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Post-Occupation Evaluation Study Report

Research Acceleration and Demonstration Building

December 2022

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INTRODUCTION

Building Understanding was asked to conduct a Post Occupation Evaluation study of the Research Acceleration and Demonstration Building (RAD Building) by the University of Nottingham. The building was completed in March 2018 with the post occupancy study conducted in 2022, having been delayed by the coronavirus pandemic. A mixture of remote interviews via Teams, and virtual focus group and face-to-face workshop were used to gather data.

PROJECT BACKGROUND

The RAD building was built on the Jubilee Campus to provide state-of-the-art facilities for research linked to the Energy Research Accelerator. A budget of £7M was allocated to this project which was externally funded via Innovate UK. Due to the external funding, there were challenging, defined deadlines for project completion. Work had to be completed by March 2018.

The 2500 sq.m building was designed to contain both office and laboratory space for leading researchers in the field of energy research. The exact details of the research to be housed were not known from the outset, and by their nature continue to be developed. Visually the building was required to reflect the striking architecture in place across the Jubilee Campus.

The design was selected following a design competition process, which involved a robust design, interview and presentation procedure. The successful architects presented a building that they felt met the visual requirements and had ‘an inherent dynamism’.

Sustainability goals were set to achieve BREEAM Excellent and also the Passivhaus standard. The original design competition set out BREEAM as a required outcome. In their submission, one of the architects identified that their scheme could also aim for Passivhaus. When the designs were reviewed this was considered as positive and seen to give this design an edge. Passivhaus was therefore added to the brief and the scheme was then developed with this as a goal. Passivhaus is not known to have been applied to laboratory buildings in the past, with labs known to have traditionally high energy consumption, hence this brought some challenges. Passivhaus accredited consultants were appointed to the project group to assist in this certification, but to date a Passivhaus certificate has not yet been obtained.

PROJECT DATA

Name of facility:	RAD Building
Location:	Jubilee Campus
Gross area:	2500 sq. m
Number of storeys:	Four
Users of the facility:	Researchers working in the field of energy research
Room types:	Laboratories and offices
Start on site:	April 2017
Date completed:	March 2018
Period on site:	12 months
Gross construction cost:	£7M
Funding:	External via grant
Contract type:	JCT Design & build

OBJECTIVES OF THIS POST-OCCUPATION EVALUATION

- To highlight issues and best practice associated with the project during procurement, and the construction phase.
- To bring to light any key issues associated with the operation and management of the project during all phases of the development process
- To draw out stakeholder feedback concerning the design of the building and the experience of those who use the facility
- To facilitate a half-day workshop, to discuss and debate the key issues revealed through the primary research
- To analyse all output from the interviews, focus group and the workshop to provide a summary report with recommendations

SCOPE OF THE STUDY

STUDY PARTICIPANTS AND METHODOLOGIES

The University of Nottingham's Estates team provided Building Understanding with background to the RAD Building project. Building Understanding used this information to generate questionnaires aimed at three main groups of stakeholders: the University's Estates team, consultant stakeholders who delivered the project, and end users of the finished facility.

Building Understanding gathered feedback from 13 individuals via interviews. In addition to a comment, some of the interview questions involved giving a satisfaction rating, where 1 = 'totally dissatisfied' and 10 = 'Totally satisfied'.

Interview methodology

In order to create an environment which matched a face-to-face interview as closely as possible, whilst achieving the efficiency of remote working, all interviews were conducted over Microsoft Teams.

Feedback, mainly by interview, was gathered from the following:

Estates Office staff

- Head of Capital Projects
- The former Capital Projects Manager
- Head of Sustainability

Consultants

Respondents represented the following stakeholders involved in the project's delivery:

- The architect
- The M&E designer
- The structural and civil designer
- The cost manager
- The Passivhaus consultant

Unfortunately, despite considerable effort, a contact at the main contractor could not obtained. During the course of the evaluation process, it was unfortunately identified that they were no longer in business. This means that the study feedback does not include the viewpoint of the main delivery contractor.

End Users

Feedback was gathered from academics working within the building as well as from one member of the facilities team

- The Professor of Dynamics, Faculty of Engineering

- Associate Professor and Reader in Physics, Faculty of Science
- Professor in Sustainable Energy, Faculty of Engineering
- Director of EPSRC Centre of Doctoral Training in CCS and Cleaner Fossil Energy
- Senior Technical Manager

The focus group

- The focus group gathered feedback from several people who use the RAD building. This included support and research staff plus a postgraduate student. Due to challenges in identifying building users, the focus group was carried out virtually on 28th October 2022. There were three attendees
- Building users were also asked to complete a rating questionnaire and these were returned by five respondents.

The workshop

The workshop objectives were to:

- Present the feedback gathered through the interviews.
- Examine to what extent the RAD Building has delivered against the original vision.
- Discuss any issues raised.
- Generate recommendations for application to future University projects.

The workshop took place on 24th November 2022. There were five attendees from the project group and whilst small this group assisted in the production of actions based on the findings.

SAMPLE SIZES

It is important to note that quantitative feedback in this report is based on small sample sizes. The qualitative feedback given, however, was extremely rich in detail from both the interviews and the focus group.

FINDINGS OF THIS POE

THE BIG PICTURE

Overall, the RAD building has been a successful project. The striking design was selected which aligns with the general aesthetic of the Jubilee Campus. The project accurately delivered this vision, whilst taking advantage of external funding available through Innovate UK.

The building provides state-of-the art laboratories, which were designed to meet the needs of the energy research teams that use it. There was considerable consultation with academic staff who would be leading research in the facility. Their needs, as they were understood at the time, were taken into account during the project delivery.

It is a building that the people who use it are proud to bring visitors to, and it has brought people together who work in similar fields of energy research, encouraging collaboration.

The decision to go for Passivhaus status was proposed by the architect in their design submission. They identified that their scheme could reach the Passivhaus standard, and the university decided that it would be a positive step to aim to achieve this certification. Passivhaus has proved challenging, despite efforts by the university and project team to understand and accommodate the requirements. To date, a Passivhaus certificate has not been obtained, and the levels of energy consumption are not fully understood. There were some challenges relating to solar gain within the building, and temperature regulation within the building has indeed proved to be problematic.

