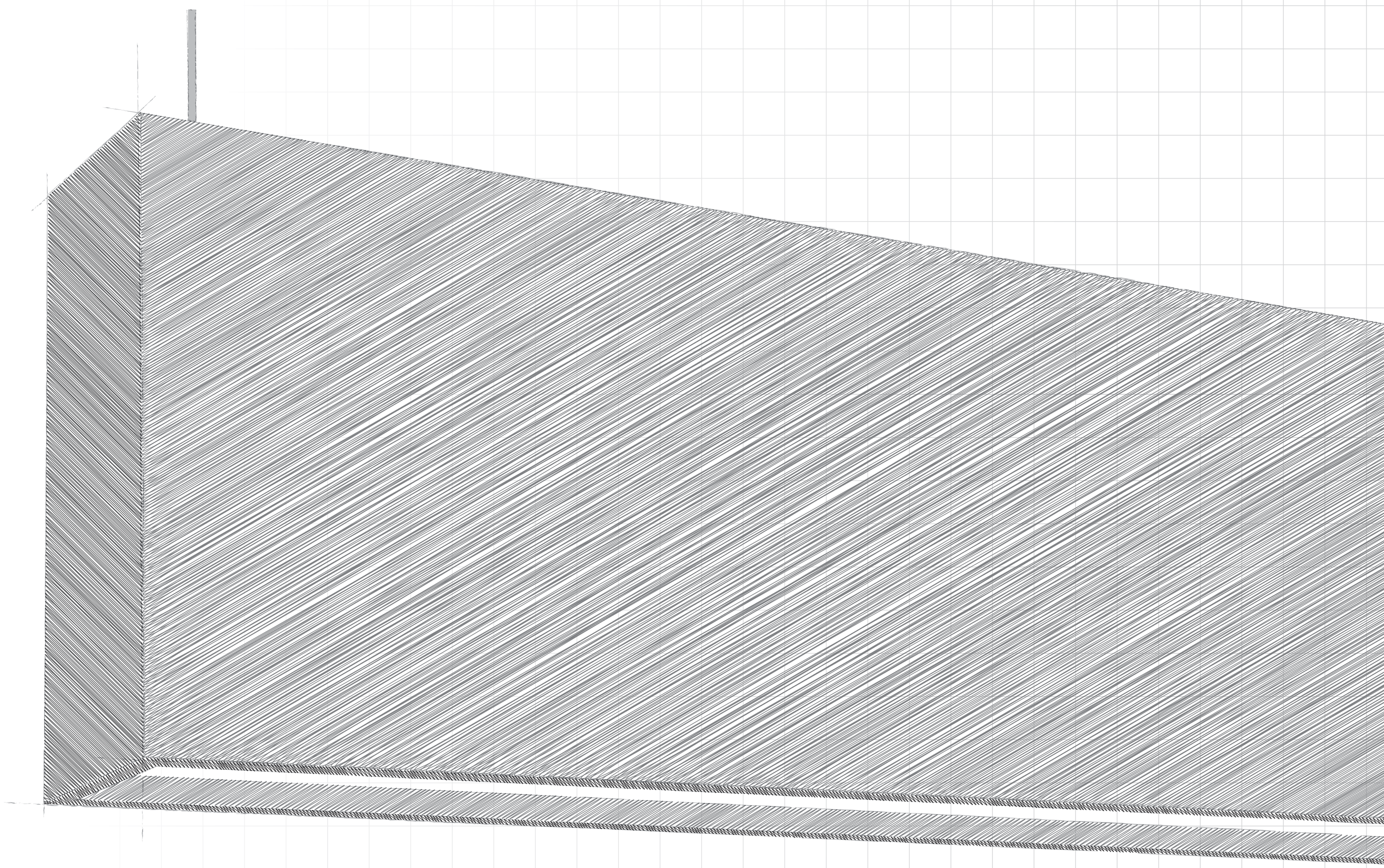
ACOUSTIC PRODUCT FAMILY

FINELITE®
Better Lighting

Specifying Design Guide

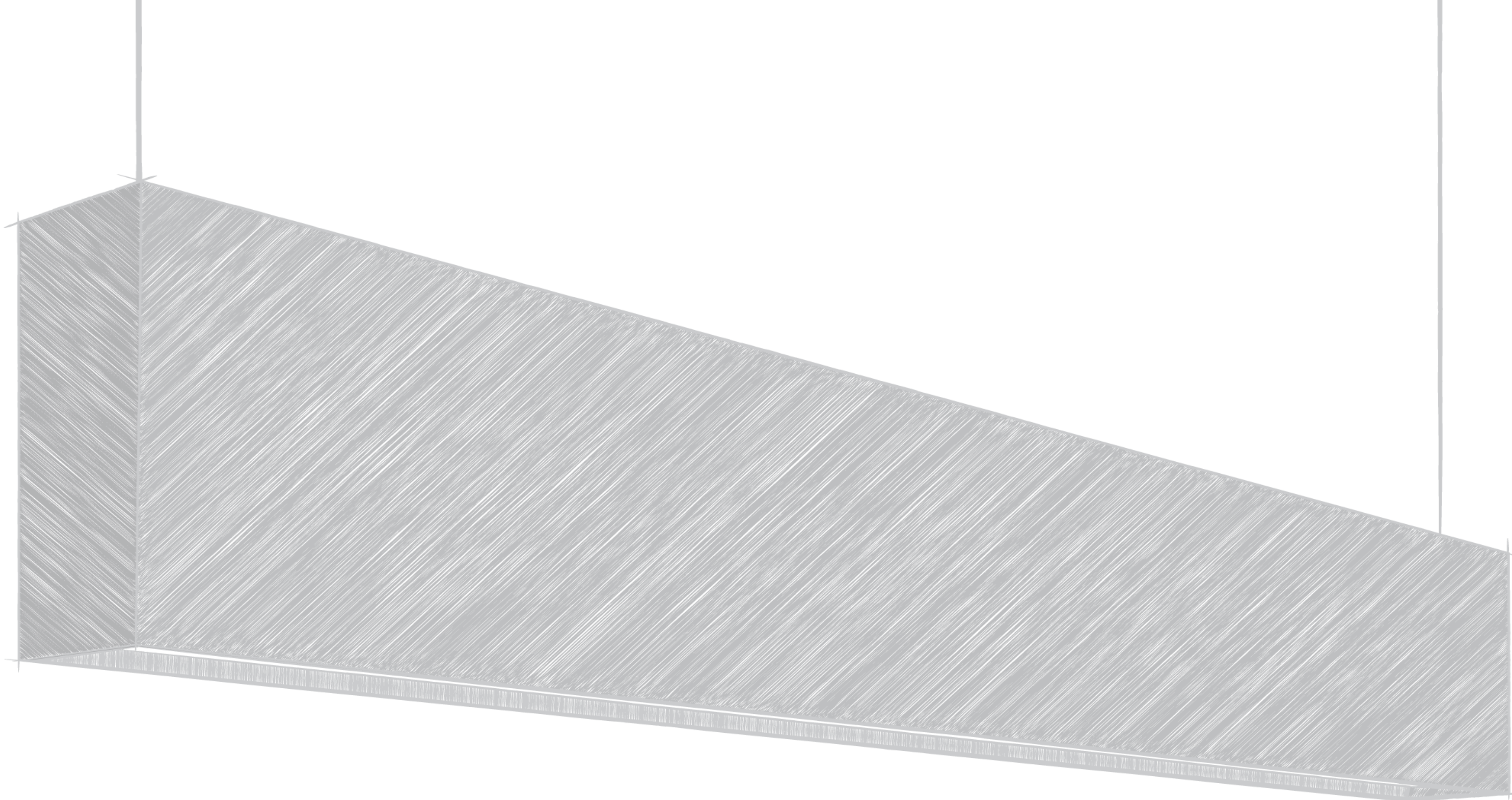


Our in-house, custom
7 STEPS TO SPECIFY

Robust Examples including
APPLICATION DRAWINGS

Informative intro to the world of
ACOUSTICS

Table of Contents



High Performing & Sound Absorbing

The design of tomorrow will increase the use of glass, concrete, exposed ceilings, and other hard surfaces into the built environment. These architectural elements not only deliver modern and desirable aesthetics, but also provide surfaces that are easily cleanable. The continued use of these non-sound absorbing elements will present us with acoustical challenges and will have direct impact on occupants' well-being and productivity.

With an occupant first approach, we introduce a sophisticated solution that integrates light and acoustics.

Within these pages, you will find our step-by-step process to confidently specify and apply sound absorbing luminaire types.

Based on Sabine’s Formula, our simplified method allows you to easily calculate by hand the amount of sound absorbing materials needed to achieve your target reverberation time.

SABINE’S FORMULA

$$RT_{60} = \frac{24\,(\ln 10)\,V}{c_{20}\,S_a}$$

7 Steps to Specify

Follow these seven steps to accurately calculate the necessary absorption and appropriate Finelite products to enhance the sonic quality of any space. Before determining the acoustical characteristics of a space, it is advisable to first calculate the lighting requirements for that space.

1 SPECIFY ROOM DIMENSIONS

2 SPECIFY SURFACE MATERIALS AND CALCULATE SABINS

3 CALCULATE EXISTING REVERBERATION TIME

4 SPECIFY TARGET REVERBERATION TIME BASED ON SPACE TYPE

5 CALCULATE TARGET SABINS FOR SPECIFIED REVERBERATION TIME

6 CALCULATE AMOUNT OF ACOUSTICAL ABSORPTION NEEDED TO ACHEIVE REVERBERATION TIME

7 CALCULATE AMOUNT OF ACOUSTICAL PRODUCT REQUIRED FOR SPACE

Calculator

We have developed a calculator that can help you specify Finelite acoustic products to meet the sound absorption requirements of your space.

