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Thermal Comfort Report

for

London Borough of Camden

at

Tybalds Estate

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Prepared By: Signature:	Charlotte Edwards				
Checked By: Signature:	David Warwick				
Authorised By: Signature:	David Warwick				

TGA Consulting Engineers LLP
Salvus House
Aykley Heads
Durham
DH1 5TS

T: 0191 386 2314
E: david.warwick@tgace.co.uk

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EXECUTIVE SUMMARY

The health and wellbeing impacts of overheating can be significant for residents, resulting in stress, anxiety, sleep deprivation and even early deaths in heat waves, especially for vulnerable occupants.

To ensure thermal comfort is achieved dynamic thermal modelling has been performed in line with the CIBSE TM59: Design Methodology for the Assessment of Overheating Risk in Homes.

The building constructions, window openings and external shading have been modelled as per the architectural design and internal gains and natural ventilation modelled as per requirements within the CIBSE TM59.

The results show that under the conditions described within this report, internal gains and opening equivalent free areas, all spaces can achieve thermal comfort using opening windows and natural ventilation.

1.0 INTRODUCTION

New developments have designs that contribute to overheating risk by having high proportions of glazing (resulting in excessive solar heat gains), inadequate natural ventilation strategies or mechanical ventilation systems that are not delivering intended air change rates.

The health and wellbeing impacts of overheating can be significant for residents, resulting in stress, anxiety, sleep deprivation and even early deaths in heat waves, especially for vulnerable occupants.

Assessing overheating risk is a complex issue that is not adequately assessed by building regulations. Therefore, it is recommended that comfort conditions are separately assessed to understand the risk of overheating.

Many factors influence overheating in developments, including the intensity of heat gains, occupancy patterns, orientation, internal layout, shading strategy and ventilation method.

Within this report dynamic thermal modelling is therefore used to simulate the internal temperature conditions to establish whether threshold conditions of discomfort will be reached.

2.0 METHODOLOGY

2.1 Dynamic Thermal Model

The building has been modelled using IES Virtual Environment dynamic thermal modelling software and the results assessed against the overheating criteria in CIBSE TM59: Design Methodology for the Assessment of Overheating Risk in Homes.

