Kursaal Centre
Concert Hall and Opera House in Donostia

The Kursaal Cultural Centre in Donostia has been designed to be used both for symphonic music and opera. Also, it will be able to be used for conferences, electroacoustic music, congress activities and cinema.
This hall will have 1839 seats. The appearance of a shell enclosure transforms the Opera House to a Concert Hall.
The hall is rectangular with longitude 41.5-m from mouth stage and width of nearly 26-m between side walls. The shell enclosure has a floor area for musicians of 251-m^2. The shell maximum height is 10.5-m, (which is prolonged inside hall by an inclined plane until 11.95 m), and the minimum is 7.7-m.
The main stall is placed in front of the stage. The main stall is softly raked. Behind this, there are two elevated terraces, steeply raked and called amphitheatre one and amphitheatre two. At both sides of these terraces are nine boxes.
The side walls are formed by inclined surfaces to provide good specular reflections to the audience area and, at the same time, taking care to avoid echoes and long-path reflections.
The ceiling is formed in each transversal section by two inclined surfaces that rise from the side walls to the centre. In the longitudinal section there are four planes increasing their height, in relation to stage platform, from the stage to rear wall of the hall.
The hall is completely made of plywood, the main absorption is due to the seats, musicians and audience.
In symphonic use, the reverberation time at mid-frequencies, fully occupied with shell and with musicians on stage, will be 1.86 sec.
In opera use the shell enclosure will disappear. In this situation, the reverberation time at mid-frequencies, fully occupied, will be 1.55 sec.
In the conference-use it will appear several velvet curtains covering the side walls and the stage. In this use, the reverberation time at mid-frequencies, fully occupied, will be 1.3 sec, good for electroacoustic music, conferences and cinema. In this situation it will be used the sound system to improve intelligibility and coverage.
The background noise inside the hall it will be really low. With air conditioning system on, it will satisfy the NC-15.

Architectural and structural details

Uses: symphonic music, opera, electroacoustical music, conferences and cinema. *Ceiling:* 20-mm to 35-mm plywood with airspace behind. *Side, front and rear walls:* 20mm or 30 mm plywood + gypsum board fixed to wall with a hard and elastic fill up material. *Floor:* Oak parquet fixed over rigid floor. *Carpet:* none. *Stage enclosure:* Yes. *Stage floor:* 40-mm pine over deep airspace (and 15 mm of oak wood placed above pine only for symphonic music). *Stage height:* 0.60 m. *Added absorptive material:* (Only in electroacoustical music and conferences) Velvet curtains covering the side walls and also the back stage wall. *Seating:* Special designed, rigid seat back, front of seat back upholstered; top of the seat-bottom upholstered; underseat, wood linear perforated Helmholtz resonator.

Architect: Rafael Moneo. *Structural engineer:* Jesús Jiménez NB35. *Acoustical consultant:* Higini Arau. *Drawings and figures:* courtesy of the acoustical consultant.

Acoustical and technical details*

Concert hall

$V = 17530\ m^3$	$S_A = 1282\ m^2$	$S_o = 251\ m^2$
$S_T = 1533\ m^2$	$N = 1839$	
$H = 13.86$ m	$W = 26$ m	$L = 41.5$ m
$D = 41.5$ m	$SD = 15.4$ m	$SW = 18.25$ m
$SH = 9.5$ m	$V/S_T = 12.85$ m	$V/S_A = 13.67$ m
$V/N = 9.53\ m^3$	$S_A/N = 0.697\ m^2$	$H/W = 0.53$
$L/W = 1.596$		
$T_{MID} = 1.86$ s (occ.)	$EDT_{MID} = 2.0$ s (unocc.)	$EDT_{MID}/T_{MID} = 1.08$
$C_{80\ MID} = 1$ dB (occ.)	BR(occ.) = 1.18	LEF (unocc) > 0.20
ITDG = 21 ms	G_{MID} (unocc) = 4 dB	ST1 = -13 dB

