BUILDING DESCRIPTION

DISNEY CONCERT HALL 01

Acoustic Consultant: Nagata Acoustics, Inc.

Architect: Frank O. Gehry (Gehry Partners,LLP)

Owner: Los Angeles County

User: Los Angeles Philharmonic

Location: 151 South Grand Avenue
Los Angeles, CA 90012-3034

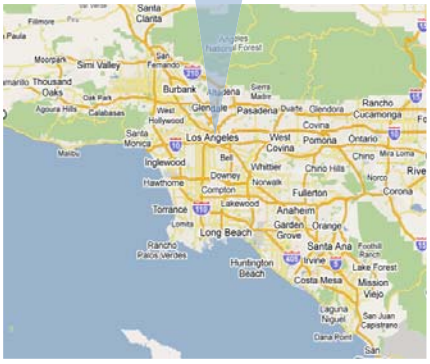
Concert Hall Seating Capacity: 2,265

Concert Hall Room Volume: 30,600 CM

Total Cost : $274 Million

The Walt Disney Concert Hall opened on October 23, 2003, 16 years after the project started, as the new home of the Los Angeles Philharmonic. The $274 million stainless-steel building with flowing lines designed by Frank O. Gehry houses the concert hall, pre-concert area, numerous rehearsal/practice rooms, other backstage and dinning facilities and amphitheater.

LOCATION

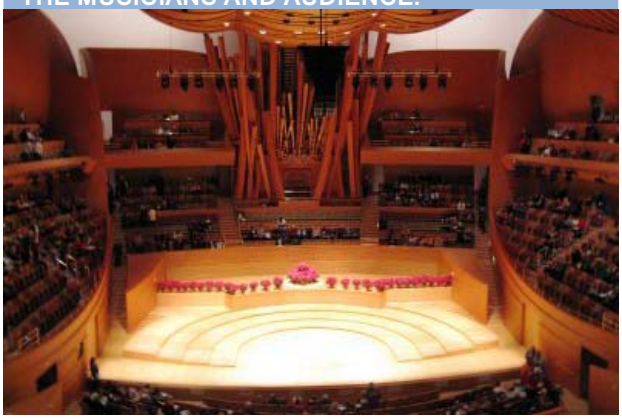


BUILDING DESCRIPTION

DISNEY CONCERT HALL 02

DESIGN

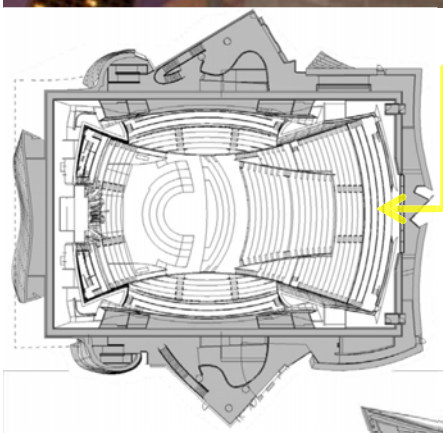
- The Walt Disney Concert Hall is a triumph–a gleaming, billowing symphony in steel, composed of thrusting, stretching, and overlapping organic forms that enclose an outstanding concert hall and excellent supporting facilities. The requirements were that the hall should provide the best possible acoustical conditions and the design should create the CLOSEST POSSIBLE CONTACT BETWEEN THE MUSICIANS AND AUDIENCE.



