

PREPARING SEGERSTROM CONCERT HALL

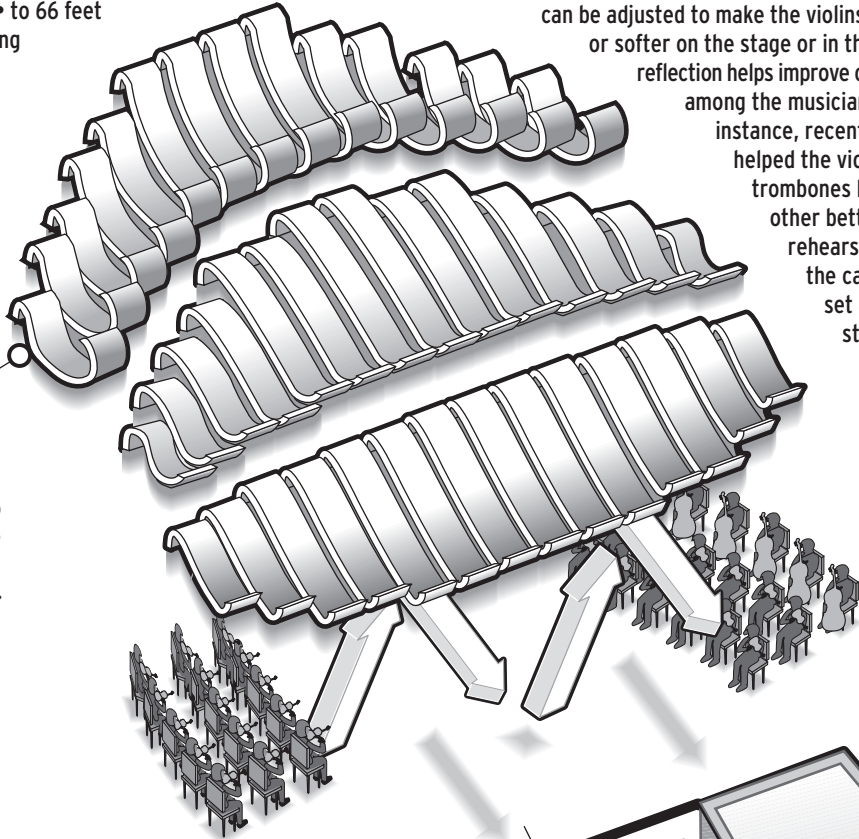
# FINE-TUNING

The new Renée and Henry Segerstrom Concert Hall was designed with an integrated adjustable acoustic system. Acousticians are in the process of experimenting with the various components, including a three-section, sound-reflecting

canopy, reverberation chambers and acoustical curtains. The musicians of the Pacific Symphony and conductor Carl St.Clair are collaborating with acoustician Damian Doria to come up with the settings that serve the music best.

## THREE CANOPIES OVER STAGE

Made of glass-fiber reinforced concrete, the canopies are huge sound-reflecting panels. The canopies can be positioned from 6 to 66 feet above the stage. By moving particular panels, certain orchestra sounds can be enhanced or reduced. Generally, as the canopy comes down, the sound bounces back more quickly, giving it more strength than if it traveled to the top of the hall.



Gaps between the canopies allow sounds to go through and up to the ceiling, increasing reverberation in the hall.

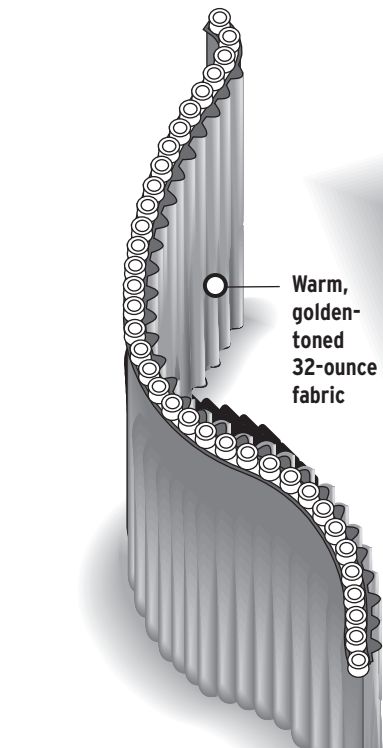
Note: Graphic shows canopies from above.