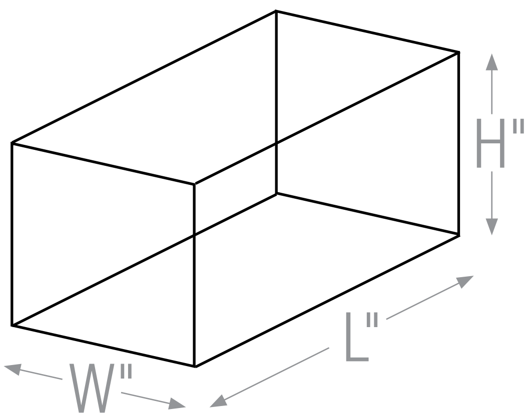
Visit our website to download our free calculation tool to help you specify Finelite acoustic products. ⟶

7 Steps to Specify

1

SPECIFY ROOM DIMENSIONS

LENGTH × WIDTH × HEIGHT



2

SPECIFY SURFACE MATERIALS & CALCULATE SABINS

First, find the coefficient of each surface material. For common workplace environments, refer to the absorption coefficient* at 500Hz. Next, multiply by the material's ft^2 area to obtain the number of sabins per surface. Finally, add all sabins equaling the total room sabins.

SOUND ABSORPTION COEFFICIENT

Materials	Sound Absorption Coefficient					
	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
Brick unglazed	0.02	0.02	0.03	0.04	0.05	0.07
Light carpet on concrete	0.02	0.06	0.14	0.37	0.60	0.65
Concrete block tough	0.01	0.02	0.04	0.06	0.08	0.10
Concrete block, painted	0.10	0.05	0.06	0.07	0.09	0.08
Linoleum, rubber, or asphalt tile on concrete	0.02	0.03	0.03	0.03	0.03	0.02
Marble or glazed tile	0.01	001	0.01	0.01	0.02	0.02
Concrete or terazzo	0.01	0.01	0.02	0.02	0.02	0.02
Wood 1/4" paneling w/ airspace behind	0.42	0.21	0.10	0.08	0.06	0.06
Heavy pane glass	0.18	0.06	0.04	0.03	0.02	0.02
Ordinary glass	0.35	0.25	0.18	0.12	0.07	0.05
Gypsum board, 5/8"	0.55	0.14	0.08	0.04	0.12	0.11
Plaster on brick	0.01	0.02	0.02	0.03	0.04	0.05

* For clarification on any acoustics-related terminology, please see glossary

7 Steps to Specify

3

CALCULATE EXISTING REVERBERATION TIME

$$\frac{\text{VOLUME OF ROOM}_{\text{ DERIVED FROM STEP 1}}}{20.35 \times \text{TOTAL ROOM SABINS}_{\text{ DERIVED FROM STEP 2}}}$$

20.35 is a constant derived from Sabine's formula. Always use this value to calculate reverberation time.

4

SPECIFY TARGET REVERBERATION TIME BASED ON SPACE TYPE

Each entry is attributed with a value range of exceptable reverberation time. Choose a value from this chart that falls within the range of the category that best describes the space to specify- in terms of size and function. Adjusting the chosen reverberation time can help simplify the formula, account for specific conditions in the real room, or arrive at a sum total of baffles that better fits the space.

IDEAL REVERBERATION TIME (BY ROOM)

Room Type	Range of Acceptable Reverberation Time (in seconds)
Recording & broadcasting studio	0.10-0.70
Classroom	0.50-0.90
Library	0.55-0.95
Fine dining	0.60-0.80
Casual restaurant	0.80-1.00
Intimate drama	0.78-1.18
Museum	0.79-1.19
Lecture & conference room	0.60-1.19
Cinema	0.70-1.28
Open office	0.75-1.25
Small theater	1.08-1.48
Multipurpose auditorium	1.41-1.90
Church	1.40-2.20
Cathedral	1.80-2.59