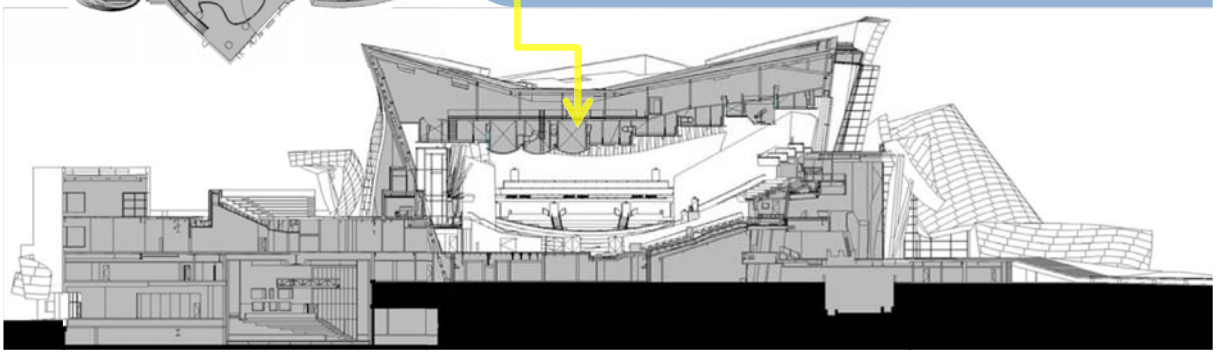
BUILDING DESCRIPTION

DISNEY CONCERT HALL 03

PLANS & SECTIONS



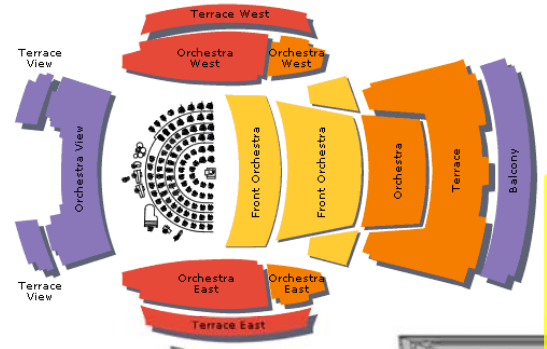
- The Concert Hall consists of a SHOEBOX-SHAPED auditorium swathed in a swirling, steel-clad cloak, with the spaces between the two providing room for supporting facilities.
- The 2,265-seat concert hall is the physical heart and musical soul of the building. Gehry worked closely with both acoustic specialists and musicians to achieve a design that produces optimum acoustics by BALANCING DIRECT AND REFLECTED SOUND.



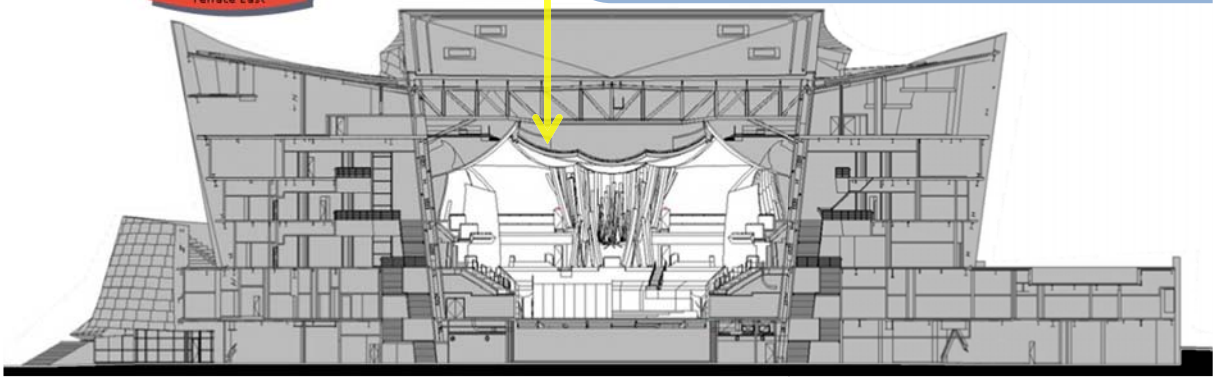
BUILDING DESCRIPTION

DISNEY CONCERT HALL 04

PLANS & SECTIONS



- The abundance of CONVEX FORMS throughout the concert hall create a near perfect acoustic environment with over 38,000 reflective faces.
- After testing more than thirty models, the final CONVEX FORM that evolved is a glorious, visually intimate space clad entirely in bowed and curving Douglas fir–a space where, in Gehry's words, "the beauty is in the ear of the beholder."

