HaworthTompkins

Post-Occupancy Evaluation report

Everyman Theatre Liverpool

January 2021

HT POE Reporting Template

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Executive Summary

1 Purpose and Aims

This study explores the post-occupancy performance of the Liverpool Everyman Theatre. Conceived in 2004 and completed in 2014, the project was driven by a shared commitment from the client and design team to build a new producing theatre that would lead the way in regenerative practices for public performance spaces.

As co-founders of the Architects Declare Climate and Biodiversity Emergency movement (AD) Haworth Tompkins have acknowledged the significant impact buildings have on climate and on global ecosystems. By signing up to the AD declaration points HT have committed to assess and re-think their approach to design.

One important aspect of this is the decision to carry out in-house light-touch Post Occupancy Evaluation (POE) studies aiming to identify strengths of completed projects, possible areas for improvement, and further learning for the design team, alongside their clients and consultants.

A key goal of the POE study was to assess the performance of the building after several years of operation and to focus especially on the main feature of the building, the assisted natural ventilation to the auditorium.

2 Methodology

The light-touch POE report (Building performance in-use) was based on guidance provided by the RIBA Post Occupancy Evaluation Primer and other relevant resources mentioned in the report.

The study was conducted as follows:

- Review of design information
- Site visit & walk-around (to provide feedback on internal layout, building fabric and durability of fit-out materials)
- Analysis of energy use, water use
- Analysis of building services
- Interviews with members of the client team
- Building User Survey (BUS) - staff & public
- Monitoring of indoor environmental conditions

3 Key findings

- The innovative ventilation strategy has been extremely successful in achieving the goals of enhanced audience comfort, better working conditions for actors and a significant reduction in operational energy and CO2
- The system runs as intended after an initial adjustment period to calibrate the Building Management System (BMS), with excellent indoor air quality conditions and without issues related to noise or smells. The only challenging times seem to be mid- season, due to the night-day temperature differences, or when there is a small audience, as the natural ventilation is driven by heat gains from both people and lighting
- Overall the monitored indoor environmental performance is very good and in some cases exceeds design expectations
- The feedback from the Building User Surveys , administered to both staff and public using the ARUP BUS methodology, is excellent

4 Content

The POE study also includes feedback on:

- materials and finishes
- space and layout
- wayfinding and accessibility
- building services
- energy and water use
- Whole life carbon analysis run by Liverpool University: the embodied carbon, and operational use over 60 years, are comparable in CO2e emissions
- theatre design specific feedback related to seat design, specialist rooms layout, stage and seating layout

A. Introduction

Context
Architects, engineers, other construction professionals, local authorities, large developers and the UK government have all made climate emergency declarations, and commitments to drastically reduce carbon emissions in the next 10 to 30 years.

As founding members of the Architects Declare movement, Haworth Tompkins are committed to evaluating their design processes; seeking to produce the best possible solutions that are environmentally, economically and socially aware, as well as suited for the client, site, and function of the project.

Sharing the lessons learnt on projects, and showcasing innovation, are key to evaluating the success of the project through:

- Evaluating the building use, materials, services
- Energy + water use monitoring
- Monitoring of Indoor environmental conditions
- Building User Surveys (Arup BUS methodology)
- Sharing the findings with the team and the wider public

Building performance
In 2014 the Everyman Theatre was awarded the RIBA Stirling Prize, RIBA National Award, RIBA North West Building of the Year, and in 2016 the CIBSE Building Performance Awards, Building Performance Champion - Project of the Year.

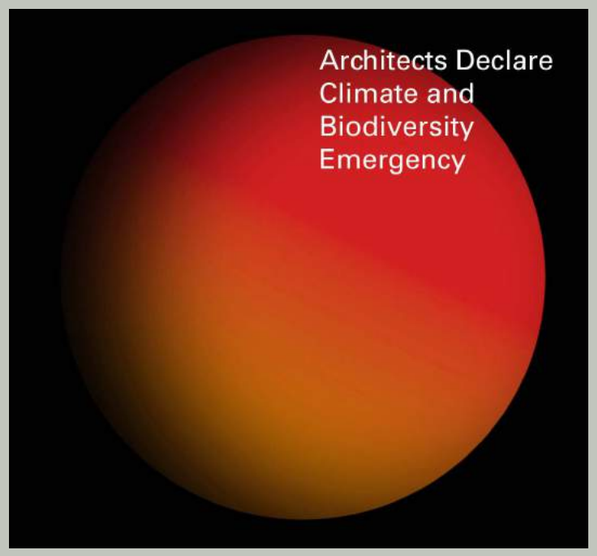
Importance of feedback to design work
Meaningful feedback in response to design work is recognised by architects, clients and consultants as an important source of information. The HT team are using the findings of this analysis in a number of ways including to guide the designs of other naturally ventilated performance spaces and inform choices such as the use of materials based on how they age. Feedback on layouts of key spaces and on maintaining complex building services and equipment is essential.

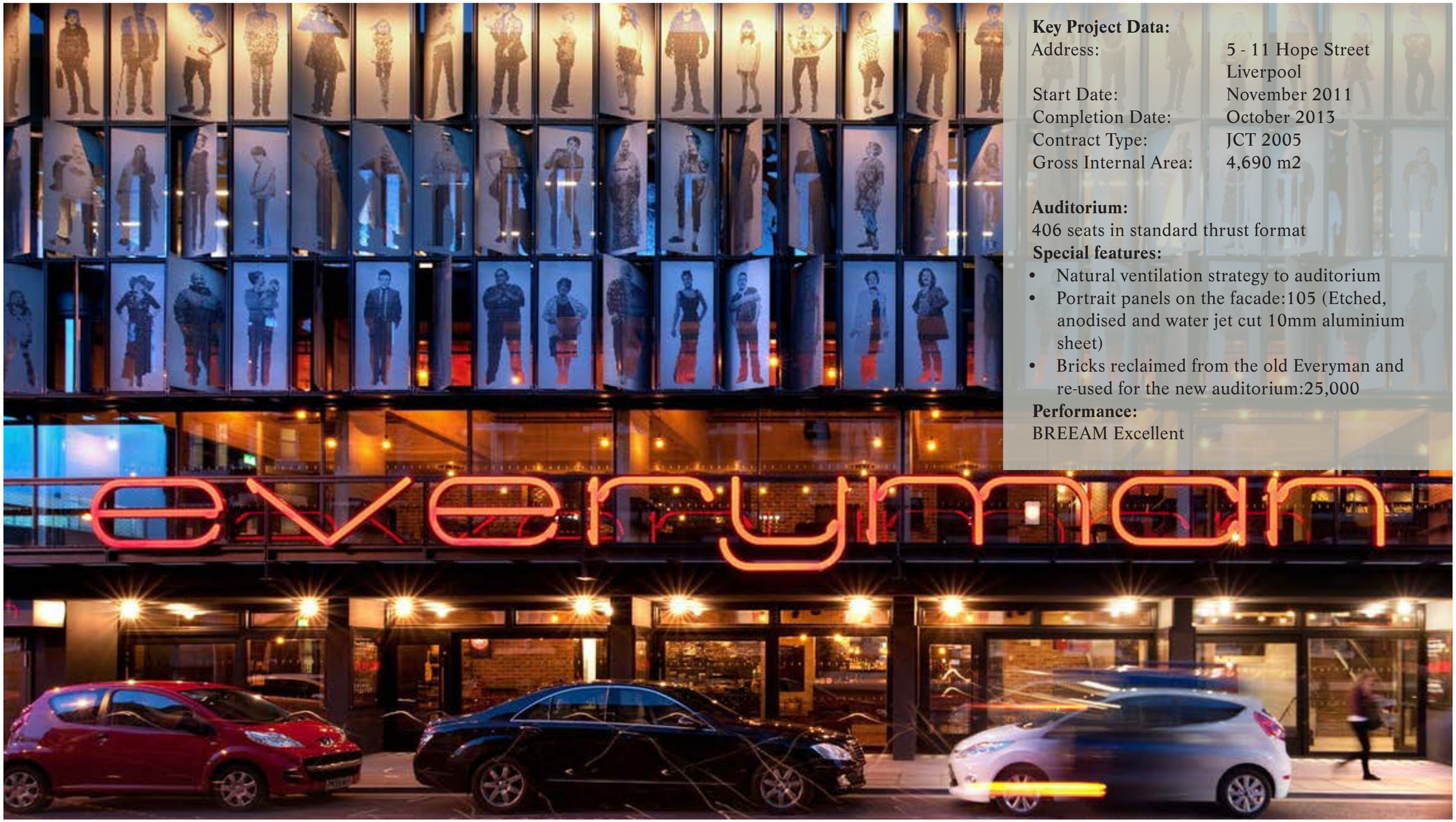
The energy usage, and the performance of the innovative assisted natural ventilation strategy in the auditorium at Everyman Theatre, have been the subject of previous monitoring and analysis in 2016, two years after completion. Results were published by the project's mechanical and environmental engineers, Waterman Building Services, in a RIBA Journal article.

The scope of this light-touch POE study was extended beyond the initial energy analysis to provide more comprehensive feedback and include:
- a site visit and open interviews with key members of staff
- monitoring of environmental data in key spaces
- carrying out Building User Surveys (using the Arup BUS methodology) for both the transient users (public) and permanent theatre staff.

This report is part of the HT projects reviews and audits initiated as part of the practice's commitments to re-evaluate their design process. This is a result of HT's involvement in the Architects Declare Climate and Biodiversity Emergency movement (AD) and signing up to the AD goals, among which these are particularly relevant to the design process and the importance of Post-Occupancy Evaluation:

- *Evaluate all new projects against the aspiration to contribute positively to mitigating climate breakdown, and encourage our clients to adopt this approach.*
- *Share knowledge and research to that end on an open source basis.*
- *Adopt more regenerative design principles in our studios, with the aim of designing architecture and urbanism that goes beyond the standard of net zero carbon in use.*





Key Project Data:

Address:	5 - 11 Hope Street Liverpool
Start Date:	November 2011
Completion Date:	October 2013
Contract Type:	JCT 2005
Gross Internal Area:	4,690 m2

Auditorium:
406 seats in standard thrust format
Special features:

- Natural ventilation strategy to auditorium
- Portrait panels on the facade:105 (Etched, anodised and water jet cut 10mm aluminium sheet)
- Bricks reclaimed from the old Everyman and re-used for the new auditorium:25,000

Performance:
BREEAM Excellent

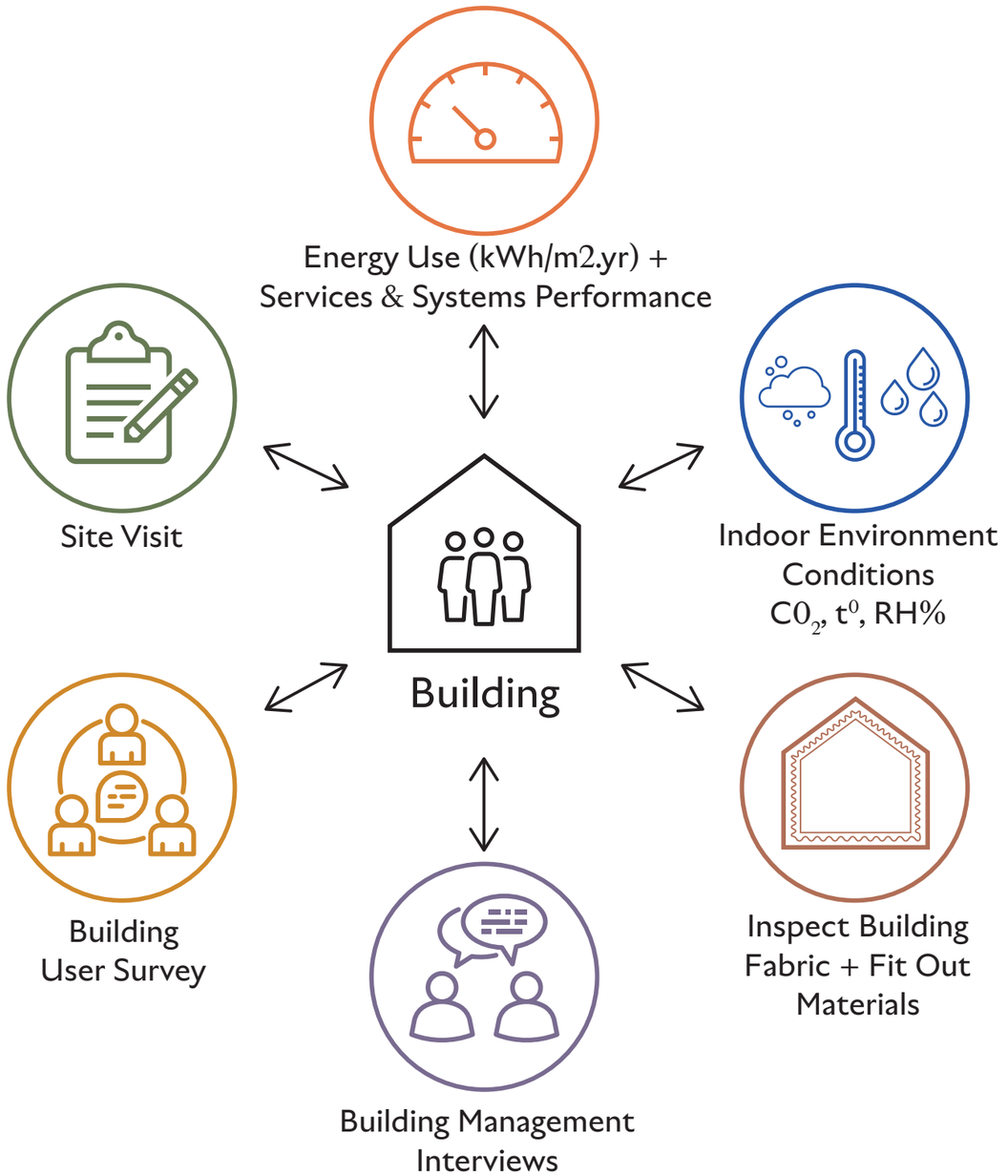
B. Post-occupancy evaluation study - Methodology and reporting

Methodology

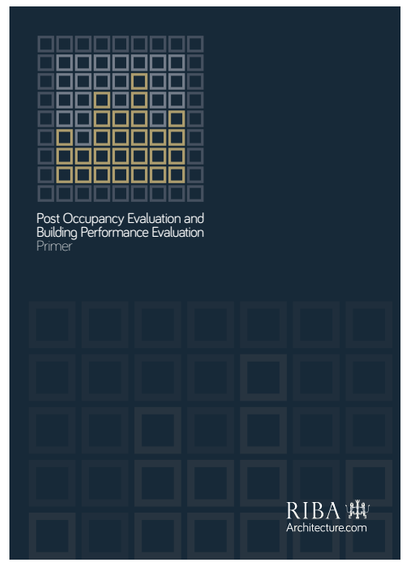
This light-touch Post-Occupancy Evaluation study is based on the reporting structure detailed in the RIBA POE Primer and described below, and is following the guidance in the RIBA 2020 Plan of Work Sustainability Overlay, InnovateUK Building Performance Evaluation studies and other relevant resources (see the *References* at the end of this report).

The study was structured on key topics to provide meaningful feedback for future projects:

1. Review of design and construction information
2. Site visit (to view layout changes, current usage of spaces vs intended usage, indoor conditions, feedback on building fabric and durability of fit-out materials, accessibility)
3. Energy use (using BMS data, focusing on: heating, ventilation, cooling if any, lighting strategy and controls) and water use and comparison with available benchmarks
4. Evaluate the performance of building services and systems, controls and maintenance issues
5. Interviews with members of the client team (who can offer feedback on how the building is performing, with particular interest in use of space, services and maintenance, review of project aims and sustainability aspirations)
6. Building User Survey to provide user feedback using the Arup BUS methodology
7. Monitoring of indoor environmental conditions (temperature, CO2, VOCs and relative humidity) in key spaces either through localised sensors or BMS data



Haworth Tompkins Light-touch Post-Occupancy Evaluation study - scope schematic



Resources for light-touch POE:
RIBA POE Primer &
Soft Landings Framework

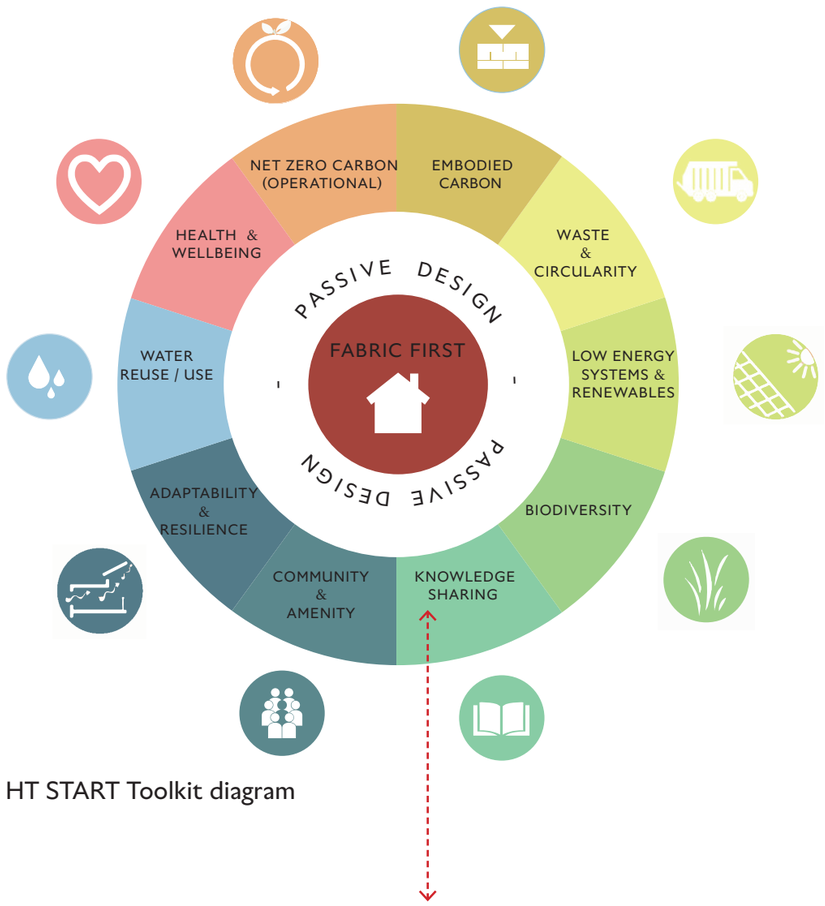
B. Post-occupancy evaluation study - Methodology and reporting

Haworth Tompkins have started to implement a bespoke design l, The Sustainability Tracking & Assessment + Regenerative design Toolkit (START).

The assessment aims to provide a holistic view on the design and performance of HT projects, focusing on several key aspects that follow closely the parameters explored by main certification schemes, as well as the RIBA Sustainable Outcomes document (2019), LETI Climate Emergency Design Guides (2020), and the UN Sustainable Development Goals.

A key part of the assessment is providing feedback from each completed project that can feed in new Haworth Tompkins designs in a way that allows the practice to learn and grow.

The 'Knowledge sharing' item in the Toolkit feeds back to each of the assessment criteria, through Post-Occupancy Evaluation studies, lessons learnt sessions within the practice, and dissemination to the wider public.



HT START Toolkit diagram

Knowledge sharing through Post-Occupancy Evaluation

Sustainability Tracking & Assessment + Regenerative design lkit (START)

Key design parameters:

1. Fabric first and passive design approach
2. Energy - operational (aiming for net zero operational carbon)
3. Embodied carbon
4. Minimising waste and using a circular economy approach to structures & materials
5. Using low energy services (heat recovery ventilation, heat pumps,etc) and on-site renewable energy generation (photovoltaic panels), battery storage & electric vehicles charging points
6. Water re-use on site, minimising mains water use
7. Enhancing the local biodiversity through a regenerative design approach, minimising pollution
8. Health & wellbeing, addressing outdoor and indoor environments, including air quality and noise
9. Community approach & providing local amenity & connection to wider systems (ecological & built neighbourhood).
10. Design for future adaptability and resilience to climate impact
11. *Knowledge sharing through lessons learnt, post-occupancy evaluation & user feedback and dissemination to the wider public & collaboration with other boroughs.*

C. Post-occupancy evaluation study
1. Review of design & construction information

Project aims
The client vision was to create a striking and clear building, to provide an exemplar Production Theatre, to raise and set new levels of energy efficiency and push the boundaries in all design processes and development. The scope of the project included a 400 seat adaptable auditorium, a large rehearsal room, public theatre bars, catering and cafe facilities, along with supporting offices, workshops and ancillary spaces.

History of the site
Originally a revivalist chapel built in 1837, by 1853 the building had become Hope Hall, a public lecture and concert room. In 1912 the site became a cinema, in 1964 became the Everyman Theatre and in 1993 went into administration. In 2005 Haworth Tompkins were appointed to design the redevelopment of the theatre (now operated together with the Playhouse as Liverpool & Merseyside Theatres Trust Ltd). HT and the clients took the difficult decision to demolish the existing theatre, and in 2014 the new theatre was rebuilt. It was considered to be of the utmost importance to retain within the new design those elements of the original theatre that made it a much loved venue. The replacement building was completed in 2014. To accommodate the new theatre the shell of the existing structure was carefully dismantled and the bricks salvaged for reuse. The reclaimed bricks were used for the walls of the 400- seat auditorium, which is the heart of the new building. The auditorium incorporates a thrust stage, which is encircled on three sides by audience seating to emulate the intimacy of its predecessor. The 25,000 exposed re-used bricks add a significant amount of thermal mass, which was critical to the auditorium's natural ventilation.
The client presented a clear and fundamental commitment to building a sustainable theatre that would lead the way in energy efficiency and sustainable techniques in performance spaces.

Design decisions
It was a condition of the funding to provide a BREEAM EXCELLENT rated building. This pushed the design team to closely interrogate all design decisions and review our fundamental concepts of how to meet these exacting requirements. By the end of the RIBA Stage 3 there were several fundamental proposals:
- have natural ventilation throughout
- provide the audience with high indoor air quality and thermal comfort
- where mechanical ventilation was a requirement of building regulations or thermal comfort required additional purge ventilation, this would be based on internal occupant comfort
- use on site power generation (CHP was chosen at the time)
- use low water usage throughout all spaces
- use a rainwater harvesting system
- adaptive solar shading to be a major feature of the main façade, to reduce solar gain and to provide occupants with glare control. As a result, the front façade was provided with a piece of public art which also doubled as a manually operated shading device, which would allow occupants to control solar gain and glare. A detailed description of the ventilation and heating strategy at design stage can be found on the following pages.