## MAKING ADJUSTMENTS

As an example, the front canopy over the string section can be adjusted to make the violins sound louder or softer on the stage or in the hall. The reflection helps improve communication among the musicians – for instance, recent adjustments helped the violins and trombones hear each other better. At a rehearsal last week, the canopies were set above the stage at 44.5, 46 and 47.5 feet.

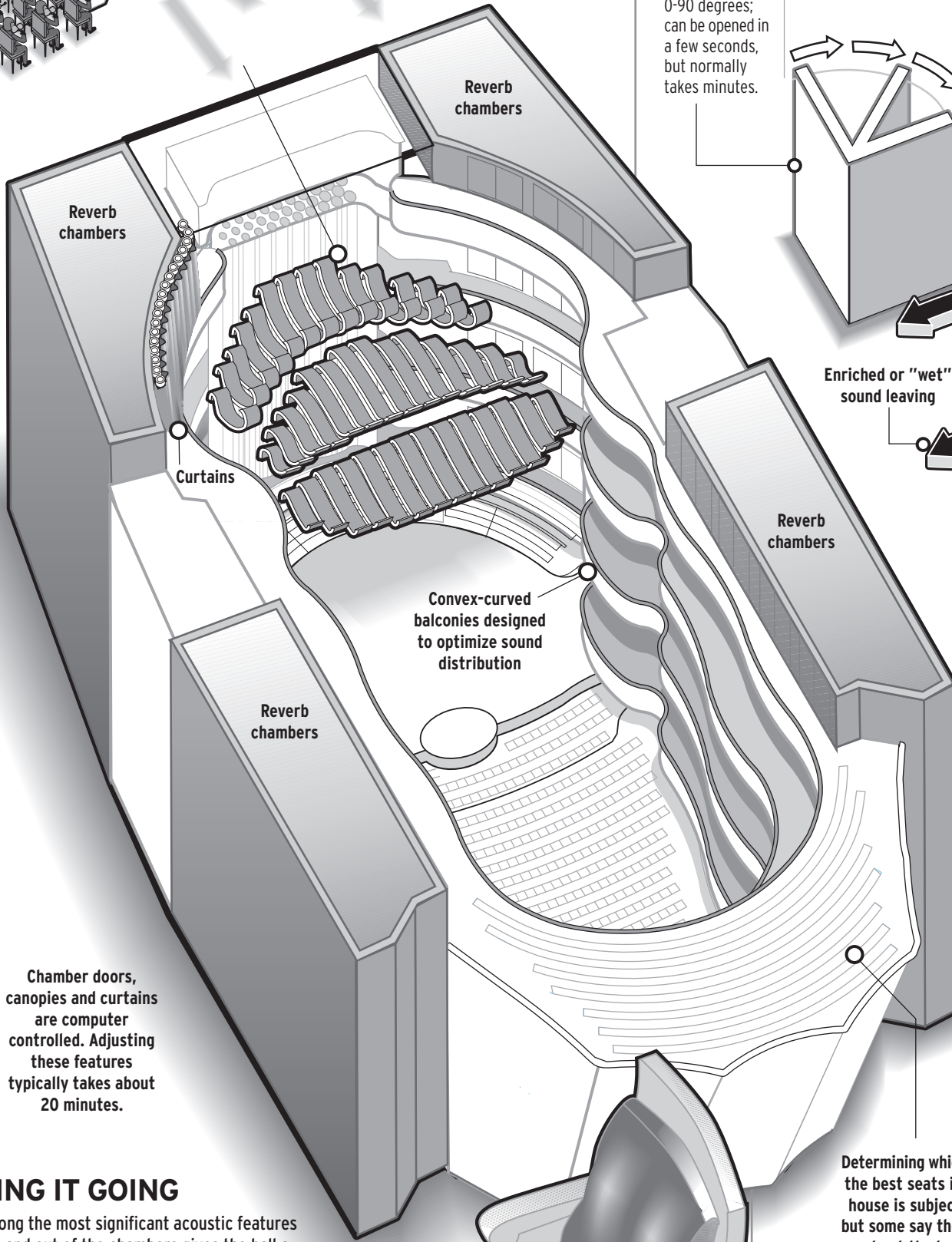
## RETRACTABLE CURTAINS

Two sets of thick velour curtains on motorized tracks can be deployed around the entire wall surface of the hall. Stored in neatly hidden closets about the hall, the curtains would be brought out to absorb sound and reduce reverberation.



Warm, golden-toned 32-ounce fabric

Curtains might be deployed for chamber music, which is intended for smaller spaces. The acoustic nature of the hall can be controlled by extending the curtains around the top portion of the room, cutting the reverberation time in half.