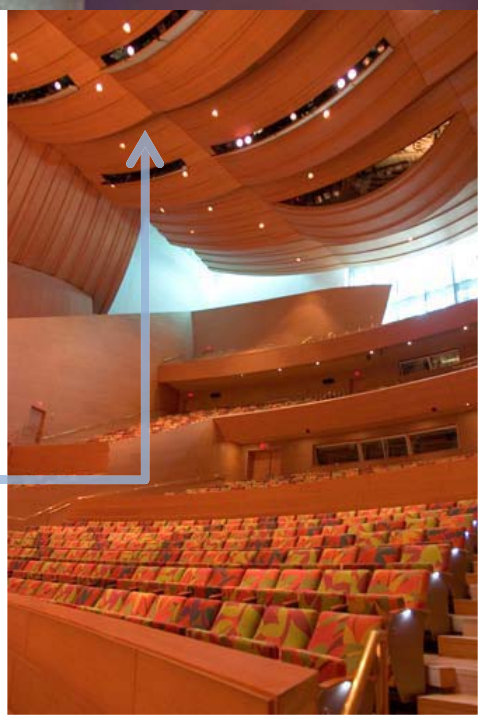


BUILDING DESCRIPTION

DISNEY CONCERT HALL 05

MATERIALS

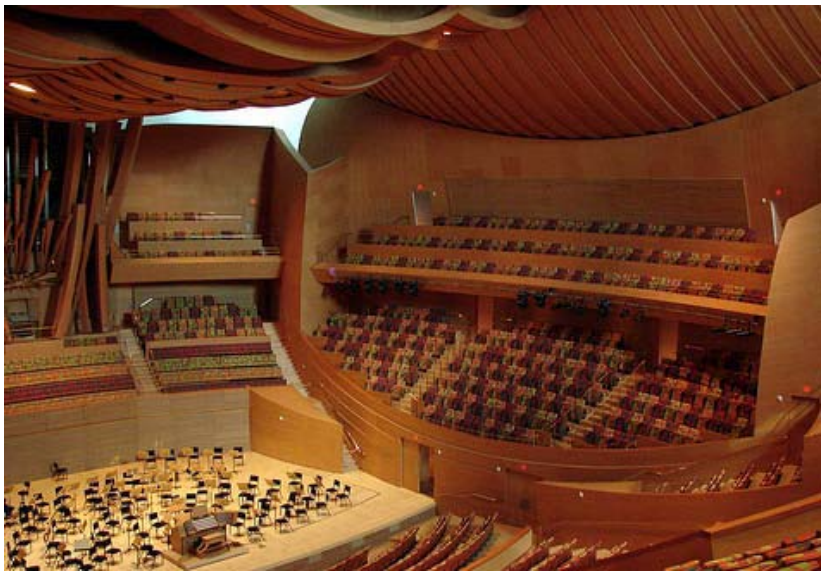
- The radically sculptured design of the WDCH's main auditorium features a curved wood ceiling consisting of many individually shaped panels, each made from DOUGLAS FIR WOOD.
- The curves of the ceiling and the flow of the interior walls actually improve the acoustics' by scattering the sound and producing more reflection, adding warmth and resonance to the sound.



BUILDING DESCRIPTION

DISNEY CONCERT HALL 06

MATERIALS



- A series of short acoustic walls among the seats create A TERRACED EFFECT known as a VINEYARD DESIGN. The fanciful colors of the upholstery are meant to give the sense of a field of wildflowers.

- Three different kinds of WOOD create the distinct acoustics to create an intimate sound in a large space WITHOUT AMPLIFICATION.

BUILDING PERFORMANCE ANALYSIS

DISNEY CONCERT HALL 07

ABSORBANCY

FINISHING MATERIALS

		α @ 500 Hz
Ceiling :	Douglas Fir	0.14
Wall :	Douglas Fir	0.17
Floor :	Oak	0.10
Seats :	Upholstered	0.88