Other services
All spaces in the building benefit from natural ventilation, with some mechanical ventilation in places. The building was equipped with a CHP unit, and a back-up boiler. A rainwater harvesting system was installed to provide water for the WCs.

BUILDING SERVICES	DESIGN
VENTILATION	Auditorium: assisted natural ventilation (with air source heat pumps to heat incoming air if/ when needed, or to boost ventilation if incoming air warm) The offices, other Front Of House spaces: natural ventilation & some mechanical ventilation
HEATING	Gas Boiler & CHP
COOLING	No cooling system
WATER	Mains water supply Rainwater harvesting system

2. Key project feature: Assisted natural ventilation strategy to auditorium – review of design

'The client wanted a sustainable, low energy theatre so natural ventilation was seen as the obvious solution.'
(Jonathan Purcell, director of building services for Waterman Building Services)

Assisted natural ventilation strategy to auditorium
The naturally ventilated auditorium relied on a careful ventilation strategy and design which included manual calculation (wind driven buoyancy driven calculations), detailed dynamic thermal simulation and then detailed computational fluid dynamic analysis to track in detail air movement, velocities, air quality and comfort.

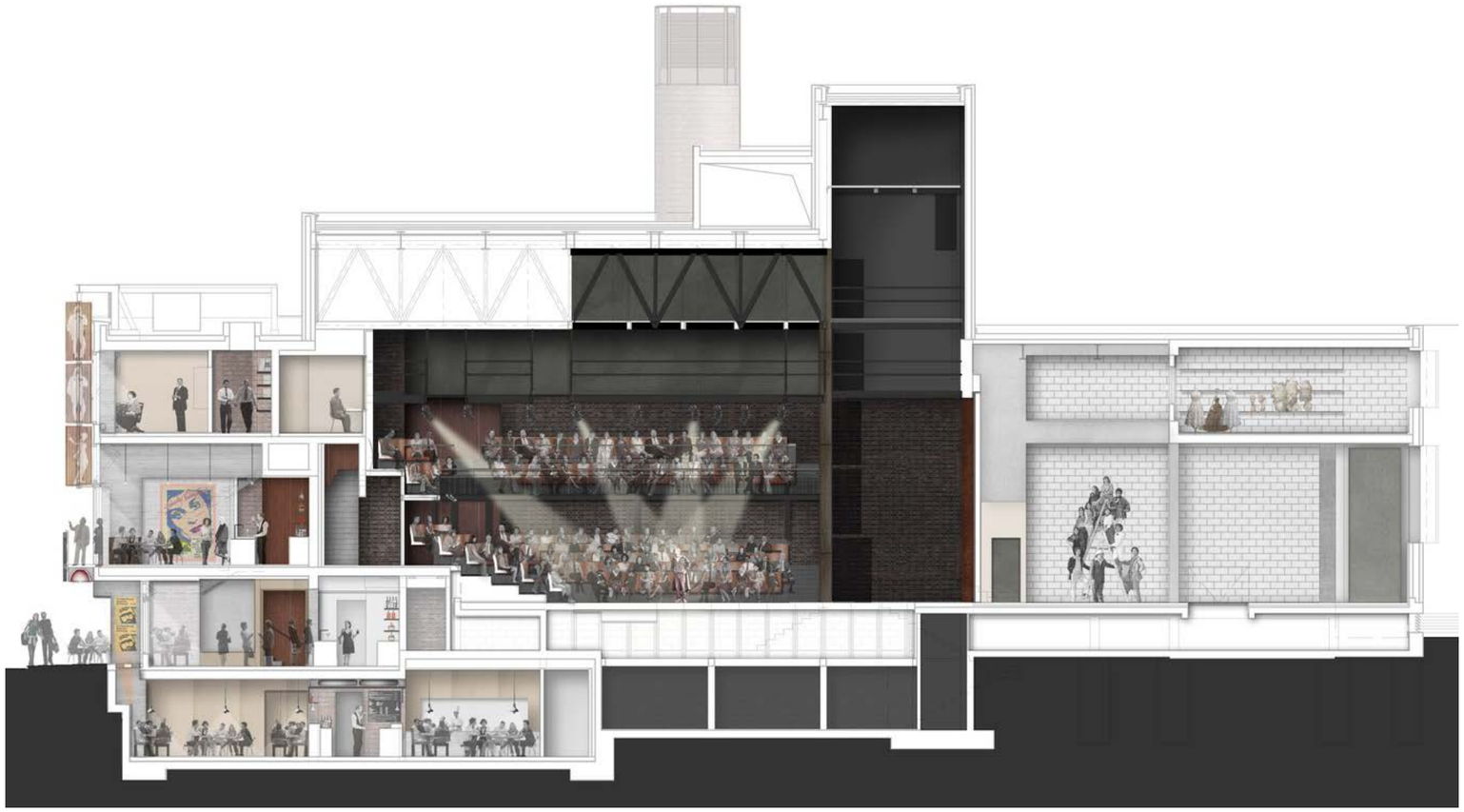
The analysis resulted in the four towers sitting above the auditorium, colloquially named by the design team Paul, George, John and Ringo.

There were tight site constraints that limited opportunities to introduce natural ventilation. However, the ventilation solution was integral to the architecture of the theatre, from the subterranean intake plenum, to the unobstructed ventilation path through the auditorium and the four giant rooftop chimneys. All are essential features of the design and ventilation strategy.

The method of ventilation adopted by the design team is to introduce fresh air at low level and then allow it to rise up, unobstructed, through the auditorium and out through its roof.

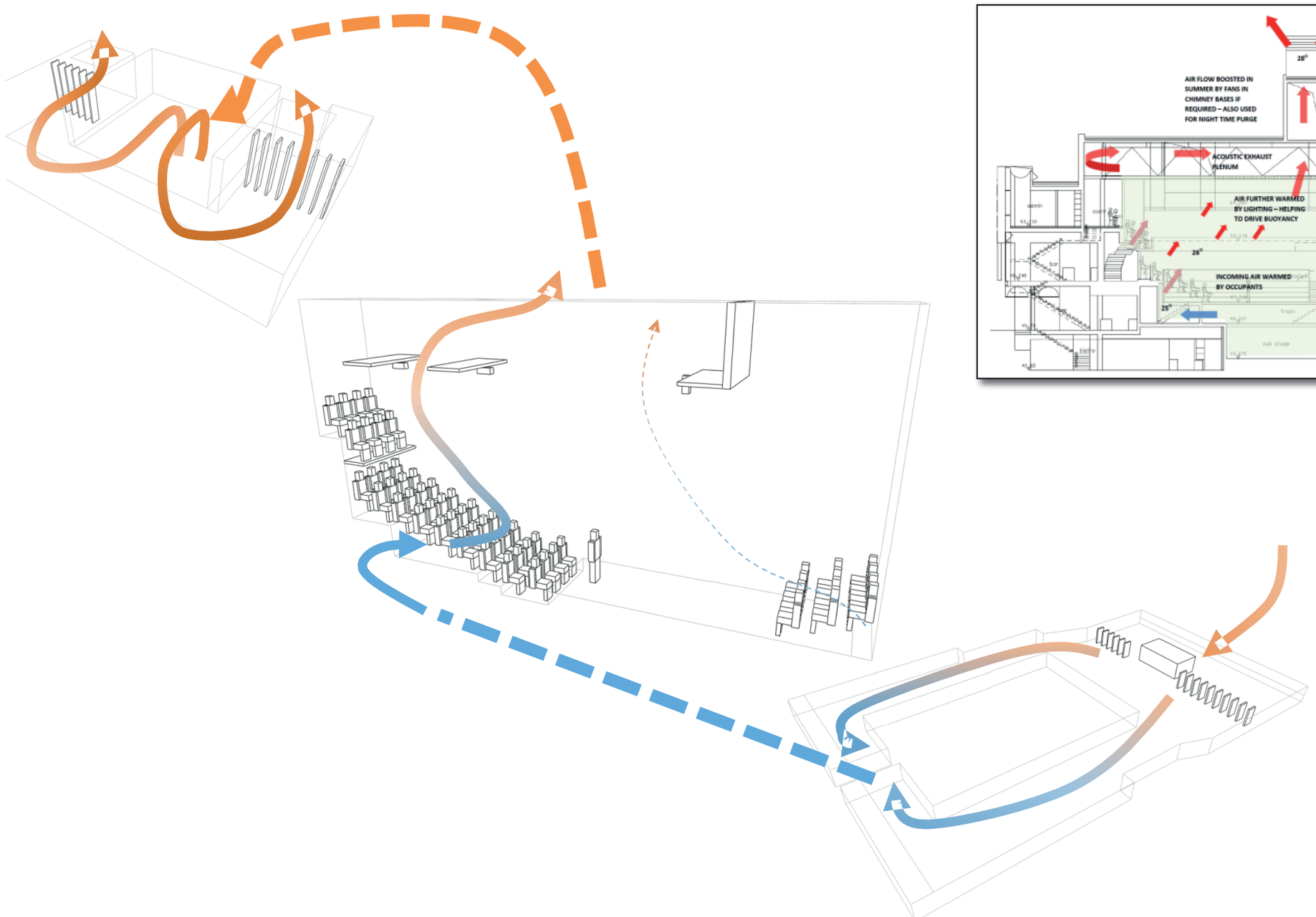
Fresh air is drawn from a road at the rear of the theatre. From an inlet louvre it passes through an acoustic attenuator and then into a large concrete plenum buried in the ground beneath the workshop area at the rear of the main stage. In the summer this concrete plenum helps cool the incoming air.

From the plenum the air passes beneath the stage, through a second set of acoustic attenuators, and into a large horseshoe-shaped plenum located beneath the rows of audience seating. Perforated grilles beneath the seats allow the air to be drawn into the auditorium.



Everyman Theatre – section

2. Key project feature: assisted natural ventilation strategy to auditorium - review of design



Everyman Theatre - Schematic of the assisted natural ventilation strategy in the auditorium

2. Key project feature: Assisted natural ventilation strategy to auditorium - review of design

The largest single source of heat inside the auditorium is the stage lighting. The stage has 140kW of lighting installed, of which 65kW could be on at any one time during a show. In addition, the occupants and other sources of heat contribute another 50kW to the space.

The buoyancy of the air is increased by heat given off by the audience and theatre lighting, causing it to rise up through the lighting gantries to an acoustically attenuated exhaust air plenum, hidden above the auditorium ceiling.

A large duct, which doubles back on itself to help prevent noise entering the auditorium, carries the warmed air from the plenum to the four large rooftop chimneys.

The rate of air flow through the auditorium is regulated by motorised dampers in the inlet and exhaust ducts. In winter fresh air supply rates are kept to a minimum using carbon dioxide and temperature sensors, and the heat pump in the air handling unit is used to preheat the auditorium when the boiler is not running.

However, once the audience is in place, the warmth they generate along with the lighting means that no additional heat is needed.

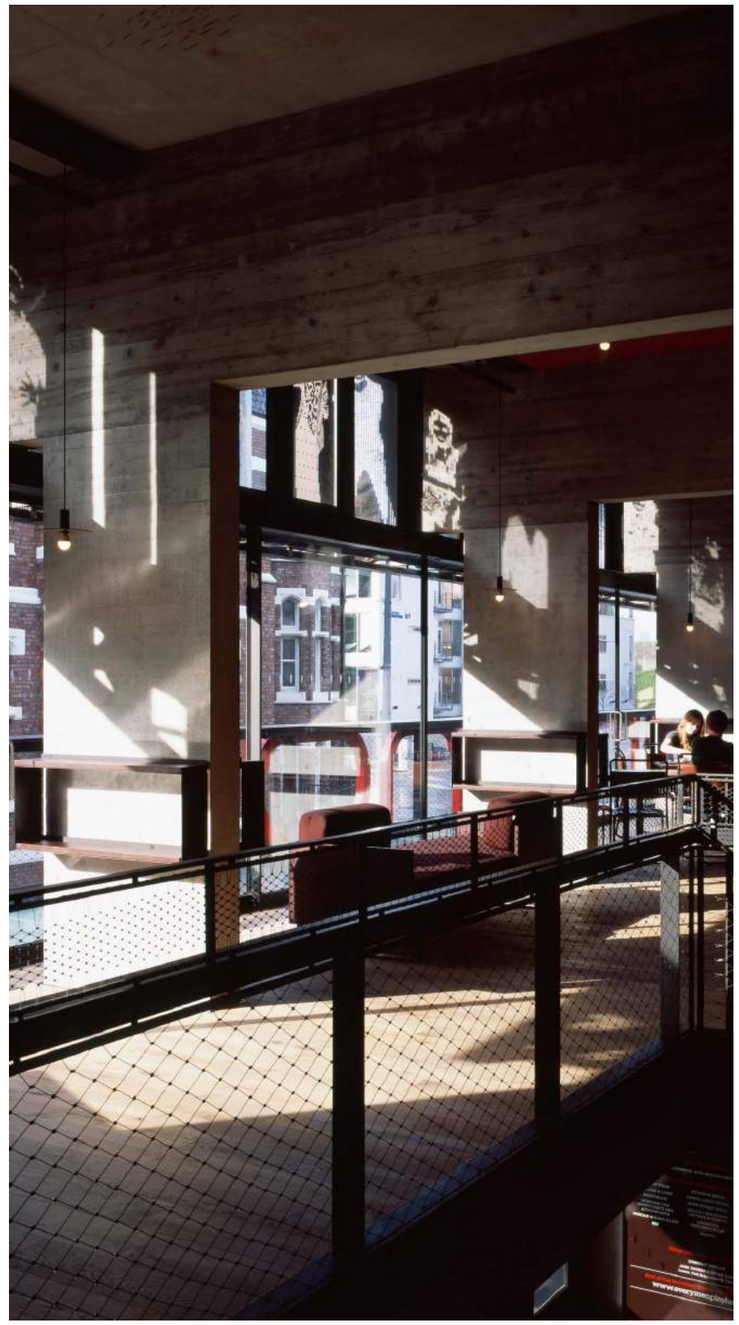
The air handling units are used to enhance the theatre's natural ventilation strategy if and when needed.

This is regulated by the automated control system as follows:

- Below 21°C the air handling unit supplies heat to the space and fresh air rates are kept to a minimum
- Between 21°C and 24°C, ventilation is progressively increased
- At temperatures above 24°C the Air Handling Unit fan is used to boost the ventilation rate
- Above 26°C, the auditorium switches to mechanical cooling with minimal fresh air.

Natural ventilation strategy to other spaces

The cellular offices and other spaces also benefit from natural ventilation, via openable windows. Only a few spaces in the building are mechanically ventilated.



ASSISTED NATURAL VENTILATION IN AUDITORIUM - KEY FINDINGS

Feedback from interviews with Facilities manager

- '*The design is extremely successful in achieving the project goals of: audience comfort, sustainable building and accessible theatre' ; 'natural ventilation in the auditorium is extremely good, the system does what it's meant to do'; 'the natural ventilation is fantastic and saves us a fortune'*
- Took a few months of adjusting the controls to get the most from the system (mid season - autumn/spring - more challenging). Example: summer, 29C outside at 7pm; 23C in the auditorium (just with passive cooling through the plenum); in mid season there can be cold draughts when cool air comes in, or during summer, after cool night, so slight heating (via boiler heat exchanger) needed to temper the air a little and reduce the feeling of draught
- The noise attenuation works extremely well ('it's bizarrely quiet') - only sound that can be heard occasionally is the bells from the cathedral nearby and only when wind blowing in the right direction;
- Only one noise issue: power flying system - in a room next to the bridge - the fan is slightly noisy, there is acoustic leakage somewhere; very likely not noticeable
- In spring, cooling via the heat pumps (ASHP) only occurs if the night time temperature doesn't drop enough, and the ASHP are running in reverse to cool down the building - night time purging doesn't work well in the spring; in autumn, heating activated to avoid cold draughts
- Complaints in auditorium: only at rehearsal time for panto performances - the space needs to be as for performance conditions; if people are there for long stints they might feel the cold
- The natural ventilation in the auditorium depends on external temperatures and the audience size (smaller audiences means additional heating via the heat pumps is needed)
- The auditorium '*very rarely*' reached the CO2 trigger; most often it is the heating requirement that triggers the need for heating in mid season or a small audience
- Seasonal commissioning: surprised to see how well the system worked; during the smoke test, one couldn't see where it was coming from, it built up like a haze, showing the system works really well to move air through; the BMS system has learnt to turn system on to be ready when auditorium will need to be in use
- Intake smells: one issue only with a lorry parked near intake; another issue was with a restaurant at the back of the building that triggered off the fire alarm due to smoke; other smells only to FOH occasionally from wood burner next door when wind direction changes

Monitored data:

The CO2 levels are well below 1000ppm, (reaching around 850ppm during a performance on Saturday evening), while the humidity and temperature levels are within the recommended ranges. (See the Indoor environmental data section)

BUS survey - public users:

thermal comfort and ventilation rated highly. (See the BUS section)

NATURAL VENTILATION IN OTHER SPACES- KEY FINDINGS

Feedback from interviews:

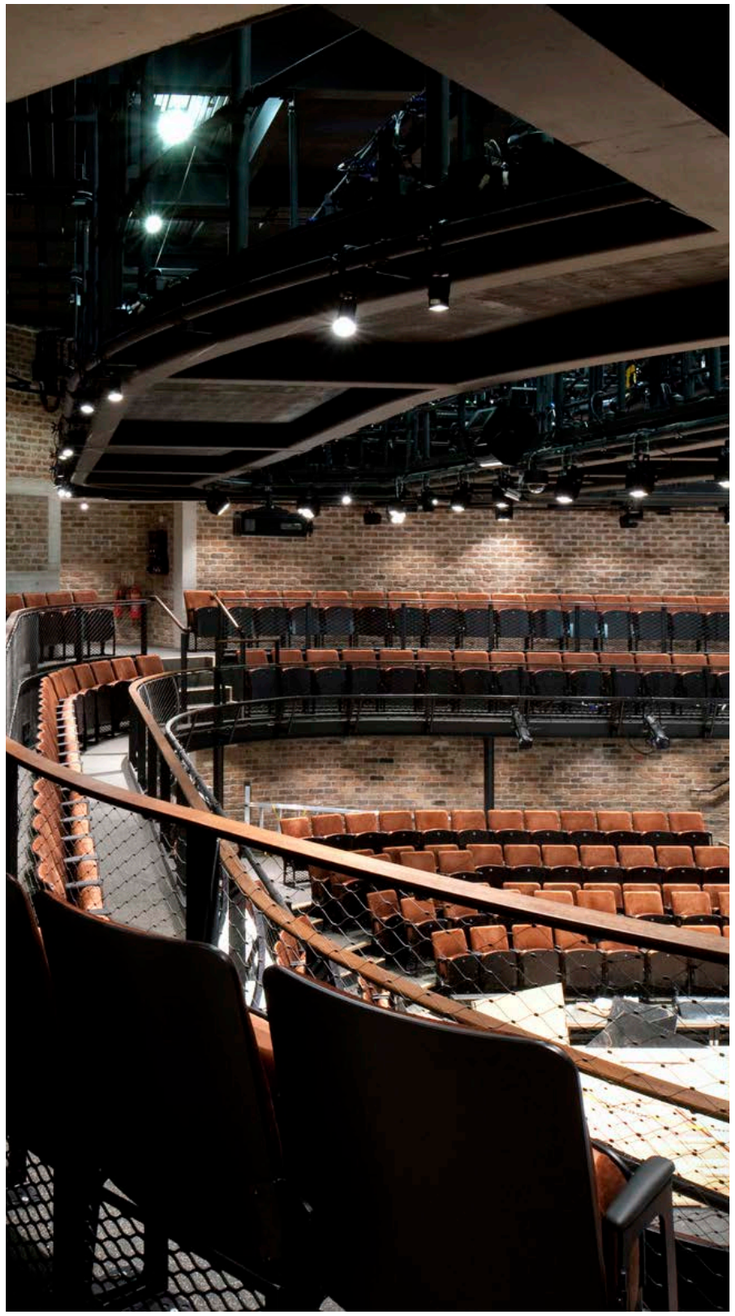
- The Ev1 space has been less successful than the auditorium, due to smaller plenum; can become warmer than it needs to be. There are ceiling fans in Ev 1 space to get air movement- but these are never used

Monitored data:

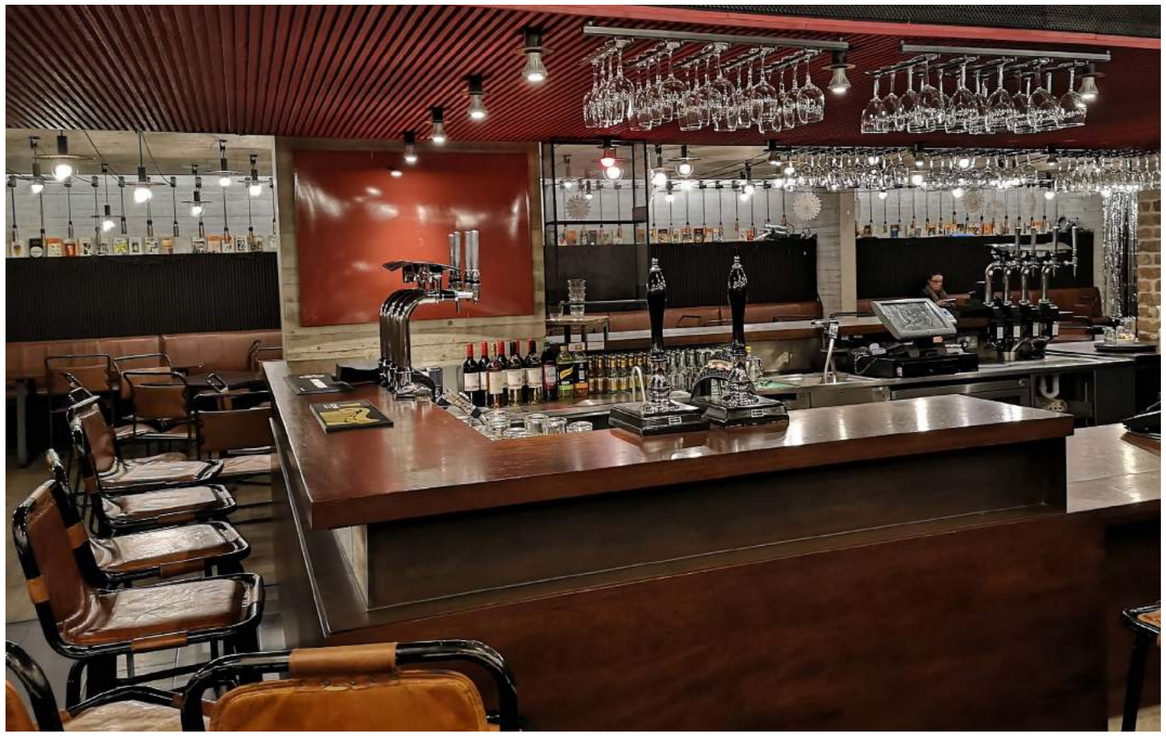
- Monitored office: The CO2 levels increase to admissible limits in the monitored office around midday, and are purged in the afternoon. The cold and mid seasons are particularly difficult for using natural ventilation only as external temperatures prevent occupants from using the windows more regularly. The office is quite small with high occupancy, with only natural ventilation to the room, so considering a heat recovery fan for high occupancy spaces would be advisable
- The dressing room performs very well in terms of thermal comfort and indoor air quality, (IAQ), as does the theatre bar (only occasional CO2 spikes which are quickly purged)

