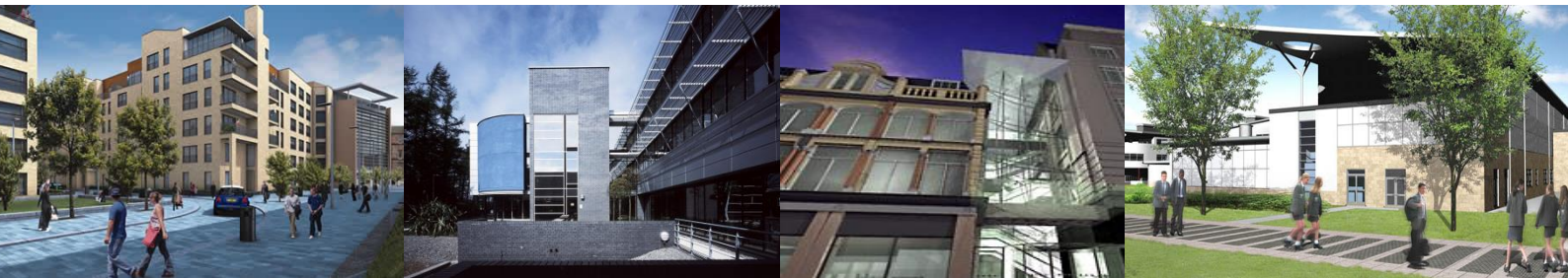


THE MORAY COUNCIL
NATURAL VENTILATION IN WINTER
COVID-19 GUIDANCE

2419-BWP-RP-0001



NATURAL VENTILATION IN WINTER
COVID-19 GUIDANCE



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CONTENTS

1.0 INTRODUCTION 3
2.0 WINTER VENTILATION STUDY 3
3.0 MODEL RESULTS & COMMENTARY 4
4.0 CONCLUSIONS 7
5.0 APPENDIX A
6.0 APPENDIX B
7.0 APPENDIX C



SCHOOL CLASSROOM – NATURAL VENTILATION IN WINTER

1.0 INTRODUCTION

1.1 In response to the Covid-19 outbreak guidance in respect of the role ventilation of occupied buildings plays in mitigating the transmission of the virus has been published and made widely available from a number of sources most notably;

- Scottish Government
- CIBSE
- REHVA
- The Royal Society

1.2 Current guidance recognises:

- *The amount of outside air that can be reasonably provided during winter is likely to be less than in the summer due to the impacts on indoor air temperature and occupant comfort. Poorly ventilated spaces are highly likely to increase the risk of SARS-CoV-2 transmission via aerosols at distances greater than 2m. It is therefore important that all reasonable steps are taken to avoid poor ventilation of indoor spaces as far as possible. and;*
- *Increased ventilation in winter may lead to unwanted occupant behavioural responses that result in ventilation provision being deactivated or minimised. For example, increased ventilation could result in colder indoor environments or cold draughts resulting in occupants closing, reducing or turning off ventilation provision, frustrating the goal of increased ventilation.*

1.3 Addressing winter ventilation of classroom spaces, outline guidance common to all sources includes:

- High level window opens, if available, should be used in preference to low level window openings.
- Use of available multiple openings rather than just single opening is likely to create a more comfortable environment with respect to draughts.
- Cross ventilation from window openings, if available, is generally more effective in providing ventilation to the space.
- Measurement of elevated CO₂ level in indoor air are an effective method of identifying poor ventilation in multi – occupant spaces.
- Maintaining CO₂ levels around and below 1500ppm represents an adequately ventilated space.
- Positioning of seating away from window openings and draft plumes should be considered.
- Relaxation of dress codes should be considered, if necessary, to allow warmer clothes to be worn.

1.4 This winter ventilation study has been produced to support the range of guidance and recommendations associated with increased natural ventilation of school classrooms during winter period.

1.5 The primary focus is on the degree of window opening required under differing weather conditions and the effectiveness of the existing heating systems in maintaining an acceptable room temperature.

2.0 WINTER VENTILATION STUDY

2.1 Two primary schools and one secondary school within the Moray Council region have been identified by the Client to carry out the winter ventilation study:

- Applegrove Primary School, Forres

- Greenwards Primary School, Elgin
- Forres Academy , Forres

- 2.2 A building model has been developed for all schools using IESVE software.
- 2.3 Various scenarios of window opening were modelled using IESVE Macroflo, Apache and the results analysed using Vistapro software.
- 2.4 The classrooms within the school building, its geographic location, its window types, opening and locations together with the fabric thermal properties form part of the model.
- 2.5 Each classroom has been assessed with 33 pupils and up to two teachers (except Greenwards 1/63 25 pupil and two teachers) in sedentary activities.
- 2.6 The heat emitters as based on the existing heating system output and the heat gains from, occupants, equipment's and alighting has been considered when assessing the classroom temperature.
- 2.7 The first part January has been selected as a representative weeks in which to report the modelling outcomes. The model weather file for this period has very cold still days, cool breezy days and milder very breezy days and is a reasonable representation of the variations during a Scottish winter.

3.0 MODEL RESULTS & COMMENTARY

APPLEGROVE PRIMARY

- 3.1 Applegrove Primary was recently fully refurbished with improved thermal performance of the building fabric, new windows and new radiator heating systems.



- 3.2 The following classrooms have been assessed:

- 3.3 **Ground floor 1/65**, the classroom window arrangement includes:

- High and low level openings on the main façade
- Clerestory windows opposite the main façade

- 3.4 **Ground floor 1/63**, the classroom window arrangement includes:

- High and low level openings on the main façade
- Clerestory windows opposite the main façade (these windows were modelled closed to allow the performance of single sided ventilation to be considered)

- 3.5 **First Floor 2/71**, the classroom window arrangement includes:

- High and low level openings on the main façade
- Windows on multiple façades

- 3.6 The results of the modelling are shown in appendix A, in summary the following comments are offered:

- 3.7 There are a good number of windows in this school with the opportunity to many permutations of window openings - high and low level, single sided, two sided and clerestory.

- 3.8 Both **Classrooms 1/65 & 2/71** offer cross ventilation and can normally be ventilated to maintain CO₂ levels below 1500ppm by opening all top windows by between 5 – 15%. On still days with little or no wind the top window may need to open up to 25%. Acceptable room temperature can be achieved although at the start of the day and after lunch the room may feel cool at first.
- 3.9 **Classroom 1/63** has been modelled on single sided window openings. The modelling results showed that it was not possible to maintain acceptable CO₂ level in the classroom using top opening only. The room can be normally be ventilated to maintain CO₂ levels below 1500ppm by opening all top and bottom windows by 10%. Acceptable room temperature can be achieved although at the start of the day and after lunch the room may feel cool at first.

GREENWARDS PRIMARY

- 3.10 Greenwards Primary is generally an open plan school originally completed in April 1977. It was extended and doubled in size one year later and was further extended in 1990 to provide specialised accommodation for children with special needs.
- 3.11 The classrooms are heated by LPHW fan convectors. An assessment has been made of the expected unit output for modelling purposes.
- 3.12 The classrooms are generally arranged around the outer perimeter of the building, though many of the open plan classrooms are interconnected and share window openings onto a number of central external courtyards.
- 3.13 The windows throughout the school are top hung hoppers only.



- 3.14 The following classrooms have been assessed:
- 3.15 **Ground floor 1/12&13**, two linked open plan classrooms - window arrangement includes:
- High level openings on the main façade
 - High level opening onto the courtyard
- 3.16 **Ground floor 1/63**, the classroom window arrangement includes:
- High openings on the main façade
- 3.17 The results of the modelling are shown in appendix B, in summary the following comments are offered:
- 3.18 There are a good number of windows in this school with the opportunity to many permutations of window openings - high level, single sided, two sided and crossflow.
- 3.19 Both **Classrooms 1/12 & 1/13** offer cross ventilation and can normally be ventilated to maintain CO₂ levels below 1500ppm by opening all top windows up to 15%. On still days with little or no wind the top windows may need to open up to 25%. Acceptable room temperature can be achieved although at the start of the day and after lunch the room may feel cool at first.
- 3.20 **Classroom 1/63** has been modelled on single sided window openings. The modelling results showed that it was not possible to maintain acceptable CO₂ level in the classroom for 35 pupils using

the top opening windows. The modelling was rerun, reducing the number of occupants to 27. The room can be normally be ventilated to maintain CO₂ levels below 1500ppm by opening all the windows up to 25%. Acceptable room temperature can be achieved although at the start of the day and after lunch the room may feel cool at first. Additionally, it is likely that cool draughts will be more prevalent.

FORRES ACADEMY

- 3.21 Forres Academy is large secondary school built around a central courtyard for the main education classrooms and with branch wings serving technical, PE and assembly etc.
- 3.22 The classrooms are generally heated by LPHW fan convectors. An assessment has been made of the expected unit output for modelling purposes.
- 3.23 The classrooms considered are arranged around the courtyard and outer perimeter of the building.
- 3.24 Ventilation is predominantly single sided through mid-hung pivot windows only.



3.25 The following classrooms have been assessed:

- **Ground floor 1/6** - facing outward onto the front façade single sided ventilation.
- **Ground floor 1/86**- facing into the courtyard single sided ventilation.
- **Ground Floor 1/91**, facing outward onto the front façade single sided ventilation:

3.26 The results of the modelling are shown in appendix C, in summary the following comments are offered:

3.27 There are a good number of windows in this school with the opportunity for a number of permutations of window opening strategies – single window, multiple windows, although only single sided is opening is available. The type of window opening mechanism does allow for some high(ish) and low(ish) ventilation within the classrooms.

3.28 **Classroom 1/6** can normally be ventilated to maintain CO₂ levels below 1500ppm by opening all windows up to 15. Acceptable room temperature should be maintainable throughout the day.

3.29 **Classroom 1/86** can normally be ventilated to maintain CO₂ levels below 1500ppm by opening all windows up to 15%. Acceptable room temperature should be maintainable throughout the day although at times at the start of the day and after lunch the room may feel cool at first.

3.30 **Classroom 1/91** can normally be ventilated to maintain CO₂ levels below 1500ppm by opening all windows up to 15%. Acceptable room temperature should be maintainable throughout the day.

4.0 CONCLUSIONS

4.1 The weather conditions including wind speed, direction and external temperature is the predominant influence on window opening requirements to provided acceptable ventilation within the classroom.

4.2 The various window opening types give a good overall snap shot of the fenestration arrangements across the Moray Council school estate.

- High and low level openings
- Top hopper openings
- Mid pane pivot openings
- Clerestory openings
- Single sided ventilation
- Cross ventilation
- Dual aspect ventilation

4.3 The specialist advice recommendations (1.3) for classroom ventilation noted above hold firm.

4.4 Cross ventilation through top opening windows is usually an effective method of promoting natural ventilation whilst helping to minimise cold draughts.

4.5 On very still days with little or no wind it may be better to use top and bottom window openings at 10% open, where available, rather than opening top windows only to 25%.

4.6 Single sided ventilation will perform better with top and bottom opening of windows. If only top opening windows exist it will be necessary to open these windows wider up to 25%at times.

4.7 As would be expected when breezier days promote greater air change within the classrooms, it will be possible to reduce the amount of window opening. This is most likely to be occupant in classroom assessed, based on, for instance increased draughts and perceived air movement.

4.8 In all cases CO₂ concentration levels build up gradually, dropping quickly to ambient levels when the classes are empty over the lunch period. This highlights the importance of having windows open at the start of the day before the arrival of the pupils and leaving windows open during unoccupied break periods. In addition, short periods of wide window opening for rapid ventilation is an effective method introducing fresh clean air to spaces.

4.9 The results of the schools and rooms tested show that when controlling the amount of window opening for adequate ventilation, that in all cases it should be possible to maintain acceptable temperature conditions utilising the existing room heating systems.

4.10 In some situations, classrooms may be cool at first at the start of the day or on the return from lunch break but soon recover to comfortable temperature levels.

4.11 Notwithstanding, for every classroom arrangement the effect of local draughts and seating positions will need to be taken into consideration.

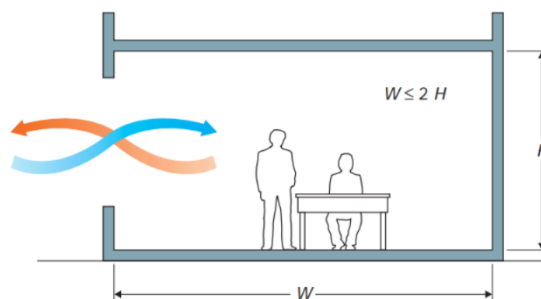


Figure 2.18 Single sided ventilation, single opening

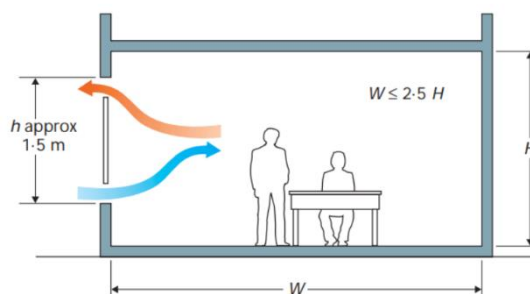


Figure 2.19 Single sided ventilation, double opening

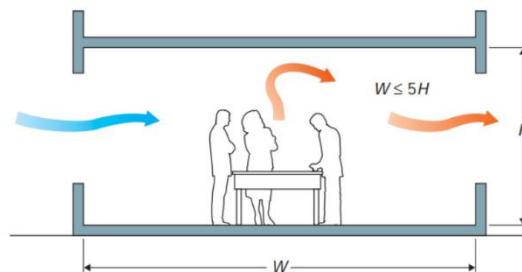


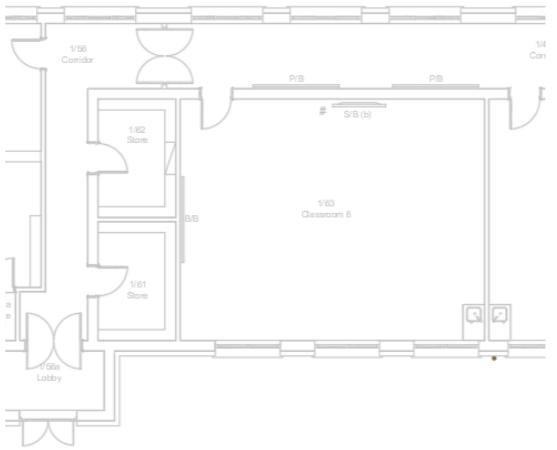
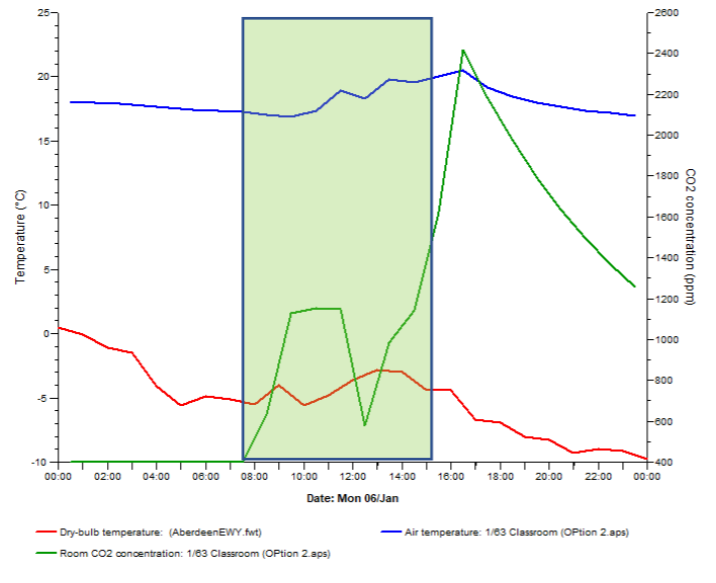
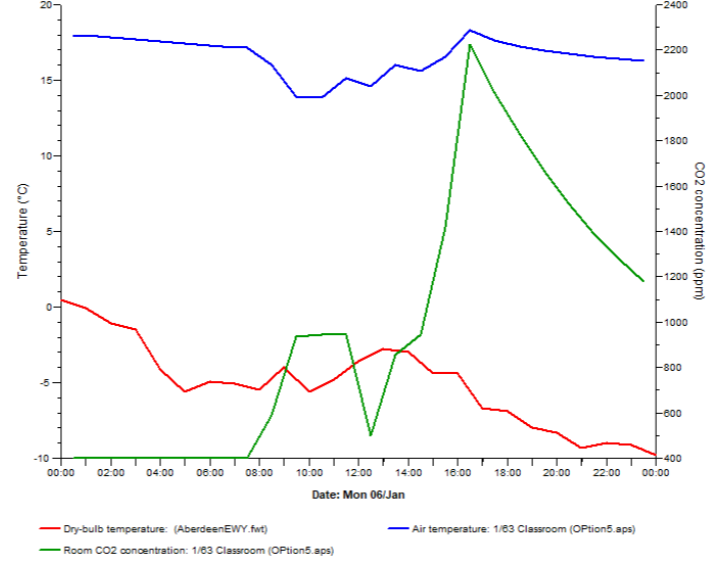
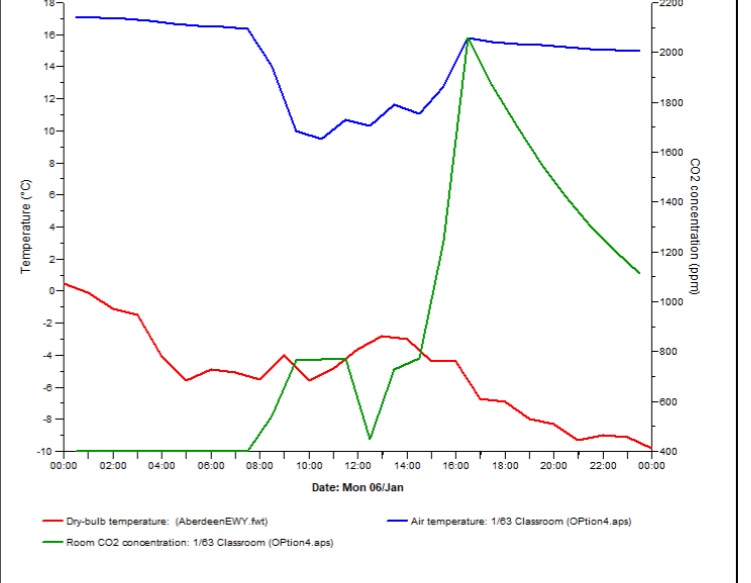
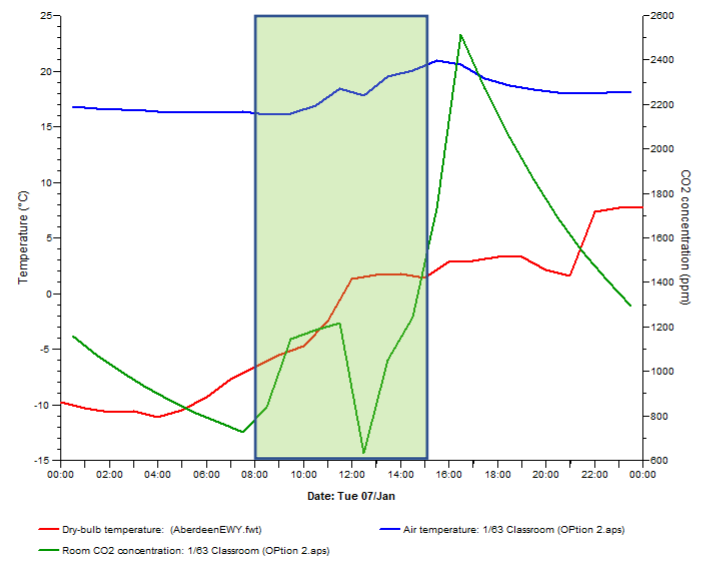
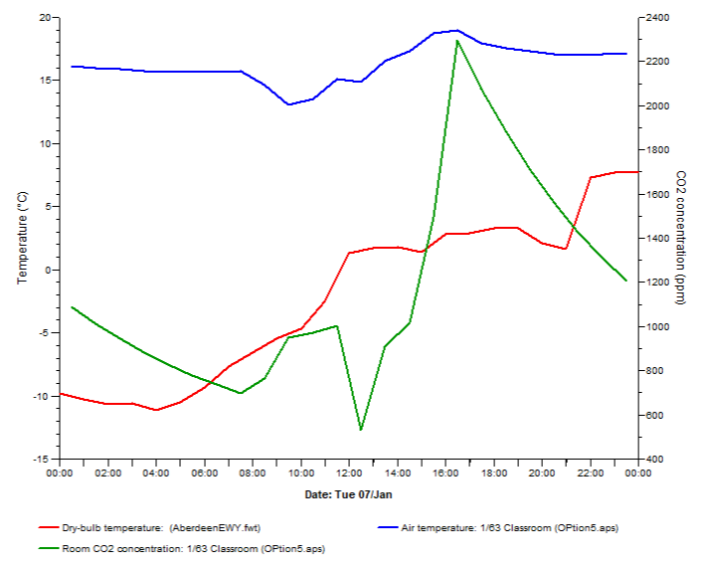
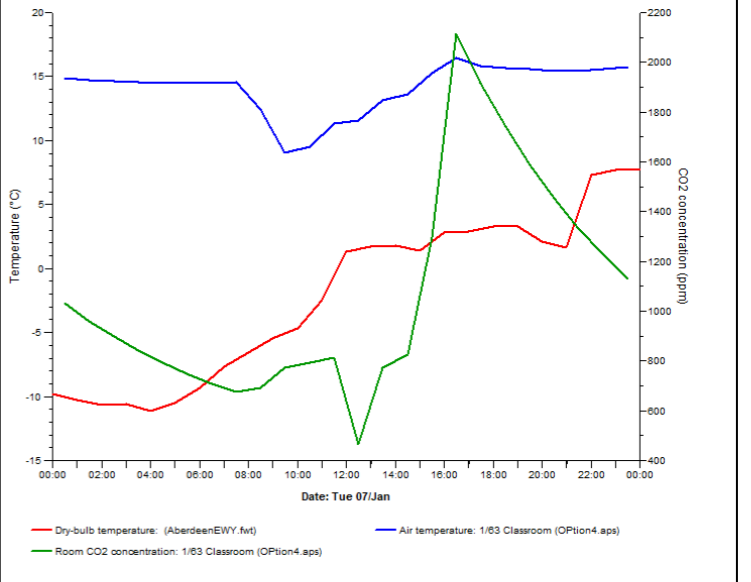
Figure 2.20 Cross ventilation



