

Modern Theatres: Royal Festival Hall

The Queen's Hall, in London, opened in 1893, seating an audience of 2,500. Located in Langham Place, it became London's principal concert venue and was home to the Promenade Concerts. The hall allegedly had drab décor and cramped seating but superb acoustics; it became known as *"the musical centre of the British Empire"*. On the night of 10 May 1941, however, just after the London Philharmonic Orchestra and the Royal Choral Society had given a concert, there was a heavy air raid, in which the chamber of the House of Commons and many other buildings were destroyed. An incendiary bomb hit the Queen's Hall and the auditorium was completely gutted by fire.

Its successor, the Royal Festival Hall, opened on 3 May 1951, but can indirectly trace its inspiration to the 1851 Great Exhibition of the Works of Industry of All Nations, more succinctly referred to as The Great, or Crystal Palace, Exhibition. The Great Exhibition held in London's South Kensington was effectively the first World's Fair.

In 1943, at the height of the Second World War, Britain's Royal Society of Arts suggested that an international exhibition be held in 1951 to celebrate the centenary of the 1851 Great Exhibition. The post-war Labour government decided to organise an event *"as a tonic to the nation"*, and the event became known as the Festival of Britain. Festival projects took place throughout the UK but the central focus was London's South Bank Exhibition near Waterloo. A number of buildings and

structures were constructed on the South Bank of the River Thames including the Dome of Discovery, the futuristic Skylon - and the Royal Festival Hall.

The Festival was regarded as a symbol of the Labour government and the succeeding Conservative government ordered the demolition and scrapping of the structures and displays, all except the Royal Festival Hall itself.

The Royal Festival Hall was built between 1949-51 by the London County Council and designed by the LCC Architect's Department, headed since 1946 by the progressive young Scottish architect-planner Robert Matthew. The hall comprised a reinforced concrete frame structure containing a concert hall with over 2,900 seats, raised above the ground, with an open foyer and stairs flowing around and below. In its conception and reception, it was widely hailed as a standard-bearer for the new, collective, social Modern architecture. Yet as first completed in 1951, it was a somewhat hybrid creation, as its near-symmetrical massiveness and stand-alone situation linked it still to the nineteenth century tradition of the grand public building, unlike the frothy exhibition pavilions around it.

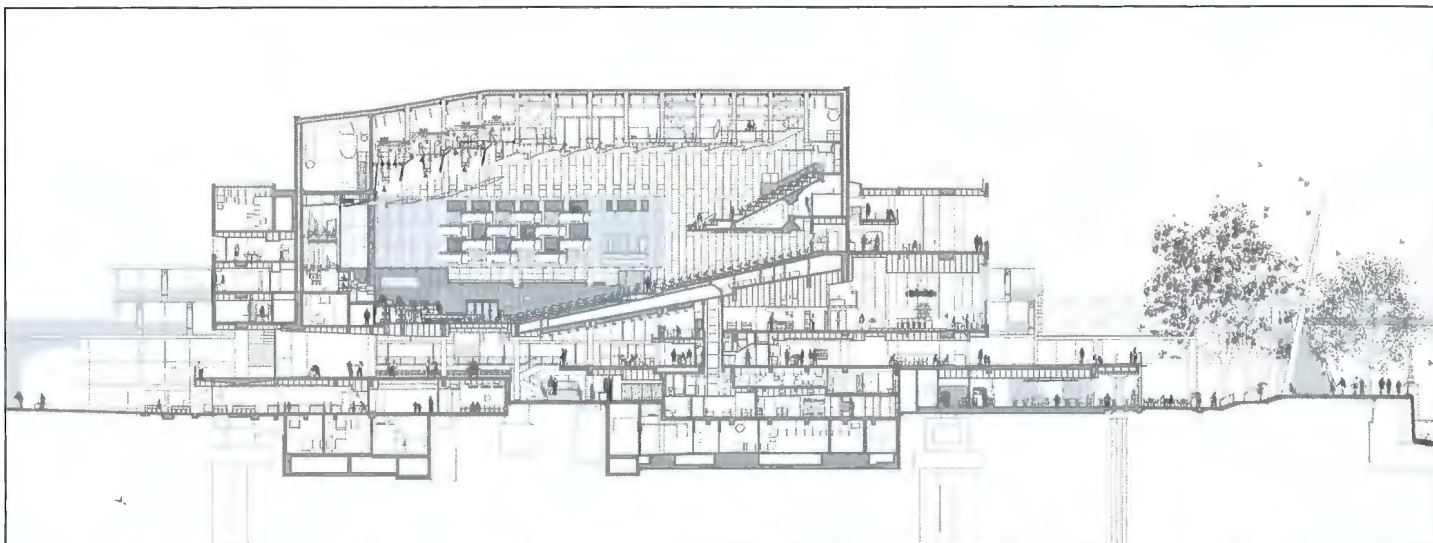
1947-1951: Robert Matthew and the LCC's original project

