

Chapter 7

Gallery of Halls that Present Pop and Rock Music Concerts

Ancienne Belgique (AB)

Number of concerts per year in this hall: 120. In all halls in the venue: 320

Founded: 1979

Capacity: 2,000

Architect: Werner E. De Bondt

Acoustician: NA

The Ancienne Belgique (AB) is a concert venue, in the very center of Brussels. As a leading musical venue, AB has already been programming international names, national chart toppers and emerging new talent for more than 30 years. An exceptional amount of attention to local talent and the Dutch language prevails in daily operations. More than 500 bands perform on the stages of the AB in the course of 320 concert days per year.

AB is the first pop and rock temple to receive recognition as a “Grote Vlaamse Cultuurinstelling”. This means AB is now one of the key cultural organizations in Flanders, a position it shares with deSingel, the Flemish Opera, and the Museum for Contemporary Art Antwerp (MuHKA). AB received this recognition because—according to the Flemish Minister of youth, sports, culture, and Brussels—it carries out a local and international pilot function (AB stimulates and promotes “more Flanders in the world and more of the world in Flanders”) and because their program reaches high standards of international quality.

The present-day Ancienne Belgique is located in a historic spot in the heart of Brussels. It used to be the house of the merchants—overseas traders—of whom the first traces go back to the eleventh century. Three centuries later the complex had evolved into a real center with a sociocultural function. The only visible evidence of that time is the inscription on the façade: “Meersliedenambacht 1781”. The Belle Epoque brought along new glory: from 1906 to 1913 the “Vieux Dusseldorf” was very popular with its German style interior, 1,500 seats, and many enthusiastic couples on the dance floor. On December 21, 1913 a renovation (the first one in a row!)

was started. This resulted in “Bruxelles-Kermesse”, also a kind of brasserie but now with a variety of artists and theater elements. In the 1920s the basement was turned into the “Caveau Flamand” where young literary talent found a way to the public.

In 1931 the entire building was bought by Mathonet, a man from Liège. This was the beginning of the Ancienne Belgique era. Liège, Ghent, and Antwerp have similar venues but the Brussels one, our AB, will survive them all thanks to the life work of Mathonet’s son, Georges. He turned the place into one of the leading European music halls. Driven by its success the building was bound to be torn down. Well, the time had come to build a bigger venue, a building that nowadays is known as the Ancienne Belgique.

In the Second World War Mathonet was more vigorous than ever: he honorably participated in the Resistance. The liberation brought a true explosion in the world of amusement and Mathonet’s AB was somehow the center of all of this. On the scene we had Annie Cordy, Charles Trenet, Gilbert Bécaud, Aznavour, Brassens, Piaf, and Adamo. Jacques Brel called it an excellent school. In 1955 Bruno Coquatrix turned an old Paris cinema into the most famous music hall of the world: the Olympia. He and Georges Mathonet became partners. Ten grand years followed.

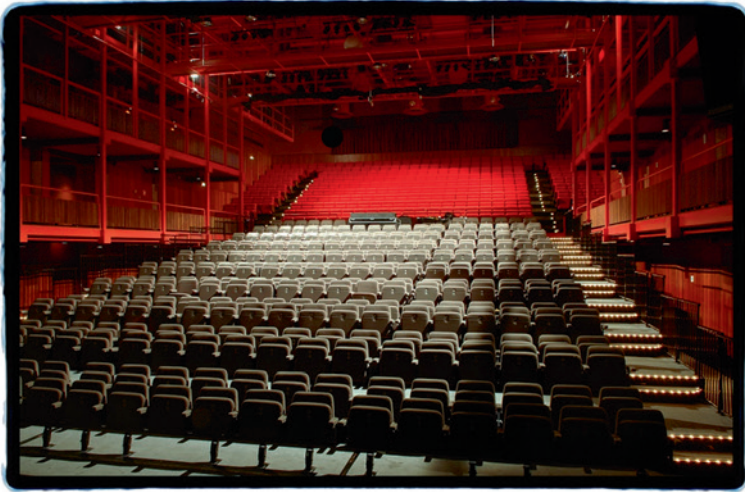
In the 1960s, Johnny Halliday, Jacques Dutronc, France Gall, and Claude Francois appeared there. After the fire at the Innovation (1967) Mathonet was forced to secure the building with concrete. This huge investment turned out to be fatal. The attempt to turn the Ancienne Belgique into a Paris Lido for the Eurocrats failed. A call for subsidies went unheard. In 1971 the Ancienne Belgique filed for bankruptcy. Georges Mathonet died shortly after and the building fell into ruin. In 1977 it was bought by the Ministry of Finance. Finally there was good news: together with the “Botanique” the Ancienne Belgique was presented to the Flemish and Walloon cultural departments.

The Flemish prefer the AB for its central location, its popular background, and its wide range of entertainment possibilities. You could compare it to the Mallemt spirit: providing the Dutch-speaking community with a friendly meeting place right in the center of the capital, a creative spot, a place to be for the young. The original name was kept: Ancienne Belgique, but the abbreviation AB became more and more common. Secretary of State Rika Steyaert opened the AB in 1979 with the famous words, “This is a house of hope.” The qualities of the venue were tested and some defects came up: the building was crumbling and not soundproof at all. All this and too many young people in that quiet and sleeping street made the City Council close down the AB in 1981. A major renovation was inevitable and started in 1982. Architect Werner E. De Bondt renovated the Bar Américain and then started building a new main hall. He opted for a robust and spectacular interior design in a high-tech dimension. Circles on two different levels guaranteed intimacy and the overall atmosphere of the hall was set in a warm, red color. The opening on December 23, 1984 was a memorable event in the history of the AB. However, the noise continued to be a problem and has had a fatal effect on the bill. The youth-oriented approach of the AB was mocked by policy-makers. Dark years followed, until a new dynamism emerged in the house. Partying through the night made way for a strictly respected closing-time.

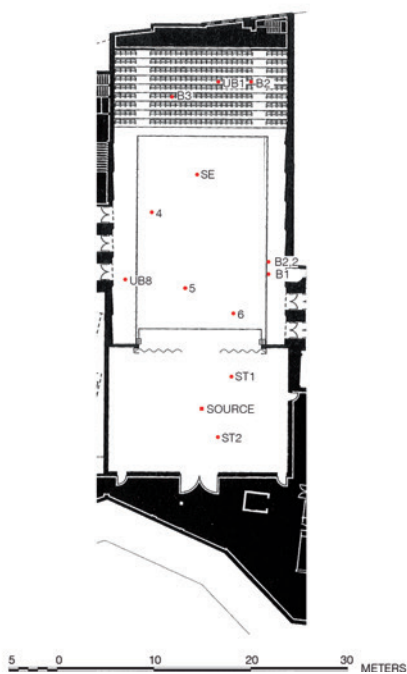
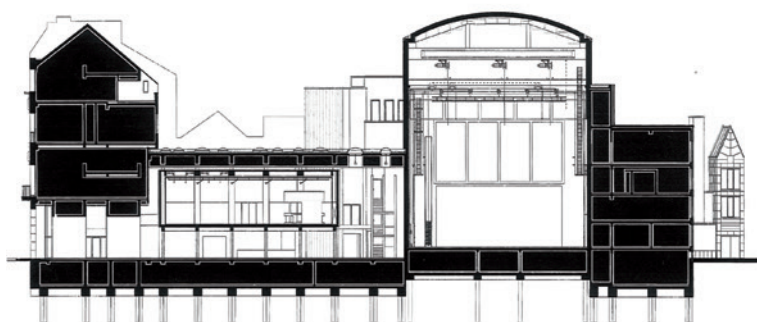
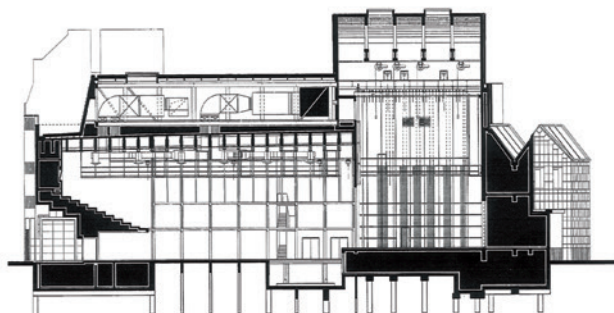
Despite the power of the crew, with Jari Demeulemeester as artistic director (director-general from 1988), fear reigned at the AB: police interventions, fines, and threats from the biggest law firms constantly reminded them of the danger of yet another shutdown. In 1986 Secretary of State Patrick Dewael ordered a thorough investigation concerning the noise. The report was disastrous but hopeful at the same time and led to a new architectural plan and a new architectural team. In 1991 Secretary of State Hugo Weckx agreed to finance a huge contemporary center for popular quality culture. His successor, Luc Martens, safeguarded the demanding but ambitious project, “The music house Ancienne Belgique, a project of the Flemish community in the capital,” as it was called at the opening on December 6th, 1996. The premises were enormously vast and technologically world-class. The main entrance was no longer in the rue des Pierres. There you now have the café and the ticket shop. Equipment can be loaded and unloaded at the loading bay or via the Square Lollepote at the back of the building. Upstairs there is a second, smaller hall: the club. Another advantage: the AB has its own recording studio. From this studio we can go around the world, live, via satellite or through the Internet. Over the years, through all the renovations, the AB profile has always been the same with the goal of presenting contemporary music, made by people of today and about the world in which they live. They want positive press advertising the newest repertoire and the newest act to fans and music lovers; in short: presenting interesting artists to a broad public of people living and thinking today. The belief in a passionate relationship between the artist and the public persists. Recent acts including Alice Cooper, Bon Iver, Brian Wilson, Queens of the Stone Age, Public Enemy, Vampire Weekend, MGMT, Joe Jackson, and Randy Newman have visited AB.



Humour, attitude, and personality. Belgian metal sensation Channel Zero enjoys a sold-out AB (picture: Gino Van Lancker).



“AB is the best venue in Europe... no, in the world!” Mike Patton, Faith No More. There is an option of installing an extra 400 chairs for a total of 700 seats. Many diffusive ducts increase the absorption also supplied by the audience.



Geometrical data	
Volume	9,500 m ³
Height, audience area	11.7 m
Surface area of stage	270 m ²
$L \times W \times H$	45.3 × 18.5 × 11.7
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.41
EDT _{125-2k}	1.41
$C_{80,125-2k}$	1.49
BR ₆₃ versus 0.5-1k	1.73
BR ₁₂₅ versus 0.5-1k	1.23
<i>Stage area</i>	
EDT _{125-2k}	1.12
$D_{50,125-2k}$	0.72
BR ₆₃ versus 0.5-1k	0.87
BR ₁₂₅ versus 0.5-1k	1.02

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Concrete/gypsum board on cavity. Many diffusive ventilation ducts, and so on. Porous absorptive plates are placed under balconies.

Walls: Wooden panels on gypsum boards on cavity. Some wooden boards are slit absorbing panels some are plates. 2 cm of cavity behind wooden panels on floor and 1st balcony level. 8 cm of cavity on 2nd balcony.

Stage Area

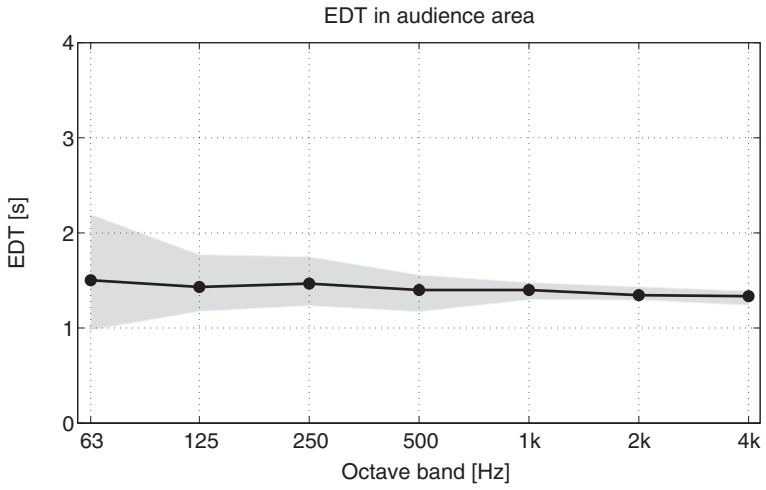
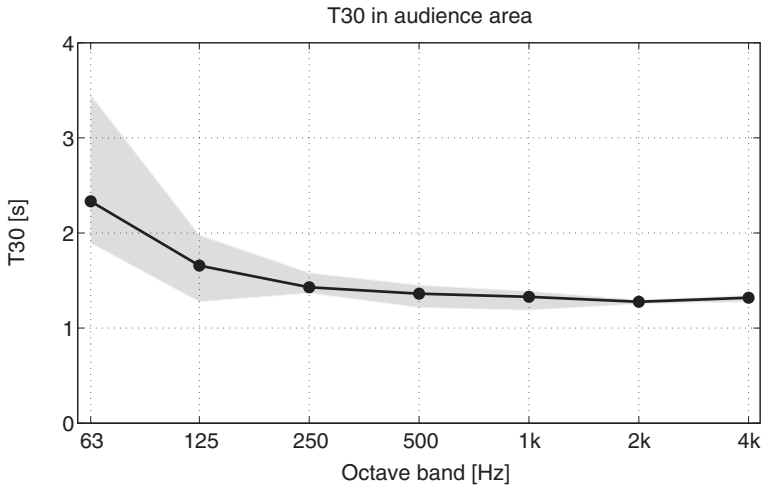
Floor: Vinyl on wood direct on concrete.

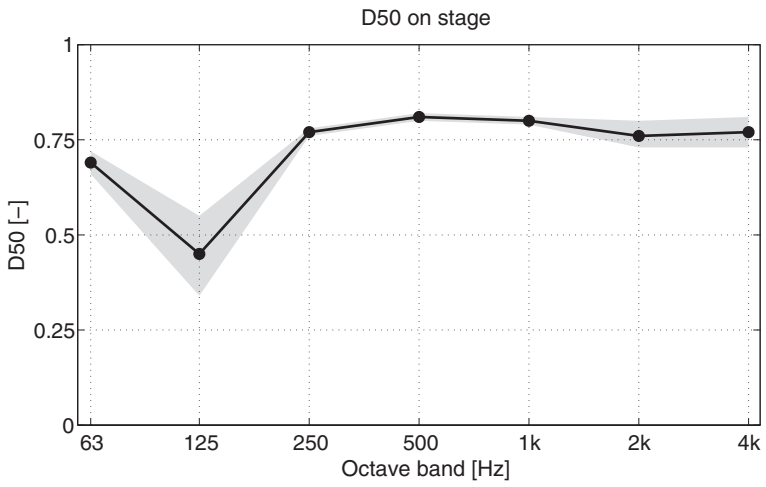
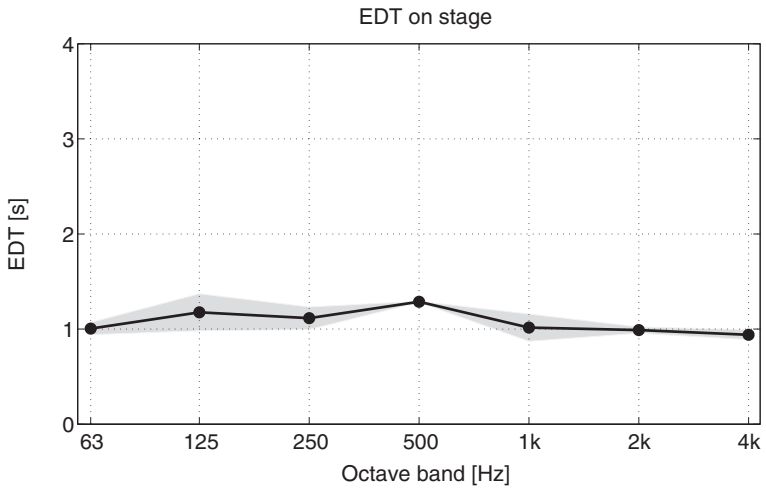
Ceiling: Concrete/gypsum board on cavity.

Walls: Wood wool panels.

State of Hall When Measured

Empty: no additional seats mounted.





L'Aeronef

Lille

Number of concerts per year in this hall: NA

Founded: 1989

Capacity: 2,000

Architect: NA

Acoustician: NA

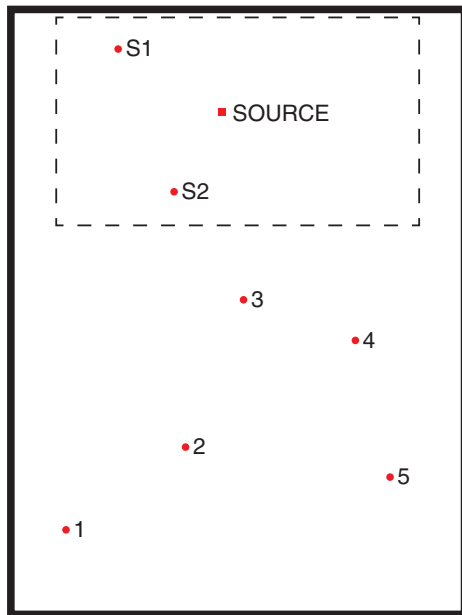
L'Aéronef was started in 1989 by Jean-Pascal Reux and Alain Bashung. In 1995 it was moved to new premises in the building d'Euralille which was designed by architect Jean Nouvel. It holds some 2,000 people.



View from stage into the hall mainly made out of concrete covered by curtains.



There is room for an additional 500 people in the balcony areas for a total of approximately 2,000.



Geometrical data	
Volume	8,500 m ³
$L \times W \times H$	32 × 24 × 12
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.39
EDT _{125-2k}	1.36
$C_{80,125-2k}$	2.20
BR ₆₃ versus 0.5-1k	2.54
BR ₁₂₅ versus 0.5-1k	1.78
<i>Stage area</i>	
EDT _{125-2k}	0.96
$D_{50,125-2k}$	0.73
BR ₆₃ versus 0.5-1k	1.87
BR ₁₂₅ versus 0.5-1k	1.65

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Concrete. 430-m² convex reflectors of wood fiber plates suspended from ceiling with 5–20 cm of porous absorption on top.

Walls: Concrete with large areas of 5-cm thick porous absorptive panels well distributed in room including back wall. Some of these are behind perforated metal plates. Wool curtain 1 m from back wall.

Stage Area

Floor: Concrete.

Ceiling: Concrete. Lowered somewhat perforated technician's grill of aluminium with 4-cm mineral wool slabs on top.

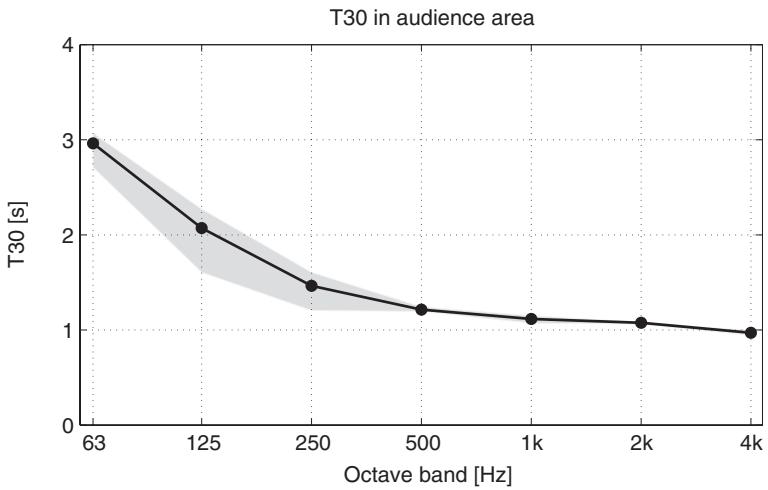
Walls: 5-cm thick porous absorptive panels hidden behind perforated metal plates. Woolen curtain ½ m from back wall.

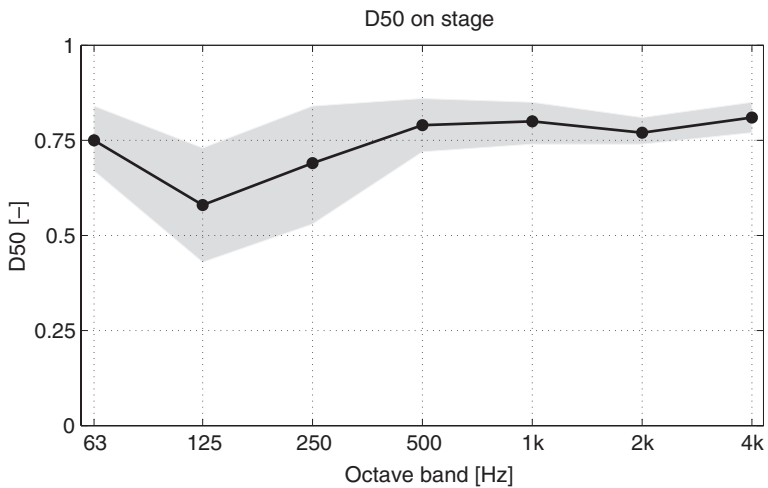
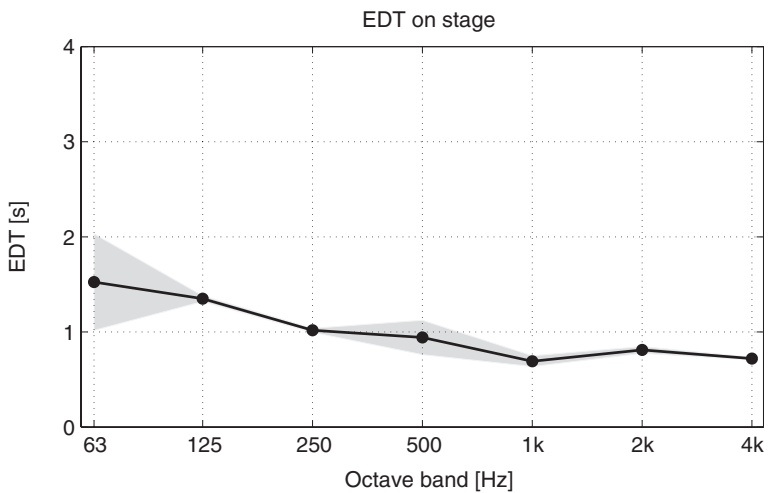
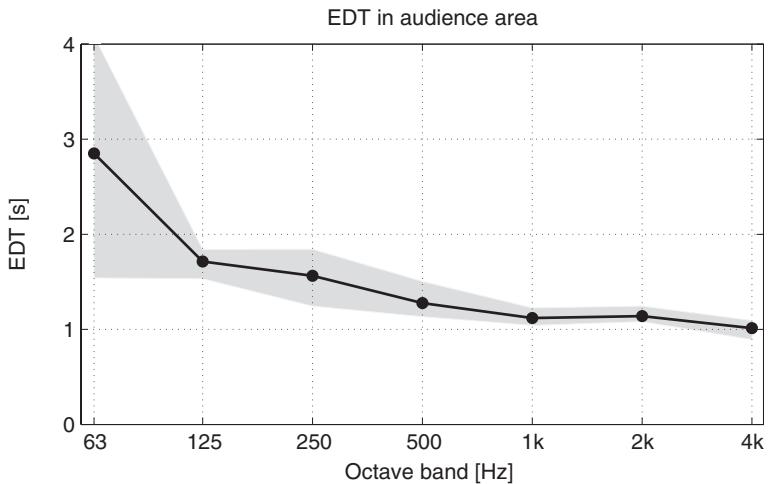
State of Hall When Measured

Empty. Two large doors were open. Balcony opening was covered with Molton. Unupholstered seating risers were packed away at the rear of the hall for standing audience performances.



Stowed away seats against the back wall are an effective broadband absorber if upholstered





Alcatraz

Milan

Number of concerts per year: 160

Total number of events: 250

Founded: 1997

Capacity: Over 3,000

Architect: Daniele Beretta

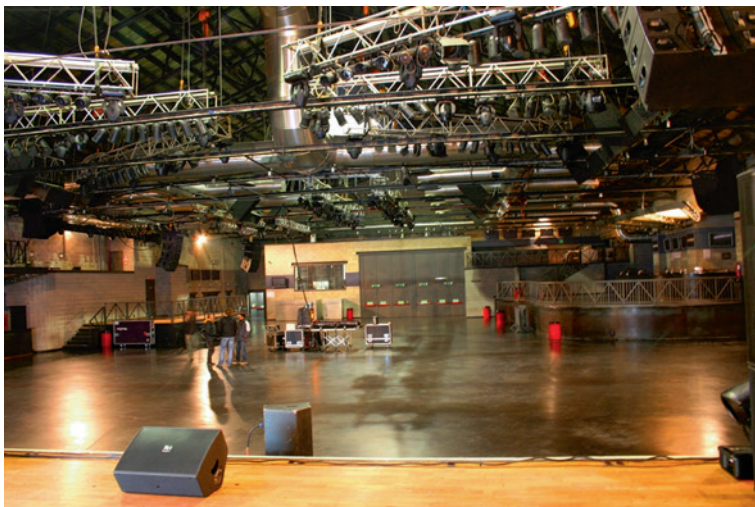
Acoustician: N/A

Owner: Roberto Citterio

The building in which it is located, which goes back to 1946, first housed a garage and then a forwarding agency. In 1997 and 1998, the facility was completely renovated, with the precise and ambitious aim of creating an area capable of meeting all the needs linked to events, shows, and musical performances. The project originated with music industry professionals with a decade of experience and unforgettable productions, who felt the need to create a self-sufficient and functional organization. Alcatraz has always distinguished itself by its versatility.

With an overall area of 3,000 m², Alcatraz is a multipurpose space that, because of its well-organized set-up and flexible structure, offers endless creative possibilities not only for important events, but also smaller and more intimate events. Within just a short time, it became a location for fashion shows and conferences, private parties, a television program, and a venue hosting performances by the most extravagant artists. Alcatraz is located close to public transport, has private parking, and is located near the Isola district. It is a symbol of the freedom to create when ideas are not subjected to any constraints.

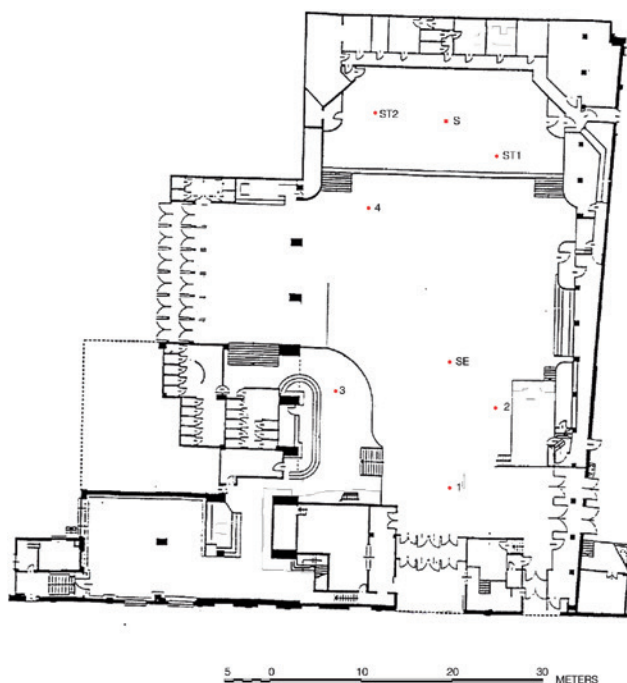
Alcatraz is not just a versatile and accommodating space; it is also made by human capital capable of providing high-level technical, logistical, and organizational support and services at each stage of an event without leaving out a single detail. The facilities are spread out over an area of 3,000 m², and are divided into different spaces that can be modified and custom made to the event. The viewing facilities, the technological systems, and the huge air conditioning tubes become an integral part of the fascinating architecture. Because it has no supporting columns, the 1,800 m² parterre has no architectural obstructions and lends itself to countless possibilities for creativeness, thanks also to the possibility of dividing spaces through a system of curtains that run on tracks.



Smaller platforms are placed on the sides of the large audience area as well as a balcony level in the back.



Mid- to high-frequency T30 is under control mainly because of a quite thin layer of porous absorption in the ceiling. The porous concrete walls help dissipate sound energy in the entire frequency span whereas the lower tones probably are never reflected from what seems to be a thin roof construction. This would cause noise problems in inhabited areas.



Geometrical data	
Volume	15,000 m ³
$L \times W \times H$	52 × 30 × 7.8–13.2 m
Surface area of stage	
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.47
EDT _{125-2k}	1.35
$C_{80,125-2k}$	1.30
BR ₆₃ versus 0.5-1k	0.96
BR ₁₂₅ versus 0.5-1k	0.89
<i>Stage area</i>	
EDT _{125-2k}	0.84
$D_{50,125-2k}$	0.66
BR ₆₃ versus 0.5-1k	0.82
BR ₁₂₅ versus 0.5-1k	0.49

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Panels of porous absorptive material behind perforated metal plates.

Walls: Porous concrete.

Stage Area

Floor: Wood direct on concrete.

Ceiling: Panels of porous absorptive material behind perforated metal plates.

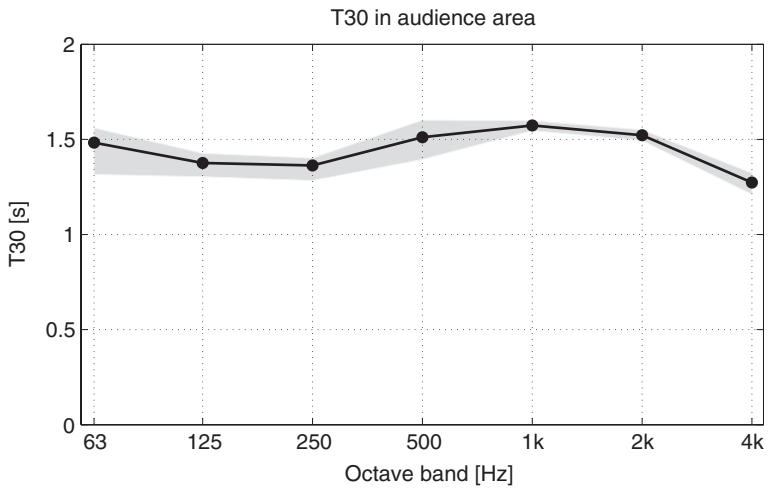
Walls: Porous concrete.

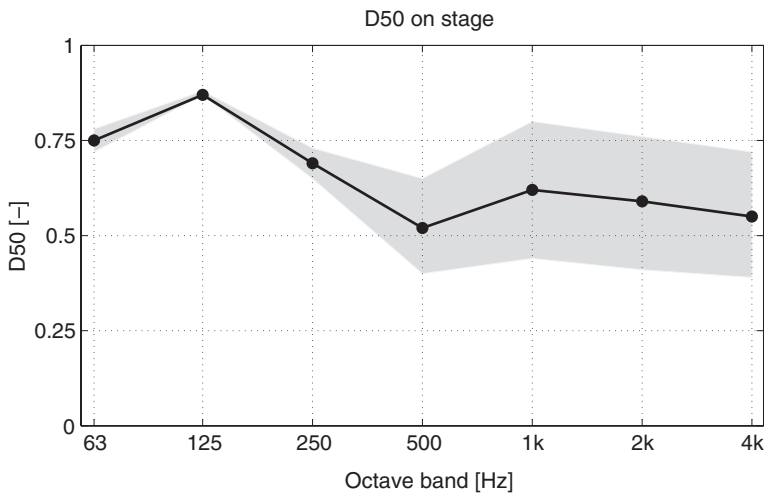
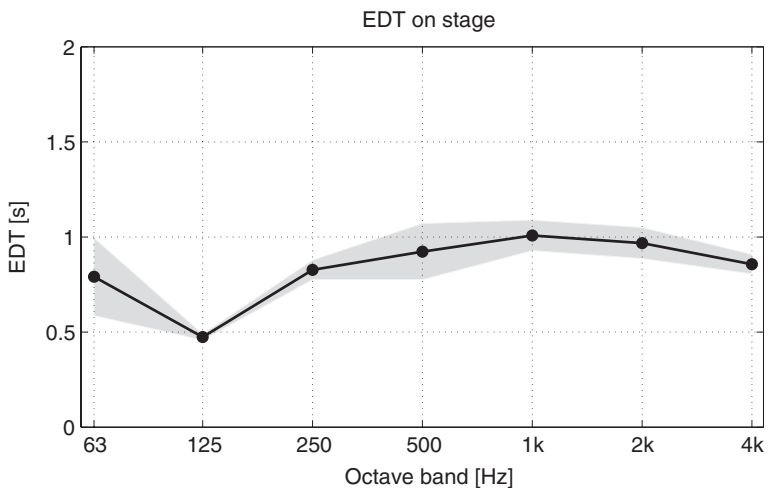
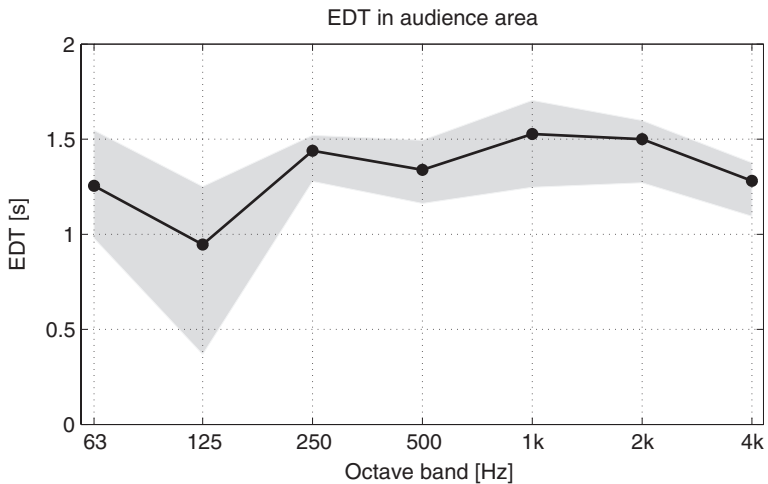
State When Measured

Empty, no curtains.



View from balcony towards the stage.





Apolo La [2]

Barcelona

Number of concerts per year: 300

Founded: 2006

Capacity: app. 400

Architect: Daniela Hartmann

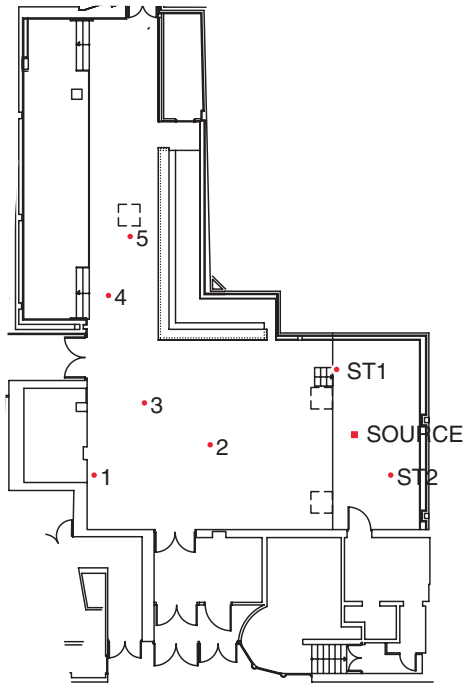
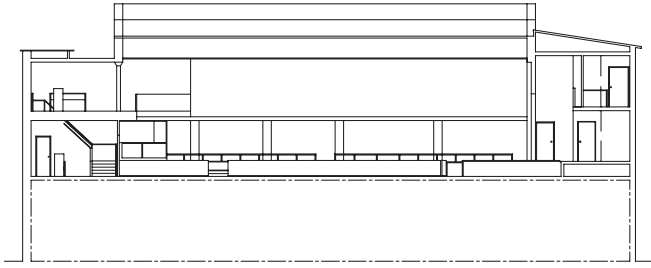
Acoustician: Jordi Martín

In 2006 a second venue, La [2] de Apolo with a capacity of 400 people was opened. This space is for medium-sized concerts and it is probably the venue that works the most in Spain, with more than 300 concerts per year. Not only has the big venue received great artists, but also Clem Snide, Hayseed Dixie, The Zombies, Wovenhand, Damo Suzuki, Herman Düne, Dick Dale, and Lisa Germano among others.

Both venues have become a referent for the Spanish music community, and the dream is to keep it for years.



The modern look of La [2] is enhanced with the metal lattice panels by the walls. Such structures may, if not carefully designed, like ventilation shafts prove to rattle noisily due to high bass levels during concerts.



Geometrical data	
Volume	1,000 m ³
$L \times W \times H$	15 × 16 × 4.0 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.75
EDT_{125-2k}	0.64
$C_{80,125-2k}$	6.90
BR ₆₃ versus 0.5–k	1.09
BR ₁₂₅ versus 0.5–1k	0.92
<i>Stage area</i>	
EDT_{125-2k}	0.22
$D_{50,125-2k}$	0.94
BR ₆₃ versus 0.5–1k	1.75
BR ₁₂₅ vs. 0.5–1k	1.02

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Mineral wool product on cavity.

Walls: Several layers of gypsum board on cavity. Decorative metal lattice.

Stage Area

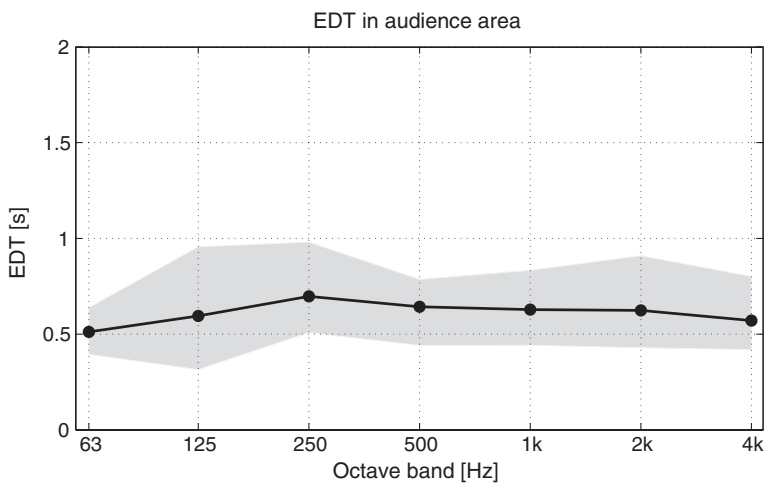
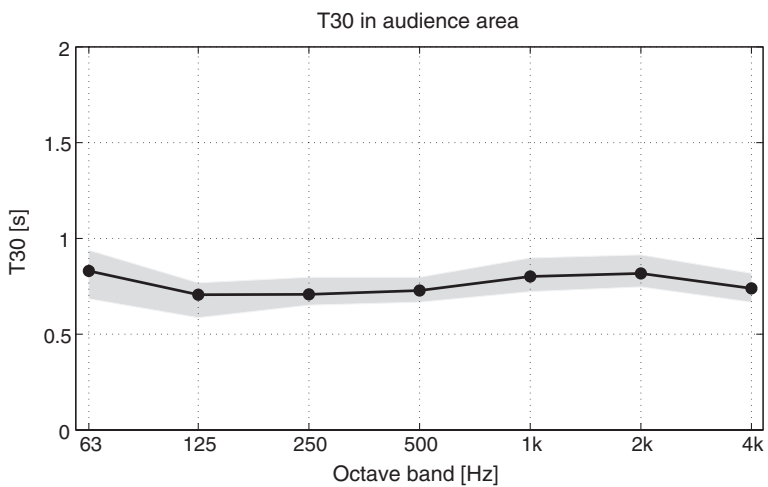
Floor: Wood direct on concrete.

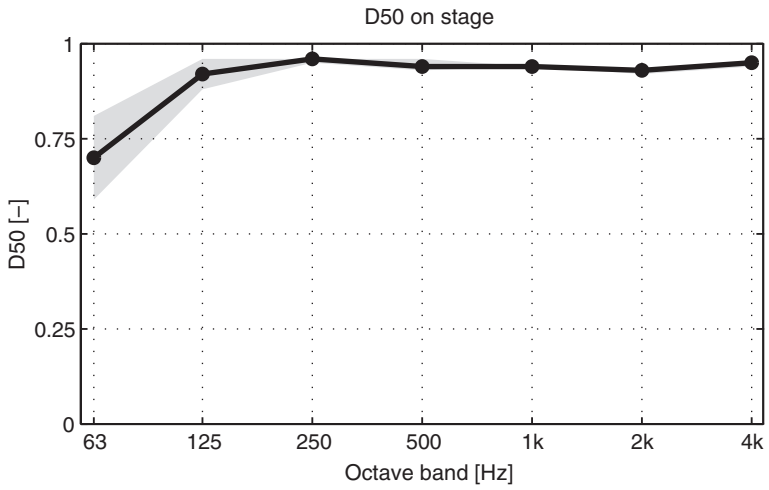
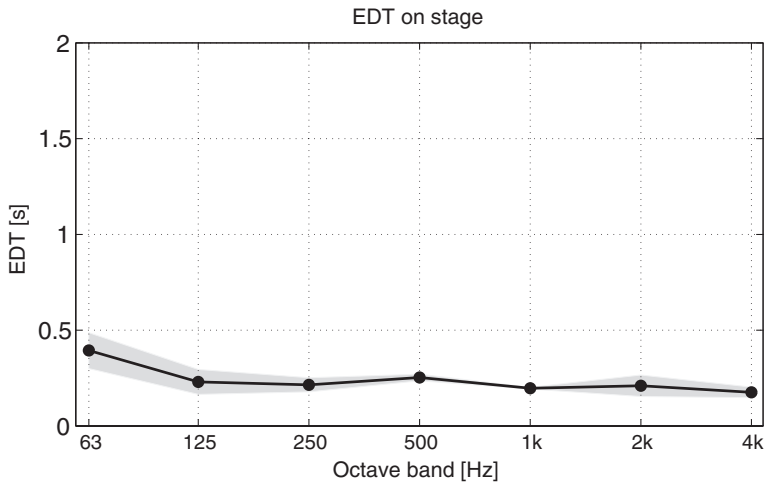
Ceiling: Mineral wool product on cavity.

Walls: Several layers of gypsum board on cavity, curtains.

State of Hall When Measured

Empty.





Apolo

Barcelona

Number of concerts per year: 270

Founded: 1936, reopened: 1989

Capacity: 1,200

Architect: Unknown

Acoustician: Jordi Martín

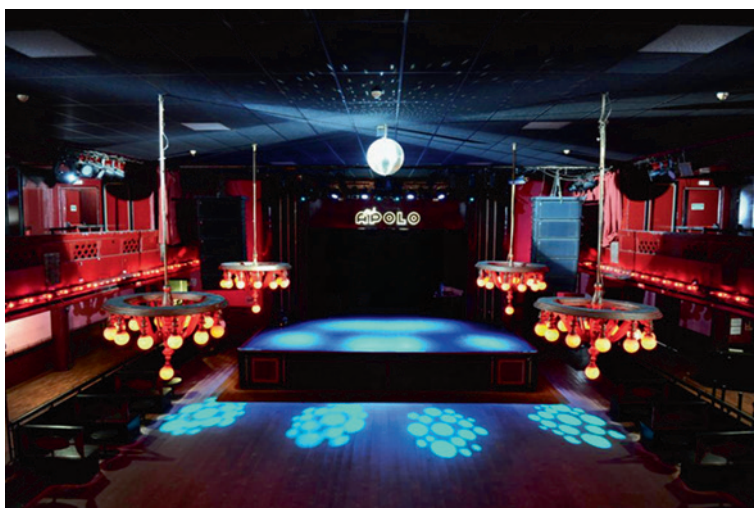
Located in Barcelona's downtown, Apolo opened its doors in 1936 as a ballroom with orchestra. It wasn't until 1989 that the venue became a rock and pop concert hall due to the increasing cultural demand of the city. The inside of the building is still made of wood, giving a beautiful old look to the space according to its age.

The venue has capacity for 1,200 standing people or 700 with seats, and technically, is one of the most well equipped in Spain. This is proved with the approximately 270 concerts that take place here each year. In addition, the infrastructure of the building and the technical materials are constantly being renewed to provide both musicians and promoters with the best conditions for the shows.

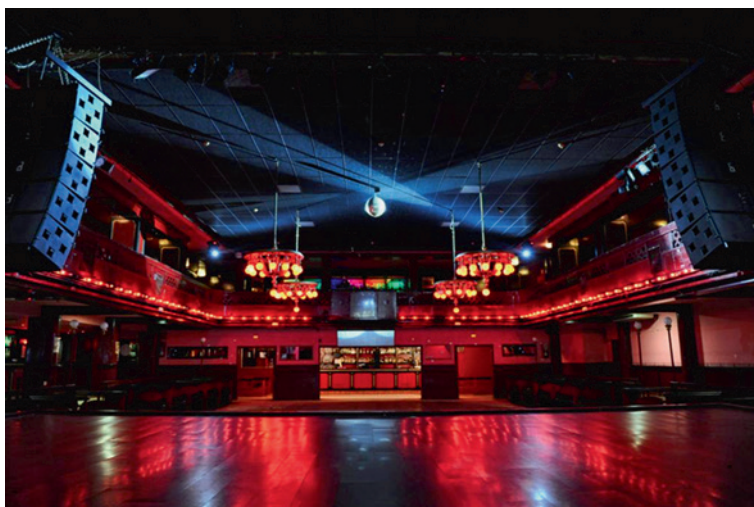
Here is a short list with some of the most important artists that have played at Sala Apolo: Smashing Pumpkins, Coldplay, Joe Satriani, Built to Spill, Yo la tengo, Dinosaur Jr, Goldfrapp, Beth Gibbons, Sepultura, Coco Rosie, Edwin Collins, Band of Horses, Tindersticks, Jonathan Richman, Gutter Twins, Solomon Burke, Robben Ford & Bill Evans, Low, and Devendra Banhart.

One of the biggest achievements of this venue is to support national bands that over the years have become important in the scene. Some of them are El Guincho, La Mala Rodríguez, Standstill, Mishima, or Lori Meyers. The aim is not only to produce concerts, but also to create a new and young local scene to improve the cultural life of the city.

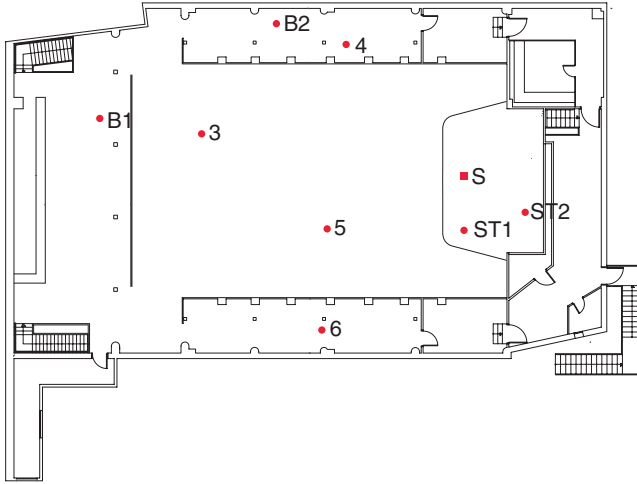
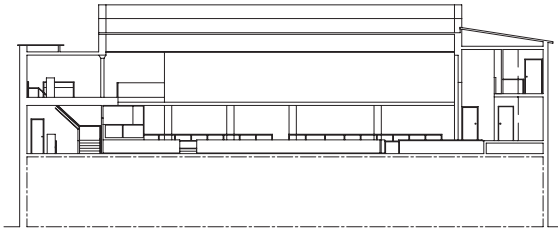
Sala Apolo has also collaborated with important festivals such as Primavera Sound since their beginnings.



The main hall at Apolo is kept somewhat in the original style from 1936.



The balcony areas are popular not only at sold-out concerts.



Geometrical data	
Volume	2,800 m ³
$L \times W \times H$	24 × 19 × 6.3 m
Surface area of stage	
Height of stage	1.15 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.98
EDT _{125-2k}	0.97
$C_{80,125-2k}$	3.61
BR ₆₃ versus 0.5-1k	0.92
BR ₁₂₅ versus 0.5-1k	0.95
<i>Stage area</i>	
EDT _{125-2k}	0.43
$D_{50,125-2k}$	0.86
BR ₆₃ versus 0.5-1k	1.83
BR ₁₂₅ versus 0.5-1k	1.49

Materials Used

Audience Area

Floor: Wood direct on concrete; platforms are wood on cavity.

Ceiling: Lowered (25 cm) porous absorptive ceiling.

Walls: Plates on cavity, one concrete wall.

Stage Area

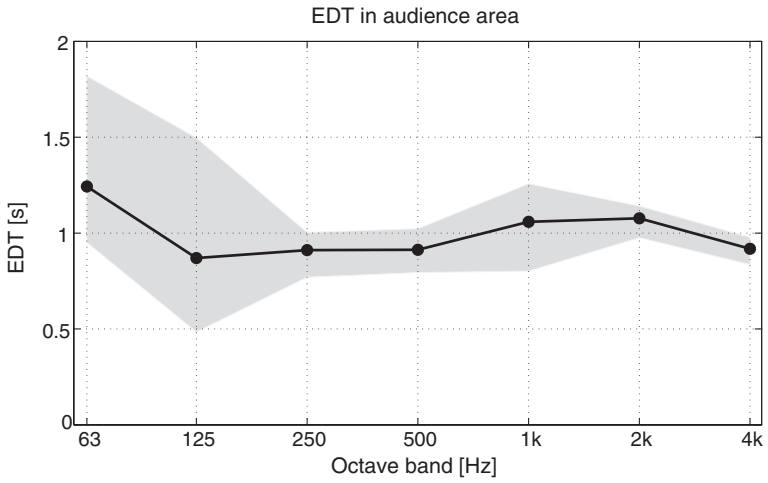
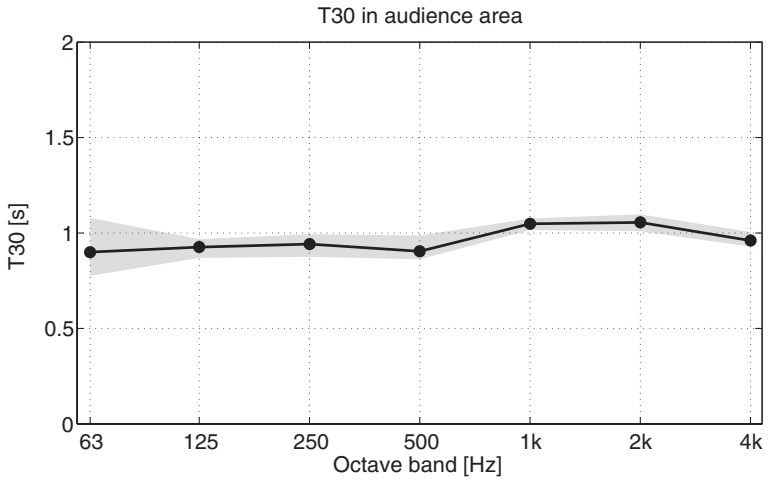
Floor: Wood on concrete.

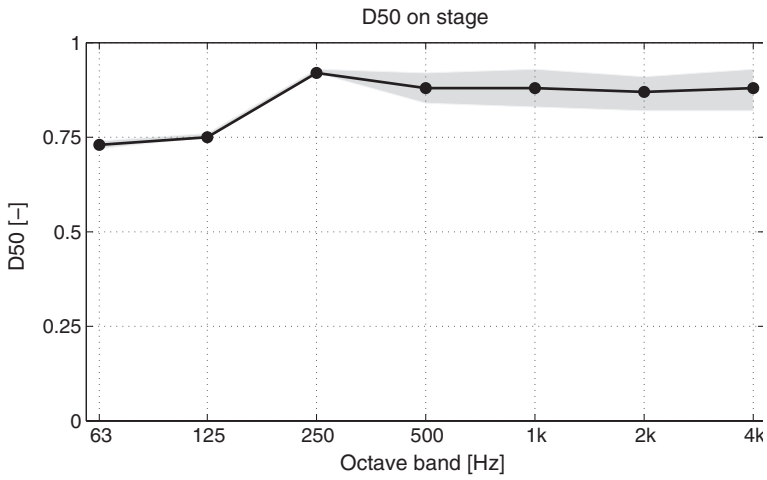
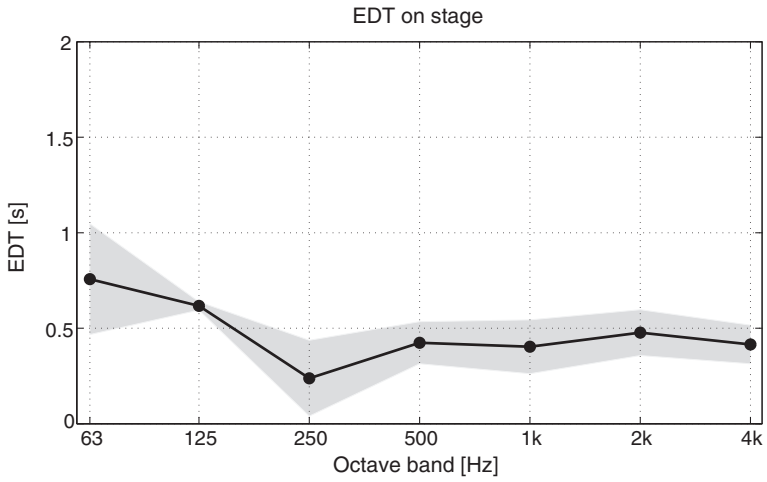
Ceiling: Lowered (25 cm) porous absorptive ceiling.

Walls: Plates on cavity, curtains.

State of Hall When Measured

Empty.





Astra

Berlin

Number of concerts per year: 120. In all halls in the venue: 320

Founded: 2009

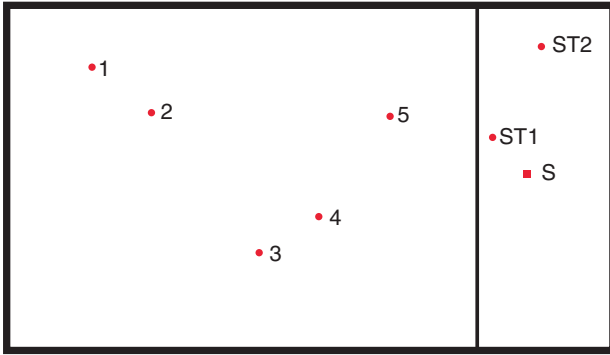
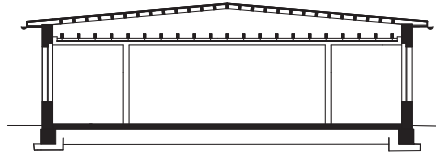
Capacity: 1,000

Architect: N/A

Acoustician: N/A



The large porous absorption-filled cavity above the suspended lamella ceiling ensures acoustic control even at low frequencies.



Geometrical data	
Volume	2,800 m ³
$L \times W \times H$	33 × 19 × 4.6 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.89
EDT_{125-2k}	0.81
$C_{80,125-2k}$	5.78
BR ₆₃ versus 0.5–1k	1.03
BR ₁₂₅ versus 0.5–1k	0.99
<i>Stage area</i>	
EDT_{125-2k}	0.41
$D_{50,125-2k}$	0.85
BR ₆₃ versus 0.5–1k	0.71
BR ₁₂₅ versus 0.5–1k	1.62

Materials Used

Audience Area

Floor: Wood direct on concrete.

Ceiling: Slit absorber: thin metal brackets of 10-cm width and 1.5-cm space; 50-cm mineral wool on top.

Walls: Lower region: wooden panels on 1 cm of cavity; painted brick wall.

Upper region: Wooden strips on 2 cm of porous absorption.

Stage Area

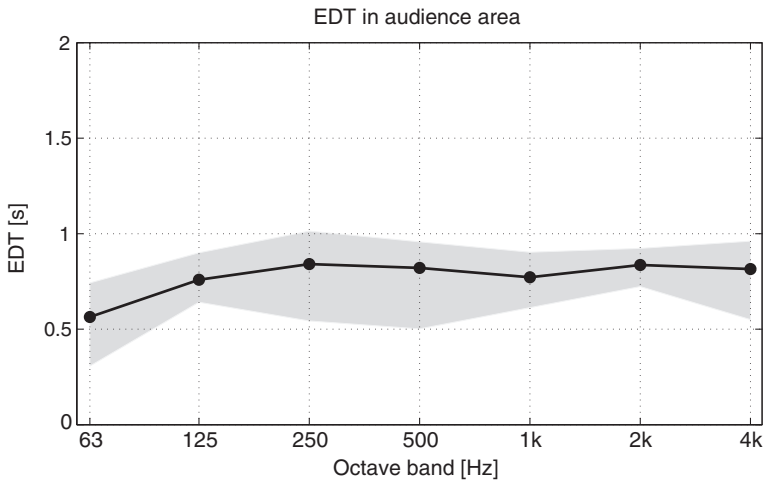
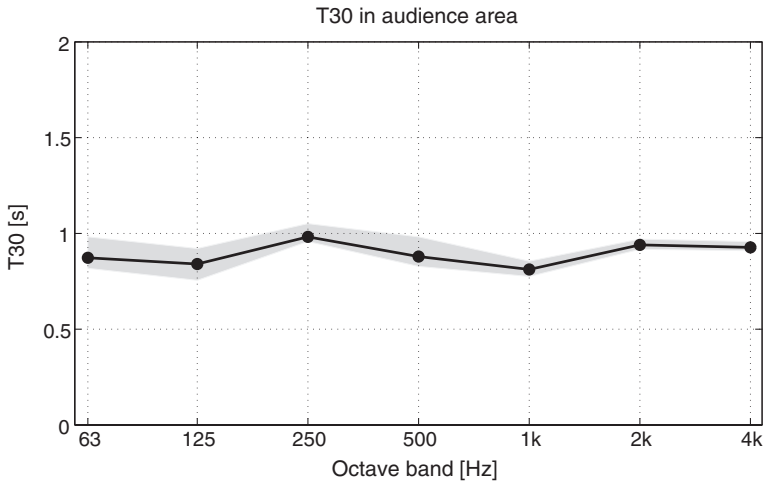
Floor: Carpet on wooden plates on cavity.

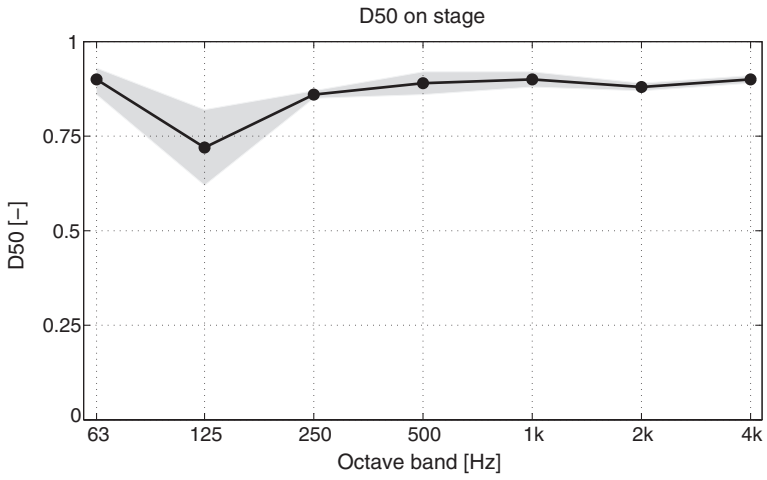
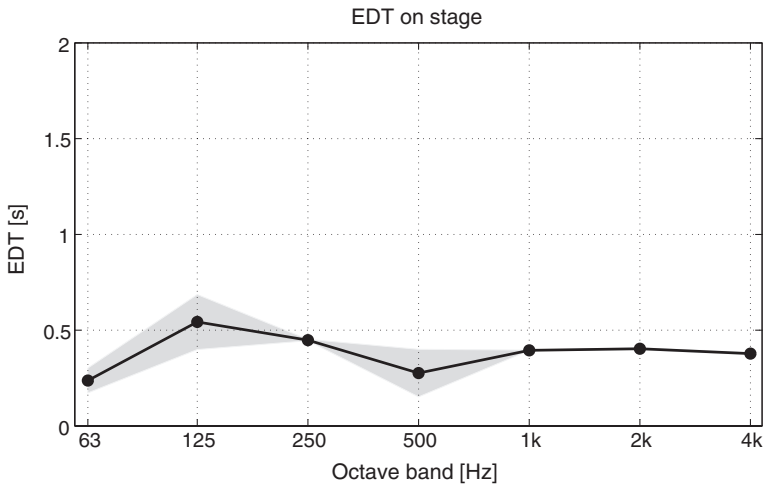
Ceiling: Same as audience area.

Walls: Curtains in front of brick wall.

State of Hall When Measured

Empty.





Bikini

Toulouse

Number of concerts per year: 150

Founded: 1983/2007

Capacity: 1,500

Architect: Didier Joyes

Acoustician: Christian Malcort

Le Bikini was originally situated on the border of the river Garonne in the center of Toulouse. It opened on the 25th of June 1983 simply as a nightclub but rapidly transformed into a music venue. Beginning with only a couple of bands a month, it later became very busy and presented a total of 5,000 concerts up until 2001. Le Bikini commenced as the place where local amateurs became hardened in the genres of the time and the taste of the audience.

In 2001 an explosion at a factory next door destroyed the venue. During the following six years Le Bikini arranged about 500 concerts in other venues before rebuilding the completely new spectacular premises used today.

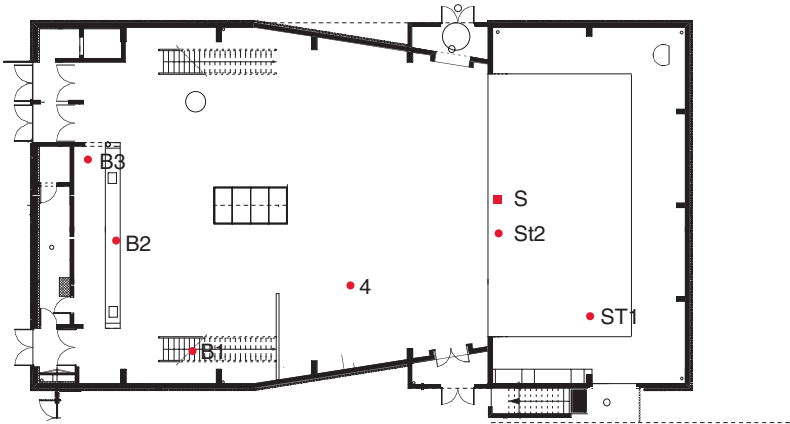
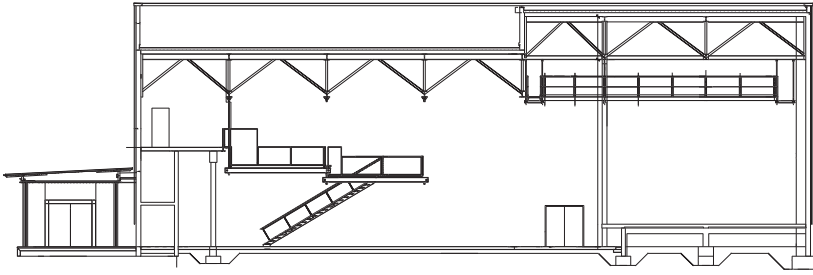
Throughout the following years Le Bikini became one of the best known music clubs in France and an inevitable stage for national as well as international acts. It is also club a where many well-known artists such as Rita Mitsouko, les Strangers, Pigalle et les Garçons Bouchers, Noir Désir, Mecano, and Lloyd Cole, were born and where stars such as Bérurier Noir, Paul Young, la Mano Negra, Little Bob, Kent, OTH, Jeff Buckley, NoFX, Tool, François Hadji-Lazaro, Muse, Coldplay, Placebo, -M-, Zebda, les Fabulous Trobadors, Arno, Korn, les Pogues, Elvis Costello, LKJ, Louise Attaque, Mickey 3D, Soulfly, Indochine, Jeff Mills, St Germain, and Carl Cox are sure to return.



