Post Occupancy Evaluation

City of London Academy

PROJECT PART-FINANCED BY THE EUROPEAN UNION

Foreword

This case study is a product of ***Building for the Future*** - an inter-regional collaboration, part-funded by the GROW EU Interreg3C joint programme, which aims to achieve balanced and sustainable economic growth.

Every construction project has its own challenges, but the impetus is towards reducing the environmental impact of buildings, both as they are built and as they are used.

AOSEC is very grateful to the partners that have been such an essential support to this project, and so it is with real admiration that I thank the Environment Agency, the LSC and SEEDA.

Dr Anne Murdoch
Chair of Board of AOSEC and Principal & Chief Executive of Newbury College

Other Titles in the Series

This guide is one of a series of 5. The others in the series are on:

- ***Commissioning Sustainable Construction in Further Education Colleges***
- ***Conserving Energy in Further Education Colleges***
- ***Conserving Water in Further Education Colleges***
- ***Case study 1 - a post-occupancy evaluation of a recently-completed FE building***

The image on the cover page is of City of London Academy.

October 2007

Executive Summary

This case study guide reviews a recently-completed educational building, City of London Academy, London. The aim of the study is to evaluate the building by undertaking a post-occupancy evaluation, and share the evidence-based lessons within the further education sector.

The performance of the building is measured in terms of three parameters of energy use, occupant satisfaction and environmental impact.

The Guide is about:

- **Energy Use in the academy** –how much energy is used and how it compares with other school buildings.
- **Occupant satisfaction** – the thermal comfort of occupants in the school and how they use the building
- **Environmental impact** – how the school addresses wider environmental concerns at the global to local level ranging from carbon emissions to the internal environment, including issues of water, waste and recycling.

This guide will help:

- **Building managers** to understand the energy and environmental performance to estimate the savings potential that can be achieved.
- **Designers and building managers** to understand how to address user needs more effectively and fine tune the systems to improve efficiency.
- Lessons learnt and feedback can be incorporated to inform the design of new buildings.

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1 Introduction

1.1 Building Description

City of London Academy in Southwark is a secondary education institute. The school is a part of the DfES funded academy programme, and is the first of the three academies to be built as a 'means of raising achievement and aspirations in socially deprived parts of London'. (Prentice and Elkin 2006). The city of London is a prime sponsor in collaboration with the London borough of Southwark.

The academy offers specialized courses in business and enterprise covering subjects like ICT, finance, business and economics. There is also a special emphasis on sports and physical education at all levels.

The academy is centrally located in the South Bermondsey area of Southwark on Lynton road and is well connected by public transport.

Fig.1 **Location Map**
Source:http://www.cityacademy.co.uk/map.html

The academy built in 2005, caters to 11-19 year old students from the south of Bermondsey and nearly 95% of the students come from within 1.5km of the school (Prentice and Elkin 2006). Designed for 1200 students, at present, there are 788 students enrolled. There are about 130 staff members in the building including teachers, administrative and estates management staff, the majority of which work only during the term time.

The school is open from 8.00 am to 8.30 pm in the term time with community activities in the evening which go on till 10.30 pm. In the vacations, the school is open from 8.00 am to 4.30 pm. The sports centre everyday is open to the community from 5.30 to 10.30 in the evening. The school has a six week break in the summers through mid- July to august end and a break during Easter and Christmas.

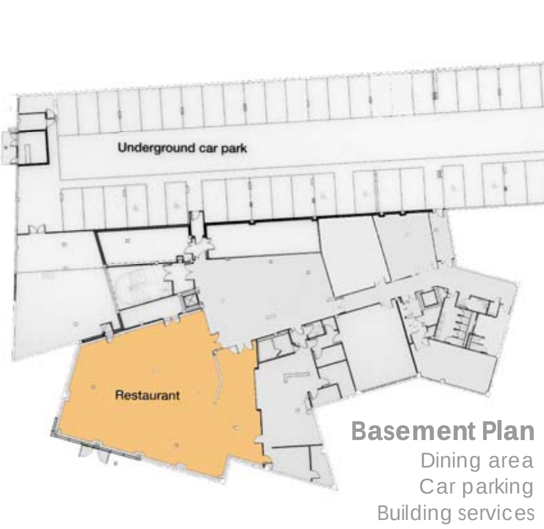
Building Design

The Academy won the Prime Minister's Public Building of the Year Award in 2006. Designed by Studio E architects, the academy is built on a brownfield site, previously a railway yard and then a park. It was built using a project partnership contract which involved sharing responsibility by all partners for the entire project as opposed to contractors and consultants working in isolation.

The academy is divided into two distinct sections determined by the overhead bridge road passing through the site. One part houses the main building with the teaching and staff areas, space for dining and assembly built over five levels including the basement, the ground floor and three floors above. The other building incorporates an oversize four court hall, a dance/gym hall and all weather pitch for hockey/football. There are also external hard play tennis/basketball courts and fitness and changing facilities. The overall gross floor area for the main building is 10,554 m^2 and for the sports building is 1,552 m^2.

Internal view of the atrium

The main building is built around a large roofed atrium which forms the central core of the school with classrooms located around it on the upper floors. There is also an open courtyard towards the eastern site edge.