In general, the project group worked well together and with the university, despite challenges within the project. It was felt that the experience of the main contractor was at times an issue, particularly constructing a building that had a very strong architectural vision alongside the Passivhaus requirements.

The majority of respondents in this PoE are satisfied with the overall outcome. The building provides good office and meeting spaces, is clean, with a positive overall ambience. The atrium gives a ‘wow’ factor on entry. Flexibility of the spaces is more challenging with particular issues relating to getting equipment onto the upper floors, due to the lack of a goods lift. The goods lift was included in the original design but was later removed from the specification.

Temperature is rather variable, and the building can be both too hot and too cold. In extreme ambient conditions, this has affected the ability to carry out some research work. The use of plug-in fans and heaters to compensate may significantly affect the energy consumption. Light is also very variable with some spaces very light but others rather dark. Following the pandemic, issues with data connectivity and AV equipment mean they do not always meet the standards that people would expect.

Despite the issues identified, the RAD building is providing facilities considered a significant improvement to those found in older buildings, such as the Coates Building. Access is good via all means of transport and people feel secure working in it.

Below are some quotes made by people involved in the evaluation:

Positives

Overall, the RAD building is a high-quality research facility which is a focal point for teams working in the field of energy research. The building was delivered to budget and made considerable efforts to be as energy efficient as possible.

Users said:

'It 'looks like a high-quality facility and a high-quality office space.'

'The building has brought different energy research together, with the building being used by science as well as engineering. This brings a nice mix of researchers'

A key stakeholder commented:

'At the end of the day, the University delivered the project within the financial parameters set. A good building was produced, and the University delivered its first attempt at a Passivhaus scheme.'

The overall ambience of the building is considered positive and generally people like working here. The atrium and living wall give a 'wow' factor when entering the building.

Users said:

'The large atrium with the living wall is a good focal point and discussion point for when people come to the university and visit'

'I think it is a pleasant building to be in. It has a nice environment internally'

The project was delivered on time and to budget and provides greatly improved facilities for researchers when compared to the older buildings on University Park. Many of the users feel that the laboratories closely meet the design plans and requests made during the consultation process. Concerns relate far more to the services within the building, such as ventilation, rather than the building fabric and visual impact.

Negatives

The goal of building a Passivhaus building was a challenge. The decision-making process in relation to this was not fully understood and there were challenges in engaging the contractor in the requirements. Some users feel that the Passivhaus status limits the future flexibility of the building.

Project group members said:

'Inevitably if the design was done and we decided to shoehorn Passivhaus into it, that will by its nature create challenges to be able to deliver the requirements.'

'It was a very tricky building in relation to the services and there were challenges getting the contractor to understand the low energy approach.'

A user said:

'The flexibility of the space is limited and because it is Passivhaus that limits it even further'

Managing temperature and light can be challenge. There is significant variation in temperature and light within the building. In the most extreme cases, equipment and experiments are affected by the temperature. Where people are uncomfortable, they are

resorting to the use of portable heaters and fans, which will negatively impact energy consumption.

Users said:

'Students borrow electric radiators from my lab, that I'm not using, and use them at their desks on the B and D floors. It shouldn't come to that, but that's what has happened'

'There are some tall windows in one of the hydrogen labs which when it's bright sunshine affects some of the equipment and the experiments that are carried out'

'The knock-on effect of that window style is that there is a row of offices on B floor, and they are just too dark, and no one wants those offices'

There was some feedback that suggested that the striking external design had compromised the internal spaces and their functionality.

One user said:

'You could have a boring looking building that would have been more functional at the end of the day'

HOW CLOSELY THE RAD BUILDING FULFILS THE ORIGINAL VISION

Overall, there is a strong feeling that visually the RAD building very closely fulfils the original vision, such as it was. In truth, the building was created to make good use of funding, offered to the University, rather than fulfilling a specific vision.

In terms of the design intent, the architect agrees that the authenticity was retained, despite the reduction in footprint size versus the original design.

One of the project team stated that it was:

'Probably one of the closest I have seen in 20 years of doing this job'.

There is considerable support amongst the project team and users in relation to the decision to make the building as energy efficient as possible, and to try to meet the Passivhaus standards. However, the fact that a Passivhaus certificate hadn't yet been issued, is believed by some, to have a significant impact in relation to success against the project vision. There is also no certainty that the energy consumption is, in fact, low enough to meet the Passivhaus standards at this time.

FEEDBACK FROM THE PROJECT TEAM

THE DESIGN AND CONSTRUCTION PHASE

The contract for the RAD Building was a Design & Build. The team was made up of a number of consultants and contractors brought together as part of and following a design competition. The design concept presented by the architect was visually striking, with unusual geometry and raking windows. The building's design is felt to align with the impact of other buildings on the Jubilee Campus.

Whilst the original design of the building was selected following a competition, changes to the footprint of the building, and the decision to apply Passivhaus standards meant that further design change was required at the start of the project.

The university and consultants agree that it was innovative to try to apply Passivhaus to a laboratory building. It is also agreed that there were elements of the design and the detailing that were challenging. As the vision for the exterior for the building had been closely defined, some felt this limited the amendments that could be made to improve summer comfort, such as the addition of brise soleil.

Overall, the construction phase went reasonably well, and the building was completed to programme. Teams did collaborate to identify solutions, although at times it was difficult to get those on-site to understand some of the requirements for sustainability. It was felt that the main contractor did not have enough experience of this type of project to perform at the level that was really required for delivery. Delivery via a design and build contract meant that some members of the supply chain were not engaged at the outset, so did not have the same buy-in to the requirements as they needed to.

Early surveys of the site were helpful to identify issues and solutions. However, it was identified that some of the site enabling works had not been fully completed before the construction phase and this led to contract variations on-site. Challenges were also identified, for example, with the amount of insulation required under the floor slab, achieving airtightness and getting the SIPS panels to mesh with the steel frame.

Significant money was spent in relation to certain features which were not commercially viable. Most notable was the plan to use the bore hole on site for heating, cooling etcetera. It was probably the right thing to investigate this, but a lot of time and money was unfortunately spent with no return.

