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Case Study

Powered Smoke Shaft Ventilation System for a Residential Development

The Ditton Walk development was designed in such a way that it prohibited a 1.5m² (as recommended by Approved Document B) smoke shaft used to naturally ventilate smoke from the common corridors. Also, due to the layout of the building at Ditton Walk, the longest corridor (13m) was in excess of the maximum travel distance (7.5m) set out in Approved Document B. Therefore a code compliant solution was not viable and a fire engineered solution was necessary.

The architect, CMI Consulting and the developer McCann Homes, initially met with both Birmingham and Cambridge Building Control and Cambridge Fire Services to discuss the options for a smoke ventilation system. McCann Homes appointed SE Controls to develop the solution.

‘The smoke ventilation system that was demonstrated today at Ditton Walk Cambridge, successfully cleared the smoke to tenable conditions from within the corridor within 60 seconds to meet the criteria as set out within the design proposal and has been successfully approved.’

Tim Spittle, Birmingham Building Control

Name:
Ditton Walk.

Location:
Cambridge.

Title:
Providing a smoke ventilation solution within a residential premise to provide safe escape routes for occupants in the event of a fire and to provide clear access for the fire service to enter the affected area, using powered ventilation techniques.

Challenge:
To design, install and commission a smoke ventilation system for the three storey block of nineteen apartments at Ditton Walk, Cambridge.

Benefits:
The fire engineered solution specified has minimised the impact of the Smoke Heat and Exhaust Ventilation system (SHEVs) on the usable floor space, creating an economic benefit to the client, through a reduced sized smoke shaft using powered extract rather than natural smoke ventilation.

The maximum travel distances allowable under Approved Document B was increased by incorporating a fire engineered solution.

Additionally the powered smoke shafts have effective extract rates considerably higher than a natural system resulting in clearer more tenable means of escape and fire fighting conditions.

Design, Cost Planning and Approval

SE Controls were able to look at several scenarios for their client by using Computational Fluid Dynamic (CFD) modelling to select the optimum solution. The ventilation system needed to meet two objectives:

1. Means of escape – Ensure that once the door to the apartment has closed, conditions within the corridor become tenable, allowing occupants to reach the stair via the corridor.
2. Fire Service access – Keeping the stair free of smoke, allowing a safe working environment for the Fire Service.

The analysis needed to prove that any proposed system must perform at least as well as an Approved Document B prescribed solution.

CFD modelling analysis

The extensive CFD analysis proved that using a conventional naturally ventilated smoke shaft system as described in Approved Document B, would fail. SE Controls therefore modelled the scenarios using their SHEVTEC® Powered Extract Fans to mechanically ventilate the lobbies via a reduced sized smoke shaft. CFD modelling was able to successfully prove that the SHEVTEC® Powered Smoke Shaft system was able to perform better than a code compliant solution and so SE Controls were happy to recommend the system to the client and Building Control.

The two scenarios were tested separately to allow for clearer assessment and clarity.

For the **means of escape** assessment, figure 2 shows the visibility within the corridor at different periods of time. The results showed that once the apartment door was closed and the system activated, visibility increased quickly to 10m, and smoke cleared completely at around 85 seconds, allowing occupants to exit effectively.