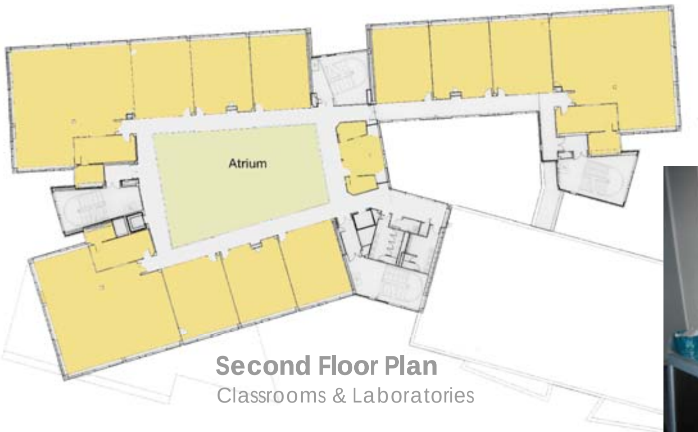
Dining area

Corridors run on all sides along the courtyard and the atrium with most of the classrooms and laboratories facing either north or south facing.

First Floor Plan
Classrooms & Laboratories

Corridors along the atrium

The external façade and the roof is constructed out of prefabricated engineered timber panels. The timber is FSC(Forest Stewardship Council) and PEFC (Pan European Forest Certification) certified and was hence sourced from sustainable forests. The curtain glazing from first to the third floor has aluminum framed, double glazed low-e windows. The floors are of pre-cast concrete.



Second Floor Plan
Classrooms & Laboratories

Typical IT lab

Third Floor Plan
Classrooms & Laboratories

South west facade

2 Methodology

The main aim of the post occupancy evaluation of the academy is to evaluate the performance of the academy with respect to energy consumption, environmental impact and occupant satisfaction and share the lessons with other buildings in the further education sector.

Certain preliminary information was collected about the building:

1. Fuel bills
2. Building plans
3. Building functions
4. Occupancy patterns and schedules

Table 1 **POE Methodology**

Required information		**Source**	**Tools**
Design	Design features	Architect, facility manager, media coverage	Interview, e-mail
Energy audit			
Fuel bill analysis	Gas & electricity use	Bills	
Space heating	Boiler specification	Facility manager	Interview
	Controls & BMS	Facility manager	Interview
	Radiators & user controls	Observation	Walk by survey
	Supplementary room heaters	Observation	Walk by survey, interview
Natural Ventilation	Window types & Controls,	Observation, Facility manager	Walk by survey, interview
		Occupants	Questionnaire
Lighting	Lights & controls	Facility manager, Observation	Walk by survey, interview
	Blinds	Occupants	Questionnaire
Environmental Audit			
Internal environment	Temperature, humidity and light (Lux) levels.	Measurement	Data loggers, spot readings taken manually
Water	Water consumption	Bills	
Waste	Recycling types	Facility manager, Occupants	Interview, Questionnaire
Travel impact	Travel emissions by users	Occupants	Questionnaire
Occupant Satisfaction Survey			
Comfort	Thermal comfort , Noise, Air & light quality	Occupants	Questionnaire
Controls	Heating, lighting, ventilation	Occupants	Questionnaire

3 Energy Audit

The energy audit of the building comprises of analysing fuel bills to recognise past trends in usage pattern, and comparing it with benchmarks to evaluate the building's performance. It also includes an assessment of the building services.

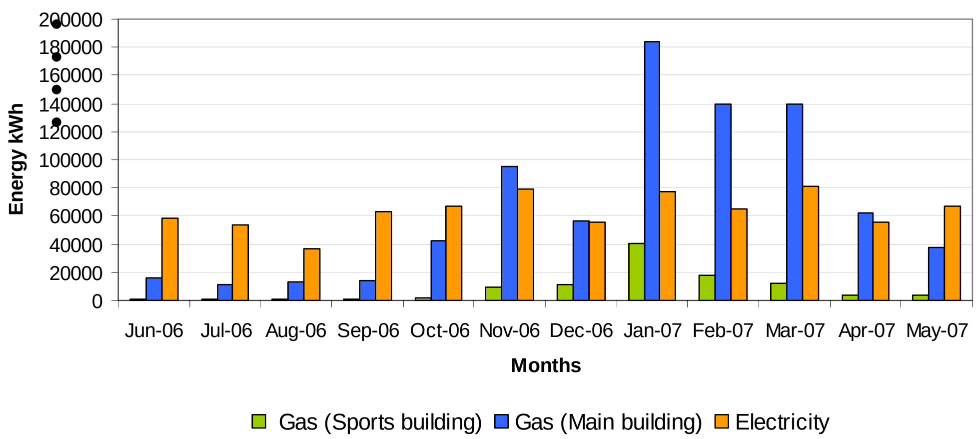
3.1 Fuel Use

The building uses two fuels, electricity and gas. Gas is primarily used for space heating and hot water. There is a separate meter each for the main building and the sports building. There is one common electricity meter for the entire site.

Total gas (space heating & hot water) used in the year June 06 – May 07 = 916,570 kWh
Total electricity used for June 06 – May 07 = 760,598 kWh

The graph below shows the monthly metered gas and electricity consumption of the building.

Fig 2. **Monthly Energy Use**



- The gas consumption is the highest in the winter months, corresponding to the heating requirements in the building, mostly January to march. December is a period of low use due to the Christmas break.
- The electricity consumption for mostly lighting, and equipment such as computers and appliances varies depending on availability of natural light (in summer, when use is slightly less) and on the school vacations which also forms a period of low use.

