Innovation and Lessons Learned

in Syrian Public School Construction

Author: Eng. Alexis Doucet (text, drawings and graphic layout)

Arabic version supervision: Arch. Alma Al Sayed

Arabic translation: Hazem Ibrahim

Première Urgence

INNOVATION
AND
LESSONS LEARNED

IN SYRIAN PUBLIC SCHOOL CONSTRUCTION

2011

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Acknowledgement

This compendium is a collaborative effort between Première Urgence, UNICEF, the Syrian Ministry of Education (MoE), and five Non-Governmental Organizations (NGOs) working in the field of school construction and rehabilitation in Syria: the Danish Refugee Council (DRC), Help, Secours Islamique France (SIF), Action Against Hunger – Spain (ACF) and the Swiss Agency for Development and Cooperation (SDC). It is the result of a series of workshops held at the Ministry of Education between November 2010 and January 2011, aiming at sharing innovation, lessons learned and good practices in school construction and rehabilitation.

As the initiator and coordinator of the process, Première Urgence would like to express its sincere gratitude to Ms. Hind Slaibi and Mr. Abdel Salam Salameh from the Ministry of Education and UNICEF for their support in the establishment of the workshops and of this book. Première Urgence would also like to convey acknowledgement to Ms. Beatriz Riesco Garcia (ACH), Mr. Jens Christian Christensen (DRC), Ms. Souad Abbas (DRC), Mr. Eberhard Wissinger (Help), Ms. Samar Sariafi (MoE), Mr. Ivan Vuarambon (SDC), Ms. Hélène Greiche (SIF), Mr. Maher Al-Kubaisi (SIF), Ms. Ola Diab (UNICEF) and Mr. Monaf Yosef (UNICEF), whose expertise contributed to the elaboration of the workshops and to the realization of this book.

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Première Urgence

Foreword

In collaboration between UNICEF, Première Urgence and some other NGOs (ACF, DRC, SIF, Help and SDC), a workshop was held at the Ministry of Education on "Innovation and lessons learned in public school construction in Syria". This workshop has contributed to enriching the expertise of a number of engineers in the Public Commission for Educational Buildings, who have participated in the workshop. The workshop focused on two themes: identifying current challenges and looking into the experiences of participating NGOs.

In terms of the challenges identified, the discussion addressed the characteristics of current buildings and the set of factors and constraints to their development, design process details, and how school construction projects are studied and implemented.

The workshop looked also into the experiences of all the organizations' architects and engineers in several projects, which were interested in increasing the value of architectural and structural features as well as all engineering aspects of the school building in the country.

At the end of the workshop, participants visited one of the school building development projects that were undertaken by Première Urgence in Jaramana area and funded by UNHCR.

The workshop has enhanced the capacity of participants in several areas including:

- **H**aving a common vision among participants towards school buildings;
- **E**nsuring integration of efforts among those in charge of developing school buildings;
- **R**einforcing the role of school administration, pupils and parents in making decisions regarding developing the school building, following a participatory approach;
- **R**einforcing the value of design elements of school buildings;
- **R**eaffirming the correct local architectural elements by removing all elements that prevent effective utilization.
- **I**ncreasing attention to and reinforcing the principles of ergonomics in all architectural elements of the building;
- **U**tilizing all local potentials and capacities, such as students of vocational and industrial institutes, in the construction and equipment of school buildings;
- **E**mphasizing the importance of structural elements related to mitigation of earthquake risks.
- **A**chieving required balance between engineering elements of the school building.

Participants proposed to give greater opportunities to discuss current models and to look into experiences of such organizations.

Director-General of Public Commission for Educational Buildings

Eng. Hind Slaibi

CHAPTER 0 INTRODUCTION

1. About this book

This document features some of the most notable innovations and lessons learned from several organizations working in the field of public school construction and rehabilitation in Syria, incorporating updated information as of early 2011.

They are presented here to highlight the innovative practices undertaken by partners to improve the quality of the school infrastructure, and to share the lessons learned as well as the good practices identified with the professionals working in future projects.

fig. 0.1 Lessons Learned Workshops at the Ministry of Education

2. Initiative

The process of collecting the lessons learned and the innovations of several organizations working in the field of school construction and rehabilitation in Syria was initiated and coordinated by Première Urgence, with the financial support of UNICEF. The objectives of this collection was to exchange good practices between professionals, centralize the information and hand it over to the Syrian Ministry of Education and the Local Administrations.

The workshops and the book have been guided by a main idea: a radical progress can be achieved in architectural design if we can simultaneously **be creative** and **learn from past experiences**.

Creativity can be a critical accelerator of progress, while learning from past experiences is basically an essential condition, if we are to avoid restarting each invention from scratch. This can be illustrated as in the graph below.

This book is the analysis of a set of experiences, challenges and conclusions of the activities we proposed and can be used as a basis for future projects, to invest creativity and research on the critical and unsolved challenges, such as recent changes (e.g. new curriculum, dwindling of water resources) or local specificities (e.g. sand storms, lack of resources).

The scope of this process of lessons learned is hence not to identify final designs for the professionals, but to initiate a database of solutions to experienced issues, for them to focus on the remaining challenges and work on the creation of contemporary and locally adapted solutions.

3. Methodology

PU gathered the experience of a variety of actors involved in different projects and contexts, and drawing practical conclusions from them can be difficult. In some specific fields, most organizations were sharing the same level of experience and had faced the same issues, leading to a rich debate on how to address them, while in other fields, only one organization had lessons to share.

Four focus areas have guided our work, as reflected in the chapters of this book:

1 • Architectural Design;

2 • Water, Sanitation and Hygiene;

3 • Equipment;

4 • Procurement, Execution and Handing over.

The examples treated in the book provide evidence of lessons learned in all four areas.

3.1. Rationale

In an attempt to rationalize the information collection process, the workshops have followed a three-step rationale, also reflected in the substructure of the chapters.

Challenges

In the first step, the general constraints were identified, as well as the recurrent issues and remaining challenges one can face when designing a specific element. These challenges can arise from the architectural program itself (the function) or be related to human, climatic or technical constraints. These issues were collected from the different organizations and then compiled; they represent a collective work that can be used by other designers as a checklist when starting a new design, or as criteria when evaluating different existing design options.

Solutions

The second step consisted in showing the solutions engineered by organizations in order to address the challenges identified in the first step. These are individual works, proposing different options, deriving from diverse contexts or concerns.

Lessons learned

In the third step, the lessons learned were analyzed: after identifying issues and testing solutions to address them, the results were not all satisfactory, since new issues sometimes emerged from the solution itself.

In an attempt to encourage the debates during the workshops and in order to confront directly the practices from different actors in common fields, we have treated each of the five main topics element-by-element, and not organization-by-organization, so that the elements are confronted to each other in a direct way.

Icons

Each identified challenge within this book is represented with an icon. The purpose of this is to help the reader interested in addressing one particular issue find quickly the related solutions and remarks.

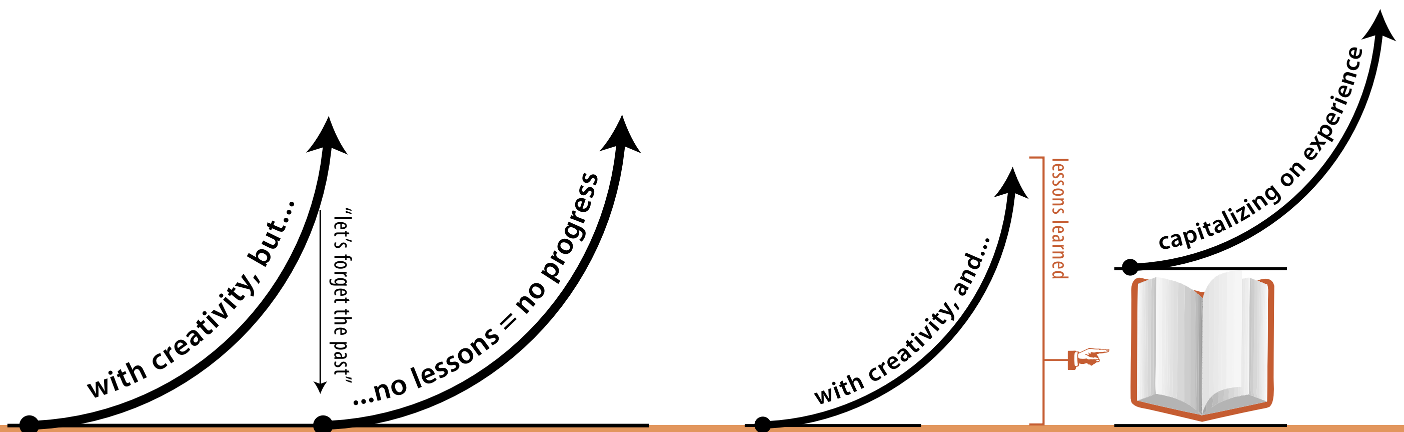
A black icon on the left shows where a challenge is first defined and explained.

An icon on the right shows where information can be found on solutions addressing the specified challenge. A green icon stands for a successful solution or good practice; a red one either a breach, a lesson learned or a practice to be avoided.

A legend with all these challenges and their icons can be found at the end of this book [see "Addressing challenges" on page 102].

4. Contributing Organizations

Apart from Première Urgence and the Syrian Ministry of Education, which is the main recipient of this book, six other organizations have participated in the workshops. Each of them is experienced and has expertise in one or several fields related to the improvement of school infrastructure in Syria.



4.1. Première Urgence

Première Urgence is an international humanitarian NGO. Its mission is to provide first-hand and immediate assistance to people who are victims of natural and economic disasters or conflicts, usually in war zones or forgotten crises.

PU in Syria

Première Urgence (PU) has been developing projects in Syria since 2008 to support Iraqi refugees.

After discussions with the Syrian Arab Red Crescent (SARC) and the Ministry of Education, PU decided to concentrate its efforts on education issues. Indeed, the af ux of Iraqi families in Syria and the presence of tens of thousands of Iraqi children in the public system significantly impacted the quality of education for both refugees and hosting communities.

Première Urgence works directly in the schools catering for both Iraqi refugees and Syrians, setting up programs of school rehabilitation and construction, remedial classes, vocational training and professional toolkits. The five-year plan of the Ministry of Education and the Child Friendly School Concept are two milestones of Première Urgence's work in Syria.

Thanks to the financial help of UNHCR and UNICEF, Première Urgence has built and equipped two new schools, five school extensions, and rehabilitated 33 other existing schools (especially sanitary facilities). Seven other schools are under rehabilitation with the objective of becoming more child-friendly.

All these activities have taken place within the governorate of Rural Damascus: in Jaramana, Sahnaya and Tell. However the geographical context, recurrent challenges are faced: lack of space in urban areas, double shift systems in schools, and a high level of vandalism from people living outside the neighborhood.

All PU's projects are designed in an innovative and sustainable way. The design of the rehabilitation and construction works, the technical equipment provided as well as the methodology developed in our educational projects are all examples of PU capacity of innovation. Those experiences are transferred to PU Syrian partners in order to insure long term effects.

Working with the Ministry of Education, Première Urgence endeavors to adapt to the Syrian context and to work in close collaboration with the local authorities. All projects are handed over to the Ministry of Education workers, who are in charge of the maintenance of the new and/or rehabilitated structures. Following the same principle, this book is handing over the lessons learned from the program and the design solutions.

4.2. Danish Refugee Council

The Danish Refugee Council (DRC) is a humanitarian, non-governmental, non-profit organization founded in 1956 that works in more than 30 countries throughout the world.

DRC fulfills its mandate by providing direct assistance to conflict-affected populations – refugees, internally displaced people (IDPs) and host communities in the conflict areas of the world; and by advocating on behalf of conflict-affected populations internationally, and in Denmark, on the basis of humanitarian principles and the Human Rights Declaration. DRC actively participates in supporting the protection of refugees, and promoting durable solutions for conflict-affected populations.

DRC in Syria

In Syria, the overall development objective focuses on the Iraqi refugees but recognizes that their host communities are as well affected by displacement and other groups like Palestinians need support. The objective emphasizes that durable solutions for all groups need to be promoted but also that it is important to preserve / protect social systems already institutionalized.

DRC was one of the first INGOs to receive in 2007 accreditation from the Syrian government to provide assistance to Iraqi refugees. DRC started operations in Syria in May 2008 by taking over and managing 8 community centers in Damascus in cooperation with the Syrian Arab Red Crescent (SARC) and UNHCR. DRC engaged then in the Education sector and rehabilitated 7 primary and secondary schools in Damascus with the support of the Ministry of Education (MoE) and UNHCR.

The Syria program has developed since then and DRC is now active in the sectors of Community Services and Education in and outside Damascus. Livelihood support to refugees has been launched in mid-2009 and is foreseen as the 3rd main area of DRC intervention. 2009 activities are divided as follows:

- **C**ommunity Services: Developing the 5 community centers located in Damascus and establishing 2 new centers in Homs and Daraa, which provide information and social / recreational support to refugees;
- **E**ducation: Capacity building of the MoE through school rehabilitation, extension, equipping, staff's training, and direct educational support to children via non formal education activities;
- **L**ivelihood support: Providing support to specific groups at risk (adolescents and women) through vocational training, social counseling and any supplementary assistance.

4.3. Help

Help – Hilfe zur Selbsthilfe[1] e.V. – is a German non-governmental relief organization founded in July 1981 in the wake of the war in Afghanistan.

Hilfe zur Selbsthilfe e.V.

Working with refugees throughout the world is a particular responsibility of Help's humanitarian work. HELP assists people in need irrespective of origin, philosophy, race or creed. Any support is solely based on the needs of those requiring assistance.

HELP assistance is fast and unbureaucratic, and includes long-term perspectives. In acute situations, HELP's relief work generally focuses on short-term assistance, while development work addresses problems of a more chronic nature.

HELP has adopted the principles and the Code of Conduct for Non-governmental organizations.

Within the framework of HELP's membership in the Coordination Committee for Humanitarian Assistance and the NGO consortium 'Aktion Deutschland Hilft', the organization participates actively in the development of operational standards, intervention strategies and other relevant issues.

HELP has signed the Code of Conduct of the International Red Cross and Red Crescent Movement and NGOs in Disaster Relief. It adheres to the operational standards as described in the 'Humanitarian Charter and Minimum Standards in Disaster Responses' of the Sphere Project.

Help in Syria

HELP is active in Syria since 2008. With the financial support of the German Foreign Office and of UNICEF-Syria, HELP contributed to the international response to Syria's call for assistance during the protracted refugee crisis.

HELP's operations in Syria focused since on the fields of educational infrastructure improvements, remedial education, livelihoods development training and social supports in Rural Damascus and in refugee camps.

HELP's team in Syria disposes of an internationally confirmed experience particularly in school construction, WASH, livelihoods redevelopment, emergency operations and fast track assistance management. Thus, HELP was able to produce quickly efficient results and to merge Syrian standards with international and its own experience.

The technical innovations introduced with HELP's activities in Syria concerned till date primarily safety design for schools including improved earthquake resistance and water treatment through intermediate technologies.

1 "Help to self-help"

4.4. Secours Islamique France

Secours Islamique France (SIF) is a French non-governmental organization founded in 1991.

SIF's Mission is to alleviate the suffering of the poorest people in France and around the world; it acts wherever humanitarian and social needs require mobilization of emergency relief and implementation of development programs.

SIF in Syria

SIF has opened an office in Syria in 2008 and started its action by providing assistance to 9000 Iraqi through Non-Food Items (NFI) distribution.

Meanwhile, SIF has been monitoring the situation of those affected by the drought in North East Syria. The release of the Syria Drought Response Plan drew our attention to the fact that the needs of the population were not being fully met.

As a response, SIF opened an office in Raqqa in July 2010 and started a Water, Sanitation and Hygiene (WASH) project in the schools in cooperation with the Ministry of Education.

The project aims at bringing a contribution to the improvement of the well-being and health status of the children and their families in the governorate of Raqqa through the renovation and construction of sanitation facilities as well as the promotion of good hygiene practices.

SIF is working in 26 schools in 6 different districts of the province, selected according to vulnerability criteria. The challenge consisted in providing an adapted and durable response to a very specific situation:

- **T**he 26 schools are located in remote areas;
- **T**he migration of population due to the drought jeopardizes the existence of some schools that could disappear in a few years;
- **T**he water is a scarce resource.

SIF developed the concept of prefabricated toilets, manufactured in Damascus and delivered directly to the schools. With a life expectancy of 50 years, built with high quality material and designed in order to avoid water waste, the toilets are mobile and can be easily removed and relocated if needed.

4.5. *Action Against Hunger - Spain*

Action Against Hunger (ACF)[2] is an international non-governmental organization that is private, apolitical, nondenominational and non-profit. It was created in France in 1979 to act all over the world.

Its mission is to fight against hunger, physical suffering and emergency situations that threaten men, women and children.

ACF in Syria

ACF in Syria has accomplished its legal registration in the end of 2008. The office was opened in March 2009.

With the main mandate of targeting the Iraqi refugees, in partnership with SARC, ACF started off with the implementation of a nutrition project for the good child development and prevention of malnutrition.

ACF received approval for a second project focused on WASH for the support to the school environment and well-being of vulnerable Syrian and Iraqi refugee children.

The third and ongoing project focuses on vocational training. As for the Syrian population, ACF designed a 4-year development program with the Arab Center for the Study of Arid Zones and Dry Lands (ACSAD).

All the projects are located in the North East, the most vulnerable region of Syria concerning nutrition, food insecurity, loss of income and employment, decreased rainfall, desertification, migration, decrease of water supply and quality.

Starting in September 2009, the WASH Project has the specific objective of improving in a sustainable way the Water, Sanitation and Hygiene environment through the improvement of hygiene practices, rehabilitation and maintenance of infrastructures in 18 primary schools (6-12 years old students), Hassakeh Governorate, through: rehabilitation of the water and sanitation infrastructures (water supply and hand washing infrastructures, latrines, handicap design toilets, potable water availability) and hygiene education sessions (School Health Curriculum, hygiene kits, trainings, workshops).

4.6. *SDC*

The Swiss Agency for Development and Cooperation (SDC) is Switzerland's international cooperation agency within the Federal Department of Foreign Affairs (FDFA). In operating with other federal offices concerned, SDC is responsible for the overall coordination of development activities and cooperation with Eastern Europe, as well as for the humanitarian aid delivered by the Swiss Confederation.

The goal of development cooperation is that of reducing poverty. It is meant to foster economic self-reliance and state autonomy, to contribute to the improvement of production conditions, to help in finding solutions to environmental problems, and to provide better access to education and basic healthcare services.

SDC in Syria

The Swiss agency for Development and Cooperation (SDC) office was established in Syria in 2005.

The Syrian office is part of a Regional approach coordinated in Amman and implementing projects in Jordan, Lebanon and Iraq.

SDC Mission and Strategic Objectives are to contribute to safe, viable and peaceful living conditions in the Middle East:

- **F**ostering inclusive and more cohesive societies;
- **I**mproving the delivery of key state functions;
- **C**atalyzing sustainable socioeconomic development.

SDC focuses on three major thematic areas of cooperation:

- **B**asic Services and Livelihoods where the focus is on improving living conditions of refugees, IDPs, vulnerable groups and vulnerable migrants.
- **P**rotection and Human Rights. In this area the focus is on building capacities of refugees, IDPs, vulnerable groups and migrants to exercise rights.
- **D**isaster Risk Reduction: SDC is interested here to enhance coping mechanisms to prevent and mitigate human-made and technological crises (including water scarcity).

2 ACF stands for "Action Contre la Faim", in French

4.7. UNICEF

United Nations Children's Fund (UNICEF[3]) is an agency of the United Nations created in 1946, originally to provide emergency food and health care to children in countries that had been devastated by World War II.

Nowadays, UNICEF provides long-term humanitarian and developmental assistance to aid education and the health of children and mothers in developing countries.

It is mandated by the United Nations General Assembly to advocate for the protection of children's rights, to help meet their basic needs and to expand their opportunities to reach their full potential.

UNICEF in Syria

UNICEF has been active in Syria since 1971, guided by the Convention on the Rights of the Child, which was signed by the Syrian Government on 1989.

UNICEF's assistance in Syria has shifted over the years to adapt to the Syrian context and new realities, including Syria's Middle-Income Country status.

UNICEF Syria's programming, in line with national priorities and needs, focuses on the following interventions:

- Improved quality of basic services for children and women;
- Advocate for the development of policy initiatives that put children first;
- Adolescents Development and Participation;
- Humanitarian support to Iraqi Refugees children and women.

In early 2007, UNICEF launched a five-year project aimed at transforming the Syrian basic education schools into Child Friendly Schools (CFS).

UNICEF's collaborative work with partners MoE, CFS model for Syria was developed through a participatory approach, consolidated and adapted as one of the strategies for improving quality of basic education by MoE as reflected in the 2010 basic education national planning document targeting age cohort 6-15 years. CFS standards founded on the principles of the four pillars: **Participation**, **Pedagogy**, **Protection** and **Physical environment**[4] has been formalized and mainstreamed within the Syrian system of education essentially to contribute to addressing a wide range of needs of children to access quality basic education, stay through and complete their learning process.

Child Friendly Schools aim to instill positive attitudes in their students and provide a joyful and attractive learning space, free of corporal punishment and reaching out to the parents and the local communities to create networks of support to the education process.

Following the successful adaptation of 53 UNRWA schools into child friendly schools in 2006, UNICEF's Palestinian Programme expanded the experience to all UNRWA 118 schools. In line with its commitment to engage in humanitarian and emergency programming in Syria, UNICEF also launched, in the summer of 2007, the Humanitarian Support Programme for Iraqi refugees, which offers assistance to refugee children and their families, through direct and capacity building support to basic social services system and policies, in the areas of health & nutrition, education, child protection, and adolescent development and participation.

The Humanitarian support was strategically integrated within the UNICEF overall plan to promote, specifically in the Education sector, quality, build capacity of MOE staff, enhance community participation in school planning, provide technical oversight to improved school physical environment creating a solid foundation for addressing educational challenges such as school drop out, equity, gender dynamics and psychosocial support as major part of CFS vision.

3 In 1953, UNICEF became a permanent part of the United Nations System and its name was shortened from the original United Nations International Children's Emergency Fund but it has continued to be known by the popular acronym based on this old name.

4 See "1.1. Child Friendly Schools (CFS)" on page 16

CHAPTER 1 ARCHITECTURAL DESIGN

1. Some identified challenges

1.1. Child Friendly Schools (CFS)

CFS is a broad topic, which cannot be treated in a few lines, and whose implications often concern how the school is managed, rather than how it is designed.

However, based on the available literature and the published guidelines, here are some of the main challenges that need to be taken into consideration when designin the building.

Inclusivity & accessibility

The school design should respond to the diversity of children **size**, **gender** and **ability level**.

Children with physical disabilities, such as wheelchair users, should have full access to all parts and features of the school without assistance.

Quality teaching & active learning

CFS should promote good quality teaching and learning processes, notably with active learning methods. These methods have a deep impact in the equipment design (see the chapter on that topic), but also on some architectural features, such as the dais in the classrooms, the libraries, multi-purpose rooms, etc.

Participation

The concept of CFS promotes communication, synergy and collaboration between pupils, parents, teachers, school administration and local community representatives, notably thanks to the creation of a school board.

This synergy can be enhanced during the school design phase, by making the school boards actively participate to the decision processes.

Making future users participate to the school design will enhance their sense of responsibility and ownership for the school infrastructure and improve its maintenance. It will also avoid some design mistakes related to the lack of knowledge of how the school is used. In this prospect, the school janitors deserve a maximal consideration, in order to facilitate their daily work of cleaning and maintenance.

Safety

The school should ensure every child an environment that is physically safe and emotionally secure.

Threats related to architectural design are numerous: falling, bumping the head or the limbs on corners, doors, etc. The easy access to an infirmary within the school can be very useful in case of injuries.

International norms of fire prevention and earthquake resilience should be applied wherever possible.

The architectural design should also help to defend and protect all children from abuse and harm. A particular attention to visual control in the architecture can reduce the risk of harassment from other pupils (e.g. through judiciously placed windows).

Physical health

The building should ensure a healthy, hygienic, and safe learning environment. The choice of materials (such as paint, tiles) and the quality of ventilation can be decisive in this prospect.

Psycho-social health, well-being and motivation

Social counseling is essential and is best done with a dedicated room for the counselor.

A colorful environment with creative shapes and drawings will contribute to creating an attractive and joyful environment, auspicious to learning and in which children feel happy, motivated, ready to learn, and live positive experiences.

A creative architectural environment can also help develop creativity of children.

1.2. Other challenges

Challenges that are not directly related to the concept of CFS include:

Security & Vandalism

The building should be safe from theft and vandalism. However the metallic protections usually used to secure a building, frequently enter in conflict with the challenge of creating an attractive and joyful environment for the children.

Quality & Durability

Even in the absence of vandalism, some architectural elements will tend to get damaged easily:

- Mechanical (movable) parts of a building, such as doors, windows, hinges and plumbing are fragile and should be reduced to the minimum;
- All exposed surfaces, such as corridor and classroom walls, waterproofing membranes and floors.

These elements should be made as durable as possible.

Daily cleaning

The daily maintenance and floor cleaning with water should be made easy, through the reduction of corners, the use of skirting and parapets, and the provision of drains on the floor.

Urban density & Expandability

There is an increasing lack of space in some Syrian urban areas, and the population density is still increasing. Therefore, the existing schools must sometimes increase their capacity by expanding inside their own compounds.

Standardization& f exibility

On the one hand, any building has a unique setting and environment, with different street accesses, plot shape, orientation to the sun and wind (and on a national level, even climate is changing), which is why any school should theoretically be unique in its design.

On the other hand, local administrations might not always have the time or the capacity to draw a new building from scratch, which is why a fixed number of standardized school models should be proposed to them.

For this reason, proposing flexible school models (especially standard structures allowing different room layouts), and adapting these to the local context is one of the main challenges of school design. The flexibility of the structure will also be useful over time, when different room arrangements will be needed.

Sustainability & passive climate-responsive design

Climate is changing from place to place, while the thermal comfort needs of humans are rather stable. This has led to a variety of architectural models and traditions through the world, to fight against (or favor) light, heat, wind and rain.

Today, technical progress has blurred the frontiers of what is suitable for a specific climate and what is not: most of the architects' mistakes can be corrected by high-tech add-ons, but such misadjusted solutions will inevitably be unsustainable, either consuming a lot of energy (Air Conditioning) or requiring an important amount of maintenance (mechanical shutters).

For this reason, the challenge is to create an architectural response that is adapted and "passive", i.e. a building that is answering to the climatic constraints and human needs, but without mechanical or energy consuming elements such as coolers, fans, lighting, electrical shutters or heaters. With the energy crisis, this challenge will be even more critical in the future years.

Cost

Everything is achievable when the budget is not limited; the real performance from the architect comes when great improvements are brought to the school design within a limited budget.

When used as a criterion of evaluation, cost should be separated into two distinct concepts: the construction cost and the cost-in-use. These two concepts are often bringing opposite solutions, since high quality buildings will need a higher initial investment but will also often resist longer without a lot of maintenance. Comparing the real cost of different solutions should hence be done in respect of its entire lifetime.

Maintenance

Maintenance needs should be reduced to the minimum, and when maintenance works are necessary, they should be easily done and affordable.

2. Design solutions

2.1. The classroom

UNICEF

When the new curriculum was established, UNICEF studied the concept of active learning class, comprising new pieces of furniture [cf. "UNICEF" on page 74] and the classroom space necessary for using them easily with a class of 25 to 30 children. While some pieces of equipment have already been produced and used, the classroom design presented here has not been implemented yet, and hence has no real lesson learned to offer. It should rather be considered as an initial proposed guideline or source of reflection.

- The recommended dimensions for these new classrooms are larger than the existing ones: 8 by 6,5 meters;
- For a class of 30 pupils, such a classroom is hence requiring 1.7m²/child, instead of the usual 1.2m²/child; this extra space is necessary to allow the reorganization of the pupils' desks in diverse layouts and include the active learning equipments in the lateral cupboards.
- Ideally, there should be windows on the two lateral sides, to ensure good and equitable lighting conditions to all children with every desk layout.

There are two possible orientations:

- The wide classroom, which is more equitable on an educational point of view (especially when the benches are situated in rows);
- The long classroom, which is more equitable on the lighting point of view and will reduce the need of artificial lighting.

fig. 1.1 Active learning desk layouts require more room space

Walls are featuring black metal plates protecting the walls from the benches impacts, for an improved durability.

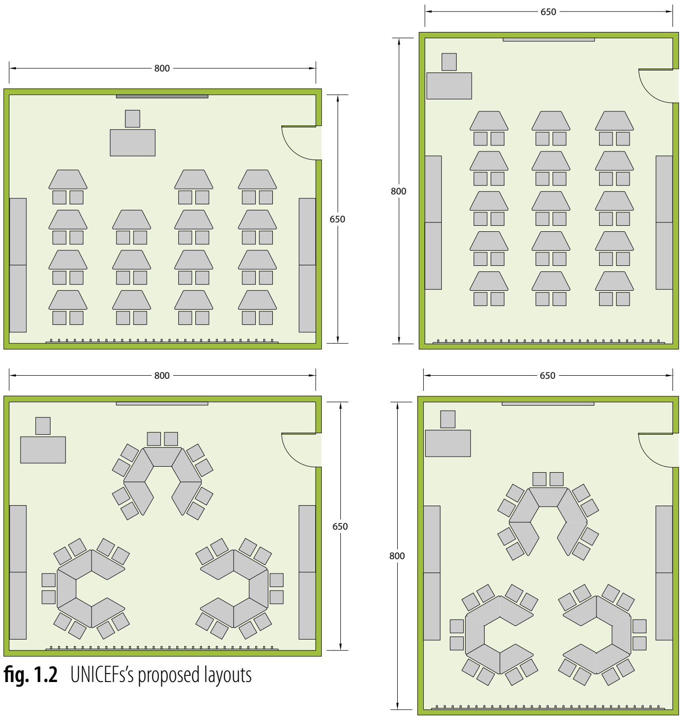


fig. 1.2 UNICEFs's proposed layouts

The main disadvantage of this new layout would be the initial cost: for the same sitting capacity, the classroom floor area is 44% larger, which will cause an almost equal increase of the construction cost, which is rather high.

fig. 1.3 PU's newly built classroom in Jaramana First School

fig. 1.4 Children asked to choose the color of their future school

PU

Removing the dais

On educational grounds, Première Urgence stands for the removal of the dais is the classrooms, especially in the new buildings.

When positioned at the front of the classroom and in the center of a dais, the teacher's desk dominates the class, symbolizing both authority and a specific pedagogy. The teacher has an uninterrupted view of the class, even when seated. Removing the dais, not only increases the space available for active learning activities, but it encourages the teacher to stand more often, leading to a more active attitude towards teaching.

A small step below the chalkboard might help the smallest children of primary schools to write on the board while keeping the board high enough for a good visibility for the rest of the classroom. The important would be in that case to make it narrow enough to avoid that the teacher uses it when speaking.

Painting and involving the users

The wall painting colors was an opportunity to involve the future users of the school in the design. A panel of teachers, school administrators and twenty children was set up, and was asked to choose the colors of the walls, doors and the façade.

In order to reconcile the diverging opinions and arrive to a consensus, two colors have sometimes been chosen, giving more diversity to the school environment. In some projects, the concept of using different gradations of the same hue was used: the darkest for the door, then the lower part of the wall, a much lighter gradation of the same color for the upper part, and white for the ceiling. Using vivid colors are an efficient way of creating a joyful environment.

In order to reduce the initial cost of construction, acrylic paint has been used on the walls, both in the classrooms and the corridor. A lesson learned is that while this paint is washable, it was also found much less resistant to impacts and scratches compared to oil painting applied on a proper wall coating. The higher cost of the latter is hence a duly justified investment for the lower part of the walls.

The classroom windows

For the windows, PU has used several types of opening systems (sliding and swing windows) and materials (wood and aluminum).

The first system is using traditional wooden swing windows, inspired by the ones existing in the old damascene houses.

- **T**hese windows are contributing to the warm and welcoming atmosphere of the room.
- **T**heir other advantage is their low level of technology, originating both from the material and the opening system, which makes them easy to be repaired.
- **T**he window was placed rather close to the external edge of the 80cm-thick walls, so that they can be opened without occupying the internal space and without interfering with the pupils. The disadvantage of this position is the associated higher risk of greenhouse effect (cf. "Dealing with the sun" on page 29) when the glass is exposed to the sun.
- **H**owever, wood for window frames is less durable and needs more maintenance than aluminum pro-

fig. 1.5 PU's newly built classroom in Jad Allah Shnan School extension

fig. 1.6 PU's wooden swing windows (Jaramana First School)

files. Furthermore, the wood is often of poor quality in Syria because it is insufficiently dried [cf. "Wood quality" on page 72]; this often makes the wood deform as it dries, which in turns makes the windows hard to be operated, as it was reported by some school administrations.

fig. 1.7 PU's aluminum swing windows (Sahnaya school extensions)

Afterwards, PU has used aluminum window frames, in order to improve their durability and modernize the school environment.

High quality swing windows with safety glass have first been used. Their durability is probably among the bests of all systems used; however:

fig. 1.8 PU's aluminum siding windows (Jad Allah Shnan school extension)

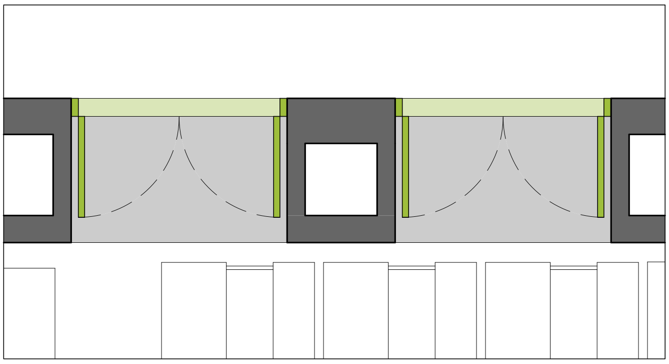


fig. 1.9 PU's swing windows opening within the wall thickness (Jaramana First School)

- **T**hese windows have been used inside walls with a normal thickness, so that they are opened within the area of where pupils are sitting on their desks, which can be dangerous or annoying;
- **T**he large fixed part is giving a modern look, but was not appreciated by the MoE for maintenance reasons: if a glass panel gets stoned and needs to be changed, the full and large panel needs to be replaced, which can be expensive;

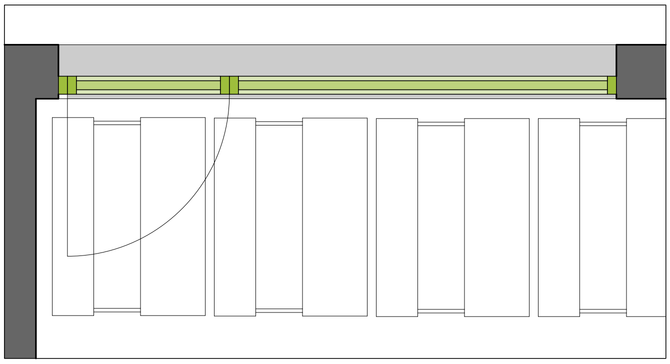


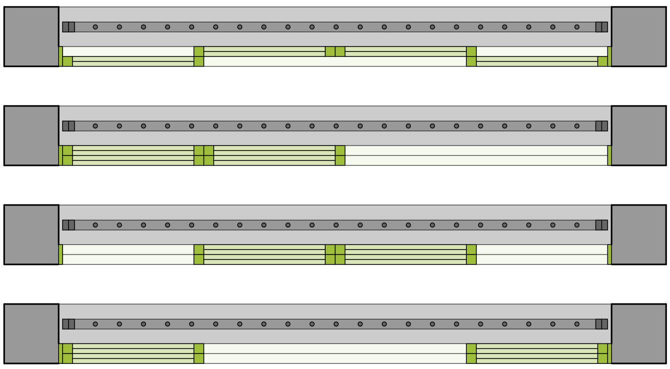
fig. 1.10 PU's aluminum swing window, opening over the pupils' desks

- **C**ompared to the first system, they have a smaller potential of ventilation, since the major part of the window cannot be opened.

