Presentation content

- Learning Objectives
- Standards and Regulations
- Natural Ventilation Systems
- Mechanical Ventilation Systems
- Hybrid Ventilation Systems
- Other areas within schools
- Who we are
- Questions?
Standards and Regulations
All the existing Standards and Regulations

Overview of all that relate to School Ventilation in Scotland

(Links to all these documents below will be provided to you)

- School Premises (General Requirements and Standards) Regulations 1967
  - Update awaiting approval for 2018
- Building (Scotland) Regulations 2004
  - Technical Handbooks used as guidance
- Building Bulletin (BB) 101: Ventilation in Schools 2006
  - By the Department for Education and Skills (DfES)
  - Update awaiting approval
- Building Bulletin (BB) 93: Acoustic Design of Schools 2015
  - By the Department for Education and Skills (DfES)
- School Design: Optimising the internal environment
  - By the Scottish Executive Education Department
- Ecodesign Energy Related Products (ErP) 2009/125/EC
  - Lot 6 1253/2014: Ventilation Units
Existing Standards and Regulations

School Premises (General Requirements & Standards) Regulations 1967

- Overarching regulations applicable to all aspects of a school building not just ventilation
- Set broad minimum standards in relation to:
  - Areas for school sites
  - Lighting
  - Ventilation
  - Etc.
- Last amended in 1979 & is currently being re-drafted to reduce duplications & make sure it matches Building (Scotland) Regulations 2004
- These are mandatory but over-arching, a little vague & you need to refer to BB101 & BB93 that are more relevant to how you design ventilation systems in schools
Existing Standards and Regulations
Building Regulations (Scotland) 2004

• Regulation 9 is for general construction. It states “Construction shall be carried out so that the work complies with the applicable requirements of Schedule 5.”

• Schedule 5 of Regulation 9 details specifics on vent, acoustics & energy in Scotland detailed on following slide

• Scottish Government Technical Handbooks provide guidance on achieving the standards set in the Building Regs. They're available in two volumes: Domestic buildings and Non-domestic buildings.

Again mandatory but not designed specifically for schools & really refer to BB101 & BB93
Existing Standards and Regulations
Schedule 5 of Regulation 9 of Building (Scotland) 2004

The seven sections of Schedule 5 are:

Please Note. The sections relevant to Vent are highlighted below in bold & detailed further on the following slides

• Section 1 - Structure (Mechanical resistance and stability)
• Section 2 - Fire (Safety in case of fire)
• Section 3 - Environment (Hygiene, health and the environment)
• Section 4 - Safety (Safety and accessibility in use)
• Section 5 - Noise (Protection against noise)
• Section 6 - Energy (Energy, economy and heat retention)
• Section 7 - Sustainability (Sustainable use of natural resources)

Again these need to be adhered to you should use BB101 & BB93 for detail
Section 3.14 Ventilation

- Every building must be designed and constructed in such a way that ventilation is provided so that the air quality inside the building is not a threat to the building or the health of the occupants.

A very broad statement, almost irrelevant to schools vent design in isolation
Existing Standards and Regulations - detail
Mandatory Standards – Section 5 (Noise) from Schedule 5 of Regulation 9 of Building (Scotland) 2004

Section 5.1 Noise separation
• Every building, which is divided into more than one area of different occupation, must be designed and constructed in such a way to limit the transmission of source noise from normal domestic type activities, between such areas, to a level that will not threaten the health of, or cause inconvenience to the building occupants.

Section 5.2 Noise reduction between rooms
• Every building, must be designed and constructed in such a way to limit the transmission of source noise from normal domestic type activities, through a wall or floor, between a room and internal space where noise is likely to occur, to a level that will not cause inconvenience to the building occupants.

Again rather vague & covered in more detail in BB101 & BB93
Existing Standards and Regulations - detail
Mandatory Standards – Section 6 (Energy) from Schedule 5 of Regulation 9 of Building (Scotland) 2004

Section 6.6 Mechanical ventilation and air conditioning (MVAC)

- Every building must be designed and constructed in such a way that:
  a) the form and fabric of the building minimises the use of mechanical ventilating or cooling systems for cooling purposes, and
  b) the ventilating and cooling systems installed are energy efficient and are capable of being controlled to achieve optimum energy efficiency.