7 Steps to Specify

5

CALCULATE TARGET SABINS FOR SPECIFIED REVERBERATION TIME

VOLUME OF ROOM
DERIVED FROM STEP 1

———————————

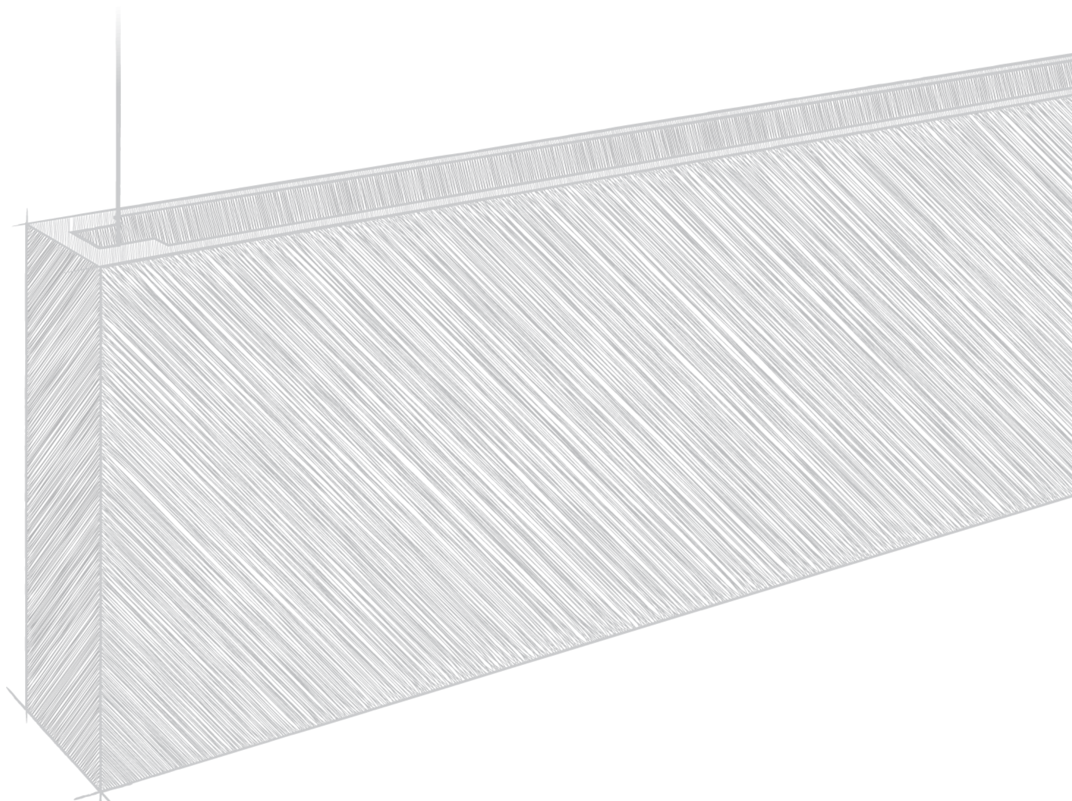
20.35 × SPEC'D TIME
DERIVED FROM STEP 4

20.35 is a constant derived from Sabine's formula. Always use this value to calculate target sabins.

6

CALCULATE AMOUNT OF ACOUSTICAL ABSORPTION NEEDED TO ACHIEVE REVERBERATION TIME

TARGET SABINS – SABINS OF ROOM
DERIVED FROM STEP 5 — DERIVED FROM STEP 2



7 Steps to Specify

7

CALCULATE AMOUNT OF ACOUSTICAL PRODUCT REQUIRED FOR SPACE

Use the data in this table to determine your acoustic solution by product.

For simple calculations, it is common to use only the absorption coefficient value at 500Hz.

SABINS NEEDED DERIVED FROM STEP 6

PRODUCT SABINS DERIVED FROM STEP 7

ACOUSTIC DATA TABLE (PER UNIT)

Product	Spacing	Sabins (ft² of sound absorption area) per Unit						Equivalent Ceiling Treatment*	
		125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	Apparent NRC	Apparent SAA
HP-2 Acoustic Baffle Lit 8"	Spaced 12"	1.33	2.24	5.23	8.29	11.46	11.85	0.85	0.84
	Spaced 18"	1.47	2.38	5.35	9.68	12.40	13.15	0.60	0.61
	Spaced 24"	1.50	2.49	5.57	9.91	13.07	13.55	0.50	0.48
HP-2 Acoustic Baffle Lit 12"	Spaced 12"	3.06	4.07	7.25	11.67	14.67	15.00	1.15	1.16
	Spaced 18"	2.54	4.65	8.04	13.09	16.37	17.07	0.85	0.87
	Spaced 24"	3.13	4.77	8.91	14.16	17.41	17.41	0.70	0.69
HP-2 Acoustic Baffle Unlit 8"	Spaced 12"	1.61	2.97	6.24	8.81	11.94	12.90	0.90	0.92
	Spaced 18”	1.46	3.45	6.55	10.25	13.09	14.35	0.70	0.68
	Spaced 24”	1.72	3.21	7.09	11.07	13.85	14.82	0.55	0.54
HP-2 Acoustic Baffle Unlit 12"	Spaced 12”	2.13	4.94	8.30	11.94	15.28	16.06	1.25	1.25
	Spaced 18”	2.13	5.22	8.77	13.94	16.96	18.17	0.90	0.93
	Spaced 24”	2.41	6.14	9.68	14.90	17.81	19.43	0.75	0.74

*Apparent NRC & SAA ratings were calculated from the measured total absorption in sabins divided by the area of a projected horizontal plane that encompasses the set of objects. This provides an accurate comparison to 2-dimensional ceiling surface treatments.

Example 1 Open Office

1 SPECIFY ROOM DIMENSIONS

LENGTH × WIDTH × HEIGHT

Volume of Room

60' x 60' x 14' = 50400 ft^3

2 SPECIFY SURFACE MATERIALS AND CALCULATE SABINS

FROM PAGE 6

CEILING, CONCRETE BLOCK PAINTED 60' × 60' × 0.06 = 216 SABINS
FLOOR, THIN CARPET 60' × 60' × 0.25 = 900 SABINS
WALL 1, HEAVY LARGE PANE GLASS 60' × 14' × 0.04 = 33.6 SABINS
WALL 2, GYSPSUM 5/8IN 60' × 14' × 0.08 = 67.2 SABINS
WALL 3, GYSPSUM 5/8IN 60' × 14' × 0.08 = 67.2 SABINS
WALL 4, HEAVY LARGE PANE GLASS 60' × 14' × 0.04 = 33.6 SABINS

Sabins of Room = 1317.60

3 CALCULATE EXISTING REVERBERATION TIME

(VOLUME OF ROOM) ÷ (20.35 × SABINS OF ROOM)