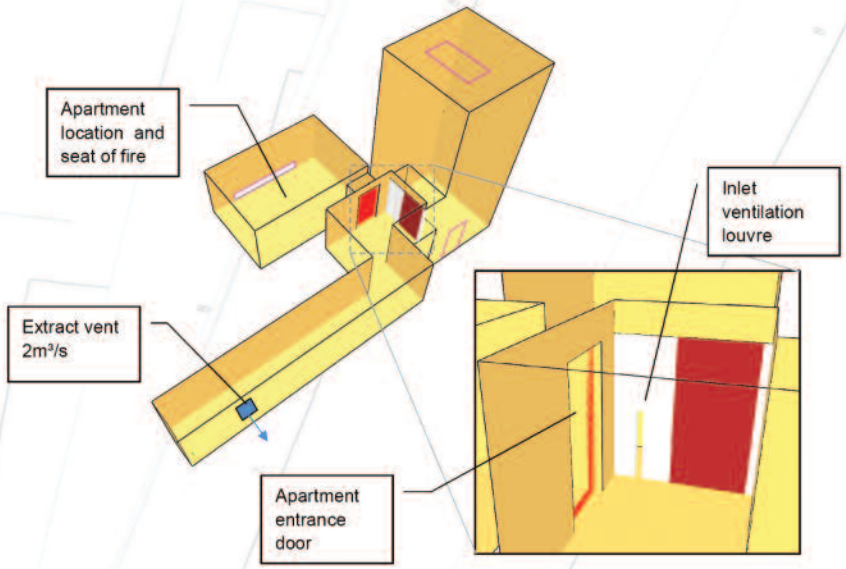
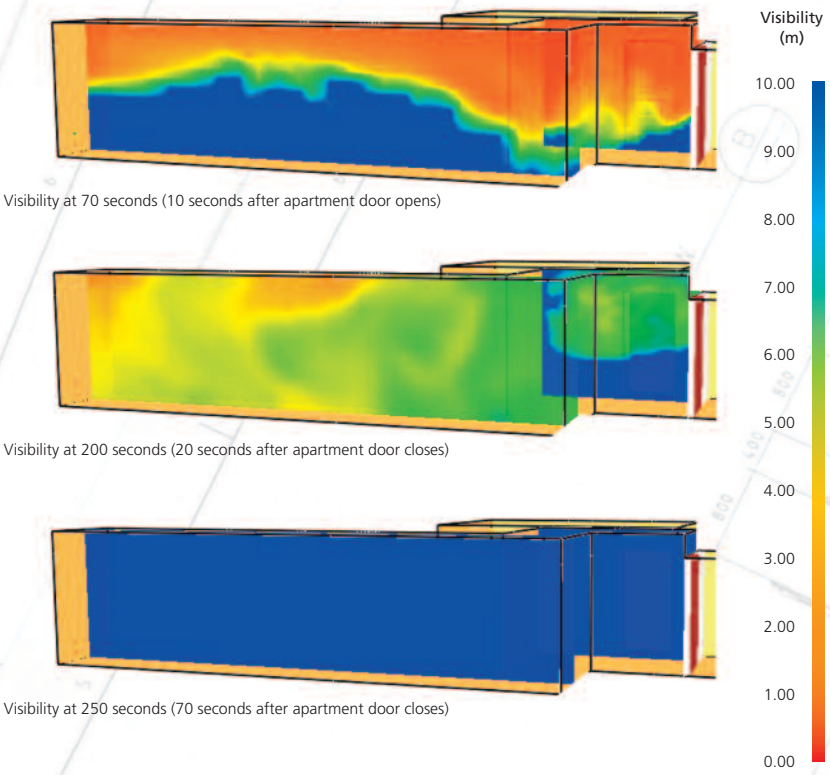


Figure 1: The proposed system that was modelled



Visibility at 70 seconds (10 seconds after apartment door opens)

Visibility at 200 seconds (20 seconds after apartment door closes)

Visibility at 250 seconds (70 seconds after apartment door closes)

Figure 2: Visibility in the common corridor

Figure 3 looks through the stair (in section) and shows the effect of the extraction fan causing the stair door to act as an inlet and keeps a majority of smoke within the corridor.

