Submission Title: **The Royal Northern College of Music,**

**Concert Hall Refurbishment**

RNCM
ROYAL NORTHERN COLLEGE of MUSIC

The Institution of Structural Engineers

# 2015 THE NORTH WEST STRUCTURAL AWARDS

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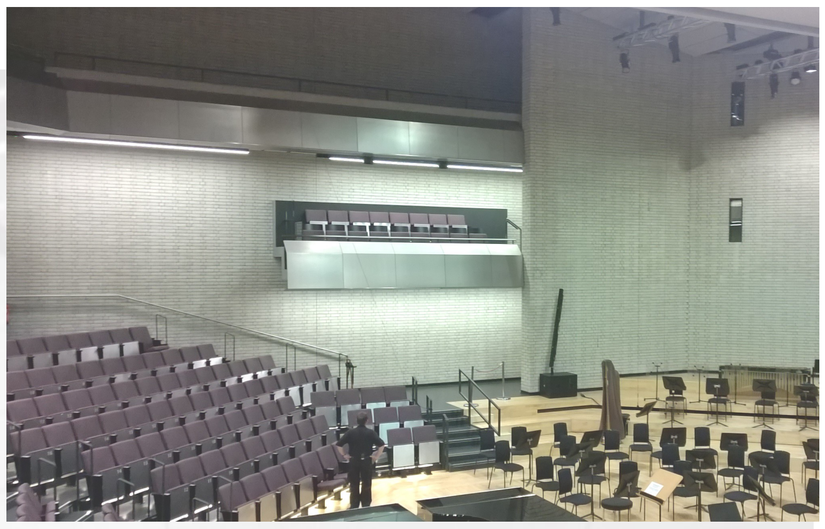

## BRIEF DESCRIPTION OF STRUCTURE

### Background

The Royal Northern College of Music was established in 1973 with the merger between the historic Northern School of Music and the Royal Manchester College of Music. The iconic 1973 college building was designed by Architects Bickerdike, Allen and Rich and has been extended over the years. The Concert Hall and surrounding supporting facilities have been largely untouched for the last 40 years since the original construction.

The project brief was to breathe new life into the Concert Hall by complete refurbishment. This included the creation of a new level of balcony structures to significantly enhance the capacity of the auditorium. This will enable the college to expand their already successful program of musical events to a wider commercial audience. In addition to this the mechanical and electrical services have been completely replaced along with new lighting design and acoustic treatment. The back of house areas and changing facilities have been brought up to modern theatre standards by the creation of a new mezzanine level which acts as an entrance to the balconies as well as forming a new and much needed student informal space.

### Structure

The original building engineers were Redlich Powell and Partners from London. The original building itself is an iconic piece of structural engineering and so any additions we were to make had to live up to the high standard set out in the past. The building is a hybrid of reinforced concrete framing with loadbearing masonry walls. The concert hall and adjoining opera theatre have been constructed using double skin calcium silicate brick walls up to one and a half feet thick in places. Steel roof trusses were then used to form the 25m clear span roof which bear directly onto the internal masonry boxes. The Concert Hall and Opera theatre are essentially isolated acoustic masonry boxes within a concrete frame structure. There are a great deal of exposed concrete elements in the building which have been detailed and constructed to a very high standard.