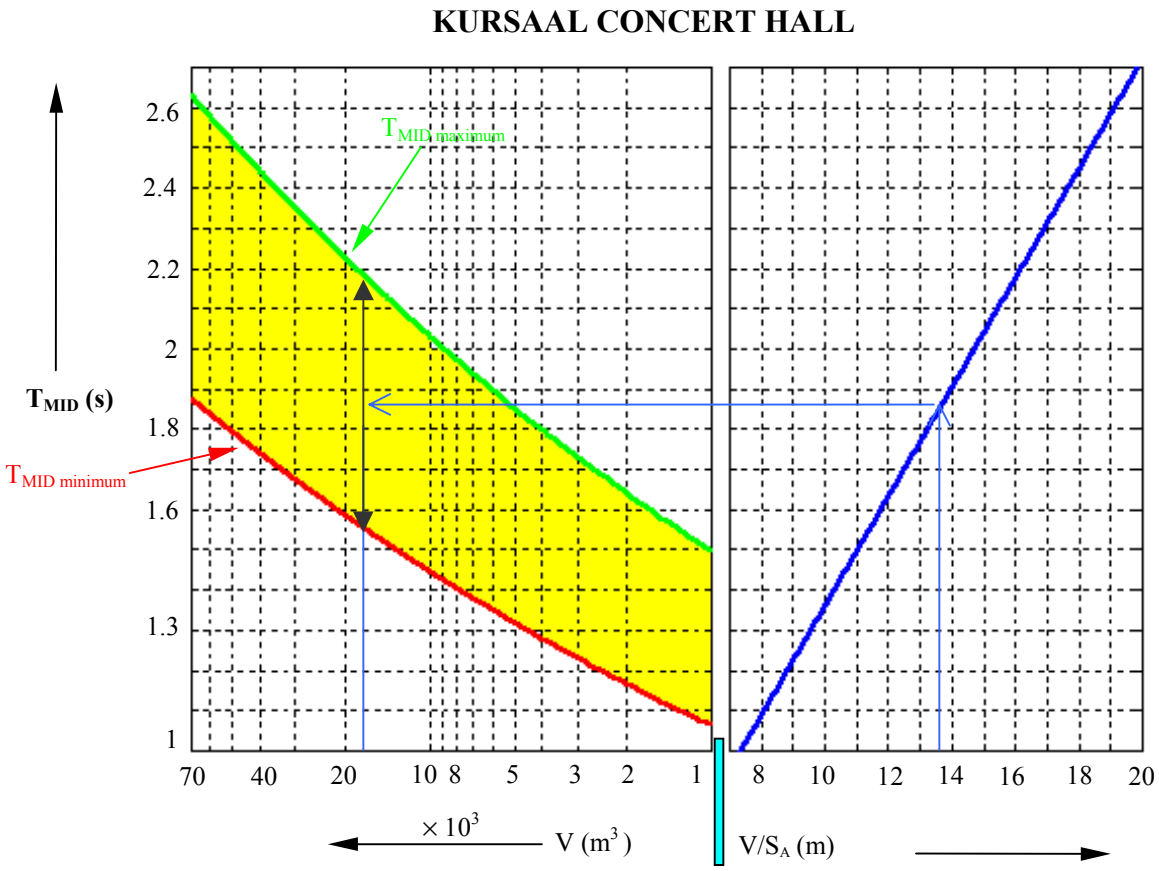
Opera house

$V = 14956\ m^3$	$S_A = 1282\ m^2$	S_o (pit)= $120 m^2$
$S_T = 1402\ m^2$	$N = 1839$	$V/S_T = 10.67$ m
$V/S_A = 11.67$ m	$V/N = 8.132\ m^3$	$S_A/N = 0.697\ m^2$
$T_{MID} = 1.58$ s (occ.)	$EDT_{MID} = 1.80$ s (unocc.)	$EDT_{MID}/T_{MID} = 1.14$
$C_{80\ MID} = 4$ dB (occ.)	BR(occ.) = 1.25	LEF (unocc) > 0.20
$RASTI = 0.6$ (occ.)		

Conferences, Electroacoustical Music and cinema

$T_{MID} = 1.3$ s (occ.)	$RASTI > 0.6$ (occ.)

***** *The terminology is explained in Appendix 1 of How They Sound Concert and Opera Halls written by Leo Beranek.*



V: Hall volume

S_A: Acoustical audience area. It includes de area of floor space over which the audience chairs are located, the aisles and the areas of strips 1.5-m wide around the seating area.