The external funding deadline meant that some aspects of the project felt rushed and that this may have affected the final finish in places. The deadline was also challenging as it meant the building had to be built without an absolute understanding of how it would be used. This may affect functionality and flexibility in future.

Recommendations

- When accepting external funding, greater consideration should be made in relation to the required deadlines and understanding of a building's purpose. Whilst external funding may be too important to overlook, in this case, ways to futureproof the building should be considered.

- Any plan to meet construction standards, such as Passivhaus, should be decided at the inception of the project.
- A balance needs to be struck between the visual concept for a building and the realities of working within it. Discussions around this should take place before a final vision is publicised.
- Experience of contractors should be a greater consideration when selecting contractors and consultants. Failure to do so may result in hidden costs.

FEEDBACK RELATED TO THE DESIGN AND LAYOUT

The RAD Building was built closely to the original design submitted by the architect.

Some members of the consultant team felt that the vision for the exterior precluded features which would have improved the building in operation. It is also felt that the design led to compromises, such as small windows in some office spaces, making some spaces less pleasant than they could have been.

The large height requirements for the labs were felt to have been incorporated into the building. One user agreed that whilst there were things in the labs that they now wished they had, this was not due to a lack of consultation, but more that needs weren't fully understood at the time.

The atrium and green wall are liked by some and considered important for a building of this type. However, others question their success and the space they occupy. The green wall was also identified as being somewhat difficult to maintain.

Flexibility

There are concerns amongst users about the flexibility of spaces. In particular, the respondents in the focus group were generally dissatisfied with this aspect of the building.

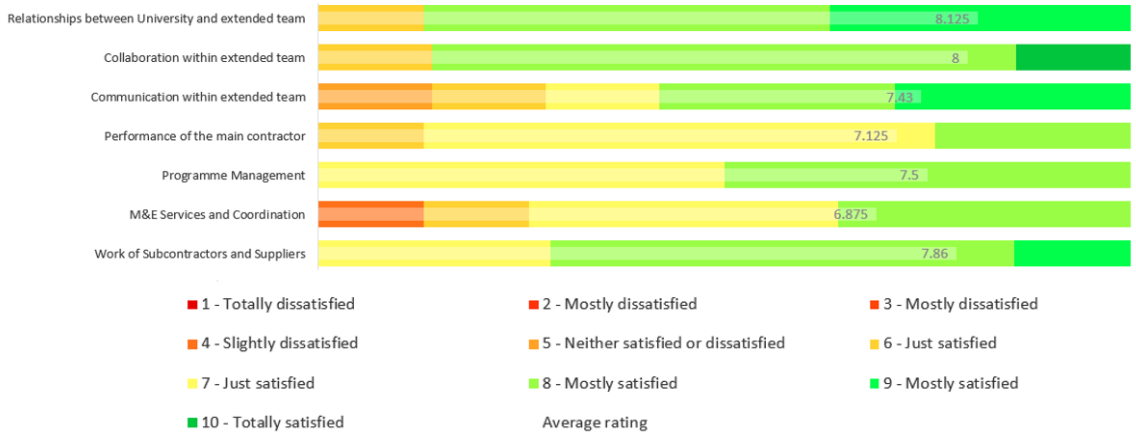
The lack of a heavy goods lift makes it challenging to get equipment moved on or off the upper floors. There is an access hatch in the roof but using this is complicated and costly. Researchers do not always have budget available to pay for access in this way. A goods lift did appear in the original plans but was not installed, with the reasons for this not fully understood by all.

Given the changing nature of the research being carried out, provision of a goods lift would have greatly increased long term flexibility and it is considered an error not to make provision for this.

Recommendations

- When selecting a building design, ensure that the impacts on internal spaces are fully understood.
- Ensure provision is made for goods and equipment transportation, to avoid challenges when changes are required.
- Consider the maintenance of specific features incorporated into internal designs.

FEEDBACK RELATING TO RELATIONSHIPS, COMMUNICATION AND COLLABORATION



During the construction phase of the project, collaboration and communication were generally considered to be quite good. Relationships between the university team and the extended project team were rated well on both sides.

There was also good engagement with the end users, which started at an early phase of the project. It is recognised that efforts were made to accommodate the needs of those that were going to be using the building, and this was critical to project success. Where issues arose, this was generally because the users were not able to clarify their needs within the required timeframes.

There were some challenges related to meeting the original vision for the building and achieving Passivhaus. However, in general, the team worked together to resolve these.

Overall, the consultant group were more positive in their ratings than the university estates team, who felt that there was a degree of tension between the architects and main contractor.

One respondent had this to say:

'I was consulted extensively, I would say, about the requirements for the laboratory'.

Collaboration

When it came to collaboration, feedback was mostly positive with most respondents 'satisfied' with collaboration. Overall, it was felt that there was a shared interest in the goals of the project and that all parties were engaged.

The Passivhaus consultants particularly felt that the university team were supportive in relation to getting information about the equipment and showed good technical understanding.

One consultant commented:

'The different parties in the project team had to collaborate in order to succeed but it did take some encouragement to get them to do so'.

Communication

A question on communication yielded lower ratings with an average rating of 7.43. There was a much wider range of viewpoints regarding communication.

At times, communication was very good but, on occasion, information was missing, and people were left to infer the detail relating to equipment. This led to errors.

In particular, the act of paying for the Passivhaus consultancy fees upfront was identified as having a negative impact on the normal progress updates that occur with monthly invoicing. If something like this occurs in future, then a specific timetable of update meetings should be set up to ensure that communication channels remain open.

Recommendations

- For future projects ensure that early engagement of key stakeholders remains a feature.
- Ensure that regular progress meetings take place, using video meetings when travel is impractical.
- Ensure that detailed information is made available to the whole project group to avoid errors and potential additional costs.

FEEDBACK RELATING TO MAIN CONTRACTOR AND SUPPLY CHAIN

Main Contractor

Feedback in relation to the main contractor averaged as 'just satisfied'. The average rating was 7.13.

The main contractor selected submitted the lowest quotation, and it was a project considered *'just outside of their reach'*. They had little Passivhaus experience and limited experience in the construction of laboratories.

In general, it appears that the team on-site did a good job and tried to engage with requirements, but there were times that errors were made which resulted in remedial work.