scott hughes

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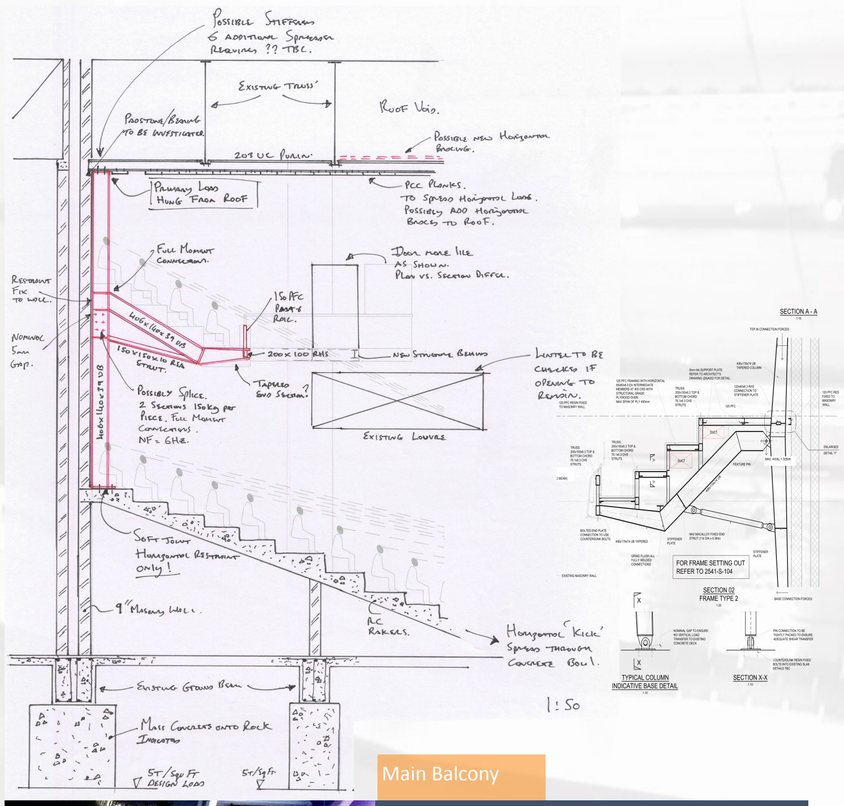
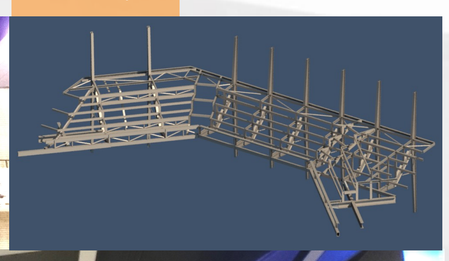
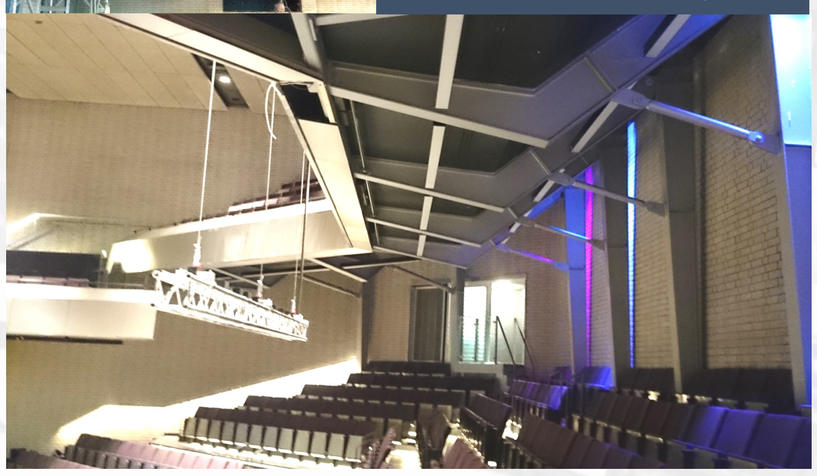




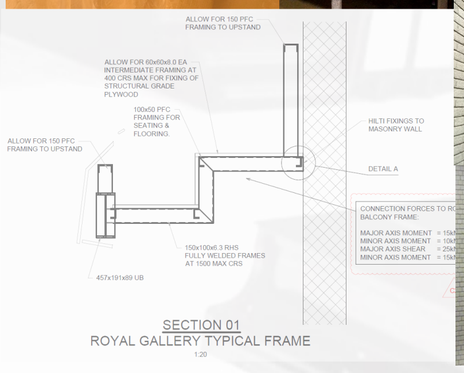


Main Balcony





Steel frame of Royal Balcony




## PROJECT DETAILS

### Site constraints

The challenge for this project was that the architectural intent was for clear site lines to all seating positions. This meant that no hangars or columns could be used to support the proposed balcony structures, not even cables. In addition to this strict acoustic requirements meant that penetrations to the acoustic box of the concert hall were to be kept to a minimum. One of the main client drivers was that the project must enhance the acoustics of the venue with reverberation times being strictly specified in the contract as a direct deliverable for the contractor.

The college was to be kept fully operation throughout the build with areas shut down only to complete specific works. This proved a challenge in managing the approach to the erection and installation of steelwork as work had to be managed to avoid disruption to both rehearsals and recitals throughout the operational spaces within the college.

The architectural design was also challenging as the first statement that the architect made was he wanted a "look no hands" approach to the balcony support. This was particularly the case with the floating balcony as the architect literally wanted this to look as if it floated above the auditorium.