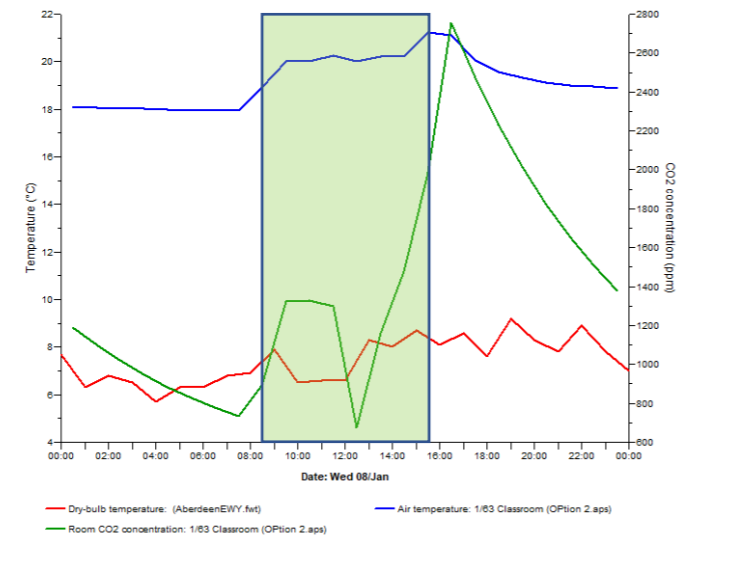
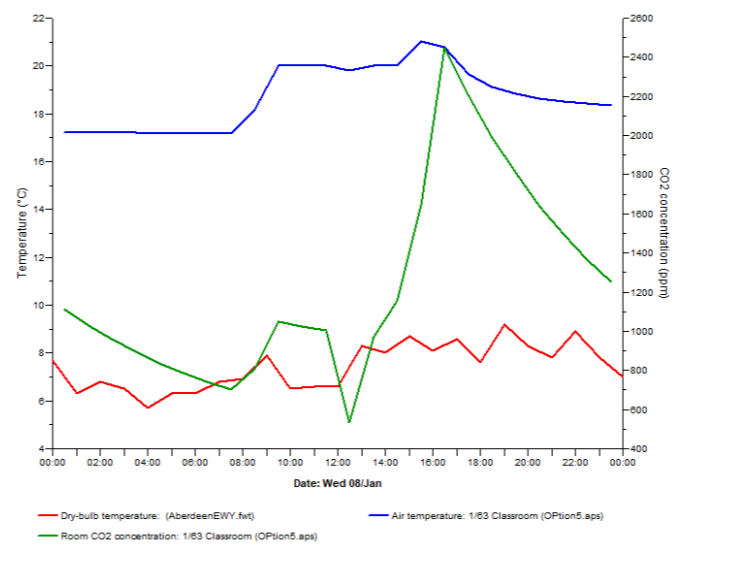
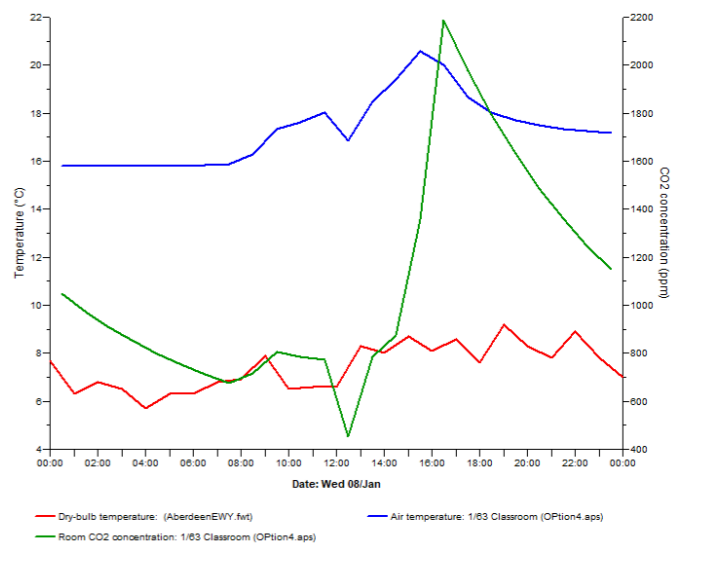
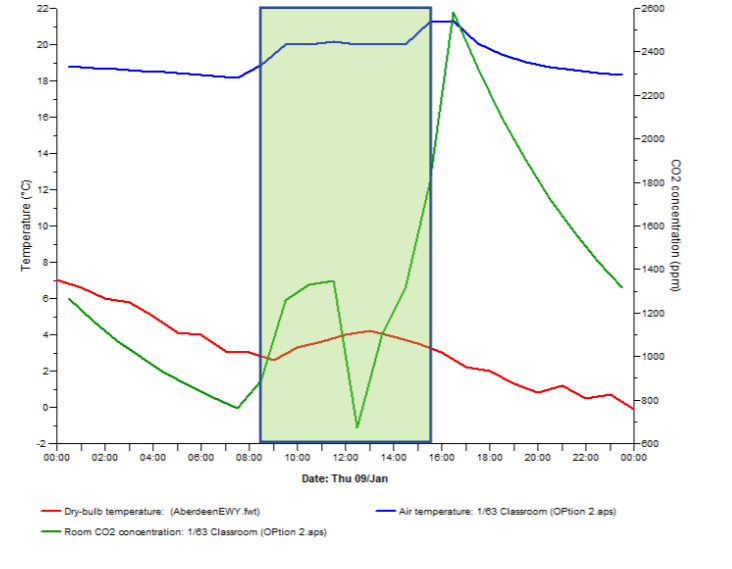
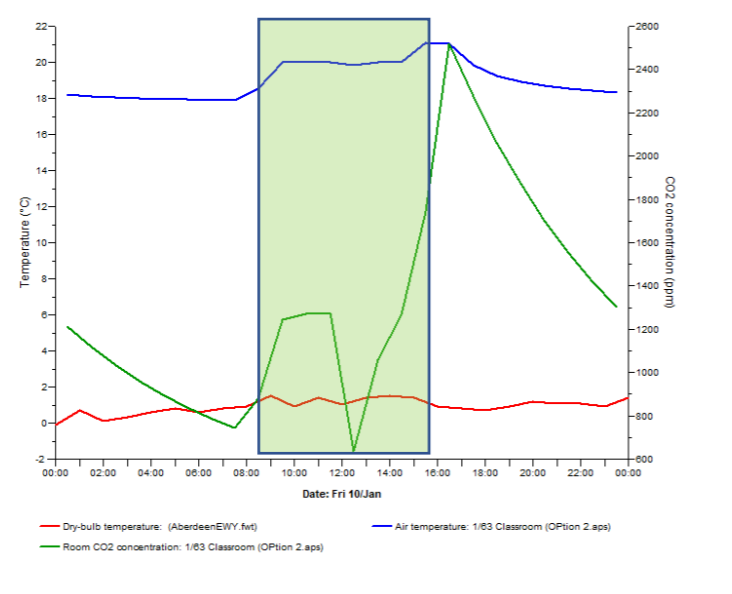
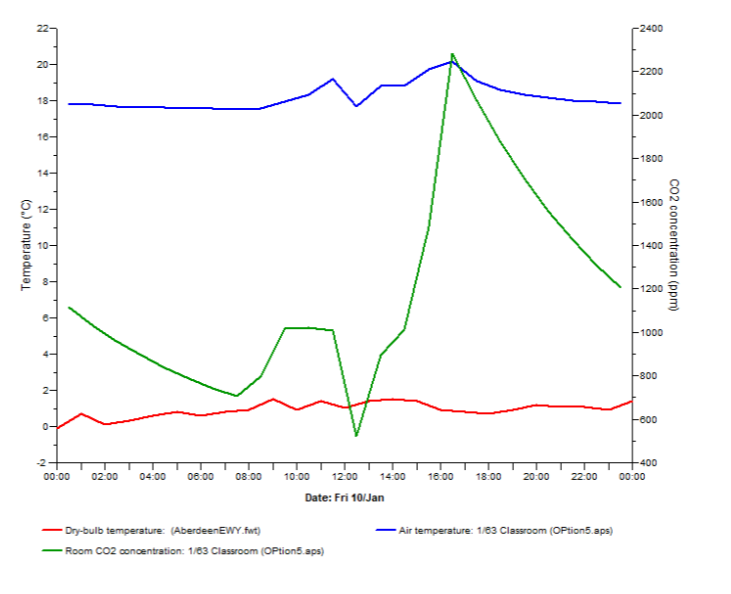
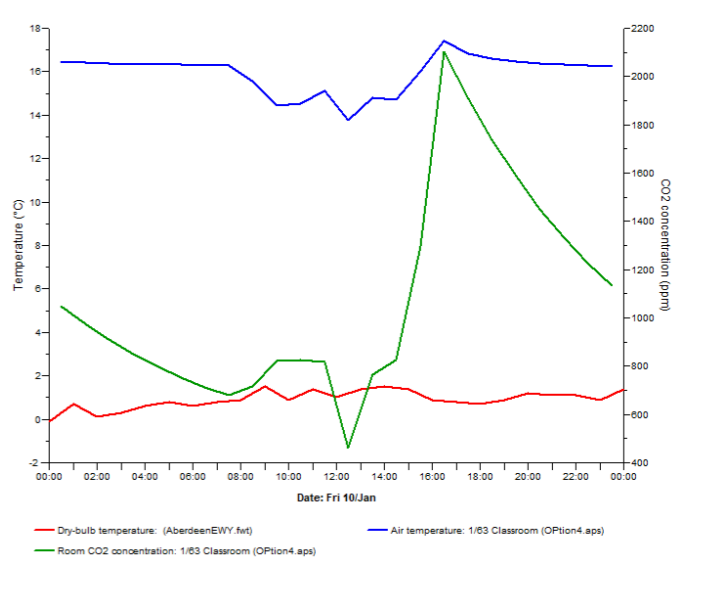
5.0 APPENDIX A

APPLEGROVE PRIMARY RESULTS

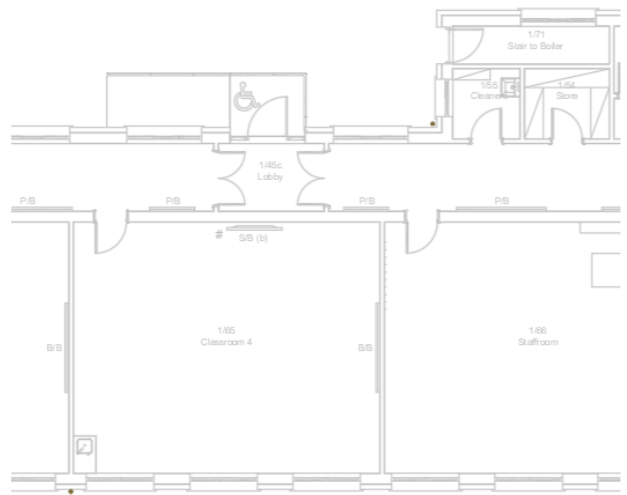
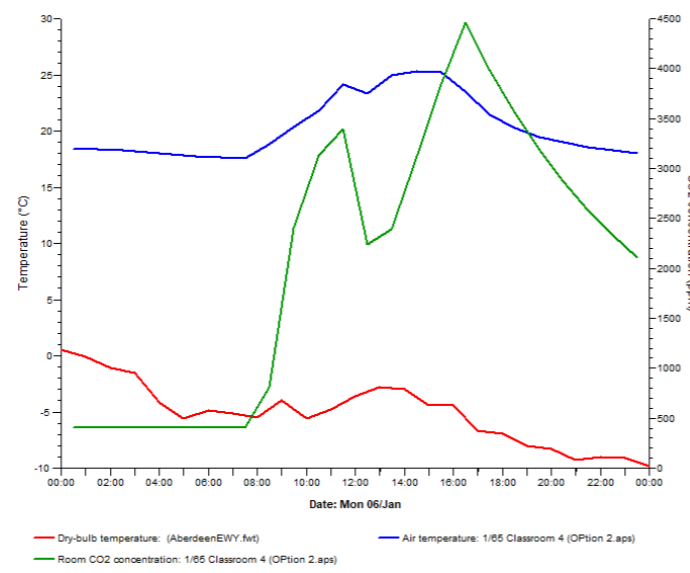
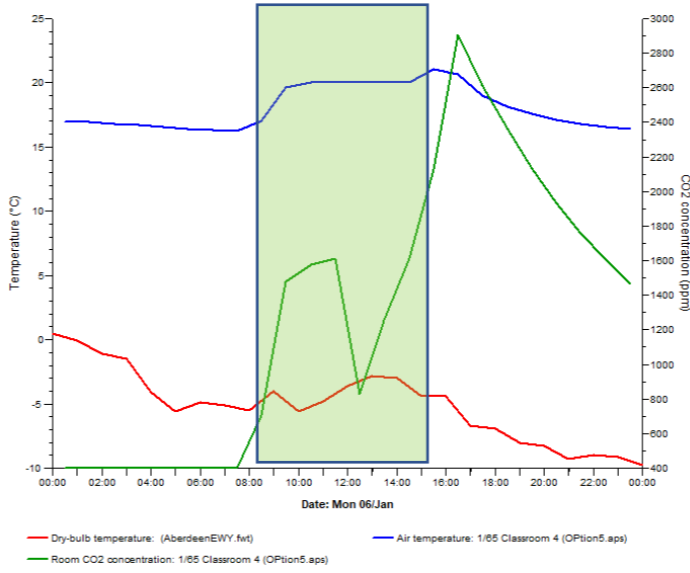
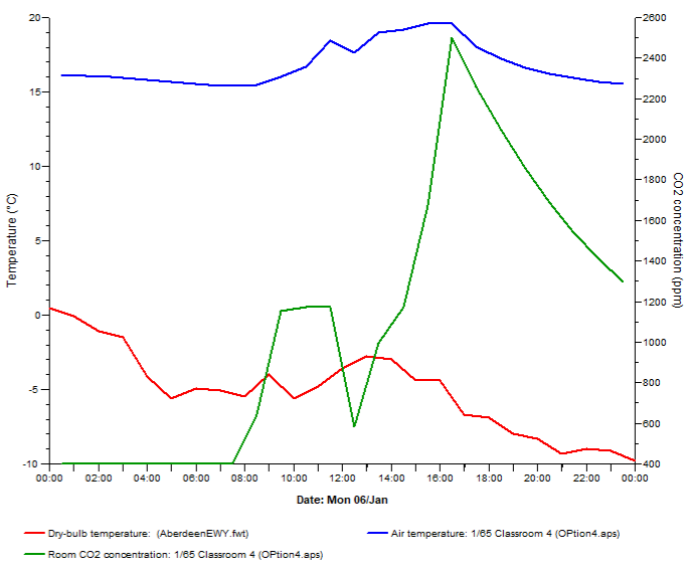
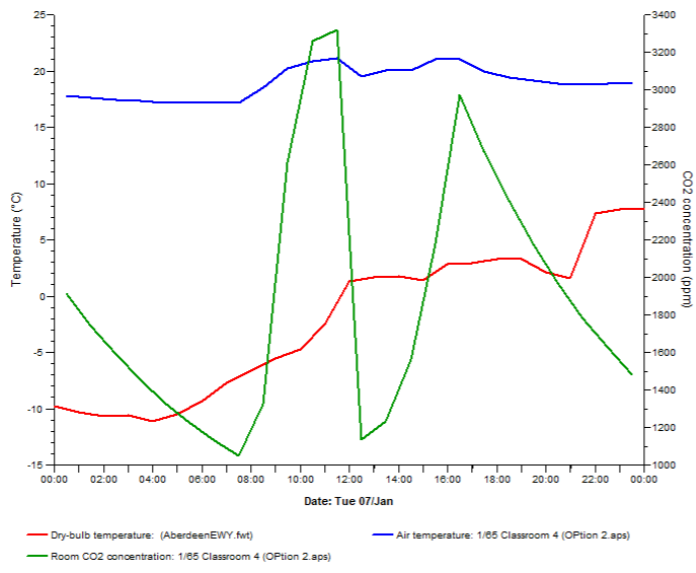
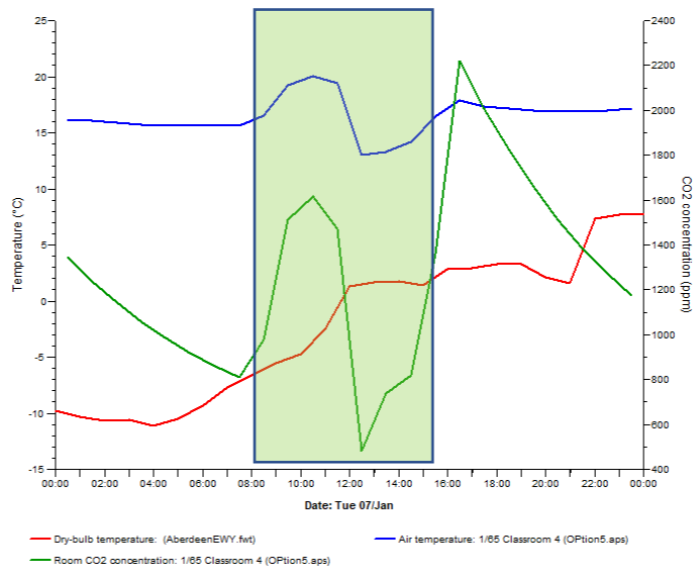
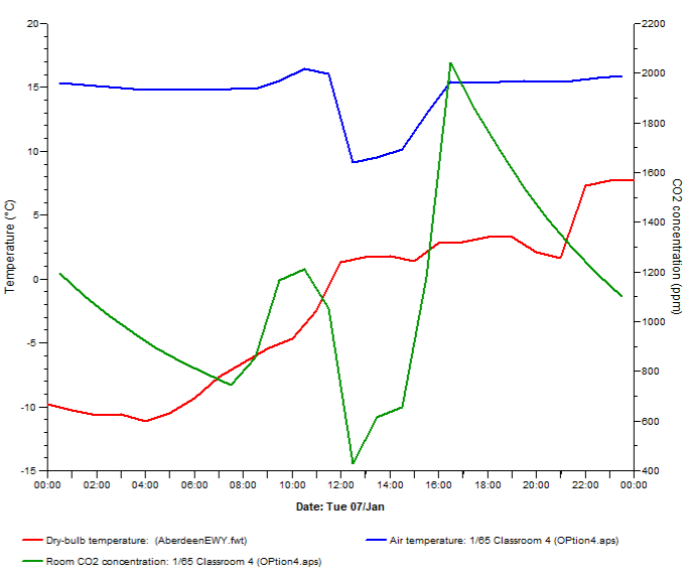
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<p>Applegrove Primary School Room 1/63</p> <p>Openable top and bottom hoppers on main façade and openable clerestory window opposite. NOTE: this room modelled as single sided ventilation from the main façade only for comparison purposes</p>		<p>Model Parameters: <i>Occupancy:</i> 33 Pupils 2 Adults <i>Lighting:</i> based on LCD @5w/m2 <i>Computers etc:</i> based on 2 PCs in use <i>Building fabric:</i> Upgraded 2017 <i>Windows:</i> Openable top and bottom hoppers on main façade and openable clerestory window opposite <i>Classroom occupancy period:</i> 8:30am -3:30pm (lunch unoccupied 12:30pm – 1:30pm) <i>Assessment is based on full heat from the installed radiator system being available to the classroom. The thermostatic radiator valves should be set at 21°C</i></p>	<p>Model Preferred Outcomes: Ventilation: In multi occupancy rooms a CO₂ level not exceeding on or around 1500ppm represents the limit of a well ventilated environment. Less than 1500ppm is better. Temperature: 19-21°C is a comfortable temperature for sedentary activities for most. 16-18°C may be acceptable when wearing seasonal appropriate clothing or during periods of higher physical activity. In both cases occupant comfort level will be influenced by, amongst other factors, the air speed and in particular the influence of cold draughts</p>
<p>Single Sided Ventilation top & bottom windows open 10% Single Sided Ventilation top & bottom windows open 15% Single Sided Ventilation top & bottom windows open 25%</p>			
<p>Monday 6 January:</p> <p>Weather conditions during the school occupation hours is a very cold (sub-zero) still winter day with N wind speed > 1.5m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the top and bottom windows will require to be approximately 10% open. Acceptable temperature should be maintainable but the room may feel on the cool side particularly before lunch.</p>			
<p>Tuesday 7 January:</p> <p>Weather conditions during the school occupation hours is a very cold (sub-zero) still winter day with S wind speed 0-4 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the top and bottom windows will require to be approximately 10% open. Acceptable temperature should be maintainable but the room may feel on the cool side particularly before lunch.</p>			

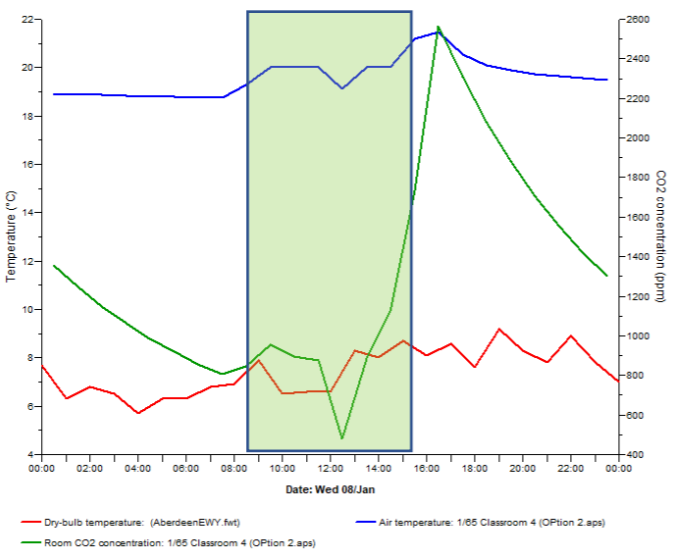
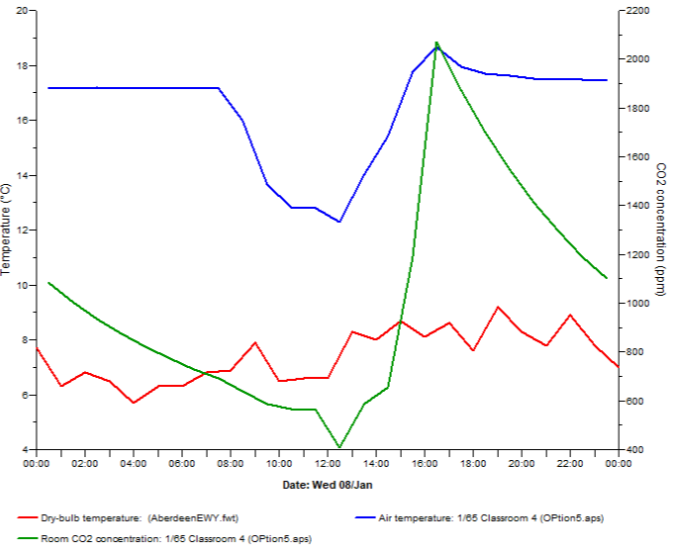
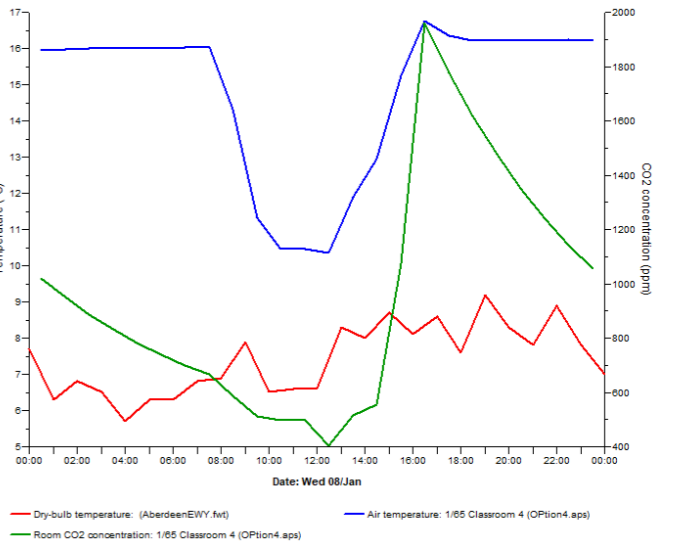
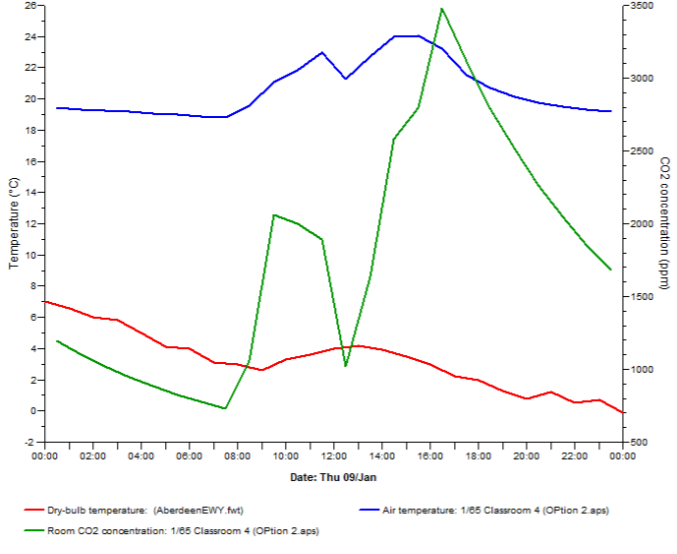
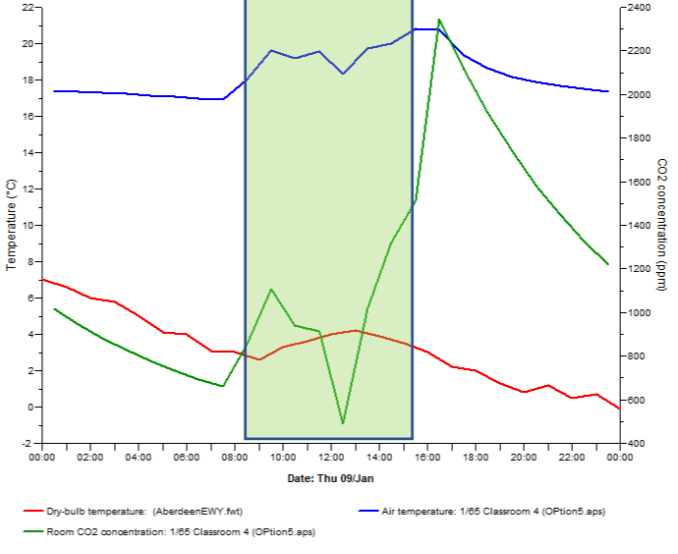
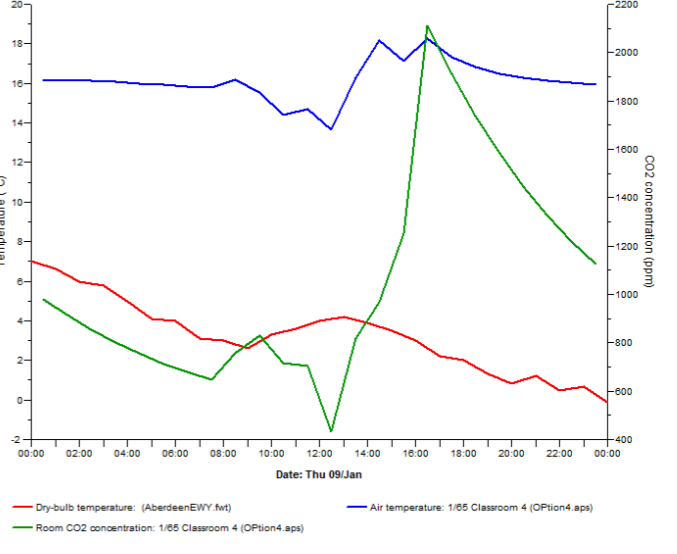
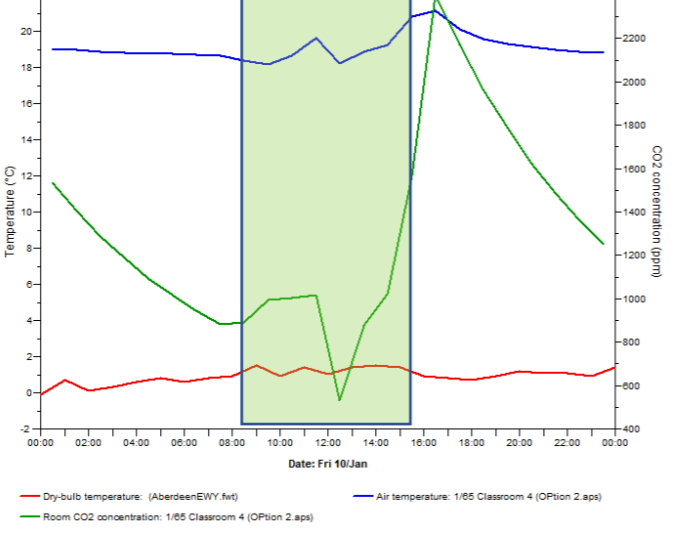
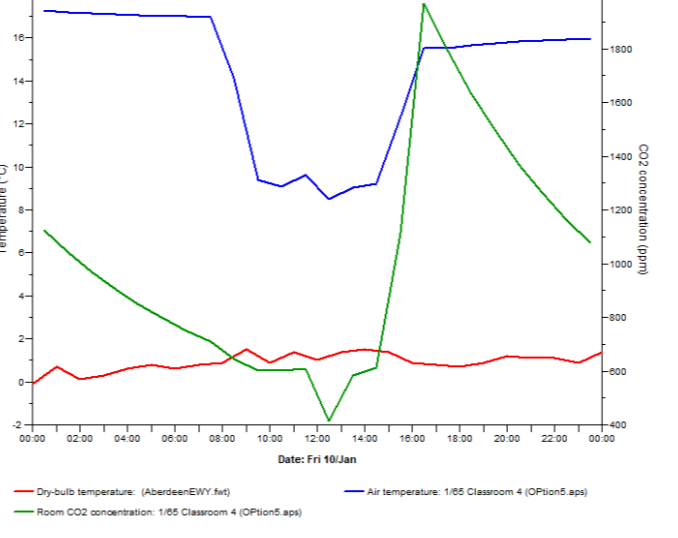
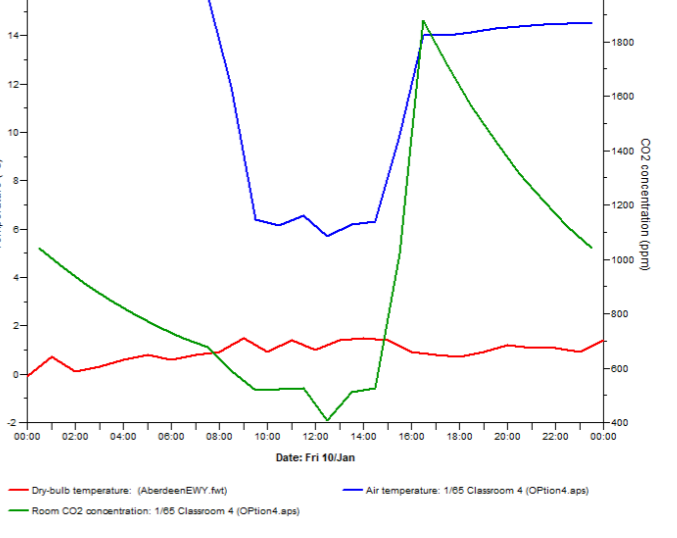
NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Wednesday 8 January:</p> <p>Weather conditions during the school occupation hours is a mild breezy winter day with SW wind speed 7-10 m/s.</p> <p>Even though it is relatively mild outside the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top and bottom windows will require to be approximately 10% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fvt) — Air temperature: 1/63 Classroom (OPtion 2.aps) — Room CO2 concentration: 1/63 Classroom (OPtion 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fvt) — Air temperature: 1/63 Classroom (OPtion5.aps) — Room CO2 concentration: 1/63 Classroom (OPtion5.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fvt) — Air temperature: 1/63 Classroom (OPtion4.aps) — Room CO2 concentration: 1/63 Classroom (OPtion4.aps)</p>
<p>Thursday 9 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with W wind speed 4-8 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top and bottom windows will require to be approximately 10% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fvt) — Air temperature: 1/63 Classroom (OPtion 2.aps) — Room CO2 concentration: 1/63 Classroom (OPtion 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fvt) — Air temperature: 1/63 Classroom (OPtion5.aps) — Room CO2 concentration: 1/63 Classroom (OPtion5.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fvt) — Air temperature: 1/63 Classroom (OPtion4.aps) — Room CO2 concentration: 1/63 Classroom (OPtion4.aps)</p>
<p>Friday 10 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with N wind speed 6-10 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top and bottom windows will require to be approximately 10% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fvt) — Air temperature: 1/63 Classroom (OPtion 2.aps) — Room CO2 concentration: 1/63 Classroom (OPtion 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fvt) — Air temperature: 1/63 Classroom (OPtion5.aps) — Room CO2 concentration: 1/63 Classroom (OPtion5.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fvt) — Air temperature: 1/63 Classroom (OPtion4.aps) — Room CO2 concentration: 1/63 Classroom (OPtion4.aps)</p>