Figure: Correlation between the optimum reverberation times for music (T_{MID}) and the relation volume versus audience area. Theory published in the Technical Journal Building Acoustics (*H.Arau 1997). Variation of the Reverberation Time of places of public assembly with audience size. Building Acoustics, Volume 4 nº 2.*

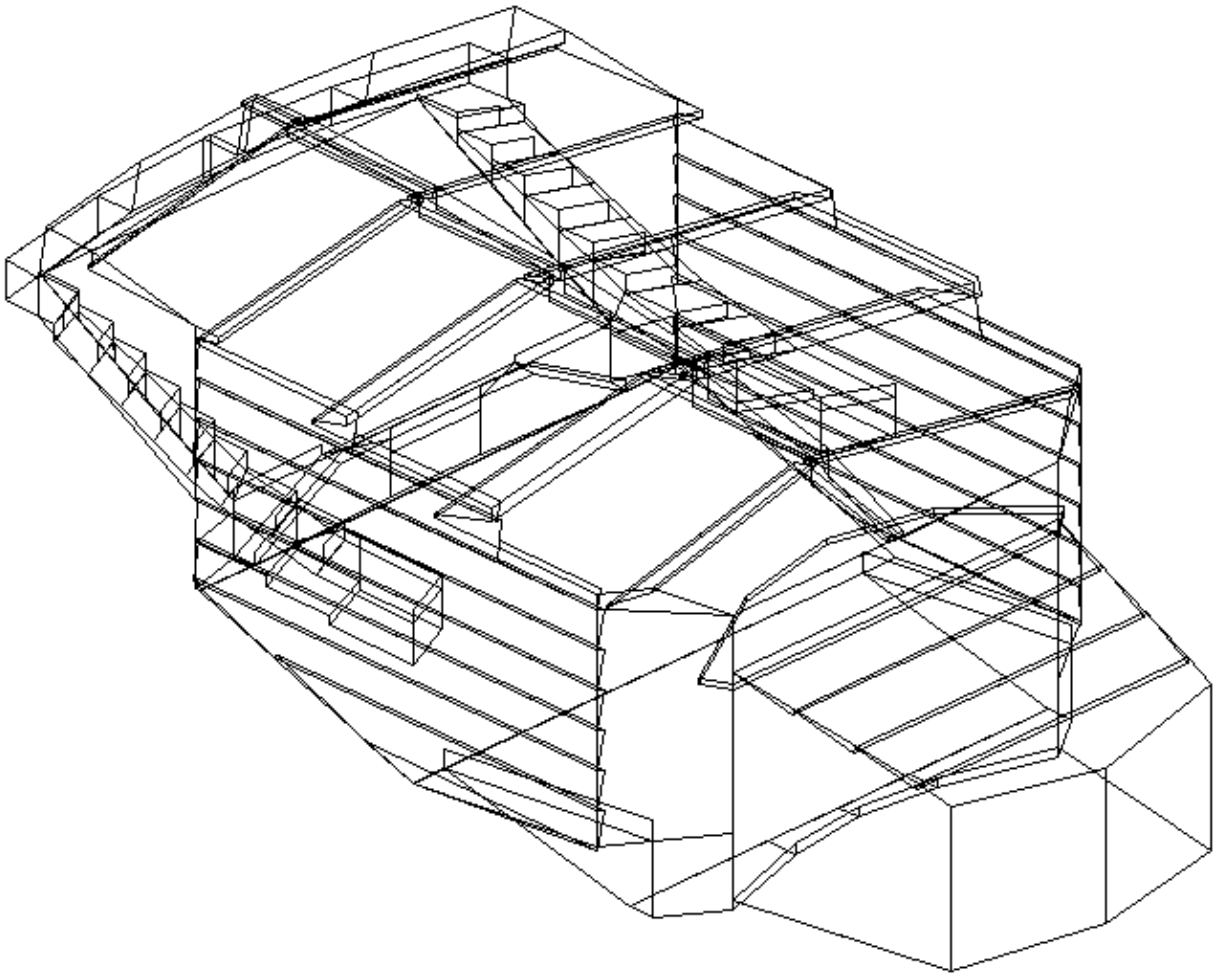


Figure: Kursaal Concert Hall in a 3D view.

The Chamber Hall of the Kursaal Centre will be a multi-use room used both for chamber music and conferences.
Like the main hall, this one provides a high level of intimacy and early lateral reflections. On the other hand, the distance from the farthest balcony seat to the stage is smaller than in the main hall, only 21 m, making it visually more intimate.
This hall is also rectangular. It has a width of nearly 21-m and a longitude of 31-m from the back-stage to the farthest seat. It seats 650 with a 77.6 m^2 stage. The stall is raked in two slopes.
The side walls are even mixed with inclined surfaces. The ceiling hall is longitudinally divided in four flat surfaces. The shell ceiling is steeply raked.
The Chamber Music Hall has been designed will be used both for chamber music and conferences. The hall is completely made of plywood, there is only the absorption due to the seats, musicians and audience. When it is used as a conference hall it appears a weighty velvet curtain covering the stage walls.
The calculated reverberation time with full audience is 1.42 sec at mid-frequencies.