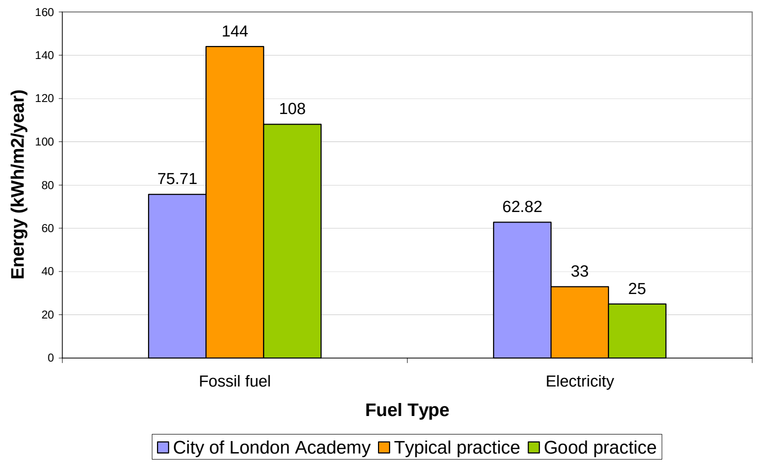
Comparison with benchmarks

To evaluate the academy's performance with respect to other secondary schools in the country, it is essential to compare the total fuel use to energy and environmental benchmarks.

Energy benchmarks

Gas = gas/gross floor area (916,570 / 12,106) **= 75.71 kWh/m²/year**
Electricity = electricity/gross floor area (760,598/12,106)
= 62.82 kWh/m²/year

Fig 3**. Comparison with Energy Benchmarks for Secondary Schools**
kWh/m2/year (gross floor area) (CIBSE 2004)

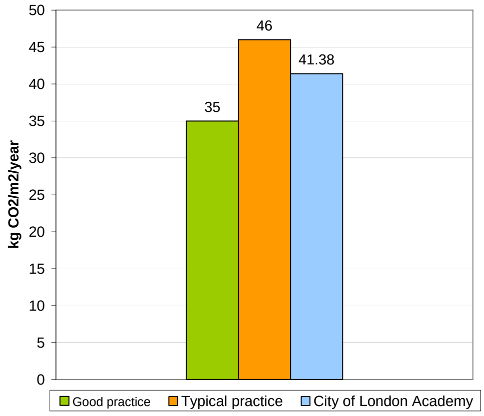


The city of London academy performs much better than a good practice benchmark for gas. This is expected of new schools as the benchmarks were devised for 1999 building regulations. The academy is built to 2002 building regulations and will hence, have better performing built fabric and more efficient boilers. The electricity use however, is much higher than typical practice. This is indicative of the increasing use of technology and equipments such as computers and smart boards for teaching. Energy for lighting could also be the reason for such a high electricity use in the school.

Environmental performance index (EPI)

Environmental performance index indicates the carbon dioxide emissions of the building with respect to good and typical practice benchmarks.
The school performs slightly better than typical benchmarks but there is potential for further savings if the aim is to reach good practice levels.

Fig.4 **Environmental Performance Index**
Kg CO_2/m^2/year (gross floor area) CIBSE



EPI = Energy benchmark for the school
*CO_2 conversion factor for the fuel
EPI for fossil fuel (gas) = 75.71 * 0.19 = 14.38
EPI for electricity = 62.82*.43 = 27
Total EPI = 14.38 + 27 = 41.38 Kg CO_2/m^2/year

Total CO_2 for the academy = 916,570*0.19 + 760,598*.43 = 501 tonnes CO_2/year

Energy consumption by fuel type

Fig 5. **Break up of energy use**
June 06 –May 07

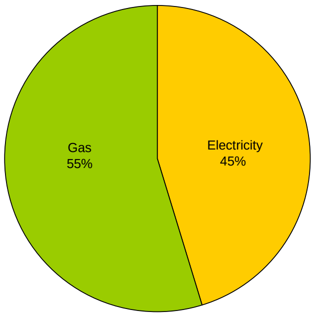
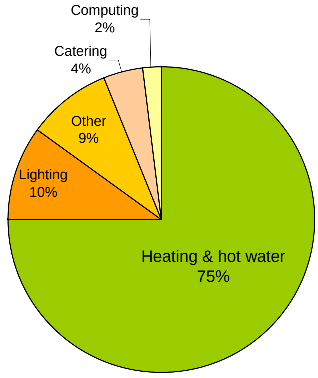


Fig 6**. Energy consumption for a typical UK school** (Carbon Trust 2005)



For a typical UK school, the electricity consumption forms around 25% of the total energy consumption assuming space heating and hot water are mostly provided by gas. However, in the city academy, electricity consumption forms around 45%of the energy use. This clearly shows that while the percentage use of fossil fuel for space heating has reduced in new buildings, the percentage of electricity use will expect a relative increase. However, comparing it with benchmarks also shows that the electricity use in absolute terms is almost double of typical practice. This implies wastage of electricity and shows that there are immense saving potential both in terms of costs and energy use.

Fig 7. **Breakup of costs of both fuels** (estimated)

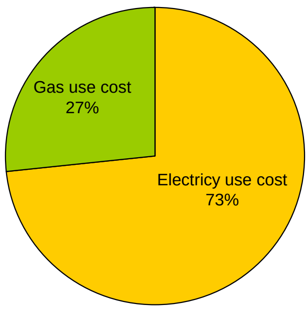
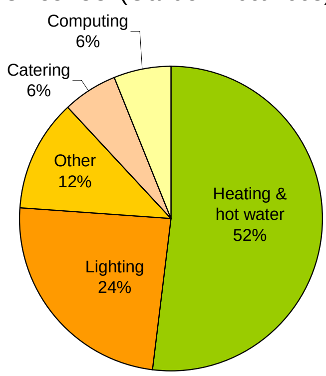


Fig 8. **Energy cost for a typical UK school** (Carbon Trust 2005)



The school has different energy contracts for gas and electricity. Assuming the unit price for gas to be 3 pence/kWh and 10 pence/kWh for electricity, the total percentage cost contribution of both the fuels can be seen.

