



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

Public Review Draft

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

**First Public Review (February 2019)
(Draft Shows Proposed Changes to Current Standard)**

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research-technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

This standard is under continuous maintenance. To propose a change to the current standard, use the change submittal form available on the ASHRAE website, www.ashrae.org.

The appearance of any technical data or editorial material in this public review document does not constitute endorsement, warranty, or guaranty by ASHARE of any product, service, process, procedure, or design, and ASHRAE expressly disclaims such.

© 2019 ASHRAE. This draft is covered under ASHRAE copyright. Permission to reproduce or redistribute all or any part of this document must be obtained from the ASHRAE Manager of Standards, 1791 Tullie Circle, NE, Atlanta, GA 30329. Phone: 404-636-8400, Ext. 1125. Fax: 404-321-5478. E-mail: standards.section@ashrae.org.

ASHRAE, 1791 Tullie Circle, NE, Atlanta GA 30329-2305

© 2019 ASHRAE

This draft is covered under ASHRAE copyright. The appearance of any technical data or editorial material in this publication document does not constitute endorsement, warranty, or guaranty by ASHRAE of any product, service, process, procedure, design or the like and ASHRAE expressly disclaims such. Permission to republish or redistribute must be obtained from the MOS.

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

The building area method is an **alternate method** to the space-by-space method. Energy savings are related to the addendum bb (space-by-space method). This addendum does not have cost implications because costs of updating lighting power density allowances were addressed in Addendum bb.

The values in this addendum supersede Addendum bw. During the period between the approval by the 90.1 Committee and publication of Addendum bw, addendum bb (Table 9.6.1, space-by-space method) values were revised. As mentioned earlier, the values from addendum bb (Table 9.6.1, space-by-space) flow into Table 9.5.1, building area method. At the end of this addendum (below the line) is a comparison of Addendum bw and this addendum.

Background Data and Supporting Analysis

Drawings of actual buildings were purchased from a public service that specializes in construction data, Dodge Data & Analytics. 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.

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

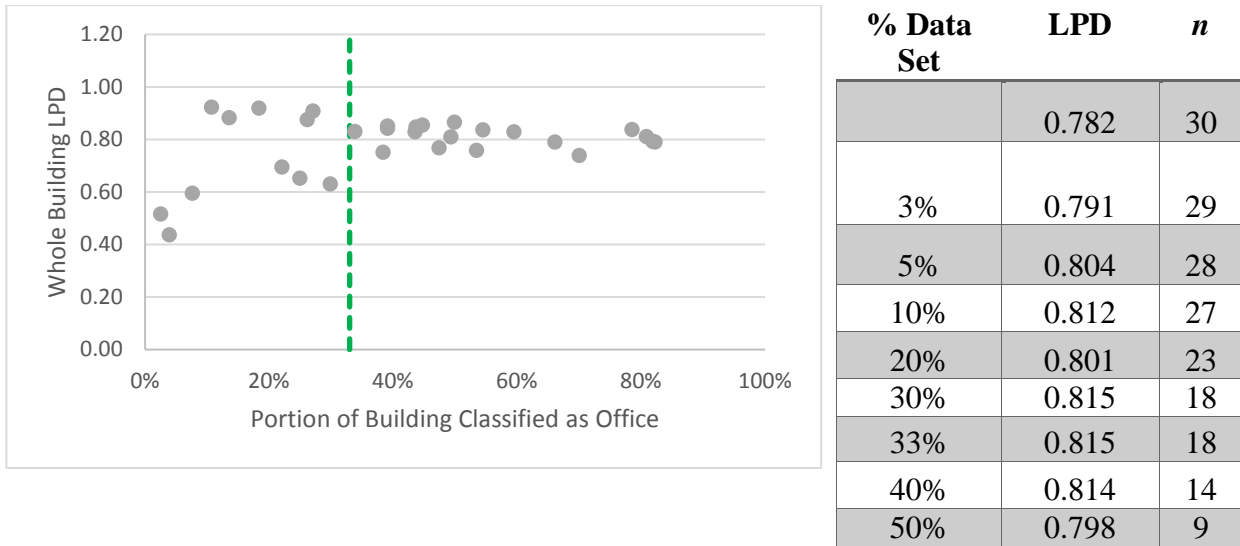


Table 9.5.1 Lighting Power Density Allowances Using the Building Area Method: LPD 0.79

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

[Note to Reviewers: This public review draft makes proposed independent substantive changes to the previous public review draft. These changes are indicated in the text by underlining (for additions) and ~~striketrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the previous draft 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 substantive changes.]

