum – A public forum dedicated to LPD discussion only.

- [Contacts](#) – Names and addresses of LPD Committee Members.
- [IESNA](#) – Link to the Illuminating Engineering Society of North America homepage.
- [ASHRAE](#) – Link to the American Society of Heating, Refrigerating and Air-conditioning Engineers homepage.
- [Members](#) – Link to Administration Functionality, Work In Progress View, and Work in Progress Administration.

NOTE: These links are available on many pages in the website.

2.1 Whole Building LPD

Within this section, the user can explore lighting power density models for entire buildings.

The lighting power density values for each building category are derived by calculating the LPD values for multiple representative buildings and computing an average that can be applied to typical national new building construction. Typically three to four sets of plans for each building type from across the United States are used in the calculation.

2.1.1 Whole Building Average LPD Category

Building Area Type	Category Average LPD (W/ft2)
Automotive Repair	0.91
Convention Center	1.22
Courthouse	1.19
Dining-Bar Lounge/Leisure	1.26
Dining-Caf./Fast Food	1.42
Dining-Family	1.6
Dormitory	1.02
Exercise Center	1.01
Gymnasium	1.12
Healthcare-Clinic	0.99
Healthcare-Hospital	1.23
Hotel	1.02
Library	1.29
Manufacturing	1.26
Motel	1.02
Motion Picture Theatre	1.23

• Figure 2-2 Whole Building Category list– LPD Values (Partial)

The Whole Building Category page contains a list of building categories and the average lighting power density (LPD) values for each category. Clicking on any building category in the list will result in a page showing a list of each individual building used to arrive at the category's LPD value as shown in the following section.

This page also contains the following links on the left border:

- Information – Link which shows information about the page being viewed.
- Glossary – List of definitions of terms used in the program. See also Section 4.
- LPD Home – Link to the LPD homepage.
- IESNA – Link to the Illuminating Engineering Society of North America homepage.

NOTE: These links are available on many pages in the program.

2.1.2 Building

The screenshot shows a web browser window titled "Whole Building LPD - Microsoft Internet Explorer". The address bar contains the URL: <http://12.109.133.210/cgi-bin/lpd/Building.pl?cid=2&ctx=Automotive%20Repair&avglpd=0.91>. The page features the "Whole Building LPD" logo and the heading "Automotive Repair". Below the heading, it says "Click on a building to explore how its LPD value was calculated." and "Automotive Repair (Overall Category Average LPD: 0.91)". A table lists three buildings with their respective metrics. A sidebar on the left contains navigation links: Information, Glossary, Category List, LPD Home, and IESNA. At the bottom, it says "© 2005 IESNA. All rights reserved."

Building Number	Square Feet	Specific Building LPD	Specific Bldg LPD Contribution %	Specific Bldg LPD Contribution Value	Source of Space Data
Automotive Repair 96479669	11724	0.83	33.33	0.277	DODGE Film Data
Automotive Repair 96551611	27739	1.1	33.33	0.367	DODGE Film Data
Automotive Repair 96801758	2941	0.79	33.33	0.264	DODGE Film Data

• Figure 2-3 Whole Building Category – Example Automotive

The Whole Building Category page contains a list of representative buildings for the category selected on the Whole Building Category List Page, which were used to arrive at the category's lighting power density (LPD) value. Clicking on one of these individual buildings will result in the space list for that building as shown in the following section.

Also shown on this page:

- Total Square Footage of the building
- Specific Building LPD (The sum of the space-weighted LPDs of the individual spaces in the building)
- Specific Building LPD Contribution percent (At this time each building is given equal weight)
- Specific Building LPD Contribution Value (The product of Specific Building LPD and Specific Building LPD Contribution %)
- Source of the Space Data.

2.1.3 Space Type List

Space Type List

Automotive Repair 96479669

Click on a space to explore how its LPD value was calculated.

90.1-2004 Model #	Space Description	Typically Associated Building	Space LPD	LPD Contribution Percent	LPD Contribution Value
9	Automotive Repair	NA (typical all bldgs)	1.21	0.006	0.007
11	Automotive Repair	NA (typical all bldgs)	0.37	0.026	0.015
12	Automotive Repair	NA (typical all bldgs)	0.86	0.046	0.039
20.1	Automotive Repair	NA (typical all bldgs)	1.32	0.049	0.065
20.1	Automotive Repair	NA (typical all bldgs)	1.32	0.039	0.051
20.1	Automotive Repair	NA (typical all bldgs)	1.32	0.018	0.024
25	Automotive Repair	NA (typical all bldgs)	1.13	0.039	0.044
27	Automotive Repair	NA (typical all bldgs)	1.06	0.038	0.041
90	Automotive Repair	Automotive Facility	0.74	0.119	0.087
90	Automotive Repair	Automotive Facility	0.74	0.13	0.096
90	Automotive Repair	Automotive Facility	0.74	0.085	0.063
90	Automotive Repair	Automotive Facility	0.74	0.405	0.298

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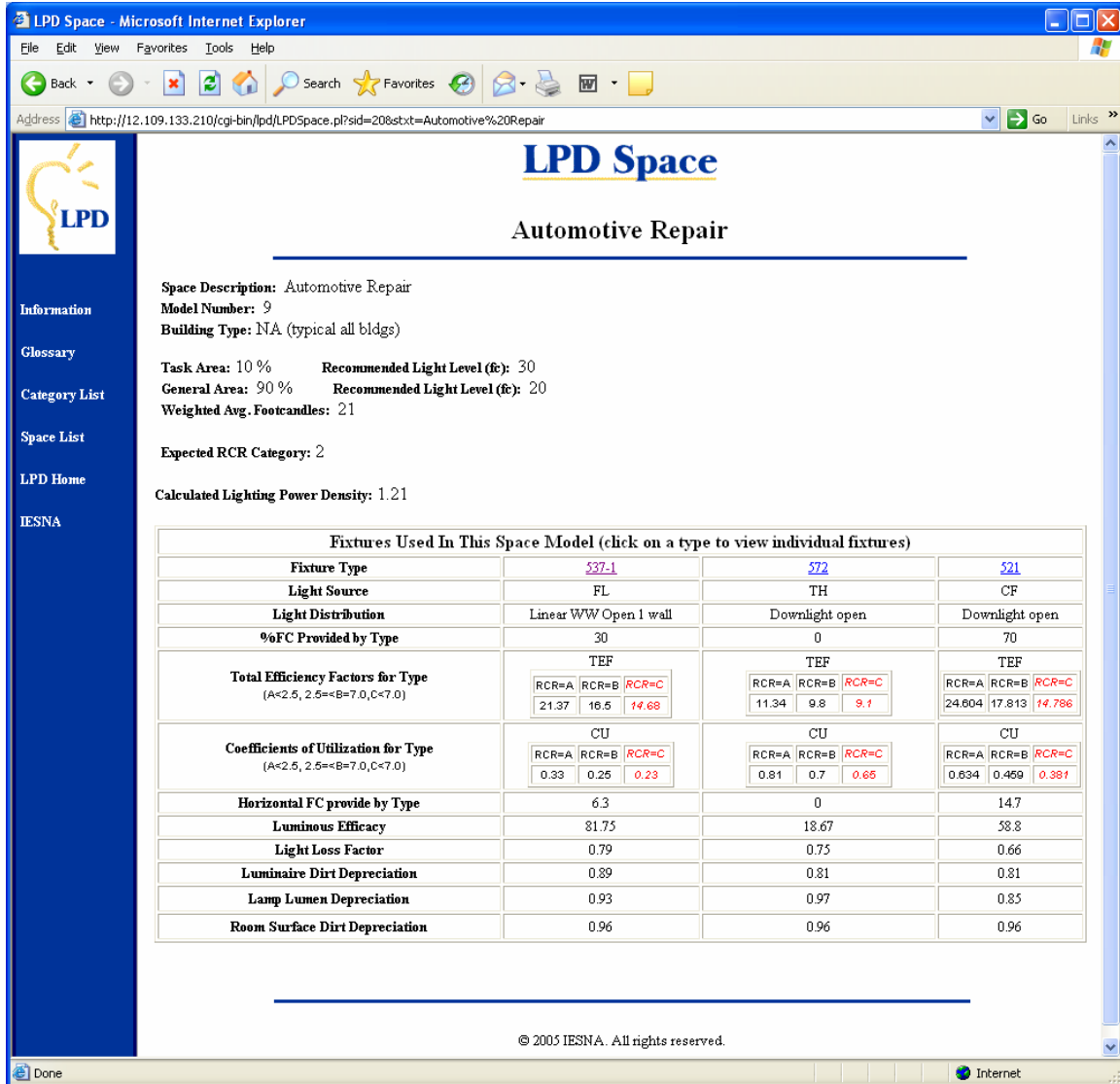
• **Figure 2-4 Space Type List – Example Automotive**