Gas contributes to only 27% of the cost while it represents the bigger share of energy use whereas electricity accounts for 73% of the total energy cost of the school. This shows that any savings in electricity will amount to huge savings in fuel costs for the schools.

3.2 Space Heating and Hot water

Gas boilers

The space and water heating in the building is provided by gas boilers. The school has separate boilers with their own meters for the main building and the sports building. The sports' building has two separate condensing gas boilers while the main building has three condensing boilers with an efficiency of about 98%. To provide adequate heating, typically, two boilers work in the winter while, in the summer, only one boiler is sufficient to provide hot water in the building.

The management was concerned about heating breakdowns in winter which often lead to the schools being closed. In order to prevent this, the school asked for three boilers, even though, it was told that two boilers would be adequate with one providing back up for another.(Prentice and Elkin 2006).


Main building boilers


Sports building boilers

Building management system (BMS)

The BMS system is linked to various services in the building including the heating system, fire alarms, CCTV security cameras, outdoor lighting and also controls the ventilation through a few automatically controlled windows.

The heating system is almost entirely controlled by the BMS, apart from the controls provided to the users. The functioning of the three boilers in the main building is controlled by the BMS, which starts the required number of boilers to provide heating and hot water depending on the requirement.

The building has 16 sub meters which divide the building into separate heating and electricity zones. However, they have not been connected to the BMS as yet, making it difficult to understand the energy use in each zone. The premises management staff is trying to correctly synchronize the BMS with the heating system and controls.

Local heating source and controls

- The rooms are fitted with radiators and thermostatic radiator valves (TRV) to enable staff and students to partially control the heating in the classrooms and their offices.
- All around the atrium, the railing encases radiators to keep the common circulation areas and the atrium warm.
- In the sports centre, heating is provided through gas heaters situated at the top.

Observations

- The heating system design separates two different building types to be controlled independently, leading to increase in efficiency.
- Within each building, the system is further subdivided into several smaller boilers which allow catering to a changing heat demand more effectively.
- The boilers are high efficiency condensing boilers with well insulated pipework.
- The building has been divided into heat zones and has 16 sub-meters, but they are not linked to the BMS as yet. It would allow for better management and ease of operation once the sub-meters are connected.


Radiators with TRV

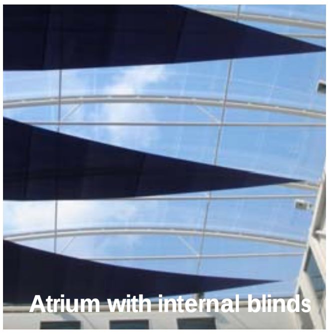

Atrium railing with radiators


Sports centre heating

3.3 Lighting

Daylight

The building is generally bright and well lit with sufficient amount of natural daylight in most spaces. The central atrium roof allows daylight into the surrounding common circulation areas. Classrooms also have internal glass walls next to the corridors, apart from windows, which allow light from the atrium into the classrooms. There is also an internal courtyard in the building which provides natural light into the circulation spaces.


Atrium with internal blinds


Internal blinds in classroom

Observations

- The atrium has three internal blinds to limit glare from sunlight penetrating into the space. The blinds only partially cover the atrium and are probably, not very effective in controlling heat gain within the space.
- North side staff offices receive inadequate daylight and require electric lights to be switched on constantly, even during the summer.
- There are no external sun shades in the building.
- There are internal heat blinds in the classrooms to protect against glare which allow partially diffused light to enter.

Artificial Lighting

The building has energy efficient lighting installed throughout. Classrooms and offices have T8 tubes in reflective/prismatic fittings. Corridors also have compact fluorescent lamps placed in reflectors.


CFL in corridors


T8 tubes in classrooms

Observations

- Light switches require keys to be switched on or off. This is to avoid breakage due to vandalism in the school.
- There are no occupancy or daylight sensors for lights in the school.

As shown from the preliminary audit, the electricity consumption in the building is much higher than average. Lighting forms a major part of electricity consumption in the school. One possible reason for this could be the absence of any sensors in the building, resulting in the lights being switched on constantly during the day. The situations is also worsened by the fact, that's switches are operated by keys restricting its use only to certain people. The use of sensors could probably have solved the problem of vandalism while reducing the energy load.

4.3 Ventilation

The entire school building is naturally ventilated. Windows in the atrium and parts of the corridor overlooking the internal courtyard are controlled by the BMS system and help in regulating temperatures in accordance with the external temperatures. The dining hall windows, assembly area and stairs also have windows which are controlled by the BMS system.


Circulation area windows


Circulation area windows


Windows in offices

4 Occupant Satisfaction Survey

The occupant satisfaction survey was carried out through a questionnaire of thermal and visual comfort, air quality and noise levels in the buildings. The survey was mostly carried out personally to collect the data.

4.1 General

Fig 8. **Average age of respondents**

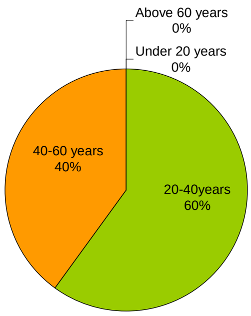
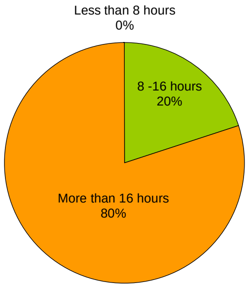


Fig.9 **Approximate time spent in the school in a week**



- The respondents consisted of mostly staff within the building ranging from teaching, administration and estates management team
- There were 10 respondents in all. Since the survey was carried out mostly in July – August, there was no student response which is recognized as a limitation of the survey.
- The male-female ratio of the respondents was equally split with five male and female responses each.
- Most of the respondents were in the age group of 20-40 years and spent more than 2 days in the school in a week. Hence, they were better placed to answer questions about the internal environment.

