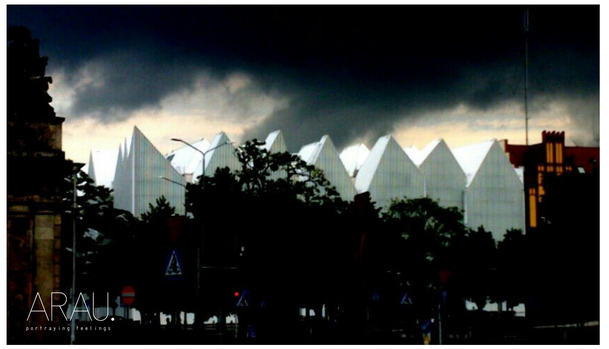
Municipal Authorities organized an international competition of Architecture over the old Philharmonic city.
The winners of the competition were the Architects, called Barozzi-Veiga team, who decided to offer the city the idea of the iceberg as new Icona, creating a new musical space inside the iceberg itself replacing the old auditorium, called: “M. Karlowicz Philhamonic Orhestra in Szczecin”

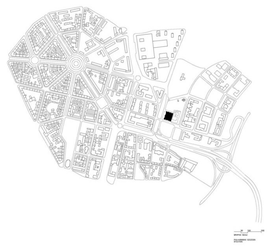


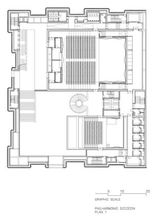
An iceberg has been born in the old Philharmonic city.

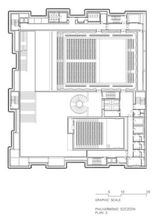
The new building and their spaces associated have been conceived in a low cost basis maximizing the quality in the keys points in the building.
It contains two main halls: **1.** Philharmonic hall with 1000 seats , and **2.** Chamber hall with 200 seats, additionally several rehearsal halls and other common spaces.
The complexity of the whole building and the lightness of the materials used, made the Acoustical project to be extremely complicated.

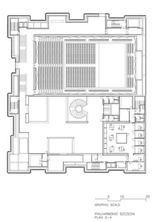
A. Therefore we calculate all aspects of reduction of the noise and vibration in the building, produced by external and internal sources. We calculate all the acoustic problems of the air sound insulation of all the zones of facade, and other many parts inner of building.
B. Also other of the aims of our acoustic project was to make a complete study of the Acoustic of the halls in order to get the best desired acoustical behavior of each hall, in relation that the rules of acoustic criteria for each use.

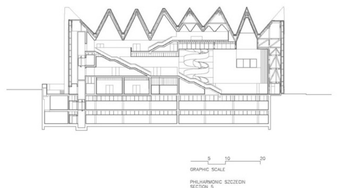
1. The aim of our Acoustic Project was to make a study of acoustic insulation to airborne sound completely around the building, all vertical walls, including the facades and the horizontal walls of all the interior spaces of the building. To do this we arranged our own computer networks, dB Insul (not Insul developed by Marshall Day), which allow us to calculate systems of single, double and three walls.
2. Another very important issue was to develop was to proceed to calculate the acoustic insulation and air facilities of all kinds, against airborne noise and vibration through the structure. All calculations were developed by own procedures calculus, dB Air, Vibro dB, allowing us to design acoustic mufflers and also calculate what kind of isolators need.
3. On the other hand we had to make a complete study of acoustic treatment of the two auditoriums and all rehearsal rooms, and also other common areas of the building, foyer, cafeteria, etc., helping to define forms, inclinations, type of material, they are finishing the walls of each room, determining their thicknesses, and then calculating the acoustic results of all acoustic parameters, with our computing systems and other systems of high relief.
4. The final acoustic tests were performed by: “Politechnika Wroclawska Katedra Akustyki i Multimediów Laboratorium Badawcze Akustyki.”