The management of the supply chain and the timeliness of appointment of sub-contractors were considered to be issues that affected the performance of the main contractor. They were felt to impact on the ease of delivering the design and Passivhaus goals, because the sub-contractors were not engaged with the vison from the outset.

Unfortunately, the main contractor has been unable to engage with the evaluation, so we have been unable to investigate the project from the main contractor's perspective.

Supply Chain

Feedback in relation to the M&E services and sub-contractors were rated as ‘just satisfied’. The M&E services aspect was considered less satisfactory overall, with an average rating of 6.88.

There was positive feedback in relation to the contractors who delivered the steel frame, the air tightness and the green wall.

Recommendations

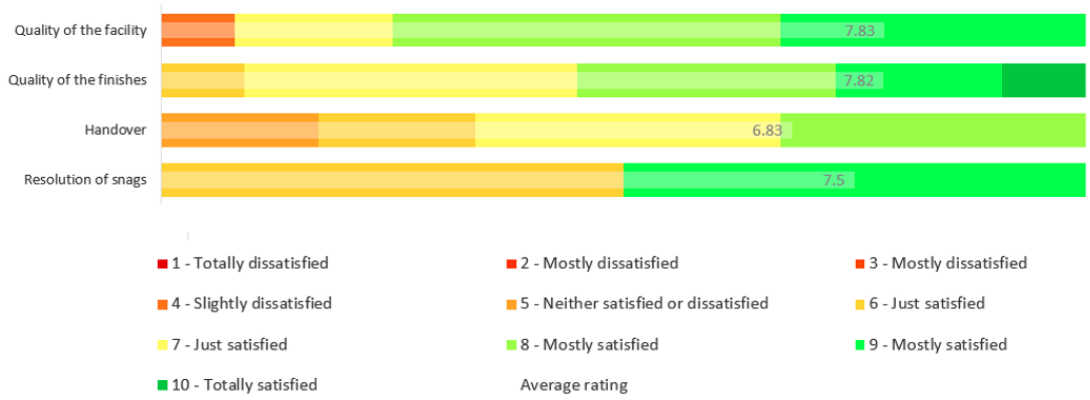
- When selecting contractors, ensure that relevant experience has weighting within the tender selection process.
- Request that sub-contractors are engaged at an early stage to ensure buy-in to any project specific goals.

FEEDBACK RELATING TO PROGRAMME

This question was only answered by two respondents, so feedback is limited. One respondent was ‘mostly satisfied’, whilst the other was ‘just satisfied’.

The project met the deadlines, which was positive. However, some information was not as forthcoming as it could have been, and information had to be chased more often than would be expected.

FEEDBACK RELATING TO HANDOVER AND DEFECTS



The handover of the building received an average rating of 6.83. The users were, in general, more satisfied than the estates team. This is perhaps unsurprising, given that the estates staff will have dealt more closely with snags and issues.

A lack of formal handover process was identified as an issue, with staff beginning to move into the building before the formal handover and commissioning had taken place. Walkarounds did take place, but they didn’t always include the full complement of appropriate attendees. In addition, it was felt that the handover information wasn’t complete with missing graphics and the potential to improve the availability of information.

The COVID pandemic may have played a part in the issues as the building was not fully occupied immediately after completion,

Respondents were happier with the resolution of defects, with an average rating of 7.5. The consultant group rated this higher than the estates team. It was however, accepted by some that as the building was not fully occupied on completion, this may mean they were not aware of all the snags identified once it was in use.

There were some minor niggles identified by users in relation to drips from concrete, which was still drying out, windows getting stuck open, door handles in the toilets and water heating in the shower, but these were either resolved over time or were dealt with in a timescale generally considered appropriate.

The biggest issue at handover appears to relate to systems such as air handling and temperature. These systems were demonstrated, although the training could possibly have been more in-depth. However, some users felt that the systems did not meet the requirements of the labs and the research being conducted. There is disagreement about whether the root cause is lack of timely engagement from the users, or lack of understanding of the requirements from the estates team. There was also a feeling that systems were being run at low levels to minimise energy usage. The Passivhaus consultant identified that energy usage information provided at this time appeared to be unexpectedly high and felt more investigation into this was required.

POST OCCUPATION – END USERS

FEEDBACK RELATING TO KEY SPACES IN THE RAD BUILDING

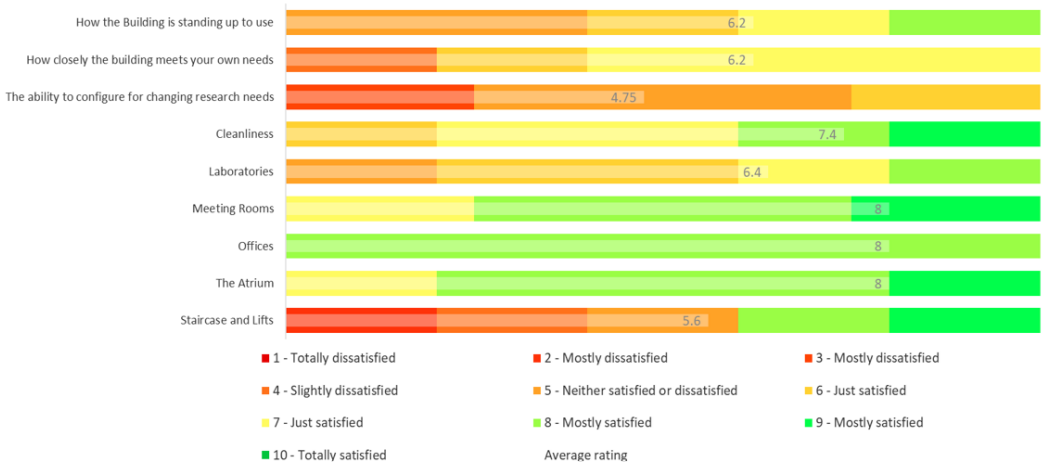
The RAD building *'provides a focal point that we can bring visitors to and explain about research that is being translated into reality.'*

There was some feeling that the green wall hasn't been a complete success and that, whilst pleasant, the atrium is wasted space. However, others really like the entrance and feel that it gives a 'wow' factor.

