Contents

Acknowledgements ........................................... iii
Introduction ................................................. iv

Chapter 1
Overview of the current situation .................... 1

Chapter 2
Health aspects of the school environment .......... 14

Chapter 3
Objectives for a healthy school environment ....... 19

Chapter 4
Recommendations .......................................... 31

Appendix A
Case studies ................................................. 35

A1. What makes a school different?
    Madras, India ........................................... 35

A2. A school for a growing population:
    Bogotá, Colombia ...................................... 37

A3. Schools made by people:
    Kenya ................................................... 40

A4. A school in a warm, humid climate:
    Viet Nam ................................................. 43

A5. Schools in a hot, dry climate:
    Rajasthan, India ....................................... 45

A6. A school in a cold climate:
    Hunza, Pakistan ....................................... 49

A7. Schools at a high altitude:
    the Altiplano, Bolivia ................................ 52
Appendix B
Technology options for environmental sanitation

Appendix C
How to carry out an audit and action plan

Appendix D
References

Appendix E
Bibliography

Index
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Introduction

More children than ever before are attending school, and for longer periods in their lives. Therefore schools in virtually every nation could do more than any other single institution to improve the well-being and competence of children and youth. Yet the evidence suggests that schools around the world have difficulty meeting critical physical, mental, and social health needs of children and youth.¹

"Schools could provide the most cost-effective means to improve the health of children and thus to advance social and economic development".¹

The health and well-being of children is a fundamental issue in education. Indeed, active promotion of health is now seen as a priority for schools. The level of concern is illustrated by the fact that WHO has set up a Global School Health Initiative. In countries around the world, the issue is being addressed through school health services, health education and school meal programmes. Although the physical environment in schools is now seen as one of the major elements of health promotion, relatively little work has so far been done on the relationship between this physical environment and the health of schoolchildren, particularly with relevance to schools in low-income communities. This document attempts to fill that gap.

It must be stressed, however, that this is not a manual. There have been numerous attempts to write manuals on school construction and furnishing. In reality, however, the underlying problems often persist irrespective of the designs used. The problems and the solutions, on the whole, are not to be found on the architect's drawing-board. Nor is this an epidemiological study. Most of the health problems of children – and their causes – are well
understood, not only by doctors but also by teachers and the children themselves. The real issues relate to the attitudes of teachers, children and communities to the shared resource that is their school.

In this document, rather, we attempt to highlight some key issues and give pointers to some simple achievable measures which can be taken by communities and local governments themselves.

A large number of schools in numerous countries was visited for the purpose of preparing this report. All the examples mentioned in the text, unless otherwise stated, were visited by the authors. The visits revealed that the health problems of school-age children are governed by a wide range of factors, some of which are specific to particular locations. In one school in Costa Rica, for example, health problems were reported to be overwhelmingly respiratory and eye infections. The school was for the children of workers in a banana plantation and located in the heart of the plantation. Consequently, the school and the children were regularly sprayed with insecticide from the plantation's aircraft. Another school visited, in Thailand, was next to a rice-processing plant. During the four months of the milling season the school buildings and grounds were permanently covered in fine dust. Not surprisingly, the prevalent health problems were respiratory and skin ailments. Cases such as these demonstrate that there is a limit to what can be achieved for children's health by improving school design per se. Most importantly, healthy children require a society which is committed to creating a generally healthy environment.

Beyond the problems particular to specific locations, certain trends are discernible which relate to general levels of prosperity. In the poorest communities the most prevalent health problems include helminth infections, gastrointestinal diseases, trachoma and acute respiratory infections. In some places, almost all children suffer from helminth infections. In more prosperous communities, health problems among children increasingly relate to inappropriate diet, particularly dental caries but also obesity. In some emergent economies there also seems to be an abnormal number of eyesight problems. (It may be that the poor lighting conditions found in so many schools
in developing countries are contributing to this problem.) In wealthy countries, asthma and other ailments related to allergies are a growing problem and may be associated with building construction and operation. The focus of this document, however, is on the problems faced by schools in poor communities.

This document sets out not to prescribe solutions but to identify the key objectives for achieving a healthier school environment. To do this it aims to:

- raise awareness and understanding of the health impact on children of the physical environment of primary schools;
- increase the priority given to developing environments in primary schools that promote health;
- define areas where interventions are feasible and suggest what can be done and how, particularly under difficult conditions and within severe budgetary constraints.

Chapter 1 provides an overview of the current situation. It points out that, up till now, programmes of school construction and recommendations for school design have generally focused on developing standard designs. It concludes, however, that experience has taught us some key lessons: that good design is not enough; that standard designs assume standard conditions; that schools are more than just classrooms, and that the greatest need is to improve existing schools.

Chapter 2 reviews the main correlations between the physical environment in schools and the health of schoolchildren. It concludes that, for most schools in low-income communities, the biggest scope for health-related improvements lies in the areas of water and sanitation.

Chapter 3 identifies eight key objectives which if met will go a long way towards achieving a healthier school: committed and informed people; a faecal-free environment; safer drinking-water; convenient handwashing facilities; well-lit learning spaces; protection from the elements; structural safety, and adequate cleaning and maintenance.

In particular, it is emphasized that decisions on the design and use of schools must be made locally. The key is to
provide local decision-makers such as teachers, parents and local politicians with the information necessary to make those decisions. The decision-makers need to develop a commitment both to bringing about change and to sustaining that change. In addition, they need knowledge about the technical options available for solving the problems they face.

The concluding chapter recommends a shift in focus in four principal and strategic areas:

■ away from buildings and towards adequate services, particularly water and sanitation;
■ away from classrooms and towards total school environments;
■ away from design and construction and towards operation and maintenance;
■ away from central regulation and towards local motivation and ownership.

The case studies in Appendix A illustrate some of the low-cost and innovative techniques which can be employed to improve health in schools. Appendices B and C contain practical information about available technology and about planning for change.
Overview of the current situation

By the year 2000 there will be over 1400 million children between the ages of 5 and 14 years, approximately 87% of whom will be living in developing countries. Children in this age group are 14 times more likely to die between their fifth and fifteenth birthdays than their age-mates in the industrialized market-economy countries.(3)

It is widely recognized that schools can play an important role in promoting society’s health. Much effort has been invested over recent years in health education techniques for schools in low-income communities, including child-to-child methods, curriculum development, and the production of locally appropriate education materials. However, the impact of the actual fabric and management of school premises on child health has been relatively neglected. Many schools fail to provide healthy environments for their pupils. Poorly designed and maintained schools can be a source of disease and ill-health. Sick children also make poor learners.

Characteristic problems

While there is no such thing as a typical school in a developing country, certain characteristics will be familiar to many observers. These include:

- overcrowded classrooms, designed for 25 children but catering for 50 children, under one overworked teacher;
- little or no furniture, with what there is in poor repair;
- darkness due to too few windows or windows that must be kept covered with shutters to keep out the sun or wind, and no electricity;
- dilapidation due to lack of maintenance, with disintegrating floors, broken doors and windows, and holes in the roof;
- no water supply, or an intermittent or inadequate supply;
- toilets which no longer work and grounds littered with faecal material;
- toilets which may work but which are padlocked since there is no water for flushing or because the children are not trusted to use them properly;
- schools where everything that can be stolen has been taken;
- underpaid, undertrained teachers who often have to travel long distances to work;
- lack of accommodation for staff;
- an absence of blackboards, school books, writing materials for the children, and didactic materials for the teachers;
- girls kept away either permanently or every month, during their periods, because decent and private sanitation facilities for them are lacking.

It is tempting to suggest that all these problems are the products of poverty and that the answer is simply more money. Many developing countries can boast showpiece examples of good, clean, well-equipped schools – schools with in-house health services, pristine washrooms, well-tended grounds, and well-trained teachers working in classrooms equipped with computers, televisions and videos. For the lucky few these model schools are undoubtedly delivering a high quality of education in an environment conducive to physical and mental health. Where both money and focused attention is available, such things are possible. And there is no doubt that education does merit a larger share of the world’s resources. But the evidence suggests that, aside from these showpiece examples, simply throwing more money at the problem does not necessarily result in sustainable solutions. Many examples exist where well-intentioned governments and donors have made significant investments in new and improved schools but with disappointing results.

**The drawbacks of standard designs**

Many countries, with the assistance of international aid, have focused on developing standard school and classroom designs. Yet results have often been poor either because
their authors did not recognize that conditions on the ground are not standard, or because provision for complementary aspects such as water and sanitation facilities, security, furniture and maintenance were neglected. These points are illustrated by the following brief examples.

In one South American country in the 1970s a standard design for a rural classroom was developed which used a steel frame, concrete-block walls and asbestos-cement roofing sheets. The windows were large unglazed openings running the length of the room, on both sides, under a widely overhanging roof. The design was intended to maximize cross-ventilation in hot, tropical conditions. The design worked reasonably enough in the hot lowlands, but was also used for villages in the Andean highlands, for whose extreme mountain climate it was totally unsuited. When the sun shone, the thin roofing sheets heated up excessively. When cloudy, the lightweight construction and unglazed windows soon led to extreme cold. When windy, dry dust was blown into the classrooms making conditions intolerable. Elsewhere, the overhanging roof was useful for preventing overheating – provided the room was correctly orientated. But often the builders of the schools placed the classrooms with no consideration for correct orientation, rendering this design feature useless.

In the former Soviet Union the tradition and ideology of centralized planning led to the use of standard designs in many areas of social infrastructure, including schools. Designs which were prepared for the temperate conditions of eastern Europe found their way to Siberia and central Asia. In the Pamir mountains, at the extreme south of the
former Soviet Union, schools were built in communities at altitudes exceeding 4000 m using these standard technologies. In one school with 1000 pupils, all the flush toilets froze and broke down every winter. Since the break-up of the Soviet Union, resources for repairs and basic maintenance have become unavailable. None of the toilets works. The staff and students of an apparently modern, three-storey concrete school have to defecate in appalling covered compounds which serve as public toilets outside the school grounds.

In the town of Khorog, the capital of the region of Gorno-Badakshan in Tajikistan, the severe winters led to the destruction by frost of all the toilets in the school.

In a west African country the World Bank financed a programme to design and build classrooms for secondary schools across the country. A standard design was used which employed a high specification, including such items as suspended ceilings and well-equipped laboratory benches. When all the schools were visited, five years after their construction, a consistent picture emerged. In rural areas the classrooms were in good, in some cases immaculate condition, with pictures on the walls and flower-beds outside. A pristine classroom was a matter of communal pride. Yet in urban schools, built at the same time to the same design, every fixture had been stripped. Suspended ceilings were gone, window and door frames systematically removed, and every pane of glass and light fitting smashed or stolen. Elsewhere in Africa examples exist of schools built with foreign aid, with sewered WCs and washbasins but no water.
In Banjul, capital of the Gambia, well-appointed classrooms built by a World Bank-funded project were rapidly vandalized and stripped.

In Central America, as in many other areas, there is a legacy of well-built schools dating from colonial periods of the late 19th and early 20th centuries. Often these old buildings continue to form the backbone of the educational infrastructure. In one such school, the main health problem was reported to be injuries such as broken arms and twisted ankles. It emerged that these were caused by children falling through the wooden floors. The floor joists and floorboards were 60 to 70 years old and simply disintegrating. Yet while the very fabric of the school was collapsing in one area, a new air-conditioned computer room containing 20 computers was operating in another.

