



Mariah Edwards

BSc Civil Engineering

2023

**ADVANCED CONSTRUCTION AND CIVIL
ENGINEERING**

Building overview

The Saint David's College Lampeter library, now known as the UWTSD Lampeter Campus library, has undergone significant changes in its function and physical structure over time. It was established in 1822 and was originally housed in the 'Old building'. The shelving capacity proved insufficient, leading to an increasing number of books to go into the stores. Due to this growth in contributions to the library collection, and the college's expected occupancy growth of 450 Arts students by 1973, the library's function and purpose outgrew the library's floor space. (UA|L|2|2|47)

The new library building was opened by H.R.H The Duke of Edinburgh in 1966. It was funded by treasury grant-aid through the University Grants Committee and the library marked the first completed among the newly approved developments and expansion initiatives of the college. The new library, designed by Elidir L.W Davies and Partners, of London, is an open plan, open access library, providing both lending and refencing services. It was designed to have shelf space for about 90,000 volumes and seating for eighty readers including four study rooms. (UA|L|2|2|47)

The college hoped that the new library design and site would meet the needs for twenty years on that basis, this space however, soon became inadequate less than 20 years later and the building was significantly remodelled and re-opened by the Prince of Wales in 1984. (Roberts, 2018)

The library supports academic research by providing access on a vast array of scholarly resources, journals and databases and contributes to the development of information literacy. Students benefit from the study spaces and collections available both online and in person.

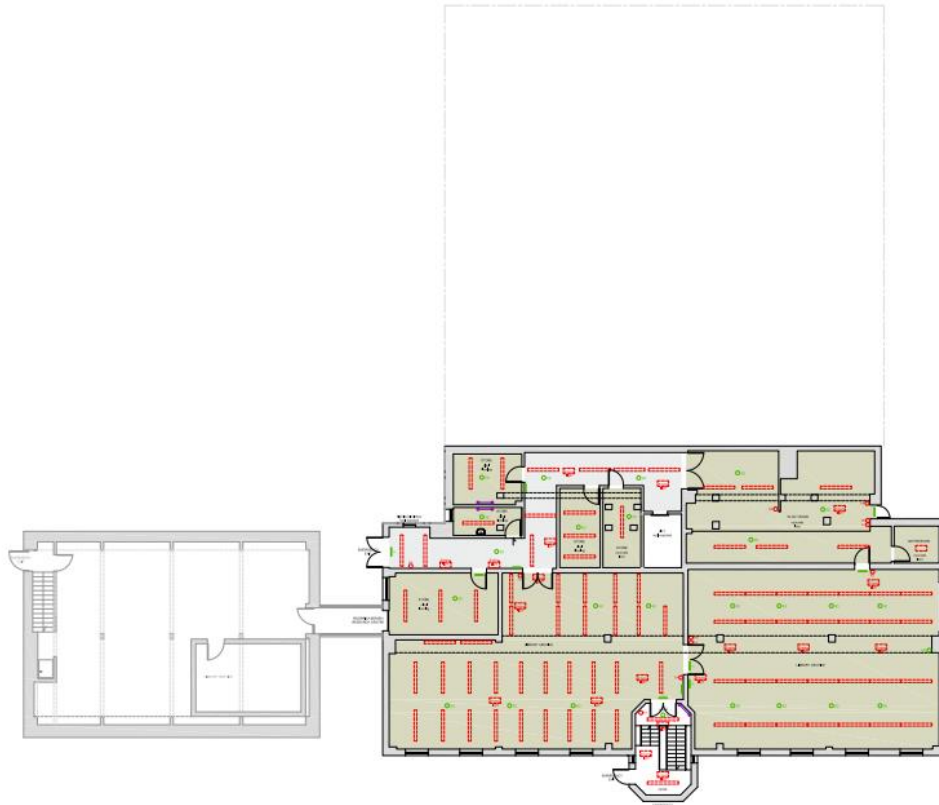


Photo showing 1966 Library - (own image,2024)



Photo showing the 1984 library extension present day-(own image,2024)