Addendum cg 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	0.71 <u>0.75</u>
Convention center	0.76 <u>0.64</u>
Courthouse	0.90 <u>0.79</u>
Dining: Bar lounge/leisure	0.90 <u>0.80</u>
Dining: Cafeteria/fast food	0.79 <u>0.76</u>
Dining: Family	0.78 <u>0.71</u>
Dormitory	0.61 <u>0.53</u>
Exercise center	0.65 <u>0.72</u>
Fire station	0.53 <u>0.56</u>
Gymnasium	0.68 <u>0.76</u>
Health-care clinic	0.82 <u>0.81</u>
Hospital	1.05 <u>0.96</u>
Hotel/motel	0.75 <u>0.56</u>
Library	0.78 <u>0.83</u>
Manufacturing facility	0.90 <u>0.82</u>
Motion picture theater	0.83 <u>0.44</u>
Multifamily	0.68 <u>0.45</u>
Museum	1.06 <u>0.55</u>
Office	0.79 <u>0.64</u>
Parking garage	0.15 <u>0.18</u>
Penitentiary	0.75 <u>0.69</u>
Performing arts theater	1.18 <u>0.84</u>
Police station	0.80 <u>0.66</u>
Post office	0.67 <u>0.65</u>
Religious facility	0.94 <u>0.67</u>
Retail	1.06 <u>0.84</u>
School/university	0.81 <u>0.72</u>
Sports arena	0.87 <u>0.76</u>
Town hall	0.80 <u>0.69</u>
Transportation	0.61 <u>0.50</u>
Warehouse	0.48 <u>0.45</u>
Workshop	0.90 <u>0.91</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>8.1</u>
Convention center	6.9 <u>6.9</u>
Courthouse	8.8 <u>8.5</u>
Dining: Bar lounge/leisure	8.9 <u>8.6</u>
Dining: Cafeteria/fast food	8.3 <u>8.2</u>
Dining: Family	7.7 <u>7.6</u>
Dormitory	8.7 <u>5.7</u>
Exercise center	8.5 <u>7.8</u>
Fire station	6.5 <u>6.0</u>
Gymnasium	8.3 <u>8.2</u>
Health-care clinic	9.1 <u>8.7</u>
Hospital	11.0 <u>10.3</u>
Hotel/motel	6.2 <u>6.0</u>
Library	9.1 <u>8.9</u>
Manufacturing facility	8.9 <u>8.8</u>
Motion picture theater	5.9 <u>4.7</u>
Multifamily	5.6 <u>4.8</u>
Museum	6.2 <u>5.9</u>
Office	8.5 <u>6.9</u>
Parking garage	1.6 <u>1.9</u>
Penitentiary	8.0 <u>7.4</u>
Performing arts theater	9.4 <u>9.0</u>
Police station	7.4 <u>7.1</u>
Post office	7.3 <u>7.0</u>
Religious facility	7.4 <u>7.2</u>
Retail	9.2 <u>9.0</u>
School/university	8.0 <u>7.8</u>
Sports arena	9.4 <u>8.2</u>
Town hall	8.0 <u>7.4</u>
Transportation	5.5 <u>5.4</u>
Warehouse	7.9 <u>4.8</u>
Workshop	9 <u>9.8</u>

Table shown to compare a previously published addendum bw that is out for review. However, values were revised during the period of approval by 90.1 and when it was released for public review. Please consider Addendum cg as the most current proposed values. Addendum cg values supersede the values in Addendum bw.

Table 9.5.1 Lighting Power Density Allowances Using the Building Area Method

Building Area Type	Addendum bw [LPD, W/ft ²] Previously approved for public review		Addendum cg LPD, W/ft ² New proposal supplanting addendum bw	
	2016 Addendum bw		2016 Addendum cg	
Automotive facility	0.74	<u>0.76</u>	0.74	<u>0.75</u>
Convention center	0.76	<u>0.64</u>	0.76	<u>0.64</u>
Courthouse	0.90	<u>0.82</u>	0.90	<u>0.79</u>
Dining: Bar lounge/leisure	0.90	<u>0.83</u>	0.90	<u>0.80</u>
Dining: Cafeteria/fast food	0.79	<u>0.77</u>	0.79	<u>0.76</u>
Dining: Family		<u>0.72</u>	0.78	<u>0.71</u>
Dormitory	0.64	<u>0.81</u>	0.64	<u>0.53</u>
Exercise center	0.65	<u>0.79</u>	0.65	<u>0.72</u>
Fire station	0.53	<u>0.60</u>	0.53	<u>0.56</u>
Gymnasium	0.68	<u>0.77</u>	0.68	<u>0.76</u>
Health-care clinic	0.82	<u>0.85</u>	0.82	<u>0.81</u>
Hospital	1.05	<u>1.03</u>	1.05	<u>0.96</u>
Hotel/motel	0.75	<u>0.57</u>	0.75	<u>0.56</u>
Library	0.78	<u>0.84</u>	0.78	<u>0.83</u>
Manufacturing facility	0.90	<u>0.83</u>	0.90	<u>0.82</u>
Motion picture theater	0.83	<u>0.55</u>	0.83	<u>0.44</u>
Multifamily	0.68	<u>0.52</u>	0.68	<u>0.45</u>
Museum	1.06	<u>0.57</u>	1.06	<u>0.55</u>
Office	0.79	<u>0.66</u>	0.79	<u>0.64</u>
Parking garage	0.15	<u>0.19</u>	0.15	<u>0.18</u>
Penitentiary	0.75	<u>0.74</u>	0.75	<u>0.69</u>
Performing arts theater	1.18	<u>0.87</u>	1.18	<u>0.84</u>
Police station	0.80	<u>0.69</u>	0.80	<u>0.66</u>
Post office	0.67	<u>0.68</u>	0.67	<u>0.65</u>
Religious facility	0.94	<u>0.69</u>	0.94	<u>0.67</u>
Retail	1.06	<u>0.85</u>	1.06	<u>0.84</u>

School/university	0.81 <u>0.74</u>	0.81 <u>0.72</u>
Sports arena	<u>0.88</u>	0.87 <u>0.76</u>
Town hall	0.80 <u>0.74</u>	0.80 <u>0.69</u>
Transportation	0.61 <u>0.51</u>	0.61 <u>0.50</u>
Warehouse	0.48 <u>0.74</u>	0.48 <u>0.45</u>
Workshop	0.90 <u>0.92</u>	0.90 <u>0.91</u>