In mid-1947, following a decision that the LCC should build a new cultural centre on the South Bank, Robert Matthew moved

The Modern Theatres series continues with Miles Glendinning and Sebastien Jouan discussing the Royal Festival Hall on London's South Bank



Photo: Andreas Praefcke



quickly to make sure his staff would design this grand, new, democratic hub. From the start, he was determined this must be not an old-style concert hall but a, *'centre for musical activities of all kinds with ample space round the Hall for walking and talking, eating and drinking, and sitting about quietly'*, offering plenty of opportunity to look outwards across the Thames while doing all those things.

But by then the proposal had already started to move rapidly from debate towards realisation, as the government decided to proceed with the Festival of Britain in the same area.

To bolster the LCC's claims to build the centre, Matthew was asked to draw up a schedule of accommodation, and some conceptual sketches. He was told by the

council leadership that it should contain a large concert hall of 3,500-5,000 seats, a small theatre, and a restaurant overlooking the river, an exhibition gallery, and meeting rooms.

Matthew identified a double acoustical problem as the core of the design challenge: how to insulate the concert hall from the deafening rumble of trains on a railway bridge right next door; and how to arrive at an optimum shape for the auditorium itself. The first obvious response was survey and scientific data gathering.

During the summer 1947 council recess, Matthew threw himself into a crash tour of European concert halls. Scandinavia, especially Sweden, seemed to be the prime influence. Nils Einar Eriksson's Göteborgs Konserthus particularly impressed Matthew. It contained a main hall with 1,400 seats, and a small 450-seat hall behind. The main hall was entirely ringed by sweeping public 'promenades' and refreshment areas, including a huge, fully glazed front foyer facing Götaplatsen, and was raised up above a lower floor.

With these Scandinavian precedents, the second of the two main conceptual elements of the eventual Festival Hall began to fall into place. Matthew had already ensured that it would be a 'Cultural Centre' and 'social focus'. Now it was becoming clear that this aim could be partly secured by linking the large and small halls and the catering space through an enveloping 'social' foyer.

In July 1948, the government 'upped the pace' by asking the LCC if the Cultural Centre could be completed in time for the opening of the Festival in May 1951. Matthew agreed on condition it be overseen by a special sub-committee, chaired by the council leader himself.

Photo: Dennis Gilbert



During July, Matthew was already busy producing initial drawings, under rather unusual conditions, as he had been confined to bed for two months by a long-standing problem of lumbago. A special drawing board was constructed for him in his bedroom, suspended above his sick-bed, from where he continued working on this initial scheme for the Centre until mid-September 1948, by which time it was officially re-designated 'Concert Hall'.

The large hall was now to have a maximum of 3,500 seats, with rear balconies, and would be entered from continuous foyer circulation areas, with refreshment service, around the perimeter. There would be a smaller hall and extensive ancillary accommodation. There was no suggestion of raising the large auditorium up in the air; if there was a shortage of space, the small hall would go outside the main building envelope.

The main design decision about the large hall was its plan form, which was an acoustic-driven choice between rectangular and fan shapes. As Matthew worked on his initial sketches, he debated this issue with advisers from Denmark, the USA and the Building Research Station (BRS). At first, his drawings favoured a fan-shaped solution. Matthew then turned to the challenge of the detailed architectural design process.

He decided on a three-part strategy. The first was to appoint a 'Concert Hall Section' of 12 young temporary Modernist architects, all newly graduated, to do the hard grind of detail design. The second was to appoint a special assistant architect to help him on the project. The third was to attract a high-calibre figure to fill the post of deputy architect, unsuccessfully advertised since August 1947.