Three layers of balconies ensure that everybody there has a great view of the stage.



Le Bikini is extreme acoustical engineering at work. Reflective surfaces are mainly floors.



Geometrical data	
Volume	7,000 m ³
$L \times W \times H$	33 × 19 × 10.2 m
Surface area of stage	270 m ²
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.5
EDT _{125-2k}	0.56
$C_{80,125-2k}$	11.41
BR ₆₃ versus 0.5-1k	0.72
BR ₁₂₅ versus 0.5-1k	0.95
<i>Stage area</i>	
EDT _{125-2k}	0.29
$D_{50,125-2k}$	0.91
BR ₆₃ versus 0.5-1k	1.63
BR ₁₂₅ versus 0.5-1k	1.59

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Configurations of different layers of mineral wool slabs.

Walls: Extreme configurations of different layers of mineral wool slabs.

Stage Area

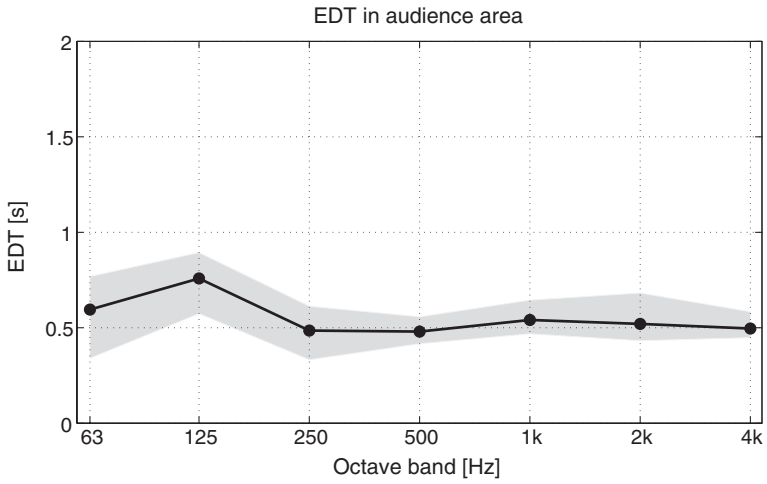
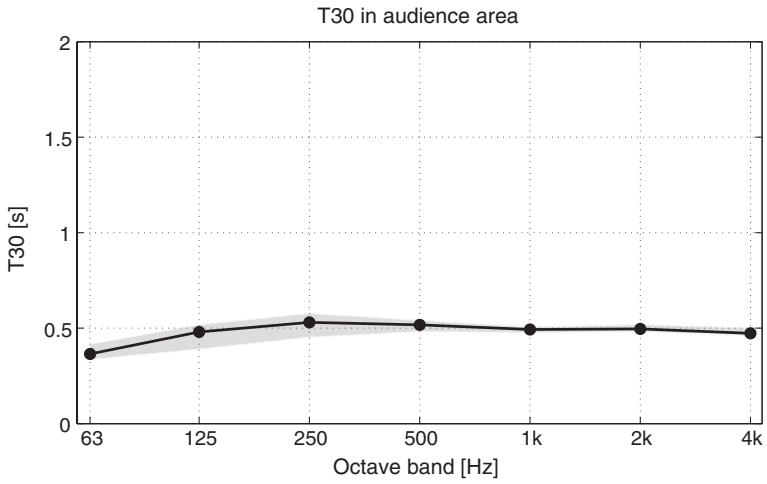
Floor: Wood direct on concrete.

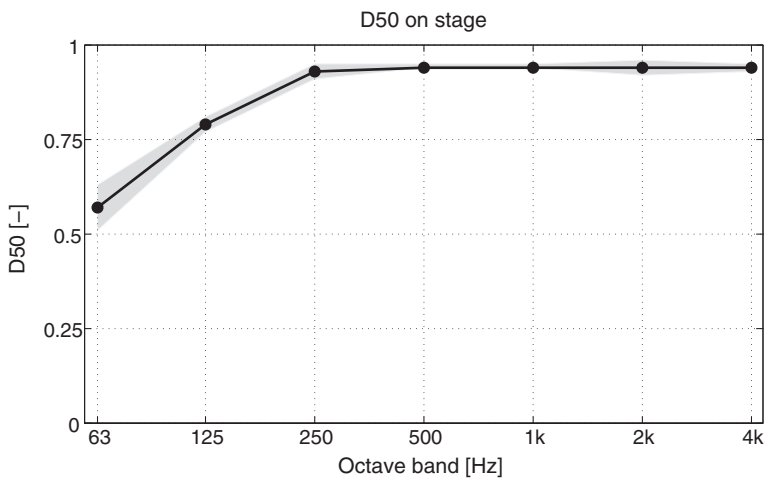
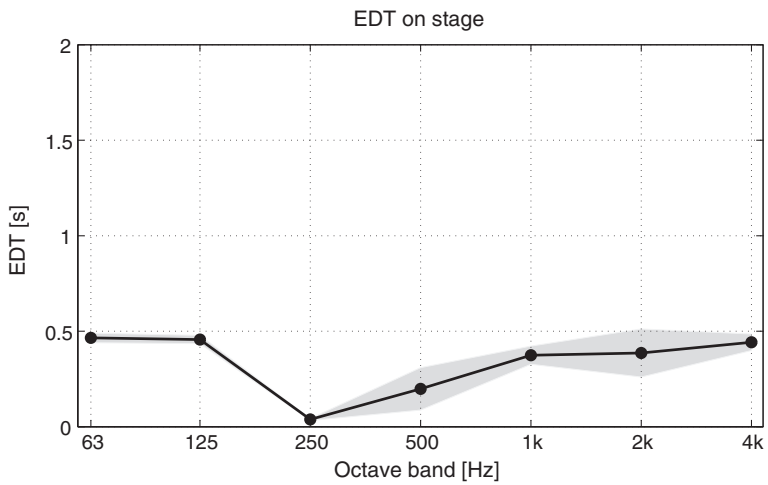
Ceiling: Configurations of different layers of mineral wool slabs.

Walls: Configurations of different layers of mineral wool slabs.

State of Hall When Measured

Empty: no additional seats mounted.





Cavern

Liverpool

Number of concerts per year on main stage: 500. On both stages in the venue: 800

Founded: 1957/1984

Capacity: 350

Architect: David Backhouse

Acoustician: N/A

The Cavern Club in Liverpool is the cradle of British pop music. Impressively, so many years after its foundation, it survives and thrives as a contemporary music venue. Through those eventful decades—before, during, and after The Beatles' reign—the legendary cellar at 10 Mathew Street has seen its share of setbacks yet has played a role in each epoch of music. In fact, with the Marquee and CBGB out of business, the Cavern is maybe the best-known rock club today. The front stage located at the end of the central vault with the traditional archways on either side is used every day from the afternoon onwards for soloists and bands playing cover versions of Beatles music and covers of other standard guitar band music. Admission is free Monday to Wednesday and there is a small general admission charge after 8 pm Thursday to Sunday.

The Cavern was born in a warehouse basement built to service Liverpool's teeming nineteenth century waterfront. Hidden amid a warren of cobbled passages by the city's shopping and business districts, Mathew Street was a dingy crooked canyon unknown to anyone who didn't work in its gaunt storerooms or drink in its only cheerful corner, the tiny Grapes pub. That all changed in 1957 when a local promoter called Alan Sytner dreamed of emulating the Parisian Left Bank jazz clubs, those subterranean dives where femmes fatales and French philosophers met to escape the straight world upstairs. Merely to imagine such a place in mundane Liverpool was a romantic vision indeed, but Sytner's plan was a winner. On the Cavern's opening night, January 16th, 1957, 600 fans crammed inside to see The Merseysippi Jazz Band (like the Cavern, they're still going strong) and about 1,500 were left outside.

Although jazz was hot in the late 1950s, a new musical mood was gathering force across Britain, especially in Liverpool. Skiffle, the folk style with a rock'n'roll influence, played DIY-style on cheap guitars and domestic utensils, threw up hundreds of teenage acts including John Lennon's Quarrymen, who soon included Paul McCartney. They played the Cavern, as did Ringo Starr in a rival skiffle act. Under the club's new owner, Ray McFall, from 1959 the jazz identity of the Cavern began giving way to the musical revolution now brewing in the city. Beefing up their sound with imported US influences, the groups had evolved a distinctive Liverpool style that would soon be christened Merseybeat.

The Quarrymen evolved over a four-year period into the Beatles, of course, who became the Cavern's signature act and were talent-spotted here by Brian Epstein, the suave young businessman from a nearby record store. Alongside other

Cavern regulars, the Beatles led a Liverpoolian takeover of British pop in 1963. In turn they inspired the “British Invasion” of America itself, effecting a transformation of global pop culture that shapes the world we live in today.

The Beatles played the Cavern almost 300 times, including lunchtime sessions. Along with Hamburg, it’s unquestionably the place where their musical identity was forged and it was the nucleus of an early fan base that was to spread around the globe. The band themselves were always nostalgic about the Cavern. In the fractured final days they attempted, poignantly, to rediscover their lost solidarity as a tough young Liverpool combo. The tune “Get Back” was ostensibly inspired by spirit of the Cavern.

In the wake of the Beatle boom the Cavern became a prestige port of call for everyone from the Rolling Stones to Queen, who each played early gigs here. In truth it was a pretty basic kind of place, a disinfected dungeon. Descending the slimy steps from Mathew Street the visitor was plunged into an underworld whose air was a rancid fug of body odor, cigarette smoke, hamburger smells, and a little something from the toilets. But the venue’s triple tunnels gave an almighty acoustic boost to any rock band; in those early days of puny amplification, the Cavern sound was uniquely powerful and its atmosphere electrifying. In the early 1960s it was the most exciting shrine of the youth revolution.

But even at the height of its fame the Cavern was not a secure business. As Merseybeat passed from favor, so the Club’s iconic status waned (while the Council grew ever more alarmed at that infamous lack of sanitation). Still, its closure in 1966 came as such a shock that it quickly attracted new investors and was reopened by no less a personage than the prime minister of the day, Harold Wilson. Later years saw the Cavern adapt to modern customs with the introduction of alcohol and the addition of a disco room. Sadly, its historic standing didn’t stop the Council closing it in 1973 to allow for work on an underground railway line. The ancient warehouse was demolished and the cellar itself, rubble-filled, lingered like a sealed tomb until 1981.

Yet something in the Cavern’s spirit refused to die. A short-lived “New Cavern” opened across the street, was then renamed Eric’s, and spawned a whole new wave of Liverpool stars, from Elvis Costello to Frankie Goes To Hollywood. Meanwhile, Lennon’s murder in 1980 awoke the city of Liverpool from its apathetic indifference to the Beatle heritage. In 1984 the real Cavern site was reclaimed and an exact replica of the old Club was built in situ, using 15,000 bricks from the original cellar. This is the Cavern of today, proudly back at 10 Mathew Street, an authentic and evocative location that draws visitors and bands from across the world. Obviously it’s the ultimate place of pilgrimage for Beatle fans—and much less hazardous than a certain London pedestrian crossing—but it’s an important modern venue, too. In recent years the Cavern has hosted memorable shows by Arctic Monkeys, Travis, Embrace, K.T. Tunstall, and Liverpool’s own The Coral, to name only a few.

The most memorable show of all, though, was on the night of December 14th, 1999, when the Cavern marked the new millennium with a back-to-basics gig by

Paul McCartney. It goes without saying that the club was packed, but in fact a far wider audience watched as well, thanks to a pioneering webcast that broke new ground in a high-tech medium undreamt of in Paul's early Cavern days. The latterday club has a larger additional stage, as well as its faithful facsimile of the vintage model; it occupies over half of the original space, and the stage McCartney played upon is merely feet away from the site of those first Quarrymen appearances.

Nowadays Mathew Street is a prime tourist destination, lined with bars, shops, plaques, and statues. There is a long-held school of thought that holds it is a place of mystic energy, long-held, admittedly, by people who have spent entire afternoons in the Grapes or the Cavern pub. But close to the club's front door is a bust of Carl Gustav Jung inscribed with his assertion that "Liverpool is the Pool of Life," and many agree with him. Across the way, a life-sized bronze John Lennon lounges against the wall, kissed and photographed by a thousand strangers a day. Beneath his hooded gaze the music fans still troop into the Cavern's entrance for an experience they will never forget. Let these songs stand in tribute to a little hole in the ground that really changed our world.

Extract from Paul Du Noyer's book, "Liverpool: Wondrous Place" is published by Virgin Books.

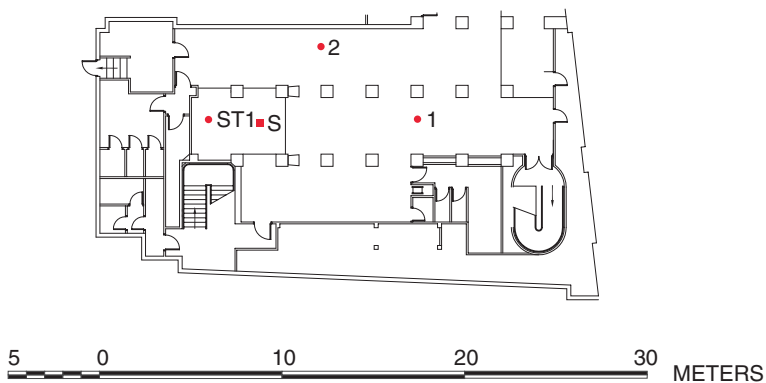
The other stage in the club (Cavern Live Lounge) is primarily used for ticketed shows featuring various tribute bands, established artists, and young contemporary band nights. There is seating for 170 people; alternatively the seating can be taken out for a standing audience of 350 people.



While the Cavern was still a jazzclub. Merseyside Jazzband late 1950s.



The Cavern was reconstructed after it had been demolished and closed down from 1973–1984 due to the construction of a subway. Near field speakers distributed in the ceiling.



Geometrical data	
Volume	600 m ³
$L \times W \times H$	21 × 11 × 2.7 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.09
EDT_{125-2k}	0.96
$C_{80,125-2k}$	4.01
BR ₆₃ versus 0.5–1k	1.06
BR ₁₂₅ versus 0.5–1k	1.13
<i>Stage area</i>	
EDT_{125-2k}	0.34
$D_{50,125-2k}$	0.86
BR ₆₃ versus 0.5–1k	1.3
BR ₁₂₅ versus 0.5–1k	1.23

Materials Used

Audience Area

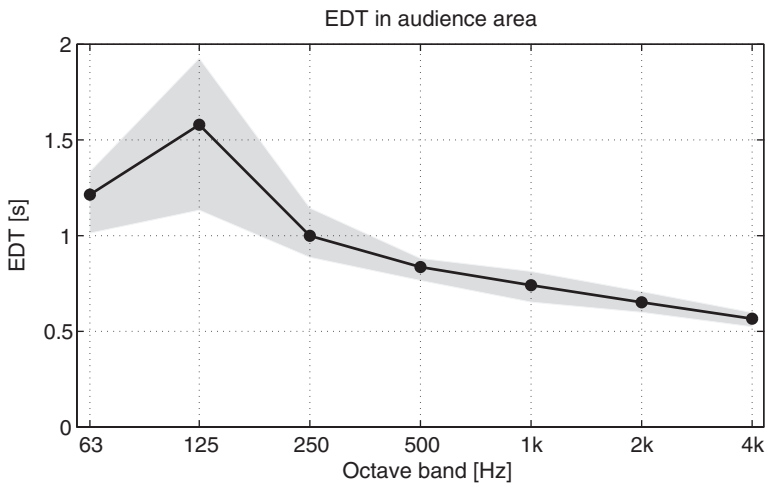
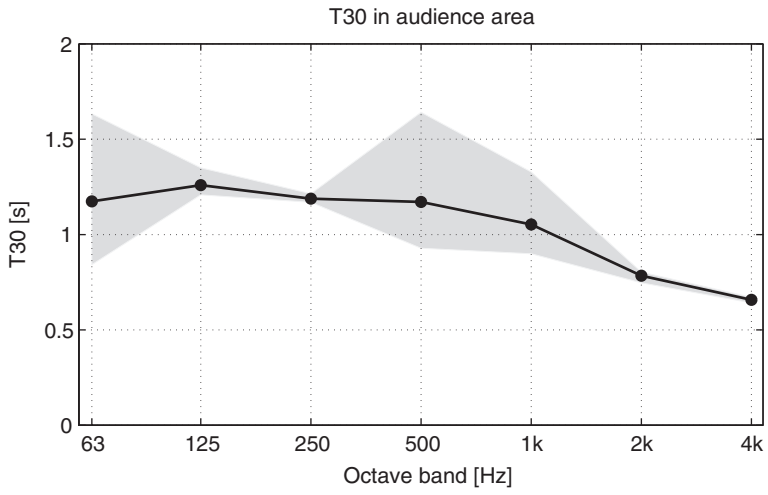
Floor: Concrete.
 Ceiling: Brick.
 Walls: Brick.

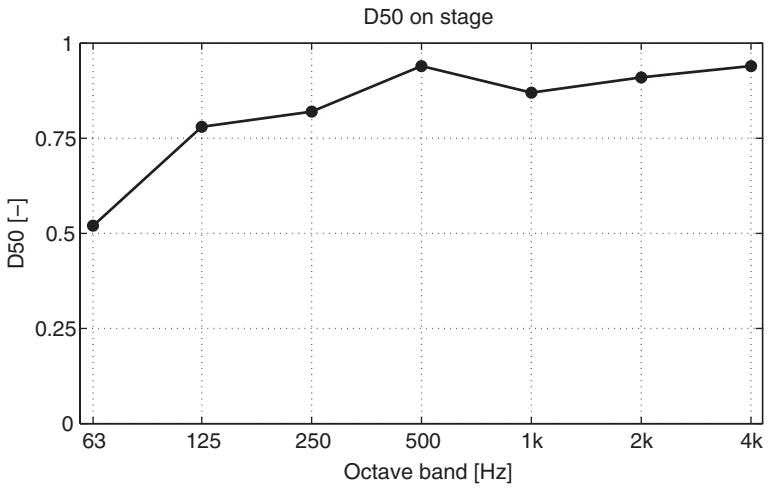
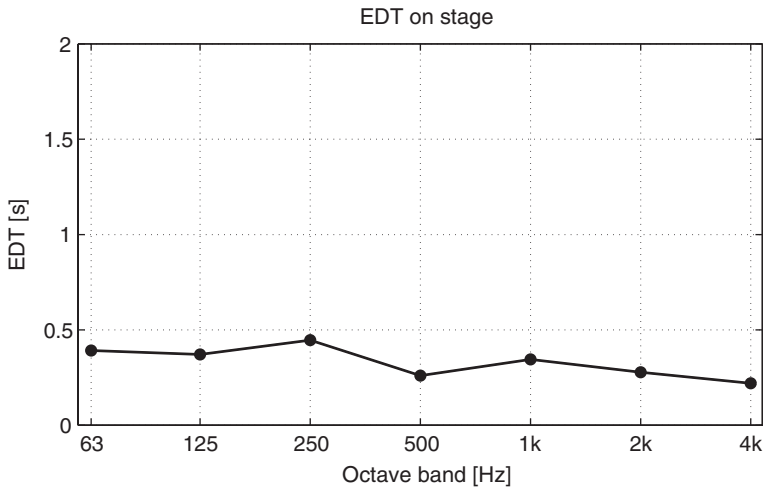
Stage Area

Same as audience area. Stage is made of wooden plates on hollow cavity.

State of Hall When Measured

Few people at tables; tables and chairs. No curtains at the time of the measurement.





La Coopérative de Mai

Clermont-Ferrand

Number of concerts per year: approximately. 55. In both halls in the venue: 125

Founded: 2000

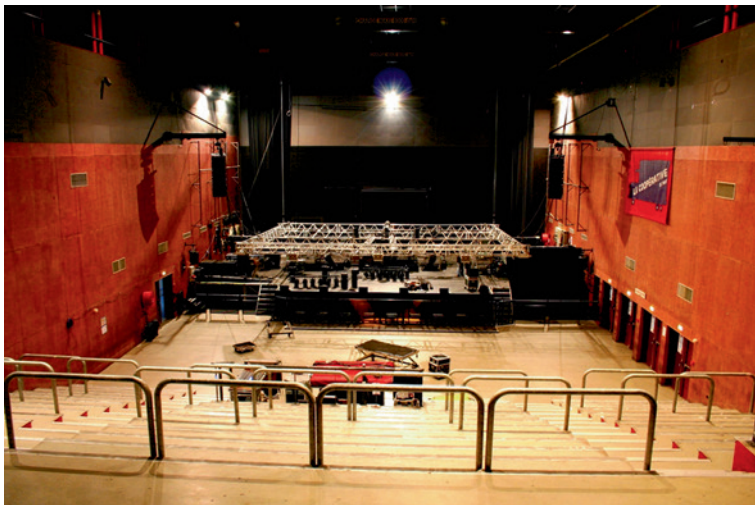
Capacity: 1,500 standing or 850 seated

Architects: P. Borderie, R. Kander, and J. M. Louviaux.

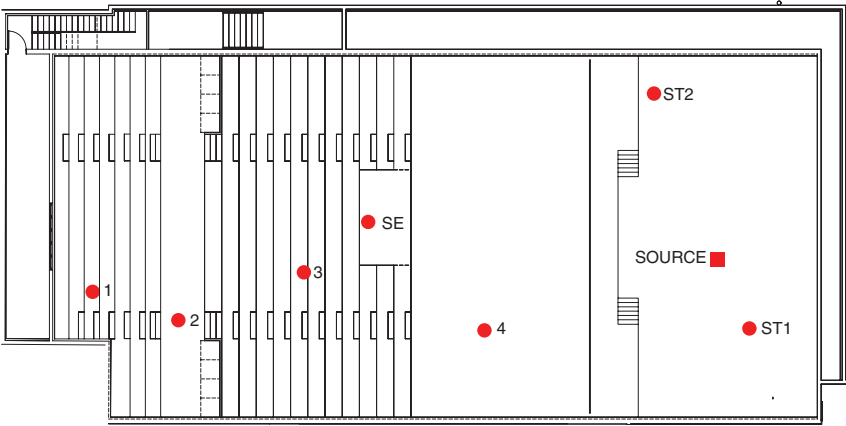
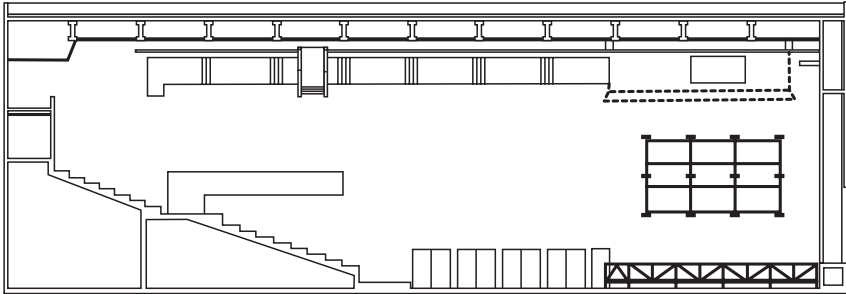
Acoustician: Emmanuel Giroflet, Thermibel.

La Coopérative de Mai is certainly the main rock venue not only of the city of Clermont-Ferrand but of the whole region of Auvergne. Over 11 years 1,500 concerts have entertained more than 1 million people in two halls. The total surface area of the building that also comprises many offices and so on is 3,000 m². Since the opening in 2000 the two stages within the venue had 1,500 concerts with more than 1 million spectators.

“La grande sale” has room for 800 seated or 1,500 standing people, 16 of which are reserved for disabled persons. The total surface area is 740 m² and has a modular stage of up to 210 m². The staircase construction ensures that everyone can find a spot with an excellent view of the stage. The smaller stage “La petite Coopé” holds 450 people.



The staircase design of the hall ensures that everyone can find a spot with perfect views.



Geometrical data	
Volume	9,000 m ³
$L \times W \times H$	40 × 19 × 13.4 m
Surface area of stage	210 m ²
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.09
EDT _{125-2k}	0.93
$C_{80,125-2k}$	4.43
BR ₆₃ versus 0.5-1k	1.8
BR ₁₂₅ versus 0.5-1k	1.27
<i>Stage area</i>	
EDT _{125-2k}	0.88
$D_{50,125-2k}$	0.77
BR ₆₃ versus 0.5-1k	0.92
BR ₁₂₅ versus 0.5-1k	1.13

Materials Used

Audience Area

Floor: Concrete with antislip treatment.

Ceiling: Suspended mineral wool.

Walls: 2-cm thick perforated panels with cavity behind. Panels in rear of the room not perforated.

Stage Area

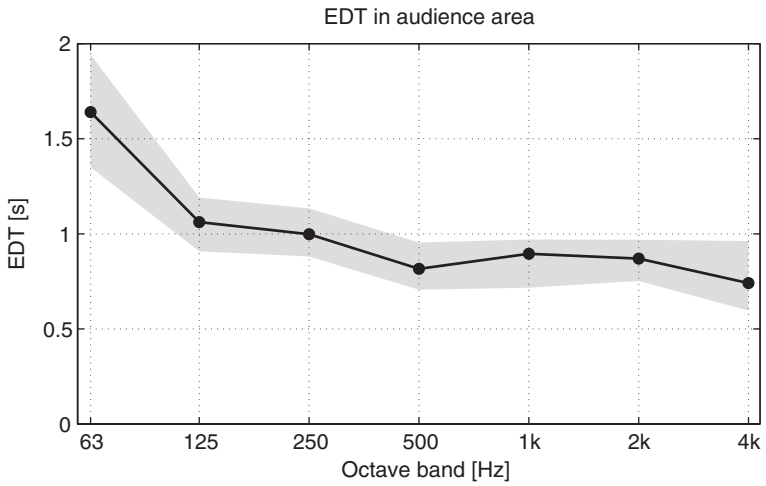
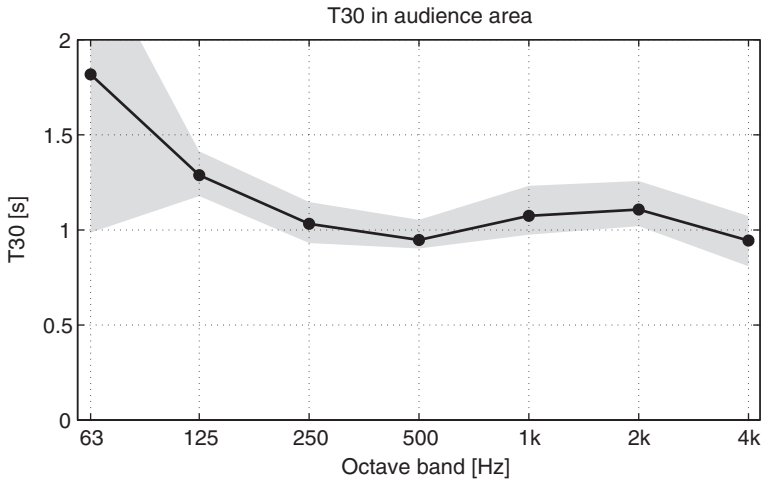
Floor: Light stage podiums.

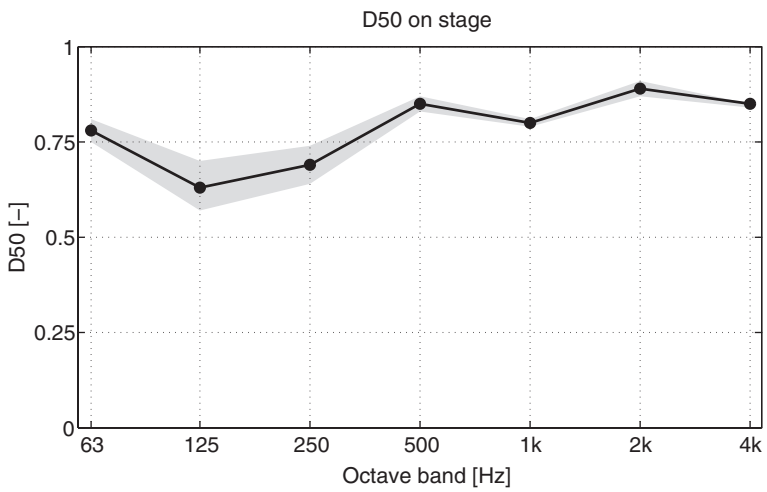
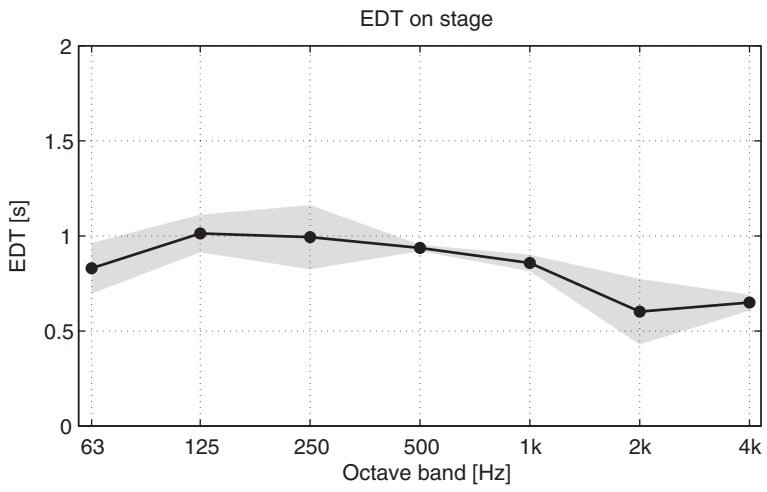
Ceiling: Suspended mineral wool.

Walls: Thin perforated metal plates with mineral wool behind direct on concrete.

State of Hall When Measured

Empty; light rigging equipment on stage floor.





Le Chabada

Angers

Number of concerts per year: 40. In both halls in the venue: 70

Founded: 1994

Capacity: 900

Architect: Architectes Ingenieurs Associes

Acoustician: Acoustique Pierre Poubeau

Le Chabada is a concert hall for popular music in Angers, Pays de la Loire, France. Since its creation in 1994, the venue has settled into an eclectic range of music genres including rap, electronic music, rock, world music, pop, reggae, and so on.

At the end of the 1980s, Angers was home to many musicians, associations, and concert promoters. Back then, the city had the reputation to be the French cradle of hardcore, popcore, grunge, and punk rock. With 63 bands and artists, Angers counted more music creators than any other French city with its most important ambassadors Les Thugs, Dirty Hands, Spécimen, and Lo'Jo Triban. In 1988 the organization, Association for the Development of Rock and Related Genres in Angers (ADRAMA) was created, uniting all "rock-associations" with the intention to start negotiating with the city council to create infrastructure for popular music.

In 1990, ADRAMA obtained the opening of 10 practice rooms for local bands and artists. Petitions and campaigns went on and finally the city council of Angers gave the go-ahead for the creation of a venue dedicated to contemporary music. Like other French cities, Angers had the benefit of the cultural dynamism of these years when Jack Lang was minister for education.

The venue opening was in September, 1994. Housed in the converted former slaughterhouse of Angers, Le Chabada covers over 1,500 m² and two floors. The two concert halls occupy the ground floor of the building. The main hall called "Grande Salle" has a capacity of 900 people including 150 fixed seats. The smaller concert hall called "Le club" has a capacity of 300 people and hosts less well-known, upcoming acts.

The city of Angers is owner of Le Chabada and delegates its administration to the nonprofit organization ADRAMA-Chabada.

Each year Le Chabada hosts about 70 concerts of various styles. Noted acts that have played at Le Chabada are: Vanessa Paradis, John Spencer Blues Explosion, Ghinzu, Soulfly, Les Thugs, Fugazi, Buzzcocks, The Ex, The Libertines, L7, Machine Head, dEUS, The Divine Comedy, Frank Black, Roots Manuva, Maceo Parker, Fred Wesley, The Herbaliser....Tindersticks, Noir Desir, The Kills, Femi Kuti, Seun Kuti, Nada Surf, Asian Dub Foundation, Toots and the Maytals, Tarwater, Les Nits, Bauchklang, Sofa Surfers, The Bellrays, Turin Brakes, Giant Train, Gus Gus, The Ex, Rory Gallagher, The Young Gods, Transglobal LKJ, The Descendents, Machine Head, L7, Buck 65, Frank Black, Sharon Jones and

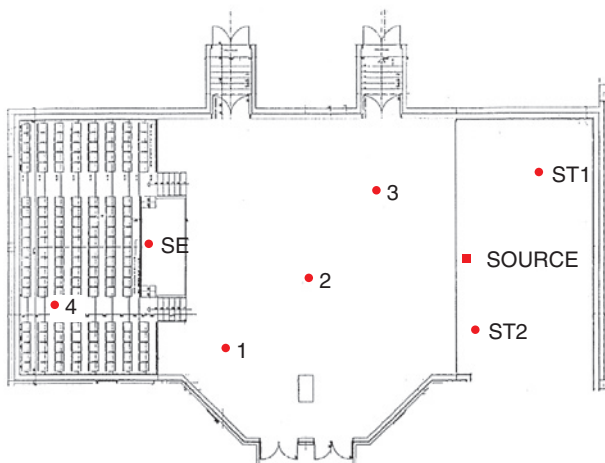
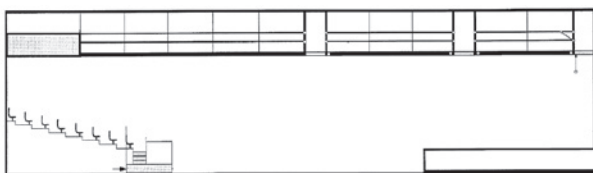
The Dap Kings, Vive la Fête, Roots Manuva, Antibalas Afrobeat Orchestra, Saul Williams, WhoMadeWho, Gojira, John Butler Trio, The Young Good Brass Band, Scott H Biram, Archie Bronson Outfit, and Liars, among others.



Minutes before the French pop act Cocoon enters the stage. Photo © Jordane Chaillou.



The hall holds 900 audiences; here approximately 150 seated. Photo © Jordane Chaillou.



METERS

Geometrical data	
Volume	2,800 m ³
$L \times W \times H$	27 × 13.5 × 7.5 m
Surface area of stage	270 m ²
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.94
EDT _{125-2k}	0.86
$C_{80,125-2k}$	3.49
BR ₆₃ versus 0.5-1k	1.54
BR ₁₂₅ versus 0.5-1k	1.21
<i>Stage area</i>	
EDT _{125-2k}	0.47
$D_{50,125-2k}$	0.85
BR ₆₃ versus 0.5-1k	3.49
BR ₁₂₅ versus 0.5-1k	2.04

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Suspended mineral wool.

Walls: Wooden panels mounted in a zig-zag configuration. Every second panel is perforated.

Stage Area

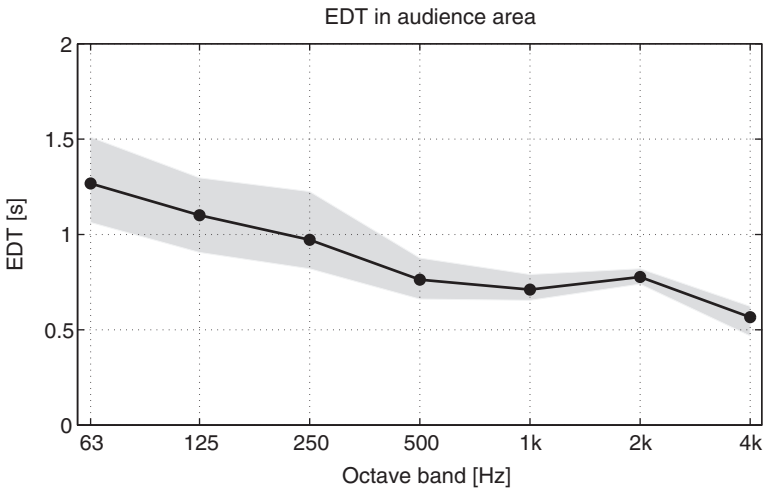
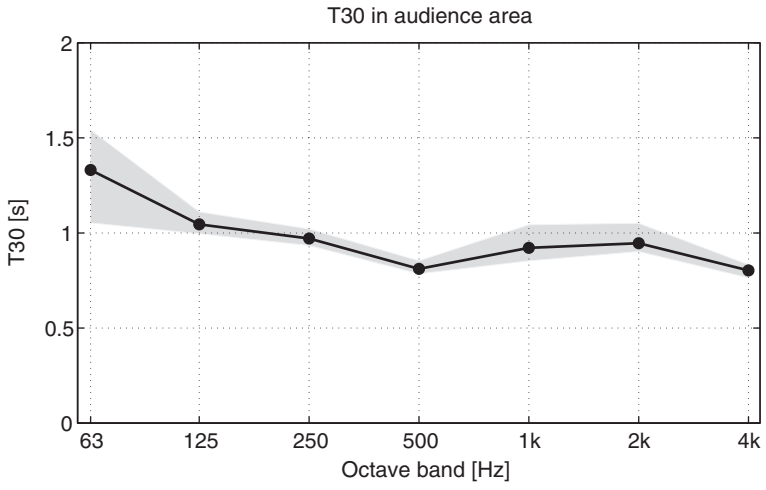
Floor: Wood on cavity on concrete.

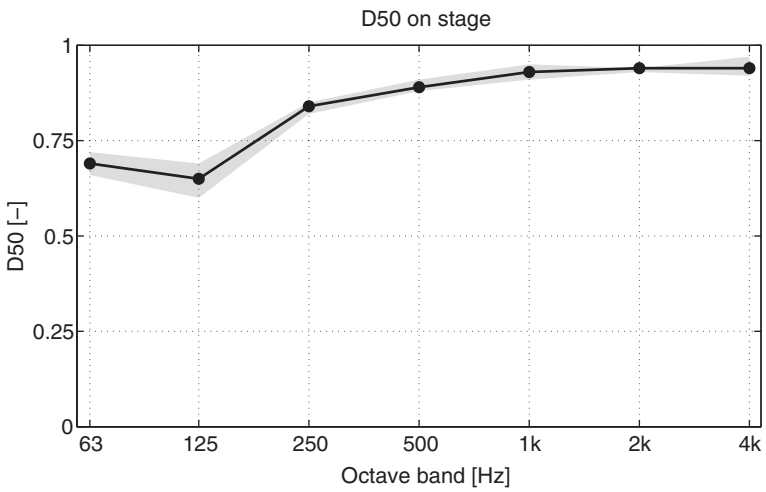
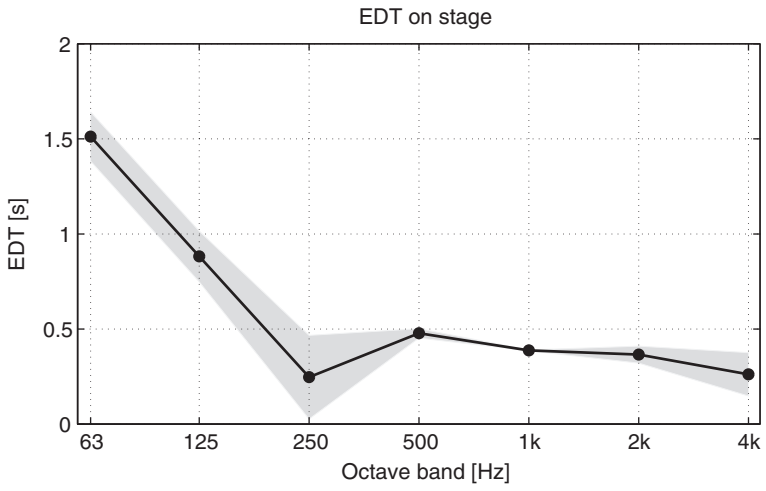
Ceiling: Suspended mineral wool.

Walls: Wood wool panels direct on concrete.

State of Hall When Measured

Empty; four smaller curtains on stage.





Cirkus

Stockholm

Number of concerts per year: 60–80

Total amount of events including concerts and musicals: 250–275

Built: 1892, refurbished in 1990 and 1997

Capacity: up to 1,800

Architect: Ernst Hägglund

The more than 115-years-old, Cirkus is situated at The Royal Djurgården, close to the very center of Stockholm and yet in a location with a feeling of being in the countryside. The exterior as well as the interior has been fully refurbished in the original design as the building has been declared a historical monument. The building has a very special charm enabling it to embrace very different events although the venue has become most known for housing the great musicals of former ABBA members Benny Andersson och Björn Ulvaeus. The musical Chess entertained over a half million people here in 2002–2003 and Mamma Mia was seen by more than 800,000 people in the years 2005–2007.

There is room in the arena for 1,800 persons, with 1,644 seats giving a feel of intimacy and closeness due to the round shape and the warm colors, brick red and forest green.

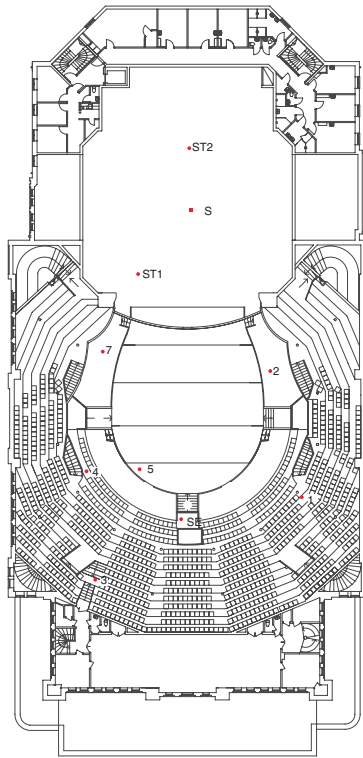
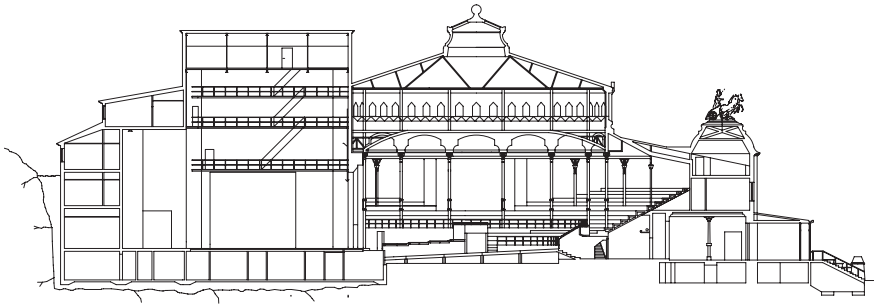
The stage is large: 27 m deep and 14 m wide. The arena is very easy to change. The seating stalls are vertically adjustable, the whole floor or just some sections. The floor can be sloping or flat and the chairs can be removed. The floor can also be changed to different platforms with help of hydraulics and show the entertainment on different levels. The Cirkus restaurant has a feeling of a Wienercafé. The kitchen has a big capacity, quantity and quality; a buffet can be arranged for a full arena.



From the stage performers enjoy a sensation of direct contact with even the most remote members of the audience.



The combination of a traditional nineteenth-century seating space with completely up-to-date stage facilities makes Cirkus a sought after venue especially for musicals.



Geometrical data	
Volume	10,000 m ³ + stage volume
$L \times W \times H$	36 × 36 × 7–13
Surface area of stage	375 m ²
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.27
EDT _{125-2k}	1.18
$C_{80,125-2k}$	3.32
BR ₆₃ versus 0.5-1k	1.29
BR ₁₂₅ versus 0.5-1k	1.11
<i>Stage area</i>	
EDT _{125-2k}	0.88
$D_{50,125-2k}$	0.81
BR ₆₃ versus 0.5-1k	1.23
BR ₁₂₅ versus 0.5-1k	0.67

Materials Used

Audience Area

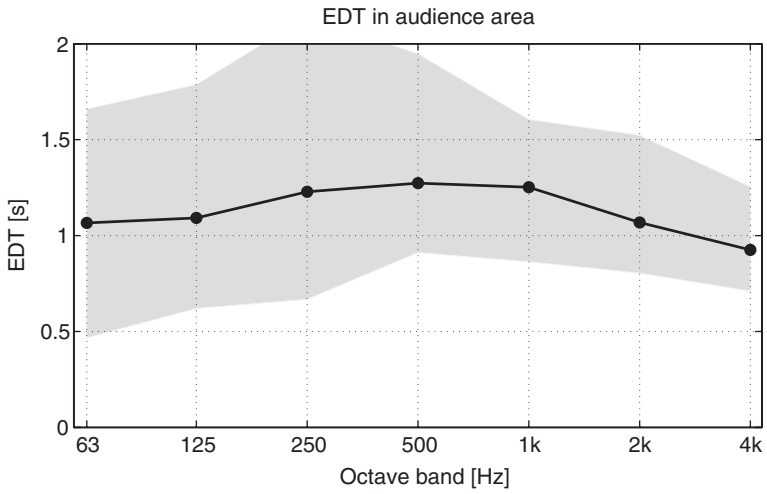
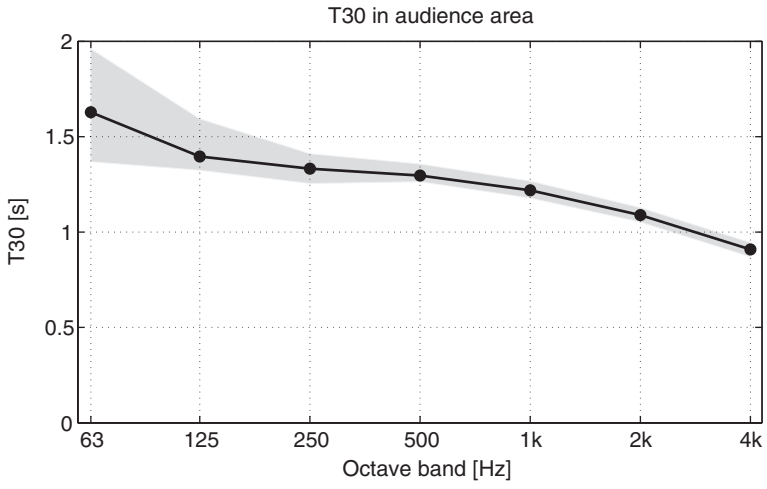
Floor: Hydraulic seating platforms. Stationary platforms constructed of plates on cavity. Upholstered chairs.

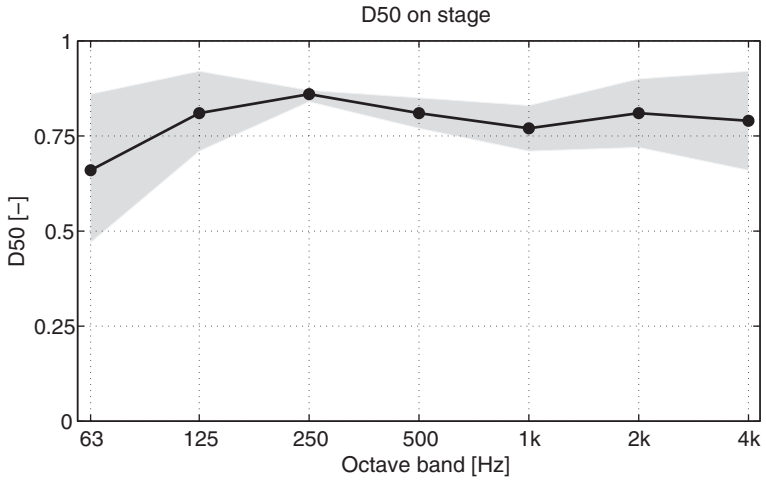
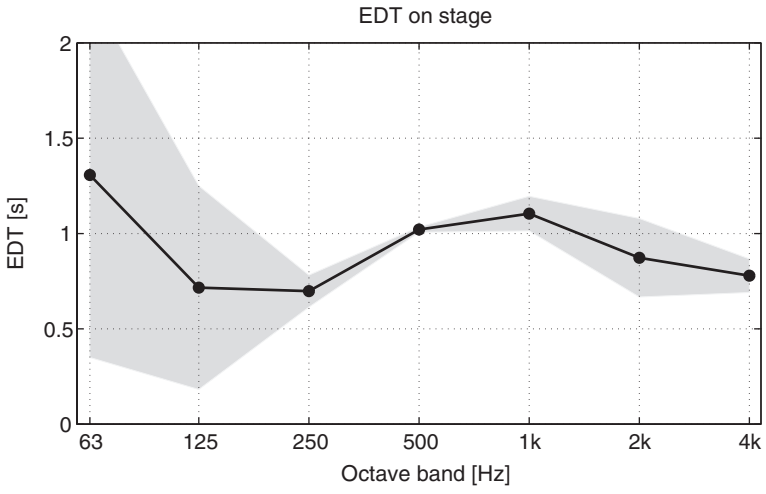
Ceiling: Probably plaster on lightweight construction on very large cavity.

Walls: Wood on cavity; gypsum board on cavity, gypsum board on brick.

State of Hall When Measured

All additional seats mounted. Shown in photos.





Le Confort Moderne

Poitiers

Number of concerts per year: 60

Founded: 1985

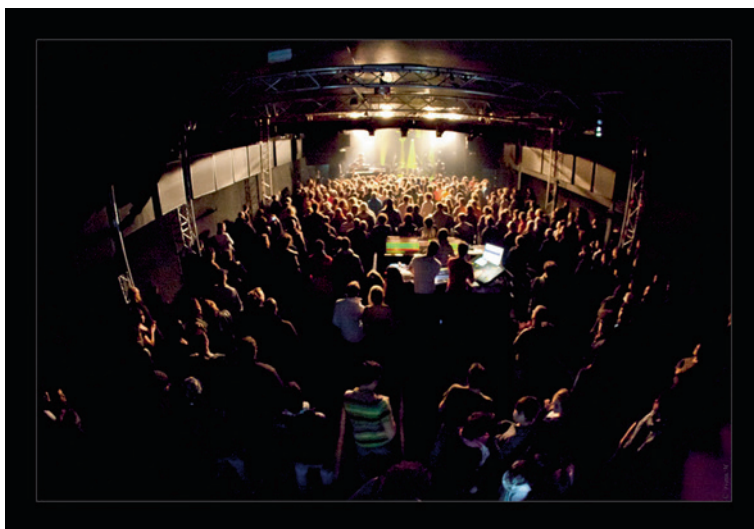
Capacity: 700

Architect: N/A

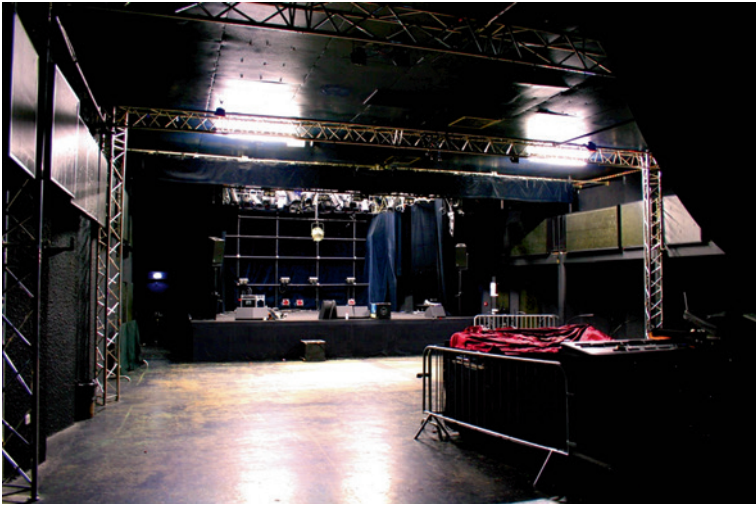
Acoustician: N/A

In 1979 the Poitiers-based organization L'Œil écoute was renamed l'Oreille est Hardie and arranged 200 concerts up until 1984 all over Poitiers: auditorium Sainte Croix, Amphi Descartes, Théâtre de Poitiers (with, for instance, Glenn Branca, The Residents), Place d'Armes (first-ever concert with Sonic Youth in Europe).

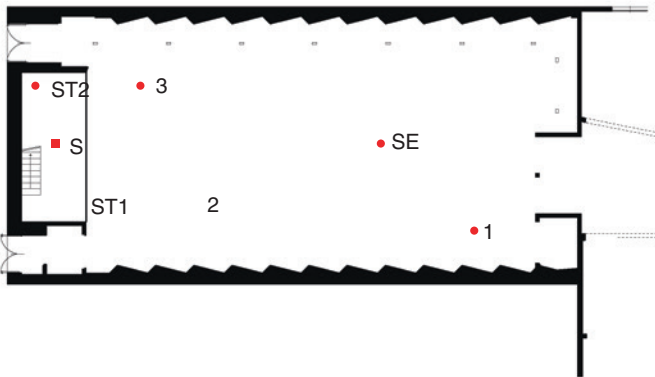
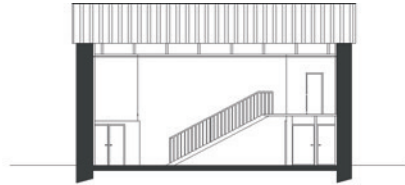
In 1985 a building to house the concerts was found. Francis Falceto, Fazette Bordage, Yerrick Benoist, and Philippe Auvin were responsible for bringing the project forward by renting the old factory building Confort 2000 for creative purposes. In 1988 the city of Poitiers bought the building and made way together with l'Oreille est Hardie for the venue as it stands today.



“High Tone” at Confort Moderne, photo: Yvain Michaud.



Confort Moderne in Poitiers has brought many cult punk acts to France.



Geometrical data	
Volume	1,400 m ³
$L \times W \times H$	25 × 12 × 4.8 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.72
EDT_{125-2k}	0.67
$C_{80,125-2k}$	6.63
BR ₆₃ versus 0.5–1k	1.99
BR ₁₂₅ versus 0.5–1k	1.8
<i>Stage area</i>	
EDT_{125-2k}	0.29
$D_{50,125-2k}$	0.91
BR ₆₃ versus 0.5–1k	1.64
BR ₁₂₅ versus 0.5–1k	1.71

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Perforated thin plate on cavity.

Walls: Zig-Zag walls of concrete with unsmooth surface. 10-cm thick porous baffles hanging down alongside the upper part of walls at a distance. Rear wall: plate on cavity.

Stage Area

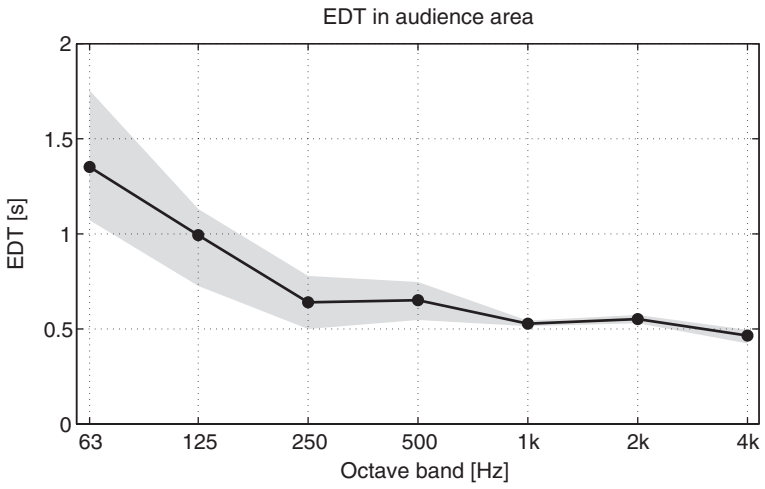
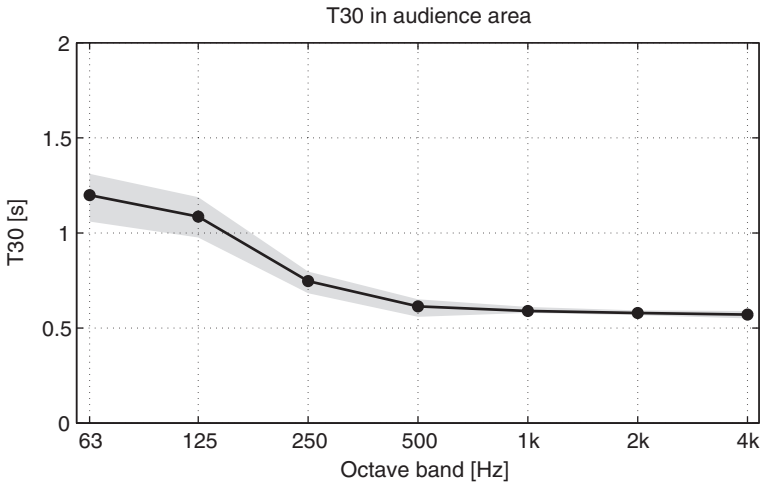
Floor: Vinyl on wood direct on concrete.

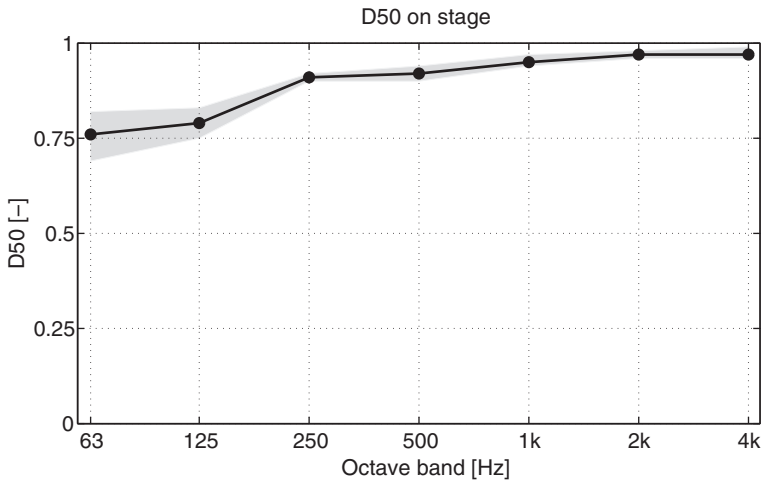
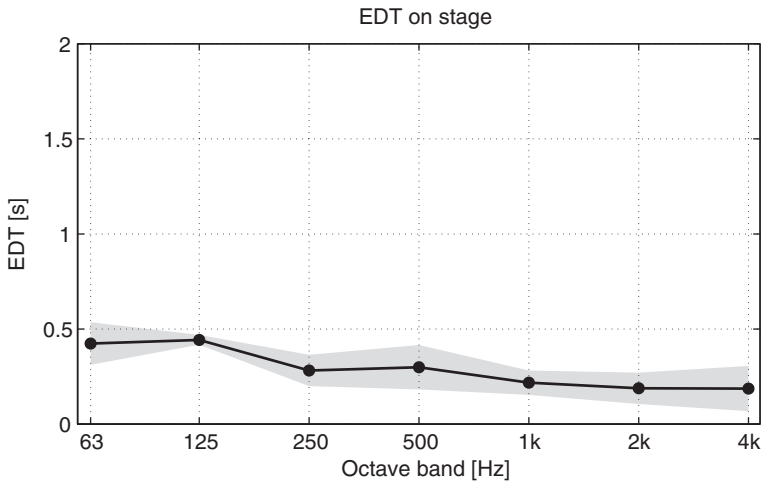
Ceiling: Perforated thin plate on cavity.

Walls: Curtain 1½ m from back and side walls.

State of Hall When Measured

Empty; no additional seats mounted.





Debaser Medis

Stockholm

Number of concerts per year: N/A

Founded: N/A

Capacity: 850 standing + 100 seated

Architect: N/A

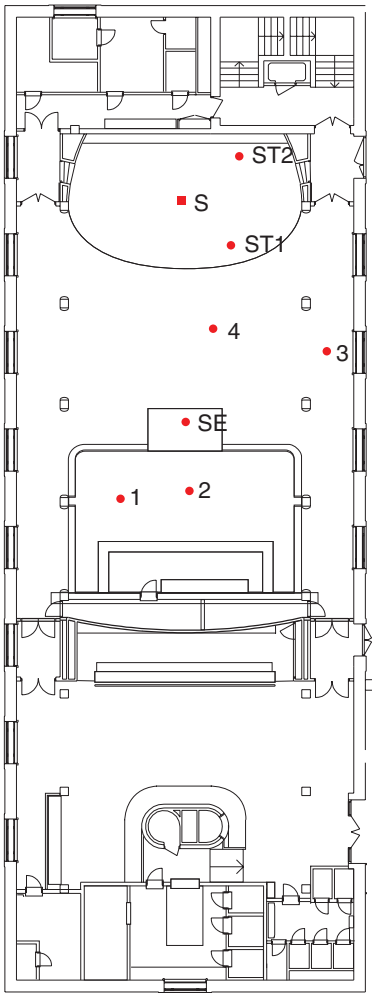
Acoustician: N/A



Choosing a diffusive instead of absorptive rear wall also at low frequencies is a possibility if the distance from the stage and PA system is not very big. The diffusers should be constructed to absorb some sound energy in the 125-Hz octave band. Singers and guitarists especially like to get something in return for their efforts.



The cavity under the stage seems to be used for a huge Helmholtz resonator that may absorb some low-frequency sound. A porous absorber may also work and priority must be given to isolating the stage from the subspeakers often placed beneath. The open area underneath the stage is too little to create any impact on the total acoustics of the room.



Geometrical data	
Volume	2,400 m ³
$L \times W \times H$	23 × 16 × 7.3 m
Surface area of stage	50 m ²
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.73
EDT _{125-2k}	0.75
$C_{80,125-2k}$	4.76
BR ₆₃ versus 0.5-1k	1.44
BR ₁₂₅ versus 0.5-1k	1.35
<i>Stage area</i>	
EDT _{125-2k}	0.53
$D_{50,125-2k}$	0.82
BR ₆₃ versus 0.5-1k	1.25
BR ₁₂₅ versus 0.5-1k	1.18

Materials Used

Audience Area

Floor: Vinyl on wood on cavity.

Ceiling: Suspended mineral wool plus mineral wool baffles.

Walls: Upper part of walls are concrete with 50-mm mineral wool products on some areas. Lower part is curtains in front of sound-insulating glazing mounted some 30 cm in front of the windows. The rear wall opposite the stage is diffusive with app 50 × 50 cm squares of varying depth.

Stage Area

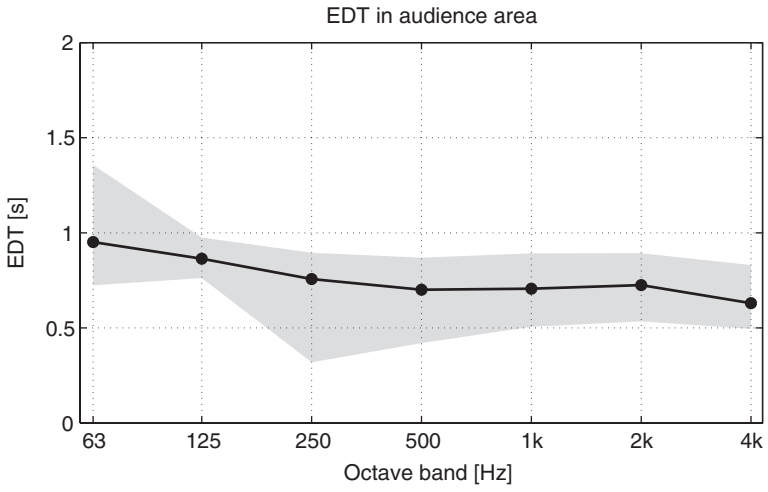
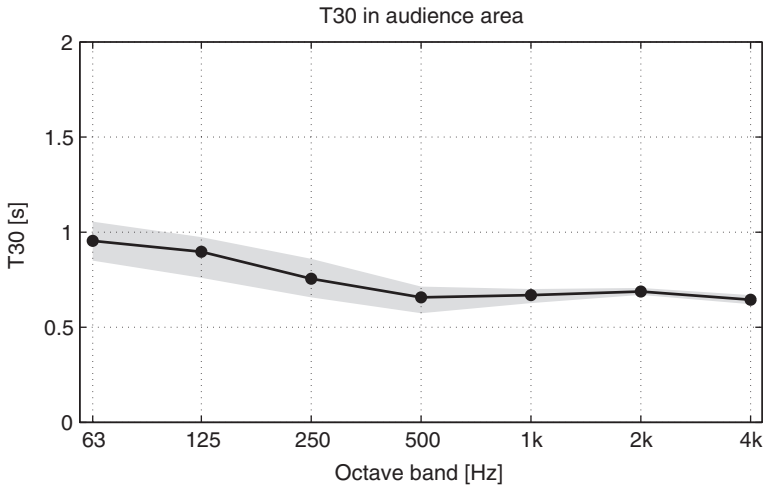
Floor: Vinyl on wood direct on concrete. Underneath the stage is a custom-built Helmholtz horn absorber.

