Preface

This publication is part of a series of work sponsored by the Scottish Executive to encourage the design and construction of sustainable schools in Scotland. It follows on from previous guidance on School Design (2003) and Sustainability (2004), published in support of the joint Scottish Executive and the Convention of Scottish Local Authorities (COSLA) school estate strategy *Building our Future: Scotland’s School Estate*.

Sustainability, in its widest sense, is at the heart of the strategy’s vision for new and refurbished schools, which support learning and teaching, and are an integral part of the community, both today and for coming decades.

Good school design has an important role in delivering this vision, not just in physically creating the healthy and ecologically-sensitive environments in which learning and teaching can take place but also in demonstrating and imbuing in pupils an awareness of the need for us all to develop more sustainable ways of living in general.

Since the launch of the strategy the Scottish Executive has, in partnership with others, been promoting the sharing of good practice in school design with stakeholders through national conferences, workshops, guidance publications and other projects. An important element of this work has been to seek out lessons and take inspiration from as many sources as possible, including examples of school buildings internationally.

In this context the two volumes entitled, *Design and Construction of Sustainable Schools* look at some examples of recent sustainable school buildings in Norway and Germany, with a view to informing the development of our school estate in Scotland. The publication will be of interest to everyone involved in school design. The first book looks at the individual buildings and their design and this, the second volume looks more widely at both specific and generic issues that arose from the whole experience.

This publication has grown from a project started in May 2003 when the Gaia Group undertook a study tour of schools designed by its Norwegian colleagues plus some sustainable schools by others. The tour party comprised Gaia staff, a number of public and private sector architects and engineers, and local authority education officials.

The initial focus of the tour was on passive design techniques and, in particular, on natural ventilation methods. It was discovered that even with a design temperature of minus 20°C in winter, a number of the schools visited were achieving very low energy use targets - achieved through an approach combining energy conservation and the use of passive heat gains.

Whilst the tour was very instructive on the technical aspects of environmental design, it also provided an insight into the involvement of both schools and the wider community and an approach to education, which were different to those prevalent in Scotland.

Following very positive feedback from the Norwegian tour, Gaia decided that a second tour to look at sustainable schools in Germany would build on the lessons learned from Norway. The German tour took place in October 2004, with equally positive feedback. Again, the tour party comprised Gaia
staff, public and private sector architects and engineers, local authority officials and representatives of the Scottish Executive.

Recognising the importance of the lessons emerging from the study trips, it was felt that there would be benefit in sharing the case studies with a much wider audience and so the partnership between Gaia, Sust - The Lighthouse on Sustainability and the Scottish Executive to disseminate the material began.

In this, the second volume of two the focus is on giving more detail on specific topics. The Norwegian visit started from an interest in energy conservation, ventilation and indoor climate, but expanded into many other areas. The German visit started from an interest in materials and health and also diversified into issues of significance to those procuring schools in Scotland.

The themes, (which establish a consistent design approach within the project descriptions), emerged empirically from the feedback of the participants and reflect the items which were of interest to them.

The second volume picks up on these and other themes in more depth. Given that the schools were of varying merit in terms of the elements the group sought to learn about, it is clearly sensible to be selective in the second volume and to discuss the most appropriate examples from the range of projects visited in order to showcase selected specific aspects. The topics are clearly identified in the contents list, whereby this volume can be read as a stand-alone publication. However, further information on individual buildings will be found in Volume 1. Between the two it is hoped that the reader will gain a rounded picture and will be able to pick up on some of the best European practice in Sustainable Schools.
The word drifted over the North Sea that Gaia Architects in Norway - and others - were designing schools that were heated primarily by a combination of the body heat of the occupants and casual gains from equipment. Furthermore, this was being achieved in a climate with a winter design-temperature below minus 20ºC.

This information was the trigger for a study tour organised by Gaia Research in May 2003, during the course of which it was established that the reality was much more complex, and even more interesting, than the mere technical aspects that had sparked the initiative.

In the first instance, it became clear to the touring group (which included architects, engineers, educationalists and school clients) that high levels of insulation and airtight construction were not enough on their own to deliver energy efficient schools. Most of the projects visited also had culverts or basements through which incoming fresh air was being preheated as it absorbed the temperature of the ground, through contact with the duct walls. In a country where it makes sense to build buildings with a basement (deep foundations below frost line) it is an opportunistic benefit to use this area for other purposes. It was quickly decided that whilst there was a more limited potential for this technique in Scotland - without such a ubiquitous basement tradition, nevertheless there were many other aspects of the passive design approach, which were readily transferable.

The culvert system can also be used to pre-cool incoming air during warm weather.

As the tour progressed, it also became clear that the pedagogy and the community involvement in the school design process were of great interest, and the group began to focus as much on the way in which the buildings were used, the Norwegian teaching methods and the extent of parental involvement in the schools, as on the buildings construction methods and the associated technical systems.

However, there was a third impression, which was stamped on the collective memory - that of the power of high quality design - the pride and joy aspect of good architecture. The high point was experienced in the visit to the school at Farsund, where despite a lack of what would be considered high levels of environmentally conscious and healthy building design practice, nevertheless the quality of the architecture was seen as a significant factor in the longevity, and therefore partly, the sustainability of the institution. It will see pupils and teachers, (and even educational practice and effective management), come and go; however, as a structure both internally and in its relationship with the town centre it is likely to be ‘a joy forever’.

A scoring system was developed during the tour (red, amber, green). Assessments were made between visits and at evening feedback sessions, to seek to identify the extent to which various aspects of the buildings visited were transferable to Scotland.

“Fresh air is a human right”
Nearly all of the schools made some use of a basement or culvert for their air intake. Most had hybrid systems, with a large variation in both their effectiveness and the extent of their environmental credentials.

The Kjeldås school used primarily stack effect (a natural chimney) for its regular operation with a back up fan, used only in times of very still weather or during high levels of room occupancy.

Meanwhile, the Kvadraturen school used merely a token amount of culvert and was primarily mechanically ventilated. The conversion of the senior school at Vanse made as
much use as it could of the redundant nineteenth century chimneys at the core of the building while still relying on more conventional supplementary systems.

Perhaps the biggest impression was made at the Borhaug nursery school where the culvert system was coupled with a passive system, whereby a ceiling delivered fresh air via a “Pore Ventilation” system (also known as Dynamic Insulation), which had turned out to be so effective via the roof mounted air intake, that the culvert was redundant. The subjective sense of freshness experienced by everyone in this building and the fact that the culvert had never been needed was a critical moment and perhaps a point of mental dismissal, by many of the group, of the ground based intake method. It must be remembered however, that due to its coastal location, this school would never reach the extremes of low temperature experienced by the schools located further inland, and also that as a coastal school it experienced on average less than six or seven days a year without wind.

The Oserød school at Nøtterøy provided an ideal learning opportunity for the group. It utilised the need for long culverts as a positive design generator whereby the teaching wings were splayed (to accommodate the culvert), within which sheltered play took place.

**Pedagogy/community**

The design of the V-shape school was also responsive to an original pedagogic approach - self-directed learning in which pupils were given their daily tasks and then, as they progressed through the school, were given ever increasing amounts of freedom to sit in the area where they felt most comfortable for working - be it the classroom, the library or the central meeting area with its range of break-out spaces.

Three of the schools (Farsund, Vanse, Oserød) impressed the group through the presentations of their head teachers - who seemed to have created a distinct sense of school community and an atmosphere of learning. Three schools equally disappointed on this basis Kvadraturen, Oddemarka and Vanse Phase 2.

Other aspects of interest included the way in which children played with good quality outdoor landscaping - use of hillocks and ground modelling, adventurous, (even risky) play equipment, out in the open in all weathers (no such thing as bad weather - only inappropriate clothing). The catering arrangements were also different from those found here, (e.g. Kjeldås, where pupils made sandwiches and saved milk cartons for recycling etc), and there was also a distinct lack of soft drinks in cans, and snacks such as sweets and crisps in evidence.

**Design/procurement**

Those schools with the greatest amount of community involvement tended to be the most successful in operation. High levels of involvement were evident in Kjeldås, Oserød, Vanse Phase 1, and Borhaug.

The approach taken in Kvadraturen, Oddemarka and Vanse Phase 2 was more “detached” with little or no community input. This resulted in schools that were not user friendly in practice. Vanse Phase 2 went to competition against parental wishes.

Farsund was an exception in that it was a competition but the community had clearly been involved in both the writing of the brief and the delivery from the point of identifying the winner.
Following the successful study tour of Norwegian schools in 2003 it was decided that a second trip to southern Germany would be worthwhile. Gaia Architects arranged the tour in October 2004 and a range of architects, engineers and education building clients took part in a very intensive exercise, which looked at a range of exemplar sustainable development projects including a number of schools, which have been selected for exposition in this publication.

The focus was on the work of three architects with a reputation for producing innovative and ecologically sound schools: Günter Behnisch, Peter Hübner and Gaia colleague Joachim Eble. During the course of the tour feedback sheets were completed by all participants and collated. A follow up workshop was held after returning to Scotland and the assessments in this publication are drawn from these discussions plus other information from source (i.e. architects and clients of the visited projects).

The core interest of the group followed from the first tour - an interest in healthy and environmentally sound construction, plus a grasp of some of the teaching methods and an understanding of mechanisms for procurement.

The group formed a distinct consensus on their most and least favourite projects (Waldorf school and Hechinger Eck school respectively), and it was reassuring to note that the design quality of these went hand in hand with their credentials for environmental performance and enlightened procurement methods. However, whilst this was the general summary view, there was much interest in the detail: in technical, pedagogic and in management terms.

**Technology/efficiency**

The perception of the construction methods of the German schools was one of high quality workmanship and good value for money. The building industry in Germany is based on traditional skills and it has not gone as far into offsite construction as the Swiss, Austrian or Dutch industries. Nevertheless, high skill levels throughout the trades were evident, showcasing an industry with longer and more rigorous apprenticeships and training than is currently the case in the UK.

The most innovative of the schools was at Pfennigäcker where a mass timber construction system (called Brettstapel), had been introduced and also, a specialist colour consultant had been employed to raise the quality of both the internal and external surfaces of the buildings.