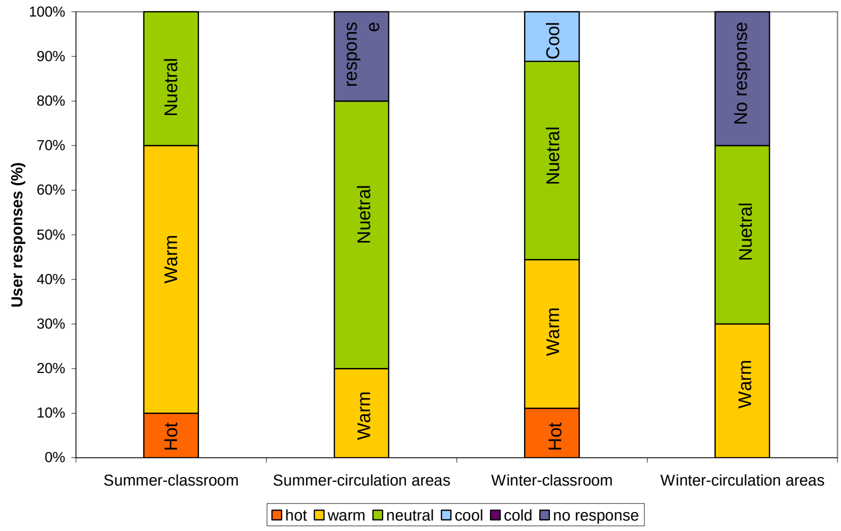
4.2 Comfort

Thermal comfort

Temperature of the space directly affects comfort within it. The users were asked to rate the temperatures in their space such as classrooms or offices in summer and winter to find out if they associate a particular temperature condition with the space. They were also asked to specify any space which was particularly uncomfortable.

- The school possibly experiences warmer summer temperatures and overheats while maintaining comfort in winters.
- The south facing classrooms, especially on the top floor and the atrium were mentioned by most people as spaces with uncomfortable temperatures. Some of the other spaces mentioned included the general and shared office spaces and the back stairs.

Fig 10. **Thermal comfort**



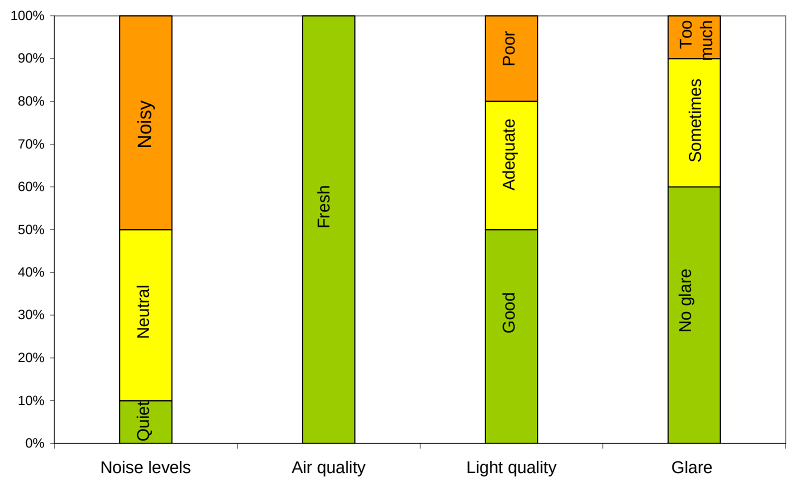
Noise levels, Air and Light quality

Noise in buildings can be a factor of discomfort in the work space. Although, most people get accustomed to the noise arising out of day to day activities of the school such as noise made by students or by the surrounding traffic, some sounds can affect concentration levels at work. The users were asked to rate the general noise levels in the building and specify, if they think it affects their ability to concentrate and hinder their day to day activities in the school.

Air and light quality in the building most directly affects the health and well being of the users. Air quality depends on a number of factors such as temperature, humidity, carbon dioxide levels and indoor pollutants and responses can provide clues to discomfort caused by often ignored factors and inadequate air change rates. The occupants were asked to rate the general air quality and movement in their space.

Availability of natural light and well lit working spaces have been linked to well being in learning environments such as schools and colleges. Users were asked to rate the quality of light and in their space and if there is any glare in their work area.

Fig 11. **Comfort**



- The response to noise levels shows that it might be dependant on the person' work area with parts of building being relatively noisier.
- 50% of the respondents who found the building noisy were not directly affected by it in a manner to affect their work. However, the other half, found the noise too bothersome.
- Some of the most common sources of noise as mentioned in the survey was the sound of rain falling on the atrium roof. Since the atrium forms the central core of the building, the design and choice of material is integral in its impact on noise. The other common source of noise was from pupils during break times, especially in the dining hall.
- Air quality was rated by all respondents as fresh and the majority 70% found the air movement in their space as comfortable without being draughty.
- The general light quality in most spaces including classrooms, work spaces and circulation areas was rated as adequate to good by 80% or more respondents. Poor responses were mostly from people in offices, who felt the natural light in the rooms is inadequate, specially compared to the other parts of the building.

4.3 Controls

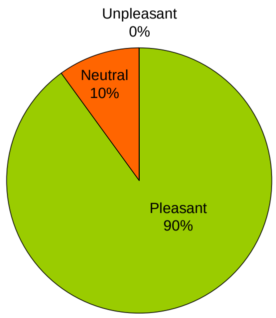
The questions in this section focus on the controls provided to users to adjust services such as heating, lighting and ventilation in their workspace. Discomfort in the space can be caused sometimes by not being able to regulate your surrounding environment to one's needs. Even when controls are provided, sometimes users are not aware about them or they are difficult to use leading to their infrequent use.