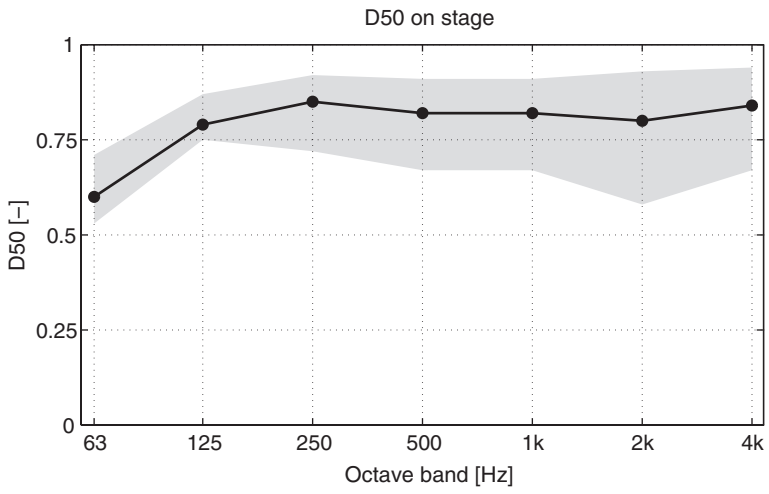
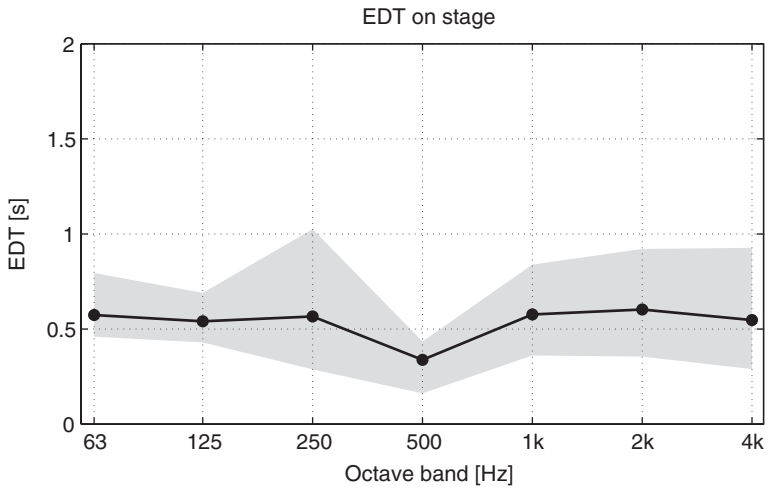
Ceiling: Suspended mineral wool plus mineral wool baffles.

Walls: No walls at the side of the stage.

State of Hall When Measured

Empty; no additional seats mounted.





Elysée Montmartre

Paris

Founded: 1989

Capacity: 1,200

Number of concerts per year: Approximately 120

Architect: N/A

Acoustician: N/A

Owner: Garance Productions

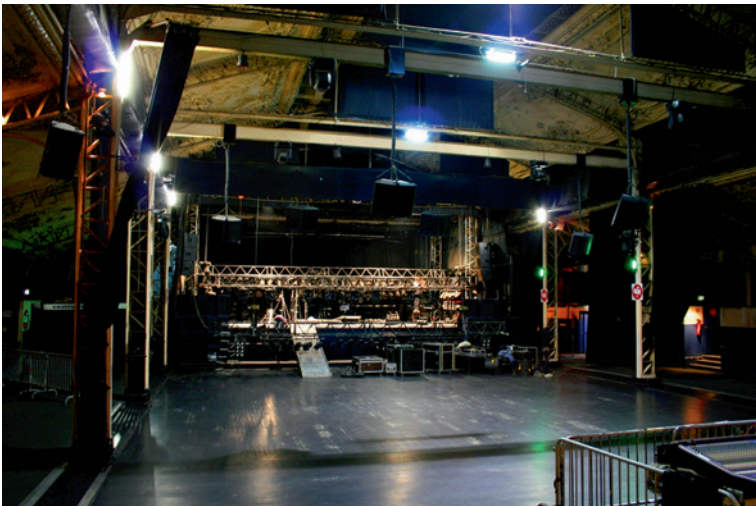
Opened in 1807, the Élysée Montmartre was a dance hall. There they showcased a new dance style: the *quadrille naturaliste* (the naturalist quadrille), or cancan, especially as performed by Valentin le Désossé and Grille d'Égout. The establishment was then composed of three buildings and a large garden. Émile Zola described its façade in his novel (and subsequent drama), *L'Assommoir*. Joseph Oller and Charles Zidler, having heard of the success of the quadrilles at the Élysée Montmartre and who wished to bring in a new audience, high society, for this kind of entertainment, engaged a great number of artists from the Élysée Montmartre for the opening in October 1889 of their new establishment, the Moulin Rouge. Zidler was especially taken with La Goulue, who became one of the most celebrated cabaret dancers. The Élysée Montmartre was also a source of inspiration for painters and artists of the Butte (Toulouse-Lautrec painted numerous posters there). The hall served as the decor for de Maupassant's *Masque* and held the 100th performance of Émile Zola's *L'Assommoir* in 1879. Costume balls such as the Bal des Quat'z'Arts (Four Arts Ball) were also held there. Following this, the musical programming of the Élysée Montmartre was diversified and developed.

In the nineteenth century the hall was the site of some of the foremost revolutionary clubs (places where discussions by Utopians and “angry young people” remade the world). In 1894, the garden was torn up to make room for the Trianon-Concert. In 1897, the Élysée-Montmartre was redone by its new owner: a separate café–concert hall. On one side, all the singing, the revues, and other poets and songwriters, and on the other side, dancing and skating. To make this happen, the architect, Édouard Niermans, reused the Pavillon de France structure built by Gustave Eiffel for the *Exposition universelle* (World's Fair) of 1889 [2]. After a fire in 1900, the hall was remodeled with modernistic decorations and a rococo decor.

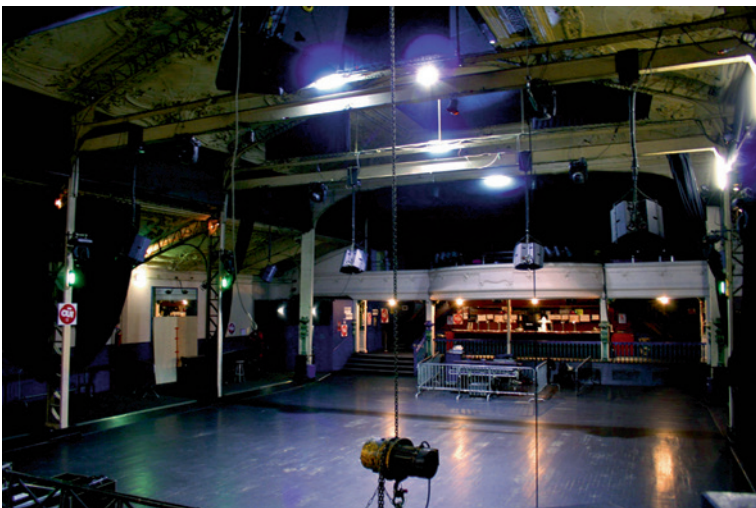
The Élysée Montmartre held, at the end of 1949, boxing and wrestling matches, and then striptease acts. In 1968, Jean-Louis Barrault mounted *Rabelais* there, a play based on the music of Michel Polnareff. The setting was in a ring. The following year, *Jarry sur la butte* was presented with the music of Michel Legrand. In 1971, Philippe Khorsand put on the play, *O Calcutta*, which was on the bill until 1975.

Artists such as Jacques Higelin, Patti Smith, Diane Dufresne, and Alain Souchon played concerts there starting in 1976, in addition to many heavy metal groups. In 1983, there was an operetta by Francis Lopez with Georges Guétary.

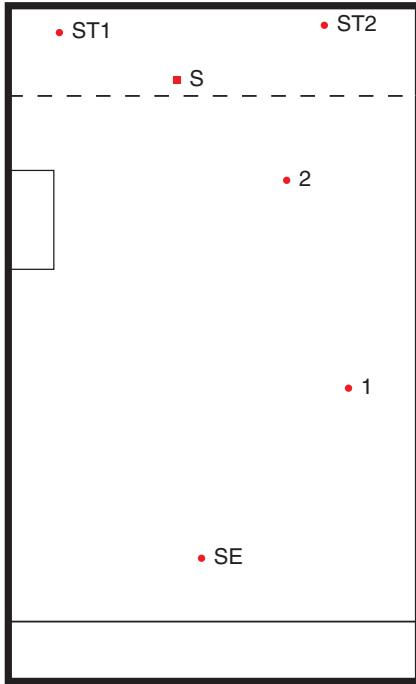
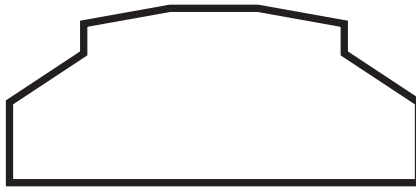
In 1989, the hall began a new era with the new owners, Garance Productions. They presented rock and reggae concerts, among others. Since 1995, the program has consisted of 15 days of *Le Bal de l'Élysée-Montmartre* enlivened by the GOLEM (Grand Orchestre de L'Élysée Montmartre), thus returning the hall to its first calling.



Beautiful nineteenth-century stucco is apparent in the ceiling.



Numerous delay speakers may lead to a near-field listening experience lacking envelopment and liveliness. But on the other hand, the total sound power in the hall is a sum of the contribution from each loudspeaker.



Geometrical data	
Volume	6,000 m ³
$L \times W \times H$	$37 \times 23 \times 4.4-9.6$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.97
EDT_{125-2k}	0.91
$C_{80,125-2k}$	4.02
BR ₆₃ versus 0.5-1k	1.13
BR ₁₂₅ versus 0.5-1k	1.34
<i>Stage area</i>	
EDT_{125-2k}	0.37
$D_{50,125-2k}$	0.89
BR ₆₃ versus 0.5-1k	2.52
BR ₁₂₅ versus 0.5-1k	1.84

Materials Used

Audience Area

Floor: Wood on joists.

Ceiling: Masonry, stucco.

Walls: Masonry, 30 % covered with drapes. Some pillars covered with drapes.

Stage Area

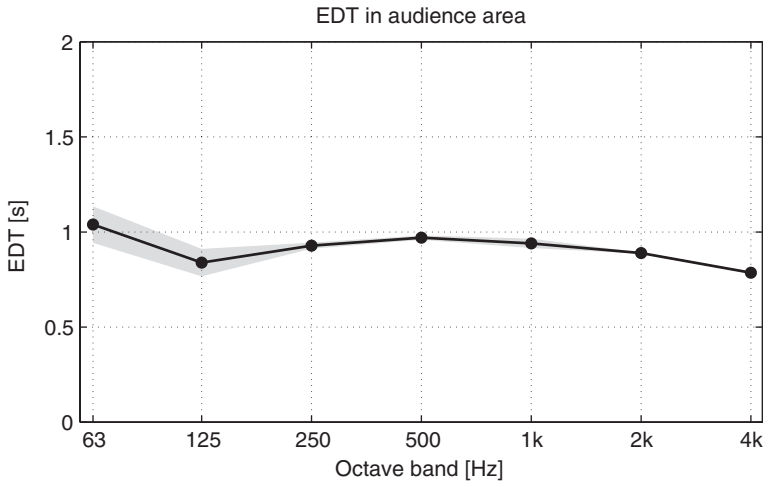
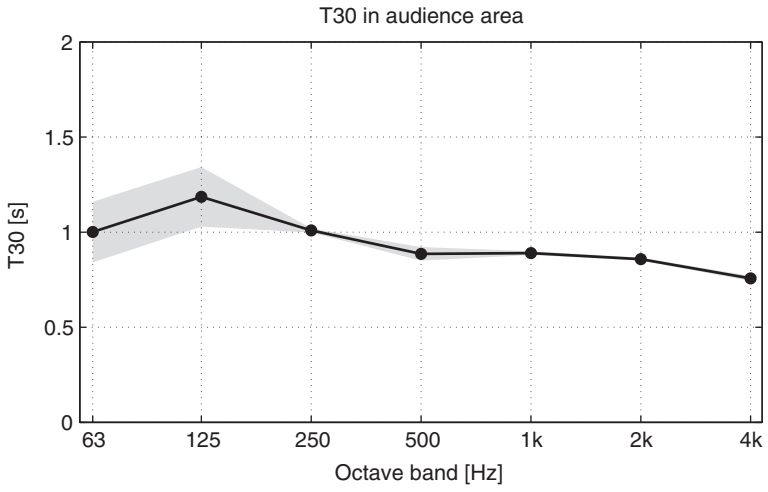
Floor: Wood on joists.

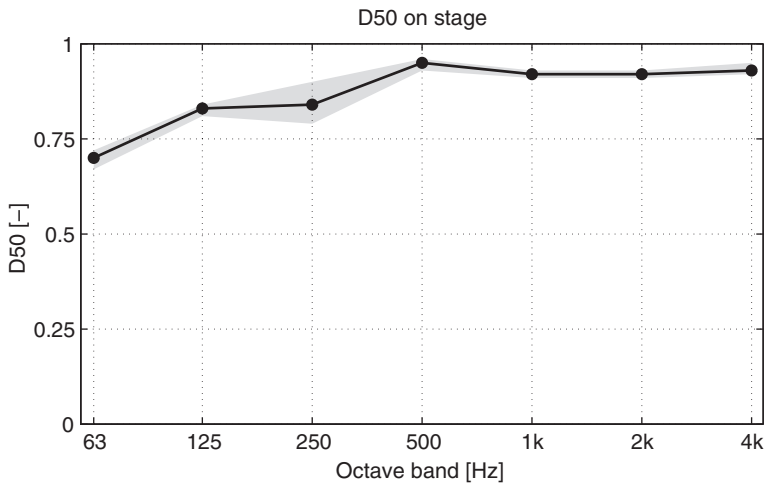
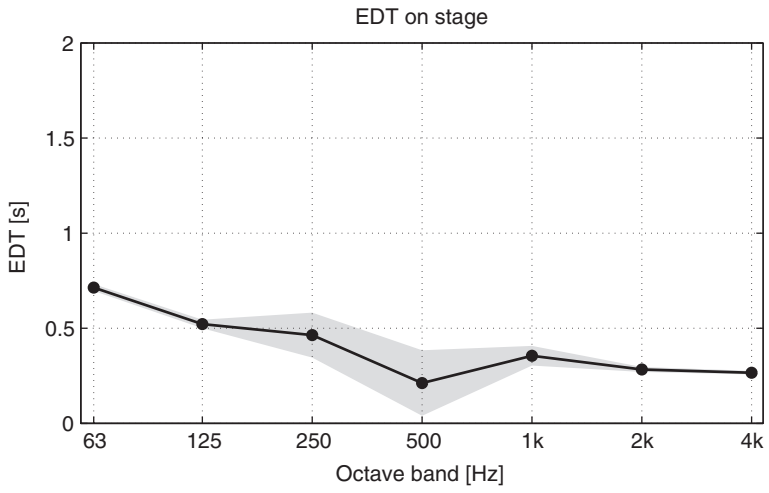
Ceiling: Masonry.

Walls: Backdrop, bare concrete walls on side at the time of the measurement.

State of Hall When Measured

Empty; lots of lighting equipment on stage.





Festhalle

Frankfurt

Number of nonclassical music concerts per year: N/A

Founded: 1909

Capacity: 13,500 without chairs

Architect: Friedrich von Thiersch

Acoustician: N/A

Owner: Stadt Frankfurt (40 %)/Land Hessen (60 %)

On May 19th 2009, it was exactly 100 years since Frankfurt's Festhalle welcomed its very first guests. From rock concerts, operas, sporting events, and circus performances to international conventions, trade fairs, AGMs, and gala balls, the Festhalle is versatility itself, housing all kinds of events with practiced ease.

With the opening of the Festhalle a hundred years ago, the city of Frankfurt finally boasted a suitable venue for hosting large-scale exhibitions and events, signaling an end to expensive makeshift solutions. At the same time, it marked the beginning of a long tradition of outstanding events of all kinds.

When Kaiser Wilhelm II made it known in Summer 1905 that he would be willing to have the traditional singing contest transferred permanently to Frankfurt as well as having the Eleventh German Gymnastics Festival held there three years later, the municipal authorities lost no time in taking action. At a meeting of town councillors, funds were allocated for a general architectural competition. The invitation to tender was issued in April 1906 and was won just one year later by Friedrich von Thiersch, who designed a 6,000 m², daylight-flooded hall, suitable for playing host to all manner of exhibitions, musical performances, and other events.

Construction work began on June 11th, 1907 and was supervised directly by the Frankfurt City Council. Responsibility for marketing and operating the hall was given to "Ausstellungs- und Festhallen-Gesellschaft", known today as Messe Frankfurt. Exactly 13 months later, the still-unplastered Festhalle hosted the opening ceremony for the Eleventh International German Gymnastics Festival. When the gymnasts had returned home, the construction was completed and officially opened on schedule.

Even at the ripe old age of 100, the "grand old lady" of event halls is still going strong. After all, nothing is too outlandish or too extravagant for the Festhalle.

From rock concerts, operas, sporting events and circus performances to international conventions, trade fairs, AGMs and gala balls, the Festhalle is versatility itself, housing all kinds of events with practised ease.

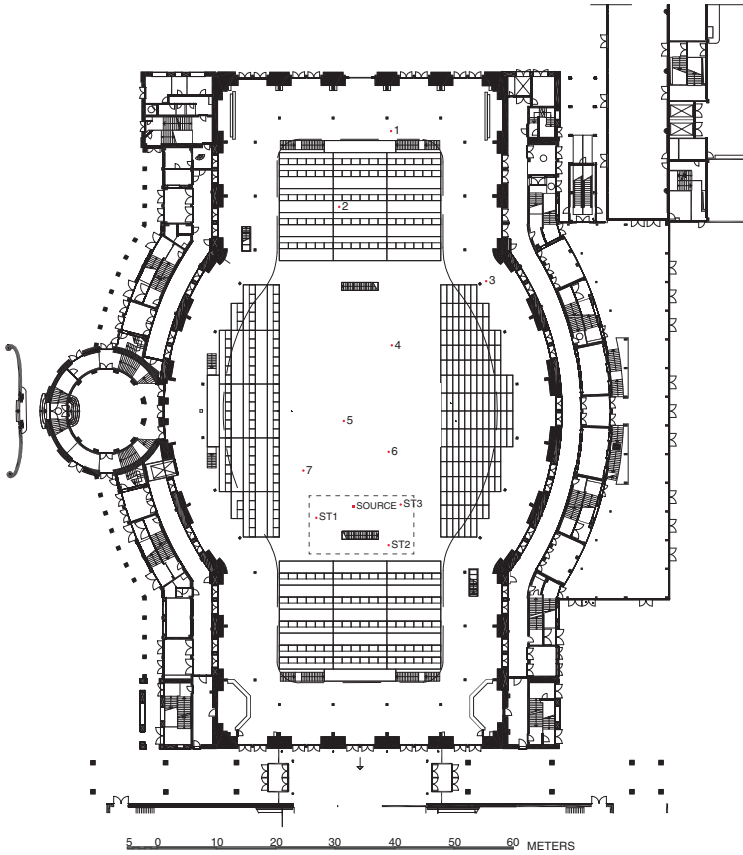
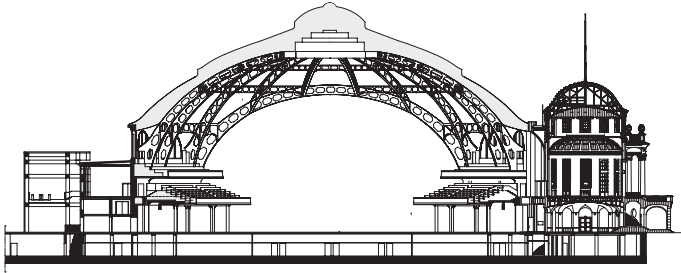
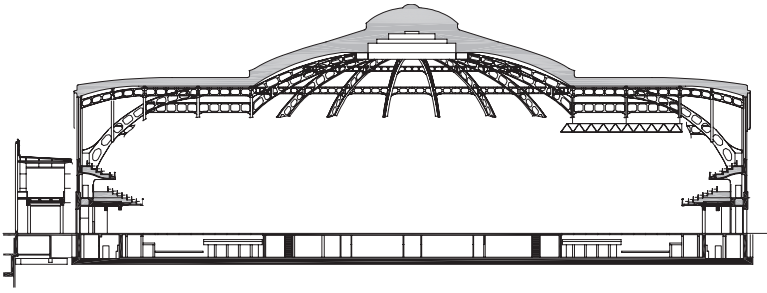
Uwe Behm, a member of the Messe Frankfurt Board of Management, sums up the unique role of the Festhalle: "As the historical core of our exhibition grounds, it is an integral part of the company's success story. We are delighted to be able to use the Festhalle for all kinds of events. The building combines event expertise, glamour and historical ambience—which is what gives it its own special atmosphere."



Visually, certainly the most spectacular of all visited venues. One's senses are sharpened.



Hard surfaces ensured the unamplified sound of the early twentieth century to be carried over the vast distances inside the hall.



Geometrical data	
Volume	110,000 m ³
$L \times W \times H_{(\max)}$	109 × 64 × 29 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	4.15
EDT_{125-2k}	4.28
$C_{80,125-2k}$	-4.06
BR ₆₃ versus 0.5-1k	0.74
BR ₁₂₅ versus 0.5-1k	0.91
<i>Stage area</i>	
EDT_{125-2k}	2.97
$D_{50,125-2k}$	0.44
BR ₆₃ versus 0.5-1k	0.6
BR ₁₂₅ versus 0.5-1k	0.74

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Masonry. Glazing in dome.

Walls: Masonry on concrete.

Stage Area

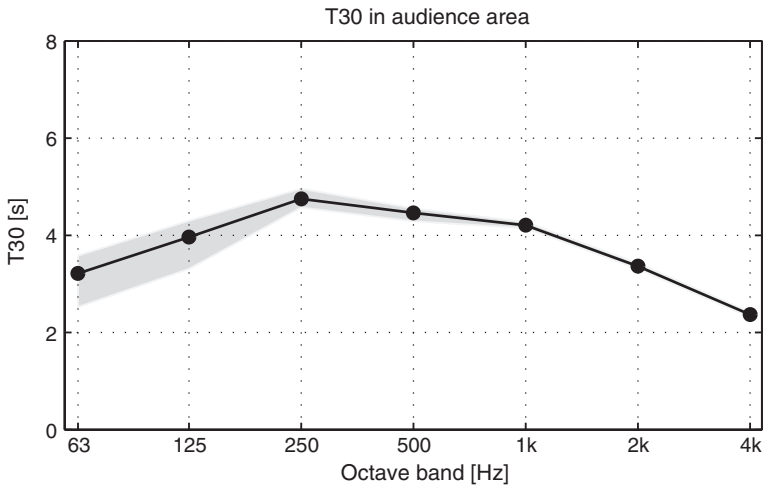
No stage.

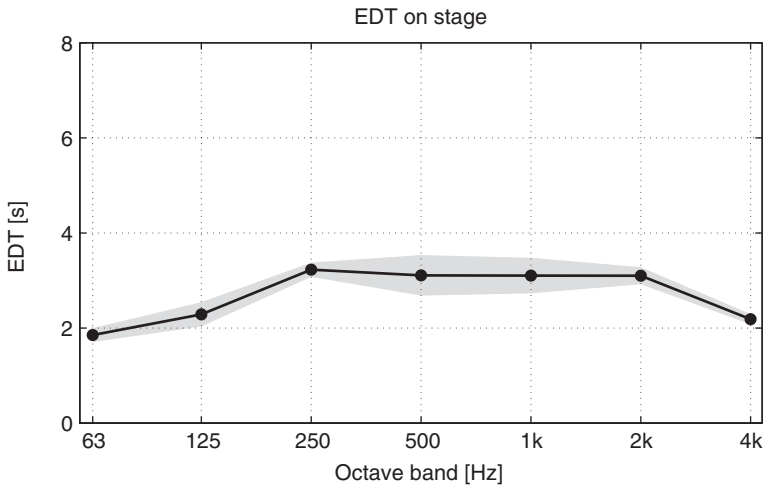
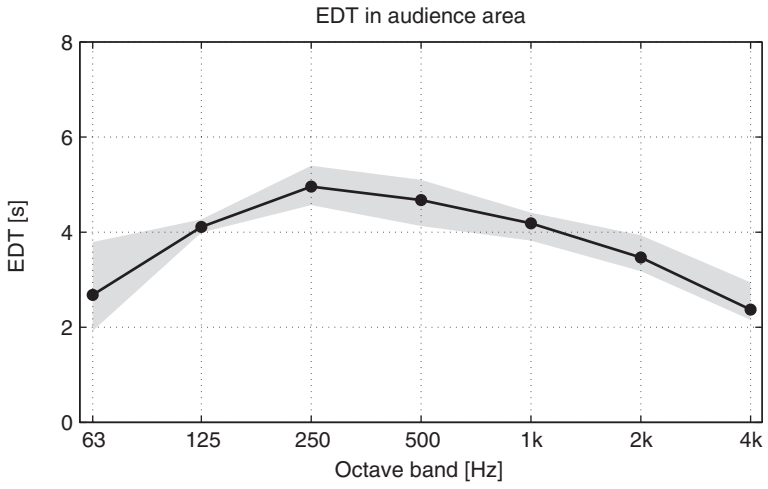
State of Hall When Measured

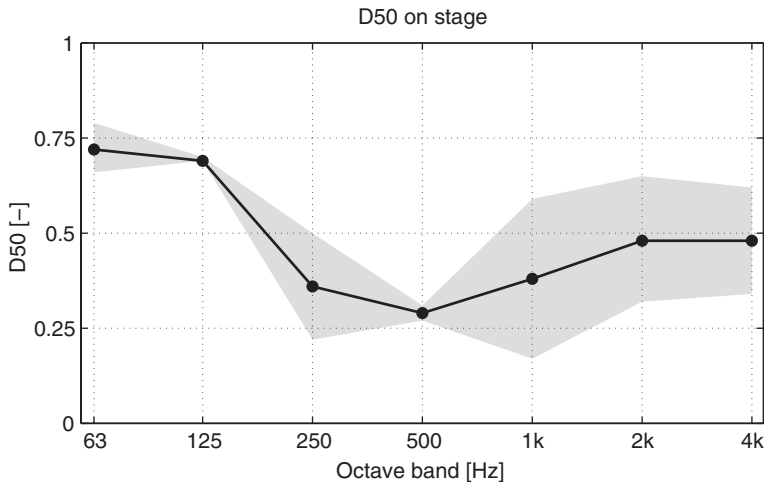
Empty; no additional seats mounted.



Festhalle.







Forest National

Bruxelles

Number of concerts per year: 100

Founded: 1970

Capacity: 10,000

Architect: NA

Acoustician: NA

Owner: Music Hall Group

Since 1970 Forest National has been a venue for major public events such as concerts, musicals, and sports events. The venue was first opened as “Palais des sports,” and then commuted into a concert venue. This resulted in a phenomenal list of artists and shows over the years and has put Brussels on the schedule of every international tour manager. The venue has hosted about 3,500 shows attended by over 15 million fans. Yearly, over 500,000 people attend an event in the hall. Forest National is the biggest concert venue in Brussels. Music Hall Group bought the venue in 1995 and renovated it: VIP lounges and VIP boxes were added, and the capacity rated up to 10,000 places. With Maurice Béjart’s *Ballets*, the venue’s grand opening celebration, the tone was set for quality from the first day onwards and has made it one of the most beloved arenas of the public, the promoters, and the artists.

An impressive list of names of artists and bands of all the styles that contemporary music has to offer have performed on the mythical stage of Forest National. Rock’n’roll legends the Rolling Stones, Queen, or U2; jazz icons Ella Fitzgerald, Count Basie, or Benny Goodman; pop divas Janet Jackson, Diana Ross, or Kylie Minogue; reggae king Bob Marley and the Wailers; French chanson ambassadors Michel Sardou or Johnny Hallyday; New Wavers The Cure, Indochine, or Siouxië and the Banshees; Latin extravaganza Santana, Gloria Estefan, or Enrique Iglesias; hard rock myths Black Sabbath, Iron Maiden, or Metallica; today’s hit wonders Katy Perry, The National, Editors, Tokio Hotel, Nelly Furtado, or 50 Cent, and last but not least Belgium’s finest artists dEUS, Hooverphonic, Ozark Henry, or Axelle Red, they all had their moment of glory, their standing ovation in Forest National.

In addition to the glitter and the glamour, the venue has also been the home of spectacular operas such as *Aïda*, *Nabucco*, and *Carmen* and moving musicals such as *Notre Dame de Paris*, *Jesus Christ Superstar*, and *Mamma Mia!*.

Other events could be hosted thanks to the magnificent round architecture of the arena. Basketball exhibitions by the Harlem Globe Trotters, equestrian shows of the Spanish Riding School of Vienna, wrestling matches, tennis tournaments, gymnastic championships, and ice-skating family happenings like *Disney On Ice* were a delight for children and adults.

In 2009 Dries Sel was appointed as new CEO with the mission of turning the mythical rock temple into a venue with a legendary future. Forest National started a diversification of its offer, welcoming genres as different as rock, R&B, rap, chanson française, family shows, circus, and so on. A first edition of *KDO!*, a show created by Franco Dragone (Cirque du Soleil’s former artistic director) especially for Forest National, sold over 60,000 tickets in the winter of 2009–2010.

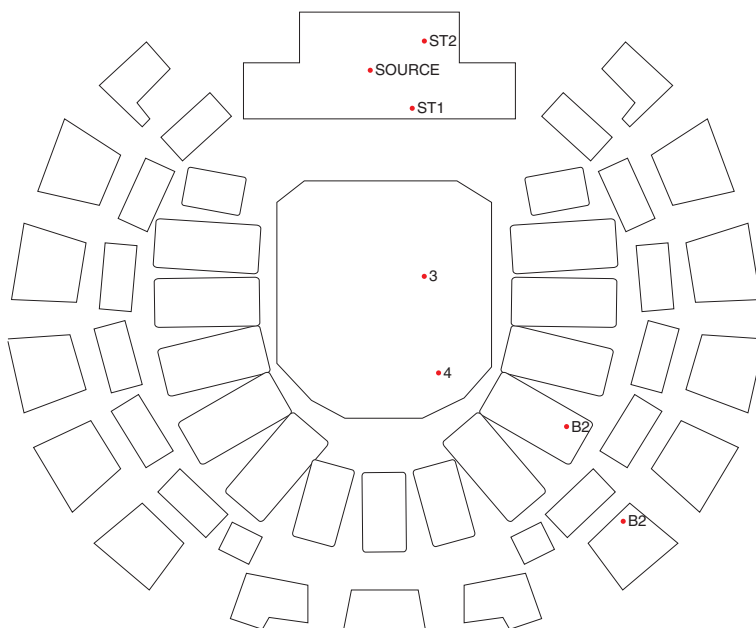
At the same time the new management team started a series of actions in order to reduce any possible negative impact of the venue on its direct neighborhood and the environment, addressing mobility and parking issues, sound emissions, energy consumption, and so on. The purpose was to create within a few years a brand new Forest National, ensuring its visitors an exceptional experience from ticket buying to the long-time strength of the venue, fabulous shows and concerts, to going home.



If walls could speak ... Since 1970 most great rock stars have passed through this hall.



Large hallways of concrete behind the seats add reverb to the reverberant space.



NTS

Geometrical data	
Volume	App. 150,000 m ³
Height	20.5 m
Acoustical data	
<i>Audience area</i>	
T_{empty}	
T_{full}	
D_{50}	
EDT	
BR_{rock}	
<i>Stage area</i>	
T_{empty}	
D_{50}	
EDT	
BR_{rock}	

Materials Used

Audience Area

Floor: Concrete.

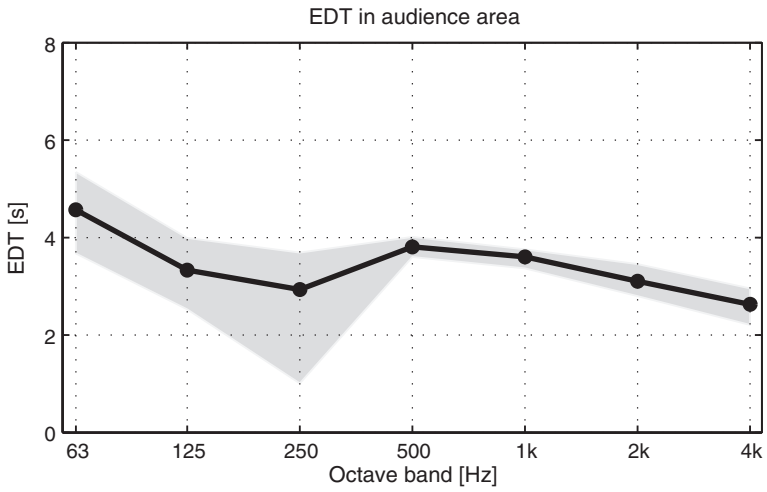
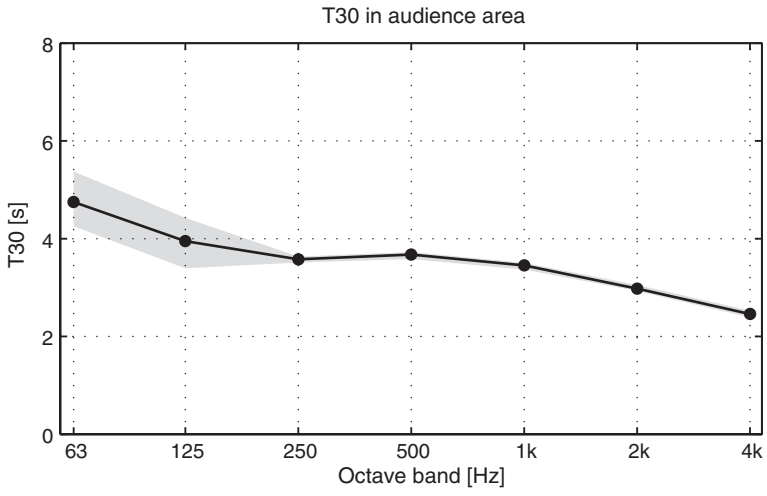
Ceiling: Thin nonperforated trapezoid steel.

Walls: Concrete.

Seats: Upholstered on back and seat.

State of Hall When Measured

Empty; some seats installed on floor. Backdrop.



Globen

Stockholm

Number of concerts per year: 50

Founded: 1989

Capacity: 16,000

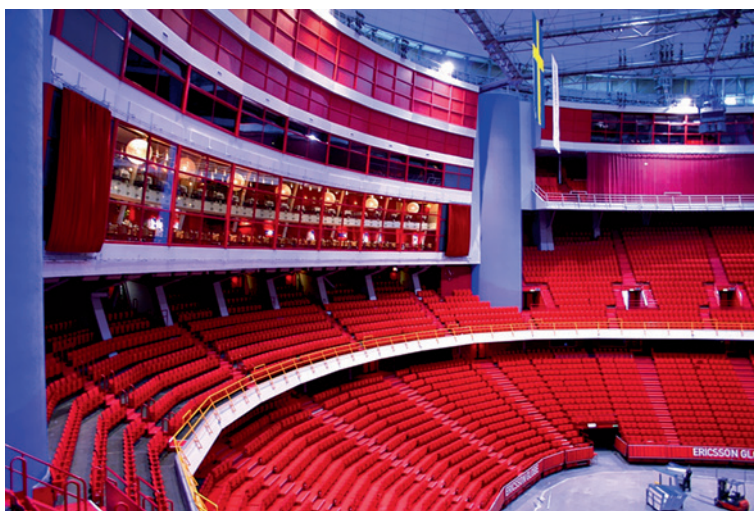
Architect: Berg Arkitektkontor AB

Acoustician: Tunemalm Akustik AB, Svante Berg, Esbjörn Adamson, and Lasse Vretblad

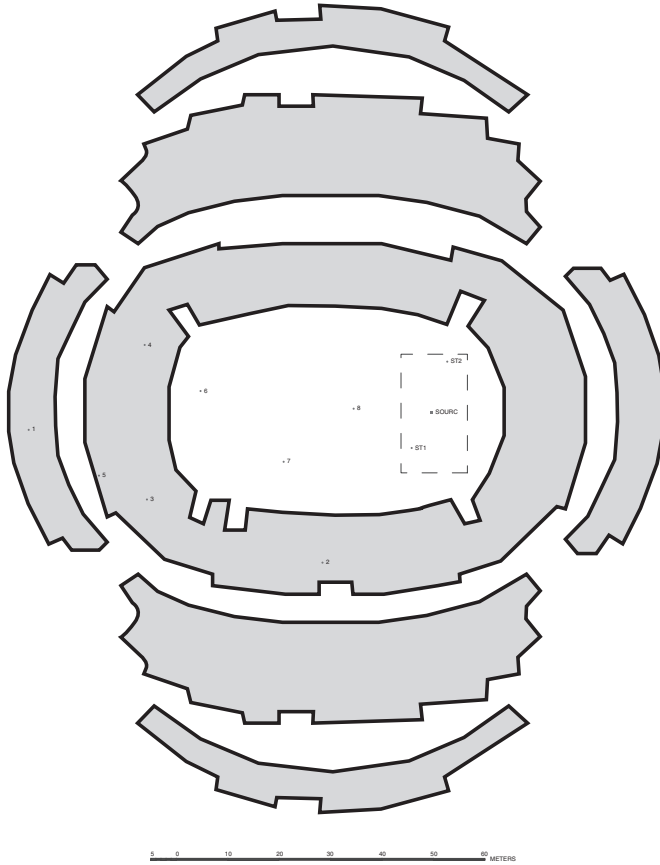
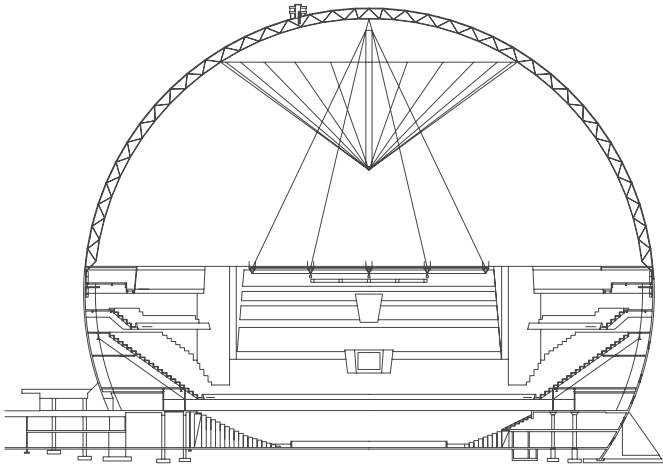
The construction work of this colossal hall began in 1986 and ended 2½ years later in 1989. It is the biggest spherical building in the world and has become a symbol for Stockholm and Sweden. The building has a horizontal diameter of 110 m, an inside height of 85 m, and has a volume of 600,000 m³.



With a volume of 600,000 m³ the Globe Arena is the largest of all halls in this book.



Curtains can be drawn in front of the windows in order to avoid echoes.



Geometrical data	
Volume	600,000 m ³
Height, audience area	85 m
Outer horizontal diameter (max)	110 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	3.71
EDT _{125-2k}	3.22
$C_{80,125-2k}$	0.27
BR ₆₃ versus 0.5-1k	1.89
BR ₁₂₅ versus 0.5-1k	1.67

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Mineral wool product.

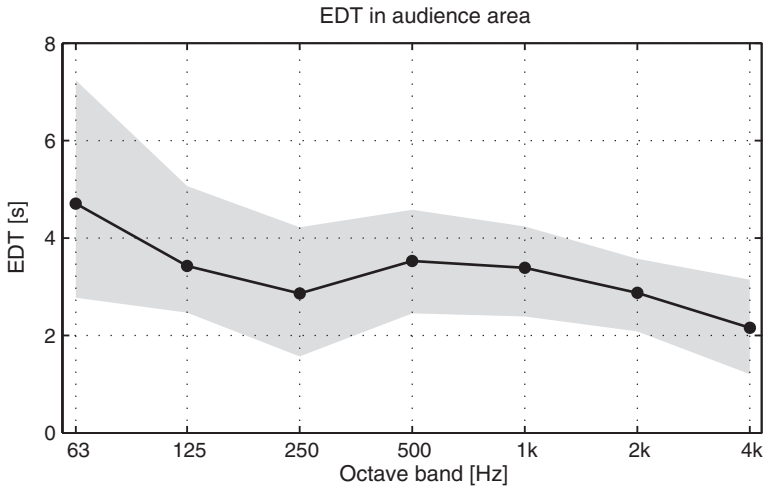
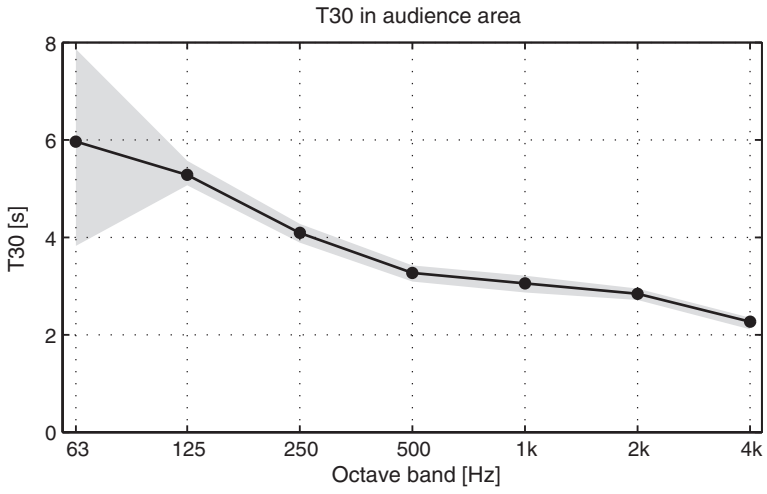
Seats: Upholstered on seat and back. Reflective when not in use.

Stage Area: NA

State of Hall When Measured

Empty; no additional seats mounted. One fourth of lower seats covered with curtain.





Grosse Freiheit

Hamburg

Number of concerts per year: 75

Founded: 1985. Building constructed in 1958

Capacity: 1,250

Architect: Erwin Nagel

Acoustician: N/A

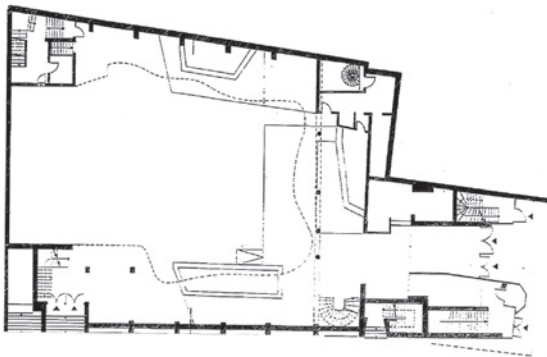
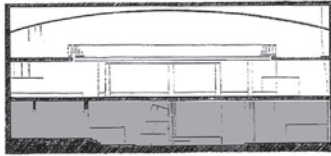
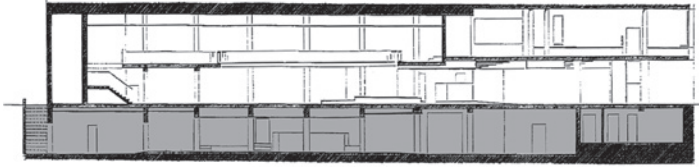
Upstairs from Kaiser Keller where the Beatles played for several months before breaking internationally is the much larger Grosse Freiheit. Considering its size, amazing artists have played here during the past decades, including Johnny Winter and Band, Stevie Ray Vaughn, Sly Dunbar, Robby Shakespeare, The The, The Ramones, Die Ärzte, Public Enemy, INXS, Cruzados, Meat Loaf, Wet Wet Wet, Faith No More, Manu Dibango, Crowded House, Nick Cave And The Bad Seeds, Sugarcubes, Living Colour, R.E.M., Underworld, John Cale, Texas, Neil Young, George Clinton, Deep Purple, Youssou N'Dour, Leningrad Cowboys, Jonathan Butler, Chris Isaak, Robert Palmer, Maceo Parker, The Jets, Seal, Tower Of Power, Fehlfarben, Curtis Stigers, Pearl Jam, Mothers Finest, Blur, Stereo Mc's, Duran Duran, Einstürzende Neubauten, Ace of Base, Michael McDonald, Björk, Sheryl Crow, Brand New Heavies, Nina Hagen, Huey Lewis, Pantera, Cranberries, Bob Geldof, Jamiroquai, Portishead, Mike and The Mechanics, Joan Armatrading, Suzanne Vega, Kid Kreole and The Coconuts, Robben Ford, Marcus Miller, Crash test Dummies, Rammstein, Bon Jovi, Miriam Makeba, Kool and The Gang, Daft Punk, The Corrs, Willie Nelson, Nena, Runrig, Saga, Macy Gray, Lou Reed, Muse, D'Angelo, dEUS, Arctic Monkeys, Travis, Heather Nova, Amy Mc Donald, and Stereophonics.



This is the kind of venue that was probably built unintentionally of fairly suitable materials for rock concerts.



With a height of less than 6 m there is enough room for a balcony level. And with a carefully adjusted PA system the mid–high frequency reverberation can possibly be tamed by the presence of a packed audience without any (other) porous absorbers in the room.



5 0 10 20 30 METERS

Geometrical data	
Volume	4,200 m ³
$L \times W \times H$	$31.5 \times 24.5 \times 6$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.48
EDT_{125-2k}	1.52
$C_{80,125-2k}$	1.75
BR ₆₃ versus 0.5–1k	0.86
BR ₁₂₅ versus 0.5–1k	0.75
<i>Stage area</i>	
EDT_{125-2k}	0.99
$D_{50,125-2k}$	0.56
BR ₆₃ versus 0.5–1k	0.64
BR ₁₂₅ versus 0.5–1k	0.97

Materials Used

Audience Area

Floor: Concrete; approximately 15 % is covered by wooden audience risers (in the back of the room).

Ceiling: Thin plate with cavity behind.

Walls: Side walls are concrete, rear wall is plate on cavity.

Stage Area

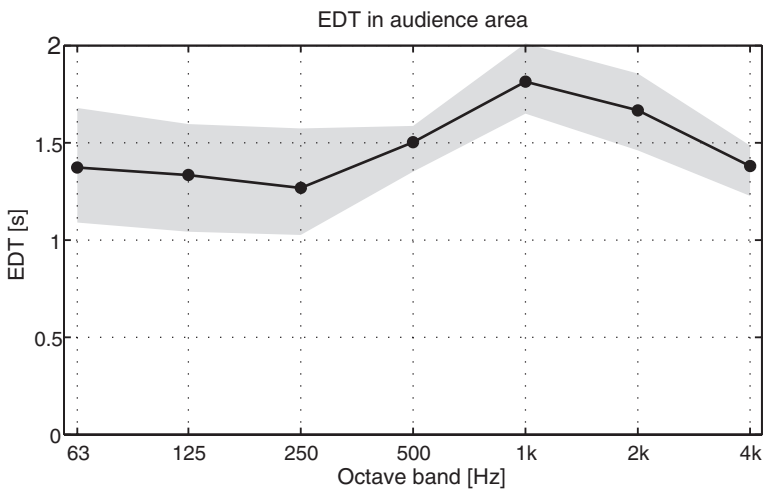
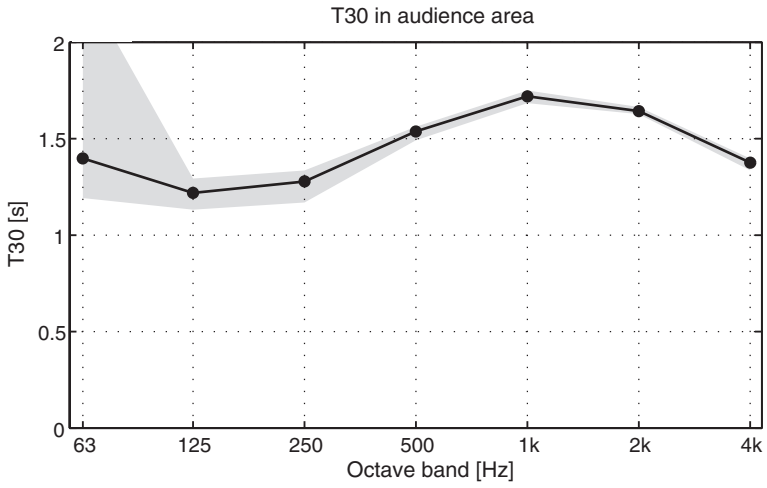
Floor: Vinyl on wood on cavity on concrete.

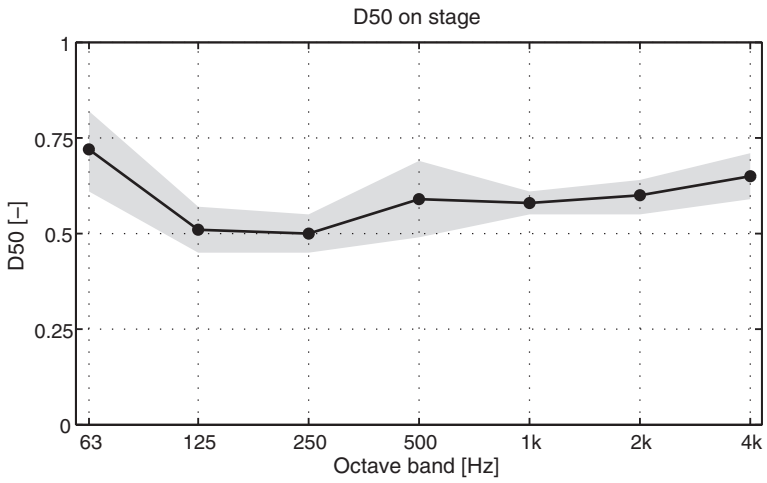
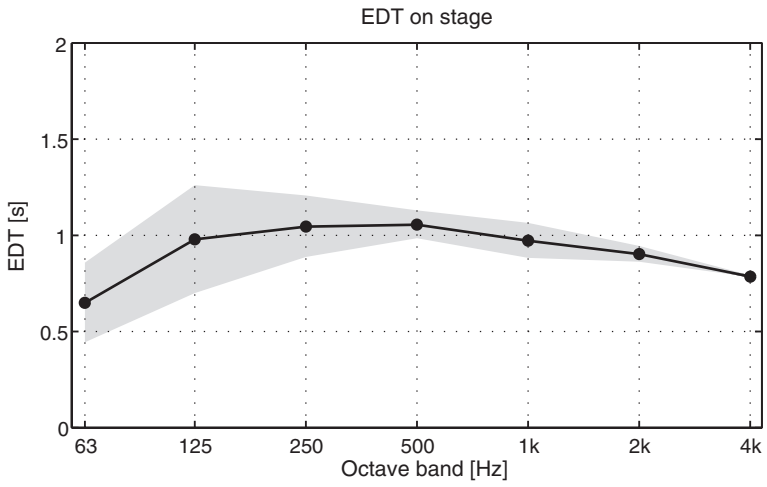
Ceiling: Thin plate with cavity behind.

Walls: Curtains.

State of Hall When Measured

Empty; a couple of flight cases and a DJ set-up on stage.





Hallenstadion

Zürich

Number of concerts per year: 70

Founded: 1939; rebuilt: 2005

Capacity: 13,000

Architect: Karl Egender and Wilhelm Müller

Acousticians of rebuild: Kopitsis Bauphysik AG, Wichser Akustik and Bauphysik AG

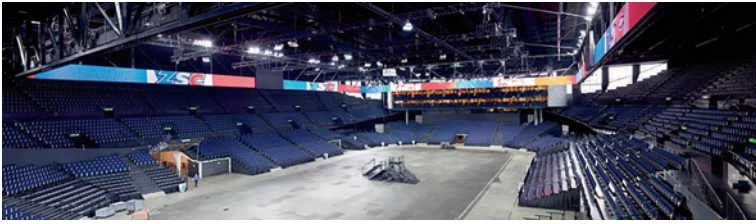
Owner: AG Hallenstadion

Bis zu 13,000 Besucher haben Platz in der Hallenstadion ARENA. Von der Eisfläche über die Konzertbühne, den Tenniscourt oder den Pferdeparcours bis zum steinig-erdigen Untergrund, auf dem sich Monster Trucks bewegen, bietet die ARENA eine enorme Bandbreite an Möglichkeiten. Auch für Corporate Events ist sie eine beeindruckende Kulisse und ideal nutzbar für Generalversammlungen, Kongresse oder Ausstellungen.

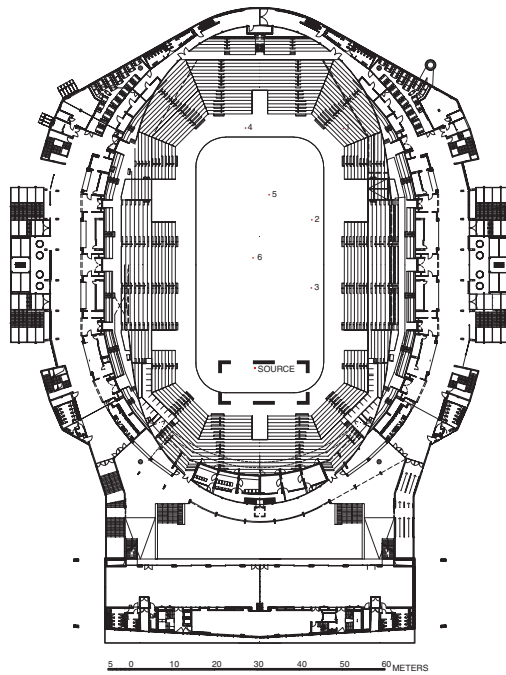
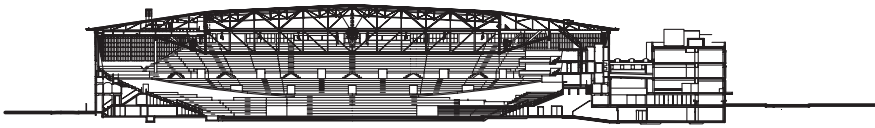
Mit dem FORUM und dem CLUB bietet das Hallenstadion zudem zwei Layouts, die speziell für Kongresse und Business Events von 600 bis 3,000 Personen beziehungsweise Konzerte für bis zu 4,500 Zuschauer konzipiert sind. Das Raumkonzept basiert auf einem standardisierten Layout, das dank diverser Vorinstallationen und der flexiblen Funktionalität sehr schnelle Umbauten und damit kostengünstigere Produktionen ermöglicht.



Hallen Stadion is an up-to-date modern facility with carefully designed acoustics.



The hall also works well acoustically for sports games. All time tennis great Roger Federer was to play a couple of days after this measurement took place.



Geometrical data	
Volume	120,000 m ³
$L \times W \times H_{(\max)}$	115 × 100 × 25 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	2.48
EDT _{125-2k}	2.07
$C_{80,125-2k}$	0.58
BR ₆₃ versus 0.5-1k	1.46
BR ₁₂₅ versus 0.5-1k	1.1

Materials Used

Audience Area

Floor: Concrete

Ceiling: Two layers of 50-mm mineral wool slabs with a 100-mm air space in between.

Walls: Porous absorbers and perforated thick plates. Curtains.

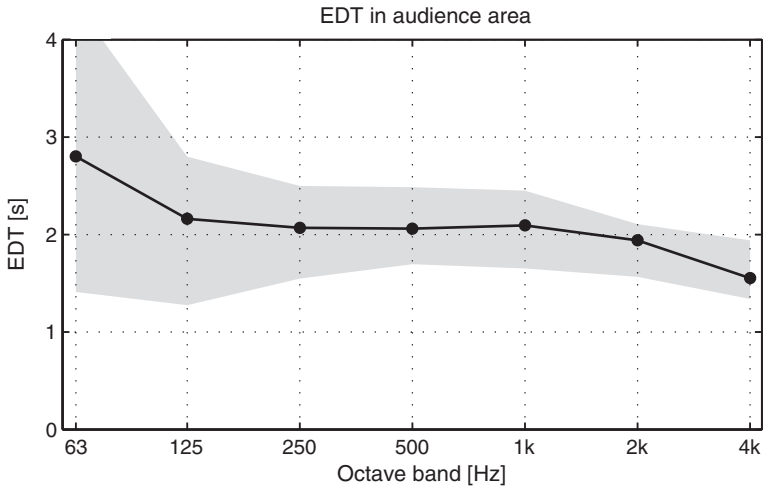
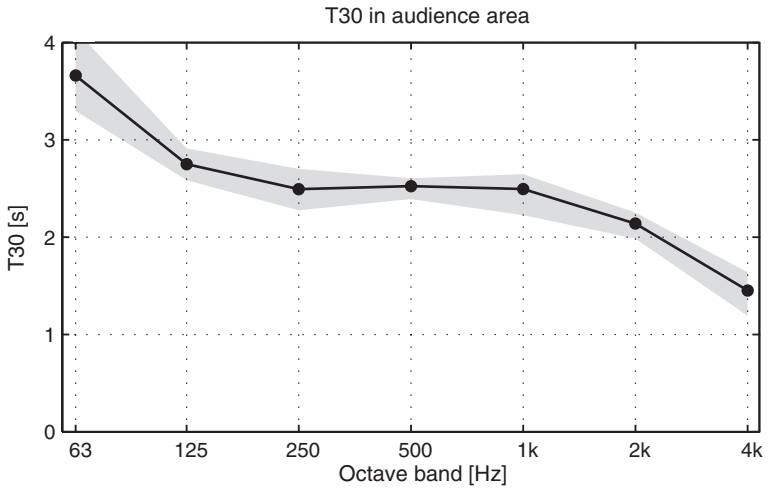
Seats: Upholstered also underneath.

Stage Area

No stage measurement.

State of Hall When Measured

Empty; no additional seats mounted on floor area.



HMV Hammersmith Apollo

London

Number of concerts per year: 120

Founded: 1932

Capacity: 5,039

Architect: Robert Cromie

Acoustician: N/A

HMV Hammersmith Apollo is one of London’s major live entertainment venues. It is located in Hammersmith, West London and is one of the UK’s largest and best-preserved original theatres. It opened on the 28th of March, 1932 as the Gaumont Palace cinema, designed in the Art Deco style by renowned theatre architect Robert Cromie, who also designed the Prince of Wales Theatre in Central London. It was designed on behalf of a joint collaboration between exhibitor Israel Davis and the Gaumont British Theatres chain. It had 3,487 seats and the opening program was Tom Walls, *A Night Like This*, and Helen Twelvetrees in *Bad Company*. It had a large 35-foot deep stage, an excellent fan-shaped auditorium (which, despite its enormous 192 foot width allows remarkable intimacy and excellent sightlines from all parts of the house), 20 dressing rooms, a Compton Manual/15 Ranks theatre organ, and a café/restaurant located on the balcony/foyer area.

HMV Hammersmith Apollo was renamed the Hammersmith Odeon in 1962 and started playing host to many legendary acts of the day, including the Beatles, the Rolling Stones, and Bob Marley. It screened its last regular film in 1984, *Blue Thunder*. Following a sponsorship deal, it was later refurbished and renamed the Labatt’s Apollo. During his 1992 sold-out tour, Michael Ball, the musical theater star, best known for his roles in *Les Miserables*, *Phantom of the Opera*, and *Hairspray*, was the last person to play the venue when it was named “Odeon” and the first person to play after it was renamed “Apollo.” The venue continued to host long-running shows and musicals such as *Riverdance* and *Dr Doolittle*.

In the early 1990s it reverted back to the Hammersmith Apollo. In 1990, it was designated a Grade II listed building by English Heritage and was upgraded to Grade II* status in 2005. 2003 saw the venue renamed as the Carling Apollo Hammersmith, after another brewery entered into a sponsorship deal with the then-owners, Clear Channel Entertainment, a US-based company (which then spun off as Live Nation UK). Major alterations enabled the stalls to be removable, allowing for both standing and fully seated events. Capacity became 5,039 (standing) and 3,632 (sitting). In 2006, the venue reverted to its former name, the Hammersmith Apollo. The owners were encouraged by Hammersmith & Fulham Council and the Cinema Theatre Association to reinstate the original Compton organ console which had been removed from the building and put into storage in the 1990s. The organ chambers were retained in the building and with its console connected up again, the huge Apollo auditorium is now filled with its sound after 25 years of silence.

The venue changed hands once again in June 2007 when it was bought by MAMA Group, a UK-based entertainment company who own a number of music venues and festivals artist management companies and other music-related businesses such as the UK's most widely circulated music magazine, *The Fly*. In 2009, it was announced that MAMA Group had entered into a joint venture with HMV to jointly run 11 live music venues across the United Kingdom, including the Hammersmith Apollo, the Kentish Town Forum, the Jazz Cafe, and London Garage. Hence, the venue is now known as the HMV Hammersmith Apollo.

A glance at the list of bands having played the venue is almost a lesson in European pop and rock history. In the early 1960s, many of the top American stars performed at the Odeon, including Tony Bennett, with Count Basie, Ella Fitzgerald with Duke Ellington, Louis Armstrong, and Woody Herman and the Herd. However, in late 1964 and early 1965, the Beatles played 38 shows over 21 nights. Special guests on the bill included the original Yardbirds, featuring Eric Clapton. In 1966, Johnny Cash performed at the venue. In the 1970s stars and bands including Bowie, Slade, Bruce Springsteen, Kiss, Thin Lizzy, Sweet, Rush, and Frank Zappa played there. In December 1979, Queen played several further concerts. The Hammersmith Odeon hosted the four-night Concerts for the People of Kampuchea, a benefit concert to raise money for Cambodian residents, who were victims of the tyrannical reign of dictator Pol Pot, of which Queen played the first night.