The library's main building, (1966 design) has a modern style featuring brick walls with a white painted cement render broken by the steel frames of narrow outward top hung windows in a vertical arrangement and polished aluminium entrance doors. Local stone is used to clad plinth of the building where it projects from the steep bank which the library is built. The library's new extension, (1984 design) was designed with the college's old building in mind as it was considered the most attractive. It features a Greek Revival-Renaissance design with slate roofing. Arched windows on the top level and squared steel frame windows on the two lower floors are separated by a cylindrical emergency staircase enclosed in the centre of the building that features a dorm forming roof/cupola. (UA|L|2|2|47)



Screenshot of existing Basement Plan, (Rees, 2023)



Screenshot of the existing Ground Floor Plan (Rees, 2023)



Screenshot of Existing Ground and Upper Floor Plan,(Rees, 2023)

The library has a gross total area of 1112 m² and has three levels. The basement accommodation includes storerooms, a meter room, a plant room and the closed access bookstack library archives. This links through the existing (1966) library floor for service and delivery which is made from the south side via the realigned service road.

The ground floor level has three meeting rooms, two office rooms where one room has the capacity for two members of staff and the other has for four. This floor also has open access book stacks. The reading room features a mezzanine level between the two bookstack floors. It serves as a pleasant integration between the books and readers without separating one level completely from the other.

The ground floor has a suspended ceiling fitted with florescent lights and squared roof light between each light fitting.



Photo showing roof light and lighting fixtures.

There are five one occupancy offices and one six-person office space. There are Male wash and female washrooms, kitchen, meeting, and storage rooms.

The 1966 library building's structural framework comprises of reinforced concrete column, beams, and floor slabs, and it features roof decking supported by extended span steel beams. In zones housing substantial bookstacks, the columns exhibit close spacing in one direction, proving support for shallow beams and a thick concrete floor slab. (UA|L|2|2|47)

The structural bay for the 1984 extension is 6.6 meters x 11.0 meters at the upper floor which was reduced to 6.6 meters x 5.5 meters at the lower floor. (UA|L|2|2|47)

In-situ reinforced concrete frame and floors were in place for the bookstack floors. The roof over the upper floor is spanned by triangular roof trusses, these are composite membranes of timber and steel opened over all except the furthestmost bay which has services within the roof space. The open trusses provide welcomed additional height and allow for glazed lighting in the slope of the roof to reinforce natural light in the reading room area. There is an area approximately 1.5 meters wide links the 1966 building to the 1984 extension. (UA|L|2|2|47)

There were site investigations that revealed that the ground of the proposed extension was made-up and contained refuse, coal ash and building rubble so it was recommended that pile foundations be used. However, due to the new library extension's proximity to the existing library it was noted that the vibration of changes in groundwater levels could have an adverse effect on the structure. Dowsett Prepakt Piles were recommended to be adopted due to its complete vibrationless and relatively noise free feature. (UA|L|2|2|47)



Photo Installing piles 1984 Library extension. (UA|OM|418)

A design superimposed load of 6.5 kN/m² (130 lbs/ft²) was adopted throughout to give the greatest flexibility this was in accordance with the BS Code of Practice CP3 Chapter V, Part 1, Dead and imposed Loads. It is still in accordance with current regulations expressed in the EN 1991-1-1:2002 (E).

