Acoustical Design of a Conference Room

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To understand how a change in height will impact the buildings performance and other systems the acoustical design of a conference room will be analyzed for the height as-built and the height that it would be if the redesigned structure had been used. The current steel system has a floor-to-floor height of 14'-0" for a typical story, of which 9'-8" is the clear height of the ceiling. The redesigned system with 12'-0" floor-to-floor only allows an 8'-0" ceiling height. This would obviously have repercussions on many of the building's other systems. For instance, the reduction of volume in a conference room would lower the reverberation time of speech. It is of interest to determine if this reduction would be enough to elicit any change in a conference room design. To determine this two conference rooms were designed so that direct comparisons could be drawn from the two different designs. In each case the target reverberation time is between 0.7 seconds and 1.1 seconds. However, attention will be focused on trying to keep this reverberation time on the low end since a small room performs better with less reverberation.

The architectural blueprints that were produced for the Weinberg Center leave each floor blank so that tenants can determine where they want to place walls and such. To work around this I chose a conference room design that is very similar to one located at the company I have interned with for two summers. This conference room is approximately 40'-0" x 16'-0", and like the Weinberg Center has a large ribbon window that takes up most of the exterior wall of the building.

The first design is the steel buildings conference room with floor to ceiling height of 9'-8". This room would have a total room volume of 6188.8 ft^3. The following spreadsheet outlines calculations for this room's reverberation time. The steel buildings reverberation times have been calculated using finishing materials that closely approximate what is used in the chosen conference room. A final reverberation time of 0.74 seconds was achieved using surface finishes as follows:

Ceiling	Suspended gypsum non-acoustical tiles
Wall	Painted gypsum wallboard
Doors	Wood
Window	¼" Thk. glass pane
Floor	Medium weight carpet

Seating	People seated in upholstered chairs	Steel Building Conference Room Design				
			Absorption Coefficients		Sα	
Surface	Material	Area	500Hz	1000Hz	500Hz	1000Hz
Ceiling	Gyp Susp	640.00	0.05	0.04	32.00	25.60
Wall	GWB	824.00	0.07	0.05	57.68	41.20
Door	Wood	84.00	0.09	0.06	7.56	5.04
Window	Glass	175.00	0.04	0.03	7.00	5.25
Floor	Carpet	320.00	0.06	0.15	19.20	48.00
	Seated People	320.00	0.88	0.96	281.60	307.20
				a=	405.04	432.29
				T=	0.76	0.72
				Tavg=	0.74	ok

The second design of this conference room is for the redesigned concrete system using a ceiling height of 8'-0". The redesigned system's room has a total volume of 5120 ft^3. The following spreadsheets outline calculations for this room. The first spreadsheet shows the reverberation time calculations by not changing any of the room's finishing materials. This was done to determine if indeed a redesign would be needed to achieve acceptable performance of the room. The previous room's surfaces will provide a reverberation time of 0.61 seconds, which is too low. New materials were chosen that increase the reverberation time to an acceptable level. The final redesigned room's reverberation time is calculated at 0.97 seconds. While this is longer than what was calculated for the first room, it is still in acceptable values range. The materials used in the redesigned room are as follows:

Ceiling	Suspended gypsum non-acoustical tiles
Wall	Painted gypsum wallboard
Doors	Wood
Window	¼" Thk. glass pane
Floor	Terrazzo or Tiles floors
Seating	People seated in wooden chairs

Concrete Building Using Same Finishing Materials						
			Absorption Coefficients		Sα	
Surface	Material	Area	500Hz	1000Hz	500Hz	1000Hz
Ceiling	Gyp Susp	640.00	0.05	0.04	32.00	25.60
Wall	GWB	637.00	0.07	0.05	44.59	31.85
Door	Wood	84.00	0.09	0.06	7.56	5.04
Window	Glass	175.00	0.04	0.03	7.00	5.25
Floor	Carpet	320.00	0.06	0.15	19.20	48.00
	Seated People	320.00	0.88	0.96	281.60	307.20
				a=	391.95	422.94
				T=	0.65	0.61
				Tavg=	0.63	Too Low

Concrete Building Redesigned Conference Room						
			Absorption Coefficients		Sα	
Surface	Material	Area	500Hz	1000Hz	500Hz	1000Hz
Ceiling	Gyp Susp	640.00	0.05	0.04	32.00	25.60
Wall	GWB	637.00	0.07	0.05	44.59	31.85
Door	Wood	84.00	0.09	0.06	7.56	5.04
Window	Glass	175.00	0.04	0.03	7.00	5.25
Floor	Tile Floor	320.00	0.02	0.02	6.40	6.40
	Seated People	320.00	0.40	0.76	128.00	243.20
				a=	225.55	317.34
				T=	1.14	0.81
				Tavg=	0.97	ok

Summary

This study was done to determine if a conference room would need to be redesigned for acoustical considerations. It may also be determined from the finding of this study that other rooms would need similar attention to design. It should not be assumed that existing materials would still work under the new conditions. It is the findings of this study that a change in the story heights of the Weinberg Center would indeed elicit a change in the acoustics of the conference room studied. If the materials are kept the same, then lower-than-acceptable reverberation times would be present. Reverberation times that are too low can adversely affect the quality of speech perceived by listeners. Sine the amount of change between the two rooms in minimal few changes would be needed. A change in the flooring material and seating types would be sufficient to keep reverberation times in the room at acceptable levels.