In the 1980s Blondie, Heroes, Cher, Van Halen, and Osbourne headlined, and in 1981, Motörhead's live album, *No Sleep 'til Hammersmith*, brought the Odeon to the international stage, becoming widely recognized. Duran Duran and Depeche Mode then both recorded live albums entitled after the Hammersmith. Iron Maiden and AC/DC played four consecutive nights. Elton John, Phil Collins, Boy George, and U2 performed three shows there in 1983 on their War Tour. David Gilmore. On February 6–7, 1984, Soft Cell played their last two shows. On June 1st, 1984, Venom accidentally burned Hammersmith's ceiling during a performance, which event can be clearly seen in the *7 Dates of Hell* concert video (during *Countess Bathory*). As a result, Venom was banned from the Hammersmith Apollo for a year. In 1986 A-Ha played six consecutive shows there. On June 9th, 1988, Dire Straits (and Eric Clapton on rhythm guitar) performed a second "warm-up" show at Hammersmith leading up to the *Nelson Mandela 70th Birthday Tribute* to be held on 11 June 11th, 1988 at Wembley Stadium, London. On October 9–11, 1988, Metallica returned to perform, on three consecutive nights, during their Damaged Justice Tour. During the 1990s the hall hosted a number of stage productions but bands such as Pantera and Megadeth found their way to the concert venue. In recent years, performers have included Prince, Oasis, REM, Stereophonics, Kylie, Elton John, Peter Kay, and Paul Weller to name but a few.



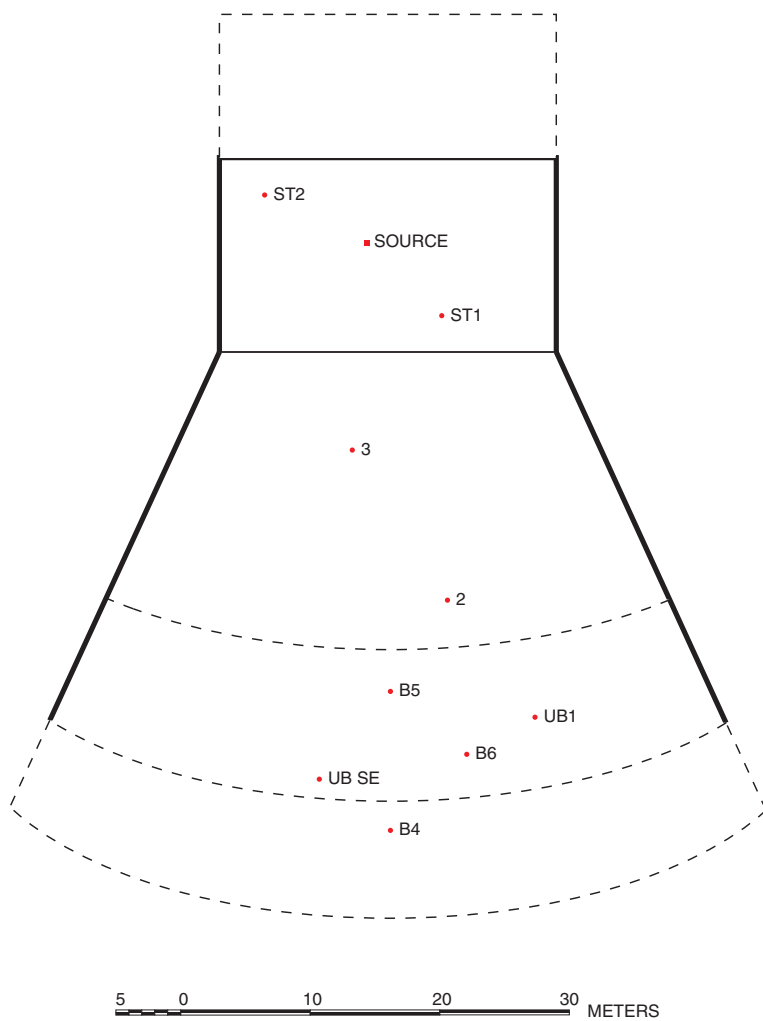
This hall is lively and performers enjoy good contact visually as well as acoustically with the audience.



There is no porous absorption apart from the upholstered seats.



The fan-shaped hall, in this case very pronounced, seems to work well for amplified music. Mid- to high-frequency sound is beautifully diffused giving an airy and lively atmosphere.



Geometrical data	
Volume	Approximately 20,000 m ³
Height, audience area	14.4 m
$L \times W \times H$	$58 \times 26 \times 14.4$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	2.35
EDT_{125-2k}	2.12
$C_{80,125-2k}$	-0.65
BR ₆₃ versus 0.5-1k	0.98
BR ₁₂₅ versus 0.5-1k	1.03
<i>Stage area</i>	
EDT_{125-2k}	2.09
$D_{50,125-2k}$	0.6
BR ₆₃ versus 0.5-1k	1.11
BR ₁₂₅ versus 0.5-1k	0.96

Materials Used

Audience Area

Floor: Hard plate on concrete.

Ceiling: Under balcony: painted plaster on masonry. Above balcony, rear: porous masonry; in front: painted ornamented plaster or wood direct on painted masonry.

Walls: painted, ornamented masonry.

Stage Area

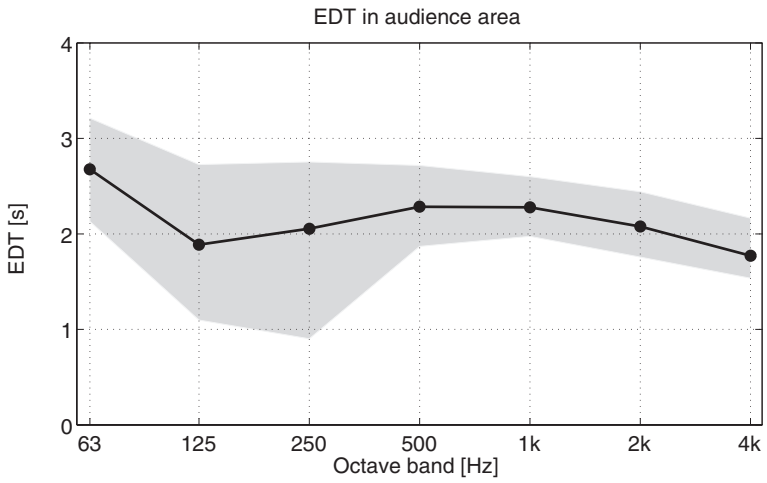
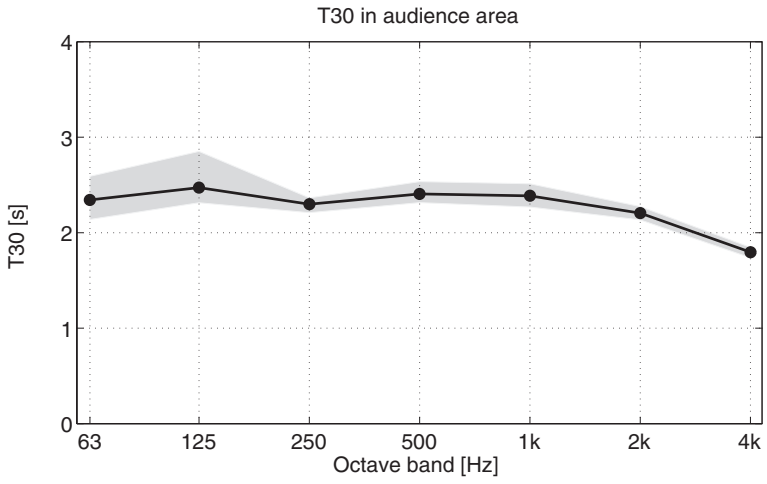
Floor: Vinyl on wood direct on concrete.

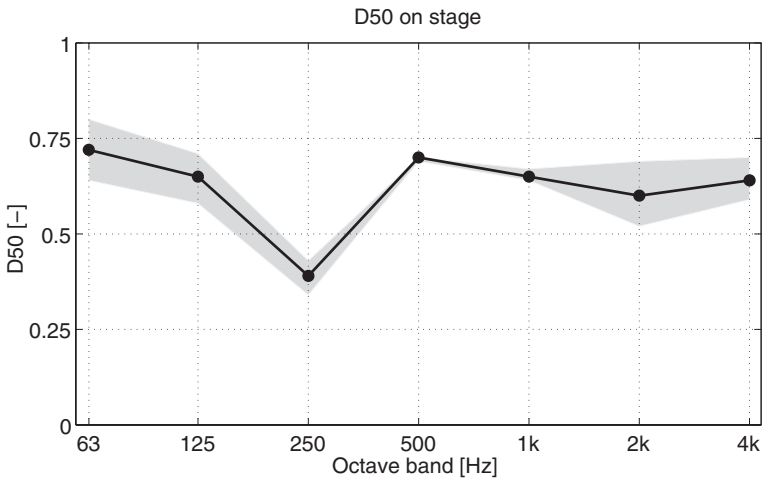
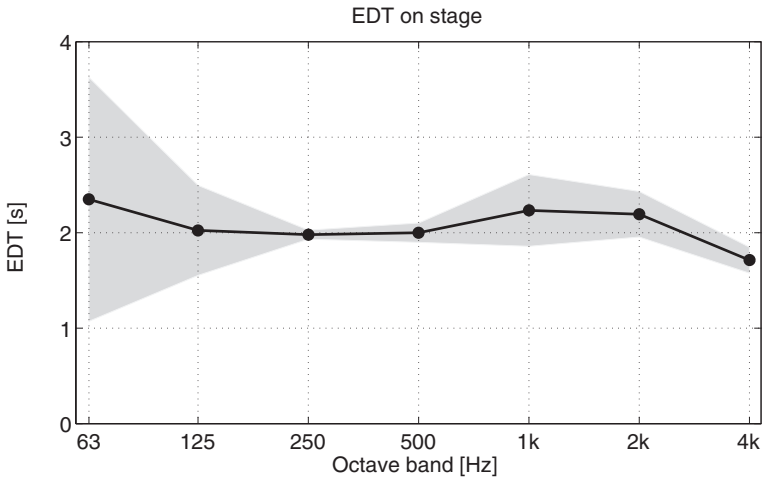
Ceiling: Masonry.

Walls: Masonry.

State of Hall When Measured

Empty; no seats mounted on lower floor. All seats mounted on balcony.





Heineken Music Hall

Amsterdam

Number of concerts per year: 50–100

Founded: 2001

Capacity: 5,500

Architect: Frits van Dongen, De Architecten Cie

Acoustician: Rob Metkemeijer, Peutz Acoustics

The founders of the Heineken Music Hall in Amsterdam (NL) had one clear vision: to create a modern multifunctional venue for the main purpose of high-quality (pop) concerts for up to 5,500 visitors. The venue opened its doors in 2001 and is to this day (according to the venue) still the only Dutch multifunctional venue that has been designed both logistically and acoustically for amplified music events.

Erica Bakker of the Heineken Music Hall explains, the starting point was a simple audience surface with balconies, the so-called Black Box which is the larger of two stages in the facility. At the time, many venues seemed to cope with the same problem: lack of sound absorption under 200 Hz. Sound echoes from front to back when not absorbed; this was the one thing that the Heineken Music Hall wanted to prevent. Not only are frequencies transported loud and clear throughout the entire main hall, but the quality of the low frequencies sounds is also higher and more defined. The venue is built according to the “box in box” principle; hardly any of the walls touch the outer walls. After concerts people can stay and dance some more in the Beat Box hall located on the first floor of the venue.

With an average of 137 events a year (both concerts and corporate events) and multiple nominations for the Pollstar Award, the venue remains a much-loved location for music lovers. With performers including Joe Cocker, John Mayer, Simply Red, Pink, Lady Gaga, Lionel Richie, Coldplay, Van Morrison, Elvis Costello, Status Quo, and others, the Heineken Music Hall has become a renowned location within its own league.

Bakker continues:

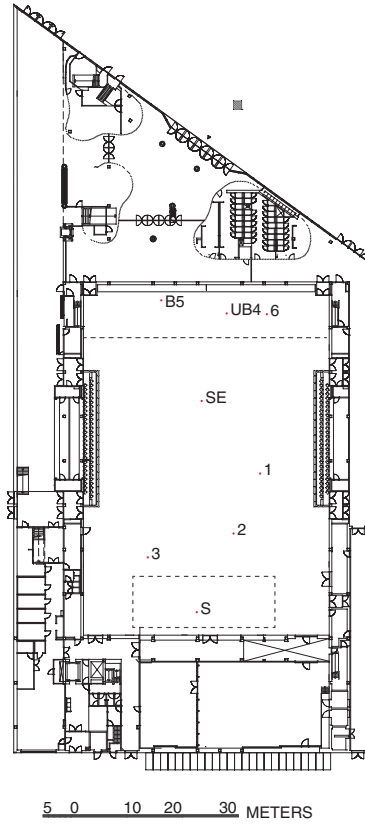
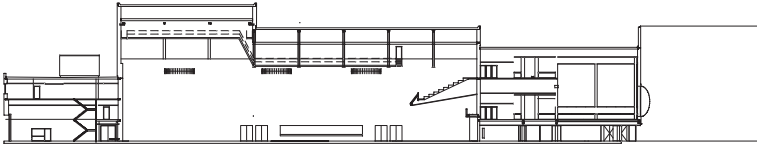
On a show date, the very first thing a crew can expect in this venue is a warm welcome; a nice cup of coffee and a hot shower. The local crew are always willing to help the production where and when they can. But do keep in mind that they want their venue to be treated the same way they treat their guests; with the utmost respect. One band decided to take being “rock ‘n roll” to the extreme and trashed up the entire dressing room. It goes without saying that the venue wasn’t happy about this and in their turn decided to let the band clean up their own mess. And they did... Obviously under slight protest, because after all, that is the true nature of “rock ‘n roll ... !”



The Heineken Music Hall is extreme acoustical engineering in a very delicate architectural design. With a volume of $50,000 \text{ m}^3$ a reverberation time of merely 1 s is indeed an extraordinary achievement.



All wall surfaces are perforated metal plates in front of porous absorption and membranes. Except for the reflective (when not in use) seats and the floor the Heineken Music Hall can be regarded as an anechoic chamber with two bars. Acoustician's paradise.



Geometrical data	
Volume	50,000 m ³
Height, audience area	20 m
$L \times W \times H$	$60 \times 43 \times 20$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.17
EDT _{125-2k}	1.11
$C_{80,125-2k}$	3.15
BR ₆₃ versus 0.5-1k	1.89
BR ₁₂₅ versus 0.5-1k	0.95

Materials Used

Audience Area

Floor: Concrete with a polyurethane coating.

Ceiling: 10-cm mineral wool and 20-cm cavity.

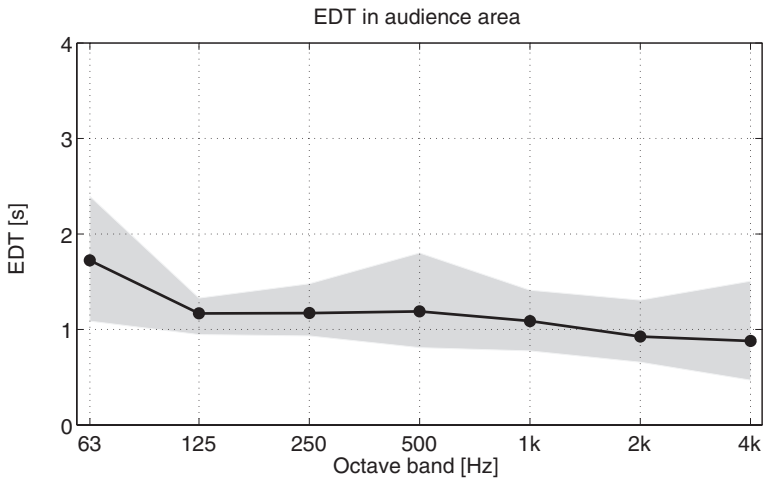
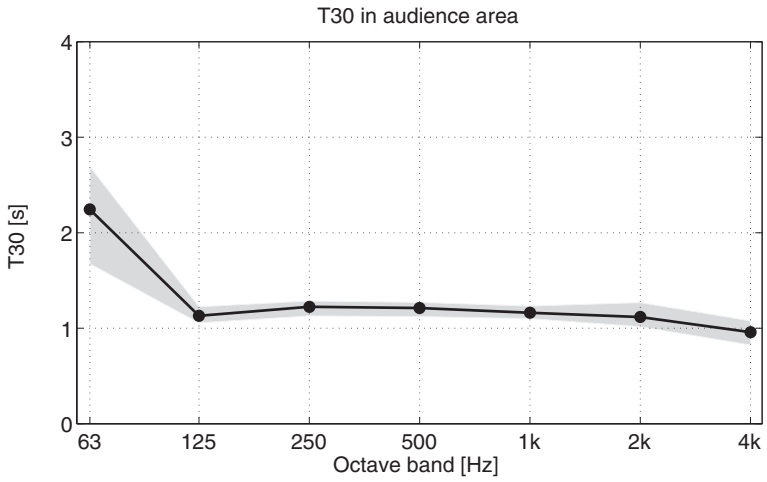
Walls: 30-cm layer of absorption material, consisting from 10-cm mineral wool, layers of foil and 20 cm of air.

Stage Area

As audience area.

State of Hall When Measured

Empty; seats mounted in the rear on floor and balcony.



Hanns-Martin-Schleyer-Halle

Stuttgart

Number of concerts per year: 65

Founded: 1983

Capacity: 15,500

Architect: ASP Architekten

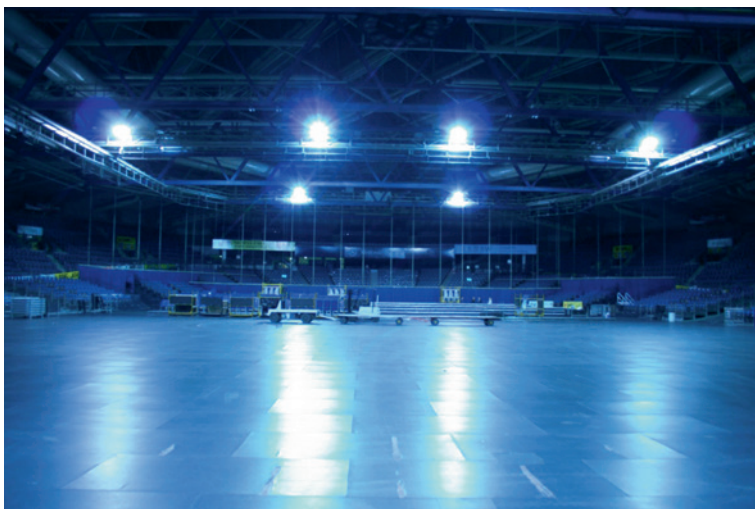
Acoustician: NA

The arena is part of a sport complex that includes the adjacent Mercedes-Benz Arena and Porsche Arena. Hanns-Martin-Schleyer-Halle is an indoor sporting arena located in Stuttgart, Germany. The capacity of the arena is 15,500 people. The hall was built in 1983 and is named for Hanns Martin Schleyer, a German employer representative, killed by the terrorist Red Army Faction. It has a 265-m (869-ft) track made of wood. The arena hosted the final phase of the 1985 European basketball championship [1]. It also hosted the Stuttgart Masters when it was a ATP Super 9 event between 1996 and 2001. The arena is also used as a velodrome and was used as the host for the 2003 UCI Track Cycling World Championships.

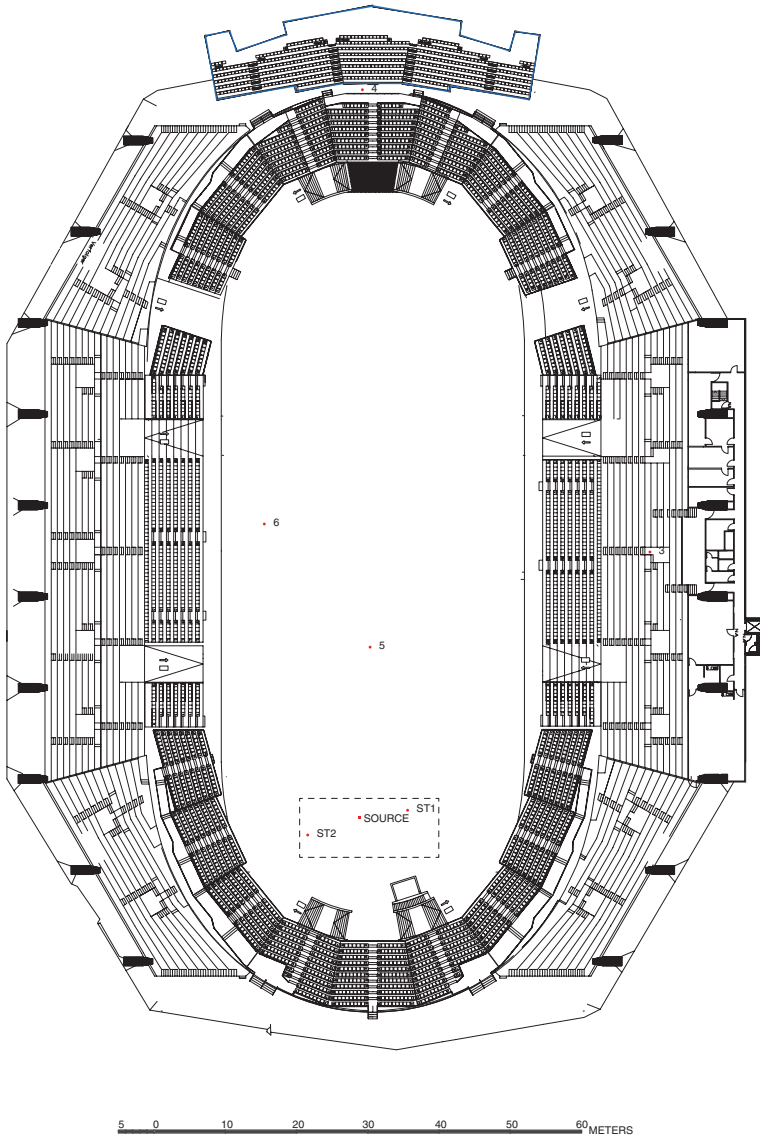
NeckarPark Stuttgart is one of the biggest and most attractive event sites in Europe. Five state-of-the-art event locations for top international sport, cultural, business, and political events line the Mercedesstrasse in the district of Bad Cannstatt: the Gottlieb-Daimler-Stadium, the Carl Benz Center, the Mercedes Benz Museum, and the Hanns-Martin-Schleyer-Halle and Porsche-Arena hall duo. Extensively modernized and enlarged in 2006, the 15,500 capacity Hanns-Martin-Schleyer-Halle is the largest indoor arena in south Germany. When officially opened in 1983 it was Europe's first multifunctional hall and together with the Porsche-Arena, which opened in May 2006, it forms a unique hall duo in the whole of Europe.

Take a closer look and immerse yourself in a hall complex that is unique and doubly good. A light-flooded and airy lobby unites both halls. The elongated Porsche-Arena is elegantly connected to the glass construction through which people stream into both halls. Flexibility is the key and this is also mirrored in the diversity of the events. From superstars on the national and international music scene to sports events and big show productions, the program of events is as star-studded as it is emotional. More than 14 million visitors to the Hanns-Martin-Schleyer-Halle are clear proof of its attractiveness.

The diversity of events can be enjoyed as a double pack in the Hanns-Martin-Schleyer-Halle and the Porsche-Arena whereby the prerequisite is a perfect and professional organizational structure. Working behind the scenes, it ensures major performances go off smoothly. This applies to a special degree to company presentations, congresses, annual general meetings, and party conferences. An outstanding example is the Porsche Annual General Meeting, which, combined with a big presentation in the Schleyer-Halle, celebrated its premiere in the Porsche-Arena. The hall duo functions in a variety of ways. With a spotlight on for a concert in the Schleyer-Halle, at the same time a first-class handball or ice-hockey match is being played in the Porsche-Arena.



Schleyer Halle.



Geometrical data	
Volume	Approximately 200,000 m ³
Height, audience area	12 m clear height, upper beam 18 m

Acoustical data	
<i>Audience area</i>	
T_{empty}	
T_{full}	
D_{50}	
EDT	
BR_{rock}	
<i>Stage area</i>	
T_{empty}	
D_{50}	
EDT	
BR_{rock}	

Materials Used

Audience Area

Floor: Wood.

Ceiling: Thin trapezoid metal without perforation.

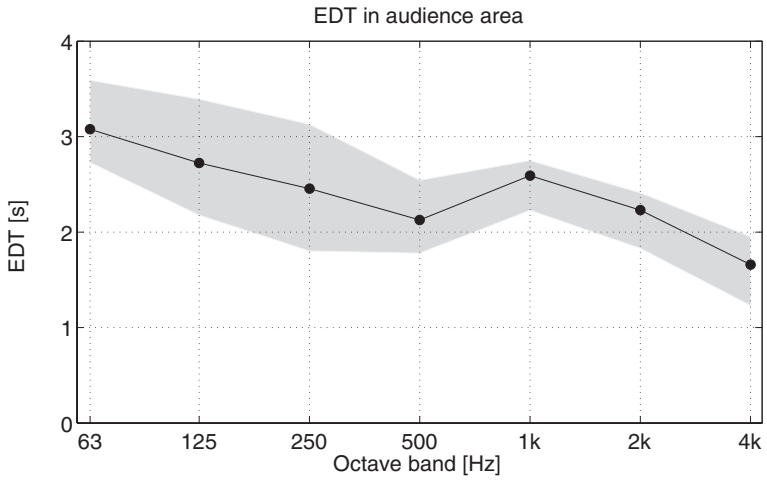
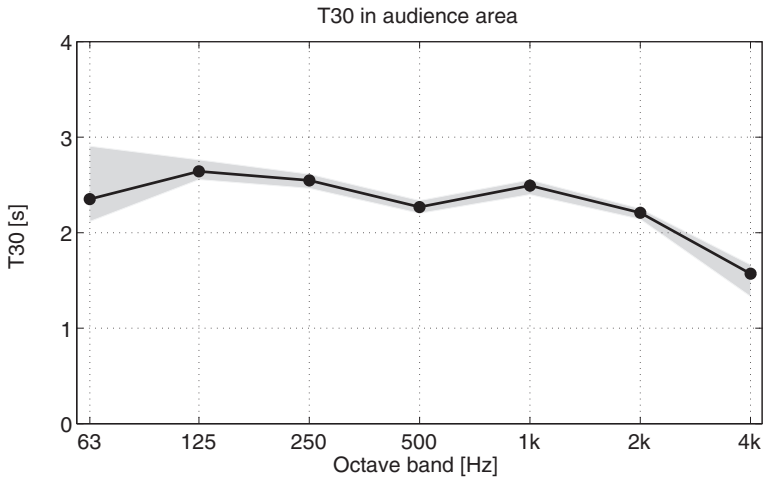
Walls: Concrete thin metal with and without perforation/concrete.

Seats upholstered on seat not on back and perforated underneath seats (see photo).

State of Hall When Measured

Empty: some additional seats mounted, curtains behind stage area and at the rear of the hall but these were only elevated 1 m from the floor.





Jyske Bank BOXEN

Herning

Number of concerts per year: N/A

Founded: 2010

Capacity: 15,000

Architect: Årstiderne Arkitekter

Acoustician: Eddy Bøgh Brixen

Jyske Bank BOXEN is Denmark's first multipurpose arena with seating for 12–15,000 people. The multipurpose arena has been specially designed to host a wide range of events and houses numerous service and VIP facilities. Jyske Bank BOXEN is therefore able to stage both national and international events such as sporting fixtures, concerts, shows, and other entertainment. Jyske Bank BOXEN was conceived by the Danish company MCH in close dialogue with sporting associations, concert organizers, business partners, and experts to ensure a state-of-the-art and future-proof venue that lives up to international standards. MCH owns and runs the multipurpose arena.

The first event in Jyske Bank BOXEN took place on October 20th, 2010 when the American pop phenomenon Lady Gaga performed at the venue, which is also known as Denmark's national arena. Just two days later, Prince visited Jyske Bank BOXEN, and since then Linkin Park and Elton John with Ray Cooper have staged shows there. In December 2010, Jyske Bank BOXEN served as the venue for the European Women's Handball Championships, where the tournament's only intermediate round and the finals were held in Herning.

The string of international concerts, shows, and sporting events continued in 2011. For example, the world première of Kylie Minogue's Aphrodite Tour was scheduled to take place at the arena, in addition to the Queen musical *We Will Rock You*, a concert by teen idol Justin Bieber, Roger Waters' *The Wall*, and a performance by R&B star Rihanna.

Jyske Bank BOXEN is part of "Vision 2025," an ambitious and long-term plan for the future expansion of MCH's physical facilities. The plan was presented on November 1st, 2000, and covers infrastructure/motorway projects, the multipurpose arena (Jyske Bank BOXEN), a stadium, a drive-in cinema, MCH Time World, and an aerial railway.

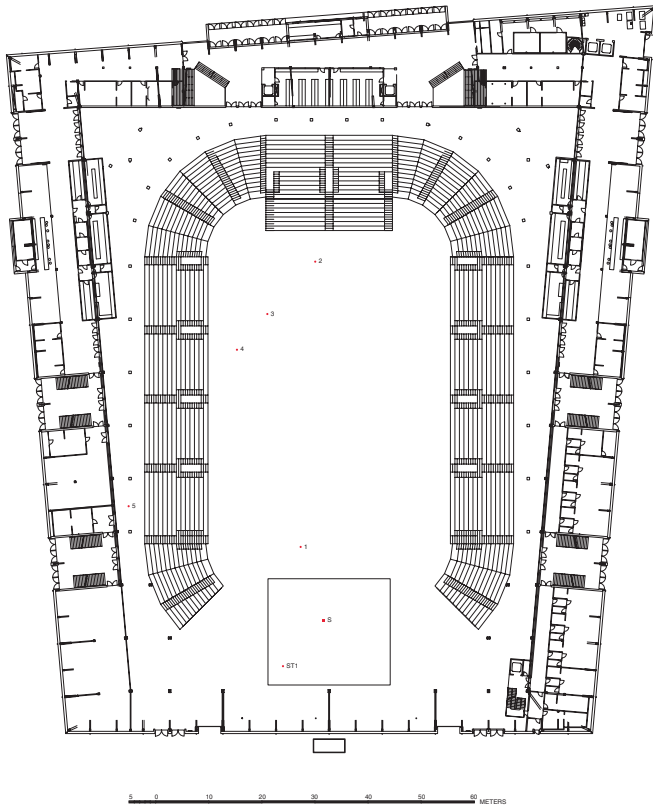
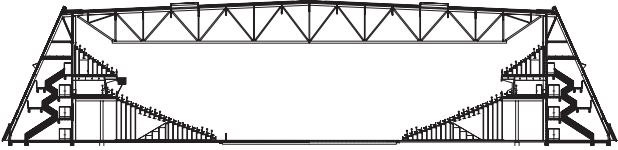
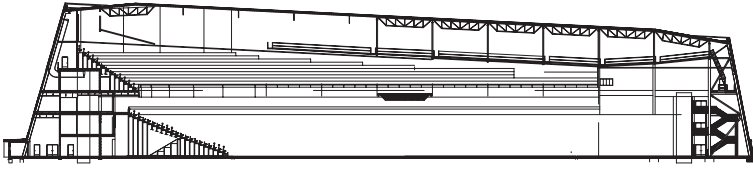
The first stage of the plan was completed in 2004 with the construction of Denmark's largest column-free hall and MCH Arena, home ground for the professional Danish football club FC Midtjylland. Since then, the infrastructure around Herning has been extended and improved, and most recently Jyske Bank BOXEN has opened. Jyske Bank BOXEN is part of MCH, one of Scandinavia's most flexible experience centers with 15 exhibition halls, a congress center, a football stadium, and now also a multipurpose arena. MCH organizes trade fairs and exhibitions, concerts, sporting events, conferences, meetings, and parties. It is situated in Herning (Denmark) a city with approximately 84,000 citizens and a population of approximately 2.6 million people within a two-hour drive.



JBB arena has a no-nonsense Nordic interior design with wooden chairs.



Apart from porous absorption in the ceiling, membrane absorbers have been used on wall areas. This hall is known in Denmark for its good acoustics for amplified concerts.



Geometrical data	
Volume	230,000 m ³
$L \times W \times H_{(\max)}$	115 × 80 × 30 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	2.81
EDT_{125-2k}	2.92
$C_{80,125-2k}$	1.35
BR ₆₃ versus 0.5–1k	0.98
BR ₁₂₅ versus 0.5–1k	0.99

Materials Used

Audience Area

Floor: Concrete.

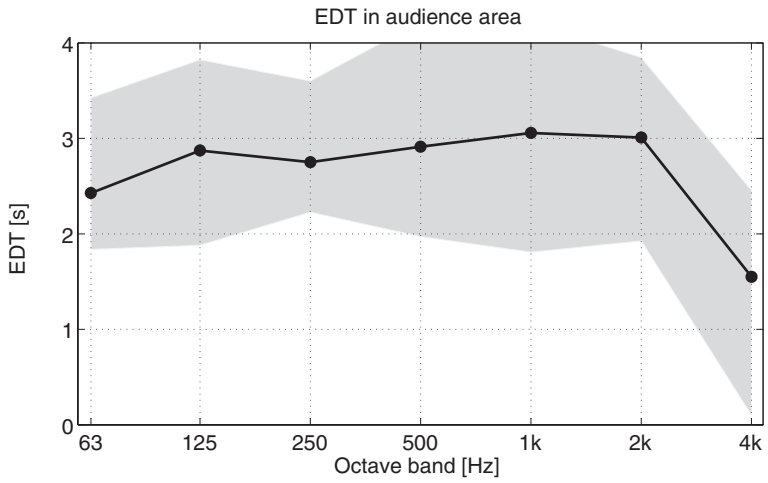
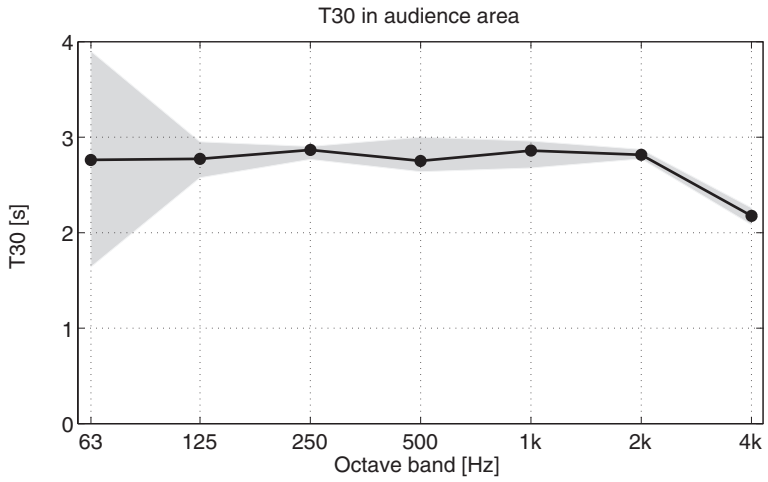
Ceiling: Steel trapezoid profile with perforation on cavity with mineral wool on top.

Walls: Upper wall areas: 100-mm mineral wool on concrete; lower wall areas: single layer gypsum board on cavity with mineral wool.

Seats are not upholstered.

State of Hall When Measured

Empty; no additional seats mounted.



Kaiser Keller

Hamburg

Number of concerts per year: 55

Founded: 1959. Building constructed in 1957/58

Capacity: Approximately 400

Architect: Erwin Nagel

Acoustician: NA

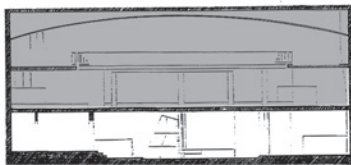
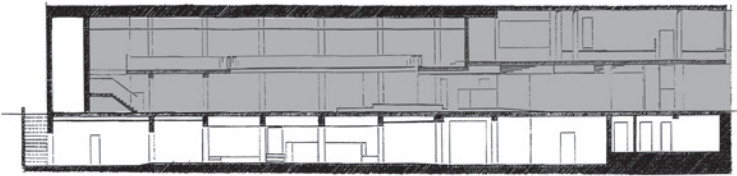
The Beatles residency in Hamburg, the German city where John Lennon, Paul McCartney, George Harrison, Stuart Sutcliffe, and Pete Best regularly performed at a series of four different clubs during the period August 1960 to December 1962, was a chapter in the group's history which honed their performance skills, widened their reputation, and led to their first recording, which brought them to the attention of Brian Epstein. The Beatles' booking agent, Allan Williams, decided to send the group to Hamburg when another group he managed, Derry and the Seniors, proved successful there. Having no permanent drummer at the time, they recruited Best a few days before their departure.

The Beatles arrived very early in the morning on August 17th, 1960, but had no trouble finding the St. Pauli area of Hamburg, as it was so well known. Unfortunately the Indra Club (placed at 58 Grosse Freiheit) was closed, so a manager from a neighboring club found someone to open it up, and the group slept on the red leather seats in the alcoves. The group first played at the club the same night, but were told they had to sleep in a small cinema's storeroom, which was cold and noisy, being directly behind the screen of the cinema, the Bambi Kino. McCartney later said, "We lived backstage in the Bambi Kino, next to the toilets, and you could always smell them. The room had been an old storeroom, and there were just concrete walls and nothing else. No heat, no wallpaper, not a lick of paint; and two sets of bunk beds, with not very much covers Union Jack flags—we were frozen." Lennon put it, "We were put in this pigsty. We were living in a toilet, like right next to the ladies' toilet. We'd go to bed late and be woken up next day by the sound of the cinema show and old German *fraus* [women] pissing next door." After having been awakened in this fashion, the group members were then obliged to use cold water from the urinals for washing and shaving.

Harrison remembered the Reeperbahn and Grosse Freiheit as the best thing the group had ever seen, as it had so many clubs, neon lights, and restaurants, although also saying: "The whole area was full of transvestites and prostitutes and gangsters, but I couldn't say that they were the audience. Hamburg was really like our apprenticeship, learning how to play in front of people." Best remembered the Indra as being a depressing place that was filled with a few tourists, and having heavy, old, red curtains that made it seem shabby compared to the larger Kaiserkeller, a club also owned by Koschmider and located nearby at 36 Grosse Freiheit. After the closure of the Indra because of complaints about the noise, the Beatles played in the Kaiserkeller starting on October 4th, 1960. [From Wikipedia, "*The Beatles in Hamburg*"]



Kaiser Keller is the basement club where the Beatles grew by playing several sets per day for months. Kaiser Keller is still used today for upcoming bands.



Geometrical data	
Volume	1,200 m ³
Height, audience area	3.1 m
Height of stage	0.4 m
$L \times W \times H$	$21.9 \times 17.8 \times 3.1$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.99
EDT _{125-2k}	1.04
$C_{80,125-2k}$	4.78
BR ₆₃ versus 0.5-1k	0.64
BR ₁₂₅ versus 0.5-1k	0.6

Materials Used

Audience Area

Floor: Tiles on concrete; approximately 20 % is covered by wooden audience risers.

Ceiling: Thin plate with cavity behind.

Walls: Concrete.

Bars made of wood on cavities.

Stage Area

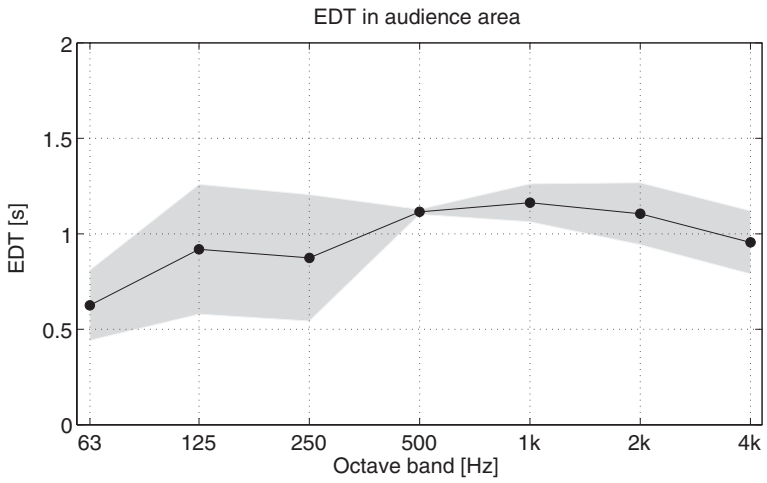
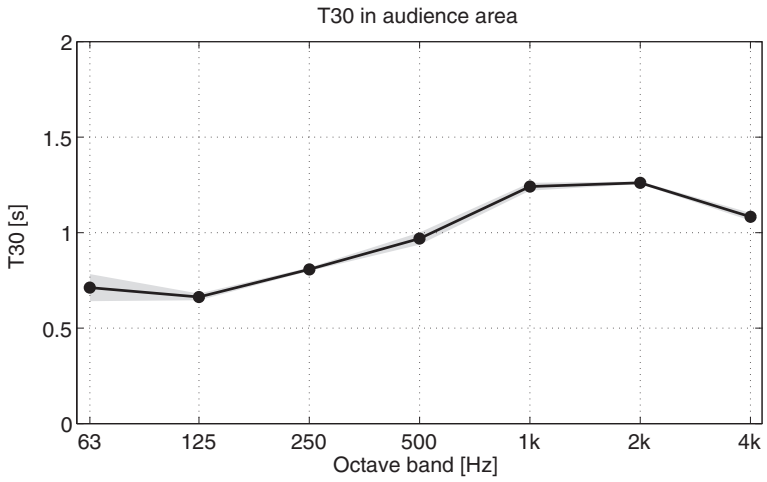
Floor: Wood on cavity.

Ceiling: Thin plate with cavity behind.

Walls: Curtains.

State of Hall When Measured

Empty: chairs and sofas on stage.



Live Music Club

Trezzo sull'Adda (Milan)

Number of concerts per year:

Founded: 1997/2007

Capacity: 1,500

Architect: Baruffi Valeria/Studio Achea

Acoustician: N/A

The Live Club was founded in 1997 in Trezzo sull'Adda as a entertainment alternative in the province of Milan. The music programming was soon given exclusive tribute nights with the most important names of the Italian indie scene. Soon artists on the international scene began to play on the live club stage, and causing the choice of a new location. The transfer took place in June, 2007. A new structure was designed and prepared to become one of the best clubs in Italy for live music, theater, events, and conventions. Inside the new venue the Live Club Restaurant and offices for the Live Club staff treat every aspect of production of an event, from the technical to the creative, administrative, promotional. The Live Club position at the crossroads between the provinces of Milan, Bergamo, and Lecco makes very easy to reach from the entire Lombardy region.

This is Live Club's fourth season of live events and DJ sets in its new structure and has already hosted big national and international artists (Afterhours, Caparezza, Vibrazioni, Joe Satriani, Buddy Guy, Misfits, Marillion, Saxon, Gotthard and many more).

For its fourth season too, national and international artists together with classic tribute bands play on Friday and Saturday nights. The weekly concerts are dedicated to alternative artists on the international music scene events ranging from good old rock to Italian and international reggae, without forgetting metal, electronic music, and hip hop. Before and after the shows the music/images experiment continues thanks to DJ and VJ performances.

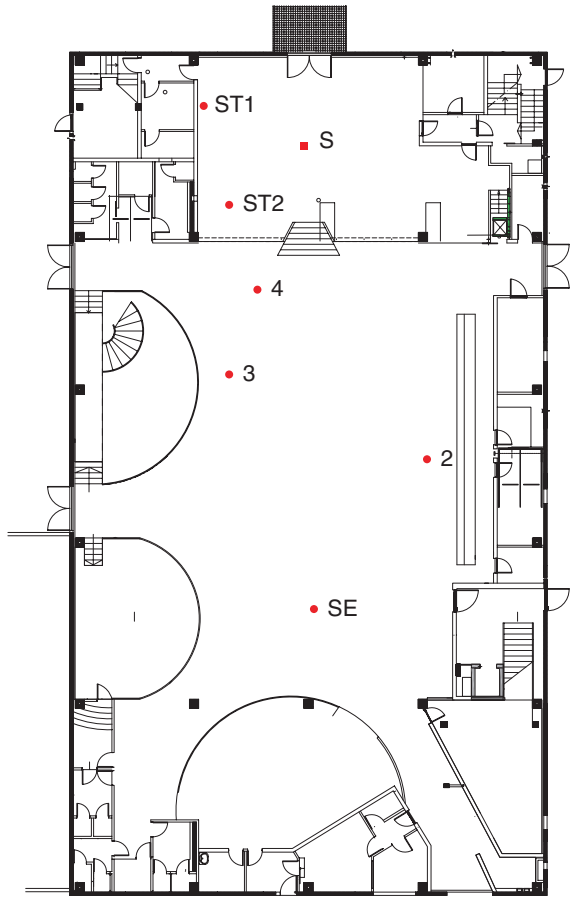
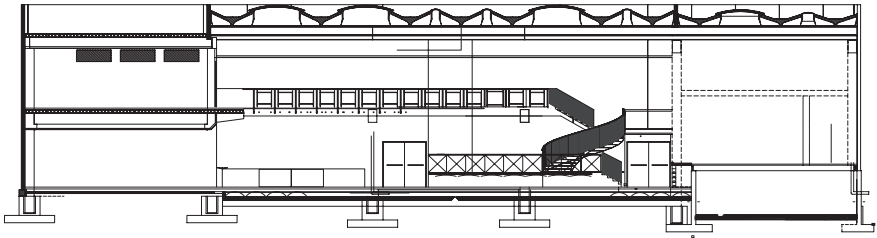
Going beyond traditional expectations, Live Club has also hosted in its brand new structure dance events (such as the 12th Adda Danza International Modern Dance Show) and theater events in cooperation with the city of Trezzo sull'Adda, that used Live Club's stage to organize several initiatives.



Several balcony levels enhance the audience dynamics.



Before sound check: tonight's band enjoying brunch "on the house" while rigging is in process on stage. Large sheets of foam suspended from walls to ceiling create a somewhat silent atmosphere in the bar.



Geometrical data	
Volume	8,000 m ³
Height, audience area	8.7 m
Surface area of stage	270 m ²
Height of stage	1.2 m
$L \times W \times H$	$43 \times 23 \times 8.7$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.17
EDT_{125-2k}	1.15
$C_{80,125-2k}$	2.70
BR_{63} versus 0.5-1k	0.75
BR_{125} versus 0.5-1k	0.96
<i>Stage area</i>	
EDT_{125-2k}	0.73
$D_{50,125-2k}$	0.62
BR_{63} versus 0.5-1k	0.66
BR_{125} versus 0.5-1k	0.67

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Suspended mineral wool with foam product on top.

Walls: Concrete. Over the bar a large area is covered with approximately 5-cm-thick foam slabs with a large distance to wall.

Stage Area

Floor: Vinyl on wood direct on concrete.

Ceiling: Suspended mineral wool with foam product on top.

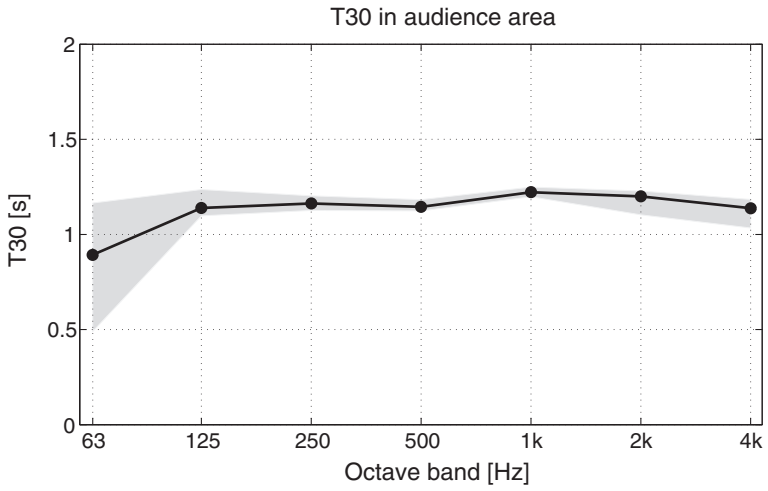
Walls: Backdrops on back wall and side walls.

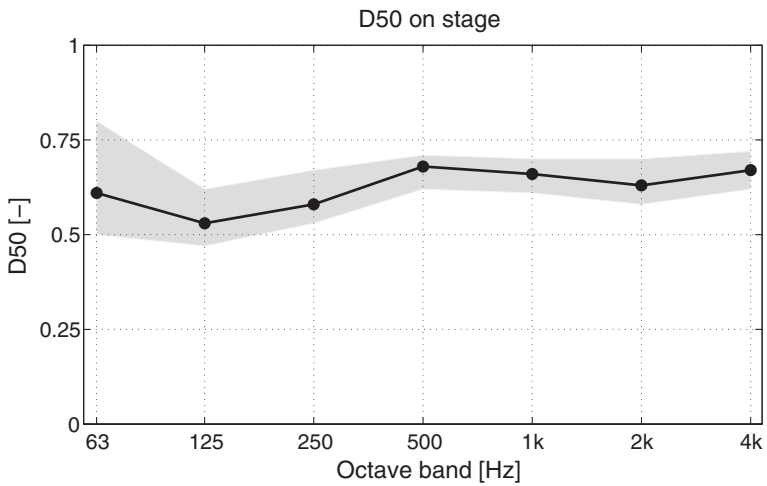
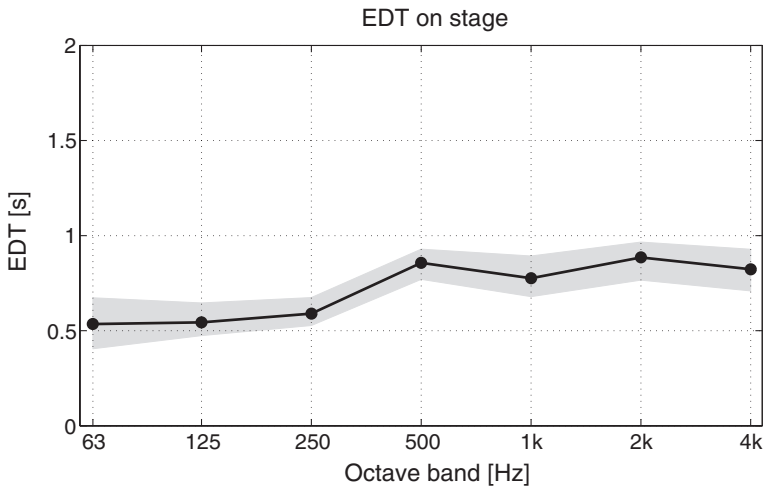
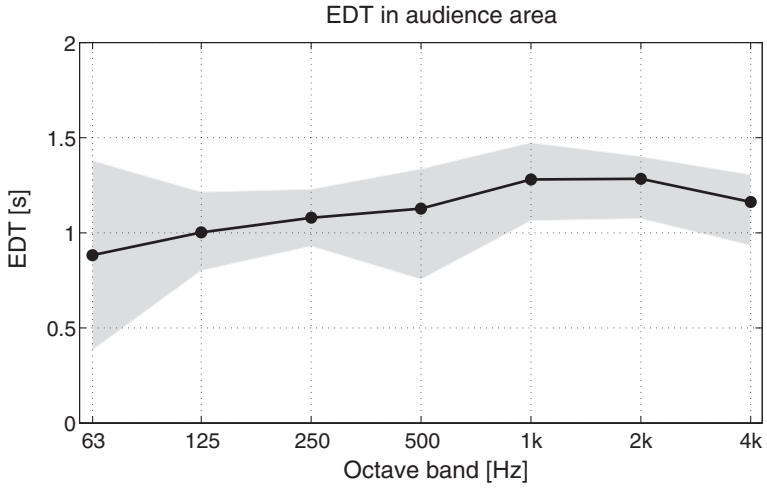
State of Hall When Measured

Empty: lighting rigs on stage.



Live performance at the Live Music Club.





LKA/Langhorn

Stuttgart

Number of concerts per year: 100–120

Founded: 1984

Capacity: 1,500

Architect: N/A

Acoustician: N/A

Er hat hatte sie alle: Nirvana, Sheryl Crow, Nina Hagen, Die Ärzte, Rammstein, Guildo Horn, Nickelback, The Black Eyed Peas, Die Schürzenjäger, Truck Stop, Jeanette Biedermann und und und. Im Liveclub LKA in Stuttgart-Wangen gaben und geben sich die Stars und solche, die es werden wollen, die Klinke in die Hand. Und das seit mehr als 25 Jahren. Das LKA ist zur Institution der Konzerthallen in der Landeshauptstadt geworden.

Damit hatte 1984 keiner gerechnet. Thomas Müller, damals Geschäftsführer der Diskothek Oz, lebte mit seiner amerikanischen Freundin in den Patch Barracks. Da bekam er mit, dass die GIs einen Countryclub vermissten. Im Industriegebiet von Stuttgart-Wangen wurde er fündig. Die Halle eines insolventen Unternehmens erschien geeignet. Wo bislang Durchlauferhitzer gelagert waren, eröffneten sie den Countryclub Longhorn. Mitbewerber beim Insolvenzverwalter damals war übrigens Werner Schretzmeier, der für sein Theaterhaus eine Heimat suchte. Das Longhorn erhielt den Zuschlag—zur Freude der GIs, die schnell den Club bevölkerten. Aber auch Deutsche zählten zu den Kunden, die zu den Klängen des DJs und der Countrybands, die live spielten, tanzten. Das Longhorn wurde zum größten Country—and Westernclub außerhalb der USA, schrieb die US-Zeitung „Stars and Stripes“.

Das erste Rockkonzert sorgte am 14. Dezember 1987 für ein volles Haus. Konzertveranstalter Henning Tögel und seine Moderne Welt suchten für den Auftritt von Nina Hagen eine preisgünstige Location. Das Longhorn, das 1,500 Zuschauern Platz bietet, zeigte sich bereit, Nina Hagen zu empfangen. Der Club platzte aus allen Nähten. „Es war gnadenlos voll“, erinnert sich Thomas Müller. „Die Kellner kamen nicht mehr durch.“ Die Saat war gelegt, Konzerte das zweite Standbein im Longhorn. Auf Nina Hagen folgten am 10. März 1988 Bobby Womack und weitere 40 Bands und Künstler. Innerhalb von neun Tagen gastierten The Pogues („Die haben sich in der Garderobe geprügelt“), The Exploited („Das suchte der Kassierer mit den Einnahmen das Weite“), Linton Kwesi Johnson, Savoy Brown und Truck Stop.

Eine weitere Änderung erfolgte 1993: Die GIs waren abgezogen worden, aus dem Countryclub wurde nach zwei monatigem Umbau das LKA, Longhorn-Kultur-Austausch, mit Livekonzerten, Rockdisco und Nachwuchsförderung. Die Countryutensilien verschwanden, Andy Blattner, der schon Gitarren von Prince besprayen durfte, zauberte Motive aus der Sixtinischen Kapelle („das finde ich neutral, spielen bei uns doch Bands unterschiedlicher Stile“) an die Wände. Am 3.

September 1993 eröffnete das LKA wieder seine Pforten. Weit mehr als 1,000 Nachwuchsbands bot das LKA seitdem Bühne und Plattform, sich unter professionellen Bedingungen Gehör zu verschaffen.

Weiterhin werden namhafte Bands begrüßt, die auf dem Weg in die großen Hallen und Stadien erst einmal das LKA Longhorn bespielten: Die Ärzte, Rammstein, Eminem, Nickelback, Korn, The Black Eyed Peas, Sheryl Crow. 1991 spielten Nirvana im Vorprogramm von Sonic Youth. Die Resonanz war eher bescheiden. Kurz darauf erschien „Nevermind“ mit „Smells like teen spirit“. Der Rest ist Musikgeschichte.

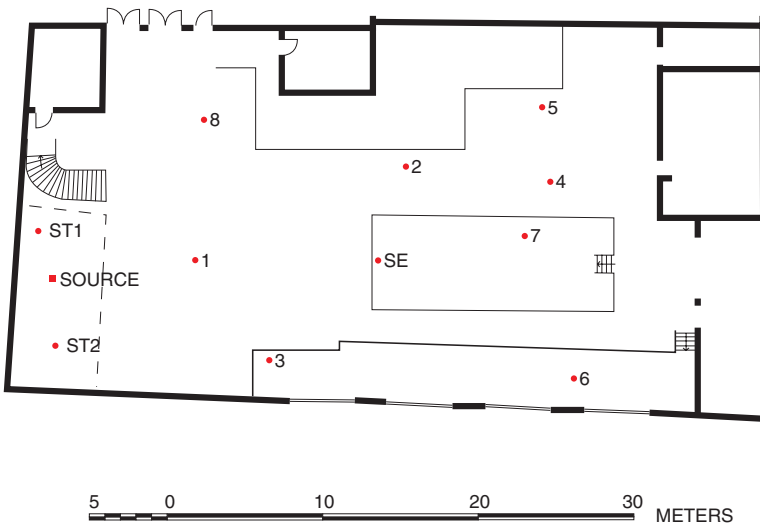
Das Bemühen um den Nachwuchs und das Engagement blieb nicht ohne Folgen: 2004 und 2005 wurde das LKA als bester nicht-geförderter Club ausgezeichnet. 2006 gab es den DASDING-Publikumspreis. Und 2009 erhielt das LKA den Gaston, „Gastro-Award Bester Club in Baden-Württemberg 2009“. Aktuell wurde das LKA 2011 mit dem MARS „Music Award Region Stuttgart“ unter der Rubrik „Best Live Location 1000“ ausgezeichnet. Keine Frage, das LKA Longhorn ist Institution unter den Konzerthallen in Stuttgart.



LKA is a legendary club driven by sheer passion.



A state-of-the-art sound system is united with a traditional style rock club. A formula of the success of the LKA.



Geometrical data	
Volume	Approximately 5,000 m ³
Height, audience area	6–8 m
$L \times W \times H$	40 × 22 × 6
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.15
EDT _{125-2k}	1.13
$C_{80,125-2k}$	3.06
BR ₆₃ versus 0.5-1k	1.42
BR ₁₂₅ versus 0.5-1k	1.33
<i>Stage area</i>	
EDT _{125-2k}	0.47
$D_{50,125-2k}$	0.86
BR ₆₃ versus 0.5-1k	0.66
BR ₁₂₅ versus 0.5-1k	0.89

Materials Used

Audience Area

Floor: Concrete; wood direct on concrete on the dance floor in front of the stage.

Ceiling: 100-mm mineral wool with a 200-mm air cavity behind.

Walls: Concrete; upper half: 10 cm of mineral wool in linen direct on concrete.

Stage area

Floor: Wooden floor on concrete.

Ceiling: 100-mm mineral wool with a 200-mm air cavity behind.

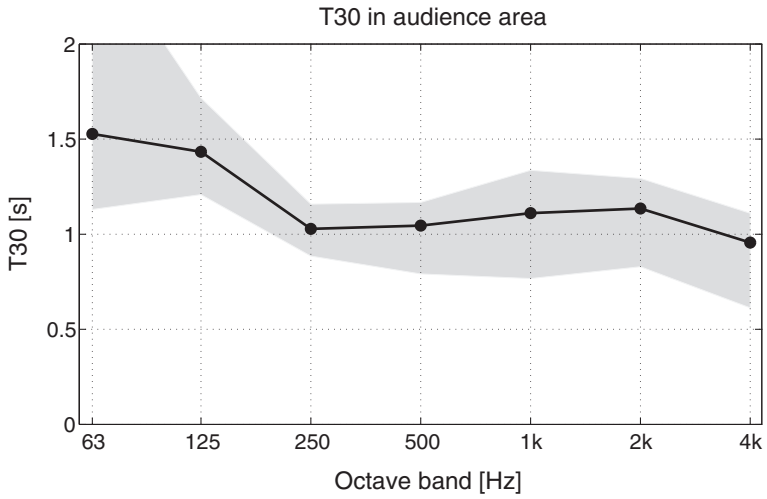
Walls: 5-cm-thick wood fiber slabs with a 3-cm cavity behind.

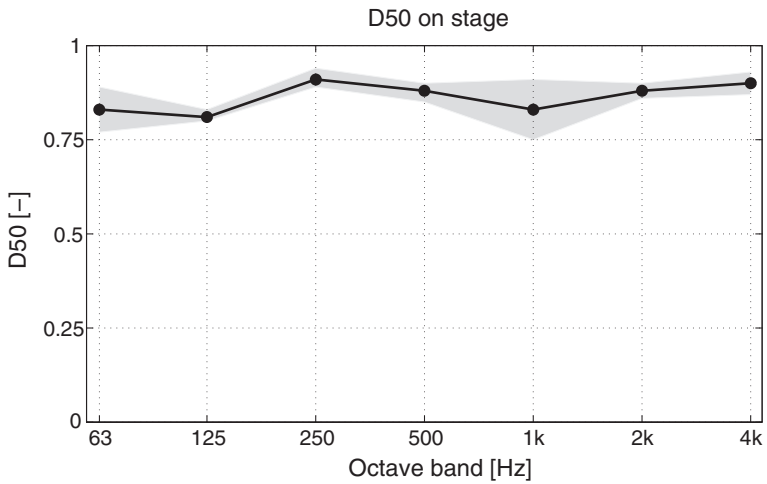
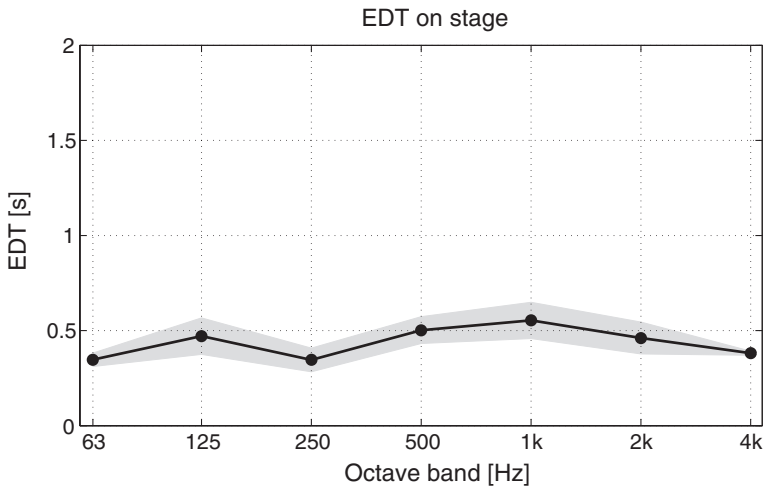
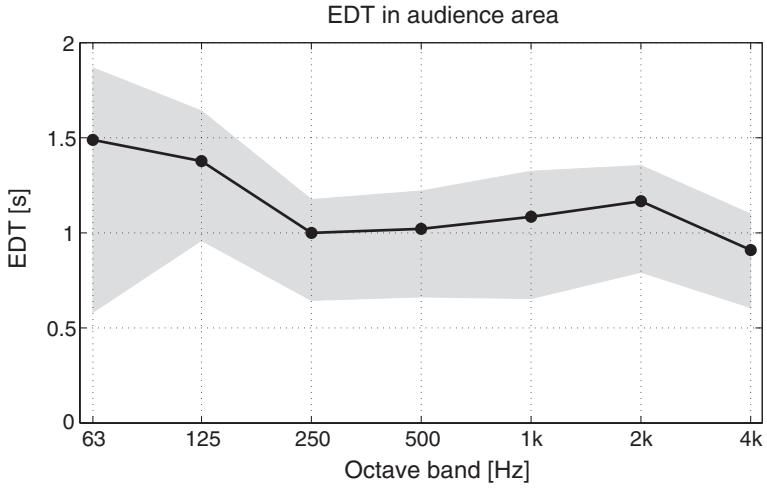
State of Hall When Measured

Empty; chairs and tables are always mounted in the rear half of the room.



The snooker room with posters from famous visiting bands.





Mediolanum Forum

Milan

Number of concerts per year: N/A Total in venue: N/A

Founded: 1990

Capacity: 11,000

Architect: N/A

Acoustician: N/A

The Forum of Milan, which is today called Mediolanum Forum, opened in 1990 and is the main covered polyfunctional venue in the north of Italy.