A well-built but now old school in the suburbs of San José, Costa Rica, is becoming hazardous due to rotting floorboards.
In the Indian state of Rajasthan the indoor environment of thousands of schools is effectively unusable. The schools were built for a hot, dry climate. Yet Rajasthan's desert climate means that for most of the year mornings are extremely cold. In order to keep warm, teaching is therefore often conducted out of doors.\(^3\)

![A village school in Rajasthan, India. Students and teachers are often more comfortable outside than in a chilly classroom.](image)

The first two examples show that, while standard designs may have their place, people must be aware of the limitations imposed by differences in climate. The west African example demonstrates that building model classrooms is not enough: the social context must also be understood and, where necessary, steps taken to protect the school fabric, both through physical protection and by building up civic responsibility. The Central American example reminds us that simply building good schools is not enough. The elements of a building have a limited life and provision must be made for repairs and replacements. The Indian example underlines the need to think of the total school environment, not just the classrooms.

For each of these examples, we do not need epidemiological evidence to conclude that a poor or deteriorating school environment is not conducive to the good health of pupils.
Looking beyond classrooms

What is a school? The answer may seem obvious – a school is a collection of one or more classrooms in which teachers teach children. The classroom is the visible manifestation of a school. But in practice this classroom-focused attitude is weak in four respects.

- Much teaching and learning can and does take place outside of classrooms. Semi-formal learning situations arise in the workplace, the kitchen, the fields and at places of worship. Informal learning takes place through play and social intercourse.

At this primary school in Petauke District, Zambia, carpentry lessons are held outdoors.

- School-based learning is not always necessarily best conducted in a classroom. In some climates, the shaded area under a tree or a grassy bank may provide a teaching environment which is healthier and more effective than a crowded, dark, cold and damp classroom.

Early morning lesson in a desert climate, Siwana Block, Rajasthan, India. Mornings are cold and children are more comfortable sitting in the sunshine.
Many schools do more than just impart knowledge and skills. Schools often perform the important role of caring for children so that their parents can go to work. In this role, schools serve both to contain children, stopping them from “running wild”, and increasingly, to protect them from accidental or intentional harm.

Schools may provide a health safety net for children from disadvantaged homes. Where meals or food supplements are supplied, schools can be a vital source of nutrition. Schools can be a focal point for vaccination programmes and a means for health and social workers to identify and make contact with deprived families.
Overview of the current situation

These additional elements all have implications for the physical fabric of a school and the way in which it is used. Yet, to date, most of the work on school design has focused on classroom construction. The school compound, on the other hand, has been relatively neglected. When the school compound is dilapidated and untended, the disrepair tends to spread to the school buildings, since people come to feel that maintenance is not their responsibility. Additionally, the grounds surrounding schools are frequently open to animals to wander in and out. Any plants that exist are soon destroyed. Often school grounds are used by the local population as short cuts and sometimes even as open public toilets.

Neglected school compounds tend to accumulate waste, both from within the school itself and dumped by people from outside. When waste builds up, because of a municipal strike for example, school grounds are likely to become a natural dumping site since they probably represent one of the few accessible open spaces. If, as is quite often the case, school buildings are adjacent to health buildings, medical waste, including items such as used syringes, can frequently be found on the ground. In malarial areas, standing pools of water around a school can be a major health hazard.

External structures, such as concrete sports grounds, are often poorly built, with inadequate foundations. They are also, inevitably, exposed to the weather and so deteriorate rapidly. School grounds tend to be characterized by jagged lumps of subsiding concrete, wide cracks, broken steps and missing inspection covers. All these features are common sources of injury.

The importance of community mobilization

In contrast to the gloomy physical evidence presented by dilapidated schools, there is also plenty of proof that poor people all over the world are highly motivated to get an education. In Afghanistan, as in many conflict areas, schools were among the first targets for destruction by warring factions. Yet in Kabul, Afghanistan’s capital, among the ruins, in rooms with walls punctured by rockets,
classes are still held, using desks made of ammunition boxes. The city's university has been razed to the ground yet students still receive lectures and sit exams as dedicated professors arrange classes in basement rooms scattered about the city.

At a school in a peri-urban area in the Gambia, the two concrete classrooms are too small for the community's needs. Every year, during the dry season, local people build ten makeshift rooms from rough poles and corrugated iron that lean against the concrete structure for support. Children attend school in two shifts to maximize the use of the classrooms. On the door of one of these crude classrooms is painted the caption "Education or death". For the pupils in that simple iron shack, the opportunity which it offers is as precious as any offered by a pristine "model" school.

In all areas of development it has become apparent that the only hope of success lies in mobilizing local communities to accept their problems as their own responsibility. Progress is being made where there are committed individuals and groups on the ground, taking matters into their own hands and trying to make their little corner of the world a better place.

In a tiny two-room rural school in west Africa, for example, the teacher has instigated a regime whereby, every day, each pupil has to bring a plastic bag full of water. This is added to a communal tank. When the children go to the toilet they have to take water to wash themselves. The toilets, which are simple pits, have high and well-maintained bamboo-screen walls to provide privacy. A rota ensures that every morning the toilets are cleaned by one of the pupils. The result is a clean and well-tended school.
with a body of pupils who, by the simple expedient of
carrying water to school each day, remain constantly aware
of hygiene and cleanliness.

In many small communities, schooling has traditionally
been a domestic affair. Certain people in the community
would develop a reputation as teachers, and children
would go to their houses to learn. Schoolrooms were often
attached to the schoolmaster's house. Similarly, in societies
in crisis, such as in war zones and refugee camps, schools
are often run in people's houses or living quarters. And in
any society it is common for mothers with young children
do to look after their neighbours' children. In Colombia,
this tradition is being continued through a growing
number of "community houses", a system which has arisen
partly in response to growing concerns about street vio-
ience. Women can apply for grants and loans to upgrade
the sanitation and kitchens of their houses so that they
can look after up to 15 children at a time. These "commu-
nity mothers" form groups of up to 15 members that work
under a management committee of local representatives.
There are now several thousand of these groups in Colom-
bia. While these community houses are primarily aimed at
preschool children they do cater for children up to the
age of seven. It is but a short step from such community-
based day care to decentralized basic schooling with all
the advantages of small groups and personal care.

Making the most of a valuable resource

In many communities, the school is the largest building
and often the only communal space, other than perhaps
the mosque or church. In such circumstances, the tradi-
tional European model of a school which is used for only
a few hours each day, and only during certain times of the
year, seems irrational. Many schools now operate in two or
three shifts and the buildings are sometimes used in the
evenings as well for adult groups. In theory, more intense
use of facilities implies a more effective allocation of
resources. This in turn should result in the provision of
improved facilities. Creating a healthy school environment,
therefore, is not just about physical design but also about
developing operational procedures to make the best use of
facilities and resources.
One way of increasing use of school facilities is through the practice of alternate-day schooling. In the 1940s a Norwegian study found no difference in educational achievement between pupils attending schools every day and on alternate days.\textsuperscript{60} The strategy depends on the availability of good educational materials to support home study. It also assumes that the prime role of a school is education. Where a school is also important as a day-care centre, any schooling based on shifts or alternate days must be combined with appropriate day-care provision.

In regions vulnerable to natural disasters, schools are increasingly being recognized as an important resource for the whole community in times of emergency. In Bangladesh, schools are being built to serve as refuges in times of flood. In Viet Nam and elsewhere, typhoon-resistant construction is being encouraged for schools.\textsuperscript{55, 60} In the earthquake-prone regions of the Karakorum mountains, in northern Kashmir, Pakistan, special reinforced-concrete designs are being used for schools, which would provide communal shelter should an earthquake strike during a severe winter.

**Making use of the “hidden” curriculum**

In all schools, apart from the formal taught curriculum, there is a “hidden” curriculum covering areas such as basic social values and the development of interpersonal skills. In some cases this is explicitly formulated by teachers and educationalists, but often it is unspoken and implicit. Messages about personal and communal hygiene are an important element of this teaching. Even if children come from very poor and unhygienic homes, they may develop healthier practices if they are exposed to a regime of cleanliness and hygiene at school. Equally, if the school is unkempt, if the toilets do not work, and if the teachers themselves do not practise what they preach, then poor hygiene behaviour can spread from school to home.
Lessons to be learnt from the experience so far

To sum up, a number of lessons can be drawn from this analysis of the current situation.

- **Good design is not enough.** Exhaustive guidelines on classroom design are not enough to improve school environments. In fact, model designs often assume an unrealistic availability of resources. More importantly, a healthy school is dependent on good management, commitment and maintenance.

- **Standard designs assume standard conditions.** Designs for model schools are only useful if applied intelligently and with care. If standard designs are used in circumstances for which they were not intended, the result can be counterproductive.

- **Schools are more than classrooms.** While much attention has been given to classroom design, many of the elements which influence child health lie outside the classroom. There is a need to think about the total school environment and the way in which schools are run. In particular, the involvement and needs of the local community should be considered.

- **The greatest need is to improve existing schools.** Before large amounts of resources are devoted to building new schools, better use should be made of existing schools. This can be achieved through better management and larger financial allocations for maintenance and repairs. It is also important to ensure that pupils and staff with disabilities are able to use facilities at existing schools.
Health aspects of the school environment

The physical and mental health of children can be influenced by a range of physical aspects of the school environment. These can be listed as: sanitation (or the lack of it); dirty hands; water quality; the microclimate; indoor air quality; noise; light (both too little and glare as a result of too much light); dangerous structures; inadequate furniture, and a hazardous location.

Added to these is the fact that, for many children, going to school is the first opportunity to mix with people other than close relatives and near neighbours. Consequently, it may represent their first exposure to a range of infectious diseases.

Sanitation

Without sufficient clean and functioning toilets children will defecate in and around the school compound. In such situations the school and its surroundings are likely to become infested with parasitic helminths.

Dirty hands

The availability of convenient handwashing facilities is as important as safe disposal of urine and faeces. Hepatitis A, diarrhoea caused by Escherichia coli, amoebic and bacillary dysentery, cholera and typhoid are among the infectious diseases which can be spread via the faecal–oral route. Staff and pupils must be able to wash their hands after defecation as well as before eating food.
The “F-diagram” summarizes the main ways in which diarrhoeal disease is spread — by faecal germs contaminating fields, fluids, fingers, flies or food. Most toilets will stop the “fluids” and “fields” transmission routes. The VIP toilet and the pour-flush toilet (see Appendix B) may also break the “flies” route. No type of toilet can, however, prevent contamination of hands.

**Contaminated water**

Many of the faecal–oral infections listed above can also spread via contaminated drinking-water. Children dipping their unwashed hands into a shared drinking-water supply is a typical route of contamination. But problems can also arise from water which is not used for drinking. If rainwater or floodwater is allowed to stand in puddles, the breeding of mosquitoes and other insects may be encouraged, leading to transmission of diseases such as malaria, dengue fever and schistosomiasis. (Similar problems can arise from accumulated waste, which, additionally, may attract flies, rodents and dogs.)

