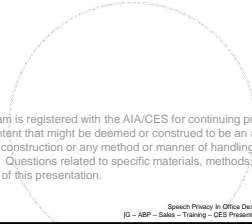


## Speech Privacy In Office Design



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Speech Privacy In Office Design Slides  
[0 - ABP - Sales - Training - CES Presentations - Office Acoustics]

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## Office Speech Privacy Seminar

- Review key office design trends and fundamental acoustical concepts.
- Discuss updated research studies on office noise.
- Explain the ABCs of design solutions to enhance speech privacy.
  - **A**bsorb noise with high performance ceilings.
  - **B**lock noise with office furniture systems.
  - **C**over background conversations with an effective sound masking system.
- Identify bottom-line results associated with an integrated acoustical office design.



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## Today's Workplace Trends

- 70% of office space is open plan.
- Employees are expensive.
  - Typical salary costs in U.S are between \$200 to \$400 per square foot per year.
- Open plan noise reduces worker effectiveness and satisfaction.



⇒ Speech noise is frequently shown on employee surveys to be the #1 facility issue causing employee distraction, stress, and loss of productivity.



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Noise – Sources Of Dissatisfaction 

# Noise

- Cause ... **speaker phones** in open plan and teaming areas.  
**The result** ... people talk louder when in use.
- Cause ... **people density** doubled due to small workstations.  
**The result** ... double the speech and office equipment noise.
- Cause ... new **work patterns** – office teaming.  
**The result** ... concentrated speech noises in greater densities.

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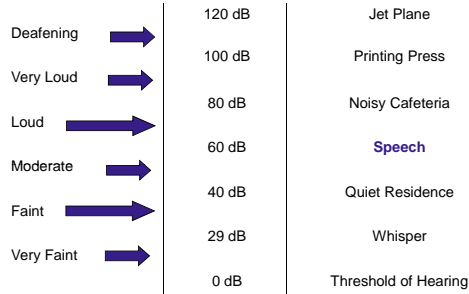
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Speech And Hearing Basics – Loudness [Level] 



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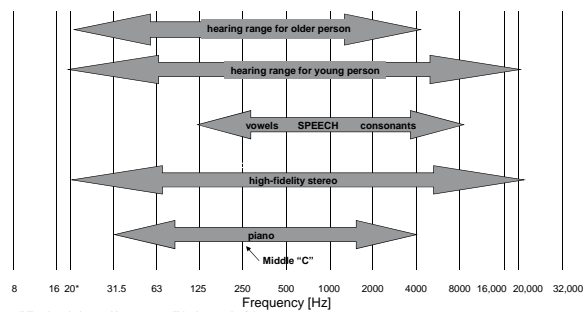
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Speech And Hearing Basics – Pitch [Frequency] 



\*Vibrations below 20 Hz are not audible, but can be felt.  
Reference: E. H. Berger et al [eds.], Noise and Hearing Conservation Manual, American Hygiene Association, Akron, Ohio, 1986.

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Acoustic Concepts – Sound Absorption 

**NRC – Noise Reduction Coefficient**

- ⇒ Measure of the **random incidence** sound absorption, used in closed spaces.
- ⇒ Indicates the ability of a surface to absorb sound from all angles.
- ⇒ Expressed as a number between 0.00 and 1.00.
- ⇒ The higher the number, the better the surface acts as an absorber.



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Acoustic Concepts – Sound Absorption 

**AC – Articulation Class**

- ⇒ Measure of **reflected speech** noise which passes over the top of systems furniture into adjoining workstations.
- ⇒ The higher the number, the better.
- ⇒ Goal: AC equal to or greater than 200.



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Acoustic Concepts – Transmission Loss 

**CAC – Ceiling Attenuation Class**

- ⇒ Measures the ceiling's ability to block sound from one room to the next. CAC is a "two-pass" test.
- ⇒ The higher the number, the better.
- ⇒ Goal: Ceiling with a CAC of 35 or greater in closed offices.



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## Acoustic Concepts – Transmission Loss

### STC – Sound Transmission Class

- ⇒ Measures a wall or furniture panel's ability to block sound from one side of a partition to the next. STC is a "one-pass" test.
- ⇒ The higher the number, the better.
- ⇒ A wall with an STC equal to or greater than 55 is considered high performance.
- ⇒ A furniture panel with an STC equal to or greater than 24 is considered high performance.



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## Privacy Index [PI]

- ⇒ Privacy Index, or PI, is a single number rating for Speech Privacy, and it includes the COMBINED acoustical performances of ceilings, sound masking, and office furniture systems.
- ⇒ PI values range from 100% to 0%.
  - Non-intrusive speech privacy is defined as 95% to 80% PI, and this is normally specified for open plan offices.
  - Less than 80% PI means increased speech intrusion, distractions, and loss of concentration and productivity.
- ⇒ Referenced in ASTM E 1130 – the standard test method for objective measurement of speech privacy in open offices using articulation index.