The Space Type List page contains a list of spaces that exist in the building selected on the Whole Building Category Page, along with the Typically Associated Building, the 90.1-2004 Model #, the Space LPD, the LPD Contribution Percent and LPD Contribution Value for each space in the building.

Space types are assigned a weighting factor, which is based on the percentage of total square footage they occupy. The LPD value for each space type (LPD Space) is multiplied by the LPD contribution percent to determine a weighted LPD contribution value for each space. The weighted LPD values of each space are added to arrive at the LPD for the whole building. Clicking on one of the individual spaces will result in the description of that particular space as shown in the following section.

NOTE: the sum of the LPD Contribution Value numbers in Figure 2-4 is the specific building LPD contribution value.

2.1.4 LPD Space



• Figure 2-5 LPD Space - Example Detail Shop

The LPD Space page is shown in the previous two figures. It contains a detailed explanation of the space's lighting power density (LPD) calculation. It also includes fixture types used in this space model. Clicking on one of the fixture types will result in a list of fixture details. The Coefficient of Utilization (CU) and Total Efficiency Factor (TEF) values for the expected Room Cavity Ratio (RCR) are highlighted in red.

The program makes the following assumptions about each space type in order to calculate the space type LPD:

1. The percentage of the space dedicated to task lighting, and the percentage dedicated to general lighting.

2. The illumination levels for both the task lighting and the general lighting. The program uses published IESNA recommended footcandles (from the IESNA Lighting Handbook, 9th edition) for this assumption where applicable.

3. A Room Cavity Ratio for the space.

The program uses up to three lighting fixture types for each space selected from a library of lighting fixtures. It then calculates the LPD for the space using the equation below.

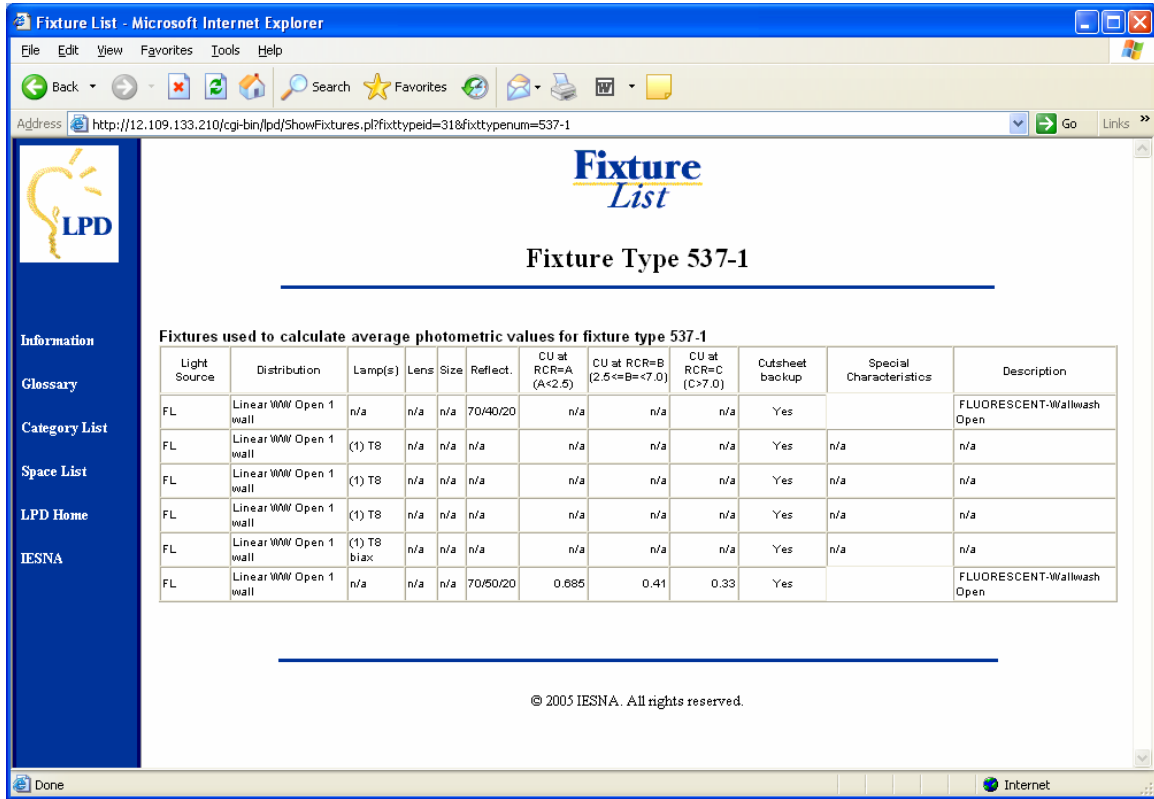
$$\text{LPD} = \text{Average Weighted Illuminance} /$$

$$([\% \text{ of light supplied by fixture type 1} * \text{TEF for fixture type 1}] + [\% \text{ of light supplied by fixture type 2} * \text{TEF for fixture type 2}] + [\% \text{ of light supplied by fixture type 3} * \text{TEF for fixture type 3}])$$

(where: TEF = Coefficient of Utilization * Light Loss Factor * Luminous Efficacy)

The Coefficient of Utilization (CU) values for a fixture type are calculated by averaging the CU values of the individual fixtures within the type. This is done for each of three Room Cavity Ratios.

2.1.5 Fixture List



Fixture List

Fixture Type 537-1

Fixtures used to calculate average photometric values for fixture type 537-1

Light Source	Distribution	Lamp(s)	Lens	Size	Reflect.	CU at RCR=A (A<2.5)	CU at RCR=B (2.5<=B<=7.0)	CU at RCR=C (C>7.0)	Cutsheet backup	Special Characteristics	Description
FL	Linear WW Open 1 wall	n/a	n/a	n/a	70/40/20	n/a	n/a	n/a	Yes		FLUORESCENT-Wallwash Open
FL	Linear WW Open 1 wall	(1) T8	n/a	n/a	n/a	n/a	n/a	n/a	Yes	n/a	n/a
FL	Linear WW Open 1 wall	(1) T8	n/a	n/a	n/a	n/a	n/a	n/a	Yes	n/a	n/a
FL	Linear WW Open 1 wall	(1) T8	n/a	n/a	n/a	n/a	n/a	n/a	Yes	n/a	n/a
FL	Linear WW Open 1 wall	(1) T8 biax	n/a	n/a	n/a	n/a	n/a	n/a	Yes	n/a	n/a
FL	Linear WW Open 1 wall	n/a	n/a	n/a	70/50/20	0.685	0.41	0.33	Yes		FLUORESCENT-Wallwash Open

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• **Figure 2-6 Fixture List – (Partial)**

The Fixture List page contains details of the fixtures, which constitute this type. Information includes: Light Source, Distribution, Lamp(s), Lens, Size, Reflectance, CU at RCR=A, B & C, Cutsheet Backup, Special Characteristics and Description.