Along with the PalaLottomatica in Rome, which is also managed by the ForumNet Group, the Mediolanum Forum is the only Italian structure to be included in the prestigious European Arenas Association (EAA), which features important European arenas. The building is arranged over three floors and has a total area of 40,000 m². Thanks to its modularity and suitability for any type of event, over the years it has become a point of reference for the biggest international events, including concerts with the most famous artists, sporting events of primary importance, shows, conventions, fairs, exhibitions, competitions, and television productions as well as smaller events, such as gala dinners and pre- or after-show activities. The Mediolanum Forum offers various internal spaces with different dimensions and characteristics. These can be used simultaneously or independently, as required by the type of event. As well as the Central Arena, the venue offers the Premium, Gallery, and Gold Halls, the Quota Otto spaces, and various external spaces. The Arena's upper tier (Quota Ventuno) hosts the "Sky Belvedere," a refined environment that directly overlooks the parterre and can be exclusively reserved for press conferences, meetings, and corporate hospitality activities. The Mediolanum Forum has ample dedicated parking facilities and will soon have a dedicated stop on Line 2 of the Milanese Underground.

The Central Arena is the heart of the Mediolanum Forum. It is the largest space within the venue and is situated at 4.96 m above the external ground level.

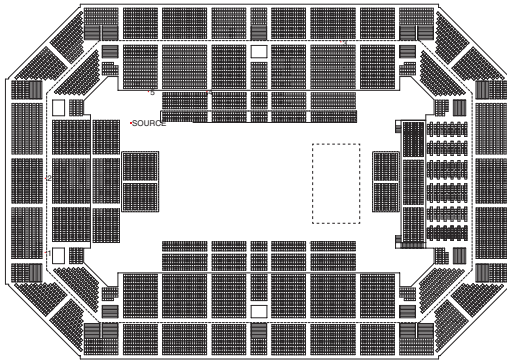
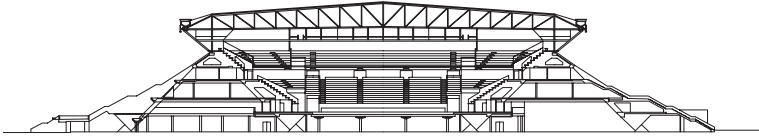
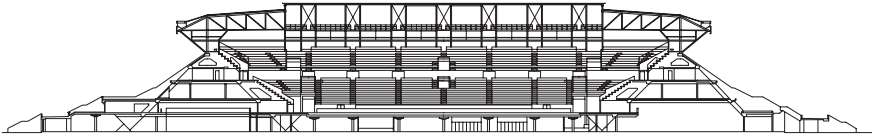
As well as hosting international music star concerts, large shows, and sporting events with different space configurations and areas, the Central Arena also hosts conventions, gala dinners and receptions, competitions, and fairs. Different space configurations can in fact be offered through the use of the building's long or short sides, the stalls, a modular use of the stands, and so on. A dimming system for the stands enables the capacity to be reduced from 11,000 to 3,500 places, and the parterre area alone can host more than 2,000 seated people. Along the two sides of the Arena there are 12 changing rooms of different sizes (that are available as service spaces) and loading and unloading take place through a roomy freight elevator and two vehicle entrances that lead straight to the parterre area. The versatility of the Central Arena is completed by the vertical height of the space which leaves plenty of room for all types of equipment to be suspended.



Mediolanum Forum is a traditional sports arena that changes its name from time to time.



A young and helpful crew meets those visiting the venue during office hours.



Geometrical data	
Volume	Approximately 150,000 m ³
$L \times W \times H_{(\max)}$	Approximately. 117 × 81 × 26 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	2.46
EDT_{125-2k}	2.56
$C_{80,125-2k}$	-8.98
BR ₆₃ versus 0.5-1k	1.26
BR ₁₂₅ versus 0.5-1k	1.05

Materials Used

Audience Area

Floor: Concrete.

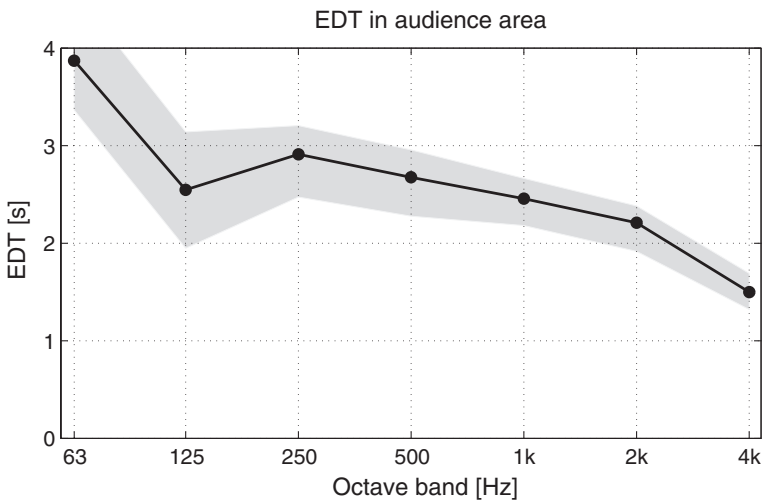
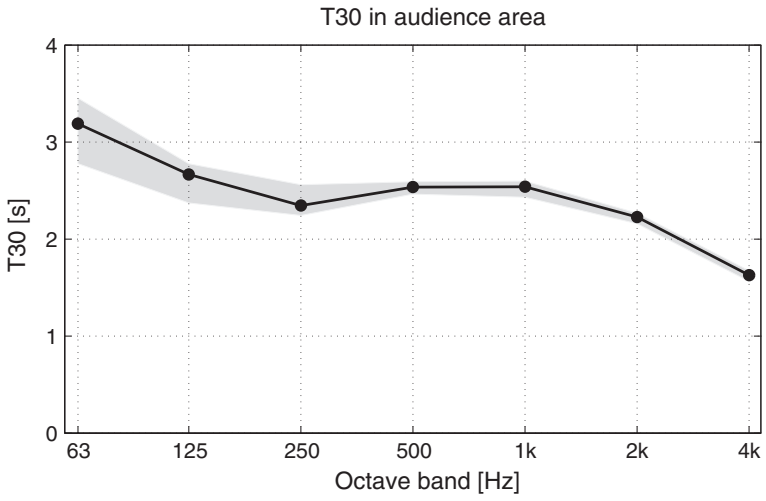
Ceiling: Perforated metal.

Walls: Concrete.

Seats are made of unupholstered plastic.

State of Hall When Measured

Empty; no additional seats mounted. Curtains drawn in front of the upper balcony level as for the 7,000 person configuration. Floor covered with rubber layer for the installment of the ice hockey field. Speakers were put in a 90-degree angle unlike measurements in other venues because of work on the floor.



Melkweg—The Max

Amsterdam

Number of concerts per year: 150. In both halls in the venue: 400

Founded: 1970 (Melkweg)/1995 (this hall, The Max)

Capacity: 1,500

Architect: Jim Klinkhamer (Jonkman & Klinkhamer Architects)

Acoustician: N/A

Owner: The building is owned by Municipality of Amsterdam. Melkweg is a foundation

The Melkweg (English translation: “Milky Way”) is a popular music venue and cultural center in Amsterdam, the Netherlands. It is located on the Lijnbaansgracht, near the Leidseplein, a prime nightlife center of Amsterdam. It is housed in a former factory and warehouse and is divided into a number of spaces of varying sizes. In addition to a large hall for rock and pop music concerts (The Max), there’s a second space for live music and there are also spaces for dance/theater, cinema, photography, and media-art. The Melkweg is run by a nonprofit organization that has existed since 1970. The building itself dates back to 1898.

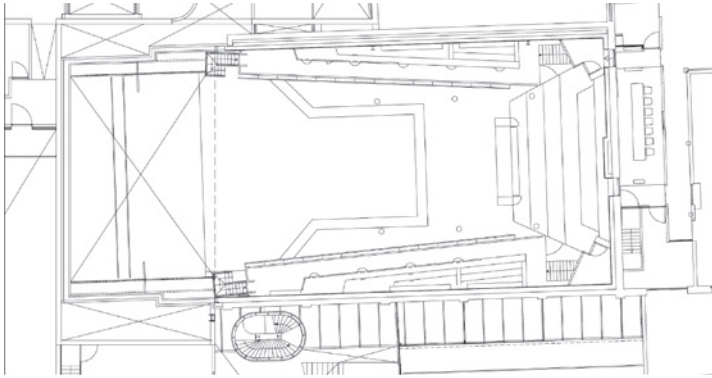
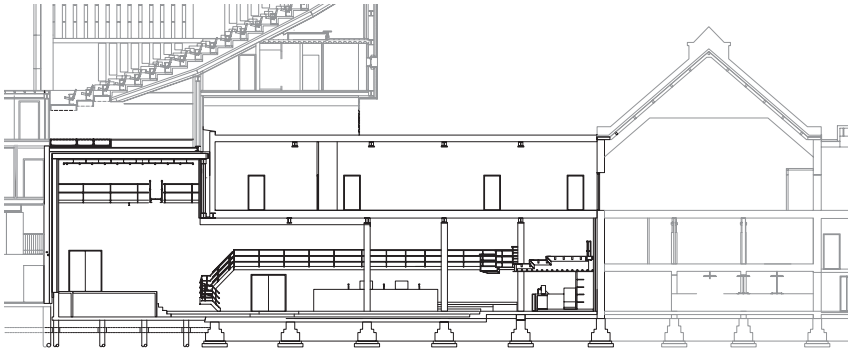
In 40 years, Melkweg developed from a social cultural meeting place to a professional cultural center, attracting over 400,000 visitors a year. Many of the big stars of pop and world music have performed here in their early days, including the Grateful Dead, U2 (first show outside Northern Ireland), Youssou N’Dour, Nirvana, Prince, Lady Gaga, and so on. The Melkweg originally had a concert hall with a capacity of 700, and extended it by creating a second, larger space for live music in 1995: The Max. This hall was enlarged from 1,000 to 1,500 capacity in 2007. Since 2009 Melkweg also programs concerts in the new Rabozaal (1,400 capacity), created together with their neighbors: the City Theatre. Photos © DigiDaan/Melkweg.



Melkweg is a legendary Amsterdam rock club.



Acousticians have obtained a high degree of absorption even at low frequencies in the ceiling.



Geometrical data	
Volume	2,600 m ³
$L \times W \times H$	32 × 15 × 5.6 m
Height of stage	1.7 m
Stage opening	14.5 × 4 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.81
EDT _{125-2k}	0.78
$C_{80,125-2k}$	6.03
BR ₆₃ versus 0.5-1k	0.76
BR ₁₂₅ versus 0.5-1k	0.78
<i>Stage area</i>	
EDT _{125-2k}	0.32
$D_{50,125-2k}$	0.9
BR ₆₃ versus 0.5-1k	1.12
BR ₁₂₅ versus 0.5-1k	0.83

Materials Used

Audience Area

Floor: Rubber on concrete.

Ceiling: Suspended mineral wool with large cavity above.

Walls: Layers of gypsum board on cavity. End wall: wooden fiber slabs.

Stage Area

Floor: Wood on cavity.

Ceiling: Suspended mineral wool with large cavity above.

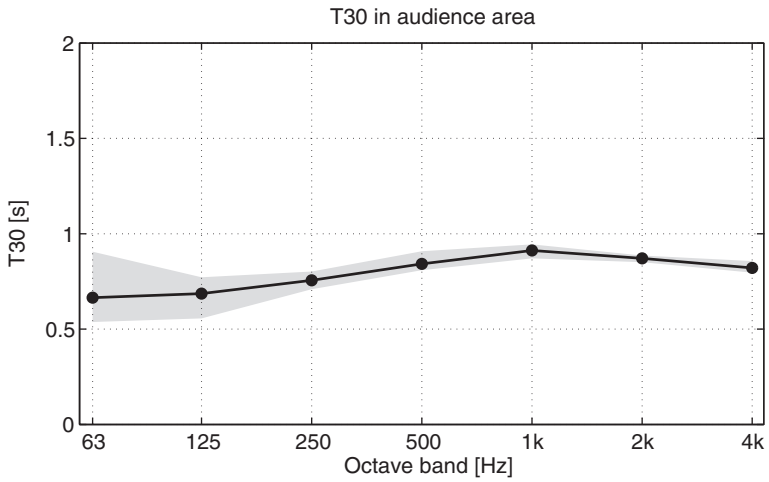
Walls: Layers of gypsum board on cavity. End wall: wooden fiber slabs. Backdrop.

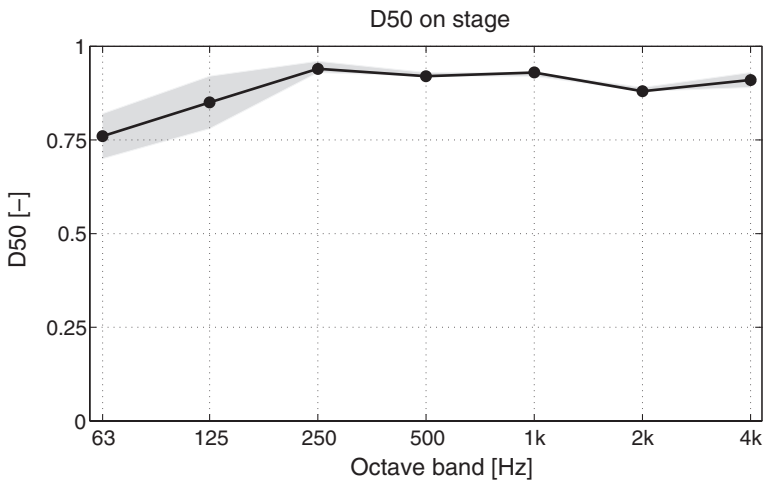
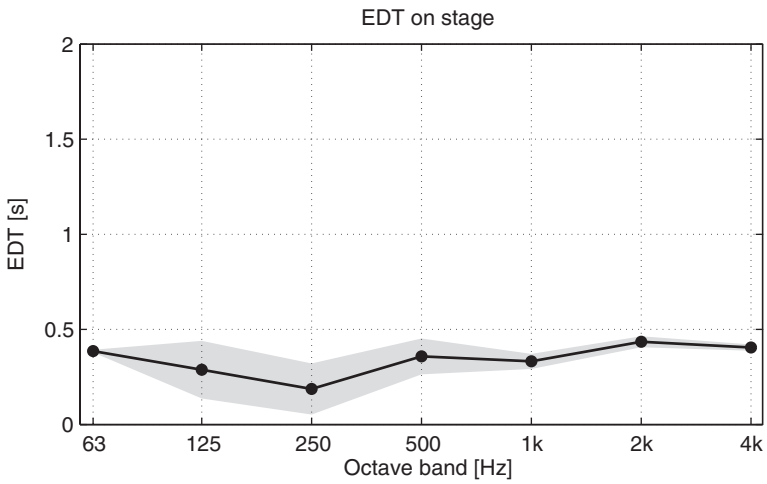
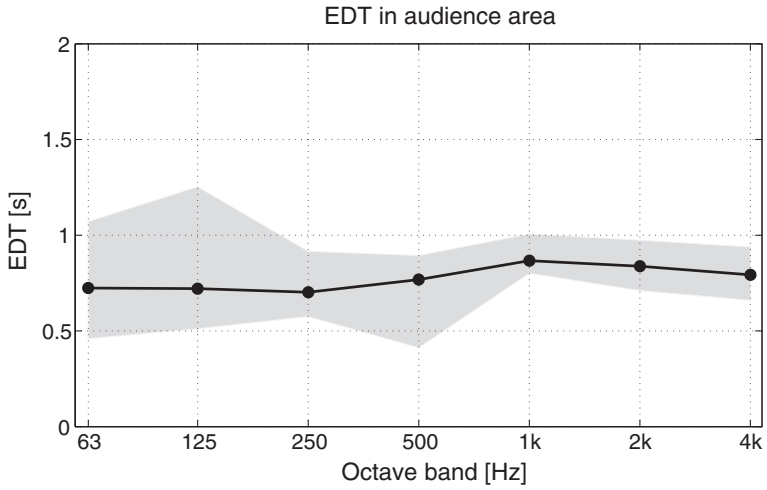
State of Hall When Measured

Empty: some equipment on stage.



Melkweg audience.





MEN Arena

Manchester

Number of concerts per year: 75+

Founded: 1995

Capacity: 21,000

Architect: DLA/Elerbe Beckett

Acoustician: Ove Arup and Partners

The Manchester Evening News Arena, managed and operated by SMG Europe, is one of the busiest venues in the world and the largest indoor arena in Europe. Opened in 1995, the MEN Arena has staged the biggest names in live entertainment from U2, the Rolling Stones, Madonna, and Pavarotti to the record-breaking 2010/2011 residency by local comedian Peter Kay. Attracting over one million visitors each year, the 21,000 capacity Arena was named “International Venue of the Year” in 2002 by industry publication *Pollstar* and has been nominated an unrivaled 10 consecutive times.

In 1995 the venue was officially opened by Torvill and Dean who broke the UK Box Office record for a single ice performance to over 15,000 fans. In 1998 Ricky “Hitman” Hatton beat Karl Taylor in his debut MEN Arena bout, the first of 14 fights at his hometown venue. 1999 saw the Arena host the homecoming of Manchester United after they won “The Treble.” In 2000 Mike Tyson’s UK debut fight at the Arena was watched by over 100 million people worldwide. 2001 saw local band James perform their farewell show at the Arena, before returning with a sell-out concert in 2007! The venue also held the 2002 Commonwealth Games’ Boxing and Netball tournaments, as well as U2 playing to 19,384 fans, the biggest single audience of their European Elevation Tour. Bono declared the MEN Arena “the best concert venue in the country.” In 2004 Madonna returned to Manchester for the first time since her 1980s British debut at the infamous Hacienda to perform two sell-out shows. In 2005 Comedian Lee Evans broke the Guinness world record for a solo act performing to the biggest comedy audience and comedian Peter Kay, who used to work as a MEN Arena Steward, returned with his record-breaking “Mum Wants A Bungalow” Tour. Now an annual event, the first Versus Cancer charity concert was staged by Ex-Smith’s member Andy Rourke in 2006. 2007 saw Kylie Minogue crowned as the biggest-selling solo artist in the history of the Arena after her January Showgirl Homecoming dates bring her total Arena performances to 17; and local band Take That became the biggest-selling act of all time with a total 27 MEN Arena performances following their 11 shows in December. In 2008 the Arena became the UK’s first music and entertainment venue to host competitive swimming after staging the 9th FINA World Short Course Swimming Championships in April and the Arena became Kylie Minogue’s number one venue after official figures reveal the international pop star has performed more shows at the Arena—and to more people—than any other venue in the world. Peter Kay broke box office records in 2009 after all 20 nights for his 2010 spring residency sold out in an hour. The local comedian later

announced he would return for an additional eight shows in 2011. In 2009 Westlife announced they would return to the Arena with two 2010 shows making them the biggest selling group (29 performances) in the history of the venue, surpassing the joint record held with Take That. Also in 2009 the Arena's summer family blockbuster, "Walking With Dinosaurs" won "Best Family Show" at the Manchester Evening News Theatre Awards, and the venue smashed attendance figures after welcoming over one and a half million ticketholders. The MEN Arena celebrated its 15th anniversary with a star-studded Birthday Bash featuring Alexandra Burke, Scouting For Girls, Pixie Lott, The Script, Beverley Knight, The Saturdays, and many others. The summer of 2011 saw the Manchester venue stage the world premiere of *Batman Live* (July) and the European premiere of *Glee* (June) as well as Kylie cementing her position as the biggest selling solo artist in the history of the venue after her four "Aphrodite Les Folies" in April shows brought her total Arena performances to 27, and the Children In Need Rocks Manchester in November, featured a star-studded line-up including Gary Barlow, Coldplay, Lady Gaga, JLS and local favorites Elbow.

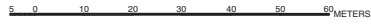
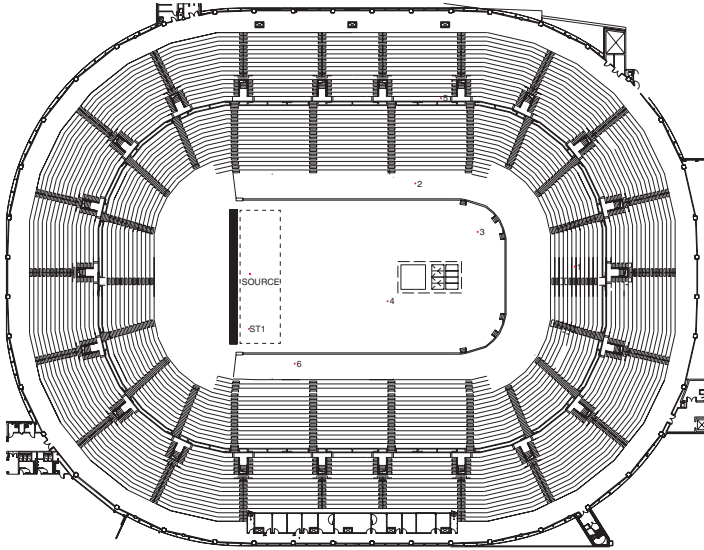
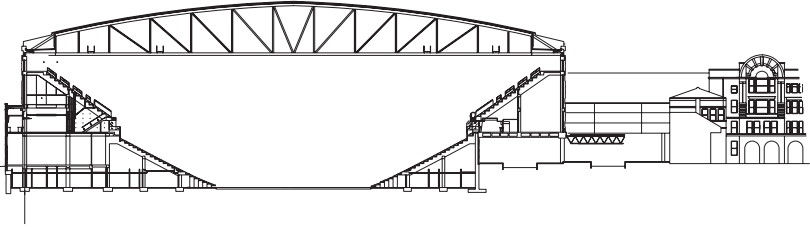
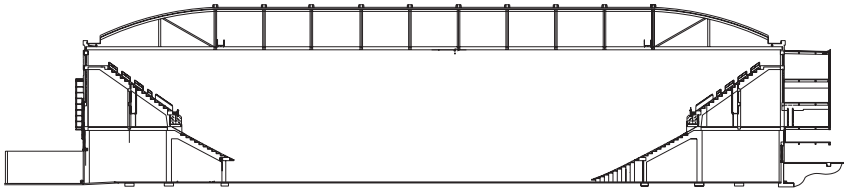
*Based on concert ticket sales between January 2002 and June 2007, as calculated by *Pollstar*.



MEN in full swing. Photo: Karin Albinsson.



Curtains in front of seats do not have a significant impact on T_{30} when they are upholstered. Curtains can on the other hand be used in front of reflective surfaces to prevent echoes and for lowering T_{30} at higher frequencies.



Geometrical data	
Volume	NA
$L \times W \times H$	$130 \times 100 \times 36$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	2.47
EDT_{125-2k}	2.22
$C_{80,125-2k}$	-0.40
BR ₆₃ versus 0.5-1k	1.46
BR ₁₂₅ versus 0.5-1k	1.34

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Thin metal trapez, perforated.

Walls: Very little wall area of concrete.

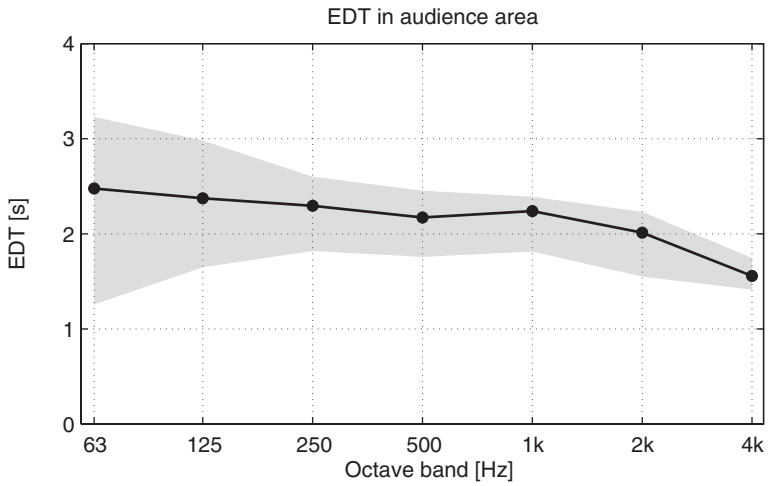
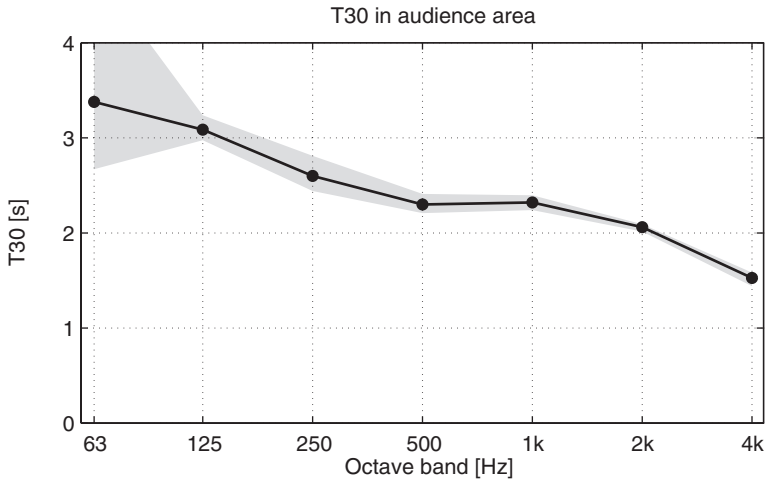
Chairs are upholstered also on rear back.

State of Hall When Measured

Empty; some rigging on floor. Most of the end of the venue was detached by large curtains probably causing only a very slight drop in reverberation time mostly above 1 kHz.



Roger Waters secures the fireworks in the MEN.



Nosturi

Helsinki

Number of concerts per year: 120

Founded: Built in 1957, converted to a concert hall in 1999

Capacity: 900

Architect:

- Original building 1957- Kaj Salenius.
- Conversion 1999- Jan Tromp and Markus Nevalainen, Valvomo Architects.

Acoustician: Akukon/Henrik Möller.

Nosturi, a live music venue with a character as versatile as that of its visitors, sits by the seaside near downtown Helsinki. The shipyard's old warehouse is operated by the Live Music Association (ELMU ry), whose offices can be found within, along with a fully licensed restaurant and rehearsal spaces for 50 bands.

Nosturi takes pride in providing a platform for a broad spectrum of culturally relevant events, including—but not limited to—concerts, raves, youth discos, performing arts, theatre, and art gallery functions. Everything from unknown underground bands to the largest mainstream acts have graced the stage of Nosturi at one time or another.

There are over 120 shows a year in the main hall and over 100 gigs downstairs at the bar.

Nosturi's main hall operates on two floors, which means that the maximum audience capacity is nothing short of 900 people. The floor level in Nosturi is narrower than the balcony level. One end of the space houses the sizeable stage, which can be observed from both floors.

The ground floor is also home to the restaurant, going by the name of Ravintola Alakerta, which serves as an excellent venue for smaller gigs and events. Alakerta can manage up to 120 standing guests, and works ideally for parties of about 70 seated guests. What is more, the outdoor summer terrace at the waterfront can comfortably seat well over 100 people in the sunshine.

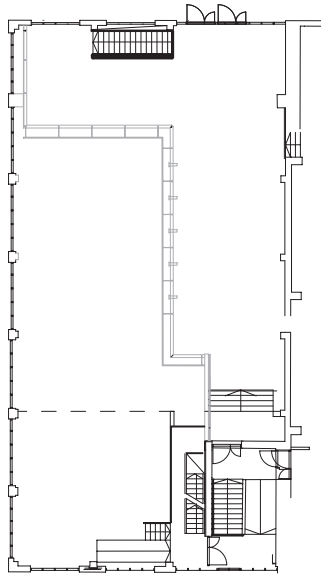
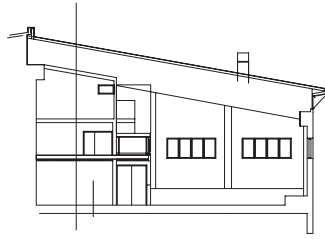
As a venue, Nosturi is easily modifiable to suit a particular purpose by altering interiors and fittings. The mezzanine, for example, can seat an audience of 250. Whether the event requires a motorcycle-able catwalk, a dinner table the length of the entire venue, or a retractable roof, everything can be (and has been!) done. Should your guests wish to arrive directly to the venue by boat, this is also possible. Naturally.



What it is all about! Photo: Eeka Mäkynen.



Classic rock venues are often found in uninhabited areas. Photo: Eeka Mäkynen.



Geometrical data	
Volume	3,000 m ³
$L \times W \times H$	29 × 14 × 6–10 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.64
EDT_{125-2k}	NA
$C_{80,125-2k}$	NA
BR ₆₃ versus 0.5–1k	2.48
BR ₁₂₅ versus 0.5–1k	1.89

Materials Used

Audience Area

Floor: Mainly concrete; raised platforms are wood on cavity.

Ceiling:

- Main ceiling: Mineral wool on concrete.
- Ceiling under balcony: Porous plate made of wood shavings and cement.

Walls: Brick and concrete, curtains and some absorbtive wall plates directly on walls.

Stage Area

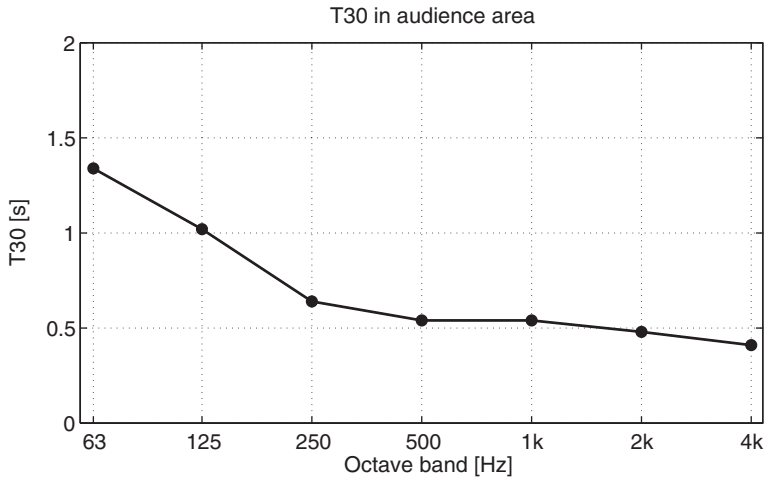
Floor: Plywood.

Ceiling: Mineral wool on concrete.

Walls: Brick and concrete with molton curtains.

State of Hall When Measured

Empty.



O₂ Berlin

Berlin

Number of concerts per year: 70. In all halls in the venue: 100

Founded: 2008

Capacity: 17,000

Architect: HOK/Kansas City

Acoustician: Wolfgang Ahnert/Acoustic Design Ahnert

Since opening on September 10th, 2008 the O₂ World Berlin has changed Germany's entertainment landscape. Owned and operated by the Anschutz Entertainment Group, one of the leaders in the sport and entertainment business, the O₂ World is widely regarded as one of Europe's most modern arenas. It is the main stage in the German capital for sports and entertainment with a capacity of up to 17,000 fans including club seats, luxury suites, private restaurants, clubs, and hospitality spaces in addition to a full array of the most modern amenities.

The Kansas City based architectural firm HOK was responsible for designing the arena that was constructed in just 727 days. The development process was managed and controlled by ICON Venue Group to complete the project on time and on budget. The O₂ World debuts many never-before experienced technological systems, conveniences, and features including one of the world's largest architectural LED lighting grids. Spanning across the entire south glass façade on the exterior of the new arena, the breathtaking 1,390-m² installation displays motion graphics and video content on a massive scale. Acoustic Design Ahnert (ADA) was contracted to secure the optimal acoustical set-up for the O₂ World. To reduce the reverberation time sound-absorbing material was installed throughout the arena bowl such as ceiling banners and panels on all the walls.

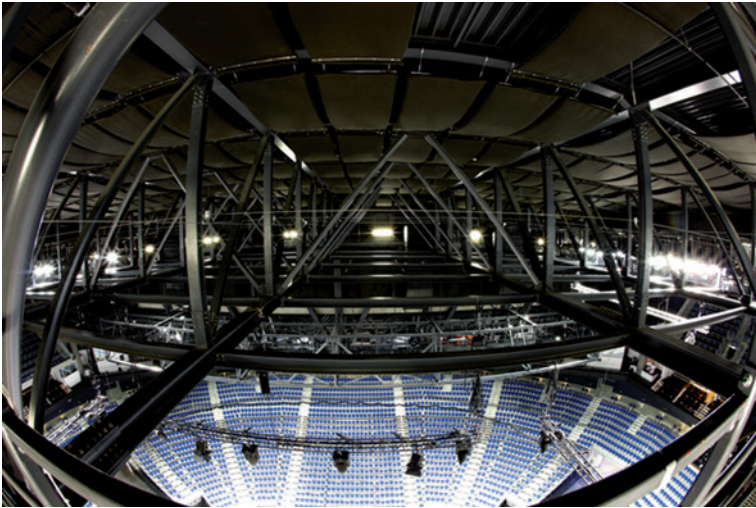
Right from the start O₂ World was put to test with four events in as many days. Opening weekend kicked off with Metallica blasting the inaugural tunes, followed by Herbert Grönemeyer the next day. Music took a break for a hockey game on day three, but was back with a Coldplay concert to complete the premiere. Although the ambitious opening program made the O₂ World an instant success, it did not happen without the expected and unexpected challenges of "breaking in" a brand new arena. Due to a busy PR schedule for the release of their record, *Death Magnetic*, Metallica were a little behind schedule and conducted their sound check while 17,000 anxious fans were already lined up outside the arena. Herbert Grönemeyer, playing a center-stage gig for the first time, performed until way after midnight, thereby challenging crew and production to execute the changeover to the hockey game, scheduled for the next afternoon, in an almost impossible time frame.

Since then O₂ World has become a must-play venue featuring concerts by Paul McCartney, Tina Turner, Pink, Eagles, Eric Clapton, Elton John, Neil Young, Kings of Leon, Supertramp, Alicia Keys, Beyoncé, The Scorpions, Lady Gaga, Joe Cocker, Kiss, Rod Stewart, Sting, Peter Gabriel, Leonard Cohen, and Depeche Mode including several own-promoted events by artists including The Black Eyed

Peas, Paul van Dyk, Die Fantastischen Vier, and Britney Spears. It has also hosted the MTV European Music Awards and the German Music Awards ECHO.



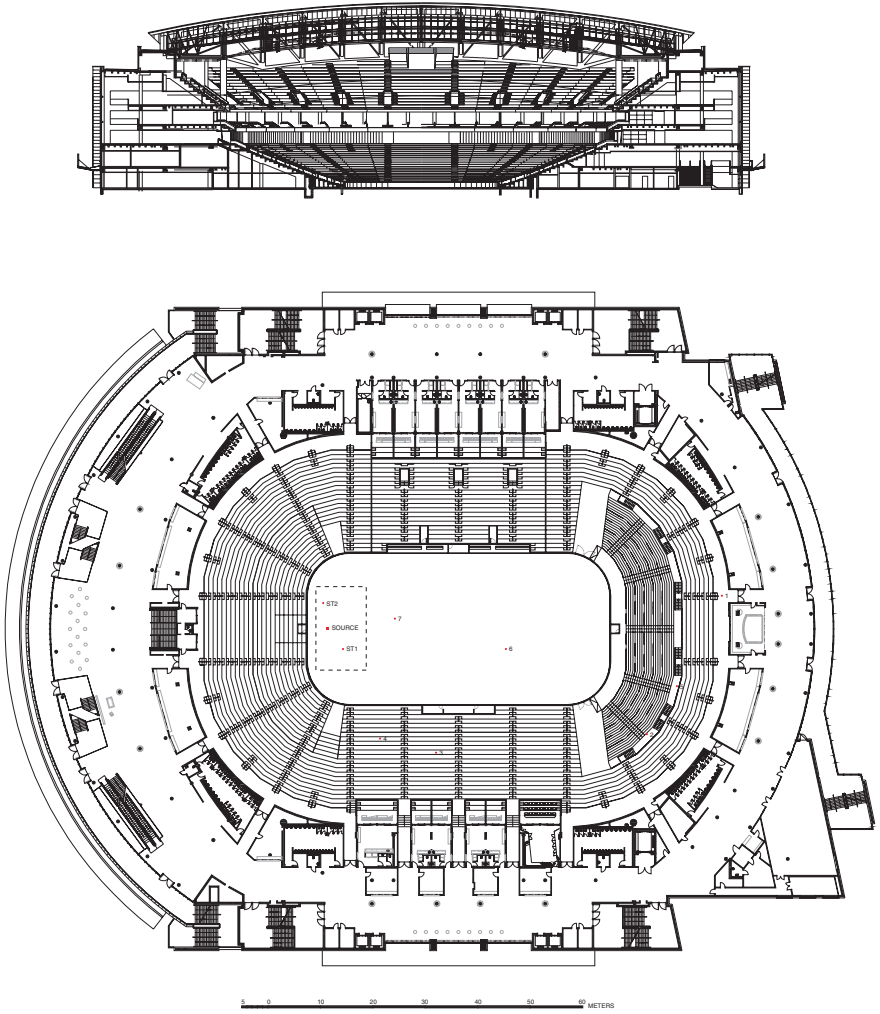
O₂ Berlin.



The American way: thick porous banners in the ceiling installed for broadband absorption.



There is 20-cm mineral wool behind the perforated metal walls with double gypsum plates behind. A good combination of absorption and insulation is achieved for the purpose.



Geometrical data	
Volume	280,000 m ³
$L \times W \times H_{(\max)}$	100 × 95 × 35 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	2.44
EDT_{125-2k}	2.03
$C_{80,125-2k}$	-0.65
BR ₆₃ versus 0.5-1k	1.7
BR ₁₂₅ versus 0.5-1k	1.19

Materials Used

Audience Area

Floor: Vinyl on concrete.

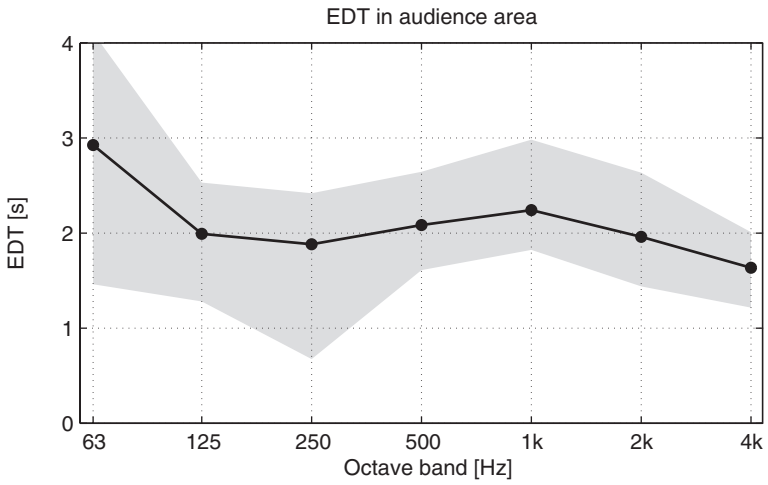
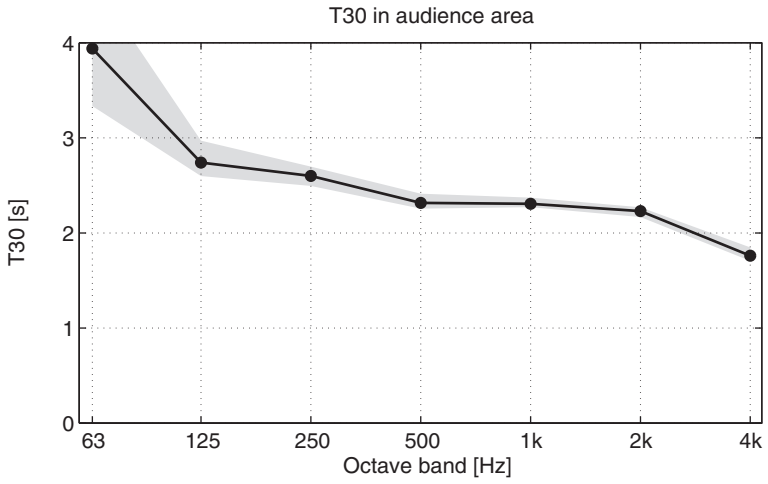
Ceiling: Thin trapezoid metal nonperforated. Suspended approximately 6-cm thick porous absorptive banners at a distance from approximately 0.3–0.6 m from metal.

Walls: Perforated metal then 20-cm mineral wool and then double layer gypsum in front of large cavity.

Seats are upholstered.

State of Hall When Measured

Empty; no seats mounted on floor.



O₂ World Hamburg

Hamburg

Number of concerts per year: 50. Total number of events: approximately 130

Founded: 2002

Capacity: 16,000

Architect: EVATA Finland OY (now Pöyry)

Acoustician: EVATA Finland OY (now Pöyry)

On November 8, 2002 the largest multifunctional arena in northern Germany opened its gates. The EVATA Finland OY Company was responsible for the building's architecture and acoustics. The arena can host up to 16,000 people. Since its opening the arena hosted more than 1,100 concerts, shows, and sporting events. Stars such as Alicia Keys, Beyoncé, Bon Jovi, Bruce Springsteen, Paul McCartney, Metallica, Shakira, Take That, and KISS performed in the venue, formerly known as Color Line Arena. Many boxing world champions were crowned and the home teams Hamburg Freezers (hockey) and HSV Handball (handball) celebrated goals and victories. About 130 events take place every year with more than one million visitors attending the shows, concerts, and home games. The arena can be minimized to a 6,500- and even a 4,000-person configuration.

Since fall of 2007 the O₂ World Hamburg is part of the Anschutz Entertainment Group, a subsidiary of the Anschutz Corporation, one of the world's leading sports and entertainment presenters. In April 2010 the arena was renamed O₂ World Hamburg and has since undergone remodeling to make one of Europe's most modern arenas even more attractive.

During the remodeling process a state-of-the-art 360-degree LED board was installed below the upper gallery. Also remodeled were 24 of the suites in the arena. The guests can choose between three different styles: classic, lounge, and high table. A highlight for special occasions is the show suite. Up to 48 people can enjoy an event in the new suite, which also can be separated into two suites with 24 seats each.

Upgrading their premium and suites sections, the O₂ World Hamburg started to build an extension to the existing building in April of 2011. The extension, which will be finished in the spring of 2012, will serve as the new entry for the arena's premium guests and suite-holders. It will offer new ways for hospitality thanks to a state-of-the-art club level and lounge level and it will be home for several new offices for arena employees.

As one of Europe's most modern multifunctional arenas the O₂ World Hamburg is open for almost any idea artists may come up with. Rammstein is known to play with fire. Cirque de Soleil once used a stage that was 40 m long. The Ben Hur show featured a historic Roman setting and live chariot racing. German rock icon Peter Dinklage entered the stage on a Harley Davidson motorcycle. The *Dinosaur* show brought the giants from primeval times back to life. And the *Night of the Jumps* featured the world's most exciting motocross stunt show, with the riders almost touching the roof.

The O₂ World Hamburg hosts all these concerts, shows, and sporting events for one reason: to entertain Hamburg. And so it does; it had 146 events in 2010 and was thereby ranked number 8 in the annual *Pollstar* magazine ranking of the top 100 concert arenas worldwide in ticket sales.



The O₂ World Hamburg is a busy arena that some may know by its former name: Color Line Arena.



The line of color is kept blue.

Geometrical data	
Volume	500,000 m ³
$L \times W \times H_{(\max)}$	150 × 110 × 33 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	2.66
EDT_{125-2k}	2.49
$C_{80,125-2k}$	-2.69
BR ₆₃ versus 0.5-1k	2.58
BR ₁₂₅ versus 0.5-1k	1.69

Materials Used

Audience Area

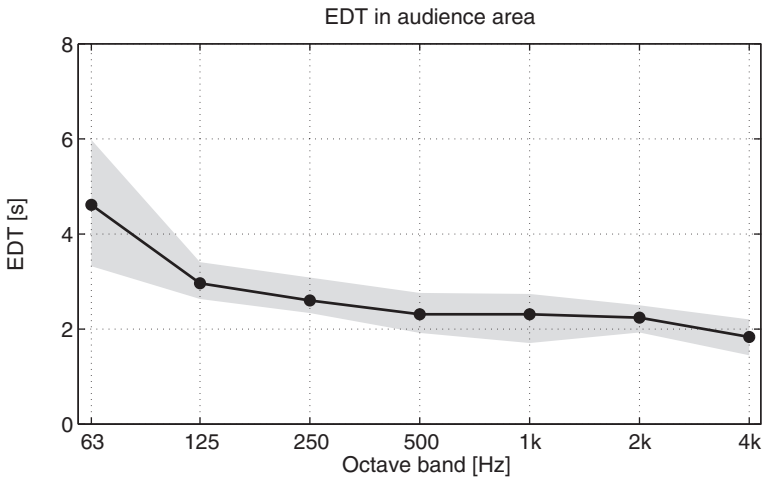
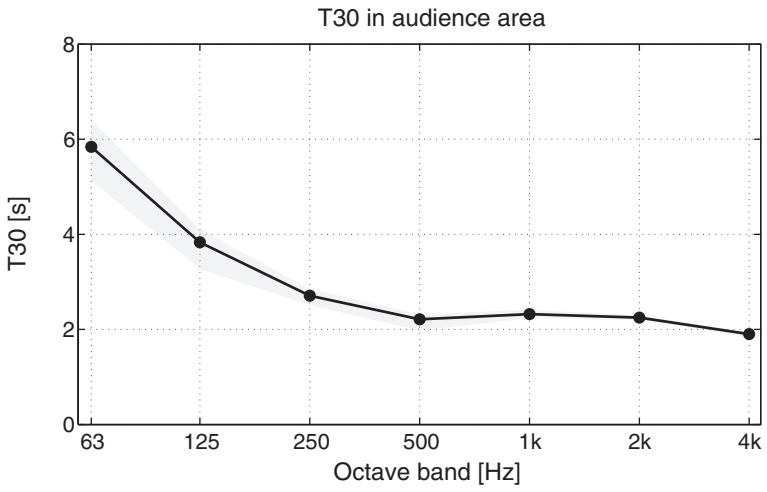
Floor: Concrete.

Ceiling: A layer of trapezoidal sheet metal without perforation, then a layer of solid insulation and roofing felt on top.

Walls: Walls made of lime-sand brick. The walls on the lower level are completely covered in cotton material.

State of Hall When Measured

Empty; no additional seats mounted.



O₂ London

London

Number of concerts per year: 60. In all halls in the venue: 120

Founded: 2007

Capacity: 20,000

Architect: N/A

Acoustician: Vanguardia Consulting

The O₂, visually typeset in branding as *The O₂*, is a large entertainment district on the Greenwich peninsula in South East London, England, including an indoor arena, a music club, a Cineworld cinema, an exhibition space, piazzas, bars, and restaurants. It was built largely within the former Millennium Dome, a large dome-shaped building built to house an exhibition celebrating the turn of the third millennium; as such, *The Dome* remains a name in common usage for the venue. Naming rights to the district were purchased by O₂ plc (now Telefónica Europe plc) from its developers, Anschutz Entertainment Group (AEG), during the development of the district. AEG owns the long-term lease on the O₂ Arena and surrounding leisure space.

Construction of the arena started in 2003 and finished in 2007. Owing to the impossibility of using cranes inside the dome structure, the arena's roof was constructed on the ground within the dome and then lifted. The arena building's structure was then built around the roof. The arena building, which houses the arena and the arena concourse, is independent of all other buildings in The O₂ and houses all the arena's facilities. The whole arena building takes up 40 % of the total dome structure. The venue, rebranded the O₂, was reopened to the public on June 24th, 2007 with a concert by Bon Jovi in the arena. The O₂ celebrated its first year with a book, including a double-page picture of Elton John from his September 2007 *Red Piano* show.

The seating arrangement throughout the whole arena can be modified, similar to the Manchester Evening News Arena [4]. The ground surface can also be changed among ice rink, basketball court, exhibition space, conference venue, private hire venue, and concert venue. The arena was built to reduce echoing which has previously been a problem in many London music venues [5]. The sound manager for U2, Joe O'Herlihy, worked with acoustic engineers on acoustics.

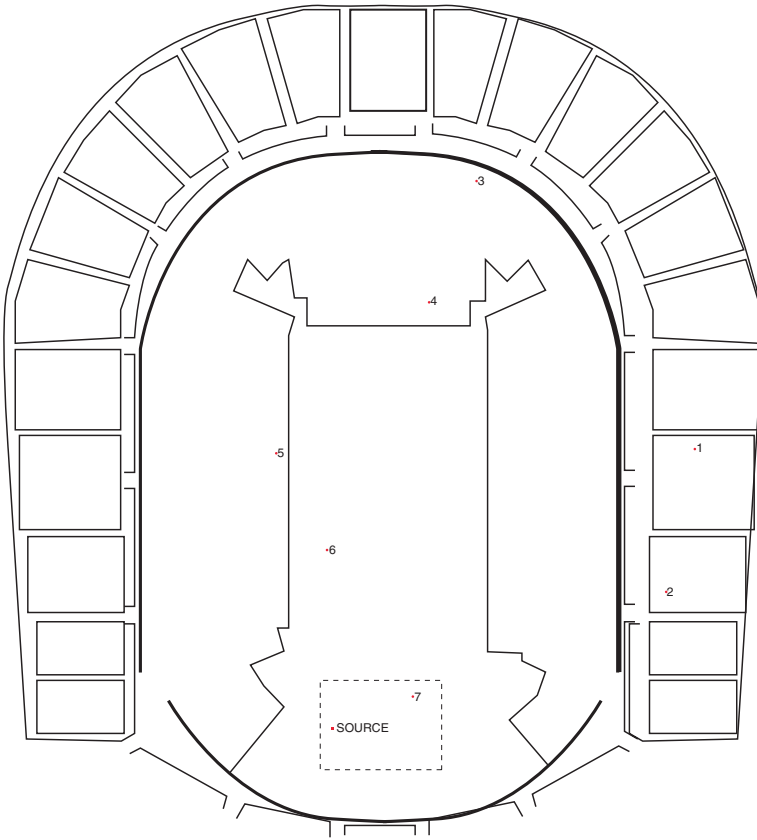
Despite The O₂ arena's being open for only seven months of the year, the venue sold over 1.2 million tickets in 2007, making it the third most popular venue in the world for concerts and family shows narrowly behind the MEN Arena (1.25 million) and Madison Square Garden in New York (1.23 million). In 2008, it became the world's busiest venue taking the crown from the MEN Arena with sales of more than two million [6]. The O₂ arena since its opening in 2007 has been host to many concerts, from UK bands and artists to international superstars. The O₂ was named the "World's Best Venue" by *Pollstar* in 2009. *Pollstar* figures for 2010 placed The O₂ as the world's number one music venue with a huge 1, 737,654 tickets sold last year, more than any other arena in the world. The *Pollstar* industry listings chart

showed The O₂ arena's year end ticket sales beat their nearest competitor, Madison Square Garden, by over 50 %.

- Anschutz opened The O₂ arena on June 23rd, 2007, with a free event for all of the building's employees billed as the O₂ premiere featuring Peter Kay, Tom Jones, Kaiser Chiefs, and Basement Jaxx, with the show hosted by Dermot O'Leary. Snow Patrol then played a concert to an audience made up of sponsors, local residents, local business employees and winners of an online competition.
- David Campbell, President and CEO of AEG Europe, commented: "Prince's 21 nights at The O₂ are a testament to London's eagerly awaited new entertainment destination. We're thrilled that a world-class artist like Prince is part of our opening season, and that he'll be breaking a world record in our arena."
- The Spice Girls performed 17 sold-out shows during their 2007/2008 *Return of the Spice Girls* tour. The first date's tickets were sold in 38 s.
- Led Zeppelin performed a one-off reunion concert at the arena on December 10th, 2007. Over one million people applied online for tickets.
- Michael Jackson was preparing for a sell-out series of 50 shows at the O₂, due to take place July 13th, 2009–March 6, 2010, when he died much too early of cardiac arrest.
- Legendary heavy metal band native to London, Iron Maiden, was scheduled to perform here on August 5th and 6th, 2011, the last dates of The Final Frontier World Tour.
- Bon Jovi performed 12 nights in June 2010 as part of their *The Circle Tour*. They also became the first -ever artists to perform on the roof of the O₂ Arena a few days prior to their 12-night residency.



Packed. The O₂ in London was rated best international arena in the world 2011 by Pollstar.



Geometrical data	
Volume	400,000 m ³
$L \times W \times H_{(\max)}$	approximately 125 × 115 × 43 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	2.17
EDT_{125-2k}	1.83
$C_{80,125-2k}$	-2.69
BR ₆₃ versus 0.5-1k	2.06
BR ₁₂₅ versus 0.5-1k	1.38

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Perforated liner over entire ceiling areal with 40-cm cavity with broadband absorption.

Walls: Upper tier rear wall: acoustic panel finish; broadband absorber of 60-cm depth. Lower tier back wall. Acoustic panels 80 % coverage above 1 m. Balcony fronts: Stretch fabric panels with absorbent behind.

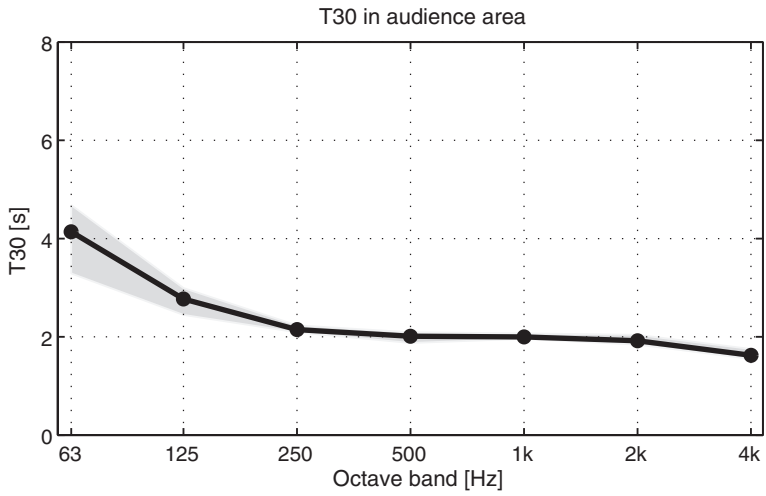
Upholstered seats with upholstered underside.

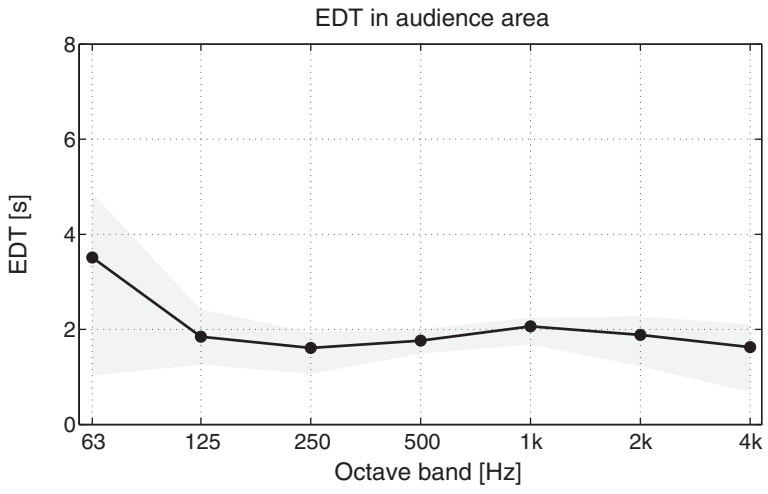
State of Hall When Measured

Empty; no seats on floor.



Spectacular. O₂ World, London from the outside.





O₁₃ Tilburg

Tilburg

Number of concerts per year: 100

Founded: 1998

Capacity: 2,000

Architect: Mels Crowwel, Benthem Crowwel Architects

Acoustician: Peutz

Owner: City of Tilburg

Unforgettable shows, amazing dance events, festivals, furious stand-up comedians, one-off projects, and even fresh young talent got the chance to perform. It is easy to say that O₁₃ is an unique venue in the center of Tilburg. O₁₃ consists of three halls: large and medium-sized auditoria (Dommelsch Hall and Small Hall) and a smaller space for new/specialist music trends (Stage01). It also contains a studio and several rehearsal rooms. Spatially the building meshes with the Tivoli parking structure as one large built mass that screens off the street and cleanly marks off the park. The expanded metal screen of the parking facility is extended on one side to project in front of the facade of O₁₃. Façades and roof are clad in black EPDM rubber filled with glass wool and sporting real CDs on its surface.

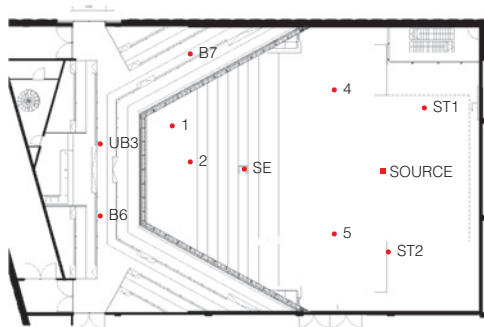
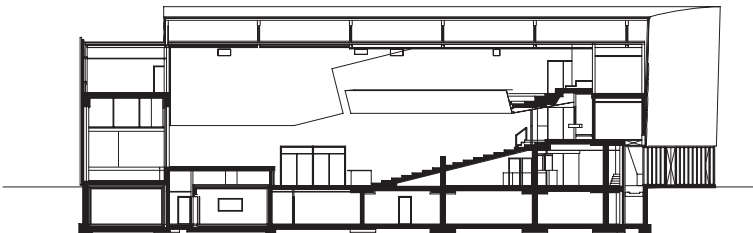
In 1998, O₁₃ was the first concert hall in The Netherlands which was newly built for the sole purpose of live music. Since then artists such as Robbie Williams, Nine Inch Nails, Muse, Alice Cooper, The Roots, Tool, Blondie, Damien Rice, Kraftwerk, Simple Minds, Snoop Dogg, 30 s To Mars, Slayer, Queens Of The Stoneage, Sigur Ros, Editors, Interpol, Armin van Buuren, Pablo Francisco, Ice Cube, Chuck Berry, and many others have performed in O₁₃. O₁₃ appeals to all lovers of pop music from The Netherlands, Belgium, Germany, and sometimes even the whole of Europe. Quality, public opinion, and affordability are of great importance. O₁₃ organizes about 400 activities with more than 230,000 visitors each year.



Everybody on the sloped audience area enjoys great views and great sound.



No one in the audience of max. 2,000 persons is more than 22 m away from the PA speakers.



Geometrical data	
Volume	7,500 m ³
$L \times W \times H$	32 × 22 × 11.0 m
Surface area of stage	8 × 22.4 m
Height of stage	1.67
Stage opening	
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.07
EDT _{125-2k}	0.88
$C_{80,125-2k}$	4.89
BR ₆₃ versus 0.5-1k	1.73
BR ₁₂₅ versus 0.5-1k	1.01
<i>Stage area</i>	
EDT _{125-2k}	0.51
$D_{50,125-2k}$	0.89
BR ₆₃ versus 0.5-1k	0.97
BR ₁₂₅ versus 0.5-1k	0.91

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Suspended mineral wool.

Walls: Concrete. Wood fiber slabs on cavity on side walls in front of the stage near the loudspeakers.

Stage Area

Floor: Nonabsorptive vinyl direct on concrete.

Ceiling: Suspended mineral wool.

Walls: Wood fiber slabs on side walls with cavity for a total of 7-cm depth.

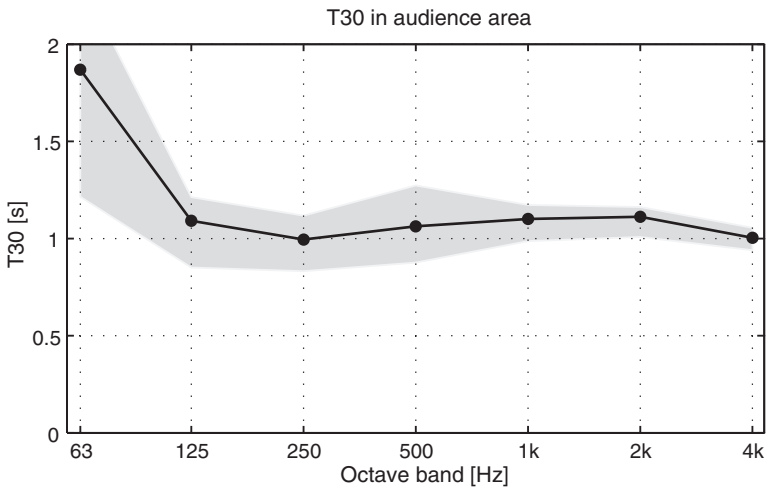
Backdrop: curtains on the back wall.

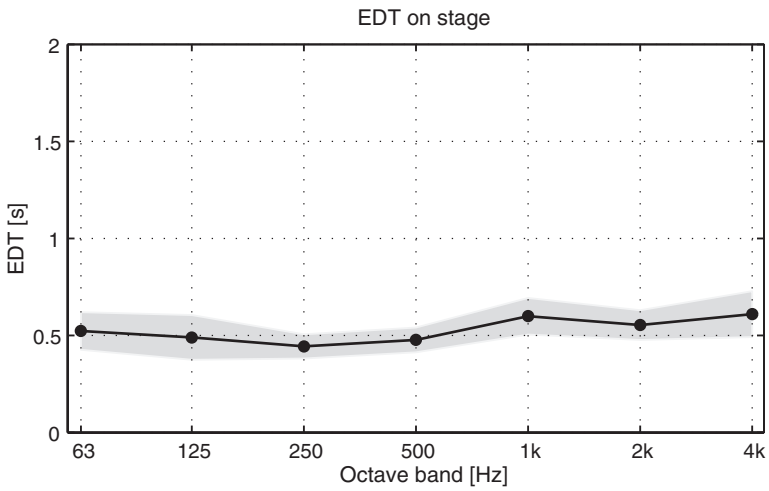
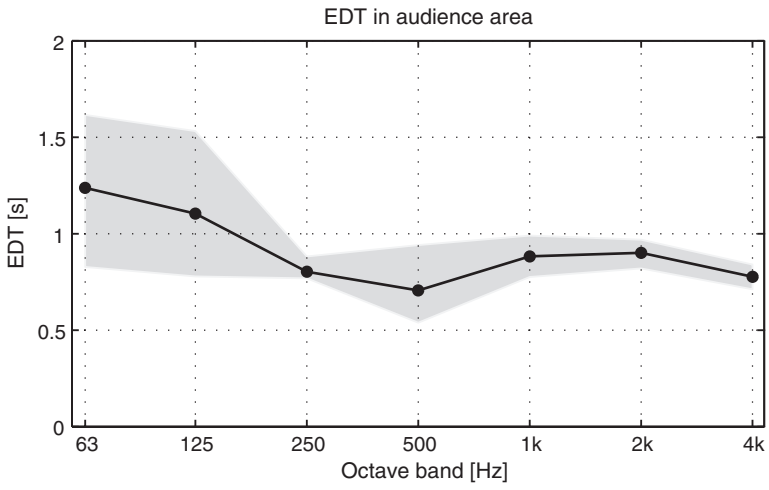
State of Hall When Measured

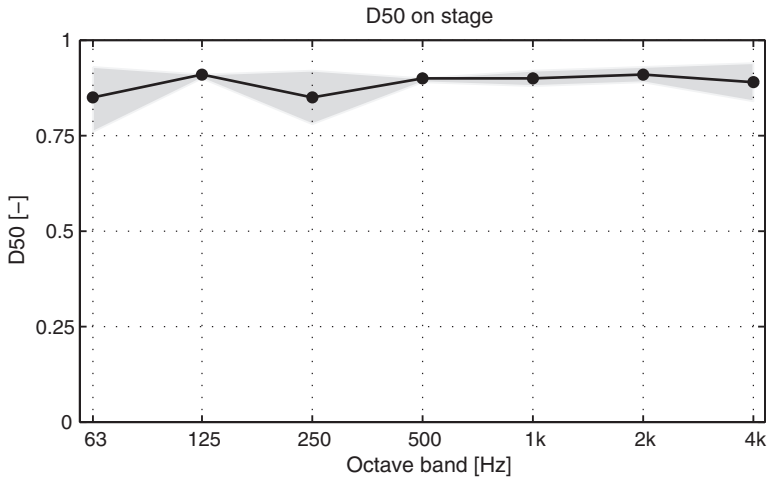
Empty.