**The microclimate**

Microclimate is determined by temperature, humidity, heat radiation and air movement. Details of the relationship between the indoor microclimate and health remain poorly understood. However, it is evidently not good for a child to spend a large part of the day in a cold, damp and poorly-ventilated classroom. Poorly nourished and inadequately clothed pupils are particularly vulnerable to acute respiratory infections. Conversely, excessively warm conditions may lead to thermal stress, fatigue, reduced learning capacity and, in extreme cases, heat stroke.\(^7\)
Indoor air quality

There is a wide range of potential indoor air pollutants which may influence the health of schoolchildren. Pollution from heating stoves can lead to chronic respiratory diseases and carcinomas. In a crowded environment, airborne bacteria and viruses can cause cross-infection. Other threats include: rotten matter produced by moulds and fungal growths; fine dust; gaseous and particulate compounds from building materials, and radon gas. Many health problems are associated with these pollutants, including acute respiratory infections and asthma.\(^7\)

Noise

High levels of noise can cause irritation, encourage aggressiveness, reduce physical and mental performance, and cause discomfort and headaches. Exceedingly loud and continual noise can lead to more serious problems.\(^7\) Children with hearing problems, visually impaired children, and children with learning difficulties are particularly dependent on a good acoustic environment.\(^9\)

Light

Bad lighting can affect the well-being of both pupils and staff. Eye-strain is a frequent complaint in classrooms and other teaching spaces where light levels are low, or where glare is excessive. Eye-strain probably largely accounts for the higher prevalence of headaches in the afternoons that has been reported by children and teachers. Poor light conditions can cause children to adopt poor posture, which itself can eventually lead to physical strain.\(^9\)

Dangerous structures

As well as protecting children and staff from the elements, the structure of a school building is intended to enhance health and well-being. But badly designed or poorly maintained structures may in fact threaten health. Classrooms often require larger roof spans than traditional domestic buildings for example, and if domestic construction techniques are used for schools, they may prove to be
inadequate, particularly in areas prone to earthquakes and typhoons.

On a smaller scale, cracks and inaccessible corners may provide homes for hookworms, mites and jigger fleas, while dampness and poor ventilation may lead to the growth of moulds and fungi. Broken windows, dilapidated steps, exposed nails, the lack of stair rails, missing inspection covers and other such hazards may cause injury.

**Inadequate furniture**

With a widespread shortage of furniture in primary schools, many children spend much of their schoolday seated on possibly damp or contaminated mud floors or cold concrete floors. This can lead to infections from hookworm, urinary tract infections and problems with joints. Moreover, what furniture there is may be used excessively. This can lead to overcrowding, with the attendant risk of cross-infection, for example from scabies. And with overuse, furniture may become damaged, causing injury. Classroom furniture may not always be used appropriately. Examples exist of desks designed for very young children (6–8 years) being used by older children (13–15 years) and vice versa. This is likely given that children attending primary schools are often above what would be considered normal primary school age. Posture problems and backache can result.

**A hazardous location**

In many cases the most dangerous aspect of a school is its location. When informal urban settlements grow up, the best land is generally taken at the outset for houses. Schools are often built on the least desirable land – for example, on the site of an old waste dump or in areas prone to flooding or subsidence. They are also often located on busy roads, increasing the risk of accidents, or at some distance from the community they are intended to serve. Size constraints at urban sites may result in overcrowding and inadequate space for exercise.

Standard school designs frequently make assumptions about the kind of site available. They require an area of
flat land with specific minimum dimensions. Often, such a site can only be found a long way from where people actually live. This results in young children having to walk long distances, sometimes in the rain, sometimes along busy roads, all of which can increase the hazards they face.

While little can be done about the location of an existing school, this issue should be considered by planners and community groups at an early stage in the development of a new school. The availability of water, for example, must be borne in mind. Moreover, even in the case of existing schools, improvements are possible. For example: footpaths and bridges can be built for getting to the school; hazardous waste can be removed from the site; efforts can be made to seal off the school from adjacent hazards such as rivers and gullies.

**Prioritizing the problems**

The numerous correlations between elements of the physical environment and child health can be listed. But there are four principles which must be considered as priority issues. These are:

- keeping the compound clean of faecal material and waste;
- providing or restoring toilets and keeping them clean;
- providing convenient handwashing facilities and encouraging their use;
- providing safe drinking-water.

If these four objectives can be achieved and sustained, schools will have a good foundation from which to start tackling other health problems.
The previous chapter outlines the potential health hazards of the school environment. This chapter describes some key objectives for tackling them. First of all, though, it must be stressed that there is no simple technical fix for achieving a healthy school environment. A global manual on healthy school construction would not be useful. Even locally developed manuals are of limited value if they try to impose standard solutions. It is far more useful for local decision-makers – primarily community leaders and teachers – to understand a set of common broad objectives and principles.

Commitment and motivation

There is no doubt that the single most important factor in achieving a healthy school environment is the presence of committed and informed people. The emphasis should be on the commitment: there is plenty of evidence that information is not enough. People are often well aware of the health risks and the theories of contamination but do not act on that knowledge. People who are not committed will always find reasons for not acting, while a committed person will seek ways around apparently insuperable problems. If necessary, committed people will also seek out information.

One committed person can motivate many others.
There is no simple formula for making people committed. However, recognizing and valuing people’s efforts, and ensuring that there is sufficient scope for their own decision-making and creativity can go a long way towards encouraging sustained commitment. This point is particularly important since, again, it argues against standard designs. There are many manuals for school design which prescribe every detail, down to the layout of pinboards and the arrangement of storerooms. Such advice may be technically valid but if teachers on the ground feel deprived of any opportunity for shaping their own environment, the end result is likely to be disappointing. The essence of commitment is a person’s belief that his or her efforts can make a difference. If not, they will feel there is little reason to fight for change.

In at least one South American and one South-east Asian country it is well known among the locals that unless teachers can pay a sufficiently high bribe they are likely to be posted by officials in the Ministry of Education to a school distant from their own community. The immediate result is high absenteeism among staff, which damages their pupil’s education. More profound, however, is the lack of commitment and involvement which many of the teachers feel regarding their schools. Their main concern is to find ways of being posted to another school nearer to home. Unless these kinds of underlying issues are tackled, proposals for physical changes to this or that detail of the school environment will count for little.

As well as encouraging the commitment of local people, seven other basic objectives can be proposed which can be achieved by taking simple practical measures and which, once achieved, will go a long way towards creating a healthier school environment. These objectives are: a faecal-free environment; safe drinking-water; convenient handwashing arrangements; well-lit learning spaces; protection from the elements; structural safety; and adequate cleaning and maintenance.
A faecal-free environment

Evidently, faeces on the ground will be a threat to health. The point to be made, though, is that staff, pupils, parents and governing bodies of schools should consider the whole school environment, not just classrooms. Ideally, concern should extend to the streets and fields between home and school, and to the pupils' homes. But at the very least, it must include the school compound.

Success in eliminating faecal material from a school compound is dependent on:

- informed and responsible pupils;
- supervision of young children;
- a compound fence, and vigilance, to stop animals and outsiders from defecating in the compound;
- toilets which are conveniently located, reliable, clean, reasonably odour-free and reasonably private.

Some technical options for improving toilet facilities are described in Appendix B.

Where site, soil and groundwater conditions permit the digging of deep pits, the VIP toilet is a well-tested, rugged and long-lasting solution. Properly built and maintained, it is almost odour-free and fly-breeding is reduced. Developed in Zimbabwe, this toilet design is the preferred model for rural and peri-urban schools in much of southern and eastern Africa.
**Safe drinking-water**

The conditions required for clean water are well known, but often they are unachievable. Recommendations to boil all water are of little value in a society where fuel is expensive and scarce. Advice about deep boreholes is of no use to a resource-starved school. Rather than concentrating on the source of the water, achievable measures are often those concerned with the handling of available water.

Frequently, water from a tap or pump is reasonably clean, but has become contaminated by the time it reaches someone’s mouth. For example, if people are dipping their hands into a water container to scoop up water in a cup, it is likely that they are contaminating it with germs from their hands. Simply providing a ladle can be an extremely low-cost solution. Similarly, in some circumstances, covering the water container with a lid may be an important step. In some schools in Viet Nam, each class has its own large kettle and is responsible for the cleanliness of its own water.

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At some schools in Viet Nam, each class has its own kettle for boiling water for drinking. Each class also keeps a supply of clean mugs stored in a lid-covered bucket.

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**Convenient handwashing arrangements**

In many countries awareness is widespread of the importance of washing one’s hands after defecation. It is reasonable to suppose that it is one of the central planks of all school health-education programmes. However, it is equally clear that handwashing is a practice that is widely ignored. Spreading the message of the importance of handwashing is not enough; it must also be an easy and convenient thing to do. People will not normally go out of their way to wash their hands.
If the tap or water source is distant from the toilet, people are unlikely to use it. If water is stored in a relatively high-sided tank it may be awkward for younger children to use. Similarly, wells with high sides may discourage people from drawing water. Taps or water tanks which are constantly surrounded by mud may also be discouraging. Hand pumps may be too stiff for a small child to use, or it may be difficult to pump and wash one’s hands at the same time.

A handwashing arrangement with a “leaking tin”, made of an oil-drum placed on a stone footing over a drainage pit filled with gravel. The small leaking container is made of a recycled tin with a handle of steel wire. This simple and effective water-saving device can be made at school by the pupils themselves.\(^{(2)}\)

A number of studies have shown that the use of soap, earth or ash for handwashing can make a significant difference to hygiene levels.\(^{(10, 11)}\) Moreover, as well as its purely functional value, the provision of soap can become a means of focusing attention on the issue of handwashing. For example, teachers may need to start a small fund to raise money from parents to pay for a regular supply of soap. This in itself can help to raise awareness among both pupils and parents.

**Well-lit learning spaces**

In many places, electric lighting is either prohibitively expensive or simply unavailable. Many teaching spaces, therefore, depend on natural light. Good lighting is especially important if resources for school books are limited and learning depends on the children seeing the blackboard clearly.
Frequently, climate conditions lead to poor lighting: either too little light or excessive glare. For example, in hot and humid climates people try to increase ventilation, which may result in a teacher standing against the glare from an open window. Where there is a lot of wind-blown dust, or the climate is cold, the tendency is to build small windows, resulting in dark classrooms.

However, the apparently obvious solution of having large windows running the length of the room is often inappropriate. In many places, glass is expensive, so it is most unlikely to be replaced when broken. It may even be stolen. On the other hand, if the windows are unglazed, problems of security and of exposure to the elements will arise. Even in areas commonly thought of as hot, there are often times of the year when cold is a problem. A classroom with open sides can be a miserable environment if there is a cold wind.

An alternative to large windows is the perforated screen wall. This is a solid masonry wall punctured by numerous closely-spaced holes through which light can filter. If the wall is built of bricks the perforation effect can be achieved by simply leaving spaces between the bricks at regular intervals. If it is made of concrete (or earth-cement) blocks, special moulds can be used to produce blocks with decorative holes. If the inside surfaces of the holes are made light in colour, either by painting them or by using plain white cement for the blocks, the amount of light reflected through the holes is considerably increased. Where masonry is not used for construction, or where there are existing large window openings, other kinds of screens can be created, for example, using horizontal bamboos.
The advantages of a perforated screen wall are that it provides security and a relatively even distribution of light. The disadvantages are that it does not protect against wind, cold and dust, and classrooms (particularly if large) can remain rather dark unless the internal walls are also light-coloured. Care must also be taken to orient the building so that direct sunlight does not penetrate the screen wall, since this will almost certainly lead to glare.