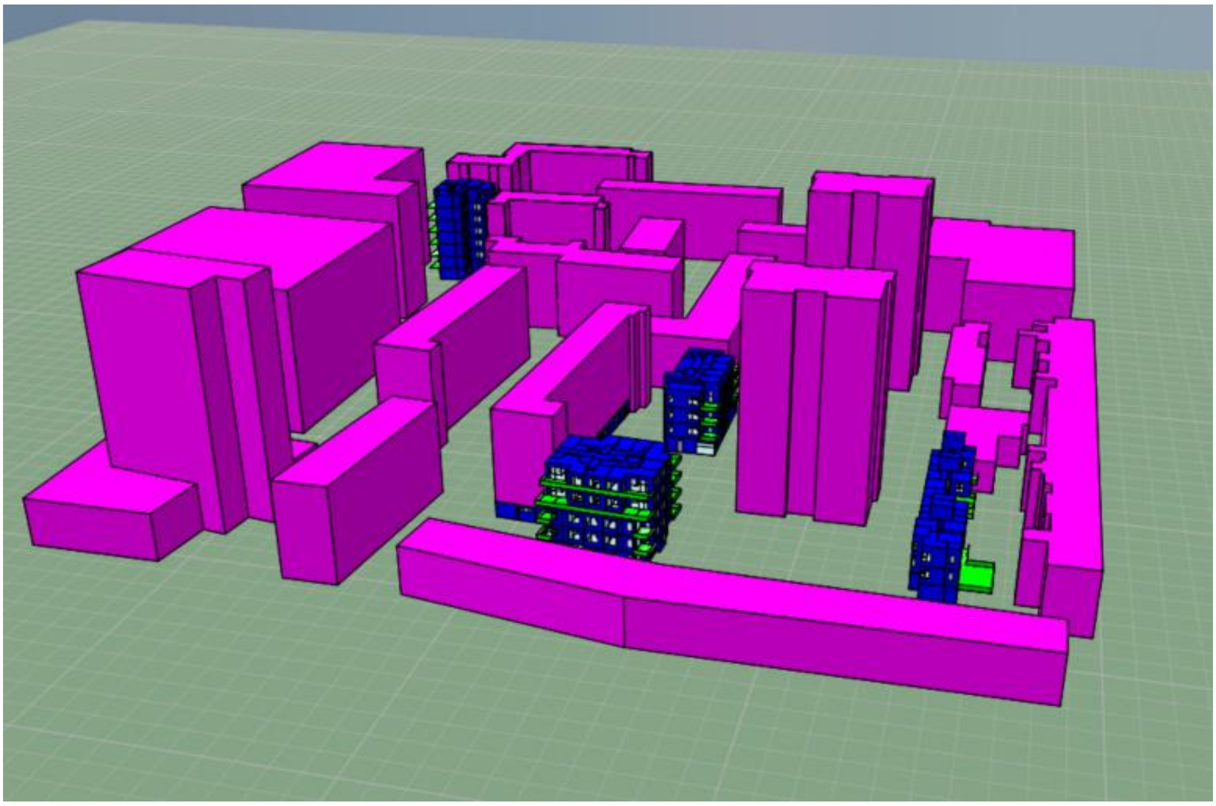

Figure 1 IESVE Dynamic Thermal Model

The CIBSE Design Summer Year (DSY) weather file for London Heathrow is used for the assessment. The DSY consists of hourly data for the full year. As required by the TM59 methodology the assessment has used the DSY1 file for the 2020s, high emissions, 50% percentile scenario.

2.2 Criteria

The residential spaces are naturally ventilated; therefore, compliance is based on passing both of the following two TM59 criteria:

- **% Hours Thermal Comfort Temperature Exceeded:**

For living rooms, kitchens and bedrooms, between 1st May and 30th September the operative temperature[1] shall not exceed the maximum acceptable temperature[2] by 1°C for more than 3% of occupied hours.

- **% Sleeping Hours above 26°C:**

For bedrooms only, to guarantee comfort during the sleeping hours, the operative temperature[1] in the bedroom between 10pm to 7am shall not exceed 26°C for more than 1% of annual hours.

[1] The operative temperature combines the air temperature and the mean radiant temperature into a single value to express their joint effect.
[2] The maximum acceptable temperature (Tmax) is calculated using the running daily mean of the outdoor air temperature (Trm) using the formula: Tmax=0.33Trm+21.8

The maximum acceptable temperature (Tmax) is calculated using the running daily mean of the outdoor air temperature (Trm) using the formula:

$$T_{max} = 0.33T_{rm} + 21.8$$

For the purposes of modelling summertime overheating the maximum average air speed through the vent was assumed to be 0.1 m/s.

2.3 Fabric Performance

Building constructions have been modelled as per the proposed building constructions, accurately reflecting thermal properties such as thermal mass, insulation and solar transmittance for glazing. Table 1 gives the fabric performance standards used within the modelling.

Table 1 Building Fabric Properties

Fabric Detail	Value
Ground Floor U-value	0.12 W/m²K
External wall U-value	0.12 W/m²K
Roof U-value	0.10 W/m²K
Glazing U-value (including frame) Glazing g-value	1.40 W/m²K g=0.40
Door U-value	1.40 W/m²K

All Bedrooms and Living/Kitchen/Dining rooms have been modelled with internal dull out roller blinds (see Table 2 Internal Shading Building Fabric Properties). The blinds are controlled to be manually closed when the incident illumination (solar gain) received on the outside surface by each window exceeds 200W/m^2.

Table 2 Internal Shading Building Fabric Properties

Internal Shading Detail	Value
Internal Shading Device	Dull Out Roller Blind
Shading Coefficient	0.374
Short-wave radiant fraction	0.53
Transmittance	0.20
Reflectance	0.60
Absorbance	0.20

2.4 Occupancy, Equipment and Lighting and Gains

Occupancy, lighting and equipment gains, and profiles in residential areas have been modelled as per the requirements of CIBSE TM59.