O₂ Tilburg is indeed a modern facility.







Olympia

Paris

Number of concerts per year: 120. In all halls in the venue: 320

Founded: 1954

Capacity: 2,200

Architect:

Acoustician:

Owner

Founded in 1888, by Joseph Oller, the creator of the Moulin Rouge, today it is easily recognizable by its giant red glowing letters announcing its name. It opened in 1889 as the “Montagnes Russes” but was renamed the Olympia in 1893. In addition to musicians, the Olympia played host to a variety of entertainment including circuses, ballets, and operettas. However, following a steady decline in appearances by the great stars, from 1929 until 1944 it served as a movie theater. It may have opened as a music hall under the German occupation of France during World War II, but certainly in 1945 after the Liberation, it was a music hall free to Allied troops in uniform. Attendees had to listen to the playing of four national anthems before the varied programs that always ended with a spirited French can-can performed by dancers, some of whom were no longer young.

Thereafter, at times it may have reverted to movies again until Bruno Coquatrix revived it as a music hall with a grand reopening in February 1954. After his death, it ultimately went into another decline and was in danger of being torn down and turned into a parking lot but on January 7th, 1993, France’s then minister of culture, Jack Lang, issued a preservation order for the Olympia that resulted in two years of construction work to rebuild a perfect replica of the façade and the grandeur of its famous red interior. Édith Piaf achieved great acclaim at the Olympia, giving several series of recitals from January 1955 until October 1962. Jeff Buckley, long an admirer of Piaf, gave what he considered the finest performance of his career there in 1995, which was later released in 2001 on *Live at L’Olympia*. Jacques Brel’s 1961 and 1964 concerts at L’Olympia are legendary and preserved to this day on new CD releases. Marlene Dietrich’s 1962 Olympia concert was broadcast. On May 3–4, 1972, The Grateful Dead played two concerts here as part of their first major European tour. Both shows were recorded and songs from each were released on their 1972 live album *Europe ‘72*.

Inaugurated by the biggest star in France at the time, singer/dancer La Goulue, the venue has showcased a wide variety of performers, from French acts including Alan Stivell, Edith Piaf, Charles Aznavour, Adamo, Gilbert Bécaud, Johnny Hallyday, and Mireille Mathieu, to international stars of very different musical genres: Chuck Berry, Joséphine Baker, The Animals, Celine Dion, Cher, Diana Ross and The Supremes, Aretha Franklin, Stevie Wonder, James Brown, Diana Krall, War, Fairuz, Jeff Buckley, Robert Plant and The Strange Sensation, Jimi Hendrix, Judy Garland, Kraftwerk, Nana Mouskouri, Genesis, Wings, Paul McCartney, Paul Simon, Led Zeppelin, David Bowie, Bob Dylan, Black Sabbath, PJ Harvey, Lady Gaga, The Corrs, Luciano Pavarotti, Morrissey, The Shadows, Nelly Furtado, New

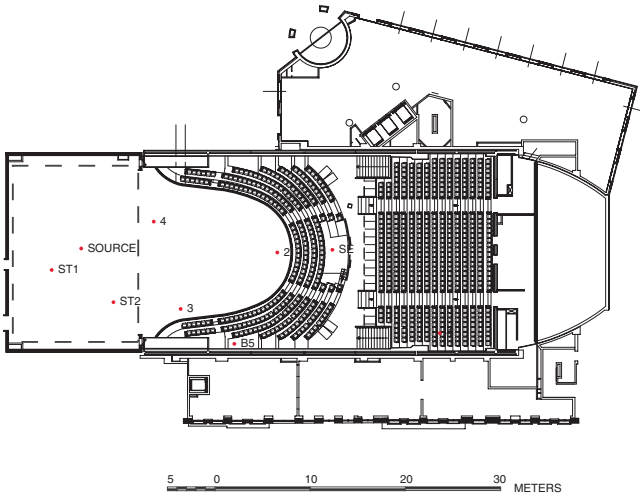
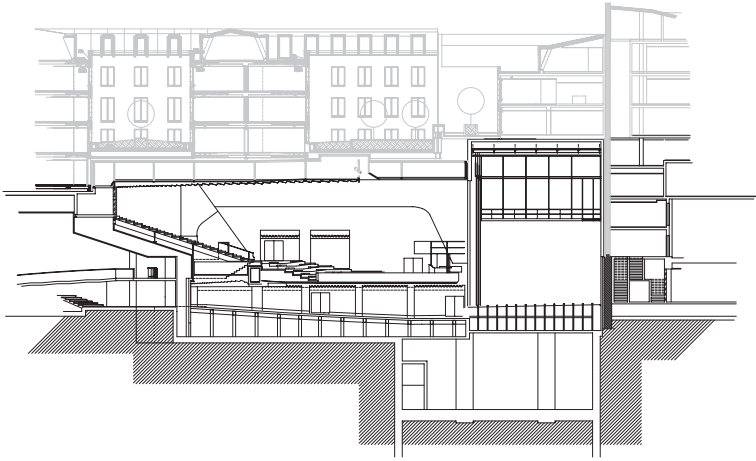
Order, Nick Cave, Nina Simone, Patti Smith, Phil Collins, Roger Hodgson, Primal Scream, KISS, Scorpions, Simple Minds, The Beatles, The Cure, The Jackson 5, Otis Redding, Red Hot Chili Peppers, The Rolling Stones, Dave Matthews Band, Björk, Dionne Warwick, Violetta Villas, Velvet Underground, Leonard Cohen, Manu Dibango, Madonna, Katy Perry, Christina Aguilera, and James Brown.



The red seats on the lower level are removable for standing audience pop and rock performances.



Piaf, Beatles, Bowie, Brel, Dylan, Zeppelin, Pavarotti, Jackson 5, Stones, Hendrix, Buckley, and Wonder.



Geometrical data	
Volume	13,000 m ³
$L \times W \times H$	50 × 20 × 14.3 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.23
EDT _{125-2k}	1.1
$C_{80,125-2k}$	3.69
BR ₆₃ versus 0.5-1k	1.63
BR ₁₂₅ versus 0.5-1k	1.47
<i>Stage area</i>	
EDT _{125-2k}	0.82
$D_{50,125-2k}$	0.84
BR ₆₃ versus 0.5-1k	1.02
BR ₁₂₅ versus 0.5-1k	1.56

Materials Used

Audience Area

Floor: Concrete with temporary flooring for the mounting of chairs. Carpet on balcony.

Ceiling: Painted concrete. Suspended reflector above balcony.

Walls: Painted plates on cavity. Walls are not vertical but tilted slightly upwards.

Back wall of thick perforated panels with cavity behind.

Stage Area

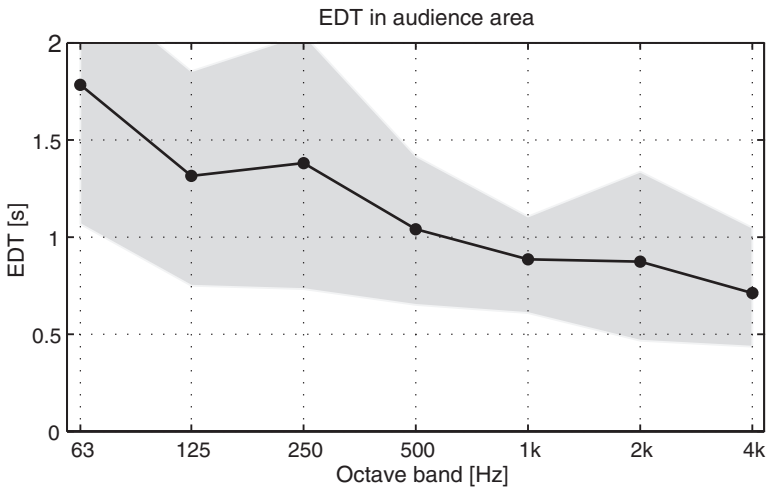
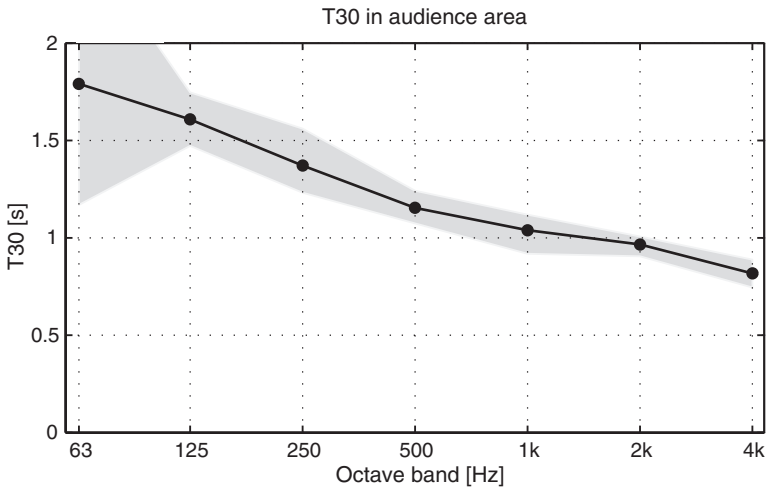
Floor: Vinyl direct on concrete.

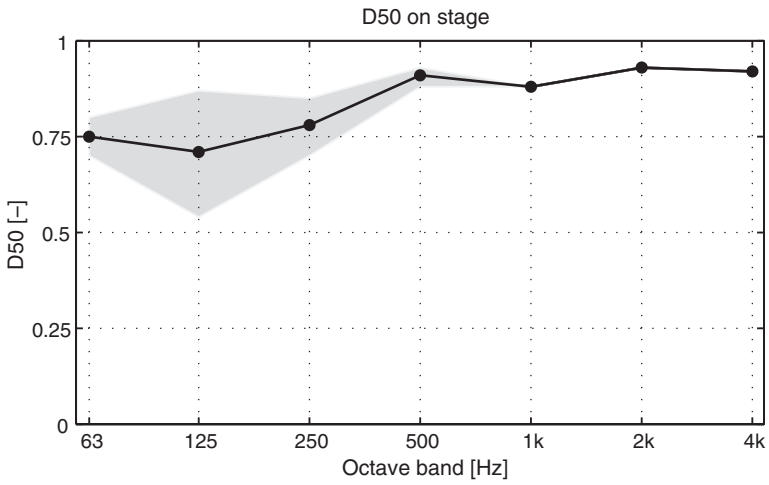
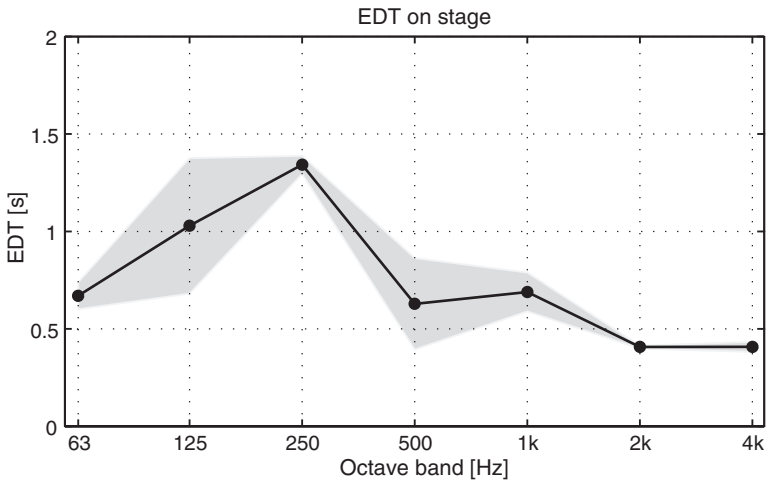
Ceiling: Painted concrete.

Walls: 5-cm thick wood fiber panels direct on concrete.

State of Hall When Measured

Empty with seats mounted. All seats on the lower level can be removed for standing audience concerts.





Oslo Spektrum Arena

Oslo

Number of concerts per year: 60

Founded: 1990

Capacity: 9,700

Architect: LPO Arkitektkontor AS

Acoustician: Multiconsult and later Brekke and Strand

Owner: Norges Varemesse

Oslo Spektrum was originally built as an indoor multipurpose arena, ideally suited for trade fairs, sports, and concert events. The first event on the program when the doors were opened to the public on December 9th, 1990 was an ice hockey game, closely followed by a rock concert featuring the famous Norwegian group a-ha. In the 20 years that have passed, Oslo Spektrum has undergone continuous improvement making the arena more flexible and better suited to the needs of organizers, audiences, and performers.

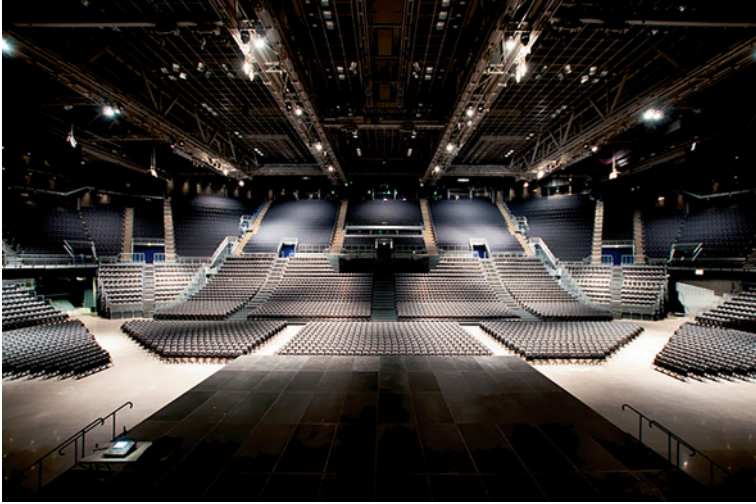
The building was designed by architects LPO Arkitektkontor AS in an architecture competition organized by Oslo City Council in connection with the development of a large inner-city area in the 1980s. A centrally located concert arena with a capacity of almost 10,000 people put both Oslo and Norway on the international concert tour map and was designed to attract international performers and events.

The building is constructed in concrete and brick and decorated internally and externally with handmade bricks produced by artist Guttorm Guttormsgaard and ceramicist Søren Ubisch based on print fragments created by artist Rolf Nesch. When audiences enter the main arena, they encounter a space that is decorated in dark tones, with muted lighting and well thought-out practical features, designed to offer the best possible overall experience.

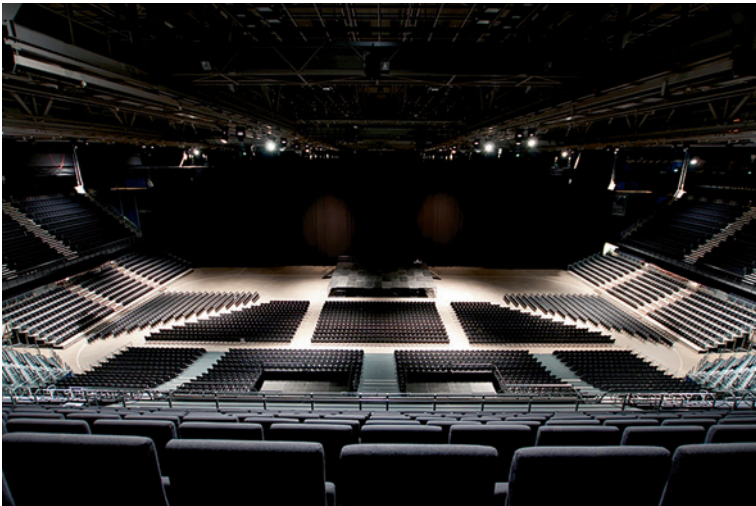
The movable grandstand and a sophisticated system of curtains offers scope for a wide variety of events. The arena can be configured as a full concert hall with general admission and/or seating. The flexible curtain system also enables the creation of a smaller arena that can be extended in response to the needs of the audience.

When the arena was built in 1990, the sound and acoustic conditions were adapted to the wide range of events that would be hosted. Since its inception, the arena has undergone a continuous process of improvement and a number of adjustments have been made in line with the shift towards a greater focus on concert events.

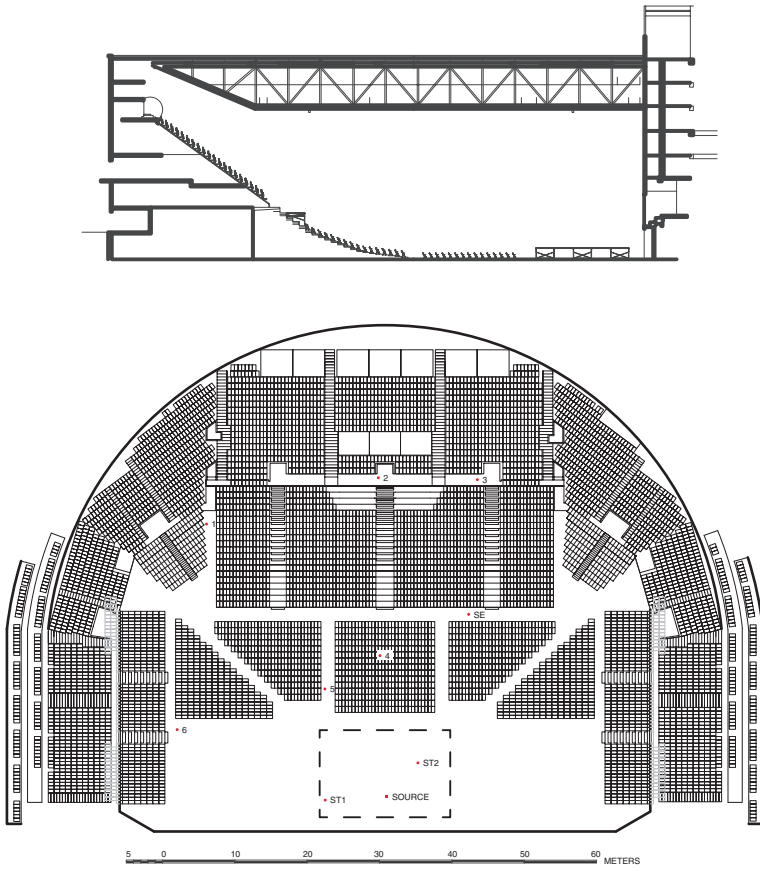
Oslo Spektrum hosts approximately 100 events a year. These include concerts, musicals, trade fairs, ice shows, sporting events, conferences, and banquets. The arena is the venue for the annual Nobel Peace Prize Concert. Elton John, Bob Dylan, Leonard Cohen, Pavarotti, Tina Turner, Frank Sinatra, Iron Maiden, and Bruce Springsteen are just some of the artists who have appeared on the Oslo Spektrum stage.



Oslo Spektrum has undergone radical acoustic improvements just prior to this measurement thanks to a dynamic leadership and correct consulting. The result is outstanding.



A low T_{30} even at 125 Hz ensures a high value of critical distance. Due to an intelligent shape of the hall only few members of the audiences will suffer from a too-reverberant sound. Here the challenge is speaker coverage.



Geometrical data	
Volume	150,000 m ³
$L \times W \times H_{(\max)}$	71 × 94.5 × 26.5 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.61
EDT_{125-2k}	1.66
$C_{80,125-2k}$	0.87
BR ₆₃ versus 0.5–1k	1.64
BR ₁₂₅ versus 0.5–1k	1.23

Materials Used

Audience Area

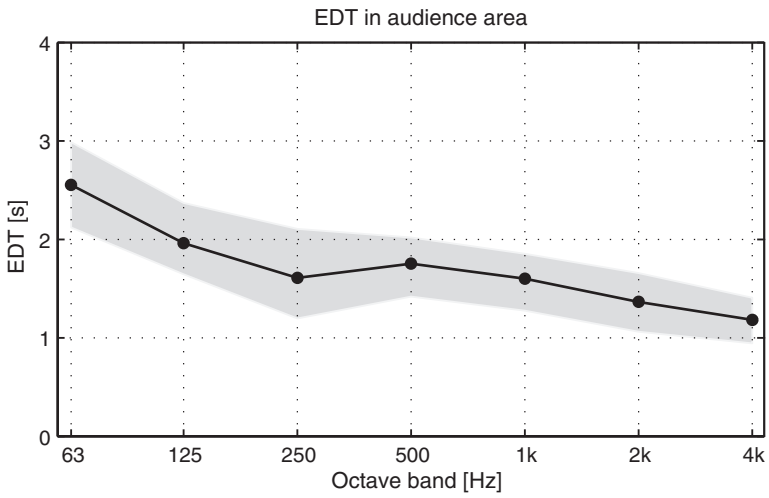
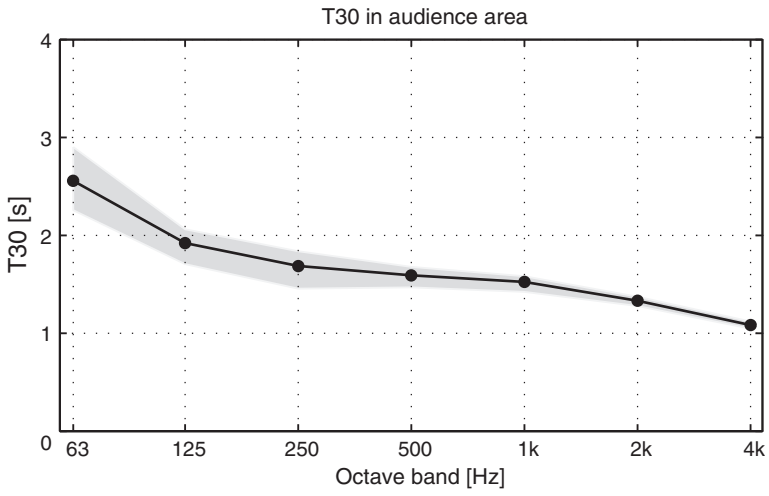
Floor: Concrete.

Ceiling: Suspended 5-cm thick mineral wool ceiling with a large cavity before a thin nonperforated steel trapezoid ceiling.

Walls: 10-cm thick mineral wool slabs with 10-cm cavity behind.

State When Measured

No additional chairs.



Palau Sant Jordi

Barcelona

Number of concerts per year: N/A

Founded: 1990

Capacity: 17,960

Architect: Arata Isozaki

Acoustician: N/A

Owner: Ajuntament de Barcelona (Barcelona City Hall)

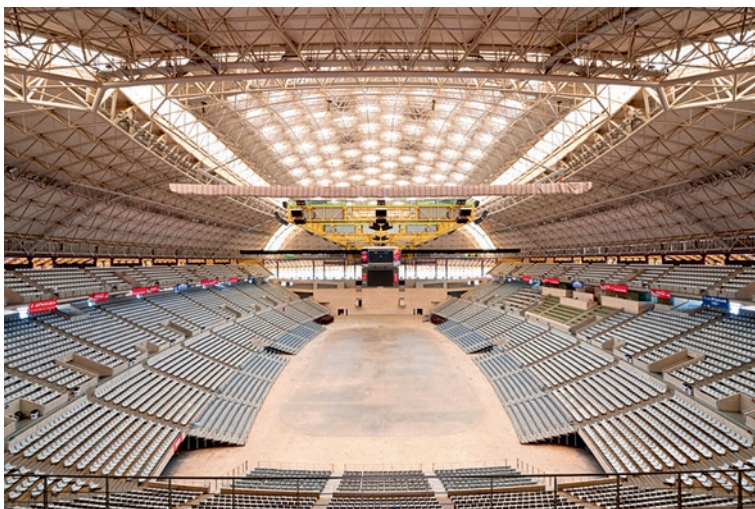
Of all the buildings of the Olympic site, Arata Isozaki's Palau Sant Jordi is the most surprising, an undeniable symbol of Barcelona. Its immense dome was built at ground level with the most advanced techniques and then raised by a hydraulic mechanism in 10 days until its height was fixed at 45 m. The Palau, conceived as a versatile and multifunctional enclosure, is equipped with state-of-the-art technology. It is an intelligent building where everything is self-adjusting: temperature, light, air, sound, and image screens. It also has numerous other sections: services for athletes, press, bars, VIPs, and the offices of the company that administers the venue.

The Main Hall is totally versatile, with a lower level of retractable seats. Up to the moment, they have been transformed into a giant swimming pool, an ice rink, a theater, or a banqueting hall.

All the pop-rock, the best singers, the best groups, the biggest and best productions, the ones that are in style and the legends. U2, Dire Straits, Madonna, AC DC, Metallica, Lady Gaga, Coldplay, Bruce Springsteen, Shakira, Fito and Fitipaldis, Estopa, and Alejandro Sanz have played there.

Shows for all Audiences Choirs performed and sung operas, the best melodic singing, the great musicals, the singer/songwriters, classical and popular dancing, flamenco, and even very particular ways of interpreting music. Montserrat Caballé, Luciano Pavarotti, Plácido Domingo, Frank Sinatra, Julio Iglesias, Joan Manel Serrat, Joaquín Sabina, and the great choreographies of Igor Moiseyev, Nacho Duato, Joaquín Cortés.

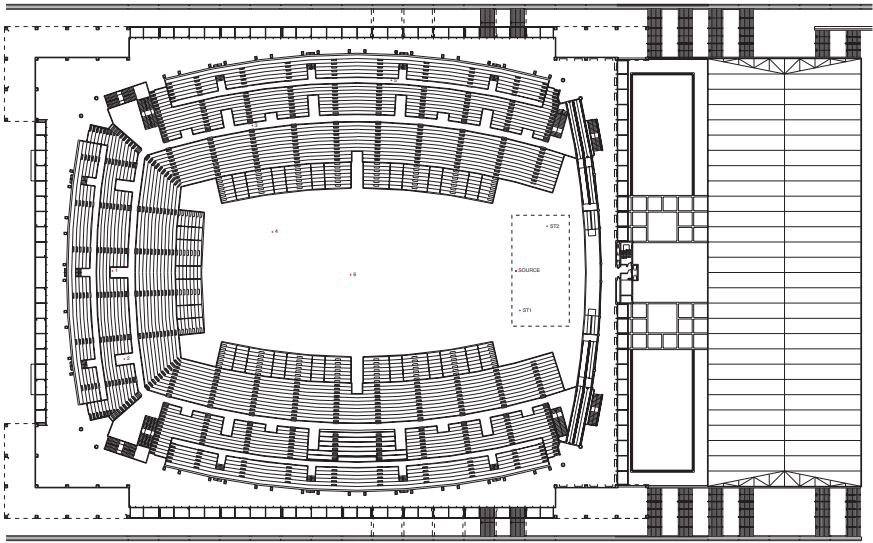
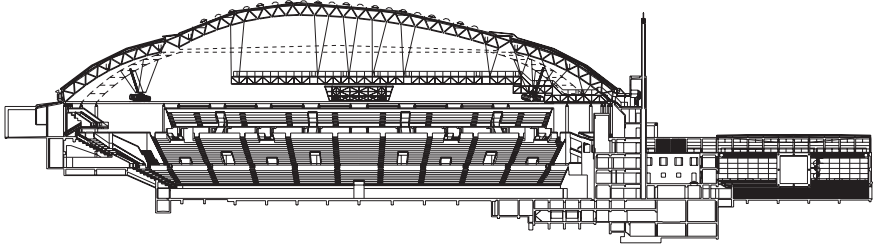
Many nonmusical events are taking place there from Disney's classics to Sponge Bob Square Pants, from the Cirque du Soleil to large television productions. It has been possible to follow the motocross competitions every year with the best competitors in the world, and to bring into the city water sports such as jet-ski racing and even windsurfing. They've had mountain sports including snow skiing and motorcycle trials, as well as social, political, religious and company events.



Palau Sant Jordi was built for the 1992 Olympic games. The lowest level of seats are removable.



The beautiful dome of zinc corrugated iron rises on the Olympic Esplanade just a couple of kilometers from the Barcelona city center.



Geometrical data	
Volume	approximately 400,000 m ³
$L \times W \times H_{(max)}$	120 × 102 × 42 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	4.98
EDT_{125-2k}	4.4
$C_{80,125-2k}$	-4.62
BR_{63} versus 0.5-1k	0.76
BR_{125} versus 0.5-1k	1.03

Materials Used

Audience Area

Floor: Concrete.

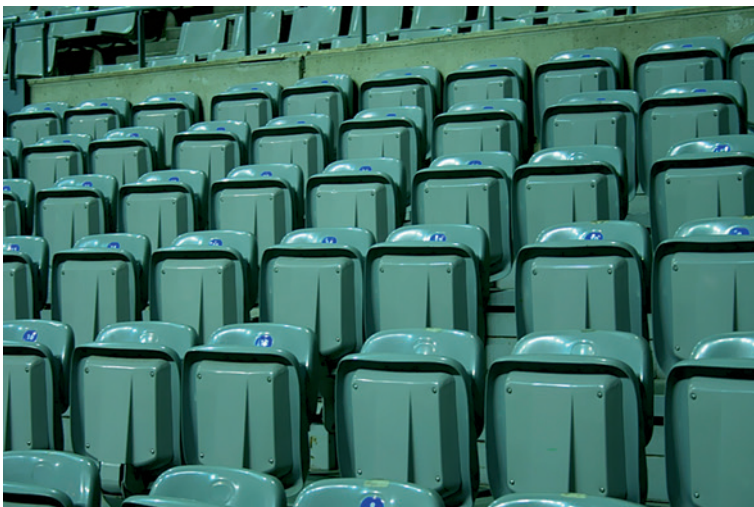
Ceiling: The circumference is thin perforated plate with a large cavity and mineral wool behind. The large area in the center of the ceiling is covered with methacrylate skylights.

Walls: Concrete. End walls of sandstone typical for the region. Direct coupling to the hard surfaced hallways behind the seats.

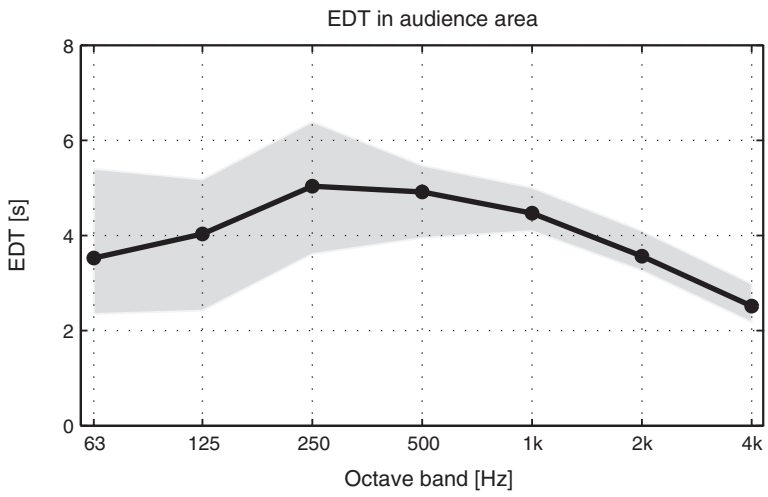
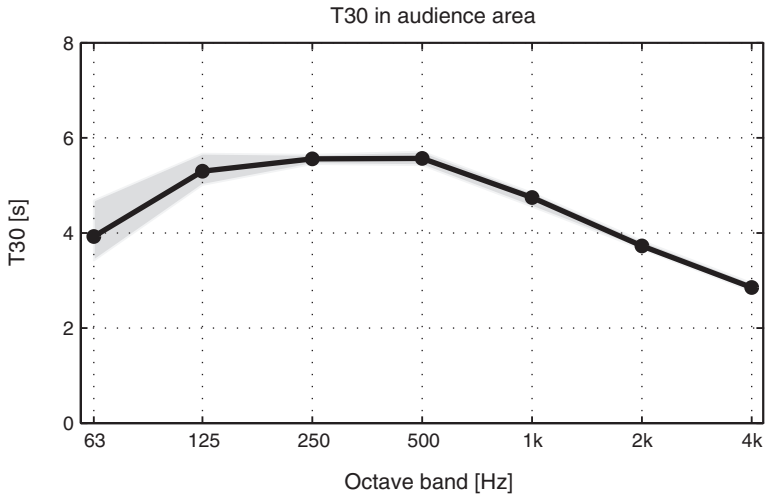
Seats are not upholstered.

State of Hall When Measured

Empty; no additional seats mounted.



The reverberation time at mid and high are bound to change very significantly indeed in venues where unupholstered seats are covered by several thousand audience members.



Paradiso

Amsterdam

Number of concerts per year: 120. In all halls in the venue: 320

Founded: 1968

Capacity: 1,500

Architect: N/A

Acoustician: N/A

It is housed in a converted former church building that dates from the nineteenth century and that was used until 1965 as the meeting hall for a liberal Dutch religious group known as the *Vrije Gemeente* (Free Congregation). It is located on *de Weteringschans*, bordering one of the nightlife and tourism centers of the city. The main concert hall in the former church interior has high ceilings and two balcony rings overlooking the stage area, with three large illuminated church windows above the stage. In addition to the main concert hall, there are two smaller cafe stages, on an upper floor and in the basement.

Paradiso was squatted by hippies in 1967 who wanted to convert the church to an entertainment and leisure club. The police ended the festivities the same year. In 1968 the city opened Paradiso as a publicly subsidized youth entertainment center. Along with the nearby Melkweg (Milky Way), it soon became synonymous with the hippie counterculture and the rock music of that era. It was one of the first locations in which the use and sale of soft drugs was tolerated. From the mid-1970s, Paradiso became increasingly associated with punk and new wave music, although it continued to program a wide variety of artists. Starting in the late 1980s, raves and themed dance parties became frequent. In recent years, the venue has settled into an eclectic range of programming, which, besides rock, can include lectures, plays, classical music, and crossover artists. Long associated with clouds of tobacco and hashish smoke, Paradiso banned smoking in 2008 in accordance with a nationwide ban on smoking in public venues.

Artists who have recorded or filmed concerts at the Paradiso include the Rolling Stones, Joy Division, Willie Nelson, Arcade Fire, Nightwish, Bad Brains, Kayak, Loudness, Nirvana, John Cale, The Cure, Soft Machine, Emiliana Torrini, Jalebee Cartel, Link Wray, Omar and the Howlers, Nick Cave and the Bad Seeds, Beth Hart, Dayna Kurtz, Dave Matthews, Smoosh, Suzanne Vega, Amy Winehouse, Fiction Plane, Epica, Editors, Motorpsycho, Pain of Salvation, Riverside, and Live. Glen Matlock played his last gig with the Sex Pistols at the Paradiso.

On May 26–27, 1995, the Rolling Stones played two semiacoustic concerts at the Paradiso. Scalped tickets reportedly sold for many thousands of dollars. Recorded tracks from these concerts were released on the Stones' *Stripped* album later that year. Keith Richards said that the Paradiso concerts were the best live shows the Stones ever did. In the 1990s, the future of Paradiso became something of a political issue in Amsterdam, because there was some political resistance to the continuation of the subsidies that allowed the venue to operate in its central city location [2]. More recently, supporters have successfully argued that the Paradiso subsidy is reasonable in comparison with subsidies given to other performance venues.



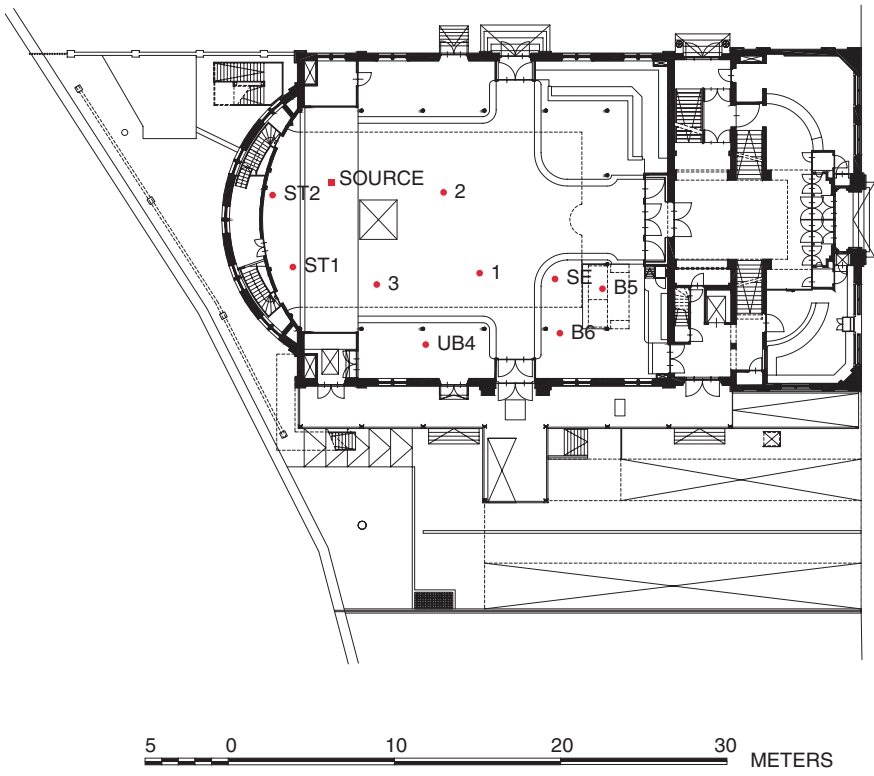
Some of the only surfaces with absorption material are underneath balconies and many surfaces are diffusive. The sound engineer's position is in the rear corner but not under the balcony.



The beautiful old church room.



There is in fact two levels of balconies.



Geometrical data	
Volume	6,000 m ³
Height, audience area	14.2 m
$L \times W \times H$	21.5 × 19 × 12–14.2 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.74
EDT _{125-2k}	1.66
$C_{80,125-2k}$	-2.34
BR ₆₃ versus 0.5-1k	0.57
BR ₁₂₅ versus 0.5-1k	0.74
<i>Stage area</i>	
EDT _{125-2k}	1.59
$D_{50,125-2k}$	0.59
BR ₆₃ versus 0.5-1k	0.38
BR ₁₂₅ versus 0.5-1k	1.27

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Wood on joists. Thick perforated plates with cavity behind lower balconies.

Walls: Masonry.

Stage Area

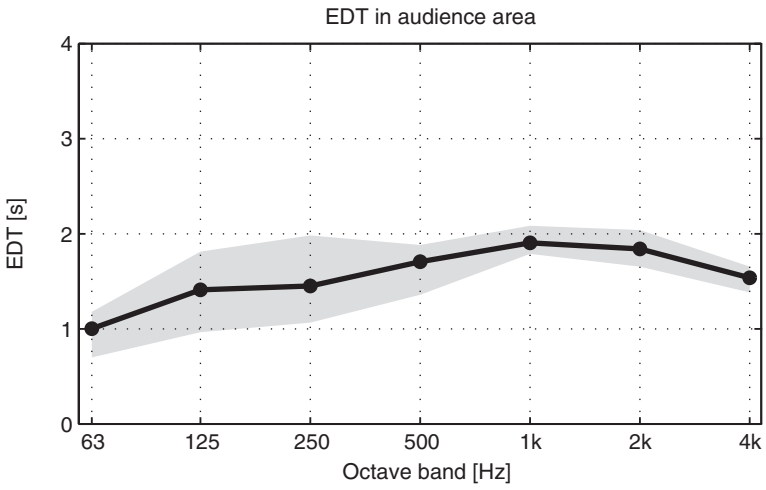
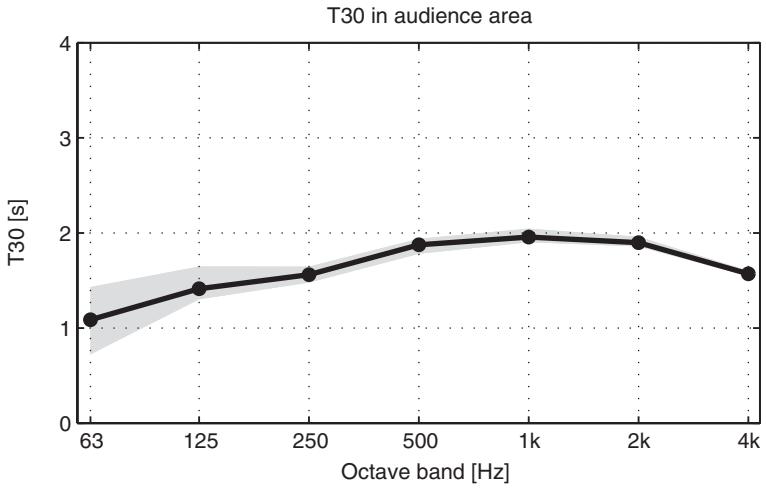
Floor: Wood on cavity.

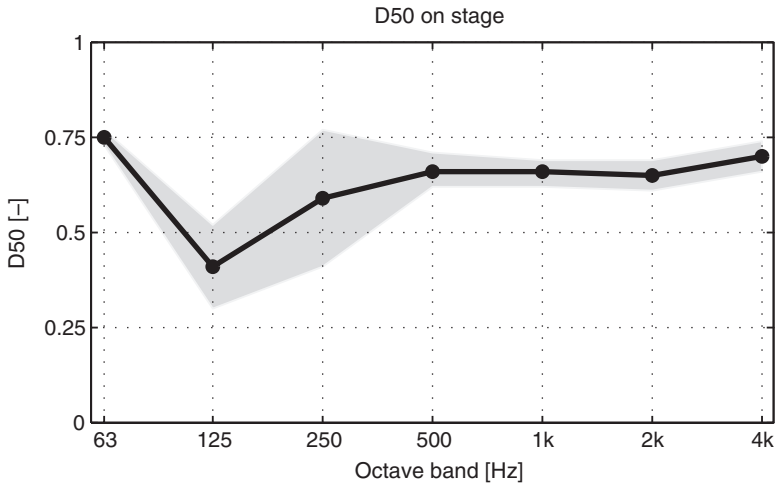
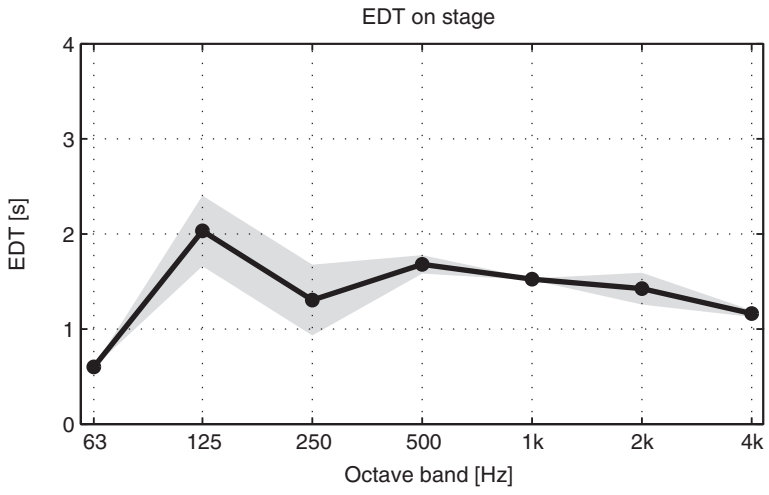
Ceiling: Wood on joists.

Walls: Masonry, curtains.

State of Hall When Measured

Empty.





Porsche Arena

Stuttgart

Number of concerts per year: 60

Founded: 2006

Capacity: 6,000

Architect: ASP Arkitekten, Stuttgart

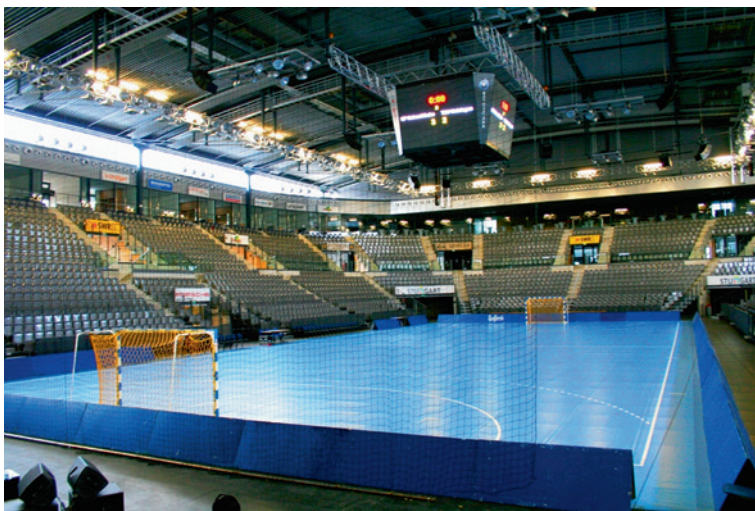
Acoustician: NA

The seating capacity of the arena varies, from 5,100 to 8,000 people and it was opened in 2006, after 14 months of construction. To fund the construction, costs had already been planned as preconstruction sales of the name rights. Dr. Ing h.c. F. Porsche AG bought the name rights, for a €10 M, for a term of 20 years. The arena is part of a sport complex that includes the adjacent Mercedes-Benz Arena and Schleyerhalle. It is the venue for the Porsche Tennis Grand Prix, a WTA Tour event, and also hosted some matches at the 2007 World Men's Handball Championship.

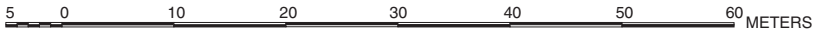
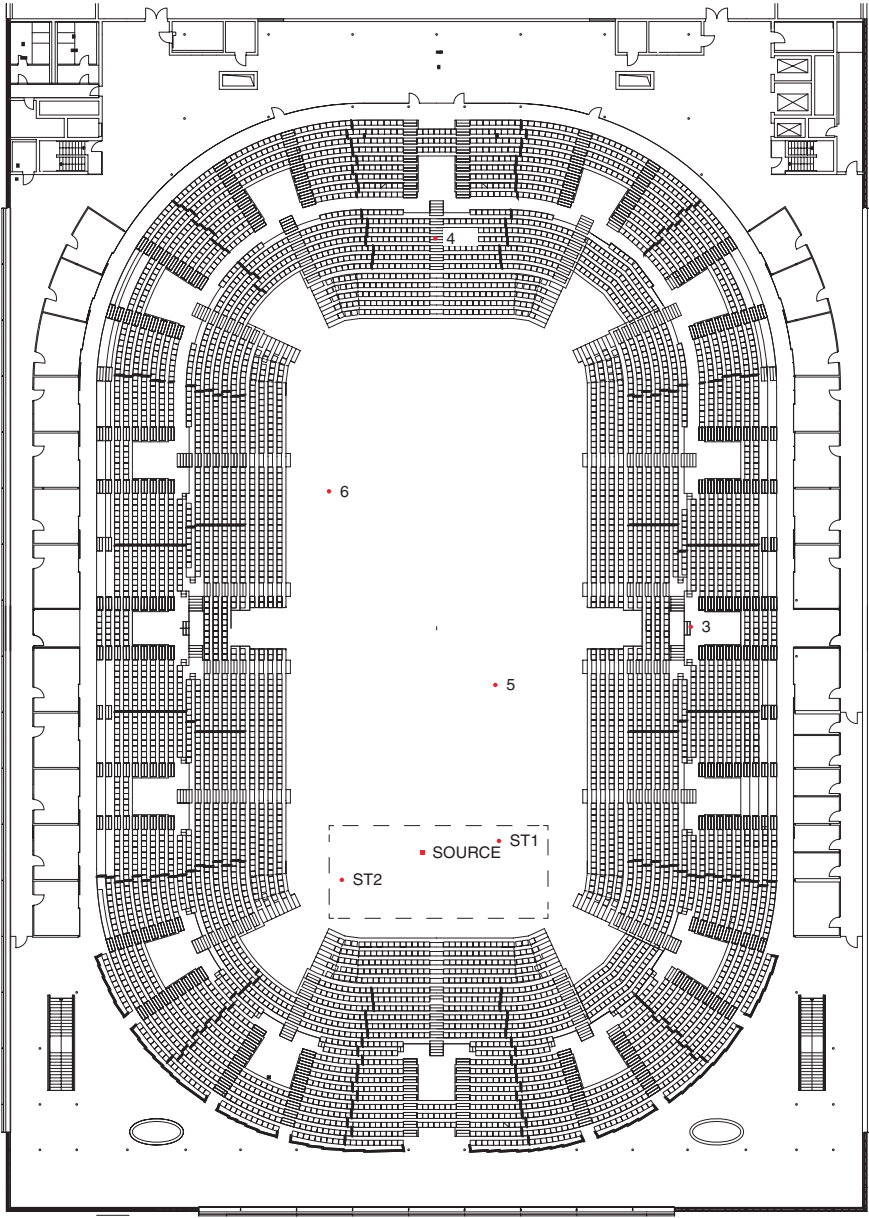
NeckarPark Stuttgart is one of the biggest and most attractive event sites in Europe. Five state-of-the-art event locations for top international sports, cultural, business, and political events line the Mercedesstraße in the district of Bad Cannstatt: the Gottlieb-Daimler-Stadium, the Carl Benz Center, the Mercedes Benz Museum, and the Hanns-Martin-Schleyer-Halle and Porsche-Arena hall duo. Extensively modernized and enlarged in 2006, the 15,500 capacity Hanns-Martin-Schleyer-Halle is the largest indoor arena in south Germany. When officially opened in 1983 it was Europe's first multifunctional hall and together with the Porsche-Arena, which opened in May 2006, it forms a unique hall duo in the whole of Europe.

A light-flooded and airy lobby unites both halls. The elongated Porsche-Arena is elegantly connected to the glass construction through which people stream into both halls. Flexibility is the key and this is also mirrored in the diversity of the events. From superstars on the national and international music scene to sports events and big show productions; the program of events is as star-studded as it is emotional. More than 14 million visitors to the Hanns-Martin-Schleyer-Halle are clear proof of its attractiveness.

The diversity of events can be enjoyed as a double pack in the Hanns-Martin-Schleyer-Halle and the Porsche-Arena whereby the prerequisite is a perfect and professional organizational structure. Working behind the scenes, it ensures major performances go off smoothly. This applies to a special degree to company presentations, congresses, annual general meetings, and party conferences. An outstanding example is the Porsche Annual General Meeting, which, combined with a big presentation in the Schleyer-Halle, celebrated its premiere in the Porsche-Arena. The hall duo functions in a variety of ways. Spotlight on for a concert in the Schleyer-Halle and at the same time a first-class handball or ice-hockey match in the Porsche-Arena.



Porsche Arena, a modern and well-designed smaller arena.



Geometrical data	
Volume	Approximately 80,000 m ³
$L \times W \times H$	m floor level max. 63 × 33 m, whole arena: 63 × 94 m, height up to 20.5 m, 12.5 m clear height
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	2.46
EDT _{125-2k}	2.33
$C_{80,125-2k}$	-2.58
BR ₆₃ versus 0.5-1k	1.62
BR ₁₂₅ versus 0.5-1k	1.15

Materials Used

Audience Area

Floor: Wood.

Ceiling: Thin trapezoid metal with perforation.

Walls: Above the seats there is glazing around the hall.

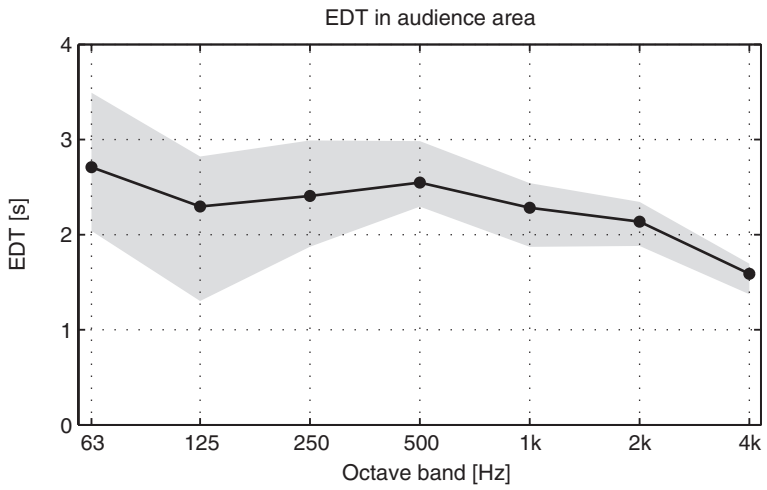
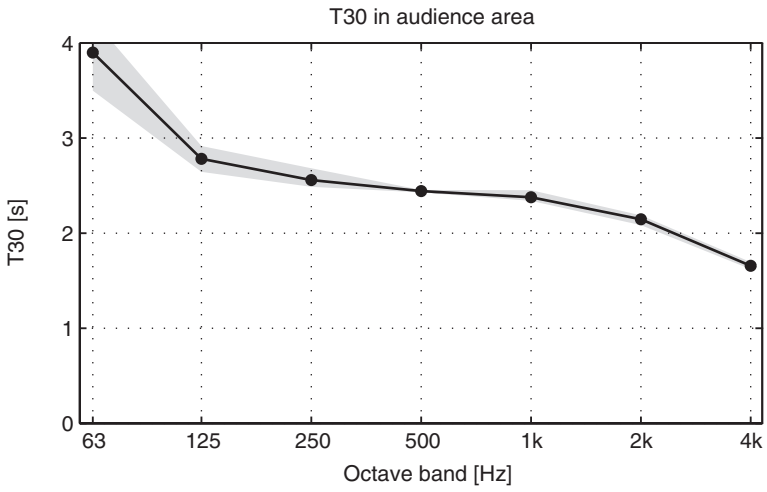
Seats upholstered on seat not on back and perforated underneath seats (see photo).

State of Hall When Measured

Empty; no additional seats mounted.



Intelligent design of chairs if they need to be absorbent while not in use. Porsche Arena.



Rote Fabrik, Aktionshalle

Zürich

Number of concerts per year: 80

Founded: 1980

Capacity: 1,200

Architect: original: Carl-Arnold Séquin-Bronner (original)

Renovation 1994: Arbeitsgemeinschaft Rote Fabrik «ARFA»:

- Claude Vaucher, Architekt SIA/SWB (Büro Z, Zürich).
- Bob Gysin + Partner, Dübendorf.
- Architekturgemeinschaft Bauplan, Zürich (Renovation).

Acoustician: Originally none; Bruno Gandet during the renovation 1994.

The Rote Fabrik (Red Factory, so named because of its red bricks) came into use as a cultural center in 1980 as a result of widespread student protests in Zürich.

The buildings housing the Rote Fabrik were originally constructed as a silk weaving mill between 1892 and 1896 by one of the period's most important architects in the field of factory construction, Carl-Arnold Séquin-Bronner. With the decline of the Swiss textile industry, the location came to be used as a telecommunications factory owned by Standard Telephon and Telegraph, a subsidiary of International Telephone and Telegraph (ITT) starting in 1940. In 1974, the buildings were bought by the city of Zürich, the idea being at the time to tear the ageing factory down and widen the freeways leading along Lake Zürich.

A public vote in 1977 demanded that the Rote Fabrik be converted into a cultural center; in spite of the vote being passed by the public, the project got lost in bureaucracy. It was not until May 30th 1980 when a demonstration against a planned credit of 61 million Swiss francs for the Zürich Opera House turned into widespread demonstrations that the project was reopened. Squatters, left-wing activists, and thousands of spectators returning from a Bob Marley concert combined to form one of the largest (and also most violent) demonstrations the city had ever seen.

Under the impression of the public outrage following the demonstration, the city council put the buildings under historical protection and made them available to the newly founded IG Rote Fabrik, the association still running the Rote Fabrik today. Even though the location was never renovated under the guide of an acoustician (except for minor improvements made by the Rote Fabrik's own sound engineers), the Aktionshalle (Action Hall), the main hall of three on the premises, quickly became a favored concert spot for many of the most important bands in the 1980 and 1990s. Patty Smith, Nirvana, Mike Patton, the Melvins, and the Young Gods, to name only a few, have valued the Rote Fabrik not only for staying true to its roots, but at the same time providing a high-quality environment for playing gigs ranging from loud and bashing to quiet and fragile.



Rote Fabrik is situated on the lake side with jetset neighbours. Photo: Patrick Rimann.



The floor upstairs from the bar is not part of the concert room. Photo: Hans van Veen.



Geometrical data	
Volume	5,000 m ³
$L \times W \times H$	$30 \times 25 \times 8.5$
Surface area of stage	80 m ²
Height of stage	1.20 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.08
EDT _{125-2k}	1.01
$C_{80,125-2k}$	2.92
BR ₆₃ versus 0.5-1k	1.34
BR ₁₂₅ versus 0.5-1k	1.47
<i>Stage area</i>	
EDT _{125-2k}	0.53
$D_{50,125-2k}$	0.86
BR ₆₃ versus 0.5-1k	1.64
BR ₁₂₅ versus 0.5-1k	1.37

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Concrete with large areas of glazing. Suspended home-made reflectors.

Walls: Concrete. At each side of the front of the stage there are two big walls 20-cm thick with thin perforated plates on each side and mineral wool in between.

Upper side wall on one side: perforated gypsum board. Back wall: painted brick.

Stage Area

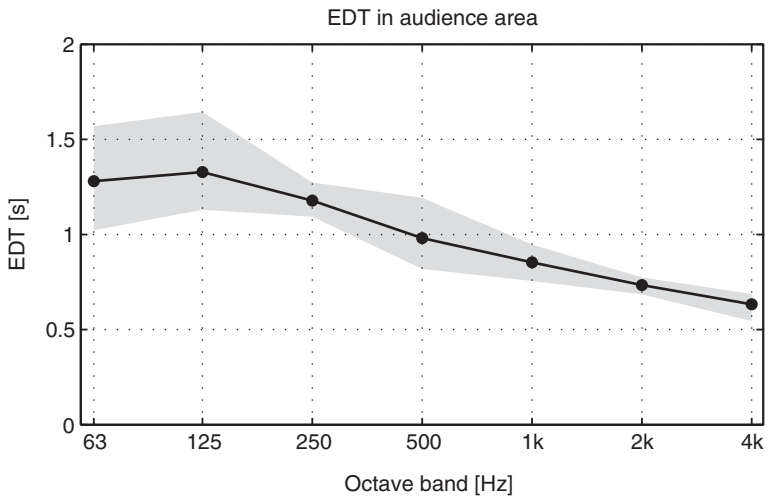
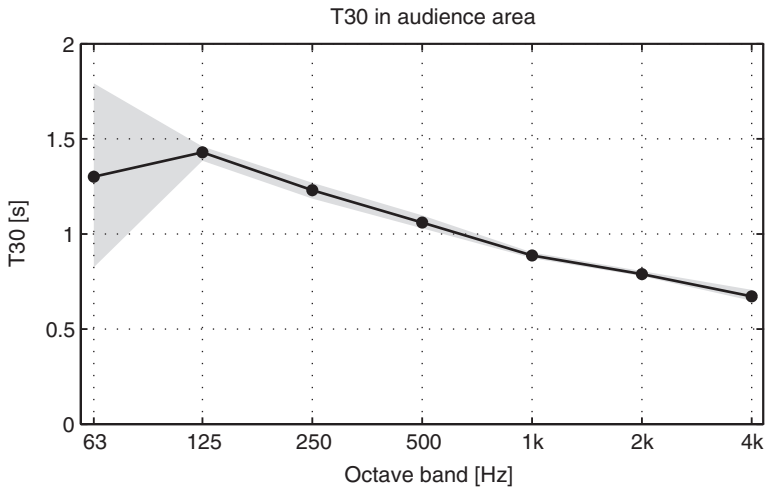
Floor: Stage risers.

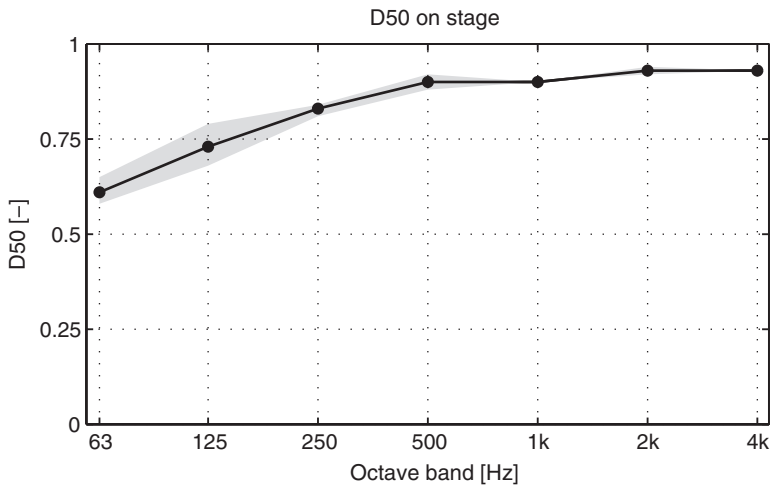
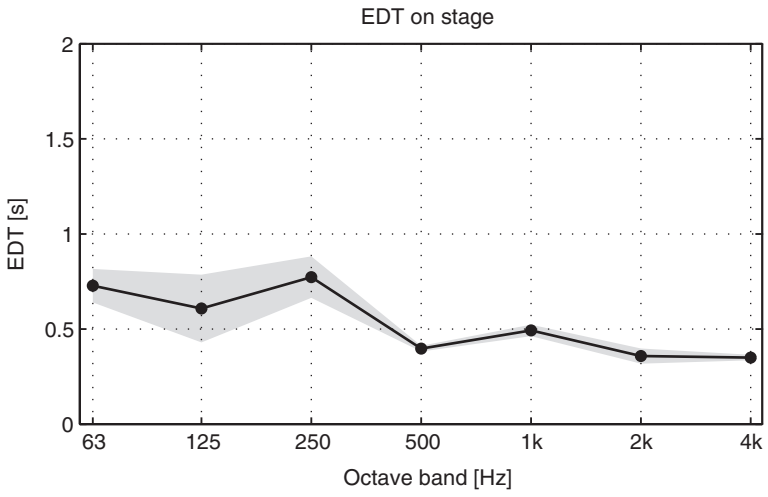
Ceiling: Concrete.

Walls: Curtains.

State of Hall When Measured

Empty; seating risers at the rear of the hall.





Rote Fabrik Clubraum

Zürich

Number of events per year: 160

Founded: 1994

Capacity: 600

Architect: Original: Carl-Arnold Séquin-Bronner (original)

Renovation 1994: Arbeitsgemeinschaft Rote Fabrik «ARFA»:

- Claude Vaucher, Architekt SIA/SWB (Büro Z, Zürich).
- Bob Gysin + Partner, Dübendorf.
- Architekturgemeinschaft Bauplan, Zürich (Renovation).