Reverb chambers

Reverb chambers

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Reverb chambers

Convex-curved balconies designed to optimize sound distribution

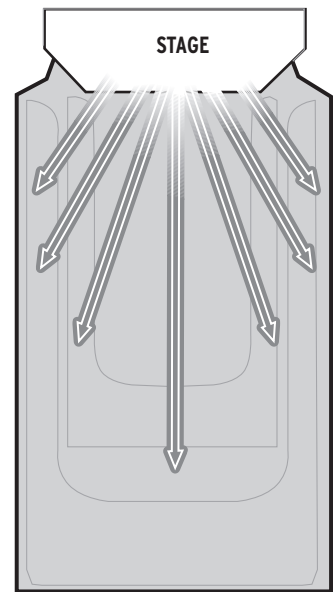
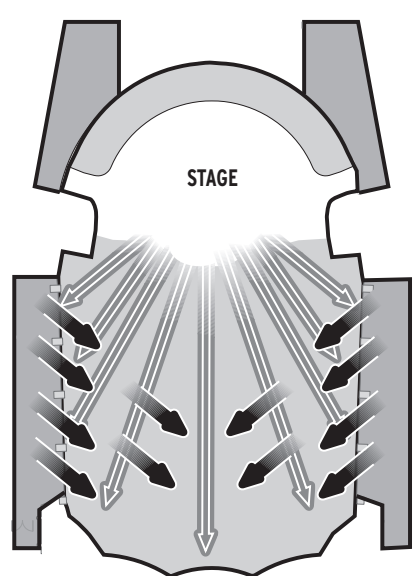
Chamber doors, canopies and curtains are computer controlled. Adjusting these features typically takes about 20 minutes.

## SOUND: KEEPING IT GOING

The massive reverberation chambers are among the most significant acoustic features of the new hall. The ability to allow music in and out of the chambers gives the hall a deeper, richer sound – and extends the decay of sound. Here is a comparison of two halls:

- SEGERSTROM CONCERT HALL (REVERB CHAMBERS)**
- Sharper initial decay helps clarity
  - Control over sustained reverberance, from almost none to 3.5 seconds