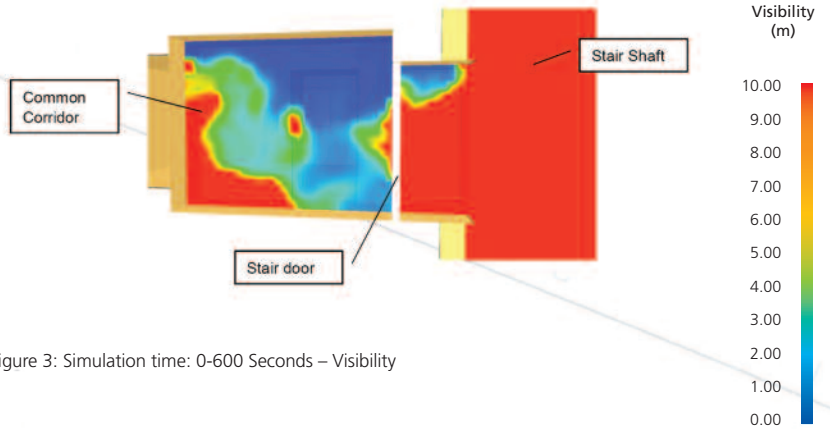
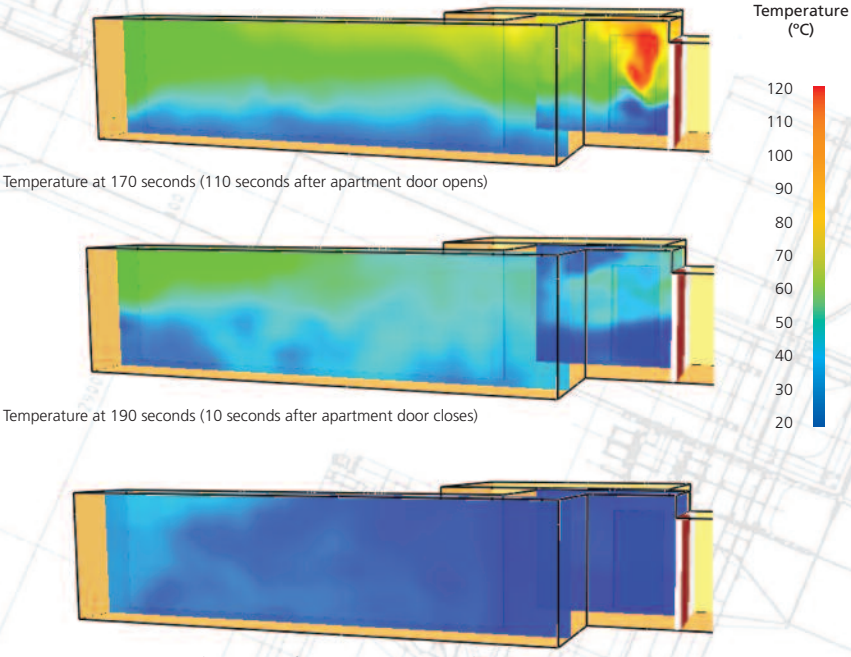


Figure 3: Simulation time: 0-600 Seconds – Visibility

Figure 4 shows the temperature in the common corridor at different intervals. Whilst the apartment door is open, the temperature does not exceed approximately 90 degrees Celsius, allowing occupants of an adjoining apartment to exit within the tenable temperature conditions. The model also shows that at approximately 30 seconds after the apartment door has closed and the system is activated, the temperature is almost ambient.



Temperature at 170 seconds (110 seconds after apartment door opens)

Temperature at 190 seconds (10 seconds after apartment door closes)

Temperature at 210 seconds (30 seconds after apartment door closes)

Figure 4: Temperature in the common corridor

Through the extensive analysis of the proposed system within the building envelope, both SHEVTEC® Powered Smoke Shaft systems were found to exceed the required criteria for means of escape and fire service access and exceed the requirements of the Building regulations and guidance of Approved Document B. The extended travel distances within the corridors were considered adequate based on the smoke clearance system being effective within 60 seconds.

The proposed SHEVTEC® Powered Smoke Shaft system incorporated the use of a 1m² shaft as the mechanical smoke extraction shaft. Make up air was designed to come from the escape stair via low level fire & smoke dampers. Replacement air into the escape stair was modelled to come via an Automatic Opening Vent (AOV) at the top of the escape stair.