Some key results:

- Lighting controls - People have control over the lights in their work space.
- Ventilation controls - The windows and blinds are easy to operate and most people use it often to control their internal environment.
- Heating controls – 80% of respondents feel they have no control over the heating in their space.

4.4 Overall experience

Fig 12. **Overall experience**



Common reasons for a pleasant experience

- Airy and natural light
- Pleasant working environment
- Nice people

Any change you would like to make to your environment in the school?

- More control
- Internal stairs in atrium,
- Single student toilet block,
- Better blinds in classrooms
- Better natural light in offices
- Fresh air supply with heat exchanger

5 Environmental Audit

The environmental audit of the building was carried out to assess the impact of the building on its internal conditions of temperatures, light and humidity and wider environmental issues of the site concerning water use and waste recycling.

5.1 Internal Environment

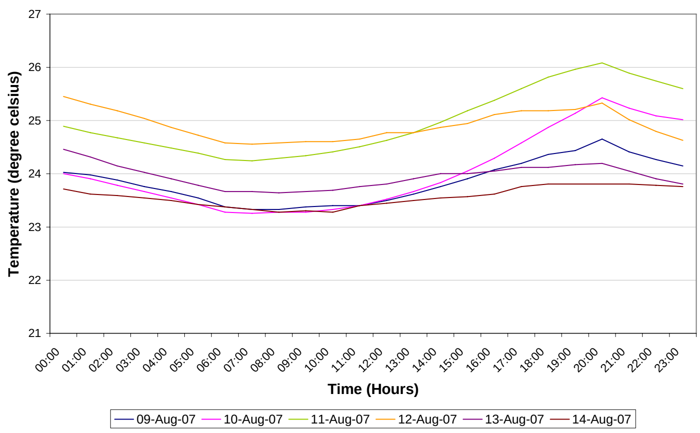
The internal environment of the building is most directly related to how the users feel inside the building and provides important clues to evaluate the building's performance. The internal environment audit was carried out through a series of measurements taken for temperature, relative humidity and light levels in the building. The measurements were taken by installing data loggers or manually recorded.

Temperature

Temperature was measured over a week in august by two data loggers. One data logger was placed in the atrium. The atrium forms the central core of the building and affects the temperature of the surrounding circulation areas. The second datalogger was placed in a top floor classroom in the North West direction. The top floor experiences the maximum extreme of temperatures in summer and winter due to the roof gaining or losing heat respectively.

All measurements were taken during the vacation period in august, when there were no students and the school was not in use. This implies that internal gains due to people occupying and using the space and from equipment such as computers have not been accounted for.

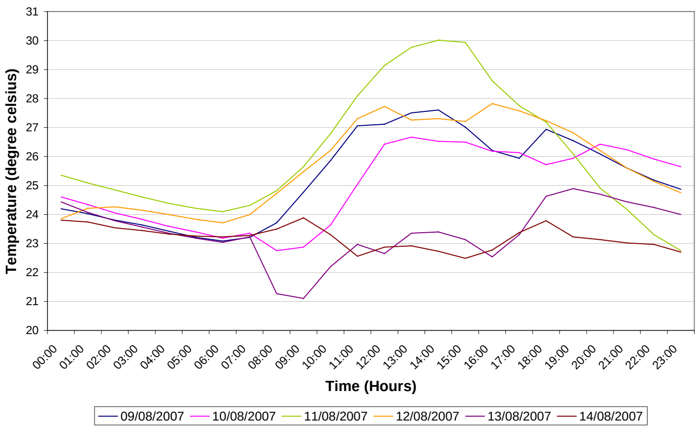
Temperatures in classroom over a week in august



The temperature in the classroom during weekdays is generally between 23°C – 24°C and rises to about 25°C on some days. As the room is on the west side, the temperature increase is noticed after 4pm when the room receives direct sunlight.

- The room remains at this higher temperature most of the night and till the early morning as the windows are closed at school closing time in the evening.
- During the weekends, on 11and 12 august, the temperature is higher than the weekdays, probably because the windows were not opened for ventilation.

Temperature in the atrium over a week in august

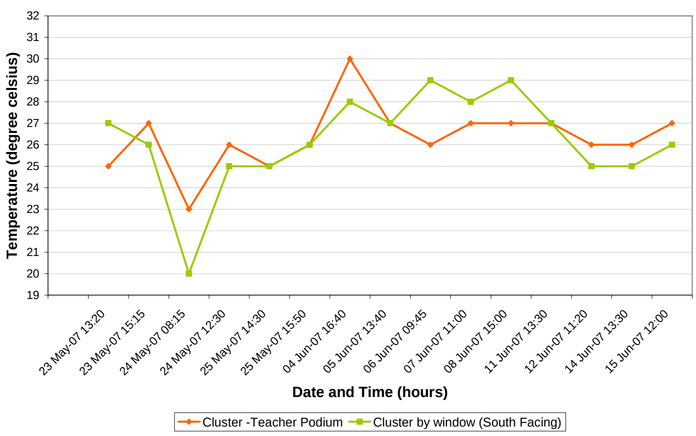


The temperature peaks after noon mostly, though on sunny days, it can go above 25°C in the morning at around 10 am. Once the building closes at 6.00 pm all the windows are closed by the staff. Hence, the temperature remains high till 8 in the evening after which the building starts to cool down a bit, but not much.

- Night time purging might be an effective way of cooling the building, especially through the atrium windows.
- The temperatures on the same days are higher in the atrium than in the top floor classroom by 3-4°C during peak times. This is probably, because the effect of windows being opened in the classrooms has a quicker effect on the local environment of the room itself.