The school which the group felt dealt most effectively with daylight, was the Waldorf school, at Kirchheim, which managed to create both external and internal spaces of interest and character within a very tight site perimeter.

Two of the schools visited in Südstadt, Tübingen were opportunistic on the back of visits focusing on housing development, but they did provide a few discussion points of value. Both projects were parts of buildings, which had other functions (offices, housing). In one case it showed that flexibility in design to cater for uses other than educational can undermine the effectiveness of design for teaching purposes. In the other, it made for a difficult division both internally and externally between the school and neighbouring activities.
Pedagogy/community
The perception of the group, in all cases, was of a relaxed attitude with regard to the accessibility by all the community into the school grounds, (lack of fencing or any perimeter separation).

Design/procurement
The aesthetic quality of most of the schools was high - and apart from Pliezhausen and Mont Cernis the same projects were also very environmentally sound.
Norwegian Schools

The following tables summarise the sustainable design qualities demonstrated in each of the schools visited on the tours.

- Good example of 1 or more of the sub categories in this area
- Modest achievements in this area
- No significant achievement in this area

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>DESCRIPTION</th>
<th>NO. OF PUPILS</th>
<th>ARCHITECT</th>
<th>INDOOR CLIMATE</th>
<th>AIRTIGHTNESS</th>
<th>DAYLIGHTING</th>
<th>COLOUR</th>
<th>LANDSCAPE AND PLAY</th>
<th>SOCIAL FACTORS</th>
<th>PROCUREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kjeldås Primary</td>
<td>Extension to existing school with strong emphasis on indoor climate.</td>
<td>300</td>
<td>Arkitektkompaniet A. S.</td>
<td>●</td>
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<tr>
<td>Oserød Primary</td>
<td>New-build PFI school with significant parent and teacher involvement in the design process.</td>
<td>400</td>
<td>Lille Fren, Oslo</td>
<td>●</td>
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<td>Oddemarke Secondary</td>
<td>Extension, initially with green agenda, but which was lost through PFI route.</td>
<td>515</td>
<td>Ole Dolva A.S.</td>
<td>○</td>
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<td>Kvadraturen High School</td>
<td>Urban high-density PFI school with agenda of achieving 98% recycling strategy.</td>
<td>1200</td>
<td>Arkitektengruppen Cubus A.S. Bergen</td>
<td>○</td>
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<tr>
<td>Eilert Sund Secondary</td>
<td>Urban school extension with successful community integration.</td>
<td>300</td>
<td>Biong Arkitekter A.S., Oslo</td>
<td>○</td>
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<tr>
<td>Vanse Primary</td>
<td>2-phase school with state of the art ecological principles, driven by the parents on the first phase, lost on the 2nd phase when education authority procurement rules dictated PFI route.</td>
<td>120</td>
<td>Asplan Viak Sør, Kristiansand</td>
<td>●</td>
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<tr>
<td>Borhaug Nursery</td>
<td>New-build nursery integrated into the landscape and focusing on healthy indoor climate; described by tour participants as a ‘kindergarten dream’.</td>
<td>38</td>
<td>Gaia Lista A.S., Lista</td>
<td>●</td>
<td>●</td>
<td>○</td>
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<tr>
<td>Borhaug Senior</td>
<td>Extension and refurbishment of existing school with a view to creating a healthy indoor climate.</td>
<td>137</td>
<td>Gaia Lista A.S. with Siv. Ark. MNAL Odd Aanensen, Lista</td>
<td>●</td>
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German Schools

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</tr>
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<tbody>
<tr>
<td>Hechinger Eck Primary School</td>
<td>Urban planning PPP project, designed for expansion.</td>
<td>270</td>
<td>Tübing Council’s Design Service</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Loretto Nursery</td>
<td>Urban 3-storey nursery with some facilities (external spaces, lift, etc.) shared with neighbours.</td>
<td>65</td>
<td>Tübing Council’s Design Service</td>
<td>○</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Pliezhausen Nursery</td>
<td>Primary School, timber construction, low energy standard, modern wood design.</td>
<td>45</td>
<td>D’Inka + Scheible, Stuttgart</td>
<td>○</td>
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<tr>
<td>Steiner School: Kirchheim Teck</td>
<td>Student-designed Antroposophical School providing an oasis in an industrial area. Cost savings achieved by teachers and parents finishing the interior.</td>
<td>3372</td>
<td>Plus + Bauplanungs GmbH hübner forster hubner, Neckartenzlingen</td>
<td>●</td>
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<tr>
<td>Schäfersfeld Grammar School</td>
<td>Modern architecture, “light, air and sun”.</td>
<td>350-400</td>
<td>Behnisch, Behnisch and Partner, Stuttgart</td>
<td>○</td>
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<tr>
<td>Pfennigäcker Nursery</td>
<td>Healthy materials, natural colours, timber construction, low energy standard.</td>
<td>160</td>
<td>Joachim Eble Architektur, Tübingen</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Further Education College: Herne</td>
<td>Large greenhouse with timber pavilions; energy strategy, water surfaces, large photovoltaic roof.</td>
<td>varies</td>
<td>Jourda + Perraudin, Lyon with Hegger Hegger Schleff HHS Planer + Architeken, Kassel</td>
<td>○</td>
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<td>○</td>
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<tr>
<td>Comprehensive School: Gelsenkirchen</td>
<td>Self-built and designed community school with individual class homes, timber construction, solar gym, extensive pupil-maintained landscaping.</td>
<td>1100</td>
<td>Plus + Bauplanungs GmbH hübner forster hubner, Neckartenzlingen</td>
<td>●</td>
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On average there are three children with asthma in every classroom in the UK, and half a million children with asthma miss school at least once a month because of their symptoms. (1)

There is increasing evidence of a relationship between the rise in allergic reaction and poor indoor air quality in modern buildings. Young people in particular are vulnerable to the health effects of indoor air pollution, and they spend most of their time (90% or more) either in their own homes or indoors in places such as nurseries and schools. The environment inside these buildings is therefore likely to be extremely important to their health and well-being.

A number of factors can affect the air quality (and other health and comfort related issues such as temperature and noise levels). These include: building design and maintenance; pollutant sources; biological contaminants; and methods of controlling, (and the actual levels of), ventilation, temperature, humidity and lighting.

Building materials have perhaps undergone greater changes than any other aspect of construction. At the beginning of the 20th century, the number of building materials in use was around 50. Now, some 55,000 building materials are available, many of which are synthetic and only 7% of which have been properly tested for their impact on human health (2). The industry routinely creates indoor climate with materials which are full of toxic glues, preservatives, finishes and paints. The change in material availability has led to a significant increase in indoor pollutants and a change in the heat and moisture retaining capacities of buildings. Fluctuations in moisture content in buildings are now greater than in the past, as are the problems caused by moisture.

Ventilation systems themselves have increasingly been found to be part of the indoor air quality problem. In a study of 15 office construction projects in Copenhagen, Fanger (3) found that only 12% of pollution in the internal air originated from the metabolism of the occupants: 25% derived from smoking, 20% from materials and furnishings and 42% from the ventilation equipment.

Spaces exposed to sudden changes in moisture loads, may have problems coping with temporary loads. Fluctuating conditions lead to the worst effects of microbial activity. Hence, when the indoor atmosphere is likely to be subjected to sudden changes in moisture loads, the damp-buffering capacity of materials becomes particularly important for maintaining an acceptable level of Relative Humidity (RH). Thermal mass can also have an impact on moisture management as rapid cooling of buildings gives rise to fluctuations in RH detrimental to both building and occupants. Synthetic building materials e.g. plastic membranes, glass fibre, etc., can sustain very large populations of micro-organisms (4), and thus can host colonies of fungi and bacteria that are 1,000-50,000 times greater than those found in natural materials. (5)
“Good indoor air quality is a human right”

[Dagfinn Jorgensen, engineer, Kjeldås Primary]
Relative Humidity levels play a significant role in the indoor climate. At low humidities, the nasal membranes become dry, and are sensitized to chemical irritants (see also 01.2 Material specification), viruses and allergens. At high humidities, mould and fungal growth as well as dust mite colonisation is encouraged.\(^1\)

Whilst the effects of low humidity are fairly self-explanatory, it is worth noting that mould spores and dust mite faeces are recognised by the World Health Organisation as two of the main asthma triggers. With 1 in 8 school children suffering from asthma, the effects of high humidities should not be underestimated. Maintaining relative humidity (RH) levels in the range 40-60% is important if both the risks associated with low and high humidity are to be avoided. This is also the preferred range in terms of achieving thermal comfort.

Depending on factors such as insulation, materials, ventilation, ‘cold bridges’ and air leakages, a building can cope with a wide range of moisture levels in the air. Hygroscopicity describes the ability of materials to absorb moisture when the humidity rises and then re-emit it when the air becomes dry (see also 01.2 Material specification). Materials that can absorb and emit moisture to a greater extent can help to stabilise relative humidity in the air and can help to prevent damp-related damage as well as mould and mite growth. Some porous materials can hold quite large quantities of moisture without any special risks of biological activity or degradation. Materials such as timber, plaster, earth and textiles have hygroscopic properties, so long as they are not treated with impervious coatings.\(^1\)

Passive systems, e.g. materials with hygroscopic properties or ‘moisture mass’, and/or ventilation systems that do not rely on mechanical methods, should always be the favoured options to regulate internal humidity levels, as these require little or no maintenance and have no energy requirement.

The diagram below illustrates the relationship between bacteria, mite and mould prevalance at various humidity levels and the impact on associated health conditions.

\(^1\) Passive systems, e.g. materials with hygroscopic properties or ‘moisture mass’, and/or ventilation systems that do not rely on mechanical methods, should always be the favoured options to regulate internal humidity levels, as these require little or no maintenance and have no energy requirement.
“Hygroscopic building materials are 9 times more effective than mechanical ventilation in controlling indoor relative humidity”

[VTT, Espoo, Finland, 2005]
Moisture mass

‘Moisture mass’, describes a property of some materials that act as moisture stores with the ability to take up excessive moisture and release it when the RH is low. At Pfennigäcker Nursery, moisture mass is achieved through extensive use of timber. The solid timber construction system Brettstapel, (see also section 01.2 Material specification) used for the walls and ceilings was left exposed and finished with natural resin paints, which maintain the timber’s ability to absorb moisture when levels are high and then release it again when the air is drier, thereby helping to balance the relative humidity, providing a unique indoor climate as a result.