BUS survey - permanent staff:

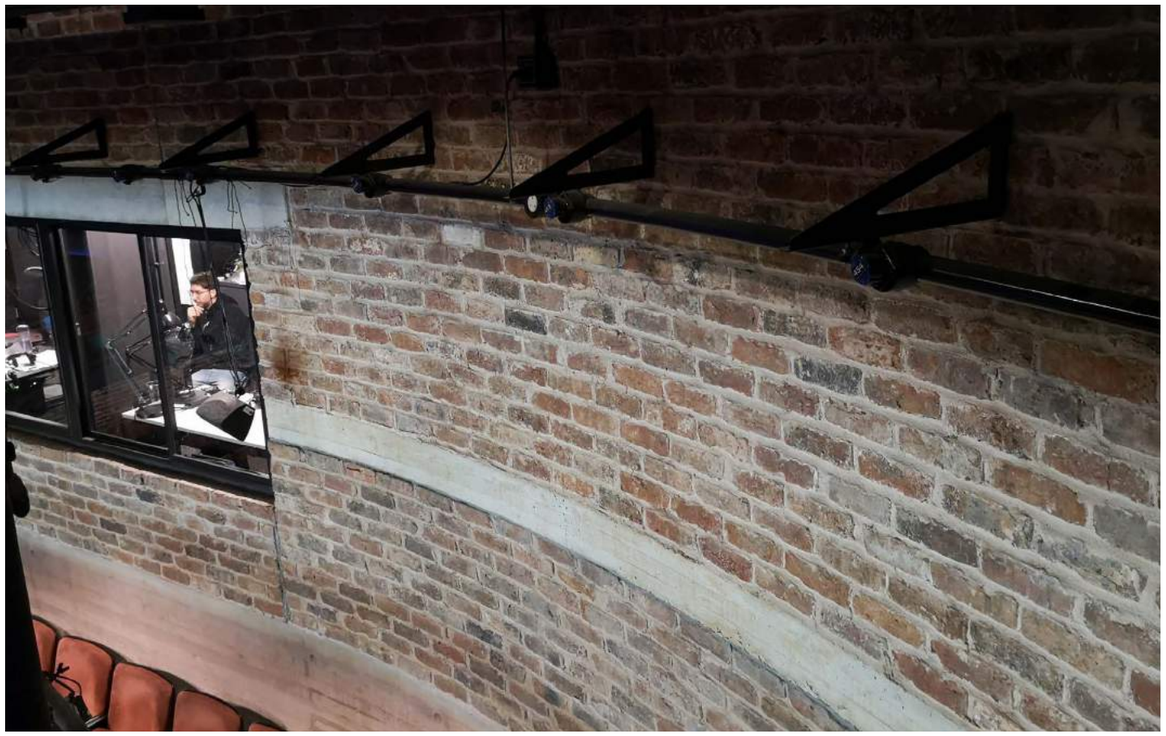
- Issues reported with temperature, humidity and air ventilation in summer, and air movement in winter, in line with the findings of the monitoring data
- Increased ventilation and/or lower occupancy in offices would help improve this
- Future projects: discuss occupancy levels per each room with the client, investigate how a mix of natural and mechanical ventilation could cover any increased occupancy over time if needed



C. Post-occupancy evaluation study
3. Site visit - January 2020



Basement Cafe bar



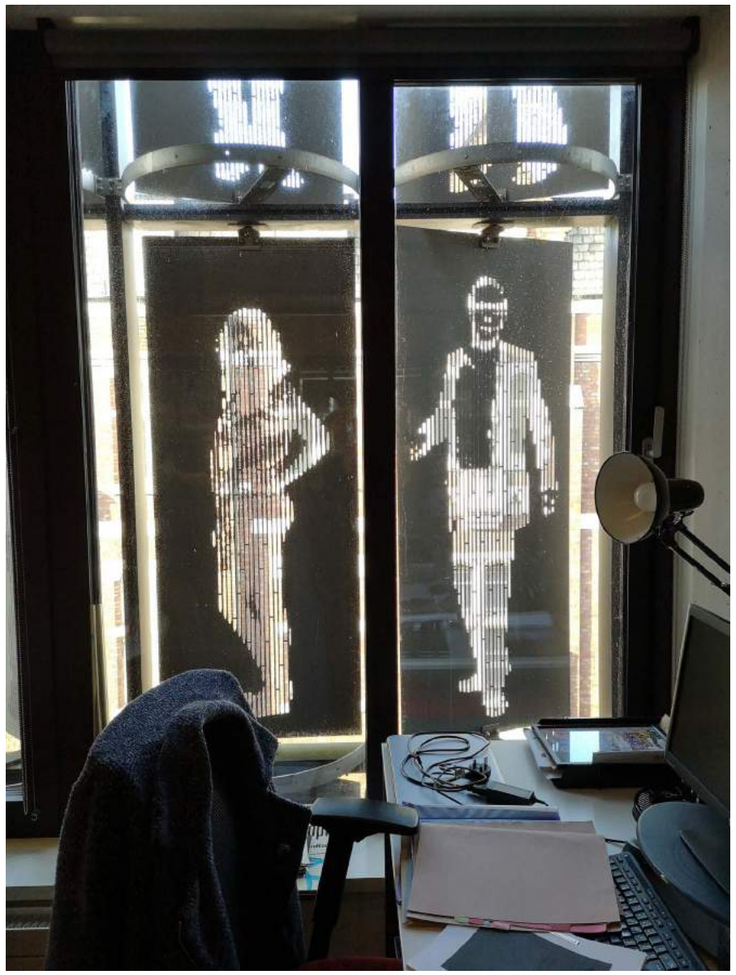
Reclaimed bricks from the previous Everyman theatre building, reused in the new auditorium

Auditorium - ventilation floor diffuser

Stage rostrum

3. Site visit - January 2020

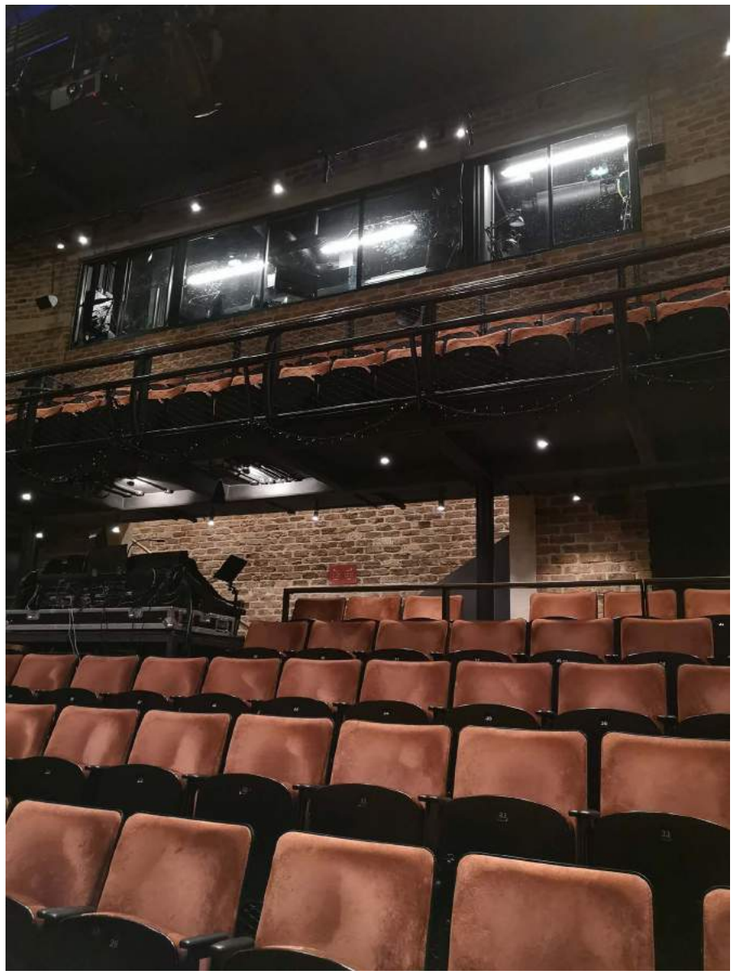
Costume department



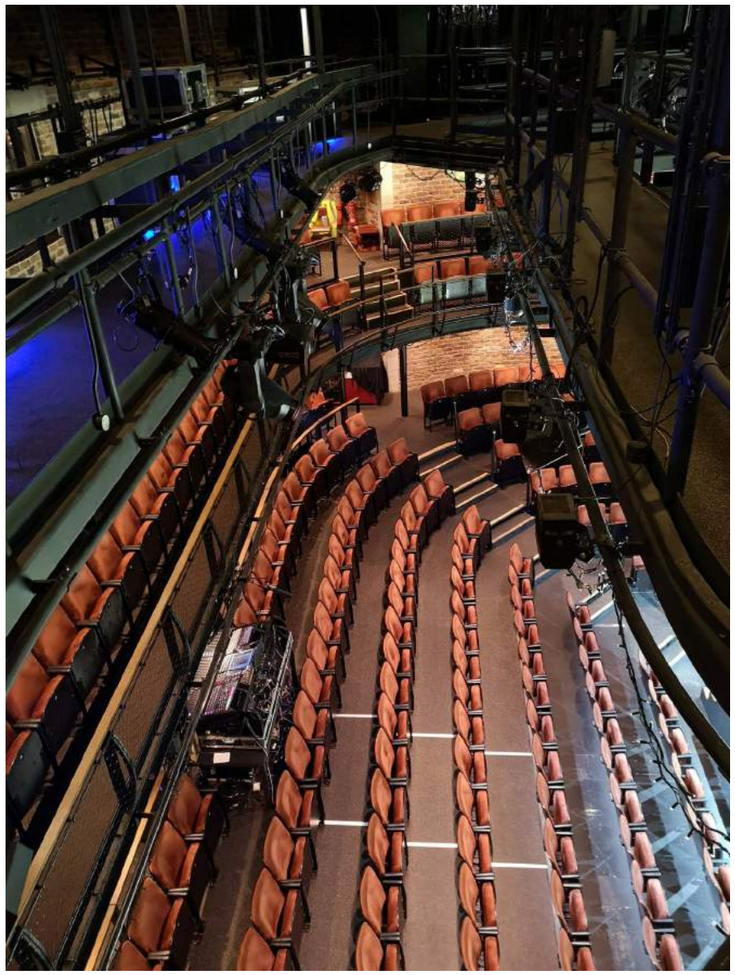
Office with bespoke louvres to control lighting and glare

Corridor to offices and skylight

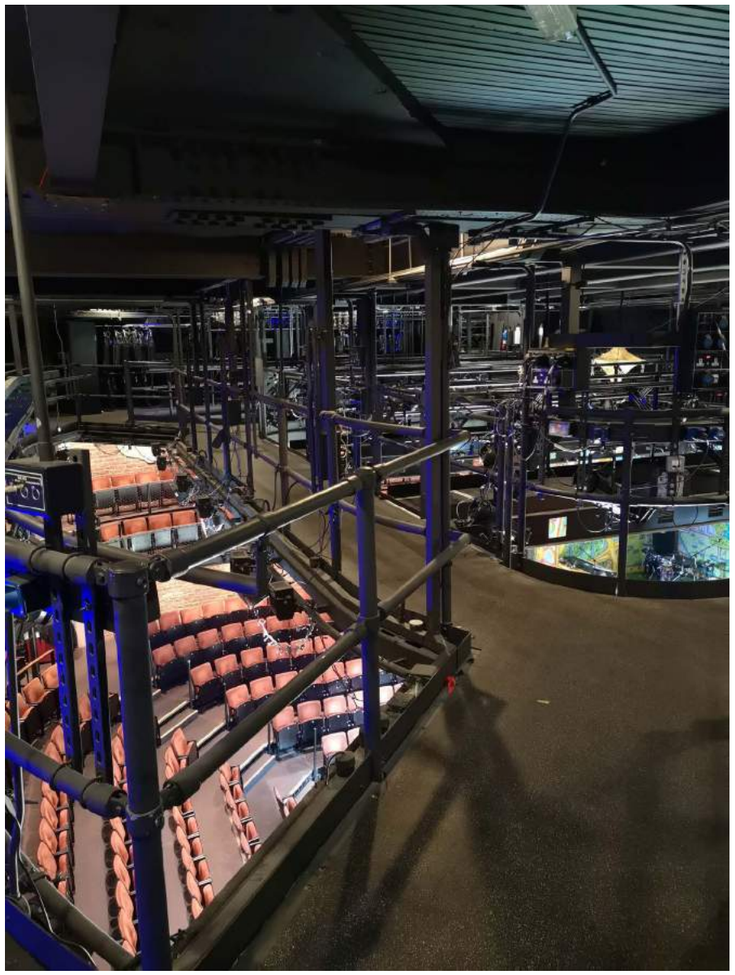
3. Site visit - January 2020



Everyman Theatre - auditorium



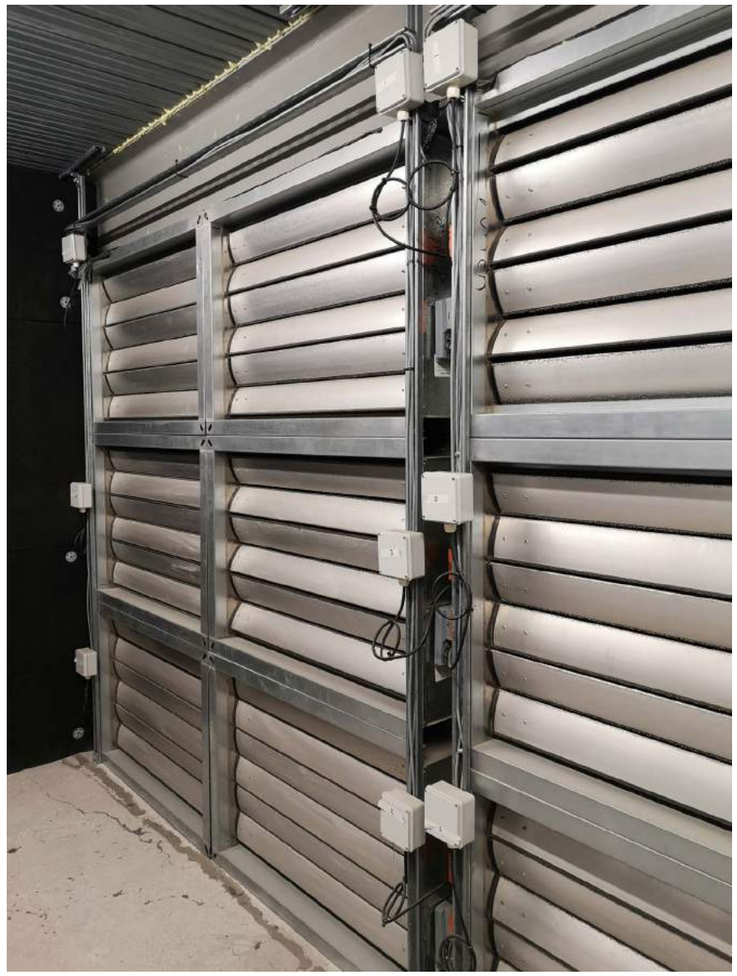
Everyman Theatre - auditorium, view from the technical bridge



Everyman Theatre - technical bridge

3. Site visit - January 2020

View up to one of the ventilation towers
(part of the natural ventilation strategy)



Motorised louvres at top of building
(part of the natural ventilation strategy)

Acoustic attenuators on top floor

Detail of acoustic attenuator
(part of the natural ventilation strategy)

SITE VISIT - KEY FINDINGS

Lighting and internal temperature

- The lighting is as per design spec (at tender: tungsten, but then variation to LED in main spaces); the rest of the lights are fluorescent - this is something the Theatre will look at changing in the future, as it requires funding; the stage lighting are not LED at the moment
- High level lighting in staircases is difficult to replace

Internal layout

- Two spaces were further divided to create extra enclosed office space
- Changes were made to facilitate wayfinding, the theatre added more laminated signs for toilets. Recommendation: HT to integrate wayfinding signage in the design in future projects
- The cloakroom space was small and under used, so now not used as such (public lockers would have been more useful); one idea was to have a pull-out cloakroom in FOH

Materials

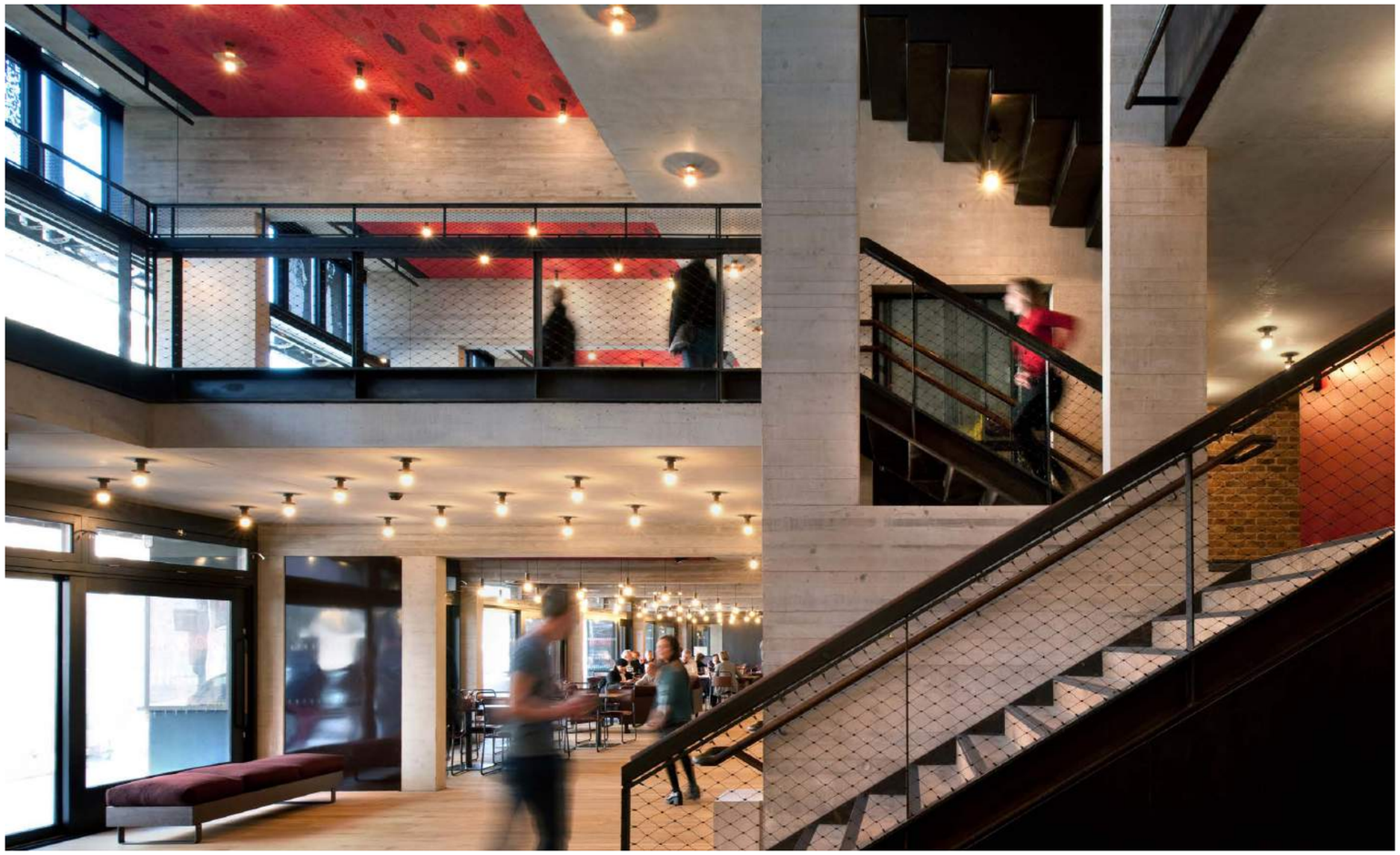
- Cork flooring in the Back of House (BOH) lost the seal in heavy traffic areas. This was due to not enough time being allowed for the seal to cure/set before being walked on which led to damage in some areas);
- Bistro floor slightly darkened
- Oil residue appears to come off from black metal
- Hardwood floor, plywood wall slightly darkened
- Red/black slatted finish in meeting room created a distracting effect and/or motion sickness – since repainted
- The auditorium seats: they all had to be sent back to the supplier to be fixed as many broke because of a poor weld design. This is an important lesson to learn, as HT are using the Everyman seat as a base for new seat designs

C. Post-occupancy evaluation study
4. Interviews

Context

Two interviews were conducted with key members of staff during the visit to the theatre in January 2020:
- Interview one with the Head of Facilities, who was part of the client team during the design and construction of the project,
- Interview two with the Head of Production

The interviews were open discussions regarding the way the building functions, usability of spaces, materials, services, comfort, controls, and focused on two main aspects:
- the functionality of the spaces within the brief constraints
- update on how the systems and services are working (more comments on this are recorded further down under the 'Services' chapter of the report)



Key findings are noted on the next pages.