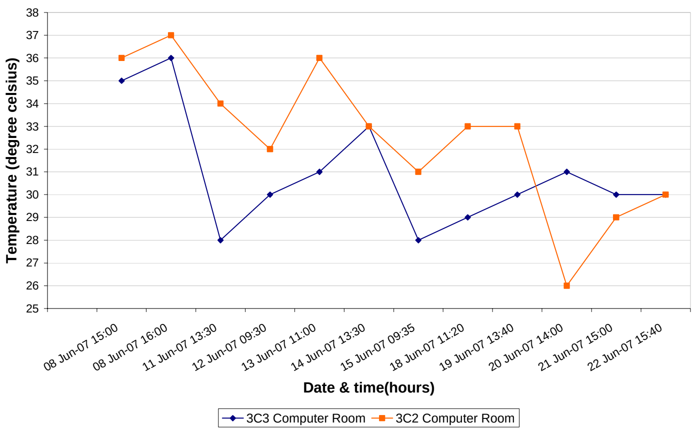
The graphs below show the data collected at one time interval during a period of two weeks. The estates management staff has been manually monitoring temperature in the south facing top floor rooms over a period of may and June to understand the conditions in the building. The data comprises of spot readings taken once each day when the rooms were being used with the windows open.

Temperature readings in the top floor Clusters



The temperature in the spaces frequently goes up 25 degrees and reaches high of over 35°C sometimes depending on the external temperature.

Temperature readings in Computer rooms 3C2 & 3C3

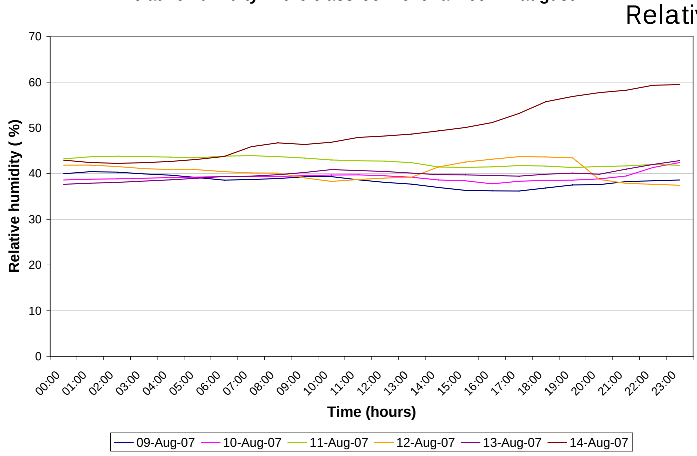


The heat generated by the computers and people using the room adds to the discomfort in the space.

Relative humidity (RH)

Relative humidity levels in the space are also linked to comfort. Very high humidity encourages microbial growth while low humidity might lead to excessive dryness in the air resulting in certain health issues such as eye irritation. A generally recommended value for spaces with controlled internal conditions is around 30- 60% relative humidity.

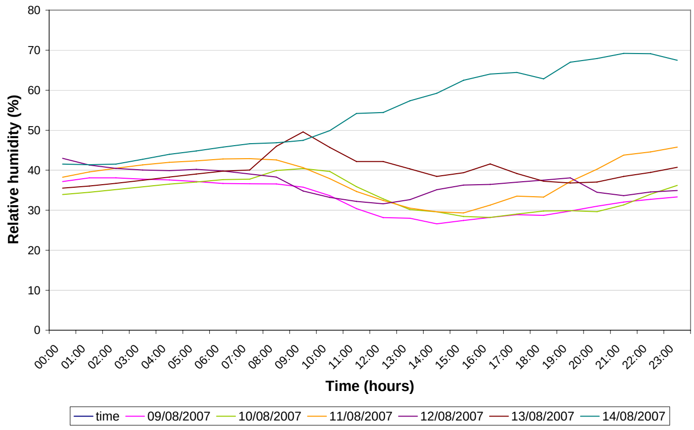
Relative humidity in the classroom over a week in august



Relative humidity was measured through data loggers in the atrium and the classroom over one week in august during vacations.

RH levels in the classroom remain well within the comfortable range except on one day. This is probably, due to low temperature in the space.

Relative humidity in the atrium over a week in august

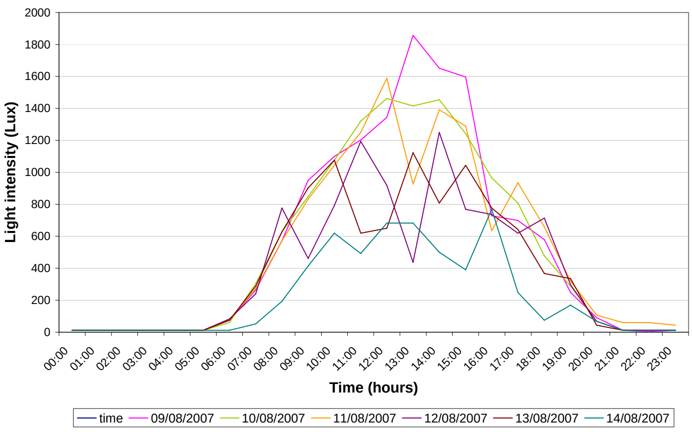


RH levels in the atrium vary more than the classroom but remain within the comfortable range.