POST-OCCUPATION – FEEDBACK FROM KEY STAKEHOLDERS

Interviewees ratings

Focus group ratings



Flexibility and Success of the Spaces

Offices, meetings rooms and the atrium were rated well. Within the focus group these were all scored with an average rating of 8, indicating that users were 'satisfied'.

Laboratories were less well rated, and the focus group participants were particularly critical about the ability to reconfigure for changing needs. The average rating for this was 4.75.

The most significant issue impacting flexibility appears to relate to the challenge of getting equipment on and off the upper floors. This is as a result of not having a heavy goods lift. One user said:

'There is lots of flexibility to resize rooms to fit equipment in, but it's going from outside to inside that is the main issue'.

Whilst there is an access hatch in the roof, using a crane to lift in equipment is expensive, has logistical challenges and raises safety issues when operating on a live campus site.

The quality of the building is generally considered good, both visually and in use. Respondents felt that most work had been finished to a high standard and that it is *'spacious and comfortable'*.

Recommendations

- Consider how equipment will be brought in and out of buildings as use changes. The initial cost of a goods lift may be worthwhile versus the ongoing cost and safety management of alternative options.

FEEDBACK RELATING TO OPERATIONAL ISSUES

Overall feedback on the operation of the building is positive, although due to the pandemic the building occupation has been lower than originally planned. Users are starting to return in 2022 and this is expected to continue.

Cleanliness

This is generally considered to be good, with all interviewees 'satisfied' with this. Focus group respondents were less positive, but the average score could still be considered 'just satisfied'.

The environment is considered pleasant, with cleaning well managed. Any issues are very minor and not related to the fabric of the building.

Day-to-day use

Overall, the RAD building appears to be operating well. The estates team are not aware of many day-to-day issues, and it was noted that the team on-site work with the users to minimise disruption when works take place.

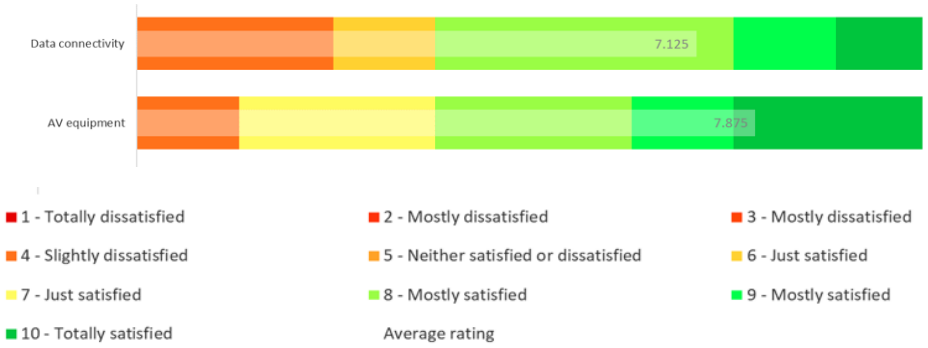
There are concerns that some equipment is being left to run 24hrs a day, seven days a week which will be unnecessarily generating carbon, increasing costs and affecting the ability to obtain the Passivhaus certificate. It's believed that from an energy perspective, the building is not performing as well as it should. This is borne out by feedback given in relation to temperature control.

Teams carrying out experiments using hydrogen were concerned about the lack of a separate extraction system. There is a system in place, and this has been signed off for the work being done. It's possible that the issue may not be due to a functionality issue, but more of confidence in, and understanding of the system. Further investigation into this may alleviate the concerns.

Recommendations

- Use the BMS data to review energy use and identify where equipment may be running unnecessarily.
- Review the hydrogen extraction system with consultants and users to check functionality. Revisit the risk assessment to ensure there is confidence in the equipment provided.

FEEDBACK ON AV AND DATA CONNECTIVITY



Users are 'just satisfied' with the AV equipment available. As remote working has adapted during the pandemic, it may be beneficial to ensure that meeting rooms are adapted to work with MS Teams, rather than older video conferencing facilities.

Data connectivity has a lower rating with 37% of the respondents not being 'satisfied' with this. The Wi-Fi is poor, meaning that the internet connection drops out, having an impact on remote meetings. In addition, mobile phone signal is poor, and it's felt that given the metal frame of the building, measures should have been put in place to resolve this. This is a probably a greater challenge post pandemic with people working in a hybrid manner.

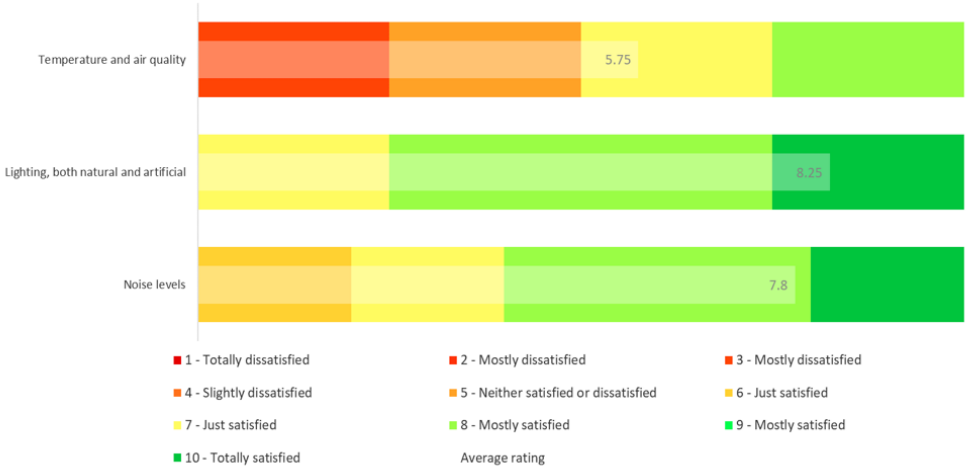
Given the expectations in terms of connectivity, this is below the standards that would be expected in a modern building and ways of improving this would be worth investigation.