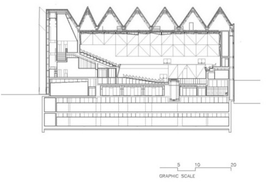


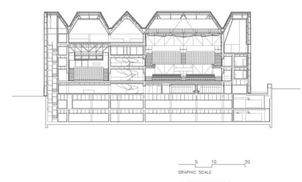




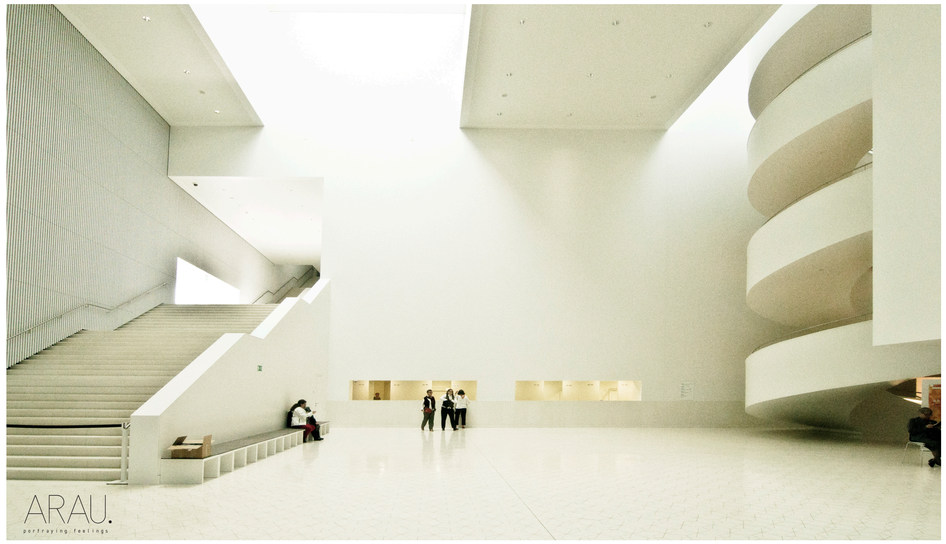


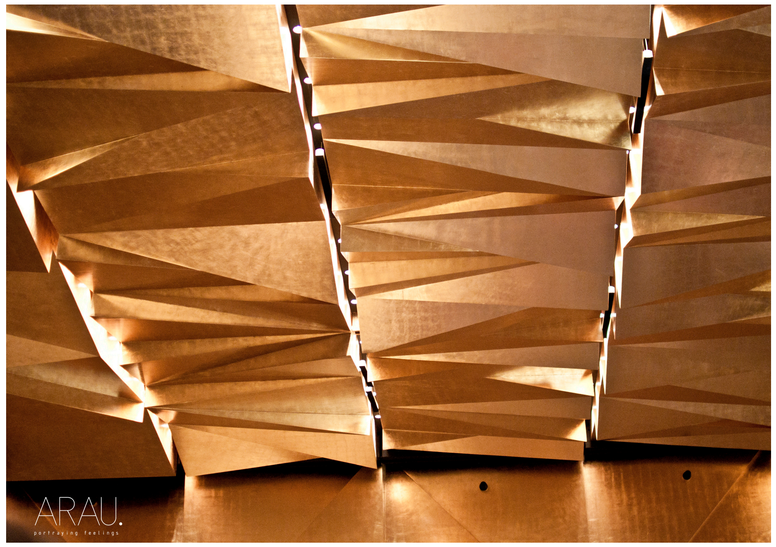






Tel: (+34) 93 284 50 16
info@arauacustica.com
arauacustica@gmail.com





What were the immediate challenges for Arau Acustica on the whole project?

The interior of the Philharmonic hides more than 12 000 square metres of space in four storeys, which include a symphonic hall, a chamber hall, rehearsal halls, music shop, cafe, spacious foyer, artists' dressing rooms, storage rooms for instruments and offices. Our purpose was to design the best rectangular auditorium in the world, even better than the Vienna Musik Verein Saal. Because it is known by all experts of the acoustic that type surround concert halls it is impossible to meet all requirements of acoustic criteria symphonic music.