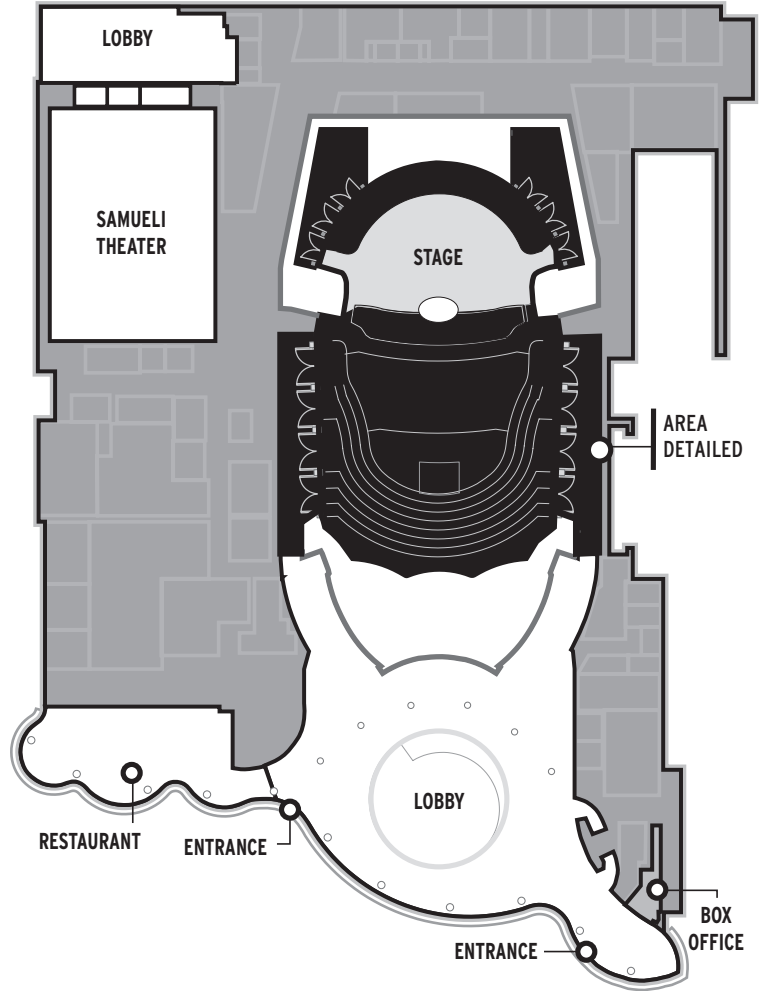
- BOSTON SYMPHONY HALL (NO REVERB CHAMBERS)**
- Energy is distributed evenly
  - Straight-line decay, little flexibility; about two seconds reverberance



## KEEPING QUIET

A crucial task for the hall's design team is to eliminate extraneous noises, such as honking cars, buzzing lights and noisy ventilation systems. For ventilation, a low-pressure air system is used. It includes vents beneath each chair, through which air slowly drifts without noise. Another feature to keep noise out is the use of concrete around the hall and the absence of any hollow subfloors or spaces inside walls.

## SEGERSTROM CONCERT HALL



## FOUR REVERBERATION CHAMBERS

Four massive chambers flanking the stage and hall use 128 computer-controlled doors that open and close to control reverberation and the sound's power. The tall, empty rooms – as high as 87 feet – are fitted with cloth panels that can be deployed to absorb sound and reduce reverberation.