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## Levels Of Acoustical Privacy

### Confidential Privacy

- ⇒ Hear only muffled sounds.
- ⇒ Appropriate for board rooms and private offices.
- ⇒ 100% to 95% Privacy Index.



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**Levels Of Acoustical Privacy** 

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**Non-intrusive, Or Normal Privacy**

- ⇒ Some sentence intelligibility.
- ⇒ Not distracting.
- ⇒ Often the privacy goal for open plan buildings.
- ⇒ 95% to 80% Privacy Index.



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**Levels Of Acoustical Privacy** 

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**Marginal, Or Poor Privacy**

- ⇒ Poor acoustics.
- ⇒ Workers hear most sentences clearly, and stress is common.
- ⇒ Distraction is common due to conversation noise.
- ⇒ Lack of concentration.
- ⇒ Work performance is decreased.
- ⇒ 80% to 60% Privacy Index.



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**Levels Of Acoustical Privacy** 

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**No Privacy**

- ⇒ Typical of most offices.
- ⇒ Clear sentence intelligibility, constant distraction.
- ⇒ 60% to 0% Privacy Index.



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## New Research Studies On Office Noise

### Center For The Built Environment, UC-Berkeley

(From surveys in seven major office buildings)

- ⇒ As many as 72% of office workers are dissatisfied with speech privacy in their workplace.
- ⇒ Poor acoustics is typically the leading source of workplace dissatisfaction.
- ⇒ No survey has found a majority of occupants satisfied with their speech privacy.

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## New Research Studies On Office Noise

### BOSTI Associates

- ⇒ Survey shows 65% of people in open plan offices are "often distracted."
- ⇒ Describes design dilemma between providing areas with acoustical privacy for quiet work, and openness for team interaction.
- ⇒ Recommends closed plan or private offices for most workers because it's so difficult to work without distractions in open plan environments.

Source: "Disproving Widespread Myths about Workplace Design,"

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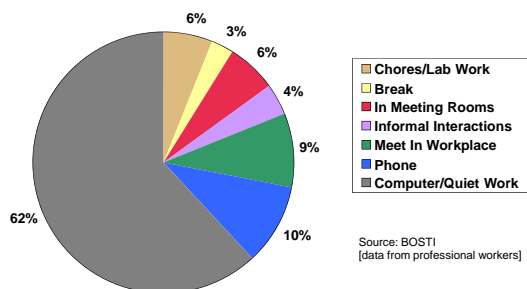
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## How People Spend Their Time At Work

62% is spent trying to do quiet, focused work.



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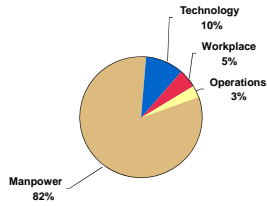
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## Why It Matters



### People Are The Most Significant Facility Investment

[based on cost of doing business over 10-year average]



And Distracting Noise Is Their #1 Problem!

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## Most Common Open Plan Design



### Materials:

- ⇒ Acoustical ceilings [NRC 0.55-0.65, AC 140-150].
- ⇒ Standard furniture divider 48" to 54".
- ⇒ No sound masking.

### The Result:

- ⇒ Acoustical tests show this performance rates as only 50% to 57% Privacy Index.
- ⇒ ASTM rates this as no speech privacy performance, per ASTM E 1130.
- ⇒ Studies show this level exists in 85% of all U.S. corporate office space.



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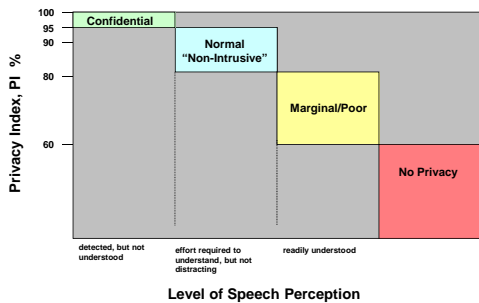
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## Defining Speech Privacy Levels



[ASTM E 1374, E 1130]



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## Keys To Speech Privacy – The ABCs™

All three components must be in place.

- ⇒ A = high-performance ceiling systems.
- ⇒ B = good furniture design/layout.
- ⇒ C = effective sound masking systems.