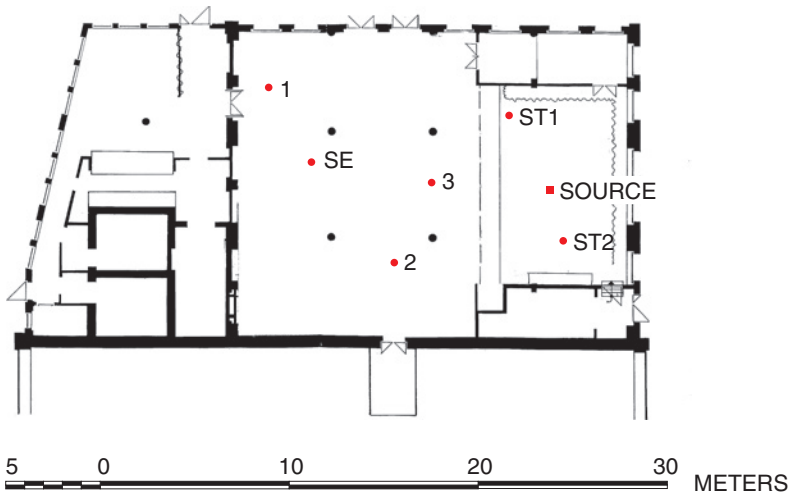
Acoustician: Originally none; Bruno Gandet during the renovation 1994.



Clubraum is mostly used for smaller concerts, theater plays, and poetry slams,
Photo: Hans van Veen.



And has as expensive an address as the bigger room next door. Photo: Jasmin Phasuk.



Geometrical data	
Volume	1,500 m ³
$L \times W \times H$	$21 \times 16 \times 4.3$
Surface area of stage	70 m ²
Height of stage	1 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.96
EDT _{125-2k}	0.79
$C_{80,125-2k}$	5.70
BR ₆₃ versus 0.5-1k	1.42
BR ₁₂₅ versus 0.5-1k	1.21
<i>Stage area</i>	
EDT _{125-2k}	0.39
$D_{50,125-2k}$	0.88
BR ₆₃ versus 0.5-1k	3.51
BR ₁₂₅ versus 0.5-1k	2.76

Materials Used

Audience Area

Floor: Vinyl on concrete.

Ceiling: Wooden fiber on cavity.

Walls: Concrete, doors; back wall: painted wood fiber panels in some areas.

Stage Area

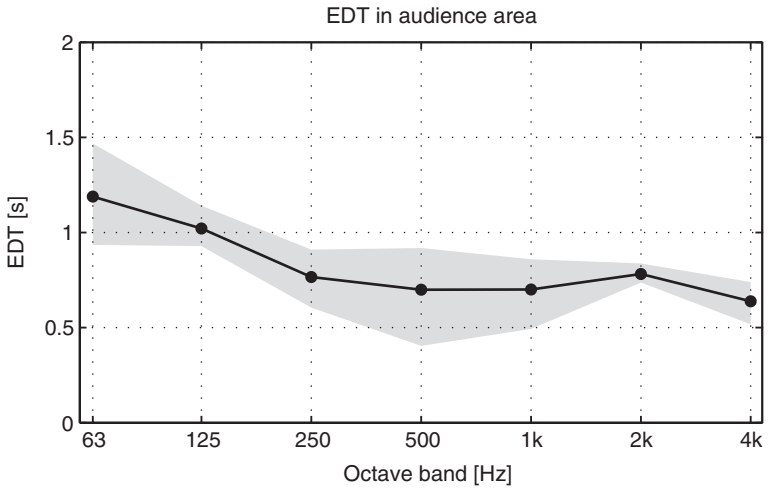
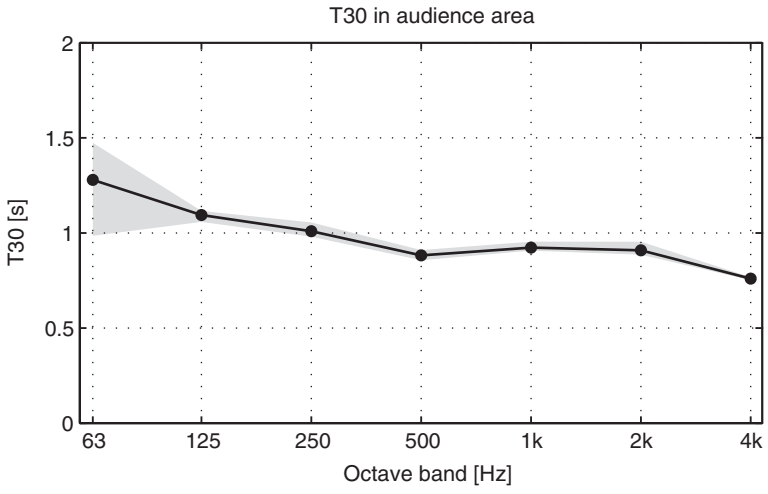
Floor: Stage risers.

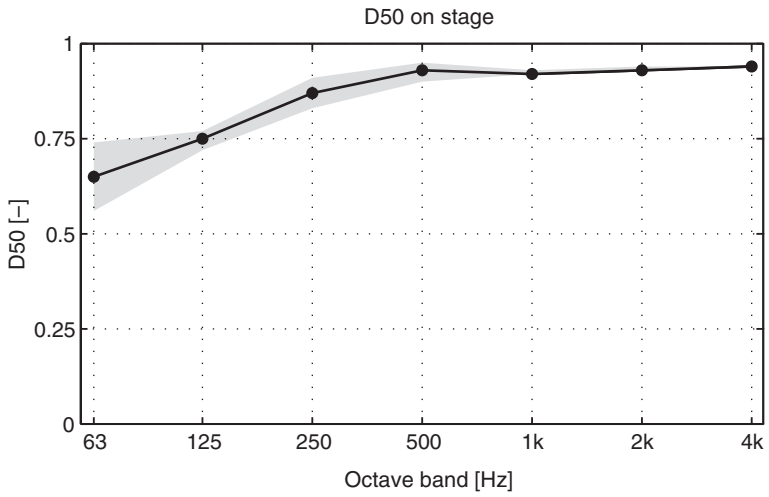
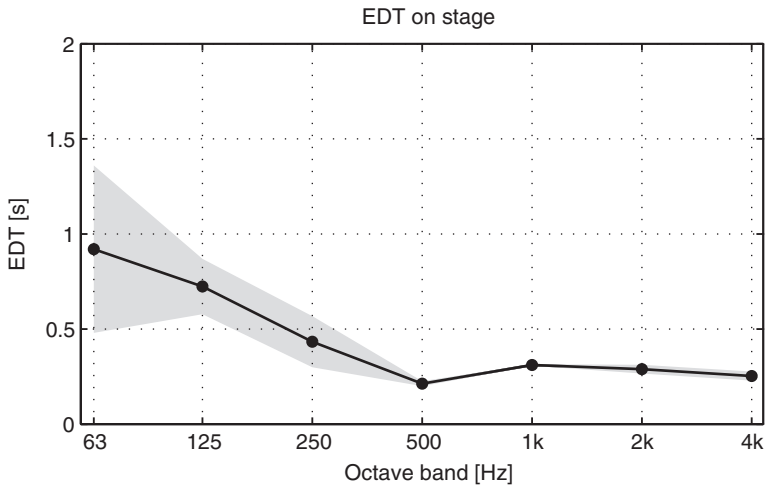
Ceiling: Wooden fiber on cavity.

Walls: Concrete covered with curtains.

State of Hall When Measured

Empty.





Rockefeller

Oslo

Founded: 1986

Capacity: 1,350

Number of concerts per year: 120

Architect: Movenstjerne and Eide

Acoustician: N/A

Rockefeller combines the advantages of both the concert hall and the club. The capacity is 1,350 spectators, but the atmosphere is that of a friendly and intimate club. Thanks to the two balconies and balustrades everyone in the audience is assured a good view of the stage. Sound and lighting conditions are undoubtedly the best in Oslo. The other needs of the audience are catered by eight bars.

Rockefeller has a location matched by few concert halls. The building previously housed Totggata Bad, one of Oslo's oldest and most stylish public baths. The building is from 1925. The premises were completely renovated in 1982, and now house offices, restaurants, and pubs, with Rockefeller occupying the old swimming hall itself. Rockefeller's smaller venue, John DEE, is located one floor down. The location provides two distinct advantages: a famous address and excellent communications. Public transport to all parts of the city can be found within a few hundred meters.

Rockefeller has a high profile on the Norwegian music scene. This is due both to the quality of the more than 10,000 bands that have appeared on their stage, and to their willingness to develop new activities. In addition to concerts Rockefeller has its own Rock Cinema, a fully equipped 35-mm cinema where the guests can enjoy movies and drinks in an informal environment. Rockefeller is nonpolitical and nonracist, and has no fixed repertoire profile that prevents us from entering new projects or exploring new trends. In 1986 Rockefeller opened (capacity 1,000), founder Hans A. Lier. In 1990 the Rock Cinema opened and in 1991 additional bar areas opened (capacity now 1,200). In 1996 the upper gallery and roof terrace opened (capacity now 1,350) and in 1997 Rockefeller opened the smaller club, John DEE (capacity 400), one floor down. In 2006 Rockefeller took over Sentrum Scene (capacity 1,800) across the street from Rockefeller. All three stages are now run by the Rockefeller administration, including booking. "The Flat" opened in 2007 as a separate area by the roof terrace (capacity 100) and in 2011 Rockefeller celebrated 25 years as a concert hall on the 14th of March, with the same leadership: Hans A. Lier, Roar Gulbrandsen and Frits Løveng.

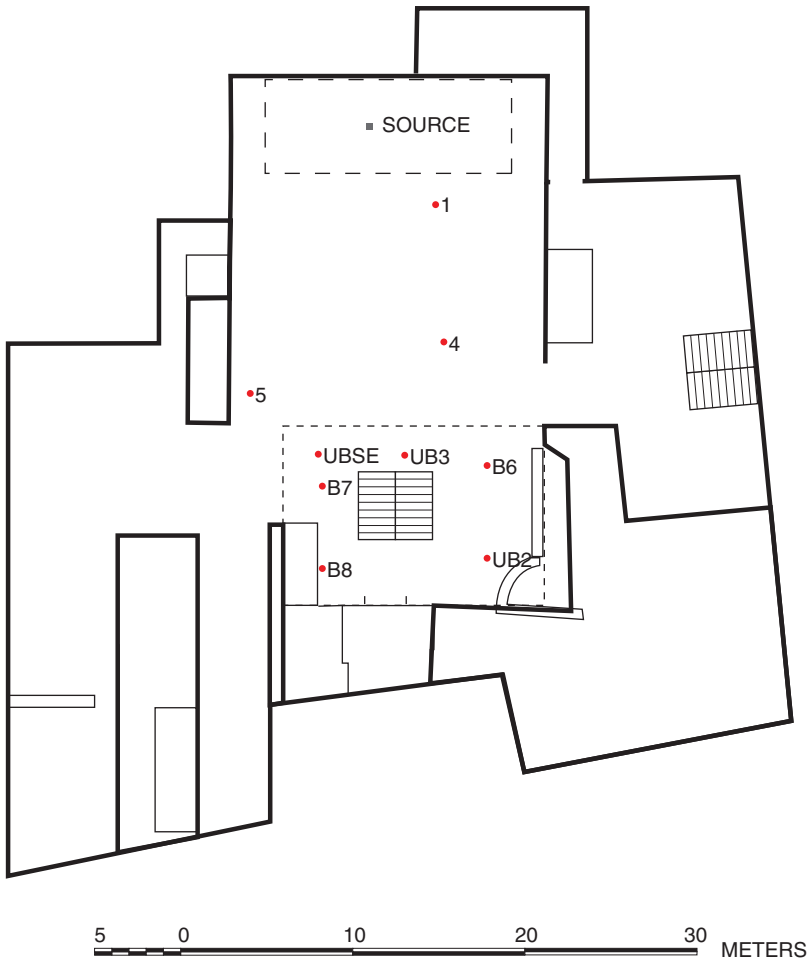
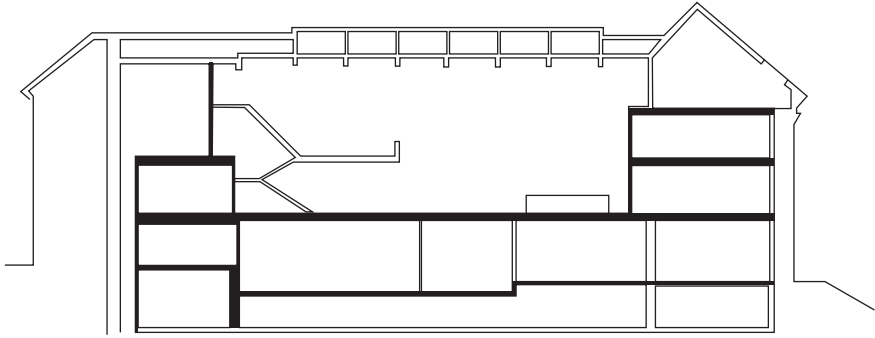
Some of the over 10,000 acts that have appeared at Rockefeller include A-ha, Beck, Blondie, Chaka Kahn, Chuck Berry, Crosby and Nash, Curtis Mayfield, David Byrne, Elvis Costello, Eminem, Faith No More, Grace Jones, Iggy Pop, Ike Turner, INXS, Jerry Lee Lewis, Jethro Tull, Kraftwerk, MC5, Morrissey, Motörhead, Ozzy Osbourne, Pantera, Patti Smith, PJ Harvey, Public Enemy, R.E.M., Radiohead, Rage Against The Machine, Ramones, Robert Plant, Run D.M.C., Santana, Snoop Dogg, Van Morrison, Willie Nelson, and ZZ Top.



Rockefeller fits 1,350 audience members on three levels.



The acoustic ceiling was suspended with a fairly large cavity by coincidence; they had to fit beneath some ventilation ducts.



Geometrical data	
Volume	5,300 m ³
$L \times W \times H$	$27.6 \times 19.6 \times 9.8$ m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.95
EDT _{125-2k}	0.85
$C_{80,125-2k}$	5.38
BR ₆₃ versus 0.5-1k	1.12
BR ₁₂₅ versus 0.5-1k	1.36

Materials Used

Audience Area

Floor: Concrete. Audience podiums of wood on cavity.

Ceiling: 2/3 suspended mineral wool ceiling with 1 m of cavity. 1/3 skylights.

Underneath balconies: gypsum board on cavity.

Walls: Concrete except on balconies: glazing with mineral wool behind and curtains in front. Back wall: painted brick.

Stage Area

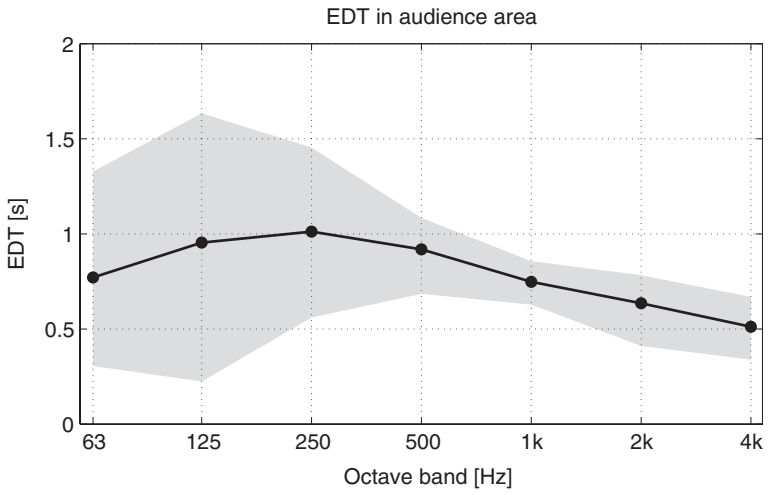
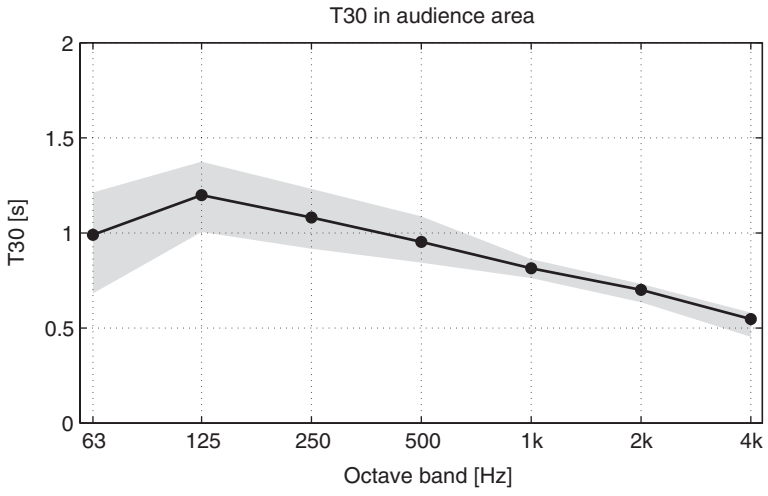
Floor: Stage risers with floor of 8 cm thick wooden slabs.

Ceiling: 2/3 suspended mineral wool ceiling with 1 m of cavity.

Walls: Curtains.

State of Hall When Measured

Empty.



Rockhal

Luxembourg

Founded: 2005

Capacity: 6,500

Number of concerts per year: 50–70. In all halls in the venue: 150

Architect: BENG Architecture

Acoustician: Dr. Albert Yaying Xu (XU-Acoustique)

Inaugurated in September 2005, the Rockhal is the most important concert venue in Luxembourg. The growing interest in contemporary popular music and the emergence of an increasingly professional local scene persuaded the Luxembourg government to provide the country a worthwhile structure. The Rockhal is under the patronage of and operates with the financial support of the Ministère de la Culture. It is located in Esch/Alzette on the historical and former industrial site Belval, which is now one of the country's most important urban development projects.

As its name implies, it was purposely built to host mainly rock and pop shows. In addition to the Main Hall it also accommodates the *Club*, a smaller concert venue with a capacity of 1,200 people. Also the Music and Resources center is an important part of the Rockhal. Its mission is to orient, inform, and assist amateur and professional musicians by providing them with a range of logistical and cultural tools and infrastructures. The Music and Resources center features a media library, six rehearsal rooms, and a recording studio and organizes conferences, workshops, and panels on a regular basis.

The Main Hall has standing room for 6,500 people and an all-seating capacity of 2,800. The flat base of the hall and the service grid covering the entire area ensure total flexibility of layout. It has a free height of 17 and is accessible for vehicles and machines up to 30 tons.

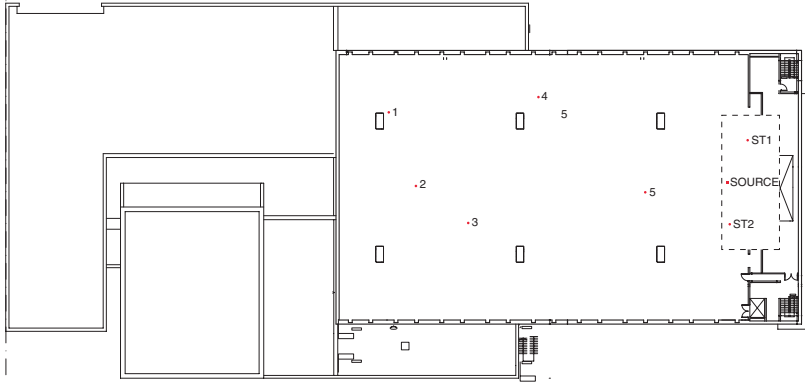
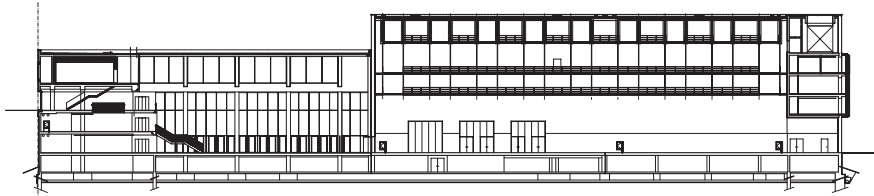
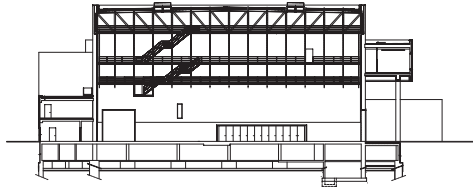
Due to its high technical standard and the ideal location in the heart of Europe, directly between Belgium, France, and Germany, the Rockhal also serves as a rehearsal venue for big arena productions. Recently productions such as those of Muse, Depeche Mode, Tokio Hotel, and The Chemical Brothers did tour rehearsals and launched their world tour with a show at the Rockhal. In 2011 it hosted among others productions Prince, Mark Knopfler and Bob Dylan, Lenny Kravitz, and Rammstein.



Rockhal—Centre de Music Amplifiée is situated on Boulevard du Rock and Roll maybe the hippest address of all venues in this book?



Rockhal is in many ways a rock temple. Seated concert.



5 0 10 20 30 40 50 60 METERS

Geometrical data	
Volume (m ³)	58,000
$L \times W \times H$ (m)	$65 \times 42 \times 21$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.47
EDT_{125-2k}	1.3
$C_{80,125-2k}$	0.95
BR_{63} versus 0.5–1k	3.03
BR_{125} versus 0.5–1k	1.73

Materials Used

Audience Area

Floor: concrete.

Ceiling: Suspended 3-cm thick mineral wool with 45-cm cavity behind.

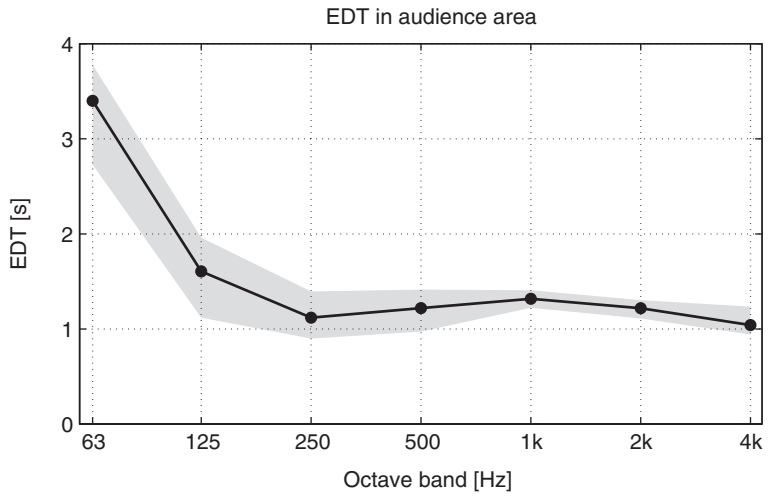
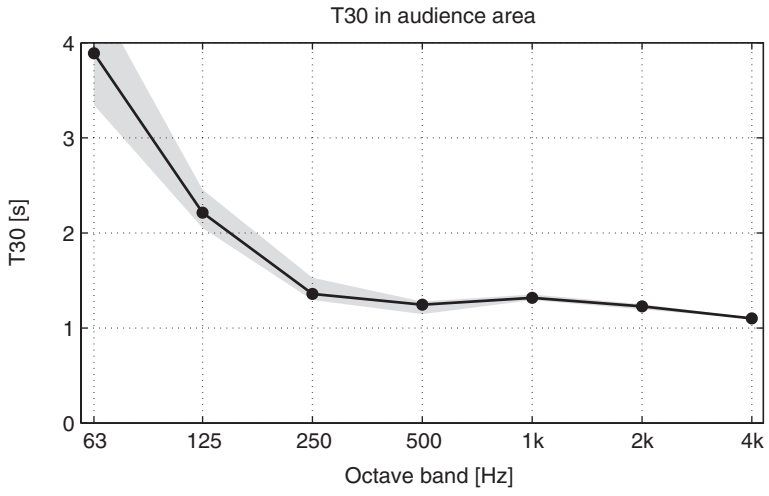
Walls: Wood fiber panels on a 6-cm cavity with mineral wool. Trapezoid metal roof.

State of Hall When Measured

Empty; a couple of vehicles in hall.



Rock temple.



Razzmatazz 1

Barcelona

Number of concerts per year: NA

Founded: NA

Capacity: 1,500

Architect: N/A

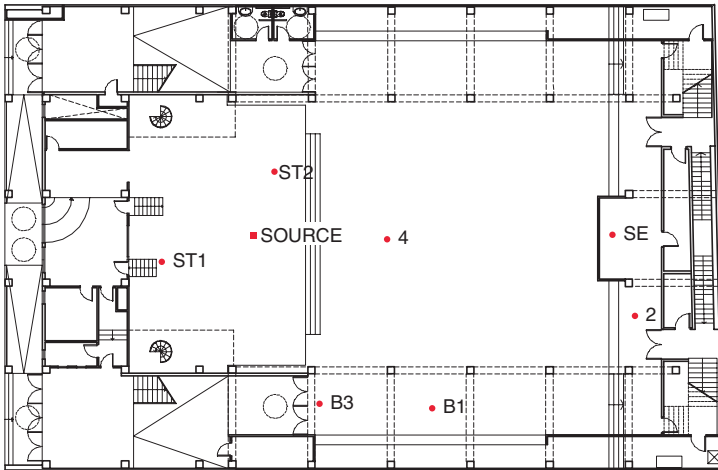
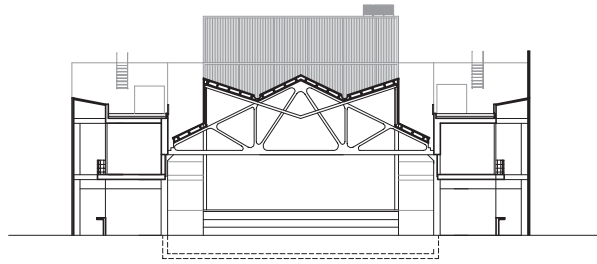
Acoustician: N/A



Dwarfs have very good views from the 1.4-m tall opening to the concrete balcony corridors on both sides of the former factory room. So do sitting audiences.



Razzmatazz sala 1. Archetype rock venue.



Geometrical data	
Volume	8,000 m ³
Height, audience area	9.8 m
$L \times B \times H$	$33 \times 26 \times 7-9.5$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.51
EDT _{125-2k}	1.43
$C_{80,125-2k}$	0.54
BR ₆₃ versus 0.5-1k	0.82
BR ₁₂₅ versus 0.5-1k	1.04
<i>Stage area</i>	
EDT _{125-2k}	0.84
$D_{50,125-2k}$	0.71
BR ₆₃ versus 0.5-1k	1.23
BR ₁₂₅ versus 0.5-1k	1.12

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Thin metal plate, nonperforated.

Walls: Concrete, curtains.

Stage Area

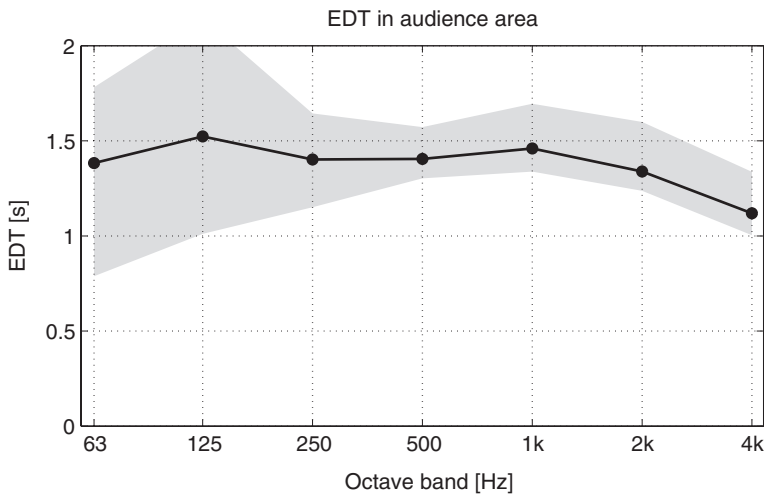
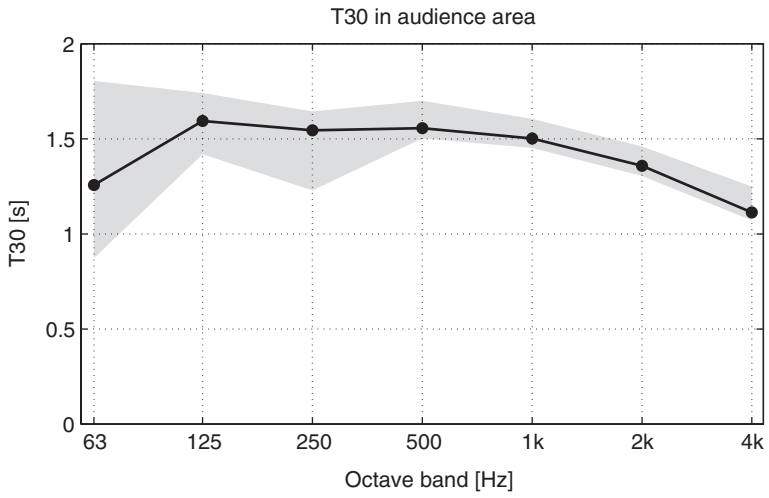
Floor: Wooden plates directly on concrete.

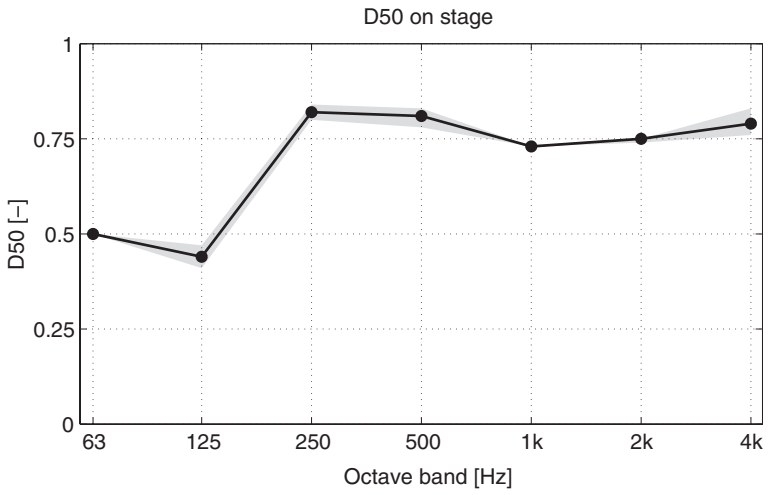
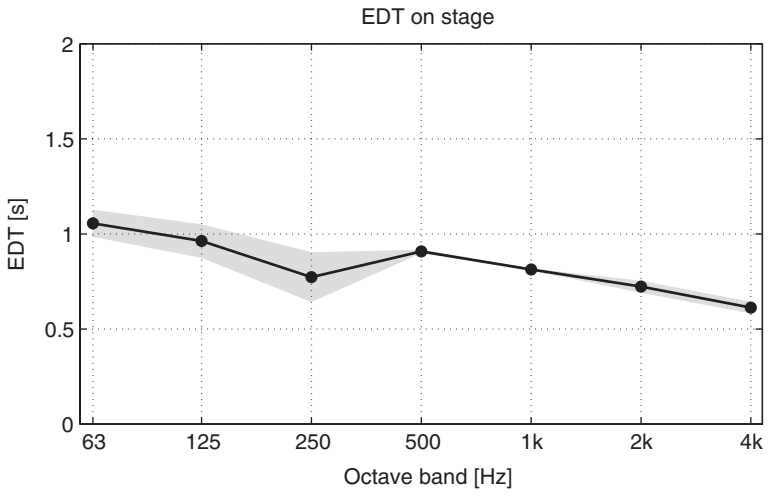
Ceiling: Thin metal plate, nonperforated.

Walls: Concrete, curtains.

State of Hall When Measured

Empty; no dwarfs.





Razzmatazz 2

Barcelona

Number of concerts per year: NA

Founded: NA

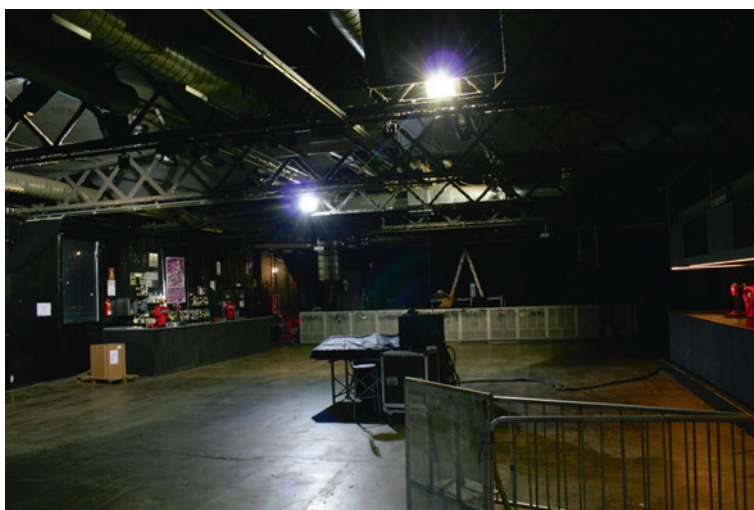
Capacity: 700

Architect: N/A

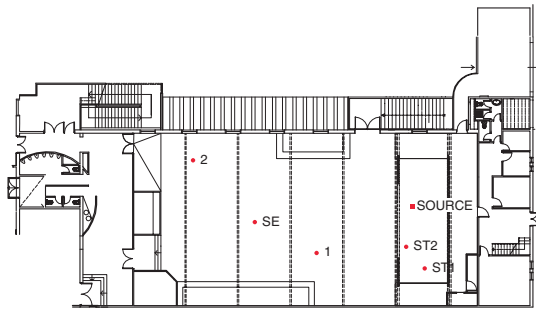
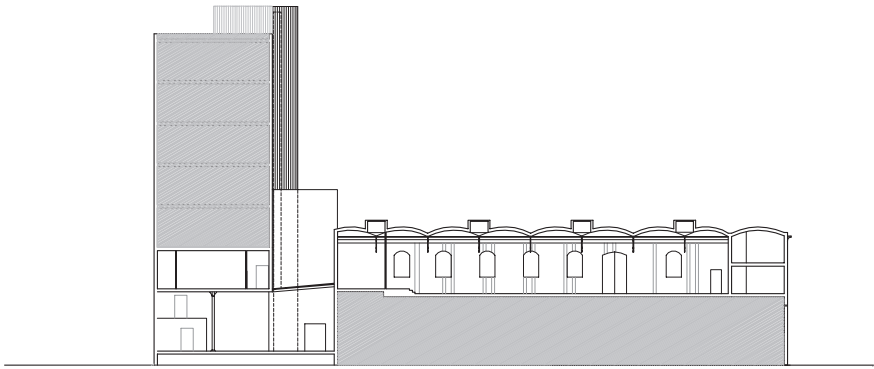
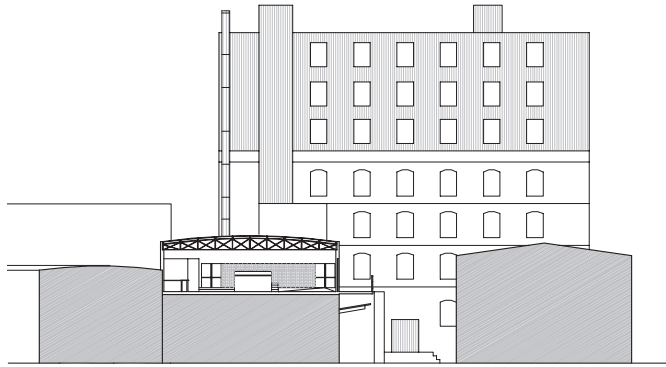
Acoustician: N/A



Razzmatazz 2. Typical underground rock club.



Razzmatazz sala 2.



Geometrical data	
Volume	2,600 m ³
$L \times W \times H$	$31 \times 16 \times 5.3$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.68
EDT_{125-2k}	1.66
$C_{80,125-2k}$	-0.52
BR ₆₃ versus 0.5-1k	1.03
BR ₁₂₅ versus 0.5-1k	1.01
<i>Stage area</i>	
EDT_{125-2k}	1.24
$D_{50,125-2k}$	0.59
BR ₆₃ versus 0.5-1k	0.68
BR ₁₂₅ versus 0.5-1k	1.21

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Painted plaster.

Walls: Concrete, a few windows; end wall: a bit of perforated bricks at DJ's location.

Stage Area

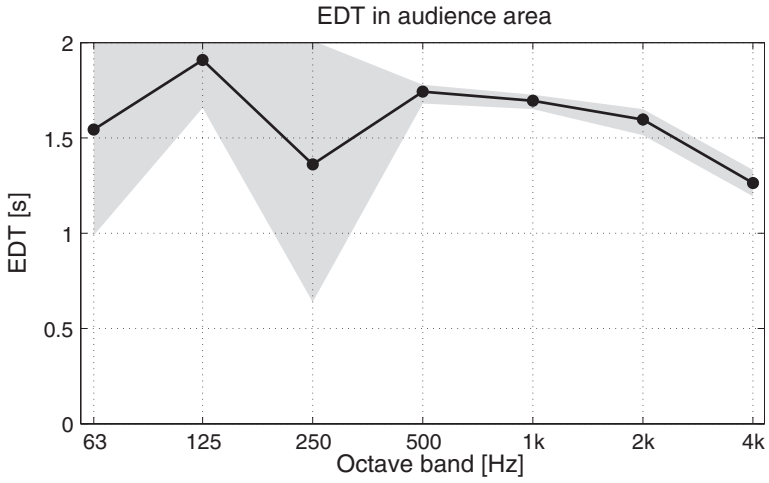
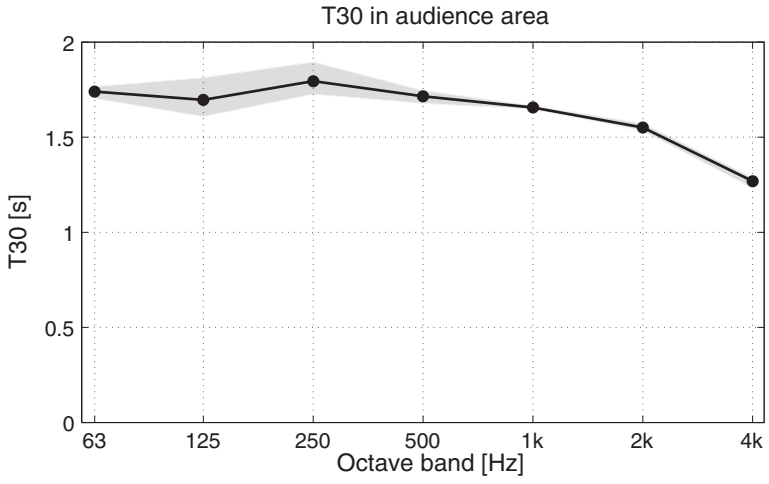
Floor: Wooden plates on risers.

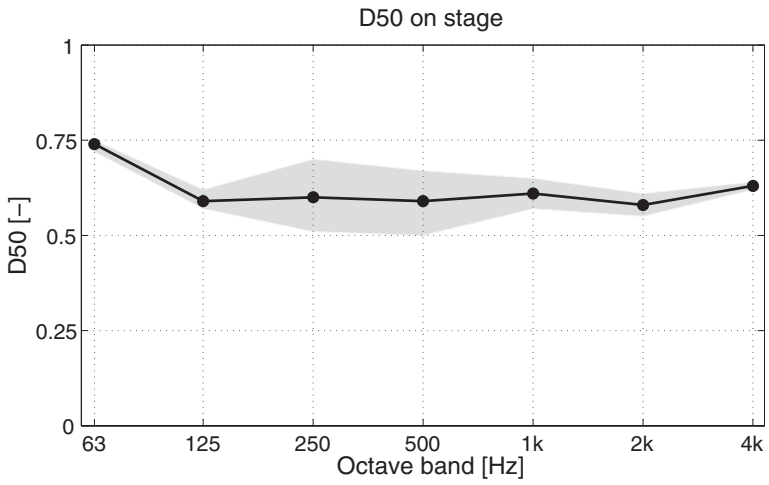
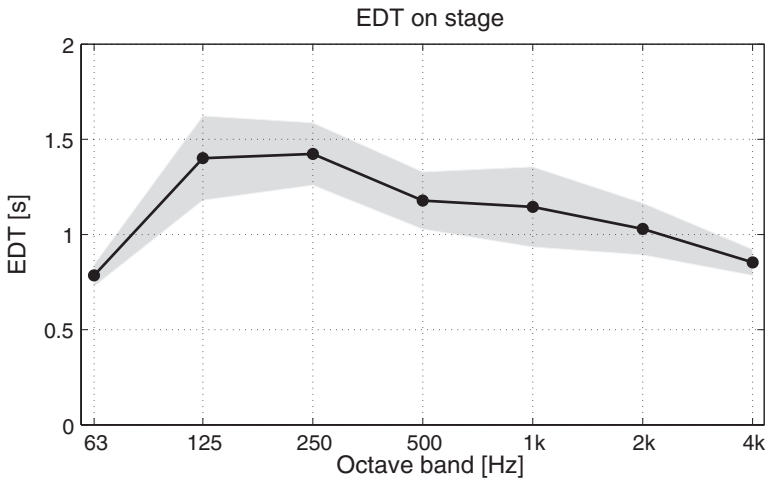
Ceiling: As audience area.

Walls: As audience area, curtains.

State of Hall When Measured

Empty.





Sala Barcelona'92/Sant Jordi Club

Barcelona

Number of concerts per year: 30

Founded: 1990

Capacity: 4,600

Architect: Arata Isozaki

Acoustician: N/A

Owner: Ajuntament de Barcelona (Barcelona City Hall)

The Sala Barcelona'92, annexed to the Palau Sant Jordi and well known as a space for organizing gala dinners and corporate events of different kinds, now has a new line of services designed for music events.

A completely open space that has let the imagination of creative people run riot and has fully satisfied event organizers.

An integral part of the Palau Sant Jordi, but at the same time totally independent, the recent installations of a stage and sound and lighting equipment have provided the venue with new technical services that facilitate corporate event programs.

With the name Sant Jordi Club, this medium-sized concert venue adds to the current number of musical venues available in Barcelona. With the aim of offering impeccable service, the Sant Jordi Club can count on upgraded and updated systems for concerts with a maximum capacity of 4,600 people.

The renovation of the Sant Jordi Club does not only feature structural improvements. With this new music venue concept, Palau Sant Jordi also commits itself to providing a wider and more select choice to the general public, as far as refurbishment is concerned, as well as access, car parks, and VIP services.

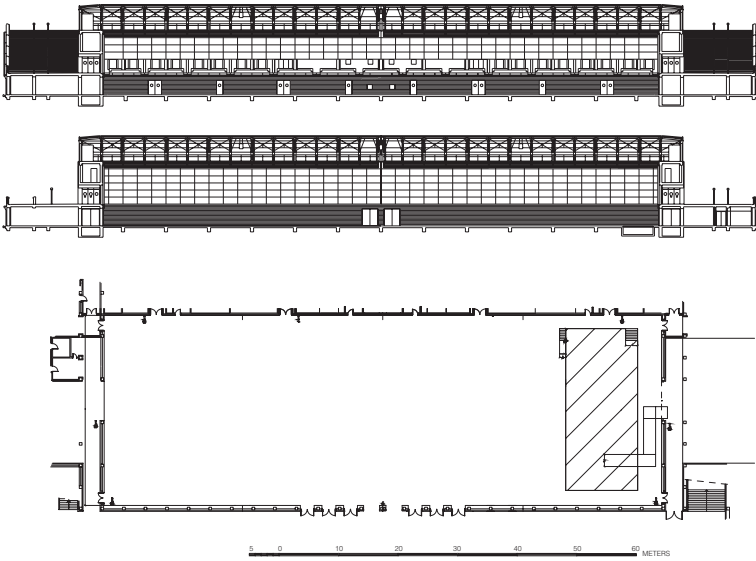
The number of concerts per year is 30, bands such as Arctic Monkeys, Jamie Cullum, Manowar, A-ha, Interpol, Alice Cooper, 30 s to Mars, Motorhead, Soulwax, and two Many DJ's are some of the shows that Sant Jordi Club held.



Curtains can be lowered to separate the long hall visually into smaller sections. The balcony is only on one side.



The Venue is situated in conjunction with Palau Sant Jordi on The Olympic esplanade.



Geometrical data	
Volume	48,000 m ³
Height, audience area	16 m
Size	93 × 32 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.81
EDT _{125-2k}	1.67
$C_{80,125-2k}$	1.65
BR ₆₃ versus 0.5-1k	0.81
BR ₁₂₅ versus 0.5-1k	1.07

Materials Used

Audience Area

Floor: Sports floor: wooden plates on joists and cavity.

Ceiling: Perforated thick plates with cavity behind.

Walls: Perforated thick plates with cavity behind. Lower walls are mainly hard thick plates (doors etc.).

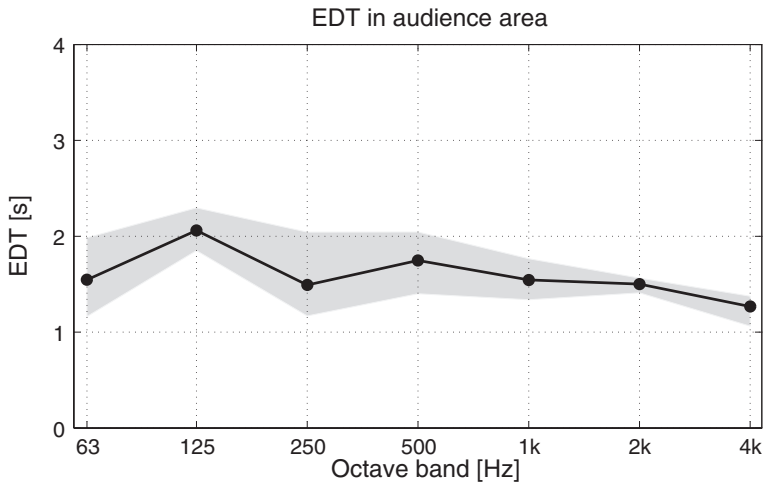
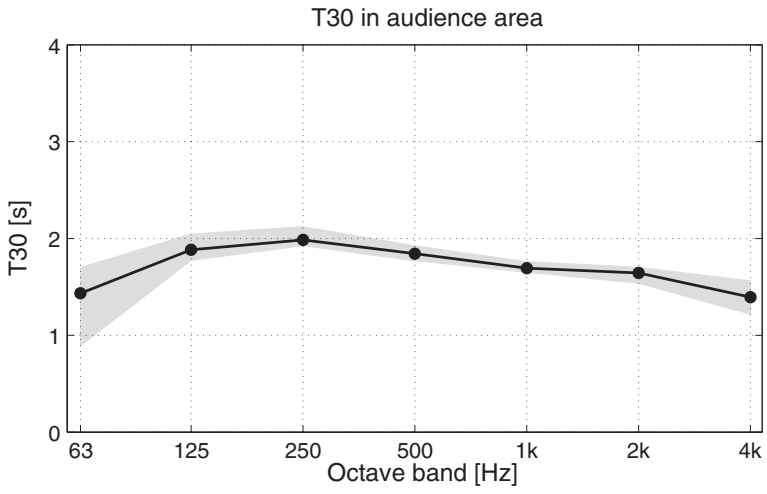
Seats are not upholstered.

Stage Area

Curtains surround the temporary staging arrangement.

State of Hall When Measured

Empty; curtain lowered ¼ of the hall's length from the rear wall opposite the stage.



Scala

London

Number of concerts per year: 150+

Founded: 1999

Capacity: Approximately 650

Architect: N/A

Acoustician: N/A

The Scala was originally built as a cinema to the designs of H. Courtney Constantine, but construction was interrupted by the First World War and it spent some time being used to manufacture aircraft parts, and as a labor exchange for demobilized troops before opening in 1920 as the King's Cross Cinema. The cinema changed hands and names several times through its life and also changed focus, ranging from mainstream to art-house to adult film over 70 years, as well as spending a short time as a primatarium.

In the summer of 1972, the Scala (then known as the King's Cross Cinema) played host to the one and only UK concert by Iggy and The Stooges (who were in London recording the album *Raw Power*.) All photographs later featured in the *Raw Power* album sleeve (including the famous cover shot) were taken that night during the show.

In the early 1990s London's popular Scala Film Club showed the film, *A Clockwork Orange*, without permission from Stanley Kubrick or Warner Brothers. At Kubrick's insistence, Warners sued and won. As a result, Scala was almost bankrupt and closed in 1993, however, the club was reopened in 1999. The cinema had been refitted, with the lower seating area incorporating the new stage, DJ booth, and dancefloor, and the upper seating area incorporated a second room and a DJ booth.

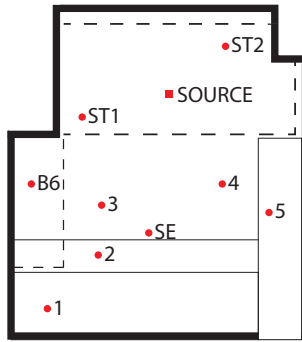
Scala now plays host to many eclectic club nights, including Ultimate Power, Face Down, University of Dub, and Pure Temptation and has featured live music acts including The Libertines, Rhianna, Jessie J, The Killers, Scissor Sisters, Robert Plant Foo Fighters, Moby, HIM, Wheatus, Adam Ant, Sheryl Crow, Sara Bareilles, Gavin DeGraw, Ray LaMontagne, Super Furry Animals, The Cutaway, The Chemical Brothers, and Avril Lavigne, Sonic Youth, Plan B, Tiesto, Enslaved, Gorgoroth, and Lacuna Coil.



Scala means stairs explains Jane as I carry my equipment the 200 stairs from street to stage.



Many later-to-be world famous acts have played the Scala. Some of them return years later.



Geometrical data	
Volume	2,000 m ³
$L \times W \times H$	$18 \times 16 \times 7.2$
Surface area of stage	75 m ²
Height of stage	0.5 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.48
EDT _{125-2k}	1.45
$C_{80,125-2k}$	0.89
BR ₆₃ versus 0.5-1k	0.96
BR ₁₂₅ versus 0.5-1k	0.96
<i>Stage area</i>	
EDT _{125-2k}	1.09
$D_{50,125-2k}$	0.71
BR ₆₃ versus 0.5-1k	0.75
BR ₁₂₅ versus 0.5-1k	0.79

Materials Used

Audience Area

Floor: Wood on joists.

Ceiling: Masonry.

Walls: Upper wall areas: concrete; lower wall surfaces: wood panels on 2-cm cavity.

Stage Area

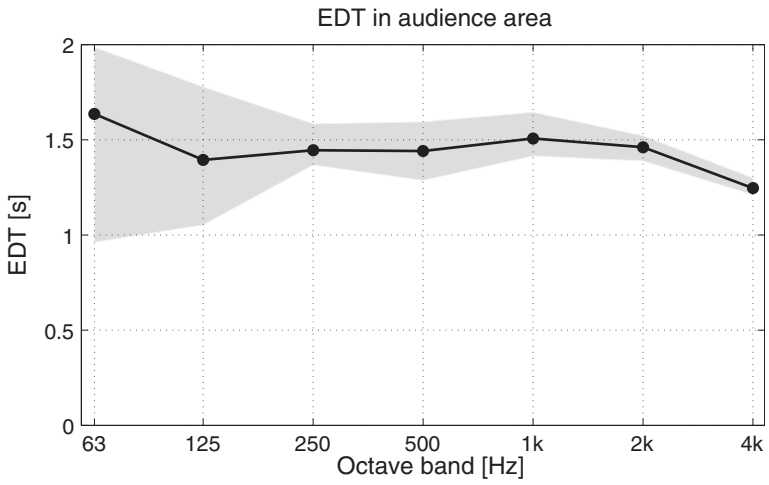
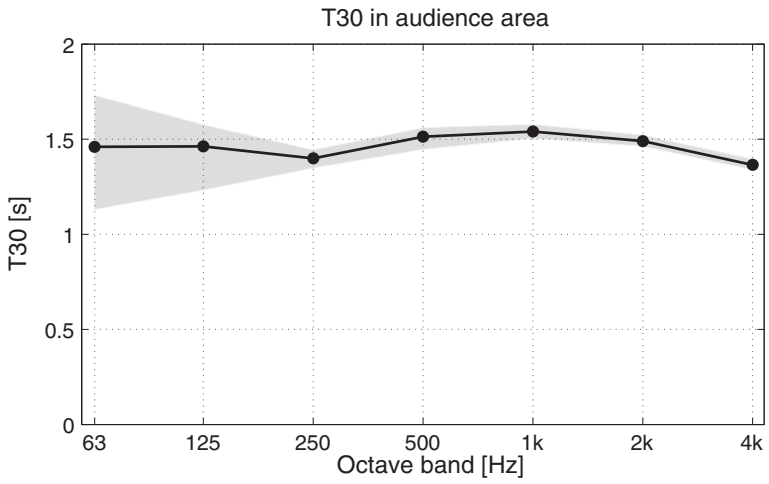
Floor: Wood on cavity.

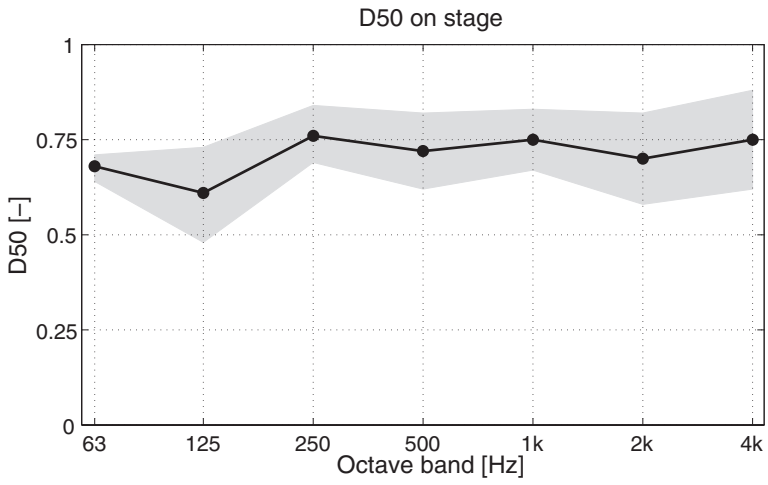
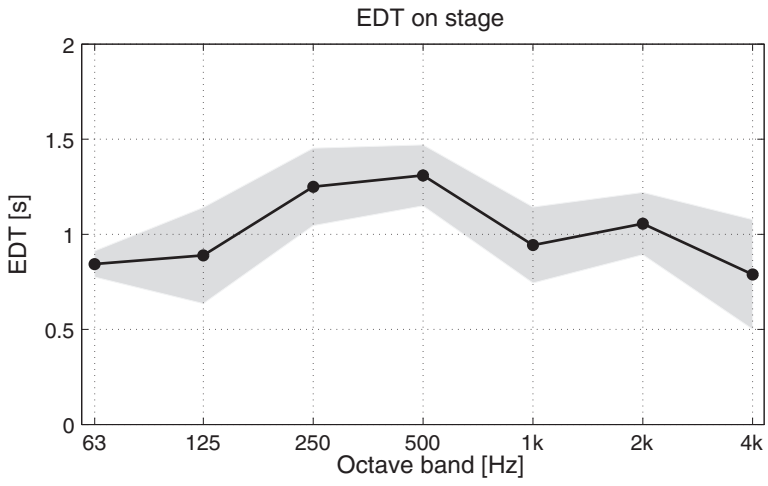
Ceiling: Masonry.

Walls: Curtains.

State of Hall When Measured

Empty.





Tunnel

Milano

Number of concerts per year: 120

Founded: 1995

Capacity: 400

Architect: N/A

Acoustician: N/A

Formerly a warehouse of the Central Railway station built in 1936, during fascism, with its typical tunnel structure and barrel vault, the original industrial building has been brought to a new life in 1995, when it turned into Tunnel, an underground music sanctuary.

In its early years artists such as Skunk Anansie, The Cardigans, Uestlove (The Roots), Calexico, and Pan Sonic performed on its stage. The club also hosted some exciting secret shows (one of those featured a memorable live performance by Soulwax).

Tunnel was one of the first clubs in Milan that bet on alternative electronic sounds, inviting DJs like Gilles Peterson and Kid Loco. During the 1990s Tunnel rapidly became the place to be for the whole alternative music scene and a landmark for Milanese clubbers.

In 2009, after several management shifts, Tunnel went back to its roots, with a farsighted glance to the future: the new staff, headed by Diego Montinaro, has thoroughly transformed the venue: completely renewed and refreshed, boosted by an astonishingly powerful sound system, the club also features renewed interiors, and a new lighting set.

Since then the club has developed a solid reputation as an interesting and innovative underground club. Tunnel, with its 350-person capacity, is the small, intimate place where some of the best DJs and bands all over the world feel at home, bands like The Buzzcocks, The Black Angels, The Drums and Lanegan and Campbell, artists like Jon Spencer, Damo Suzuki (ex Can), and Lisa Germano with Phil Selway to name a few.

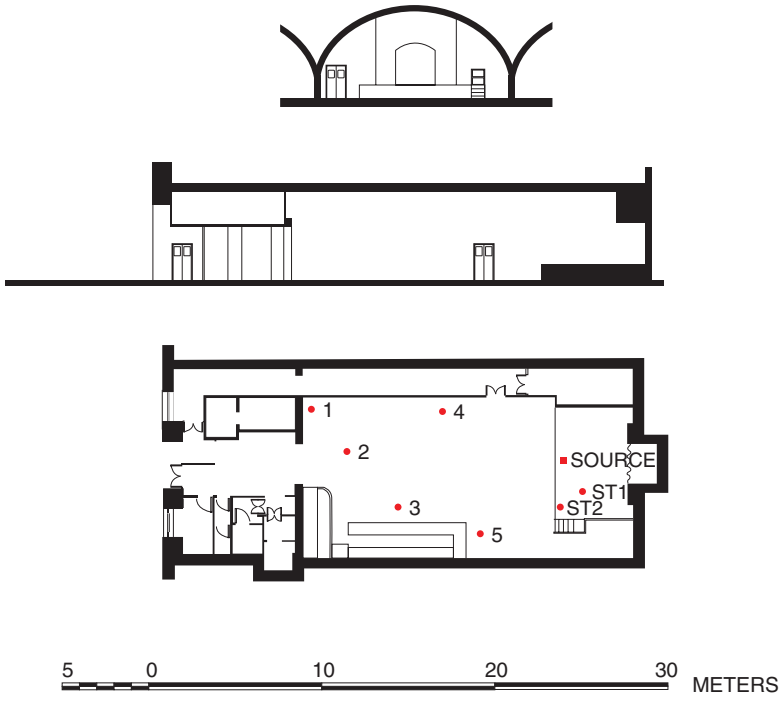
The club nights also have become really popular and the club has recently invited guest DJs including Moodymann, Etienne de Crecy, Audio Bullys, and Andrew Weatherhall. Far from being an empty, soulless case, Tunnel has many faces, always keeping the same underground flavor.



A tunnel is a nightmare for any acoustician because of focusing effects. Tunnel seems to do fine. Photo: Cecilia Giolli.



The porous light concrete and the absence of a back wall is believed to be the reason why Tunnel does not seem to have significant bass problems. Photo: Cecilia Giolli.



Geometrical data	
Volume	700 m ³
$L \times W \times H$	$19 \times 9 \times 1.2-5.4$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.94
EDT_{125-2k}	0.76
$C_{80,125-2k}$	5.69
BR ₆₃ versus 0.5-1k	0.82
BR ₁₂₅ versus 0.5-1k	0.94
<i>Stage area</i>	
EDT_{125-2k}	0.4
$D_{50,125-2k}$	0.89
BR ₆₃ versus 0.5-1k	2.36
BR ₁₂₅ versus 0.5-1k	0.95

Materials Used

Audience Area

Floor: Tiles on concrete.

Ceiling: Concrete.

Walls: Light concrete; light concrete covered with a painted porous insulation product.

Stage Area

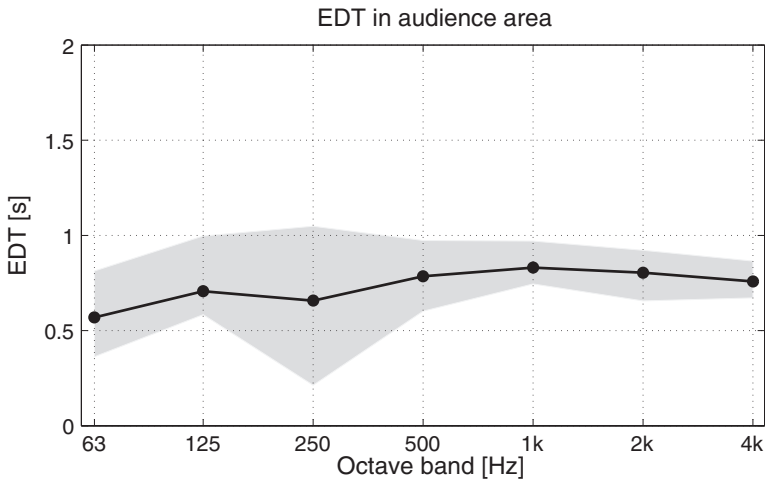
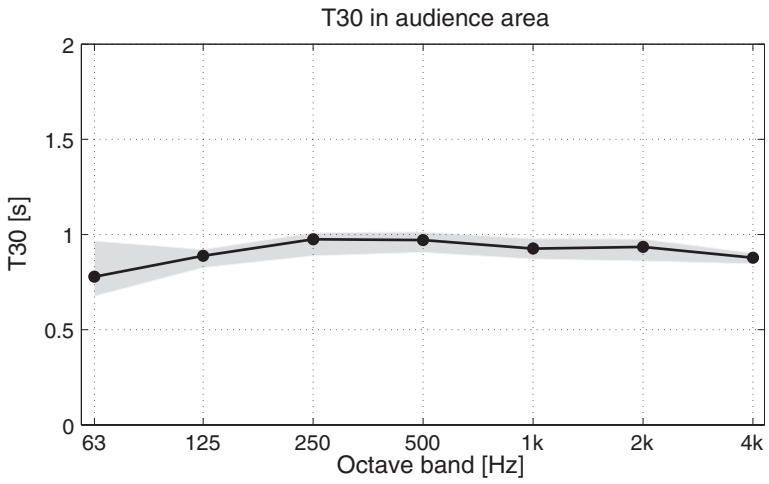
Floor: Tiles on concrete.

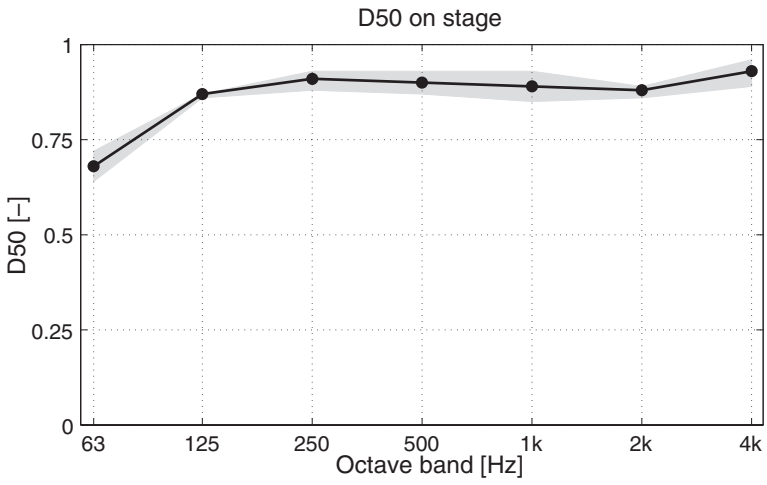
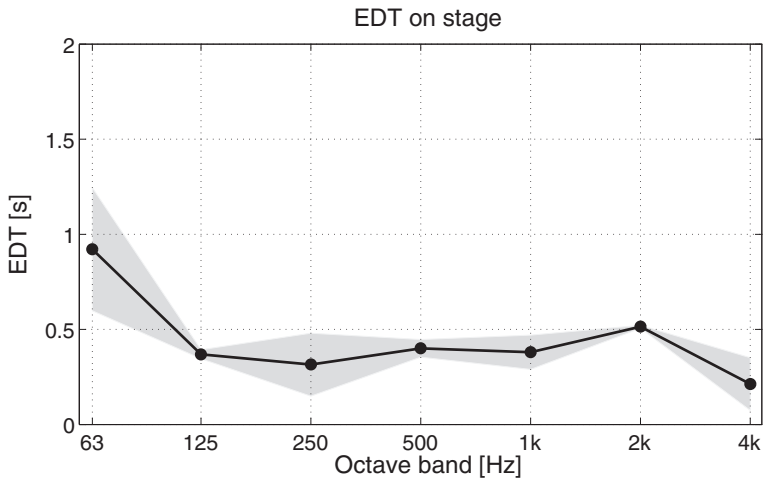
Ceiling: 5-cm foam product on concrete.