2.2 Space Type LPD

Within this section, the user can explore lighting power density models for individual spaces.

2.2.1 Space Type List

The screenshot shows a web browser window titled "Fixture List - Microsoft Internet Explorer". The address bar shows the URL: <http://12.109.133.210/cgi-bin/lpd/ShowFixtures.pl?fixtypeid=31&fixtypenum=537-1>. The page features the "Fixtures List" logo and the title "Fixture Type 537-1". Below the title, a table lists fixtures used to calculate average photometric values for this fixture type. The table has 11 columns: Light Source, Distribution, Lamp(s), Lens, Size, Reflect., CU at RCR=A (A<2.5), CU at RCR=B (2.5<=B<7.0), CU at RCR=C (C>7.0), Cutsheet backup, Special Characteristics, and Description. The table contains 7 rows of data. A copyright notice "© 2005 IESNA. All rights reserved." is located at the bottom of the page.

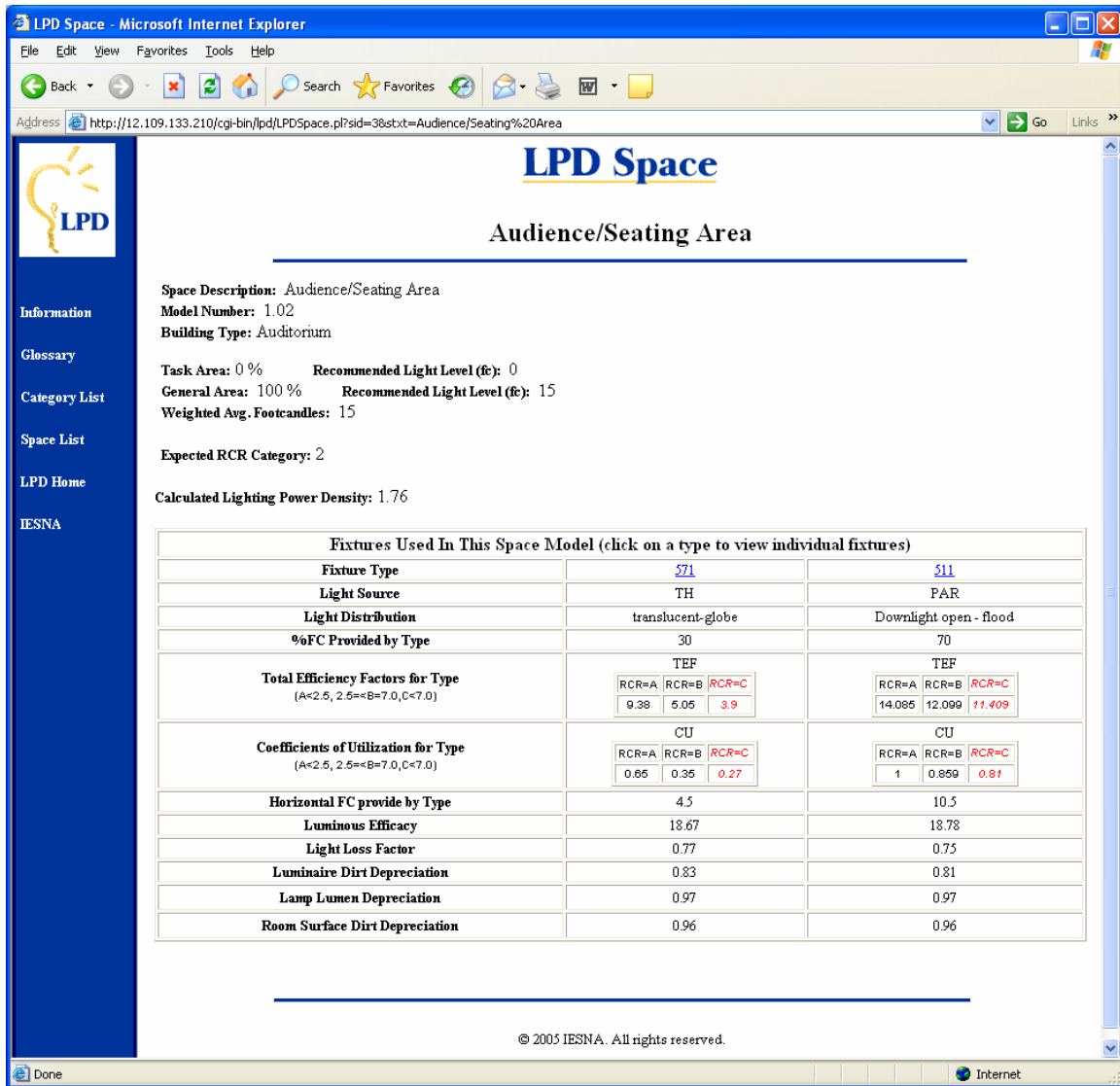
Light Source	Distribution	Lamp(s)	Lens	Size	Reflect.	CU at RCR=A (A<2.5)	CU at RCR=B (2.5<=B<7.0)	CU at RCR=C (C>7.0)	Cutsheet backup	Special Characteristics	Description
FL	Linear WW Open 1 wall	n/a	n/a	n/a	70/40/20	n/a	n/a	n/a	Yes		FLUORESCENT-Wallwash Open
FL	Linear WW Open 1 wall	(1) T8	n/a	n/a	n/a	n/a	n/a	n/a	Yes	n/a	n/a
FL	Linear WW Open 1 wall	(1) T8	n/a	n/a	n/a	n/a	n/a	n/a	Yes	n/a	n/a
FL	Linear WW Open 1 wall	(1) T8	n/a	n/a	n/a	n/a	n/a	n/a	Yes	n/a	n/a
FL	Linear WW Open 1 wall	(1) T8 blax	n/a	n/a	n/a	n/a	n/a	n/a	Yes	n/a	n/a
FL	Linear WW Open 1 wall	n/a	n/a	n/a	70/50/20	0.885	0.41	0.33	Yes		FLUORESCENT-Wallwash Open

• **Figure 2-7 Space Type List - (Partial)**

The Space Type page contains a list of all the spaces in the database, independent of any particular building.

The list also contains the Typically Associated Building, the 90.1-2004 Model # and the 90.1-2004 Model LPD (calculated primary LPD - the LPD at the expected room cavity ratio) for each space. Clicking on one of the individual spaces will result in the description of that particular space as shown in the following section.

2.2.2 LPD Space



• Figure 2-8 LPD Space - Example Airport Concourse

The LPD Space page is shown in the previous two figures. It contains a detailed explanation of the space's lighting power density (LPD) calculation. It also includes fixture types used in this space model. Clicking on one of the fixture types will result in a list of fixture details.

The program makes the following assumptions about each space type to calculate the space type LPD:

1. The percentage of the space dedicated to task lighting, and the percentage to general lighting.
2. The illumination levels for both the task lighting and the general lighting. The program uses published IESNA recommended footcandles (from the IESNA Lighting Handbook, 9th edition) for this assumption where applicable.

3. An assumed Room Cavity Ratio for the space.

The program uses up to three light fixture types for each space selected from a library of light fixtures. It then calculates the LPD for the space using the equation below.