Architectural and structural details

Uses: chamber music and conferences. *Ceiling:* 15-mm to 30-mm plywood with airspace behind. *Side and rear walls:* combines 15-mm plywood fixed to wall with a hard and elastic filling up material and 25-mm plywood inclined. *Floor:* Oak parquet fixed over rigid floor. *Carpet:* none. *Stage floor:* 45-mm oak over plywood over deep airspace. *Stage height:* 0.8-m. *Added absorptive material:* (Only in conferences) Velvet curtain covering the back and side stage walls. *Seating:* Special designed, rigid seat back, front of seat back upholstered; top of the seat-bottom upholstered; under seat, wood linear perforated Helmholtz resonator.

Architect: Rafael Moneo. *Structural engineer:* Jesús Jiménez NB35. *Acoustical consultant:* Higini Arau. *Drawings and figures:* courtesy of the acoustical consultant.

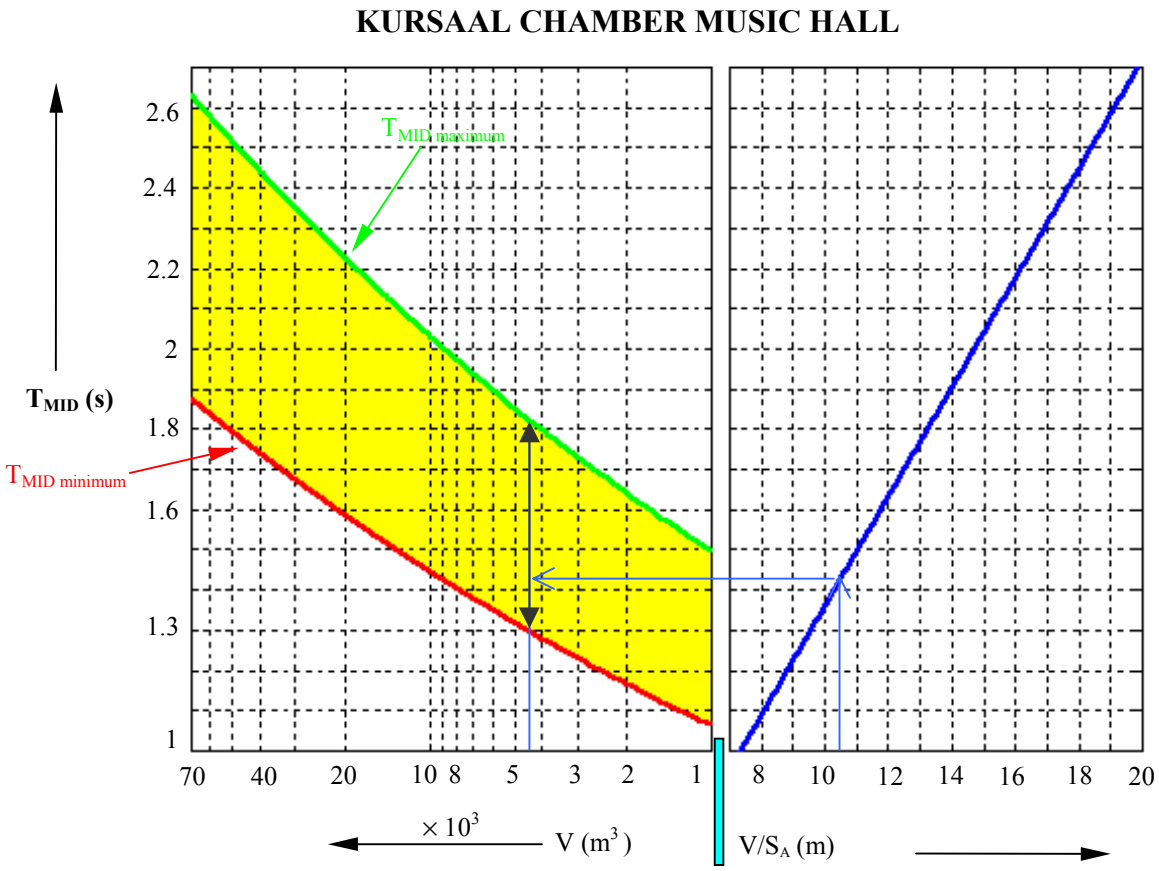
Acoustical and technical details*
Chamber Music

V = 4395 m^3	S_A = 458 m^2	S_o = 77.61 m^2
S_T = 535.61 m^2	N = 650	H = 6.9 m
V/S_T = 8.20 m	V/S_A = 10.5 m	V/N = 6.76 m^3
S_A/N = 0.697 m^2		
T_{MID} = 1.42 s (occ.)	EDT_{MID} = 1.83 s (unocc.)	EDT_{MID}/T_{MID} = 1.28
$C_{80\ MID}$ = 3 dB (occ.)	BR(occ.) = 1.19	LEF (unocc) > 0.20
RASTI = 0.6 (occ.)		