Walls: 5-cm foam product on concrete.

State of Hall When Measured

Empty; a DJ setup on stage.





Vega

Copenhagen

Number of concerts per year: 120. In both halls in the venue: 260

Founded: 1996, building: 1956

Capacity: 1,500

Architect: Vilhelm Lauritzen

Acoustician: Jordan/Jan Voetmann

VEGA is a regional venue, owned and operated by the foundation Koncertvirksomhedens Fond, which was created with the sole purpose of presenting concerts. Parts of the foundation's service is based on municipal and state grants.

In 2010 approximately 300,000 people visited VEGA and the venue has been named as the best concert arena in Europe by the international music magazine *Live*. With two separate concert halls VEGA presents a broad program of music, covering many different styles. The great hall, Store VEGA, has capacity for 1,500 guests, and the smaller hall, Lille VEGA, has space for 500 people.

Furthermore, the VEGA Lounge and Ideal Bar are at street level, and are both there to create the perfect setting for a night out in Copenhagen's music and night-life. VEGA has a total of 12 bars serving the audience and musicians. VEGA's central location in Copenhagen and the close proximity to southern Sweden, make VEGA the obvious choice when indoor concerts by international artists are being planned.

Annually around 250 concerts and events are held at VEGA, reflecting VEGA's objective to find the right balance between new talent and more established names in rock, pop, soul, hip hop, electronic, and world music as well as presenting the audience with various club concepts. VEGA's own production of concerts and events each year is represented by about 150 concerts, club events, showcases, and special events.

VEGA has opened the doors to most of Scandinavia's leading artists as well as several international stars including Prince, David Bowie, Björk, Suede, Kylie Minogue, Norah Jones, Moby, Foo Fighters, Blur, Fatboy Slim, DJ Shadow Girl Talk, Erol Alkan, DJ Shadow, and others. VEGA's technical equipment, where particularly the sound system is of high quality, guarantee a perfect experience.

VEGA is known as one of the leading concert stages in Europe. This is not only due to optimal venue audio and lighting conditions, but also because the building is an exciting architectural gem, which provides the perfect setting for evocative arrangements. The original 1950s design gives the building a unique atmosphere, and VEGA's decor with dark wood paneling, mahogany floors, friezes, and the many original details of railings, balustrades, and lamps in typical Scandinavian style are the hallmarks of VEGA.

The building was originally named The People's House and was the stronghold of the Danish trade union movement. It was built in 1956 and designed by the famous Danish architect Vilhelm Lauritzen, who is also known for other period building works such as Broadcasting House and the award-winning old terminal

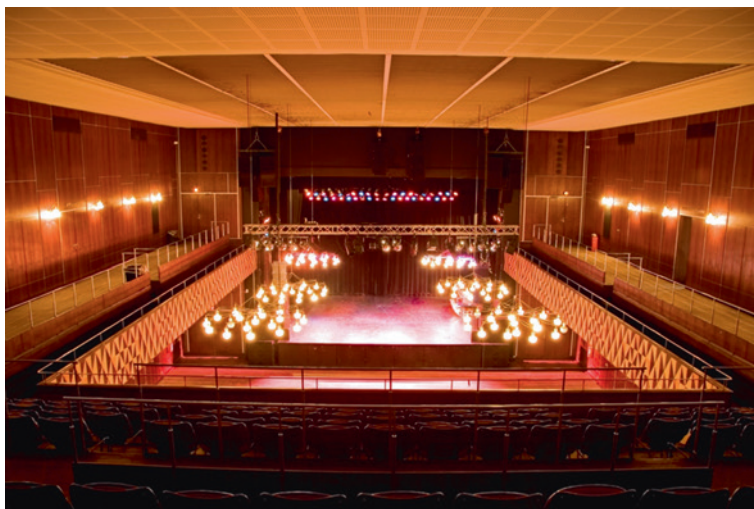
at Copenhagen Airport. Since the unions pulled out, The People’s House was deserted for many years and was beginning to decay. But after an extensive restoration in 1996 the building reopened as VEGA—House of Music. The property is one of the youngest listed buildings in Denmark.

- Most people know VEGA for concerts and VEGA’s Night Club, but the atmospheric halls and labyrinthine hallways contain a wealth of other options. In addition to the two halls, Store and Lille VEGA, VEGA has many other rooms that each have a distinctive character and offer the opportunity to house small- and medium-sized companies. The beautiful premises can also provide a framework for, for example, press conferences, company parties, general meetings, and cultural events.

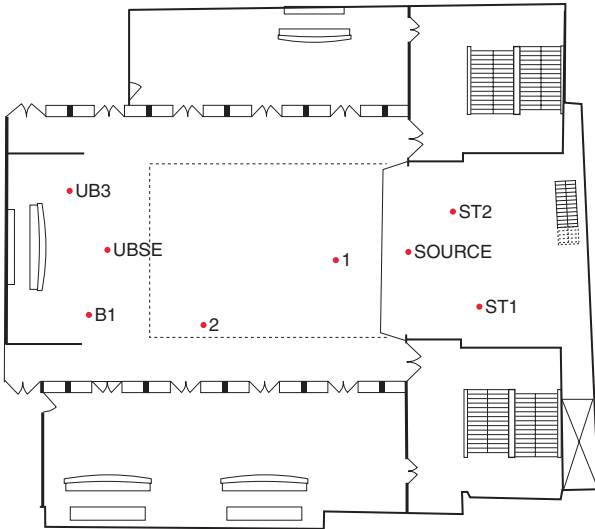
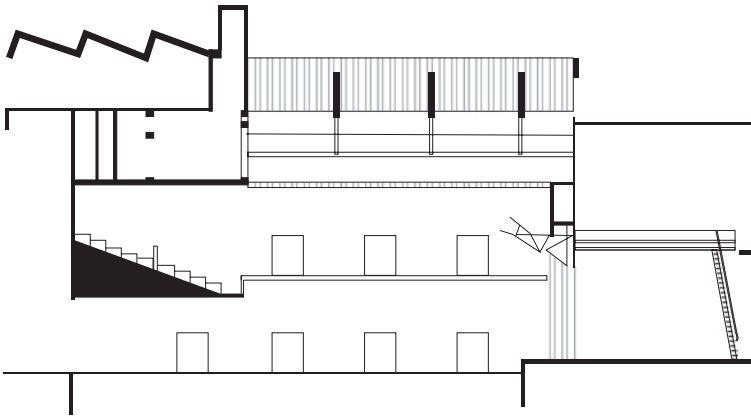
Headed by a board of seven members, VEGA has approximately 180 employees, most of whom are paid by the hour. In its daily operation and administration VEGA employs about 35 full-time employees.



Wooden panels in excess including the floor and a porous absorber with a 3-m cavity in the ceiling ensure control of the T30 including the crucial 125 Hz octave band. And it leaves a nice airy sound not too reverberant once the audience is in place.



Vega is without doubt the best established Danish rock venue of its size. The build-up of T30 below 100 Hz only becomes perceivable far back on the stage where one can feel a lack of early support due to the huge stage tower.



Geometrical data	
Volume	6,000 m ³
$L \times W \times H$	$38 \times 19 \times 10.5$
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.2
EDT_{125-2k}	0.97
$C_{80,125-2k}$	4.97
BR ₆₃ versus 0.5–1k	1.34
BR ₁₂₅ versus 0.5–1k	0.98
<i>Stage area</i>	
EDT_{125-2k}	0.51
$D_{50,125-2k}$	0.88
BR ₆₃ versus 0.5–1k	3.83
BR ₁₂₅ versus 0.5–1k	1.92

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Concrete with large areas of glazing. Suspended home-made reflectors.

Walls: Concrete. At each side of the front of the stage there are two big walls 20-cm thick with thin perforated plates on each side and mineral wool in between.

Upper side wall on one side: perforated gypsum board. Back wall: painted brick.

Stage Area

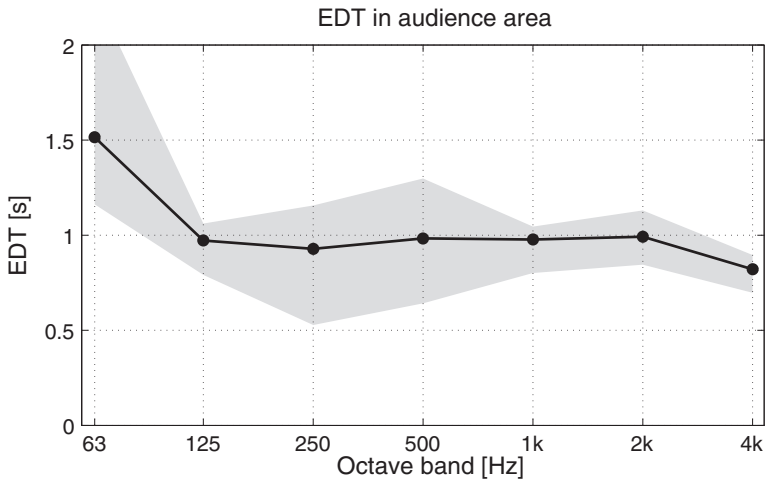
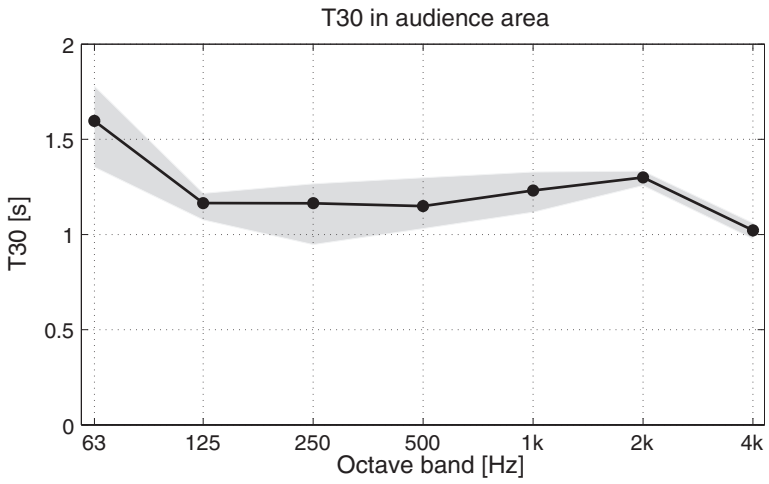
Floor: Stage risers.

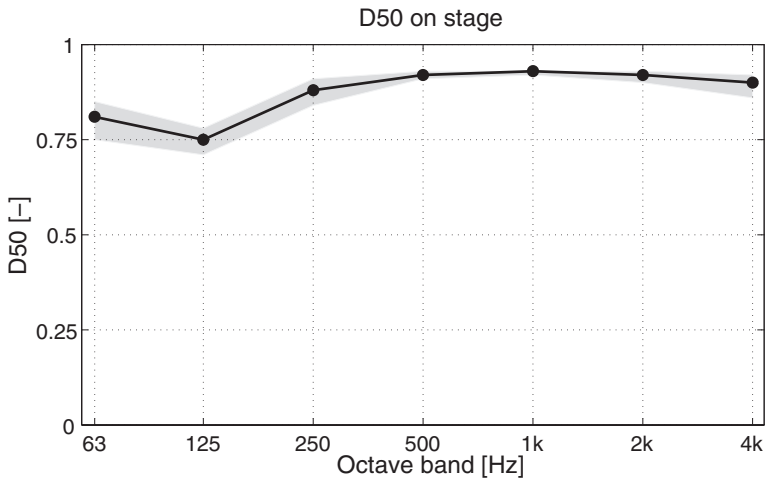
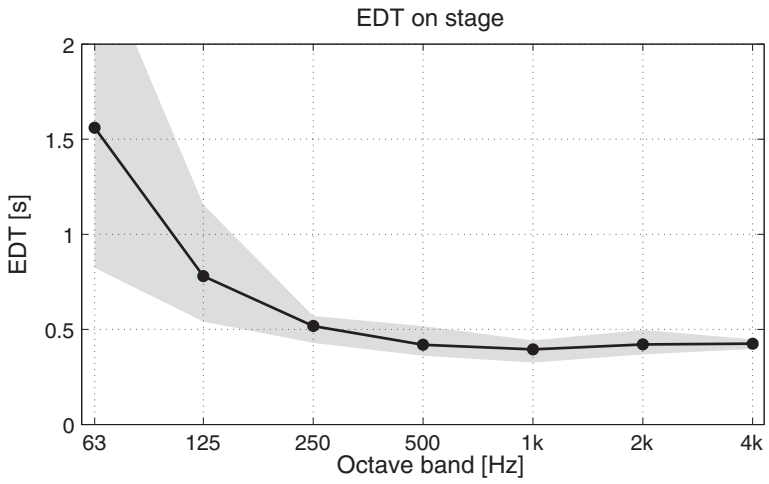
Ceiling: Concrete.

Walls: Curtains.

State of Hall When Measured

Empty; seating risers at the rear of the hall.





Wembley Arena

London

Number of concerts per year: 50

Built: 1934; refurbished: 2006

Capacity: 12,000

Architect: Owen Williams

Acoustician: N/A

Wembley Arena, by many called the UK's flagship live music venue, first opened its doors in 1934 as the Empire Pool and Sports Arena. At that time the building was considered a great innovation being one of the only buildings of its size with such a vast roof span and having no supporting columns anywhere within the auditorium, thus giving a full view to all guests. It opened as a multi-purpose venue, hosting public swimming sessions as well as international swimming competitions, boxing, and a variety of sporting events. In 1948 it was the venue for the swimming events of the Olympic Games and went on to host numerous sporting and musical events. The famous Wembley lion was adopted by the home ice hockey team as their name (The Wembley Lions), as did the neighboring speedway team at the Stadium next door.

72 years and a £35 million refurbishment later, the venue reopened its doors in April 2006 with a twenty first-century look and has become synonymous with live music, welcoming scores of sell-out shows and one-off UK tour dates from major recording artists each year. Wembley Arena has played host to some of the greatest music acts of all time, but is also well known as a sports and entertainment venue. Playing host to ice skating shows such as *Disney on Ice*, *Holiday on Ice*, and *Dancing on Ice*, family events such as CBeebies and Thomas the Tank Engine and even becoming a luxury equestrian center for the pampered horses of the Spanish Riding School and Masters Snooker it retains its historic links with Wembley following its move from the Conference Centre in 2007.

The Arena continues to play host to the greatest global recording artists, including Madonna, Bruce Springsteen, and the Rolling Stones as well as popular sports personalities and most enchanting children's shows and is looking forward to celebrating many more great years of entertainment.

The Arenas first solo rock band concert was the Monkees in 1967 and also played host to the only time the Beatles and the Rolling Stones appeared on the same bill, at the NME Poll winners Party in 1964. When the venue was known as "Empire Pool," it hosted the annual *New Musical Express* Poll Winners' concert during the early 1960s. Audiences of 10,000 viewed acts including the Beatles (who performed there three times), Cliff Richard and The Shadows, Joe Brown and the Bruvvers, The Rolling Stones, The Who, Dave Dee, Dozy, Beaky, Mick and Tich, and many others, hosted by Jimmy Savile and Pete Murray. The individual performances were then finished by a famous personality joining the respective performer on stage and

presenting them their award. The Beatles were presented one of their awards by actor Roger Moore and Joe Brown was joined on stage by Roy Orbison, to present him his. These were filmed and recorded and later broadcast on television.

A notable attendance record was set in the early 1970s, by David Cassidy, in his first tour of Great Britain in 1973, when he sold out six performances in one weekend. In 1978, Electric Light Orchestra sold out eight straight concerts (a record at the time) during their *Out of the Blue* Tour. The first of these shows was recorded, televised, and later released as a CD/DVD. ABBA also played six sold-out concerts, in one week in 1979 and one song from these concerts, “The Way Old Friends Do,” is on their album, *Super Trouper*.

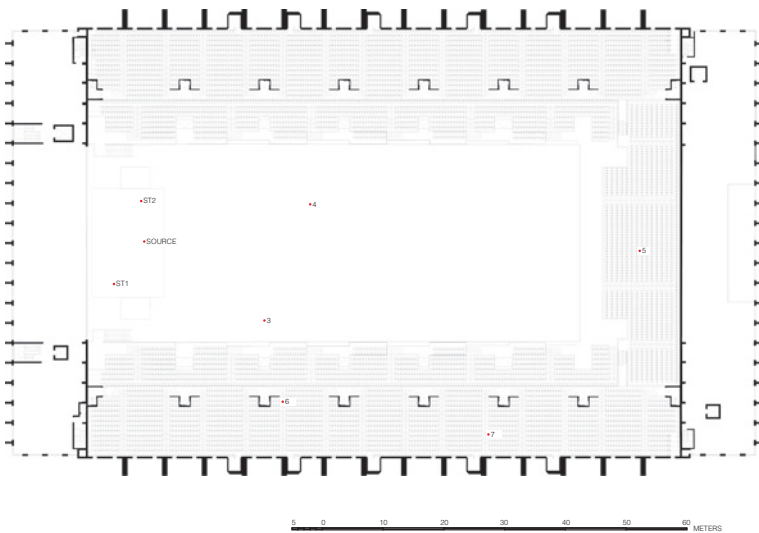
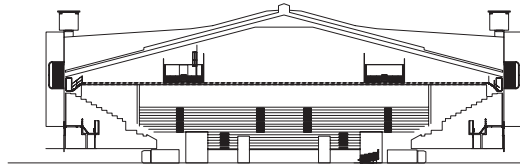
In April 1994, Barbra Streisand began her *Barbra—The Concert* Tour, with four performances at the arena. They marked her first performances in the United Kingdom after 28 years and were the only shows outside of the United States. The opening song on the first night, “As If We Never Said Goodbye,” was recorded and transmitted on BBC TV’s *Top of the Pops*. Christina Aguilera performed three shows at the arena during her *Stripped* world tour on 2–3 and 5 November 2003. They were filmed and later released as a DVD, titled *Stripped Live in the U.K.* Beyoncé performed, on two consecutive nights, at the arena during her *Dangerously in Love Tour* on November 10–11, 2003. Her show on the 10th was filmed and later released as a DVD, titled *Beyoncé: Live at Wembley*.

Pop band Busted sold out the arena a record 11 times in one year, in 2004 P!nk performed two shows at the arena during her *I’m Not Dead Tour* in October and December, 2006. They were filmed and later released as a DVD, titled *Pink: Live from Wembley Arena*. Pearl Jam holds the attendance record for one show, with 12,470 fans at their 2007 gig [1].

Cliff Richard holds the record for the most headline shows by one artist, having played his 61st concert at the arena in October 2009. Tina Turner is the female artist with the most shows at Wembley, with 26 and with 7 at Wembley Stadium.



Legendary. Curtains in the ceiling lower the RT only at high frequencies. Same constellation at measurement.



Geometrical data	
Volume	approximately 150,000 m ³
$L \times W \times H$	96 × 70 × 24 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	2.56
EDT_{125-2k}	2.41
$C_{80,125-2k}$	-3.47
BR ₆₃ versus 0.5-1k	2.1
BR ₁₂₅ versus 0.5-1k	1.64

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Perforated plate probably with some cavity behind.

Walls: Beneath the lower balcony: concrete and doors. At both end walls and on walls over the upper balconies: perforated thin plate with 5–10-cm porous absorption behind.

Seats are not upholstered.

State of Hall When Measured

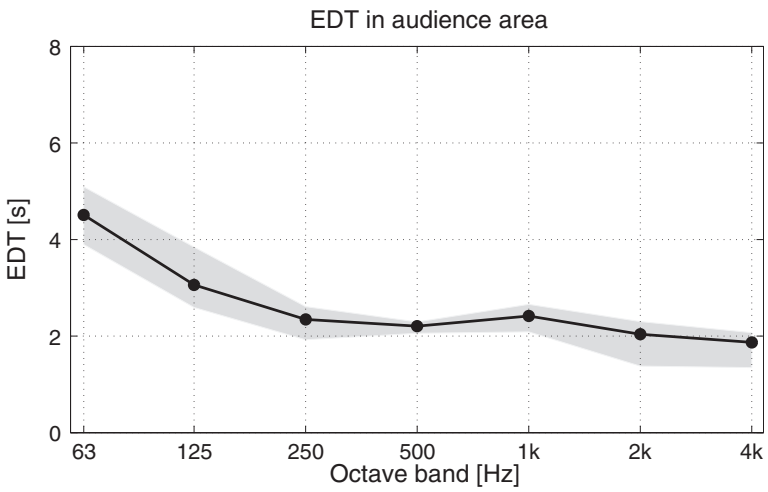
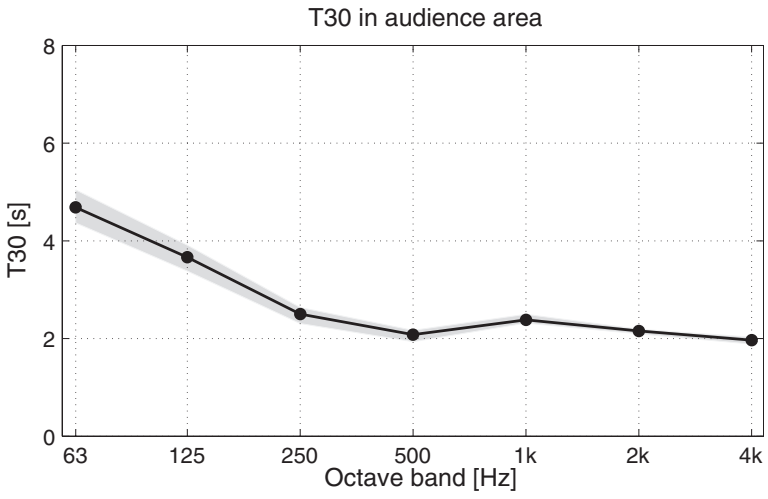
Additional seats mounted on the entirety of the floor. Curtains in ceiling as in photo but also on the sides 2/3 down from stage.



Wembley Arena. “...venues, it seems, do get better with age.” (The Times).



“The arena looks great—it looks fantastic—and comfy seats too!!!” (Music Week).



Werk

München

Number of concerts per year: N/A

Capacity: 1,500

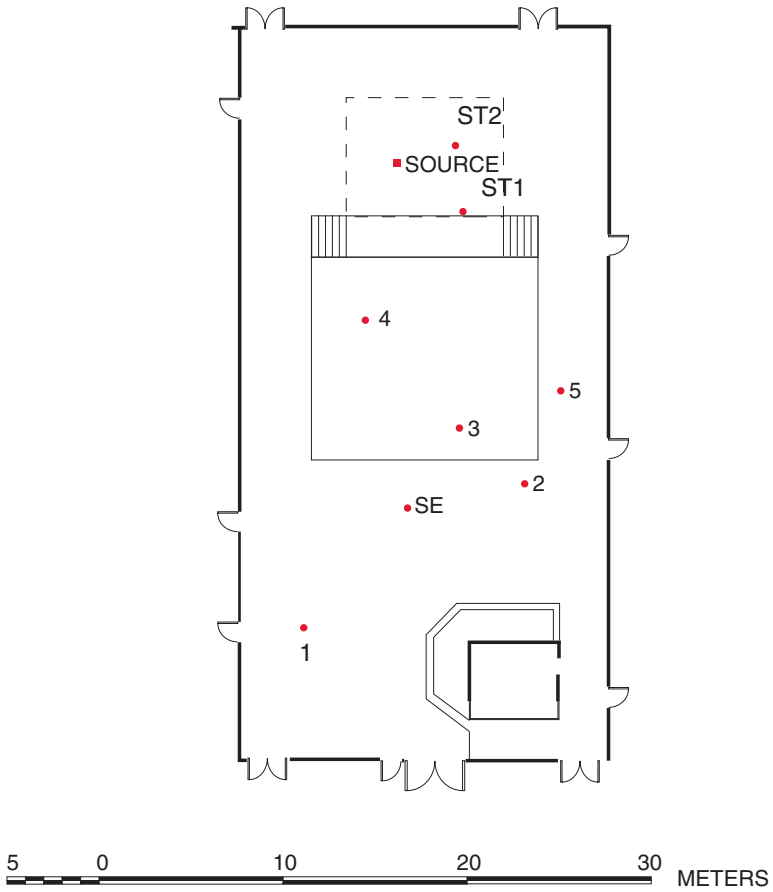
Founded: N/A

Architect: N/A

Acoustician: N/A



Due to noise issues with neighbors the future of the club is uncertain.



Geometrical data	
Volume	4,000 m ³
$L \times W \times H$	40 × 20 × 5 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.39
EDT_{125-2k}	1.46
$C_{80,125-2k}$	-0.15
BR ₆₃ versus 0.5-1k	0.96
BR ₁₂₅ versus 0.5-1k	1.04
<i>Stage area</i>	
EDT_{125-2k}	0.8
$D_{50,125-2k}$	0.7
BR ₆₃ versus 0.5-1k	0.77
BR ₁₂₅ versus 0.5-1k	1.07

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Concrete with large areas of glazing. Suspended home-made reflectors.

Walls: Concrete. At each side of the front of the stage there are two big walls 20-cm thick with thin perforated plates on each side and mineral wool in between.

Upper side wall on one side: perforated gypsum board. Back wall: painted brick.

Stage Area

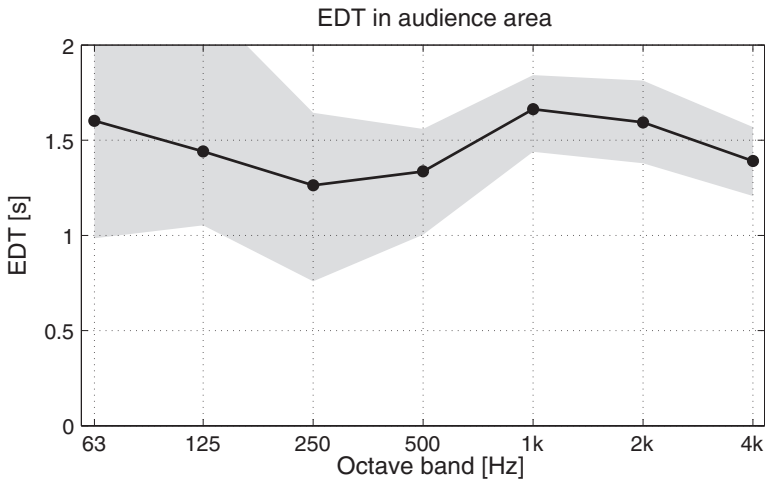
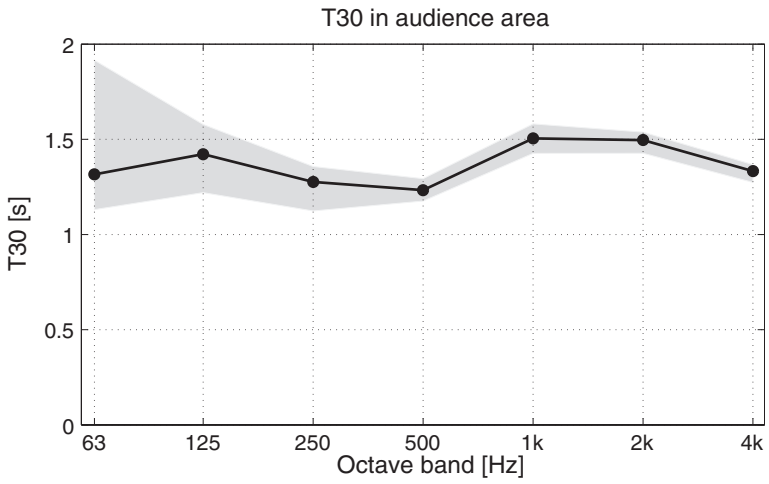
Floor: Stage risers.

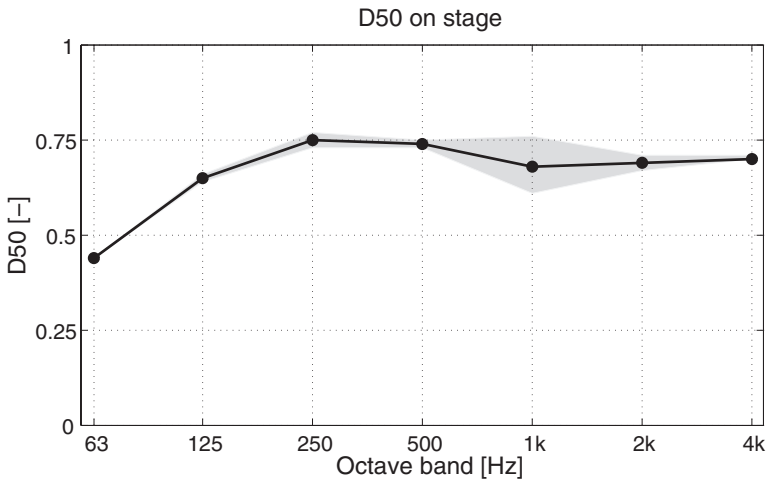
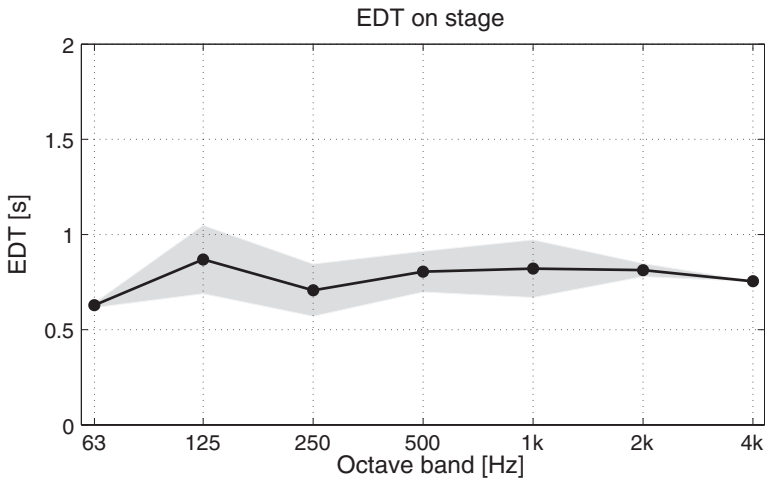
Ceiling: Concrete.

Walls: Curtains.

State of Hall When Measured

Empty; seating risers at the rear of the hall.





Zeche

Bochum

Number of concerts per year: 150

Founded: 1981

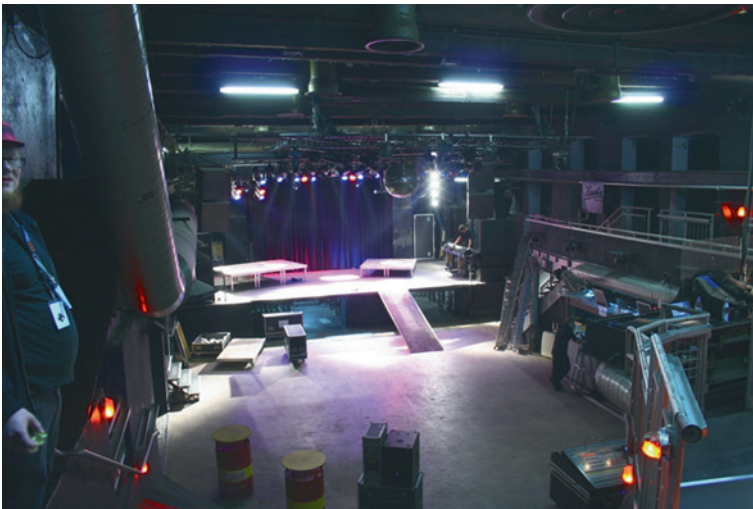
Capacity: 1,100

Architect: N/A

Acoustician: N/A

Die *Zeche Bochum* ist ein Veranstaltungsmultiplex mit Diskothek in Bochum. Sie wurde im November 1981 eröffnet und war mit Vorreiter für Konzepte der Sozio-Kulturellen Zentren. Ihre Räumlichkeiten mit Veranstaltung-, Verzehr- und Tanzbereichen befinden sich in der ehemaligen Schlosserei der Zeche Prinz Regent in Bochum-Weitmar.

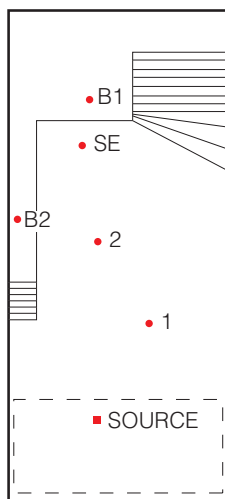
Anfänglich wurden Veranstaltungen in der Zeche Bochum teilweise bei kultureller Anerkennung öffentlich mitgefördert, jedoch musste sie sich kommerziell selbst von Beginn an von allein tragen und war ein Vorreiter für weitere Musikklubs in Deutschland. Die Musikrichtung war zunächst dem Underground verpflichtet, später verlegte man sich auf Pop und Mainstream. Die Zeche Bochum war von Anfang an regelmäßiger Veranstaltungsort für Konzerte. Zum Interieur zählt neben der Veranstaltungshalle mit Empore, eine Kneipe, ein Restaurant und ein kleiner Veranstaltungsraum.



Zeche is one of Germany's most legendary clubs of this size.



Balcony and staircase levels make it possible for everybody to find a spot with good visibility.



Geometrical data	
Volume	2,700 m ³
$L \times W \times H$	26.7 × 11.9 × 7.2–10.3 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.13
EDT_{125-2k}	1.17
$C_{80,125-2k}$	0.45
BR ₆₃ versus 0.5–1k	1.13
BR ₁₂₅ versus 0.5–1k	1.23
<i>Stage area</i>	
EDT_{125-2k}	0.74
$D_{50,125-2k}$	0.78
BR ₆₃ versus 0.5–1k	0.95
BR ₁₂₅ versus 0.5–1k	1.7

Materials Used

Audience Area

Floor: Wood direct on concrete.

Ceiling: Thin plate on cavity filled with mineral wool.

Walls: Concrete with areas of windows covered with wooden plate. Curtain on upper 2 m.

Stage Area

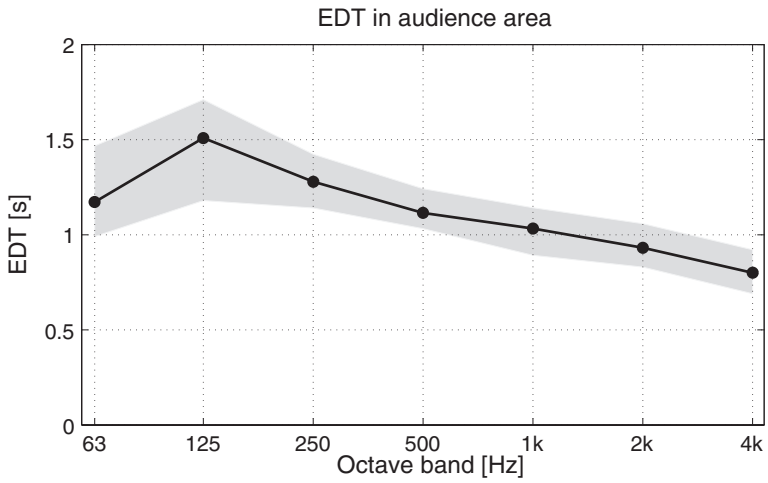
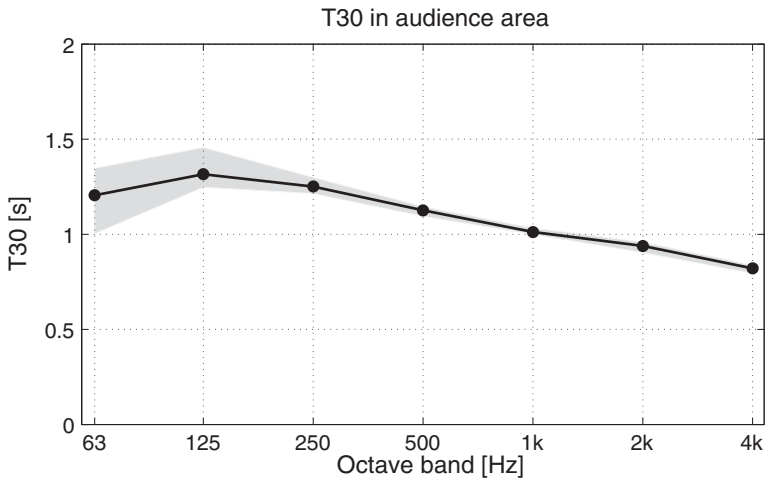
Floor: Modular stage risers.

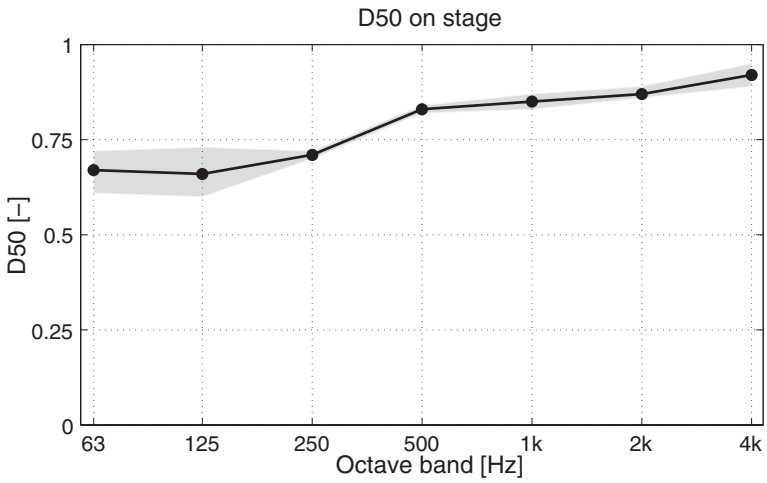
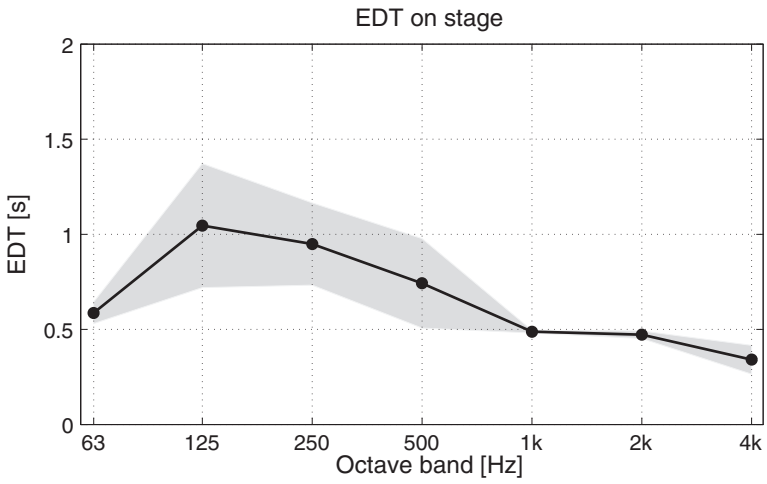
Ceiling: Thin plate on cavity filled with mineral wool.

Walls: Curtains.

State of Hall When Measured

Empty; risers on stage.





Zeche Carl “Kaue”

Essen

Number of concerts per year: 60

Founded: 1970

Capacity: 600 (250 seated)

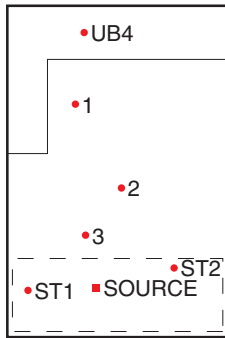
Architect: N/A

Acoustician: N/A

Situated in the north of Essen, Zeche Carl has a long and interesting history. Originally the site of a gas coal mine that opened in 1861, it boasts one of the oldest (and best preserved) Malakov Towers in the region. For a long time, Zeche Carl has been a “prototype” of the structural change witnessed by the entire Ruhr area. The mine closed in 1970, and the site was converted into a cultural center that same decade by an initiative made up of local citizens, youth groups, and the local Protestant congregation. Over the years, and with the backing of agencies including the city of Essen, the center grew to become one of the most significant sociocultural institutions in Germany. Activities were forced to a temporary halt when the organization behind the center went bankrupt, but a new association was found to run it and in the autumn of 2009 the Zeche Carl casino building reopened with a revised concept to continue its work as an intergenerational, cross-nationality forum for the citizens of Essen, and as a nationally influential cultural center for the entire urban area and the region as a whole. The events that take place at Zeche Carl include cabaret, concerts, parties, courses, workshops, readings, exhibitions, and much more, and social institutions and self-help groups also use it as their base.



Zeche Carl. Very typical T30 values across frequency.



Geometrical data	
Volume	Approximately 1,000 m ³
$L \times W \times H$	Approximately 18 × 12 × 5
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	0.9
EDT_{125-2k}	0.72
$C_{80,125-2k}$	5.55
BR ₆₃ versus 0.5–1k	1.97
BR ₁₂₅ versus 0.5–1k	1.54
<i>Stage area</i>	
EDT_{125-2k}	0.48
$D_{50,125-2k}$	0.89
BR ₆₃ versus 0.5–1k	2.87
BR ₁₂₅ versus 0.5–1k	2.6

Materials Used

Audience Area

Floor: Tiles on concrete.

Ceiling: Concrete 20 % of which is covered with felt 1 m from ceiling.

Walls: Concrete.

Stage Area

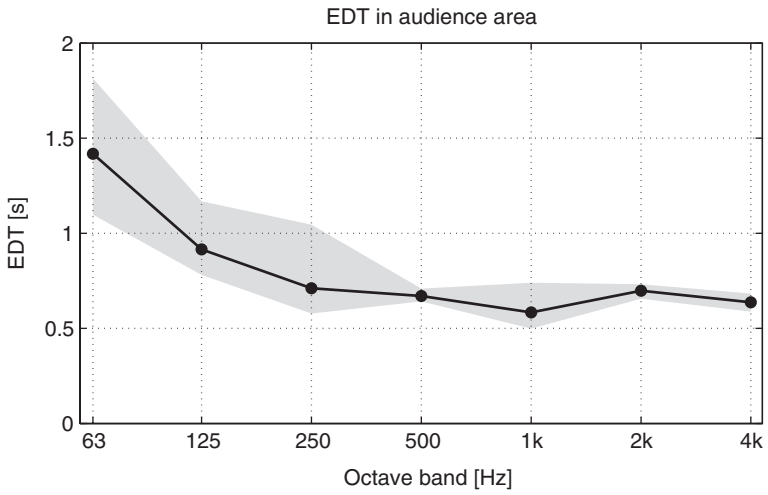
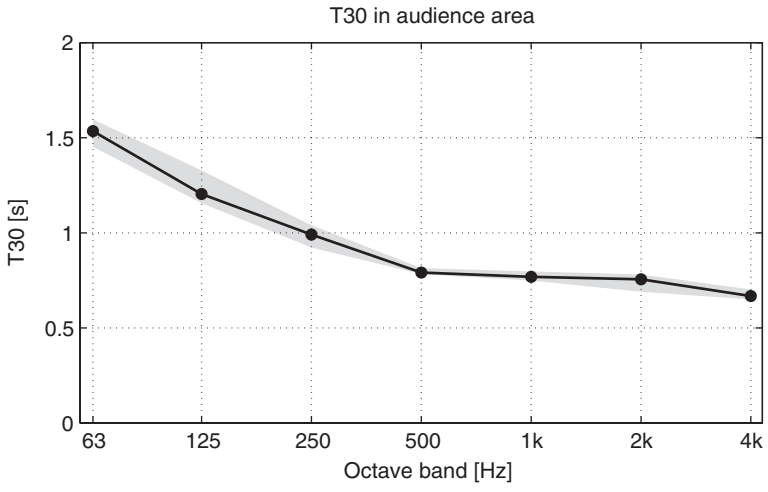
Floor: Wood on joists.

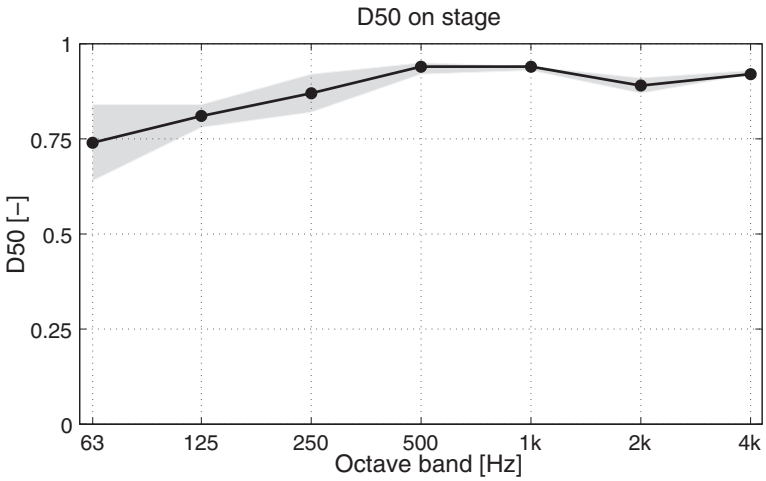
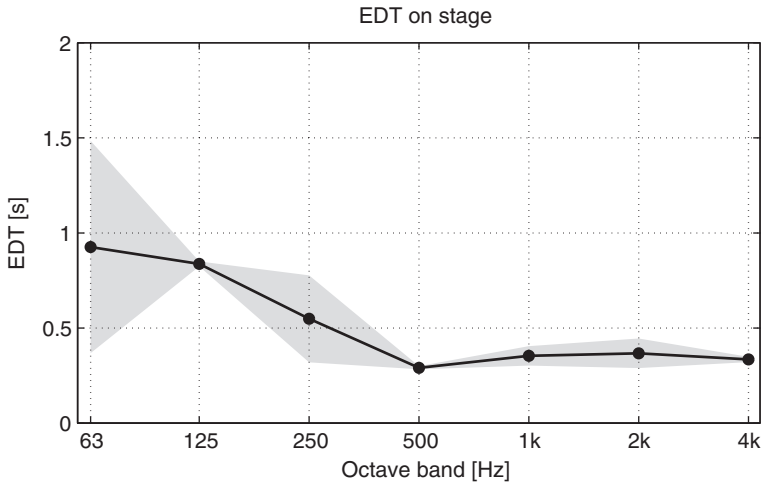
Ceiling: Suspended mineral wool.

Walls: Backdrop at a 20-cm distance from rear wall.

State of Hall When Measured

Empty; a few chairs etc. on the floor. No measurement on balcony.





Zénith Paris—La Villette

Paris

Number of concerts per year: Around 110

Number of total events per year: Around 150

Founded: 1984

Capacity: 6,238

Architect: Philippe Chaix et Jean Paul Morel

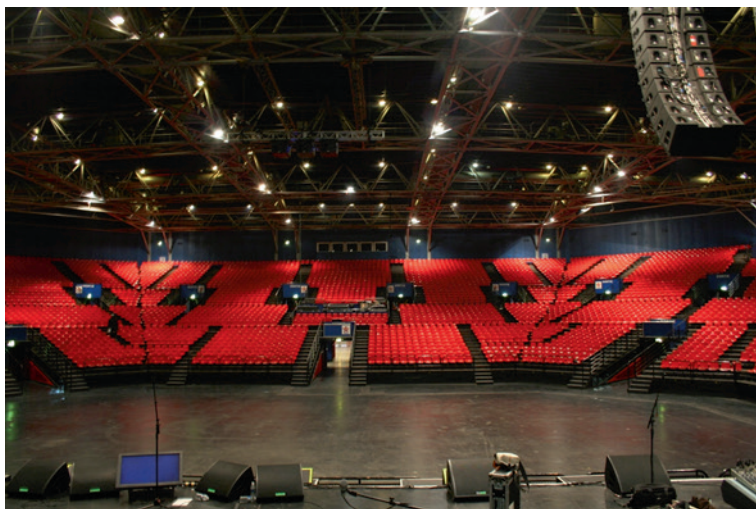
Acoustician: N/A

In 1981, Jack Lang opened the doors of the ministry of culture to rock and also to pop music.

The politicians of the ministry together with professionals and artists, introduced the richness of today's music. The ZENITH burst forth from an idea, like all good ideas: conceiving a special room adapted for these types of music. It was brought into being with a theatrical professional, Daniel Colling (assisted by Daniel Keravec) and two architects, Philippe Chaix and Jean Paul Morel. They invented the concept of the ZENITH.

The public was not mistaken and immediately shaped the place for music. Recognized from the beginning as a temporary prototype, the ZENITH of Paris, situated on the Parc de la Villette, is still as lively 27 years later as when it first opened. Above all, it is because the concept of the ZENITH is simple and responds to true needs that it was an immediate success. Popular music does not necessarily rhyme with delicacy and the ephemeral. It must satisfy the public who wish, as is normal, to see well, to hear well, to be well seated, and welcomed, and also to count on theatrical professionals: spectacles that are more and more sophisticated, but also very different from each other. There cannot be stationary rooms for fixed heavy scenic equipment. Rapport with the stage, the acoustic quality, and the movement of a great number of spectators must all be taken into account.

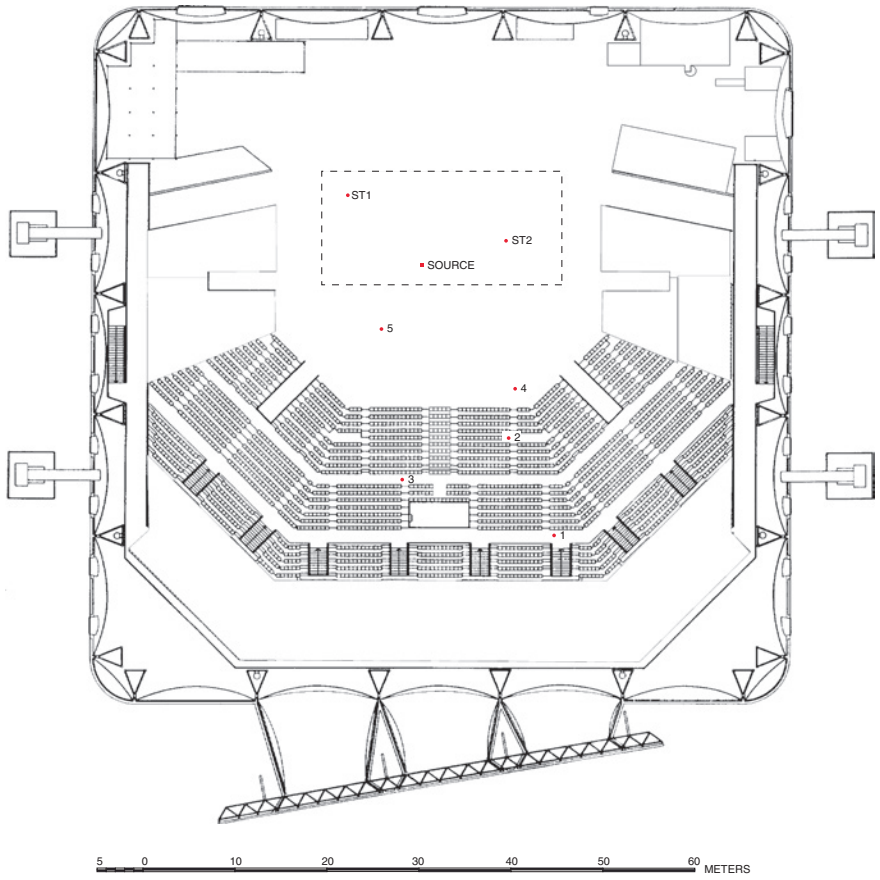
An intriguing thought in the trade has permitted the definition of criteria that guarantee functional usage closer to the demands of the artists and the public: these criteria were the object of a unique contract of its type. The Zenith of Paris has been the prototype for 17 other Zeniths in France.



Every other wall panel (*blue*) behind the audience is reflective; the others are absorptive. All have a thin steel plate on the back. There is nothing in the tent that reflects sound below some 150 Hz.



Zénith is a concept that has proven its success all over France. The size is excellent; there is a great proximity between the performer and even the farthest away audience members. Photo © Jean-Luc Bouchard.



Geometrical data	
Volume	Inside 90,000 m ³
$L \times W \times H$	Inside 70 × 70 × 19
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	1.8
EDT_{125-2k}	1.68
$C_{80,125-2k}$	-0.19
BR ₆₃ versus 0.5-1k	0.82
BR ₁₂₅ versus 0.5-1k	1.07

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Inner tent cover with cylinders ($d = \sim 15$ cm) of foam stretched across 60 cm.

Walls: Inner walls are panels of perforated thin metal but every second one is blinded. There is a 7-cm cavity with mineral wool and a back plate of thin metal. Behind are the hallways before the outer tent.

Stage Area

Floor: Stage risers.

Ceiling: As audience area.

Walls: None. Backdrop behind stage.

Seats: Plastic not upholstered.

State of Hall When Measured

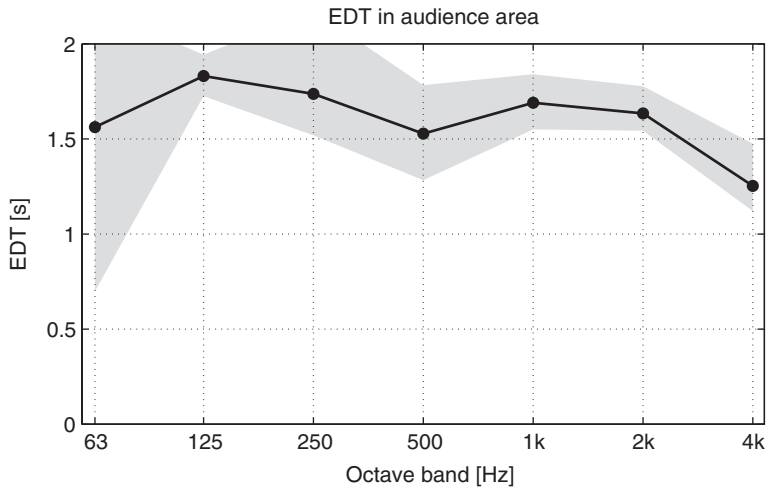
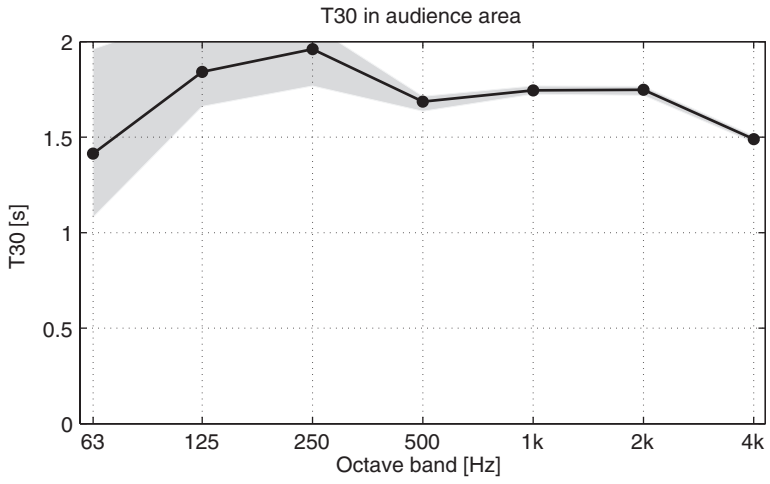
Empty as on upper photo; instruments on stage.



As the Zenith de Paris was opened only as a temporary venue unconventional but quite efficient solutions are found in every corner. Here foam cylinders on wires in the ceiling.



Zenith de Paris is simply a tent. Photo © Jean-Luc Bouchard.



Zenith Strasbourg

Strasbourg

Number of concerts per year: 100. Total number of events: 120

Founded: 2008

Capacity: 12,000

Architect: Massimiliano Fuksas

Acoustician: Altia

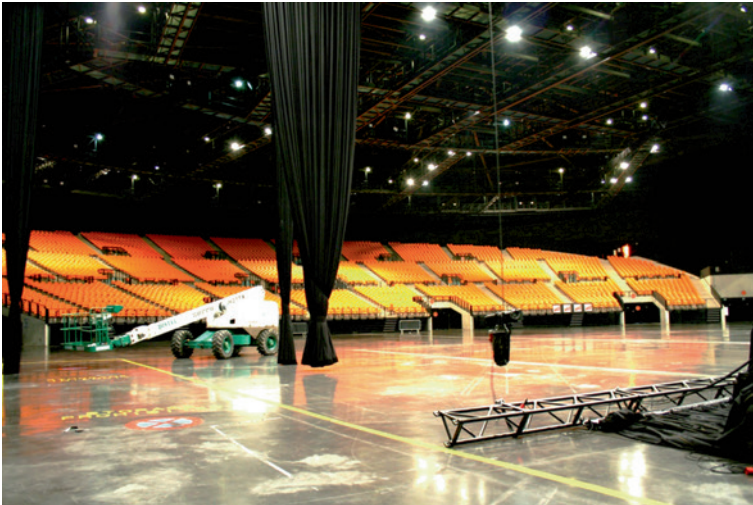
A missing link in the large scale of event halls existed in the Strasbourg area, and the Zénith Strasbourg became a stopping-place shaped for large musical shows and international artists. The quality of the room, its scenic and acoustic devices, and its dimensions were thus perfectly adapted particularly to Anglo-Saxon artists, who made European Strasbourg a stop on their international tours.

Local and regional producers have also, from the beginning, held the idea of constructing such equipment, offering the public a choice of hospitable conditions, visibility, acoustical comfort and irreplaceable security.

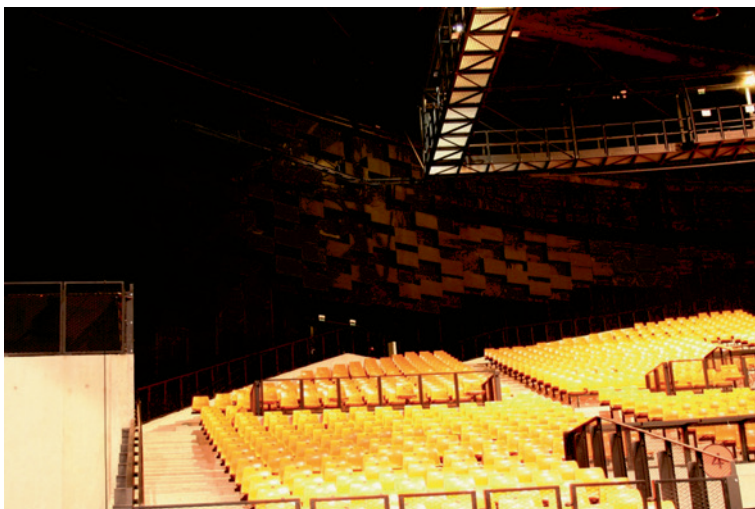
The Zénith can accommodate nearly 12,079 spectators. Above all designed to receive a variety of shows and live music, the equipment equally permits holding diverse demonstrations such as conventions and large sporting events.

Graced with respect for the environment, construction faithful to the Zenith concept (quality, modularity, functionality) favors durable, easily recyclable, energy-saving materials.

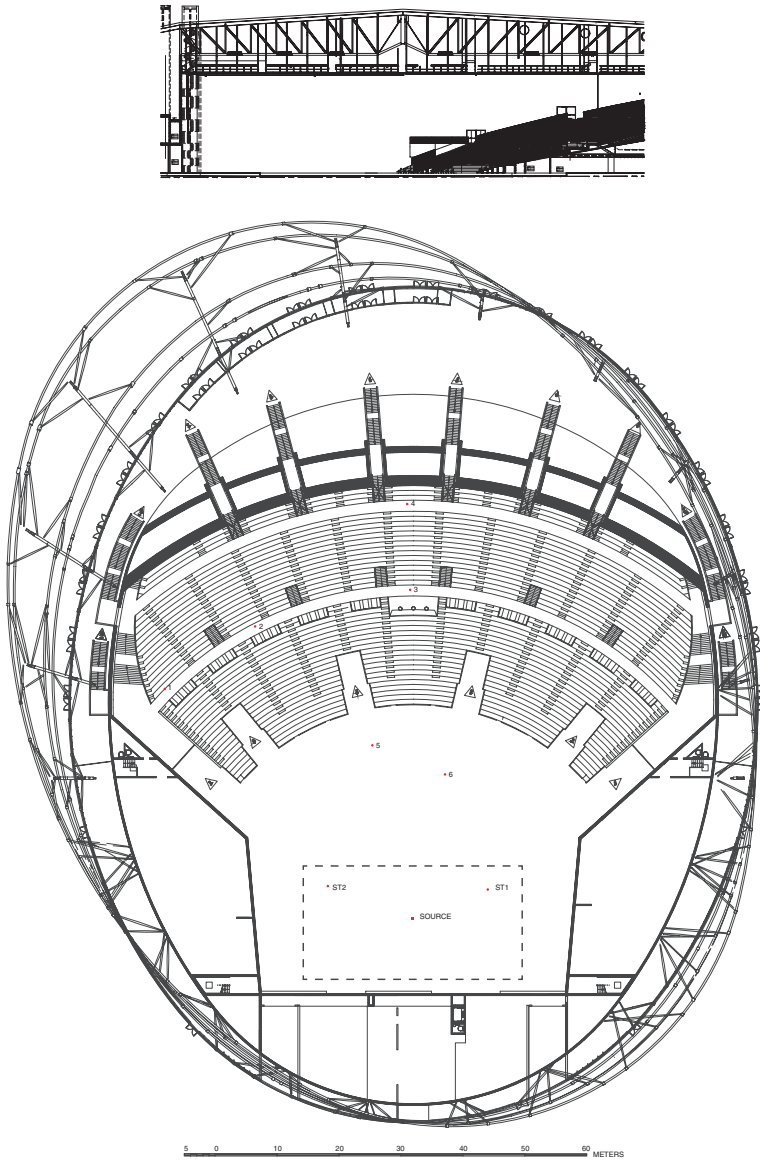
The Starsbourg Zenith is managed as a function of a public service delegation, by the SNC ZENITH DE STRASBOURG, an affiliate of VEGA.



Zenith Strasbourg was in 2011 the newest of all the French Zeniths.



To avoid sound focusing effects because of the wall's concave curvature special diffusive patterns have been applied on wall areas.



Geometrical data	
Volume	Approximately 85,000 m ³
$L \times W \times H$	60 × 60 × 24 m
Acoustical data	
<i>Audience area</i>	
$T_{30,125-2k}$	2.07
EDT_{125-2k}	1.92
$C_{80,125-2k}$	0.53
BR ₆₃ versus 0.5–1k	1.61
BR ₁₂₅ versus 0.5–1k	1.28

Materials Used

Audience Area

Floor: Concrete.

Ceiling: Thin trapezoid metal plate.

Walls: 5-cm thick mineral wool direct on concrete; rear wall is diffusive plates.

State of Hall When Measured

Empty as in photo; no additional chairs on floor.



Strasbourg Zenith.



Strasbourg Zenith: “Le grill”.