SHEVTEC®
Roof Vent

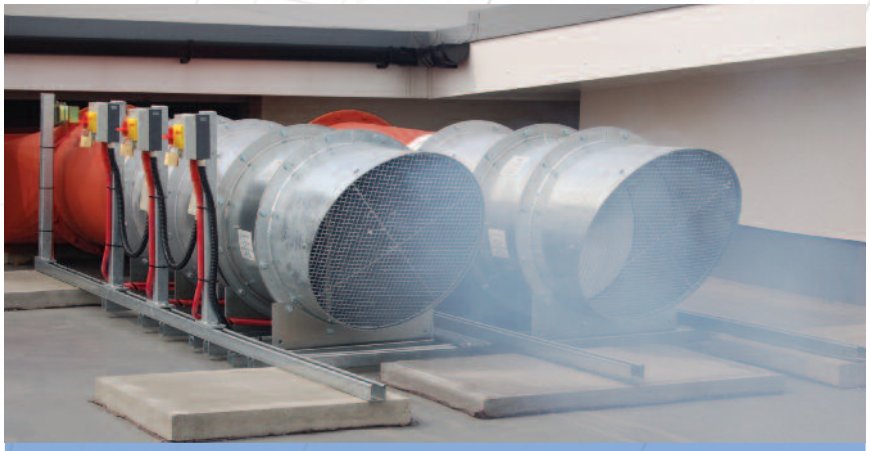
Due to the limited provision for inlet ventilation during the means of escape scenario, it was necessary to limit the air extraction rate to an amount that would be provided by the smoke and fire damper. The CFD model identified the optimum extraction rate of 2m³/s. The fire service access strategy, enables the fire service to manually increase the fan speed to 4m³/s via the Manual Control Point (MCP). This ensured that the system is easy to operate for fire service use.

SE Controls solution was accepted by the client and approved by Building Control.

Specification and Tendering

SE Controls provided the client with a detailed specification, system performance description, equipment schedule and wiring schematics to enable them to be sure they were obtaining competitive and compliant tenders.

The correct operation of the system was crucial for the system to operate according to the design strategy. The system was designed



SHEVTEC®
Powered Extract Fans

to operate on a floor by floor basis. If there is a fire on the first floor of the apartment block, only the first floor Smoke Shaft Door should open, with all unaffected floors remaining closed. In conjunction to the opening door on the fire floor, the SHEVTEC® Damper and the SHEVTEC® Roof Vent to the staircase, will supply the replacement air, which will all simultaneously power open. This replacement air is drawn into the building from the SHEVTEC® Roof Vent, through the SHEVTEC® Damper, allowing smoke to be drawn into the smoke shaft via the extraction of the SHEVTEC® Powered Extract Fans.

The SHEVTEC® Powered Extract Fans were specified for installation on the roof. The speed of these fans can be increased by the fire brigade using a Manual Control Point (MCP) located at the base of the escape stair. The proven track record of SE Controls' fully tested OS2 control system was specified to ensure the system's control philosophy could be achieved.

Three SHEVTEC® Smoke Detectors on each floor level are linked to each networked OS2 controller. When activated the OS2 controllers communicate to power open the corresponding Automatic Opening Vents (AOVs).

The fire rated smoke shaft door opens automatically using a SHEVTEC® Smoke Shaft Door Actuator fitted to the back of the door within the shaft. As the AOVs were to be located below 1100mm from the FFL, SE Controls recommended safety grilles to be installed at each level to alleviate any further fall protection and to aid in maintenance.

SHEVTEC®
Smoke Shaft Door Actuator

SHEVTEC®
Damper

SHEVTEC® Dampers were specified for installation where the staircase meets the corridor. The 24v motor driven damper is certified and compliant and is used for replacement air whilst smoke is extracted.

A SHEVTEC® Roof Vent was specified to be located in the top of the escape stair to supply replacement air into the building on activation.

Manual Control Points (MCP) were specified to be situated in each corridor to allow the fire services to manually override the facilities to operate the system and to increase the fan speed from the base of the stairs on entry. The MCPs are coloured orange in accordance with the forthcoming EN12101-9.