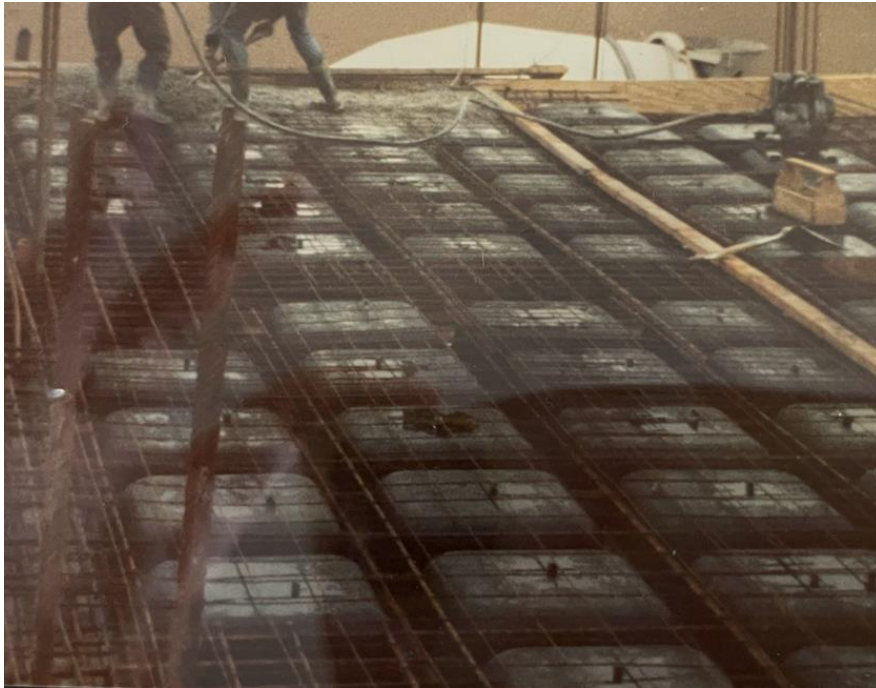


Photo showing library (1984) extension waffle floor slab being installed (UA/PM/441)

The heating and ventilation system is considered adequate for the building structure. Skirting heaters and natural convectors, located mainly at the building's perimeter to counter fabric heat losses. Low- temperature hot water is circulated by heating pumps and is temperature controlled using a mixing valve based on external weather

conditions.



Photo showing heaters around the reading room (own image, 2024)

The heating system uses low-pressure hot water and is controlled by an outside thermostat adjusting heat output based on external temperatures. Mechanical ventilation in book stack areas.

Building Assessment

While the Cupola/ Dome adds to the architectural appeal of the building it has pose some issues to the interior due to leakages.



Photo showing cracks along the walls below the cupola. (own image, 2024)



Photo showing dampness in wall below the cupola. (own image, 2024)



Photo showing container placed to collect water from the leaky cupola. (own image, 2024)



Photo showing condensation around ceiling. (own image, 2024)

Steps were made to improve the building's operational energy performance by installing LED lighting with enlighten smart sensors. This saw an energy saving of 86482 kWh from 98376 kWh. This in turn had a total lifetime carbon saving (20 years) of 354.60 tonnes and avoided an 8% increase in the annual lighting expenditure.

The installation of 212 building mounted photovoltaic electricity generating panels with a Watt peak of 380 is expected to save 16.74 tonnes of (CO₂).



Photo showing PV modules installed on roof.

There is a scheduled improvement to replace windows at a net value of £77,847.33 from single to triple glazed. This replacement is expected to provide better insulation, improve energy efficiency, and reduce heat loss and cold draughts.

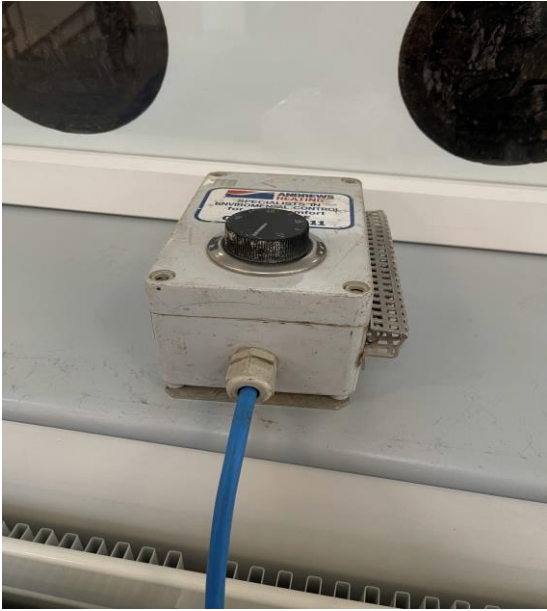
These changes have led to an increasing in its energy performance operational rating from previous years, from an operational rating of E in 2013 to 75 C in 2019 to 48B currently.