Recommendations

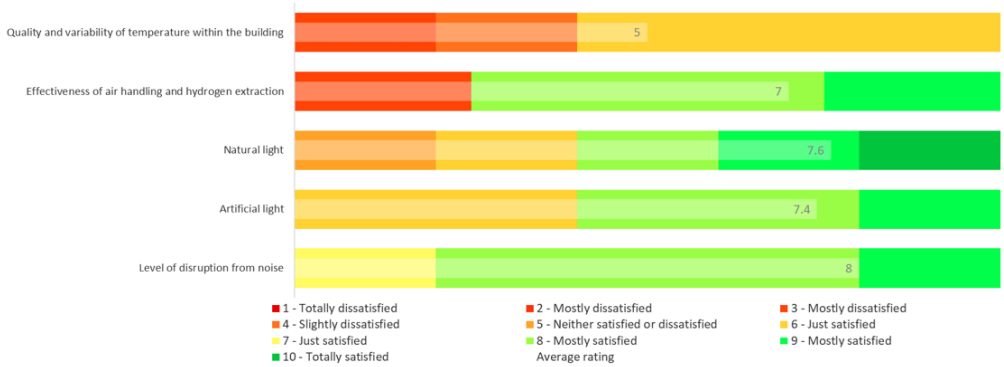
- Review the Wi-Fi availability in the building to identify if any improvements can be made.
- Review the AV equipment availability to see if it meets post-pandemic needs.

FEEDBACK RELATING TO THE QUALITY OF THE INTERNAL ENVIRONMENT

Interviewees ratings



Focus group ratings



Heating and cooling

Temperature was the lowest rated aspect of the RAD building, with an average score of 5.75. from interviewees and 5 from focus group respondents. The majority of users are either ‘mostly dissatisfied’ or ‘neither satisfied nor dissatisfied’.

The RAD building is very warm in the summer and cannot be easily cooled. The aspect of the building means that some offices are cold in the winter and very warm in the summer. In laboratories there are no opening windows and the original lack of blinds does not allow users to mitigate against solar gain. The installation of blinds has taken place in some areas but is challenging due to the slanting windows. Further blinds may be needed elsewhere in the building.

The focus group highlighted that plug-in heaters and fans are being used to mitigate against the extremes of temperature. This goes against the Passivhaus ethos and will significantly increase energy use, affecting the planned green credentials of the building.

Passivhaus requirements are considered to have played a part in the high temperatures due to the requirements for airtightness and minimising energy demand. The Passivhaus consultant identified that summer comfort was a concern that they raised during the construction phase of the building. However, means of solving this do not appear to have been discussed with the right people in order to make design amendments.

Recommendations

- Review the BMS data to identify trends in relation to temperature across the building.
- Install blinds to assist in the management of solar gain.
- Educate users on the different performance which is to be expected within a Passivhaus building. Aim to stop behaviours which will increase energy consumption.
- Monitor BMS data energy usage on a routine basis to identify changes which need review.

Lighting

Light is generally good within the building, with most respondents 'satisfied' with it. The building has many large windows, and it was noted that the artificial lights have been set up so that they are brighter towards the dark end of labs.

It was identified that some spaces are too bright in the summer. Some offices are very dark due to small windows, making them spaces which users don't want to be in. '*There are some dark spaces such as the small offices on B floor'.* In one of the west-facing hydrogen labs, the bright sunshine can affect the equipment and experiments taking place. The installation of blinds should improve this situation where there is a problem.

There are minor niggles in relation to the sensors for lights in offices, which switch lights off if someone has been still at their desk for too long. However, adjustments have been made to resolve this problem. Some offices also only have very small windows, although others have much large ones.

Recommendations

- Install blinds to reduce glare from direct sunlight.
- Move sensors where required.

Sound

This had an average rating of 7.8 amongst interviewees and 8 within the focus group, hence most users are 'satisfied' with noise levels.

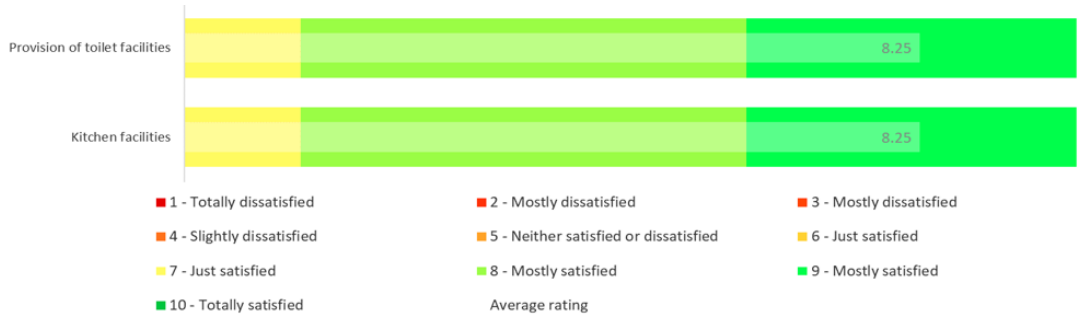
There were some comments that conversations from other rooms and floors can be heard, but in general this was not considered a significant problem or distraction.

One user did however raise an issue with disruptive levels of noise within their laboratory. In hindsight, it's felt that soundproofing of some equipment would have been beneficial and would have made day-to-day working more pleasant.

Recommendations

- For future projects, consider if there are areas where specific equipment calls for soundproofing measures.

General Facilities



Almost all users were ‘satisfied’ with toilet and kitchen facilities.

One respondent noted that it was positive that all toilet facilities were gender neutral. This avoids an inclusivity issue present in many older buildings.

Additional elements end users would have liked to have seen

- Blinds for windows.
- A goods lift so that equipment can be taken to upper floors.
- A heat pump to assist with temperature control.
- A separate gas extraction system which is not linked to the overall air handling.
- A pump room to reduce noise.
- Double height doors in the laboratory.
- Bin store.
- Ability to maintain the green wall without bringing in a cherry picker.
- Greater redundancy in the systems to improve flexibility.
- Better ability to drill into the energy usage data.

FEEDBACK RELATING TO ACCESSIBILITY AND NAVIGATION

Accessibility was generally considered good, and respondents felt that accessibility for the disabled was also as required. Unfortunately, no feedback was obtained from individuals with disabilities, so it is difficult to be certain that there are no issues.