Project Management – Installation Coordination

Coordination of specific site stages is a key element of SE Controls' effective and proven project management system. All of SE Controls' project customers have a single point of contact (the Project Leader) throughout the entire project duration. Each project team has dedicated project administration, coordination and installation resources at its disposal to ensure the client receives consistency and the highest levels of customer service and delivery management. SE Controls worked closely in conjunction with McCann Homes and their electrical subcontractor (who carried out the cable installation), to ensure installation of the system went smoothly, to time and to budget.

PRODUCTS INSTALLED:

- 2 x SHEVTEC® Powered Extract Fans
- SHEVTEC® Roof Vent at the top of stair to create replacement air
- SHEVTEC® Dampers to provide replacement air via the stairs into the corridor
- SHEVTEC® Smoke Shaft Door Actuator
- SHEVTEC® Smoke detector
- Manual Control Point (MCP)
- OS2 control system
- OSLon network communication

'There were very clear guidelines set out about the anticipated installation process, I'm glad to say that all the dates were met and everyone is happy with the system and we had sign off from the Building Control. We can now go on to get completions for development.'

Gary Fleckney
Contracts Manager, McCann Homes

Commissioning and Handover

It is essential that all smoke ventilation systems are tested via cause and effect analysis to demonstrate that they actually do what they are designed to do. Over some 27 years of installing smoke ventilation systems, SE Controls have refined this process and hugely experienced commissioning engineers are able to "get a result" on site, saving time, money and the need for return visits.

Increasingly SE Controls are utilising smoke tests to satisfy their clients and approving bodies that fire engineered solutions work in accordance with their design. This methodology was employed at Ditton Walk for the benefit of the client, Birmingham and Cambridge Building Control and Cambridge Fire Brigade.

SE Controls were able to prove that the installed system functioned in accordance with their design thereby validating the CFD modelling. The approving bodies had no hesitation in accepting the system, allowing McCann Homes to proceed to formal handover.

Service & Maintenance

Smoke ventilation systems are life saving systems and it is therefore essential that regular preventative maintenance is carried out to the required standards by competent personnel, who are familiar with the specification and strategy for the particular application. Under the Regulatory Reform (Fire Safety) Order 2005 legislation this is the responsibility of the Management Company or owner of the premises. SE Controls maintenance division are able to provide 24 hour support for 365 days of the year to its maintenance clients to ensure that their installations are always ready to perform their life safety function whenever they are called upon to do so.

Visibility in the corridor before system operation

Visibility in the corridor after 20 seconds

The following regulations apply to a smoke ventilation design:

- Approved Document B – Smoke Ventilation design and provision for residential buildings.
- BS 9999 series – Smoke Ventilation Design
- Regulatory Reform Order (RRO)
- Building Regulation 2009, Regulation 7 CE marked products
- EN 60335-2-103 – Finger Trap Avoidance above 1100mm from FFL
- Fire Engineered Solutions – CIBSE Guide E - Fire Engineering
- EN12101 series of smoke ventilation regulations

– Part 1 Specification for Smoke Barriers

– Part 2 Specification for Natural Smoke and Heat Exhaust Ventilators

– Part 3 Specification for Powered Smoke and Heat Exhaust Ventilators

– Part 4 Fire and Smoke Control Installation of Kits

– Part 6 Pressure Differential Systems

– Part 7 Smoke Control Ducts

– Part 8 Smoke Control Dampers

– Part 9 Control Panels

– Part 10 Power Supplies.

SE Controls are able to offer consultation and advice on projects that must perform to the design intentions set out in Approved Document B. Their extensive involvement in government sponsored working groups has provided a unique insight into the methodology behind Approved Document B, meaning the solutions proposed are guaranteed to meet the most demanding requirements.

All SHEV's components must be successfully tested to the BS EN 12101 before they can carry the CE mark.

Visibility in the corridor after 35 seconds

Visibility in the corridor after 50 seconds

secontrols.com

SE Controls
Lancaster House
Wellington Crescent
Fradley Park
Lichfield
Staffordshire WS13 8RZ

Tel: +44 (0)1543 443060
Fax: +44 (0)1543 443070

Email: sales@secontrols.com
Visit us at: www.secontrols.com