The occupancy and equipment gains are presented in Table 3.

All spaces are modelled with a lighting gain of 2W/m^2 between the hours of 1800 and 2300.

Table 3 Residential Occupancy and Equipment Gains and Profiles

Space Description	Time Profile	Occupancy	Equipment Load
Double Bedroom	0800-0900	2 people [full gain]	80 W [peak]
	0900-2200	1 person [full gain]	
	2200-2300	2 people [full gain]	
	2300-0800	2 people [70% gain]	10W [base]
Single Bedroom	0800-2300	1 person [full gain]	80 W [peak]
	2300-0800	1 person [70% gain]	10W [base]
1 Bedroom Living Room / Kitchen / Dining (1B LKD)	0900-1800	1 person	110W
	1800-2000		450W [peak]
	2000-2200		200W
	2200-2400	unoccupied	110W
	2400-0900	unoccupied	85W [base]
2 Bedroom Living Room / Kitchen / Dining (2B LKD)	0900-1800	2 people	110W
	1800-2000		450W [peak]
	2000-2200		200W
	2200-2400	unoccupied	110W
	2400-0900	unoccupied	85W [base]
3 Bedroom Living Room / Kitchen / Dining (3B LKD)	0900-1800	3 people	110W
	1800-2000		450W [peak]
	2000-2200		200W
	2200-2400	unoccupied	110W
	2400-0900	unoccupied	85W [base]
4 Bedroom Living Room / Kitchen / Dining (4B LKD)	0900-1800	4 people	110W
	1800-2000		450W [peak]
	2000-2200		200W
	2200-2400	unoccupied	110W
	2400-0900	unoccupied	85W [base]

2.5 Ventilation Strategy

Mechanical ventilation heat recovery (MVHR) delivers mechanical supply and extract to provide fresh air to the apartments and has been added to the bedrooms, living/kitchen at 8l/s, on continuously. All apartments are cooled by natural ventilation.

All spaces are assumed to have an infiltration rate of 0.10 air changes per hour.

The window and external door openings have been added as per the architectural layouts/elevations.

The openable area of each window or door has been assumed to be 90% of the structural area.

There is a mixture of opening types in the residence areas, including tilt and turn and side hung windows and doors. Side hung doors are assumed to open 90°. The tilt and turn windows are assumed to operate in the turn mode to control overheating and are therefore modelled as side hung windows that open fully (open 90°).

Openings in each room are controlled separately and modelled to open when the internal air temperature exceeds 22°C, the room is occupied, and the outdoor air is temperature is less than the indoor air temperature.

The exposure type is assumed to be semi-exposed for all openings.

Internal doors have been assumed to be closed within the model.

2.6 Simulations

One iteration of the model has been performed:

- **Simulation 1:** Opening Windows

3.0 RESULTS

The full results for the bedrooms are presented in Appendix A, the full results for the Living/Kitchen rooms are presented in Appendix B.

As required within CIBSE TM59, due to spaces using blinds to achieve thermal comfort, the analysis results with and without blinds are presented.

3.1 Simulation 1: Opening Windows

A summary of Simulation 1 results with blinds are presented in Table 4 and without blinds are presented in Table 5.

With natural ventilation, all bedrooms and kitchen/living achieve thermal comfort.

The results without blinds demonstrate the benefit of and requirement for blinds in the bedrooms and kitchen/living spaces.

Table 4 Summary of Results (with blinds)

	Number of Spaces	Spaces Passing % Hours Thermal Comfort Temperature/ 28^{o}C Exceeded	Spaces Passing % Sleeping Hours above 26^{o}C	Pass/Fail
Bedrooms	88	88	88	Pass
Kitchen/ living	56	56	N/A	Pass

Table 5 Summary of Results (without blinds)

	Number of Spaces	Spaces Passing % Hours Thermal Comfort Temperature/ 28^{o}C Exceeded	Spaces Passing % Sleeping Hours above 26^{o}C	Pass/Fail
Bedrooms	88	88	85	Fail
Kitchen/ living	56	49	N/A	Fail

4.0 CONCLUSIONS

Thermal comfort has been analysed using CIBSE TM59: Design Methodology for the Assessment of Overheating Risk in Homes.