On the other hand we set out to do two configurations: **1.** A concert hall by the standards even stricter symphonic music, and **2.** An ideal space also for electro acoustics concert hall.

What type of concert hall is the main Symphonic Hall?

This room is rectangular such as we have explained above. We estimate of Reverberation Time in function of the volume according to the laws of acoustic dimensioned to concert halls given from our publication of Higini Arau in Building Acoustics Vol 4 nº2, 1997, we have a volume = 10375 m3 and audience N= 954 seats. The Reverberation Time T mid calculated by dimensioned was T mid = 1.97 s.

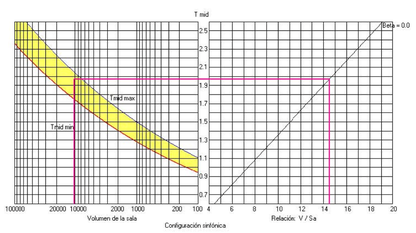
How was initial acoustic design work approached for the Symphonic hall?

The walls: We played with every surface of the room with the laws of reflection and mirror diffraction indicates Christian Huygens, so that the different inclination of the planes get a totally diffuse sound camp where it is not possible any flutter echo or no echo. We know that if the wave length of sound were enough minor than surface dimensions of each plates, then will obtain a mirror reflection on each plates. For there to be a reflection mirror at least the lengths x, y plane reflector must be: Lx, Ly > 3λ, being λ the sound wave length that we wish to reflect.

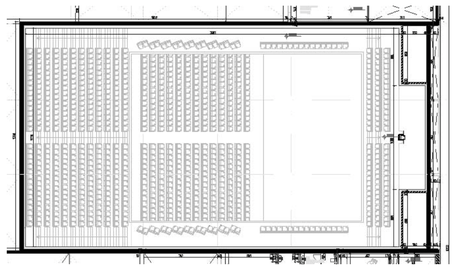
We understand the diffraction of the sound wave breaking on plate, because of which the plate has similar length of the obstacle on which is breaking, as it is indicated by the Principle of Christian Huygens.

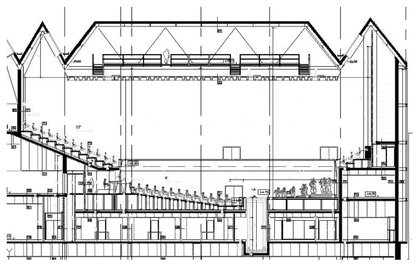
The ceiling of the hall has been divided into 12 sections of plates among the skylights in the hall.
These zones of the ceiling more fragmented, have been achieved with a subdivision that does not follow any mathematical or geometrical law, only has followed the law mentioned before.

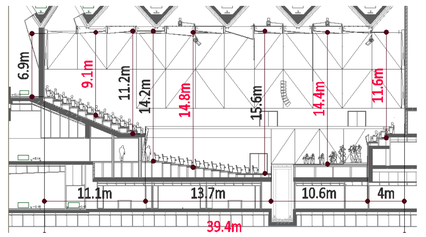
The aim of this areas fragmented is to obtain by diffraction a loss of sound energy to get the viewer a feeling of a soft enough sound, since sound mirror is almost nonexistent in these zones.
In the central position of the hall, between the stage and the amphitheater, we have placed great plates of dimensions 3.08 x 5.56 m and 3.08 m x 3.70 m, divided by triangular plates, which produce a reflection 3D sound mirror, similar to the plates of the walls. The maximum height of the deviation among all vertex more separated in relation to horizontal plate is 300 mm. This is so for all plates of walls and ceiling of the hall. With this geometrical disposition we are sure to get a good projection of sound from 125 m to 4000 Hz frequencies, with reflections mirror and sound diffraction. Therefore all acoustic problems of a hall are avoided, as echoes, echoes flutter, resonances, and so on.