At Vanse Primary, moisture transfusive (breathing) walls help to manage internal moisture levels. The walls are ‘moisture open’ thus allowing excessive moisture to diffuse to the external air due to pressure differentials between inside and out. The system balances the internal humidity levels and provides an indoor climate which is pleasant for the occupants and which is also an unsuitable climate for moulds and mites: organisms which are both recognised as presenting a significant risk to occupants’ health. Internally, the walls are finished with plasterboard or timber with natural paints in order to maintain the ‘breathability’ of the structure.
“At low humidities, the nasal membranes are sensitized to chemical irritants, viruses and allergens. At high humidities, mould and fungal growth as well as dust mite colonisation is encouraged”
Material specification

Choice of construction materials has the potential to affect the environment, the economy and the health of manufacturers, contractors, and occupants. It is therefore vital that we choose products with care and that we ensure that any impact made is positive.

Materials and health

Only benign materials, that is, materials that are not deleterious to people or the environment in production, in use, or in disposal, should be specified. This is particularly important in school and nursery buildings as the toxins emitted by a large number of modern building materials are more dense than air and will gravitate towards floor level, thus occupying precisely the same space and section of air as the most vulnerable occupants - small children.

The City of Tübingen Council has recognised the importance of a healthy indoor climate and the risks posed by some building materials. As a result they have implemented a policy of avoidance. Materials associated with health risks, such as most timber treatments, solvent based paints, adhesives, PVC, CFCs, and mineral fibre insulation, are placed on a risk register. Existing schools constructed prior to the implementation of the policy are monitored for indoor pollution, and materials detected that are on the risk register are removed. The use of such materials in new-build situations is now prohibited and any design team or contractor working for the council must sign a contract agreeing to comply with this policy. Any deviation from this must be well founded and requires to be sanctioned by the council.

In Norway, the benefits of benign materials to the indoor climate are recognised in the building regulations, which allow a 20% reduction in air change rates in buildings that use low emission (pollution) materials.

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PVC\(^{(1,2)}\)

Risks
- **During manufacture:** ingredients such as vinyl chloride monomer emit dioxin and other persistent pollutants that can present both acute and chronic health hazards.
- **During use:** PVC products can leach toxic additives, for example, flooring can release softeners called phthalates (one of the recognised asthma triggers and also linked to genital deformities\(^{(3)}\), premature births\(^{(4)}\), hormone disruption\(^{(5)}\) and cancer.\(^{(6)}\)
- **In disposal:** leaches toxic additives when disposed of in landfill; emits dioxin and heavy metals when incinerated.
- **In fire:** emits hydrogen chloride gas and dioxin.

Possible PVC alternatives:
- stainless steel conduits;
- PE, PP or rubber sheathing to wiring;
- copper or PE water pipes;
- cast iron rainwater goods;
- linoleum or rubber in lieu of vinyl floor coverings.

Formaldehyde\(^{(7)}\)

Formaldehyde is used in hundreds of industrial processes including the manufacture of paints, plastic products, paper, textiles, carpets, pesticides and fumigants, particle boards, MDF, chipboard and plywood, cosmetics, thermal insulation foams, furniture, biomedical products, leather goods, adhesives, glues and resins.\(^{(7)}\)
Risks

- Exposure to high levels or long-term low levels of formaldehyde may cause cancer (emissions still occur after installation).
- Formaldehyde is recognised as an asthma trigger.

Possible formaldehyde alternatives:
- cellulose insulation in lieu of foamed insulation;
- water-based paint in lieu of wallpaper and associated glues;
- natural timber in lieu of MDF and chipboard (Note: timber naturally contains formaldehyde, but at levels that are acceptable in terms of minimum health risk).

Solvents

(chemicals commonly used in paints and adhesives).

**Risks** range from: irritation & headaches to dermatitis, colour blindness, brain damage, cancer and even death.

Possible solvent free alternatives:
- natural water-based emulsion paint;
- linseed oil-based gloss paint;
- avoidance of materials containing or requiring glues, e.g. manufactured wood products, wallpaper;
- where use of glues is unavoidable, (e.g. for installation of linoleum or rubber flooring) use solvent & formaldehyde free glues;
- avoidance of timber treatments through detailing.

**Foto Grafikateliers** Loretto Nursery in Tübingen was built avoiding the use of timber treatments, solvent based paints, adhesives, PVC, CFCs, and mineral fibre insulation in line with Tübingen Council’s policy.
Regarding: Compliance with the conditions for environmental protection

The architect/engineer commits
- to include the following regulations in planning and tendering and
- to guarantee the compliance of the following regulations in the submission as well as in the project monitoring.

This commitment is part of the contract.

1. Protection of Wood
On principal the use of wood preserver is not allowed. If the construction necessitates wood preserver (see examples in DIN 68 800 Part 3, April 1990), the following products are allowed: inside the building only oure boris salt products and outside the building beech distillates or CKB-salts (chromate/potassium/boric acid).

2. Paint, varnish, adhesives (for carpets, coverings...)
Only non-solvent materials respectively materials signed with RAL-UZ 12 (Blue Angel, Environmental Label No.12) are allowed.

3. Halogen-free Materials (PVC)
Exceptions are admitted in the field of electric cables as well as tubes for the sewage system. In the last case the tender must include the following sentence: “The contractor is committed to recycle PVC-waste from the building site separately”.

4. Materials containing CFC
The use of materials containing totally halogenated chlorofluorocarbons (for example R11 and R12) is permitted. The use of partly halogenated chlorofluorocarbons is exceptionally allowed, but reasons must be given for each individual case.

5. Tropical Timber
The use of tropical timber is not allowed.

6. Mineral Fibrous Insulating Material
Only mineral fibrous insulating material with carciogenic index lower than 40 is allowed. (Carcinogenic index in the meaning of the technical guideline for hazardous materials 905).

7. Resolution of the City Council to the use of grey water

8. Resolution of the City Council to the low energy standard

9. Consideration of the accident prevention regulations

Sometimes the architect or engineer may think it inevitable to use material not according to the numbers 1 to 5. In this case the deviation must be explained in detail and the municipality must agree before tendering. The valid alternatives must be nominated precisely in the tender.
Materials and mites
Some materials have the ability to assist with control of the indoor environment, for example: they can regulate moisture levels (see 01.1 Humidity); they can affect the levels of bacteria (e.g. timber has been shown to have lower levels of bacteria on the surface than other materials); and can aid dust mite control. Ease of cleaning is important to maintain low levels of mites, the faeces of which are recognised as one of the major asthma triggers. The provision of smooth floor coverings instead of carpets is an extremely effective method of controlling dust mites. Whilst the mites’ faeces themselves can be removed by vacuuming, the mites cling to the carpet fibres with the help of suckers on their legs. If they are left to reproduce, which they do at an incredible rate, they replace the removed faeces in a very short space of time. Unless carpets are steam-cleaned regularly, which would present a significant maintenance burden for any school, the root of the problem is not dealt with. Avoidance of carpets and use of smooth floor coverings was noticeable in all of the schools visited in Germany and Norway. There was little evidence to support the concerns voiced in the UK regarding high levels of noise in classrooms with smooth/ uncarpeted floors. Only in one nursery, Pliezhausen, where all the walls and ceilings were finished with smooth, hard, surfaces, was a problem with noise apparent. Elsewhere, tiled or linoleum floors were clearly favoured and found to be acceptable from an acoustic point of view.

Chris Morgan Brettstapel timber finishes at Pfennigücker Nursery.

Chris Morgan Timber panels constructed from lower grade timber, frequently off cuts, dowelled together without the use of glues.
“The design of the form and fabric of a building is the most important fundamental decision that is made in a building in terms of its downstream impact on indoor climate quality” [Howard Liddell, Gaia Architects, 2005]
Materials and miles travelled
Choice of building materials and the distance they will be required to travel has an impact on both the local economy and the wider environment. By opting for local materials, the travel distance and associated energy requirements are reduced and subsequently CO₂ emissions are minimised. Furthermore, locally sourced materials benefit local businesses by providing employment and associated local financial investment. However, whilst we should therefore always strive to specify local products, it will be necessary, where benign materials are not available locally, to source products from further afield. In this situation, the effects on economy, health and the environment will need to be considered and the specifier will be required to make a choice that minimises the overall negative impact.

Pfennigäcker Nursery has the advantage of being located in a region with a high level of sustainable timber resources. It was therefore a natural decision for both the architects and the client to use local timber. The wide-ranging benefits of an innovative, solid timber construction system, Brettstapel®, which utilises lower-grade timber, convinced the client of the merits of the proposed approach and outweighed their doubts. The use of local timber for construction of the panels for Pfennigäcker demonstrates the extensive impact the choice of construction materials can have - it minimised transport distances and associated energy requirements, provided a boost for the local timber industry (forestry, sawmill and joinery companies), dramatically reduced construction time and associated costs on site and it still, 7 years after completion, provides a unique, healthy indoor climate.

Benefits of timber
• Timber has a surface temperature that is close to the air temperature. This is conducive to creating a comfortable environment. Timber also has moisture regulating properties. Its hygroscopic properties make it suitable for breathing constructions, which provide a unique indoor climate.
• The density of bacteria on the surface of timber is lower than that of a lot of other materials.
• Timber regulates the indoor climate by providing moisture control and a degree of thermal mass.