The results show that under the conditions described within this report, internal gains and opening equivalent free areas, all spaces can achieve thermal comfort using opening windows and natural ventilation.

It also has to be noted that the CIBSE TM59 assessment is intended to test residential spaces for overheating. As such the methodology applies occupancy profiles where the spaces are heavily occupied (i.e. there is always someone in the bedrooms and cooking is assumed in the kitchen throughout the summer) and the weather profile is a future design summer year weather file. Typically, the levels of overheating calculated would not be experienced.

Please note that results and recommendations are based on the assumptions described in this report. If any of the inputs change, results are likely to change and the recommendations might not be appropriate.

APPENDIX A BEDROOM SPACES OVERHEATING RESULTS

Table 6 Simulation 1 Results for Bedroom Spaces

Space	DSY1 2020 (with blinds)			DSY1 2020 (without blinds)		
	% Hours Thermal Comfort Temp Exceeded	% Sleeping Hours above 26ºC	Pass/ Fail	% Hours Thermal Comfort Temp Exceeded	% Sleeping Hours above 26ºC	Pass/ Fail
B 00 1 Double Bedroom	0.8%	0.8%	PASS	1.6%	0.9%	PASS
B 00 2 Double Bedroom	0.0%	0.7%	PASS	0.0%	0.8%	PASS
B 01 1 Double Bedroom	0.3%	0.8%	PASS	1.1%	0.9%	PASS
B 01 2 Double Bedroom	0.1%	0.8%	PASS	0.2%	0.8%	PASS
B 01 2 Single Bedroom	0.5%	0.7%	PASS	0.8%	0.8%	PASS
B 01 3 Double Bedroom	0.0%	0.7%	PASS	0.4%	0.8%	PASS
B 01 3 Single Bedroom	0.5%	0.8%	PASS	0.8%	0.8%	PASS
B 01 4 Double Bedroom	0.1%	0.8%	PASS	0.8%	0.9%	PASS
B 02 1 Double Bedroom	0.4%	0.8%	PASS	1.2%	0.9%	PASS
B 02 2 Double Bedroom	0.2%	0.8%	PASS	0.4%	0.8%	PASS
B 02 2 Single Bedroom	0.6%	0.8%	PASS	0.9%	0.8%	PASS
B 02 3 Double Bedroom	0.1%	0.8%	PASS	0.5%	0.9%	PASS
B 02 3 Single Bedroom	0.5%	0.8%	PASS	0.8%	0.8%	PASS
B 02 4 Double Bedroom	0.1%	0.8%	PASS	0.9%	0.9%	PASS
B 03 1 Double Bedroom	0.4%	0.8%	PASS	1.1%	0.9%	PASS
B 03 2 Double Bedroom	0.4%	0.8%	PASS	0.5%	0.8%	PASS
B 03 3 Double Bedroom	0.3%	0.8%	PASS	0.6%	0.9%	PASS
B 03 4 Double Bedroom	0.1%	0.8%	PASS	1.0%	0.9%	PASS
B 04 1 Double Bedroom	0.3%	0.8%	PASS	1.0%	0.8%	PASS
B 04 2 Double Bedroom	0.4%	0.8%	PASS	0.5%	0.9%	PASS
B 04 3 Double Bedroom	0.4%	0.9%	PASS	0.7%	1.0%	PASS
B 04 4 Double Bedroom	0.1%	0.8%	PASS	1.0%	0.9%	PASS
C 01 1 Double Bedroom 1	0.0%	0.8%	PASS	0.0%	0.8%	PASS
C 01 1 Double Bedroom 2	0.1%	0.6%	PASS	0.2%	0.6%	PASS
C 01 2 Double Bedroom 1	0.3%	0.9%	PASS	0.3%	0.9%	PASS
C 01 2 Double Bedroom 2	0.2%	0.7%	PASS	0.4%	0.7%	PASS
C 01 2 Single Bedroom	0.3%	0.4%	PASS	0.9%	0.4%	PASS
C 02 1 Double Bedroom 1	0.0%	0.8%	PASS	0.0%	0.8%	PASS
C 02 1 Double Bedroom 2	0.0%	0.5%	PASS	0.0%	0.5%	PASS
C 02 2 Double Bedroom 1	0.0%	0.8%	PASS	0.0%	0.8%	PASS
C 02 2 Double Bedroom 2	0.1%	0.6%	PASS	0.2%	0.6%	PASS
C 02 2 Single Bedroom	0.2%	0.4%	PASS	0.9%	0.4%	PASS
C 03 1 Double Bedroom 1	0.0%	0.6%	PASS	0.2%	0.6%	PASS
C 03 1 Double Bedroom 2	0.0%	0.8%	PASS	0.0%	0.8%	PASS
C 03 2 Double Bedroom 1	0.1%	0.6%	PASS	0.2%	0.6%	PASS
C 03 2 Double Bedroom 2	0.0%	0.8%	PASS	0.0%	0.9%	PASS
C 03 2 Single Bedroom	0.2%	0.4%	PASS	0.7%	0.4%	PASS
D 01 1 Double Bedroom	0.9%	0.5%	PASS	1.1%	0.6%	PASS
D 01 1 Single Bedroom	0.6%	0.5%	PASS	0.8%	0.5%	PASS
D 01 2 Double Bedroom	0.0%	0.4%	PASS	0.0%	0.4%	PASS
D 02 1 Double Bedroom	0.8%	0.5%	PASS	1.1%	0.6%	PASS
D 02 1 Single Bedroom	0.4%	0.5%	PASS	0.7%	0.5%	PASS
D 02 2 Double Bedroom	0.0%	0.5%	PASS	0.0%	0.5%	PASS

