



**BSR/ASHRAE/IES Addendum bw
to ANSI/ASHRAE/IES Standard 90.1-2016**

Public Review Draft

Proposed Addendum bw to Standard 90.1-2016, Energy Standard for Buildings Except Low-Rise Residential Buildings

**First Public Review (January 2019)
(Draft Shows Proposed Independent Substantive)**

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FOREWORD

The building area method is an alternate method in addition to the space-by-space method. It does not save energy because the energy savings have already been accounted for in the space-by-space method. This addendum does not have cost implications because costs of updating lighting power density allowances were addressed in Addendum BB.

Background Data and Supporting Analysis

Drawings of actual buildings were purchased from a public service that specializes in construction data, Dodge Data & Analytics.¹ Data from these drawings (known as “takeoffs”) were entered into a database called the National Construction database. One specific data stream from the takeoffs is the portion of a building that are different spaces. Table 1 provides an example of a building classified as an “office” and how the portions of the spaces in the building comprise the total amount of space in the building. This method is irrespective of the total area of the building.

Table 1. Example Space Data

Sub-Space Type	Portion of Building	Sub-Space Type	Portion of Building
Office - enclosed	7.2%	Active storage	0.3%
Conference Meeting/Multipurpose	6.9%	Lounge/Recreation	1.7%
Corridor/Transition	12.1%	Office - enclosed	38.9%
Office - enclosed	7.3%	Lobby	2.4%
Electrical/Mechanical	1.8%	Restrooms	2.9%
Lobby	0.5%	Active storage	1.9%
Active storage	1.8%	Inactive storage	14.3%

The 90.1 lighting model has multiple building types and the sample size (n) varies by building type. Originally, the model did not filter out the building data set. Table 2 shows another office building included in the “office” building data set. Notice that the offices only comprise 13.6% of the total building. In contrast, the building in Table 1 show that 53.5% of the space is office.

¹ <https://www.construction.com/>

Table 2. Example Space Data

Sub-Space Type	Portion of Building	Sub-Space Type	Portion of Building
Classroom/Lecture/Training	24.0%	Office - enclosed	13.6%
Corridor/Transition	6.3%	Conference Meeting/Multipurpose	24.0%
Lobby	4.7%	Restrooms	5.8%
Food Preparation	2.2%	Stairway	8.2%
Reading Area	4.8%	Active storage	2.9%
Electrical/Mechanical	3.5%		

Because the whole building is a composite of all the individual spaces in the building, the mixture of spaces is important. Conversely, the mixture of individual spaces should be broad enough so that it does not specifically skew the results. In some cases, if the space-by-space mixture contains a large portion of spaces that differ from the larger building category, it could result in the whole building lighting power density (LPD) value that significantly differs from the applicable space-by-space value.

Table 3 includes a graph of the ANSI/ASHRAE/IES Standard 90.1-2016 (90.1-2016) lighting model of the data set for office whole building. The X-axis is the portion of spaces classified as either “office-open plan” or “office-enclosed”. The Y-axis were the LPDs of each of these buildings. The space-by-space LPD value for open office is 0.81 and enclosed was 0.93. The Building Area LPD value is 0.79. The columns in the table show the portion of the data set where a portion of the building is a composite of enclosed and open offices, the resultant LPD, and sample size (n). Notice as the data set is filtered so that the minimum portion of the building being a composite of office open plan and enclosed increases, the whole building LPD approaches the space-by-space LPD values (0.81 and 0.93 respectively). The committee decided to filter the dataset (where possible) based on the criteria that 33% of the underlying data space-by-space must match a certain sub set to be used to calculate the whole building LPD. In Table 3, the green dashed line represents 33% of the data set.