### Design Philosophy

The balcony structures can be split into three elements; the main balcony, the floating balcony and the royal balcony.

The Main Balcony: In order to support a new major balcony with no obvious supports to the front, with no frame to fix to or to take back span cantilevers to we were led down the idea of "suspending" the new balconies from the existing roof structure. The existing roof trusses span left to right across the concert hall space and the rear wall is subsequently relatively lightly loaded. The first truss is 3m off the wall with a series of 203UC's spanning front to back picking up an acoustic precast ceiling. This gave us the idea of dropping down a cantilevered bracket frame hung directly from the steel UC immediately before it bears into the wall. Following a combination of sketching and 3D modelling we came up with a frame the worked by hanging the load from the roof and putting a push pull into the roof bracing and 300mm thick concrete raker slab of the auditorium.

The Floating Balcony: In order to achieve this design we had to compromise one of the main constraints of the brief; acoustics. However with some careful treatment details this has been successful mitigated. The main principle of the floating gallery is a pair of steel columns beyond the concert hall wall fixed to the existing ground and second floor slabs providing a cantilever arm which punches through the concert hall wall. The frame puts a push pull into the two slabs and forms a basis from which to build the rest of the balcony. The balcony was made up of a series of welded frames all brought in in sections and fully welded up on site. The erection sequence was complex and we produced a series of "how 2" step by step drawings, extracted from the Revit model, in order to assist the sub-contractor with this element of works as the erection was critical to the final deflection figures and subsequent natural frequency of the balcony.

The Royal Balcony: This is the smallest of the three but still has character. This again achieves the visual illusion of appearing to have no support. It is also fabricated form a series of frames welded up on site to form the completed structure. The main supporting element is a 406UB cantilevered within the acoustic cladding of the balcony. The cantilever is supported from two columns built into and hidden within the main entrance to the hall. These columns have been detailed to appear to be part of the door framing and architectural design intent.

### Design Innovation

The innovation we have shown in this project is to push the boundaries of what was possible within the constraints of the existing building by a mixture of careful engineering analysis and lateral thinking. The key to the whole design and architectural success is that the sight lines are clear and we have achieved this by pushing the existing structure as hard as possible and utilizing what was already in situ rather than inserting new. We have managed to install a substantial new tier of balconies with no new additional foundations within the hall and in some cases without seeing any method of support.

## CREDITS & PROJECT DETAILS

Structural Engineer - Kris Clark, Scott Hughes Design

Client - The Royal Northern College of Music

Architect - Building Design Partnership

M@E Engineer - Booth King

QS - Rider Levett Bucknall UK Ltd

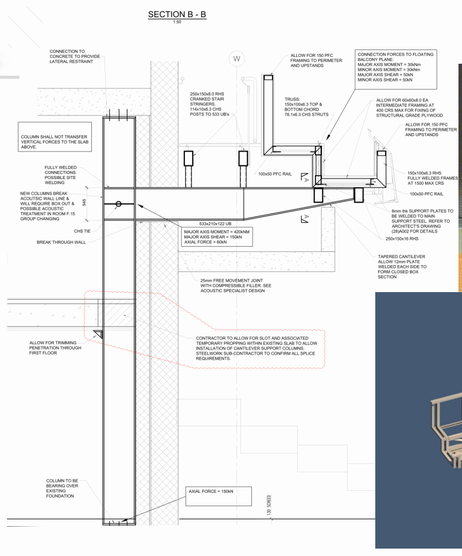
Main Contractor - Styles & Wood Projects Ltd

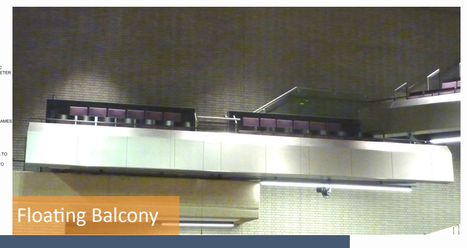
Form of Contract -Traditional JCT

Contract start on site - December 2013

Contract completion on site - September 2014

Overall construction costs - £5 million



Floating Balcony

### Project Successes

The biggest success from our perspective is that the finished result looks like it could have been originally designed to fit into the existing structure. The detailing and construction of the steelwork is at home in its setting and adds to the aesthetics of the space as oppose to being an intrusion. The acoustic properties of the hall are better than ever and the general functionality has been improved with the ancillary facilities that have also been a great addition to this fantastic building.