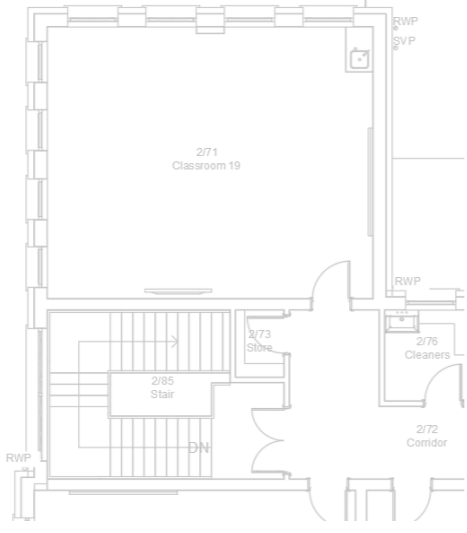
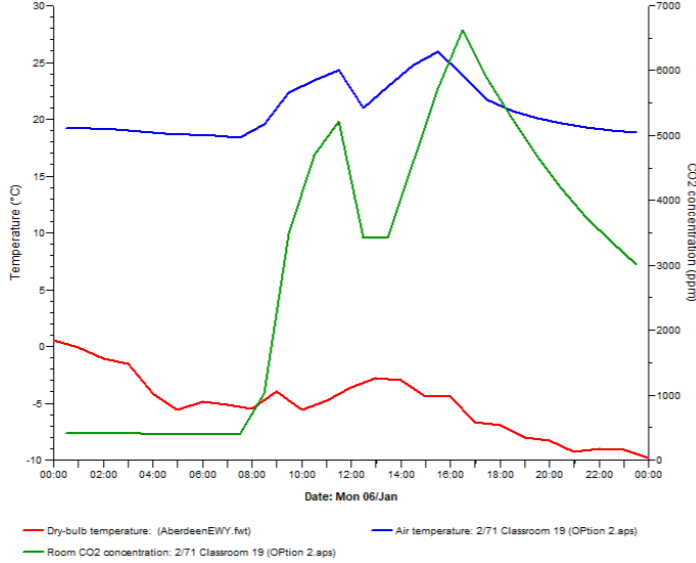
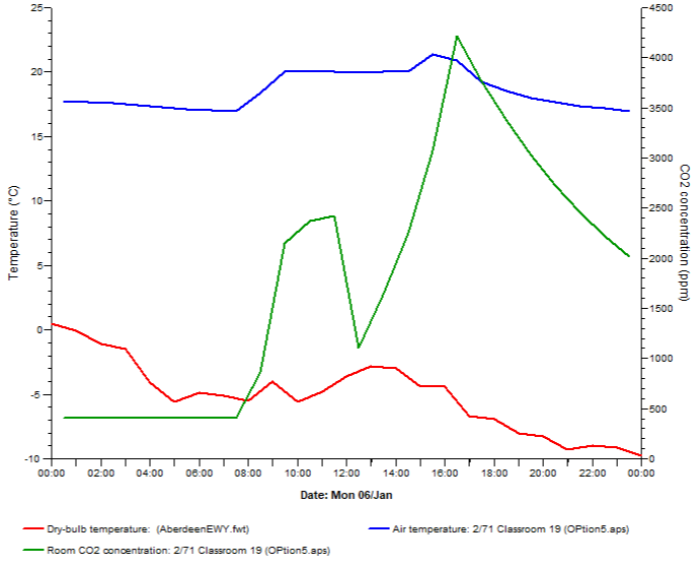
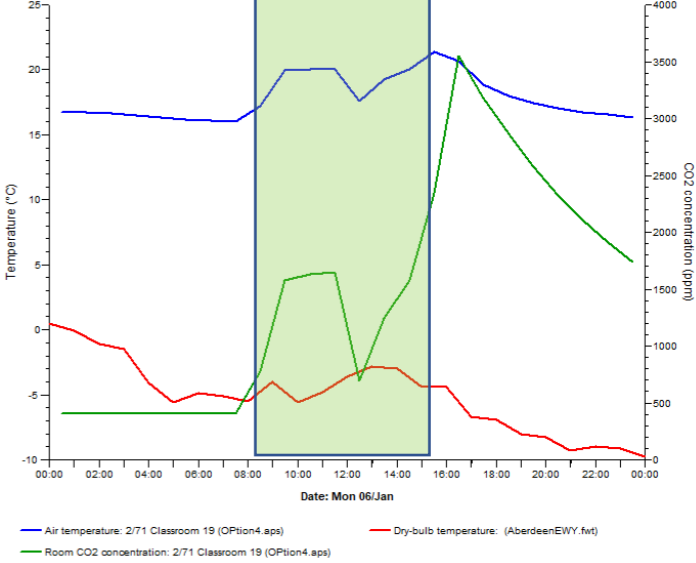
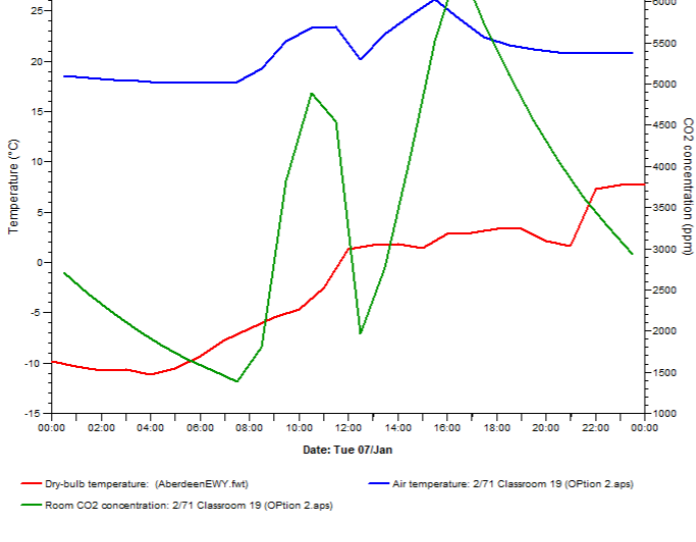
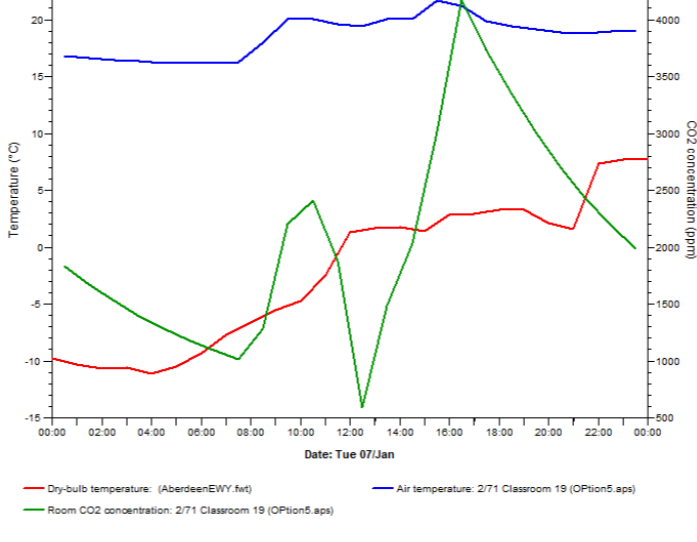
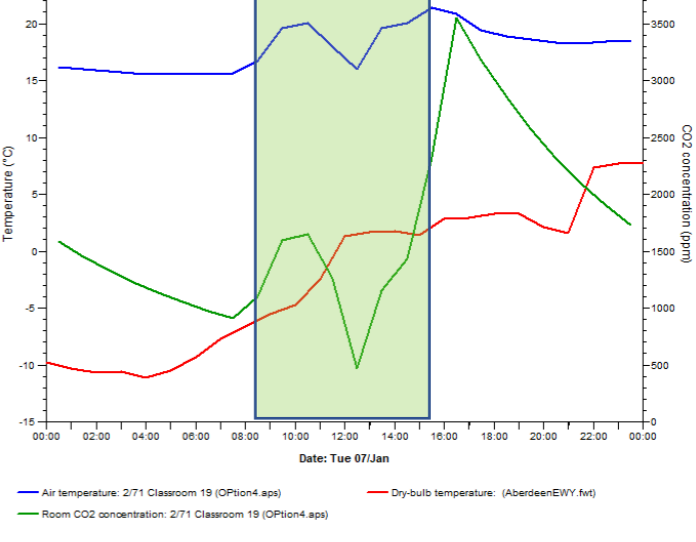
NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Applegrove Primary School Room 1/65</p> <p>Openable top and bottom hoppers on main façade and openable clerestory window opposite</p>		<p>Model Parameters: Occupancy: 33 Pupils 2 Adults Lighting: based on LCD @5w/m2 Computers etc: based on 2 PCs in use Building fabric: Upgraded 2017 Windows: Openable top and bottom hoppers on main façade and openable clerestory window opposite</p> <p><i>Classroom occupancy period: 8:30am -3:30pm (lunch unoccupied 12:30pm – 1:30pm)</i></p> <p><i>Assessment is based on full heat from the installed radiator system being available to the classroom. The thermostatic radiator valves should be set at 21°C</i></p>	<p>Model Preferred Outcomes: Ventilation: In multi occupancy rooms a CO₂ level not exceeding on or around 1500ppm represents the limit of a well ventilated environment. Less than 1500ppm is better. Temperature: 19-21°C is a comfortable temperature for sedentary activities for most. 16-18°C may be acceptable when wearing seasonal appropriate clothing or during periods of higher physical activity. In both cases occupant comfort level will be influenced by, amongst other factors, the air speed and in particular the influence of cold draughts</p>
<p>Monday 6 January:</p> <p>Weather conditions during the school occupation hours is a very cold (sub-zero) still winter day with N wind speed > 1.5m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 15% open. Acceptable temperature should be maintainable but the room may feel cool at the start of the day.</p>	<p>Cross Ventilation top windows open 5%</p> 	<p>Cross Ventilation top windows open 15%</p> 	<p>Cross Ventilation top windows open 25%</p> 
<p>Tuesday 7 January:</p> <p>Weather conditions during the school occupation hours is a very cold (sub-zero) still winter day with S wind speed 0-4 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 15% open. Acceptable temperature may be maintainable but the room will certainly feel cool at the start of the day and struggle a bit on the return after lunch.</p>	<p>Cross Ventilation top windows open 5%</p> 	<p>Cross Ventilation top windows open 15%</p> 	<p>Cross Ventilation top windows open 25%</p> 

NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Wednesday 8 January:</p> <p>Weather conditions during the school occupation hours is a mild breezy winter day with SW wind speed 7-10 m/s.</p> <p>Even though it is relatively mild outside the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 5% open. Acceptable temperature should be maintainable but the room may feel cool at the start of the day.</p>			
<p>Thursday 9 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with W wind speed 4-8 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>			
<p>Friday 10 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with N wind speed 6-10 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 5% open. Acceptable temperature should be maintainable throughout the day.</p>			

NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

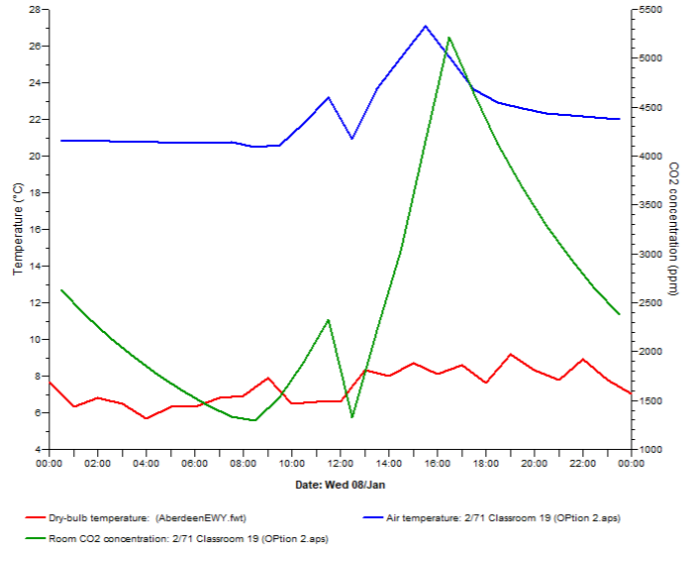
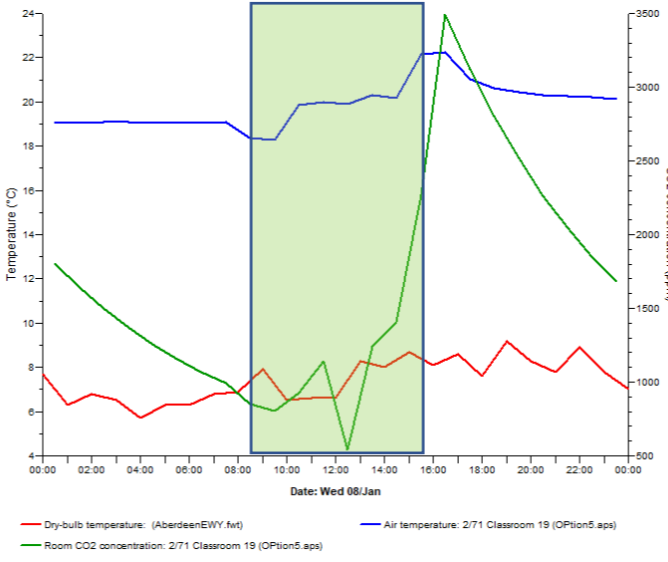
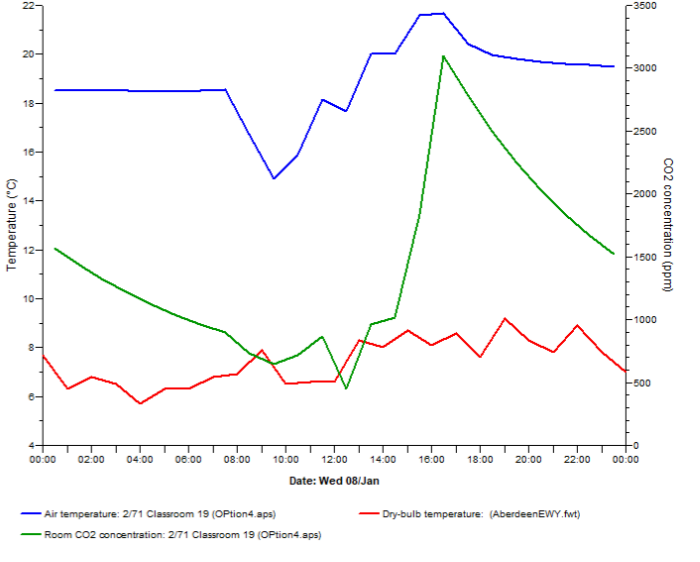
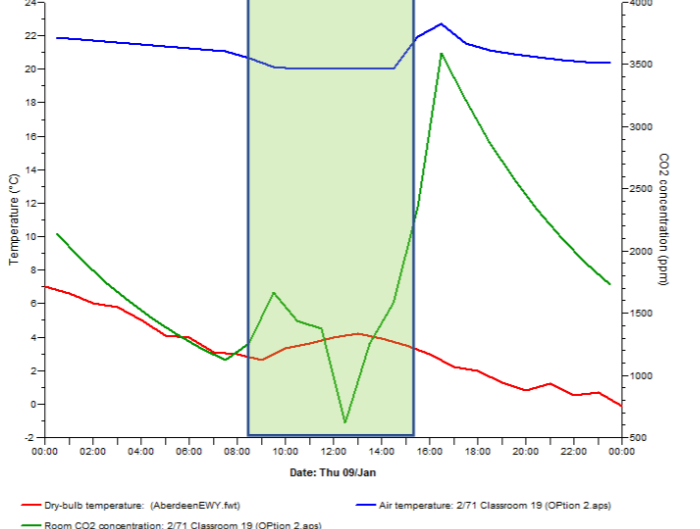
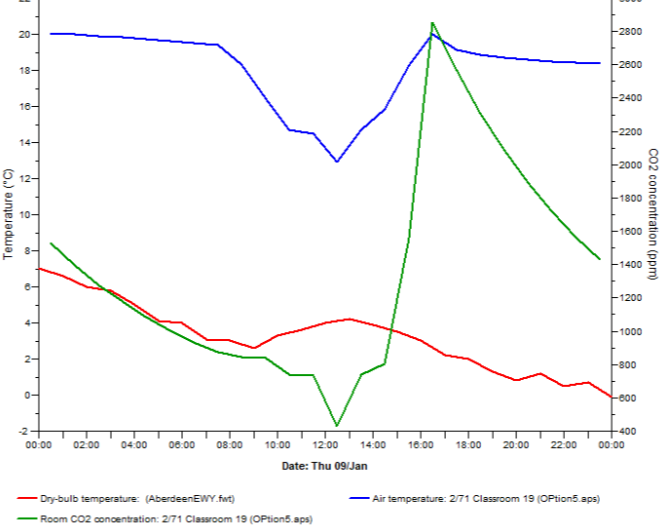