There are toilets for the disabled on every floor, there is a large lift and the entrances to labs are level. There is some concern that doors may be heavy for those with mobility issues and that open plan study spaces may not be the best option for users with certain additional needs.

The front door has had some issues and has failed on occasion. This relates to it being a double leaf automatic door, and the doors and sensors having to operate in a certain routine.

It was noted that different floors have different colour coding to aid navigation, but that some visitors do not initially find the lift as it is not in the atrium. Better signage may be beneficial.

The cycle storage was identified as a positive addition by a number of respondents. It appears to be being used well and supports sustainable accessibility to the building. One respondent felt that the double height storage is unnecessary and not well liked by users, so design may be worth review for future projects. Car parking and accessibility on foot were also positively commented on.

The focus group gave a low score for staircases and lifts; however, this relates to the absence of a heavy goods lift, rather than an issue with general access.

FEEDBACK RELATING TO SECURITY

Security was one of the highest rated aspects of the building with an average score of 9.

In general, people feel safe working in the building and do not have concerns when it is dark.

One respondent has had his bike wheels stolen and has lost equipment from external areas. He felt that there aren't enough security cameras to deter people from committing theft.

FEEDBACK RELATING TO ENVIRONMENTAL PERFORMANCE AND SUSTAINABILITY

The decision to try to obtain both BREEAM Excellent and Passivhaus certificates was a challenging goal for the university. However, despite the construction and ongoing in-use challenges, respondents generally supported the aim to go for these standards.

It was innovative, and difficult, to apply the Passivhaus standards to a laboratory building. This was particularly the case given the research to be done in the building was not fully understood at the start of the project, and that the nature of some of the hydrogen experiments require significant extraction for safety.

Challenges were created by lack of Passivhaus experience within the project team. The main contractor had little experience in this area, and explanation was required for the reasons why some options were chosen, or why certain technical information was required. The architect and other consultants felt that a lot had been learned about Passivhaus and its principals, that can be applied to other projects whether they are going for Passivhaus or not.

The building met the requirements for a BREEAM Excellent certificate. This illustrates that many sustainability goals were reached in the construction of the building.

At the moment it is not clear whether the building is meeting the Passivhaus standards which is principally focussed on energy consumption. There is metering in the building, but the university team is not currently drilling down into the data that is available. The Passivhaus consultant, indicated that the last set of data that they were given was not as expected and would suggest that energy consumption is higher than anticipated.

There are concerns within the university estates team that some systems are being run routinely rather than only when needed, simply to be on the safe side. This will have a significant impact on energy use and is likely to mean that energy consumption is much higher than anticipated. It may be that further training, discussion and calibration is required to minimise energy use, whilst meeting the needs of academic staff and researchers. The issues with temperature mean that plug-in heaters and fans are being used and this will increase the energy use in a way that was not originally anticipated. Users need to understand that the building will behave in a different way to a traditional building and adapt to some extent.

Despite the elapsed time, The Passivhaus consultant is keen to work with the university to review the available data with a goal to trying to get certification for the building if at all possible. The university has recently recommenced discussions to identify whether a Passivhaus certificate can be obtained, or not.

Recommendations

- Use BMS data to fully understand energy consumption and take the steps identified to more efficiently manage temperature.

- Make efficient, minimised, long-term energy use the primary goal.
- Work with the Passivhaus consultant to identify if a certificate can be obtained or not.

FEEDBACK RELATING TO QUALITY OF RAD BUILDING

The quality of the facility was rated with an average score of '7.83' amongst the project group and key stakeholders. 75% of respondents were 'satisfied' with this. The focus group were slightly less positive with respondents rating with an average score of '7'.

Only minor issues were identified with poor workmanship and the building was felt to have an excellent external impact that sits comfortably in its surroundings.

Internally there are some minor issues with finish, most notably with untidy pipework and plastering.

WHAT MIGHT HAVE BEEN DONE DIFFERENTLY?

It was identified that defining the brief more clearly at the outset of the project would have aided both delivery on-site and in the final building. If the Passivhaus requirement had been identified before the design submissions, then some of the later challenges may have been avoided. The design could have better mitigated against solar gain which would have made the internal environment more comfortable.

Whilst accepting the £7M external funding from Innovate UK paid for the RAD Building, it was a challenge to build to the deadlines when the final use of the building was not fully understood. It would be wrong to suggest that the university should not have accepted the funding, but it may want to consider how it would respond more effectively in the event of similar external funding offers in future.

Whilst the external aesthetic was important to the Jubilee Campus, being very rigidly committed to an architectural vision has impacted the comfort of the building users.

The method of selection for the main contractor could have had different priorities to ensure that price is not too heavily weighted compared to experience and capability. It is understood that this has already been reviewed by the university.

Suggestions identified by interviewees included:

Project team

- Only accepting funding if there is a clearly defined project to spend it on.
- Defining Passivhaus or other requirements from the outset.
- Considering the internal spaces as much as the external aesthetic.
- Ensuring the procurement process considers experience when appointing.

End users

- Having a better understanding of needs when consultation takes place.
- Being more insistent about equipment required, such as the goods lift and separate hydrogen extraction.

- Greater consideration given to temperature management
- Better briefing during the project and at handover.

DOES RAD BUILDING MEET THE NEEDS OF THOSE WHO USE IT?

In general, the building does meet the needs of the users. There are newly built laboratories which took into consideration the needs of the researchers as they were understood during the design and build phase. There are ample meetings rooms, with good conference facilities for larger meetings. The building has a good ambience and is considered a nice place to bring external visitors to tell them about the important energy research being done at the university. The facilities are better than those available in the old engineering buildings on the University Park Campus.

The RAD building is accessible by car, bike, public transport and on foot. Security is good and people feel safe. The building is accessible, and provision has been made to be inclusive.

The RAD building has brought together teams working on similar research from the faculties of engineering and science, which is positive from a utilisation and collaboration perspective.

There are some issues in relation to flexibility, temperature, gas extraction and data connectivity. These affect comfort of users and may limit some of the ways of working. Review of this could improve the experience of working in the RAD building as well as informing future projects.

OVERALL OUTCOME

Good overall satisfaction ratings were awarded by the people who participated in the evaluation. The project team rated this with an average score of ‘8.8’, with the estates team giving an overall rating of ‘7’. Users rated their over satisfaction as ‘7.25’.