Section 6.7 Commissioning building services

- Every building must be designed and constructed in such a way that energy supply systems and building services which use fuel or power for heating, lighting, ventilating and cooling the internal environment and heating the water, are commissioned to achieve optimum energy efficiency.

Again rather vague & covered in more detail in BB101 & BB93
Standards and Regulations
BB101 ventilation guide

BB101 2006: Guidelines on ventilation, thermal comfort and indoor air quality in schools

- In Scotland referred to as the DfES BB101 in Scotland these are non-statutory guidance for planning & designing new & existing schools. It doesn't therefore have to be adhered to but it has become the recognised default standard.
- So it has therefore become the default standard but it is not mandatory
- Advises how to meet the regs & guidance is given on how to design ventilation in schools.
- Sets out minimum comfort criteria to avoid problems such as cold drafts and summertime overheating.
- There are also BB102 (Designing for Disabled Children & Children with Special Educational Needs) This covers the additional requirements for these buildings, e.g. increased vent rates, acoustics, etc.

Maximum CO₂ limits

During daytime occupation, maximum CO₂ must not exceed 5,000ppm
At any time, occupants should be able to lower CO₂ to 1,000ppm
Average CO₂ during occupied day must be less than 1,500ppm

Current BB101 Requirements

Image source: CIBSE Journal: Education Facilities Special, April 2017, pg. 11
Standards and Regulations

Future of BB101

The newest revision is BB101 (2016) & this is still awaiting approval.

It includes the latest guidelines on IAQ & the reduction of pollutants.

It is yet to be implemented so refer to 2006 version that is still current for an indeterminate period.
Standards and Regulations
School Design: Optimising the Internal Environment

- A Scottish specific document

• This is a guidance document to take BB101 & BB93 into a Scottish context, mainly because of the cooler Scottish climate

• Developed by the Scottish Executive Education Department & covering:
  • internal air quality (IAQ)
  • heating
  • ventilation
  • acoustics
Links to all regulations

All the regulations mentioned can be downloaded using the following links below.

We will send you all a copy of this presentation if you would be kind enough to provide us with your email addresses.

School Premises (General Requirements and Standards) Regulations 1967:

School Premises (General Requirements and Standards) Regulations: 2017 Consultation

Building (Scotland) Regulations 2004

Scottish Technical Handbooks:

Building Bulletin (BB)101: Ventilation in Schools
https://consult.education.gov.uk/capital/bb101-school-design-iaq-comfort-and-ventilation/

Building Bulletin (BB)93: Acoustic Design of Schools 2015

School Design: Optimising the internal environment
http://www.gov.scot/Publications/2007/02/28144045/0

Ecodesign Energy Related Products (ErP) 2009/125/EC
https://www.gov.uk/guidance/placing-energy-related-products-on-the-uk-market

We will also email you our 4 page technical design guide that simplifies (as much as possible) the ErP regulations & how they effect you as designers of air-handling systems. This includes the impending 2018 revisions A further CPD explain this is available & we would be happy to provide this at a later date.
Standards and Regulations
DfES BB93 Acoustic Guide

DfES BB93: Acoustic Design of Schools
• Sets out minimum performance standards for the acoustics of school buildings and how to meet them
• Relevant to both noise transferred through the building structure & from ventilation equipment
• Provides guidance on noise ingress from external sources, noise transfer between spaces, and acoustic absorption within spaces
For example, general teaching spaces have a noise limit of 35dB(A) L_{Aeq, 30mins} for new builds.
Standards and Regulations
BB101 (2006) School Overview

- **Gym / Halls**: 8 l/s/person or 2.5 ACH*
- **Offices**: 10 l/s/person
- **Common Spaces / Hallways**: 1 l/s/m²
- **Teaching Spaces**:
  - 3-8 l/s/person (Natural Vent)
  - 5-8 l/s/person (Mech Vent)
- **Dining**: 8 l/s/person or 2.5 ACH*
- **Science Labs**: 5 ACH

