Ritchie
+ Daffin

Acland Burghley School Assembly Hall Renovation Works

The principal aim of the project is to improve the public amenity of the assembly hall at Acland Burghley School and to ensure the space can provide a comfortable environment for occupants to enjoy the space and safeguard its functional use with a warming climate.

Due to the historical importance of the exposed concrete in the existing building, there is little scope to improve the fabric of the assembly hall, however double-glazed windows were installed in a recent renovation. Where possible the reinstatement of the original passive environmental conditioning measures that are currently out of service has been sought. This includes the recommissioning and enhancement of a historic high-level openings for exhaust air; and repurposing the stage builders' work for a supply air path.

Mechanical and electrical systems in the assembly hall have been perpetually retrofitted over its lifetime, many of which are not well-integrated to the original design of the hall. The services engineer, Ritchie+Daffin, have carried out an appraisal of the existing services. Services, such as the lighting and small power electrical accessories, that are near or at the end of their life and poorly integrated will be replaced or relocated. Services that have been recently renovated, such as the gas boiler and LTHW heating system will be retained. Where possible, retained services will be better integrated into the space by concealing behind refurbished timber linings.

Ventilation

A major component of the scope of this project is to improve the ventilation and environmental conditioning of the Hall. The hall was originally designed to be naturally ventilated by the existing clerestory windows. These are difficult to operate, and overtime have been blocked up or the air paths have become obstructed by black-out blinds. When opened the windows are acoustically problematic with the playground noise spilling into the hall, and sound from internal activities breaking out.

As such an enhanced ventilation system is required that can overcome the need for blackout across the existing clerestory windows and achieve better acoustic privacy between interior and exterior. The proposed ventilation system needs to cater for a maximum occupancy of 300 persons to limit heat and CO_2 build-up.

From our perspective the historic nature and constraints of the hall does not preclude the pursuit for energy efficient and passive systems in improving comfort, and we are aware of the measures we can incorporate into the building to counteract the thermal performance of the fabric which is substantially lower than modern standards.

Our proposed ventilation strategy utilises a buried earth duct that acts as a heat exchanger with the relatively constant ground temperature to temper the fresh air into the hall. With this system, all of the cooling energy required for comfort in summer is provided passively – taken directly from the ground. Over the hopefully long life of the building, this will lead to significant energy and carbon savings compared to mechanical cooling alternatives – whilst also precluding the need for refrigerant gases.

An earth duct is particularly well suited to an auditorium space both by the acoustic privacy provided through the long ventilation path and by enabling the thermally massive concrete walls and soffit to be precooled before events – ideal in a space where the heat gain from occupants is intermittent.

The earth duct is formed of a large diameter concrete duct approximately 70m in length and buried at least 1m belowground. An air intake terminal is located at one end of the duct with the other end connecting directly into the building.

A low power fan blows fresh air through the duct and into the space. The duct is in contact with the ground which is at an inherently stable temperature of 12-14˚C. In the summer, the air supply to the hall is cooled by the surface of the duct to as low as 21˚C from 30˚C external temperature. This approach avoids the need for an active mechanical cooling system as all the air is cooled passively. In winter, the air is passively pre-heated by up to 8˚C on a 0˚C day. This pre-warming of the air helps reduce the heating energy required to temper the space and the associated carbon emissions of the systems operation.

The air supply will be introduced at low level within the room at a slow and gentle rate. Known as displacement ventilation, this provides air where it is required, adjacent to the audience, at very low velocity to reduce the risk of draughts. The low velocity also helps to reduce noise associated with the supply air.

The advantage of supply air at low level is that it works well with natural stack effect of rising warm air. The air absorbs heat from the occupants as it rises and therefore only needs to be supplied a few degrees lower than the desired room temperature. Stale air will be exhausted from the space at high level through existing openings that are currently blocked up. The existing openings will be fitted with acoustic thermally insulated and motorised louvres. An attenuated air path will also be formed from the air exhaust terminals on the facade to the ceiling void to reduce sound break out / in.

The ventilation system will be controlled automatically based on the internal temperature and air quality by modulating the fan speed and opening the high-level vents. This will reduce energy usage by ensuring it is only operating when necessary.

In summer the ventilation system will be run on a low duty during the night-time to purge the heat build-up in the earth duct and thermal mass of the space to harness free cooling.

Active Measures

Bathrooms and WC's shall be provided with local mechanical extract ventilation fans operating from presence detectors linked to the lighting. Fans shall have efficient DC motors with a specific fan power of less than 0.5W/l/s

Lighting will be replaced with highly efficient LED luminaires throughout. These will mimic the visual aesthetic of the historic fittings. The lighting controls will be simple and easy to use with dimming and presence detectors within corridors and WCs.

Motorising the blinds to the auditorium to make them more readily deployable or retractable, improving the gloomy feel of the space and reducing the excessive demand for artificial lighting.