The comments were grouped under two headings:
- Strengths
- Opportunities for learning & improvement

Overall comment: *'the design is extremely successful in achieving the project goals of: audience comfort, sustainable building and accessible theatre'.*

KEY FINDINGS - strengths and opportunities for improvement

Interview one - Key comments: Project Strengths

- All the natural ventilation comments are included in the separate section on this topic (see previous pages)
- Great support from BMS company and Watermans (MEP) to answer queries
- No issues with other BOH spaces
- Changing behaviour is difficult: users sometimes leave windows open + radiators on
- The Theatre bar is pretty good
- The Workshop seems to work well

Interview one - Key comments: Opportunities for learning & improvement

- BMS: advance training would have been needed on BMS, but not enough time between practical completion and opening, only 4 months; needed longer to tweak the systems; in early days they were on the phone to the BMS company a lot
- Green room: echo - acoustics could be improved

Other comments:

- the mechanical ventilation system that serves FOH, meeting rooms and open plan offices needs to cope with different demands at different times. High demand in one room triggers higher fan speed and volume to keep up the pressure, so the system becomes very noisy and there is draught; the controls were changed recently to avoid system going to full speed
- FOH store with freezers overheats, so a ventilation extract was added later but runs when entire system is running
- The theatre bar can get a little chilly at times and a bit crowded but not a massive problem
- Difficult to get people to use the secondary auditorium entrance; seating numbering might help; now there are seat numbers listed above the auditorium doors
- Workshop: issue with roller shutter; fire shutter is quite big; shutter currently out of use awaiting repairs or replacement

Lifts:

- Materials: damaged easily
- Platform lift in FOH operation problematic (only used with a member of staff) - as lift easily tripped out if not operated carefully;
- Possible issue with wheelchair escape if platform lift is not working or a mains outage and other lifts not working, however there are evacuation points in auditorium
- What would they have done differently: fight the planners on the building envelope (height); it would have made a huge difference (not another floor but to ease height issues on level 7 + the fly tower); the planners did approve a higher building on the street, subsequently to the Everyman planning approval

4. Interviews

KEY FINDINGS - strengths and opportunities for improvement

Interview two - Key comments: Project Strengths

- Access - very good
- Dressing rooms good size, adequate counter space
- Lighting accessible and straightforward to use
- Dressing rooms complimented on finishes
- Auditorium - good environmental conditions
- Different configurations of thrust used

Interview two - Key comments: Opportunities for learning & improvement

- Vertical travel - access: it is challenging to move large items
- Thrust grid not wheelchair accessible
- Seats: the swing mechanism had a faulty weld detail that snapped and meant the seats had to be repaired
- Grab posts added later to the auditorium - fixings are tricky
- Custom dollies were made for seats
- Removable proscenium panels - plywood - not wearing well and too heavy
- Green room could be closer to stage
- Lack of crew room space (only lockers)
- There is some storage in the plenum
- Function rooms used as rehearsal room not quite big enough
- Access to Rehearsal room could be better
- Seating: in the round seating doesn't quite work, blocks don't meet up and make the rostra difficult to work, doesn't line up with the stalls and particularly the balcony
- Method of moving rostra is difficult
- Stage decks movement and height - difficult to assess risk, a significant and costly process
- Proscenium panels difficult to pull out
- Flight case storage problematic

C. Post-occupancy evaluation study
5. Building systems and services

Context
The building services were not inspected directly, but the functionality, fitness for purpose and issues that arose during the six years since completion were discussed in the interview with the Head of Facilities. Their comments are noted below and summarised in the chart on next page. Please also refer to the Design review section of this report for a summary of services and systems.

KEY FINDINGS

The natural ventilation, acoustics and controls generally work well - see separate section on this.

CHP: currently not working, issues with maintenance and quality of water causing blockage of internal plate heat exchanger, external plate heat exchanger and filters, difficult to obtain information from non-UK manufacturer

Boiler: needs to be on most of the time to avoid seals cooling down and leaking

Rainwater harvesting: not working, issues with amount of rainwater reaching the system and the pumps.

ASHP: volume of refrigerant not allowing a more nuanced use of the system (only on/off now) - newer ASHPs would not pose this problem.

KEY FINDINGS - strengths and opportunities for improvement

BUILDING SERVICES & STRATEGIES	STRENGTHS/FINDINGS	OPPORTUNITIES FOR IMPROVEMENT
BOILER	now providing all heating requirements (boiler has capacity to handle all load however there hasn't been a period of sustained cold so far)	**Boiler: issues with seals leaking in heat exchanger if boiler turned off**, so boiler runs from early morning to at least midnight and short periods overnight to avoid system cooling down, leaks occurring at night (leaking into auditorium); heat exchanger was replaced (it was in warranty)
COMBINED HEAT AND POWER PLANT (CHP)		**CHP: ran for first few years only; problems with water quality and with the system, foreign manufacturer with no UK representative, not very responsive; annual maintenance used for first couple of years; the whole system has now been stripped back twice and rebuilt; when working, it works well; out of service for two years, relying on gas boiler alone;** the manufacturer had mentioned problems with the circulation pump (CHP needs service after 6000 hrs and turns off). The water quality was an issue: secondary plate heat exchanger (PHE) needed; the CHP has a built in plate heat exchanger (PHE) that silts up and was replaced once already, a second one will be installed soon. **The theatre maintenance company have now undertaken a full service in situ with the manufacturer so they can undertake planned maintenance in future as an alternative to sending an engineer abroad to be trained.**
NATURAL VENTILATION	excellent	mid-season tweaking needed over initial year after completion, but solved
ACOUSTICS	working fine	issue with one fan - not noticeable in the auditorium
RAINWATER SAVING SYSTEM (CONNECTED TO TOILETS)	when system was working, it was working well getting water to toilets; but not enough pressure without pumps; blockages when intensive use	**Rainwater harvesting not working: issues with the pumps.** Theatre now on their way to getting a second set of pumps in 5 years (pumps were overheating). **Also,** the system didn't have enough water from the roof into the tanks; made changes- added more channels to the roof; diverted rainwater from side and front roof into the rainwater harvesting system. A VE element was to get rid of profiled insulation; the problem is the drain positions are designed with profiled insulation in mind. The inverter also causing issues; what would do differently: have a back-up storage tank for rainwater harvesting on roof to have system work on gravity if pumps not working. **Rainwater harvesting out of use for more than a year now at time of this report.** MEP chasing the manufacturer at the moment.
CONTROLS	working fine	-
AIR SOURCE HEAT PUMP	generally fine	**ASHP can be on or off only, no control over volume of refrigerant**; more recent ASHPs would not pose this problem (the technology has evolved since the completion of the building).

C. Post-occupancy evaluation study
6. Energy use analysis

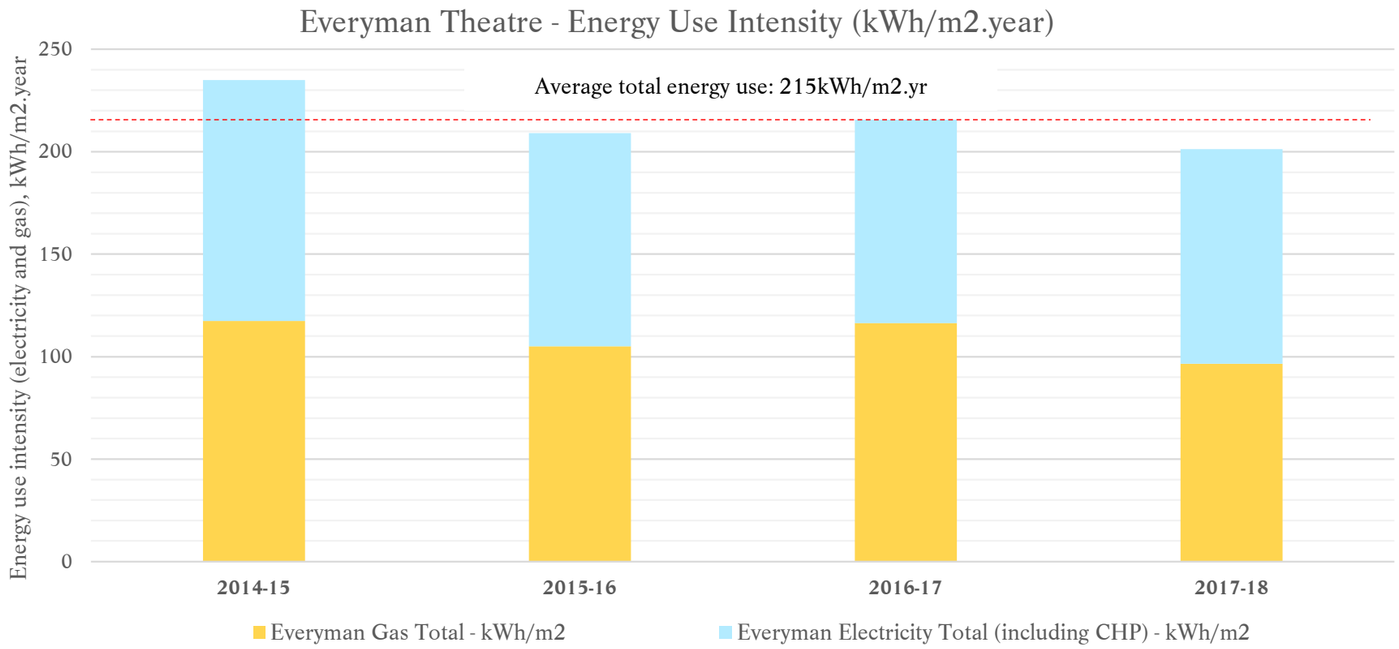
Operational energy use

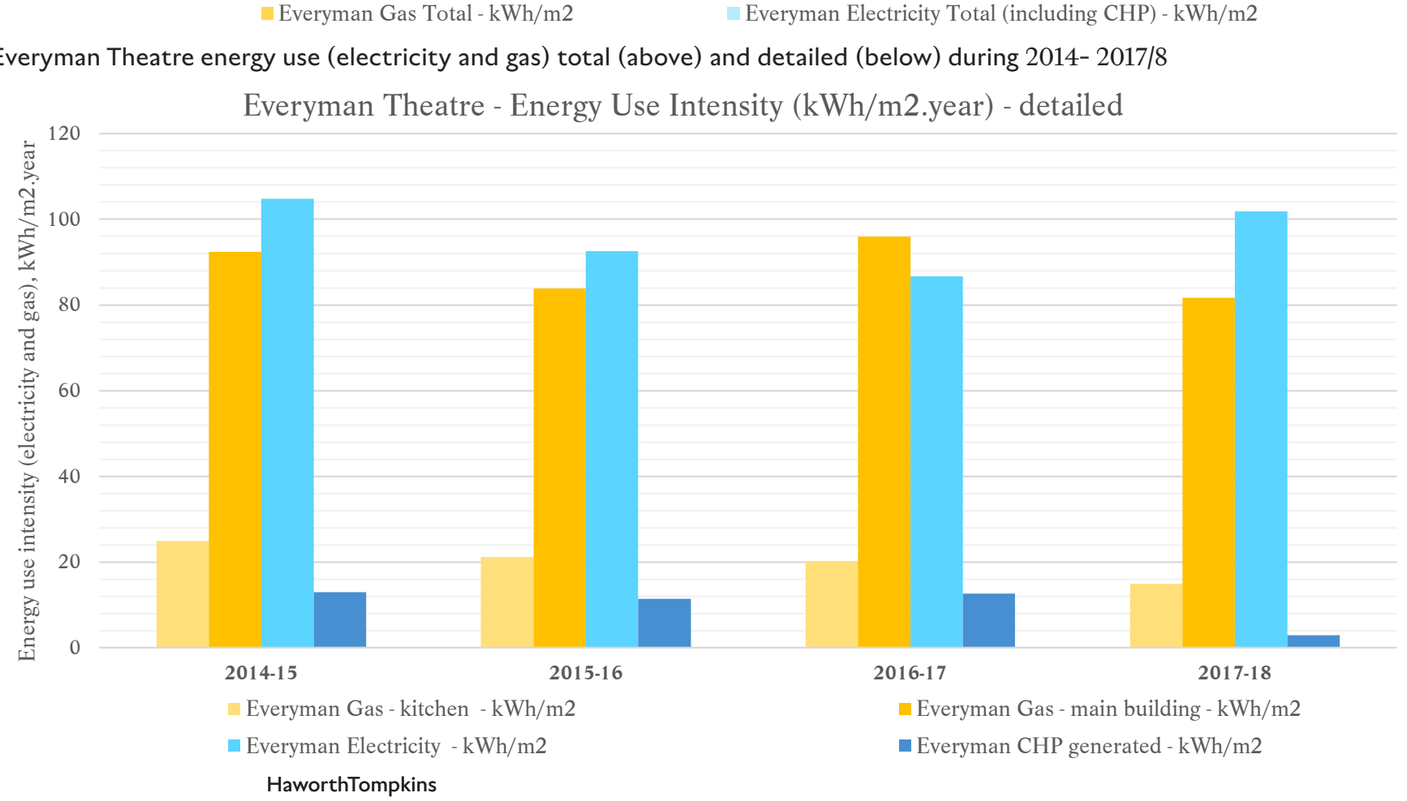
The energy use of the theatre is analysed through the data provided by the BMS system.
The data from 2014 to 2018 shows the theatre was using on average approx 215kWh/m2.year.

This included electricity generated by the CHP, which has not been in use in the last years due to technical issues (see the *Building services* section of this report). The CHP generation in the year 2017- 2018 was very limited (only a few months) as seen in the chart to the bottom right (dark blue). As a result, the grid electricity use increased (light blue), while the heating requirement was provided by the boiler.

The energy use appears to settle down after the first year of use. Both the theatre facilities manager and the building services consultants were keen to monitor the energy use after completion to ensure the functioning of all systems is optimised and to adjust the natural ventilation controls for optimum performance. (see the *Interviews* section of this report).

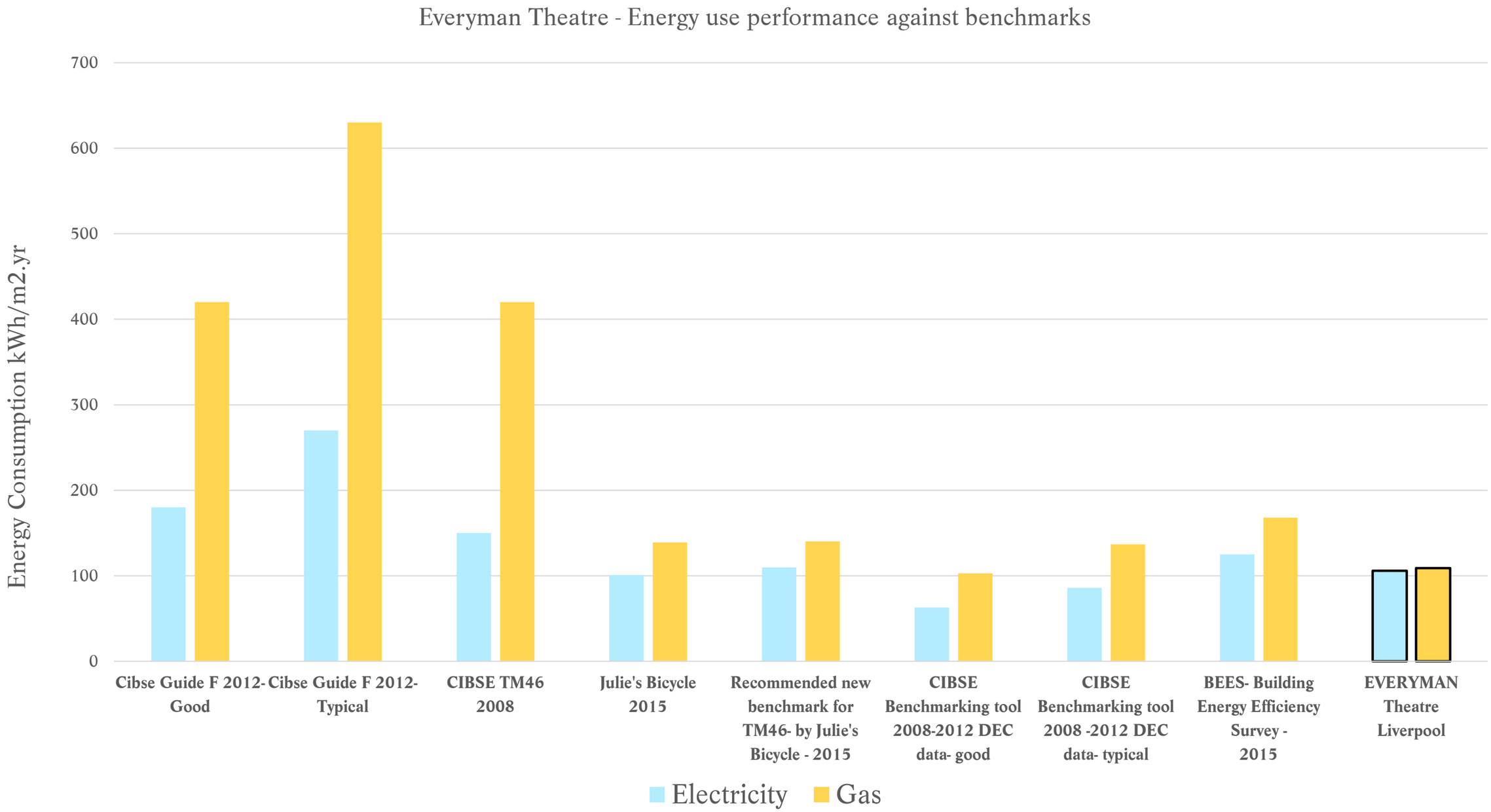
A close analysis of how the building operates, and how occupant controls are used, is crucial in the first years after completion in order to ensure the most effective energy use that best suits the functioning of the building. (see *Energy, People, Buildings: Making Sustainable Architecture Work http://www.energypeoplebuildings.com/*)





Everyman Theatre energy use (electricity and gas) total (above) and detailed (below) during 2014- 2017/8

6. Energy use analysis



Everyman Theatre energy use (electricity and gas) compared to relevant performance spaces benchmarks:
CIBSE Guide F (2012 benchmarks), CIBSE Benchmarking Tool (based on DEC data from 2008 - 2012) and performance spaces in-use data gathered by Julie's Bicycle (2015)

6. Energy use analysis

KEY FINDINGS

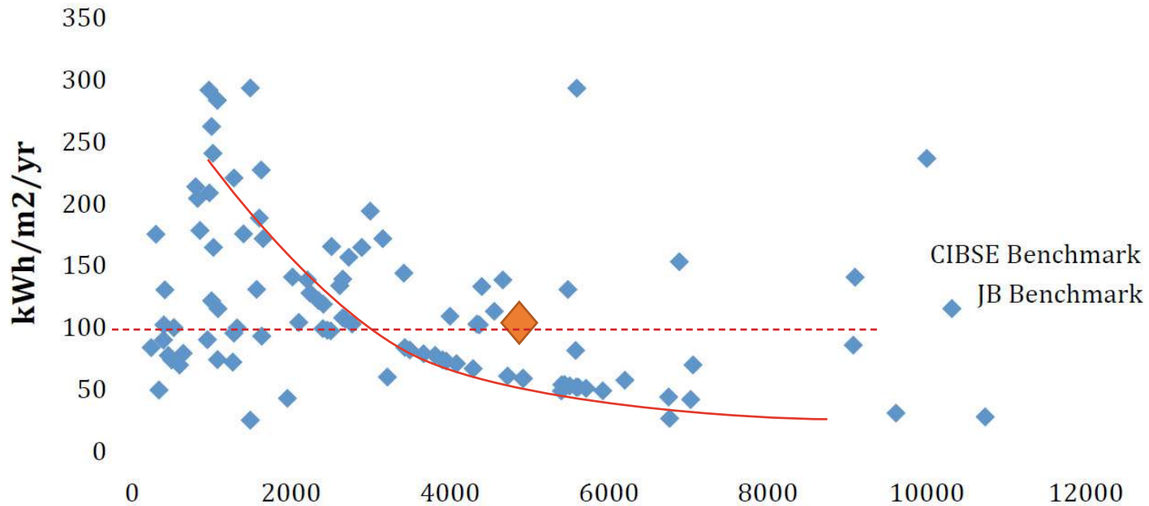
Operational energy use

The average yearly energy use of the Everyman theatre was plotted against similar electricity and gas data included in *Julie's Bicycle* report *Creating a robust dataset for benchmarking the cultural building sector - 2015.*
(More information can be found here: *https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q20000008I71I*)

The charts show that the energy use of performance spaces are clearly dependent on the scale of the building.

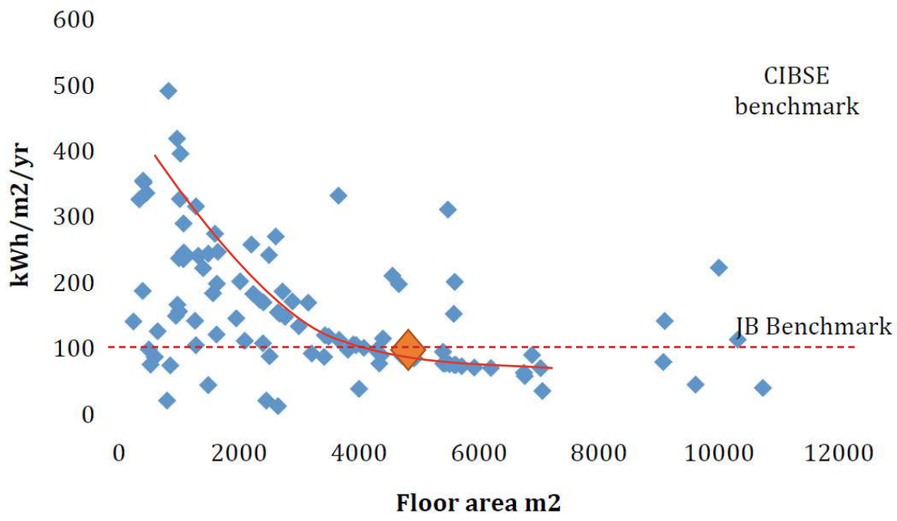
The Everyman Theatre is performing slightly above the curve for its floor area when it comes to electricity use, and is within the trend regarding the gas usage.
The slightly higher electricity use per sqm can be attributed to a high density of use in a relatively small building, whereas typical performance buildings with similar electricity use might have similar functions accommodated in a much larger building.