LPD = Average Weighted Illuminance /

([% of light supplied by fixture type 1 * TEF for fixture type 1] + [% of light supplied by fixture type 2 * TEF for fixture type 2] + [% of light supplied by fixture type 3 * TEF for fixture type 3])

where TEF = Coefficient of Utilization*Light Loss Factor*Luminous Efficacy

2.2.3 Fixture List

The screenshot shows a web browser window titled "Fixture List - Microsoft Internet Explorer". The address bar shows the URL: <http://12.109.133.210/cgi-bin/lpd/ShowFixtures.pl?fixttypeid=58&fixttypenum=511>. The page content includes the "Fixture List" logo and the title "Fixture Type 511". Below the title, a section titled "Fixtures used to calculate average photometric values for fixture type 511" contains a table with 12 columns: Light Source, Distribution, Lamp(s), Lens, Size, Reflect., CU at RCR=A (A<2.0), CU at RCR=B (2.5<=B<7.0), CU at RCR=C (C>7.0), Cutsheet backup, Special Characteristics, and Description. The table lists 11 different fixture configurations. At the bottom of the page, there is a copyright notice: "© 2005 IESNA. All rights reserved." The browser interface includes a menu bar (File, Edit, View, Favorites, Tools, Help), a toolbar with navigation buttons, and a status bar at the bottom showing "Done" and "Internet".

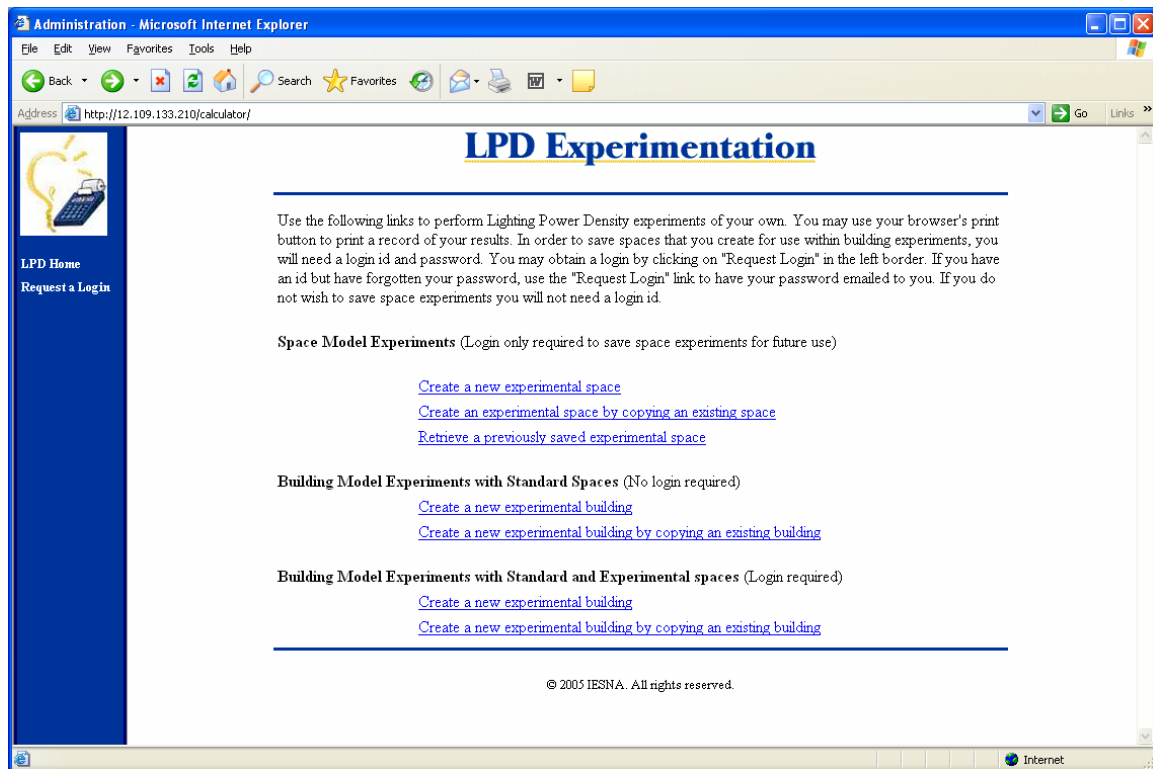
Light Source	Distribution	Lamp(s)	Lens	Size	Reflect.	CU at RCR=A (A<2.0)	CU at RCR=B (2.5<=B<7.0)	CU at RCR=C (C>7.0)	Cutsheet backup	Special Characteristics	Description
PAR	Downlight open-flood	50 W	n/a	5" Dia	80/50/20	1.21	0.97	0.91	Yes	Clear Alzak	Reflector Incandescent Downlights - Open
PAR	Downlight open-flood	250W max	n/a	n/a	80/50/20	1	0.86	0.82	Yes	n/a	n/a
PAR	Downlight open-flood	250W max	n/a	n/a	80/50/20	1	0.87	0.83	Yes	n/a	n/a
PAR	Downlight open-flood	150W max	n/a	n/a	80/50/20	0.7	0.59	0.55	Yes	n/a	n/a
PAR	Downlight open-flood	75W max par30	n/a	n/a	80/50/20	0.93	0.78	0.72	Yes	n/a	n/a
PAR	Downlight open-flood	100W par38	n/a	n/a	80/50/20	1.06	0.95	0.9	Yes	n/a	n/a
PAR	Downlight open-flood	50W par30	n/a	n/a	80/50/20	1.06	0.94	0.9	Yes	n/a	n/a
PAR	Downlight open-flood	150 W	n/a	7" Dia	80/50/20	1.13	0.98	0.92	Yes	Clear Alzak	Reflector Incandescent Downlights - Open
PAR	Downlight open-flood	150W	n/a	6" Dia	80/50/20	0.91	0.79	0.74	Yes	Clear Alzak	Reflector Incandescent Downlights - Open

• Figure 2-9 Fixture List

The Fixture List page contains details of the fixtures that constitute this type. Information includes: Light Source, Distribution, Lamp, Lens, Size, Reflection, CU at RCR=A, RCR=B & RCR=C, Cutsheet Backup, Special Characteristics and Description.

The Coefficient of Utilization (CU) values for a fixture type are calculated by averaging the CU values of the individual fixtures within the type.

2.3 Calculator – LPD Experimentation



• **Figure 2-20 LPD Experimentation**

The LPD experimentation page allows the user to select which type of experiment he or she would like to conduct with space models and building models.

This page contains two links: “LPD Home” which takes the user back to the LPD homepage and “Request a Login” which is required so that experimental space models can be saved and retrieved. The user must enter his/her email address to obtain a login ID. After pressing “Add New User”, an ID and password will be sent to the entered email address. If you do not wish to save space experiments you will not need a login.

NOTE: All the pages in the calculator section have a calculator in the upper left corner.

2.3.1 Space Model Experiments

2.3.1.1 Create a New Experimental Space

Space Experiment

Enter or modify values and press the calculate button to view results.

Typically Associated Building Type:

Model Number:

Space Description:

Expected RCR: A (A<2.5) [RCR Lookup](#)

Percent Task Area: <input type="text"/>	Recommended Footcandles (Task Area): <input type="text"/>
Percent General Area: <input type="text"/>	Recommended Footcandles (General Area): <input type="text"/>

Note: Percent of Task Area and Percent of General Area must total 100.

Please select up to three fixture types for this space:

[Display Fixture Type Details](#)

Fixture Type	Percent of Foot Candles
Fixture Type 1: <input type="text" value="None"/>	Footcandle %: <input type="text"/>
Fixture Type 2: <input type="text" value="None"/>	Footcandle %: <input type="text"/>
Fixture Type 3: <input type="text" value="None"/>	Footcandle %: <input type="text"/>

Note: The Percent of Foot Candles column must total 100.

This data was generated from user assumptions and is not part of the approved ASHRAE/IESNA 90.1-2004 standard.