• 1m³ of timber locks approximately 930kg of CO₂.
• The machining of 1m³ of timber requires (dependent on moisture content) 40-140kWh of energy compared with 600 - 700kWh for brick walls or concrete and 2300kWh for steel.
• Occupants perceive the surface of timber to be warm, allowing the room temperature to be reduced by up to 1-2°C without loss of comfort compared with higher thermal mass materials such as blockwork or brick. Energy consumption and heating costs can therefore be reduced.
Improving thermal comfort and indoor air quality through the provision of fresh air is known to be vitally important to individuals’ perception of a space, their health and well-being, and productivity. Any ventilation system should be flexible enough to provide this under a wide range of conditions.\(^1\)

**Why ventilate?**
- To control air quality and avoid odour by diluting and removing moisture and pollutants which can be hazardous to health and buildings, or simply unpleasant.
- To remove heat and pollutants directly from localised sources and areas.
- To provide ‘free’ cooling during warm occupied periods and, if necessary, remove unwanted heat when the building is unoccupied.
- To act as a carrier for mechanical heating, cooling and/or humidity control.
- To provide oxygen for breathing (a small element compared with the rest of the above).

**Passive ventilation**
The first choice for ventilation should always be to adopt a passive approach. Passive ventilation has a number of advantages.
- It reduces the scale of the mechanical and electrical installation required and associated capital cost.
- At 5 - 15\% of overall running costs, fan power is a major contributory factor in the overall energy consumption of a building. The avoidance of mechanical ventilation systems will therefore have a significant impact on these costs, as well as on the CO\(_2\) emissions associated with energy consumption.
- Passive ventilation reduces maintenance requirements.
- Passive systems are generally simpler, easier to understand and therefore controllable by occupants, who have been shown to experience greater satisfaction if they can control their environment themselves.

There are a number of types of passive ventilation system available. These range from straightforward openable windows, through stack (chimney-effect) ventilation to hybrid systems driven by wind-force as opposed to electrical fans.

Not all buildings, or parts of a building, will require the same approach, and strategies need to reflect outside air quality, orientation, location, seasonal effects and usage patterns - including temporary loads.

The comprehensive school at Gelsenkirchen is ventilated using a hybrid system. The primary system is natural with a mechanical support system in place in the theatre if increased loads demand a ventilation rate not achievable by the passive system alone. Both the sportshall and the theatre receive incoming air via culverts and expel used air with the aid of stack ventilation. The extracted air from the sportshall is pulled through the changing rooms to make use of the heat not required in the hall. Additional ventilation in the hall is available via openable windows and stack effect through rooflights when required. The classrooms receive fresh air via windows and clerestory lights and “used” air is extracted via ventilation chimneys in the circulation ‘street’.
“Improving thermal comfort and indoor air quality through provision of fresh air is important to health and well-being, and productivity”
Culvert ventilation
The primary school at Vanse uses a natural ventilation system aided by stack effect. The air intake is via an automatic damper through a culvert underneath the building, where the stable underground temperature provides pre-heating in winter and pre-cooling in summer. Risk of low level draughts is minimised by the combination of the fact that classroom windows open inwards and are hinged at the bottom, and in addition, underfloor, low temperature heating is used, encouraging upward air movement.

Furthermore, a ridge level opening is designed to assist the stack effect by drawing air upward due to the driving effect of the wind (known as the Bernoulli effect). This is controlled by an extract damper in each classroom, which can be opened by teachers in response to the internal conditions and which will close automatically at the end of the day. Night cooling is an option, but the building is unoccupied during the warmest months and the provision of some thermal mass, in combination with a shape and orientation that minimise solar gain, and high frequency lighting to reduce internal gains, minimise the need for passive cooling. The building has no mechanical fans.

Internal moisture control is achieved by the use of hygroscopic materials including wood surfaces and “moisture-open” paint finishes.
Pore ventilation
Pore ventilation, the system used at Borhaug Nursery, is an approach to building ventilation, which uses the building fabric rather than mechanical systems. Air is drawn into the building through its insulation, which acts as a counter-flow heat exchanger and heat usually lost by conduction to outside is exchanged with the air drawn in.\(^{(2)}\) At Borhaug Nursery the building is pressurised using a roof fan above the toilet. The negative pressure draws outside air through the roof eaves where it warms or cools in the “dynamic insulation” before entering the room. Used air is extracted from the main rooms via the WC areas.

This system turned out to be so effective that in the six years since the building was completed the culvert system, installed as a backup, has not been required. The sense of freshness experienced in the nursery made a lasting impression on the Scottish visitors and convinced all of the effectiveness of the chosen ventilation strategy, one that could be easily adopted for use in Scotland – and which has already been used in sports centres in Callendar, Kinlochleven and Drumchapel.
1. Fresh air intake under eaves through cold attic.
2. Cold attic with access hatch for inspection.
3. Incoming air is drawn in through a dynamic ceiling, consisting of two layers of 100mm cellulose mats. The bottom mat is compressed so that the overall air pressure resistance is 2 Pascal. The top layer can be replaced should the pores become filled with dust (this does not appear to happen in practice and should not be necessary).
4. Air is delivered partly preheated to the rooms, at below the desired temperature.
5. Air is extracted via the following rooms: toilets, washroom, changing room and staff rest room.
6. Air extraction is controlled by an adjustable damper.
7. The ventilation windows open inwards, and are bottom hinged to cause least possible risk of draughts.
8. The roof overhang protects south facing windows from excessive solar gain.
9. Radiator thermostats are to be set to maintain a room temperature of no more than 19 - 20°C.
10. The floor heating thermostat is set as low as possible, to maintain a room temperature of maximum 17°C.
Airtightness

Chris Butters Borhaug Nursery achieves an airtight construction despite an irregular form
There is currently little data available on airtightness of schools, but with BRE recently reporting that one third of all buildings tested are failing the airtightness test required by the current Building Regulations in England and Wales, it is safe to assume that a significant number of schools are leaking energy (and therefore money).

Airtightness contributes positively to the indoor climate and to occupants’ comfort by eliminating draughts. Also, controlling infiltration, makes it easier to regulate ventilation and heating accurately and to predict requirements. A reduction in heat-loss through gaps in the building envelope significantly improves energy efficiency, thereby saving on heating costs (a major factor in the whole life cost of a building) and reduces the emissions associated with energy production.

**Build tight**

Holes in the building fabric are generally not clearly visible and leakage paths can be obscure, following pipe and cable routes, or taking paths under skirtings and through sockets, nevertheless leakage can have a dramatic impact on indoor comfort, climate, running costs and the environment. It is therefore crucial that airtightness is given the same consideration as the rest of the building design and, above all, that airtightness tests are carried out as part of the building construction and completion process (at ‘first fix’ stage and near completion stage).

The importance of such issues should be raised at the outset with both the design team and the contractor, to ensure that all are informed as to the requirements of the construction, in particular, at junctions and the position of the airtightness layer within the construction depth. The provision of an internal service zone, in front of the airtightness layer will simplify things and allows cables and pipes to be run without puncturing this important barrier. It is vital that tests are factored-in from the outset and are included in the cost plan as well as specified within the programme as this is the only appropriate control method to ensure airtightness is delivered. As reported failure rates show, thinking that a building is airtight and being airtight are not necessarily the same thing.

Borhaug Nursery demonstrates that airtightness is possible even with an irregular form. Airtightness here enabled accurate ventilation control and the use of pore ventilation system (see also Pore ventilation 01.3), which relies on airtightness to operate optimally. The uniquely fresh indoor climate impressed all the Scottish visitors.

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In conducting a “blower test” intentional openings (e.g. windows, doors, vents) are sealed and the building is pressurised to 50 Pascal with the aid of a large fan. Leakage rates are then measured and the airtightness is defined as an air leakage rate in m3/hr per square metre of the building envelope. Current Scottish Regulations do not require buildings to be tested for airtightness, and English and Welsh Regulations only require a rate of 10 m3/hr/m2 to comply – a rate more than twice that routinely achieved in buildings in Scandinavia. Low energy buildings, however, require leakage rates significantly below that, and the aim should be to achieve 2-3m3/hr/m2@50pa.
Lighting is a major factor in determining the way in which people experience the internal environment and how they are able to respond to certain tasks. Good lighting enhances the quality of a space and contributes to creating an appropriate atmosphere. If appropriately designed and integrated, lighting can contribute significantly to distinctive and attractive architecture, and to occupants’ sense of well-being. In fact research indicates that daylighting can have a positive impact on people’s health and physical development.\(^{(1, 2)}\)

**Pupil benefits**

Researchers in Sweden monitored behaviour, health, and cortisol (a stress hormone) levels in 90 primary school children over the period of a year in four classrooms with varying levels of daylight. The results indicated that work in classrooms without daylight may upset the basic hormone pattern and this in turn may influence the children’s ability to concentrate or cooperate, and also eventually may have an impact on annual body growth and absenteeism.\(^{(3)}\)

In Canada, the Alberta Department of Education compared, over a two-year period, primary school children attending schools with full spectrum light (daylight or artificial light sources simulating daylight) with children attending primary schools with conventional mixed artificial and natural lighting.\(^{(4)}\)

The results showed that the pupils subjected to the full spectrum light were healthier, had fewer days off school, more positive moods and better scholastic performance. The research also concluded that the use of daylighting had enabled heating, ventilation and air-conditioning requirements to be reduced, thereby reducing the associated overall running costs and moreover noise levels, thus providing better learning environments. In addition, it was found that the use of daylight in school libraries resulted in significantly reduced noise levels, due to improved concentration levels among the children.

One study found that in classrooms with the highest levels of daylighting, students’ learning progressed 20% faster in mathematics and 26% faster in reading than similar students in classrooms with the least daylighting. The apparent significance of daylighting quality surprised some of those involved and to ensure the study’s validity, California’s Public Interest Energy Research (PIER) programme, administered by the CEC, funded a follow-up study, employing an independent technical advisory group to re-analyse the data. The re-analysis confirmed the initial study’s findings with a 99.9% confidence level.\(^{(5)}\)
Advantages of Daylight

- zero electrical energy consumption;
- reduced running costs;
- enhances the quality of a space and contributes to creating an appropriate atmosphere;
- positive impact on occupants’ health;
- positive impact on children’s educational development.