D 03 1 Double Bedroom	0.9%	0.5%	PASS	1.1%	0.6%	PASS
D 03 1 Single Bedroom	0.4%	0.5%	PASS	0.8%	0.5%	PASS
D 03 2 Double Bedroom	0.0%	0.5%	PASS	0.0%	0.5%	PASS
D 04 1 Double Bedroom	0.9%	0.5%	PASS	1.4%	0.6%	PASS
D 04 1 Single Bedroom	0.5%	0.5%	PASS	0.9%	0.5%	PASS
D 04 2 Double Bedroom	0.0%	0.5%	PASS	0.0%	0.5%	PASS
D 05 1 Double Bedroom	0.9%	0.5%	PASS	1.5%	0.6%	PASS
D 05 1 Single Bedroom	0.5%	0.5%	PASS	1.0%	0.5%	PASS
D 05 2 Double Bedroom	0.0%	0.4%	PASS	0.0%	0.5%	PASS
D 06 1 Double Bedroom	0.7%	0.4%	PASS	1.5%	0.4%	PASS
D 06 2 Double Bedroom	0.0%	0.5%	PASS	0.0%	0.5%	PASS
EM.01 01 Double Bedroom 1	0.0%	0.5%	PASS	0.0%	0.5%	PASS
EM.01 01 Double Bedroom 2	0.0%	0.4%	PASS	0.5%	0.4%	PASS
EM.01 02 Double Bedroom	0.0%	0.5%	PASS	0.0%	0.5%	PASS
EM.02 01 Double Bedroom 1	0.0%	0.4%	PASS	0.0%	0.5%	PASS
EM.02 01 Double Bedroom 2	0.1%	0.4%	PASS	0.6%	0.4%	PASS
EM.02 01 Single Bedroom	0.0%	0.5%	PASS	0.0%	0.5%	PASS
EM.03 01 Double Bedroom 1	0.0%	0.5%	PASS	0.0%	0.5%	PASS
EM.03 01 Double Bedroom 2	0.0%	0.4%	PASS	0.2%	0.4%	PASS
EM.03 01 Single Bedroom	0.0%	0.5%	PASS	0.0%	0.5%	PASS
EM.04 01 Double Bedroom 1	0.0%	0.5%	PASS	0.0%	0.5%	PASS
EM.04 01 Double Bedroom 2	0.0%	0.4%	PASS	0.2%	0.4%	PASS
EM.04 01 Single Bedroom	0.0%	0.5%	PASS	0.0%	0.5%	PASS
EM.05 01 Double Bedroom 1	0.0%	0.4%	PASS	0.0%	0.5%	PASS
EM.05 01 Double Bedroom 2	0.0%	0.3%	PASS	0.0%	0.4%	PASS
UB.01 Double Bedroom	0.1%	0.8%	PASS	1.0%	0.8%	PASS
UB.01 Single Bedroom	0.5%	0.6%	PASS	0.8%	0.7%	PASS
UB.02 Double Bedroom	0.0%	0.7%	PASS	0.6%	0.8%	PASS
UB.02 Single Bedroom	0.5%	0.8%	PASS	1.4%	0.9%	PASS
UB.03 Double Bedroom 1	0.1%	0.8%	PASS	0.8%	0.8%	PASS
UB.03 Double Bedroom 2	0.1%	0.9%	PASS	0.6%	1.1%	FAIL
UB.04 Double Bedroom 1	0.1%	0.8%	PASS	0.7%	0.8%	PASS
UB.04 Double Bedroom 2	0.2%	0.9%	PASS	0.6%	1.1%	FAIL
UB.05 Double Bedroom	0.1%	0.6%	PASS	1.3%	0.7%	PASS
UF.01 Double Bedroom	0.2%	0.8%	PASS	1.3%	1.0%	PASS
UF.02 Double Bedroom	0.5%	0.8%	PASS	1.6%	1.0%	FAIL
UF.03 Double Bedroom 1	0.0%	0.7%	PASS	0.6%	0.8%	PASS
UF.03 Double Bedroom 2	0.0%	0.7%	PASS	0.7%	0.8%	PASS
UF.03 Single Bedroom 1	0.0%	0.6%	PASS	0.0%	0.7%	PASS
UF.03 Single Bedroom 2	0.4%	0.7%	PASS	1.1%	0.7%	PASS
UR.01 Double Bedroom 1	0.0%	0.8%	PASS	0.4%	0.8%	PASS
UR.01 Double Bedroom 2	0.0%	0.8%	PASS	0.4%	0.9%	PASS
UR.02 Double Bedroom 1	0.0%	0.7%	PASS	0.0%	0.7%	PASS
UR.02 Double Bedroom 2	0.0%	0.8%	PASS	0.6%	0.8%	PASS
UR.02 Single Bedroom	0.4%	0.7%	PASS	0.9%	0.7%	PASS