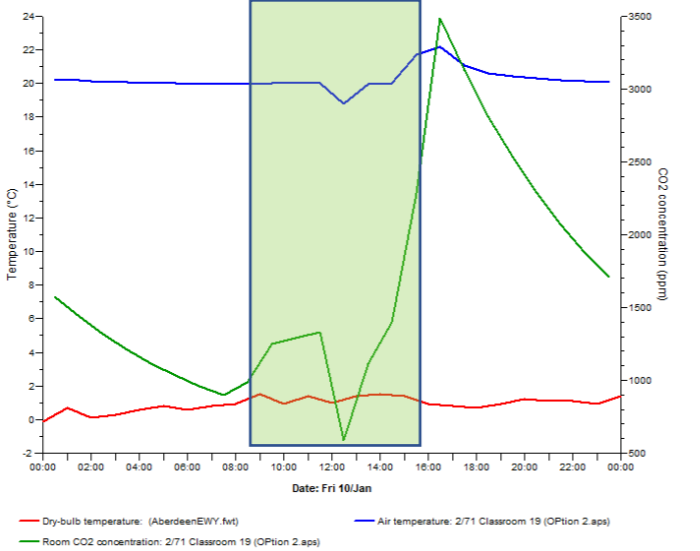
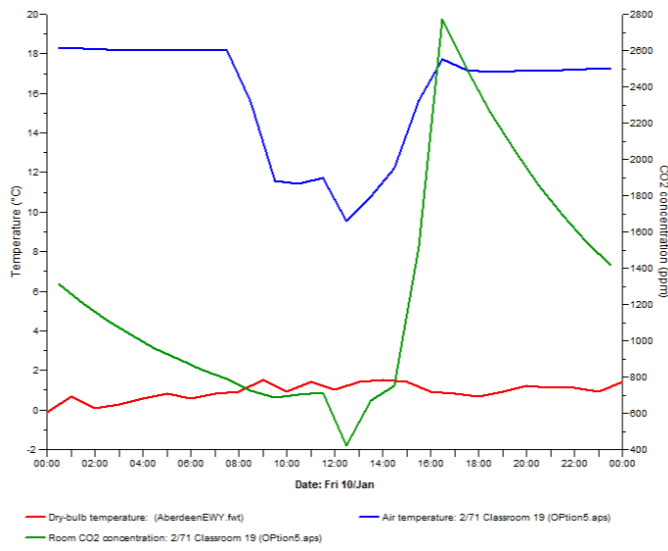
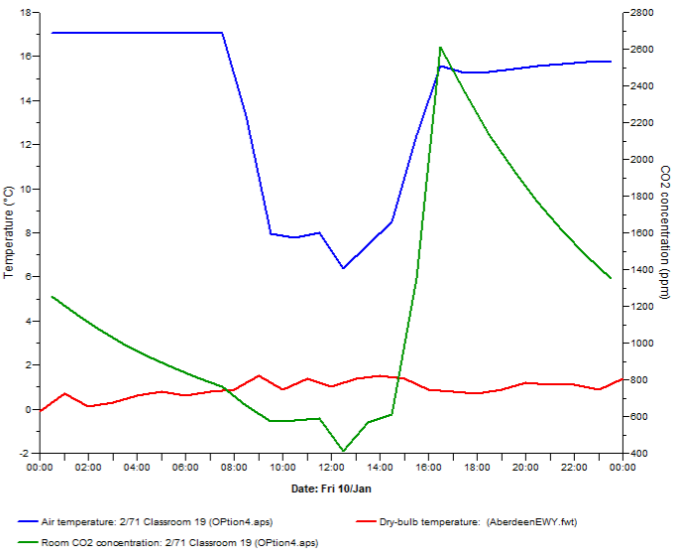
<p>Applegrove Primary School Room 2-71</p> <p>First floor corner classroom with openable windows on two adjacent sides.</p>		<p>Model Parameters: <i>Occupancy:</i> 33 Pupils 2 Adults <i>Lighting:</i> based on LCD @5w/m2 <i>Computers etc:</i> based on 2 PCs in use <i>Building fabric:</i> Upgraded 2017 <i>Windows:</i> Openable top and bottom hoppers</p> <p><i>Classroom occupancy period:</i> 8:30am -3:30pm (lunch unoccupied 12:30pm – 1:30pm)</p> <p><i>Assessment is based on full heat from the installed radiator system being available to the classroom. The thermostatic radiator valves should be set at 21°C</i></p>	<p>Model Preferred Outcomes: Ventilation: In multi occupancy rooms a CO₂ level not exceeding on or around 1500ppm represents the limit of a well ventilated environment. Less than 1500ppm is better.</p> <p>Temperature: 19-21°C is a comfortable temperature for sedentary activities for most. 16-18°C may be acceptable when wearing seasonal appropriate clothing or during periods of higher physical activity. In both cases occupant comfort level will be influenced by, amongst other factors, the air speed and in particular the influence of cold draughts</p>
<p>Monday 6 January:</p> <p>Weather conditions during the school occupation hours is a very cold (sub-zero) still winter day with N wind speed > 1.5m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 25% open. Acceptable temperature should be maintainable but the room will certainly feel cold at the start of the day and the return after lunch</p>	<p align="center">Cross Ventilation top windows open 5%</p> 	<p align="center">Cross Ventilation top windows open 15%</p> 	<p align="center">Cross Ventilation top windows open 25%</p> 
<p>Tuesday 7 January:</p> <p>Weather conditions during the school occupation hours is a very cold (sub-zero) still winter day with S wind speed 0-4 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 25% open. Acceptable temperature should be maintainable but the room will certainly feel cold at the start of the day and the return after lunch</p>	<p align="center">Cross Ventilation top windows open 5%</p> 	<p align="center">Cross Ventilation top windows open 15%</p> 	<p align="center">Cross Ventilation top windows open 25%</p> 



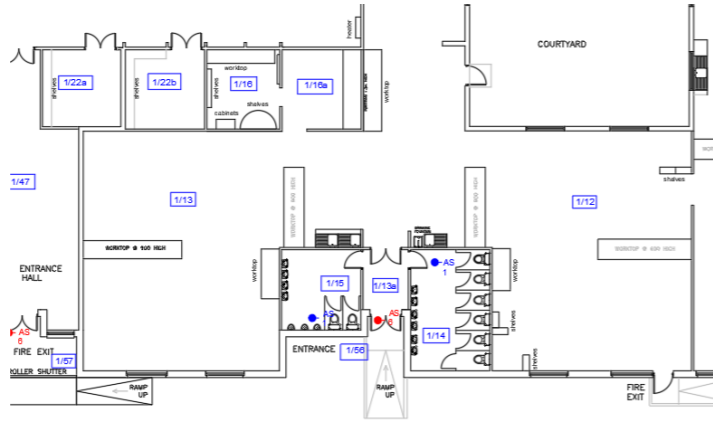
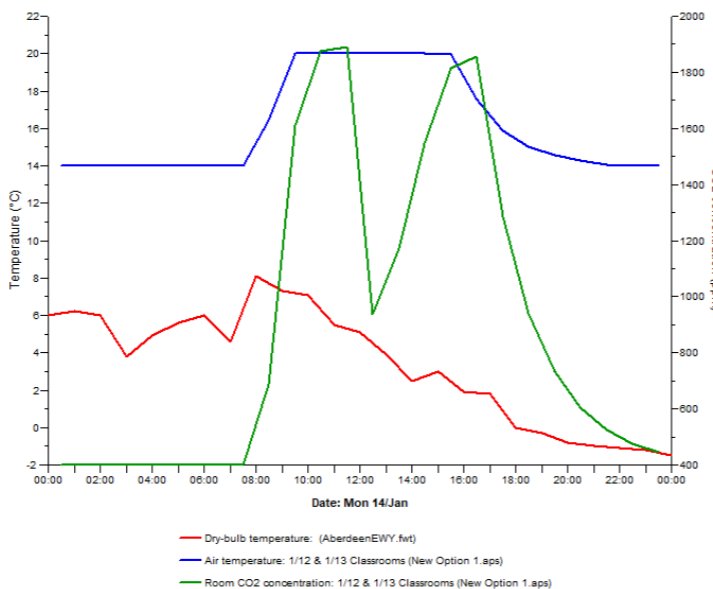
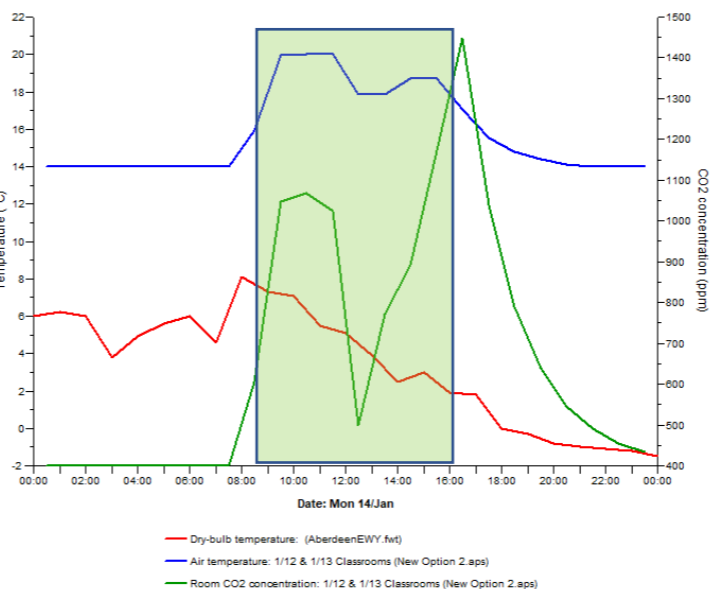
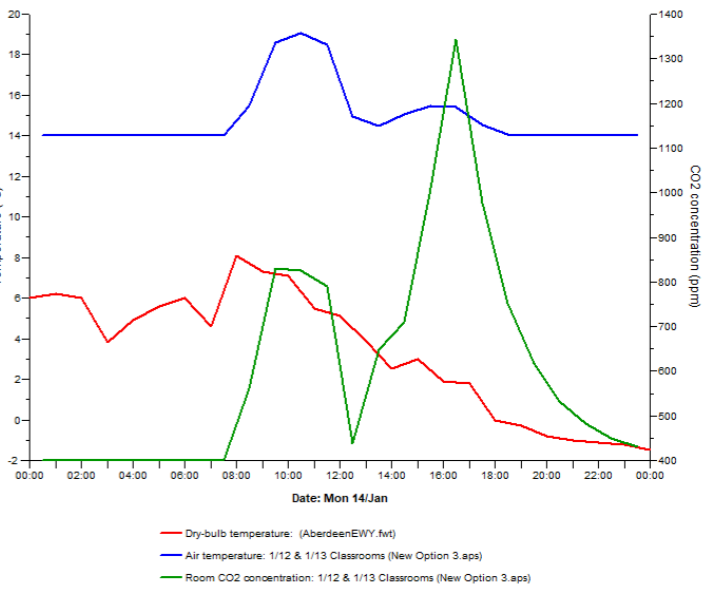
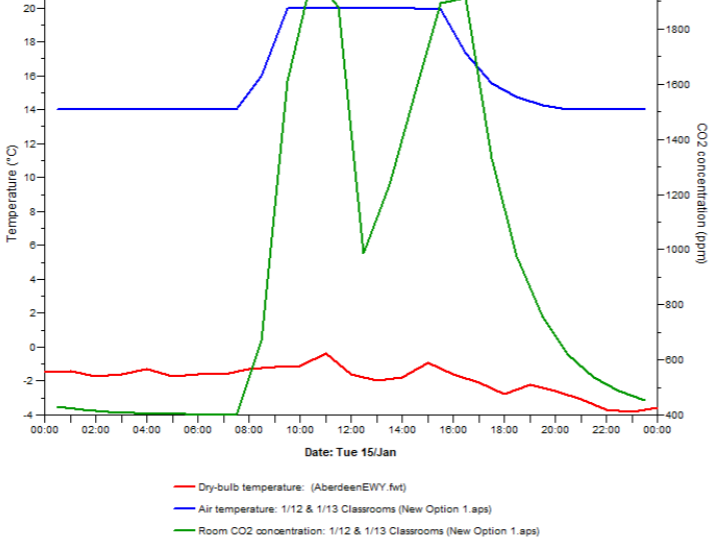
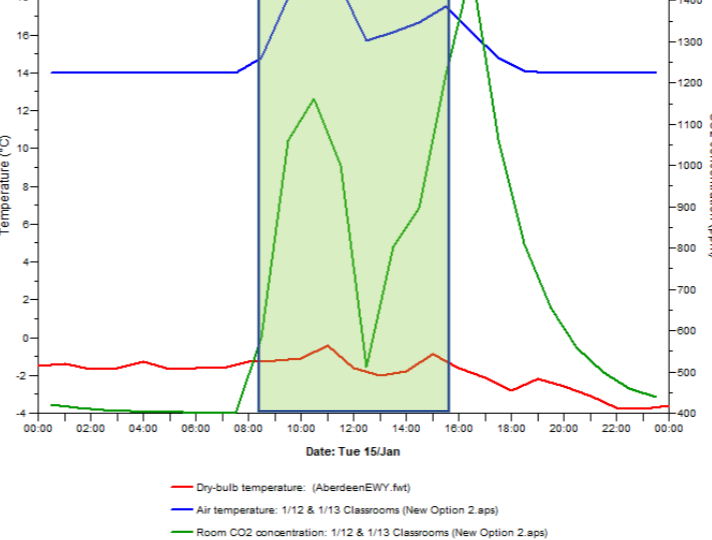
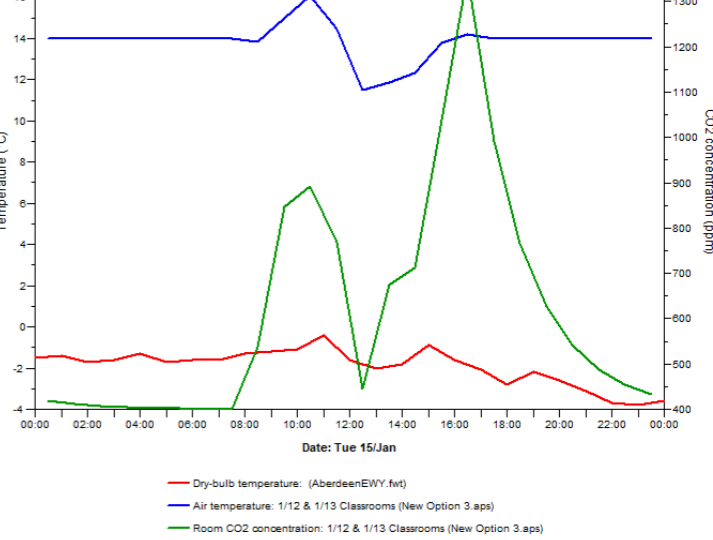
6.0 APPENDIX B

GREENWARDS PRIMARY RESULTS

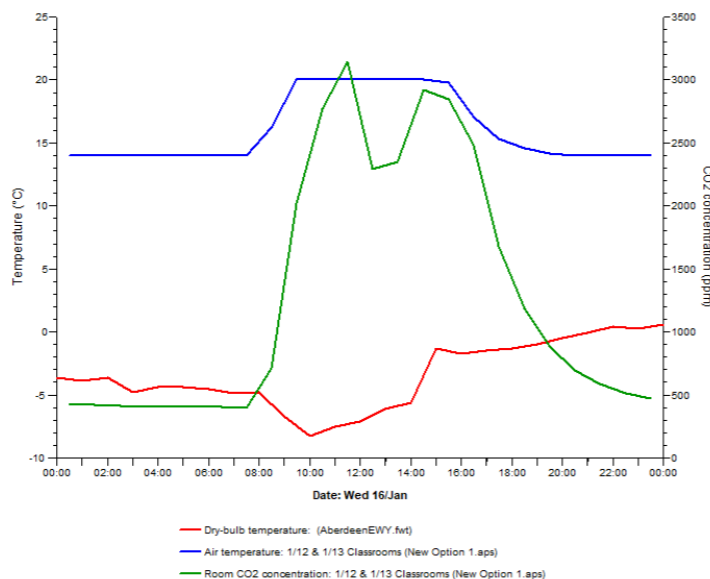
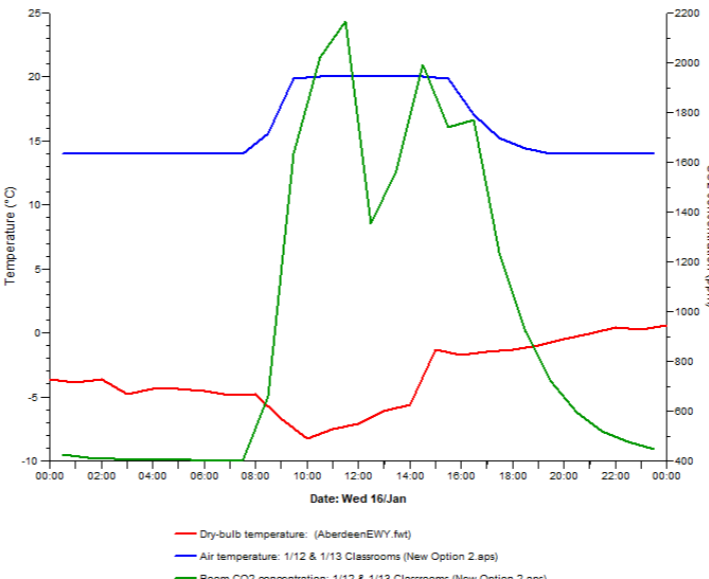
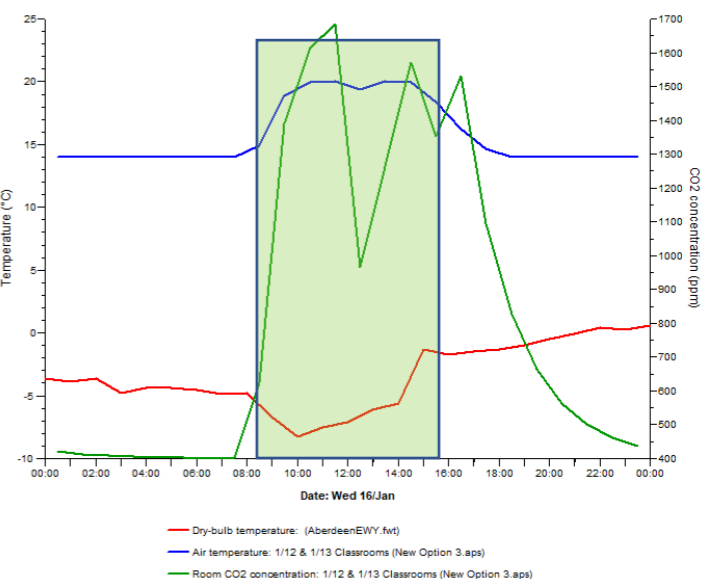
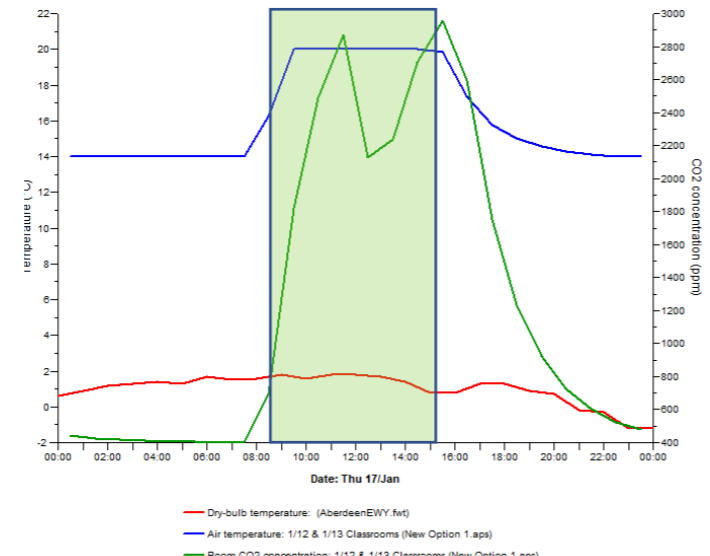
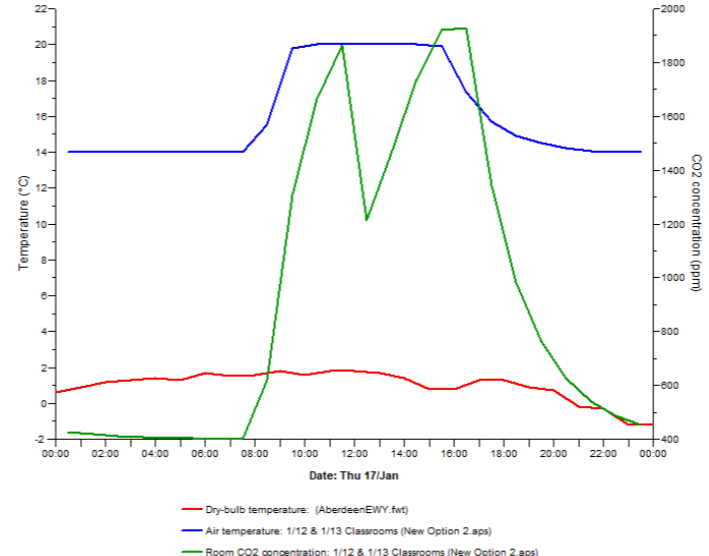
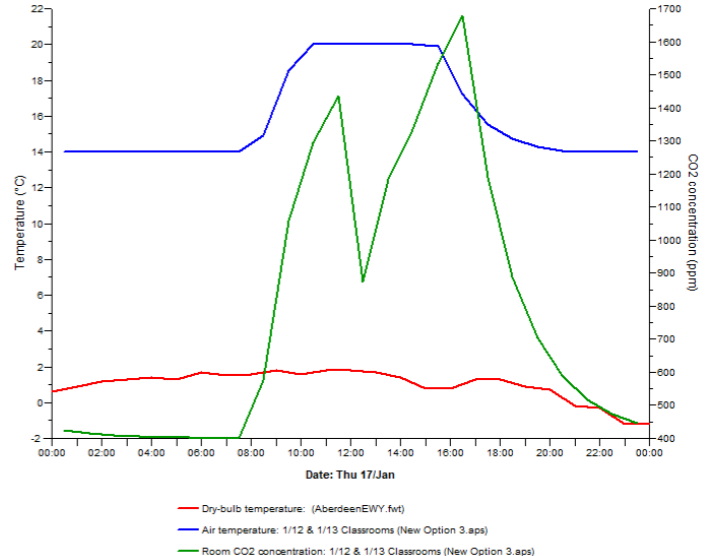
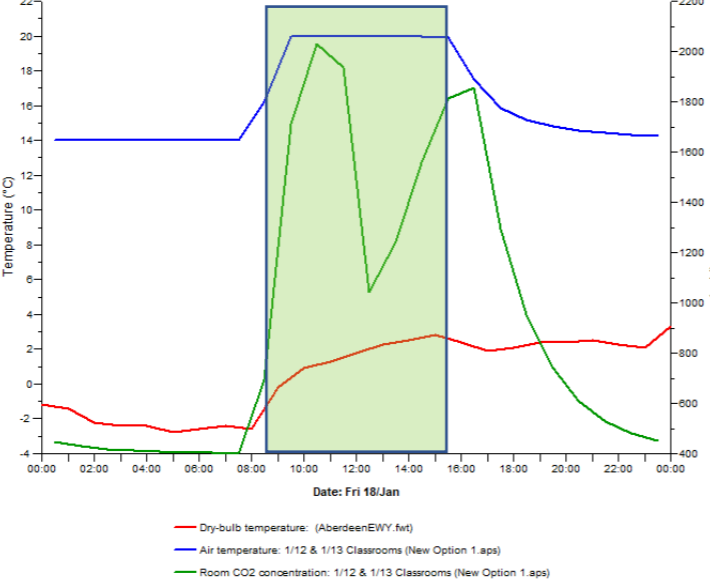
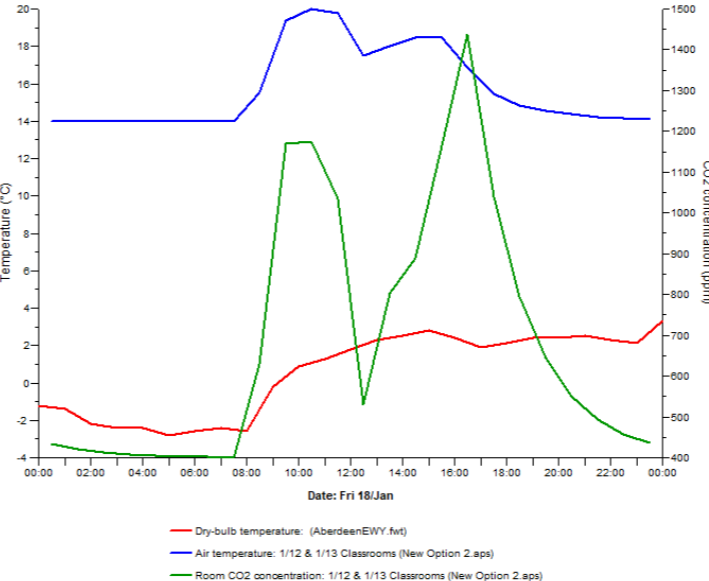
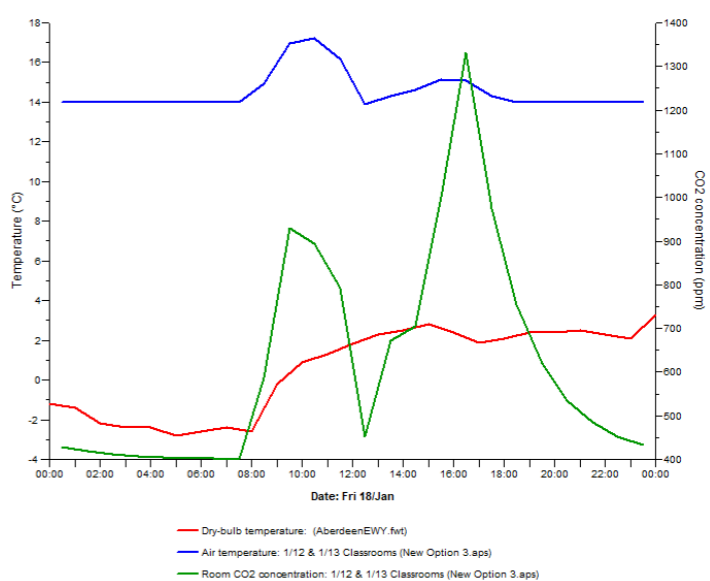
NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Wednesday 8 January:</p> <p>Weather conditions during the school occupation hours is a mild breezy winter day with SW wind speed 7-10 m/s.</p> <p>Even though it is relatively mild outside the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 2/71 Classroom 19 (Option 2.aps) Room CO2 concentration: 2/71 Classroom 19 (Option 2.aps)</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 2/71 Classroom 19 (Option 5.aps) Room CO2 concentration: 2/71 Classroom 19 (Option 5.aps)</p>	 <p>Air temperature: 2/71 Classroom 19 (Option 4.aps) Dry-bulb temperature: (AberdeenEWY.fwt) Room CO2 concentration: 2/71 Classroom 19 (Option 4.aps)</p>
<p>Thursday 9 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with W wind speed 4-8 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 5% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 2/71 Classroom 19 (Option 2.aps) Room CO2 concentration: 2/71 Classroom 19 (Option 2.aps)</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 2/71 Classroom 19 (Option 5.aps) Room CO2 concentration: 2/71 Classroom 19 (Option 5.aps)</p>	 <p>Air temperature: 2/71 Classroom 19 (Option 4.aps) Dry-bulb temperature: (AberdeenEWY.fwt) Room CO2 concentration: 2/71 Classroom 19 (Option 4.aps)</p>
<p>Friday 10 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with N wind speed 6-10 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 5% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 2/71 Classroom 19 (Option 2.aps) Room CO2 concentration: 2/71 Classroom 19 (Option 2.aps)</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 2/71 Classroom 19 (Option 5.aps) Room CO2 concentration: 2/71 Classroom 19 (Option 5.aps)</p>	 <p>Air temperature: 2/71 Classroom 19 (Option 4.aps) Dry-bulb temperature: (AberdeenEWY.fwt) Room CO2 concentration: 2/71 Classroom 19 (Option 4.aps)</p>