Consider

- daylight vs heat loss;
- daylight vs excessive solar heat gain;
- daylight vs glare;
- use of rooflights to provide a more even spread of light than vertical windows;
- the fact that a higher daylight factor is achievable with rooflights than with windows or clerestories;
- the fact that occupants appreciate views.
Daylighting and energy
Apart from the perceived health and educational benefits, the use of daylight in lieu of artificial lighting has ecological and economical advantages. The energy consumption associated with artificial lighting traditionally represents a significant proportion (25–30%) of the overall primary energy consumption and up to 50% of the electrical load of buildings. A reduction in the requirement for artificial lighting can therefore impact greatly on the overall energy requirement and running costs of a building. This is because lamps used less frequently will require to be replaced less often, thus reducing maintenance costs as well as energy consumption.

Whilst natural light should always be the first choice for illuminating a space during the day, except where the function specifically excludes it, care should be taken to ensure that uncontrolled natural lighting and/or poor control does not give rise to thermal discomfort. This increases the need for compensatory heating or cooling. Therefore it is important to balance heat gains from daylight with thermal losses through glazing and the electrical energy savings from a reduced requirement for artificial lighting. In other words, optimisation of daylight and integration with well-designed artificial light requires that the building form, fabric, internal layout, finishes, and building systems are considered holistically.

The orientation of windows and rooflights requires careful consideration to avoid glare, overheating and excessive heat loss whilst achieving solar gain (when required), daylighting and views. Adjustable shading may be required to satisfy varying requirements throughout the year including control of glare and excess solar gain due to the sun’s varied altitudes.

Rooflights (including sunpipes) are effective because they can provide light from the brightest part of the sky, the zenith, deep into a space. Furthermore, they achieve higher daylight factors compared with vertical windows and provide a more even distribution of daylight than clerestories. They are, however, potential sources of glare, and light-coloured surrounds and reveals are recommended to diffuse the light.
Rooflight over central space at Kirchheim Little School
Light quality
A number of schools viewed on the tours achieved high levels of daylighting whilst avoiding glare. The visitors were impressed by the light and airy feel of the buildings.

At the nursery in Vanse, Norway, diffuse daylight is channelled into the rear of the classrooms. This is achieved by using a continuous band of rooflights with a reveal to avoid direct light and potential glare.

Solar gain and daylighting provision have also been finely balanced at the Steiner School at Kirchheim Teck in order to minimise the requirement for artificial lighting and to avoid the need for solar shading. The tour group were impressed that only very limited artificial lighting was required, even on a somewhat gloomy day in October.

Although the secondary school at Eilert Sund in Norway did not meet many truly green criteria, it was nevertheless felt that the building would sustain itself due to its architectural merits. The tour participants loved the light and airy spaces and the connection to the surrounding townscape (and the community) and felt that a building that was enjoyed to this extent worked well, and would continue to thrive as a community school.
In addition, the high levels of daylight throughout result in a significant conservation in artificial lighting requirement.

Whilst the tour group where generally taken with the comprehensive school at Gelsenkirchen, Germany, with its daylit spaces and bright and airy feel, it was the naturally lit library and sportshall, which particularly impressed. The library has large areas of glazing, which also provide an effective connection to the external landscape, supplemented by clerestories to achieve high levels of daylighting. The sportshall is naturally lit via glazing located above the line of sight of a ball, supplemented by borrowed light through the health centre on the upper level and diffuse light from rooflights beneath which metal grids are suspended. Both areas can regulate the amount of solar gain and avoid glare by the use of external blinds.
“I want colours” was the strong wish of a 15-year-old who, when interviewed by Burke and Grosvenor\(^{1}\) for their book ‘The School I’d Like’ described her school as ‘a magnolia prison’. This was the view taken by many children who mentioned a desire for colours, lots of them, for the school they’d like. In 2000 Maxwell\(^{2}\) found that children thought colour was important and that the colour of the walls in their school was uninviting and boring.

Whilst the children’s wishes alone should be reason enough for designers and clients to take colour seriously, various research results highlight the importance of colour in the learning environment, linking colour to productivity, attitudes and behaviour. Papadatos\(^{3}\) concluded in 1973 that colour schemes in schools would reduce absenteeism and promote positive feelings about schools. Sinfosky and Knirk’s\(^{4}\) research showed that colours affect a student’s attention span as well as students’ and teachers’ sense of time, and this was supported in 2003 by Engelbrecht’s research\(^{5}\), which suggests that the colour of the walls in classrooms affects productivity and accuracy.

Two of the German schools visited on the 2004 sustainable schools tour showed particular attention to detail with regard to colour: Pfennigäcker Nursery and Gelsenkirchen Comprehensive.

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Joachim Eble Architektur and Lasuveda, Atelier für Farbgestaltung. Original drawing showing colour scheme for Pfennigäcker with sky tones an vertical elements and red and yellow on earth-bound buildings.
“Every colour produces a corresponding influence on the mind” [Goethe]
**Pfennigäcker**

At Pfennigäcker red, the colour of childhood, serves as the active, energising colour and has been used in well-considered proportions to create a friendly house style. This is placed alongside different colours that are used to generate refreshing contrasts. For example, by using red and yellow earth tones with blue sky tones, the designer can create lifelike rhythms: like breathing in – breathing out; activity – rest; day – night. Red is used as the active, energizing colour as suggested above, whereas blue acts as the reflective colour between the sky and Earth, expressing airiness and openness and blue has also been used as a ‘colour break’.

Barbara Eble’s colour concept for Pfennigäcker is designed to support the architectural form’ using blue tones on the towers and roofs that reach to the sky, red and yellow tones on the ‘earth-bound’ buildings. Throughout the building, colour is used as an orientation aid, to provide sensual experience, to carry energy and generally as a symbol of ‘love of life’.

The stronger external colours are taken through to the internal circulation spaces where they become lighter in tone and lighter still the closer you get to the play group rooms. Thus, the colours in the corridors are stronger tones of the colours used in the classrooms, welcoming the child to his or her ‘house’. In the classrooms themselves the colours ‘retreat’ in order to give the children’s personalities the greater importance.

The colours of the linoleum floors in the classrooms correspond with the warm external and internal colours whilst cooler blue tones representing the outdoors are used for the corridor floors.
“Our world is already affected by aesthetic boredom, and it would be fatal for a school”

[Heiner Nienhaus]
Gelsenkirchen

The colour design ethos for the school in Gelsenkirchen was developed and established through workshop consultation: warm shades to create the basic mood, warm and sunny - a Mediterranean feel - even in bad weather. Green was avoided generally as a surface colour, (apart from in the chapel, where discussions with various faiths favoured this colour as being contemplative and peaceful), but is present throughout in the planting. Red was used on the ‘town hall’ element to signify its importance.

Our perception of colour becomes more sophisticated as we grow up. The choice of colours at Gelsenkirchen was influenced by the general rule of education adopted here, namely to ‘collect every child at the stage they are at’. Classroom colours have therefore been chosen according to the dominant colours associated with the pupils’ ages, whereas the colours selected for specialist rooms have been chosen to reflect the activities.

Heiner Nienhaus’s view is that colour should be applied in line with the above and to suit the architectural form, but that there is still room for the consultant to express themselves,
apply playful ideas, highlight unexpected focal points and so on. He is further of the opinion that a colour scheme must take all of the building’s surfaces and spaces into account if it is to be successful in the long run. A successful scheme will still work if single colours in the scheme are deemed ‘out of fashion’. Relationships between building elements should be visualised as ‘unity in diversity’ with a colour link. Bathing everything in a single colour, whatever the colour, would result in aesthetic boredom and should be avoided.

Different colours, textures and surfaces activate the senses. Focal points and colours act as a guide through the building, acting as a kind of colour choreography. Colour in the rooms becomes an experience in time and space.

Decoration should combine with the building to contribute to a new architecture. Paint finishes should not be regarded as a picture, a wonderful icon, but art that develops through use, through being actively acknowledged. If this is achieved, then the colouration of the school can become a pedagogic assistant. The aim should be to achieve a school that is an artistically formed utilitarian building.
The child’s right to play is recognised in Article 31 of the United Nations Convention on the Rights of the Child, which was ratified by the UK government in 1991. “States recognise the right of the child to rest and leisure, to engage in play and recreational activities appropriate to the age of the child and to participate freely in cultural life and the arts”\(^{(1)}\).

Beyond satisfying the child’s right to leisure, play can also provide the exercise that is increasingly recognised as essential if the current rise in childhood obesity and associated illnesses is to be curbed.

Furthermore, outdoor play connects children with the landscape and the weather. It gives them an insight into the environment and an appreciation of the weather which they can only gain from experiencing it. Otherwise how can we expect children to grow up with an understanding of nature if we constantly ‘protect’ them from it?

Participants on the study tours to the Norwegian and German schools were impressed at the extent to which children were given the opportunity to play outdoors, rather than shielding them from the elements. They were also impressed by the approach adopted by most schools visited, which allows children to play outside in all weathers based on the premise that \textit{“there is no such thing as bad weather – only inappropriate clothing”}, and grants them access to adventurous, even risky play equipment. In fact, they were so convinced of the positive effect this approach has that they now promote it for the schools they are involved in here in Scotland.

\begin{center}
Behnisch, Behnisch and Partner Schäfersfeld Grammar sits long and low in the landscape
\end{center}
Oserød Primary “sand river” in playground between classroom wings
“Outdoor play connects children with the landscape and the weather”
“States recognise the right of the child to rest and leisure, to engage in play and recreational activities appropriate to the age of the child and to participate freely in cultural life and the arts”

[Article 31, UN Convention on the Rights of the Child, 1991]
Further to participating in the first of the two sustainable schools trips to Norway, Gillian Ross-Pond, Depute Director of Education at Dundee City Council reported to the rest of the participants at a ‘wash-up’ workshop, that the trip has had a significant effect on the approach taken to outdoor/all weather play in Dundee. This section outlines the new approach to dealing with the weather, illustrated through a Scottish case study on Fintry Nursery.

Research indicates that while exercise enhances brain activity, fresh air and movement makes a healthy body. Young children need, and benefit from, extended periods of physical activity outdoors every day. Developing quality outdoor play is now a requirement for all Early Years Practitioners.