Existing Reverb Time

$$\frac{50400}{20.35 \times 1317.60} = 1.88 \text{ s}$$

4 SPECIFY TARGET REVERBERATION TIME BASED ON SPACE TYPE

FROM PAGE 7

OPEN OFFICE = 0.92 SECONDS

Target Time = 0.88 s

5 CALCULATE TARGET SABINS FOR SPECIFIED REVERBERATION TIME

(VOLUME OF ROOM) ÷ (20.35 × SPEC TIME)

Target Sabins

$$\frac{50400}{20.35 \times 0.88} = 2813.34$$

6 CALCULATE AMOUNT OF ACOUSTICAL ABSORPTION NEEDED TO ACHIEVE REVERBERATION TIME

TARGET SABINS – SABINS OF ROOM

Sabins Needed

2813.34 – 1317.60 = 1495.74

7 CALCULATE AMOUNT OF ACOUSTICAL PRODUCT REQUIRED FOR SPACE

FROM PAGE 9

HP-2 ACOUSTIC BAFFLE LIT 12", SPACED 24" = 8.91 SABINS

SABINS NEEDED ÷ PRODUCT SABINS

Baffles Needed

$$\frac{1495.74}{9.68} = 154.51 \text{ rnd up to } 155$$

At least 155 acoustic baffles are needed to reach target reverberation time in the space. Lighting calculations indicate 35 8' long fixtures are needed. Therefore, 120 unlit baffles will allow you to meet your acoustic goals.

35 lit / 120 unlit 12" baffles

Example 1 Open Office

Room Type Open Office
Luminaire Mounting Height 9'
Room Reflectances 80/50/20
Target Reverberation Time 0.88 seconds
Initial Reverberation Time 1.88 seconds

HP-2-D-8'-B-835-F-ABL

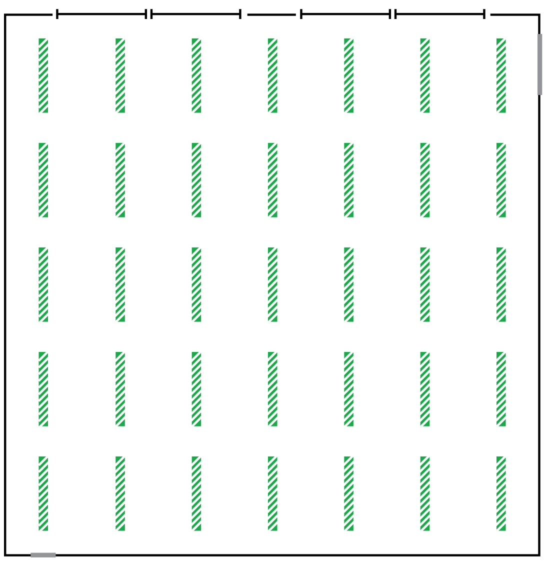
Lighting Performance	
Average Light Level at Workplane (Footcandles)	28
Energy Consumption (Lighting Power Density)	0.45 W/ft²
Room Size (Area)	18' × 14'

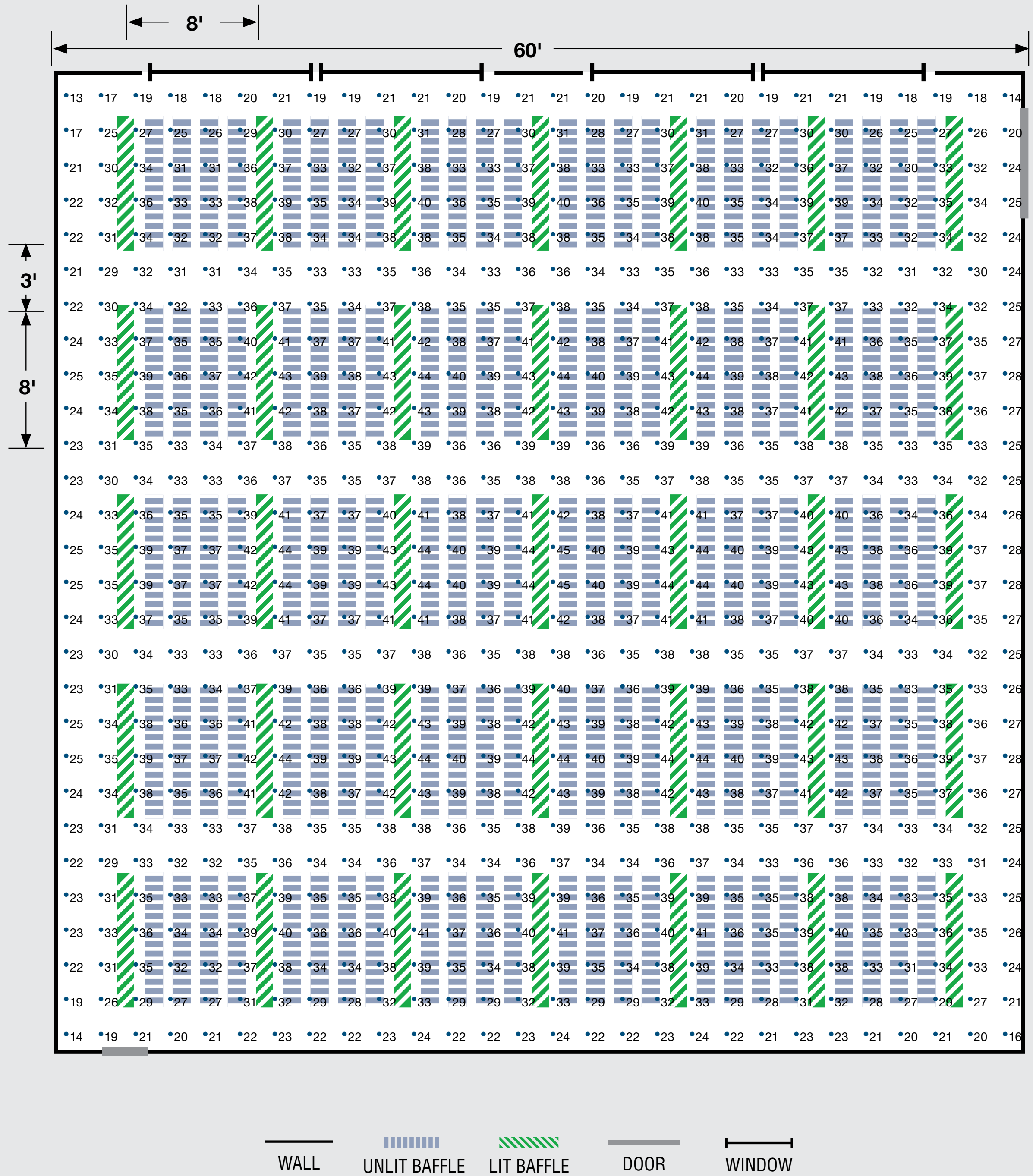
S – Standard Output, B – Boosted Standard Output, H – High Output, V – Very High Output