If any one of the three is missing, **good acoustics will be compromised.**

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## ABCs Of Acoustical Design

**A**bsorb noise  
with high-performance **ceiling systems.**



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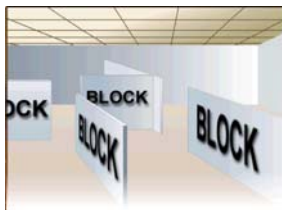
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## ABCs Of Acoustical Design

**B**lock noise  
with effective **furniture** design and layout.



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## ABCs Of Acoustical Design



**C**over noise with a quality **sound masking** system that covers the space uniformly.



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## Integrated Design Strategy Goal – Normal Privacy



The integration of **ceilings**, **furniture**, and **sound masking** systems creates an opportunity to target a specific level of speech privacy.

	Typical OP	Better OP	Best OP
<b>A</b> bsorb [ceiling]	140 AC 0.55 NRC	170 AC 0.70 NRC	200 AC 0.90 NRC
<b>B</b> lock [furniture]	48" panel STC = 14	60" panel STC = 24	66" panel STC = 24
<b>C</b> over [masking]	no masking	w/masking	w/masking
<b>Result</b>	40% PI	76% PI	88% PI

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## Critical Role Of The Ceiling System



- ⇒ Control reflected sound from both close and distant sources.
- ⇒ Need high sound absorption in the critical frequency range of speech; based on speech intelligibility.
  - 500 Hz
  - 1000 Hz
  - 2000 Hz
  - 4000 Hz



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## Critical Role Of The Ceiling System

- ⇒ Conventional NRC rating isn't appropriate for open plan.
  - ☑ NRC is the average of 250, 500, 1000, and 2000 Hz band absorption.
  - ☑ 250 Hz band isn't significant for speech; however, 4000 Hz band is very important for speech.
  - ☑ NRC is only applicable for distant noise sources in open plan, such as to reduce annoyance in call centers having low furniture panels, or in between groups of open team areas.
- ⇒ AC values are most important for open plan speech privacy.

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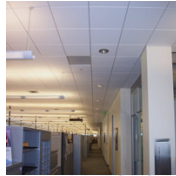
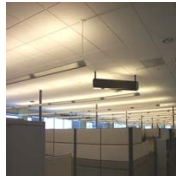
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## Critical Role Of The Ceiling System

**Articulation Class:** A measure for rating the speech privacy performance of a ceiling in an open plan environment where sound is reflected off the ceiling between two adjacent spaces divided by partial-height furniture panels.

A ceiling system with  $AC \leq 150$  is low performance, whereas one with  $AC \geq 200$  is high performance.



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## Critical Role Of The Ceiling System

### AC Index Of Typical Ceiling Products

Open Sky	AC 240
High-performance Fiberglass	AC 210 to 190
High-performance Mineral Fiber	AC 180 to 170
Standard Mineral Fiber	AC 160 to 150
Drywall/Glass	AC 120

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**Critical Role Of The Ceiling System** 

**Role Of Ceiling AC In Achieving Privacy**  
**[Workstation Design 6' x 8']**

⇒ **Condition #1**

- Ceiling AC 140/NRC 0.55.
- Masking sound 48 decibels = result = 73% Privacy Index.
- 60" panel height.

⇒ **Condition #2**

- Ceiling AC 200/NRC 0.90.
- Masking sound 48 decibels = result = 82% Privacy Index.
- 60" panel height.

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**Sound Masking Systems Role** 

**Why Needed?**

- ⇒ Creates a "bland sounding" background noise [similar to HVAC noise] to cover intruding speech.
- ⇒ Modern HVAC systems – including V.A.V. and under-floor air systems – make buildings too quiet.
- ⇒ A moderate level of background noise is now required to block out conversations from being overheard.

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**What Is Sound Masking?** 

**Key Features Of Sound Masking Systems**

- ⇒ Precise, electronically engineered background sound that is used to mask distracting noise.
- ⇒ Masking sound spectra are designed for speech frequencies from 200 Hz to 5000 Hz.
- ⇒ Masking sound should be uniform in its coverage of a space.

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## Sound Masking Systems Role



### Role Of Masking In Achieving Privacy [Workstation Design 6' x 8']

- ⇒ **Condition #1**
  - ☑ AC 200/NRC 0.90 ceiling.
  - ☑ 66" high furniture panel = 88% Privacy Index.
  - ☑ 48 decibels masking sound.
- ⇒ **Condition #2**
  - ☑ AC 200/NRC 0.90 NRC ceiling.
  - ☑ 66" high furniture panel = 70% Privacy Index.
  - ☑ No masking.

**Cost:** approximately \$1.25/SF installed.

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## Furniture System Role



### Today's Smaller Workstations – Product Design Features Needed

- ⇒ Panel height of at least 60", with 66" preferred.
- ⇒ Panel STC = min 24.
- ⇒ Sound absorption on furniture panels is effective only for tall panels, or for distant sound sources.