Fintry Nursery School grounds are extensive and provide a rich learning environment for the children. Our outdoor space comprises large areas of grass, wide-open space, mature trees and a small tarmac area. The children have the freedom to play and the opportunity to release their energy, develop their imaginations, be creative and investigate. This sounds like a wonderful curriculum resource, and it truly is. When it rains, however, grass becomes a quagmire. Ordinary shoes and clothes are just not suitable, and offer no protection. If the children are to be outside every day, regardless of the weather, they need to be suitably dressed. Although parents are asked to ensure that their children come prepared for fair or foul weather, this does not always happen. We had to find a way round the problem.

Recalling a slideshow presentation for staff involved in PPP schools sparked off the idea. The slides from Borhaug, a nursery school on the southern most tip of Norway called the Lista peninsula, showed the nursery children having fun in all weathers. Suitably dressed in sturdy waterproof suits, the children were outdoors in rain, sleet, wind or snow.

The suits, complete with wellies attached, were hosed down over a “cattle grid” after use to wash away the mud! Could this be the solution we were looking for?

After a search for suitable outdoor clothing, we purchased all-in-one waterproof suits with a fleecy lining from Outdoor Action Scotland, and haven’t looked back since. Our muddy suits are not hosed down though – we don’t have a cattle grid – we just use a traditional washing machine.

Since then we have been pro-active in our developments to create a healthy lifestyle for children and staff. Outdoor play is more exciting; the children have the freedom to walk, run, splash in puddles and make mud pies without worrying about dirtying their clothes.

Reggio Emilia\(^2\) believes that: Fostering a link with the outside environment is important because school as a place of learning and discovery cannot be seen as an island. Rather, within the school children can learn how to become full and active participators in the greater, outside environment.

“Thanks to a golden opportunity to see how Norwegian Early Years practitioners provide outdoor play in a cold climate, the learning environment at Fintry has been enhanced all year round. Our children are now able to learn on a larger and more active scale than is possible indoors. Daily exercise, fresh air and natural sunlight have had a positive impact on staff and children’s wellbeing. We continue to strive and develop the learning potential of our outside environment.”\(^3\)

\(\text{(Janice E. Rae, Head Teacher, Fintry Nursery)}\)
“There is no such thing as bad weather - only inappropriate clothing”  

[Scandinavian saying].

Fintry Nursery Children at play in all weather suits

Fintry Nursery freedom to splash in puddles
05.2
Adventure or Risk?

The German and Norwegian schools visited on the respective trips allow children to experience risk, whereby the children are not constantly shielded from dangers as perceived by adults, but are given the opportunity to decide for themselves what they are capable of, providing them with a vital tool for developing their independence.

Wherever possible, schools and nurseries provide extensive opportunity and variety for outdoor play, even, as with the Loretto Nursery School in Tübingen, where provision beyond a rooftop terrace seemed almost impossible due to the tight urban site. In this case, the client and architects entered into detailed discussions with the residential neighbours in order to develop a strategy that would allow both children and adults to share external spaces and provide communal play areas. The communal nature of these playgrounds necessitated fence-free areas, and the insurance company for the nursery was initially unwilling to insure the nursery school children under such circumstances, which threatened to jeopardise the scheme. The client took the view that learning to recognise imaginary boundaries was part of the children’s development, explaining that defining these boundaries was the school’s task. They were ultimately successful in convincing the insurance company that the children would comply with the rules and were able to provide the children with space in which to move around and develop.

Whilst the provision of communal play areas open to the public may prove difficult in post-Dunblane Britain, Loretto shows that designers and clients need to be creative to ensure that children are given adequate outdoor space in which to express themselves.

The play areas seen on the tour also showed that there is a case for being less restrictive when it comes to landscaping and play equipment in the future. In almost all of the German and Norwegian schools, a variety of play options are made available, and children are allowed to determine for themselves what level of risk they are capable of dealing with. No areas are deemed out of bounds, or fenced off, and where the school grounds include woodland areas, these are also offered for play, whether as planned or natural landscapes.

The Scottish visitors were impressed by the high quality and accessibility of the outdoor landscaping and the use of planting and ground modelling to provide a variety of spaces for children to play, exercise, learn responsibility, be creative or just be inspired – hillocks, walls and frames to climb, sandpits and ‘building sites’ to work in, ‘jungles’ to explore, gardens to tend. Outdoor play is seen as a significant part of the child’s development and is given the same importance as the internal teaching spaces.
“...learning to recognise imaginary boundaries is part of children’s development”
“Children need to play in order to develop active minds and bodies”

[Brian Hemming, Estate Strategy Manager, Highland Council, and tour participant]
Ian Cameron Kjeldås adventure playground among trees

Ian Cameron Vanse playground in natural landscape

Plus + Bauplanung Gardens at Gelsenkirchen

ADVENTURE OR RISK?
The schools tour to Norway was originally conceived for the purpose of investigating the design approach taken there, however, it soon became apparent that it was not the design approach alone, but also the operation of the buildings, combined with a variety of other factors relating to day-to-day activities and the running of the schools, which resulted in successful and sustainable projects.

Leadership
The extent to which head teachers show leadership appears to be at the forefront of the non-building related factors that have a lasting impact on the success of the schools. The head teachers who displayed vision, commitment and the ability to guide others, have managed to create a distinct sense of community and an atmosphere of learning, which is crucial to the overall success of the schools (see also 07 Procurement).

Gelsenkirchen is one of the 17 towns in Emscher Park area that were given the resources to undertake an iconic regeneration project. At Gelsenkirchen Comprehensive, the Client, the Protestant Church of Westphalia, showed vision in deciding to use the opportunity to host a competition for the design of a new comprehensive school that would provide a boost to the existing and proposed adjacent residential areas in educational, social and urban development terms. This vision was supported, and driven by the first headteacher who was already in position in the existing school, and who was determined to create a school that provided a ‘house for living and learning’. In other words, a school that would help to balance the hardship that some of the pupils might be experiencing at home and which provided them with a stable base from which to develop. Although this headteacher has now left the school, his replacement shows the same dedication and enthusiasm. The current headteacher impressed the visitors with his sense of pride in the school. And in spite of the fact that he was not involved in the initial stages of the original campus design and construction, he has been involved in subsequent phases, but did not appear to differentiate between any of these. He is clearly keen to continue the work of his predecessor by providing a community school that benefits the neighbourhood as a whole and of which the area can be proud. His pride extended to showing two visiting groups around the building on a bank holiday, eager to demonstrate what has been achieved. His enthusiasm and the presence of school children in the building, in particular using the library on a holiday, convinced the Scottish visitors of the success of this school.
Similar commitment was experienced at Borhaug Senior, where strong leadership from the head teacher, with a clear pedagogic philosophy and a determination to link strongly with parents and the rest of the community was visible. This was also found to be the case at Eilert Sund Secondary, Vanse Primary, and Oserød Primary (see Case Studies in Volume 1).

It was clear to all those attending the visits that even where sustainable buildings had been provided, it was the guidance of the head teacher that maintained and ensured the long-term sustainability of the schools.
Child-centred learning

The design of both the Norwegian and German progressive schools was responsive to a general pedagogic approach of self-directed learning, in which pupils are given their daily tasks and then as they progress through the school, are given ever increasing amounts of freedom to decide on the most appropriate work space for themselves. The buildings support this approach by providing a variety of spaces for children to choose from – ranging from areas within the classroom or the library to break-out spaces elsewhere in the school – allowing them to make their own decision as to where they feel most comfortable and where they can concentrate best.

The classroom is seen as a base from which the children can develop, providing them with a strong sense of stability and security that allows them to break-out and work independently – but always safe in the knowledge that they have a haven to return to. This is further supported by the attitude to child-centred learning, which requires the teachers to move around and allows the children to remain in their classrooms.
“Every child has three teachers: the other children, the teacher and the space”

[Swedish saying]
Some of the German schools, notably Pfennigäcker Nursery and Gelsenkirchen Comprehensive, reflected this approach externally in the design by providing ‘class-houses’, which provide a single base for the children/ pupils for the duration of their education, and which not only provide a space within which children are taught, but also a place they can feel ‘at home’ in, and where they learn responsibilities and independence.

**Gelsenkirchen**

Class-houses at Gelsenkirchen comprehensive are built as terraced houses, with no internal connection to the main building, and complete with individual external entrances, WCs, lobby areas and gardens. Pupils remain in one house for the duration of their education here and are responsible for maintaining their own WC, lobby and garden areas.

Each class is also taught in tandem by the same female/ male team for the first six years, with the two teachers working in close collaboration with the children’s parents or guardians, further strengthening the sense of stability with pupils who may lack this kind of support at home.

The Protestant Church of Westphalia, concerned about the high unemployment and associated social problems in the Gelsenkirchen area embarked on the project of building a new school with the aim of “establishing a comprehensive school in an area with particular need for regeneration, that would set a sign of hope and help to prepare young people to deal with the urgent problems of our day”. The church committed itself to a special progressive educational approach: The four letters “F E L S” (in German: “rock”) create the symbol for the concept that can be characterised in the following way:

- as a ‘family school’ it does not aim to compete with the pupils’ homes, but attempts to establish a family-like atmosphere in which the children and teenagers feel at home;
- as an ‘educating school’ it tries to set a course against a culture of indifference, therefore giving equal attention to the forming of the character and the acquisition of knowledge;
- the term ‘lifeschool’ refers to learning concepts that integrate music, theatre, crafts, sport, games, and annual school trips into the regular lessons.
- finally, it is also a ‘school for the quarter’, linked to its local surroundings in Gelsenkirchen-Bismarck in a variety of ways.

**Plus + Bauplanung**

‘Class-house’ Gelsenkirchen

‘Individual class-houses at Gelsenkirchen linked by internal street’
**Borhaug**

At Borhaug Nursery the ethos of the school is set out, and displayed on the wall in large letters at the entrance, in a set of explicit principles, which were derived together with the children – again displaying an approach that is centred on the children and their needs.