After his first choice for the job, his old Edinburgh friend and helpmate Alan Reiach, had procrastinated and finally failed to turn up to an interview at County Hall in November 1948, Matthew shifted to a fall-back plan under which the project would now have to be overseen by the new deputy and October 1948 saw the appointment of Leslie Martin, the week after Matthew finally put his proposal for the single-level complex to the council.

In this October report, indicating his determination to shape the 'reception' of the Festival Hall as a set-piece building, Matthew promised that he and his team would design what 'will be one of the historical buildings of London'. But the newly assembled team was immediately faced with a crisis. Matthew had only finished his initial sketch plans in September, including the main and small halls

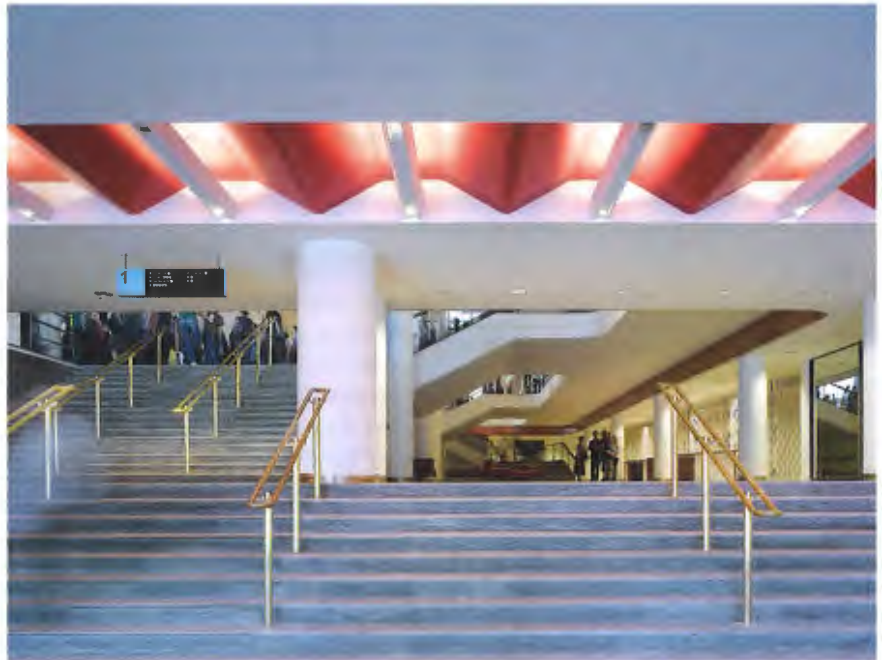


Photo: Dennis Gilbert

surrounded by an acoustic buffer of foyers and promenade space. But now it emerged that, as part of the Festival planning, the building's 'footprint' in Holden's masterplan would now have to be so strictly enforced that the main and small halls, with surrounding foyers, could not both fit on the site at the same level.

The demands of science came suddenly to the fore again, when the newly-appointed acoustic consultants, Peter Parkin and Hope Bagenal of BRS, objected to the fan-shaped auditorium, believing it risked echoes, and insisted on the substitution of a rectangular shape.

The obvious response to the site restriction, following the Göteborg and Stockholm precedent, was to lift the main auditorium up above the small hall, extending the foyer space below as well as around the main hall: what became known as the 'egg in a box' concept. Matthew and the newly appointed Martin, along with Parkin and Bagenal, it seems likely, took this decision, jointly. But from that point on, shifting decisively from his 'detail' to 'delegated' mode, Matthew was happy to leave almost the entire detailed working through of the design to his deputy and team, intervening only at crisis points. Here the most important choice was Peter Moro, an émigré German Modernist, who was initially engaged in October 1948 as a specialist in interior design and fittings.

By the end of November 1948, a revised scheme was ready for approval. The 3,100-seat auditorium, with its 'acoustic box' of double-thickness concrete walls, was surrounded by an envelope of access stairs, galleries and

foyers, with the fan-shaped small theatre hall below and behind. Emphasising the affinity with the light, temporary architecture of the surrounding Festival pavilions, the entire structure around the auditorium was to be of steel framing. The first drawings showed the small hall squeezed in partly beneath the main auditorium, with an ungainly block still projecting from the rear.

