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green star
environmental rating system for buildings
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Green Star Credit Cover Sheet Round 2

Green Star - Office Interiors v1.1
Inn-3 Environmental Design Initiatives

Points available: 5 **Points claimed:** 1 **CIR or TC Used:** N

Round 1 Assessment Comments
The project may wish to consider providing a comparison between the typical base building system performance and the displacement ventilation system to show which has superior performance. In addition, the project may also wish to consider more clearly justifying why this initiative should receive additional points over and above those claimed in IEQ-1 and IEQ-8.

Compliance with Credit Criteria
The project has provided a level of air change effectiveness within the tenancy that meets the benchmarks stipulated in the Green Star - Office v3 IEQ-2 Air Change Effectiveness credit.

Documents Provided
- Round 1 Submission is provided in its entirety.

Discussion
In the Round 1 advice from the Certified Assessors, it was stated that the project may wish to 'more clearly justify why this initiative should receive additional points over and above those claimed in IEQ-1 (Ventilation Rates) and IEQ-8 (Individual Comfort Control). The project team would like to suggest that achievement of high levels of air change effectiveness is not an initiative that is rewarded by the IEQ-1 and IEQ-8 credits. While many displacement ventilation systems achieve points under IEQ-8 because they have in floor diffusers for each occupant, award of the IEQ-1 credit is based on outside air provisions and does not directly reward systems that achieve effective air changes across the NLA of the tenancy.

The project team believes that as air change effectiveness is addressed under a separate credit within Green Star - Office v2 as ventilation rates and individual comfort control, it would seem appropriate that Green Star - Office Interiors v1.1 would address air change effectiveness separately. As there is no air change effectiveness credit within the Green Star - Office Interiors v1.1 tool, we have applied for innovation credit for this initiative on the grounds that this issue is outside of the scope of this rating tool.

The project team further believes that the case for improved IEQ, and therefore environmental benefit, has already been made by the fact that Green Star base building rating tools reward this initiative.

The report provided demonstrates the project's compliance with the base building IEQ-2 Air Change Effectiveness credit, which provides two points. We are claiming one innovation point for this initiative.

Innovation
Inn-3 Environmental Design Initiatives

Points Available	Points Claimed	CIR Submitted
5	1	N

Credit Criteria
Up to five Innovation points are awarded at the discretion of the Green Building Council of Australia (GBCA) where it is demonstrated that a design feature provides a significant environmental benefit but is not awarded points under the Green Star – Office Interiors rating tool criteria.
The application will be assessed by the GBCA against the following criteria:
* What is the measurable environmental benefit of the innovation?
* Which significant environmental benefits of the innovation have been addressed by Green Star – Office Interiors credits?
More than one innovation can be submitted but the maximum points available for any one building assessment under Inn-1, Inn-2 and Inn-3 is five (total).

Documents Provided

✓	Short report with modelling that shows how displacement air provides an air change effectiveness of 95% for approximately 96% of the tenancy NLA.
✓	Mechanical as-built plans calling out where displacement air is supplied.

Discussion
- The GBCA tenancy undertook considerable effort to retrofit displacement ventilation into the existing office space inherited by the organisation. A re-used raised floor was supplied to provide a displacement ventilation solution that offered individual comfort control to over 60% of the workstations. It was determined that this solution would be a flagship initiative towards increased indoor environmental quality and although the health benefits provided by a high air change effectiveness is not recognised within the Green Star – Office Interiors v1.1 rating tool, it was deemed a worthy initiative for the GBCA tenancy and became one that was protected as the limited budget forced the removal of other items within the tenancy.
- The attached report and modelling show the effectiveness of the displacement ventilation system installed in the fitout in providing fresh air to the space.
- Air change effectiveness is rewarded within the Green Star base building rating tools, but not included in Green Star – Office Interiors. Therefore, we feel this initiative qualifies for an innovation credit as it provides a significant benefit to the health of the occupants and is not otherwise covered within this tool.

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Thursday, 15 May 2008

Advanced Environmental

Joe Karten
GBCA
Level 15, 179 Elizabeth Street
Sydney NSW 2000

Innovation Claim - Air Change Effectiveness

Dear Joe

Please find below our submission for innovation points. The submission is titled “Air Change Effectiveness”.