In cold climates, where small windows are necessary to reduce heat loss, it makes sense to maximize the light which can enter through a small opening. A roof light lets in considerably more light than a window of equal size in a wall. It can also help to bring more light into the centre of the room, which is often poorly served by wall windows. However, care has to be taken to avoid direct sunlight falling onto desks. With any window, the light entering can be increased to a surprising extent simply by painting white the surfaces of the reveal (the hole in the wall) and the window frame.

A school in the Gambia with thick mud walls and small windows had a corrugated iron roof. To overcome the inevitably poor lighting the teachers removed the sheet of corrugated iron immediately over the blackboard and relaid it, weighed down with stones, slightly to one side of its original position. This left a narrow slit, about 10 cm wide, running down the slope of the roof. The result was a strip of daylight around the teacher and over the black-
board. When direct sun came through the slit there was some glare, but on the whole the arrangement gave satisfactory results. During the short rainy season the roofing sheet was returned to its original position.

Clearly, such a solution is not ideal. However, this example illustrates that it is possible to take low- or no-cost actions which can significantly improve conditions for both pupils and teachers.

It is also important to make the best use of any light once it has entered the room. Untreated mud-and-dung plaster on the walls, for instance, will make a room relatively dark. The underside of a thatched roof will absorb a lot of light. The level of light can be dramatically increased with a light-coloured ceiling and light paint or lime-wash on the walls. These can also reduce glare by ensuring that light is reflected from all directions. In addition, making sure that the blackboard is of reasonable quality and regularly repainted can be a relatively cheap way of mitigating the impact of poor lighting.

**Protection from the elements**

It goes without saying that a school building should protect its occupants from rain, wind, sun and snow. But it need only offer as much protection as necessary. A classroom of a standard required in a northern country
with a cold and wet climate may be quite unnecessary and in fact inappropriate in a tropical country. The protection of a tree or a veranda may be all that is needed and often preferable to an enclosed space which reduces light and ventilation.

An open-air classroom in Bangladesh.

In many cases the real requirement is simply for a store-room in which teaching materials can be protected from the weather and secured against thieves. In other cases, the best way of affording protection from the elements may be to organize school holidays so that they coincide with the rainiest, coldest or hottest season, as the case may be.

Schools should be designed to prevent extremes of temperature inside classrooms. However, is not uncommon for schools to be designed with large exposed windows, which can result in overheating. Classrooms either become unusable or else expensive air conditioners have to be employed. Air conditioners, apart from being a luxury that few countries can really afford, can themselves be a threat to health: they can be a home to mosquitos and harmful bacteria, they can increase noise, and they can expose children to extremes of hot and cold as they pass from outside to indoors. One simple way to reduce overheating, is to plant shade trees and climbers outside large windows.
Structural safety

It is obvious that the health of children will not be enhanced if the school building falls down. This is more the concern of engineers and builders, but teaching staff should check their schoolrooms on an occasional basis for cracks in the main structure. Of more immediate importance are small-scale structural issues: doors falling off their hinges, rotten floorboards, broken glass, exposed nails and broken paving stones. While large-scale structural problems are likely to require significant amounts of money to solve, a simple but systematic safety audit can reveal hazards which have simple remedies (see Appendix C).

Local regulations and standards regarding structural safety must be followed even in community-built schools. This school is in Abu Road Block in Rajasthan, India. Part of the building has collapsed due to poor construction.

At the very least, every school should possess a hammer. This basic tool can be used to knock back exposed nails and clear away fragments of glass from a frame when a window has been broken. Such a detail may seem trivial, but in many schools, nails and shards of glass are a constant threat and a cause of injury to children. Before becoming involved in the details of, say, earthquake- and typhoon-resistant construction, basic ways to make existing schools safer should be sought.

In many societies, communal work sessions are traditional. If parents can be persuaded to work together, even just for one day once a year, then such a labour force, which will inevitably include people with specialist skills, can tackle much of the heavier structural repair work. Working together, parents can accomplish tasks such as clearing away broken concrete, rebuilding eroded steps, replacing
rotten fence posts, re-laying roofing sheets and repairing furniture and play equipment.

Structural safety plays an important part in good sanitation. Children are often scared that a toilet may collapse, sometimes with good reason. A toilet’s squat platform or slab should be well made and protected from the elements. It must also be clearly seen to be safe. The interior of a pit toilet should generally be lined to prevent its sides from collapsing. Surface water from rain should be directed in channels away from toilets, to avoid any erosion of the pit.

**Adequate cleaning and maintenance**

Problems of structural safety can often be avoided through careful routine maintenance. Dealing with broken roof tiles or undermined foundations straightaway, as soon as they occur, minimizes the need for expensive structural repairs later. Often, where a capital budget is available for construction but resources for routine upkeep inadequate, the result is dilapidated buildings which need to be replaced far earlier than should be necessary.

The key to good maintenance is not letting the situation deteriorate too far before taking action. Broken, clogged or soiled toilets, in particular, will deteriorate rapidly if action is not taken immediately. Rectifying the situation then becomes a major task.

Often a serious problem occurs because everybody thinks it is the responsibility of somebody else. Adequate maintenance, therefore, requires that areas of responsibility are clearly defined and understood by all.

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Adequate maintenance requires that areas of responsibility are clearly defined. This picture shows schoolchildren in Viet Nam cleaning their school compound and toilets.
Waste collection is an example of an activity for which several different people can be assigned responsibility for the different parts. Children and teaching staff may be involved in collecting waste in the classroom and compound. A caretaker may be responsible for managing a waste pile and emptying bins. And a municipal waste collector may be responsible for final disposal. Sometimes, one part of the process breaks down. In such a case, dialogue between all the parties involved is important.

A similar example can be made of a problem such as bats in a roof space. Over a prolonged period bat droppings can accumulate to the point whereby structural collapse becomes a serious risk. But because nobody knows who is responsible for the periodic removal of bat droppings nothing is done until the situation becomes serious.

Cleaning can be made easier if some thought is given to the design of a school building and its grounds. If a classroom door opens directly onto an unprotected mud path, mud and dust will inevitably be brought into the classroom. In designing a new school or upgrading an existing one, attention should be paid to providing clean and dry pathways up to the school buildings.
Recommendations

Advocating a change of emphasis

A long list of detailed environmental criteria for the design of schools could easily be drawn up. Indeed, over the last 50 years or more, numerous design manuals have been produced following just such an approach. Yet many schools still remain unhealthy environments. What is needed, rather, is a change of thinking about what the physical environment of a school is, and what it depends on. In particular, we suggest, there should be a shift of focus in four respects:

- away from buildings and towards adequate services, particularly water and sanitation;
- away from classrooms and towards total school environments;
- away from design and construction and towards operation and maintenance;
- away from regulation and towards motivation and ownership.

In each of these areas, the changes required are not so much technical as social and attitudinal. It cannot be emphasized too strongly that the single most important factor in achieving a healthy school environment is the presence of at least one motivated and informed teacher. The next most important element is a community which provides support in terms of encouragement, physical work and material resources. If these two factors exist, a healthy and vibrant school can emerge in the most adverse of circumstances. Without them, even wealthy societies have poor schools.

For too long the provision of schools has been seen as an issue of construction. Certainly, new schools are required. But a school environment is like a living organism, and therefore requires continuous sustenance. The construction
of the school building should be seen as the birth of a “living school”, rather than as an end in itself. A living school has many components (children, parents, staff) and needs (the supply of water, the removal of waste). Again, like any living organism, its relationship with the outside world is highly important. If the school is seen as being apart from the community, rather than integral to it, it will soon become neglected.

None of this is to say that there is no scope for technical innovation. The ideas described in Appendix B are examples of some of the technical measures which can be taken to improve school environments. But the people choosing and evaluating the technical options must be the people on the ground. A technical device for handwashing, for example, may work well in one community but be totally inappropriate in another. The role of national and international bodies, therefore, lies not in prescribing solutions, but in disseminating the range of choices available.

Recommendations to planners

Existing recommendations concerning minimum standards for space, lighting and sanitation should be followed and a reliable water supply ensured. But given the financial constraints in many countries, some of the recommendations suggested in the past may be unrealistic. In such circumstances the emphasis must be on achievable action. The following recommendations may provide a useful starting point.

- When a new school or additional facilities are being constructed, involve the local community from the earliest stage of site selection and design. If the community does not feel some kind of ownership it is likely that the school will fall into disrepair and be vandalized. An imperfectly designed but well-cared-for school is preferable to an ergonomically designed but neglected school.
- Where relevant and feasible, combine new schools with housing for teachers.
- Dedicate a larger proportion of available resources to maintenance.
Recommendations

- Dedicate more of the construction budget to building (or planting) an adequate perimeter fence.
- Dedicate more of the construction budget to water and sanitation provision.
- Provide incentives for cleanliness (for example, a prize for the cleanest school).
- Facilitate exchange of information between teachers (for example, through newsletters) on a broad range of issues but including practical experiences of school hygiene. Encourage teachers to visit schools that use innovative techniques.
- Demand an annual audit of the school environment, carried out by the parent–teacher association, followed by an action plan. Share the most innovative action plans with other schools.
- Place more emphasis on following up health education initiatives, to find out why staff and children do not act on what they already know.
- Develop procedures to increase the use of facilities, such as shifts and alternate-day teaching, so that more resources are available for maintenance and teaching materials.
- Encourage high-profile public figures (senior politicians and sports personalities, for example) to support school health campaigns.

Recommendations to head teachers

Existing national recommendations concerning health education, nutrition and hygiene should be followed as far as possible. It must be recognized, however, that circumstances may impose many constraints on schools, and that such recommendations will accordingly not always be feasible. Solutions, even partial or temporary solutions, must be developed locally. The following suggestions, used in conjunction with the ideas discussed in Appendices B and C, may offer a way forward.

- Recognize that the priorities are: fencing in the school compound and keeping it free from faecal material and waste; the provision of toilets and urinals and keeping them scrupulously clean; the provision and use of
handwashing facilities, and the provision of safe drinking-water.

- If an active parent–teacher association does not already exist, create one. Seek out key people in the community who can help with specific activities such as fundraising, plumbing, repairs, carpentry, etc.

- Involve non-teaching staff and parents, as well as teachers, in developing ideas for improving safety and hygiene.

- If the water supply is shared with the general community, look for ways of setting up an independent supply.

- Think creatively about teaching spaces. Do not use a classroom that is dark, airless, too hot or too cold if a lesson could be better conducted outside in the open, in the shade of a tree or in some semi-enclosed space. Think of low-cost ways of creating more external covered spaces.

- Use plants creatively, not just to beautify and build pride, but also to ensure a secure perimeter fence, to provide privacy for toilets, to supplement nutrition, to modify the microclimate, and to reduce glare in teaching areas.

- Develop daily routines which involve children and parents in health-related activities – for example, bringing water to school, subscribing to a soap fund, clearing waste from the school compound, etc.

- Organize events to raise money for the construction and maintenance of water and sanitation facilities, and to raise awareness of hygiene issues.

- In larger schools, devise incentive schemes such as prizes that encourage teachers to strive for cleanliness.

- Do not be content with just keeping the school clean. Organize events that help children to spread good hygiene behaviour to their homes and the streets.

- If a school is subject to external dangers, such as pollution and dangerous roads, encourage the parent–teacher association to take a lead in campaigning for change.