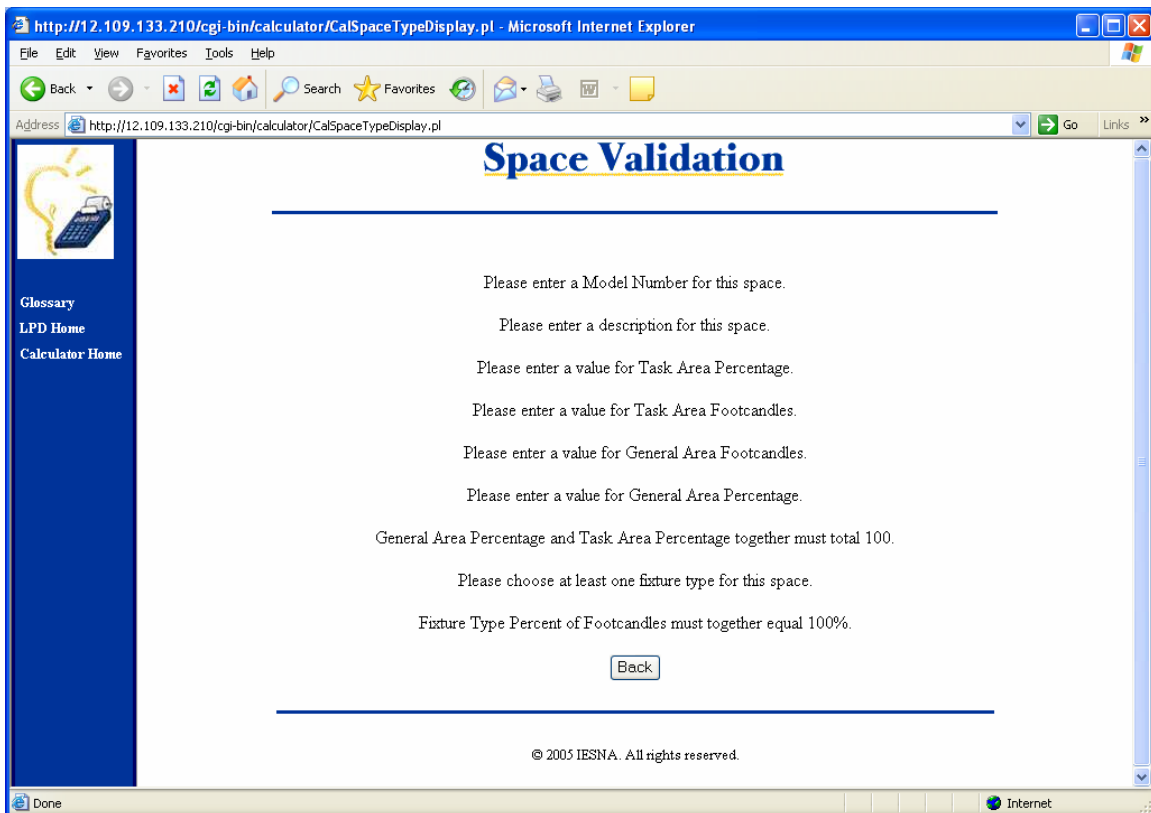
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• Figure 2-31 Space Experiment

The Space Experiment page shown on the previous two figures allows the user to enter values and have the software calculate the new lighting power density (LPD) for each new situation.

This page has two links. The first link, "RCR Lookup", brings up a RCR lookup table, which contains RCR values for various room dimensions displayed by length, width and height. See Figure 2-13 RCR Lookup Table (Partial). The second link, "Display Fixture Type Details", brings up a table showing a list of all the fixture types currently in the database to aid the user in choosing proper values for the space experiment he or she is conducting.

After all the data is entered, press the "calculate" button. A "Display Space Model Values" page appears with the choices: "Save Space Model" which allows the user to save the experiment (password is required) on the system's database for a maximum of 90 days, or "Change Values" which brings the user back to the previous page, Figure 2-11, where values can be changed.



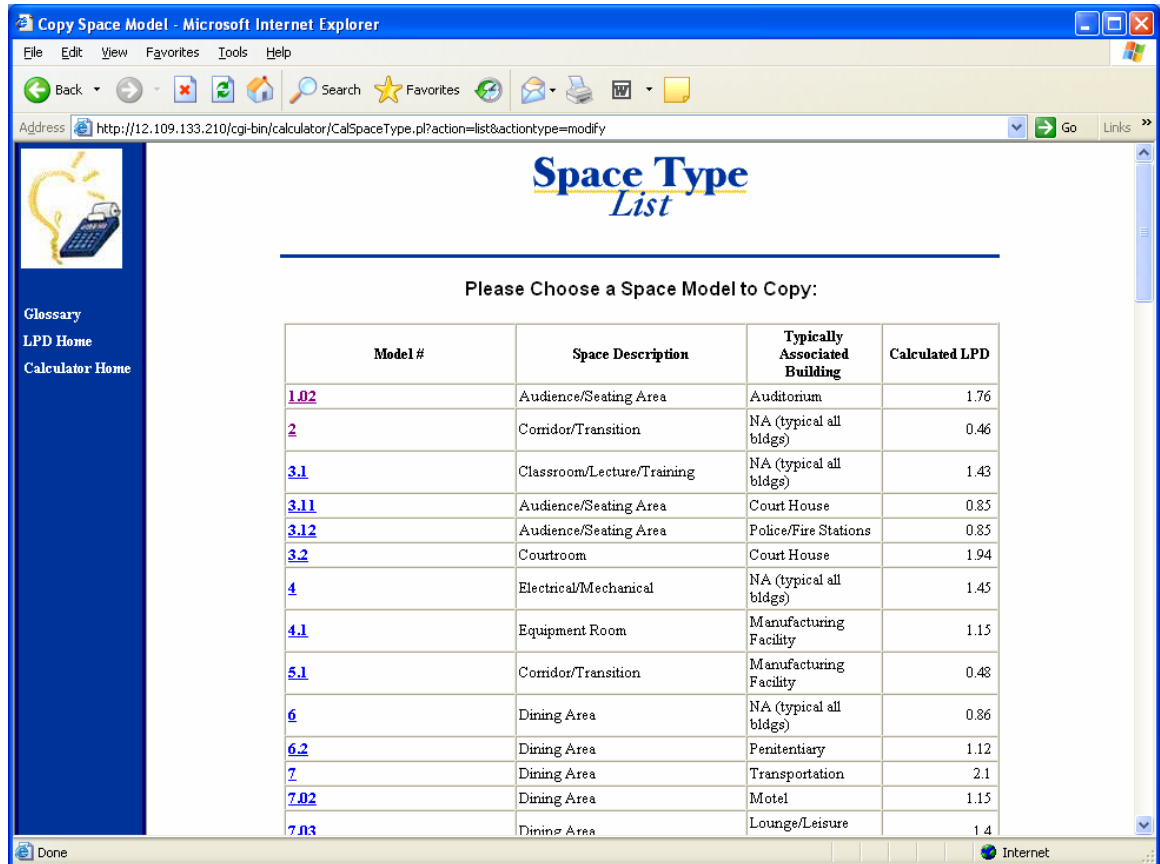
• **Figure 2-12 Space Validation Page**

The Space Validation page appears when insufficient or out of range data is entered and the submit button is pressed.