// agata Acoustics

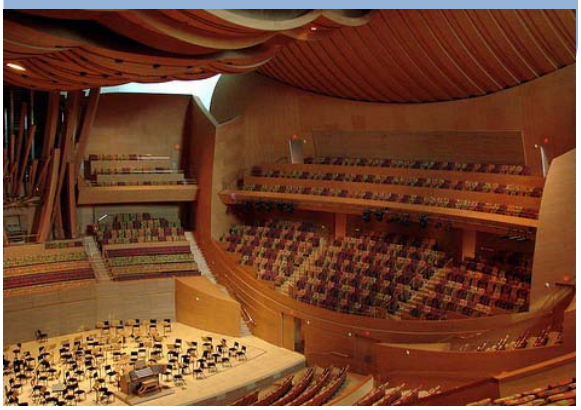
General Building Materials and Furnishings[a]		125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC[f]
		Absorption Coefficients (α)						
Brick, unglazed		0.03	0.03	0.03	0.04	0.05	0.07	0.005
Brick, unglazed, painted		0.01	0.01	0.02	0.02	0.02	0.03	0.00
Carpet, heavy, on concrete		0.02	0.06	0.14	0.37	0.60	0.65	0.29
Carpet, heavy, on 40-oz hairfelt or foam rubber		0.08	0.24	0.57	0.69	0.71	0.73	0.55
Concrete block, coarse		0.36	0.44	0.31	0.29	0.39	0.25	0.35
Concrete block, painted		0.10	0.05	0.06	0.07	0.09	0.08	0.05
Fabrics								
Light velour, 10 oz/yd², hung straight, in contact with wall		0.03	0.04	0.11	0.17	0.24	0.35	0.15
Medium velour, 14 oz/yd², draped to half area		0.07	0.31	0.49	0.75	0.70	0.60	0.55
Heavy velour, 18 oz/yd², draped to half area		0.14	0.35	0.55	0.72	0.70	0.65	0.60
Floors								
Concrete or terrazzo		0.01	0.01	0.015	0.02	0.02	0.02	0.00
Linoleum, asphalt, rubber, or cork tile on concrete		0.02	0.03	0.03	0.03	0.03	0.02	0.05
Wood		0.15	0.11	0.10	0.07	0.06	0.07	0.10
Glass								
Large panes of heavy plate glass		0.18	0.06	0.04	0.03	0.02	0.02	0.05
Ordinary window glass		0.35	0.25	0.18	0.12	0.07	0.04	0.15
Gypsum board, ½ in. nailed to 2 × 4's 16 in. o.c.		0.10	0.08	0.05	0.03	0.03	0.03	0.05
Marble or glazed tile		0.01	0.01	0.01	0.01	0.02	0.02	0.00
Openings								
Stage, depending on furnishings					0.25–0.75			
Deep balcony, upholstered seats					0.50–1.00			
Grilles, ventilating					0.15–0.50			
Plaster, gypsum or lime, smooth finish on tile or brick		0.013	0.015	0.02	0.03	0.04	0.05	0.05
Plaster, gypsum or lime, on lath		0.14	0.10	0.06	0.05	0.04	0.03	0.05
Plywood paneling, ⅜ in. thick		0.28	0.22	0.17	0.09	0.10	0.11	0.15
Rough wood, as tongue-and-groove cedar		0.24	0.19	0.14	0.08	0.13	0.10	0.14
Slightly vibrating surface (e.g., hollow core door)		0.02	0.02	0.03	0.03	0.04	0.05	0.03
Readily vibrating surface (e.g., thin wood paneling on 16-in. studs)		0.10	0.07	0.05	0.04	0.04	0.05	0.05
Water surface, as in a swimming pool		0.008	0.008	0.013	0.015	0.020	0.025	0.00
Absorption of Seats and Audience[g]		**125 Hz**	**250 Hz**	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**	**NRC[f]**
Audience, in upholstered seats, per ft² of floor area		0.60	0.74	0.88	0.96	0.93	0.85	—
Unoccupied cloth-upholstered seats, per ft² of floor area		0.49	0.66	0.80	0.88	0.82	0.70	—
Audience, person occupied, per ft² of floor area		0.57	0.61	0.75	0.86	0.91	0.86	—
Students in tablet-arm chairs, per ft² of floor area		0.30	0.42	0.50	0.85	0.85	0.84	
Acoustic Absorptive Materials	**Mtg[e]**	**125 Hz**	**250 Hz**	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**	**NRC[f]**
High-performance vinyl-faced fiberglass ceiling panels								
1 in. thick	E405	0.73	0.88	0.71	0.98	0.96	0.77	0.90
1.5 in. thick	E405	0.79	0.98	0.83	1.03	0.98	0.80	0.95
Painted nubby glass cloth panels								
¾ in. thick	E405	0.81	0.94	0.65	0.87	1.00	0.96	0.85
3 in. thick	E405	0.78	0.92	0.79	1.00	1.03	1.10	0.95
Random fissured ¾-in.-thick panels	E405	0.52	0.58	0.60	0.80	0.92	0.80	0.70
Perforated metal panel with infill 1 in. thick	E405	0.70	0.86	0.74	0.88	0.95	0.86	0.85
Typical averages, mineral fiber tiles and panels								
¾ in. fissured	E405	0.47	0.50	0.52	0.76	0.86	0.81	0.65
¾ in. textured	E405	0.49	0.55	0.53	0.80	0.94	0.83	0.70
¾ in. fissured	E405	0.28	0.33	0.66	0.73	0.74	0.75	0.60
¾ in. textured	E405	0.29	0.35	0.66	0.63	0.44	0.34	0.50
¾ in. perforated	E405	0.27	0.29	0.55	0.78	0.69	0.53	0.60
3 in. thick × 16 in. square on 24-in. centers	A	0.40	0.61	1.92	2.54	2.62	2.60	