Chart 1: Performing Arts Building Energy Benchmark for Electricity, n=109



Julie's Bicycle Performing Arts Building Energy Benchmark and Everyman Theatre energy use (electricity - above, and gas - below)

Chart 2: Performing Arts Building Energy Benchmark for Gas, n=109



6. Energy use analysis

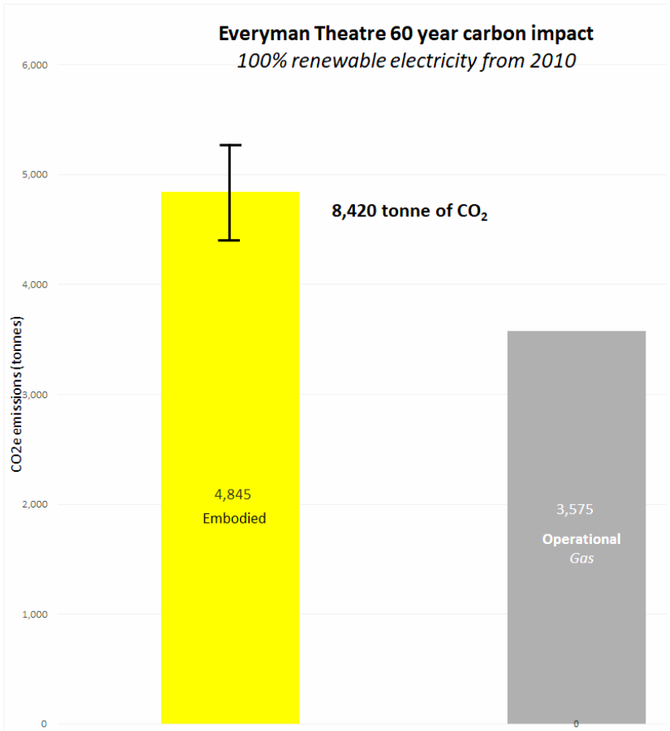
Whole Life Carbon Analysis

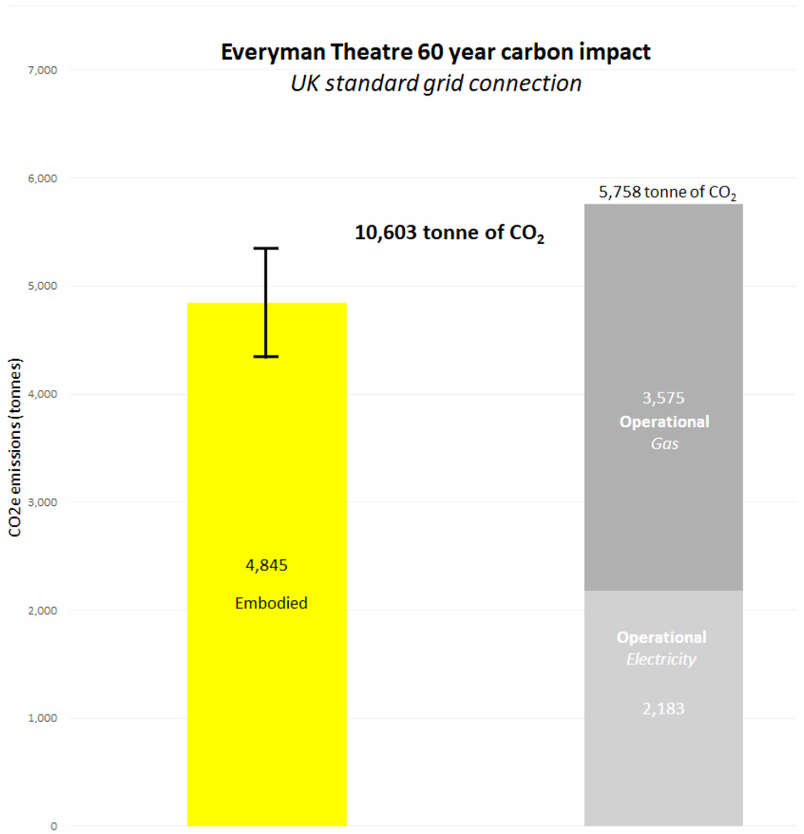
Dr Stephen Finnegan (University of Liverpool) and the Chief Executive of Liverpool & Merseyside Theatres Trust are currently working in collaboration to measure the whole life carbon impact of the theatre and develop a plan to reduce this impact to zero. (More information can be found here: *https://sway.office.com/GbDofbu8wQFn6BvW?ref=Link&loc=play*) The work includes an assessment of the embodied carbon emissions related to the construction and maintenance, as well as the operational carbon.

The study estimated the embodied carbon to be approx 4845t/CO2 (with a 10% accuracy margin), meaning approx. 1033kgCO2e/m2. The operational carbon was estimated at 5758tCO2e over 60 years life time of the building (from electricity and gas use). It is worth noting that the **Everyman Theatre sources 100% of its electricity from a renewable energy provider.**

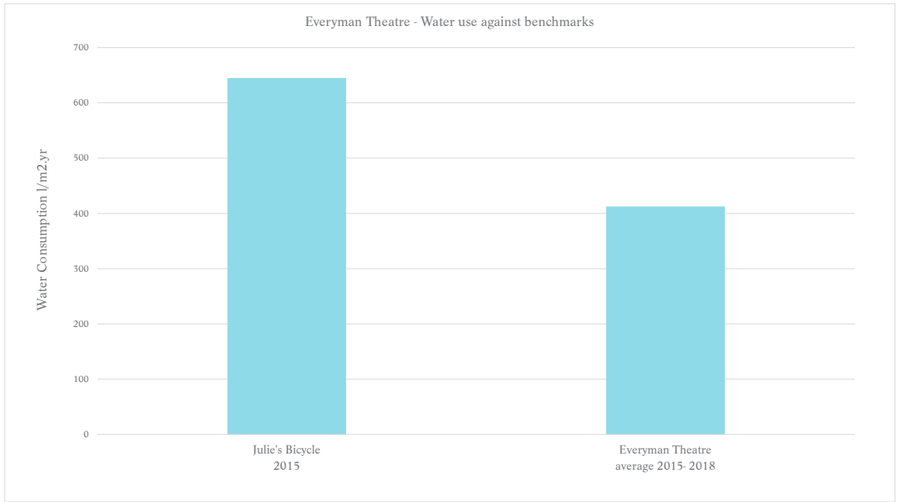
Water use

The average water use (between 2015-2018) was approx. 1935m3/year, which is approx 413l/m2.yr. This is almost 40% lower than the average water consumption recorded by *Julie's Bicycle Performing Arts Benchmark for 2015.*





Whole life carbon study- Liverpool University (dr Stephen Finnegan) & Everyman Theatre, grid connection vs 100%renewable electricity
(reference: https://sway.office.com/GbDofbu8wQFn6BvW?ref=Link&loc=play)



Everyman Theatre - 2014-2018 average water use l/year vs benchmark

C. Post-occupancy evaluation study
7. Building User Survey (BUS) - staff

Two Building User Surveys were carried out in January 2020, one answered by the staff working in the building (28 responses), and the other by the public present at an evening performance (transient users of the building, 29 responses).

Methodology
The detailed analysis of benchmarked survey responses provides an in-depth comparison between the results for each benchmarked variable in the survey in comparison with the Arup BUS benchmark data set. It is worth noting that the Everyman Theatre was compared against the Arup 2019 UK non-domestic building benchmark. This is a sample of 70 non-domestic buildings that includes a range of use types, such as offices, schools, galleries, libraries and visitor centres. ***There are no other performance spaces included in the Arup BUS benchmark at this time.***

Staff survey strengths and opportunities for improvement:
-*numerous perceived strengths of the project,* from building design overall, image to visitors, thermal comfort in winter and overall in summer, lack of glare, etc.

- *perceived opportunities for improvement:* humidity, temperature and ventilation in the summer (office spaces), personal control over cooling/heating, amount of artificial light and amount of natural light.

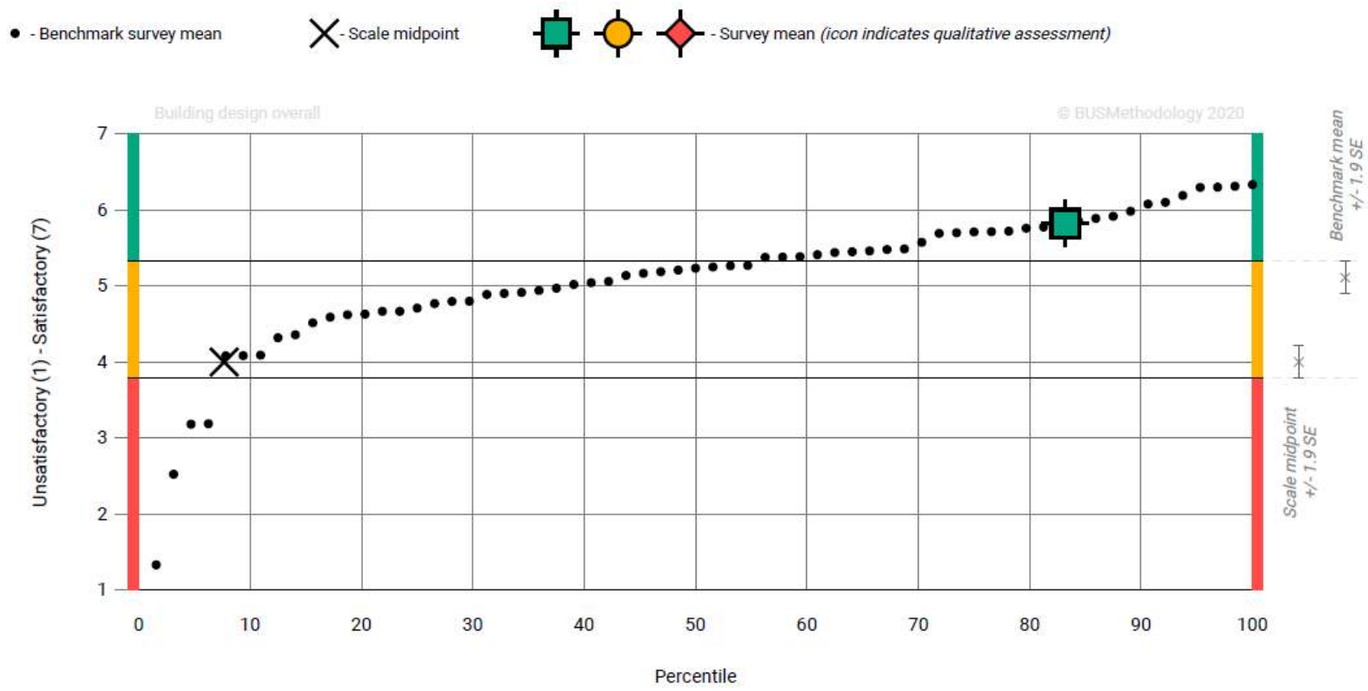


Figure 1.2: *Question mean response relative to the benchmark set*

	Mean	Percentile	SE	Mean - 1.9SE	Mean + 1.9SE
Question mean response	5.82	83.20	-	-	-
Benchmark mean	5.11	43.17	0.11	4.90	5.32
Scale midpoint	4.00	7.67	-	3.79	4.21

Everyman Theatre - BUS staff survey - appraisal of the building design overall

The Everyman scored 5.82 out of 7 for the *Building design overall* in the staff BUS survey, in the 80th percentile (i.e. better than 80% of all the other buildings in the benchmark)**.**

7. Building User Survey (BUS) – staff

KEY FINDINGS - strengths and opportunities for improvement - STAFF SURVEY

PERCEIVED STRENGTHS	NEUTRAL/GOOD	OPPORTUNITIES FOR IMPROVEMENT
Building design overall	Lighting overall	Effect of building on perceived health
Conditions overall in summer	Overall comfort within the building environment	Humidity in summer
Conditions in winter overall	Perceived change in productivity as a result of environmental conditions in building	Temperature in summer
Needs being met by facilities	Adequacy of space at work area	Ventilation in summer
Thermal comfort in summer	Effectiveness of space use	Air movement in winter
Thermal comfort in winter	How well facilities meet needs	Ventilation in winter
Availability of meeting rooms	Air movement in summer	Personal control over cooling
Cleaning	Air quality in summer	Personal control over heating
Image to visitors	Temperature variation in summer	Amount of artificial light - much
Personal safety	Air quality in winter	Amount of natural light - little
Storage arrangements	Humidity in winter	Frequency of unwanted interruptions
Usability of furniture	Temperature in winter	Noise from colleagues
Glare from sun and sky	Temperature variation in winter	
Noise from outside	Personal control over lighting	
Other noise from inside	Personal control over noise	
Effectiveness of response to requests for changes	Personal control over ventilation	
Speed of response to requests for changes	Glare from lights	
	Noise from other people	

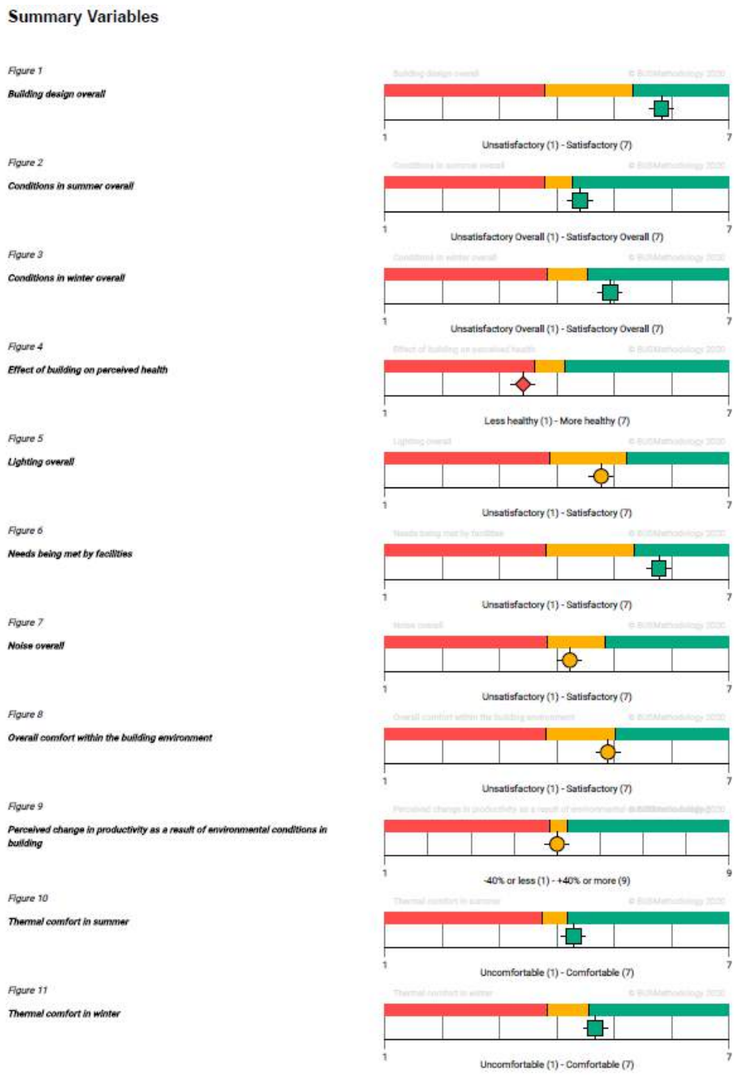
7. Building User Survey (BUS) - staff

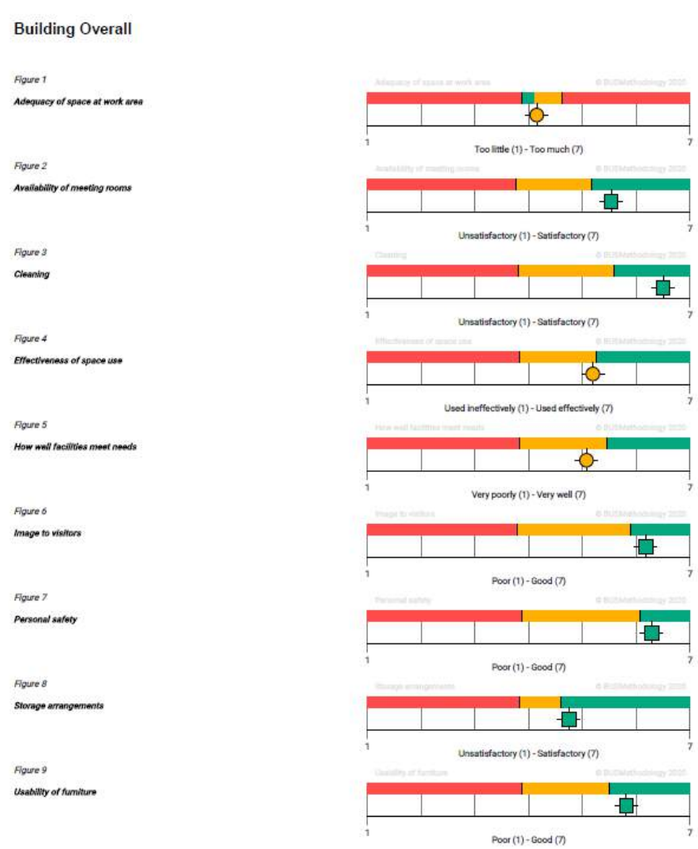
Staff survey

Some of the comments regarding building design overall:

- *'A beautiful building to work in.*
- *Pleasant working/social space with good light. Pleasant use of building materials.*
- *The concrete can be a bit oppressive. Having to swipe so many doors to get places can be frustrating.*
- *Well laid out, easy to navigate.*
- *Stirling prize!*
- *It's quite difficult for people with mobility issues to negotiate.*
- *Customers really like the building.*
- *Interesting modern design. Not very practical.*
- *I love the design. The green room door would be better placed at stage level if I am being picky.*
- *Overall the building is gorgeous - but there are a few practical elements that frustrate.*
- *No natural light (very little) in BO. Very cramped. No storage space. Cold.*
- *You can hear everything. And it's cold a lot of the time.*
- *Beautiful building. The open plan office can be an issue.*
- *I love it. I helped design process with HT.*
- *Sometimes it is difficult to move large set pieces around. Rehearsal room is difficult to access. The green room is far from stage.*
- *The ceiling is low.*
- *The auditorium is very satisfactory but I find FOH is not so welcoming.'*

All the qualitative survey comments/responses and the detailed quantitative BUS staff survey analysis are included in Appendix 1 of this report.





7. Building User Survey (BUS) - public users

Methodology

The transient (public) users survey was carried out during the interval of an evening performance held in the auditorium at The Everyman Theatre in January 2020.

Public survey - Some of the comments regarding building design overall:

- *It would be good to have bigger stage and smaller bar.*
- *not enough women's toilets*
- *the bar also shut by the time I got served*
- *It's an amazing building and Liverpool city council needs to support the arts with more money!!*
- *Great.*
- *Very happy.*
- *Good, but could do with more toilets.*
- *My son comes every month to the café to play board games.*
- *It's good. I like it.*
- *I love the building.*
- *The building has a really good feel/vibe/energy about it.*
- *Love it!*

Strengths and opportunities for improvement:

-numerous perceived strengths of the project, from building design overall, image to visitors, overall comfort and thermal comfort, comfortable seating, view of stage and sound during performance.

-opportunities for improvement: lighting in toilets, leg room, signage.

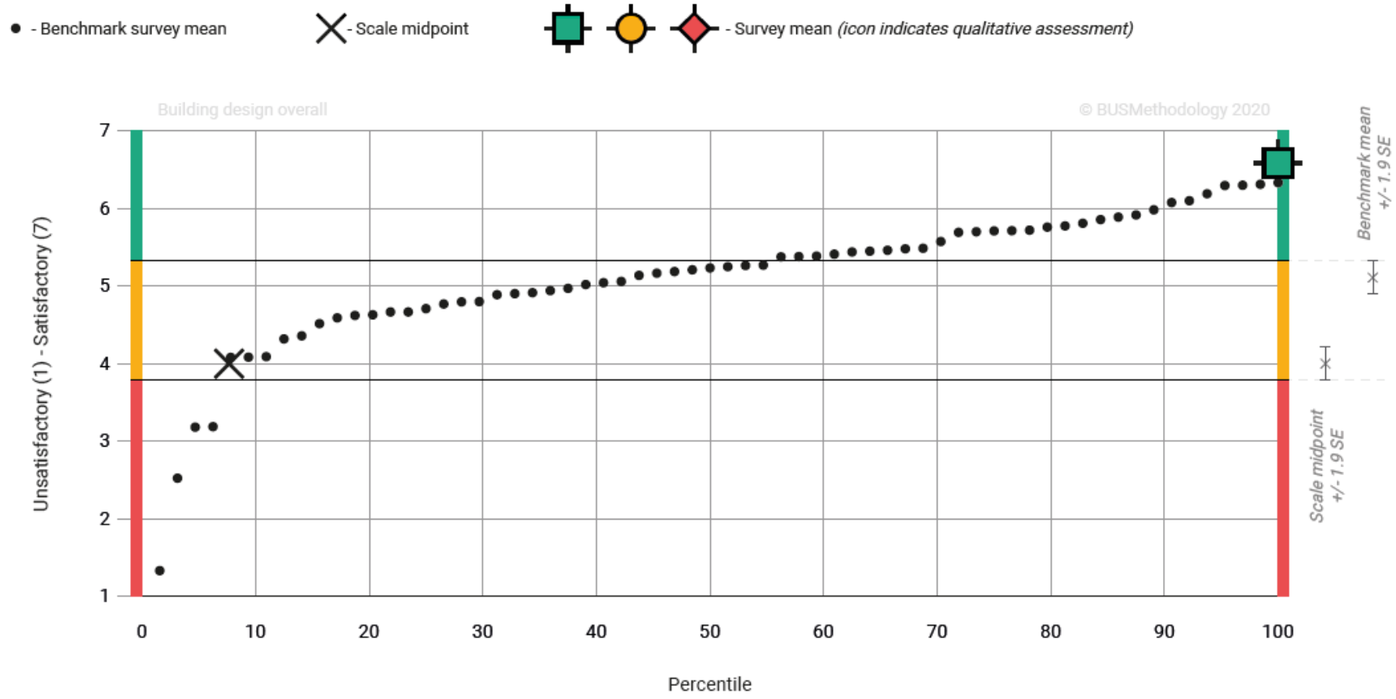


Figure 1.2: *Question mean response relative to the benchmark set*

	Mean	Percentile	SE	Mean - 1.9SE	Mean + 1.9SE
Question mean response	6.59	100.00	-	-	-
Benchmark mean	5.11	43.17	0.11	4.90	5.32
Scale midpoint	4.00	7.67	-	3.79	4.21

Everyman Theatre - BUS public survey - appraisal of the building design overall - showing an excellent appraisal of the building by the audience.