All this would have been rather different from the more unified building we know today, but even this version was not destined to be built, as a sudden shortage of steel in January 1949 meant it would have to be totally redesigned almost overnight in reinforced concrete, costing 50% more and potentially taking far longer.

This was a strategic crisis tailor-made for the unflappable Matthew. Rather than put the sacrosanct completion date at risk, he decided to cut down the size of the building by simply chopping off the rear third, including the small hall and the stage and administrative areas, which would be built at some future date. The rear wall would be finished with temporary cladding.

Of course, the cutting out of the small hall made the egg-in-a-box concept completely redundant in functional terms, but to avoid any further design delays Matthew decided to leave it as it was, and just keep going. The polarisation between light steel structure and massive auditorium had gone, and the foyer, no longer linking two halls, now took on an autonomous importance – which would later encourage architectural critics to hail it in its own right. The project had assumed its final conceptual form – not through one masterly design decision, but through a series of accidental, reactive developments.

Opening and reception

This somewhat hybrid, individual-collective process would be obscured by the triumphal, propagandist presentation of the building, orchestrated largely by Matthew in the press over the following two years. His only significant 'failure' was the hall's title, decided in March 1950. Matthew opposed the term 'Hall' as too pedestrian and argued instead for the name 'Royal Belvedere', to emphasise the 'beauty of the London scene which may be viewed from its terraces, galleries and roof gardens'. But the name was eventually settled through a bizarre mix-up; the council's preferred name, the Clerk from a letter to the king, accidentally omitted 'Queen Elizabeth Hall' and the latter instead made his own suggestion, 'Royal Festival Hall'.

To avoid further embarrassment, the council decided just to go along with this accidental choice – which was subsequently sanctified in the post-completion 'reception' of the hall, dominated by the exalted, religio-humanist language that widely prevailed in the early post-war reconstruction years in Britain: for example, the conductor Malcolm Sargent hailed it as 'the temple of those spiritual joys which are so mystic but so very real'.

Visiting the hall after its opening in 1951, the renowned Swiss modernist architect, Le Corbusier, declared, "*In America, I battle with the superficial, here things are done seriously*". He added that the building had been designed by youngsters and handed over to greybeards. Its architecture, back in the heyday of the Festival of Britain, was received as a triumph. A building that was both modernist and monumental, with large volumes and plenty of spaces for people to discuss, drink, see people and be seen. Its acoustics however did not match the architectural acclaim it received.

Room acoustics of the original concert hall

The architect and acoustician had conceived the 2,901-seat auditorium at the core of the Royal Festival Hall as an egg-in-the-box. The hall could also accommodate a 120-strong orchestra, and a choir of 250 singers as well as an organ. Its prime purpose was for symphony concerts, which is to say that other uses such as speech or amplified music were subordinate to the acoustic requirements for symphonic music.

Unfortunately, the hall became known from its very opening as generally too dry and lacking warmth of sound with a weak bass tone. In retrospect, it seems that the original acoustic designer, Hope Bagenal, had not adequately considered several crucial acoustic design parameters such as an appropriate volume per seat (V/N) required for a modern concert hall and underestimated the absorption factor provided by an audience. Musicians on the platform also had difficulty hearing themselves and others.

Initial discussions envisaged a reverberation time target of 2.2 seconds matching that of other contemporary successful concert halls and recommended back in 1931 by Bagenal and Wood, who were then the established authorities in acoustic design of concert halls.

Hope Bagenal's main challenge therefore started with the very large audience capacity, at almost 3,000 seats. Today, it is generally

agreed that an appropriate V/N for a modern concert hall is around 10-11m³/seat in order to obtain a reverberation time in the region of 2 to 2.2 seconds. By contrast, Hope Bagenal, in an apparent effort to contain the size and volume of the hall (and above all its budget!) tried to work on a lower volume per seat V/N of 7.56m³/seat. Taking in consideration this factor, he reduced the ambition of the reverberation time target down to 1.7 seconds.

After the rejection of the fan-shaped option, which would have provided more intimacy and proximity but no blend or fullness of sound, it was decided that the hall shape would be hybrid with a fan-shaped platform, choir area and stalls continued by a rectangular-shaped rear auditorium section.