Acoustic Quality	
Per-Unit Sabins	9.68
Target Reverberation Time	0.88 s
Initial Reverberation Time	1.88 s

Before Specifying Acoustic

Application fulfills lighting needs





Example 2 Conference Room

1 SPECIFY ROOM DIMENSIONS

LENGTH × WIDTH × HEIGHT

Volume of Room

18' x 14' x 9.5' = 2394 ft^3

2 SPECIFY SURFACE MATERIALS AND CALCULATE SABINS

FROM PAGE 6

CEILING, CONCRETE ROUGH 18' × 14' × 0.04 = 10.08 SABINS

FLOOR, THIN CARPET ON CONCRETE 18' × 14' × 0.25 = 63 SABINS

WALL 1, HEAVY LARGE PANE GLASS 18' × 9.5' × 0.04 = 6.84 SABINS

WALL 2, GYSPSUM 5/8IN 14' × 9.5' × 0.08 = 13.68 SABINS

WALL 3, GYSPSUM 5/8IN 14' × 9.5' × 0.08 = 10.64 SABINS

WALL 4, HEAVY LARGE PANE GLASS 18' × 9.5' × 0.04 = 5.32 SABINS

Sabins of room = 109.56

3 CALCULATE EXISTING REVERBERATION TIME

(VOLUME OF ROOM) ÷ (20.35 × SABINS OF ROOM)

Existing Reverb Time

$$\frac{2394}{20.35 \times 109.56} = 1.07 \text{ s}$$

4 SPECIFY TARGET REVERBERATION TIME BASED ON SPACE TYPE

SEE PAGE 7

Target Time = 0.80 s

5 CALCULATE TARGET SABINS FOR SPECIFIED REVERBERATION TIME

(VOLUME OF ROOM) ÷ (20.35 × SPEC TIME)