The table below shows the typical energy use of the library.

Energy use	Electricity	Other fuels
Annual energy use (kWh/m2/year)	40.94	173.38
Typical energy use (kWh/m2/year)	114.98	270.93
Energy from renewables	8.6%	0%

UWTSD Main library energy use. (Gov. UK 2023)

A report for the period 2021-2023, showed the electric and gas usage at the campus library showed that the months that students are typically on campus show an increase in consumption compared to the Easter and Winter breaks when its assumed students go off campus. There was a drop zero kWh from November 2023, and this is in line with no heating available to the entire library. To address the issue of no heating, The reading room and upper floor are being heated by portable gas heaters with a vent hose pipe connected. This is shown in the images below.





Meeting rooms which are sometimes used as lecture rooms are being heated with up to two 2kWh, oil filled electrical radiators. A member of staff noted that these are left running all day and throughout the night to keep the rooms heated as we are the winter months and lectures have resumed. This is expected to have significant impact on energy costs.



Photo showing electrical radiators (own image, 2024)

Some of the good things about the building library building is the Mezzanine floor that optimizes space and provide flexibility, it creates an open space that is inviting to readers and occupants of the library. The roof lighting and its ratio to lighting fixtures, the benefits are an increase natural daylight. Materials procured in the construction of the library was also locally sourced which plays a fundamental role in reducing the embodied energy that is associated with materials that travel long distances.

Future Specifications

An assessment of whole life cost would be taken at earliest stages of design with consideration to all relevant cost and revenues associated with building components and the entire building. The wider site would be assessed before building form, fabric, and technology.

A future proofed approach would be adapted to maximise sustainability by anticipating and planning for change over the long term.

An assessment of location for the library would be done as there are clusters of buildings around the library like the Canterbury building. This would be done to ensure they would not have negative impacts on the buildings comfort control strategy such as overshadowing. Analysis would be done to consider solar path to maximise the potential benefits of solar gain.

Tools such as a simplified energy model (SBEM) or dynamic thermal model would be used to assess the environmental performance of the building design to meet part L compliance for building regulations. Comfort calculations, daylight modelling, Noise mapping and acoustics analysis, passive design assessment tools would also be used to investigate and explore efficient building forms and layout.

Space planning would be done to avoid a lack of space and an unwelcoming environment for occupants. For example, this involves ensuring enough bathroom facilities to ensure that there is not an overflow or inconvenience towards library users when needs be and having open spaces to encourage movement and avoid congestion.

A fabric first approach would be taken to maximise energy performance of the building during the design process over fuel sources and renewable energy.

Steps would be taken to limit heat loss through the building fabric by provision of thermal insulation and passive solar design considerations. To avoid any heat loss, create potential for condensation, mould growth and fabric decay, thermal bridges will be designed out but where it cannot be avoided the impact of heat loss would be calculated.

The goal would be to achieve an airtight building of 0.6 air changes per hour by having a high build quality and inspections to identify and correct any issues. Insulation continuity would be priority to retain heat and reduce energy consumption.

To reduce hot water demand, water saving taps would be implemented to help use energy resources efficiently. Biomass heating systems would be considered along with Solar PV models to provide a clean renewable energy source. Installing a ground source heat pump offers efficient heating and cooling.

Instead of In-situ reinforce concrete frame and floors full structural timber frame with cross laminated floor supported on glulam timber, internal and external glulam bracing.

Changing from a steel and concrete structure would help in reducing the upfront carbon, however, the use of timber frame poses fire risk so specialists engineering input would be required a greater effort would need to be placed on noise and vibration treatment due to reduced density.

Mixed mode ventilation would be implemented by allowing windows to be openable but have indicators telling persons when they're best kept closed. This would be best to enable passive cooling in the spring and autumn. The timber floor would be built up without floor access for services.

Design for manufacture and assembly (DfMA) would be used for offsite prefabrication and onsite construction of components such as structural columns and beams. This would help in reducing material use, waste generated and embodied carbon will enable a faster built time and safer working environment as working at height with be shortened.

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