- Lead from the front. Use the school sanitation facilities yourself and be seen to be washing your hands and cleaning the compound.
In 1992, Maria Sörensson of the International Water and Sanitation Centre (IRC) in the Hague, the Netherlands, carried out a detailed study of 22 public primary schools in and around Madras in India. In many respects the schools were very similar: all were co-educational, run by the local government and served similar types of population. However, water and sanitation conditions differed significantly. Three of the schools had clean functioning toilets, a well-tended compound and well-observed handwashing practices. In the other 19 schools, children were defecating in the compound, the water was contaminated and the waste area was poorly controlled.

One of the interesting observations of the study was that children and staff in all 22 schools were well aware of the links between poor hygiene and ill health. Madras has an active hygiene education programme and interviews with children confirmed that health messages were understood. However, in the majority of the schools neither staff nor pupils were putting their knowledge into practice.

Sörensson’s study, based on observation and extensive dialogue, revealed four common factors which distinguished the three more hygienic schools from the other 19.

- **A secure compound.** Madras is short of space and water. Schools which have their own water supply find that members of the neighbouring community enter the compound to use the water. Also, people enter to defecate either in the toilets or in the compound, because both offer more privacy than the streets. Only 25% of houses have their own toilets. Schools that built compound walls and, in one case, employed a watchman, were more able to maintain clean compounds.

- **A key member of staff.** All teachers in the Madras area receive training in hygiene and environmental sanitation. The majority have received additional train-
ing from the Institute of Public Health. But Sörensson's study demonstrates that training is not enough. The three successful schools each had at least one member of staff who was truly motivated. He or she was committed to putting words into practice and this enthusiasm spread to pupils and other staff. Sörensson suggests that the key to future success lies in trying to understand this spark of motivation, which goes beyond mere training.

- **Group involvement.** An important element of the success achieved by these key individuals was that they managed to involve and stimulate those around them. In particular, they won the cooperation of lower-status cooking and cleaning staff. Additionally, children took an active part in cleaning and repairs. By working alongside the non-teaching staff, pupils developed an attitude of respect which was missing in some of the other schools. The teaching staff also involved themselves in hygiene activities, showing that they were prepared to practise what they preach. Parents were involved in special events, such as a “Water Day”, where children promoted hygiene to their families.

- **Achievable solutions.** In the 19 schools where hygiene was poor, staff complained of a lack of resources and a lack of support from the authorities. In the three successful schools, even though resources were limited, teachers found ways to make small changes. Some were cost-free organizational measures, such as involving children and staff in cleaning. Others required small purchases, such as that of a ladle for the water tank so that children were not dipping their hands into the common water supply. Another initiative involved persuading parents to supply their children with sandals.
Case studies

A2 A school for a growing population:
Bogotá, Colombia

In many respects, Colombia is typical of Latin American countries. Its basic health and development indicators are among neither the best nor the worst for the region. Infant mortality in 1995 was estimated at 32 deaths per 1000 children. Population growth is 1.66% per year, life expectancy is 69.3 years, and 73% of the population lives in urban areas. A distinguishing characteristic of Latin America is the high proportion of the population living in cities (Argentina 88%, Bolivia 60%, Brazil 78%, Chile 84%, Peru 72%, Venezuela 93%).

The capital of Colombia, Bogotá, is a classic example of a Latin American city which, over the last 30 years, has undergone a dramatic transformation through the large-scale and rapid growth of informal settlements. The oldest and most famous of these is Ciudad Bolívar. With well over a million inhabitants, it has come to be seen as a city in its own right. The Barrio Vista Hermosa is in one of the oldest parts of Ciudad Bolívar and is around 30 years old. It is built on the steep hillsides that surround old Bogotá and, since the Colombian uplands are subject to both earthquakes and sudden torrential rains, buildings on these unstable slopes are at constant risk of disaster. Situated at 3000 m above sea level, the barrio experiences wide differences between night-time and daytime temperatures. The thin mountain air results in an exceptionally harsh, burning sun.

The school of San Rafael was formed by a committee of parents in Barrio Vista Hermosa early in the life of the settlement. In many ways it is typical of an urban school in Latin America. The original school buildings were built by the community and, over the years, the school has spread up the steeply sloping site in a piecemeal way. There are now 19 classrooms. The older ones are of brick with corrugated iron sheets on the roof. More recent ones
have concrete-block walls, a prefabricated steel frame and
asbestos-cement roofing sheets. Once established, the
school was adopted by the Colombian Government. A
government health centre has been built on a neighbour-
ing site. The school now has 1400 pupils ranging from
5 to 14 years old. They are taught in two shifts of 700
pupils each, by 22 teachers. Like most schools in Colom-
bia, it does not provide the children with a meal but does
have a small school shop selling sweets and the like.

The head teacher, Señora Sophia Ramires, and her staff
realized that for a school such as theirs to serve its com-
community it was important first to understand the community.
In 1994, at their own initiative, they organized a socio-
economic survey of the catchment area. They interviewed
152 families and found that 63% of them had been forced
to migrate from other parts of the city because of eco-
nomic pressures. The remaining 37% were rural peasant
families who had come to the city either in search of
better work or because they had been forced from their
land by the violence that currently afflicts parts of
Colombia. The teachers estimated that 46% of the adults
could be classified as illiterate and that 30% of the fami-
lies were living off less than one official minimum wage.
Two-thirds of families lived in houses which they had built
themselves. Many of these started as simple shacks which
had been progressively upgraded over the years.

Despite the relative poverty of the area and the prevalence
of self-built houses, the teachers from San Rafael estimated
that 95% of their pupils come from homes that have their
own water closet (WC). As in most of Latin America, a
high priority is placed on having a WC. At the school,
there is one WC for the teachers and a further 20 for the
pupils. Approximately 30% of these are in some way
damaged but the rest are functioning. Some of the taps to
the washbasins are broken, but not all. Drinking-water is
taken from standpipes. Although the water supply across
the district is sporadic, the school has a large elevated
water tank which ensures that sufficient water is always
available.

Since the health clinic is just next door it is perhaps not
surprising that there is no programme of visits from
doctors or nurses. The staff of both the school and the
health centre reported that the major health problem for children in the area was malnutrition. They reported problems of both eyesight and hearing, and felt that the latter was due to malnutrition. Dental problems caused by too much sugar in the limited diet had also been observed. The school does not have a health education programme. As with all schools in Colombia, a condition for entering the school is a certificate of vaccination.

The school is also typical in its management and maintenance. There are broken windows, damaged furniture and crumbling steps on the steep slopes. Funds for routine maintenance from the government are scarce. On the other hand, external walls are painted with murals and inside there are many posters and notices, indicating a level of care and pride. Also, the level of cleanliness is high. Each family has to pay a small amount each term to help cover the cost of materials. The school compound is surrounded by a high concrete wall and can only be entered through a steel gate that opens into an internal lobby, which is constantly supervised (in Bogotá’s city-centre schools levels of security are even higher, with bars on the windows and a sense of constant vigilance).

San Rafael is neither an exceptionally innovative school, nor particularly bad. But it illustrates that people on the margin of Latin American urban society are keen to have schools for their children and prepared to invest their time and resources to obtain them.

The school of San Rafael in Bogotá is built on a steep slope. The long flights of concrete steps are a major hazard.
Case studies

A3 Schools made by people:
Kenya

Kenya shares many of the characteristics of other developing countries. More than 50% of its population is under 15 years old. The projected population growth indicates a doubling of the number of school-age children every 17 years. But where Kenya differs from many countries is that, rather than seeing this as a massive problem to be resolved by central government, Kenyans are using traditional methods of community self-help to tackle the problem from the bottom up.

The formal schooling system in Kenya was initiated by Christian missionaries in the mid-19th century. By 1950 three-quarters of schools were missionary schools. From the outset, the normal course was for the local community to provide land and buildings while the missionaries provided trained teachers and teaching materials. However, many communities became dissatisfied with the type of education on offer and, since they were already providing the school facilities, decided to break free of the missionary system and set up their own schools.

To this day, the central government does not get involved in primary school construction (except in some exceptional circumstances, such as schools for nomadic groups). The Ministry of Works provides prototype designs for schools and there are regulations governing materials and standards. However, it is clear that these regulations are not rigidly imposed since many schools are built of mud and thatch which is explicitly prohibited. Also, unlike in many other countries, the Kenyan primary school is not a static creation; there is a steady process of gradual improvement. A school may start as a simple hut of mud and thatch but gradually become transformed into a complex of concrete and corrugated-iron classrooms.

The key to this process of improvement is that local people feel that their school belongs to them, rather than
to the government. In Kenya there is an established practice of communal self-help, known as *harambee*, which can be roughly translated as "let's all pull together". When Kenya became independent in 1963, the principle of *harambee* became a corner-stone of development policy:

“Our motto of *harambee* was conceived in the realisation of the challenge of nation-building that now lies ahead of us. It was conceived in the knowledge that to meet this challenge, the government and people of Kenya must pull together. We know that only out of our efforts and toil can we build a new and better Kenya" (Jomo Kenyatta, 1963).

*Harambee* projects are normally initiated, planned, implemented and maintained by local communities. By their nature they are low-cost and make the best use of locally available resources.

A number of studies have been made of the *harambee* tradition. One study concluded that "one of the keys to the success of most projects is the existence of at least one individual with energy, wisdom, and talent for organisation"[13]. For a major *harambee* project, such as building a school, a community will generally form a committee to oversee the works and resolve any problems arising from the existence of different community interests. In 1968, the government decided to formalize the status of these committees. An Education Act officially recognized their role in negotiating with the authorities and in raising money for construction and maintenance.

Even though the Kenyan Government has never financed the construction of primary schools, most communities now have sufficient basic facilities to ensure that their children receive eight years of schooling. While the standards of construction, furniture and maintenance cannot be described as high, they are in fact higher than in neighbouring countries where schools are provided by government. The conditions which have made Kenya's achievement possible can be listed as:

- the high priority given to education by local communities;
- the well-established tradition of communal self-help;
- a consistent government policy, since independence, giving the local community responsibility for the construction of schools and teachers' houses, the provision of furniture and maintenance;
- no government interference in design, choice of materials and construction methods.

A characteristic of community-built *harambee* schools in Kenya is that they start with simple and cheap local materials (mud and wattle walls, thatched roofs and mud floors) and over time are progressively upgraded (brick walls, metal roofs and concrete floors).
Case studies

A school in a warm, humid climate: Viet Nam

Ninh Hai is an agricultural commune in Ninh Binh Province, about 100 km south of Hanoi in Viet Nam. The area has a typical monsoon climate with a warm and humid summer, with temperatures above 30°C, and a rather cold and rainy winter. The schools are closed when winter temperatures drop below 8°C.

Ninh Hai Commune has a population of 5000. The primary school has 700 pupils drawn from a distance of up to 3 km and is run in two shifts. The school compound, covering 2000 m², is surrounded by a river, ponds, rice paddies and steep hills.

Established in 1963, the school has 13 classrooms and 25 teachers for the two shifts (some schools in Viet Nam, particularly in mountainous areas, have three shifts). The classrooms have adequate furniture and light conditions.
are good. Window openings are large to provide for good cross-ventilation during the warm, humid period. The oldest part of the school has window openings from the floor up, with wooden shutters. This allows for effective cooling at the level where pupils are sitting.

The old building of the Ninh Hai Primary School in Ninh Binh Province in Viet Nam, has tall “French windows”, providing good cross-ventilation and light.