The last system used is composed of sliding windows with an aluminum framing.

- **I**t has been reported as being very convenient, thanks to the multiple opening options (possibility of leaving a central, lateral or extremities openings, cf. drawing).

fig. 1.11 PU's sliding windows, with several opening possibilities.



- **E**ach panel has a horizontal subdivision, in order to further reduce the glass panel size and reduce the cost of maintenance.

The main disadvantages of sliding windows are:

- **A** reduced durability (compared to an aluminum swing window) because of the necessary internal mechanisms (wheels) and lock system;
- **S**ome difficulties to lock the windows if the chosen profile is not of the highest quality or if execution is not perfect;
- **T**he reduced opening capacity (if compared to the first system), which is maximum 50% of the glass area [5], and which can induce undesired greenhouse effect in the summer in case the window is not properly protected with a sunshade [cf. "Dealing with the sun" on page 29].

2.2. *From the classroom to the corridor*

SDC

For dilapidated door replacement, SDC made an important upgrade in the design of the doors and door related accessories (door panel material, handle, hinges, etc.).

The metal frame for the door was elongated around the edges of the wall to protect them.

fig. 1.12 SDC's metal doorframes

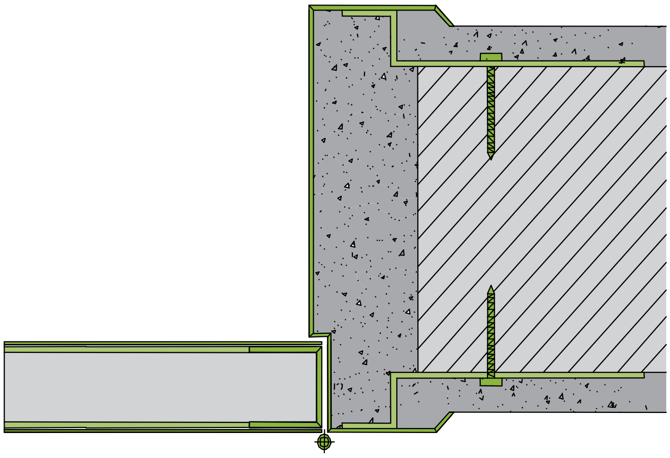


fig. 1.13 SDC's metal doorframe details

UNICEF - MoE

Classroom doors are among the weakest points of a school building.

Children are often partly responsible for the damage, as they tend to kick the doors as a game.

The parts most exposed to damage are the door handle, the lock, the frame, and the door itself.

In order to improve durability, UNICEF brought two solutions to their projects:

- **R**eplacing the latch bolt of the lock with a roller bolt: if kicked, the door will just open (instead of being broken), and fixed doorknobs can be installed instead of handles.
- **A**dding steel frames to the edge of the masonry (as SDC), which play the role of strike plate. Steel doorframes have rounded edges, to reduce the risk of being hurt.

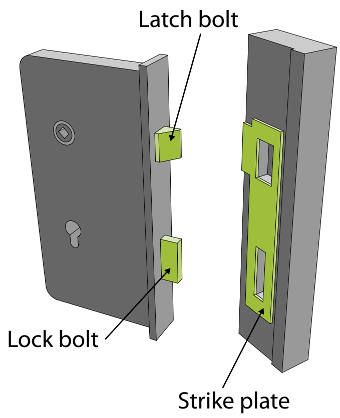


fig. 1.14 Doorlock glossary

fig. 1.15 UNICEF's roller bolt

In order to create a more protective environment for the children and reduce the risk of harassment (from other pupils or from teachers), glass panels have been inserted inside existing doors, so that the classroom can be observed from the corridor at all times [cf. fig. 1.16 on page 22].

fig. 1.16 UNICEF's insertin of glass panel inside doors

UNICEF provided complete guidelines for improving the accessibility of wheelchair users (available on the CD-ROM) in schools. Here below are some useful dimensions concerning the space required around the doors, according to the different possibilities of accesses and door opening.

What designers often forget is the extra lateral space needed by wheelchair users to reach the handle in the case of frontal access.

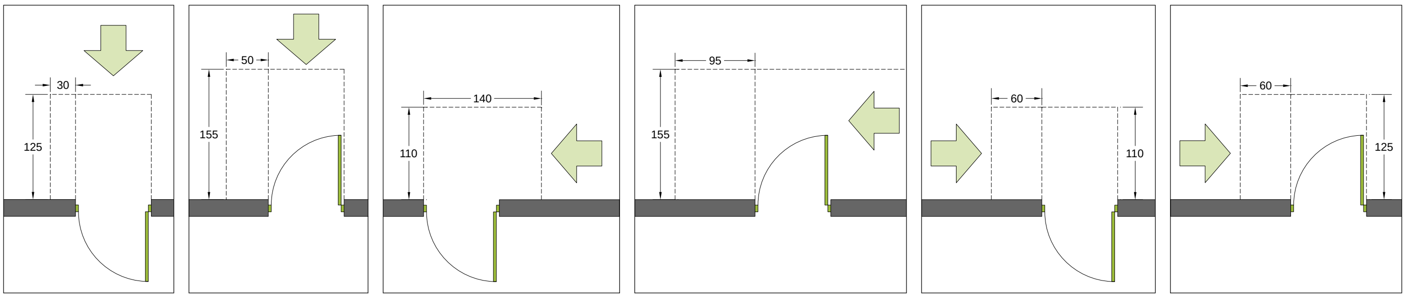


fig. 1.17 UNICEF's door dimensional guidelines for wheelchair users, according to access direction and door opening side.

PU

During the course of its projects, Première Urgence has worked with several systems of walls, doors and windows interacting with the corridor.

The inclusion of low windows in the classrooms can increase the child safety and increase the transparency of what is going on inside the classrooms. Unfortunately, this could be implemented in few projects (only some of the ground floor rooms in Jaramana First School [cf. fig. 1.20 on page 23] and in Sahnaya Extensions [fig. 1.24 on page 23] in a lesser way), due to the reluctance linked to the fear that children would get distracted or the glass could get broken.

When using more complex wall systems, such as thick double walls [fig. 1.19 on page 23] or "S-walls" [fig. 1.23 on page 23], one special attention should be paid to the accessibility of wheelchair users. In the first plan [fig. 1.19], when going inside the classroom, the space to access the entrance door is not wide enough [compare with the first graph of fig. 1.17]. The third plan [fig. 1.23] will be even more problematic: a wheelchair user will not be able to access the handle for going outside of the classroom [compare with the second graph of fig. 1.17]. This could be simply avoided by enlarging the access bay by 50cm on the side of the door handle. These design problems are less likely to occur with thin walls [cf. fig. 1.21 & fig. 1.25].

International fire-prevention safety rules specify that to ensure evacuation, all doors in public places should open from the inside to the outside: in case of fire, people tend to run together to the nearest exit and if the door is opening to the inside, people will be jamming in front of it, which will hamper evacuation and can cause severe injuries.

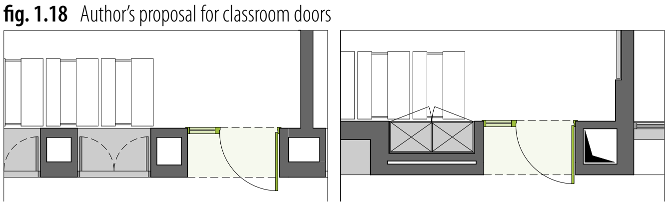
In the first projects, this was proposed by PU but was actually abandoned due to the reluctance of the maintenance department of the MoE, which feared they might hurt children running in the corridor.

However, in the project of Jad Allah Shnan school extension [cf. fig. 1.25], PU managed to convince all parties that doors opening to the outside make sense and that the injury fear is not supported, at least until it has been tested and evaluated on real scale. Doors are provided with a magnetic doorstop, so that they can remain fixed into place when they are open, thereby reducing the risk of injury.

During the brainstorming sessions, it was mentioned that doors opening to the outside might pose a problem when classrooms are situated on both sides of the corridor. Wherever possible, this could be solved by alternating the doors accesses instead of making them face each other in the corridor.

In the first two projects [cf. fig. 1.19 & fig. 1.23], the presence of thick or S-shaped walls could have been ideally used to make doors open to the outside within the thickness of the wall, and without protruding too much inside the corridor [cf. fig. 1.18]. These proposals, also integrating the additional lateral space necessary for wheelchair users accessibility, and designed as a vertical window for a better transparency of what is going on inside the classroom, could be used in future projects.

fig. 1.18 Author's proposal for classroom doors



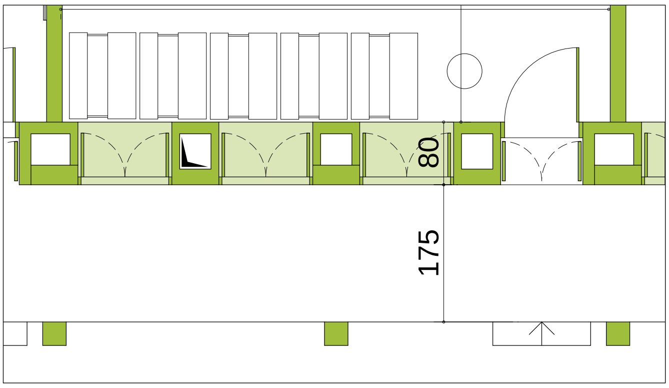


fig. 1.19 PU's first system of classroom wall (Jaramana First - Ground Floor)

1

fig. 1.20 PU's first system of classroom wall (Jaramana First - Ground Floor)

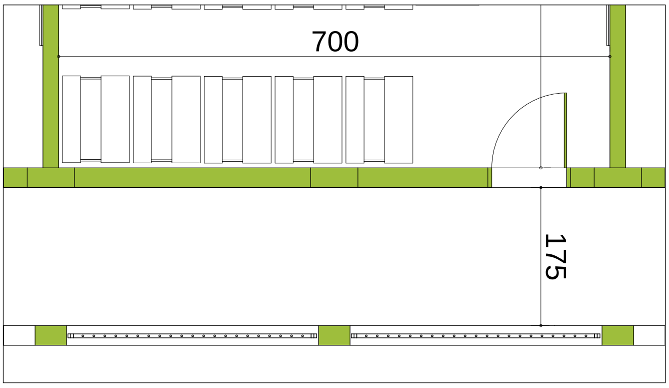


fig. 1.21 PU's second system of classroom wall (Jaramana First - First Floor)

2

fig. 1.22 PU's second system of classroom wall (Jaramana First - First Floor)

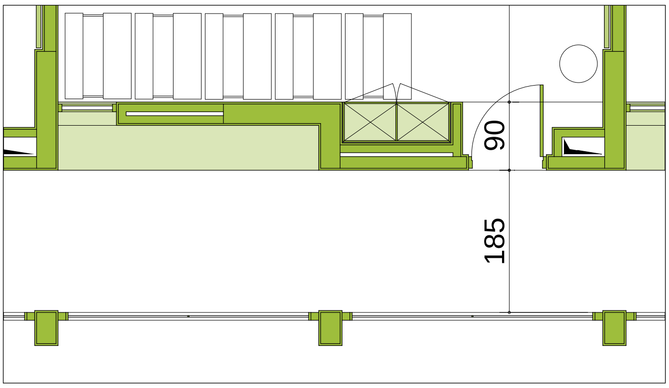


fig. 1.23 PU's third system of classroom wall (Sahanaya School Extensions)

3

fig. 1.24 PU's third system of classroom wall (Sahanaya School Extensions)

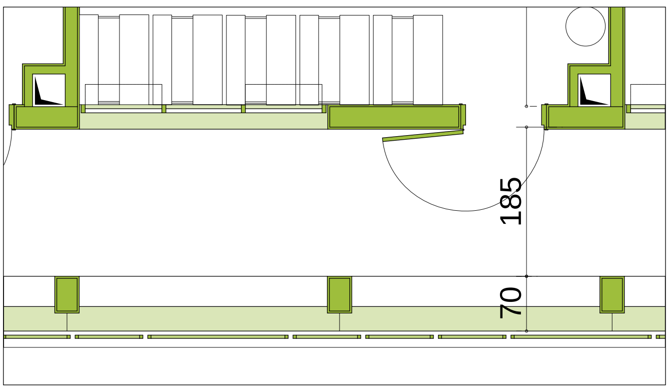


fig. 1.25 PU's fourth system of classroom wall (Jad Allah Shnan)

4

fig. 1.26 PU's fourth system of classroom wall (Jad Allah Shnan)

2.3. The corridors

PU

Security protections

Première Urgence has used five different kinds of security protections for the corridors.

1 • The first type [fig. 1.27] is a conventional one. The main improvement compared to the ones classically used for schools is that they are using the full height of the floor (improving the visual contact from the courtyard) and using rounded tubes. The vertical bars prevent the children from climbing, but are not considered as aesthetically pleasant, because of its similitude with a prison.

2 • The second type, used only on ground floors, is a more radical step towards integrating the corridor with the courtyard: the grilles are here situated just in front of the windows, giving full freedom of movement. This system has many advantages:

- **T**he access to the classrooms is easier;
- **T**he corridor is part of the courtyard: it plays the role of canopy, it offers more variety of space and is saving space in dense urban areas;
- **T**he amount of steel is reduced (for the grille itself, but also because the canopy is less necessary).

Although there is no real drawback to this system until now, the school administrations were found reluctant to it. They mainly fear that windows would get broken. However no incident was noticed till then, making these fears unjustified.

fig. 1.27 PU's first system of grilles

fig. 1.28 PU's second system of security grilles (Jaramana First School)

3 • The third type was a new design using horizontal bars, in an attempt to make it look more modern and reduce the imprisonment feeling. However, it appears that it is too easy to climb on it and therefore represents a major risk to the children's safety, especially if they cover the whole façade and go all the way to the top of the building. As it can be used as a ladder, this grille design also needs thicker steel sections, to withstand the weight of children.

4 • The fourth system, used on the first floor, was another attempt to modernize and enhance the look of the school façade: it is composed of high quality melamine resin coated (Formica®) wooden particle-boards. Apart from aesthetics, their main advantage is for sun protection: if placed on a façade oriented to the West, they will protect the corridor from the hot late afternoon sun in the summer, and thanks to their lightweight material (wood), they will not store heat. [cf. "Dealing with the sun" on page 29]

fig. 1.29 Jad Allah Shnan decorative hand-weld grilles, inspired by the traditional "Mashrabiyah"

fig. 1.30 PU's third system of security grilles (Sahnaya School)

fig. 1.31 PU's fourth system of security protections (Sahnaya School)

fig. 1.32 PU's fifth system of security grilles (Jad Allah Shnan School)

However, this kind of protection has also some disadvantages:

- **T**he view from the corridor to the courtyard (and vice-versa) is blocked in an irrational way,
- **T**he material has no proven experience in outdoor applications,
- **M**aintenance might be difficult (need to find exactly the same boards or need to replace them all at the same time).

In order to improve the durability of these panels, it is strongly advised to make them by design exactly or no more than 244 cm long, so that no connection is necessary between two pieces of board (which would be a weak point).

5 • The last system is composed of metal grilles and making use of regular steel profiles, but welding them in a set of creative patterns. Six different patterns have been designed, taking inspiration from traditional decorative patterns used in old buildings in the region [Detailed drawings of patterns are available on the CD]. Their use and performance are identical to the classical grilles found in most public schools, but are avoiding the "prison-effect". The major challenge is to find patterns which are simple enough to be welded and repeated, so as to reduce their price, but without making the façade too monotonous. The grilles are here full height (spanning from one slab to another), and hence need bracing to the columns. The colors have been chosen in collaboration with a panel of teachers and twenty children, as for the classroom.

A lesson learned from the last two systems is that great results can be obtained for the façade by installing the first floor protections in front of the first floor columns instead of in-between them, because the architect has then a total freedom of composition.

Floor cleaning

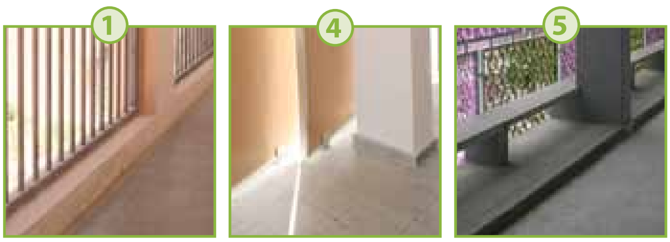
Floor cleaning in Syrian Schools is washed down, without using a mop.

For this reason, Première Urgence tries to equip the corridors with drains and upstands.

The drains should be carefully planned from the beginning. Models where the drain lid is attached with a hinge are better, so that the lid cannot be lost or stolen.

The upstand is necessary on the upper floors, to avoid that water runs down the façade and in order to ease the cleaning process. In the presence of columns in the corridor, the upstand should embrace them (5), so that no angles are hampering the cleaning process.

There is no upstand on (4), and water will fall on the façade or the canopy when the corridor will be cleaned.



Corridor benches

PU

Wherever possible, PU tries to provide benches in the corridors, for two reasons: it can transform them from a "non-place" –used only for transit– to a "place" children can use between the classes.

It can also be a useful additional space in dense urban areas, where the playground is usually relatively small.

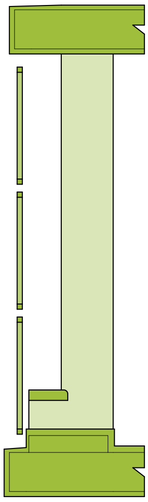


fig. 1.36 Section

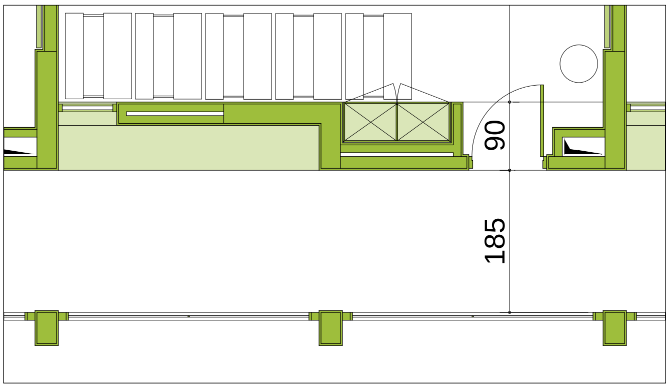


fig. 1.33 Benches integrated inside the "S-wall" in Sahanaya school extensions.

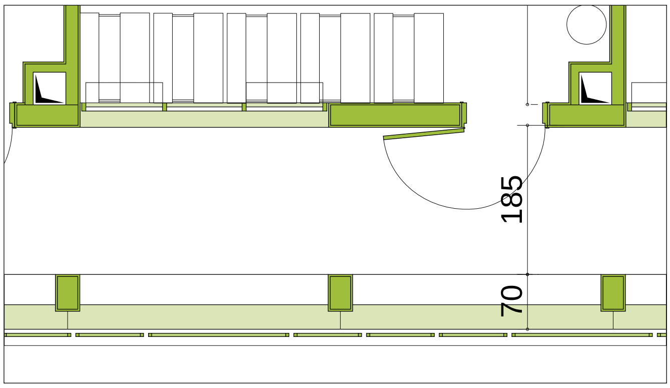


fig. 1.35 Continuous bench between the corridor columns in Jad Allah Shnan School extension.

Two systems have been used:

The first design is integrating separate benches inside the classroom walls, facing the corridor. This system could be an advantage when the view is interesting (depending on the kind of protection installed).

The second design is a continuous bench, facing the classrooms like in a waiting room. The advantage of this option is that no space is lost, even in between the columns, which is not used otherwise. Also the legs and feet of the children sitting are not in the way of people walking by and reduce the possibility of accidental tripping.

fig. 1.34 PU's first type of corridor benches, part of the "S-wall" concept

fig. 1.37 PU's second type of corridor benches, between the first floor columns

Painting drawings

UNICEF - MoE - PU

In order to make the corridors more attractive to the children, several organizations have paintings made on the walls.

A catalogue of possible drawings from the artist can be presented to the school administration or to the children, who can choose among them.

In order to take inspiration and adapt drawings to the architecture of its buildings, PU construction team also make sometimes creative sketches by themselves and discuss them with the school administration before giving them to the painter.

DRC

In order to facilitate the maintenance of the school and make the defects on the walls less evident, walls have been painted with veins, like the ones in marbles.

Plastering

SDC - PU

When plastering walls, SDC and Première Urgence are using rounded edges on the exposed corners. As well as reducing the risks of injuries, this improves the durability of the walls.

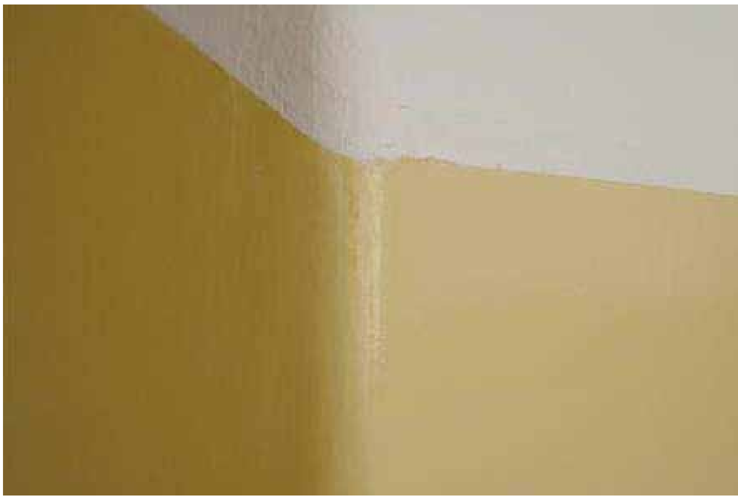


fig. 1.44 Rounded plastering in SDC's school rehabilitation projects

fig. 1.38 UNICEF/MoE corridor paintings

fig. 1.39 UNICEF/MoE corridor paintings

fig. 1.40 UNICEF/MoE corridor paintings

fig. 1.41 PU's corridor wall paintings

fig. 1.42 PU's corridor wall paintings

fig. 1.43 DRC's corridor wall painting in Hajeera School Extension

2.4. *The building and the climate*

Dealing with the outside temperature

PU

Double walls with air cavity have been used in most of PU projects, in order to improve the thermal insulation of the building. Better insulation increases the thermal comfort of the users, and can reduce the heating costs in winter and mechanical ventilation needs in the summer.

The insulation property of different kinds of walls is measured by its thermal resistance (the higher, the most insulating it is), which can be calculated by simply summing up the different resistances of each layer of the wall and then compared in a rational way.

A simple wall built with 20cm hollow concrete blocks and plastered on both sides [fig. 1.46] has a thermal resistance[6] value of 0,36 [W/m2K].

A thin double wall [fig. 1.47] built with two 10cm hollow concrete blocks, separated by a 5 cm air layer (non ventilated) and plastered, has a thermal resistance[7] of 0,64 [W/m2K]. With the same total thickness of masonry, this wall is hence nearly doubling its insulation property, for a 20% cost increase.

If for the same masonry works, the air layer is increased up to 40cm [fig. 1.48], calculation shows that there is strictly no increase in the thermal resistance of the wall. This is due to the natural air convection movements, which are diffusing the heat in the air layer. Thick double walls can be built to create shafts, closets or for aesthetical purposes, but concerning thermal insulation, there is no gain above 2cm for a single air layer[8]. According to PU's experience, the price of such masonry works is about 60% higher than a simple wall (taking into account the necessary slab extensions, lintels, masonry around the windows and plastering, but not the land underneath).

Inserting insulating materials inside a double wall, such as simple EPS (expanded polystyrene) panels, would be much more efficient: a thin 4cm panel between two masonry blocks would raise the thermal resistance[9] to 1.78 [W/m2K] (five times the simple wall), for an estimated price increase of 40% compared to the simple wall. This has not been used by PU yet, but is given for reference.

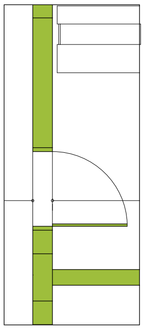


fig. 1.46 Wall 1

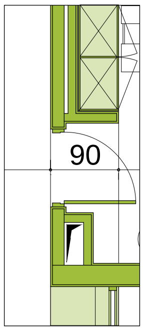


fig. 1.47 Wall 2

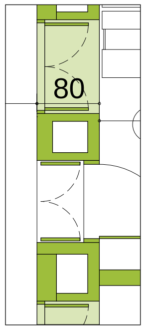


fig. 1.48 Wall 3

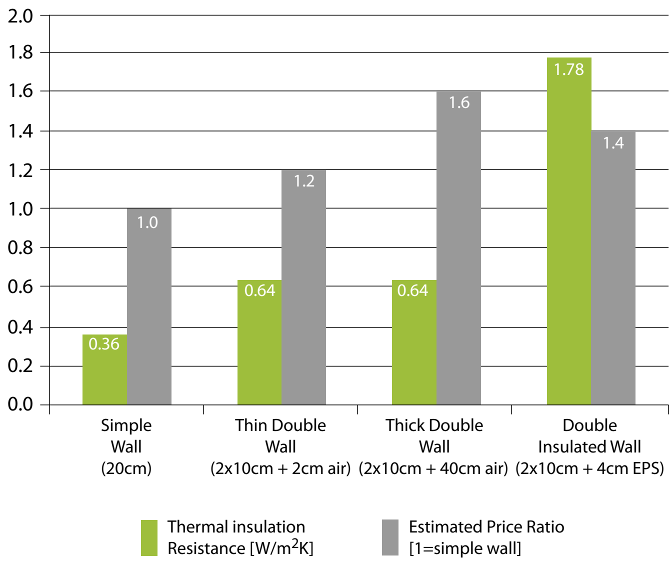


fig. 1.45 Comparative chart showing thermal iresistance (nsulation) and price

6 $R_{air\ (int)} + R_{plaster} + R_{block} + R_{plaster} + R_{air\ (ext)} = 0.12 + 0.016 + 0.17 + 0.013 + 0.04 =$ 0,359 W/m²K

7 $R_{air\ (int)} + R_{plaster} + R_{block} + R_{air\ (2\text{-}40cm)} + R_{block} + R_{plaster} + R_{air\ (ext)} = 0.12 + 0.016 + 0.14 + 0.17 + 0.14 + 0.013 + 0.04 =$ 0,639 W/m²K

8 Obviously, the case of separate layers of air –such as in triple walls– is different, and thermal resistances of air layers are then added to each other.

9 $R_{air\ (int)} + R_{plaster} + R_{block} + R_{insulation} + R_{block} + R_{plaster} + R_{air\ (ext)} = 0.12 + 0.016 + 0.14 + 1.14 + 0.14 + 0.013 + 0.04 =$ 1.779 W/m²K

PU

When used in architecture, glass exposed to the sun is responsible for what is called the "greenhouse effect" [cf. "2.1. Greenhouse effect" on page 98] : sunlight enters through the window glass, is converted into infrareds (heat) when getting into contact with objects inside the room (walls, floors or furniture), and these infrareds cannot escape through the glass. This leads to the natural warming of the inside space, which is useful in winter, but can be a serious issue in the summer.

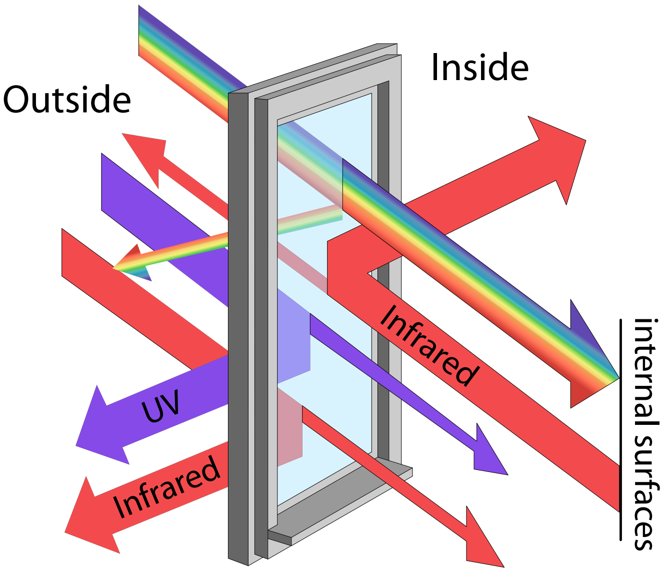


fig. 1.49 Greenhouse effect

A first conclusion is that because of the greenhouse effect, fighting heat in the summer period can be achieved only through external protections. Indoor curtains are not useful against heat: they will act as any other internal surface, and will trap heat inside.

Meanwhile, external curtains or mobile window blinds would be efficient for heat, but would get damaged very quickly by the rain and the wind and would need a lot of maintenance.

For this reason, Première Urgence has studied and calculated external sunshades that meet three conditions:

- **W**indows are fully protected from the sun when the outside temperature is high,
- **S**unrays are fully allowed inside when the outside temperature is low,
- **T**he sunshade is fixed, non-mechanical, and do not need to be operated by anyone.

In order to design solar protections meeting these three criteria, Première Urgence followed a special technique[10] combining solar charts (representing the sun position) and climatic data (showing the average external temperature). The complete study, originally made for the design of Jad Allah Shnan School, can be found in appendixes.

Here below are the conclusions, which are applicable to any other building in Damascus, for windows facing South, North, West or East. To adapt these results to other Syrian regions with a different climatic context or for windows that are not oriented exactly to one of the four cardinal points, the reader can follow the methodology of PU's study presented in appendix.

10 Source: author's own work, « Use of solar charts in climatic design » in: Sustainability aspects of architectural and urban design, Katholieke Universiteit Leuven, 2006

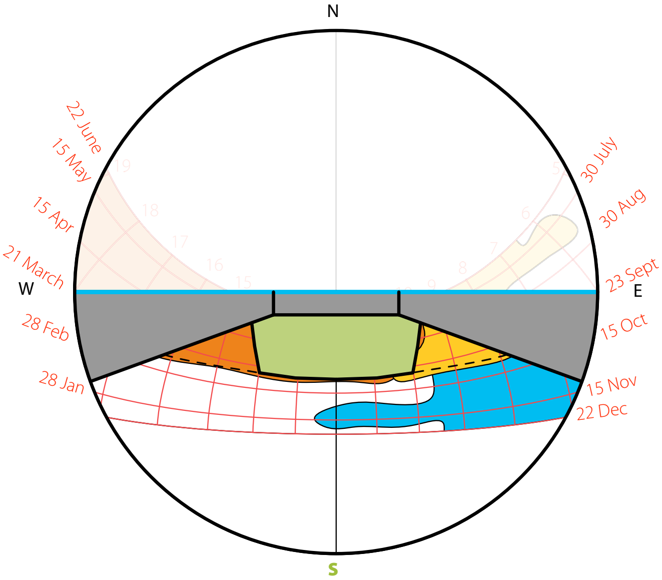


fig. 1.50 Stereographic chart representing a window oriented southwards

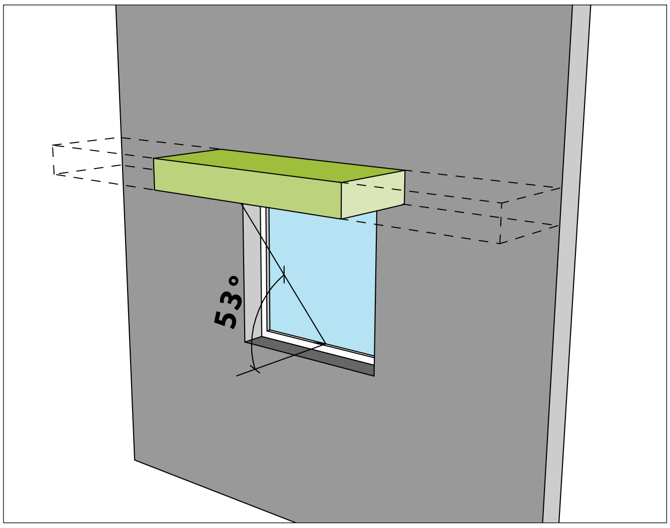


fig. 1.51 PU's recommended sunshade for a window oriented southwards

Any window oriented southwards can easily be protected from the high sun of the summer with a horizontal sunshade while allowing solar heat gains in the cold winter days.

This can be seen on the graph, where the protection (in green) is covering most of the orange zone (hot sun in the summer) but not the blue or white ones (cold sun in winter).

The required depth of the sunshade will vary according to the height of the window, so what is useful to remember is that **the optimal angle between the horizontal and the edge of the sun protection is 53°** [fig. 1.51], measured at the lowest point of the glass panel. If the angle is larger (shorter sunshade), there will be some direct sunlight entering during at least part of the hot season, and if the angle is smaller (longer sunshade), the window will be unnecessarily protected from the sun during the cold season.

To protect the window during the entire warm season (the orange and yellow zones), this protection should be extended laterally (dashed line on the drawing and on the graph). If several windows are next to each other the sunshade can be continuous.

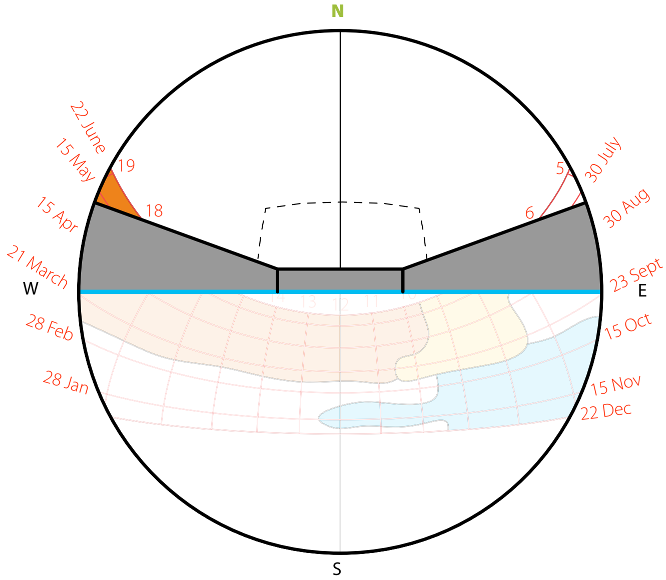


fig. 1.52 Stereographic chart representing a window oriented northwards

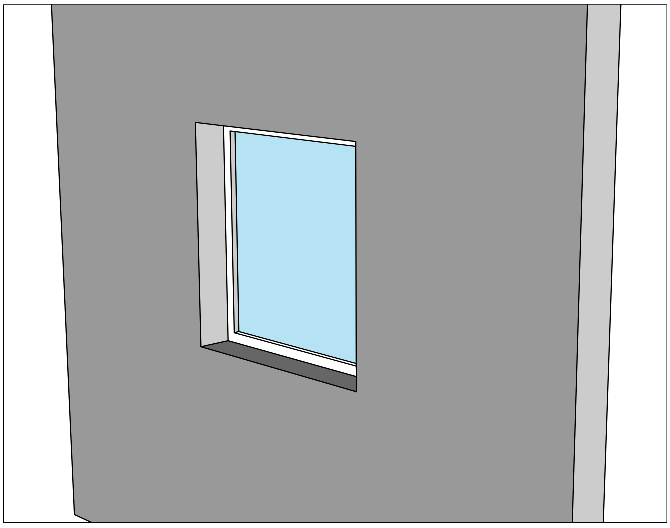


fig. 1.53 PU's recommended sunshade for a window oriented northwards

For the windows facing north, the graph above shows that such a protection is useless (dashed line), because it is never hiding the sun.