Target Sabins

$$\frac{2394}{20.35 \times 0.8} = 147$$

6 CALCULATE AMOUNT OF ACOUSTICAL ABSORPTION NEEDED TO ACHIEVE REVERBERATION TIME

TARGET SABINS – SABINS OF ROOM

Sabins Needed

147 – 109.56 = 37.44

7 CALCULATE AMOUNT OF ACOUSTICAL PRODUCT REQUIRED FOR SPACE

SEE PAGE 9

HP-2 ACOUSTIC BAFFLE LIT 12", SPACED 24" = 8.91 SABINS

SABINS NEEDED ÷ PRODUCT SABINS

Baffles Needed

$$\frac{37.44}{8.91} = 4.2 \text{ rnd up to } 5$$

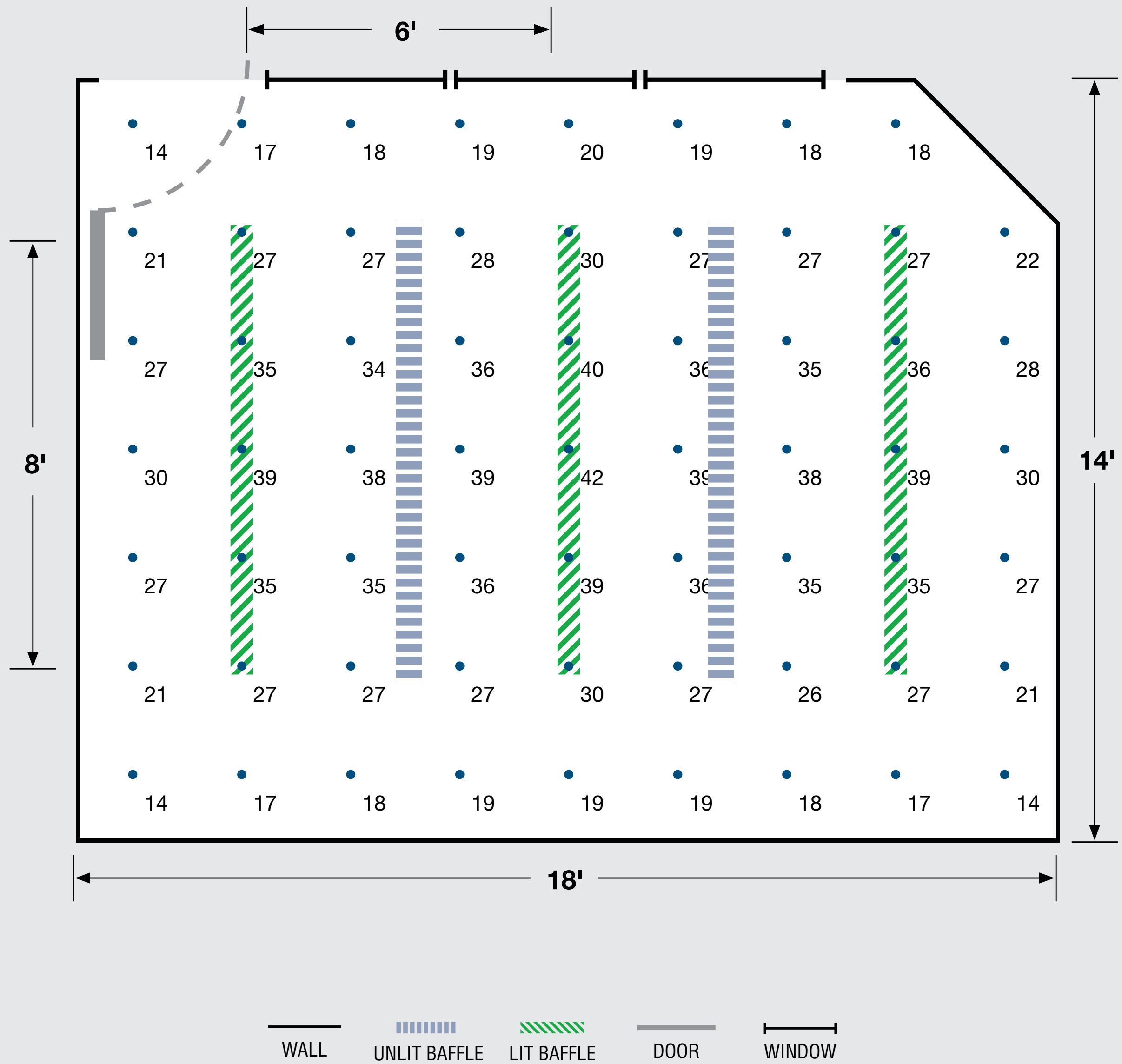
At least four acoustic baffles are needed to reach target reverberation time in the space. Lighting calculations indicate three 8' long fixtures are needed. As designers, we need to balance the visual aesthetic of the lit and unlit baffles. Since it is okay to use more unlit baffles than are needed, our recommendation would be to suggest three lit baffles and two unlit baffles.

3 lit / 2 unlit 12" baffles

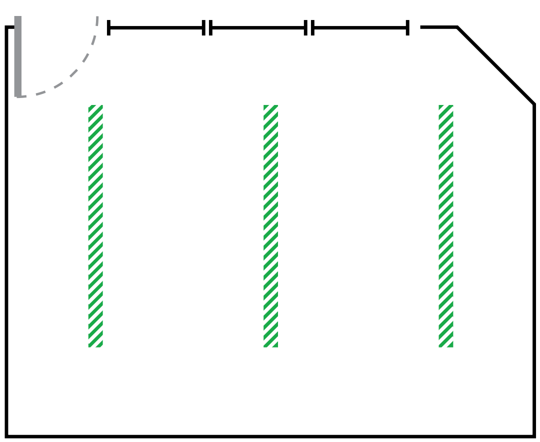
Example 2
Conference Room

Room Type Conference Room
Luminaire Mounting Height 8'
Room Reflectances 80/50/20
Target Reverberation Time 0.80 seconds
Initial Reverberation Time 1.07 seconds

HP-2-D-8'-B-835-F-ABL	
Lighting Performance	
Average Light Level at Workplane (Footcandles)	28
Average Light Level Conference Table (Footcandles)	39
Energy Consumption (Lighting Power Density)	0.45 W/ft²
Room Size (Area)	18' × 14'
S – Standard Output, B – Boosted Standard Output, H – High Output, V – Very High Output	
Acoustic Quality	
Per-Unit Sabins	8.91
Target Reverberation Time	0.80 s
Initial Reverberation Time	1.07 s



Before Specifying Acoustic
Application fulfills lighting needs



Blank Worksheet

Use this page to enter your own data and calculate your acoustic needs.