The Issue:

Air change effectiveness is an attribute of office spaces which measures the ability of a system to remove air-borne pollutants from the space. Increased air change effectiveness improves the quality of air in the space, which has a positive impact on occupant health and productivity.

Generally, the fitout of a single tenancy in a multi-tenanted building has little opportunity to improve on the air change effectiveness within that tenancy. This is due to the limited change that can be effected upon the existing base building HVAC system.

Therefore, air change effectiveness is not currently rewarded in the Green Star Office Interiors V1.1 rating tool.

By improving the air change effectiveness within the tenancy of this project, the applicant provides a measurable environmental benefit which is not otherwise awarded points by Green Star – Office Design.

The Innovation

The tenancy proposes an alternative mechanical solution to the existing base building solution. However, it is expected that the HVAC strategy for the tenancy will not have an adverse effect on other base building systems or other tenancies.

The general design intent for the mechanical services is to provide a system that provides a superior indoor environmental quality by removing pollutants and maintaining superior thermal comfort within the capabilities of the existing ventilation capacity.

It will also be demonstrated that the Air Change Effectiveness (ACE) meets the following criteria for at least 90% of the NLA. The ventilation systems are designed to achieve an Air Change Effectiveness (ACE) of >0.95 when measured in accordance with ASHRAE F25-1997. ACE is to be measured in breathing zone (nominally 1m from finished floor level)

The fit-out mechanical services are comprised of the following systems:

- The existing dedicated (floor-by-floor) air handling unit (AHU) provides cooling to the space with swirl diffusers providing overhead supply – same design solution as the LS Melbourne Office

- Chilled water is supplied to the AHU by the base building central thermal plant and there has been no change to the coil flow rates. AHU filters will be upgraded to improve indoor air quality

- Supply air is provided to occupants from displacement diffusers:
    - With individual flow control in the raised floor east of the core; and
    - From side-wall diffusers elsewhere
- Outside air is provided at a 50% improvement on AS1668 requirements and the AHU has an economy cycle for low load applications which is controlled on both temperature and CO_2.
- Façade heat loads from the bay windows are exhausted directly through the bay window bulkheads.
- The utilities store is exhausted to a tenant exhaust system at a rate of 350 L/s (there is provision for 400 L/s for the tenancy).
- Space heating is provided by duct-mounted electric heaters.

Displacement ventilation supplies cool air to the conditioned space at low level where it slowly warms due to heat loads in the space and rises to the ceiling level through natural buoyancy. A warm stratified layer forms at the ceiling level which increases the cooling capacity of the system due to the temperature gradient created.

Air is exhausted from the ceiling level, easily and effectively taking with it pollutants from the space.

Advantages of this system include:

- Supply air temperatures can be warmer, >18°C. The higher supply temperature improves the chiller COP and reduces energy consumption
- Increased rate (100%) of outside air is supplied to the space
- Humidity control at higher supply air temperatures requires less energy
- Thermal comfort – supply air is at temperatures closer to the set point and at lower velocities.
- Individual controls are supplied at each air supply diffuser in the floor

Displacement ventilation from floor diffusers is provided via the raised floor in the area to the east of the core. The utilities store is supplied with air from overhead diffusers and exhausted to a tenant exhaust system. Wall plenum diffusers provide displacement ventilation to the remaining spaces. Diagrams of the system are shown in the figures below.

The system results in an Air Change Effectiveness (ACE) of ~0.95 when measured in accordance with ASHRAE F25-1997. ACE is measured in the breathing zone (nominally 1m above finished floor level.

The Environmental Benefit

Increased air change effectiveness improves the quality of air in the space, which has a positive impact on occupant health and productivity.

Sick building syndrome is a situation whereby a build up of pollutants in the interior spaces of a building cause repeated staff illness and reduces productivity of occupants. A building of mould in ductwork is a common cause of sick building syndrome – promoting the growth of bacteria which causes illness.

Sick building syndrome has been found to be significantly reduced by improving air change effectiveness:

- Improving the air change effectiveness reduces the amount of indoor air pollutants within the space;

- The reduction in indoor air pollutants provided by improved air change effectiveness can be enough to reduce the rate at which airborne illness is spread within an office building;

- The reduction in indoor air pollutants provided by improved air change effectiveness has a positive impact on worker wellbeing and productivity; and

- Improvements in health and productivity resulting from improved air change effectiveness are entirely separate from improvements related to ventilation rates.