However, one can see that the masonry around the window (in grey) plays an important role, especially on the west part, since it is hiding the late afternoon sun.

Calculation shows that **a window recess of 15-20cm is ideal**.

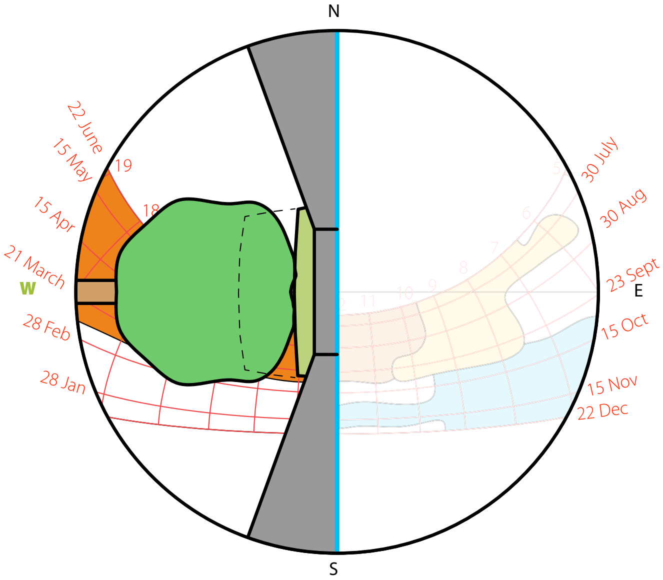


fig. 1.54 Stereographic chart representing a window oriented westwards

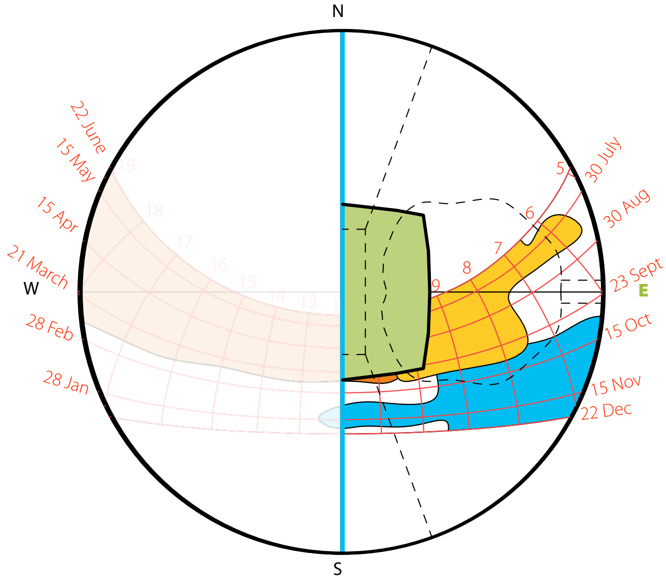


fig. 1.56 Stereographic chart representing a window oriented eastwards

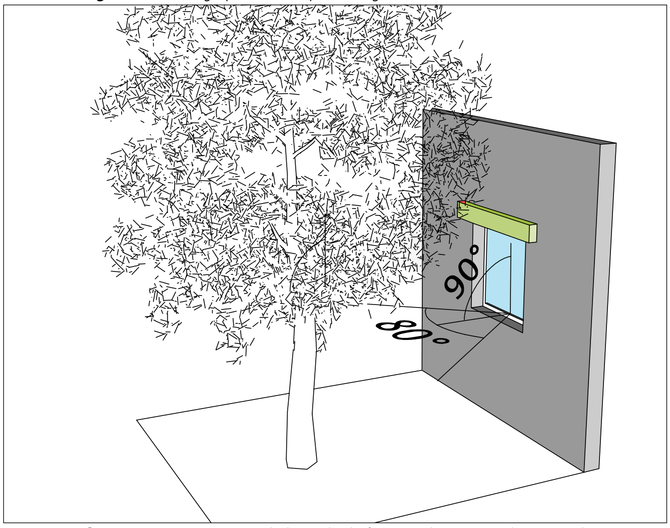


fig. 1.55 PU's recommended sunshade for a window oriented westwards

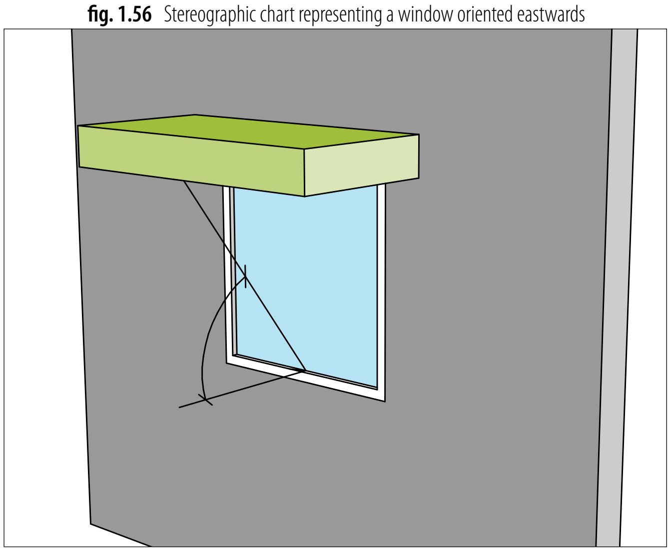


fig. 1.57 PU's recommended sunshade for a window oriented eastwards

Any west-facing window will be very difficult to protect from the sun, because during the hot summer afternoons, the sun is low. A similar protection as the one on the south façade (represented as a dashed line) would actually need to be infinite to cover the orange zone: from the vertical to the horizontal, a full 90° angle needs to be covered.

The alternative would be to have a protection in front of the window. This can be sometimes an existing building situated close enough (frequent in dense urban areas) or a tree can also be planted. A short horizontal cover (in light green) can sometimes ideally complete the frontal protection (the tree) to ensure that the full 90° angle is covered.

However, these solutions are generally working only on the ground floor, and are very difficult to be implemented on a second floor for example, if there is no close or tall building nearby.

Hence, any window on the west façade should be avoided, whenever possible.

Concerning the windows facing East, the situation is slightly similar to the West, but in a less dramatic way. A sunshade on the top can be useful as a protection from the hottest hours, but there is no precise angle because the temperatures of the yellow zone are increasing progressively from 20°C in the early morning to 25°C at 9:00 AM.

A tree could be very helpful, especially if it is a deciduous one: by loosing its leaves in winter, it would allow the sun to reach the window when greenhouse effect is desired.

Depending on technical and aesthetical factors, the window can here be set at the external edge of the wall, making the grey zones disappear and saving one additional hour of direct sun in the winter (dashed line).

This study shows the importance of considering a school building not as a ready-made object that one can copy-and-paste and rotate in any convenient direction, but rather as something deriving directly from its setting: orientation, climate and urban context.

Dealing with the wind

PU

During the summer, ventilation can improve the thermal comfort of the room occupants. The wind going through the building or produced artificially by ceiling fans is actually not lowering the air temperature itself; it is making the human body cool down by increasing the sweat evaporation.

For this reason, Première Urgence has been taking special care about natural ventilation in its latest projects.

- **T**he main advantage of natural ventilation compared to ceiling fans and air conditioning is that it requires no energy to work, and is hence more environmental friendly and does not engage a cost.
- **T**he main disadvantage is that it depends on the weather and the context, and will not always be sufficient.
- **S**ince wind has no impact on the room air temperature, ventilation as a means of cooling is working only if each person is situated directly in the wind flow. Windows should hence be placed so that everybody can benefit directly from the flow.
- **N**atural ventilation is working best if the wind is brought to the room through small openings, and taken out through large ones: the air flow, when passing through the smaller openings, will accelerate (thanks to Venturi's effect), resulting in higher wind speed inside the room. Weather data about most frequent wind orientation can be very useful[11].

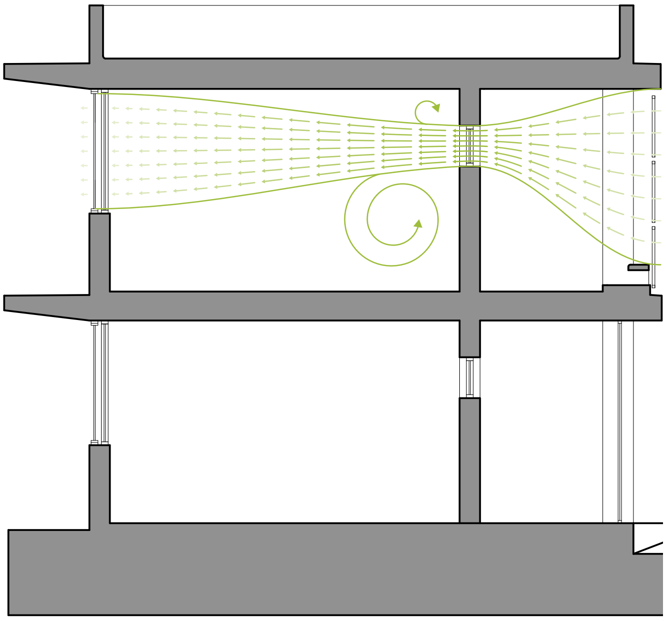


fig. 1.58 Wind speed increases in the proximity of a reduced window thanks to Venturi's effect

11 Data about wind speed and orientation is available on www.wunderground.com for 24 different weather stations in Syria.

Dealing with the sandstorms

UNICEF

When working in the dry regions of Syria, UNICEF thinks that the conventional system of grilles (such as in the corridors) is not very adapted to regions where sandstorms are frequent: dust is brought regularly in the corridors, which is both unhealthy and increasing the maintenance needs.

UNICEF is therefore suggesting installing glass windows instead of grilles in the corridors in order to make them airtight, in these particular regions.

Of course, as mentioned above [cf. "Dealing with the sun" on page 29], special care will have to be taken to protect these windows from the direct sun to avoid any risk of greenhouse effect, which would be unbearable, and windows will need to be entirely openable, to ensure ventilation in the classrooms.

2.5. The building layout and structure

Large school compounds

MoE

The Public Commission for Educational Buildings of the Ministry of Education has designed a new kind of very large school compound, to be built in city outskirts, for several reasons:

- **T**here is an increasing lack of available land to build schools inside urban areas,
- **G**athering four schools on the same compound makes it possible to share infrastructure between them (playgrounds, laboratories, libraries), and hence to make this infrastructure with more features and quality.

It is presently being built in the periphery of Damascus, in the city of Qudssaya.

The school layout adopted is a former one but re-adapted to the new curriculum.

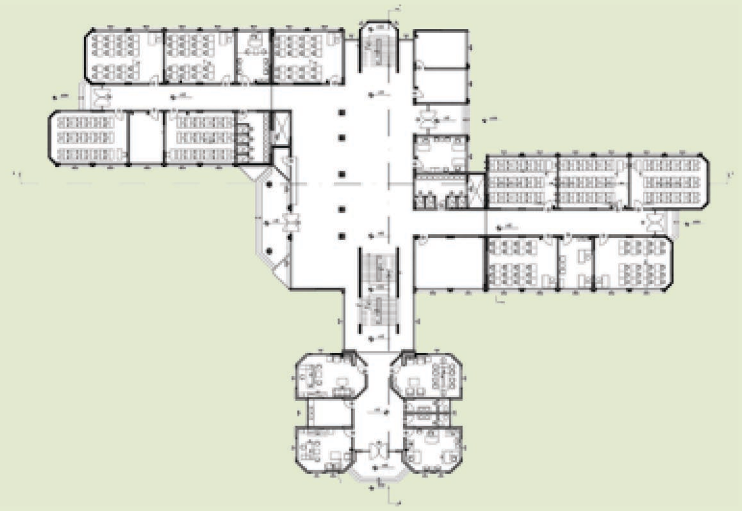


fig. 1.59 MoE's school layout as used in large compounds

Toilets are situated inside, to gain space and improve their maintenance, as done by some NGOs.

Each school building has a large entrance hall, combined with large stairs.

The administration rooms, situated below on the plan, are clearly separated from the area occupied by the classrooms. However, the counselors and supervisors, which have to be in direct contact with the children, have their dedicated space between the classrooms. On the first floor, there is one large multipurpose room on top of the admin rooms.

Double walls are used, to improve thermal insulation.

The compound is composed of four schools sharing this same layout: three have been rotated with different orientations and one has been mirrored. There are also three other buildings plus outdoor infrastructure, shared by the four schools.

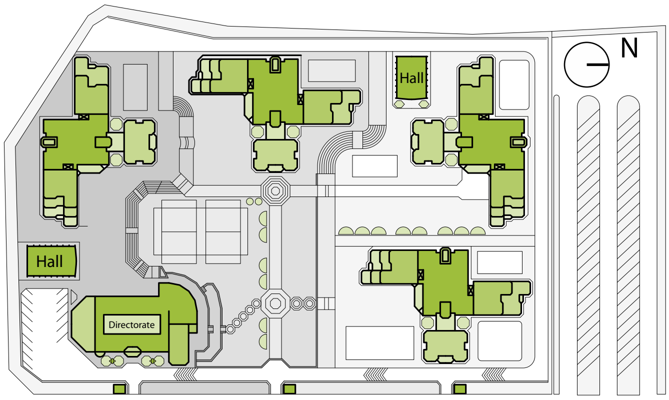


fig. 1.61 One of the new large school compounds, currently under construction in Qudsseya

A large parking lot has been planned to the North (on the right), to welcome the cars and busses necessary to transport the pupils.

Since the site is rather hilly, large landscaping works had to take place in order to make it suit the pre-established school building layouts. Three different flat areas have been created, linked by slopes and stairs, which are used in some places as open-air theaters. Many green areas have also been provided.

fig. 1.60 MoE's school elevation

fig. 1.62 MoE's new school compound in Qudssaya, with the theater

fig. 1.63 MoE's new school compound in Qudssaya: the directorate building

The hall building situated at the extreme south is a theater [fig. 1.62 on page 33], which will be also used for extra-curricular cultural activities, while the one at the west is a sports hall.

The large building called "directorate" and situated in the southeast corner of the compound, is used to host several services.

The ground floor is occupied by the administration at the East, close to the entrance stairs. Opposite is a large computer room. The South is occupied by service rooms, and the North by a cafeteria, which will help animate the compound and will serve as a meeting place for the parents. Laboratories are situated at the first floor; since they are shared by the different schools, they could be better equipped, and each child will have his own sink and experiment table, so that the experiments are not done only by the teacher, in accordance to the active-learning principles. The entrance hall, provided with a stage, will be useful for ceremonies, and as a waiting room for the parents coming to enroll their child.

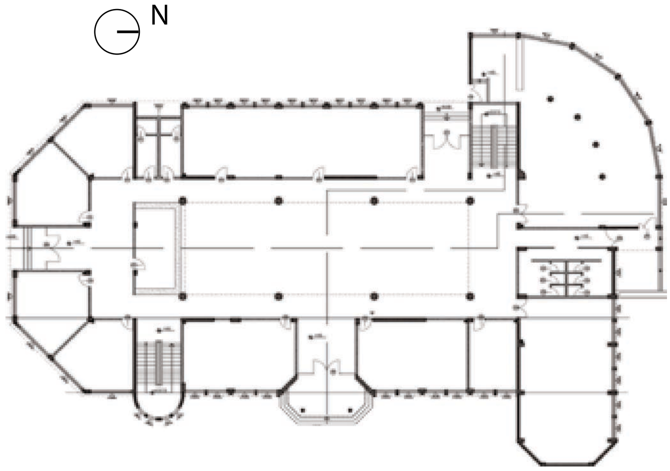


fig. 1.65 Ground floor plan of the directorate building

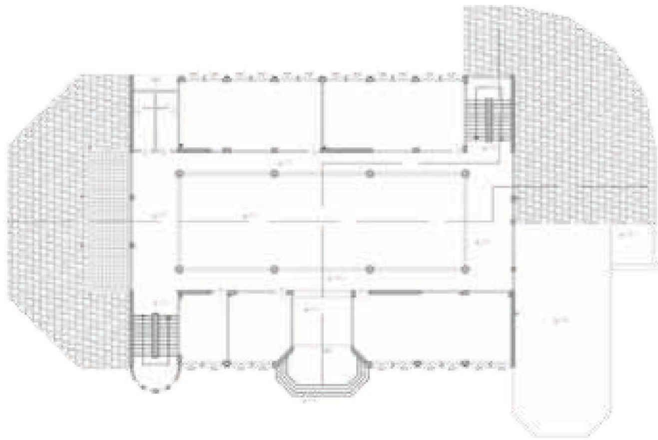


fig. 1.66 First floor plan of the directorate building

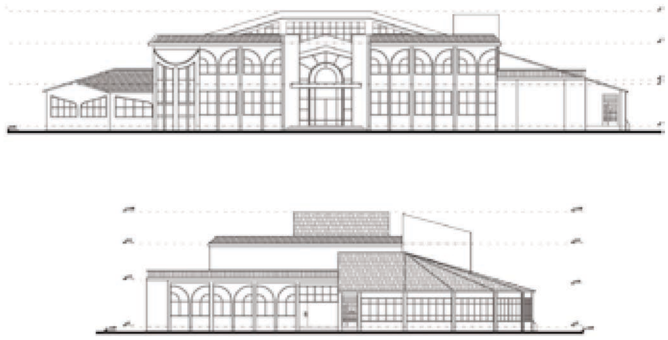


fig. 1.67 Elevation of the directorate building

fig. 1.64 MoE's new school compound in Qudssaya, inside the directorate building

PU

For building new schools and school extensions, Première Urgence has worked mainly with two new layouts.

The "L" shape

For the first school construction project, PU chose to take and improve a Syrian public school model: the L-shaped "A/99" layout, one of the most used by the Ministry of Education.

fig. 1.68 MoE's A/99 School layout

However, Première Urgence modified many of its aspects, with the objective of providing a more modern and child-friendly school but with normal costs, in order to ensure that the Ministry of Education can take advantage from it. The main changes and improvements are:

- **T**he two buildings were placed differently from the usual setup, in order to break the jail aspect of the classical "U building position" and open the school to the outside;
- **A** narrow pedestrian street was left between the two school buildings, as a public green area open to the parents waiting for their children and to neighbors, in order to make the school a part of the neighborhood and make people feel responsible for it;
- **T**he compound walls are not fully enclosing the school buildings; compared to the usual position of schools with a compound wall all around the building, this option is saving an important space (2m x the building length), which would have been considered as a dead area. This principle could be applied to any other school building in the future.
- **E**ach school has 3 entrances: a main entrance; a side entrance that leads to the alley between the schools and a service entrance that leads to the playground;
- **T**he ground floor is fully accessible for people with special needs, including the toilets;
- **T**he ground floor corridor is open to the courtyard, in order to give protection to children against sun and rain but also to change the general aspect of the school, which was closed and unwelcoming [cf. fig. 1.28 on page 24];

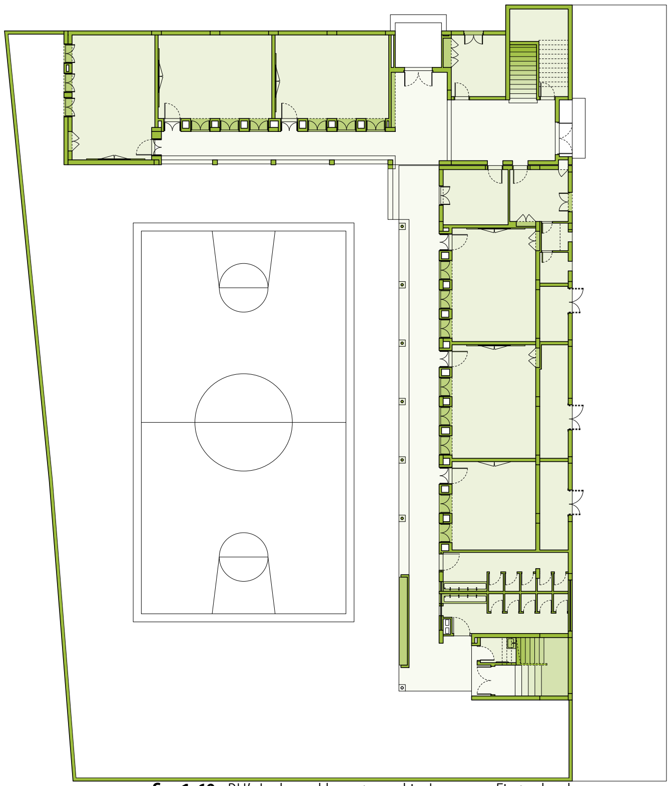


fig. 1.69 PU's L-shaped layout, used in Jaramana First school

- **T**he toilets were integrated inside the building in order to gain space in the playground (especially useful in a dense urban area),

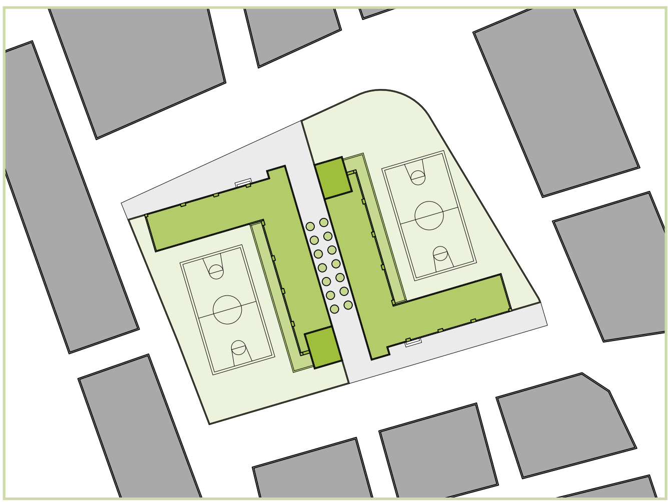


fig. 1.70 PU's Jaramana First school, situation plan

avoid the waste of space and to ensure their frequent maintenance;

- **T**eachers' facilities are designed to meet the school staff's needs: kitchenette, separate toilets, suitable furniture;
- **T**he library and the computer lab have both a dedicated space, which was designed 1,5 times larger than a regular classroom (46 m^2) so that a full class can be comfortably installed for reading or for other active learning activities;
- **S**torage areas have been included on the ground floor; they are accessible from the alley, plus one storage room on each floor.
- **T**he building structure has been modified in order to be earthquake resilient up to 8 on the Richter scale.
- **T**hick double walls have been used in some places. These were useful for housing technical shafts and book closets [cf. "PU's book closet in Jaramana school extension" on page 83].

However, some lessons could be learned:

- **O**riginally, windows were made tall and narrow because it was believed that it would let the daylight enter without having too much direct sunrays coming into the classroom. The sunlight study made later showed us it was a misconception (except for the Northern windows). Wide and short windows would be more adapted to the southern façade, provided that the window is recessed.
- **T**he windows oriented to the East and West will be very difficult to protect from the sun without the use of external shutters.
- **C**onsidering the sun orientation, mirroring the west-building layout to the east instead of rotating it by 180° [cf. fig. 1.70 on page 35] would have been preferable, to have the corridors exposed to the south, but the position of the buildings was partially imposed by the plot shape.
- **T**he position is also increasing the number of necessary compound walls, although this fact can be justified by the will to create a pedestrian alley between the schools.
- **T**he creation of storage rooms on the ground floor (between the classrooms and the alley) is very useful to resolve the recurrent storage problem existing in Syrian schools. However, their position has two disadvantages: it makes the cross-ventilation of classrooms impossible, and it gives the alley an aspect of "back alley" where everything is permitted (including throwing rubbish) instead of a respectful front façade.
- **T**he total absence of external windows on the ground floor, which was imposed by the MoE by fear of vandalism or having the children distracted, actually reinforces the jail-effect and is encouraging graffiti's. Classroom could have windows on the street façade if they are a little higher than the head of the sitting pupils, to avoid them being too easily distracted. The risk of vandalism against the windows is not higher than for any other house.
- **T**he corridors are partially inverted on the first floor (they are on the alley side instead of the playground side). This generated a lot of rubbish in the alley (thrown by pupils from the first floor). Furthermore, school administrations do not like these first floor back-corridors as they cannot be visually controlled from the playground. The first floor corridor should be kept on the side of the playground.
- **T**he overall cost per square meter was high: 20 000 SYP (without the equipment).

These lessons learned should not hamper school builders from reusing this layout, which shows many qualities, and could easily be improved. Complete plans are available on the CD-ROM.

fig. 1.71 PU's Jaramana First School (Left) and Rabih Daoud C2 School (Right) in Jaramana

The 6-class extension

The second layout developed by PU is a small building designed to build school extensions within existing school compounds, in order to increase their enrollment capacity. It was first used in three schools in Sahnaya, and later reused in Jaramana.

The main features of this school layout are:

- Small dimensions, which make it easy to be built in many existing school compounds;
- Expandability: in some schools the structure was calculated so that it can accommodate one more floor in the future; the continuous corridor makes it easy to be expanded laterally as well;
- Earthquake resilience, up to 8 on the Richter scale;
- The integration of a toilet block inside the building, to take into account the increased enrollment capacity;
- An administration room built on top of the toilets;
- The "S-wall" [cf. fig. 1.74], integrating benches in the corridor [cf. fig. 1.34 on page 26], a shaft for the stovepipes and book closets in the classrooms [cf. fig. 3.43 on page 83];
- Thin double walls have been used, to improve thermal insulation within a minimum cost.

The price per square meter for this kind of extension varies between 16 000 to 18 000 SYP (without the equipment).

Experience shows that the additional cost for having made these extensions earthquake-resilient is only 5%.

Detailed plans of these extensions are available on the CD-ROM.

A weak point and lesson learned from this model is concerning the small administrative room situated on top of the ground floor toilets. Actually the director room (director and assistant) has to be in close contact with the secretary room. Having the director and the secretary in different buildings is a problem. Many options for the rearrangement of rooms were thought, but the new admin room is small and does not allow welcoming other purposes such as teacher room or library. This room has hence to be considered as a counselor room with a storage area, for example. If the administrative purpose is really wished in this place, the layout should be adapted to have an extra admin room on the same floor. Alternatively, the room can also be enlarged with the toilets underneath, to welcome other functions.

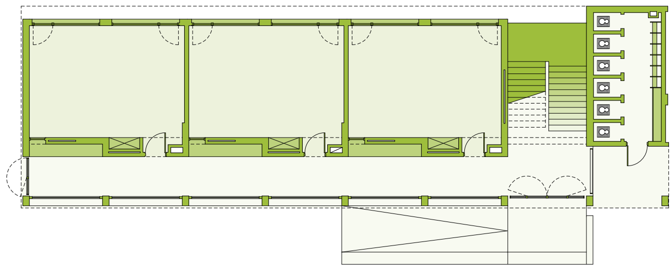


fig. 1.73 PU's 6-Classroom Extension layout

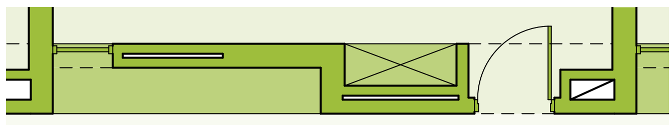


fig. 1.74 Detail of the "S-wall"

fig. 1.72 One of PU's 6-classroom extensions, here in Hussein Zein School in Sahnaya

Earthquake retrofitting

SDC

During its school rehabilitation projects, SDC has worked on the retrofitting of existing schools for earthquake resilience, in order to reduce their vulnerability.

The retrofitted school buildings were all similarly designed: two-storey buildings with reinforced concrete skeleton structures. Only columns were supporting the slabs; reinforcement walls were not present in the original condition. This led to a very small earthquake resistance.

In order to take up the horizontal loads from seismic impact, reinforced concrete shear walls were built in front of the façade. These are 25cm thick, connected to the building and extend from the foundations up to the roof. Steps of the intervention are [cf. fig 1.75 to 1.79] :

1 • Uncovering existing structure;

2 • Enlarging foundations;

3 • Planting dowels with epoxy into existing structure;

4 • Laying reinforcement;

5 • Casting concrete;

6 • Plastering the shear wall.

To indicate the shear walls as a special element, they were plastered in a different color. The orange color was obtained using massar, a local sand product without any artificial color [cf. fig. 1.80].

The roughness of the finished exterior plaster was lessened at the lower part up to a reasonable height in order to mitigate the injuries or scratches sustained from bumping into it.

fig. 1.81 Rounded plastering

Where possible, four walls (one in each front) were implemented. At the schools that consisted of two expanded units, only three walls per unit were built.

fig. 1.80 One of SDC's earthquake retrofitted school

The calculations for the earthquake study were done by experienced engineers from a local company, with an adequate simulation and calculation software to define earthquake measures.

We should mention that the efficiency of this kind of intervention has been challenged by other NGOs: they argue that while the structure might be protected, all other masonry walls inside the building are not linked to the structure with dowels; in case of an earthquake, these non load bearing walls are expected to fall down on the occupants and are representing a major threat to their safety.

fig. 1.75 Enlarging the foundations

fig. 1.76 Installing steel dowels

fig. 1.77 Installing reinforcement

fig. 1.78 Casting Concrete

fig. 1.79 Curing and plastering

School restructuring

DRC

The concept of school restructuring was initiated in 2010 by DRC. It is based on the field findings reporting that much space is wasted in the existing Syrian schools. It offers a cheaper and more sustainable school improvement solution.

The assessment should look at the school in terms of:

- Space allocation;
- School population's movements;
- Organization of school functions;
- Current and effective use of space.

Special reorganization is then proposed and approved by the school director, the DoE and MoE.

Restructuring aims at making more space available to children and does not necessarily mean construction of additional classrooms. Works are nevertheless needed and light rehabilitation works and equipment are part of the restructuring package.

An example of school restructuring is shown on the plans below. This work has been undertaken in Hajjeera High School for Boys. The project initially consisted in a four-classroom school extension. However, thanks to the restructuration, several other spaces have been created.

- Before the intervention, the school access was done through the building, as it was made before the small school extension had been built (on the left). This access was moved in order to give direct access to the playground as a gathering and distributive place; as a result, some space was gained to create an admin room where the former entrance used to be.
- Classrooms (in dark green) were given priority. They have all been grouped in the external side of the building, so as to keep them away from the noise and distraction of the playground, but also to make them benefit from a view on the trees around the building. On the contrary, administrative rooms (in grey) have been brought to the internal side, to improve the visual control of the playground.
- The basement, which was used only as a storage area –mainly because of the absence of natural light– has been converted into a space hosting diverse services and activities for the pupils (in lighter green). Three multipurpose rooms (serving as library, laboratory, etc.) have been created and are enjoying natural lighting through windows thanks to a window well (excavated space with retaining walls). A hall is also hosting sports equipment such as table tennis.
- The Janitor room had to be moved; it is now inside the building, but close to the entrance.
- Spaces that had to be shared before (teacher's room, libraries and advisors) have now their dedicated space, and a toilet was also included for the teachers.

The restructuring process should be done in close cooperation with the school administration; this will also increase their sense of ownership. The discussions and planning can ideally take place during the spring, to allow the works during the summer holidays.

fig. 1.82 Hajjeera's School, before DRC's restructuring

fig. 1.83 Hajjeera's School, after DRC's restructuring

2.6. The playground

Landscaping, trees and benches

SDC

SDC created some resting areas in the school playgrounds, using basalt benches and trees.

The shape, forming an "eight", is rather welcoming.

fig. 1.84 SDC's external benches in masonry

fig. 1.85 SDC's external benches in masonry

PU

In Jad Allah Shnan School, Première Urgence used colorful planter boxes and benches in order to enhance the playground space.

- **M**ost planter boxes serve as a backrest for the benches and were planted with a small tree.
- **T**he colors, proportions and dimensions are repeating the ones existing in the school façade, for a more harmonious environment.
- **I**n primary schools, benches should not be too high: 30cm height is most suitable for small children.

Trees have also been planted in other projects (Sahnaya, CFS schools in Jaramana), since they are not expensive, are greatly improving the aspect of the courtyard and can provide shade while making use of dead areas. Trees are a good opportunity to involve the children in a child friendly activity, when the planting is integrated in the educative process.

fig. 1.86 PU's fifth system of security grilles Jad Allah Shnan School)

fig. 1.87 PU's planterboxes in Jad Allah Shnan School

DRC

The greening initiative (planting in school playgrounds) was launched by DRC in 2010 in 10 schools. Children are the main actors of the school greening: along with their Science teachers, they plan and plant trees. They take full ownership of the plants, as they are responsible for care and maintenance of those green areas.

The educative purpose is combined to the improvement of the learning environment, which contributes to children retention in the schools.

An agreement is found with the supplier, which has also to ensure the maintenance for half a year.

DRC is not monitoring the planting directly: eight schools write and send them a regular report showing the progress and how the children take care of the plants.

Help

For external benches, Help is recommending the use of masonry with a marble top [cf. fig. 1.90], since it is easier to maintain.

Using timber for external benches [cf. "5.1. Benches" on page 86] is not recommended.

fig. 1.88 Children participating to the greening initiative

fig. 1.90 Help's masonry benches and plants

fig. 1.89 DRC's greening initiative

Canopies

PU

Canopies and pergolas are useful in playgrounds to provide shade and protect from the rain, and Première Urgence has designed and installed them in many schools.