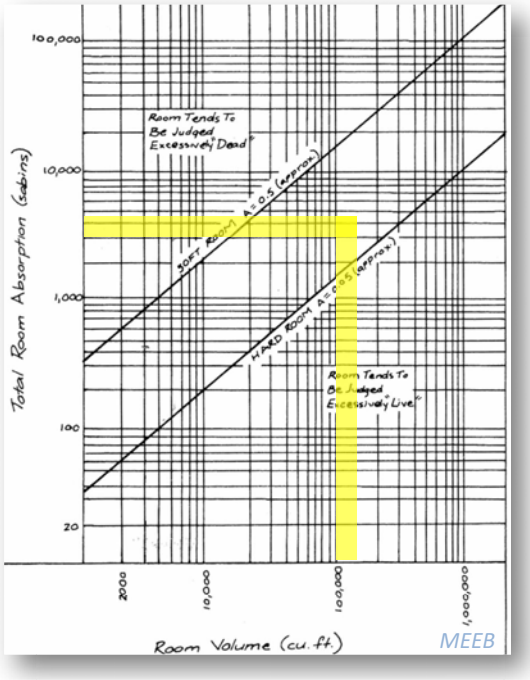
BUILDING PERFORMANCE ANALYSIS

DISNEY CONCERT HALL 08

ABSORBANCY

After analyzing the coefficients of absorption we have determined that the Disney Concert Hall space is indeed live.

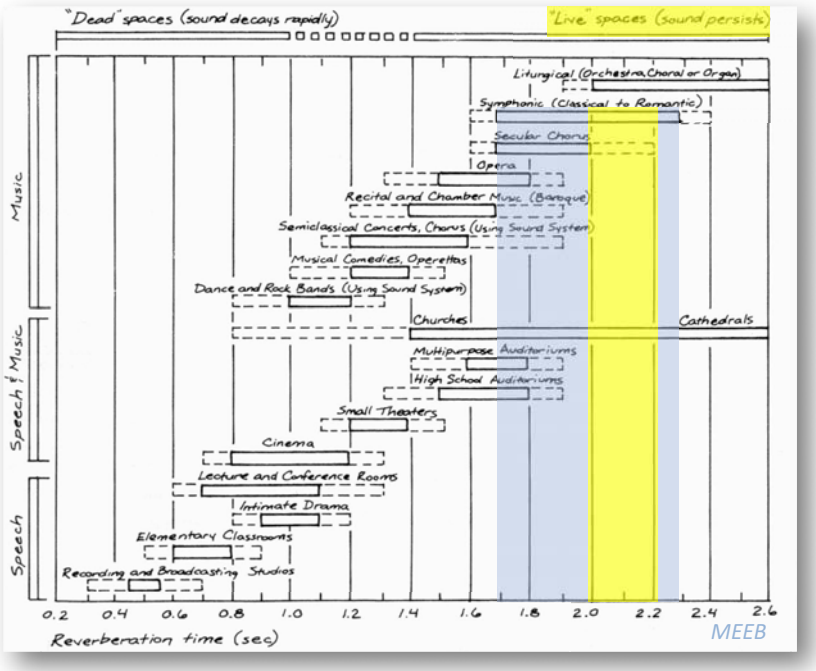




BUILDING PERFORMANCE ANALYSIS

DISNEY CONCERT HALL 09

REVERBERATION



REVERBERATION TIME

Unoccupied:
2.2 sec (@ 500 Hz)