The rectangular and deep shape of the hall probably contributed to the sense of distance from the musical action and a lack of acoustic intimacy. Bagenal also famously underestimated the absorption indicator provided by an audience with 0.33 instead of the generally accepted 0.57 per person. The single largest area of acoustic absorption in a concert hall is the audience, and any miscalculation in this area will set the acoustic design on a wrong trajectory from the start.

The hall also suffered mistakes during the construction phase. The original ceiling, which followed a line designed to reflect sound toward the rear of the audience, was initially intended to be of solid plaster 50mm thick which would have provided a considerable mass for the low frequency reverberance, hence giving good bass tone and warmth to the sound. Unfortunately, this thickness was reduced by mistake to 10 to 20mm thickness of plaster. Once completed, the thickness was brought back to the specified 50mm by using lightweight vermiculite plaster instead of the specified material. This mistake was unfortunate as it made the ceiling more absorbent at low frequency than originally intended.

Finally, acoustic absorption was scattered across the hall. There was a risk of echoes from the back walls and, consequently, the rear walls of the auditorium also included additional mid-to-high frequency acoustic treatment in the form of cushions stuffed with glass wool on 100mm battens with rockwool in the cavity.

On stage, the side wooden screens separating the orchestra from the choir consisted of 10mm thick wooden panels on 100mm battens with acoustic absorption in the air space, making this surface a very good low frequency absorber. All these factors resulted

in the notoriously dry acoustic conditions with a reverberation time with an audience down to 1.5 seconds at mid-frequencies and lacking bass tone and warmth.

Reverberation is only one aspect of acoustics: other factors need be considered, such as clarity of sound, loudness and self-hearing for the orchestra. These factors were also not resolved satisfactorily, further contributing to the poor acoustics of the hall.

The original canopy above the orchestra was designed not to obstruct other use requirements, such as the organ for example. The organ consultant required an unobstructed opening for the organ of 18m horizontally by 9m vertically, which meant that the platform (including the choir seats) had to be wider than desirable for orchestral or choir purposes.

The other consequence was that the canopy was located partly too high above the orchestra (15m high, above the conductor) and was chiefly designed with the intention to reflect sound towards the audience rather than to the orchestra providing the latter with little feedback. The orchestra therefore did not benefit from early reflections from the canopy, which are required for self-hearing.

The other important acoustic design consideration in a concert hall is the sound insulation from external noise and vibration events. The egg-in-the-box concept was also influenced by the idea of limiting noise and vibration emanating from the nearby underground and surface railway lines. However, although the hall might be an 'egg-in-the-box', it is not a fully-fledged 'box-in-a-box' construction, like most modern concert halls located close to railway lines (such as the Bridgewater Hall in Manchester or the more recent Milton Court Concert Hall in London). The proximity of two major sources of noise with above ground trains on the Hungerford Bridge and underground trains running directly under the building, posed a challenge.

The noise from the above ground trains was measured, resulting in the conclusion that a double leaf concrete envelope construction would be necessary. Walls consisted of two 250mm thick concrete walls separated by a 300mm air space with absorption in the cavity. The roof itself consisted of a 150mm thick inner leaf of concrete carried by 600 to 1200mm high sleeper walls (i.e. depending on the camber of the roof) and covered with a 100mm thick reinforced concrete external roof with 50mm glass wool in the cavity. The ground vibrations were also measured and results concluded that the hall did not require modern

anti-vibration box-in-box construction. Extra precaution was given, however, to reduce the risk, and the hall was built as high as possible above the ground.

From the 1960s alterations to the 2005-7 refurbishment

The hall was substantially altered in 1964 with major changes to the river façade, entrance and foyers. This renovation also introduced an "assisted resonance" system to try and improve the acoustics. Additional foyers and terraces were added to the building, which effectively extended it by 9m towards the river. An entirely new façade and main entrance were created facing the river.

At that time, Leo Beranek, an acclaimed American acoustic consultant, researcher and writer, advised that the interior surfaces and treatments were absorbing too much sound. BRS developed an electronic system to increase the reverberation time, called 'assisted resonance'. This comprised strategically positioned microphones in the hall, each located in a Helmholtz Resonator and designed to limit the microphone to one specific frequency. The sound from each

microphone was amplified and fed back into the hall by a loudspeaker. The system had 172 channels covering the lower frequencies of 58 Hz to 700 Hz. It was claimed to have increased the reverberation time from 1.4 to 2.5 seconds in the 125-octave band. While the assisted resonance system gave some improvement, it never fully solved the problem and, as it aged, became increasingly unreliable leading to its use being discontinued in 1998. Around that time, the conductor Simon Rattle declared that performers 'lose the will to live' when confronted with such poor acoustics.