Generally, different materials can be used for the covering; experience shows that:

- **B**urnt clay roof tiles, which are used traditionally, are not advisable in schools because tiles are easily stolen, and can be broken by vandals throwing stones at them as a game. Falling tiles are then very dangerous for children passing under them. Furthermore, clay tiles will accumulate sun heat, and if they are used alone (without a thermal insulation), they will increase the heat of the space underneath.
- **P**olycarbonate panels have been used by PU in many schools. They offer a good protection against rain and, as most lightweight materials, have a low thermal capacity and do not store heat; however, since they do not let the infrared escape, they are provoking a greenhouse effect, which makes them uncomfortably hot anyway during the warm season [cf. "2.1. Greenhouse effect" on page 98]. UV-coated panels have been used in order to protect the polycarbonate from the damage of the sun. However, durability is still not judged satisfactory: the panels are easily broken or deformed, and were stolen in some schools located in poor areas.
- **P**lants growing on a pergola are used traditionally in Damascus for covering the narrow streets, especially in the old city. Première Urgence has rediscovered this very simple cover in its latest projects, because it is actually the most efficient protection against the sun: it doesn't store heat and it doe not provoke greenhouse effect. Furthermore, it is not expensive and will neither be damaged by vandals nor be stolen. On the one hand, it will need some maintenance (watering, pruning and floor cleaning when the leaves fall), but on the other hand it can be considered a "self-repairing material". Plants are protecting against the sun only, but in many regions is Syria, rain is not the main climatic constraint. Furthermore, since no specific slope needs to be respected (as compared to a rain protection), there is much more freedom in the shape one can give to the pergola, leading to more creative shapes, which are aesthetically attractive for the children.
- **O**therwise, as already mentioned above [cf. fig. 1.28 on page 24], an excellent solution remains the canopy integrated to the building as in Jaramana 1st School: this option makes use of the ground floor corridor as a canopy, and is protecting against the sun and rain without greenhouse effect and with relatively little heat storage (depending on the orientation), provided that the absence of grilles between the columns is accepted by the school administration.

fig. 1.91 PU's polycabonate canopy in one of Sahnaya school extensions.

fig. 1.94 PU's pergola as designed for Jaramana Second School, with planterboxes

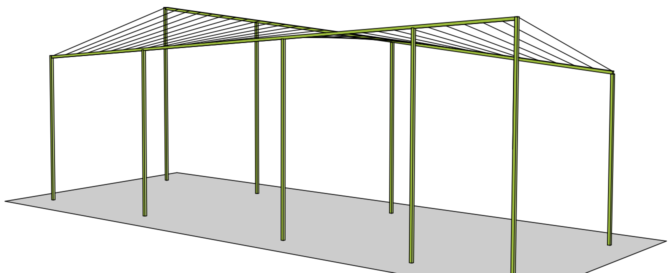


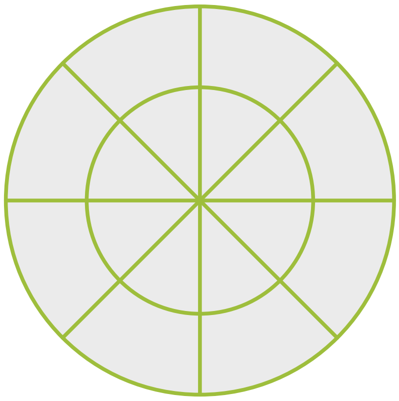
fig. 1.93 PU's pergola in Jad Allah Shnan, using a creative design

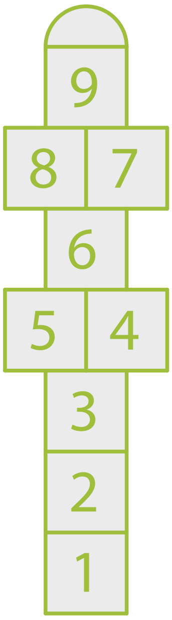
fig. 1.92 PU's pergola in Jad Allah Shnan, reusing old steel profiles

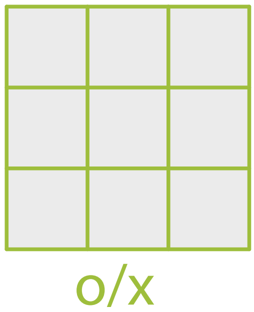
PU

Since a playground is meant for playing, PU painted games on the floor tiles, with special epoxy paint. Several games can be painted, such as a hopscotch or OXO; the designs used are taken from the ones children have been observed as spontaneously drawing on the floor.

Painting games on the floor is a good way to optimize the use of the playground space and animate it.







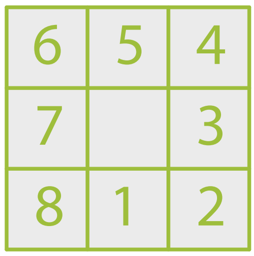


fig. 1.95 PU's hopscotch game painted in Jaramana First School Extension

fig. 1.96 One of PU's painted games, in Jad Allah Shnan school extension

2.7. Accesses

Stairs

PU

Stairs are one of the most dangerous places in buildings. For this reason, Première Urgence is respecting international building codes[12] when dimensioning stairs.

Some rules are:

- **T**he Blondel formula: 2T+R = 62.5 cm (where T is the tread and R the rise)
- **M**inimum tread length: 23 cm
- **M**aximum rise height: 21 cm
- **W**ithin a stair flight, all steps should have exactly the same dimensions (special care should be taken during execution for the first and last steps).

These rules are not always respected in the existing schools, either due to the negligence f the designer or because of a lack of supervision of the works.

Another identified issue is the frequent use of terrazzo as a construction material for the steps. This is not very durable, mainly because this material, as any other kind of concrete, has no resistance to tensile efforts apart from its steel reinforcement. The step nose is then a typical problem: the steel reinforcement needs to be covered by enough concrete to be protected from rust, but this concrete cover is subject to the strongest tensile efforts (by the users of the stairs). The result is that a very large number of these terrazzo steps have a broken nose, which is then a major threat for children safety.

12 Some of these rules are mentioned in UNICEF's accessibility guidelines.

For an improved durability, PU is recommending the use of marble instead, with smaller noses.

A lesson learned, which was identified rather recently, is the fact that when cleaning the stairs (which is traditionally done in Syria with large amounts of water), water is falling from the edge of the stairs. Since this water is dirty, it is quickly staining the walls and ceilings.

Existing MoE's schools have a masonry parapet, but this was wrongly abandoned in PU projects, although it would be very useful and is also perfectly compatible with marble steps. A small parapet (in green on the drawing) having the same height as a skirting would be sufficient to retain water.

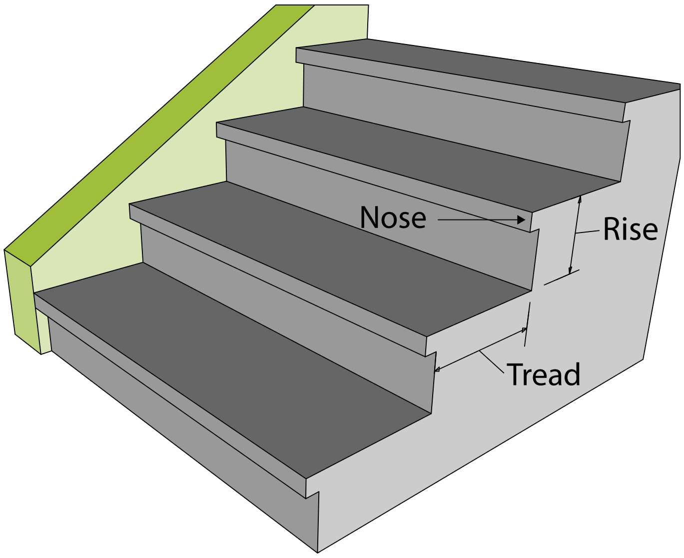


fig. 1.98 Glossary of the stairs

fig. 1.97 MoE's terrazzo steps suffer frequent damage

fig. 1.99 PU's stairs with marble steps instead of terazzo

Ramps

UNICEF

In its guidelines book on school accessibility for Children with Special Needs, UNICEF is giving guiding dimensions for ramps and other accesses.

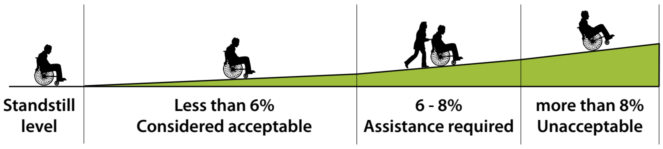


fig. 1.100 UNICEF's dimensional guidelines for slopes

Above are the indicative admissible slopes for ramps; 6% should be the maximum reference, so that the child can have access to the school without requiring the help of anyone. The interested reader will find the complete guidelines on the CD at the end of the book.

PU

From its first rehabilitation projects, PU has installed ramps in schools, respecting the UNICEF's guidelines. PU is ensuring that at least one school / gender / grade / area is adapted to children with special needs, so that any disabled child, whatever his age or gender, has access to one school.

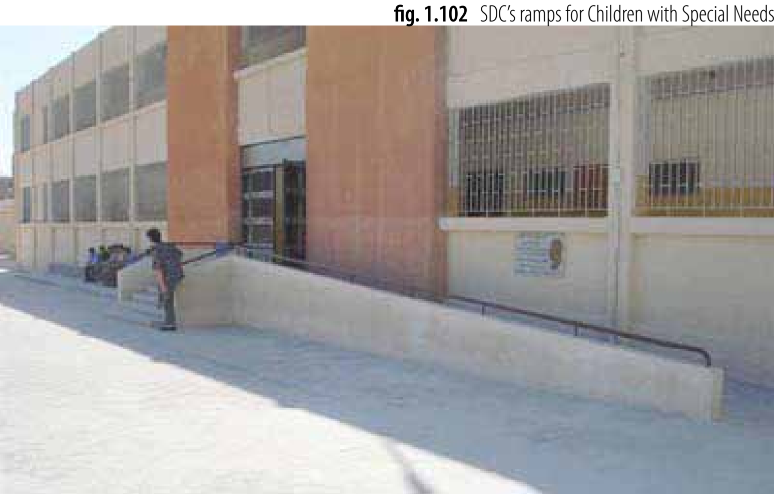
Afterwards, all projects always included access ramps where needed to access the building or the toilets.

fig. 1.101 PU's access ramp for Children with Special Needs

SDC

SDC has built ramps of basalt to guarantee access to the ground floor of the school buildings and the sanitation block for disabled children on wheel chairs, who may join the school in the future.

fig. 1.102 SDC's ramps for Children with Special Needs



Gates

PU

School playgrounds are frequently used by trespassers from the neighborhood in search of sports infrastructure. For this reason, school directors are frequently asking to increase the height of the compound walls.

However, PU believes that whatever the height of a compound wall or a gate, neighbors in search of public spaces and sports infrastructure will find the way to come inside, and the higher the walls and the gate, the less the trespassers will been seen from the street, giving them full freedom to act without visual control.

In a first attempt to reverse the tendency of overprotection and improve the visual control of the playground, a simple grille was installed as a school gate in Sahnaya. However, the horizontal bars were making them too easy to be climbed, and the gate was not accepted by the school administration, so that a metal plate had to be fixed afterwards.

PU's current conclusion is that the ideal gate would need to be transparent like a grille, but not too easy to climb, so that it is accepted by the administration. Using vertical bars with spacing inferior to a foot's width, with horizontal bracing welded on the internal face only, would probably make an ideal design.

fig. 1.103 PU's gate in Sahnaya School

fig. 1.104 Gate blinded shortly afterwards

SDC

In some schools, SDC provided a second entrance to improve escape routes.

Building doors are made to open to the outside in order to respect fire prevention safety rules.

fig. 1.105 SDC's secondary compound gate

fig. 1.106 SDC's building gate opening to the outside

CHAPTER 2 WATER, SANITATION & HYGIENE

1. Introduction

"Water, sanitation and hygiene" is a concept that cannot always be treated as separate arguments. The following chapter does not aim at treating the topic exhaustively; it aims at directly comparing different solutions to common and shared issues. For this reason, six topics are treated: the water pre-treatment, drinking water fountains, the hand washing basins, the toilets, the sanitary block, and the water recycling.

1.1. General issues and challenges

Some of the challenges identified during the brainstorming sessions apply to all items of this chapter and have been grouped.

Hygiene & Prevention of fecal-oral infections

Reducing the spread of diseases is important. It is the scope of this entire chapter: water, sanitation and hygiene are all aimed at reducing the risks of infections, most notably when happening through the fecal-oral route. Fecal-oral infection is a process during which pathogens in fecal particles from one host are introduced into the oral cavity of another potential host. Cholera, Hepatitis A, Typhoid fever, Poliomyelitis and Salmonella are only a few examples of diseases that can be transmitted through this route.

Transmission occurs through five main **vectors**: hands, flies, soil, water and food[13].

Many barriers were invented to fight each of these possible contaminations.

Regarding Syrian schools, it can be said that:

- **Adequate sanitation**, such as frequently flushed and well maintained toilets connected to a proper sewage system, will address directly three out of four vectors and will ensure a dramatic reduction of the risk of transmission [cf. "5. Toilets and urinals" on page 60].
- **W**hile hands contamination is nearly inevitable, **hand washing with soap** immediately after going to the toilet would be a sufficient and necessary means to fight the last vector of transmission. In schools or elsewhere, this is unfortunately not done frequently enough. In countries where sanitation is adequate, scientists estimate that up to 80% of infections are transmitted by our hands[14]. [cf. "4. Hand washing basins" on page 57]
- **I**n case water has been contaminated (and especially in areas where sanitation is inadequate), it can also be **treated** for human consumption [cf. "2. Water supply and treatment" on page 48].
- **W**hile the scope of sanitary facilities is normally to fight against these transmissions, they might actually sometimes promote involuntarily the diseases transmission, if they are badly designed because of a lack of understanding of the above-mentioned vectors. Bacteria and viruses are invisible, so one should constantly imagine where they can easily develop

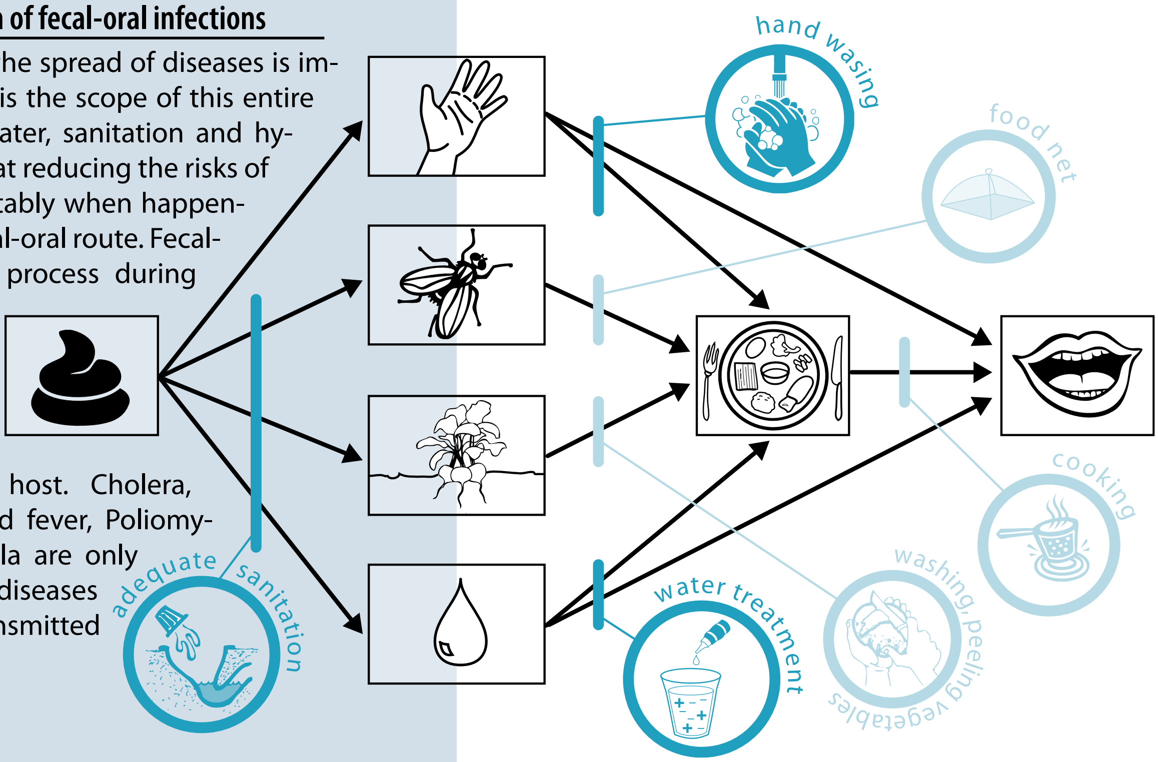


fig. 2.1 Vectors of transmission through fecal-oral route and barriers

13 ACF, "Water, sanitation and hygiene for populations at risk", 2005

14 Centers for Disease Control and Prevention, "Put your hands together", 2008

and through which movements they are transmitted when thinking of tap installation, door handles, etc.

Durability, easy maintenance & resistance to vandalism

Water and sanitation construction and rehabilitation projects have generally a very short lifetime.

Everyday cleaning and maintenance should be ensured through trainings [cf. "4. Handing over & Maintenance" on page 95], but concerning the design:

Everyday cleaning should be made as easy as possible, to encourage it;

Maintenance needs should be reduced to the minimum, through care about good design and quality of execution;

When repairing is necessary, it should be kept **simple** and made **affordable**;

All items should be resistant to vandalism and discourage theft, especially the ones situated outside.

We will see in the proposed solutions that **two opposite approaches** do exist to address this challenge:

- **P**roviding **high quality products** will reduce the maintenance needs. However, these products are also expensive to be replaced and they are sometimes hard to find on the local market, which does not make the maintenance simple or affordable. Furthermore, high quality products **can be stolen**, especially in poor areas, and if this is addressed through security protections, it can increase the difficulty of the replacement of the item.
- **P**roviding **low-tech products** is a cheaper option. Broken items can be easily replaced and being less valuable, the risk of being stolen is reduced. Thereby the need of protection is lowered. However, these products will tend to **be more fragile and break more easily**. With this approach, the maintenance is made easy and affordable, but the frequency of the maintenance interventions will probably increase.

These two approaches can be considered according to the context. They can also be combined when the context permits it.

Related to the issue of maintenance, limescale is also one of the enemies of taps and other mechanisms: it is reducing their lifetime. Push-button taps, for instance, are especially sensitive to clogging because of limescale deposits.

Water saving

High population growth and urbanization in Syria has increased the pressure on water resources. In some basins, such as that of the Barada around Damascus, water consumption exceeds availability of renewable water resources, resulting in **overexploitation of groundwater**[15][16].

For this reason, saving water is an extremely important issue in many regions of Syria, and will become even more so in the coming years.

Accessibility & Ergonomics

The accessibility can refer to **children with special needs**, such as the ones circulating in wheelchairs.

But on a more global perspective it can refer to the **ergonomics** and the ease of use of the facilities.

Small children might find that some taps are situated too high and some others might find them too low, or they might find the push buttons too hard to operate. All facilities should be easy to use by any child **without assistance**, whatever his age, size, gender or physical condition.

Cost & replicability[17]

The initial cost of production or construction of a feature is an essential criterion of evaluation.

The **simplicity** of an invention or design will also make it easier to be copied and adopted in other projects. The use of local materials and techniques will also promote the spread of a specific design.

Aesthetics & Attractivity

As for all design related to school, water and sanitation facilities should be aesthetically attractive for children, to promote a **stimulating school environment** and also reduce vandalism.

15 In the Mleita plain around the town of Al-Nabk in the Kalamoon Mountains north of Damascus, for example, the water table declined from 35 meter in 1984 to below 250 meter in 2009. Agriculture all but disappeared and the fertile valley was turned into a dusty wasteland (Syria Today:When Every Drop Counts, by Francesca de Châtel, January 2010).

16 "A 2002 study by The Arab Center for the Studies of Arid Zones and Dry Lands and the German Federal Institute for Geosciences and Natural Resources, BGR, found that in the period between 1993 and 2000 groundwater levels in the Damascus Ghuta and its surroundings had dropped by more than 6m per year in certain areas" (Syria Today:Mining the Deep, by Francesca de Châtel, January 2010)

17 Replicability: property of an activity, process, or test result that allows it to be duplicated at another location or time.

2. Water supply and treatment

2.1. Additional specific identified challenges

In schools water is mainly needed for drinking, hand washing, toilet flushing, floor cleaning and plant watering.

Water quantity

- Drinking and hand washing: water needs will vary from one individual to another, and depends also on the climate. The *Sphere guidelines for minimum water quantity in schools* calls for a total of 3 liters of water per student per day, including drinking and hand washing.
- Toilet flushing: 20-40 liters/user/day for conventional flushing toilets connected to a sewer but only 3-5 liters/user/day for pour-flush toilets (flushed by hand with a bucket). Central flush systems [cf. "Central flush system" on page 61] can also reduce the water consumption, because it allows flushing all toilets once (after playground time) or twice a day, transforming the "liters/user/day" into "liters/toilet/day".

Storage

Water is sometimes scarcely available in Syria, while in many places the water availability is reduced to set hours during the day. This issue is usually solved by storing water in tanks, but can also be addressed through water recycling [cf. "7. Water recycling" on page 67].

If used, the tank will need:

- To have a sufficient capacity, calculated according to the needs [cf. "Water quantity" supra].
- To ensure that water quality is preserved. Plastic tanks are more suitable than metal ones for drinking water because they are chemically inert.
- To be secured. The lids of plastic tanks are difficult to lock and can be easily unscrewed by thieves or vandals, while metal tanks lids usually come with two loops to install a lock.

Water quality

The requirements in terms of quality will depend on what the water is used for.

- For human consumption, the best water quality should be provided. Giving access to safe drinking water can result in tangible benefits to the health of children, and every effort should be made to provide safe and quality drinking water. Water has to satisfy microbial, chemical and acceptability criteria.
- Hand wash basins should also be provided with the same safe drinking water: children will be tempted to drink water from the same tap just after washing their hands.
- Toilet flushing does not need a high water quality. Grey water containing soap, as the one coming from the hand wash basins, is even ideal because of its detergent capacity.
- Floor cleaning (and rinsing), and plant irrigation need clean water (soap free) but it doesn't require the quality of drinking water.

Treatment

The quality of the water in the distribution network system or from harvested rainwater will greatly vary from place to place. It should systematically be tested to measure its drinkability. Depending on the criteria that are not respected, several treatments will be necessary and many options are available, with diverse pros and cons.

Here are a few treatments used in schools in Syria:

- Filtering can be useful on both a microbial and chemical point of view. The denser the filter is, the more efficient it will be, but the lower the water flow will be and the more maintenance it will need to prevent it from clogging. A filter that is not maintained properly can quickly make the quality of the water worse than the one supplied.
- Decantation consists in separating water from the solid matter in suspension just by storing it for some time in a container, so that sediments have the time to precipitate by natural gravity. It can be useful for reducing the turbidity of water.
- Chlorine disinfection is used by the municipalities and in some schools to ensure the microbial quality of water. Chlorine is effective only on low turbidity water (maximum 5 NTU and preferably less than 1NTU): water that is not perfectly clear will need tremendous amounts of chlorine for disinfection, because chlorine will react with organic matters in suspension before killing bacteria. Water that is clear (<5NTU) and sufficiently chlorinated (more than 0.5 mg/l of free residual chlorine measured after reaction) is considered safe on a microbiological point of view; these two parameters can be measured easily with simple tests.
- Softening of water is the reduction of the concentration of calcium, magnesium, and other ions in hard water, which are responsible for limescale deposits.

2.2. *Design solutions*

Help

In order to ensure the provision of safe drinking water, Help has developed two kinds of water treatment in Syria.

The first, presented here, is an affordable regular chlorination system for schools; the second is a high-tech, high performance reversed osmosis plant designed for refugee camps.

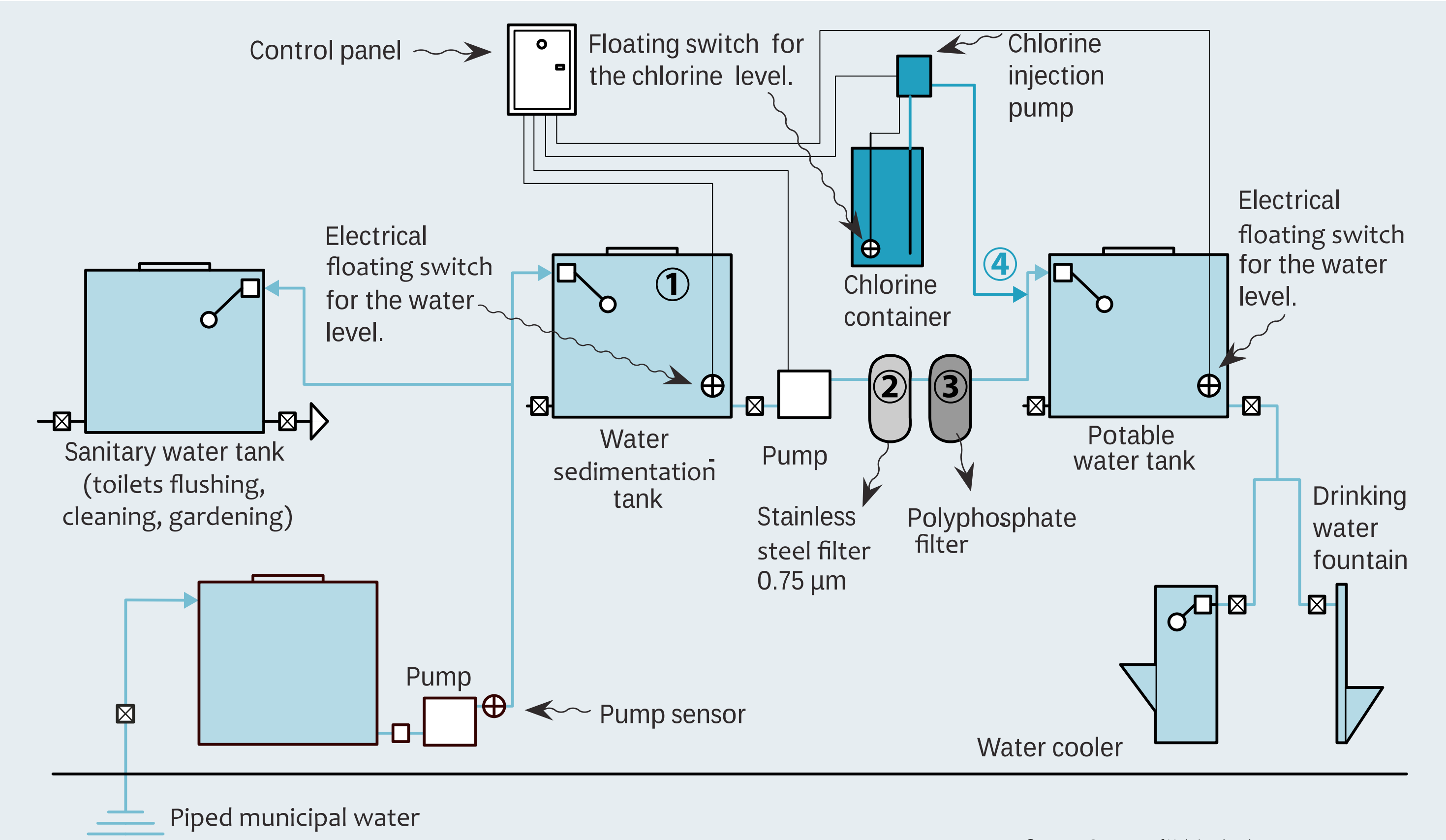


fig. 2.2 Diagram of Help's school water treatment system

The chlorination plant, as tested in schools, consists of several water tanks and a four-step treatment unit. The water coming from the municipal water network is stored in a first tank, from where it is pumped to two different networks: the sanitary one (which does not require treated water), and the drinking water treatment unit itself.

1 • The first step of treatment consists of **sedimentation** in a tank, at the bottom of which the largest particles in suspension will be deposited, to reduce the maintenance needs of the filter. A sensor continuously informs the control panel of the level of water inside the tank.

2 • The second treatment consists in the **filtering** of water through a 75µm[18] porous steel filter: as mentioned in the challenges, chlorine is effective only with low-turbidity water. Since the filter is very effective, the water does not flow easily through it, and a pump is needed. Filters with thinner holes have been tried; they have a higher filtering potential but they require more pressure and more frequent maintenance, so that 75µm is the ideal size.

3 • The third treatment is the **softening** of water with a polyphosphate filter: the polyphosphate dissolves into the water and coats the calcium and magnesium in it, making it impossible for these agents to precipitate out of the water and create the problems associated with hard water (e.g. limescale deposits).

4 • The fourth phase is the decontamination through **chlorine**. A chlorine dispenser, controlled by the central unit, will inject the chlorine at a constant

fig. 2.3 Help's water treatment plant for schools (steps 1 to 4)

18 Meaning that 75µm is the maximum size of the holes of the filter.
1µm = 1 micrometer = 1 micron = 0,001 mm

rate as the water flows. The control panel monitors the entire process.

5 • The next tank stores the treated water, which can be directed to the drinking fountain or to a water cooler (this can be considered as a fifth treatment, working on the acceptability criterion of temperature). The hand-washing basins also need to be provided with the same drinking water, as children might drink from the taps [cf. "Drinking" on page 57].

This system was successfully implemented in 4 schools of 600 pupils. The cost of a unit was about 140 000 SYP, depending on the length of the pipes necessary, and the water can be considered safe at 91-92%. One of the lessons learned is that the small pipe for injecting chlorine tends to get damaged easily (partially by the UV of the sun), and it should be made of high quality HDPE, not PVC.

The maintenance of the system (filters, chlorine supply) will require training for the school administration and the janitor.

The targeted free residual chlorine at the delivery point is 0.5 mg/liter (which complies with WHO recommendations). The municipalities chlorinate usually at a concentration 1 mg/l, but due to the length of the networks it unavoidably goes down to a concentration of 0 to 0.2 mg/l at the consumers end.

To avoid over chlorination, the trained school janitors are advised to control the water in the sedimentation tank with a simple smell test on warm hands. Smell normally develops at concentrations of free chlorine higher than 0.7 mg, so if there is a smell of chlorine, the janitor switches off the automatic chlorination injection for one day until the next odor control.

As a source of free chlorine, Help is using liquid non-perfumed chlorine from the local market (Clorox®), so that the cost for consumables (without electricity for the pumps) is kept extremely low (less than 500 SYP/year).

fig. 2.4 Help's automated chlorine injection system

3. Drinking Water Fountains

3.1. Additional specific identified challenges

Dirt, rubbish and algae

Deep basins with a normal drain system will get dirty very quickly, and once the drain is clogged, they will start to be filled with water.

Since it is situated outside, the water will get mixed with dirt and algae will start developing. Even when the drain issue is solved [cf. fig. 2.12 on page 52], a deep basin is more difficult to maintain than a shallow one, and is not needed for drinking.

fig. 2.5 Dirt and rubbish quickly accumulates inside deep basins

Furthermore, pupils will often be tempted to use the outside basin as a rubbish disposal. The deeper the basin, the more this attitude will be encouraged.

As a temporary remedial, some schools have installed a grille on top of the basin, so that only water can pass through it. This is demonstrating the issue, but can probably be avoided if the basin is correctly designed.

fig. 2.6 Drinking basin covered with a grille to prevent trash deposit in Qabun vocational school

fig. 2.7 SDC's original tap protection

fig. 2.8 A tap protection inspired from the one of SDC, but missing most of its advantages

3.2. Design solutions

SDC

Tap protections

In order to prevent the taps from being stolen, SDC has designed special tap protections, which have several additional advantages:

- **Water saving**, as the design allows the tap to open only partially; 
- **Fighting the spread of diseases**, by preventing children from putting their mouth on the tap (the tap is recessed inside);
- **Protection of children against injuries** that happen when children push each other by the taps and hit their head on it. 

Important details of the design are:

- The protections are designed to be **removable only from inside** the sanitation block, and with tools. These measures prevent them from being stolen. 
- The tap protection is made out of **stainless steel** (regular painted steel will get rusted because of the continuous presence of water) 
- **The top face should have a slope**, to avoid that children climb on it.

This system of tap protection has proved to be successful in Syria and has already been reused by several other organizations.

SDC's tap protection still has some disadvantages:

- The ergonomics: the position needed for drinking is not natural; 
- Hygiene: mouth-to-mouth disease transmission is reduced, but the risk of fecal-oral transmission is increased: children will be tempted to use their hands for drinking; 
- The execution: fixing the protections from inside is not easy; 
- The look: not child friendly, and baptized "the helmet" by many. 

Basin

The construction of the basin of the drinking water fountain consists out of easy to maintain marble plates, which are connected to each other [fig. 2.11].

- The basin bottom has a **slope of 2%,** to ensure a proper drainage.
- In order to help maintenance, water is collected in a **drain on the floor level**. Through an opening in the side plate, the janitor can remove the rubbish that accumulates on the grill covering the manhole.

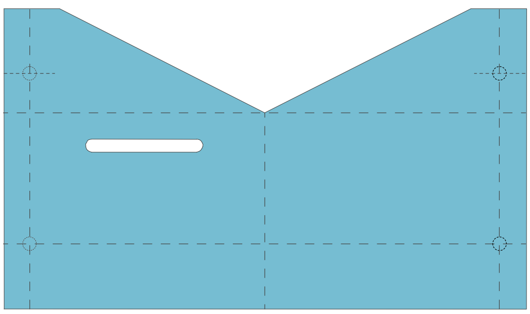


fig. 2.9 SDC's tap protection: cutting plan of the main steel plate

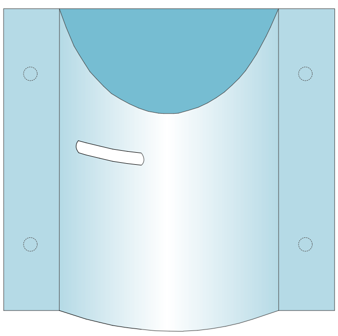


fig. 2.10 SDC's tap protection after welding

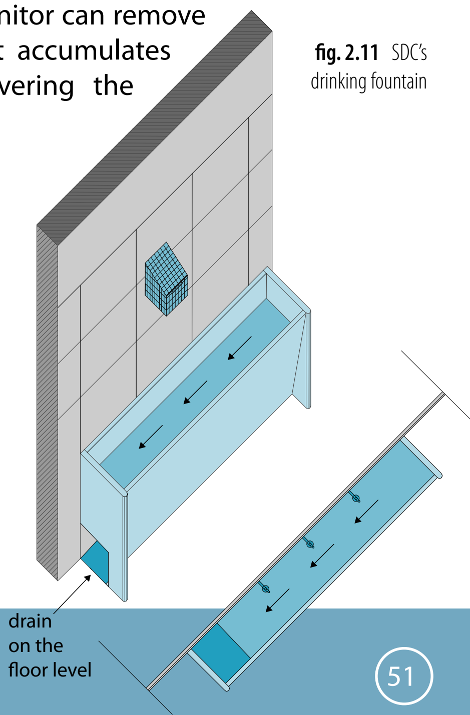


fig. 2.11 SDC's drinking fountain

fig. 2.12 SDC's drinking fountain marble basin, with the lateral open drain

fig. 2.14 DRC's suspended marble fountain, further liberating the drain

This system prevents the basin to be filled with water even when the drain is clogged.

Another proposal from SDC was to **bring outside the water cooler** (which can be found in the corridors of many schools), but to protect it with an enclosure. This solution gives more space around the water cooler compared to a corridor, and avoids water spillage inside the school.

Danish Refugee Council

The tap protections and the basin drainage system were inspired by the work of SDC, but:

- For the taps protections, **hexagon-socket screws** are used and fixed from outside. This is facilitating execution, and the probability that vandals or thieves unscrew the cover is rather low, because an adapted hexagonal key is required;
- Where possible, the marble basin was **lifted from the ground** and fixed to the wall, making the daily maintenance easier, and helping to drain the playground area as well;

fig. 2.13 SDC's external watercooler protection

fig. 2.15 DRC's unfoldable watercooler protection

fig. 2.16 DRC's drain , here similar to SDC's, but placed at the middle of the fountain

- **D**epending on the local configuration and space availability, the drinking fountain has sometimes been created **inside an enclosed area**, thereby making the taps cover unnecessary.

In order to increase the available space around the water cooler, it was sometimes placed outside with a protection made of two panels, which unfold as a platform and a roof [fig. 2.15 on page 52].

The disadvantage is that the platform is reducing accessibility to disabled children.

fig. 2.17 DRC's tap protection with hexagonal socket crews
fig. 2.18 DRC's drinking fountain installed in an enclosed area

fig. 2.19 UNICEF's low-tech faucets are not too tempting for the thieves and are cheap to replace.