The school has no functioning water supply, however. A rainwater tank was built in 1994 (a UNICEF-funded project) but does not work. Water for washing is taken from the heavily polluted river. The children bring drinking-water from home.

A small toilet for students is located by the river. It is too small for the number of students attending the school and quite smelly. There is a definite risk that river water could be polluted by leakage from the toilet pit. Somewhat better toilets are available for the staff, in the staff quarters.

The major health problems among pupils are: trachoma (40% of students); goitre (23%); and malnutrition (3%). An annual health check of the students is carried out by staff from the commune’s health centre.

This example shows that even in a community where major efforts have been made to provide a good physical environment for the school, no successful solutions have been found for water supply and sanitation problems.
Case studies

A5 Schools in a hot, dry climate: Rajasthan, India

The state of Rajasthan in north-western India has a typical desert climate: hot and dry, with extreme temperature variations between night and day. Daytime temperatures often exceed 45°C, while early morning temperatures may be below 10°C. There is also a distinct winter season (November–February) with dry, sunny and cool weather. The rainy season, with heavy but infrequent monsoon rains, extends from late June to late September.

Rajasthan has a population of about 47 million people, living in over 50 000 villages and smaller communities. Many of these are located far away from any road usable by motor vehicles. There are an estimated 10 million primary school-age children (6–14 years). Officially there are about 37 000 primary schools in Rajasthan. In addition, thousands of informal education centres cater for children unable to attend formal school.

Most of the schools consist of a stone or concrete building with two or three classrooms and a veranda on one side. Some schools have no classroom accommodation. Others have no more than a simple teaching space of mud and thatch. According to the Fifth All-India Educational Survey, there are more than 6000 schools without any building or with buildings made of non-permanent materials. About 5000 communities are not served by a school at all.

A village school in Siwana Block, Rajasthan, India, consisting of two tiny classrooms, one large veranda and a perimeter wall, with no water supply and no toilet.
In Rajasthan, India lessons are often conducted out of doors, either because it is more comfortable or else because there is no classroom.

The standard classroom in Rajasthan has heavy masonry walls and small, shaded window openings. It is primarily designed to protect its users against excessive heat, yet for a large part of the year, temperatures inside these classrooms are far below what is required for comfort. For four or five months each year it is actually too cold to sit in a conventional classroom in the morning, especially for undernourished and scantily clad children. In the early hours, therefore, classes are often held outdoors, in the sun, against an east or south-east facing wall. After an hour or two it may be more comfortable to sit in the light shade of a tree, and so the class will move. Towards midday the deep shade of a veranda may offer more agreeable conditions. The classroom is often not used at all during this part of the year.
In April and May, however, when the weather becomes really hot, a conventional building with a thick roof provides a better environment than any outdoor location. Classes are also held indoors when it rains. Unfortunately most rural schools in Rajasthan have leaking roofs. However, in most of Rajasthan there are, on average, only a few days of rain (from late October to early June).

Light conditions indoors are often poor. Windows are small, the veranda on one side blocks out much of the light, shutters are sometimes closed to keep out heat and dust, and there are only traces of white paint on ceiling and walls. There is no furniture except, usually, a table for the teacher. The children sit on the floor on thin mats.

The school compound is most often a dusty area without any paving, play equipment or attempts at landscaping. Sometimes there is a perimeter wall, but usually not. More than half of the schools have no water supply and most have no toilets. There is no functioning school health service in Rajasthan.

This case study shows that conventional primary-school buildings in Rajasthan are poor and potentially health-threatening environments. Teachers and students are able to cope with cold, poor light and overcrowding by using a variety of open and semi-open teaching spaces. Other deficiencies, particularly lack of water and sanitary facilities and inadequate maintenance, require a change of emphasis, as advocated in Chapter 4.

Attempts are being made, however, to reorder priorities through the Lok Jumbish Programme for Improvement of Primary Education in Rajasthan. Village education committees have been formed and village-based funds
established for the repair and maintenance of school buildings. Between 1992 and 1996, building development work began in 800 villages. A large number of architectural and engineering consultants continue to participate in this unique research and development effort. The Lok Jumbish programme, with its emphasis on maintenance and repairs, construction of boundary walls and the creation of "gardens of learning", (3) is now beginning to have an impact on the general school buildings programme of the Rajasthan Government. (15)
Case studies

A6
A school in a cold climate:
Hunza, Pakistan

The Karakorum Mountains lie in northern Kashmir. For much of the year the region is gripped by harsh winter conditions (although temperatures in the valley bottoms can climb above 40°C in the summer). The Hunza valley, in the heart of the Karakorums, contains villages which are sometimes cut off by snow and glaciers for several months of the year.

These small and remote villages are very vulnerable to disasters, in particular earthquakes, but also avalanches, mud slides and fires. Since houses are often built closely together to conserve heat, a whole village can be destroyed by one house fire. So if such a fire happens in midwinter the population of the whole village is at risk of dying from exposure.

The Hunza valley was first opened up to road traffic in the late 1970s. Before then, it was largely isolated from Pakistan’s health and education services. When work did start on building schools and health centres, standard designs were often employed. These had been developed for the hot Punjabi plains and the resulting buildings were therefore ill-suited to the freezing conditions of a Hunza winter. Moreover, they had not been designed for a seismically active area.

Radial design for schools in Hunza, Pakistan ensures that pupils and staff can move around under cover. But at the same time each classroom has adequate external walls to ensure good ventilation during the hotter weather.
Motivated by these concerns, the Aga Khan Education Services of Pakistan initiated a programme to help communities build improved rural schools. Concern was also expressed that very few girls were receiving any education. The new programme was designed to place an emphasis on girls' education and included creation of an academy for the higher education of girls. The programme started in the early 1980s and now many of the girls who were among its earliest pupils are employed as teachers and health workers in the region.

The basic school design employed in the programme is modular in form, so that it can be adapted to cope with villages of different sizes and with expansion over time. Each classroom module radiates from a central access area. This means that staff and children can pass between rooms without leaving cover, but at the same time each classroom has adequate external walls to ensure good ventilation during the hotter weather. The classrooms have relatively small windows in the walls to retain the heat, but they also have skylights to maximize the amount of daylight which can enter. But at the same time, the design of the skylights is based on traditional smoke holes in order to prevent too much direct sunlight from entering the classroom, causing glare. Each classroom has an energy-efficient wood-burning stove so that the rooms can be used during the coldest periods of the year. Each child is expected to bring a contribution of firewood during these times.

The schools are constructed of reinforced concrete, with hollow concrete blocks for the walls to increase thermal insulation. The roofs are covered with a layer of earth to increase the thermal mass of the building, provide greater insulation and to protect the layer of waterproofing. The concrete is heavily reinforced with steel so that it can withstand a substantial earthquake. Apart from serving to protect any children in the school at the time of an earthquake, the schools are intended to be a community resource during times of disaster. If a village is struck by an earthquake or a fire, then the school is the one building of reasonable size which can provide basic shelter for everyone.

The schools also serve as a community meeting-place and a venue for activities such as vocational training courses
and literacy classes. To cope with these extra activities, the schools have a very robust structure. They also have a lockable store.

The schools are built by the community, with expert supervision provided by the Aga Khan Housing Board of Pakistan (AKHB-P). Low quality of workmanship is characteristic of many community-built constructions. However, the AKHB-P treats the schools as vehicles for providing training in construction techniques, and therefore insists on the highest standards. It is possible to visit remote villages, many hours drive from the nearest asphalt road, electricity supply or large town, and find a superbly built concrete school perched high in the mountains. More than a hundred of these schools have been built and the programme of construction continues.

A research and development programme has now been initiated to try and modify the school design so that it makes better use of local materials, without significantly reducing its ability to withstand earthquakes. Sanitation provision is another weak area of the original design. At the moment, pour-flush toilets are used, but these are ill-suited to the climate because the water trap can easily freeze. Also, children traditionally clean themselves with stones, which they tend to throw into the toilet, causing it to become blocked. A sister organization, the Aga Khan Health Services, has a research and development project which is developing and promoting forms of dry sanitation more suited to the terrain, the culture and the climate.\textsuperscript{16}
Case studies

A7 Schools at a high altitude: the Altiplano, Bolivia

The Altiplano – or “high plain” – is a plateau in the Andes mountains, covering two-thirds of Bolivia and extending into southern Peru. It is a cold, windy and treeless region, at an altitude of 3500–4000 m. It also contains snow-capped mountain ranges, with peaks reaching above 6000 m. Because of the altitude and lack of cloud cover, the area suffers from extremes of temperature, with daytime highs of 25–30°C and night-time lows well below freezing. The Altiplano is the most heavily populated region of Bolivia. Most people live in small, remote villages.

The majority of the schools consist of simple one- or two-classroom buildings with walls of sun-dried blocks or burnt bricks, and a roof of corrugated iron sheets or tiles. The schools have no heating stoves. So for most of the day, the indoor temperature is far too low for comfort. Outdoor conditions, even if sunny, are often too cold and too windy for sedentary activities.

Since 1993, the United Nations Children’s Fund (UNICEF) has provided 25 schools in the Provinces of Bustillo, Ibanez, Charcas and Bilboa with simple greenhouses built of sun-dried mud blocks, timber and ultraviolet-resistant plastic film (polyethylene). Each greenhouse has a floor area of about 40 m². Similar greenhouses have also been provided for 192 households and villages.\(^7\)
The purpose of these greenhouses is to enable the schools and households to grow vegetables. Some of them work very well and, even on very cold days, provide a comfortable indoor climate. Such a greenhouse could be turned into a classroom and could even be attached to a school building. Classes could use the greenhouse or the conventional classroom according to whichever offered the most favourable and healthy microclimate.

In the cold, windy and sunny conditions of the Altiplano, a greenhouse provides a much better indoor climate than a conventional, unheated classroom. So why not use the greenhouse as a classroom? It could even – though this has not yet been done – be attached to the school building.

To promote personal hygiene among schoolchildren, UNICEF in Bolivia has instigated a pilot project to introduce school bathrooms with solar-heated water. The bathroom units are usually combined with toilets and handwashing facilities.

Some schools on the Altiplano in Bolivia have been provided with hygiene units containing showers with solar-heated water, toilets and handwashing facilities.
Technology options for environmental sanitation

The main purpose of school environmental sanitation is to prevent the exposure of students and staff to pathogenic organisms. Meeting this objective requires: effective human excreta disposal facilities; a regular water supply; safe drinking-water; easy-to-use handwashing arrangements; good drainage; and a functioning system for cleaning the premises and removing waste. Any physical improvements must of course be accompanied by hygiene education.

All these points, but particularly the management of human excreta and related behavioural issues, are heavily influenced by the local natural environment and cultural traditions. Universal prescriptions are of limited value and production of a meaningful manual to cover every situation would be impossible. The purpose of this appendix, therefore, is merely to outline some general principles and indicate the range of technical solutions available.

Human excreta disposal

Human excreta consists of urine and faeces. These two substances have quite different properties.

- **Urine** is basically water and dissolved nutrients. From a health point of view it is reasonably safe, as long as it is not directly deposited in ponds, streams or lakes. In fact, it is of potential value as a fertilizer. Urine is fairly easy to dispose of within a school compound. It can be infiltrated into the ground, evaporated, or collected in a container for use (diluted with water) as a fertilizer.