System Description

Displacement ventilation supplies cool air to the conditioned space at low level where it slowly warms due to heat loads in the space and rises to the ceiling level through natural buoyancy. A warm stratified layer forms at the ceiling level which increases the cooling capacity of the system due to the temperature gradient created.

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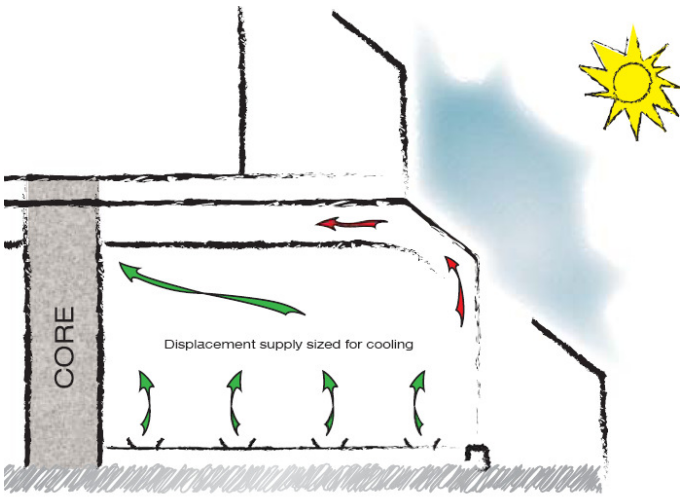
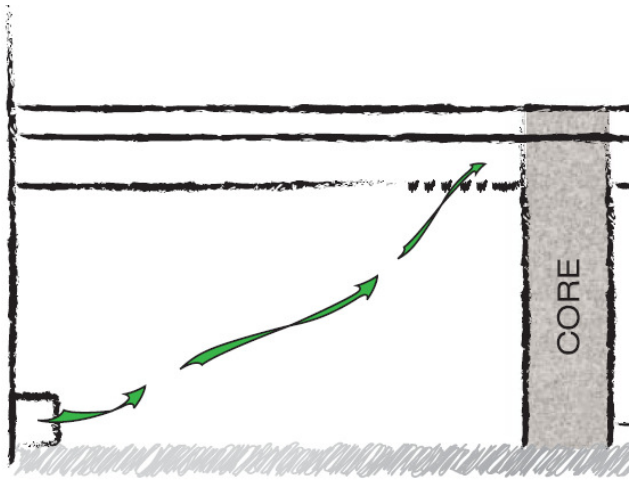
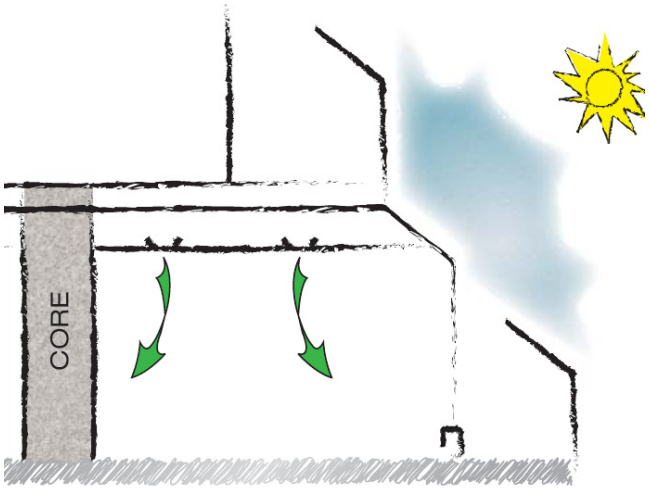