UNICEF

UNICEF has taken the option of low-cost, low-tech unprotected taps for the fountains situated outside.

- **F**or the same price of the tap protections or high-end materials, many spare taps can be given to the school for replacing the broken or stolen ones.
- **I**n order to ensure a better accessibility to small children, two different heights of taps are provided.

fig. 2.20 Two heights for the taps and the basin increase accessibility
fig. 2.21 Lesson learned: Polypropylene (PPR) pipes are not strong enough to support the taps

PU

Première Urgence worked consecutively with three different models of drinking fountains.

First generation

The first one is using simple, low-cost taps protected by steel protections inspired by the traditional fountains existing in the old city of Damascus. Experience shows that taps maintenance greatly varies between the schools, showing a partial responsibility of the school administration.

The main advantage is that these taps are **cheap and easy to replace**.

However, lessons learned show some disadvantages:

- The regular steel (i.e. non-stainless), even if very well painted, is not advisable for a drinking fountain, since the continuous sollicitation from water will induce **stain** and regular painting maintenance needs;
- The model is not very child friendly;
- The tap is not well protected;
- As for the other previously monetionned models, it is not easy to use (inadequate drinking position), nor hygienic.

The marble basin is shallow, but is not resistant enough: in some schools marble plates were stolen and ceramic tiles broken. Furthermore, the slope was insufficient.

Second generation

The second model is taking another approach to maintenance and protection.

- To save water, **push-button** taps were chosen.
- These are **low-cost** taps made in Syria so that they are easy to replace and not tempting thieves.
- They are composed of **two parts**: the body and a removable mechanism.
- The body is **sealed with epoxy glue** into the wall, as a further protection against theft.
- To ensure maintenance, the push-button **mechanism can be unscrewed** and easily replaced. Since only the mechanism can be substituted, it is less prone to theft and is reducing maintenance cost.

There are two lessons learned however:

- When water is not treated for softening, limescale will tend to make the **button hard to push**, which can pose a problem of accessibility (children will sometimes push with their feet on it) and increase maintenance needs;
- Since the taps are unprotected, the cap of the **button goes missing** after a while in some schools, making the taps unusable.

fig. 2.22 PU's first generation of tap protection

fig. 2.24 After two years, without maintenance

fig. 2.23 PU's first generation of basin

fig. 2.25 Some basins suffered damage

fig. 2.26 PU's second generation of taps

fig. 2.27 Inadequate drinking position

fig. 2.28 PU's second generation of basins

Third generation

The third model created by PU is an experiment of trying to address several challenges simultaneously after collecting them from PU's previous experiences. The wished improvements were concerning the **accessibility**, the **hygiene**, the **durability**, the **easy maintenance** and the **ergonomics**.

- **T**he basin is featuring a **slope**, so that each child can find a tap matching exactly his height (the exact maximum and minimum height have to be adapted to the school cycle).
- The **handle** for opening and closing the water was moved from the wall to the basin, so that it can also be reached by small children or children with special needs.
- **T**o improve hygiene and avoid disease transmission through the fecal-oral route [see "1.1. General issues and challenges" on page 46], water is coming from the bottom, as in commercial drinking fountains found in some public places, so that children can drink without using the hands[19].
- **E**rgonomics are much improved: since the water outlet is moved to the basin edge, children can drink in a **natural position**, which is not the case with the taps on the wall [fig. 2.31].
- **A**n important detail is that the marble edge should have a slope so that water is flowing towards the inside of the basin even at low outflows [cf. fig. 2.29].
- **T**o improve the resistance to vandalism, the concept of tap itself has been abandoned: the mechanism (a valve) is now separated from the water outlet. This allows protecting efficiently the valuable part (the valve), while keeping the water outlet easily accessible for cleaning. The valves have been protected thanks to specially designed steel protections, composed of a U-shaped steel plate with a handle for controlling the valve [fig. 2.33 on page 56].
- **T**o facilitate the maintenance, the protections can be removed without any tool: they are fixed with a longitudinal steel bar going through all of them [fig. 2.33 on page 56], secured with a lock at its end. When the lock is opened, one can pull the steel bar out and release all steel covers for inspection at once.

However, this model still needs improvements:

- **T**he type of valve used (compression and not quarter turn) needs several turns to be closed, which is not encouraging the children to close it after drinking, leading to a waste of water if it is not recycled [cf. "7. Water recycling" on page 67]. Quarter-turn or push button valves could be used instead, with the same principle of protection.
- **T**o ease the cleaning, the basin could be shallower and the drain system should have been inspired by the work of SDC. One could use a design inspired by the hand-washing basin from SIF [cf. "fig. 2.44 SIF's prefabricated handwashing basin" on page 58].
- **A**nother lesson learned is that the execution is not easy (this increases the price) and needs diverse skilled labor (which needs coordination, e.g. between the welder and the mason). While the concept is ideal, the design should be further improved and simplified by reducing the number of materials and techniques used.

19 Washing hands can help prevent the transmission of diseases, but very few people –let alone a thirsty child– will do it before drinking water.

fig. 2.29 PU's third generation tap, with water coming bottom-up

fig. 2.30 PU's third generation of drinking fountain

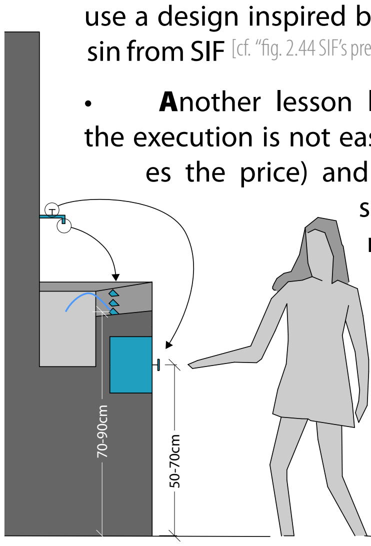
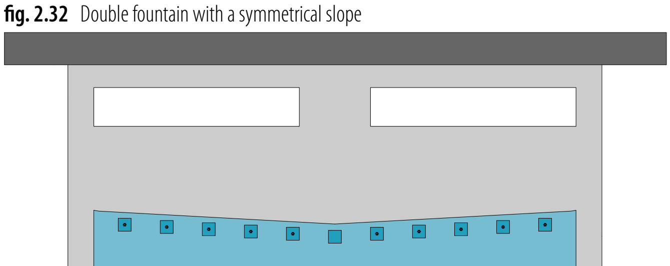


fig. 2.31 Improving accessibility and ergonomics

fig. 2.32 Double fountain with a symmetrical slope



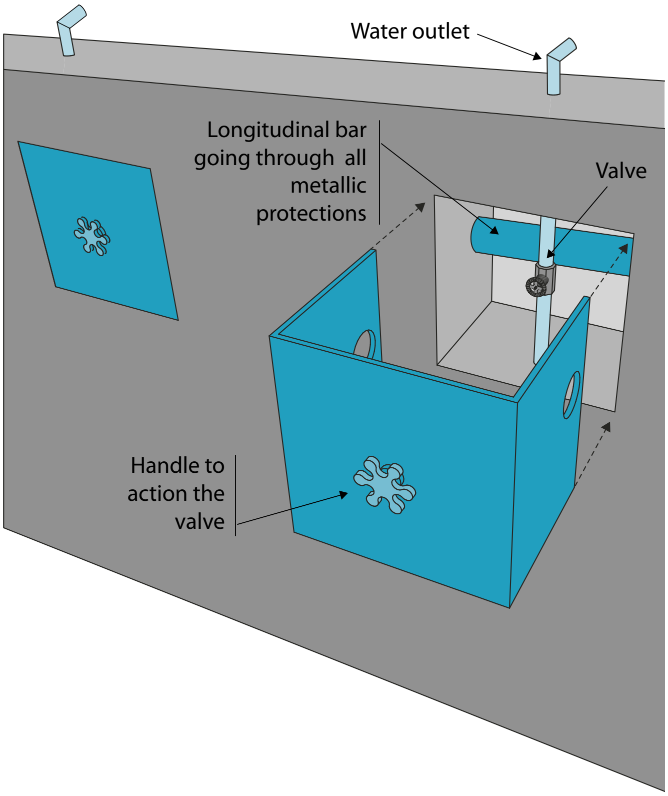


fig. 2.33 Details of the valve metallic protection

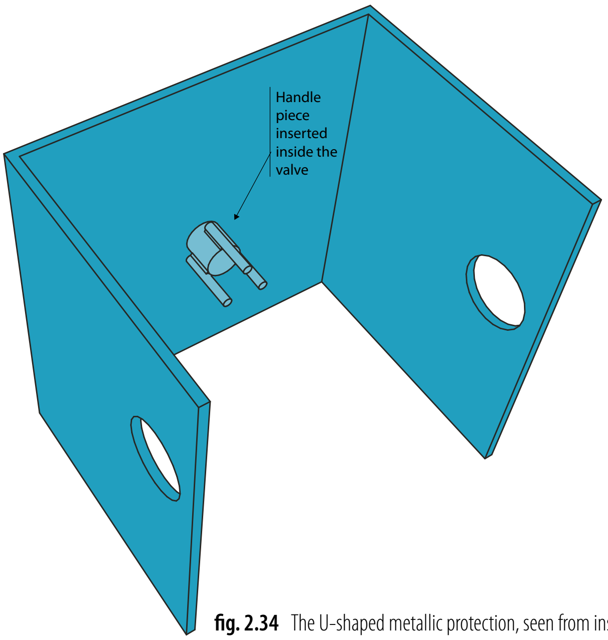


fig. 2.34 The U-shaped metallic protection, seen from inside

ACH

- In order to help save water in a water scarce region, Action Against Hunger Spain is using push-button taps (the same as PU second model, cf. supra).
- To protect these taps, the idea was here to make an easy-to-realize integral protection of the fountain.
- The system is useful in contexts where the taps should not be accessible for use outside of school hours: in water-scarce regions for example.
- Another advantage is that the lid can also be used as a protection to prevent dust and sand from clogging the basin. This could be an additional criterion for desert areas.
- The disadvantage is that the janitor will need to open and close the protection on a daily basis.
- For safety reasons, the protection hinge is situated at the lower edge (if on the contrary the protection was opened towards the wall with a hinge on the upper edge, it might fall on the children by accident).
- One of the lessons learned of this model is that the plate should be heavily reinforced, otherwise it can be vandalized [fig. 2.36].

MoE

While creating new sanitary blocks, the Ministry of Education has been working on the possibility to include the drinking fountain inside the block [cf. "fig. 2.72 MoE's sanitary block" on page 64].

As mentioned earlier, this would make the use of tap protections unnecessary, which can help compensating the increase of the price of the additional necessary roof.

fig. 2.35 ACF's drinking water fountain with integral protection

fig. 2.36 ACF's first try of integral protection, insuf ciently reinforced.

4. Hand washing basins

4.1. *Additional specific identified challenges*

Washing hands after going to the toilets aims at avoiding the transmission of diseases through the fecal-oral route [cf. "fig. 2.1 Vectors of transmission through fecal-oral route and barriers" on page 46]. In addition to the important general challenges mentioned at the beginning of the chapter, here are the ones specific to the hand washing basins.

Drinking

The separation between drinking fountains and hand-washing basins is a concept created in the mind of the designer, and this distinction is not always obvious for the user, especially when it is a child and no awareness raising sessions are held in schools. At any moment, a child might decide to drink from the hand washing basins.

Soap

Even if it can sometimes help removing apparent dirt, **washing hands without soap has no impact at all on the removal of bacteria or viruses**. Scientific research has shown that if no soap is used while washing hands in a public place, hands will actually get even more contaminated during the process, because of the need of touching the tap.

Hence, there should always be a specific location for a soap next to each tap, to encourage the children to use it (or highlight its absence to the school administration).

Awareness campaigns and trainings should also take place with the school administration so that soap is always available and with the children so that it is used on a regular basis.

Hands-free rinsing

After scrubbing hands with soap, it is the rinsing process that will take most of the bacteria away[20]. Touching the tap (or a door handle) after this stage will re-contaminate the hands.

One can open the tap with the soapy hands, but after rinsing them, one should be able to close it without the hands. This is why many public spaces (such as airports) tend to install expensive hands-free taps with infrared sensors, while in hospitals, restaurants or trains it is frequent to find foot-, knee-, or arm-operated taps.

20 Although drying them with a paper towel can eliminate a further 24% of the bacteria remaining on the wet hands.

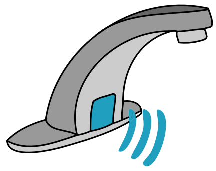


fig. 2.37 Infrared sensor tap

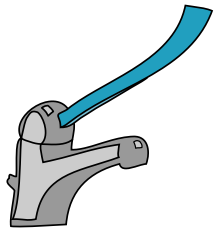


fig. 2.38 Wrist tap

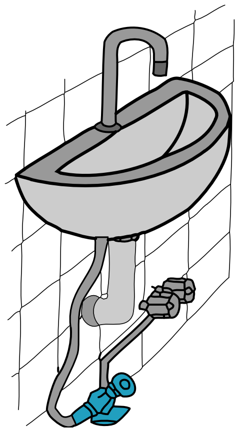


fig. 2.39 Foot tap

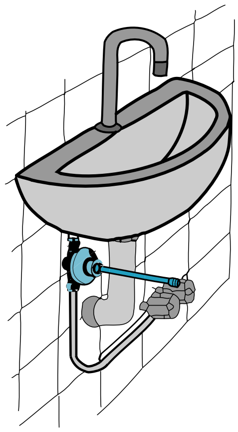


fig. 2.40 Knee tap

The more complicated the mechanism, the more maintenance will be needed, and this is particularly true if it contains electronic components such as an infrared sensor. But there are also simple or low-tech solutions that can help reduce the need of contact with the tap after rinsing (e.g. the "tippy-tap" promoted by UNICEF in Africa, showing that hygiene is not a luxury), and this has to be taken into account as much as possible.

fig. 2.41 Tippy tap

4.2. *Design solutions*

DRC

The hand-washing basin is following the same concept as the drinking water fountain:

- It is lifted and hanging from the wall, to facilitate the cleaning of the floor;
- Since this basin is situated inside, the tap protections are not necessary, and low-cost quarter-turn taps have been used;
- It is using few construction materials, and the design is very simple and effective.

The main identified disadvantages are:

- The water spills on the floor around the drain (although this could be improved easily);

fig. 2.42 DRC's handwash basin

fig. 2.43 DRC's handwash basin drain

- **T**he absence of soap holders (or at least a place the school administration could use for dispensing soap);
- **T**he need to touch the tap to close it after hand washing. Longer tap handles, if installed together with an awareness raising campaign, would make possible to close the taps with the forearm instead of the fingers.

SIF

In the context of their work on prefabricated sanitary blocks [cf. "SIF in Syria" on page 13 and "SIF" on page 66], Secours Islamique France has designed a new model of hand washing fountain basin that can be prefabricated.

fig. 2.44 SIF's prefabricated handwashing basin

fig. 2.45 SIF's prefabricated handwashing basin, finished and painted with epoxy

- **T**he basin model is very simple and effective: only concrete with epoxy painting is used. it makes this low-tech yet elegant model highly replicable in many contexts.
- **I**t is further improving the drain system from SDC: it is easier to clean and able to serve as a drain for the floor area, but without necessarily creating a cantilever.
- **T**o prevent water from spilling around the drain, the last part of the channel leading to the drain is not completely vertical, but slightly tilted, so that water is not falling but rather flowing on a very steep slope.
- **T**he very shallow basin designed here is ideal: it will ease the maintenance and will avoid deposits of waste and dirt.
- **T**he use of epoxy paint on concrete as a finishing and waterproofing material was judged satisfactory until now. However, other materials can also be installed easily on the inner inside the channel (e.g. a piece of marble, or ceramic tiles) to further ease the cleaning and durability.

While the basin itself is excellent, the taps are probably not ideal, because screw-taps need a long manipulation to be closed, which is not hygienic after the pupils have rinsed their hands.

A specific place for the soap should also be integrated into the design of the basin.

ACF

- **T**he basin is here also composed only of marble, but is supported on the floor.
- **A**n attractive color was chosen for the ceramic tiles, making the place more child friendly.
- **P**ush-button taps have been installed. This can be an improvement for the hygiene and the "hands-free rinsing" issue [cf. "3.1. Additional specific identified challenges" on page 50], on the condition that the water runs long enough to allow a complete rinsing of the hands without having to retouch the tap to close it.
- **H**owever, the provision of soap is here also made nearly impossible.

fig. 0.2 SIF's hand washig basin details

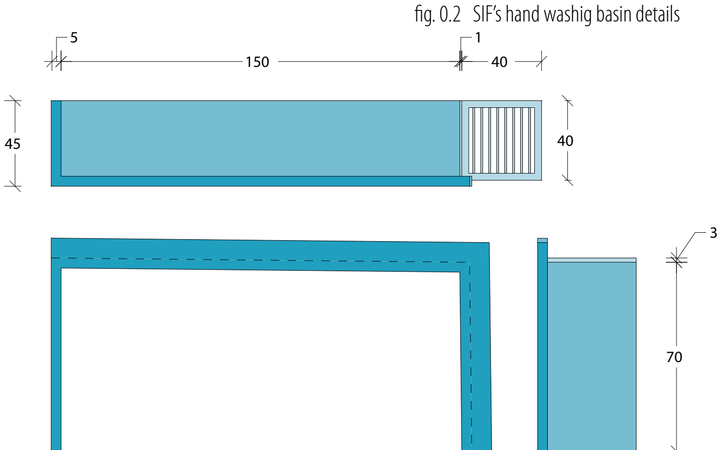


fig. 2.46 ACF's hand washing basin

PU

- **T**his basin shape, with "climbing" floor tiles, is another way of easing the cleaning of the floor. However, the drain can be obstructed more easily and will need regular maintenance.
- **T**he horizontal marble plate makes the provision of soap possible, but a specifically designated area would probably promote its use better, since a wet soap is very slippery.
- **T**he main improvement here is about the taps, which are high quality, Italian, push-button taps with a timer. Hands-free rinsing is ensured, because the water flows enough time for it (6 to 15 seconds, adjustable).
- **A**part from hygiene and durability, the high quality of the taps also increases the accessibility, since they do not tend to become harder to push after some time. They cannot be stolen because they are situated inside a closed area.
- **T**heir high price (1500 SYP) is justified as an initial investment for durability, but can hinder their replacement or maintenance.
- **M**irrors were also installed, to promote good hygiene and appearance among the pupils, and reduce the risk of gibes. For an increased safety and durability, these are unbreakable: they are made of polished stainless steel.

MoE / UNICEF

The Ministry of Education and UNICEF are generally using individual sinks for the hand washing instead of a long basin with a row of taps.

- **I**ndividual sinks can be useful for promoting the use of soap [cf. fig. 2.48].
- **S**oap provision can be also promoted through simple soap holders [fig. 2.49].
- **I**n order to ease the daily cleaning, the basin is now placed under a marble plate [fig. 2.50], so that any water situated on the plate can easily be pushed inside the sinks.

The main disadvantages of this kind of design are that:

- **S**eparate sinks are not necessary and can increase the price or reduce the number of taps available;
- **T**he type of tap is not ideal for hygienic hand washing: it can be closed only with the fingers, and require several turns until it fully stops. This process can re-contaminate the hands.

fig. 2.47 PU's handwashing basin with mirrors

fig. 2.48 MoE's individual hanging basins **fig. 2.49** MoE's individua basins over marble plate

fig. 2.50 MoE's new system of individual basins under the marble plate

5. Toilets and urinals

5.1. Challenges

In addition to the important challenges mentioned at the beginning of the chapter, here are the ones specific to the toilets and urinals.

Gender

As in many countries, toilets in Syria are preferably segregated according to gender, to promote their use, increase intimacy and avoid harassment.

In mixed schools, this tends to be the norm. However, this has also to be taken into account in single-gender schools, as these might become mixed in the future: a possible split of the toilets into male and female areas should be planned wherever possible.

Availability

Enough toilets should be provided for the pupils, and gender equity should be sought in terms of equal queuing times, not in terms of equal toilet numbers. Providing an equal number of toilets for males and females, especially in the presence of urinals, is a mistake (often made by an architect in search of spatial symmetry). It will penalize the female pupils.

Recognized minimum international standards [21] are 1 toilet for 30 girls and 1 toilet for 60 boys, both in emergencies and on the longer term. According to this standard, a balanced mixed school with 720 pupils should hence have 12 toilets for the girls and 6 for the boys.

Anal cleansing

In Syria, anal cleansing is traditionally done with water. Separate bidets are frequent at home, but in public toilets the use of a bidet shower is the most advisable.

Defecation posture

Squatting is a much more natural and healthier position for defecation than sitting. Squat toilets are generally used in Syrian schools, and this is a positive fact [22].

Of course, children with special needs will prefer to be seated; the use of a seat toilet is still the best option for them.

Vandalism

Vandalism here mainly concerns the common graffiti on the inside face of the doors, which should be taken into consideration for maintenance.

Sewage

The obstruction of sewage pipes in schools is frequent, which is due to four factors: the bad design and execution of the network (small pipes), the lack of water, the solid material thrown in the toilets by children, and the lack of maintenance by the school management.

5.2. Toilet Design Solutions

SDC

The use of wood in sanitation blocks was avoided. Doors and doorframes installed in sanitation blocks are all made out of metal painted with epoxy paint.

For an improved durability, all the metal frames of the doors were welded together as one long monolithic element. The latter, apart from supporting the doors, is linking all the partition walls together through one continuous lintel, and also covers the frontal edges of these walls, which are otherwise usually covered by fragile ceramic tiles exposed to frequent vibration efforts.

Plastic hoses, used as bidet showers, were fixed inside the toilet stalls to their taps with clamps to prevent falling on the floor and coming in contact with impurities (hence spreading contamination to other children).

For wheel chair users, one toilet stall equipped with an access ramp, was made available. A squat toilet was installed, and a portable fitting toilet seat was given to the school. The logic of this design calls for normal use of the stall as long as there are no disabled children registered in the school.

fig. 2.51 SDC's toilet metal doorframes

fig. 2.52 SDC's anal cleansing hose

21 Sphere Handbook 2011, p. 130 [Available at: http://www.sphereproject.org/]

22 Nowadays, some people tend to advocate in favour of a seat toilet, but because they are wrongly associated with an idea of modernity. As clarified during the brainstorming sessions, the use of an elevated seat in everyday situations –be it a normal chair or a seat toilet– is actually a custom originating from western countries and which was mainly aimed at keeping a distance from a cold f oor. As such, it should be associated with a specific (cold) climate rather than with an idea of progress. (cf. also A. Ravéreau, Learning from Tradition, 1982).

fig. 2.54 DRC's toilet stepless floor to ease the cleaning

Once a disabled child joins the school, the portable seat can be fixed above the squat toilet and the stall becomes dedicated for the disabled child.

DRC

The same steel doorframes as SDC's have been used with success, but are not touching the floor as a protection against rust.

Existing wooden doors have been here rehabilitated and also protected from moisture by being installed 10cm above the floor.

The main innovation concerns the ease of maintenance: in the entire sanitation block, there is only one level for the tiles, thereby creating a continuous flat surface. The removal of any steps or corners is making the daily cleaning faster and easier. Special care has to be brought to the slopes, to avoid that water spills from the toilets.

To reduce the maintenance needs, the color of the floor tiles was specifically chosen to reduce the visibility of dirt inside the toilets.

fig. 2.53 SDC's removable seat for disabled children

fig. 2.55 PU's central flush system network

fig. 2.56 PU's central flush system valve

PU

Central flush system

The central flush system is one of the first innovations from PU, developed in 2008 in collaboration with UNICEF. This system has been widely acclaimed and is in use by several organizations, since it appears as very advantageous:

- **I**t comprises a central water tank and a unique valve, which allows the janitor to flush all toilets at the same time;
- **T**his system considerably improves and eases the daily maintenance of the toilets;
- **T**he central flush system is also saving water and reduces the very high mechanical maintenance needs associated with individual tanks.

Of course, from the tank to the toilets, larger sections of polypropylene plumbing are necessary to ensure an adequate pressure (example for 6 toilets: 63mm for the main line from the tank to the valve, 40mm for intermediary distribution lines, and 32mm for connecting the toilets to the distribution line).

Doors

Concerning the toilet doors, Première Urgence has first worked with metal doors in WC rehabilitations. But the experience is that:

- **M**etal doors will tend to rust, even if well protected with a special paint,
- **T**hey are also more difficult to clean, because of the reinforcements situated at the back of the metal sheet.

After that, both melamine resin coated particleboards (Formica) with a wooden frame and regular wooden laminate doors with paint have been used in new constructions.

- **E**xperience shows that regular laminate doors with paint are not very resistant to

fig. 2.57 PU's metal doors in rehabilitation projects

fig. 2.58 PU's melamine doors

fig. 2.59 PU's toilets for Children with Special Needs

impacts (because they are hollow), and paint will also be easily scratched after time.

On the contrary, doors made with two panels of Formica with a wooden frame probably offer the best option so far, because:

- They are rather cheap;
- They are very resistant to impacts (plain boards) and scratches (melamine resin coated);
- They are very easy to clean;
- They can offer child friendly colors (see picture).

Whatever the material, the toilet doors should always be lifted 10-15cm from the ground to avoid contact with humidity.

Bidet shower

A lesson learned concerning the bidet shower is that simple plastic hoses with a tap are better for durability than metallic ones: bidet showers (with a button) are more practical but get broken too quickly.

Children with Special Needs

Concerning the toilets for children with special needs, apart from the respect of the dimensional norms published in UNICEF's handbook [cf. fig. 2.60], PU stands for the provision of an integrated bidet inside the toilet seat instead of a separate handheld bidet shower: it is much easier to use for a child with a limited movement capacity.

UNICEF

In its work on improving the accessibility to children with special needs, UNICEF already provided full guidelines concerning the dimensions of toilets for wheelchair users. On fig. 2.60 below are a few drawings concerning the dimensions and useful accessories, as a reminder; however, the interested reader will find the complete guide in pdf format on the CD-ROM situated at the end of this book.

Concerning the sewage network, UNICEF insists on the fact that it should be carefully designed and executed, in order to reduce the risk of pipes obstruction. Some minimal dimensions have to be used:

- The pipe diameter between WCs and the collecting pipe should be not less than 6 inches;
- The diameter for the main pipe should be about 6-8 inches;
- The thickness of the PVC pipes for the network shouldn't be less that 3.6 mm.

Moreover the use of manholes inside the toilet blocks might attract rats and insects and would induce bad smells. For this reason, the manholes should be put outside the toilets blocks wherever possible. If the situation does not allow for outside manholes, it is possible to use a design where a water drain situated at the higher end of a collecting pipe will allow the maintenance of the line [cf. fig. 2.61 on page 63].

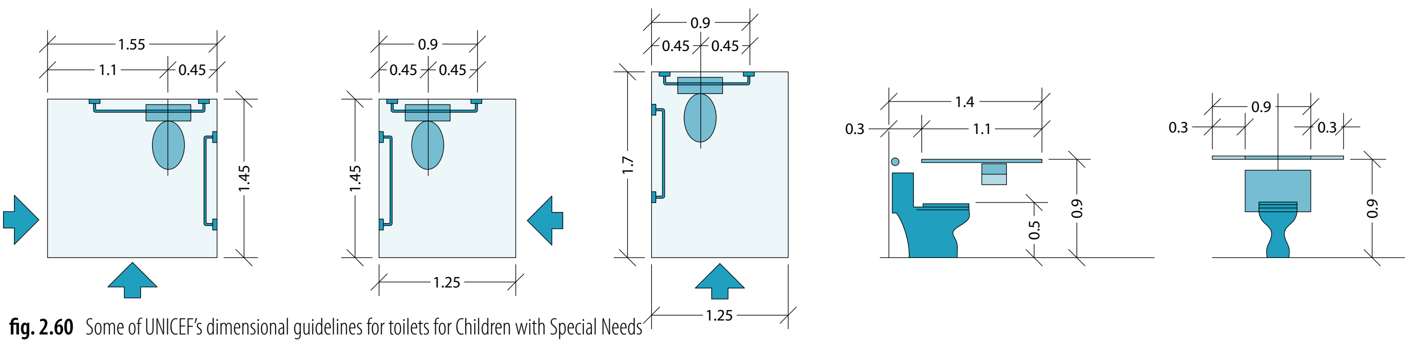


fig. 2.60 Some of UNICEF's dimensional guidelines for toilets for Children with Special Needs

fig. 2.61 UNICEF's sewage system

fig. 2.62 ACF's toilets

fig. 2.63 ACF's toilets for Children with Special Needs

fig. 2.64 Help's toilets

5.3. *Urinal Design Solutions*

PU

To facilitate daily maintenance, urinals can use a (separate) central flush system, with a smaller valve and smaller diameter plumbing needed, since no high pressure is required in the absence of solid waste.

The wall-type of urinal is preferred to the ceramic ones because:

- It reduces the amount of plumbing and the cost;
- It is more durable;
- It is easier to clean;
- It is increasing accessibility: there is no risk of a urinal positioned too high or too low.

Urinal partitions are in marble, with a rounded corner at the top to improve children's safety.

Help

In case of rehabilitation, an easy and low-cost way to install a central flush system for urinals is to install an external perforated polypropylene pipe. It can then easily be replaced for maintenance.

ACF

The use of ceramic individual urinals is also possible. It can help reduce the smells and improve the hygiene, but the solution can be more expensive (2050 SYP/unit), and the plumbing is more difficult to maintain.

The problem of the reduced accessibility due the different size of pupils can be addressed by installing urinals at different heights (for example along a slope), so that every child can find the one suiting his needs, as explained for the drinking water fountain [cf. "Third generation" on page 55].

fig. 2.65 PU's tiled urinals with rounded marble partitions and central flush system
fig. 2.66 Help's urinals with external pipe for central flush
fig. 2.67 ACF's ceramin urinals with marble partitions

6. The sanitary block

6.1. Design solutions

SDC

The roofs of the one-storey buildings suffered from leaking tanks, broken water drains and rubbish collecting on them. They could not be maintained properly as they were only accessible with ladders, which generally were missing. This frequently led to water damages inside the building. SDC's intervention consisted in:

- **R**emoving the water tanks from the sanitary block to transfer them onto the main school building,
- **I**mproving the toilet roof waterproofing with a new insulated slope covering and protecting the whole sanitary block roof, removing the parapet [fig. 2.70];
- **I**mproving the drainage system: the roof is drained over one edge, where the rainwater pipes are removed and where a water nose is applied and lets the water fall onto the floor [fig. 2.71].
- **P**roviding a ladder to the janitor so that (s) he can regularly maintain the roof.

The water tanks used to be situated on the one-storey sanitation block. There are now situated on the main roof, which is accessible from the main staircase. The area for the tanks was insulated and tiled [fig. 2.68].

An "alert pipe" was installed to the facade to indicate when a tank is leaking. Besides the advantage for maintenance, the position of the tanks on the main roof also increases the water pressure in the distribution system and minimizes the possibility of vandalism.

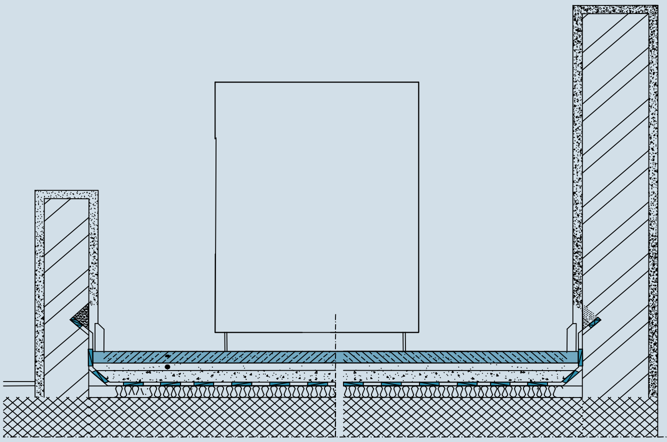


fig. 2.68 Tank area is waterproofed and tiled

MoE

The School Building Maintenance Department of Rural Damascus has been working on a new design of sanitation block. The drinking water fountain is situated inside an entrance hall, which can be closed with a gate, so that taps do not need to be protected.

A toilet for children with special needs is also integrated. In order to improve the aesthetics, a high and tilted parapet wall is hiding the water tanks situated on the roof.

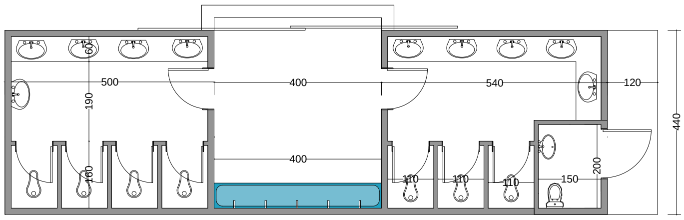


fig. 2.72 MoE's sanitary block

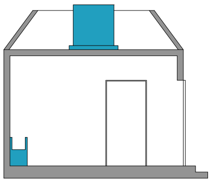


fig. 2.73 Section

fig. 2.69 SDC's tiled paltform for water tanks

fig. 2.70 SDC's parapetless roof rehabilitation

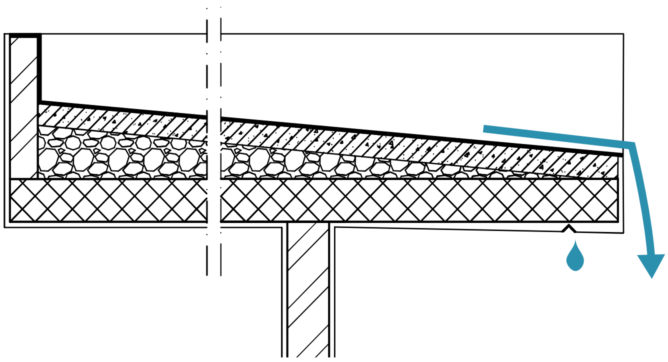


fig. 2.71 SDC's parapetless roof and waternose

DRC

Apart from easing the maintenance by removing all steps and corners and providing a single flat surface in the entire area ["DRC" on page 61], two other considerations have been taken into account by DRC at the level of the sanitation block.

The first consideration concerns the layout: it should be symmetrical wherever possible when built inside a single-gender school, so that it can easily be divided into two parts if the school becomes mixed after some time (this idea is respected on the example of the picture but not on the plan).

fig. 2.74 DRC's symmetrical, stepless floor sanitary block

The second consideration concerns the position of the block inside the school compound. In Syrian schools the sanitation block has generally been built as far as possible from the school building, to keep the bad smells away. The problem with this system is that because of the distance, the bad smell is tolerated. DRC is hence proposing a completely opposite approach, and suggest that the toilets are situated close to anyone who has a decisional power on its maintenance. Therefore, the smell will become an issue and will be taken care of. In this prospect, the toilets should be situated inside the school building. The drawing shows an example of a toilet block that has been rebuilt close to the janitor's room, giving him or her more sense of responsibility and ability to keep it clean.