- **Faeces** consist of water, cellulose fibres, nutrients, bacteria, viruses and parasite eggs. From a health point of view faecal matter is extremely dangerous and many cultures have strong taboos about handling it or cleaning up a faecally-contaminated environment. It is
difficult to dispose of and there are no easy, low-cost methods.

Schools basically have three options for human excreta disposal: drop-and-store, flush-and-discharge, or sanitize-and-reuse.

**Drop-and-store toilets**

A *drop-and-store toilet* is basically a storage chamber for isolating the pathogens contained in faeces so that they cannot spread in the environment. There are three types: the ventilated improved pit toilet (VIP), the traditional pit toilet (TPT) and the toilet with urine separation (TUS).

**The VIP toilet.** Where site, soil and groundwater conditions permit the digging of pits 2–4 m deep, the VIP toilet is a well-tested, robust and long-lasting solution. If properly built and maintained, it is almost odour-free and fly-breeding reduced to a minimum. Variations on the VIP theme have been in use in west Africa since at least the 1940s. In eastern and southern Africa, particularly in Zimbabwe, the VIP toilet has been in use since the 1970s. A full description, including a version for schools with several compartments, can be found in Morgan and in a number of manuals on sanitation published over the past 20 years.\(^{20, 21, 22}\)

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A cross-section of a VIP toilet. The vent-pipe serves two purposes: by drawing air from the pit it creates a down-draught through the drop-hole, so making the toilet odour-free and, when provided with a fly-screen, the vent-pipe acts as a fly-trap.\(^{19}\)

*Source:* (19).

© Ministry of Health, Zimbabwe.
The main disadvantage of the VIP toilet is its high initial cost. Many poor communities claim that they cannot afford to provide their school with toilets of a VIP standard.

**The TPT.** A low-cost alternative to the VIP toilet is the traditional pit toilet. It is reasonably easy to build, given favourable site, soil and groundwater conditions. Its functioning is easy to understand and, like the VIP, it can withstand considerable abuse and still function. The main disadvantages of the traditional pit toilet are that it smells unpleasant and that it generally produces considerable amounts of flies.

The **TUS.** With some modification in design, and changes in user behaviour, it is possible to eliminate or considerably reduce the two aforementioned faults of the pit toilet. A bacterium present in human faeces, *Micrococcus urae*, uses its urease enzyme to split the carbamide in urine into ammonia and carbon dioxide. It is this process that produces the unpleasant smell when human faeces and urine are mixed. The modified toilet, therefore, involves keeping urine and faeces separate. It is most appropriate in areas with a fairly dry climate, and where water is not used for anal cleaning (as the pit must be kept dry).

Pit toilets with urine diversion have recently been developed in El Salvador. The pit and superstructure are no different from those of ordinary toilets. The difference is in the squatting slab or the seat and bowl, which are designed in such a way that urine is collected separately and drained off into a soakage trench. Where this type of
technology options for environmental sanitation

A traditional pit toilet will function much better if urine and faeces are treated separately. The pit should be kept dry and some ash or soil added from time to time. The urine can be collected in a jar or infiltrated into the soil.[99]

A squatting slab with urine diversion; faeces drop down the hole, whereas urine is collected in a pan in front of the drop-hole and diverted to a container or soakage trench.

To reduce the risk of fly-breeding, some dry material (for example, ash, soil, husks or yard sweepings) should be added at the end of every day that the toilet is in use.

Flush toilets

A flush toilet is a machine for mixing water, urine and faeces. The water is used to transport the excreta through pipes to a septic tank on site, or to a lake, river or the ocean via a municipal sewerage system. A water seal prevents odours from coming back up the pipe.

The WC. A typical school in a developing country has no access to a municipal sewerage system. There is usually not enough water to run sewered WCs, nor enough money to operate and maintain them. They would therefore not
be a realistic option in most of the situations described in this document.

A WC is basically a machine for mixing water, urine and faeces.

The pour-flush toilet. In communities where water is traditionally used for anal cleaning, some kind of pour-flush toilet can be an option. The pour-flush toilet has a water seal and is therefore odour-free and fly-proof.\(^{(20, 22, 24)}\)

A pour-flush toilet with two pits. (The drains and pits are still to be covered).\(^{(20)}\)

Sanitize-and-reuse toilets
These toilets are based on the destruction of pathogens and the reuse of urine and/or processed human faeces as fertilizer and soil conditioner. Pathogen destruction is
accomplished either through a dehydration process or decomposition (composting).\(^{223}\)

In most sanitize-and-reuse systems, urine and faeces are treated separately. The best method is never to let the two substances mix. Use of modified squatting slabs and toilet seats will achieve this (see above, the TUS). More examples of toilets designed for urine separation can be found in Winblad and Kilama.\(^{120}\) When urine is collected separately it remains relatively sterile and can often be used as a fertilizer without any further treatment.

So far, toilets based on dehydration or decomposition have not been tested systematically in a school environment. However, the technology is simple and costs can be fairly low. On the other hand, these dry toilets are more easily misused than pit toilets and should be introduced only where sustained competent operation can be expected. The main use for dry-and-reuse technologies is where local conditions rule out any other toilet system: where the ground is too rocky for digging pits; where the groundwater level is too high; where the land is seasonally flooded; or where the environment is so sensitive that any discharges into soil or groundwater would be unacceptable.

**The dehydrating toilet.** The Vietnamese dehydrating toilet is a box with two chambers built above ground. Urine is collected separately and piped into a jar, where it is stored until used as a fertilizer. Faeces drop into one of the chambers (the other is kept closed). Paper used for anal cleaning is put into a metal bucket and burnt.
After defecating, users sprinkle some ash, lime or soil onto the faeces. When the chamber is nearly full it is topped up with soil and the drop-hole is sealed with mud. The second chamber is then used. When the second chamber is nearly full, the first is opened and emptied. The dehydration process kills the pathogens in the faeces and makes them safe for use as a fertilizer and soil conditioner.\(^{(20)}\)

**The composting toilet.** The composting toilet illustrated below was developed by Greenpeace, an environmental organization, in an attempt to protect the sensitive natural environment of the Pacific islands. It is a single-chamber composting toilet, combined with a greenhouse for evapotranspiration of urine and water. A nylon fishing net hanging from hooks fastened to the chamber walls is used to separate solids from liquids. A mat woven from palm leaves sits in the net to catch solid materials. In some cases, strips of polyester torn from old clothing hang from the net. These enhance evaporation by acting as wicks to draw up liquids into the airflow generated by the large-diameter vent-pipe.\(^{(26, 27)}\)

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**Toilets for temporary use**

In times of disaster or emergency, existing toilets may become suddenly unusable. Or special events at a school may require extra temporary toilets for a few days. In dry weather the shallow trench latrine can be used.\(^{(28)}\) In wet
weather, a bucket toilet with urine separation is a possible option. This is less smelly, easier to handle and requires less frequent emptying than a conventional bucket toilet system (which mixes urine and faeces).

This trench latrine for temporary use during emergencies and for occasions when extra toilets are required is about 30 cm deep. Users cover their stools with a small amount of soil. This type of latrine is easier to build than a conventional deep trench latrine and each user has the benefit of a fresh defecation site. The excreta is deposited in the top layer of soil where decomposition occurs quickly.\textsuperscript{(24)}

**Urinals**

Although toilets are used for urination as well as defecation, there are good reasons for schools to provide urinals. Conventionally, urinals are provided only for boys, but they can also be effectively used by girls. Where urinals are provided, the number of toilets required is reduced. A good urinal can be built and maintained at lower cost than a good toilet. As stated above, odours will be reduced if urine and faeces are dealt with separately.

The compost urinal. The simplest form of urinal is an enclosure around a paved floor, with a shallow pit or trench filled with a mixture of dry organic material (grass, leaves and compost). The pit or trench should be no more than 50–60 cm deep. Once a week the urine-soaked organic material should be removed to a compost heap and the trench refilled with dry organic material. A detailed description of a slightly more elaborate – and odour-free – composting urinal can be found in Patel.\textsuperscript{(25)}
A compost urinal for people who squat to urinate.

How many toilets and urinals? Many countries have recommendations about how many toilets and urinals should be provided for a given school population. The figures can vary enormously. In Thailand, it is typically 3 toilets per 100 pupils, while in Viet Nam it is 1 toilet for every 100–200 pupils. Reasons for the wide variations include differences in climate, diet, school hours, proximity of the pupils' homes and so on. It therefore serves little purpose to specify universal norms.

Rainwater collection in a ferrocement tank at a school in Kenya.
Water supply

A primary school needs water for general cleaning purposes, personal hygiene, the operation of WCs and pour-flush toilets, and to water plants. In addition, the school must be able to provide safe drinking-water for students and staff.

Ideally, a school should have its own reliable water-supply system. This may be: piped water from a municipal supply; a gravity-flow system from a natural spring; water drawn from a pond, borehole or well, or collected rainwater. Until such a system is set up, water must be carried to the school, either by vehicle or in bottles and cans by students and staff. The variety of situations and options available is too large to be meaningfully dealt with in this document, but the illustrations show some examples.
Handwashing arrangements

Handwashing can be arranged in many ways and at low cost, even where there is no piped supply of water. The illustrations show a number of examples.

In a school hygiene promotion programme in Botswana, each classroom is provided with pitcher, bucket and soap.

The mukombe is a simple, water-saving handwashing device used in Zambia and Zimbabwe. It is made from the fruit of an indigenous plant. The fruit is hollowed out and the end of the neck fitted with a wooden plug. A slot is cut into the plug so that some water passes through it when the mukombe is tipped forward. For a detailed description see Morgan.19

Source: (19).
© Ministry of Health, Zimbabwe.
In Zimbabwe some schools have a hand-washing device consisting of an open tank fitted with taps. The tank is filled with water that the students bring from home. Water remaining at the end of the week is used for irrigating the school garden. (Over the weekend the tank is dry, so mosquito breeding and algae growth are not a problem during this period.)

In areas where trachoma is a problem, washing facilities should be extended to enable daily face-washing by all students. However, no towels should be provided as this could contribute to the spread of the disease.

A free-standing, double-sided washstand at a school in Thailand. Washbasins and taps are in a lower position on one side to fit smaller children.
Safe drinking-water

Schoolchildren in developing countries sometimes bring their own water bottle to school. Some countries, however, have set minimum standards for the supply of safe drinking-water to pupils. For instance, in Viet Nam, every school is supposed to provide 0.33 litres of boiled water per pupil per day in summer and 0.1 litres in winter.

Some schools boil water to make it safe. Fuel can be saved if this is done on an energy-efficient stove. Examples of stoves are given in Micuta.\(^{(30)}\)

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Women caretaker delivering drinking-water to a school in Rajasthan, India.