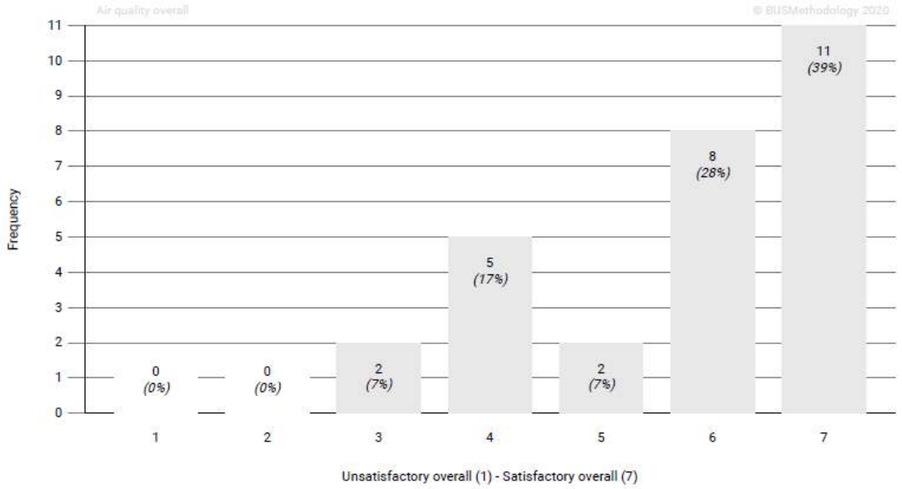
The Everyman scored 6.59 out of 7 for *Building design overall* in the public BUS survey, in the 100th percentile compared to the other buildings in the benchmark. All the quantitative responses and qualitative comments to the staff and public users BUS surveys are included at the end of this report.

7. Building User Survey (BUS) - public users

Conditions

Air quality overall

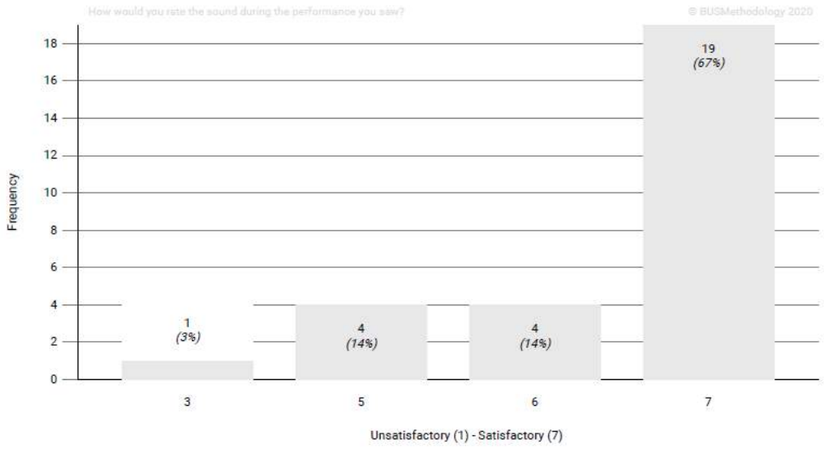
*Scale: **1: Unsatisfactory overall - 7: Satisfactory overall***
*Mean response: **5.75***
Answers from 28 of 29 respondants



Custom Questions

How would you rate the sound during the performance you saw?

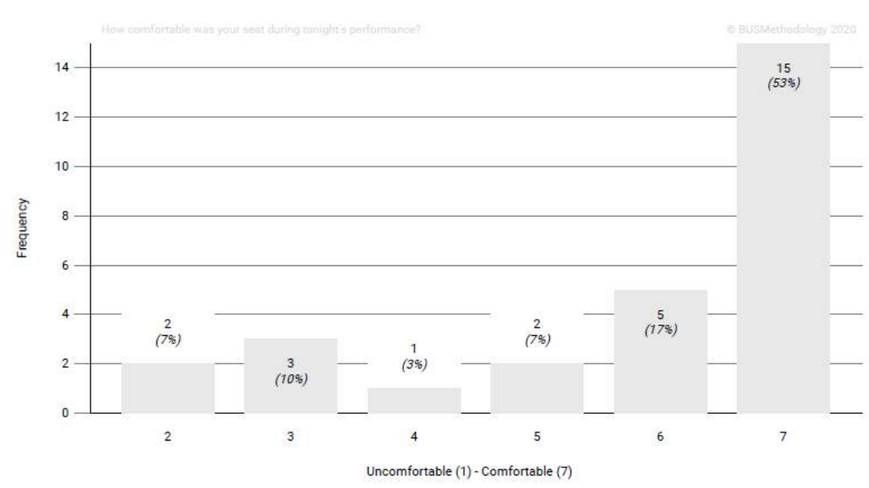
*Mean response: **6.43***
Answers from 28 of 29 respondants



Custom Questions

How comfortable was your seat during tonight's performance?

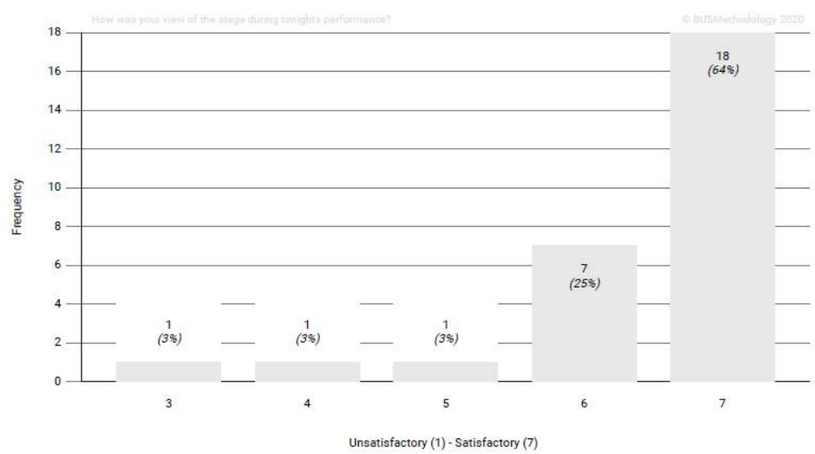
*Mean response: **5.79***
Answers from 28 of 29 respondants



Custom Questions

How was your view of the stage during tonights performance?

*Mean response: **6.4***
Answers from 28 of 29 respondant



Several bespoke questions were added to the standard Arup transient user survey, to capture the user experience in a performance space: sound and visibility of stage during the performance, seat comfort, etc.

7. Building User Survey (BUS) – public users

FINDINGS - strengths and opportunities for improvement - PUBLIC USERS SURVEY		
STRENGTHS	NEUTRAL/GOOD	OPPORTUNITIES FOR IMPROVEMENT
Building design overall	Temperature in winter	Lighting in the toilets (a bit dark)
Effect of building on perceived health		‘Slight problem with leg room.’
Lighting overall		‘Not enough women’s toilets’
Needs being met by facilities		‘The lack of knee room is an issue. I have had a knee replacement that reduces the amount of bend, that’s why I choose the front row of circle as it has netting and gives more room.’
Noise overall		‘The signage is poor, it doesn’t match tickets’
Overall comfort within the building environment		
Thermal comfort in winter		
Image to visitors		
Air quality overall		
Comfortable seat during performance		
View of the stage (62% in stalls, 38% in circle)		
Sound during the performance		

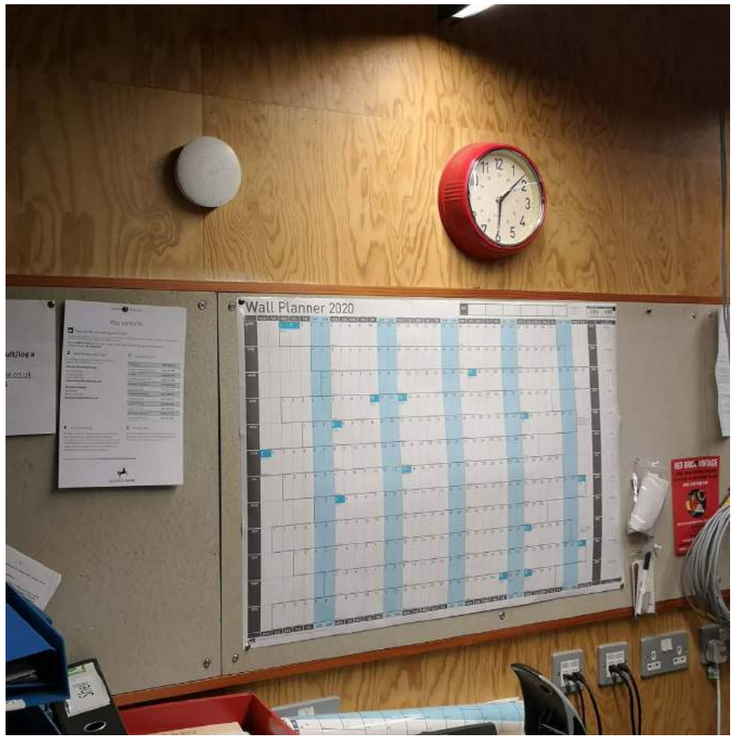
C. Post-occupancy evaluation study
8. Indoor environmental conditions (monitored data)

Methodology

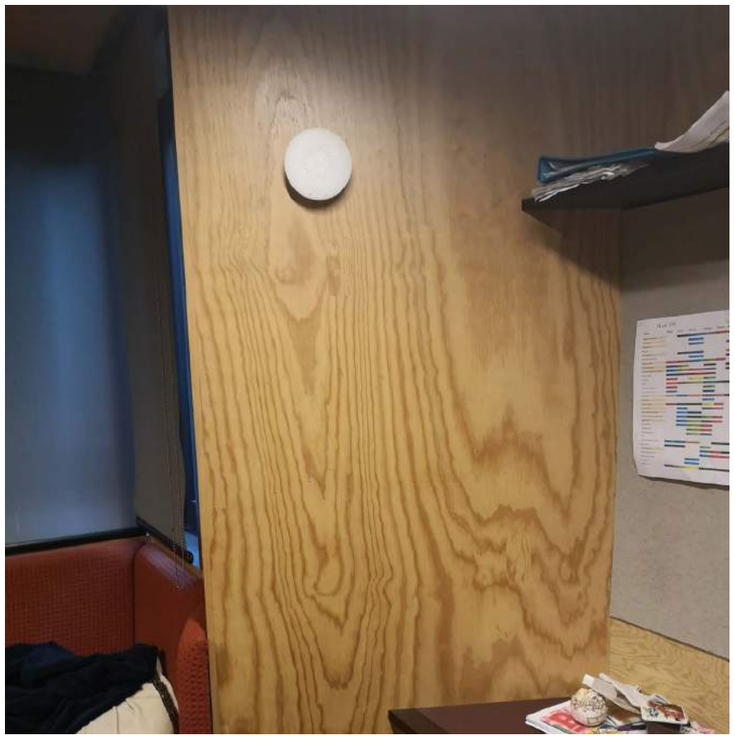
Several *Airthings Plus* sensors were installed during the site visit in January 2020, to record environmental conditions in key spaces in the building. The data was recorded between January and March 2020 (when the theatre closed due to the lockdown).

The sensors logged temperature, CO2 levels, relative humidity, VOC levels, air pressure and Radon levels.

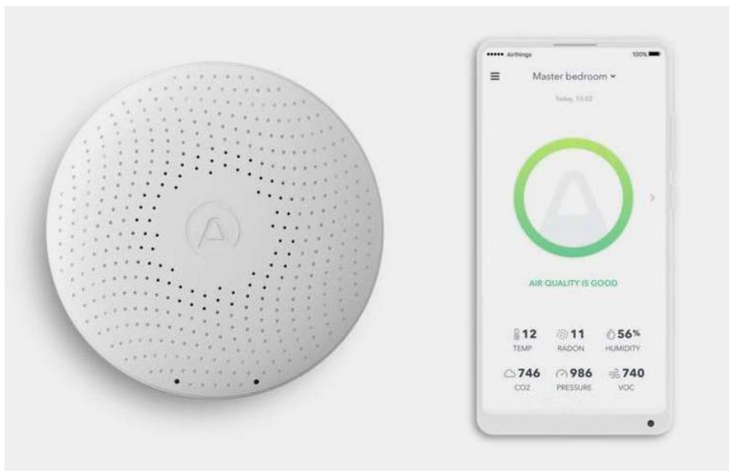
They were placed in the auditorium, the theatre bar on the first floor, one of the dressing rooms, and the finance office.



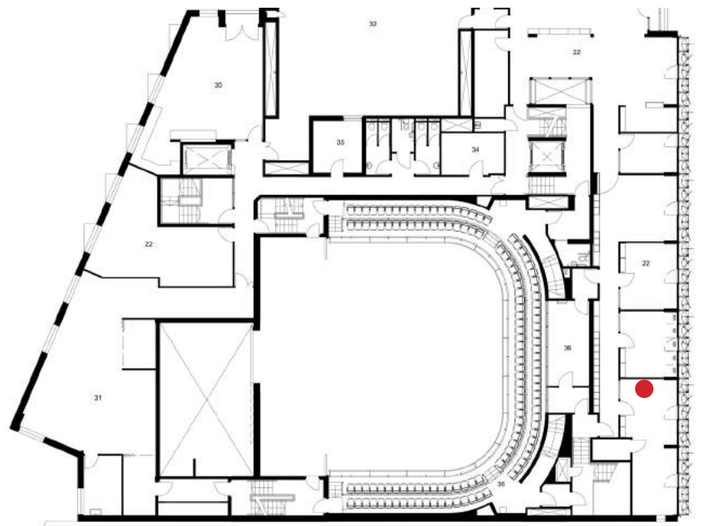
Environmental sensor installed in the finance office

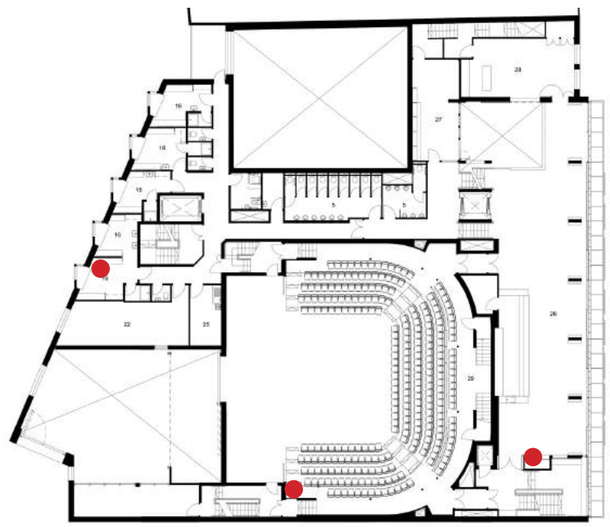


Environmental sensor installed in a dressing room



Environmental sensors (Airthings Plus) installed in Jan 2020





● Locations of environmental sensors installed in Jan 2020: auditorium, office, dressing room and theatre bar

8. Indoor environmental conditions

Auditorium

The data logged by the environmental sensors in the naturally ventilated auditorium between January and March 2020 (when the theatre closed due to the lockdown) shows the parameters are within the normal levels (green lines), with some occasional spikes (in orange), but not above the admissible limits (which would show in red).

Auditorium : Environmental data - January - March 2020

8. Indoor environmental conditions

Auditorium

Subsequent analysis focused on the last performance held on 14th March.

The CO2 levels are well below 1000ppm, (reaching around 850ppm during the performance on Saturday evening), while the humidity and temperature levels are within the recommended ranges.

Auditorium: Environmental data - performance on 14th March 2020

8. Indoor environmental conditions

Dressing room

The analysis of data recorded between January and March 2020 shows that the temperature, relative humidity and CO2 levels are within recommended values, however the VOC levels seem to go a bit higher when the dressing rooms are occupied (spikes in VOC levels match the CO2 activity).

This might be related to materials/garments/props being used in the dressing room at particular times while preparing for a performance.

Dressing room: Environmental data - January - March 2020

Dressing room: Environmental data - performance on 14th March 2020

8. Indoor environmental conditions

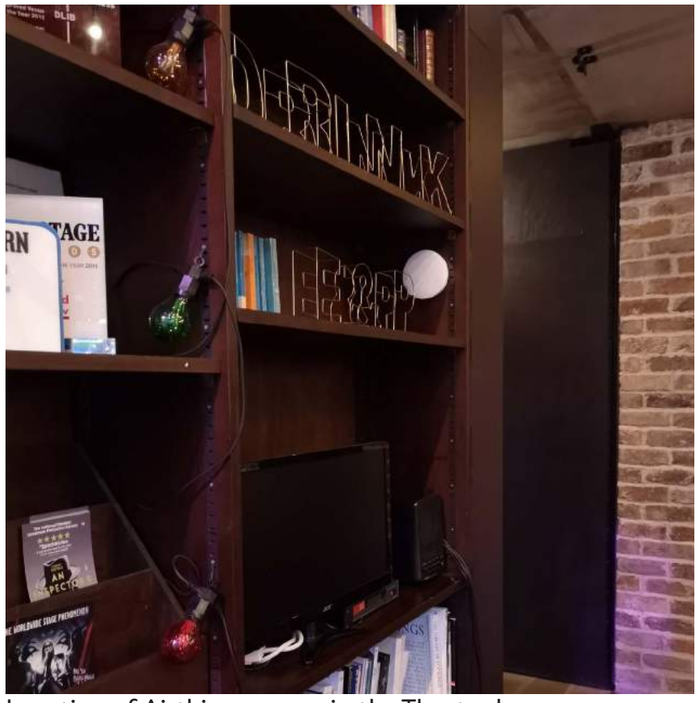
Theatre bar

The analysis shows that on a monthly basis there are a few CO2 and VOCs spikes during January - mid March (see chart to the top right).

However a close-up look (chart bottom right) reveals that the CO2 spikes are well below the 1000ppm mark during midday and only occasionally reach 1000ppm (very likely the interval of the evening performance).

The temperature and relative humidity are within recommended levels throughout the period analysed.

Theatre bar first floor: Environmental data - January - March 2020



Location of Airthings sensor in the Theatre bar

Theatre bar first floor: Environmental data - performance on 14th March 2020

8. Indoor environmental conditions

Finance office

The monthly data showed that there are regular increases in the CO2 concentration in the office, so a closer look was required.
The chart to the right looks at a typical week. It is easy to see the daily midday spikes in CO2 concentration which then are purged until next day. Similarly, the changes in relative humidity (RH) match the increased occupancy. On Thursdays and Fridays there are fewer people in the office, reflected also in lower RH and CO2 levels.

A close-up look at a typical day (Tuesday 10th March), bottom right shows in more detail that the CO2 levels rise above 1000ppm at midday, however the peak is still under the max.1500ppm limit recommended by CIBSE Guide A. The midday CO2 concentration is probably contained by opening the windows to allow the two CO2 peaks (indicated with black dotted lines on the chart) to purge (these match the two slight drops in internal temperature and relative humidity due to increased ventilation).

The office is quite small with high occupancy. The winter and the mid-season are particularly difficult for using natural ventilation alone in offices, since external temperatures prevent occupants from using the windows more regularly, as they wish to avoid cold draughts. A mixed mode approach (natural ventilation and heat recovery fan) might be a better solution for high occupancy spaces.

Finance office: Environmental data in a typical week

Finance office: Environmental data on a typical day

8. Indoor environmental conditions

KEY FINDINGS

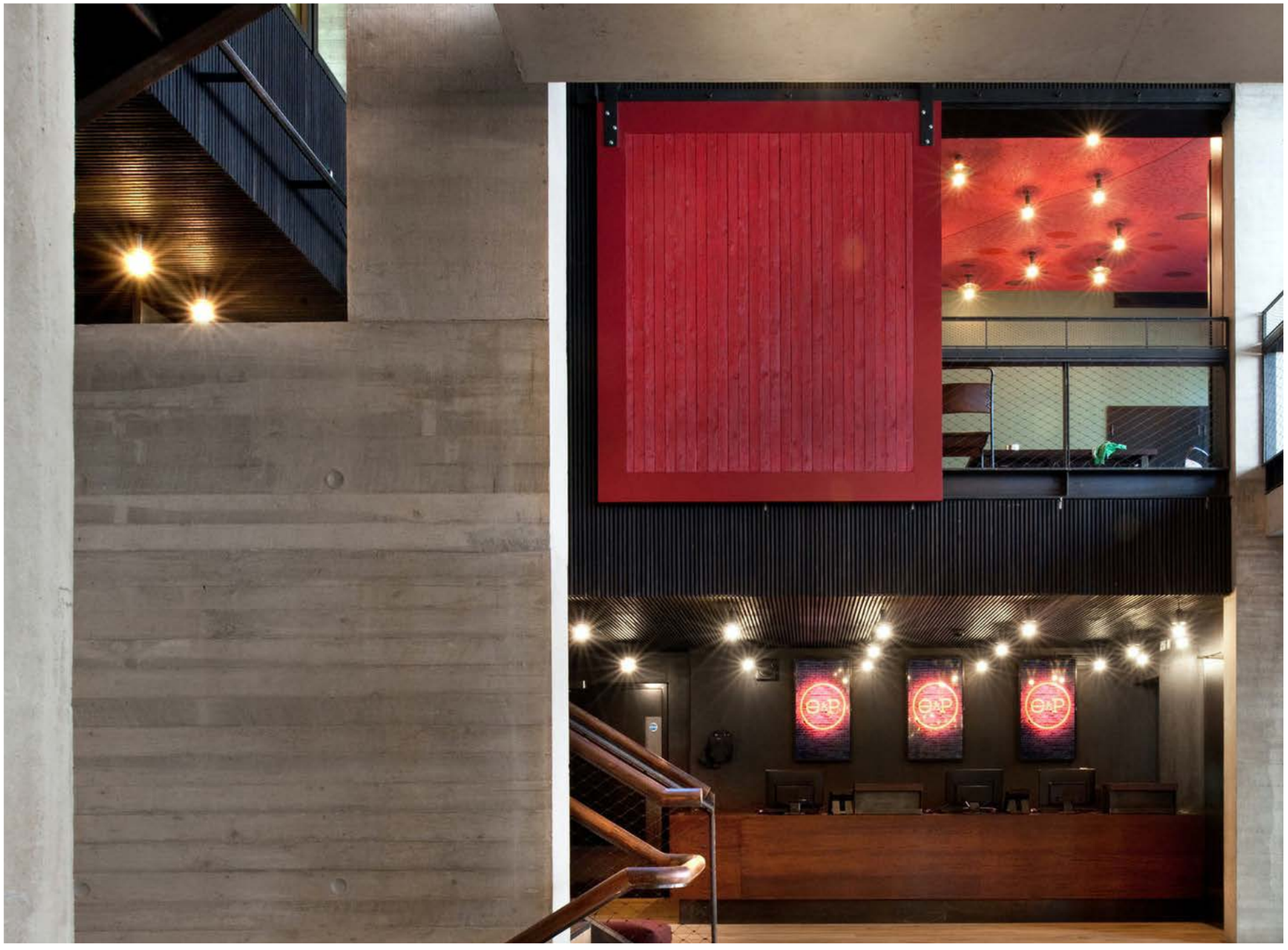
Most spaces perform really well in terms of thermal performance and Indoor Air Quality (IAQ), the only spaces to investigate further would be the naturally ventilated offices.