*whichever is greater*
Standards and Regulations
BB93 (2015) School Overview
New Build Limits

Offices
40 dBA

Common Spaces / Hallways
45 dBA

Teaching Spaces
35 dBA

Gym / Halls
40 dBA

Dining
45 dBA

Science Labs
40 dBA
## Additional information on individual areas

### Primary School Classroom

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB101 – 1.5.1, 1.5.2</td>
<td>Purpose-provided ventilation</td>
</tr>
<tr>
<td></td>
<td>Max. 8 l/s/p</td>
</tr>
<tr>
<td></td>
<td>Ave. 5 l/s/p</td>
</tr>
<tr>
<td></td>
<td>Min. 3 l/s/p</td>
</tr>
<tr>
<td>BB101 – 1.4</td>
<td>Air quality</td>
</tr>
<tr>
<td></td>
<td>&lt; 1500 ppm average</td>
</tr>
<tr>
<td>Temperature</td>
<td>Min. 15 °C</td>
</tr>
<tr>
<td>BB93: 1.1.2</td>
<td>Acoustic performance</td>
</tr>
<tr>
<td></td>
<td>New build 35 dBA</td>
</tr>
<tr>
<td></td>
<td>Refurb 40 dBA</td>
</tr>
</tbody>
</table>
### Additional information on individual areas

**Secondary School Classroom**

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB101 – 1.5.1, 1.5.2</td>
<td>Max. 8 l/s/p, Ave. 5 l/s/p, Min. 3 l/s/p</td>
</tr>
<tr>
<td>Purpose-provided ventilation</td>
<td></td>
</tr>
<tr>
<td>BB101 – 1.4</td>
<td>&lt; 1500 ppm average</td>
</tr>
<tr>
<td>Air quality</td>
<td></td>
</tr>
<tr>
<td>BB93: 1.1.2</td>
<td>New build 35 dBA, Refurb 40 dBA</td>
</tr>
<tr>
<td>Acoustic performance</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>Min. 15 °C</td>
</tr>
</tbody>
</table>
### Additional information on individual areas

#### Science Laboratory

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB101 – 2.5</td>
<td>5 ACH</td>
</tr>
<tr>
<td>BB101 – 1.4</td>
<td>&lt; 1500 ppm average</td>
</tr>
<tr>
<td><strong>Air quality</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>Min. 15 °C</td>
</tr>
<tr>
<td>BB93: 1.1.2</td>
<td>New build 40 dBA Refurb 45 dBA</td>
</tr>
<tr>
<td><strong>Acoustic performance</strong></td>
<td></td>
</tr>
</tbody>
</table>
What is ErP and Ecodesign?

Directive to make the use of energy and energy related products more efficient

- ErP stands for “Energy Related Products”
- ErP is supported by Ecodesign Directive (2009/125/EC) to make energy related products more efficient, by phasing out inefficient products
- Part of the EU’s commitment to reaching the 2020 goals, aiming to reduce greenhouse gas emissions by 20% and overall energy consumption by 20%.
- Compliance with the ErP Regulations is in addition to Section 6 of the Scottish Building Standards.
- ErP is relevant to both New and Existing buildings as it is associated to the manufactured AHU
Lot 6 of ErP 2018

Ecodesign Directive is split into a number of areas of related products, called "lots", focusing on the product areas with the most substantial energy consumption and the highest potential for energy savings

• Lot 6 concerns Ventilation Units

• Highly relevant area to energy, as HVAC represents about 15% of the total energy consumption in the EU

• Two classifications of Ventilation Units (VU):
  • Residential Ventilation Units: RVUs
  • Non Residential Ventilation Units: NRVUs

• Regulation does not apply to:
  • Ventilation units where electric power is less than 30W (per air stream)
  • Axial or centrifugal fans, which are only equipped with a housing
  • Processing ventilation
  • More information available through link & technical guide that we will provide you
Natural Ventilation Systems

Ventilation Options available
Natural Ventilation
How does Natural Ventilation control indoor air quality and temperature

Natural Ventilation Systems work by natural forces:

- Wind – causing differential pressures
- Thermal Buoyancy – called stack effect
- Building design dictates air movement rates & air quality. So early interaction between architect & mechanical services consultant is vital
Natural Ventilation
Effectiveness is determined by the outdoor conditions

Factors effecting Natural Ventilation Systems

- Wind speed, temperature, humidity and surrounding topography
- Orientation of the building – windows or openings, size and location

Applicable to new build only

- Very difficult to implement in existing buildings
Comparisons
Natural Ventilation Systems

Advantages:
• Can be very energy efficient
• Lower maintenance and capital costs for simpler systems

Disadvantages:
• Uncertainty on performance
• Complex and technical design process
• Difficult to fit into existing buildings
• Does not work well in environments with loud external noise sources e.g. close to roads, etc.
• Normally does not filter outdoor contaminants
• Not so popular in cooler climates
Hybrid Ventilation Systems

Ventilation Options available
Hybrid Ventilation
Controls indoor air quality & temperature using both natural and mechanical ventilation systems

Works by:

- Switching automatically between natural vent & mechanical at different times to optimise conditions & lowest energy use
- Takes advantage of the external ambient conditions as much as possible including night time free-cooling
- Uses Mechanical Ventilation to maintain IAQ and temperature when external conditions are not favourable

The 2016 revision to BB101 mentions the favourable cost benefit of using Hybrid ventilation
**Hybrid Ventilation Unit**

**Components**

**Modes**
- Full fresh air mode
- Fresh mixing mode
- Full recirculation mode
- Full natural mode

**Components**
- Supply grille
- Acoustic lining
- Integrated controls
- High efficiency EC fan
- Support bracket
- Cable access and HMI port
- Modulating actuator
- Filter (optional)
- Mixing dampers
- Heating (optional)

**VES Ecovent Hybrid**

*ErP 1253/2014 Loop Ready*
Hybrid Ventilation Unit
Unit Operation – Full fresh air mode

Key benefits
- To reduce higher CO₂ and hotter temperature levels
- Mixing damper is closed, allowing no recirculation
- Exhaust air is forced to atmosphere through the introduction of fresh air
Hybrid Ventilation Unit
Unit Operation – Fresh mixing mode

Key benefits

- As CO$_2$ levels drop in the classroom air may begin to be recirculated
- Cooler outdoor air is mixed with recirculated air, where the ratio of fresh air is modulated to control temperature and CO$_2$
Hybrid Ventilation Unit
Unit Operation – Full recirculation mode

Key benefits

• With fan running for colder conditions
• Mixing damper is fully open, allowing air to be recirculated from the space and passed over a LPHW coil for heating (if fitted – depending on spec)
• CO2 is the dominant factor & in this mode, levels in space would be satisfied.
Hybrid Ventilation Unit

Unit Operation – Full natural mode

Key benefits

• Unit shuts down & windows may be opened (indicated on separate control panel) allowing for natural ventilation

• This happens when O/S air temperature & internal CO2 are within specified levels
The panel features can be adjusted to local requirements & can comprise items as follows:

- Boost switch – increases fan speed for set period of time
- Off switch
- Boost/Off active indication (orange)
- System enabled (green)
- Open windows indication (green)
Ecovent Hybrid (EVH)

Ease of Installation

**Key benefits**
- Ceiling mounted – simple standard drop rod fixing
- Lighter than mechanical only MHVR systems
- Robust finish
- Versatile window connections
- Double deflection grille, improving location flexibility & adjust air distribution onsite

**Options**
- Push fit valve connections (LPHW for options)
- Commissioning is available by VES
- Trailing / flying leads and wiring looms available for power & controls for ease of installation
Comparisons
Hybrid Ventilation Systems

Advantages:
• Takes advantages of both systems
• Increased energy savings over a Mechanical Ventilation Systems
• Lower capital, maintenance and installation costs vs. Mechanical Ventilation Systems

Disadvantages:
• Less control than a Mechanical Ventilation Systems
• Can have additional running costs due to heat recovery not being constantly available
• Less suitable for noisy external environments
• Generally does not have filters for external contaminants but these are optional
Ventilation Options available

Mechanical Ventilation Systems
Mechanical Ventilation

Mechanical Ventilation Systems give much closer control & consistent conditions within the space