A school stove for energy efficient boiling of water.\(^{(32)}\)

Source: (32).
© Belerive Foundation, Switzerland.
Drinking-water can also be disinfected using ultraviolet radiation. In its simplest form the treatment involves filling transparent containers, such as plastic bags with water, then exposing them to sunlight for several hours. Another method is to direct a continuous flow of water through a solar collector. Disinfection is achieved through a combination of ultraviolet radiation and increased temperature.\(^{(31)}\)

**Drainage.** This is an important matter associated with water, its supply and use. All stagnant water around water-supply points should be drained away to flower-beds, trees, banana plants, etc., or to a stone-filled drainage trench.\(^{(20)}\)

**Solid waste disposal**

Schools produce paper, cardboard and plastic waste which has to be collected for disposal. Suitable containers must be provided in classrooms. However, there may not be an organized system of waste collection in the local community. In such instances, paper waste can either be buried in the ground or burnt in an incinerator made from an oil drum. Organic material can be composted, for instance in big cement rings, and used as fertilizer for trees and plants in the school compound. The Ministry of Health in Thailand is currently testing a system of waste separation in schools by providing three containers: for organic waste, non-organic waste and paper.
Composting bins at a primary school in Chachoengsao Province in Thailand.
How to carry out an audit and action plan

Clearly, the maintenance needs of schools vary enormously depending on location, materials, resources available, etc. But some general principles can be identified.

- Funds must be allocated for maintenance and repair. As a general rule, spending on maintenance over a 20-year period, should roughly equal the original construction cost.
- Decisions must be made, with all parties, about who is responsible for what. This may include the children.
- Situations must not be allowed to deteriorate too far before action is taken.
- Routines, both daily and annual, must be developed. For example: children might bring water to school each day; the compound might be cleaned at weekly cleaning sessions; or gardening might be carried out periodically by groups of parents.

The impetus for action on maintenance should be an annual school environmental audit and action plan (SEAAP). This should be used as an opportunity to:

- bring together all the people concerned with the school;
- reinvigorate possibly flagging enthusiasm for daily routines;
- reflect on which matters, if any, have been missed;
- identify obstacles to progress, whether financial, organizational or material.

While each school may have specific requirements, there are some key areas of concern. The following may suggest some useful lines of enquiry.
The compound. Is it secure? Does the perimeter wall or the gate need repairs? Is it being kept clean? Are there neglected or underused corners? Are there opportunities for flower-beds, trees or vegetable plots? Is there any play equipment? If so, does it need repairs? If not, what possibilities exist to acquire some? Are the hard surfaces safe – are there dangerous steps or broken concrete? Is the compound clean? Are the children actively involved in keeping it clean?

The school buildings. Is the main structure sound? Is the roof leaking? Are there broken windows or doors? If so, have they been made safe? Are there broken or missing handrails? Are the floors dry and can they be kept clean? Do any areas require whitewash?

Furniture. Do the blackboards need repainting? Are the desks and chairs safe?

Drinking-water. Is there an adequate supply of drinking-water? If not, what can be done about it? If the drinking-water is being stored on the premises, is it being adequately protected from contamination? Can children freely take water without contaminating it for others?

Handwashing. Is there adequate provision for handwashing? Is the supply of water reliable? If not, are there possibilities for on-site water storage? Do all the taps work? Is water being wasted? Is the handwashing facility conveniently placed in relation to the toilets? Can small children use it easily? Is there soap? If not, what can be done to provide soap or a substitute? Are children constantly reminded of the need to wash their hands? Do staff wash their hands and are they seen to do so?

Sanitation. Are there toilets and urinals? Are there enough? Are they clean? Do they smell? Do they all work? Can they be used in all weathers? Who is responsible for providing them? Who is responsible for maintaining them? Who is responsible for cleaning them? If toilet paper is used, is there enough and who provides it? If water is used for cleaning, is there enough and who provides it? What are the children’s attitudes to the toilets? Is there any reluctance to use them due to smells, dirt or lack of privacy?
**Waste.** Who is responsible for cleaning the classrooms and the compound? Where is waste stored? Is it adequately contained and protected from vermin? Is it regularly removed from the site? If not, who is responsible?

These questions are of little use unless they can lead to action. In some cases the action may involve mobilizing key members of the parent–teacher association to exert political pressure on local government, for example to provide a better water supply or more regular waste collection. In other cases it may lead to a day of collective work by parents, staff and children to repair, clean or build. Other issues may require new daily routines such as cleaning rotas for the compound and toilets.

All decisions for action should be recorded. The following year the decisions of the previous SEAAP should be compared against performance.

Local and national authorities should ensure that maintenance and repair work is done by the most appropriate body. For instance, most maintenance and repair jobs are very small and do not require the intervention of engineers and skilled labour. A Ministry of Education could have a minor works department responsible for day-to-day maintenance, calling on the Ministry of Works (or its equivalent) only when more major construction work is required. In this way overall resources can be conserved.
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Index

Afghanistan .................................................. 9
Bangladesh .................................................. 12, 27
Bolivia
  Altiplano .................................................. 52-53
Botswana .................................................. 64
Central America ........................................ 5, 6
Cleaning .......... vi, 10, 18, 20, 29-30, 34, 36, 54, 62, 63, 69, 70, 71
Climate .............. 3, 6, 7, 24, 25, 27, 37, 43-44, 45-48, 49-51, 52-53, 56
Colombia .............. 11, 37-39
  Bogotá .................................................. 37-39
Commitment & motivation .......... vi, vii, 10, 13, 19-20, 31, 36
Communal self-help .......... 10, 11, 28, 40
  Harambee .................................................. 41-42
Compound ......................... 9, 14, 18, 21,
  30, 33, 34, 35, 39, 43, 47, 54, 67, 69, 70, 71
Construction ................. iv, vi, vii, 3, 4, 6, 9, 10, 12,
  16, 19, 24, 28, 29, 31, 33, 34, 40-42, 43, 50-51, 71
Contaminated water .......... 15, 22, 35, 70
Costa Rica ........................................ vi, v, 5
Defecation ....................... 4, 14, 21, 22, 35, 60, 61
Design ................. iv, vii, 9, 11, 13, 31, 32, 42, 51
  standard design ........ vi, 2-6, 13, 17, 20, 49
Drainage ......................... 54, 67
Drinking-water .......... vi, 15, 18, 20, 22, 34, 38, 54, 63, 66-67, 70
Ecuador ........................................ 3
Eastern Africa ......................... 21, 55
El Salvador ........................................ 56
Excreta ......................... 54, 61
“F-diagram” ......................... 15
Faeces/faecal material ................ vi, 2, 14, 18, 20, 21, 33, 54, 56-60
Furniture ..................... 1, 3, 10, 14, 17, 39, 41, 42, 43, 47, 70
Gambia (the) ..................... 10, 25, 26
  Banjul ........................................ 5, 10
Greenhouses ......................... 52-53, 60
Handwashing .......... vi, 14, 18, 20, 22-23, 32, 34, 35, 53, 54, 64-65, 70
Health problems

acute respiratory infections .................................. v, 15, 16
airborne bacteria and viruses .................................. 16
allergies .............................................................. v
asthma .............................................................. v, 16
carcinomas .......................................................... 16
chronic respiratory diseases .................................... 16
dengue fever ........................................................ 15
eye problems ......................................................... v, 16, 39
gastrointestinal diseases ......................................... v
goitre ................................................................. 44
headaches ............................................................ 16
hearing ................................................................. 16, 39
heat stroke ........................................................... 15
helminth infections ............................................... v, 14
hookworm ............................................................. 17
infectious diseases ............................................... 5, 9, 16, 17, 28
injuries ............................................................... 9, 15
malaria ................................................................. 39, 44
malnutrition .......................................................... 14, 15
poor diet .............................................................. v
respiratory ailments ............................................... v
schistosomiasis ..................................................... 15
trachoma ............................................................. v, 44, 65
urinary tract infections .......................................... v, 17

India

Madras ............................................................... 35–36
Rajasthan ............................................................ 6, 7, 8, 28, 45–48, 63, 66, 67
Indoor air quality/pollution ...................................... 14, 16
Kenya ...................................................................... 40–42, 62
Nyanza Province .................................................... 8, 24
Latin America ....................................................... 37–39
Light(ing) .............................................................. vi, 1, 14, 16, 20, 23–26, 32, 34, 47, 50
Location ............................................................... 14, 17–18, 69
Microclimate .......................................................... 14, 15, 34, 52
Noise ..................................................................... 14, 16, 27
Operation & maintenance ....................................... vii, 3, 11, 31, 32, 33
Pakistan

Hunza (Karakorum Mountains) ................................. 12, 49–51
Parents ................................................................. vii, 8, 21, 23, 28, 32
"community mothers" .............................................. 11
parent–teacher association ...................................... 33, 34, 71
Plants & trees ........................................................ 7, 9, 27, 33, 34, 46, 63, 67, 70
Protection from the elements ........................................ vi, 16, 20, 24–27
Sanitation .................................................. 3, 14, 29, 32, 34, 44, 51, 54, 55
School as a living organism ....................................... 31–32
School environmental audit and action plan (SEAAP) ........... 69, 71
South America ................................................. 3, 20
South-east Asia .................................................. 20
Southern Africa .................................................. 21, 55
Soviet Union (former) .......................................... 3
Structural dangers .................................................. 9, 14, 16–17, 28, 30, 34
maintenance/repair ........................................... 1, 3, 6, 9, 13,
20, 28, 29, 34, 36, 39, 41–42, 47, 48, 69, 71
safety ........................................................... vi, 16–17, 20, 28–29, 70
safety audit ....................................................... 28
Tajikistan .......................................................... 4
Temperature ...................................................... 15, 27, 37, 43, 45, 46, 49, 52, 67
Thailand .......................................................... v, 62, 65
Chachoengsao Province ........................................... 67, 68
Toilets ................. 2, 9, 10, 12, 14, 18, 21, 29, 33, 35, 44, 47, 53, 62, 70
composting toilet ................................................. 59–60
dehydrating toilet .............................................. 59–60
drop-and-store toilet ............................................. 55
flush toilet ......................................................... 57
flush-and-discharge toilet ....................................... 55
pit toilet .......................................................... 10, 15, 29, 59
pour-flush toilet ............................................... 15, 51, 58, 63
sanitize-and-reuse toilet ...................................... 55, 58–59
toilets for temporary use ........................................ 60–61
TPT ............................................................... 55, 56
TUS ............................................................... 56–57
VIP toilet ........................................................ 15, 21, 55–56
WC ............................................................... 4, 38, 57, 63
Urinals ........................................................... 33, 57–58, 61–62, 70
compost urinal ................................................... 61
Urine ............................................................. 14, 54, 56–59
urine diversion/separation ...................................... 56–57, 59, 61
Viet Nam ........................................................ 12, 22, 25, 29, 62, 66
Ninh Binh Province ........................................... 25, 43–44
Waste .......................................................... 9, 15, 17, 18, 32, 33, 34, 35, 54, 71
collection ....................................................... 30, 67, 71
hazardous waste ............................................... 18
medical waste .................................................. 9
solid waste ..................................................... 67
<table>
<thead>
<tr>
<th>Category</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>3, 9, 10, 14, 18, 22–23, 32, 34, 35, 69, 70</td>
</tr>
<tr>
<td>solar-heated</td>
<td>53</td>
</tr>
<tr>
<td>Water &amp; sanitation</td>
<td>vi, vii, 3, 31, 33, 34</td>
</tr>
<tr>
<td>Water supply</td>
<td>1, 2, 32, 34, 35, 38, 44, 47, 54, 63, 64, 71</td>
</tr>
<tr>
<td>West Africa</td>
<td>4, 6, 10, 55</td>
</tr>
<tr>
<td>Zambia</td>
<td>64</td>
</tr>
<tr>
<td>Eastern Province</td>
<td>24</td>
</tr>
<tr>
<td>Petauke District</td>
<td>7</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>21, 55, 64, 65</td>
</tr>
</tbody>
</table>