The members of the project team were proud to be involved in the project and in the final building.

Conclusion

Overall, the project utilised significant external funding to build a modern facility for dedicated energy research. The building is aesthetically dynamic and sits well within the other buildings on the Jubilee Campus.

There are some aspects of the RAD building which users feel are not optimal, most notably temperature, flexibility and data connectivity. However, there are also many things that users are positive about, such as the ambience, meeting and office spaces and having a dedicated facility used by academics working in similar energy research fields.

The university delivered its first attempt at a Passivhaus project. Despite the challenges it brought, the project group and users all support the goal of trying to make this an energy efficient building. Having made this effort, the university now need to do some work to ensure that actual energy use is monitored, and steps are taken to optimise the energy use in the facility. If possible, a Passivhaus certificate should be obtained.

To sum up, respondents said:

‘One of the key things is the quality of the building that the university ended up with. They have got a highly sustainable facility.’

APPENDIX I: RECOMMENDATIONS

Temperature and Humidity

This is the lowest scoring aspect of the building, hence resolving some of these issues should improve user satisfaction significantly.

- Use the BMS data to review historic data about the temperature and humidity in the building and use this to understand trends.
- Consider occupancy levels as part of the review and look at these compared to original plans.
- Where there are areas that are too hot, too cold or with significant temperature variation; identify actions to mitigate. This may include actions such as installing additional blinds or moving sensors for the air handling system. If occupancy levels are significantly different from plan, then the control strategy may need acomplete review.
- As a Passivhaus building, temperature management and the way heating and cooling works will be different from traditional buildings. Present findings and education information to the faculties and ensure that this is cascaded down to building users. Explain that use of portable heaters etc. will have a negative effect on the building management system overall.
- When installing new equipment, consider the impact this may have on temperature and review whether the control strategy needs to be adjusted accordingly.
- Monitor temperature and humidity data on an ongoing basis to ensure that controls put in place continue to work and are not being adjusted or affected by user behaviours.
- Potentially commission a consultant to carry out this work if the university does not have the resource. Alternatively use the skills of a PhD student with an interest in this field.

Review of energy use and Passivhaus certificate

It is important to understand the energy use within the building to manage costs. This will also identify if a Passivhaus certificate can be obtained or not.

- Review the BMS and energy use data to identify how this compares to the original planned estimates. Look at whether energy use has significantly changed over time.
- The steps taken to improve temperature should reduce energy consumption.
- Identify if any systems are being run full time as a ‘fail safe’, for example in relation to gas extraction, as this will significantly affect energy use.
- Ensure any domestic equipment bought, such as fridges and water coolers, is as energy efficient as possible.

- Set up a process to review energy consumption on a routine basis, possibly using a visual dashboard. Use this to identify changes made locally before they have a significant effect on costs to the university.
- Potentially commission a consultant to carry out the initial review or use the skills of a PhD student with an interest in this field.
- Once the energy use is understood, a decision can be made with the Passivhaus consultant as to whether a formal certification can be obtained. This would be the ideal scenario, however positively managing the energy consumption overall is the more important goal.

Passivhaus, BREEAM and future projects

Having made this attempt to construct a Passivhaus building, the university has learned a great deal about the positive aspects of this system to add to their considerable experience in relation to BREEAM. Building sustainable buildings is clearly the goal, but the best way to do this is something that the university it still working towards.

- The university team need to decide and document the goals and standards in relation to sustainability in construction and refurbishment.
- Based on this, a decision should be made on whether to use BREEAM, Passivhaus or another system. One system may not be appropriate for all buildings.
- The focus should be on ongoing energy efficiency and net zero carbon, rather than simply obtaining a certificate.
- For future projects, the expertise in relation to carbon neutral goals should be brought into the project at the earliest possible point.
- The skills and competence on contractors and consultants should be considered during the procurement phase but is identified as being challenging with current UK experience.

Safety concerns in relation to hydrogen extraction

This is a particular issue, affecting one group of researchers. In reality, the issue may be one of lack of confidence in the system rather than the system being unsuitable for intended use.

- The Technical Manager and safety advisors should review the system with the appropriate consultant and the team carrying out research.
- The risk assessment should be updated to reflect the findings and demonstrate that all potential hazards are covered.
- Ensuring this system is being used correctly and only when required should assist with the management of energy use.

Flexibility and provision of goods lift

The original plans did show a goods lift, and it is not fully understood why and when this was removed from the final build. Whilst there is an access hatch in the roof, craning in equipment comes with cost and safety issues. This is reducing the ease of change within the

facility. This issue cannot be overcome for this project but does provide useful information for future projects.

- For future plans, ensure that the implications of any design changes are fully understood, even if there are short term cost savings.
- If a separate goods lift cannot be accommodated, ensure that the personnel lift is large enough to transport equipment and heavy items.

Data Connectivity

The data connectivity is not as good as would be expected, particularly with changes to ways of working.

- Request a review of connectivity via the DTS business partner.
- Act on recommendations of this survey to improve connectivity and use of mobile phones.

Additional meeting facilities

Changes to ways of working has increased the use of MS teams and some felt there was now a need for more small, flexible meeting spaces within the RAD building. Small meeting pods were recommended, as are available in other buildings.

- Identify to faculties that if they feel these would be useful, then they can purchase and install in the building.
- It may be worthwhile to trial the use of some pods, borrowed from another facility in the short term.

Managing the aesthetics of a building vs functionality

The striking external aesthetics of the building have affected the internal spaces and some feel that this is not always positive. There was no deliberate decision to prioritise the external features over the internal ones but there are lessons to be learned in relation to this.

- It would clearly not be beneficial for all buildings to be ‘standard’ boxes and the striking architecture of the RAD building is appropriate and positive for its location.
- For future projects the internal spaces should be considered in detail and any implications from the external design fully understood. If there are challenges created to internal spaces these should be mitigated against.
- For future projects ensure that how the building will be used is fully understood before commencing on the project and accepting external funding.
- Contractors and consultants should understand that the university is open to discussion about the external design and changes required to improve user comfort and operation. Communication channels should be clear to consultants.