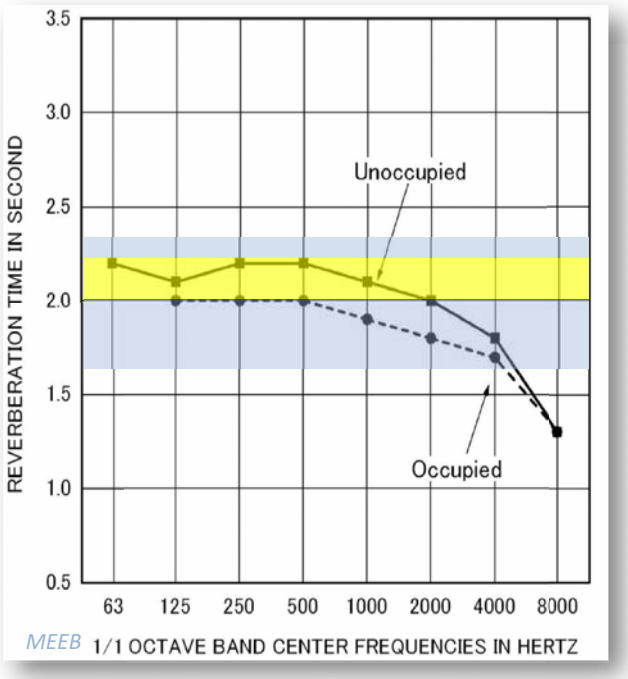
Occupied:
2.0 sec (@ 500 Hz)

// agata Acoustics

BUILDING PERFORMANCE ANALYSIS

DISNEY CONCERT HALL 10

REVERBERATION



This graph provided by *agata Acoustics* depicts the reverberation times of the Disney Concert Hall at different frequency levels and occupancy.

BUILDING PERFORMANCE ANALYSIS

DISNEY CONCERT HALL 11

REVERBERATION

Type of Space (and Acoustical Requirements)	NC Curve	Equivalent* dBA
Concert halls, opera houses, and recital halls (for listening to faint musical sounds)	10–20	20–30
Broadcast and recording studios (distant microphone pickup used)	15–20	25–30
Large auditoriums, large drama theaters, and houses of worship (for excellent listening conditions).	20–25	30–35
Broadcast, television, and recording studios (close microphone pickup only)	20–25	30–35
Small auditoriums, small theatres, small churches, music rehearsal rooms, large meeting and conference rooms (for good listening), or executive offices and conference rooms for 50 people (no amplification)	25–30	35–40
Bedrooms, sleeping quarters, hospitals, residences, apartments, hotels, motels, and so forth (for sleeping, resting, relaxing)	25–35	35–45
Private or semiprivate offices, small conference rooms, classrooms, libraries, and so forth (for good listening conditions).	30–35	40–45
Living rooms and similar spaces in dwellings (for conversing or listening to radio and TV)	35–45	45–55
Large offices, reception areas, retail shops and stores, cafeterias, restaurants, and so forth (for moderately good listening conditions).	35–50	45–60
Lobbies, laboratory work spaces, drafting and engineering rooms, general secretarial areas (for fair listening conditions).	40–45	50–55
Light maintenance shops, office and computer equipment rooms, kitchens, and laundries (for moderately fair listening conditions)	45–60	55–70
Shops, garages, power-plant control rooms, and so forth (for just acceptable speech and telephone communication). Levels above PNC-60 are not recommended for any office or communication situation	—	—
For work spaces where speech or telephone communication is not required, but where there must be no risk of hearing damage.	—	—

MEEB

agata Acoustics calculates the Noise Criteria (NC) to be at 15, which fits in perfectly in the *MEEB* criteria for concert halls.

BUILDING REDESIGN

DISNEY CONCERT HALL 12

SOLUTIONS

1. ADJUSTABLE HEIGHT ACOUSTIC CEILING PANELS

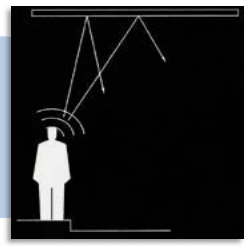
The Suspended Ceiling Panels work quite well with the convex shape that they have, though they only provide a specific range of resonance that is only effectively changed by the size of the audience.

2. Removable Seating

Though the various tiers of seating are well placed and improve the reverberation in this space, they are limited to one configuration and occupancy size. If they could be relocated for smaller or different events then the sound could be better tailored per attendance.