These are the required fields for the Space Experiment page:

- Model Number (maximum 5 characters)
- Description (maximum 70 characters)

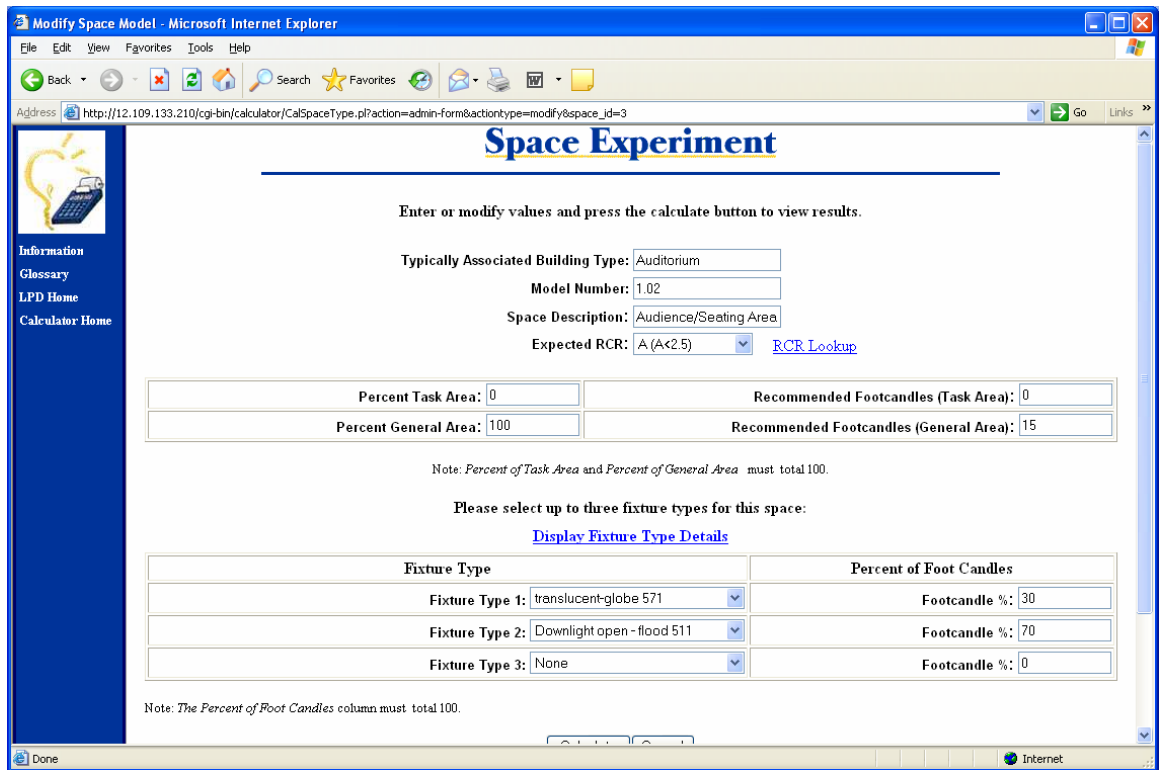
2.3.1.2 Create an Experimental Space by Copying an Existing Space



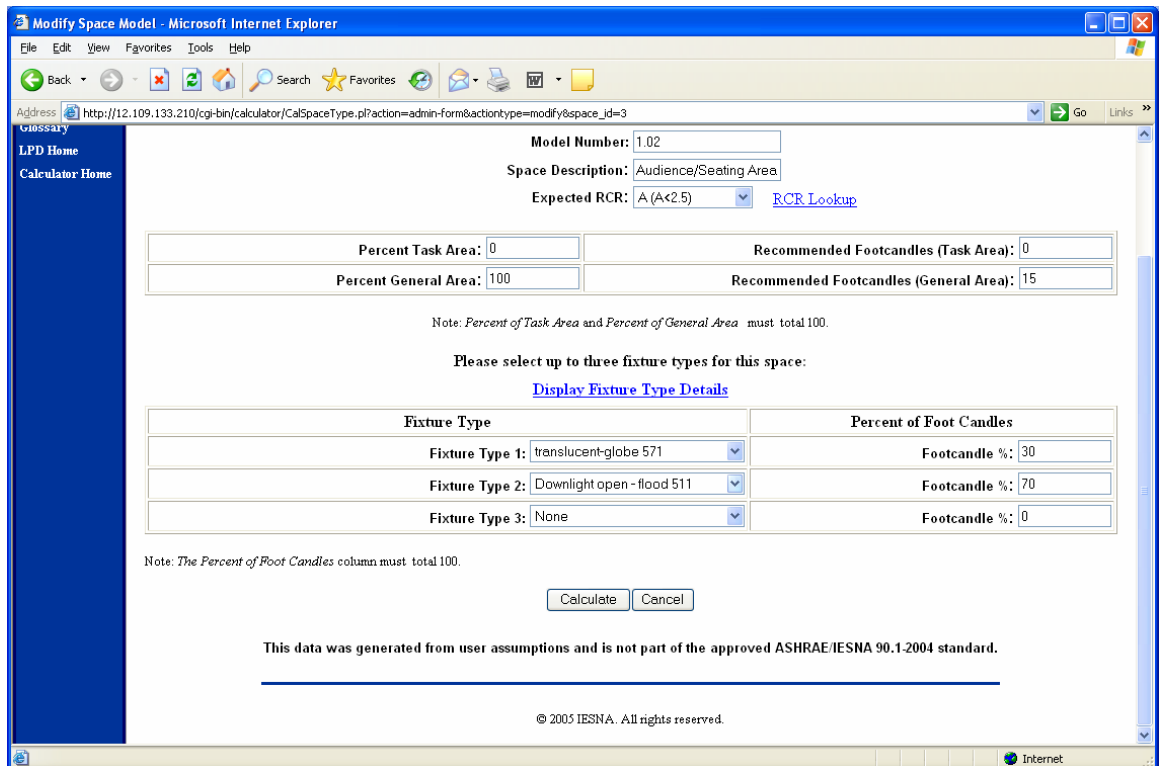
• Figure 2-44 Space Type List – (Partial)

The Space Type page contains a list of all the spaces in the database, independent of any particular building.

The list contains the Typically Associated Building, the 90.1-2004 Model # and the 90.1-2004 Model LPD (calculated primary LPD - the LPD at the expected room cavity ratio) for each space. Clicking on one of the individual spaces will result in the description of that particular space as shown in the following section, which can be changed in the user's experiment.



• Figure 2-15a Space Experiment with Existing Space



• **Figure 2-15b Space Experiment with Existing Space**

The Space Experiment with Existing Space page on the previous two figures allows the user to conduct a space experiment using the data from an existing space to calculate lighting power density (LPD) values. To experiment with an existing space, the user will be presented with a list from which to choose (See Figure 2-14). The user clicks on a space type to bring up a page where any of the values can be changed.

After data is changed, the user presses the “calculate” button. A “Display Space Model Values” page appears with the choices: “Save Space Model” which allows the user to save the experiment (password is required) on the system’s database for a maximum of 90 days, or “Change Values” which brings the user back to the previous page, Figure 2-15, where values can again be changed.

This page has two links as described in Section 2.3.1.1.

2.3.1.3 Retrieve a Previously Saved Experimental Space

The user enters a username and password to retrieve a previously saved experimental space. Changes may be made to the space as described in the previous two sections.

2.3.2 Building Model Experiments with Standard Spaces

2.3.2.1 Create a New Experimental Building

display Whole Building Model - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address <http://12.109.133.210/cgi-bin/calculator/CalBuilding.pl?action=admin-form&actiontype=insert> Go Links

Whole Building Experiment

Enter or modify values and press the calculate button to view results.

Building Identifier:

Building Category: Automotive Repair

Source:

Total Square Footage:

Space Description	Alias	Percentage
		Total 0%

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• Figure 2-16 Whole Building Experiment

The Whole Building Experiment page allows the user to enter values for a whole building and have the software calculate the new lighting power density (LPD) for each new situation.

After all the data is entered, press the “Calculate” button. A “Results” page appears with the choices: “Done” which concludes the experiment, or “Back” which brings the user back to the previous page, Figure 2-16, where values can again be changed.

Required fields for the Whole Building Experiment page: Building Square Footage (integer value), Building Identifier (maximum 40 characters) and Source (maximum 40 characters)

At least one space must be selected in the Whole Building Experiment. A validation page similar to Figure 2-12 appears when insufficient or out of range data is entered.

When adding a space to the experiment, required fields are: Alias (maximum of 80 characters), and percentage of space (decimal value, example 0.90). The percentage of space must equal 100%.

