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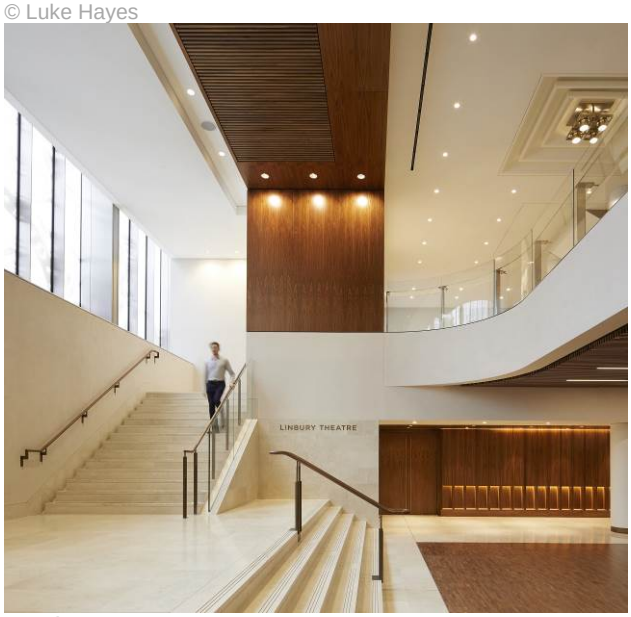

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ROYAL OPERA HOUSE – OPEN UP

NOISE MONITORING WITHOUT MICROPHONES

COMMENDED AT ANC AWARDS 2019

Client:	Royal Opera House Covent Garden, London
Cost:	£50.8m
Construction Managers:	Rise Management Consultants
Project Managers:	Equals
Completion:	September 2018

BAP provided advice on construction noise management and noise and vibration monitoring services during the Royal Opera House Open Up refurbishment.

The project has seen a significant amount of works carried out within the existing building. The main opera house and auditorium remained open for regular scheduled performances during the entire demolition and construction process. Quiet conditions were paramount and essential to daily activities.

BAP provided the following services:

- Comprehensive advice on construction noise and vibration matters throughout the project;
- Extensive noise and vibration trials and ad-hoc surveys;
- Advice to inform high-level project programme;
- Preparation of noise and vibration monitoring specifications;
- Design, installation and management of innovative noise and vibration monitoring system to notify the contractor and the client about potential breach of noise limits in the Opera spaces during rehearsals and performances.

BAP work on the project was commended at the ANC Awards 2019.

Bickerdike Allen Partners
Architecture Acoustics Technology

CASE STUDY

ROYAL OPERA HOUSE – OPEN UP

NOISE AND VIBRATION MONITORING

COMMENDED AT THE ANC AWARDS 2019

The challenge

The Royal Opera House (ROH) Open Up project aimed at enhancing the visitor and artist's experience by making the building more inclusive. To accomplish this goal, a major structural reconfiguration and refurbishment have been proposed in the heart of the existing and live building.

The Opera building remained open throughout the project which meant that substantial structural interventions including demolition, excavation and piling took place within metres of noise sensitive spaces. This posed a significant risk to the operations of the ROH as most artistic activities require very quiet conditions. Any delay would cause a significant financial loss and reputational damage.

> *"It has been akin to open-heart surgery while running a marathon"*
>
> Alex Beard, ROH CEO

Works commenced in September 2015 and completed in Autumn 2018. Bickerdike Allen Partners LLP (BAP) were approached in late 2014 building on our experience from the British Museum WCEC project.

The client's requirement was simple – strictly no interruptions to any performances and rehearsals. To achieve it, our approach comprised very early planning and management of noise throughout the construction.

A crucial element of this strategy was an early warning system capable of notifying the contractor and project members

about a potential breach of noise limits in the Opera spaces.

Since artists themselves generate high levels of sound a traditional microphone-based monitoring was not possible as the readings would have been affected and alarms would have been triggered. It was clear that an innovative approach was required.

Approach

From very early on in the project BAP co-operated closely with the ROH to identify sensitive areas where staff and visitors would be adversely affected by construction noise.

One of the key elements was understanding how structure-borne energy (and therefore noise) is transmitted through the building. Extensive trials were carried out across the building with noise and vibration levels measured simultaneously at numerous receiver positions including Main Auditorium.

The knowledge of the building derived from these trials and conclusions from the subsequent analysis were incorporated into the high-level project management plan. This helped the client and the contractor to plan work and incorporate mitigation measures early on.

BAP prepared a noise and vibration specification which became part of the contractor's tender package and allowed the client to intervene when noise levels were deemed too high.

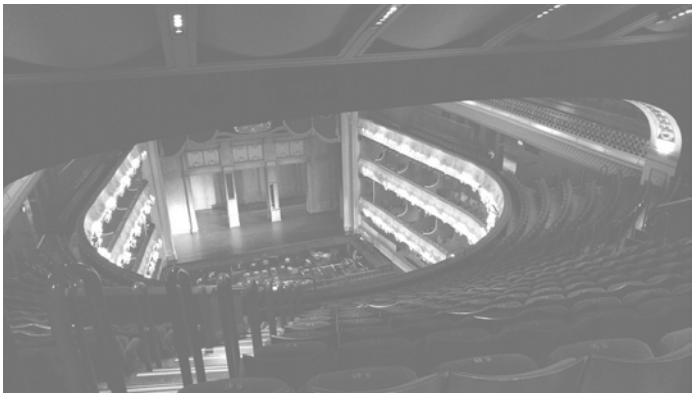
Noise monitoring

To tackle the problem of monitoring, BAP explored a principle that vibrating surfaces radiate noise, a level of which can be estimated from vibration measurements on wall or floor.

Based on the information collected about the building, BAP developed a bespoke curve which enabled live monitoring of vibration.

Two monitoring stations were installed – one the Orchestra Rehearsal Room 2 and Main Auditorium shouldering the main site area. Both locations were used either by hundreds of visitors and dancers and craftsmen and this vibration activity had to be considered to minimise a number of false alarms.

Conclusions



BAP approach and our innovative monitoring system was praised by the client and the contractor as crucial in ensuring the ROH was able to function throughout the major refurbishment project. Nearly 1000 performances were successfully staged throughout the project along with all necessary rehearsals.

Our work on the Open Up project received a commendation at the Association of Noise Consultants Awards in 2019.

Testimonials

"*BAP acted as an acoustic consultant; informing the design process of the highly complicated, multi-functioning building. However their expertise was particularly highlighted in relation to their monitoring of construction related noise and vibration and management to prevent sound transfer to adjacent spaces, staff and of course performances. One of the key goals for the project was completion of the works without impacting a single performance. With the crucial help of BAP, we were successful in that."*

H Oakley, Open Up Project Co-ordinator

"The judges recognised that this project explored new ways of monitoring noise in sensitive spaces where traditional measurement methodologies could not be used. There was good collaboration with the design team, construction team and the client which met the challenge of allowing performances to keep going. It was highly complex project delivered to the satisfaction of the client."

ANC Commendation Award 2019 feedback