Table 3. Analysis of ANSI/ASHRAE/IES Standard 90.1-2016 Whole Building Office LPD Values

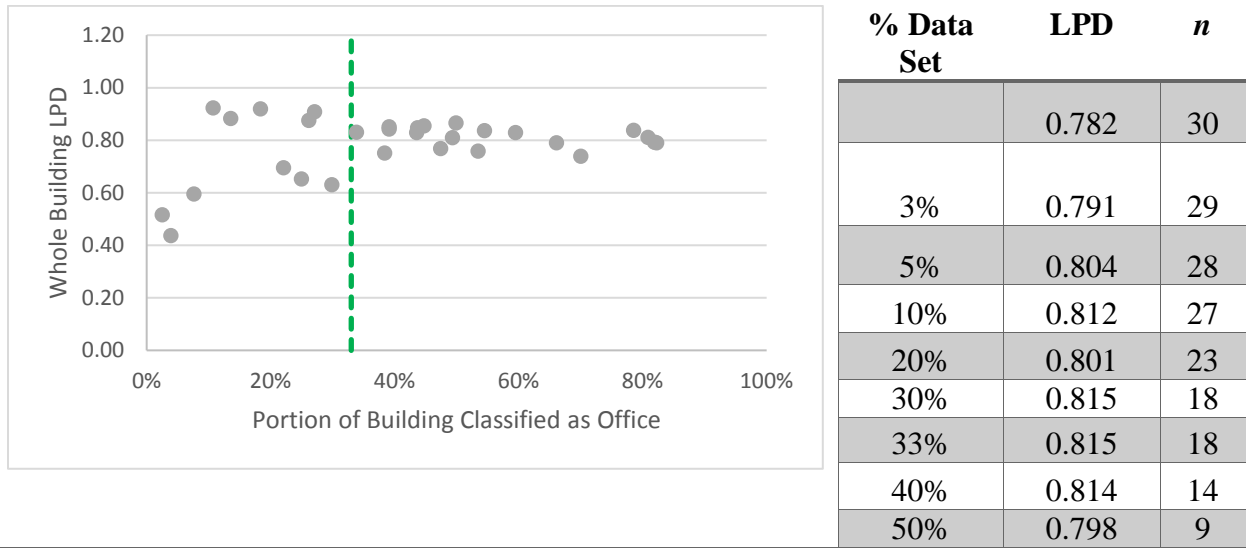
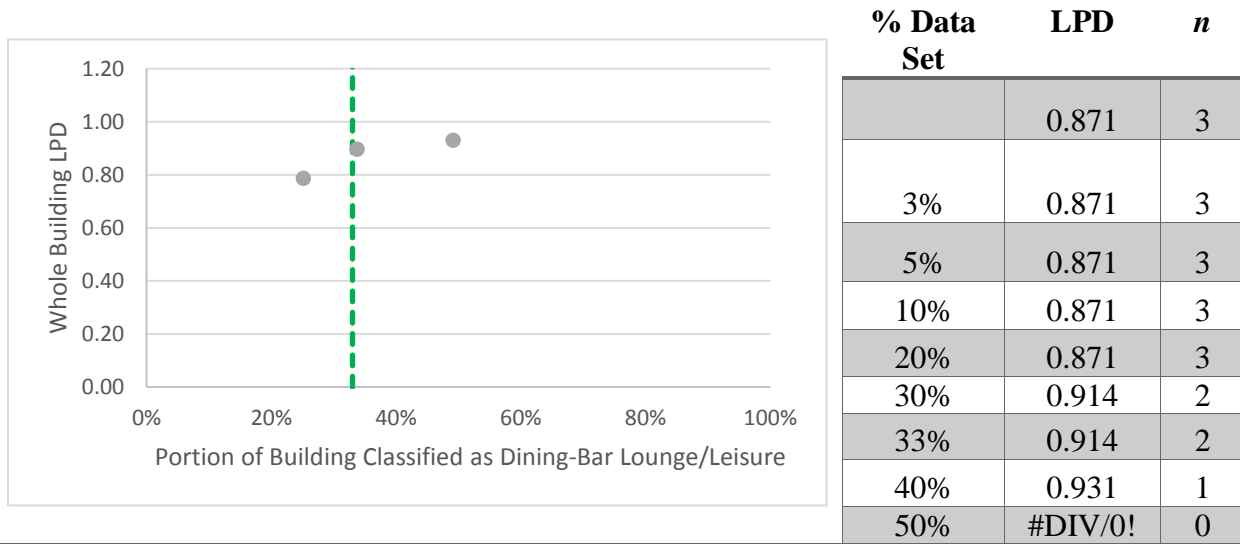