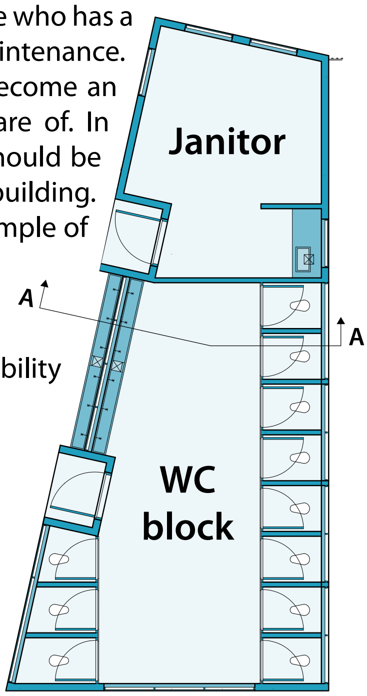


fig. 2.76 Detail of DRC's sanitary block

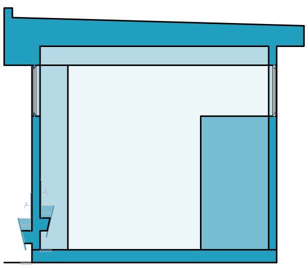


fig. 2.77 A-A cross-section

PU

PU is sharing the same approach as the one mentioned above, and in case of new school construction, it always incorporates the sanitation fixtures inside the school building. This saves also a lot of space in the playground and avoids wasting space.

The WC block has also been made symmetrical so that gender segregation is possible if the school becomes mixed in the future.

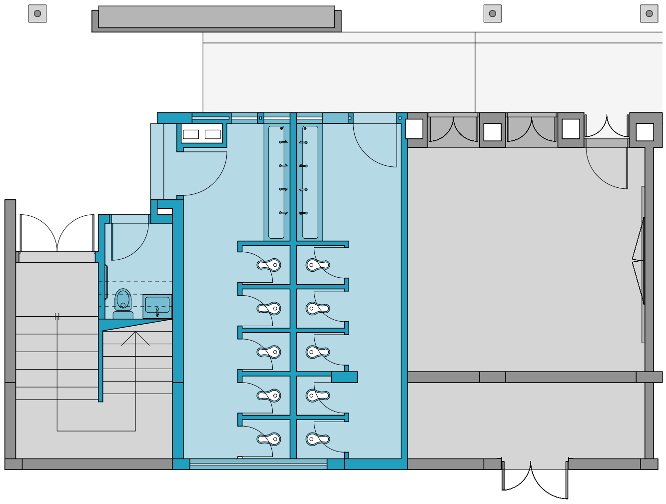


fig. 2.78 One of PU's sanitary block, symmetrical and integrated to the building

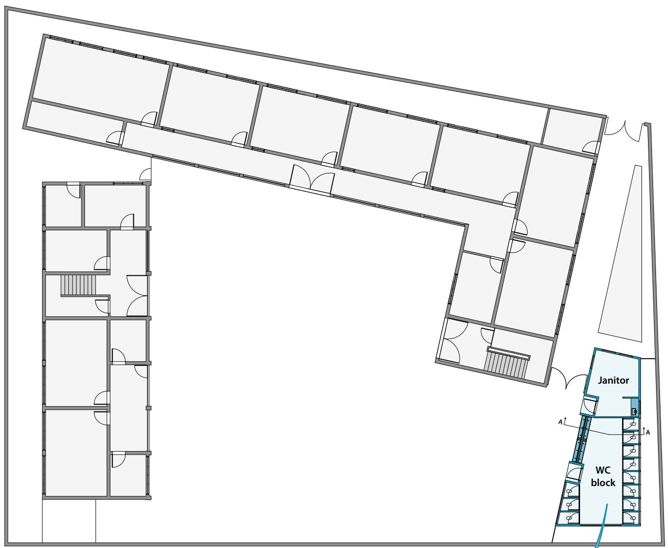


fig. 2.75 DRC's sanitary block rebuilt attached to the janitor room.

fig. 2.79 SIF's sanitary blocks under prefabrication

fig. 2.83 Inside the sanitary block

SIF

When the same toilet blocks need to be installed in various remote locations, prefabrication can constitute the cheapest and easiest option. These toilet blocks have been prefabricated by SIF in Damascus and delivered to several remote areas. Advantages of prefabrication can include:

- A reduced time of construction;
- A reduction in the production cost (scale savings and reuse of formworks);
- An easier quality control;
- An greater availability of skilled labor and materials;
- An easier management of weather conditions;
- A reduction of waste materials (remaining quantities can be used for another toilet block).

Some possible disadvantages are:

- The risk of using technologies and materials that are not locally supported for maintenance,
- The need to adapt to the context specificities (although prefabrication does not mean necessarily standardization),
- The difficulties of transport.

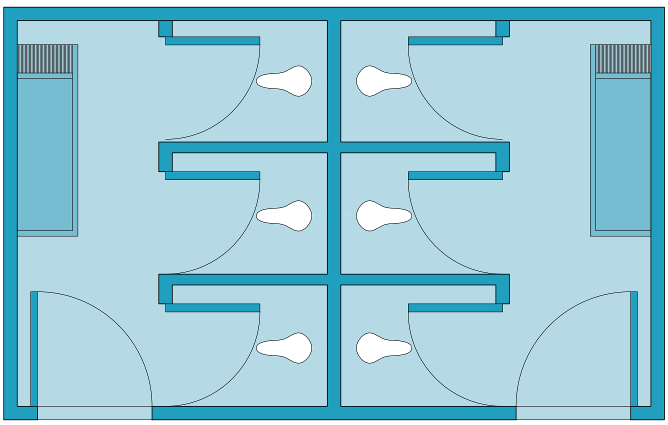
Although it was not the main reason of the choice of prefabrication, these toilet blocks offer also the advantage of being movable from one school to another, which is useful in case of emergencies or other fast-changing contexts.

fig. 2.80 SIF's sanitary blocks being delivered

fig. 2.82 SIF's sanitary blocks after installation in a remote area

fig. 2.81 SIF's sanitary blocks being installed

fig. 2.84 The plan of SIF's prefabricated sanitary blocks



7. Water recycling

7.1. *Design solutions*

Wastewater is a source of water. This is often forgotten, although it can substantially reduce water consumption, which is a major challenge for the years to come (cf. "Water saving" on page 47). In schools, useful wastewater sources are rainwater, water from the drinking fountains, and water from handwash basins.

These waters can be harvested, treated if needed, stored, and reused for other purposes.

UNICEF

There is a lack of water in Syria in general and especially in remote and rural areas. In order to save water, reduce its wastage and preserve the environment, UNICEF is supporting the usage of a central flush system alimented by grey waters, as explained here below.

1 • Firstly, to increase the available pressure, clean water is pumped to a water tank on the roof of the main school building, which can be distributed for drinking and hand washing.

2 • Secondly, the grey waters are collected from the drinking water fountains and the washbasins, and collected into the wastewater drum.

Before storage, water can undergo a light treatment, such as sedimentation or soap skimming.

3 • Thirdly, the water is pumped to the tank for flushing the toilets.

4 • Toilets can then be flushed with these grey waters using the central flush system [cf. "Central flush system" on page 61].

5 • Lastly, in case there is no sufficient water, the tank has a secondary alimentation, so that normal fresh water can be also used to flush the toilets in case of emergency. For this reason, the drinking water tank should be situated higher than the central flush tank, so that water can be transferred by gravity, without any pump. The system is then working even in case of a power cut.

Water from the fountain and rainwater can also be collected and used for trees, plants and vegetable garden watering. In this case, the water should not come from the hand-washing basins, since the presence of soap should be avoided.

A rough estimate shows that enough wastewater will normally be produced for flushing the toilets without the need of the secondary alimentation. If we take into account the several international quantity standards previously mentioned in this chapter:

- **3** liters/pupil/day for drinking and hand washing, out of which at least 2,5L will go in the wastewater pipes
- **1** toilet for 30 girls, 1 toilet for 60 boys (higher number than the present reality in Syrian Schools)
- **2**0 liters needed per toilet with a central flush system

and if we apply it to the previous example of a mixed school of 720 pupils with a balanced gender ratio, we have:

- **(**12+6)=18 toilets, needing roughly 360 liters for flushing
- **(**360/2,5)=144 pupils will need to use the drinking and hand-washing features.

This means that 20% of pupils using the drinking and hand-washing facilities would be enough to make the flushing system work without the need of fresh water, thereby saving 360 liters of fresh water per day.

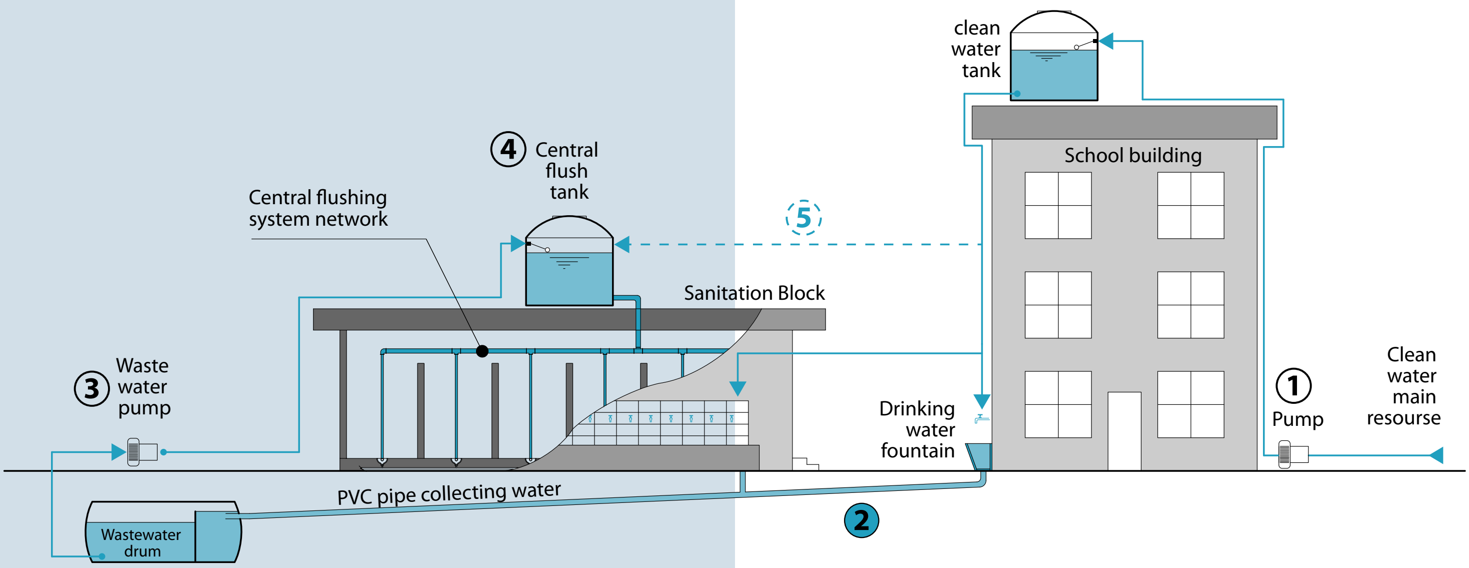


fig. 2.85 UNICEF's water recycling scheme

CHAPTER 3 EQUIPMENT

1. Pupils' desks

1.1. Identified issues and challenges

Flexibility and active learning

The traditional rectangular shape and dimension of the classrooms in Syria derive from a tradition of "passive learning" teaching methods, where all pupils are sitting in rows and are listening to a teacher positioned at the front of the classroom. However, the teaching methods have recently been changing in Syria, following a global trend towards more active learning practices.

These active-learning teaching methods involve a frequent rearrangement of the desks in the classrooms, in order to create a variety of layouts, depending on the activity (small sub-groups, one large U shape or circle for common discussions, one long rectangle to work on a common piece of art).

fig. 3.1 Pupils' desks disposed as a U

These different layouts typically require more space in the classroom than three rows of desks, while the existing narrow classrooms will probably remain unchanged. For this reason, a focus will be put on the school equipment design, which will have to be very flexible. This represents one of the main challenges of the pupils' desks for the coming years.

Ergonomics and the size of the pupils

Anthropometry of pupils is an important issue that should be considered when designing school furniture. The lack of adequacy between anthropometric dimensions of students and the ones of the furniture is causing musculoskeletal disorders, headaches, ache in neck and shoulder muscles, decrease in concentration, and tiredness of eyes.

The size of the children will change according to gender and age. A Syrian statistical study showing average anthropometric data of pupils from different ages would be useful while designing new desks.

The size of individuals is variable, therefore tolerances have to be included in the dimensions.

Pupils' safety

The ergonomics concerns not only the general shape but also some details. When designing a pupils' desk, one must avoid any sort of protrusion: sharp edges, angles, screws and bolts are all possible threats to the child and his clothes. Moreover, avoiding protrusions will generally help also the maintenance.

Attractiveness and aesthetics

As the most visually present item in a classroom, a pupils' desk can have a lot of impact on its general atmosphere. It should therefore be aesthetically attractive.

While aesthetics is reputed to be a matter of taste, two objective criteria of evaluation can be taken into consideration:

- **T**he care that the designer has put into its design and the details. Planning, anticipating details, and coordinating (with other pieces of furniture in the room or the color of the walls) right from the beginning can considerably improve the aesthetics.
- **T**he level of enthusiasm that a shape or a color will raise among the children. This can be objectively measured just by asking the pupils directly, or making them chose between different options.

Impacts prevention

The important issue of bench-to-walls and bench-to-bench impacts was first identified by SDC during one of their assessment of the existing pupil's desks models in the public schools.

Most traditional models of benches, chairs, desks have a steel base that is narrower than the wooden element situated on top of it, while many apparent backrest screws are a dangerous protrusion.

fig. 3.2 The consequence of bench-to-bench impacts

As a result, the pupil's desks will tend to very heavily damage the walls [fig. 3.3] (even after a short period of time) because of their frequent moves, and get damaged [fig. 3.2] (for instance, a screw from a backrest scratching the front of another pupils' desk).

This issue can be easily addressed[23] and at no cost if the designer (or welder) is aware of it.

Cost of production and ease of assembly

The initial cost of a pupils' desk remains the main limiting factor concerning any wished improvement. The cost of production is closely linked to the ease of assembly of the different parts and the materials used. Simplifying the design in an intelligent way and thinking of how it will be produced can sometimes improve the characteristics of the desks and generates no extra cost.

Quality & Cost-in-use

As in any other item in this book, the durability and the cost of the maintenance of the pupils' desks during its life is a very important factor: investing in high quality can cost more at the beginning but can eventually save money on the longer term.

The main external aggressions to the pupils' desks that were identified are the vandalism by the pupils (writing and scratching on the desktops), the water used intensively by the cleaning teams (sometimes carelessly watering the windows and walls with too much water, particularly after the holiday period), and the frequent movements and vibrations.

Type of technology and materials and ease of repair

It is important to draw a clear distinction between the level of quality and the level of technology of a technical solution. The two concepts are easily confused, often because of industrial marketing.

- **H**igh-tech materials and technologies rely on a specialized industry for their production (e.g. plastic polymers). They generally offer the advantage of either a higher level of performance (weight, strength) or the one of a lower price. Because of their technology, these materials can generally not be repaired easily by just anyone. Some cannot even be painted.
- **O**n the contrary, low-tech materials (such as wood) have often a lower performance, but their great advantage is that they can be easily fixed anywhere with a few skills.

Depending if the used technology is quality-oriented or cost-oriented, it can have diverse impacts on the initial price, the need of maintenance or the ease of repair, which is why their evaluation and the choice between them is not always easy to make.

fig. 3.3 The consequence of desk-to-wall impacts

Whatever the choice, it is essential, for maintenance, that the chosen technology is available locally and mastered by the local workforce.

Ease of cleaning the f oor

The footprint of the pupils' desks on the floor can constitute an obstacle for cleaning. Horizontal reinforcement bars placed near the floor will hamper the cleaning of the floor, especially if desks are difficult to move.

23 Taken into consideration by absolutely all NGOs working with "traditional" pupils' desks, this issue symbolizes by itself the kind of "design tradition" (cf. introduction) which can be reached quickly and at no cost just by sharing experience and which should be absolutely promoted at all levels.

Environmental sustainability

Offering environmental friendly solutions has become a major challenge of the recent years, and will become an even larger issue in the future years. Key criteria that should be taken into account here are the possible reuse of old parts for new desks, the recyclability of materials (for other purposes), the embodied energy[24] and the carbon dioxide emitted during the life cycle of the item.

The recycling of the existing old desks is also an important issue: many of them are stored in dead areas in the schools (roofs, backyards, basements), which is a waste of space as much as a waste of equipment.

Sitting capacity

The general shape of a pupils' desk will impact the sitting capacity of the class. The current pupils' desk model often accomodates three students on the bench instead of two, while new models of benches, if less compact, might reduce the enrolment capacity of a school if used in an old building.

The reference number of children sitting in a standard classroom in Syria is 32. This figure can be taken into account while designing new desks for a certain type of classroom. Going over this number will reduce the quality of education, and under it will reduce the enrolment capacity of the school.

1.2. Design solutions

Ministry of Education

As mentioned by several organizations, the current pupils' desks models, produced by the MoE for many years, have several advantages:

- **T**hey use circular tubes that are ideal for the safety of the children;
- **T**hey use only two materials (steel and beech wood), which makes them easy to assemble and recycle;
- **T**hey use local materials and local low-cost technology, which is probably why they are the cheapest option and are easy to be repaired.

The Vocational Training department of the MoE has also used fiber material (instead of beach wood or MDF) for the existing desk design and produced 2000 desks that were distributed to schools.

The feedback from the schools was very positive. Manufacturing the desks from fiber materials proved to be 30% more expensive than wood. Each desk would cost an extra 700 Syrian Pounds.

This will probably increase the durability of the desks, but as mentioned above, high-tech materials are more difficult to repair.

Three weak points were identified in existing desks:

- **T**he screws have sharp edges, which is a threat to the children, their clothes, the classroom's walls and the other desks;
- **T**he unprotected, roughly cut extremity of the tubes, for the same reasons;

fig. 3.4 Protruding screws with square bolts

fig. 3.5 Double flat screws

- **T**he wooden desktop, which is larger than the steel base and will damage the walls of the classroom [fig. 3.3 on page 69].

While these points might appear to be details, they actually cost a lot in maintenance because of the damage they cause.

SDC

SDC was the first organization to recognize the above-mentioned advantages of the existing MoE pupils' desks models, while also pointing out their weaknesses and working intensively on their remedial, following thus an incremental progress approach.

Plain beech wood (or "zan" in Arabic) was generally kept for joinery, since it is more resistant and easier to rehabilitate, but laminated wood was also used for the desktops.

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24 Embodied energy is defined as the commercial energy (fossil fuels, nuclear, etc.) that was used in the work to make any product, bring it to market, and dispose of it. Embodied energy is an accounting methodology which aims to find the sum total of the energy necessary for an entire product life cycle. This life cycle includes raw material extraction, transport,[1] manufacture, assembly, installation, disassembly, deconstruction and/or decomposition (source: wikipedia.org).

Hardware

A first innovation was the use of double-sided flat screws, in order to reduce their protrusion and potential damaging effects.

These screws –when made in China– are reasonably priced, compared to the ones usually used: they represent a total increase of 25 SYP only per desk.

These screws should be used with washers, in order to avoid their accidental or intentional unscrewing. To ensure a good fixation, 4 screws should be used for each element (12 screws per desk).

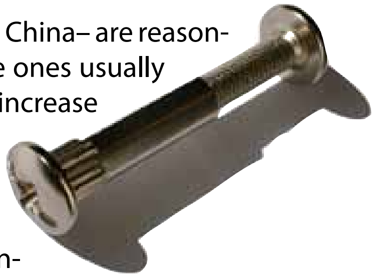


fig. 0.3 Double-sided flat screws

fig. 3.6 Curved legs (and horizontal bars) avoid desk-to-desk impacts

Structure

The second main innovation concerns the steel structure itself.

In order to avoid damages to the walls and between the pupils' desks themselves, three modifications were brought to the classical structure:

- **C**urves were added to the front and the back [fig. 3.6];
- **T**wo horizontal bars were added to the front (one working with the back curves to keep space between the desks, the other one as foot rest);
- **V**ertical bars were tilted or curved [fig. 3.7], so that the wooden desktop is prevented from touching and damaging the walls (the base is touching the wall skirting first).

The steel thickness for the tubes is usually 2.5 mm, while only 2 mm can be used for the footrest.

The horizontal bar at the base is also bent, so that the desk is resting on four spots only (instead of the full length of the bar) and remains stable even if the tiles are not completely even.

fig. 3.7 Vertical supports are tilted to avoid lateral desk-to-wall impacts

The last modification concerns the backrest and desktop supports: the two classical independent supports (which have sharp edges and are not very strong) are united as one single bar with curved edges. As mentioned earlier, the backrest is then fixed with four screws.

fig. 3.8 One single bent bar for the backrest

fig. 3.9 One single bent bar is supporting the desktop

Help

Help is sharing the same conclusions of SDC and has experience using the same type of steel structure with lateral and rear distance holders, and using the same kind of double-end flat screws to protect the children and their clothes.

On the other hand, it is defending the use of massive timber for the desktop, seat and backrest, and is against laminated materials, which are considered as not sustainable.

It is drawing the attention on the fact that the timber available on the local market is generally not sufficiently aged. Hence, cracks may open during summer and during heating periods.

This can be addressed by including warranty clauses in the suppliers' contracts, obliging the supplier to replace all cracked elements during the warranty period (non-cost service).

fig. 3.10 Curved legs (and horizontal bars) avoid desk-to-desk impacts

PU

Concerning the structure of the pupils' desks, PU is also sharing the same conclusions and design of SDC, with lateral and rear distance holders.

Different shapes have been tried for the lateral offset: curves were used at the beginning because they are more elegant, but were abandoned in the latest projects because they are less easy to fabricate and tend to increase the cost of fabrication.

In addition to SDC's work, research focused mainly on four areas: the hardware, the wood quality, the joinery and aesthetics.

Hardware

In the first projects, regular flat-ended bolts were used, with Nylon insert lock nuts, to prevent them from being unscrewed through vibrations. The protruding bolt end was then cut short and made smooth.

The double-sided flat screws [fig. 3.5 on page 70] were then used, but even if they represent a great improvement compared to the normal ones, were not judged satisfactory for two reasons:

- They can still damage the clothes of the children because the heads are slotted (for the screwdriver);
- They are too easy to be unscrewed, both intentionally (by children for instance) and by the vibrations.

The third kind of hardware now used by PU is composed of a black hexagon socket screw, which is easy to replace but hard to unscrew without a tool, a black split washer to avoid unscrewing by vibration, and a steel thread insert, which is hidden inside the wood.

fig. 3.11 Hexagonal socket screw, split washer and thread insert

Thanks to these hidden screws, the wooden boards of the seat and backrest are left totally unscathed, which is a benefit for the children comfort, protecting their clothes, and also greatly improving the durability of the wood, since there is no space where the water or dirt can enter the wood.

Wood quality

PU experienced the exact same problem as other NGOs concerning the wood in Syria: insufficiently dried wood will tend to bend when drying, implying important efforts that glue or nails alone cannot resist.

Using quartersawn wood [cf. "2.2. Quartersawn wood" on page 99] could be a solution, but it is barely available in Syria.

The only solution is hence to find kiln-dried wood. Since the difference cannot be seen with the naked eye, the only solution is to make a moisture test in a laboratory. This can be done in the University of Damascus, so that a low level of moisture can be ensured. The recommended moisture content of wood for this kind of furniture is between 8 to 12%. The exact recommended moisture content will depend to the local context: it should be as close as possible to the average relative humidity of the air.

Joinery

The desktop box is assembled with traditional dovetail joints, which are the strongest and most durable. Large wooden panels such as the desktop surface are classically made with spline joints (a strip placed into grooves), but the strip is stopped before reaching the edge of the desk, so that it is invisible and that the thin edges of the grooves are

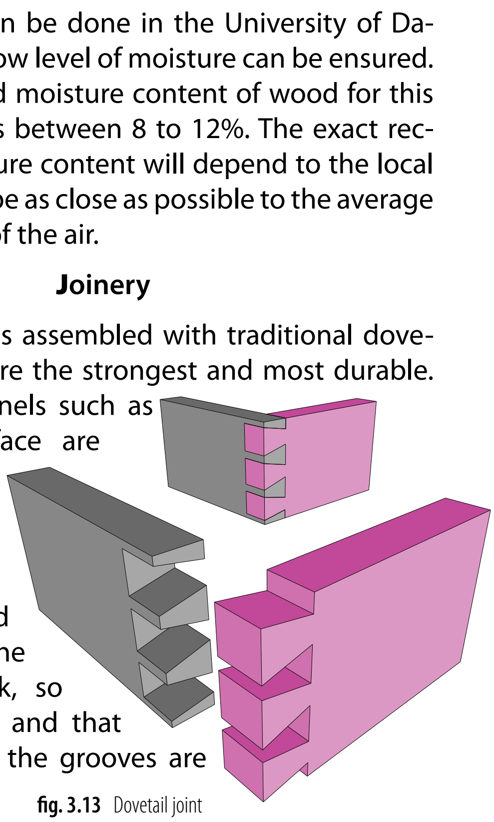


fig. 3.13 Dovetail joint

fig. 3.12 Hidden screws leave the wooden boards unscathed

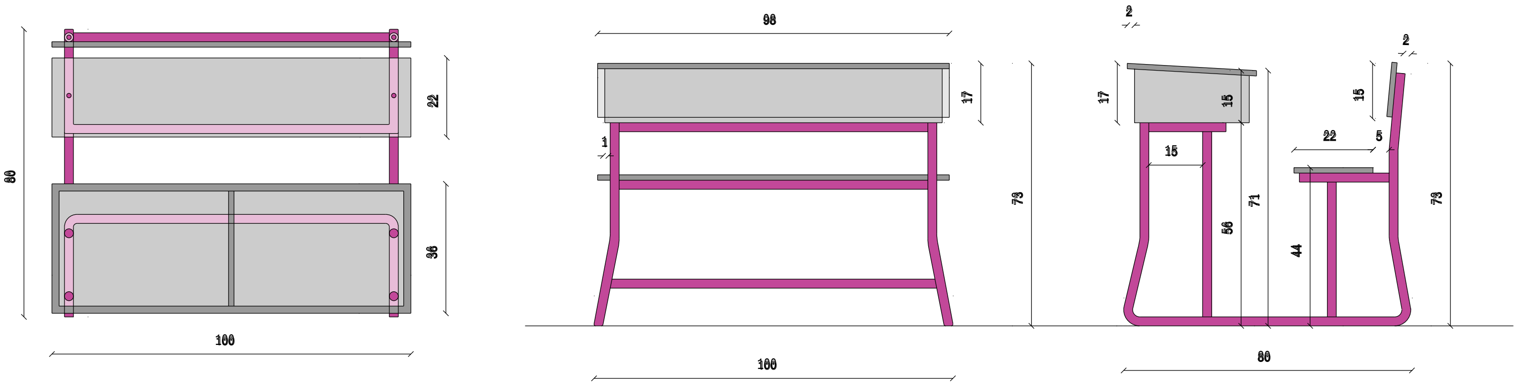


fig. 3.15 PU pupils' desks dimensions

less subject to damage. In a further precaution to avoid wood bending, the desktop surface is fixed with nine screws hidden by a wooden plug.

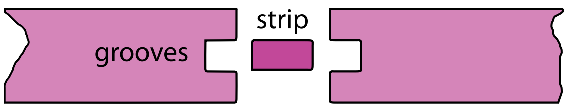


fig. 3.14 Spline joint

Aesthetics

To improve the aesthetics, the same materials and colors are used for the different pieces of furniture inside the classroom: all elements are composed of steel painted black and wood. Coordinating the colors can greatly improve the ambiance of the classroom and does not cost anything. Screws are invisible on the side of the wood, and are black on the side of the steel, so that they remain elegant.

Ergonomics

In terms of ergonomics, the pupils' desks could be improved by slightly tilting backwards the backrest instead of forming a right angle with the seat: this would increase the comfort.

Danish Refugee Council

The Danish Refugee Council put a great effort in redesigning the traditional pupils' desks from scratch, while keeping their simple technology (to make them easy to repair and keep the cost low) and also integrating the previous innovations of SDC. The objectives were to simplify the structure (and its assembly, reducing the welding points), increase the accessibility, and the durability.

fig. 3.16 DRC's pupils' desks dimensions

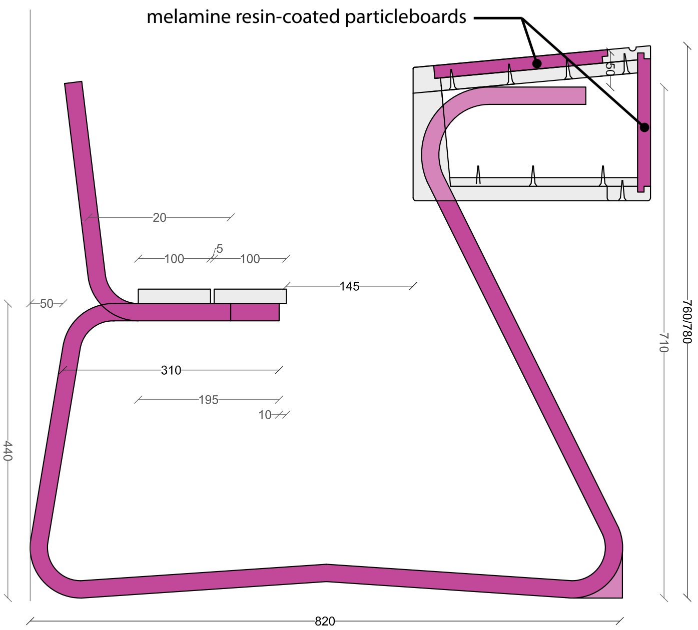


fig. 3.17 The same colors and materials are used for all items.

Structure

The new proposed design is requiring a smaller amount of bars but thicker steel tubes are needed to manufacture the frame, which makes the desks more durable and 3 kg heavier. The use of steel was carefully rationalized: the total length of steel tubes used in the design of one desk is 6 m, the same length as standard tubes on the market, which is reducing the waste and cost. The new shape (with no vertical bars to support the desktop) makes it also more accessible by the pupils.

Wood quality

DRC noticed the same problem with beech wood in Syria: it is generally not dry enough and tends to bend or warp after some time.

After having to correct this issue in 30 schools, DRC has now decided to use a composite material: a melamine-resin-coated particleboard (such as Formica®) for the top and front panel with a beech-wood frame [fig. 3.16], and possibly MDF as well. It is estimated to have the same global cost, and can be useful in overcoming the weaknesses of plain beech wood.

The bench is composed of two separated boards, which are not connected with a spline joint. While this can be less comfortable for the pupils, it reduces the cost of maintenance (only one board can be replaced instead of the entire bench).

Hardware

To avoid the issue of the screws loosening up after some time –due to the vibrations–, DRC is using one-way screws, which cannot be unscrewed after installation. However, this might cause a problem for maintenance.

fig. 3.18 DRC's One-way screws

Aesthetics

The same materials and colors are used for the different pieces of furniture inside the classroom: all elements are composed of steel painted in red and wood (or imitation) [fig. 3.17 on page 73]. As mentioned earlier, coordinating the colors can greatly improve the ambiance of the classroom without increasing the costs.

Maintenance

One of the best lessons learned by DRC was to provide the schools with toolboxes and training for the maintenance of the pupils' desks. This gives the school administration a sense of ownership and responsibility, and in case a part of the furniture gets damaged in the future, it can be fixed directly by the school staff.

UNICEF

Since the current desks models were not designed for the active-learning teaching methods as promoted in the new Syrian curriculum, UNICEF has worked on a brand new model of pupils' desk.

The proposed desktop has a trapezoidal shape, a design that enables several similar desks to be assembled

fig. 3.19 The designed trapezoidal desk

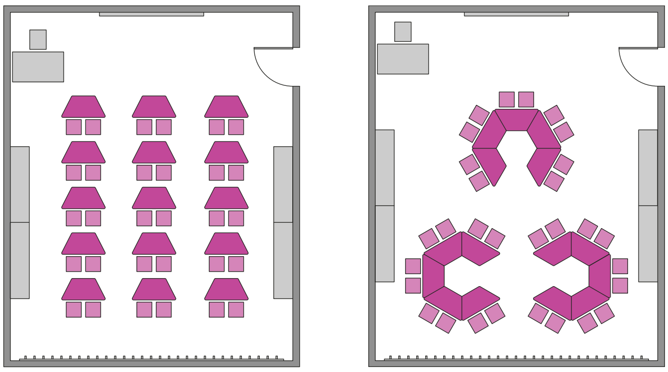
fig. 3.21 Desks disposed for workgroups of 4 pupils

together into active-learning group formations, such as a hexagon or U-shape.

The system of a table with separate chairs is improving the mobility and flexibility for a few layouts.

It is also improving the ergonomics: the chair is better than a bench and can also be positioned to any distance from the desk to suit the size of the child.

fig. 3.22 Some of the possible positions



Furthermore, it should be noted that having only four independent legs for the desk and each chair and suppressing the horizontal bar at the bottom will ease out the cleaning of the classroom.

However, during the brainstorming session, three main disadvantages were identified for the new shape under its current state:

fig. 3.20 The trapezoidal desks in use

fig. 3.23 Desks disposed in "U" for larger workgroups.

- When the desks are used in a conventional layout (three rows of independent desks), or even in groups of four desks, the available surface for the pupils to write is less adapted than the traditional models. The same possibilities of movement could be obtained with a regular rectangular table.
- The rearrangement of the desks into groups is taking more space than the three rows, and this rearrangement can be difficult inside the existing, rectangular classrooms. This means that the enrollment capacity is somehow reduced.
- The current model fails to take advantage of lessons learned from past experiences: while all previous models worked on the prevention of desk-to-wall impacts, this new model appears to be even more prone to damage the walls, especially in an educative environment which promotes very frequent desks moves. This last point could probably be greatly improved with little efforts (for example with legs vertically aligned to the edge of the desktop board).

1.3. Pupils' desk check-list

Challenge	Objective	Solution
Flexibility and active learning	Make desk rearrangements easy.	Light movable desk with independent chairs (UNICEF)
Ergonomics	Make it comfortable.	Improve lateral accessibility (DRC), or use independent chairs (UNICEF)
Safety	Reduce the risks of injuries to the child and his clothes.	Avoid sharp edges (SDC) or use hidden screws (PU).
Attractiveness & aesthetics	Make the desk beautiful.	Unify colors of furniture (PU, DRC), use new shapes (DRC, UNICEF) and take care of the finishing (PU).
Impact prevention	Avoid desk-to-desk and desk-to-wall impacts	Use frontal, rear and lateral space holders (SDC & all NGOs)
Cost of production & assembly	Reduce the production cost, make the assembly easy.	Use low-tech materials (MoE, NGOs), adapt design to the standard sizes of market products (DRC).
Quality & cost-in-use	Improve durablility, reduce the maintenance needs.	Test wood moisture in laboratory (PU), hide screws and joinery (PU), protect particle boards (e.g. Formica®) with wooden frame (DRC), make unscrewing difficult (PU, DRC).
Technology & ease of repair	Make it easy to be repaired locally.	Use low-tech, locally available, repairable materials and assembly (MoE, SDC, Help, PU).
Ease of cleaning the floor	Make floor cleaning easy.	Reduce the number of bars (DRC) or make desks and chairs easy to move (UNICEF)
Environmental sustainability	Minimize the impact on the environment.	Use local materials, if possible use recycled or recyclable materials.

2. Chalkboards & white boards

2.1. Identified issues and challenges

Running costs

School administrations have a very limited annual budget for the basic maintenance of their infrastructure, equipment and stationery. This fact has a significant impact on the choice to be made between the different types of boards, because they will imply the use a different type of writing tool.