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## Furniture System Role



### Role Of Furniture Panel Height In Achieving Privacy [Workstation Designs 6' x 8' to 8' x 8']

- ⇒ **Condition #1**
  - ☑ Ceiling 200 AC/0.90 NRC.
  - ☑ Masking sound 48 decibels – result – 84% Privacy Index.
  - ☑ 62" panel height.
- ⇒ **Condition #2**
  - ☑ Ceiling 200 AC/0.90 NRC.
  - ☑ Masking sound 48 decibels = result = 68% Privacy Index.
  - ☑ 48" panel height.

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## Furniture Design and Layout Issues



- ⇒ STC of furniture panels is key for tall panels, STC of 24 preferred as part of solution to achieve normal speech privacy.
- ⇒ Four-sided cubicles are needed – any less will compromise privacy.
- ⇒ Avoid line-of-sight layout between workers from cubicle to cubicle.
- ⇒ Use full-height, demountable walls, or tall furniture panels for office teaming areas.
- ⇒ Glass sections at top of furniture panels [above 48"] is effective.
  - ☑ Benefit of day lighting.
  - ☑ Benefit of visual connectivity.
  - ☑ Standard DS glass is acceptable for STC 24.

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## Additional Acoustical Considerations



### Exposed Deck Ceiling Applications

- ⇒ No Ceiling/No Plenum
  - ☑ Can cause problems with sound reflecting off the hard slab above, causing excessive reverberation.
  - ☑ Specular reflections between adjacent open plan cubicles with ceiling heights less than 15' cause distractions for nearby occupants.
- ⇒ Ceiling Clouds/Interrupted Plenum
  - ☑ Can help control specular reflections between cubicles.
  - ☑ Can be used to reduce distant reverberation within the space.



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## Additional Acoustical Considerations



### Ceiling Height Impacts Sound Absorption

- ⇒ High Ceilings
  - ☑ Longer path for sound to travel.
  - ☑ Easier to achieve good speech privacy and low annoyance.
  - ☑ Wider range of ceiling choices.
  - ☑ Better masking installation likely.
- ⇒ Low Ceilings
  - ☑ Shorter path for sound to travel.
  - ☑ Ceiling performance is critical.
  - ☑ Congested plenums typical.
  - ☑ Masking system spacing affected.



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**Additional Acoustical Considerations** 

**Lighting Fixtures And Other Devices  
In The Ceiling Plane**

- ⇒ Any element installed within the ceiling plane might adversely affect both the sound absorbing [AC] and sound barrier [CAC] performance of the ceiling.
- ⇒ The right type of lighting fixture for use in the open plan office is critical to minimize sound reflection off the fixture:
  - A flat-lens fixture is the worst offender.
  - Pendant lighting fixtures are best.



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**Additional Acoustical Considerations** 

**Under-Floor Air Distribution Systems**

- ⇒ Often results in HVAC background noise that is typically 10 dB less than would otherwise be expected [space is too quiet, background noise adversely affects occupants].
- ⇒ Masking becomes more important, since the degree of speech privacy achieved depends upon the ratio of intruding speech to background noise, which is often one-half as loud as expected.



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**Design Considerations** 

**Different Spaces ... Different Needs**

- ⇒ For mixed-use spaces and different workers/functions.
- ⇒ Examples in open plan:
  - Employees need normal speech privacy to work without distraction.
  - Administrative workers who depend upon collaboration and teaming.
    - Dividers below 60" might be preferred.
    - Objective is to reduce the radius of annoyance.
- ⇒ Common solution:
  - High-performance ceilings.
  - Effective sound masking.
- ⇒ It's about balance ... the right design for your space.

 **Absorb and Cover**  
distracting noise.

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## Summary Of Open Plan Acoustics



- A**bsorb Acoustical ceilings [AC 210 to 200].
- B**lock Standard furniture divider 60" to 66" with panel STC = min 24.
- C**over Uniform sound masking system.

Open plan office design goal is a PI = 80% to 95%, to achieve "non-intrusive, normal" speech privacy.

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## Bottom-Line Results



### Realizing The Benefits Of A Balanced Open Plan Acoustical Design

- ⇒ **Employees** benefit through:
  - Better, quieter work environment.
  - Ability to concentrate and still collaborate with colleagues.
- ⇒ **Employers** benefit by:
  - Improved environment that addresses both current and future technologies.
  - More satisfied workers ... improved attraction/retention.
  - More productive workers.

**SATISFIED CLIENTS**

**Less Churn + More Productivity = Lower Costs + Added Revenue**

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