Table 9.5.1 Lighting Power Density Allowances Using the Building Area Method:	LPD	0.79
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Table 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method:		
1. Office – enclosed and < 250 ft ²	LPD	0.93
2. Office – enclosed and > 250 ft ²	LPD	0.93
3. Office – open plan	LPD	0.81

Table 4 shows a similar example, but in this case, for Dining: Bar Lounge. 90.1-2016 Building Area Method for Dining: Bar was 0.90. There are three buildings that comprise this data set. Notice in the table the green line denoting 33% of the data set containing “dining area”. One of the spaces in the data set has a building where only 25% of the building is “dining.” Under the revised committee ruleset, this space would be removed from this data set and not used to calculate the building area LPD. Notice that the dining space-by-space value is 0.93. When the 33% ruleset is applied, the building area method LPD is 0.91, very close to the space-by-space LPD.

Table 4. Analysis of ANSI/ASHRAE/IES Standard 90.1-2016 Whole Building Dining: Bar lounge/leisure LPD Values



% Data Set	LPD	n
	0.871	3
3%	0.871	3
5%	0.871	3
10%	0.871	3
20%	0.871	3
30%	0.914	2
33%	0.914	2
40%	0.931	1
50%	#DIV/0!	0

Table 9.5.1 Lighting Power Density Allowances Using the Building Area Method:	LPD	0.90
Table 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method:		
1. Dining Area – Bar/Lounge or leisure dining	LPD	0.93

Table 5 maps the building area method and the space-by-space values. For a building data set to be included in the analysis, 33% of the spaces in the data set must be the spaces to be used in the dataset.

Table 5. Building Area Method

Building Area Type	Space-by-Space Type
Assisted Living	Living Quarters
Automotive Facility	Garage Service/Repair
Convention Center	Hotel/Conference Center - Conference/Meeting
	General exhibition
Courthouse	Courtroom
Dining-Bar Lounge/Leisure	Dining Area
Dining-Café/Fast Food	Dining Area
Dining-Family	Dining Area
Dormitory	Living Quarters
Exercise Center	Fitness Area
Fire Station	Fire Station Engine Room
Gymnasium	Playing Area
Healthcare Clinic	Exam/Treatment
	Medical/Industrial Research Laboratory
Hospital	Exam/Treatment

	Medical/Industrial Research Laboratory
Hotel / Motel	Living Quarters
Library	Stacks
Manufacturing	General Low Bay
Motel	Living Quarters
Motion Public Theater	Audience / Seating Area
Multifamily	Corridor/Transition
	Stairway
Museum	General Exhibition
Office	Office - enclosed
	Office - open plan
Office-Medical	Office - enclosed
	Office - open plan
	Exam/Treatment
Parking Garage	Parking
Penitentiary	Confinement Cells
Police Station	Confinement Cells
	Office - enclosed
	Active storage
Post Office	Sorting Area
Religious	Worship - pulpit, choir
	Lobby
	Audience/Seating Area
Retail	Merchandising Sales Area
	Specialty Store Sales Area
School-Middle	Classroom/Lecture/Training
Sports Arena	Lobby
	Audience Seating Arena
Theater Performing Arts	Audience/Seating Area
	Lobby
	Lounge/Recreation
Theater Motion Picture	Audience/Seating Area
Town Hall	Office - enclosed
	Conference Meeting/Multipurpose
School-Middle	Classroom/Lecture/Training
Sports Arena	Lobby
	Audience Seating Arena
Theater Performing Arts	Audience/Seating Area
	Lobby
	Lounge/Recreation
Theater Motion Picture	Audience/Seating Area
Town Hall	Office - enclosed
	Conference Meeting/Multipurpose
	Lounge/Recreation