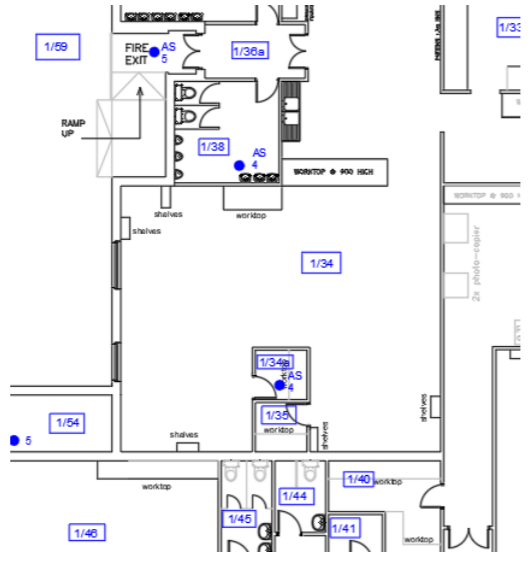
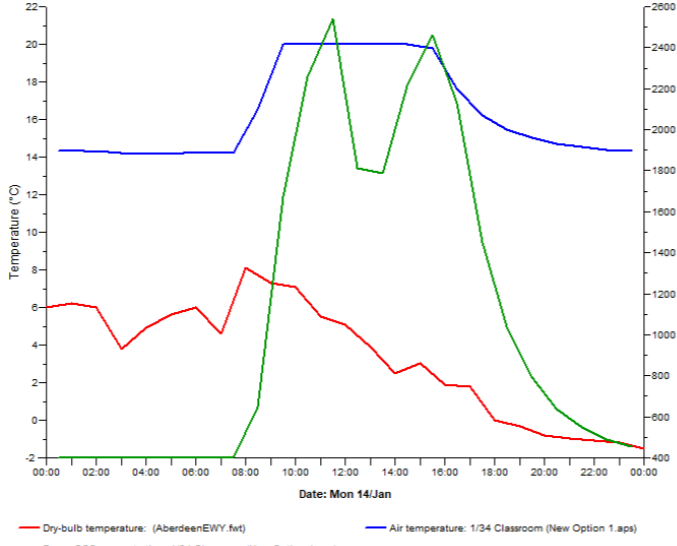
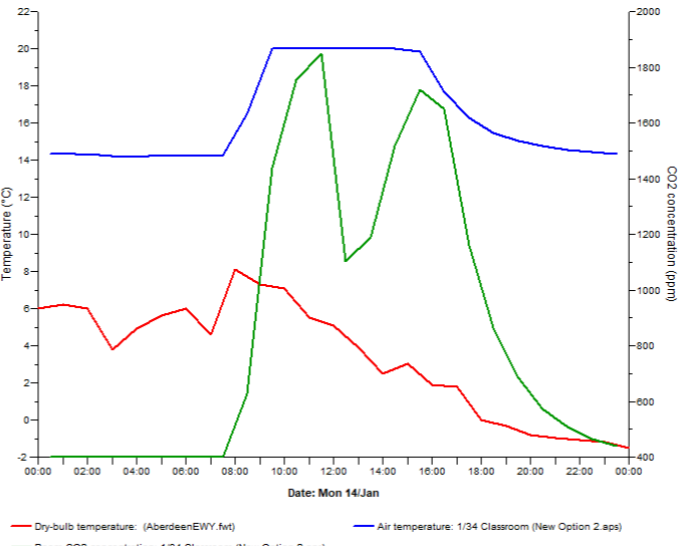
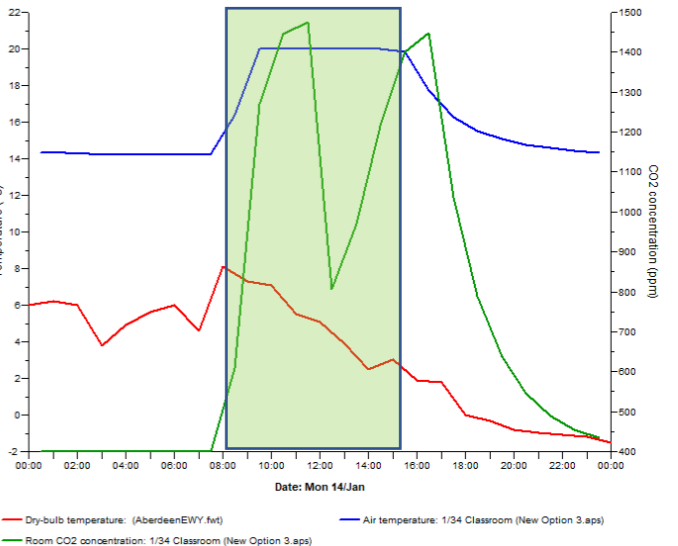
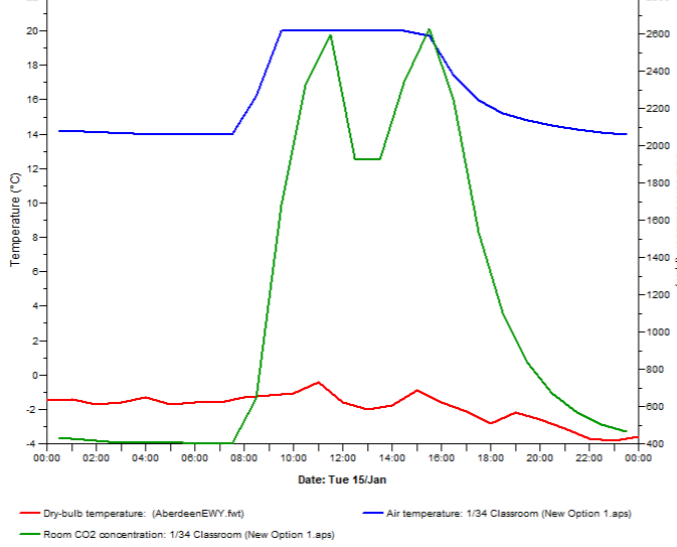
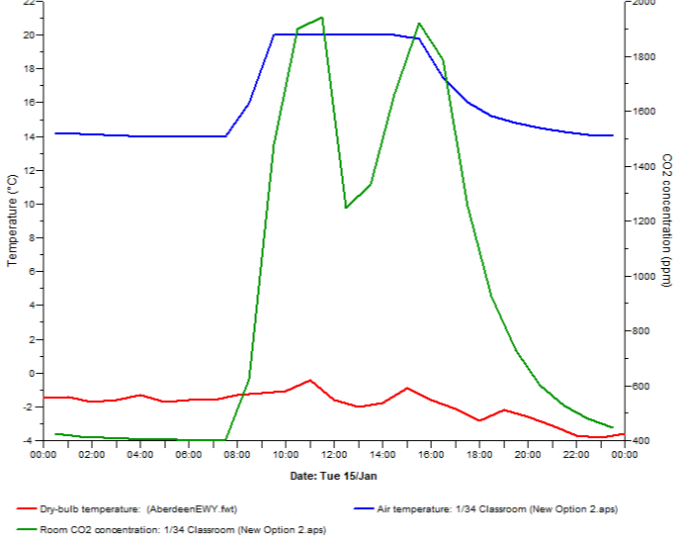
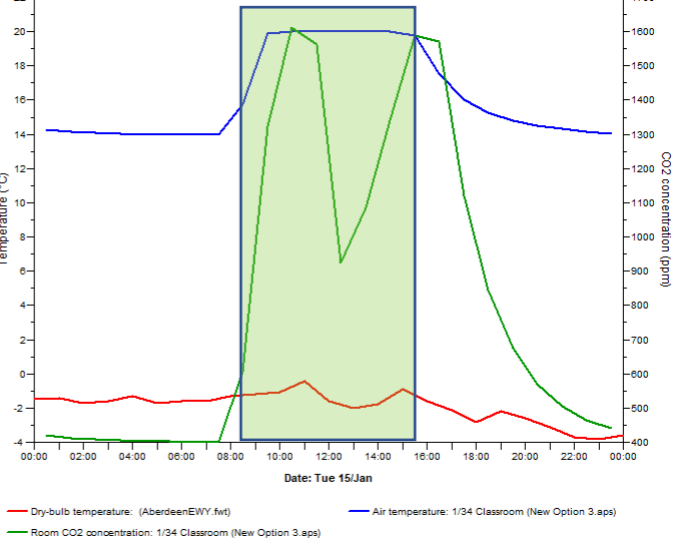
NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Greenwards Primary School Room 1-12 & 1-13</p> <p>Ground floor pair of linked classroom sharing access to the courtyard and classroom with openable windows on two opposite sides.</p>		<p>Model Parameters: <i>Occupancy:</i> 33 Pupils 2 Adults <i>Lighting:</i> based on LCD @10w/m² <i>Computers etc:</i> based on 2 PCs in use <i>Building fabric:</i> Age appropriate <i>Windows:</i> Openable top hoppers only</p> <p><i>Classroom occupancy period:</i> 8:30am -3:30pm (lunch unoccupied 12:30pm – 1:30pm)</p> <p><i>Assessment is based on full heat from the installed fan convector system being available to the classroom. The thermostat should be set at 21°C</i></p>	<p>Model Preferred Outcomes: Ventilation: In multi occupancy rooms a CO₂ level not exceeding on or around 1500ppm represents the limit of a well ventilated environment. Less than 1500ppm is better.</p> <p>Temperature: 19-21°C is a comfortable temperature for sedentary activities for most. 16-18°C may be acceptable when wearing seasonal appropriate clothing or during periods of higher physical activity. In both cases occupant comfort level will be influenced by, amongst other factors, the air speed and in particular the influence of cold draughts</p>
<p>Monday 14 January:</p> <p>Weather conditions during the school occupation hours is a cooling winters day with NW wind speed 7-11m/s.</p> <p>The predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately between 5-15 % open. Acceptable temperature should be maintainable but the room will may feel cool at the start of the day and the return after lunch</p>	<p align="center">Cross Ventilation top windows open 5%</p> 	<p align="center">Cross Ventilation top windows open 15%</p> 	<p align="center">Cross Ventilation top windows open 25%</p> 
<p>Tuesday 15 January:</p> <p>Weather conditions during the school occupation hours is a very cold (sub-zero) still winter day with NW wind speed 7-9 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 5-15% open. Acceptable temperature should be maintainable but the room will certainly feel cool at the start of the day and the return after lunch.</p>	<p align="center">Cross Ventilation top windows open 5%</p> 	<p align="center">Cross Ventilation top windows open 15%</p> 	<p align="center">Cross Ventilation top windows open 25%</p> 

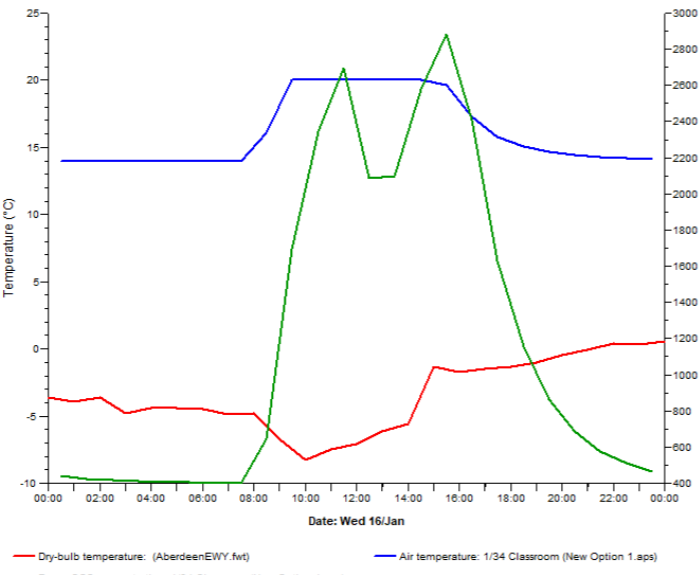
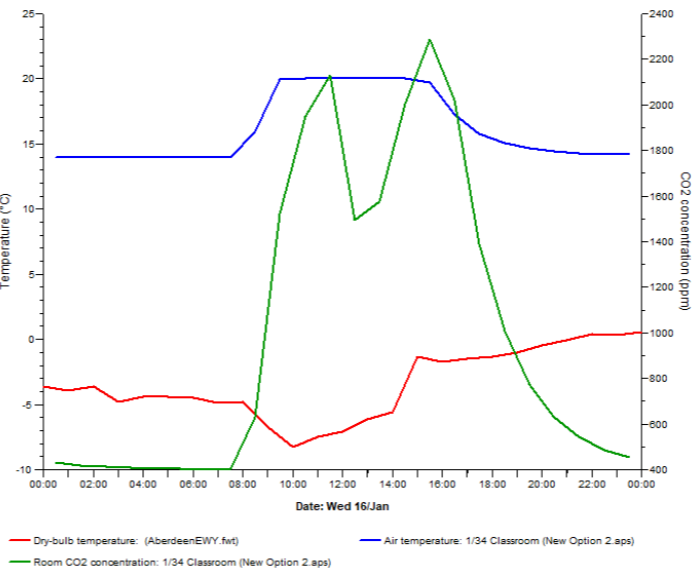
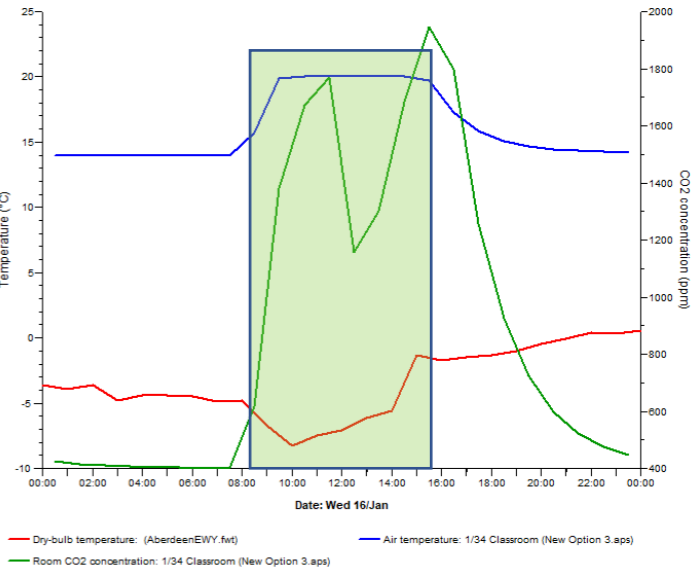
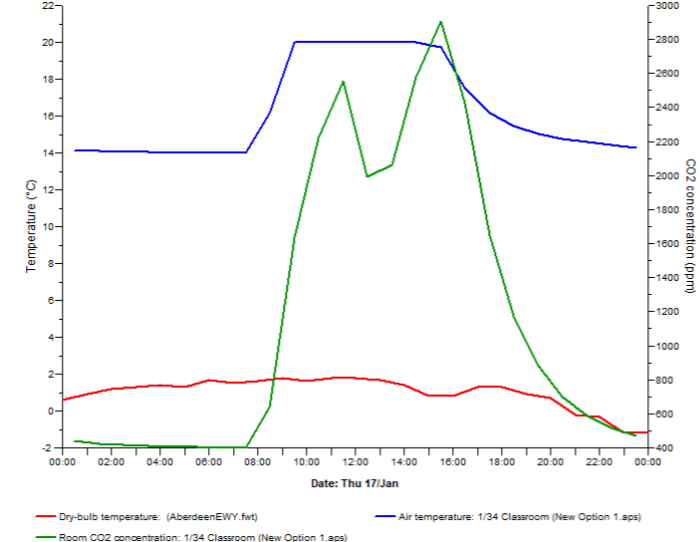
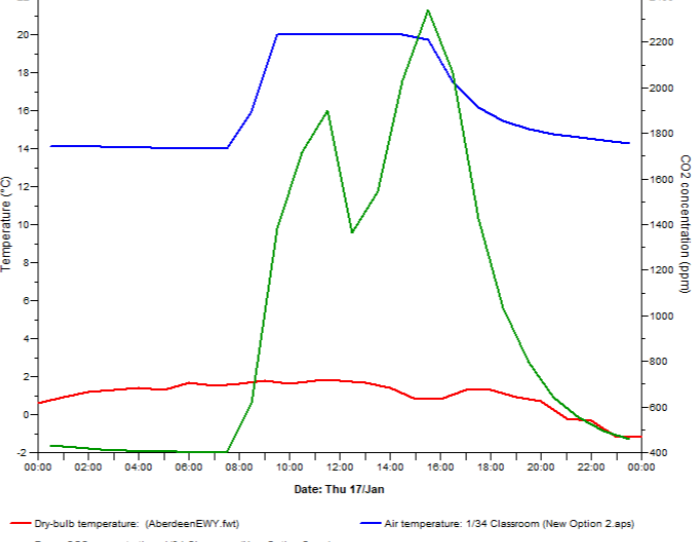
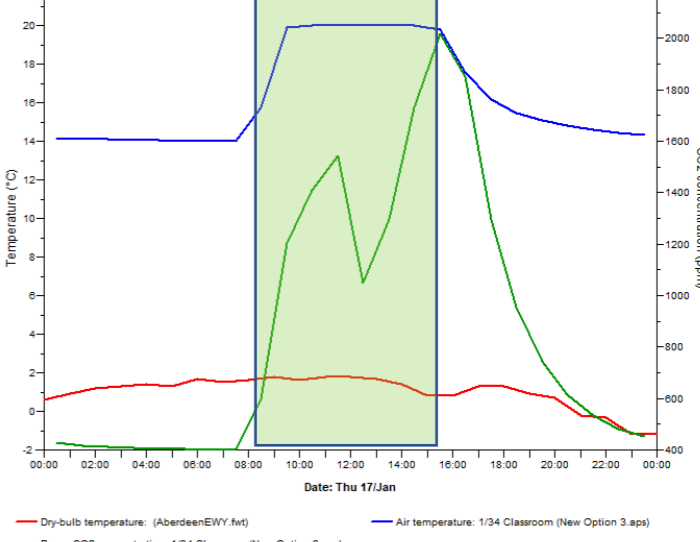
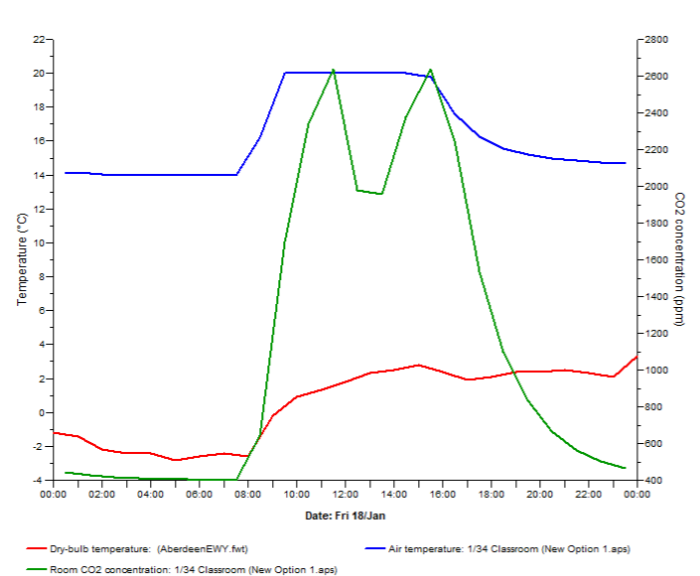
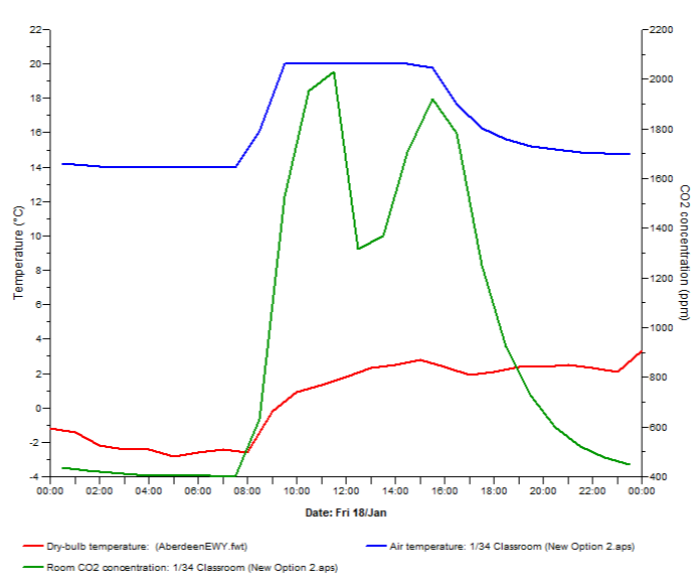
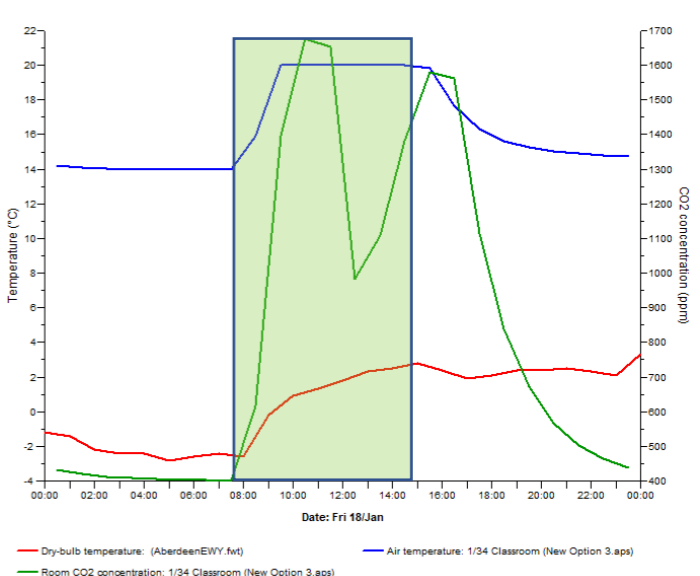
NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Wednesday 16 January:</p> <p>Weather conditions during the school occupation hours is a mild breezy winter day with NE wind speed 0-1.5 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation CO2 level may exceed 1500ppm for a short period), the top windows will require to be approximately 25% open. Acceptable temperature should be maintainable but the room may feel cool at the start of the day.</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 1/12 & 1/13 Classrooms (New Option 1.aps) Room CO2 concentration: 1/12 & 1/13 Classrooms (New Option 1.aps)</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 1/12 & 1/13 Classrooms (New Option 2.aps) Room CO2 concentration: 1/12 & 1/13 Classrooms (New Option 2.aps)</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 1/12 & 1/13 Classrooms (New Option 3.aps) Room CO2 concentration: 1/12 & 1/13 Classrooms (New Option 3.aps)</p>
<p>Thursday 17 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with E wind speed 3-8 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 5% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 1/12 & 1/13 Classrooms (New Option 1.aps) Room CO2 concentration: 1/12 & 1/13 Classrooms (New Option 1.aps)</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 1/12 & 1/13 Classrooms (New Option 2.aps) Room CO2 concentration: 1/12 & 1/13 Classrooms (New Option 2.aps)</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 1/12 & 1/13 Classrooms (New Option 3.aps) Room CO2 concentration: 1/12 & 1/13 Classrooms (New Option 3.aps)</p>
<p>Friday 18 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with S wind speed 3-9 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 5% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 1/12 & 1/13 Classrooms (New Option 1.aps) Room CO2 concentration: 1/12 & 1/13 Classrooms (New Option 1.aps)</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 1/12 & 1/13 Classrooms (New Option 2.aps) Room CO2 concentration: 1/12 & 1/13 Classrooms (New Option 2.aps)</p>	 <p>Dry-bulb temperature: (AberdeenEWY.fwt) Air temperature: 1/12 & 1/13 Classrooms (New Option 3.aps) Room CO2 concentration: 1/12 & 1/13 Classrooms (New Option 3.aps)</p>

NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Greenwards Primary School Room 1-34</p> <p>Ground floor classroom with openable windows on a single side.</p>		<p>Model Parameters: Occupancy: 25 Pupils 2 Adults Lighting: based on LCD @10w/m2 Computers etc: based on 2 PCs in use Building fabric: Age appropriate Windows: Openable top hoppers only</p> <p><i>Classroom occupancy period: 8:30am -3:30pm (lunch unoccupied 12:30pm – 1:30pm)</i></p> <p><i>Assessment is based on full heat from the installed fan convector system being available to the classroom. The thermostat should be set at 21°C</i></p> <p>Note: this classroom struggled to achieve ventilation standards on 35 occupants. It was therefore modelled on the reduced occupancy of 27.</p>	<p>Model Preferred Outcomes: Ventilation: In multi occupancy rooms a CO₂ level not exceeding on or around 1500ppm represents the limit of a well ventilated environment. Less than 1500ppm is better.</p> <p>Temperature: 19-21°C is a comfortable temperature for sedentary activities for most. 16-18°C may be acceptable when wearing seasonal appropriate clothing or during periods of higher physical activity. In both cases occupant comfort level will be influenced by, amongst other factors, the air speed and in particular the influence of cold draughts</p>
<p>Monday 14 January:</p> <p>Weather conditions during the school occupation hours is a cooling winters day with NW wind speed 7-11m/s.</p> <p>The predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately between 5-15 % open. Acceptable temperature should be maintainable but the room will may feel cool at the start of the day and the return after lunch</p>	<p>Single sided ventilation top windows open 5%</p> 	<p>Single sided ventilation top windows open 15%</p> 	<p>Single sided ventilation top windows open 25%</p> 
<p>Tuesday 15 January:</p> <p>Weather conditions during the school occupation hours is a very cold (sub-zero) still winter day with NW wind speed 7-9 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 5-15% open. Acceptable temperature should be maintainable but the room will certainly feel cool at the start of the day and the return after lunch.</p>	<p>Single sided ventilation top windows open 5%</p> 	<p>Single sided ventilation top windows open 15%</p> 	<p>Single sided ventilation top windows open 25%</p> 

NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

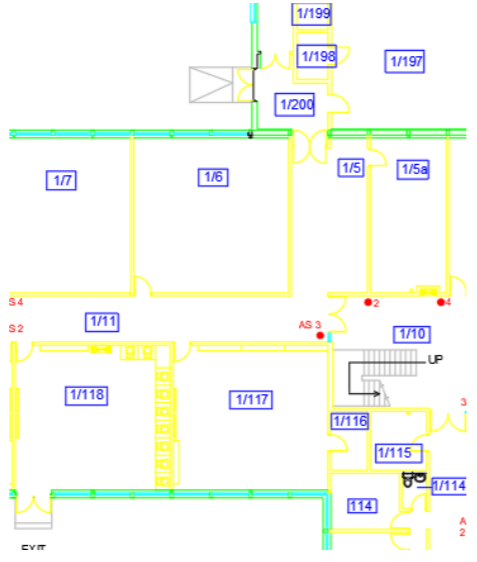
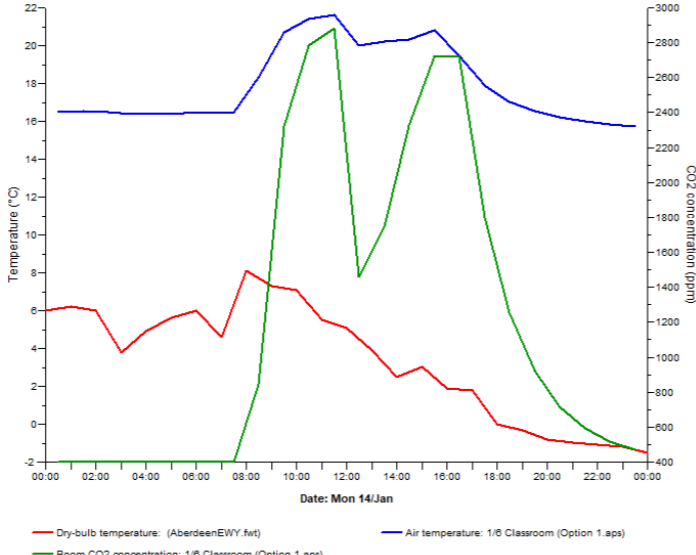
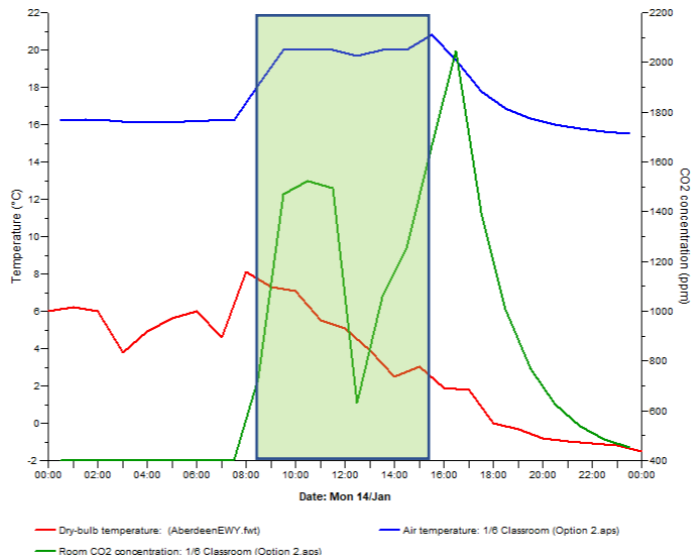
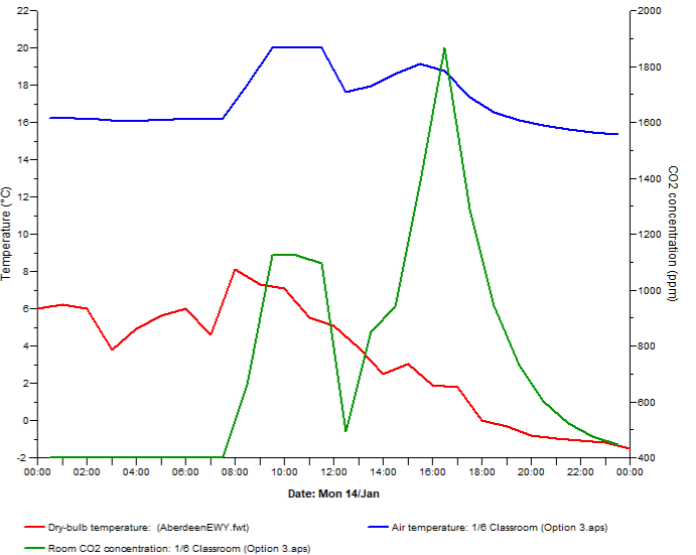
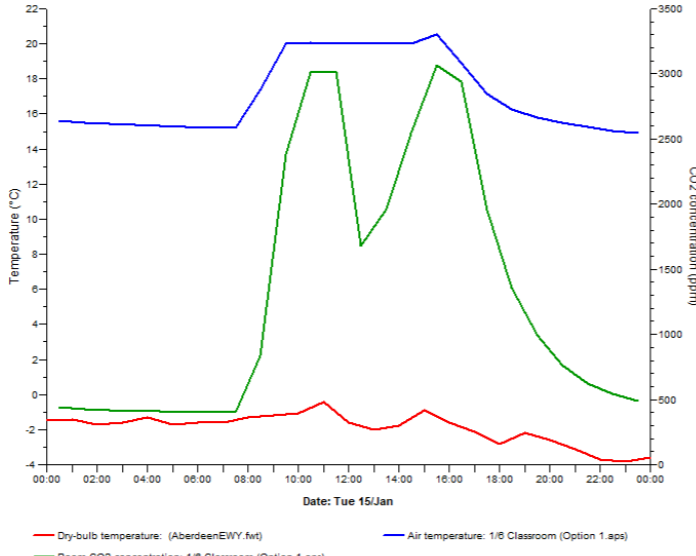
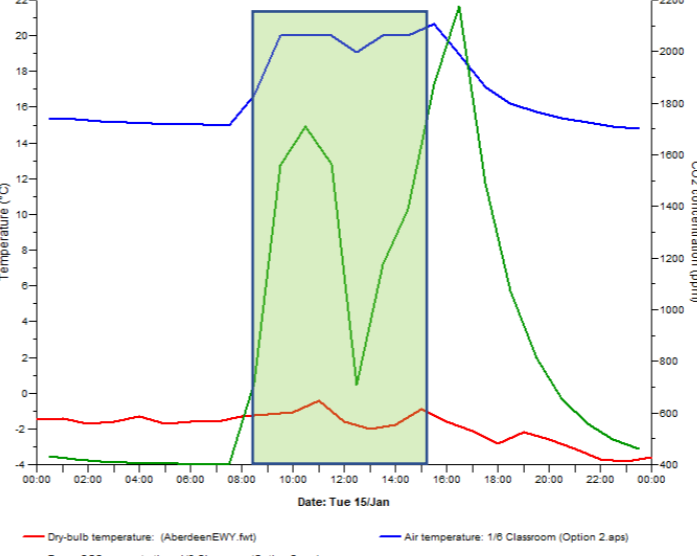
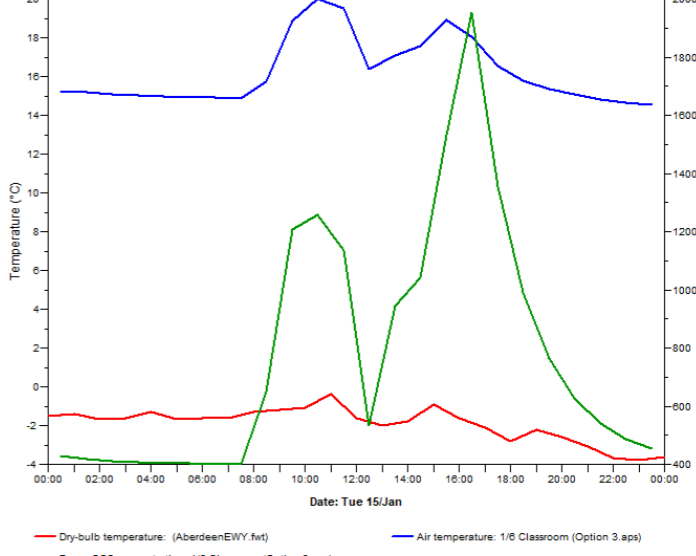
<p>Wednesday 16 January:</p> <p>Weather conditions during the school occupation hours is a mild breezy winter day with NE wind speed 0-1.5 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation CO2 level may exceed 1500ppm for a short period), the top windows will require to be approximately 25% open. Acceptable temperature should be maintainable, but the room may feel cool at the start of the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/34 Classroom (New Option 1.aps) — Room CO2 concentration: 1/34 Classroom (New Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/34 Classroom (New Option 2.aps) — Room CO2 concentration: 1/34 Classroom (New Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/34 Classroom (New Option 3.aps) — Room CO2 concentration: 1/34 Classroom (New Option 3.aps)</p>
<p>Thursday 17 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with E wind speed 3-8 m/s.</p> <p>A cold day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 25% open. Acceptable temperature should be maintainable throughout the day, but the room may feel cool at the start of the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/34 Classroom (New Option 1.aps) — Room CO2 concentration: 1/34 Classroom (New Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/34 Classroom (New Option 2.aps) — Room CO2 concentration: 1/34 Classroom (New Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/34 Classroom (New Option 3.aps) — Room CO2 concentration: 1/34 Classroom (New Option 3.aps)</p>
<p>Friday 18 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with S wind speed 3-9 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation CO2 level may exceed 1500ppm for a short period), the top windows will require to be approximately 25% open. Acceptable temperature should be maintainable, but the room may feel cool at the start of the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/34 Classroom (New Option 1.aps) — Room CO2 concentration: 1/34 Classroom (New Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/34 Classroom (New Option 2.aps) — Room CO2 concentration: 1/34 Classroom (New Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/34 Classroom (New Option 3.aps) — Room CO2 concentration: 1/34 Classroom (New Option 3.aps)</p>



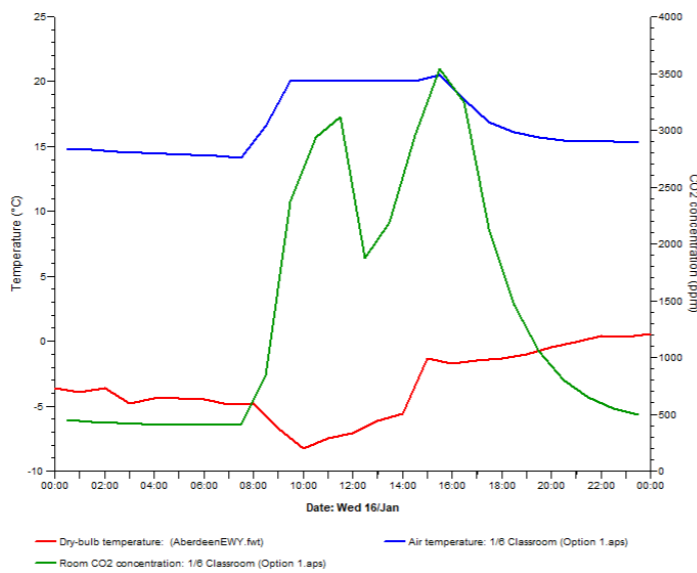
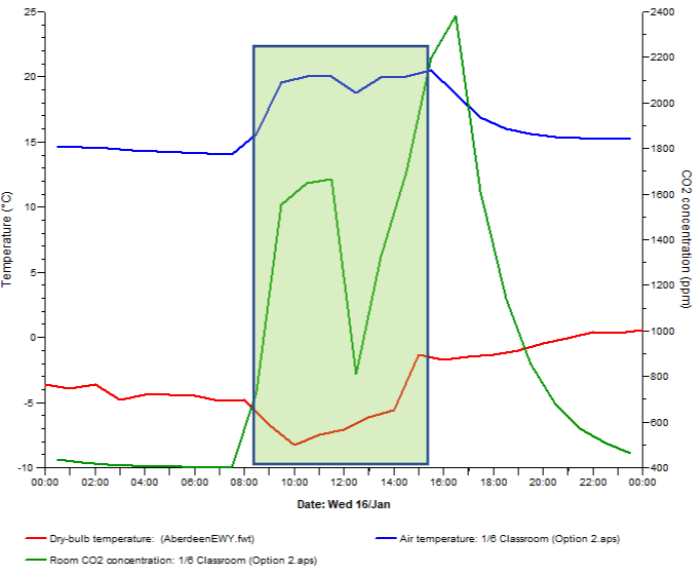
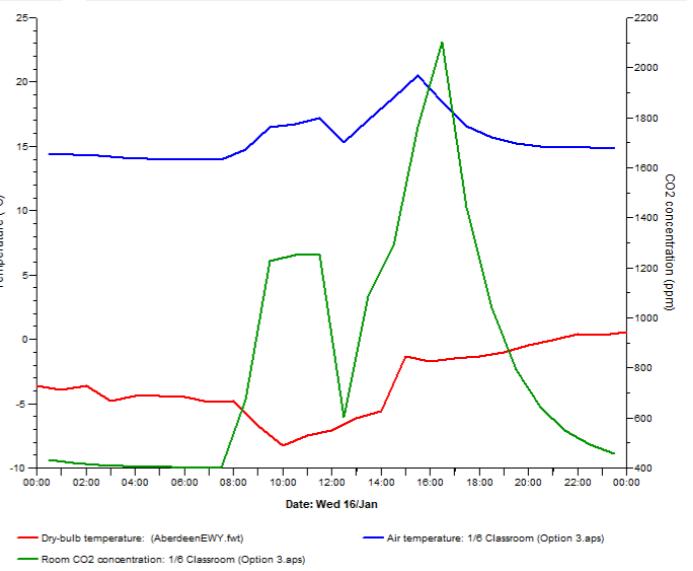
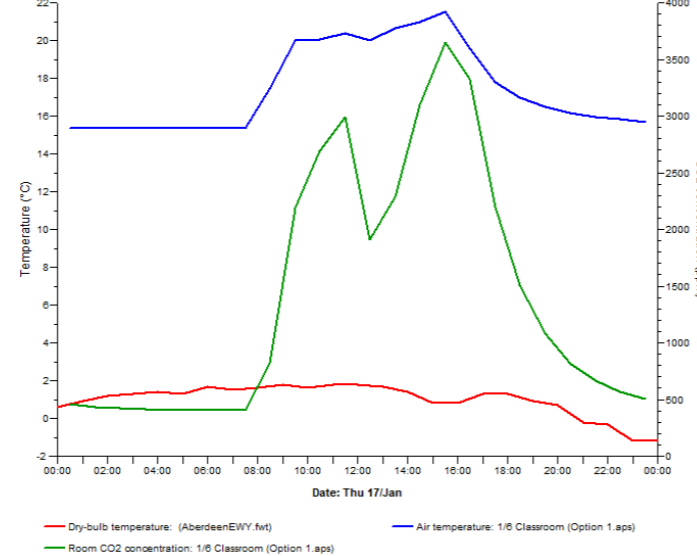
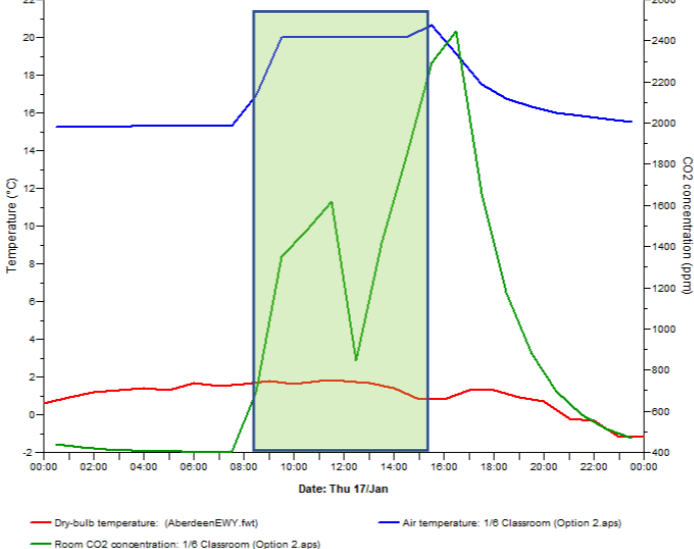
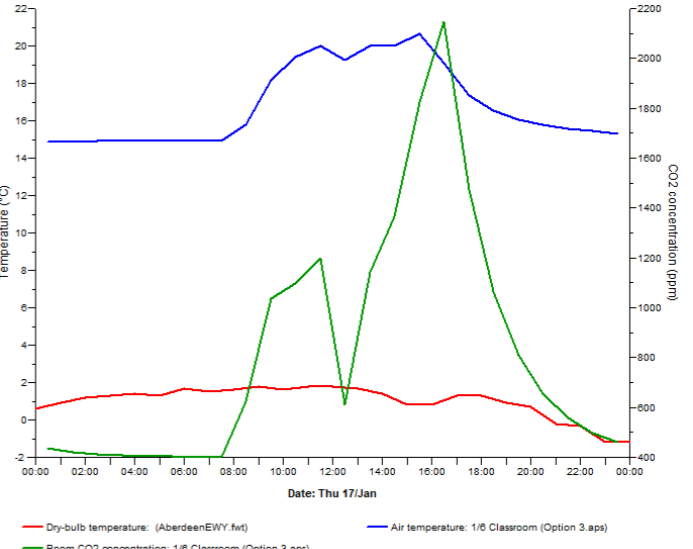
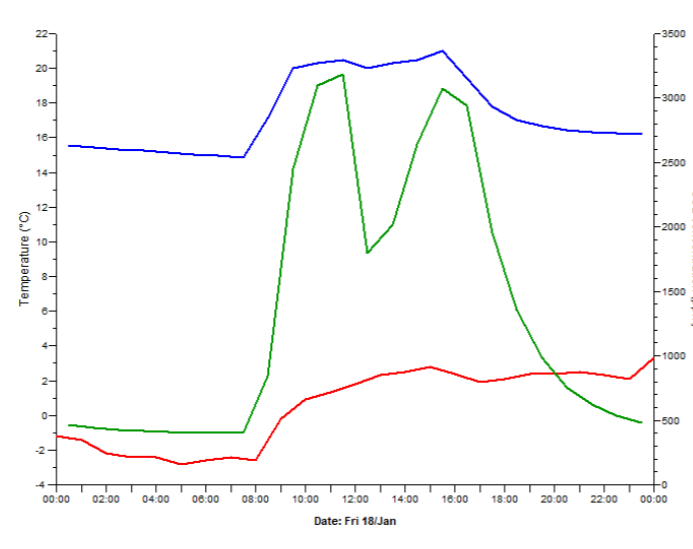
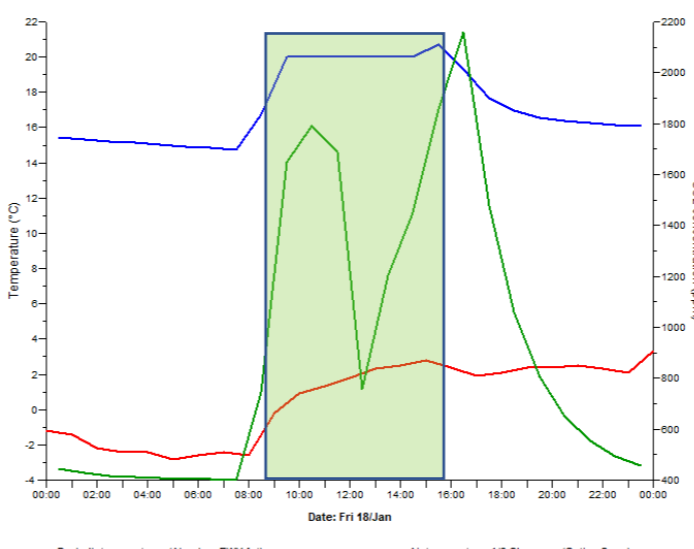
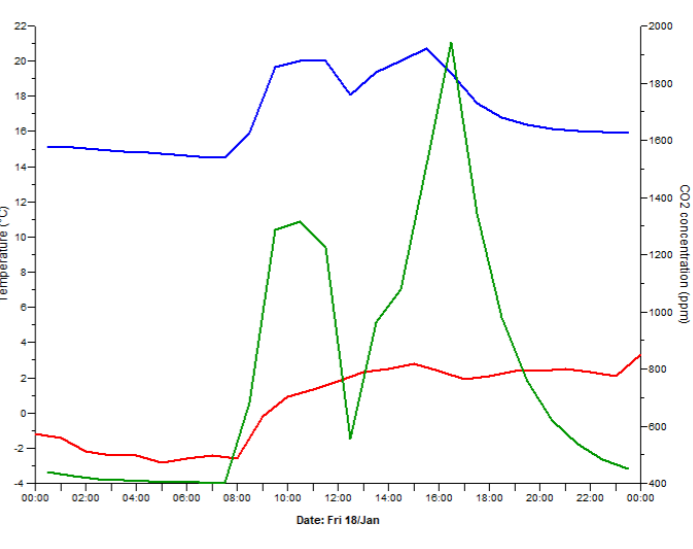
7.0 APPENDIX C