- Can include:
  - Heating elements (EHB / LPHW coils)
  - Air conditioning
    - Heat pump
    - Free cooling
    - Dehumidifiers
  - Various grades of filters to suit local environment
  - Heat Exchangers / heat wheels for heat recovery

Counterflow Low Profile Acoustic schools heat recovery AHU
Mechanical Ventilation Comparisons

Advantages:
- Works in all environments, regardless of external conditions
- Can be fitted into almost all buildings, new and existing
- IAQ and temperature is maintained constantly
- Not adversely affected by external noise sources
- Can be centralised or decentralised to meet specific requirements
- Has filters for outdoor contaminants
- Potential for heat recovery and cooling

Disadvantages:
- Can have larger capital, maintenance and installation costs
- Generally uses more energy than the other types
Options for Other Areas in Schools
Hybrid units are aimed specifically for classroom areas.

Areas such as corridors, toilet blocks and small offices may require smaller units with low specific fan power.

These can be provided with integrated controls.

**General Area Requirements:**
- BB101 ventilation rates 1 l/s/m²
- BB93 acoustic design for schools 45 dBA
Kitchens
In education

• Kitchens provide opportunities to save energy and reduce running costs
• Where steam cooking predominates, it's possible to recover heat from the air extracted from a kitchen canopy
• Integrated gas interlock can be provided with standard control panels to ensure safe cooking practices, via airflow detection
• **Minimum School Kitchen Requirements are:**
  - BB101 ventilation rates 10 l/s/p
  - BB93 acoustic design for schools 50 dBA

However good practice should refer to DW172 for kitchen vent design to ensure sufficient extraction from canopies
**Halls**

In education

- **Requirements:**
  - BB101 8 l/s/p or 2.5 ACH
  - BB93 acoustic design for schools 40 dBA
- So this often needs a larger AHU ideally with CO₂ / VOC monitoring to maintain IAQ & give minimum energy usage
School swimming pools
In education

- Temperature & humidity conditions are critical for comfort & to protect the building fabric

- **No specific BB regulations.** But pool halls should be designed in accordance with the requirements to maintain temperature & humidity whilst using the least amount of energy. Ideally the airflow distribution should be designed also to move disinfectant by-products from the pool surface.

- AHU’s should be designed specifically to deal with this environment & give close control of humidity, temperature & air quality.

- We offer a separate CPD on how to design pool hall ventilation & also the very latest innovations from the pan-European research project called Intellipool that we have been part of. This improves pool water & pool air quality & minimises energy & water usage
Who we are
Family business providing bespoke HVAC solutions
Who we are

Family business providing bespoke HVAC solutions

- 50 years’ experience in designing, developing and manufacturing market leading HVAC equipment.
- Experts in delivering bespoke solutions, with a focus on energy efficiency.
- Industry leading site services capability and consultant level design ability.

VES Scottish Team Office
Tay House, 300 Bath Street, Glasgow G2 4JR
Our Products
Overview of our ventilation services

Bespoke ventilation

Standard ventilation

Controls

Associated HVAC Products
Our Services
Overview of our ventilation services
Customisable solutions

In addition to the standard Ecovent Counterflow units, VES offers the EVC-A range.

When a major building contractor required a very low profile heat recovery solution to fit into pre-existing classroom designs, they contacted VES. To achieve the required low profile, the spigot arrangement of the Ecovent Counterflow was changed from side-by-side to top and bottom. No simple task, as the products still need to achieve airflow and acoustic requirements. Nevertheless, VES succeeded where others had previously failed and the EVC-A range is now available as a standard product.

- Low height for shallow voids
- Low weight
- Low noise: Built in attenuator (size 1 and 2)
- Multi-dock fan arrangement increases laminar flow across plate heat exchanger for effective and efficient operation
- On board chassis mounted controls
- CO₂ monitoring
- Smaller filters for easier maintenance access
- Convenient mounting and access points

Feedback from the contractor has been overwhelmingly positive and in a few short months, several hundred units have been supplied to primary and secondary schools around the country.
Thank you for attending. We’d be pleased to answer any questions you may have.