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]

Addendum bw to 90.1-2016

Modify the standard as follows (IP and SI Units)

Table 9.5.1 Lighting Power Density Allowances Using the Building Area Method

<i>Building Area Type^a</i>	<i>LPD, W/ft²</i>
Automotive facility	0.74 <u>0.76</u>
Convention center	0.76 <u>0.64</u>
Courthouse	0.90 <u>0.82</u>
Dining: Bar lounge/leisure	0.90 <u>0.83</u>
Dining: Cafeteria/fast food	0.79 <u>0.77</u>
Dining: Family	0.72
Dormitory	0.64 <u>0.81</u>
Exercise center	0.65 <u>0.79</u>
Fire station	0.53 <u>0.60</u>
Gymnasium	0.68 <u>0.77</u>
Health-care clinic	0.82 <u>0.85</u>
Hospital	1.05 <u>1.03</u>
Hotel/motel	0.75 <u>0.57</u>
Library	0.78 <u>0.84</u>
Manufacturing facility	0.90 <u>0.83</u>
Motion picture theater	0.83 <u>0.55</u>
Multifamily	0.68 <u>0.52</u>
Museum	1.06 <u>0.57</u>
Office	0.79 <u>0.66</u>
Parking garage	0.15 <u>0.19</u>
Penitentiary	0.75 <u>0.74</u>
Performing arts theater	1.18 <u>0.87</u>
Police station	0.80 <u>0.69</u>
Post office	0.67 <u>0.68</u>
Religious facility	0.94 <u>0.69</u>

Retail	1.06 <u>0.85</u>
School/university	0.81 <u>0.74</u>
Sports arena	0.88
Town hall	0.80 <u>0.74</u>
Transportation	0.61 <u>0.51</u>
Warehouse	0.48 <u>0.74</u>
Workshop	0.90 <u>0.92</u>

Modify the standard as follows (SI Units)

Table 9.5.1 Lighting Power Density Allowances Using the Building Area Method

<i>Building Area Type^a</i>	<i>LPD, W/m²</i>
Automotive facility	7.6 <u>8.2</u>
Convention center	8.2 <u>6.9</u>
Courthouse	9.7 <u>8.8</u>
Dining: Bar lounge/leisure	9.7 <u>8.9</u>
Dining: Cafeteria/fast food	8.5 <u>8.3</u>
Dining: Family	8.4 <u>7.7</u>
Dormitory	6.6 <u>8.7</u>
Exercise center	7.0 <u>8.5</u>
Fire station	5.7 <u>6.5</u>
Gymnasium	7.3 <u>8.3</u>
Health-care clinic	8.8 <u>9.1</u>
Hospital	11.3 <u>11.0</u>
Hotel/motel	8.1 <u>6.2</u>
Library	8.4 <u>9.1</u>
Manufacturing facility	9.7 <u>8.9</u>
Motion picture theater	8.9 <u>5.9</u>
Multifamily	7.3 <u>5.6</u>
Museum	11.4 <u>6.2</u>
Office	8.5 <u>7.1</u>
Parking garage	1.6 <u>2.0</u>
Penitentiary	8.1 <u>8.0</u>
Performing arts theater	12.7 <u>9.4</u>
Police station	8.6 <u>7.4</u>
Post office	7.2 <u>7.3</u>

Religious facility	10.1 <u>7.4</u>
Retail	11.4 <u>9.2</u>
School/university	8.7 <u>8.0</u>
Sports arena	9.4 <u>9.4</u>
Town hall	8.6 <u>8.0</u>
Transportation	6.6 <u>5.5</u>
Warehouse	5.2 <u>7.9</u>
Workshop	9.7 <u>9.9</u>