3. Convex Balcony Facades

With all the of the curves in and around this facility, it is somewhat surprising that the balcony facades are just a flat angled surface. These edges could be redesigned to provide a better range for reflection of sound.



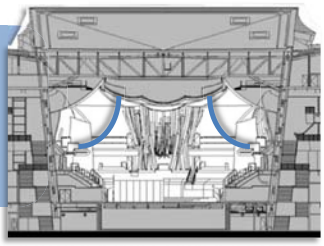
BUILDING REDESIGN PERFORMANCE ANALYSIS

DISNEY CONCERT HALL 13

INTENTIONS

1. ADJUSTABLE HEIGHT ACOUSTIC CEILING PANELS

If these ceiling panels were made to be able to be lowered on the sides or as a whole it would drastically change the dynamic in the room and allow the room to be adjusted to best suit the venue.

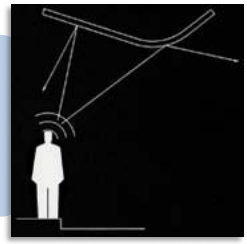


2. Removable Seating

The same approach for seating of a vineyard could be applied to a retrofit. To be able to change where they are planted to best suit the 'season' or occasion. Especially for events that may have a smaller audience since, as previously shown the occupancy can have a large effect on sound quality.

3. Convex Balcony Facades

If the bottom edges were rounded out or of the over downward angle was built of the have a curve to its surface in either plan or in section it would improve the diffusion of sound around the audience rather than back toward the open space.