The feedback from the BUS survey is supported by the findings of the monitoring data recorded in one of the offices.

Recommendations for future projects:

- discuss expected occupancy levels with the client, ventilation provisions in offices for both current and future use, and possibility of increasing ventilation rates for slightly higher occupancy should that occur. Due to type of occupancy and use it is recommended that offices benefit from natural, and some form of mechanical, ventilation if appropriate

- to note that in the cold season and mid-season it is difficult to rely on opening windows in offices due to cold draughts, therefore in these times of the year localised heat recovery fans triggered by CO2 levels can be a solution if the occupancy becomes higher than assumed at design stage




theatre

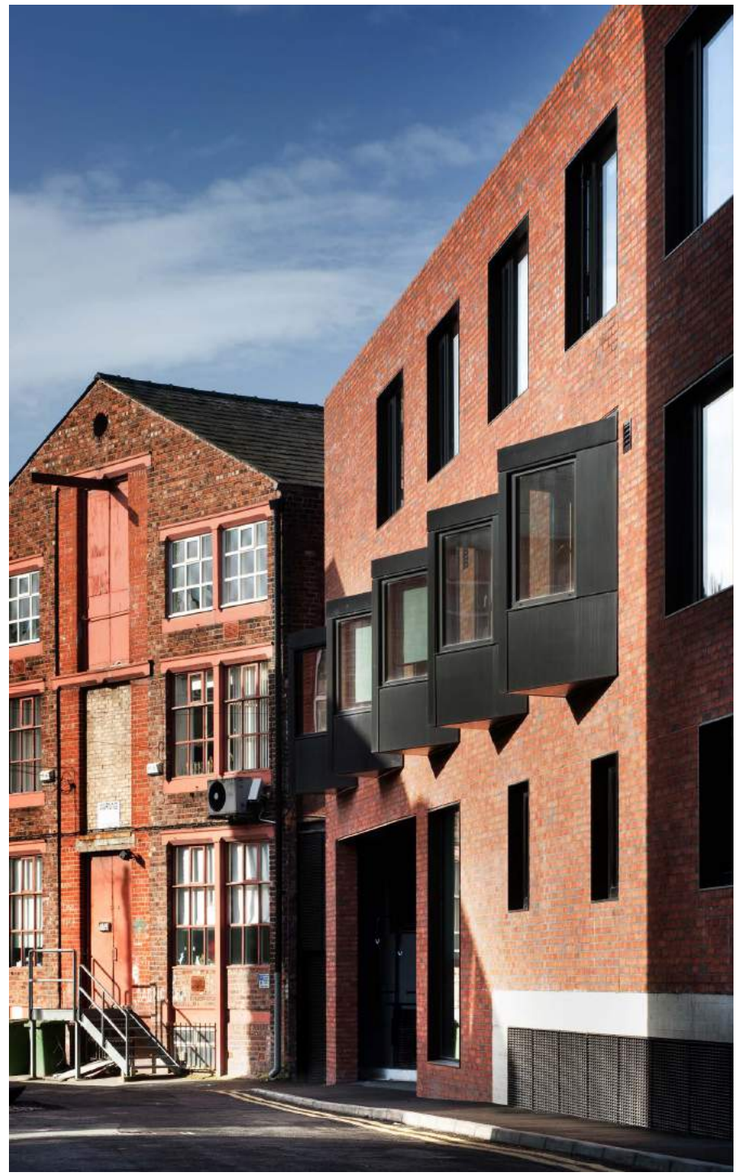
D. Summary of Key Findings

Site visit: use of space and materials

- Internal layout: more office space needed (however, the constraints of the site were recognised from the beginning of the project)
- Wayfinding: changes were made and more signs added for toilets and seat numbering
- Materials: some materials wore down, especially flooring, tending to get slightly darker; lift materials damaged easily
- Platform lift in FOH: operation problematic (only used with a member of staff)
- The cloakroom was not used. The theatre considering a pull-out cloakroom instead

Energy use

- Average energy use (including CHP generation) between 2014 - 2018: 215 kWh/m2.year.
  This compares favourably with performance space benchmarks based on recent data, such as Julie's Bicycle (240kWh/m2.yr – 2015 average), similar to the CIBSE beta benchmarking l based on DEC information (2008 -2012 data), and better than the BEES Building Efficiency Survey of 2015 for performance spaces.
- The whole life carbon analysis run by Liverpool University with the theatre revealed that the embodied carbon and operational use over 60 years are comparable in CO2e emissions and equally important (the operational energy slightly higher). Everyman Theatre are working with the University to plan a roadmap to net zero carbon, helped by the fact that the theatre electricity is currently 100% supplied from off-site renewable sources.
- Water use of 413l/m2.yr, better than the performance space benchmark of 2015 by Julie's Bicycle (at 645l/m2.yr).



D. Summary of Key Findings

Interviews
Perceived Strengths:

- Design extremely successful in achieving the project goals of: audience comfort, sustainable building and accessible theatre
- Assisted natural ventilation in auditorium is extremely good, the system does what it's meant to do
- What would have done differently: oppose planners on the building envelope (height) for fly tower height
- Access - very good
- Dressing rooms: good size, have enough counter space, complimented on finishes
- Lighting: accessible and straightforward to use
- Auditorium: good environmental conditions
- Different configurations of seating layout used

Perceived Opportunities for Learning and Improvement:

- Lack of crew room space (only lockers)
- Grab posts added to auditorium
- Removable proscenium panels - plywood - not wearing well, difficult to pull out
- Seating: in the round seating doesn't quite work, mechanism of seat swing mechanism required
- re-working, the method of moving the rostra is difficult, custom dollies were made for seats
- Stage decks movement and height - difficult to assess risk, significant process and costly

D. Summary of Key Findings

Building Services

- Boiler: issues with leaking seals
- CHP: out of service for past two years, issues with water quality, lack of support from non-UK manufacturer
- Rainwater harvesting system: out of use for a year, recurring issues with pumps and water flow
- ASHP: generally working well; newer heat pumps would work better (the technology has improved since the completion of the building)
- Acoustics: working fine
- Natural ventilation strategy in auditorium: excellent
- Some issues with mechanical ventilation system serving both FOH, meeting rooms and open plan office, as different demands at different times

Building User Survey - staff and public
Staff:

- Numerous perceived strengths of the project, from building design overall, image to visitors, thermal comfort in winter and overall in summer, lack of glare, etc
- Perceived opportunities for improvement: humidity, temperature and ventilation in the summer (office spaces), personal controls over cooling/heating, amount of artificial light and of natural light. Accessibility: comments regarding wheelchair access in the FOH office area

Public:

- Numerous perceived strengths of the project, from building design overall, image to visitors, overall comfort and thermal comfort, comfortable seating, view of stage and sound during performance
- Number of toilets, comments regarding leg room

Indoor Environmental Conditions (monitored)

- Of the key spaces that were analysed, very good performance in the auditorium, dressing room, theatre bar
- The monitored office (finance office) has a large number of occupants relative to the size of the room, and here the CO2 levels spike daily to around 1000ppm and occasionally up to the 1500ppm limit during midday, however this is purged towards the end of the day. Using the natural ventilation alone will be difficult in winter and mid-season periods; a solution is to use CO2 heat recovery fan back-up in spaces that may have higher occupancy at a later stage when the building is in use

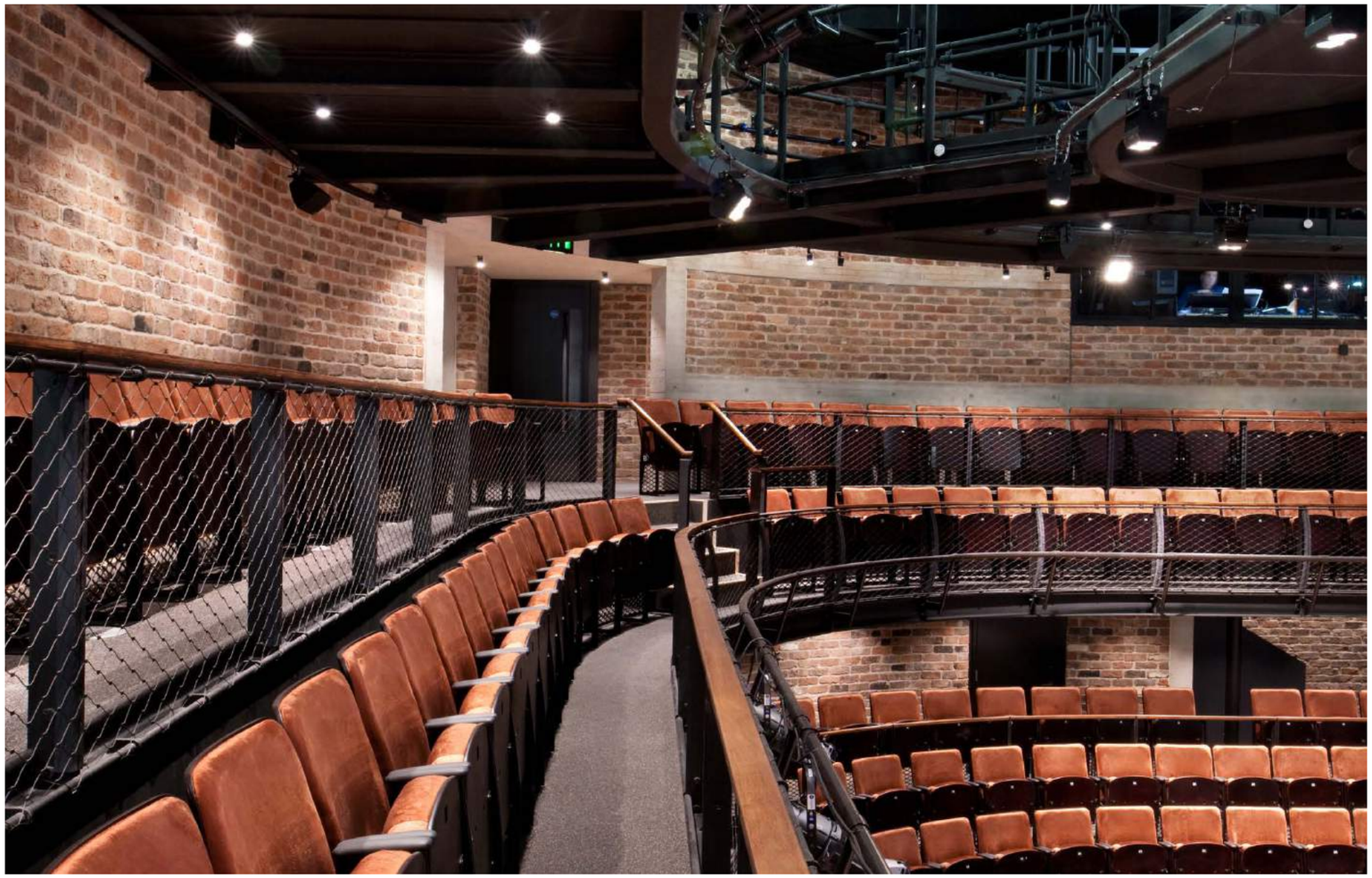
E. Conclusion

Meaningful feedback in response to design work is recognised by architects, clients and consultants as an important source of information.

As founding members of the Architects Declare movement, Haworth Tompkins are committed to evaluating their design processes, seeking to produce the best possible solutions that are environmentally, economically and socially aware, as well as suited for the client, site, and function of the project.

The aim of this light-touch Post-Occupancy Evaluation study was to build on the previous analysis carried out by the building services engineers, to provide a more comprehensive feedback. This included a site visit (with details on materials, internal layout, theatre specific spaces, seating, etc), monitoring of indoor environmental conditions, interviews with members of the client's team, and carrying out Building User Surveys for both the permanent theatre staff and the public.

The study findings show that the building has been very popular with staff as well as the public and most comments and feedback focused on space allocation for staff, toilets for the public, user control in high occupancy spaces, the durability of several finishes, and recurring maintenance issues related to some of the services.



The HT team are using the findings of this analysis to guide their designs of other similar performance spaces, inform the choice of materials, the layout of key spaces and discuss the maintenance of complex building services.

The report has become part of internal lessons learnt presentations to the entire office and the POE process has been shared with the wider public via presentations at the *AJ Summit 2021* and as a case study included in the *RIBA Plan for Use Guide 2021.*

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+44 (0) 20 7250 3225, info@haworthtompkins.com

Appendix 1

References

Post Occupancy Evaluation and Building Performance Evaluation - RIBA Primer https://www.architecture.com/knowledge-and-resources/resources-landing-page/post-occupancy-evaluation

Energy, People, Buildings: Making Sustainable Architecture Work - Judit Kimpian, Hattie Hartman, Sofie Pelsmaker http://www.energypeoplebuildings.com/

Housing Fit for Purpose: Performance, Feedback and Learning - book by Fionn Stevenson

RIBA Plan for Use Guide https://www.architecture.com/knowledge-and-resources/resources-landing-page/plan-for-use-guide

Building Performance Network UK - an NGO dedicated to BPE in-use - contains many case studies and extensive guidance https://building-performance.network/

Mayor of London ‘Be seen’ energy monitoring guidance, pre consultation draft: https://www.london.gov.uk/sites/default/files/gla_be_ seen_guidance_april_2020.pdf

Building Knowledge: Pathways to Post Occupancy Evaluation: https://www.architecture.com/-/media/gathercontent/post-occupancy-evaluation/additional-documents/buildingknowledgepathwaystopoepdf.pdf

Report: Measuring the Impact of your Design - Creating +Positive spaces by Measuring the Impact of your Design via Pre- and Post-Occupancy Evaluation (POE) Publication date: September 2019 https://info.interface.com/whitepapers-en_GB?systemAlert=Impact_Design

Soft Landings Framework - Bill Bordass https://www.bsria.com/uk/consultancy/project-improvement/soft-landings/

Whole life carbon study - Everyman Theatre Dr Stephen Finnegan (University of Liverpool) and Mark Da Vanzo (Chief Executive of the Everyman and Playhouse Theatre) - https://sway.office.com/GbDofbu8wQFn6BvW?ref=Link&loc=play

Appendix 2

Display Energy Certificate (DEC)

Energy Performance Certificate
Non-Domestic Building

HM Government

EVERYMAN THEATRE
Liverpool & Merseyside Theatres Trust Ltd
13 Hope Street
LIVERPOOL
L1 9BH

Certificate Reference Number:
0090-1966-0374-4121-8090

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Asset Rating

More energy efficient

A+ ..... Net zero CO_2 emissions

A 0-25
B 26-50
C 51-75
D 76-100
E 101-125
F 126-150
G Over 150

31 This is how energy efficient the building is.

Less energy efficient

Technical Information

Main heating fuel:	Natural Gas
Building environment:	Heating and Mechanical Ventilation
Total useful floor area (m^2):	4073
Building complexity (NOS level):	5
Building emission rate ($kgCO_2/m^2$):	49.56

Benchmarks

Buildings similar to this one could have ratings as follows:

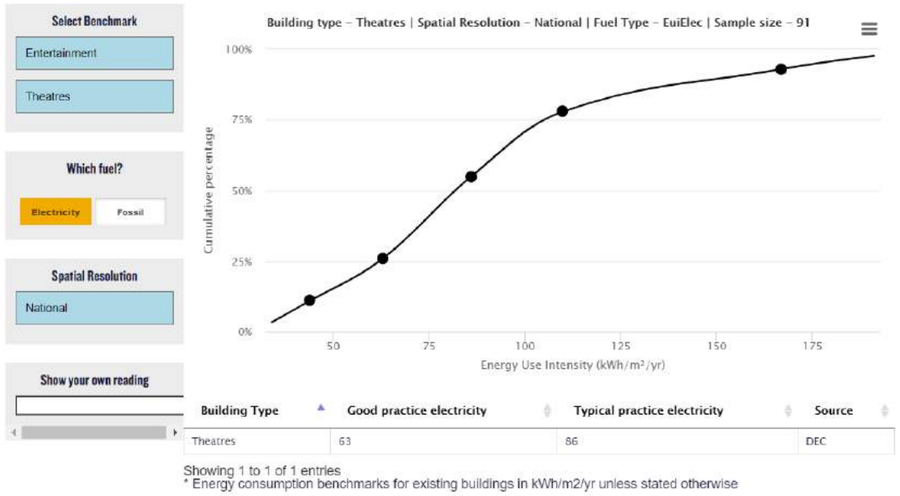
34 If newly built
90 If typical of the existing stock

Green Deal Information

The Green Deal will be available from later this year. To find out more about how the Green Deal can make your property cheaper to run, please call 0300 123 1234.

CIBSE benchmarking Tool - theatres - electricity and gas

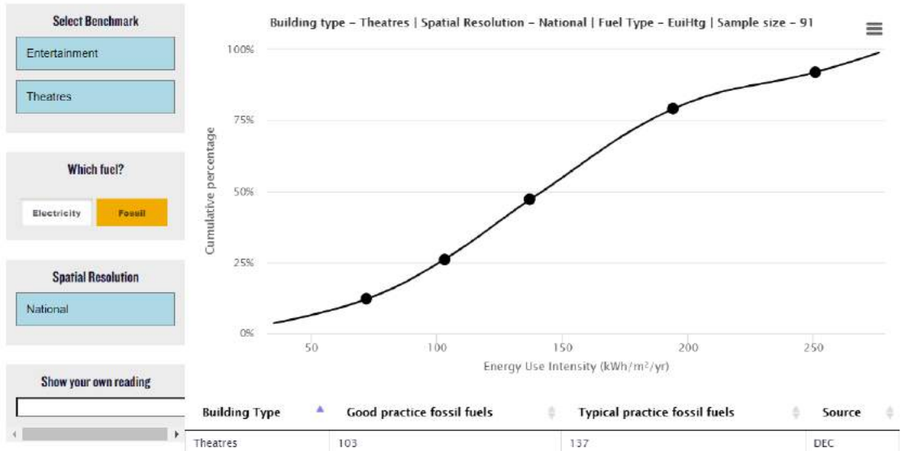
ENERGY BENCHMARKING TOOL DASHBOARD



Building Type	Good practice electricity	Typical practice electricity	Source
Theatres	63	86	DEC

Showing 1 to 1 of 1 entries
* Energy consumption benchmarks for existing buildings in kWh/m2/yr unless stated otherwise

ENERGY BENCHMARKING TOOL DASHBOARD

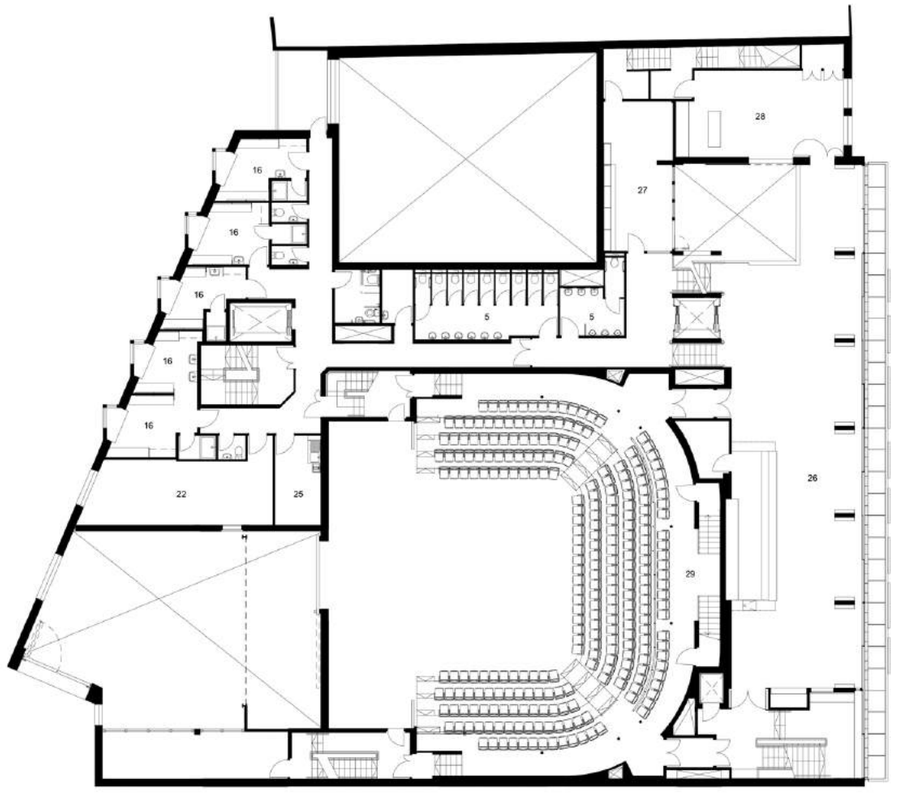


Building Type	Good practice fossil fuels	Typical practice fossil fuels	Source
Theatres	103	137	DEC

Showing 1 to 1 of 1 entries
* Energy consumption benchmarks for existing buildings in kWh/m2/yr unless stated otherwise