### DOOR SPECS

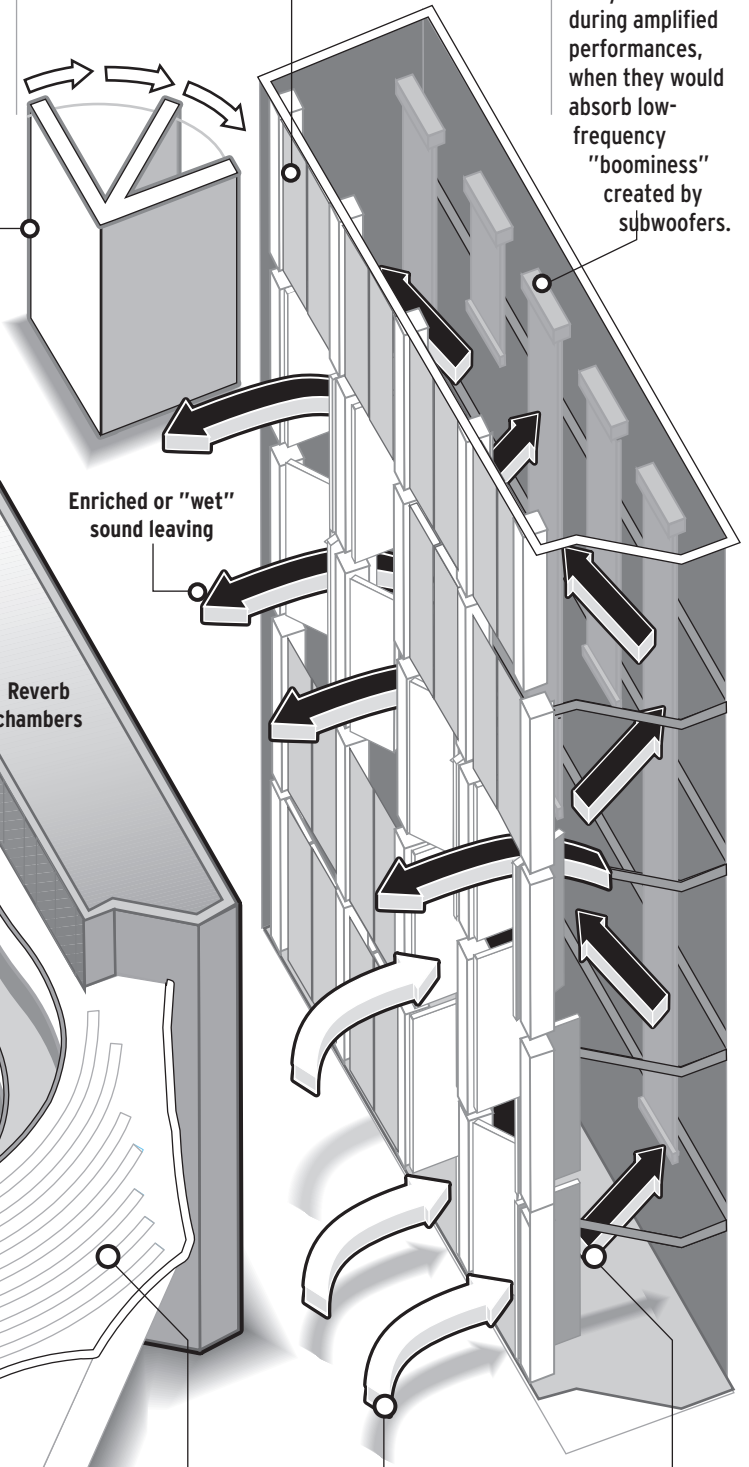
- Concrete faced with Canadian maple veneer.
- Up to 15 feet high, weigh 7,000-15,000 lbs.
- Open from 0-90 degrees; can be opened in a few seconds, but normally takes minutes.

### OPENING IT UP

With the chamber doors open, sound enters and is "absorbed" – shortening the decay of sound in the main room. Once the sound is in the chamber it bounces around in the hollow space, creating an enriched sound that then returns to the audience.

### CURTAINS

All four chambers have fabric panels that can be lowered to absorb sound. The curtains would likely be used during amplified performances, when they would absorb low-frequency "boominess" created by subwoofers.



Enriched or "wet" sound leaving

Determining which are the best seats in the house is subjective, but some say the high seats at the back of the hall get the fullest acoustical sensations.

Sound entering reverb chambers

The hall can be customized for different performances. For voice recitals, where more resonance is desired, the chamber doors might be opened and the curtains only partially extended.

## TESTING PROCEDURES

Most of the testing during the weeks before opening night is not with machines, but with trained ears. Collaboration between acousticians and the orchestra will create five to 10 settings for the hall's adjustable acoustic controls. Here are two objective tests being conducted:

- 1 **SINE WAVE** uses eight microphones positioned throughout the hall to ensure that efficient use is being made of the amplified loud speakers.
- 2 **SINE SWEEPS** send low and high frequencies around the room; they are then measured by a computer to determine how the hall reacts to different sounds.