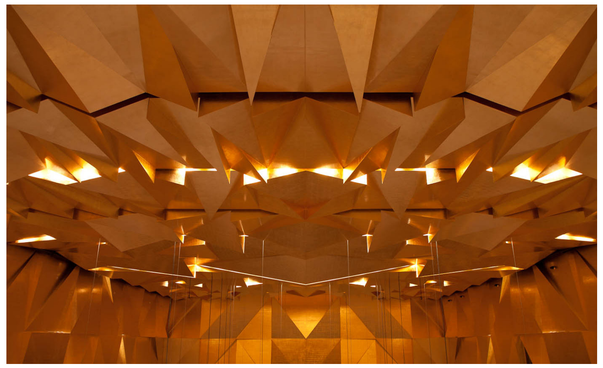
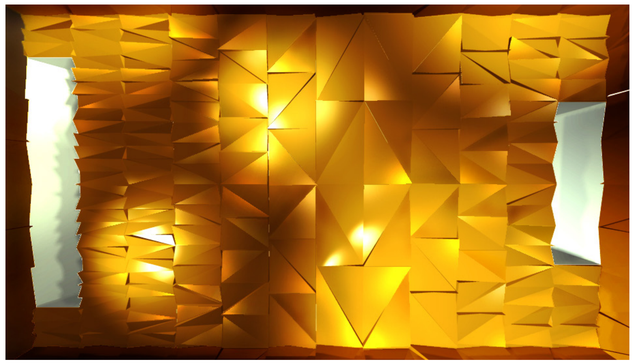
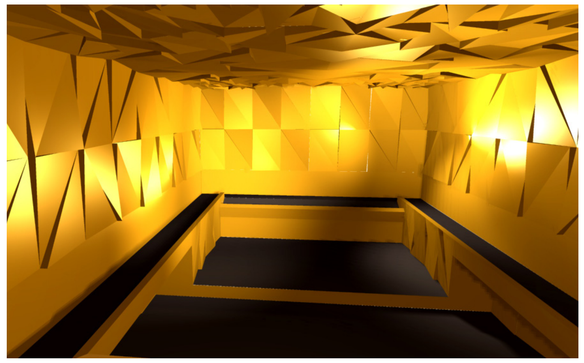
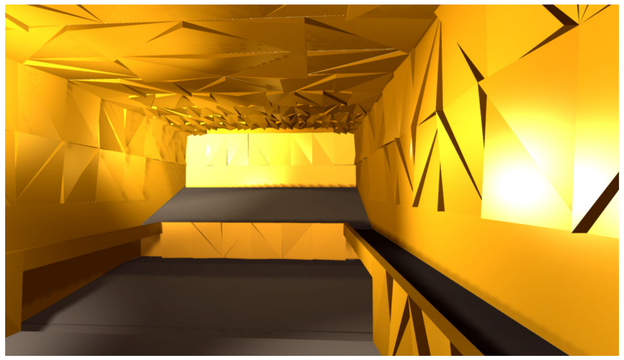


This format plan is: the length of the hall is 39.4 m and its width is 22.64 m, practically complies with the law of the golden ratio of Fibonacci.