Light levels

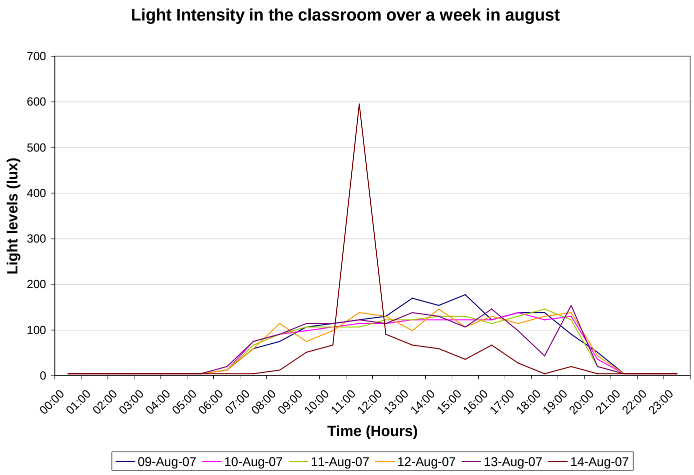
Light levels were measured through data loggers in the atrium and one North West corner classroom on the top floor over one week to asses the quality of natural light in spaces. The recommended light level (including electric lights) in classrooms is in between 300-500 lux depending on the nature of the task.

Light Intesity in the atrium over a week in august



The light level in the room during the daytime is mostly between 100-180 lux. Since the school was not in use, the classroom readings can be assumed to be only natural daylight readings.

The single high reading of 600 lux might correspond to switching on of electric lights in the room.



The atrium receives large amount of daylight during the day as can be seen from the recorded lux levels.

5.2 Local environment indicators

Water Use

Information about the total water use in school was not available. The table below provides water consumption for typical and good practice use in secondary schools in UK, which can be used to estimate the water consumption in the school.

Table 2 **Water benchmarks for schools** (Carbon Trust 2005)

Water consumption (m^3/pupil/year)	Secondary school (no pool)
Good practice	2.7
Typical	3.9
Poor practice	5.8

Total number of school students = 788
Typical water use = 788 * 3.9 = 3073.2 m^3 /year
Good practice water use = 788 * 2.7 = 2127.6 m^3 /year

Waste and Recycling

There are currently no particular strategies in place for recycling though recycling is encouraged among staff and students.

Amongst the responses received from staff, almost 90% people are aware about environmental strategies within the school such as energy efficient lighting and a number of recycling initiatives. The school collects and recycles mostly paper and other stationary items such as cartridges, CDs, batteries. Plastics and uniforms are also recycled.

Transport

The city academy is located within easy access of public transport links. The nearest bus stop is less than 200 meters away and the school has good links with the underground tube stations as well as mainline train station.

The school has around 60 car parking spaces in its underground parking with spaces for cycle parking as well. The school promotes its staff to walk or cycle to work or travel by public transport and car shares. Majority of the school pupils come within from within arrange of 1.5 km with the average distance traveled is about 500 meters.

The graphs below are based on the responses received in the occupants' survey. The staff members were asked to specify the distance they travel to reach the school and the mode of transport.

Fig 13**. Distance traveled**

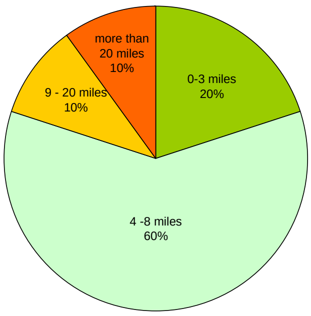
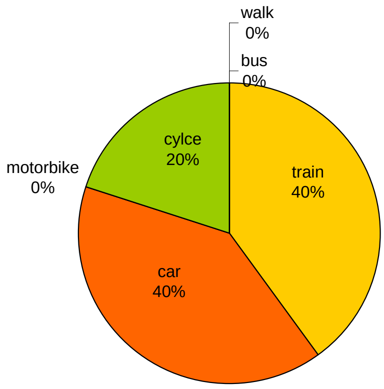


Fig 14. **Mode of transport**



- Majority of the staff live within 8 miles of the school which is easily accessible by public transport.
- However, 40% of the staff still travels by cars instead of public transport.

6 Conclusions

1. The academy's carbon emissions are slightly better than typical practice but fall short of good practice.

2. Gas consumption is much better than good practice benchmarks due to improved fabric and efficient boilers.

3. A very high electricity component of the total energy load as compared to other schools.

- Lighting is the major user of electricity in buildings. To avoid glare in south side classrooms and overheating of spaces, internal blinds are drawn during the day which requires the use of electric lights.
- There are no light sensors and hence, all lights are constantly on during the day. Installing sensors for daylight and occupancy with manual overrides can help in energy savings especially in areas of intermittent use such as toilets and circulation areas.

- Another possible reason might be increase in numbers of IT equipment as compared to other schools.
- Ensuring that the computers are kept on a standby mode during intermittent use and switched off after the lessons will result in energy savings. Switching just the monitor off when not in use will itself result in saving 60% of the energy required to run a computer.(Carbon Trust 2007)

4. High summer temperatures in the school, especially in south facing rooms on the top floor and the atrium.

- It is essential, that passive design measures such as correct orientation, façade and window design including shading strategies are used effectively to avoid heat gain and protect the spaces from excessive glare.
- Night purging through top floor windows can help in cooling the building overnight before the start of the next day. Security measures will need to be considered.
- The atrium also experiences high temperatures and direct sunlight in the summer. Overheating and ventilation issues in the atrium should be considered carefully at the design stage.

5. BMS system is not connected to all sub-meters and is difficult to synchronize with the services.

- The premises management staff are trying to correctly synchronize the BMS system to meet user demands effectively.
- The sub-meters need to be connected to the BMS system to understand where and how much energy is being used.
- Results of occupant satisfaction survey show that 80% people feel they do not have any control over the heating in their space and would prefer simple controls to manage their environment.

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Post Occupancy Evaluation

City of London Academy

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