1 SPECIFY ROOM DIMENSIONS

LENGTH × WIDTH × HEIGHT

2 SPECIFY SURFACE MATERIALS AND CALCULATE SABINS

SEE PAGE 5

3 CALCULATE EXISTING REVERBERATION TIME

VOLUME OF ROOM ÷ (20.35 × SABINS OF ROOM)

4 SPECIFY TARGET REVERBERATION TIME BASED ON SPACE TYPE

SEE PAGE 6

5 CALCULATE TARGET SABINS FOR SPECIFIED REVERBERATION TIME

VOLUME OF ROOM ÷ (20.35 × SPEC TIME)

6 CALCULATE AMOUNT OF ACOUSTICAL ABSORPTION NEEDED TO ACHIEVE REVERBERATION TIME

TARGET SABINS – SABINS OF ROOM

7 CALCULATE AMOUNT OF ACOUSTICAL PRODUCT REQUIRED FOR SPACE

SEE PAGE 8 | SABINS NEEDED ÷ PRODUCT SABINS

Acoustics 101

An introduction to acoustic terminology. Read to develop your vocabulary and understanding of the subject.

Acoustics

The science of sound.

Architectural Acoustics

The science of sound as it applies to the built environment. The field can be divided into Room Acoustics, Building Acoustics, and MEP Noise Control. Room Acoustics is the most common of these, and refers to the control of sound created within a space to adequately support the space's function. The acoustic qualities and coverages of surfaces and objects determine a room's acoustic character.

Acoustical Material

A material used to alter a sound field. The material may be used to absorb, block, or damp acoustical energy.

Absorption

The conversion of sound energy into heat due to the properties of a material, thereby reducing the amount of reflected energy in a space.

Absorption Coefficient

The ratio of sound absorbed to the sound incident on the material. The absorption coefficient of a material depends on the frequency of the sound wave. An absorption coefficient of: 1 = total absorption, 0 = total reflection.

Acoustic Conditioning

The acoustic conditioning of a space is the means of designing the space to achieve a high sound quality by applying different materials and techniques to absorb or distribute sound from a sound source.

ASTM C423

A standard test method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

Baffle

A free-hanging acoustical sound absorbing unit, normally suspended vertically and in combination with other baffles, arranged in a variety of patterns to reduce reverberation and noise levels.

Decibel (dB)

A unit of measurement of sound level. The units define how loud a noise source is, ranging on a comparative scale from 0-194. A dB reading of “0” indicates the faintest sound the human ear can detect, while a dB reading of “180” would be the equivalent to standing on a rocket pad during launch.

Frequency

The measure of the rapidity of alterations of a periodic signal expressed in cycles per second or Hertz.

Hertz (Hz)

A unit of measurement of frequency, or cycles per second. One complete oscillation of a sound wave is called a cycle. One Hertz is equal to one cycle per second. The human ear can detect frequencies from about 20 Hz to about 20,000 Hz.

Noise Reduction Coefficient (NRC)

A single number rating derived from measured values of sound absorption coefficients in accordance with ASTM Test Method C423. More specifically, NRC is an average of sound absorption coefficients at frequencies corresponding to the human voice (250, 500, 1000, and 2000 Hz). Like absorption coefficient, NRC provides an estimate of the sound absorptive property of an acoustical material. For example, a hardwood flooring material of NRC 0.30 absorbs 30 percent of incident sound and reflects the remaining 70 percent back into the room. A glass door of NRC 0.05 absorbs 5 percent of the sound and reflects 95 percent.

Octave Band

A range of frequency values, where the highest frequency of the band is double the lowest frequency. The band is usually specified by the center frequency.

Reverberation

The sustained sound in a space after the source ceases. It is created when sound is reflected repeatedly, causing a large number of reflections to build up and then decay as the sound is absorbed by the surfaces of objects in the space.

Reverberation Time

A quantification of reverberation, reverberation time of a room or space is defined as the time it takes for sound to decay by 60 dB after the source of the sound has stopped.

Sabin

A unit of measure of sound absorption. 1 sabin is equal to 1 square foot of perfect absorption. The unit of sabin is particularly useful for sound-absorbing objects because it can be used to represent the total absorption of each object, unlike NRC which requires a clear square footage for use.

Speech and Communication

The maximum reverberation time for clear speech is about 1 second for most normal-size rooms. When reverberation time exceeds 1 second, speech becomes increasingly more difficult to understand, and becomes unintelligible at reverberation times of 3 seconds or more. Speech intelligibility improves as reverberation time decreases, with the ideal for classrooms or lecture spaces being lower than 1 second.

Sound Absorption Average (SAA)

A single number rating of sound absorption properties of a material obtained from ASTM C423. SAA was proposed as a replacement to NRC and works largely in the same way. It is the average of the absorption coefficients for the twelve one-third octave bands from 200 to 2500 Hz. Like NRC, SAA values normally range from 0.00 to 1.00. When the value is 1.00, it indicates 100 percent sound absorption per square foot of material.

Sound Absorption

The acoustical process whereby sound energy is dissipated as heat rather than reflected back to the environment.

Sound Absorption Coefficient

The fraction of incident sound energy absorbed by a material as measured by ASTM Test Method C423. For instance, if a material reflects 70% of the sound energy incident upon its surface, then its Sound Absorption Coefficient would be 0.30.

Calculator

We have developed a calculator that can help you specify Finelite acoustic products to meet the sound absorption requirements of your space.

Visit our website to download our free calculation tool to help you specify Finelite acoustic products. ⟶