During the first 30 years of its existence the Royal Festival Hall operated in a very traditional manner with the upper level of the foyers opening shortly before the evening performance and closing immediately after the audience departed.

In 1983, the Greater London Council (the successor organisation to the London County Council) introduced a radical 'open foyer' policy where the foyers were opened to the public all day, every day with exhibitions, lunchtime concerts, informal evening concerts, bars, shops and buffets. Shortly after that, in 1988, the Festival Hall was designated as a Grade I listed building by English Heritage –

one of the first 'post-war modern listings' in England - in a recognition of its 'exceptional' architectural and historic interest.

The building closed in 2005 for another major (£91 million) refurbishment under architects Allies and Morrison. The riverside of the building was changed again with a series of restaurants and cafes being created at low level. For this 2007 refurbishment, the American acousticians, Kirkegaard Associates, were selected to provide the acoustic design input. The ambition was to improve the acoustic conditions of the Royal Festival Hall whilst not altering the architectural effect of the original building. Even so, there were protests, led by the Twentieth Century Society, which objected in particular, to the removal of the original canopy, claiming that the "the architectural consequences of this will be disastrous".

Kirkegaard's work focused therefore on what was possible, namely to remove the low frequency absorption provided by the lightweight ceiling, strip off any surfaces susceptible to absorption of sound (i.e. absorption on the rear walls, carpet in some areas) and replace it with sound diffusing finishes, while redesigning the platform and the canopy. These replacements made the renovation work more difficult due to the presence of asbestos.

A new auditorium ceiling, heavier and denser than the original ceiling, was installed. The ceiling consists of an internal waveform consisting of lightweight glass-reinforced gypsum shells with a 250mm thick layer of plaster and bricks above. Warm wood panelling was also installed across the hall, rejuvenating the feel of the auditorium and providing the hard surfaces required to increase the reverberance. The original teak floor was reinstated and any carpet replaced by hard floor. The stage was remodelled with a slightly less fan-shaped design and the original canopy was replaced by a small wing-shaped canopy, made of modern Nomex material (a flame resistant material used by the US Army during the second Iraq war), stretched over a frame.

This contributed greatly to the improvement of the acoustic conditions for the musicians on stage, providing them with self-hearing but also reopening the available volume above the old canopy and hence improving the reverberance thanks to extra volume. The organ itself was also refurbished by its original maker, Harrison & Harrison, its depth reduced by 1.1m to satisfy architectural and

acoustic requirements. A variable acoustic system was also introduced which reduced the reverberance for amplified music events.

Despite all these efforts, however, the reverberance was merely increased to 1.65 seconds, still below the 1.7 originally intended by Hope Bagenal and far from the 2.2 seconds that a modern symphonic concert hall requires. The hall also presents balance problems in some parts while crispness is at more of a premium than warmth. But there was nevertheless a discernible improvement, and the press and musicians hailed the new acoustics, acclaiming the clear amelioration of the sound quality of the hall which now possesses a new bloom and sound clarity and gives the music room to breathe, providing a fluid procession of solos in the Birtwistle to the dynamism and richness of colours in the Firebird.

Royal Festival Hall – Conclusion

Over 65 years the Royal Festival Hall has grown to be one of the world's most significant concert halls largely thanks to its geographical location in London. As a concert hall it has hosted most of the world's leading orchestras and music ensembles. Musicians and orchestras need to be seen and heard in London; it is important for their reputation to be reviewed by the London critics (alongside those in New York and some other cities).

But the Festival Hall has always been an acoustically flawed hall with too dry an acoustic caused by too short a reverberation time; and even now, despite the many attempts to improve its acoustic performance, it will never be an acoustically great concert hall. Accordingly, today, in 2017, plans are afoot to create a new Centre for Music for the capital, under the co-sponsorship of the Barbican Centre, the London Symphony Orchestra and the Guildhall School of Music. At the heart of the new Centre would be an acoustically perfect 1,900 seat concert hall, rectifying at last a deficiency that has weighed on London concert-goers since the loss of the Queen's Hall in 1941.

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