APPENDIX B LIVING/KITCHEN/DINER SPACES OVERHEATING RESULTS

Table 7 Simulation 1 Results for Living/Kitchen/Dining spaces

Space	DSY1 2020 (with blinds)		DSY1 (without blinds)	
	% Hours Thermal Comfort Temp Exceeded	Pass/ Fail	% Hours Thermal Comfort Temp Exceeded	Pass/ Fail
B 00 1 LKD 1B2P	1.0%	PASS	2.0%	PASS
B 00 2 LKD 1B2P	1.3%	PASS	1.5%	PASS
B 01 1 DLK 1B2P	1.6%	PASS	1.9%	PASS
B 01 2 DLK 2B3P	1.6%	PASS	1.9%	PASS
B 01 3 DLK 2B3P	1.0%	PASS	1.3%	PASS
B 01 4 DLK 1B2P	1.6%	PASS	2.5%	PASS
B 02 1 DLK 1B2P	1.7%	PASS	2.0%	PASS
B 02 2 DLK 2B3P	1.9%	PASS	2.1%	PASS
B 02 3 DLK 2B3P	1.1%	PASS	1.4%	PASS
B 02 4 DLK 1B2P	2.1%	PASS	3.2%	FAIL
B 03 1 DLK 1B2P	1.8%	PASS	2.2%	PASS
B 03 2 DLK 1B2P	1.8%	PASS	2.4%	PASS
B 03 3 DLK 1B2P	1.2%	PASS	1.9%	PASS
B 03 4 DLK 1B2P	2.1%	PASS	3.1%	FAIL
B 04 1 DLK 1B2P	2.1%	PASS	2.7%	PASS
B 04 2 DLK 1B2P	1.9%	PASS	3.0%	PASS
B 04 3 DLK 1B2P	1.5%	PASS	3.0%	PASS
B 04 4 DLK 1B2P	2.6%	PASS	4.0%	FAIL
C 01 1 DLK 2B4P	2.1%	PASS	3.0%	PASS
C 01 2 DLK 3B5P	1.7%	PASS	2.3%	PASS
C 02 1 DLK 2B4P	2.0%	PASS	2.8%	PASS
C 02 2 DLK 3B5P	1.5%	PASS	2.1%	PASS
C 03 1 DLK 2B4P	2.1%	PASS	3.0%	PASS
C 03 2 2 DLK 3B5P	1.3%	PASS	1.7%	PASS
D 01 1 DLK 2B3P	1.3%	PASS	2.0%	PASS
D 01 2 DLK 1B2P	1.2%	PASS	2.0%	PASS
D 02 1 DLK 2B3P	1.2%	PASS	2.0%	PASS
D 02 2 DLK 1B2P	1.5%	PASS	2.5%	PASS
D 03 1 DLK 2B3P	1.4%	PASS	2.3%	PASS
D 03 2 DLK 1B2P	2.0%	PASS	2.8%	PASS
D 04 1 DLK 2B3P	1.5%	PASS	2.6%	PASS
D 04 2 DLK 1B2P	2.2%	PASS	3.1%	FAIL
D 05 1 DLK 2B3P	1.5%	PASS	2.6%	PASS
D 05 2 DLK 1B2P	2.2%	PASS	3.2%	FAIL

D 06 1 DLK 1B2P	0.9%	PASS	1.9%	PASS
D 06 2 DLK 2B2P	2.8%	PASS	4.0%	FAIL
EM.01 00 Kitchen/Dining 4B7P	0.4%	PASS	0.5%	PASS
EM.01 00 Living Room 4B7P	2.7%	PASS	3.2%	FAIL
EM.02 00 Kitchen/Dining 3B5P	0.4%	PASS	0.5%	PASS
EM.02 00 Living Room 3B5P	2.0%	PASS	2.6%	PASS
EM.03 00 Kitchen/Dining 3B5P	0.4%	PASS	0.5%	PASS
EM.03 00 Living Room 3B5P	1.6%	PASS	2.1%	PASS
EM.04 00 Kitchen/Dining 3B5P	0.4%	PASS	0.5%	PASS
EM.04 00 Living Room 3B5P	1.7%	PASS	2.0%	PASS
EM.05 00 Kitchen/Dining 2B4P	0.5%	PASS	0.6%	PASS
EM.05 00 Living Room 2B4P	1.4%	PASS	2.2%	PASS
UB.01 DLK 2B3P	0.4%	PASS	1.2%	PASS
UB.02 DLK 2B4P	0.8%	PASS	1.5%	PASS
UB.03 DLK 2B4P	0.7%	PASS	1.4%	PASS
UB.04 DLK 2B4P	1.0%	PASS	1.8%	PASS
UB.05 DLK 1B2P	0.7%	PASS	1.3%	PASS
UF.01 DLK 1B2P	0.7%	PASS	2.2%	PASS
UF.02 DLK 1B2P	0.8%	PASS	2.2%	PASS
UF.03 DLK 4B6P	1.7%	PASS	2.9%	PASS
UR.01 DLK 3B5P	1.1%	PASS	2.2%	PASS
UR.02 DLK 3B5P	1.1%	PASS	1.9%	PASS