Under floor supply displacement ventilation in the raised floor east of the core



Side wall plenum supply diffusers for other spaces



Swirl diffusers in the utilities store

Air Change Effectiveness

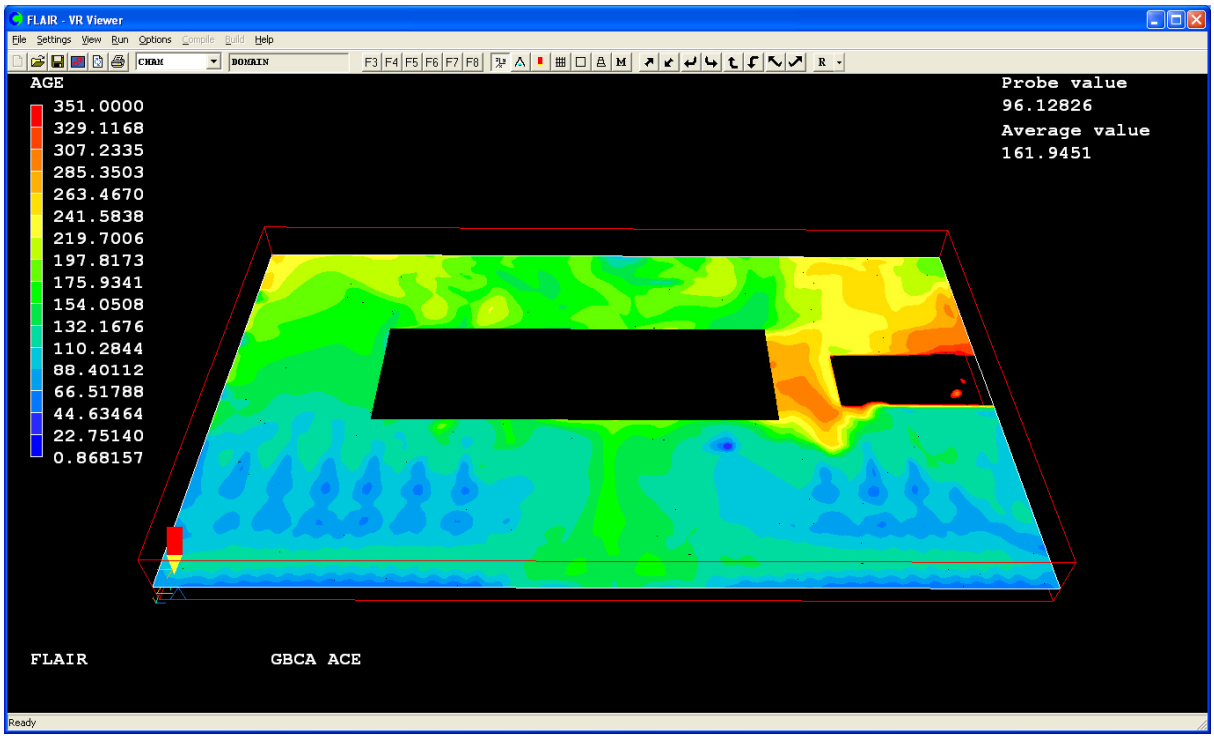
Air change effectiveness (ACE) in the space was measured in accordance with ASHRAE F25-1997. Modelling was conducted to determine the age of the air in the space in the breathing zone (nominally 1m above finished floor level) using Phoenics, a computational fluid dynamics (CFD) program.

The aim of the modelling was to demonstrate that an ACE of at least 0.95 is achieved for more than 90% of the floor plate.

Calculations

To determine the ideal age of air, the volume of the space and the supply air rates were calculated. This gave an ideal age of air of 333 seconds. To achieve an ACE of 0.95, the age of air should not exceed 351 seconds for at least 90% of the floor plate.

The results, as shown in the figure below, demonstrate that the system results in an Air Change Effectiveness (ACE) of ~0.95 when ACE is measured in the breathing zone (nominally 1m above finished floor level) for more than 96% of the floor plate.



These results demonstrate that the design of the displacement ventilation system is able to provide the effective delivery of clean air through reduced mixing with indoor pollutants.