- **G**reen and black boards are to be used with chalk. This is an inexpensive and environmentally friendly solution.
- **W**hite boards require the use of special markers with washable ink, which are quite expensive, and can therefore constitute a financial burden for the school administration or even for the teacher.

Health

The use of chalk with green boards tends to generate dust, especially when it is wiped out without water. This dust is considered by some to create an unhealthy environment in the classroom for the children. This point is nevertheless discussed by some NGOs.

Durability

Boards are fragile, and are one of the most exposed items of a classroom, since they are traditionally the focal point of the teaching (supporting writing but also other pedagogical materials such as maps, etc.), and are situated next to the most active area of the room (movement of the teacher, children invited in front of the class, presence of a dais, etc.).

For this reason, special care should be taken regarding the resistance (to impacts and scratches), and the fixation of the board should be adequate. Boards with movable parts will tend to get more quickly damaged than simple panels fixed on the wall.

The pen or chalk holder will tend to be damaged very easily, and should be designed not only to support writing tools, but also to widhstand the efforts implied by misuse, such as a child or an adult leaning on it.

Didactics

The main function of a board is to transmit information to an audience by displaying it. The media available to the teacher can influence the quality of the teaching. White boards will tend to offer a higher visibility (stronger contrast) and stronger colors.

Apart from writing, at least three other media are used for display in this place in Syria: magnetic letters, printed material, and video projections.

Magnetic letters are being used in primary schools to teach writing. They can only be used on metallic boards. In Syria, metallic boards are usually associated with the idea of whiteboards. However, these are actually separate concepts: metallic chalkboards do exist, as well as wooden whiteboards.

Maps and other printed material is also of common use in the classrooms. These can be hung to a hook or attached with magnets (depending on their weight), but it is important to take it into account so that the necessary means are provided.

The use of computer with a video projector is a third media that is more and more frequent and currently highly promoted. This typically requires a screen, but white boards are sometimes adequate, which is an advantage [cf. "Educational projector unit" on page 82]. However, this will depend on the position of the projector: because of the shininess of the board, a child situated exactly in the reflection angle of the light will see a white spot in the middle of the projected image.

Flexibility

The choice between a whiteboard and chalkboard might be made upon a list of criteria that the board will need to respond to. The running costs will play in favor of the chalkboard, while the didactics will generally favor the white boards.

The choice of a school for one or the other option should not be considered as irreversible: it is frequent to see a school pass from one system to another and vice-versa, and change in less than a year. Whatever the final choice, the other option should always be kept in mind as a possible choice that could be adopted by the school administration a few years later.

Aesthetics

When both chalkboard and whiteboard are being used, a special care should be taken regarding aesthetics: most of the time, the lack of planning, later ad-hoc changes and the fact that industrial whiteboards and older chalkboards do not have the same dimensions provide a visually unpleasant result.

2.2. Proposed solutions

UNICEF

To improve the school environment and reduce the dust, UNICEF decided to focus mainly on providing white boards to the schools.

Most of the time, this was done through screwing the new whiteboard on top of the existing green boards.

- **T**he board is made of MDF wood of European origin (dim. 240 x 120 cm, thickness 8 mm only); it is not magnetic but more resistant to impacts than metallic boards, because it is plain and not hollow.
- **T**he melamine resin layer (Formica® or equivalent) on the top is white, suitable for writing with white board markers. It is fixed with an 8 cm aluminum frame around the board, and provided with a pen/eraser holder, an eraser and 4 markers of different colors.
- **T**he makers supplied to the schools are refillable to reduce running costs.

fig. 3.24 Whiteboard added on top of an existing chalkboard.

Magnetic whiteboards were supplied to elementary schools to allow the use of magnetic letters and numbers. However, the price of a magnetic whiteboard (6000 SYP) is double the price of a regular board (MDF-based ones cost 2000 SYP).

Most of the schools that were provided with whiteboards are very satisfied but still report a shortage of markers.

SDC

SDC has worked on the installation of a new wooden frame for the chalkboards, with the same size as the white boards that were previously provided by UNICEF.

The chalkboards were then painted, and the white boards reinstalled over them. If, for any reason, the school administration decides to go back to using chalk, they can conveniently remove the whiteboard and find the chalkboard behind it, ready to be used.

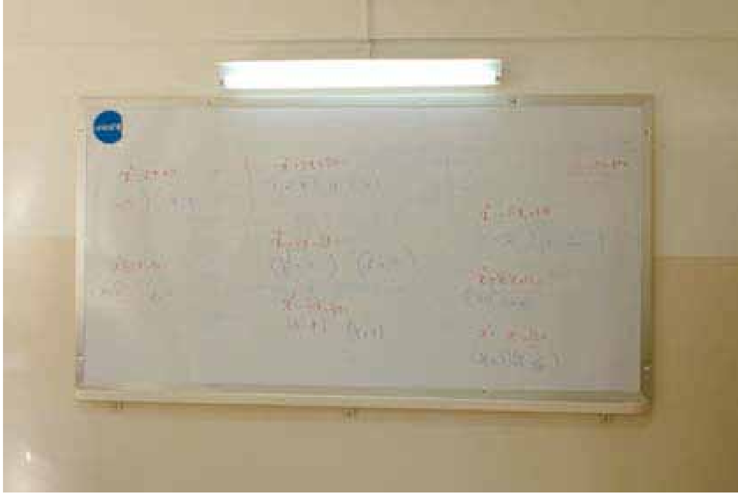


fig. 3.25 SDC's superposed white- and chalkboard with frame and reinforced chalkholder.

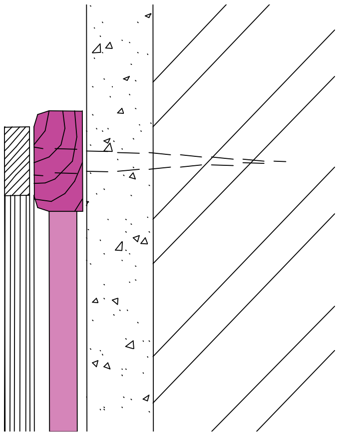


fig. 3.26 Wooden frame detail

Having identified the issue of the chalk holder, which tends to get damaged, SDC has increased its thickness and decreased its width. This modification made it much more robust to misusage (e.g. children leaning on it). It is also fixed strongly to the wall with a minimum of three metal angles.

Help

Thinking that the risk of pollution through chalk dust is not supported, Help is in favor of the green boards.

As mentioned in the challenges here above [cf. "Running costs" on page 76], the white boards require specific markers. Often out of stock, permanent markers are then used and the subsequent cleaning operation with liquid chemical implies higher risks of pollution than chalk dust.

PU

Première Urgence also believes that chalk dust is a minor issue compared to other challenges.

For this reason, green boards were installed in the first projects, as they offer a lower cost-in-use, even if their initial cost (4000 SYP) can be higher than some white boards. The chalk holder provided is thicker and narrower, for more resistance.

However, white boards are currently preferred by most of the schools. Sometimes the school administration is requesting white boards without considering or acknowledging its financial burden.

The solution adopted by PU was to carefully analyze and previously discuss with the school administration if they can afford white boards markers and how they would finance them.

PU is also advising the administration to use ink to refill the refillable white board markers instead of buying new ones, although this advice is not always followed.

As already mentioned in the architectural design chapter [cf. "Removing the dais" on page 19], for didactical purposes, PU is not providing dais inside the classrooms. Removing the dais below the board makes its height very critical: it should be in reach of the children and also visible from the back of the classroom. This can be achieved without the use of movable boards, on the condition that the position is carefully adjusted. This will depend on the grade of the school and can be tested while installing the boards with a few pupils.

In both cases, the board should be well fixed to the wall, with metallic angles, because they are exposed to a lot of forces.

fig. 3.27 PU chalk board with wooden chalk holder

In order to allow the hanging of different didactical elements (such as geographical maps, for example), PU is also suggesting providing a hook on top of the board.

DRC

In order to resolve the bad aesthetics resulting from a white board fixed on top of a chalkboard with different sizes, and in order to facilitate the frequent shift from one type to another, DRC decided to design and provide an element that is integrating both systems from the beginning.

It is composed of a green chalkboard, a wooden frame all around it and a superposed white board inserted inside the frame. Both boards have the same size, for improved aesthetics.

By simply lifting the white board a few centimeters, it can be removed anytime.

The wooden frame is also serving as an integrated chalk or marker holder.

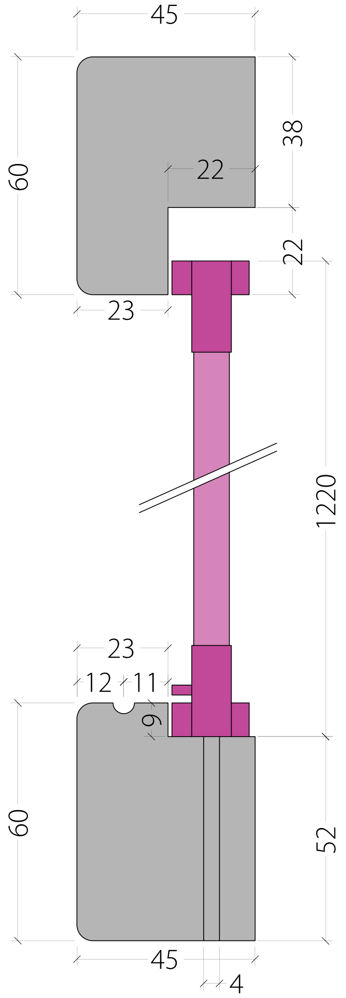


fig. 3.29 Details of DRC's frame with reversable board

fig. 3.28 DRC's solution, with a white board esily to be reversed

2.3. Boards check-list

Challenge	Objective	Solution
Running costs	Are the consumables affordable for the school?	• **U**se chalkboards to reduce running costs (PU, Help) or • **D**istribute refillable whiteboard markers (UNICEF).
Health	Are there dangerous emanations?	• **U**se whiteboards to reduce the dust in the classrooms (UNICEF).
Durability	Is the board resistant to impacts and scratches?	• **F**ormaica-coated MDF panels are very resistant (UNICEF). • **M**etallic boards, if used, should be plain, not hollow. • **C**halk/pen holders should withstand the weight of a child sitting on it (SDC, PU, DRC)
Didactics	Does the board allow diverse media to be used?	• **M**etallic boards allow the use of magnetic letters (UNICEF). • **W**hiteboards can be used as a screen for projectors (DRC). • **P**rovide a hook for hanging maps (PU).
Flexibility	Can the school shift easily from one type to another?	• **M**ake superposed whiteboards easy to unscrew (SDC) or • **M**ake them removable without tools (DRC).
Aesthetics	Is the board aesthetically attractive?	• **I**f whiteboards are superposed on green boards, make them exactly the same size (SDC, DRC)

3. Books and multimedia

3.1. Identified issues and challenges

Book accessibility and visibility

Books should be in easy reach of children, not locked into cupboards to protect them from the children. The purpose of a library is to give the children the opportunity to learn and an easy access to knowledge.

Ergonomics

Comfortable seats and tables are important, and a special attention should be dedicated to the reading position of the child.

Safety

The library should be as safe as any other classroom. The issues here are fire prevention and the risk of a shelve falling on the children if they try to climb on it.

Attractiveness

The atmosphere should be child friendly in order to attract the children and make them associate reading with the idea of a nice experience.

Daily cleaning

The room should be easy to maintain and to clean, a fact that can sometimes interfere with the accessibility of the books.

3.2. Solutions in dedicated rooms

PU

A child friendly ambiance was created in the library through the use of specific materials.

The chairs are inspired from the traditional model found in Syria. They are comfortable while using low-cost local technology.

fig. 3.30 PU's flexible shelves for libraries

The bookshelves are flexible in use and size: they are composed of independent steel columns and wooden boards, which can easily be adapted to diverse dimensions and uses.

Boards (244 X 30 cm) are made of MDF in lacquer finish, the columns are made of horizontal and vertical welded steel sections (4 X 4 cm), painted with black epoxy.

The library was supplied with books and magazines.

Most books are in easy reach of the pupils; however, these shelves should be fixed to the wall for safety reasons.

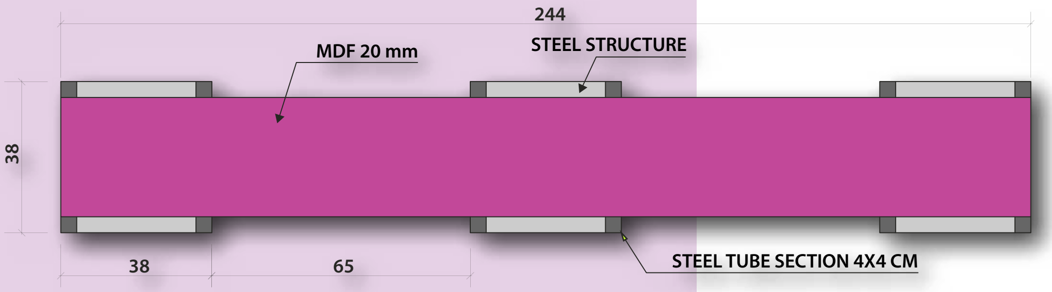


fig. 3.32 PU's sheves plan

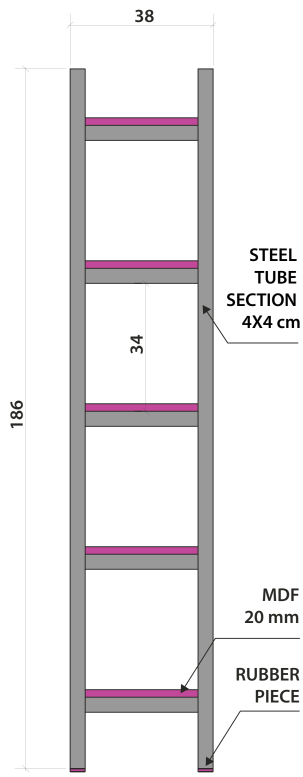
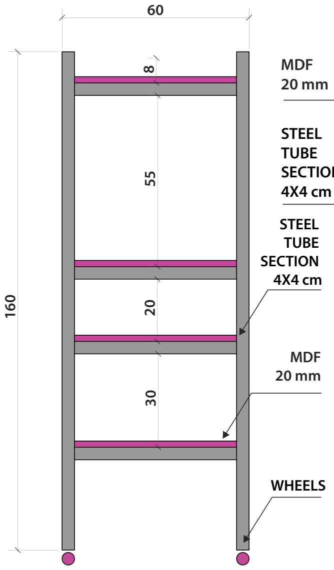


fig. 3.31 PU shelves elevation

The library was also provided with multimedia active learning equipment, as the education process is not only about reading. This shelve is using the same materials and specifications as the bookshelves, but is smaller and is provided with wheels, in order to facilitate transportion.

fig. 3.33 PU's multimedia equipment



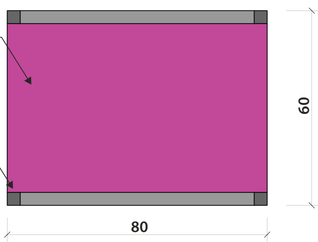


fig. 3.35 PU's Multimedia shelves plan

fig. 3.34 PU's Multimedia shelves elevaion

Danish Refugee Council

The same components are used for different purposes: libraries, closets in the classroom, laboratory, teachers' desks, administrators' room, etc., in order to create harmony and increase flexibility.

These elements are hanged to the wall, to protect them from the humidity and ease the cleaning of the rooms.

In the computer lab, the tablet is fixed to the wall for the same reason (on fig. 3.38 the photo was shot before the final installation of the computer central units on top of the tablet).

The key idea of this project is to "keep it simple".

fig. 3.36 DRC's multi-usage suspended modules and tables
fig. 3.37 DRC's multi-usage modules suspended to the wall
fig. 3.38 Computer shelve suspended to the wall

Help

As a lesson learned, Help is also insisting on the need to provide a suitable, separate electrical supply to the computer rooms. Often this is underestimated, and the room cannot be used due to insufficient power supply.

3.3. Solutions inside the classroom

Books and multimedia equipment can be brought directly inside the classrooms, instead of gathering them inside a library. This is especially the case for manuals, dictionaries or other kind of books for which one copy should be available per student.

Danish Refugee Council

Book closets

The same multipurpose element, as used in the libraries and the administration rooms, has been used as a book closet inside the room. Here it is provided with doors and lock, so that the teacher can keep some didactic books and accessories in a safe place but have them at hand when needed.

As with other elements [fig. 3.37 on page 81], the closet is here conveniently fixed to the wall, to ease the cleaning of the classroom and protect the wooden element from moisture.

fig. 3.39 DRC's suspended book closet

Educational projector unit

As a contribution to the provision of active learning tools, DRC has developed a projector enclosure unit. This unit is to be used during the transition phase until all classrooms can be fully equipped with active learning material.

fig. 3.40 DRC's educational projector unit

fig. 3.41 DRC's educational projector unit

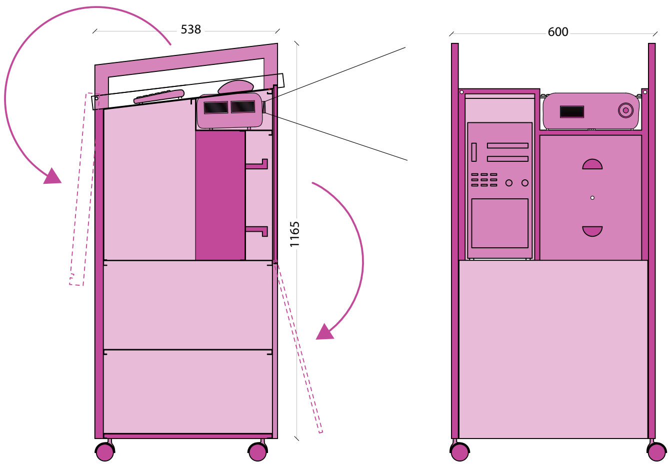


fig. 3.42 DRC's educational projector unit. [see detailed execution drawings in the database.]

This unit (EPU) is composed of a movable steel tank used to hold and protect the projector and the computer. Wheels ensure an easy movement among classrooms, thereby maximizing the efficiency.

Once opened, the educational projector unit gives access to a working station with a keyboard, mouse and the projector. The central unit of the computer is situated inside the main box, and no screen is provided, since the projected image is sufficient.

Providing such EPU to the schools is a necessity to help implementing the new curriculum, taking in consideration the current financial difficulties in the ministry of education to provide each class room with an individual projection set.

PU

Première Urgence is also providing book closets inside the classrooms.

In the case of new school construction, these could be planned from the beginning and could hence be inserted inside the double walls, as the closets existing in the old Damascene houses.

Inserting the closets into the walls makes them more durable, taking less space and they are also protected from water when the room is being cleaned.

fig. 3.43 PU's book closet in Sahnaya school extension

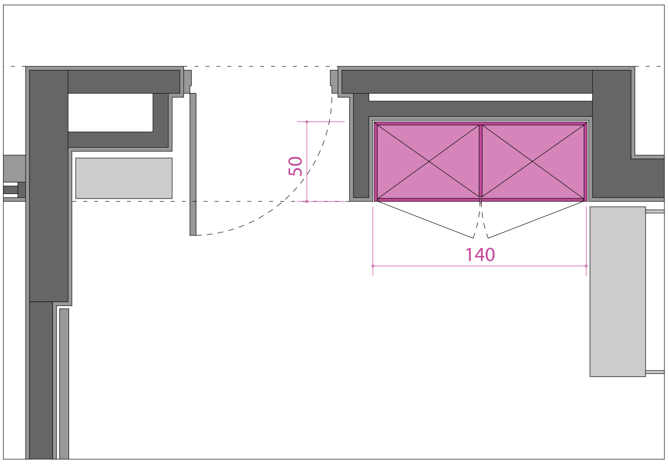


fig. 3.44 PU's book closet in Sahnaya schoolextension

Integration inside the wall is of course less feasible in the case of school rehabilitation.

In some schools the style was inspired from the houses of the old city, in others it has a more modern look.

A lesson learned was that teachers prefer smaller book closets (140 x 50 cm is more than what is really needed) and that it should have a lock, so that the teacher can leave his material without fearing theft in his absence.

UNICEF

UNICEF designed shelves in the context of their work on the new curriculum.

fig. 3.48 UNICEF's classroom bookshelves dimensions.

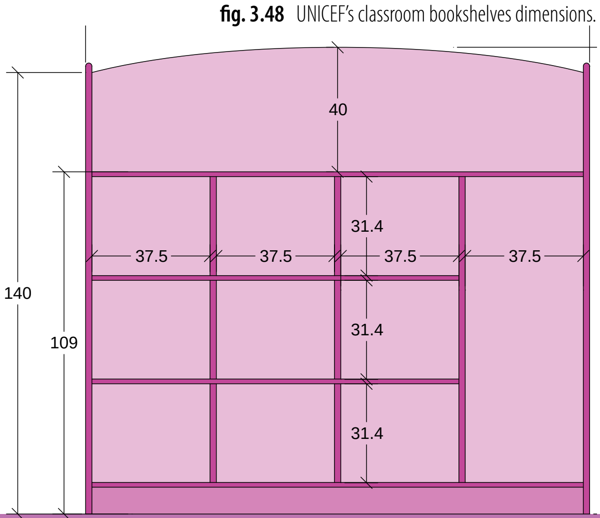


fig. 3.45 PU's book closet in Jaramana school extension

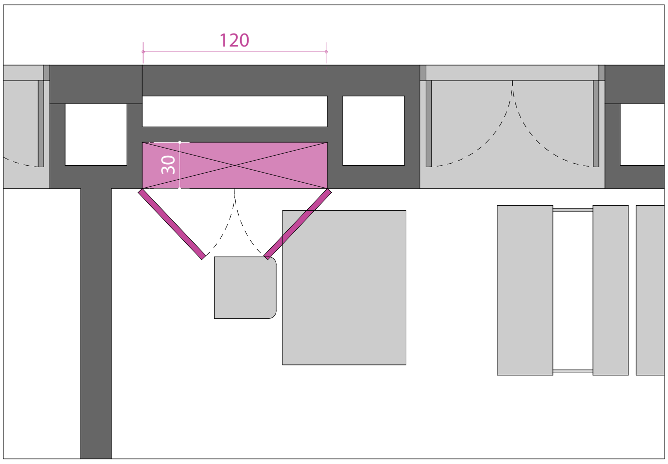


fig. 3.46 PU's book closet in Jaramana school extension

These shelves have been designed to be child friendly. They have clearly been designed to be directly used by the pupils, since their content is easily reachable and visible.

However, the shelves have been laid on the floor, which might be a problem for the books and reduce the durability of the shelves because of the floor cleaning.

[See full technical specifications and drawings on the CD-ROM]

fig. 3.47 UNICEF's classroom bookshelves

4. Heating equipment

4.1. Identified issues and challenges

Thermal comfort

Heating a room can be achieved by different means: either through radiation or convection.

- **C**ommon modern radiators, as used in central heating systems, are heating mainly through convection (although their name suggest the opposite –they should be called convectors–), which means that they heat the air passing nearby them, which will move naturally inside the room. They provide a high comfort because the air of the room will be warm and the temperature homogeneous.
- **S**toves, or fireplaces, are heating mainly through radiation. This means that the heat is transported through infrared radiations, which will heat exposed surroundings surfaces including people, instead of heating the air. The heat inside the room will tend to be much less homogeneous, and the thermal comfort will be reduced: the child next to it will feel hot and the child at the back of the room will not benefit from it.

While the best place for radiators is under the windows (the thermal weak points of a room), the best place for a stove is theoretically the middle of the room.

Durability

The durability of the heating system will depend on its components. Stovepipes get damaged very easily, because they are weak, and exposed.

A frequent issue with heaters is that they are traditionally removed from the classrooms during the hot season. This can save some space inside the classrooms, but it has an impact on the durability of the stove and their pipes, which are periodically submitted to a series of efforts.

Health

Health can be affected by emanation of gases and smoke inside the living environment.

Combustion taking place inside the living environment will emit carbon dioxide and consume the oxygen of the room, which can cause several health issues, especially in crowded classrooms. A simple remedial could be to increase the ventilation of the room, but this is of course counterproductive in terms of heating.

When there is not enough oxygen to produce carbon dioxide, such as when operating a stove in an enclosed space, carbon monoxide, a highly toxic and potentially deadly, odorless and colorless gas, is produced.

Smoke can sometimes also be emitted inside the room, if the exhaust pipes are not perfectly airtight, which is very frequent.

These three risks are real with the natural-vent stoves currently used inside the classrooms.

To avoid these risks, direct-vent heaters and stoves have been invented: they are connected to outside in an airtight way. Thereby it uses only outside air for combustion and presents no risk of unhealthy emanations inside the classroom, even if the living space is not ventilated. [see "Direct-vent heaters" on page 99]

Safety

Apart from the emanations, the stoves represent also a risk in terms of safety.

The oil tank can fall and cause fire, while its hot surface is a potential source of burns. The risk of fire, even if relatively limited, is to be taken seriously, since the stove is most of the time situated next to the sole entrance door, and could hamper evacuation incase of fire emergency.

Cost of production and cost-in-use

As for any other item in this book, the initial cost of the heating system is an important criterion of selection, and is probably explaining why traditional stoves are still in use in the schools.

Compared to other pieces of furniture, the cost-in-use of the heaters is much more important than the initial cost: it is constantly consuming fuel, and any change in consumption and efficiency can quickly become a more important factor than the initial cost in terms of economy.

Environmental sustainability

Closely linked to the efficiency and fuel consumption, the environmental impact such a heating system can have should be an important criterion. The more oil is consumed, the more carbon dioxide is emitted, hence contributing to a global greenhouse effect.

4.2. Some solutions

Classical natural-vent stoves

All foreign organizations working in Syria are using the traditional natural-vent stoves as a heating system in the schools.

Most schools are asking to keep this system of heating, since it is rather flexible: no empty room will be heated by accident, easy control of who is consuming how much, etc. Furthermore, the initial investment necessary for these stoves is very low compared to a central heater with radiators-convectors.

However, these independent stoves are consuming more fuel (around 100-150 liter/class/year), are less efficient and procure less comfort than other central heating system. They are also less ecological, less durable, less healthy and more dangerous.

SDC

In order to improve the stability and hence the safety of the traditional stove, SDC decided to fix the pipes to the wall with two metallic rings. This custom-made accessory is composed of a metal plate with two rings.

Apart from safety considerations, the metal plate is also preventing the wall from getting black from the heat of the pipe, which usually happen and is unaesthetic.

fig. 3.49 SDC's fixing plate for exhaust pipes

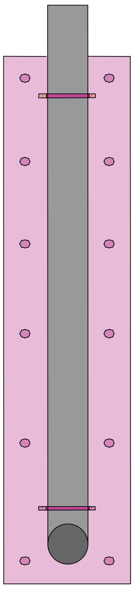


fig. 3.50 Stovpipe Fixing

Help & PU

In order to further improve the safety and thermal comfort, PU and Help came to the same conclusion in their practice: the position of the stove should be carefully chosen and designed.

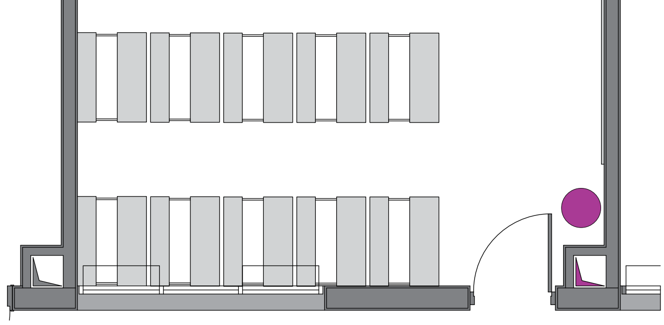


fig. 3.51 Recommended position for stoves by PU and Help

It should be close to the chimney in order to reduce the risks of leaking through the pipes, and in a dead corner (such as behind the door, with a door stop, if it is opening to the inside) to reduce the risk that someone topples it or gets burnt by its surface.

Putting the stove in the corner can lead to an unbalanced heating in the room, but Help is mentioning that the temperature can be easily homogenized by putting the ceiling fan into slow motion.

Ministry of Education

The Syrian Ministry of Education is convinced that other systems of heating have to be tried, most notably central heating. For this reason, the new school compounds, such as the one being built in Qudsaya, are already being equipped with central heating [fig. 3.53].

Apart from reducing the fuel consumption and improving the safety, this also allows providing hand washing taps with warm sanitary water [fig. 3.52].

Experience will show to which level this can reduce the fuel consumption of schools.

Then, a quick calculation comparing the initial cost and the yearly consumption of fuel between the central heating and the traditional stoves can bring interesting conclusions such as the number of years of use after which the initial investment in central heating is profitable and the amount of fuel and money that can be saved during the lifespan of a heater.

These precise answers will be useful pieces of information that can be used as persuasive arguments in future projects and hopefully in the rehabilitation of existing schools.

fig. 3.52 Qudssaya central heating valves

fig. 3.53 MoE's central heating system under test.

5. Outdoor equipment

5.1. Benches

Danish Refugee Council & PU

Providing a sitting area in the playground is essential for children. The pictures below show a few designs that have been realized as pieces of furniture. However, the bench is an item on the fringe between equipment and architecture. Some other examples have been realized in concrete or masonry by most NGOs [cf. fig. 3.59 on page 87 and "2.6. The playground" on page 40].

fig. 3.54 DRC's external bench

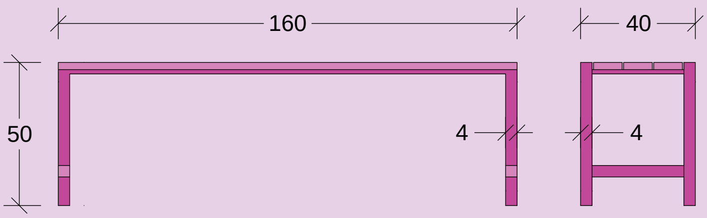


fig. 3.56 PU's bench dimensions

fig. 3.55 PU's external bench

fig. 3.57 SDC's plastic trash boxes

5.2. Trash boxes

SDC

SDC has been providing standard plastic trash boxes in the schools, in order to help the garbage collection.

PU

In order to meet a number of criteria that are cannot be fulfilled with products available on the market, PU has decided to redesign new steel trash boxes.

- Standard plastic trash boxes were judged too high for primary schools: they are out of reach for many children, and this does not encourage their use. The new box is low enough to allow first grade pupils to access it easily.
- The plastic trash boxes are damaged easily, so steel was preferred.
- The covers of the standard plastic trash boxes are meant to be either fully open or closed. It is difficult and unhygienic to lift the cover, while leaving it open exposes its content to flies, sun, heat and rain. A concrete box was built to protect the trash box from the elements. This also increases the stability and safety (children wanting to climbing on it won't make it fall) and it integrates the trash boxes into the landscaping of the courtyard, for better aesthetics.
- Three wheels instead of two were provided, so that one can push or pull the trash box without lifting it.

fig. 3.58 PU's trashbox

fig. 3.59 PU's trashbox integrated in the courtyard landscaping

The lessons learned from this trash box are :

- The wheels and structure need to be very strong in order to withstand the efforts of all kinds (including its lifting when emptied into the trash truck).
- It would be easier to insert inside the concrete box if the rotating wheel (and the handle) were planned to be at the frontal part instead of the one at the back.
- The cart will tend to damage quickly the concrete box, so the concrete should be protected with a steel frame or rails on the ground to guide the wheels.
- Because of its reduced size, children can play with it as if it was a cart. This should be taken into account.

5.3. Sports equipment

Sports equipment is a standard feature of schools and as the benches, is on the fringe between equipment and architecture. Sports equipment has to be adapted to school gender and age level.

PU

In a view of saving space in dense urban areas, Première Urgence developed a type of basketball panel that is suspended to the façade wall. This model is ideal, since it does not require laying foundations, which makes it cheaper and easier to install. It is composed of a steel pipe and two steel cables attached to the columns.

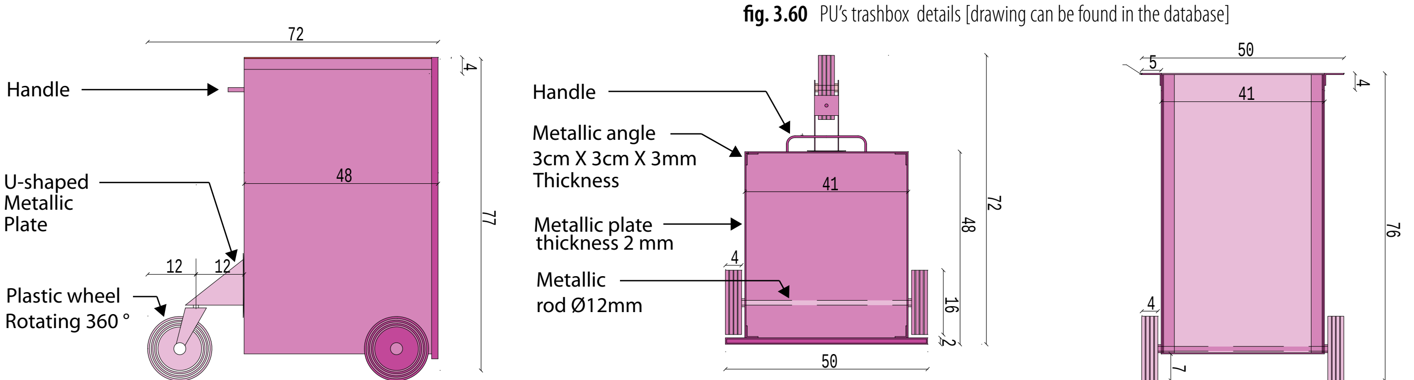
As an alternative to basketball, Première Urgence also provided handball goals in some schools. This can be a good idea but should come in addition to the basketball panels, since schools are used to them.

fig. 3.61 DRC's multisport equipment

fig. 3.62 PU's handball goals

fig. 3.63 PU's suspended basket panel

fig. 3.60 PU's trashbox details [drawing can be found in the database]



6. Other ideas

6.1. Fire extinguishers

PU

Première Urgence has provided fire extinguishers inside the schools since its first projects, as part of a general strategy of fire prevention.

In the first projects, they were installed in the corridors, as a first measure. However, it was later observed that the most dangerous item in a classroom is actually the stove, whose situation next to the only exit door is rather critical. In case the fuel tank is toppled and gets on fire, the exit becomes impossible.

For this reason, and even if the accidents are considered as rare, one small extinguisher was provided in each classroom of Jad Allah Shnan School. They were integrated in a closet inside the wall, next to the teacher's desk, so that it is protected but also in easy reach in case of emergency.

Training for their use is preferable for teachers and other administrative staff; this can be included in the general training on maintenance during the handing over process.

fig. 3.64 PU's extinguishers integrated inside the wall

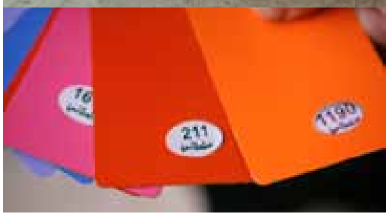


fig. 3.66 Drawings are frequently exposed in corridors
fig. 3.67 PU's drawing boards inside the corridors
fig. 3.68 Melamine resin coats are available in many child friendly colors

6.2. Drawing holders

PU

Children's drawings are frequently exposed in the corridors of the schools, but this is usually done in an improvised way, which is neither aesthetic nor durable.