Conferences

T_{MID} = 1.20 s (occ. + curtain)	*RASTI* > 0.6 (occ)

* *The terminology is explained in Appendix 1 of How They Sound Concert and Opera Halls written by Leo Beranek.*



V: Hall volume

S_A: Acoustical audience area. It includes de area of floor space over which the audience chairs are located, the aisles and the areas of strips 1.5-m wide around the seating area.

Figure: Correlation between the optimum reverberation times for music (T_{MID}) and the relation volume versus audience area. For chamber music it is recommended a T_{MID} value between the middle and the low interval limits. Theory published in the Technical Journal Building Acoustics (*H.Arau 1997). Variation of the Reverberation Time of places of public assembly with audience size. Building Acoustics, Volume 4 nº 2*.

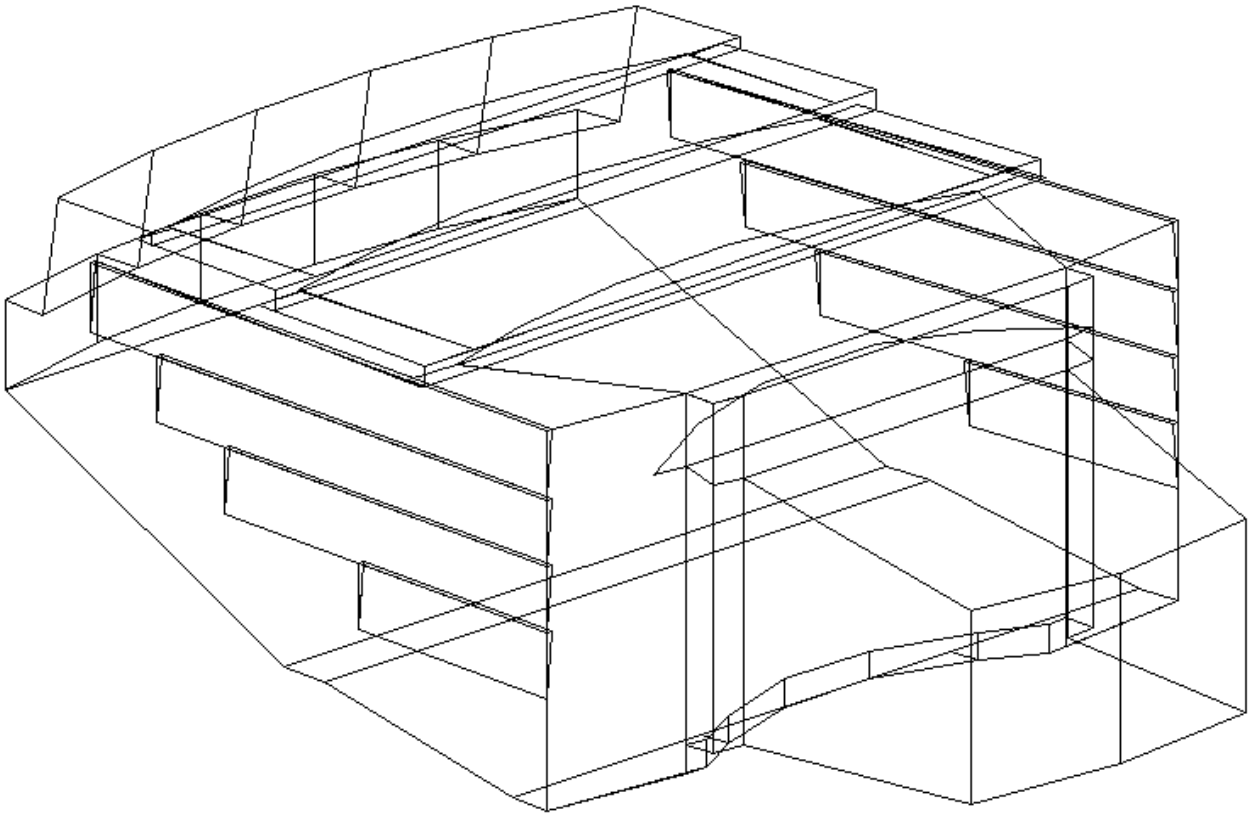


Figure: Kursaal Chamber Music Hall in a 3D view.