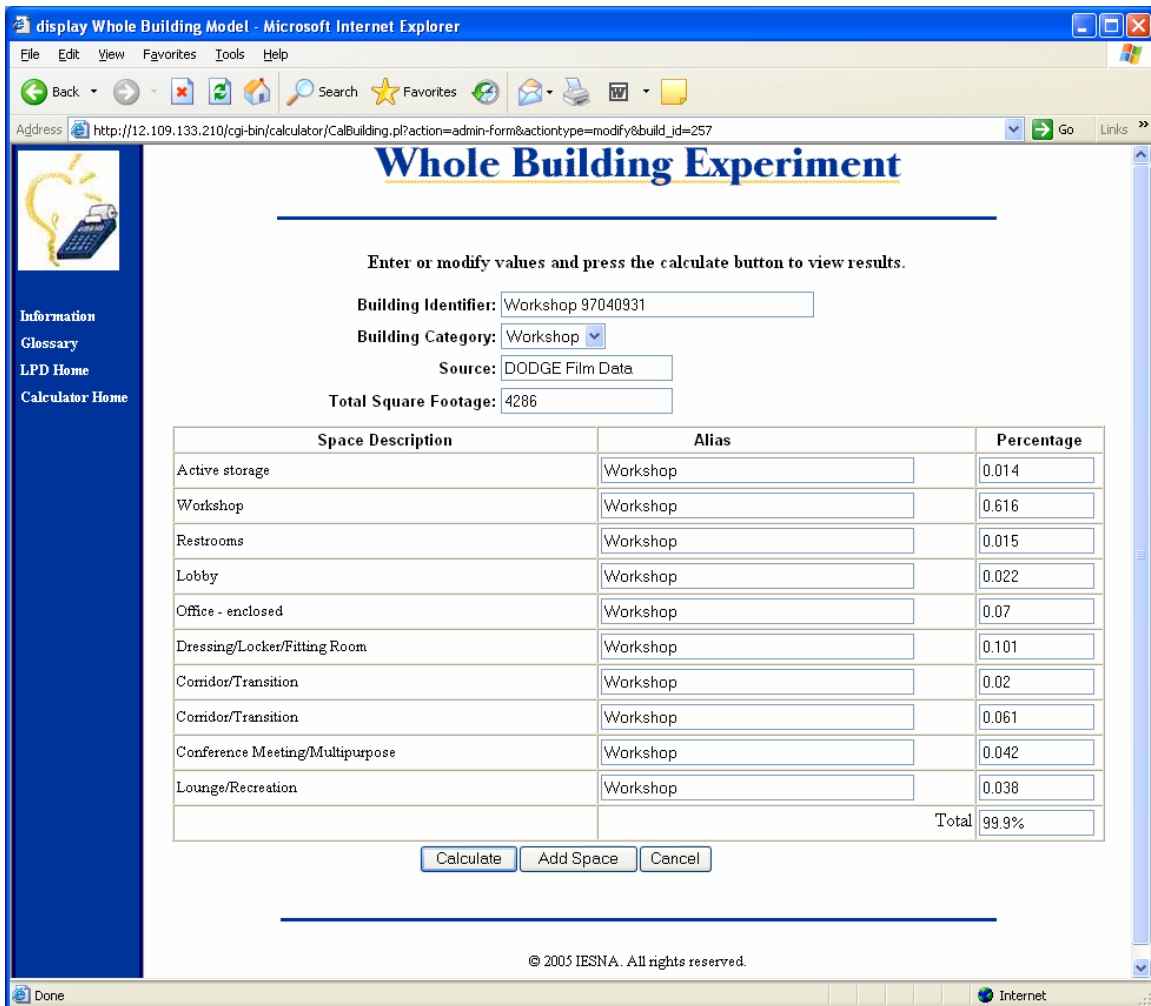
2.3.2.2 Create a New Experimental Building by Copying an Existing Building

Building	Square Feet	Sum of all Space LPD's	Weighted Avg. LPD
Automotive Repair 96479669	11724	0.83	0.277
Automotive Repair 96651611	27739	1.1	0.367
Automotive Repair 96801758	2941	0.79	0.264
Convention Center 94028053	23658	1.12	0.561
Convention Center 96075322	298365	1.32	0.662
Courthouse 652452	21693	1.31	0.436
Courthouse 96588736	20325	1	0.333
Courthouse 97028713	6150	1.25	0.418
Dining-Bar Lounge/Leisure 743605	16978	1.34	0.448
Dining-Bar Lounge/Leisure 96589458	2134	1.21	0.402
Dining-Bar Lounge/Leisure 97036968	1628	1.24	0.413
Dining-Caf./Fast Food 631237	1251	1.22	0.203
Dining-Caf./Fast Food 721639	3409	1.54	0.257
Dining-Caf./Fast Food 762174	4669	1.48	0.247
Dining-Caf./Fast Food 96751230	5109	1.47	0.246
Dining-Caf./Fast Food 97037778	2000	1.38	0.231
Dining-Caf./Fast Food 97041999	4463	1.43	0.238
Dining-Family 615167	4793	1.62	0.108
Dining-Family 623272	3904	1.56	0.104
Dining-Family 650568	5437	1.62	0.108
Dining-Family 692839	6338	1.62	0.108
Dining-Family 710189	5579	1.61	0.108
Dining-Family 738065	9656	1.7	0.113
Dining-Family 749149	7609	1.79	0.119
Dining-Family 749542	6853	1.6	0.108

Figure 2-57 Whole Building Experiment List

The Whole Building Experiment page contains a list of all the whole building models in the database.

The list contains the Square Feet, Sum of all Space LPD's, and Weighted Average LPD for each building. Clicking on one of the whole building models will result in a page with all the details of that particular building as shown in the following figure.



• Figure 2-18 Whole Building Experiment with Existing Building

The Whole Building Experiment with Existing Building allows the user to change values of an existing building and have the software calculate the new lighting power density (LPD).

To experiment with an existing building, the user will be presented with a list from which to choose (See Figure 2-17). After all the data is entered, press the “calculate” button. A “Results” page appears with the choices: “Done” which concludes the experiment, or “Back” which brings the user back to the previous page, Figure 2-18, where values can again be changed.

Required fields are the same as for the Whole Building Experiment page. See Section 2.3.2.1. A validation page similar to Figure 2-12 appears when insufficient or out of range data is entered.

When adding a space to the experiment, required fields are: Alias (maximum of 80 characters), and percentage of space (decimal value, example 0.90). The percentage of space must equal 100%.