Supporting Documentation

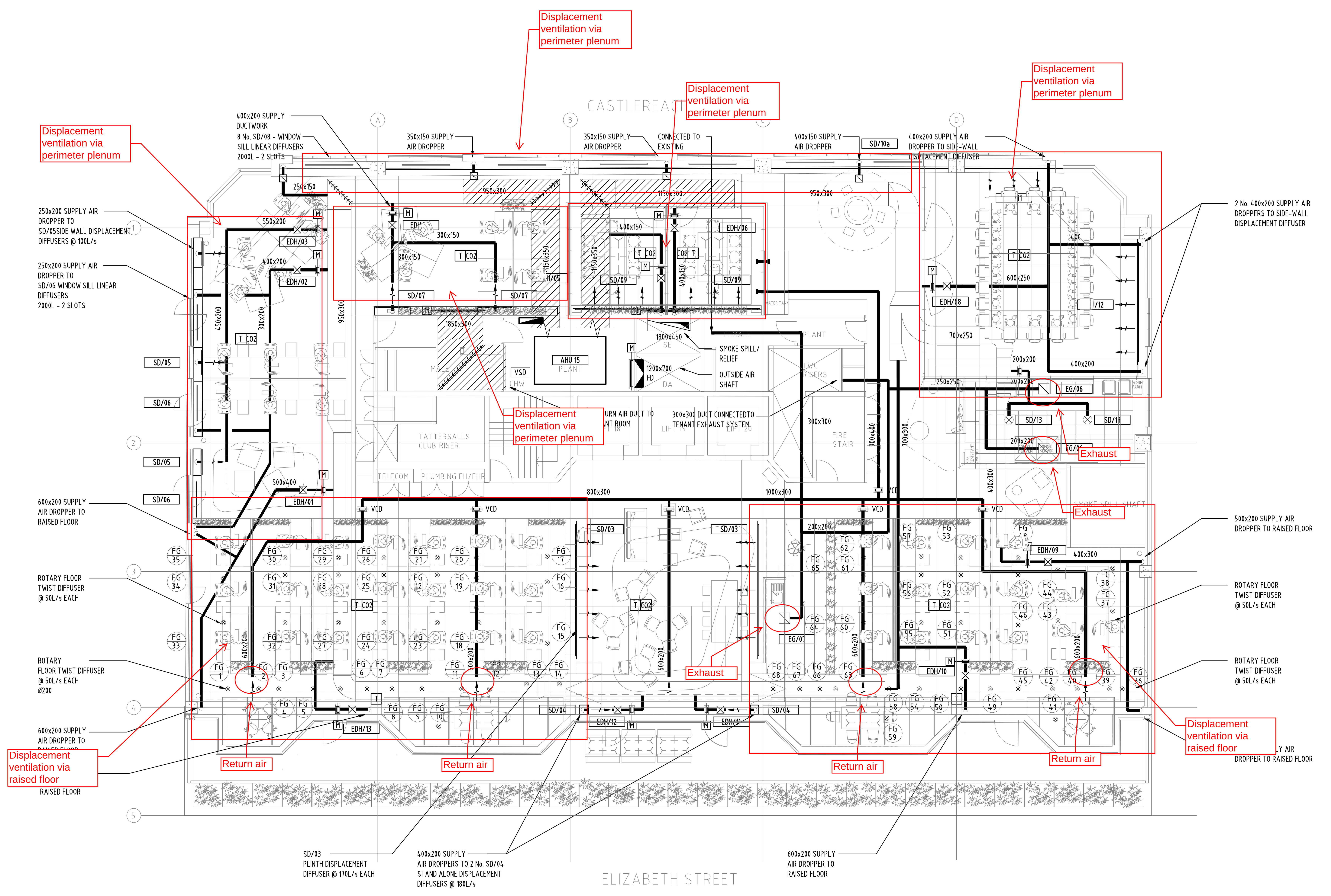
The following supporting documentation is provided to demonstrate the validity of the modelling for ventilation effectiveness:

- Mechanical As Built Drawings noting supply and return air diffusers and grills

Yours sincerely

Richard Palmer

Inn-3.1: 2



LEGEND

AxB	RECTANGULAR DUCTWORK
	SUPPLY AIR DUCTWORK
	RETURN AIR DUCTWORK
	EXHAUST AIR DUCTWORK
	DROPPER
SD/xx	STAND ALONE DISPLACEMENT DIFFUSER
SD/xx	SIDE WALL DISPLACEMENT DIFFUSER
SD/xx	SWIRL DIFFUSER
	ROTARY FLOOR DIFFUSER
EG/xx	RETURN/EXHAUST AIR GRILLE
FD	FIRE DAMPER
VCD	VOLUME CONTROL DAMPER
M	MOTORISED DAMPER
EDH/xx	ELECTRICAL DUCT HEATER
T	TEMPERATURE SENSOR
CO2	CO2 SENSOR
	DISTRIBUTION BOARD
FG 48	FLOOR DIFFUSER NO.

Rev	Description	By	Date
A	AS BUILT	ENRAVEL	11.03.2009

CONSULTANT

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Drawing Title
DUCTWORK LAYOUT
L15

CAD File		Drawn	-
Coordinated		Scale	1:100 @A1
Project Architect		Date	11-03-09
Project Director			
PTW Project No. -	Drawing Number ST 236-M01 A	Rev A	
JLW Project No. ST 236			

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