**Borhaug Nursery School Aims and Values:**
- each child should have a friend in the nursery;
- every day should be filled with play, humour and joy;
- children have the right to share in decision making about the daily life in the nursery;
- each child should be heard and seen in the course of the day;
- all should learn courtesy together;
- children should master new challenges;
- respect should be shown to all to avoid bullying or ostracising of individuals;

Although only one school (Kirchheim Unter Teck) visited on the tours consciously adopted the Rudolf Steiner teaching methods, which allow each pupil to develop at his or her own speed, and emphasise an integrated approach to learning about oneself, one’s relationship with, and responsibility to others and the surrounding environment, it seemed that most of the schools had a similar approach. Whilst other schools didn’t give the arts a central role as the Steiner school does (in line with its philosophy of learning by doing), what was significant was that they all viewed the school day holistically and didn’t appear to consider any tasks to be insignificant. All tasks – at Gelsenkirchen even the cleaning of the WCs - are considered beneficial for a child’s development and understanding of the immediate and wider environment and, as such, are integrated into the curriculum.

*Plus + Bauplannung* Kirchheim Unter Teck, learning about the environment as part of the curriculum
06.2
School food

The catering arrangements in Norway were different from those found in Scotland: not only did pupils prepare their own sandwiches for the short breaks, but in some cases they also organise their own lunches, making use of an open school kitchen and dining area. All menus were based on the principles of healthy eating and the schools appeared to be devoid of fizzy drinks as well as crisps and sweets.

In Germany, children do not generally stay at school over lunch. Quite frequently their school day finishes at lunch time with school starting at 7.30 - 8am. However, where children are still in the care of the schools, (e.g. at Kirchheim Teck, where after-school care is offered to accommodate working parents, and at the Loretto Nursery where children are also looked after during normal working hours), a similar attitude to that of their Norwegian counter-parts was apparent. At the Steiner School pupils cook their own lunch in the school kitchen, helped by those parents who are able to make time.

Even the Loretto Nursery involves the children in the cooking of their own lunches, something the Scottish visitors thought would be problematic in schools here in Scotland due to health and safety fears and regulations. Nevertheless, involvement of children in making food should be considered and the benefits of allowing children to participate in the preparation of their meals should not be underestimated. What was apparent at all of the schools/ nurseries where pupils were involved in cooking and preparing food was that eating is seen as part of the school day, and not just a feeding break between lessons. As with every other activity in the school, including lessons, it is part of the whole learning experience and as such is given due recognition. Cooking and eating together achieves more than just satisfying the children’s hunger built up over a morning’s work. It allows them to interact, work as a team, experience responsibility, develop a sense of time and timescales, and simply learn about healthy food – something which could have a considerable impact here, given our nation’s obsession with ready-meals and apparent lack of knowledge when it comes to preparing food from scratch. Recent statistics show that one in in five of 12 year olds in Scotland is clinically obese.
“Scotland’s children are our future and we must offer the building blocks that will help them make healthier choices”  

[Rhona Brankin, Deputy Health Minister, 2005]
It became apparent on both the tours that continued community involvement plays a significant role in the overall success of the schools and nurseries. At Farsund in Norway the conscious decision was made not to relocate the new extension for Eilert Secondary School to the town periphery, but to remain in the centre of town and extend the existing school – despite the tight site.

The result, although not the most ecological school, (this wasn’t part of the brief) is a school that impresses through its community integration. Not only are library and meeting room spaces open to the public, but the school also provides business opportunities for the local population, of all age groups, as well as access to its sports facilities out of school hours.
The comprehensive school at Gelsenkirchen takes a similar approach, aiming to be a meeting place, a cultural centre, open and linked to the local community and a signal of hope in an area dominated by depression. In addition it enables former pupils, who for the duration of their education are made to feel ‘at home’ in the school, to retain a connection to the place that provided them with a stable base for a significant number of years.

The Steiner school at Kirchheim Unter Teck is not a community school and as such does not provide facilities for the local community. Recognising the importance of community involvement, however, the school is eager to encourage parent participation in both management and day-to-day maintenance. The chosen management form of the school is a cooperative comprising the staff, parents and pupils, who elect a management board for a 4-year period. Whilst the board takes responsibility for the management, remaining Cooperative Members are involved and consulted through general meetings. Parents and older pupils are also responsible for cleaning the classrooms as well as preparing lunches for children taking after-school care. Apart from minimising running costs – a benefit to the parents who have to contribute to the upkeep of the privately run school – the involvement is seen to connect the parents to the school their children attend.
Whilst the Loretto Nursery does not offer community facilities, it promotes integration by sharing external spaces with direct neighbours as well as the general public. Allowing the children to play in areas used by the community blurs the boundaries between ‘us’ and ‘them’. The children are taught imaginary boundaries, within which they are to remain for their own safety, but they are not cordonned-off and the children and the public mingle.

It seems that the personal connection with the schools that extends beyond the pupils themselves is key to the long-term success and sustainability. Rather than being an unknown (and subsequently viewed as a difficult, even nuisance), neighbour, the schools are regarded as part of the community and as such are valued and cared for – as highlighted by the youth centre in Stuttgart Stammheim, which, due to its community involvement, has experienced no vandalism in the thirteen years it has been operating. Furthermore people of different cultures, generations or religions, or possibly all three, who may otherwise not meet, are brought together and have the opportunity to connect, and at the very least develop an awareness of one another.

Whilst the visiting group expressed concerns relating to the relaxed attitude to accessibility by all the community into school and nursery grounds (lack of fencing or any perimeter separation) the benefits of involving, even serving, the wider community are clearly demonstrated in the schools visited. The extent and nature of community involvement may have to be refined to suit schools here in Scotland, but community participation in some form should be provided if we are to experience the benefits of integrating our schools into the community rather than providing educational ghettos.

Chris Morgan Community Library at Gelsenkirchen Comprehensive
Procurement

Range of procurement methods

Three different methods of procurement were in evidence in the schools visited on the tours, and although the procedures employed in Norway and Germany do not correspond exactly to equivalent circumstances in the UK, they were close enough to be recognisable under familiar UK terminology.

These are as follows (see also Table 1):
• Traditional - design team led with traditional tender.
• Design Competition – mostly with traditional tender.
• Contractor led by -
  a) PPP/ PFI equivalent;
  b) Design and Build (novated design team at tender stage).

Half the schools visited were procured by traditional means, a quarter by competition (with traditional tender), a quarter by contractor-led means and one, Kvadraturen, following a design competition.

In terms of the perception of the schools by the study group:
• all of the traditionally procured schools were well received;
• half of the schools procured by design competition were reviewed well, and half reviewed poorly;
• only one of the contractor-led schools (Oserød) was well received – the rest reviewed poorly.

In a previous Scottish Executive publication on Sustainability the issue of the impact of disruption or severance in the procurement process was discussed. This can result in a period of uncertainty during which the ‘green baton’ may be dropped.

<table>
<thead>
<tr>
<th>Approx rating</th>
<th>School</th>
<th>Procurement method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kirchheim</td>
<td>Traditional</td>
</tr>
<tr>
<td>2</td>
<td>Borhaug (N)</td>
<td>Traditional</td>
</tr>
<tr>
<td>3</td>
<td>Pfennigäcker</td>
<td>Traditional</td>
</tr>
<tr>
<td>4</td>
<td>Farsund</td>
<td>Design Competition</td>
</tr>
<tr>
<td>5</td>
<td>Gelsenkirchen</td>
<td>Design Competition</td>
</tr>
<tr>
<td>6</td>
<td>Kjeldås</td>
<td>Traditional</td>
</tr>
<tr>
<td>7</td>
<td>Vanse 1</td>
<td>Traditional</td>
</tr>
<tr>
<td>8</td>
<td>Oserød</td>
<td>Design/build (Novtd)</td>
</tr>
<tr>
<td>9</td>
<td>Borhaug (Snr)</td>
<td>Traditional</td>
</tr>
<tr>
<td>10</td>
<td>Schäfersfeld</td>
<td>Traditional</td>
</tr>
<tr>
<td>11</td>
<td>Loretto</td>
<td>Traditional</td>
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<tr>
<td>12</td>
<td>Pliezhausen</td>
<td>Design Competition</td>
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<tr>
<td>13</td>
<td>Oddemarke</td>
<td>PPP</td>
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<td>14</td>
<td>Herne</td>
<td>Design Competition</td>
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<td>15</td>
<td>Vanse 2</td>
<td>PPP</td>
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<tr>
<td>16</td>
<td>Hechinger Eck</td>
<td>Design/Build (Novtd)</td>
</tr>
<tr>
<td>17</td>
<td>Kvadraturen</td>
<td>PPP</td>
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</table>
Taking this risk together with the observations made by the study group in terms of the impact of the procurement route on the success or otherwise of this limited sample of schools, it is not possible to arrive at the conclusion that one method of procurement will inevitably lead to better results over another. However, there does appear to be an indication that certain routes seem to have a better chance of success than others (see ratings table 1). This, therefore, represents a significant challenge to contractor led projects, whether in Norway, Germany or Scotland.

Community involvement
One consistent factor in the most successful schools was the extent of community and parental involvement. Those projects with the greatest amount of pre- and post-design and construction stage involvement performed better and were generally more evidently ‘sustainable’ than those where this had not been the case. High levels of involvement were evident in Kjeldås, Oserød, Vanse phase 1, Borhaug, Pfennigäcker, Kirchheim Teck (where a cooperative client was formed comprising school staff, pupils and parents) and Gelsenkirchen Comprehensive.

Including community involvement is important for a number of reasons:

- It can broaden the community’s horizons and provides experiences – in some cases hands-on – to which they would otherwise not have access.
- Building together improves the sense of community and is particularly valuable in areas such as Gelsenkirchen, which is part of an industrial area in decline dominated by a sense of depression and in need of positive influences.
- Involvement in the building process, whether it be in the design, or the construction, or both, provides those involved with a sense of pride and ownership – a sense that is passed on to friends and family and even down the generations.
This was particularly apparent at a youth centre visited in Stuttgart Stammheim. The local youths were heavily involved in the design and construction of the centre 13 years ago and those involved have long left, but the sense of ownership remains. Today’s youths all know somebody who was involved at the time and through this feel that they themselves were involved. The result is a centre which is used extensively and has no problems with vandalism.

**Gelsekirchen**

At Gelsenkirchen Comprehensive participation was a central part of the development – from design through construction to post occupation. Design basics were integrated into lessons such as physics and maths or art. Pupils learnt about human dimensions and space requirements by drawing and building scale models of themselves based on measurements carried out on one another: how far can we reach and how much space do we need when standing and sitting? They worked out what furniture was required and how much space it would need.