2.3.3 Building Model Experiments with Standard and Experimental Spaces

2.3.3.1 Create a New Experimental Building

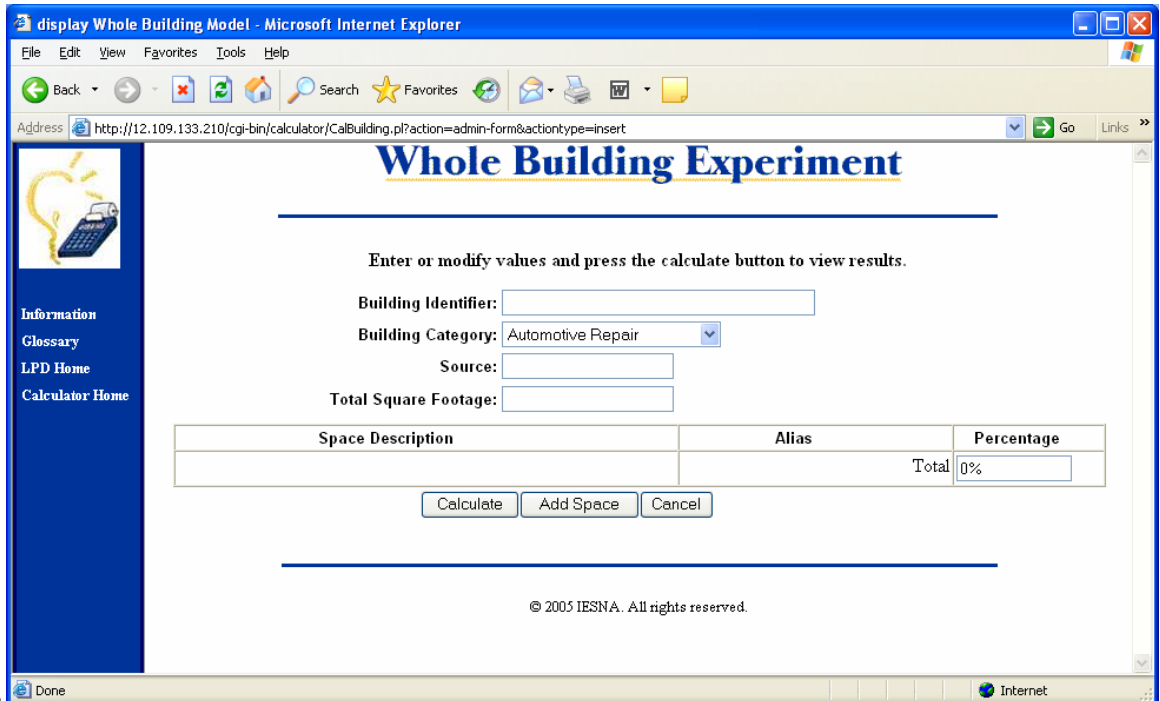


Figure 2-69 Building Model Experiment with Standard & Experimental Spaces

This section can only be accessed with a network password , as described in Section 2.3.

The Building Model Experiment with Standard & Experimental Spaces page allows the user to add different spaces to a building and have the software calculate the new lighting power density (LPD) for each new situation.

After all the data is entered, press the “calculate” button. A “Results” page appears with the choices: “Done” which concludes the experiment, or “Back” which brings the user back to the previous page, Figure 2-19, where values can again be changed.

These are the required fields for the Building Model Experiment page:

- Building Square Footage (integer value)
- Building Identifier (maximum 40 characters)
- Source (maximum 40 characters)

At least one space must be selected in the Building Model Experiment. It can be either a standard space (selected from a pull-down list) or an experimental space. The validation page similar to Figure 2-12 appears when insufficient or out of range data is entered.

When adding a space to the experiment, required fields are: Alias (maximum of 80 characters), and percentage of space (decimal value, example 0.90). The percentage of space must equal 100%.

2.3.3.2 Create a New Experimental Building by Copying an Existing Building

Space Experiment

Enter or modify values and press the calculate button to view results.

Typically Associated Building Type:

Model Number:

Space Description:

Expected RCR: [RCR Lookup](#)

Percent Task Area: <input type="text" value="0"/>	Recommended Footcandles (Task Area): <input type="text" value="0"/>
Percent General Area: <input type="text" value="100"/>	Recommended Footcandles (General Area): <input type="text" value="10"/>

Note: Percent of Task Area and Percent of General Area must total 100.

Please select up to three fixture types for this space:

[Display Fixture Type Details](#)

Fixture Type	Percent of Foot Candles
Fixture Type 1: <input type="text" value="Linear Direct lensed 530"/>	Footcandle %: <input type="text" value="70"/>
Fixture Type 2: <input type="text" value="Linear WWW open - 2 walls 537-2"/>	Footcandle %: <input type="text" value="30"/>
Fixture Type 3: <input type="text" value="None"/>	Footcandle %: <input type="text" value="0"/>

Note: The Percent of Foot Candles column must total 100.

• **Figure 2-20 Building Model Experiment with Standard & Experimental Spaces - Copy Existing Building**

The Building Model Experiment with Standard & Experimental Spaces – Copy Existing Building page allows the user to add different spaces to an existing building and have the software calculate the new lighting power density (LPD) for each new situation. After accessing this section with a network password, (obtained in Section 2.3), the user must select a building from the list shown in Figure 2-77 Whole Building Experiment List.

After all the data is entered, press the “calculate” button. A “Results” page appears with the choices: “Done” which concludes the experiment, or “Back” which brings the user back to the previous page, Figure 2-19, where values can again be changed.

Required fields for the Building Model Experiment page are the same as in the previous section 2.3.3.1.

At least one space must be selected in the Building Model Experiment. It can be either a standard space (selected from a pull-down list) or an experimental space. A validation page similar to Figure 2-12 appears when insufficient or out of range data is entered.

When adding a space to the experiment, required fields are: Alias (maximum of 80 characters), and percentage of space (decimal value, example 0.90). The percentage of space must equal 100%.

3 Glossary

CU (Coefficient of Utilization) - The ratio of lumens from a luminaire (fixture) received on the workplane to the lumens emitted by the luminaire's lamps alone.

General Area - The percentage of the area of an individual space type that is considered to be general and illuminated with general lighting.

HFC Horizontal Footcandle - Quantity of light (measured in footcandles) on a horizontal surface.

Luminous Efficacy (LE) - The total lumens emitted by a light source divided by the total lamp power input, expressed as lumens per watt. Lamp power includes a ballast, where applicable.

LDD (Luminaire Dirt Depreciation) - An adjustment factor that accounts for the fractional loss of task illuminance due to luminaire dirt accumulation.

LLD (Lamp Lumen Depreciation) - An adjustment factor that accounts for the fractional loss of lamp lumens at rated operating conditions that progressively occurs during lamp operation.

Lens - A glass or plastic element used in luminaires (fixtures) to change the direction and control the distribution of light rays.

Light Distribution - The way in which light is emitted from a luminaire (fixture); often classified as direct, semi-direct, diffuse, semi-indirect or indirect.

Light Source - The lighting technology that is applicable to the specific luminaire. Typically fluorescent - FL, compact fluorescent - CF, metal halide - MH, incandescent – INC, high pressure sodium – HPS, low pressure sodium - LPS.

LLF (Light Loss Factor) - The fractional remainder of task illuminance due to all combined lumen depreciations including LDD, LLD, and RSDD.

LPD (Lighting Power Density) - A measure of electrical power used to provide lighting to a space - expressed in watts per square foot (or watts per square meter).

RCR (Room Cavity Ratio) - A number relating the dimensions of an enclosed space (length, width, height) that affects the overall Coefficient of Utilization of a luminaire within that specific space.

Recommended Light Level - The horizontal light level (expressed in footcandles) that is considered appropriate for the space or area. These values are generally taken from the IESNA Lighting Handbook, 9th edition, where applicable.

Reflectance - The ratio of light reflected from a surface to the light falling on the surface.

RSDD (Room Surface Dirt Depreciation) - An adjustment factor that accounts for the fractional loss of task illumination due to dirt on room surfaces.

Size - The size of a lens covering a luminaire opening – typically applied to downlights.

Source - A reference to the source of the building space-by-space description and footage data (typically sets of building plans) from which building space square footage takeoffs are completed.

Task Area - The percentage of the area of an individual space type that is considered to be for specific tasks and illuminated with task lighting.

TEF (Total Efficiency Factor) - A total efficiency factor used in calculating space type LPDs that includes initial Luminous Efficacy, Light Loss Factor (LLF), and Coefficient of Utilization (CU) and is expressed in lumens per watt.

Weighted Average Footcandles - The footcandle level considered to be typical over an entire space that accounts for both general and task footcandle levels and the space to which each is applied.

Weighted Average LPD - The allowable LPD value for a building type (i.e. office, fire station, library). This value is an average of the whole building LPD values for multiple buildings of this type. This value can be "weighted" in favor of one or more of these individual buildings if that building exhibits unique characteristics within its general type and there is data to support its actual share of new construction. Currently all buildings within a building type are given equal weight.