Appendix 3

DRAWINGS



N

0 5 10m

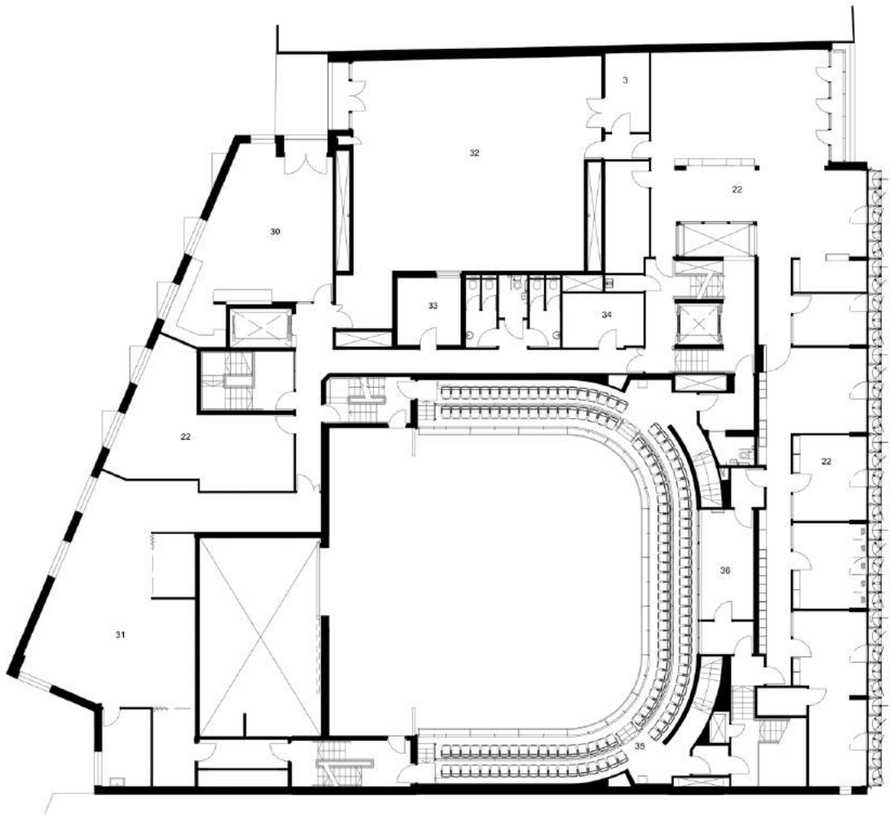
G+1 PLAN
EVERYMAN THEATRE, LIVERPOOL

ANNOTATION KEY

1 ELECTRICAL INTAKE ROOM
2 RAINWATER TANK ROOM
3 STORE
4 CLOAKROOM
5 W.C.
6 BISTRO
7 KITCHEN
8 CELLAR
9 SUB-STAGE
10 STAFF CHANGING
11 REFUSE STORE
12 Y & C CHANGING
13 STAGE DOOR
14 ACTORS' QUIET ROOM
15 STAGE MANAGEMENT
16 DRESSING ROOM
17 STAGE KITCHEN
18 WORKSHOP
19 STAGE
20 YOUTH AND COMMUNITY (Y&C) STUDIO
21 CAFE
22 OFFICE
23 BOX OFFICE
24 GET-ROUND CORRIDOR
25 LAUNDRY
26 BAR
27 WRITERS' ROOM
28 FUNCTION ROOM
29 AUDITORIUM STALLS
30 GREEN ROOM
31 WARDROBE
32 REHEARSAL ROOM
33 SOUND RECORDING ROOM
34 SERVER ROOM
35 AUDITORIUM CIRCLE
36 CONTROL ROOM
37 TECHNICAL GALLERY
38 MEETING ROOM
39 DIMMERS & AMPS
40 PLANT
41 LIGHTING WORKSHOP
42 TECHNICAL GRID
43 EXTRACT PLENUM
44 FLYTOWER
45 AIR SUPPLY PLENUM

Appendix 3

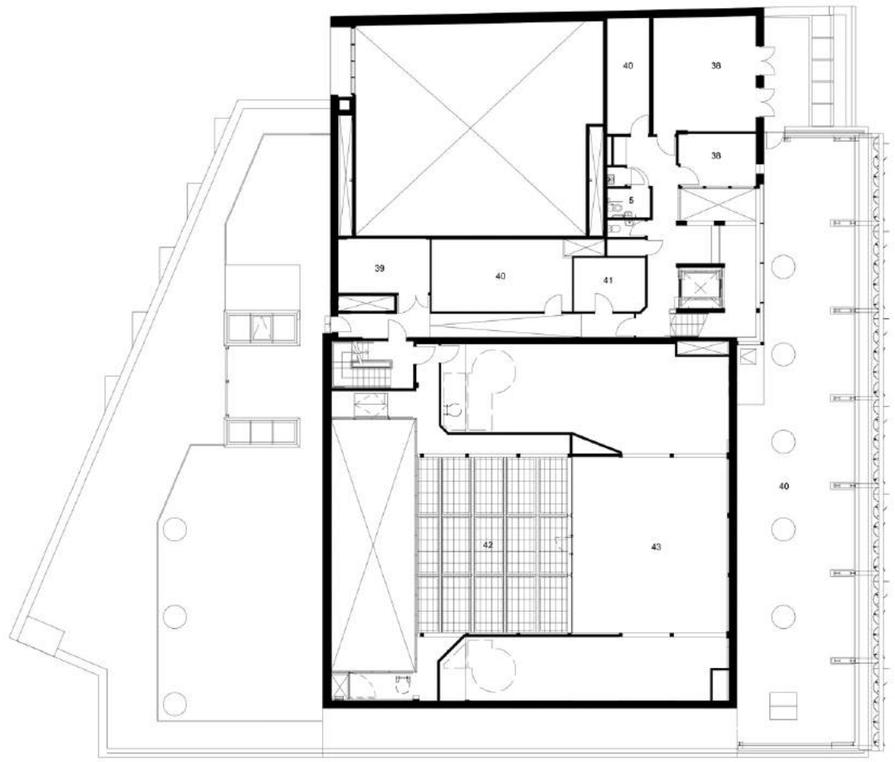
DRAWINGS



N

0 5 10m

G+2 PLAN
EVERYMAN THEATRE, LIVERPOOL



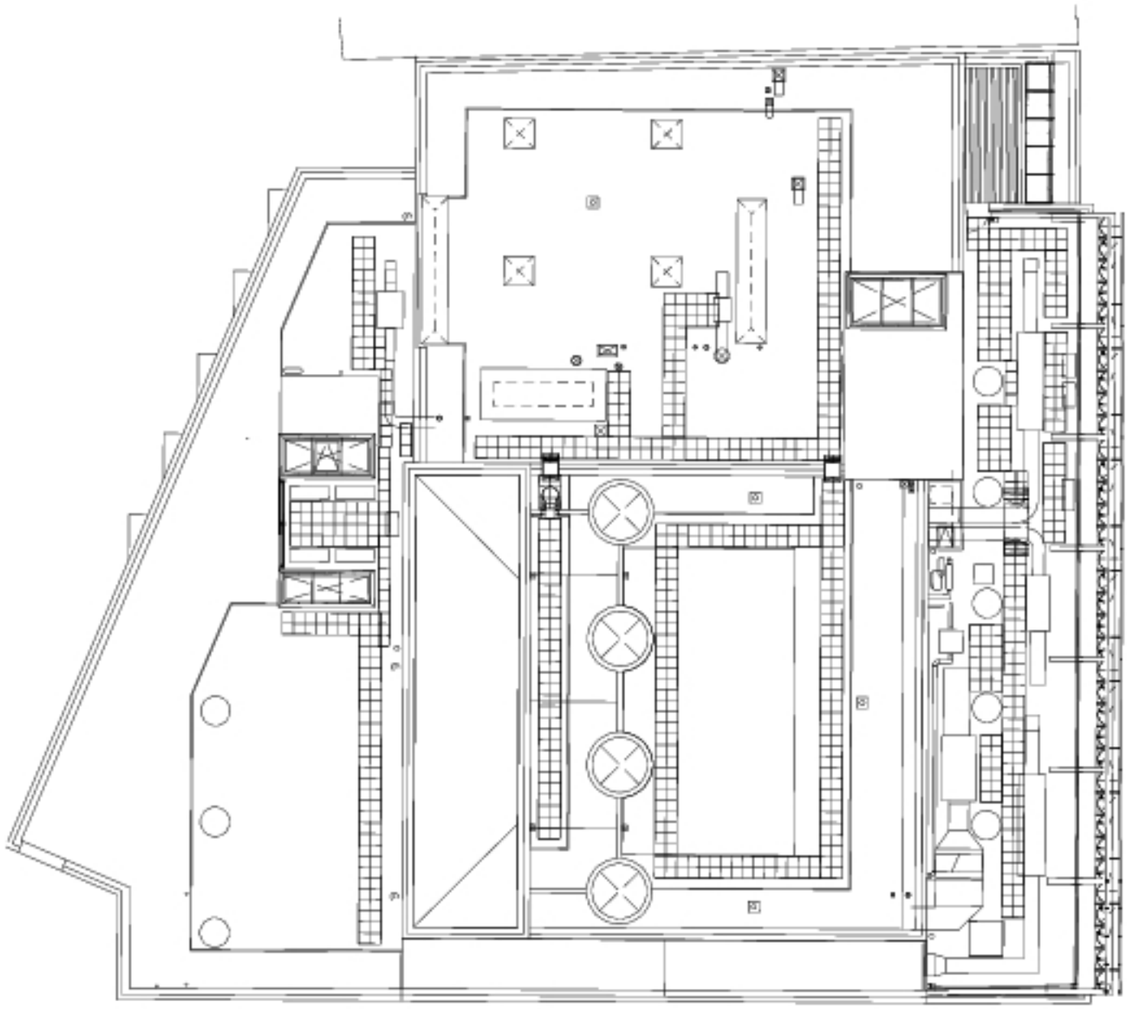
N

0 5 10m

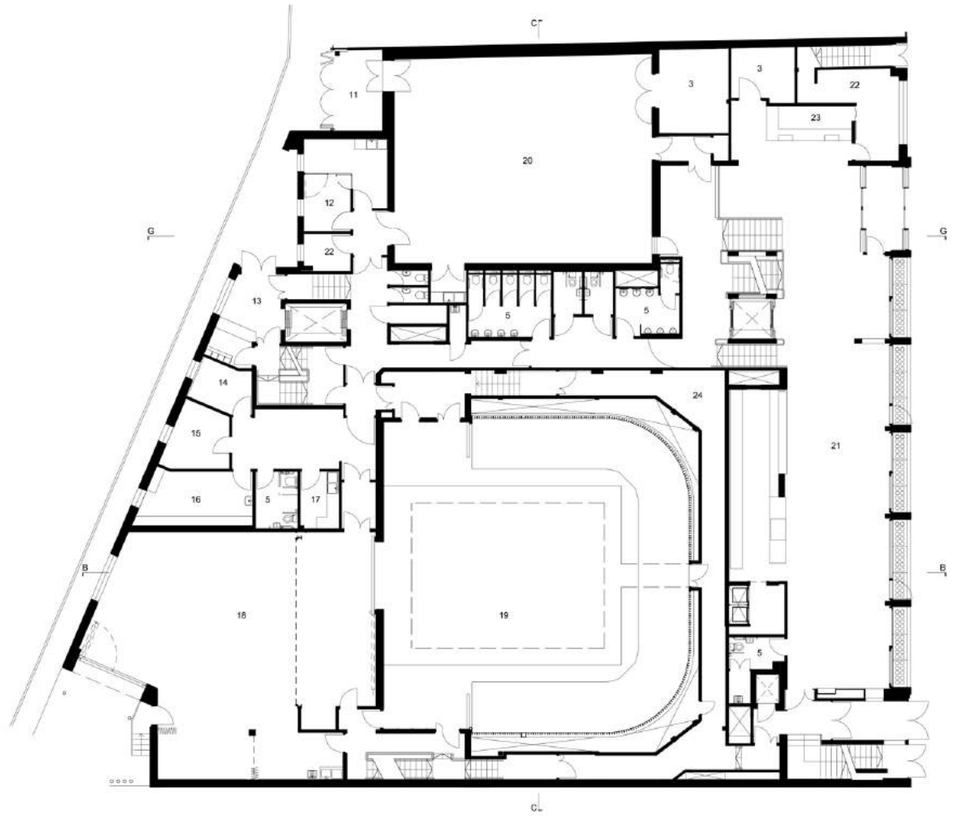
G+3 PLAN
EVERYMAN THEATRE, LIVERPOOL

Appendix 3

DRAWINGS



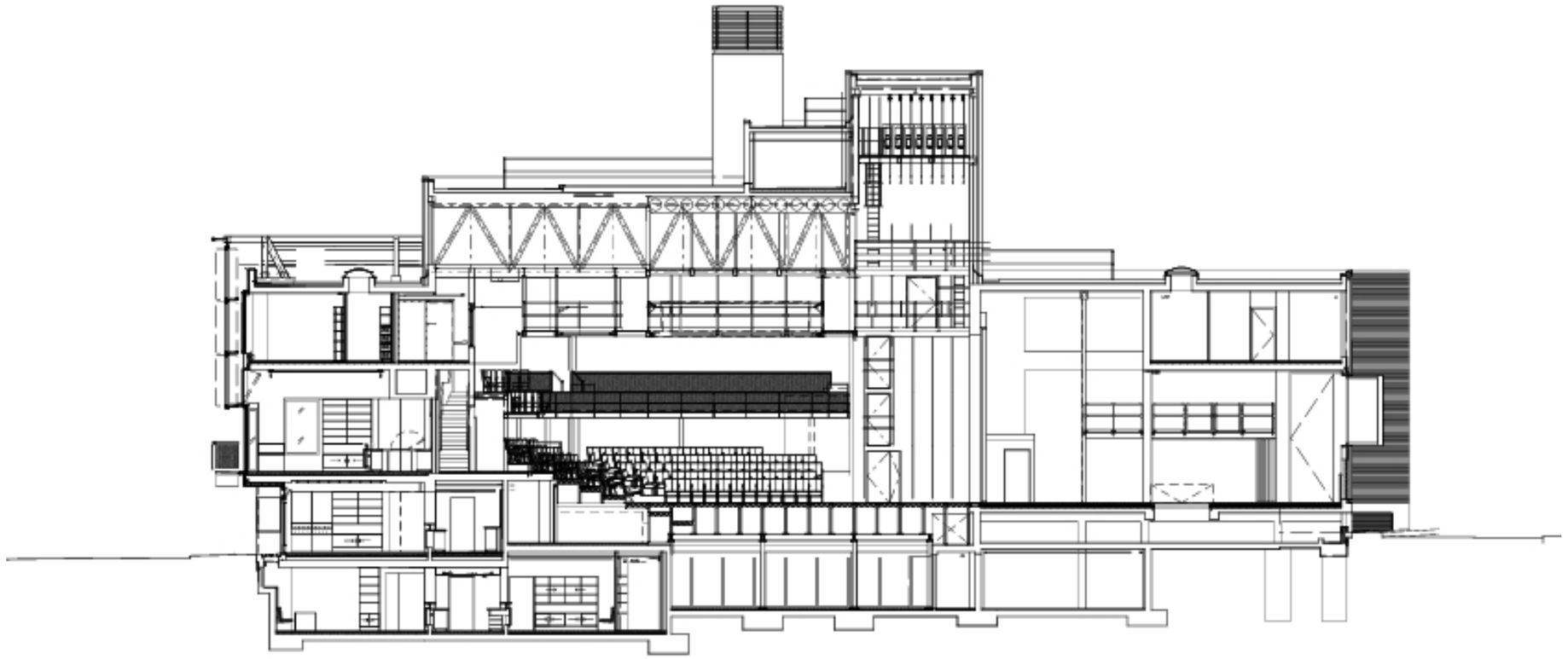
ROOF LEVEL
EVERYMAN THEATRE, LIVERPOOL



G+0 PLAN
EVERYMAN THEATRE, LIVERPOOL

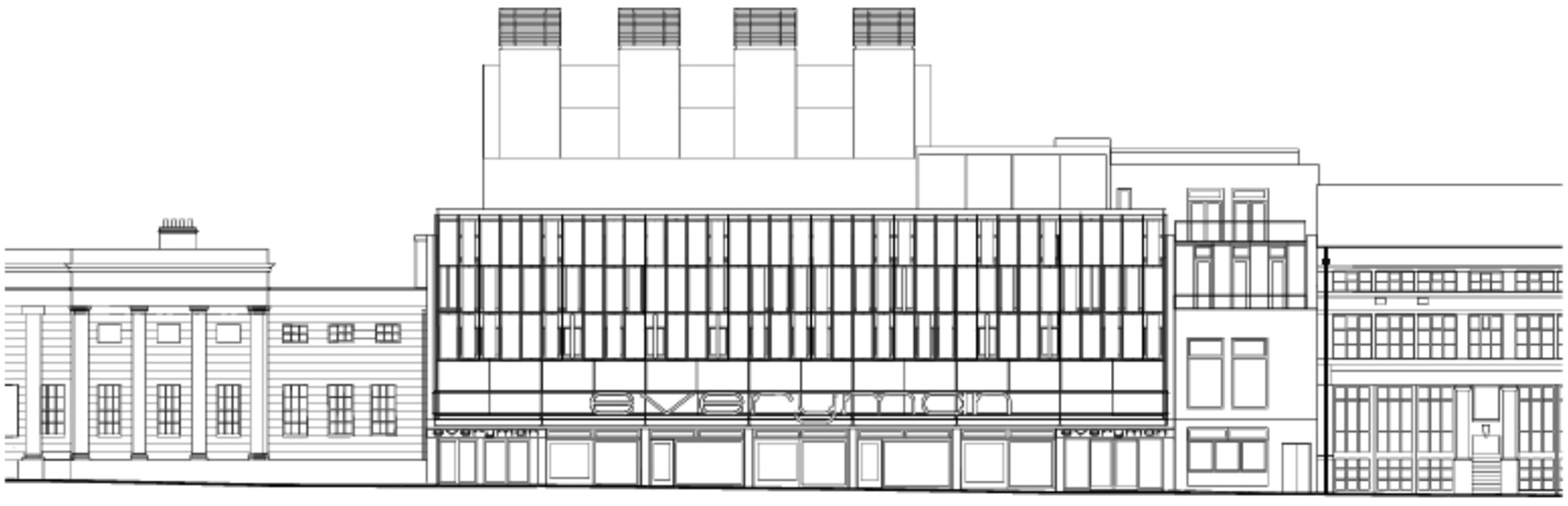
Appendix 3

DRAWINGS



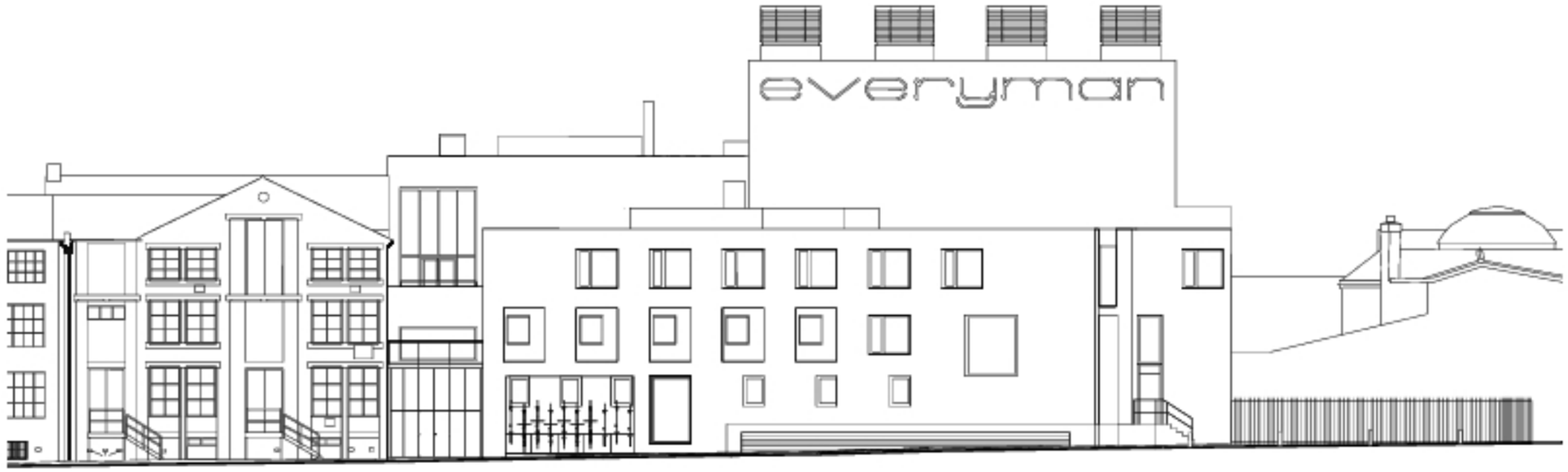
Appendix 3

DRAWINGS



Appendix 3

DRAWINGS



Appendix 4

Project Team

Design Team Credits

Architect:	Haworth Tompkins
Interiors and Furniture Design:	Haworth Tompkins with Katy Marks at citizens design bureau
Client:	Liverpool and Merseyside Theatres Trust
Contractor:	Gilbert-Ash
Project Manager:	GVA Acuity
Quantity Surveyor:	Gardiner & Theobald
Theatre Consultant:	Charcoalblue
Structural Engineer:	Alan Baxter & Associates
Service Engineer:	Watermans Building Services
CDM Coordinator:	Turner and Townsend
Acoustic Engineer:	Gillieron Scott Acoustic Design
Catering Consultant:	Keith Winton Design
Access Consultant:	Earnscliffe Davies Associates
Collaborating Artist:	Antoni Malinowski
Typographer:	Jake Tilson
Portrait Photographer:	Dan Kenyon

Detailed Design Team

Architect: Haworth Tompkins
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Toby Johnson
Roger Watts
Will Mesher
Katy Marks
Patrick Quinn
Marc Tuitt

Email: info@haworthtompkins.com

Interiors and Furniture Design:
Haworth Tompkins with Katy Marks at citizens design bureau

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Andrew Thearle
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Appendix 5

Building User Surveys (BUS)

Detailed BUS results were shared with the client and design team.

Excerpts from the analysis have been included in the main body of the report.

All data has been anonymised and was analysed by ARUP using their BUS methodology.