The architects also taught them about spatial relationships:
- how to get from one room to another;
- relationships between indoors and out;
- and about timber construction;
- how far a joist can span;
- where posts or columns are required, and so on.

Equipped with these design tools, the children were involved in design workshops to formulate their aspirations for their future school-village and to design their class-houses and other spaces. The result is a school that impresses through its positive feel, particularly as it is set in an area generally dominated by negative attitudes. The building provides a sense of home, aided by the attitude to teaching, which requires the teachers to move around and allows the students to stay in their class-house for the duration of their education, thus providing a sense of stability that may be lacking at home.
The arrangement of the class-houses enables students to take responsibility and interact with their environment – each class has a garden and a lobby with WC, which is maintained by the students themselves. The involvement of the wider community and incorporation of community facilities has resulted in the building being an integral part of the area, with the students maintaining involvement once they have left the school.

**Pfennigäcker**

In Stuttgart, the Education Department decided that all of the children at Pfennigäcker Nursery – those visiting the crèche and the after-school centre included – should be involved in the build process of the new building. No one had any experience of this and no one quite knew how to go about such an exercise, but the general consensus was that the children should actively experience the development of the new building and the resulting changes in their daily surroundings from the demolition of the old building to the move into the new one. Workshops with the children were held on site, fitted into the daily routine of the Nursery.

The aim of involving the children was to:

- let them take part in the forming of their environment;
- enable them to realise their strengths and limits;
- learn about different professions and what they involve;
- build their self-confidence;
- deal with changes and reduce fear;
- enjoy participation;
- increase sense of value and sensitivity, and simply;
- to activate their senses.

As the project and the workshops progressed and teachers learnt what was possible, the children's input and active involvement increased. The process showed that children could also be involved throughout the construction period. Even site visits are possible, if all involved work together.
This book makes extensive use of the Sustainable Construction CPD modules by Gaia Research

Indoor air quality
(2) Only 43% of high production volume chemicals have been tested for potential human toxicity, only 7% have been tested for their effect on children’s development Chemical Hazard Data Availability Study, U.S. Environment Protection Agency.


The Consumer Product Safety Commission has noted that one phthalate formula common to certain building materials - DINP - is a mixture of up to 100 chemical variants, of which only five have been minimally studied: “Aggregate Exposures to Phthalates in Humans,” Health Care Without Harm, July 2002. www.noharm.org/library/docs/Phthalate_Report.pdf, p.16, footnote 149 (DINP: Diisononyl phthalate, a general use vinyl plasticizer. It is the primary plasticizer used in vinyl toys, though it finds many other applications such as garden hoses, shower curtains, vinyl flooring and wall covering. Source: www.phthalates.org
(3) Fanger PO (1988) Introduction to the olf and decipol units to quantity air pollution perceived by human indors and outdoors. Energy Buildings 12:1-6
(5) Volatile Compounds Originating from Mixed Microbial Cultures on Building Materials under Various Humidity Conditions. Anne Korpi, Anna-Liisa Pasanen, and Pertti Pasanen. Department of Environmental Sciences, University of Kuopio, 70211 Kuopio, Finland

Humidity
(1) Sustainable Construction CPD Module 6/15, Ventilation and Cooling Strategies by Gaia Research

Material specification
(2) PVC: An Evaluation Using The Natural Step Framework. TNS in conjunction with the Environment Agency, supported by a co-ordination group comprising representatives of major retailers and the two UK PVC manufacturers explore the place of PVC in a future world. Published July 2000.
(4) Pre-term births: Latini, G, C de Felice, G Presta, A del


(7) London Hazard Centre


Ventilation
(2) www.gaiagroup.org/Research/RI/DI/index.html

Daylighting
(2) Understanding daylighting in Sportshalls by Gaia Research for SportScotland: http://daylight.sportscotland.net/


Colour
(6) Barbara Eble is the principal of Lasuveda, Atelier für Farbgestaltung, colour consultants for Pfennigäcker Nursery, http://lasuveda.de/leitged/haupt.html

Landscaping and Play
(1) Article 31, United Nations Convention on the rights of the Child
(2) The Reggio Emilia Approach to Early Years Education pg12.
(3) Janice E. Rae, Head Teacher, Fintry Nursery School, Dundee
Further reading, advice and information

GENERAL
BRE webpage on building better schools;
www.bre.co.uk

Building Bulletin 87 -
Guidelines for Environmental Design in Schools;
Free download available at www.teachernet.gov.uk/management/resources
financeandbuilding/schoolbuildings/designguidance/sbenvironmentalhs/
energy

Design Advice Service
Design Advice offers professional, independent and objective advice on energy
efficient and environmentally sound building design. Initial design consultancy
is free - further consultancy, with partial funding, may be available.
www.thecarbontrust.co.uk/energy/pages/page_67.asp

Client Advice Guides
Series of client guides by Gaia Research for SUST.
www.sust.org

Centre for Alternative Technology (CAT)
The centre provides information on a wide range of issues and offers a free
information service as well as providing consultancy services.
T: 01654 702 400
www.cat.org

AECB (Association for Environment Conscious Building)
Set up to increase awareness of sustainability within the construction industry,
the association covers a wide range of expertise from architecture to specialist
sub-contractors. It produces a publication listing the range of services available
from members. www.aecb.net

INDOOR AIR QUALITY – GENERAL
www.excite.co.uk
Online directory providing links to other websites with information on indoor air
quality.

‘An Integral Solution for Ventilation, Health and Energy’
Free download of this Dutch report is available at:
hybvent.civil.auc.dk/puplications/paper%20met%20kaft-scherm.pdf

Transsolar
Climate consultants for Steiner School at Kirchheim Teck and Gelsenkirchen
Comprehensive.
www.transsolar.com

INDOOR AIR QUALITY – HUMIDITY
Passive Building Design, A Handbook of Natural Climatic Control. N.K.
Bansal, Indian Institute of Technology, New Delhi, India, G. Hauser, G. Minke,

Indoor Air Quality and Mol Prevention of the Building Envelope. Roger
Morse, AIA and Don Acker, PE Morse Zehnter Associates.
www.wdbg.org/design/env_iaq.php?print=1

INDOOR AIR QUALITY – MATERIALS
3394 8

GreenSpec
Free online service providing useful information on building materials (eco
ratings etc) and sustainable alternatives (together with specification sections).
www.greenspec.co.uk

Green Directory
Scotland’s on-line database of indigenous, ecologically benign materials,
products and related services.
www.sust.org/directory

Sustainable Construction CPD Module 1/15, Materials Selection, ISBN 1-

VOC emmissions
Free download of information leaflet available at:
www.bre.co.uk

Brettstapel
For those who can read German; a free download on the Brettstapel system
(Reihe 1, Teil 17) is available at:
www.informationsdienst - holz.de

London Hazard Centre
The hazard centre has an online library providing information on materials.
www.lhc.org.uk

Rematerialise
Online directory of recycled materials. www.kingston.ac.uk

Handbook of Sustainable Building: An Environmental Preference Method
for Selection of Materials for Use in Construction & Refurbishment.
The Natural House Book
Pearson D., 2000, Gaia Books
www.snf.se/snf/english/chemicals.htm
Website providing information on REACH = Registration, Evaluation, Authorisation and restrictions of Chemicals.

INDOOR AIR QUALITY – VENTILATION
Building Integrated and Hybrid Ventilation Website
(partly in English) providing information on Norwegian Buildings with hybrid.
www.byggforsk.no/prosjekter/hybvent
(in Norwegian and English)

The Gaia Group
For information on dynamic insulation go to:
www.GaiaGroup.org


Natural ventilation in non-domestic buildings


AIRTIGHTNESS
Airtightness in commercial and public buildings
B C Webb, R Barton, Sep 3, 2002,
Report providing information on designing and testing for airtightness. Availabe from BRE as hard copy or pdf. www.brebookshop.com

An Airtight Case for Green Building
Article from the Green Building Bible on airtightness available online at:
www.newbuilder.co.uk/archive/airtight_building.asp

A number of companies offer advice, consultancy and testing services:
STROMA Technology, Wakefield, www.airtightness-services.co.uk
BSRIA Ltd, Bracknell, Berkshire, www.bsria.co.uk

DAYLIGHTING
Lighting and Daylighting: Sustainable Construction CPD Module 2/15,
Sandy Halliday.
T: 0131 558 7227

Understanding daylighting of sports halls
Gaia Research for SportScotland Available free online at:
http://daylight.sportscotland.net/

Lighting – expert advice for designers, owners and building managers
BRE information leaflet available to download at: www.bre.co.uk

Lighting Design for schools: Building Bulletin 90
ISBN 0 11 271041 7, January 1999
The Stationery Office

http://www.brebookshop.com

DETR GPG 245/1998 Desktop guide to daylighting - for architects. Guidelines available free online:
www.cibse.org/pdfs/GPG245.pdf

Designing Buildings for Daylight
Bell J & Burt W., 1996 , BRE.

CIBSE Daylighting and Window Design
LG10:1999. £33.00 members - £66.00 non-members.

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F: 0049-7553/96704
http://color-blau.com

PROCUREMENT
Sustainability, Building Our Future: Scotland’s School Estate, Scottish Executive

Children make their school
The book describing the design process at Gelsenkirchen Comprehensive.
Peter Hübner, ISBN 3-932565-52-5

The Green Guide to the Architect’s Job Book
The process guidance which underpins development of the Sustainable Construction CPD. Halliday S.P., RIBA Publ. Available from Gaia Research,
T: 0131 558 7227, F:0131 558 7337

FURTHER READING, ADVICE AND INFORMATION
Credits

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Commissioned by: The Scottish Executive, Eileen Gill
Head of School Estate Branch

Edited and facilitated by: Sust. The Lighthouse on Sustainability
www.sust.org

Publication design: Skratch, Glasgow
www.skratchdesign.co.uk

ISBN: 1-905061-08-0

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Text the authors
Images the listed bodies
The publication the publishers

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