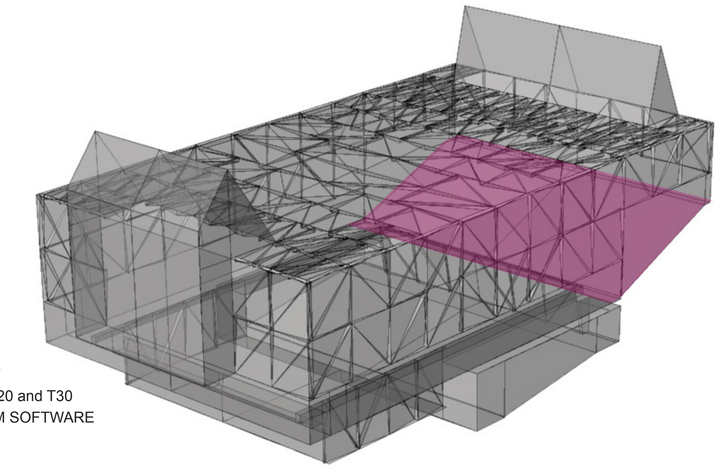




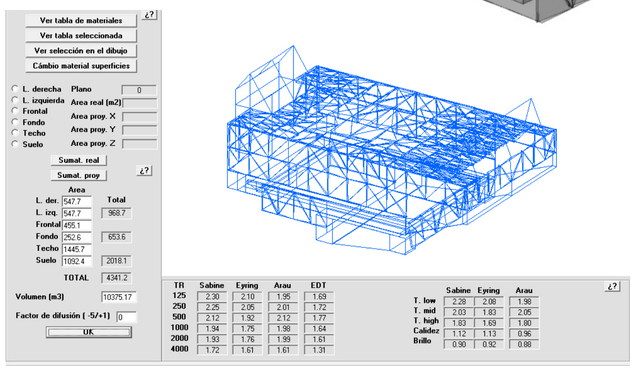





Can you talk about the acoustic modelling undertaken?

In our project we use different acoustic systems acoustic modeling. The software for calculation used in the project are Arau Acustic Rooms developed in our office since 1995, also used an old software named Epidaure of J.P. Vian of CSTB, and the Odeon, where my theory of reverberation is implemented with Sabine and Eyring. The results of RT on all computing systems were next to the computed results:



(+) Global Quick Estimation RT
(o+) Average of RT_ODEON T20 and T30
From ARAU ACOUSTIC ROOM SOFTWARE



TR	Sabine	Eyring	Arau	EDT
125	2.30	2.10	1.95	1.69
250	2.25	2.05	2.01	1.72
500	2.12	1.92	2.12	1.77
1000	1.94	1.75	1.98	1.64
2000	1.93	1.76	1.99	1.61
4000	1.72	1.61	1.61	1.31

	Sabine	Eyring	Arau
T. low	2.28	2.08	1.98
T. mid	2.03	1.83	2.05
T. high	1.83	1.69	1.80
Calidez	1.12	1.13	0.96
Brillo	0.90	0.92	0.88

RT OF PHILARMONIC HALL WITH OCCUPIED SEATS by Odeon Software

FREQUENCY (Hz)	125	250	500	1000	2000	4000	TMID	TLOW	THIGH
(+) RT_ODEON T30	2.63	2.36	2.14	2.00	2.03	1.80	2.04	2.49	1.915
(+)RT_ ODEON T20	2.62	2.35	2.13	2.00	2.00	1.78	2.06	2.485	1.89
(o)RT_ ODEON Tav	2.655	2,355	2.135	2	2.015	1.79	2.05	2.48	1.90

How was the end acoustic evaluated in the Symphonic Hall?

The Owner wished that end acoustic tests were carried out by a testing laboratory Poland highly qualified. This Laboratory was:
“Politechnika Wroclawska Katedra Akustyki i Multimediów Laboratorium Badawcze Akustyki.”
http://www.akustyczna.pl/pl/nowosci/pomiary-akustyczne-filharmonia szczecinska . https://www.youtube.com/watch?v=OqmY9TMSUe8 .

The values of RT measured are:

SYMPHONIC HALL	**125**	**250**	**500**	**1000**	**2000**	**4000**	**MID**
T30 (Hall) (s)							
Empty seat	2.19	2.02	1.98	2.1	2.17	1.95	2.04
Ocupied seat	1.84	1.76	1.86	1.99	2.05	1.87	1.93

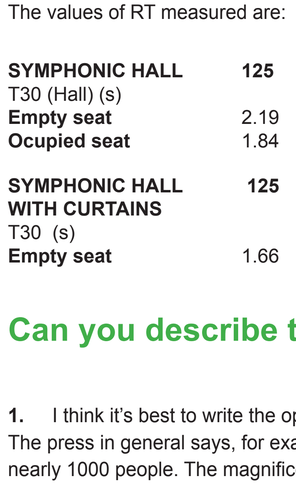
SYMPHONIC HALL WITH CURTAINS	**125**	**250**	**500**	**1000**	**2000**	**4000**	**MID**
T30 (s)							
Empty seat	1.66	1.50	1.38	1.40	1.46	1.38	1.43

Can you describe the sound in the Symphonic Hall?