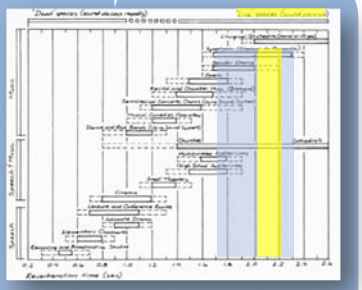


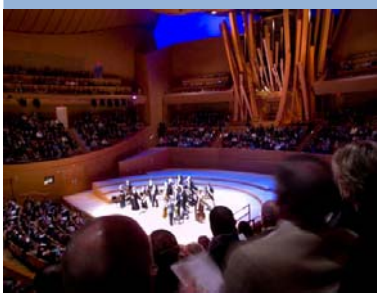
BUILDING REDESIGN PERFORMANCE ANALYSIS

DISNEY CONCERT HALL

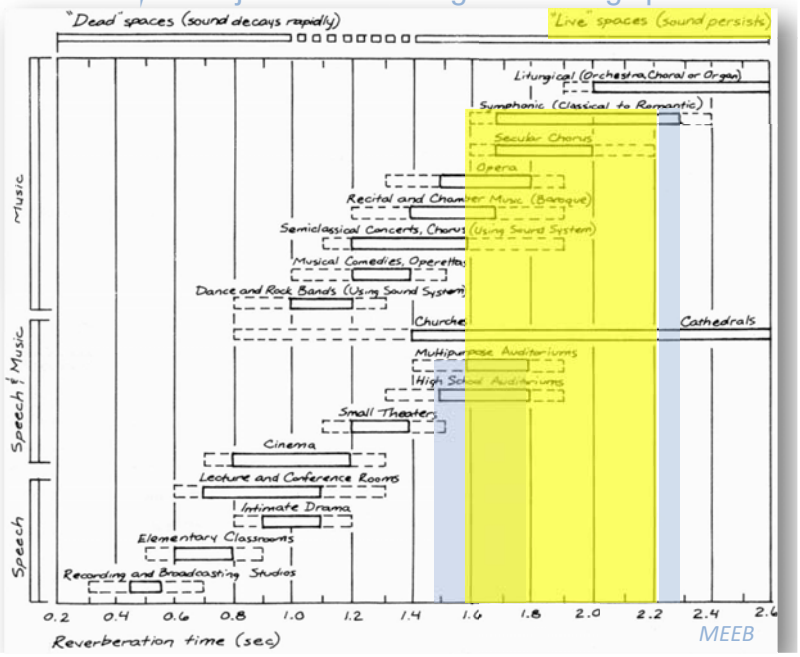
REVERBERATION

CONTEXT





PROBLEM: Adjustable seating & ceiling panels



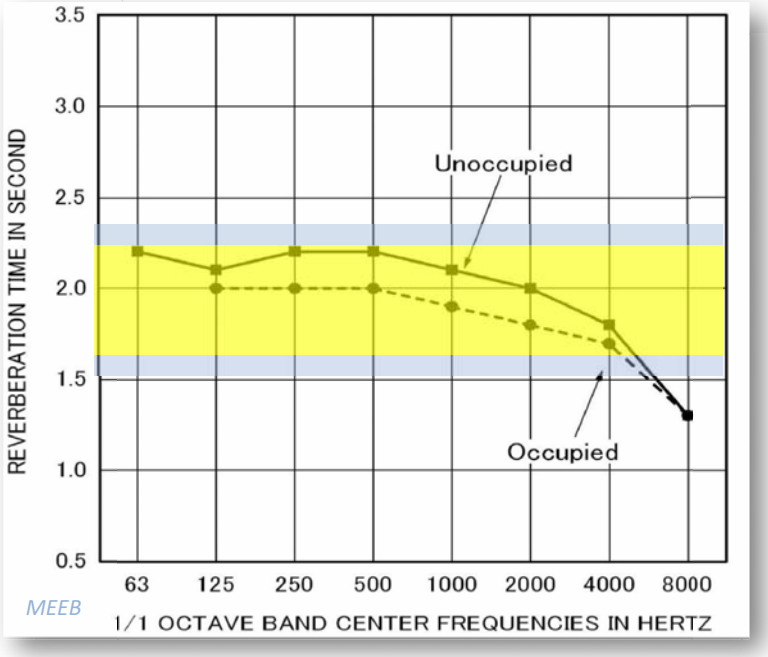
MEEB

BUILDING REDESIGN PERFORMANCE ANALYSIS

DISNEY CONCERT HALL

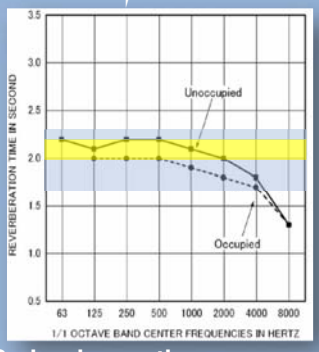
REVERBERATION

PROBLEM: Adjustable seating & ceiling panels



MEEB

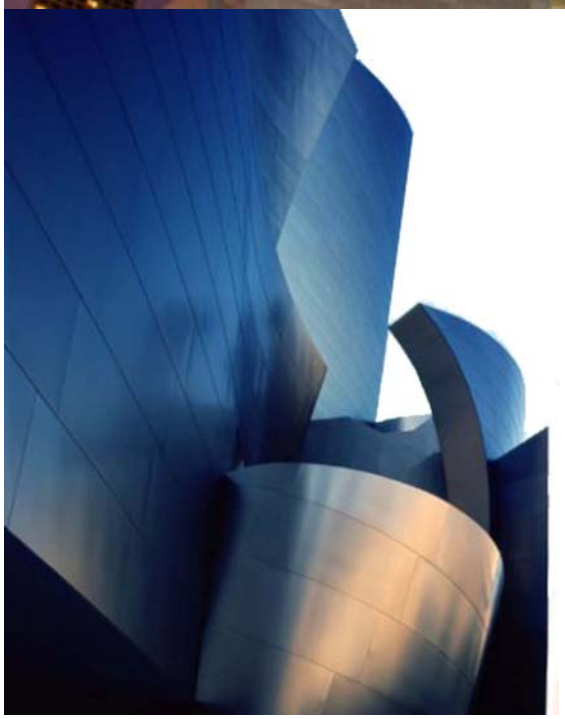
CONCLUSION



By implementing adjustable height ceiling panels and flexible seating, the hall could meet recommended reverberation times for smaller venues, thus making it a more versatile space

CONCLUSION

DISNEY CONCERT HALL 16



Viewed from any angle, this structure has an intriguing and powerful presence, while the dynamic shapes of Gehry's design and the shining surface of the steel walls suggest movement and the lyricism of music. The Walt Disney Concert Hall is a building that perfectly articulates the glamour and dynamism of the city of Los Angeles for which it now provides both a stunning architectural landmark and an inspirational experience.

QUESTIONS