FORESS ACADEMY RESULTS

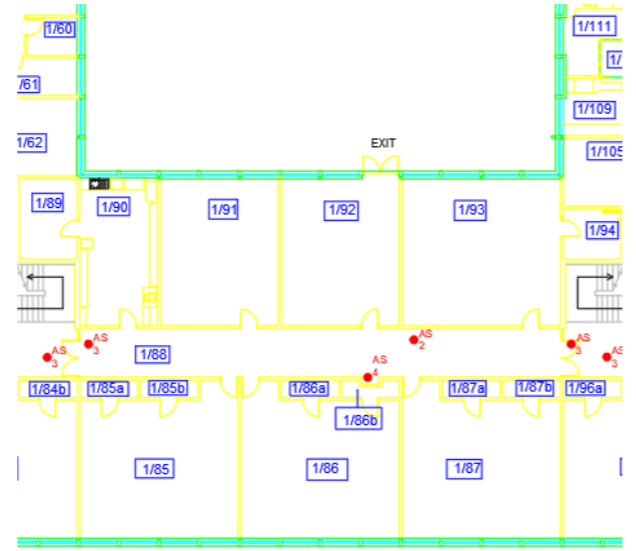
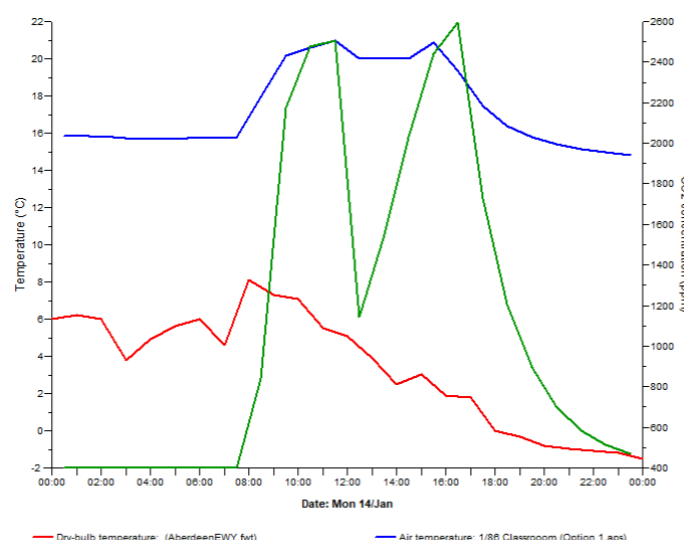
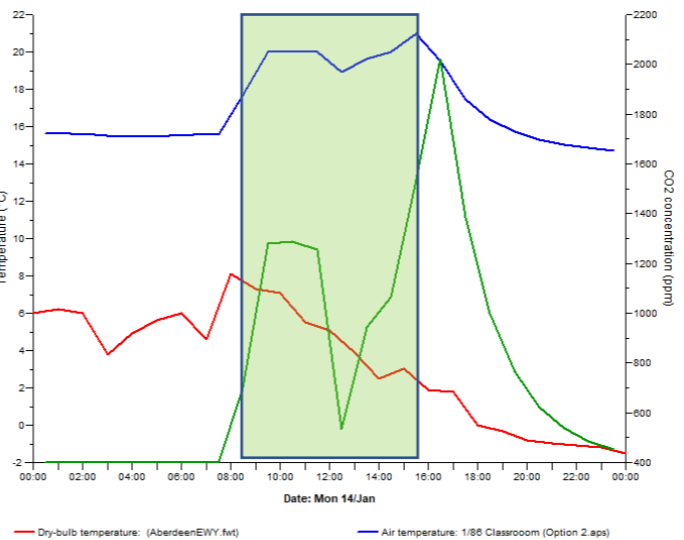
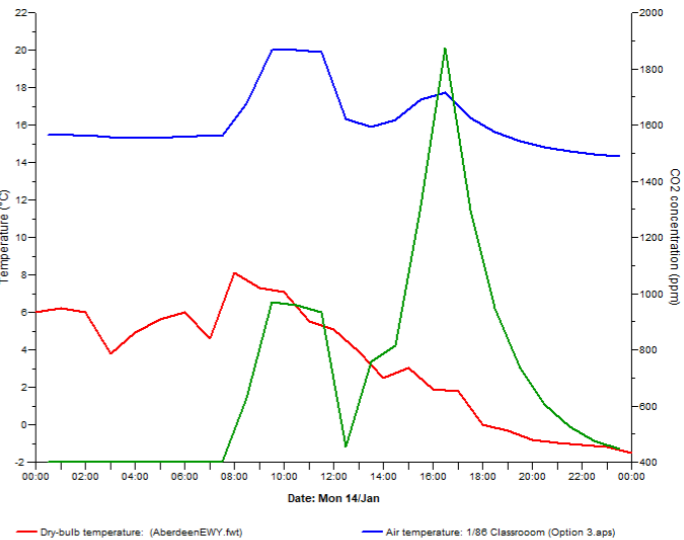
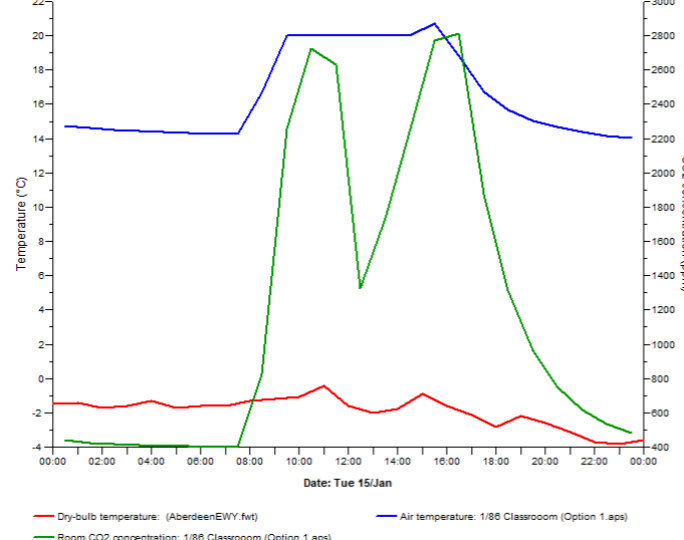
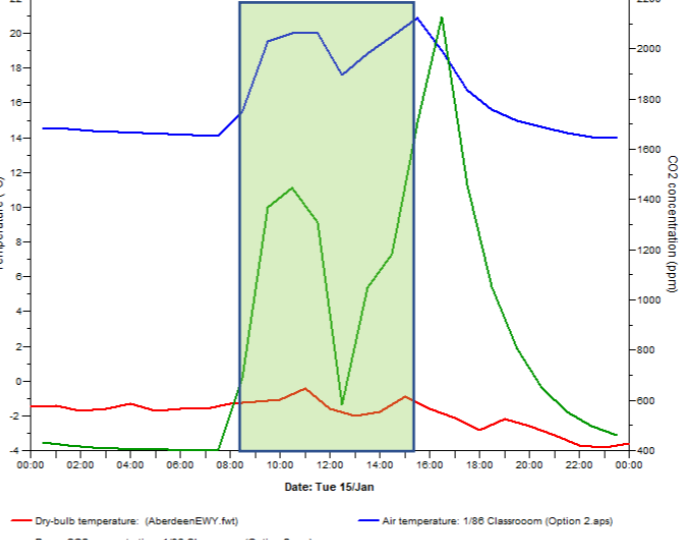
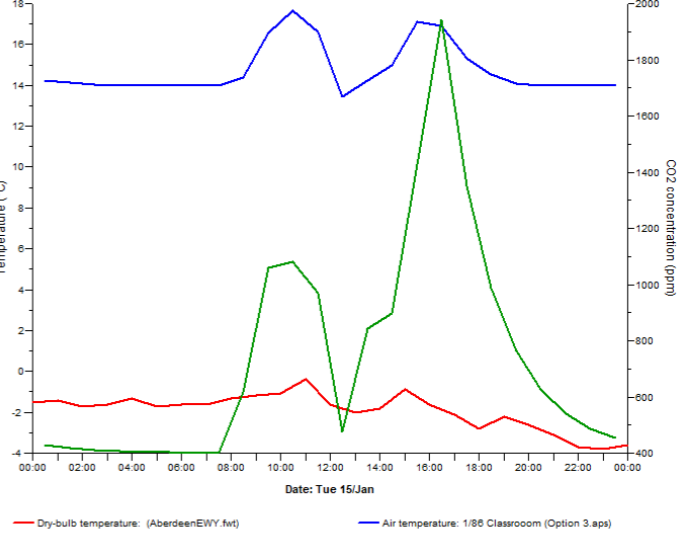
NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Foress Academy Room 1-6</p> <p>Ground floor classroom out onto the school grounds and with mid pane openable windows on a single side.</p>		<p>Model Parameters:</p> <p><i>Occupancy:</i> 33 Pupils 2 Adults <i>Lighting:</i> based on LCD @10w/m2 <i>Computers etc:</i> based on 2 PCs in use <i>Building fabric:</i> Age appropriate <i>Windows:</i> Openable top hoppers only</p> <p><i>Classroom occupancy period:</i> 8:30am -3:30pm (lunch unoccupied 12:30pm – 1:30pm)</p> <p><i>Assessment is based on full heat from the installed fan convector system being available to the classroom. The thermostat should be set at 21°C</i></p>	<p>Model Preferred Outcomes:</p> <p>Ventilation: In multi occupancy rooms a CO₂ level not exceeding on or around 1500ppm represents the limit of a well ventilated environment. Less than 1500ppm is better.</p> <p>Temperature: 19-21°C is a comfortable temperature for sedentary activities for most. 16-18°C may be acceptable when wearing seasonal appropriate clothing or during periods of higher physical activity. In both cases occupant comfort level will be influenced by, amongst other factors, the air speed and in particular the influence of cold draughts</p>
<p>Monday 14 January:</p> <p>Weather conditions during the school occupation hours is a cooling winters day with NW wind speed 7-11m/s.</p> <p>The predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the windows will require to be approximately 15 % open. Acceptable temperature should be maintainable throughout the day.</p>	<p>Single Sided Ventilation mid windows open 5%</p> 	<p>Single Sided Ventilation mid windows open 15%</p> 	<p>Single Sided Ventilation mid windows open 25%</p> 
<p>Tuesday 15 January:</p> <p>Weather conditions during the school occupation hours is a very cold (sub-zero) still winter day with NW wind speed 7-9 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>	<p>Single Sided Ventilation mid windows open 5%</p> 	<p>Single Sided Ventilation mid windows open 15%</p> 	<p>Single Sided Ventilation mid windows open 25%</p> 

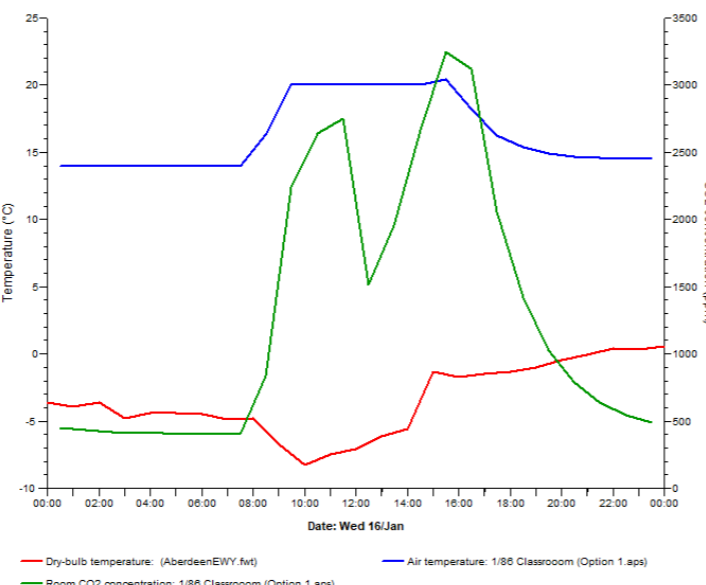
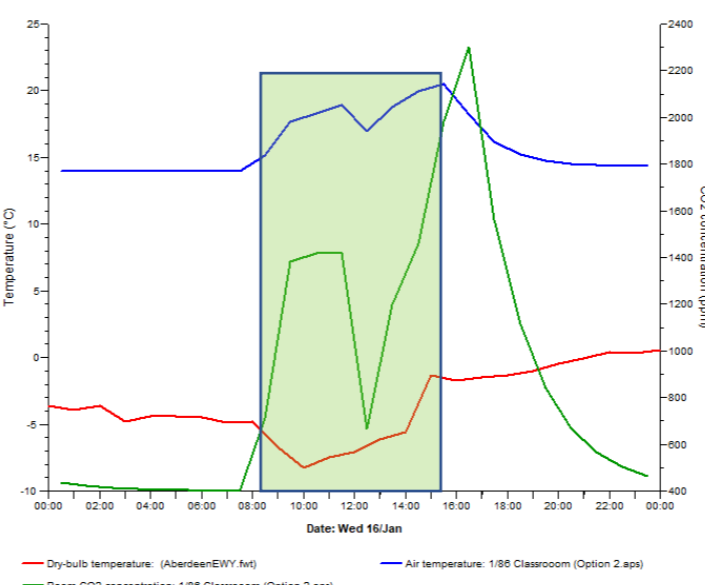
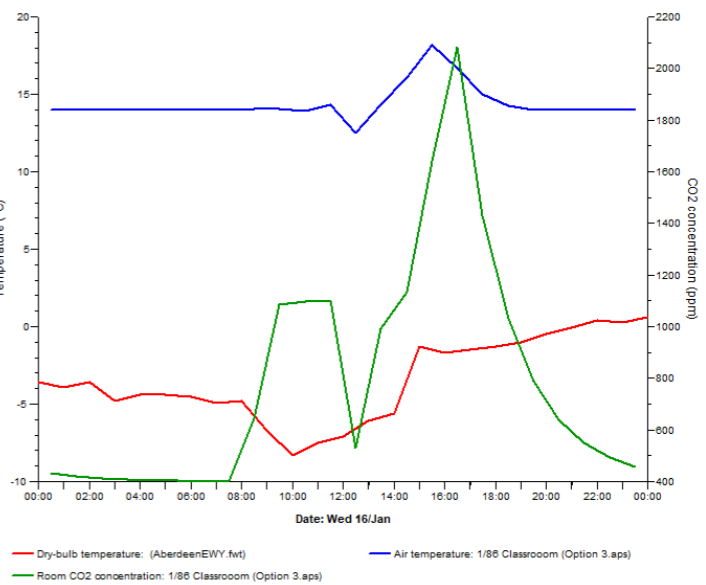
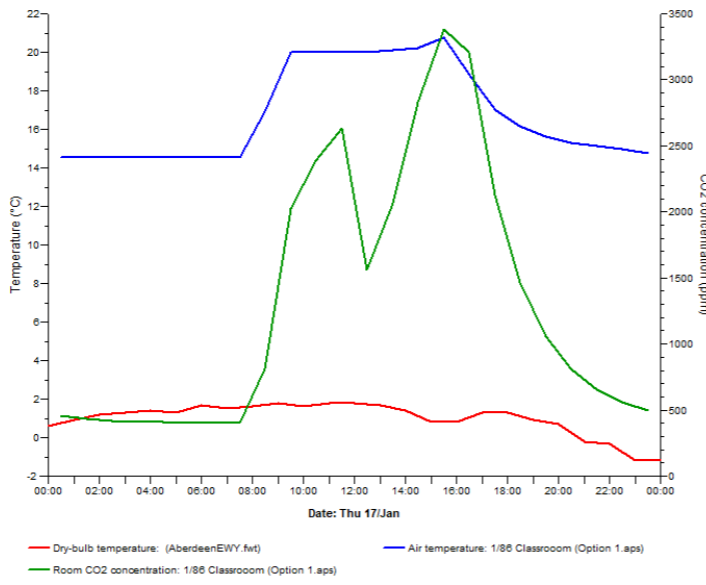
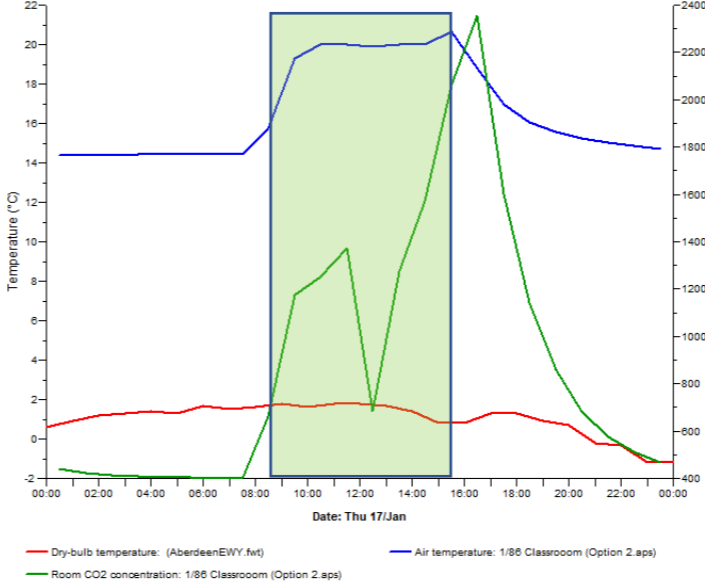
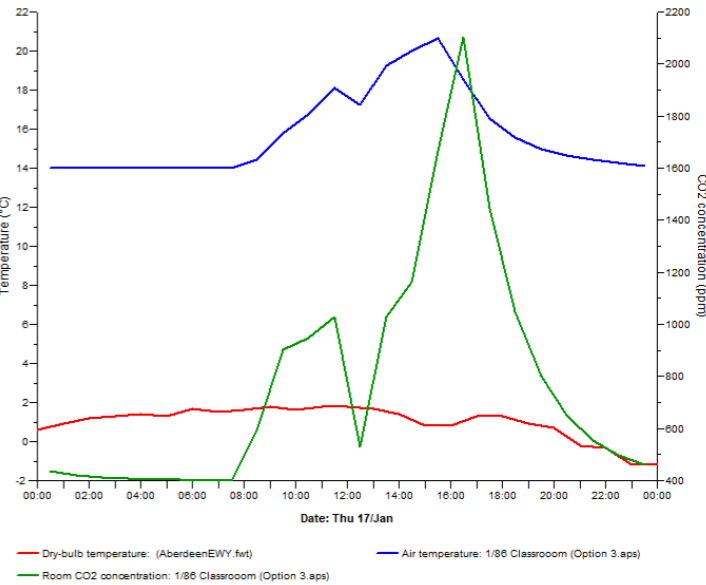
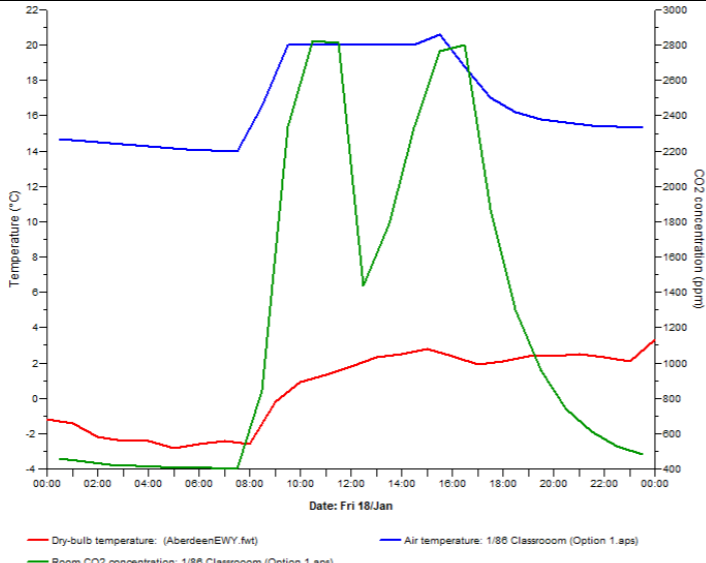
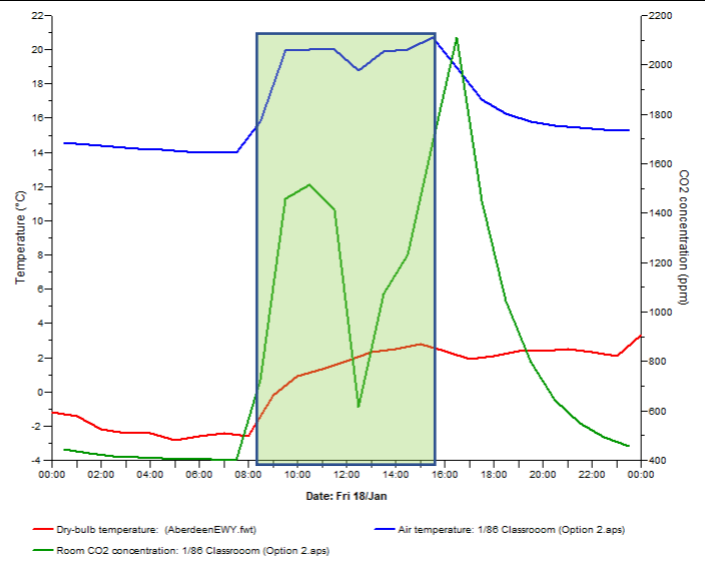
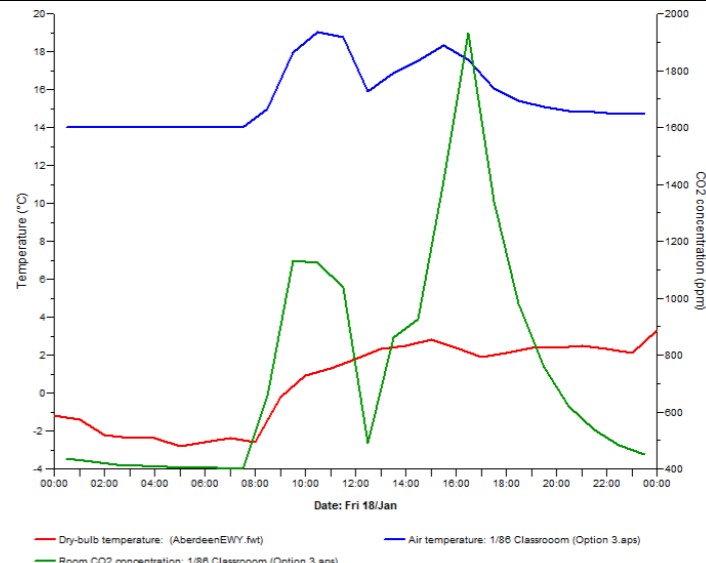
NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Wednesday 16 January:</p> <p>Weather conditions during the school occupation hours is a mild breezy winter day with NE wind speed 0-1.5 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation the windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/6 Classroom (Option 1.aps) — Room CO2 concentration: 1/6 Classroom (Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/6 Classroom (Option 2.aps) — Room CO2 concentration: 1/6 Classroom (Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/6 Classroom (Option 3.aps) — Room CO2 concentration: 1/6 Classroom (Option 3.aps)</p>
<p>Thursday 17 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with E wind speed 3-8 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/6 Classroom (Option 1.aps) — Room CO2 concentration: 1/6 Classroom (Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/6 Classroom (Option 2.aps) — Room CO2 concentration: 1/6 Classroom (Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/6 Classroom (Option 3.aps) — Room CO2 concentration: 1/6 Classroom (Option 3.aps)</p>
<p>Friday 18 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with S wind speed 3-9 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/6 Classroom (Option 1.aps) — Room CO2 concentration: 1/6 Classroom (Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/6 Classroom (Option 2.aps) — Room CO2 concentration: 1/6 Classroom (Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/6 Classroom (Option 3.aps) — Room CO2 concentration: 1/6 Classroom (Option 3.aps)</p>