1. I think it’s best to write the opinion of experts and music lovers who have heard the room since opening. The press in general says, for example: The symphonic hall, also known as the Sun Hall, may accommodate nearly 1000 people. The magnificent acoustics of the Sun Hall originates from special geometry of the walls and ceiling, developed by the architects together with Dr. Higini Arau, a specialist in architectural acoustics from Barcelona. All parameters of the symphonic hall (strength, uniformity of sound, delay and lateral energy fractions) produce an effect comparable to the model of such undertakings – the concert hall Musikverein in Vienna. (to see: http://filharmonia.szczecin.pl/the_building).

2. I can to explain my sensation: At the opening of the Symphony hall, when I heard the music of a Polish composer called Marek Jasiński, and even more so after the 9th Symphony Beethoven, I noticed the extraordinary feeling that the sound came over me throughout my being causing me extraordinary emotion that was impossible to explain it, when the sound invaded my senses producing much joy and cry of emotion.

https://vimeo.com/129086298 Mies Van der Rohe Award
https://www.youtube.com/watch?v=a5xJUECKBjg Inauguration



ARAU ACUSTICA, is the professional acoustic studio of Dr. Higini Arau in Barcelona (Spain). The studio has been working in every scope of architectural acoustics, civil and industrial engineering and urban, industrial and traffic contamination for more than 40 years.Nowadays, a multidisciplinary team works in the Arau Acustica. Every member of the team-work has been trained in the studio. The members came from different Universities (Engineering and Architecture Departments) and some of them attended specialized courses and Masters in Acoustics.The Arau Acustica has the recent advances in acoustic and vibrational technology for measurements and calculations.

QUALIFICATIONS: Higini Arau, PhD. Physic Sciences by the Barcelona University with the qualification of “EXCELLENT CUM LAUDE”.

SOCIETIES THAT BELONGS:
- Member of the Sociedad Española de Acústica SEA (member of the board of directors) since 1971.
- Member since 2013, and associate member since 1976 of the Acoustical Society of America ASA
- Firm member of the National Council of Acoustical Consultants since 2013.
- Member of the European Acoustics Association EAA since 2000.

TEACHING
He is external profesor of Masters of Acustic in la Universidad Ramón Llull (La Salle) de Barcelona, UEM Europea Universidad Madrid, UN Navarra Universidad, Universitat Internacinal de Catalunya UIC, etc, and performed master classes in several Universities and Tecnological Centers of Spain.
RESEARCH AND DESIGN AWARDS
- Obtained the Accésit of ResearchJUAN VIGON del “Patronado del Instituto Nacional de Técnicas Aerospaciales “Esteban Terradas” “(1980 / 1981).
- Award Rehabitec 1996 por el Teatro Metropol.
- Award of Architecture FAD 2000. Especial Mention.
- Award Construmat 2001 by “Instituto del Teatro”.
- Silver Certificate of the Acoustical Society of America, ASA.
-Diploma of “du Reconhecimiento de Sociedad Portugesa de Acústica”.
- Award “Auszeichnung gutes Bauen 2006-2010”, Suiza, por el Tonhalle de St. Gallen.

MAIN SCIENTIFIC PUBLICATIONS AND CONFERENCES

PhD.Higini Arau throughout his long scientific career, on a personal basis without help from any government agency, has conducted a series of research papers published in technical journals and national and international, presented in the Journals of maximum international profile