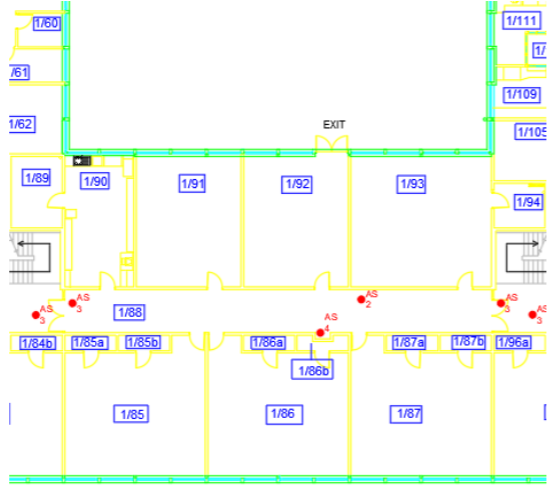
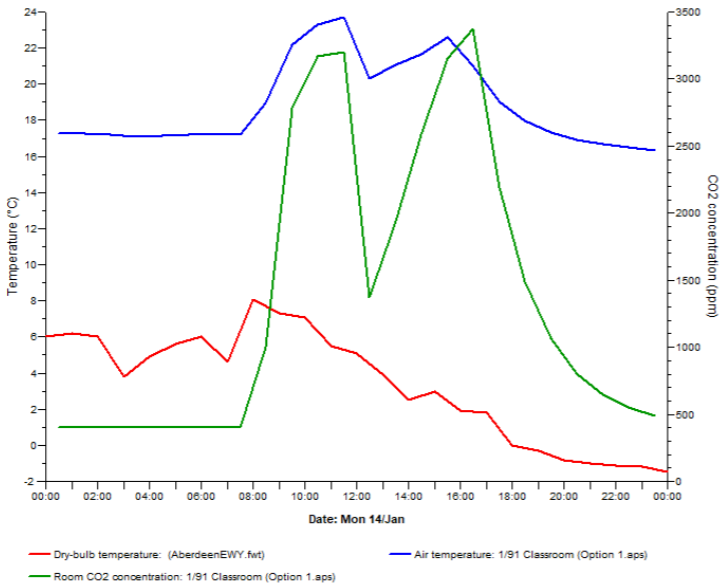
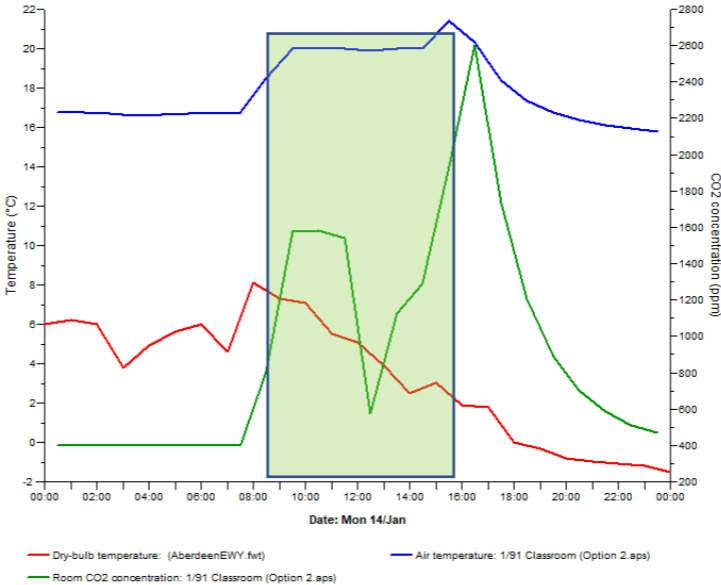
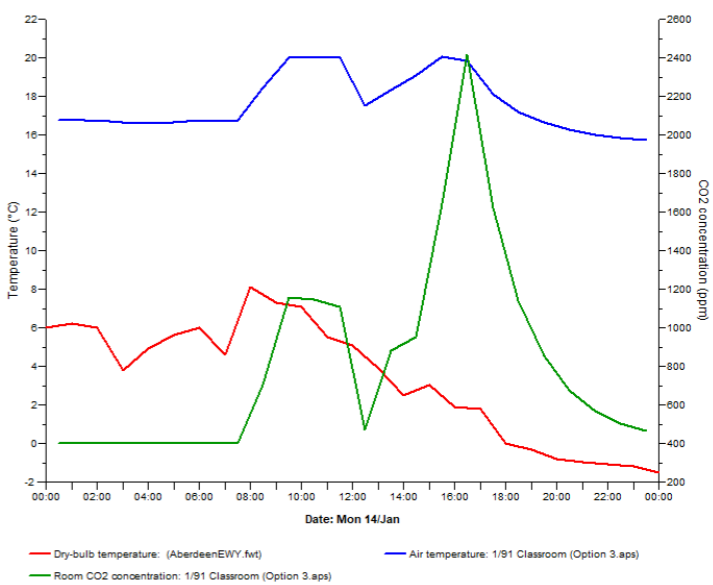
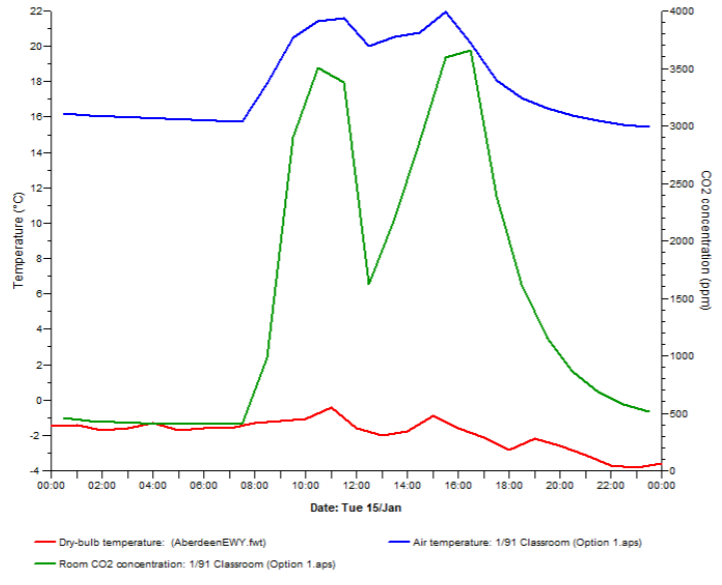
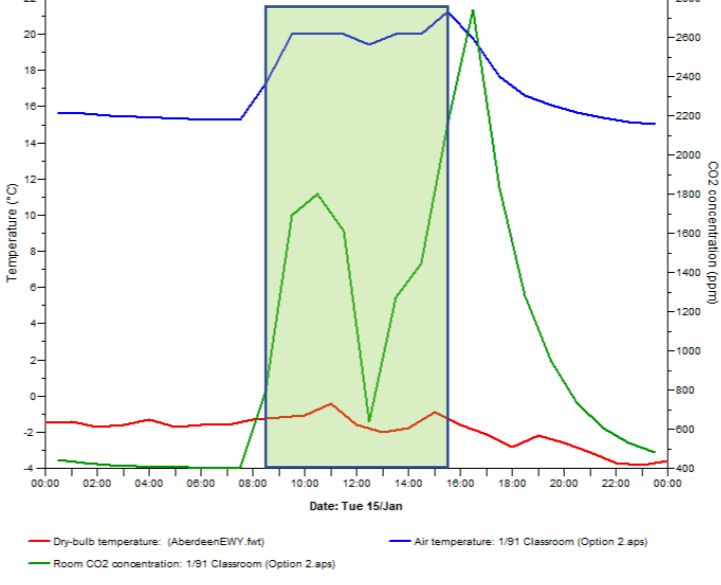
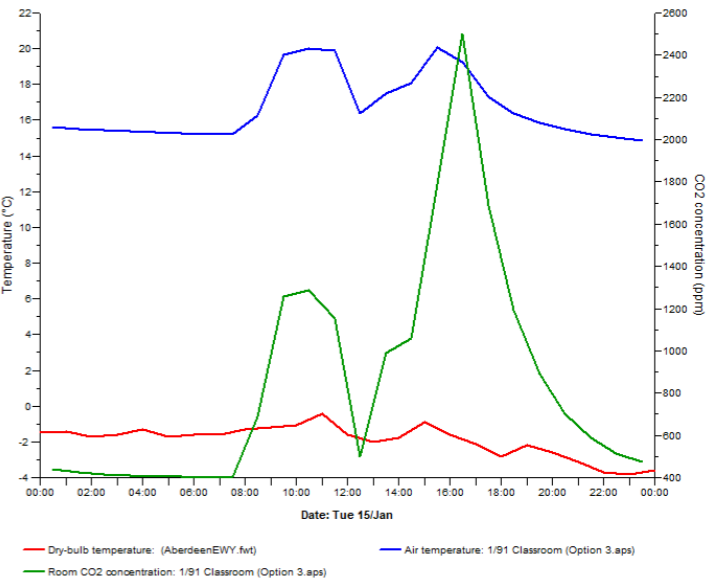
NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Foress Academy Room 1-86</p> <p>Ground floor classroom out onto the school grounds and with mid pane openable windows on a single side.</p>		<p>Model Parameters: <i>Occupancy:</i> 33 Pupils 2 Adults <i>Lighting:</i> based on LCD @10w/m2 <i>Computers etc:</i> based on 2 PCs in use <i>Building fabric:</i> Age appropriate <i>Windows:</i> Openable top hoppers only</p> <p><i>Classroom occupancy period:</i> 8:30am -3:30pm (lunch unoccupied 12:30pm – 1:30pm)</p> <p><i>Assessment is based on full heat from the installed fan convector system being available to the classroom. The thermostat should be set at 21°C</i></p>	<p>Model Preferred Outcomes: Ventilation: In multi occupancy rooms a CO₂ level not exceeding on or around 1500ppm represents the limit of a well ventilated environment. Less than 1500ppm is better.</p> <p>Temperature: 19-21°C is a comfortable temperature for sedentary activities for most. 16-18°C may be acceptable when wearing seasonal appropriate clothing or during periods of higher physical activity. In both cases occupant comfort level will be influenced by, amongst other factors, the air speed and in particular the influence of cold draughts</p>
<p>Monday 14 January:</p> <p>Weather conditions during the school occupation hours is a cooling winters day with NW wind speed 7-11m/s.</p> <p>The predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the windows will require to be approximately 15 % open. Acceptable temperature should be maintainable throughout the day.</p>	<p>Single Sided Ventilation mid windows open 5%</p> 	<p>Single Sided Ventilation mid windows open 15%</p> 	<p>Single Sided Ventilation mid windows open 25%</p> 
<p>Tuesday 15 January:</p> <p>Weather conditions during the school occupation hours is a very cold (sub-zero) still winter day with NW wind speed 7-9 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day, but it may feel a little cool after the lunch break.</p>	<p>Single Sided Ventilation mid windows open 5%</p> 	<p>Single Sided Ventilation mid windows open 15%</p> 	<p>Single Sided Ventilation mid windows open 25%</p> 

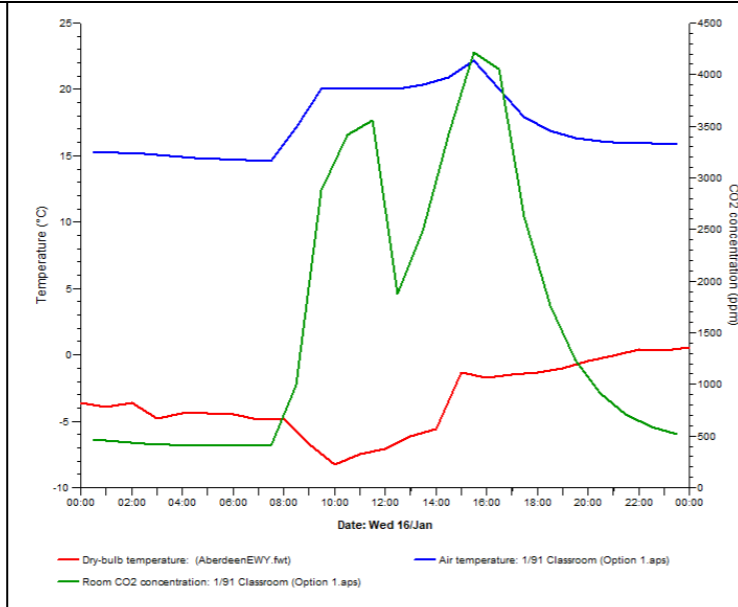
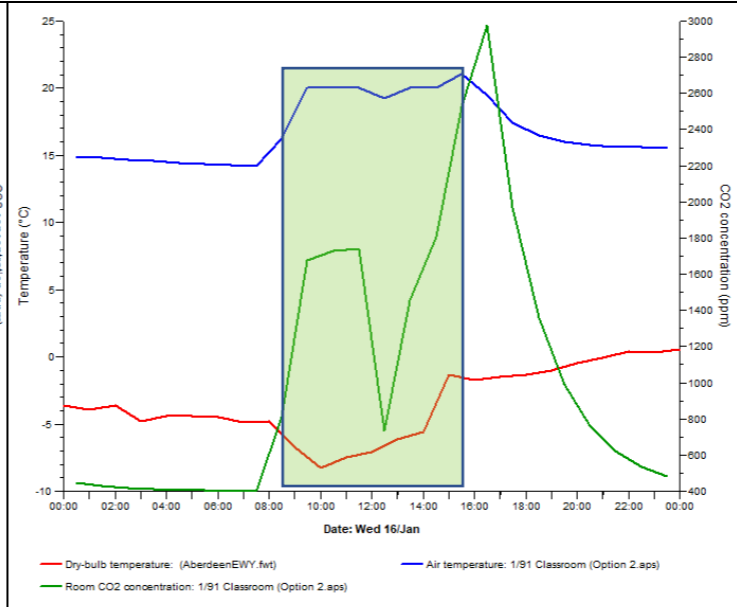
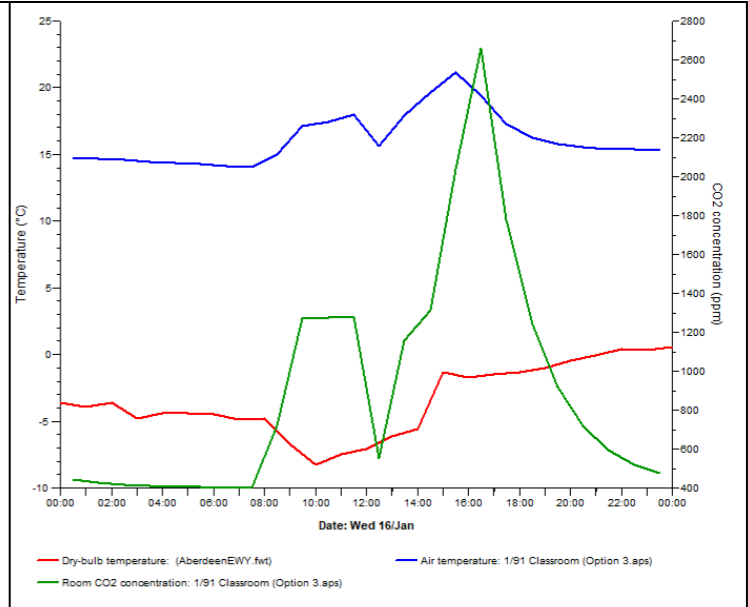
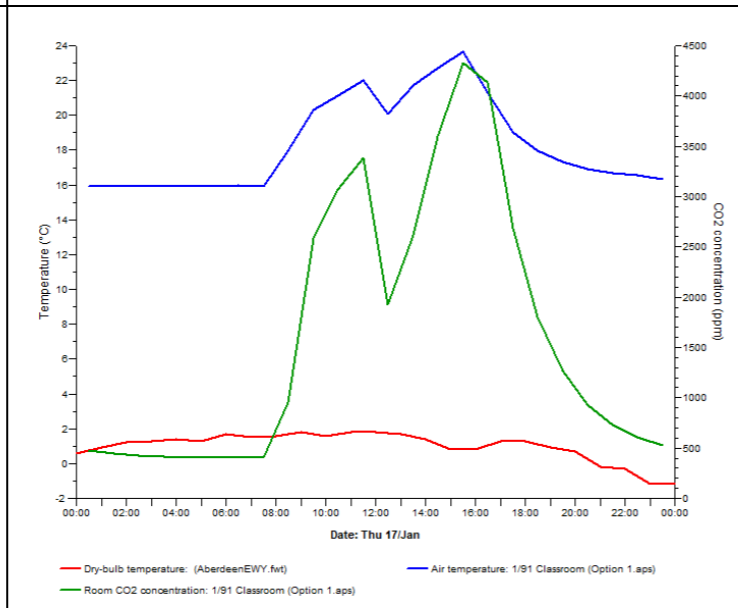
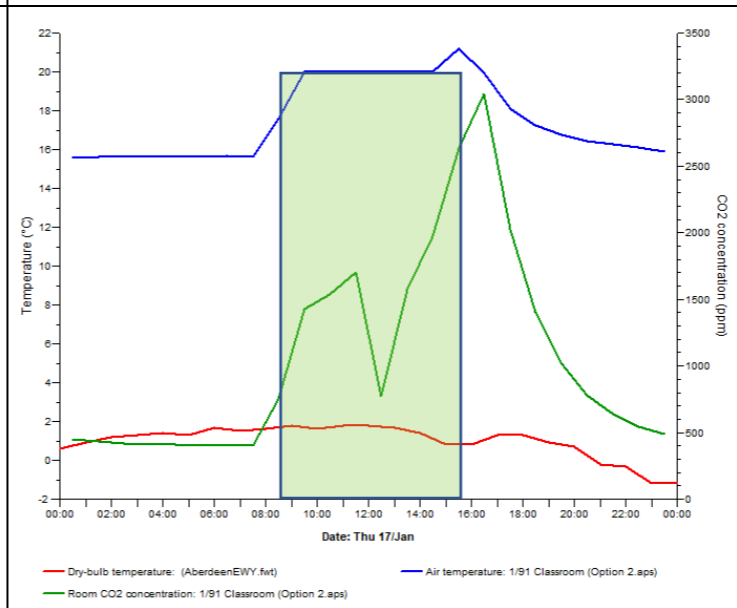
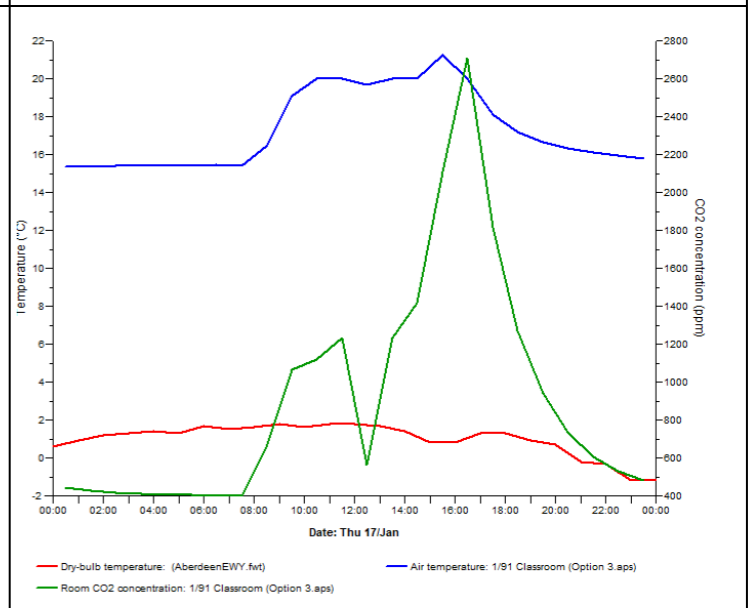
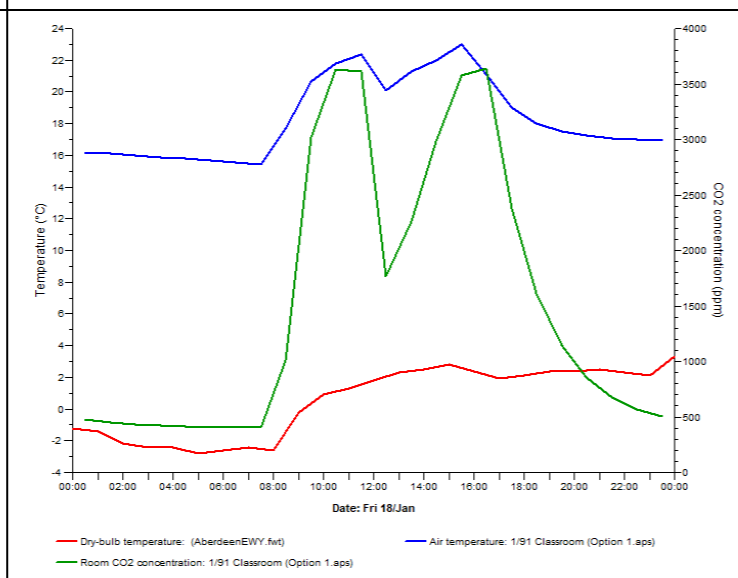
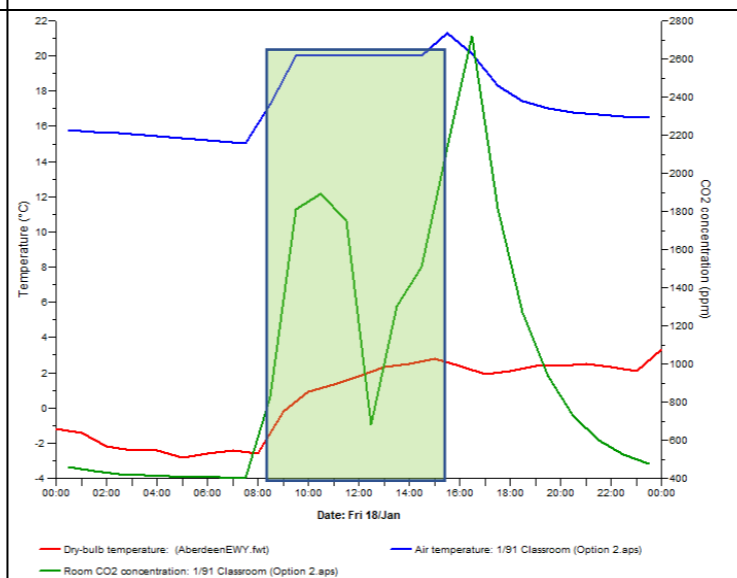
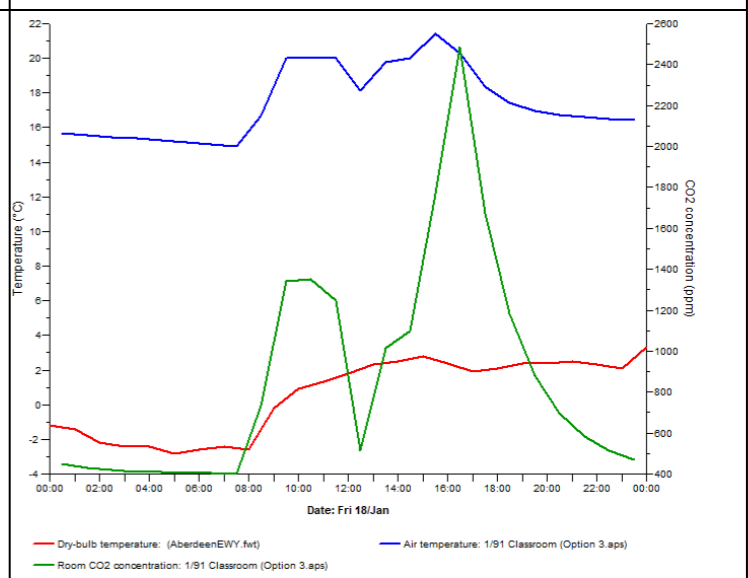
NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Wednesday 16 January:</p> <p>Weather conditions during the school occupation hours is a mild breezy winter day with NE wind speed 0-1.5 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation the windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day, but it may feel a little cool after the lunch break.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/86 Classroom (Option 1.aps) — Room CO2 concentration: 1/86 Classroom (Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/86 Classroom (Option 2.aps) — Room CO2 concentration: 1/86 Classroom (Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/86 Classroom (Option 3.aps) — Room CO2 concentration: 1/86 Classroom (Option 3.aps)</p>
<p>Thursday 17 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with E wind speed 3-8 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/86 Classroom (Option 1.aps) — Room CO2 concentration: 1/86 Classroom (Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/86 Classroom (Option 2.aps) — Room CO2 concentration: 1/86 Classroom (Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/86 Classroom (Option 3.aps) — Room CO2 concentration: 1/86 Classroom (Option 3.aps)</p>
<p>Friday 18 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with S wind speed 3-9 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/86 Classroom (Option 1.aps) — Room CO2 concentration: 1/86 Classroom (Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/86 Classroom (Option 2.aps) — Room CO2 concentration: 1/86 Classroom (Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/86 Classroom (Option 3.aps) — Room CO2 concentration: 1/86 Classroom (Option 3.aps)</p>

NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Foress Academy Room 1-91</p> <p>Ground floor classroom onto a courtyard and with mid pane openable windows on a single side.</p>		<p>Model Parameters: <i>Occupancy:</i> 33 Pupils 2 Adults <i>Lighting:</i> based on LCD @10w/m2 <i>Computers etc:</i> based on 2 PCs in use <i>Building fabric:</i> Age appropriate <i>Windows:</i> Openable top hoppers only</p> <p><i>Classroom occupancy period:</i> 8:30am -3:30pm (lunch unoccupied 12:30pm – 1:30pm)</p> <p><i>Assessment is based on full heat from the installed fan convector system being available to the classroom. The thermostat should be set at 21°C</i></p>	<p>Model Preferred Outcomes: Ventilation: In multi occupancy rooms a CO₂ level not exceeding on or around 1500ppm represents the limit of a well ventilated environment. Less than 1500ppm is better.</p> <p>Temperature: 19-21°C is a comfortable temperature for sedentary activities for most. 16-18°C may be acceptable when wearing seasonal appropriate clothing or during periods of higher physical activity. In both cases occupant comfort level will be influenced by, amongst other factors, the air speed and in particular the influence of cold draughts</p>
	<p>Single Sided Ventilation mid windows open 5%</p>	<p>Single Sided Ventilation mid windows open 15%</p>	<p>Single Sided Ventilation mid windows open 25%</p>
<p>Monday 14 January:</p> <p>Weather conditions during the school occupation hours is a cooling winters day with NW wind speed 7-11m/s.</p> <p>The predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the windows will require to be approximately between 15 % open. Acceptable temperature should be maintainable throughout the day.</p>			
<p>Tuesday 15 January:</p> <p>Weather conditions during the school occupation hours is a very cold (sub-zero) still winter day with NW wind speed 7-9 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation, the windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>			

NATURAL VENTILATION IN WINTER : COVID-19 GUIDANCE

<p>Wednesday 16 January:</p> <p>Weather conditions during the school occupation hours is a mild breezy winter day with NE wind speed 0-1.5 m/s.</p> <p>Even though it is very cold outside the predominant factor in natural ventilation effectiveness is the windspeed and direction. In order to achieve acceptable ventilation the windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/91 Classroom (Option 1.aps) — Room CO2 concentration: 1/91 Classroom (Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/91 Classroom (Option 2.aps) — Room CO2 concentration: 1/91 Classroom (Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/91 Classroom (Option 3.aps) — Room CO2 concentration: 1/91 Classroom (Option 3.aps)</p>
<p>Thursday 17 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with E wind speed 3-8 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/91 Classroom (Option 1.aps) — Room CO2 concentration: 1/91 Classroom (Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/91 Classroom (Option 2.aps) — Room CO2 concentration: 1/91 Classroom (Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/91 Classroom (Option 3.aps) — Room CO2 concentration: 1/91 Classroom (Option 3.aps)</p>
<p>Friday 18 January:</p> <p>Weather conditions during the school occupation hours is a cool breezy winter day with S wind speed 3-9 m/s.</p> <p>A cool day, the predominant factor in natural ventilation effectiveness remains the windspeed and direction. In order to achieve acceptable ventilation, the top windows will require to be approximately 15% open. Acceptable temperature should be maintainable throughout the day.</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/91 Classroom (Option 1.aps) — Room CO2 concentration: 1/91 Classroom (Option 1.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/91 Classroom (Option 2.aps) — Room CO2 concentration: 1/91 Classroom (Option 2.aps)</p>	 <p>— Dry-bulb temperature: (AberdeenEWY.fwt) — Air temperature: 1/91 Classroom (Option 3.aps) — Room CO2 concentration: 1/91 Classroom (Option 3.aps)</p>