In its work on Child Friendly Schools, PU designed drawing holders, simply cutting melamine coated particle boards (Formica®) with a CNC machine: these are cheap, durable and offer many colors.

For each drawing, an additional smaller hole was cut to honor the author with his/her picture or name.

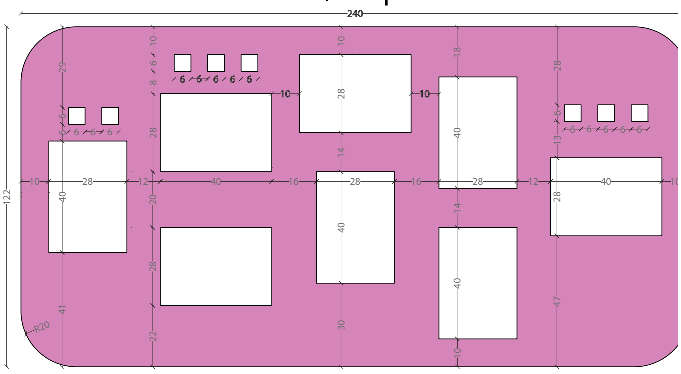


fig. 3.65 Dimensions of drawing holders

6.3. *Display panels*

PU

Another kind of display in the corridors has also been used (in Jaramana First School), composed of a cork panel protected by lockable glass doors.

It is more expensive, but also more durable. It is especially well adapted to display official communication papers from the school administration.

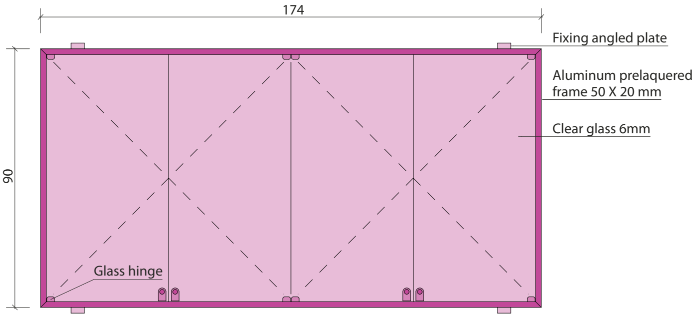


fig. 3.69 Elevation of PU's display panel

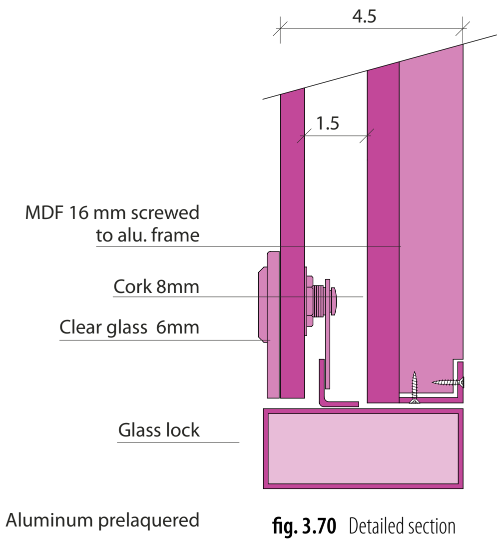


fig. 3.70 Detailed section through the display panel

fig. 3.71 PU's protected cork display panels in the corridors

fig. 3.72 PU's clothes hanger in the corridors

6.4. *Hangers*

PU

In Jaramana first school, hangers were provided in the corridors, so that children can hang their belongings.

This helps reinforcing the homely atmosphere of the school.

However, some children fear theft, and installing them inside the classrooms would ensure a better use.

UNICEF

UNICEF is also providing hangers in their active-learning classes.

These have a nametag on top of them, so that each child has his own dedicated space inside the classroom to hang his coat or bag.

fig. 3.73 UNICEF's hangers inside a classroom

6.5. Cork panels

PU

Virtually all Syrian classrooms are decorated on their walls with drawings and didactic documents. This decoration is most of the time realized by the teacher or the pupils' parents.

While it benefits to the classroom ambiance, and increases the sense of ownership, it is usually done in an unprofessional way, for example by fixing two horizontal wooden rafters, spanned by some fabric and with expanded polystyrene under it [fig. 3.75], so that drawings can be fixed with pins or needles and removed easily.

The bad quality of execution and the low durability is coupled with the risk of using dangerous materials that are not fireproff, such as synthetic fabrics.

For this reason, PU fixed cork panels in its latest projects on the classroom walls. It is composed of 1 cm thick plain cork panels (more durable than thin ones fixed on polystyrene) directly glued onto the wall, with a wooden frame. The natural color of the cork and the wood matches with the color of the pupils' desks.

fig. 3.74 A completed classroom before handing over
fig. 3.75 The classroom in use with the typical strip of fabric

fig. 3.76 PU's cork panels solution before handing over
fig. 3.77 PU's cork panels solution in use

6.6. Key box

PU

Providing a well-organized key box will help the administration in its organization.

Labels and numbers for each key should correspond to a number written on the door lock.

fig. 3.78 PU's keybox

CHAPTER 4
PROCUREMENT, EXECUTION & HANDING-OVER

1. Some identified challenges

Time

Reducing the time necessary for the execution of the works is a very important challenge, for three reasons:

- **I**t is important to provide the desired enrollment capacity to beneficiaries as soon as possible, especially in case of emergencies, such as the influx of Iraqis , as it occurred in the past years;
- **I**t can reduce the total cost of construction;
- **W**hen works are taking place inside existing schools, it will reduce the nuisance (working during the holidays) and the exposure of children to dangers of the works, thereby reducing the risk of an accident.

Quality

Ensuring a maximum quality of execution is one of the main roles of worksite supervision. Three typical sources of problems can be identified regarding the issue of the quality of execution:

- **T**he mistakes due to a lack of skills of the contractor or of his team;
- **T**he misunderstandings between the designer and the contractor due to imprecise or incomplete documents;
- **T**he voluntary attempts at reducing the quality of materials or execution by the contractor in order to maximize his profit.

Cost

While the cost of a construction is mainly influenced by its design, it can also be decreased through appropriate measures:

- **D**uring the procurement procedure (ensuring transparency in the selection process and avoiding agreements between suppliers);
- **I**n the contract clauses;
- **I**n works supervision (avoiding delays and mistakes).

Safety

Dealing with the safety of the future occupants is mainly ensured through appropriate design. The safety of the passerby (especially children) and of the workers during the execution phase is a main challenge of the site supervision and should be a priority.

Maintenance

As seen through the previous chapters of this book, maintenance needs, its easiness and its cost can be addressed through design. However, the effectiveness of daily cleaning and basic maintenance will depend on the capacity and goodwill of the school administration and the janitors. This can be improved during the handing-over process. The contractor or supplier can also be responsible for part of the maintenance during a certain period of time, if specified in the contract.

2. Procurement procedures

All NGOs

In order to keep the cost of construction low and obtain the best value for money, international organizations use specific procurement procedures, aimed at ensuring a free and fair competition between several suppliers.

In most of the cases, different procedures are put into place according to the estimated amount of the works: the higher the amount, the stricter and the most transparent the procedure. For instance, UNHCR's general policy for implementing partners that do not have their own approved procedures is:

- For amounts under 20 000 USD, a quotation procedure must be followed by contacting at least three different suppliers;
- For amounts over 20 000 USD, a call for tender procedure must be followed.

The exact threshold separating two procurement procedures depends on the organization.

Some key points of call for tender procedure are:

- The invitation to tender must be announced publicly, e.g. by publishing an announcement in a newspaper;
- Offers are collected in sealed envelopes, and opened only in the presence of a bid opening committee;
- Offers must be submitted before a specific and precise deadline, and cannot be modified afterwards;
- External members to the organization are invited to the bid opening to ensure transparency;
- Offers are constituted of two parts: a technical offer and a financial one;
- Criteria of evaluation of the offers are established before the bid opening by the evaluation committee;
- Technical offers are first evaluated; the ones which are not meeting the criteria are discarded;
- Among the offers meeting the technical criteria, the cheapest must be selected.

Criteria of technical evaluation can be:

- Compliance with technical specifications, relevant international standards, technical norms or with required time schedules;
- Payment terms;
- Guarantees, after-sales services and training, or aspects covering maintenance and operating costs;
- Capability, capacity, financial standing, past experience and performance of the bidder.

Examples of invitations to bid from PU & DRC for construction projects and equipment are on the CD-ROM.

3. Contracting

Help

Safety regulations

School children, construction site workers and the general public living or acting close to the construction building sites are exposed to the risk of accidents.

In a bid to improve safety during the execution phase of school construction and rehabilitation projects, Help has edited specific Safety Regulations to be implemented by all implicated actors.

These safety regulations give specific instructions for:

- The implementing agencies (NGOs);
- The operating contractors for rehabilitation and construction works;
- Their sub-contractors, personnel and visitors;
- The school administrators, teachers and technical staff;
- The local government;
- The resident and non-resident general public in the vicinity of the schools.

These safety regulations shall be observed with scrutiny in order to prevent accidents or any hindrance that might cause or induce physical harm or material damage.

Responsibility for safe conditions is to be assumed by all above-mentioned parties, and – in the case of the school children – by their educators, teachers and parents.

The detailed regulations, which should be appended to any school construction contract, can be found on the CD-ROM.

Payments

In order to speed up the execution of the works and reduce their cost, Help is insisting on the need to make possible **advance payments** to the contractor, as part of a construction contract.

Failure to do so will put the contractor in a difficult financial situation at the beginning of (and during) the works, which will cause recurrent delays and will actually increase the total cost of construction.

PU

Time schedule

A detailed time schedule is helpful to follow up the works and speed them up by identifying the critical path. This schedule is often required as part of the technical offers in a call for tender. However, even though this schedule needs to be updated to include deadlines before the works start, many contractors fail to do so on time. Two lessons learned about this are:

- **T**he works should not be allowed to start at all before an updated time schedule is given by the contractor;
- **A** well-thought, realistic time schedule made by the contractor himself using basic means such as a spreadsheet software is sometimes better than a graphically impressive time schedule made with professional project management software. They are indeed often ordered by the contractor from an external consultant office, and the contractor will therefore neither be able to update it himself nor use it for managing the works.

Penalties

In order to ensure that the works are finished within the specified time schedule, including a liquidated damages clause in the contract is also a frequent method. However, this same clause can sometimes increase the cost, since the financial offers received from bidders during a tender will generally be higher, since they will cover the financial risk linked to possible delays.

For this reason, Première Urgence is adapting its penalty rate mentioned in the contract:

- **I**f the deadline is very important (works to be finished just before the beginning of a school year), 5‰ of the contract amount per day of delay is requested as a damage;
- **I**n other cases, the penalty is reduced to 3‰.

In any case, it is mentioned that the total penalty for delays cannot exceed 15% of the contract amount, to avoid frightening the bidders, while if the delay exceeds a specific duration, the contract can be annulled.

A lesson learned is that the penalty rate must be clearly expressed by working days, not calendar days: the latter is generally not clearly understood and is often leading to contestations.

Shop drawings & technical specifications

In order to clarify the works, detailed shop drawings are often necessary. However, PU often found it very difficult to obtain them on time from contractors. For this reason, it is recommended to insert a clause in the contract, such as the possibility of immediate warning or penalties in case the contractor is not providing them on time (for example within 7 days after request by the contracting authority). These shop drawings can greatly help to reduce the risk of mistakes and improve the quality of execution.

Book of technical specifications are one of the main tools to ensure the quality of execution. However, the contractor often forsakes these and treats them as a secondary document. For this reason, it is good practice to integrate them directly with the other documents: either as a part of the contract, in the form of a detailed Bill of Quantities describing the works, or on the plans themselves.

Maintenance & guarantee

The quality of the works and their initial maintenance can be greatly improved by inserting in the contract a clause forcing the contractor to guarantee and ensure the maintenance of the building or equipment for a specific period of time.

For construction works and pupils' desks, PU typically requires a guarantee of respectively one and three years, asking the contractor to visit the works twice per year. Upon completion of the works, a temporary reception of the works is signed; for one year, 10% of the contract amount is kept as a guarantee, which can be used to repair any defects in case the contractor fails to do it himself. Only after one year is the final acceptance certificate released and the remaining 10% released.

Safety regulations

Safety regulations edited by Help [see "Safety regulations" on page 93] are systematically included in PU's contracts. However, some of these regulations (concerning the worker's safety) are very difficult to be fully implemented in the practice: the workers often abandon the use of safety helmets a few days (or hours) after being reminded to wear them at all time by us or the contractor. This happens especially during the hot season.

Mentioning in the contract specific penalties to the contractor about infringements to this rule (penalty/worker found without helmet/day) could be a useful tool, although it has not yet been tested.

4. Handing over & Maintenance

SDC

Most of the rehabilitation works made by SDC took place during the school summer holidays. At the end of the works, a final inspection was conducted. Any defects and comments found were listed and handed over to the contractor and the consultants, to be rectified.

Afterwards, the technical handover took place, in the presence of the school principal and an Engineer representing the Planning Directorate of the MoE.

The project team checked if all comments had been rectified. In some schools, minor work had still to be done, which were followed up by the school principal.

At the end, the handing over document was signed: it declared that SDC was no longer responsible for the schools but that the MoE was. Examples of such documents can be found on the CD-ROM.

When School started at the beginning of September, all construction works were finished, the final quantities for each school were established, the Final Bill of Quantities compiled, the as-built plans were updated and the final payments for contractors and consultants were released. At this point the services of the local contractor weren't needed any more and his contract ended.

An opening ceremony was then held at beginning of October.

Help – UNICEF

"Schools are like clocks. If one wheel breaks down, the entire system collapses" (Help)

Without proper maintenance, no school building can last forever. For this reason, UNICEF and Help have been working to equip with maintenance tools those who provide daily up-keep to Syrian schools: janitors and maintenance personnel.

They have also coordinated training sessions (more than 60) for janitorial staff in and around Damascus, for tasks such as repairing worn-out furniture and keeping schools clean. The training program, for some of the janitors, could also result in newfound pride in their work, and they were also bringing back their skills at home.

PU

Following the same logic, PU has also distributed complete tool boxes to facilitate the fixing of common problems. Indeed, during the different assessments it appeared that schools were in a bad shape due to the accumulation of unfixed small problems. This was caused by the lack of available equipments; this toolbox should help proceed with any kind of repairs. The schools may have to buy other necessary material for reparation, but this toolbox contains all the necessary equipments, and will largely reduce the cost of common repairs in the school.

The toolbox and the training were accompanied by a maintenance guide, and an engagement for maintenance to be signed by the school director, declaring to have read the manual, and be ready to supervise the work of the school cleaning and the maintenance staff ensuring the permanent cleaning and maintenance of the sanitary blocks in the school. The detailed content of the toolbox as well as the manual for maintenance are available on the CD-ROM support.

In a process of involvement of the pupils' families (such as in CFS), parents can also participate to school maintenance, depending on their own skills (plumbers, electricians, sewers, etc…). The school board can hence play an important role in the process of maintenance by finding community members or parents that can volunteer for small maintenance works. This is one of PU goals in the current CFS project.

fig. 4.1 UNICEF / Help toolbox given to the schools during the trainings

fig. 4.2 PU's toolbox distributed during the trainings on maintenance

CHAPTER 5
CONCLUSION

As explained in the introduction, this book is based on a workshop organized with the Syrian Ministry of Education, which for the very first time confronted and gathered the experience of all the international organizations working in the field of public school construction within the country.

The time constraints forced us to focus on a limited set of topics, and this book has hence by no way the pretention to be exhaustive on the matter. However, the quantity of information collected was rather impressive and exceeded everyone's expectations.

Consequently, several conclusions can already be drawn from this first experience.

First of all, the solutions presented in this book show that the various organizations had already identified many challenges, and that they developed several innovations in an attempt to address them, showing a real commitment towards progress.

Moreover, it has been observed that many organizations were sharing the same concerns (e.g. regarding safety, cleaning, maintenance, active learning or accessibility) and even, in a few cases, the same design solutions to a common identified issue.

Three factors can be identified as having contributed to this fruitful transfer of information:

- **S**ome organizations had already started collecting some of their own innovations in the form of an illustrated report (SDC) or guidelines (UNICEF), thereby showing the usefulness of such kind of books.
- **T**he number of contractors working on the construction and equipment of public schools is somehow fairly limited in Syria, and they will often be the middlemen keeping track of the innovations and suggesting them to other organizations afterwards;
- **T**he qualified Syrian staff working for international organizations has often multiplied the missions with many of them, ensuring therefore the transmission of information and becoming the richest resource on innovation and lessons learned.

In the few situations where organizations had the opportunity to learn from each other's innovations, tremendous progress was achieved, partly thanks to the possibility given to designers to focus more on unresolved challenges instead of "reinventing the wheel".

Gathering for the first time in one book most of these identified challenges, solutions and lessons learned in one book, and handing them over to the Syrian Ministry of Education, eager for innovation, seems to predict great further progress.

However, it is essential to remember that the workshops and this book should only be considered as the first steps of the improvement process. Indeed, looking at the challenges and solutions, the following statements can be made:

- **A**ll challenges identified in this book have been at least once partially addressed, proving that there is always at least one possible solution which could be a source of inspiration for future works;
- **M**ost importantly, none of the current designs addresses all the challenges simultaneously;
- **M**any solutions addressing different challenges have luckily the potential to be combined together into one signle design.

The conclusion of these observations is hence that if the Ministry of Education has the wish, as expressed in the past, to reuse some of the ideas presented in this book to create new national standards, the next crucial step is not to simply select one model (of pupils' desk, of drinking fountain, etc.), but to carefully design, for each of these items, a new model that would address contemporaneously all the identified challenges, by combining some of the existing solutions, taking inspiration from them or inventing new ones.

Lastly, Première Urgence would like to thank the Ministry of Education and UNICEF for their cooperation and support, without which this process would not have been possible. The Ministry's own experience was very useful for the workshops and its genuine commitment to progress in the field of School Design is deeply appreciated.

CHAPTER 6
APPENDIXES

1. Table of acronyms

ACF - **A**ction Against Hunger (in French: **A**ction **C**ontre la **F**aim)

ACSAD - **A**rab **C**enter for the **S**tudy of **A**rid **Z**ones and **D**ry lands

CFS - **C**hild **F**riendly **S**chools

DoE - **D**irectorate **o**f **E**ducation

DRC - **D**anish **R**efugee **C**ouncil

FDFA - **F**ederal **D**epartment of **F**oreign **A**ffairs

HDPE - **H**igh-**D**ensity **P**oly**E**thylene

INGO - **I**nternational **N**on-**G**overnmental **O**rganization

IR - **I**nfra**R**ed

MDF - **M**edium-**D**ensity **F**iberboard

MoE - **M**inistry **o**f **E**ducation

NFI - **N**on-**F**ood **I**tems

NGO - **N**on-**G**overnmental **O**rganization

NTU - **N**ephelometric **T**urbidity **U**nit

PU - **P**remière **U**rgence

PVC - **P**oly**V**inyl **C**hloride

SDC - **S**wiss agency for **D**evelopment and **C**ooperation

SIF - **S**ecours **I**slamique **F**rance (Islamic Relief France)

UNHCR - **U**nited **N**ations **H**igh **C**ommissioner for **R**efugees

UNICEF - **U**nited **N**ations **C**hildren's **F**und (formerly **U**nited **N**ations **I**nternational **C**hildren's **E**mergency **F**und)

UNRWA - **U**nited **N**ations **R**elief and **W**orks **A**gency for Palestine Refugees in the Near East

UV - **U**ltra**V**iolet

USD - **U**nited **S**tates **D**ollar

WHO - **W**orld **H**ealth **O**rganization

2. Glossary

2.1. Greenhouse effect

The sun emits various kinds of electromagnetic radiations towards the Earth, which bear a different name according to their wavelength (or frequency): ultraviolet (UV), light (the wavelengths visible by the human eye), infrareds (heat), etc.

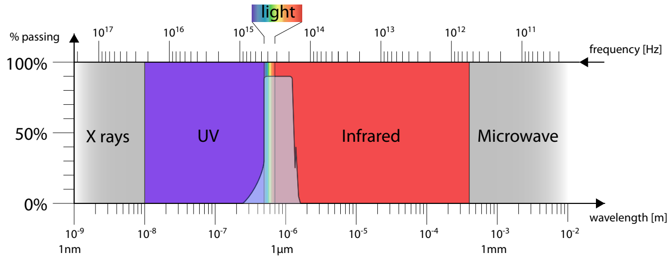


fig. 6.1 Sun radiations and % of them passing through the glass

Glass, as shown by the curve on the graph above, is a material that has been optimized to fully let pass visible light (around 90% of the narrow rainbow colored vertical strip), while reflecting nearly all ultraviolet rays and the vast majority of infrared radiations (heat) as well.

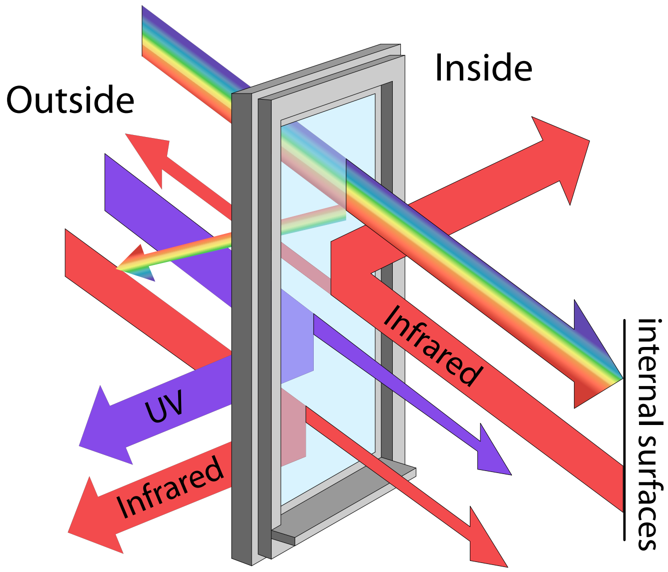


fig. 6.2 The greenhouse effect in architecture

When used in architecture, glass exposed to the sun will therefore create what is called the "greenhouse effect": most of the sunrays are reflected except from the visible light and when this light enters into contact with objects inside the building (walls, floors or furniture), part of it is converted into infrareds (heat), which are then trapped inside. This leads to the natural warming of the inside space, which is useful in winter, but can be a serious issue in the summer.

2.2. *Quartersawn wood*

Quartersawn wood [25] (as opposed to flatsawn) defines wood that is cut exactly radially (towards the heart of the log), or to put it differently, at right angles to the growth rings.

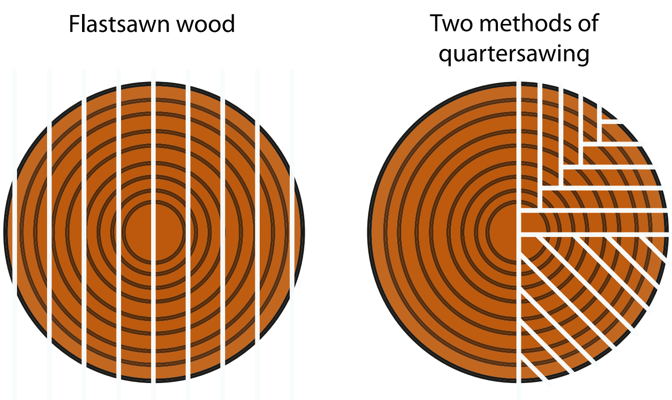


fig. 6.3 Flatsawn vs. quatersawn wood

Wood cut in this way is prized for certain applications, but it will tend to be more expensive as well.

Its main advantage is a greater stability of form and size (less warping; and shrinkage is less troublesome), which is why quarter sawn wood is especially important in making furniture.

2.3. *Direct-vent heaters*

[cf. "Health" on page 84 in "4. Heating equipment" on page 84]

To avoid risks of toxic gases emanations (such as Carbon Monoxyde) inside enclosed living spaces, and avoid consuming the oxygen of the rooms for combustion, direct-vent heaters and stoves have been invented: they are connected to outside in an airtight way, thereby using only outside air for combustion and present no risk of unhealthy emanations inside the classroom, even if it is not ventilated.

The tube is typically larger than normal exhaust pipes, since it includes both an inlet and outlet.

Some of these direct-vent stoves [fig. 6.4] also include a heat exchange chamber, where the outgoing combustion air preheats the incoming air. The same heat exchanger is used also to warm the air of the room, so that the stove is heating both by radiation and convection, for a much-improved efficiency.

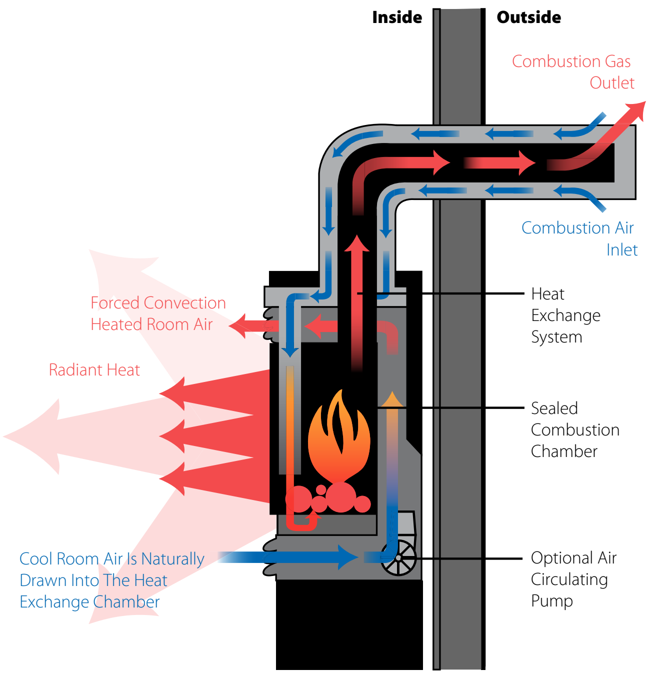


fig. 6.4 Direct-vent heater with heat exchanger

25 Source: Wikipedia.org

3. Designing sunshades

This is the study first made by Première Urgence for Jad Allah Shnan school extension, in Jaramana. Conclusions from this study, applicable to other schools, are presented in the first chapter. [cf. "Dealing with the sun" on page 29]

In order to design solar protections meeting three criteria:

- Windows fully protected from the sun when the outside temperature is high,
- Sunrays fully allowed inside when the outside temperature is low,
- The sunshade is fixed, non-mechanical, and don't need to be operated by anyone,

Première Urgence followed a special technique combining solar charts and climatic data.

	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19 h
28-Jan			4	5	6	8	9	9	11	11	11	11	10		
28-Feb			4	6	9	12	13	14	15	15	16	16	15		
21-Mar		7	7	9	11	12	14	16	16	16	17	18	15	14	
15-Apr		14	14	17	19	21	23	23	23	24	23	22	21	19	
15-May		12	14	17	20	23	25	27	29	30	31	31	31	29	
22-Jun	17	17	19	22	25	29	30	32	34	34	35	35	34	34	32
30-Jul		20	21	23	25	27	29	32	33	35	36	36	35	34	
30-Aug		17	17	21	24	26	29	32	34	36	36	36	36	34	
23-Sep		16	16	20	23	25	27	28	30	31	31	32	31	30	
15-Oct			15	18	21	24	26	27	28	28	29	28	25		
15-Nov			7	10	13	15	17	19	20	21	20	19	17		
22-Dec				5	8	10	12	14	14	16	15	14			

fig. 6.5 Hourly average temperatures for Damascus

1 - Temperature

The first step is about searching for the weather average temperatures, for each month of the year and each hour of the day. The graph shows the values for Damascus, and will need to be adapted to other Syrian regions[26].

- The blue zones indicate the cold timezones, when the greenhouse effect is greatly needed and the sunrays should reach the windows;
- The light orange zones indicates the warm zones, when windows should be protected from sunrays;
- The dark orange zones are when sun should be absolutely avoided;
- The white ones indicate non-critical zones.

Two examples are taken to explain the next steps:

A: On August 30th at 1:00 PM, the average temperature for a typical year is 34°C

B: On January 28th at 11:00 AM, the average temperature for a typical year is 9°C

2 - Sun position

The second step is about analyzing the sun position at each of these moments. For a specific latitude, the sun's course in the sky is always the same from one year to another. This means that for a selected date and on a certain time, the exact position of the sun can be defined precisely, through formulas. The course of the sun for the latitude of 33.5°N is represented on the stereographic projection below, which is valid for Damascus or even Baghdad, but which is also a good approximation for the entire Syrian territory (varying from 32 to 37°N).

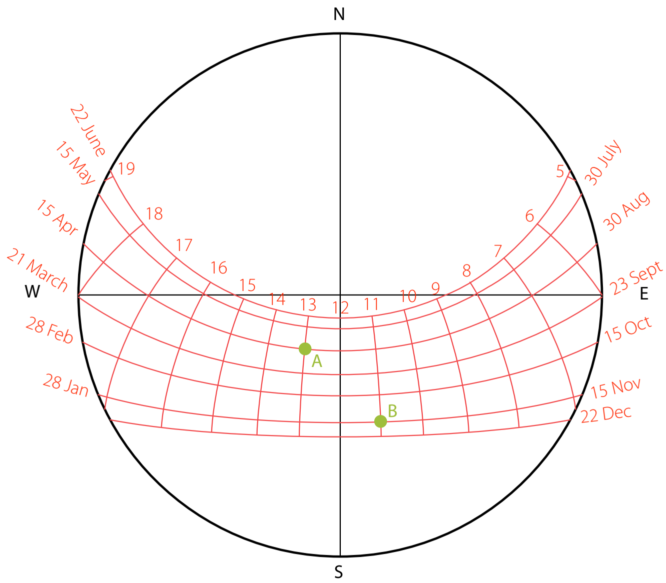


fig. 6.6 Stereographic projection of the sun position for the latitude of 33.5°N

Actually, as shown on the graph, the sun follows exactly the same course at two separate moments of the year.

For example, the sun is in the "A" position on 30th August at 1p.m., but also on 15th April at the same time.

3 - Temperature + sun position

Combining the first two steps, the hourly values of temperature and the hourly position of the sun can then be represented on a single graph [fig. 6.8], allowing the designer to analyze, for any specifically oriented window, how to cope with the sun, i.e. if the window needs to be protected from or reached by the sunrays.

Since the sun has exactly the same position at two moments of the year but with two different external temperatures, the most critical of the two temperatures needs first to be chosen.

For the example "A", 34°C (Aug 30th) is more critical than 23°C (April 15th). [fig. 6.5]

The first temperature table can hence be summarized, using the most critical temperatures for each sun position. [fig. 6.7]

---

26 Data is from the Damascus International Airport Weather Station, taking the average of 5 representative years. Complete data from 24 different weather stations in Syria is available on wwww.wunderground.com

	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5 h
22 Jun	32	34	34	35	35	34	34	32	30	29	25	22	19	17	17
15 May & 30 Jul		34	35	36	36	35	33	32	29	27	25	23	21	20	
15 Apr & 30 Aug		34	36	36	36	36	34	32	29	26	24	21	17	17	
21 Mar & 23 Sep		30	31	32	31	31	30	28	27	25	23	20	16	16	
28 Feb & 15 Oct			15	16	16	15	15	14	13	12	9	6	4		
28 Jan & 15 Nov			10	11	11	11	11	9	9	8	6	5	4		
22-Dec				14	15	16	14	14	12	10	8	5			

fig. 6.7 Summarized table showing most critical temperature for each sun position

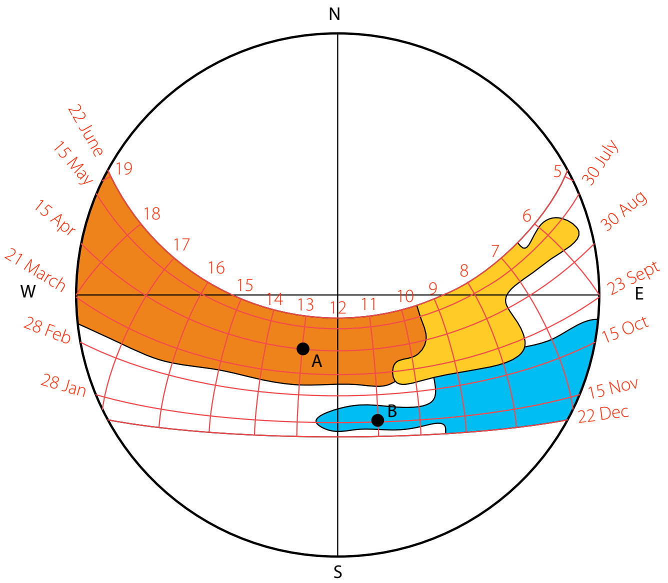
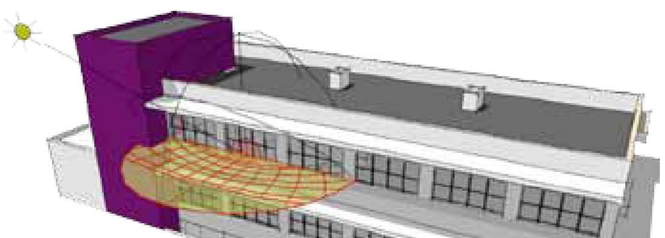


fig. 6.8 Chart showing sun position and temperature zones

4 - Building environment

The fourth step is about representing on the same graph the built environment of the window we want to analyze.

fig. 6.9 A window oriented to the South, with the stereographic projet of the sun position

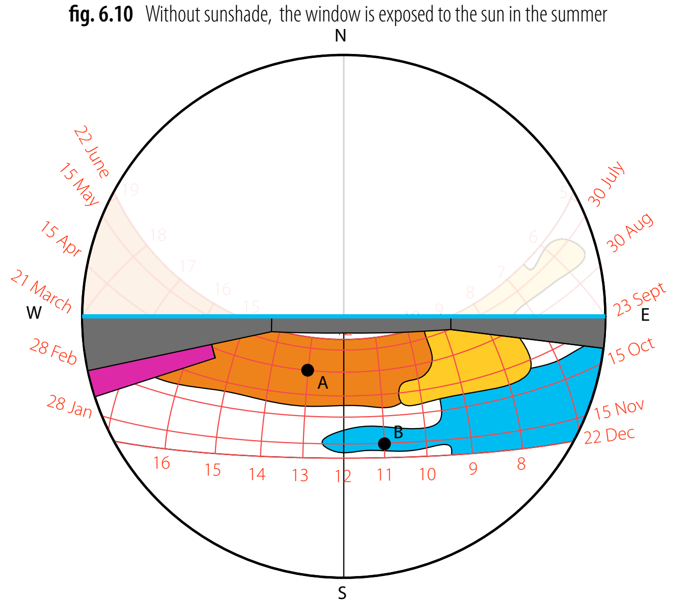


Taking the example of the window oriented exactly southwards on the school above, one can represent the architectural elements that are protecting the window from the sun at a given time during the day.

The first graph is showing the usual situation, when no attention is taken regarding the sun's orientation: the dark grey area is representing the masonry frame around the window, while the purple zone is showing the impact of the purple staircase block of the building from the school above. One can see that the sun is nearly never hidden.

Ex. A : the position of the sun is not hidden by any architectural element, while the outside temperature is 34°C. This means that the sun will be striking the window and overheat the building.

fig. 6.10 Without sunshade, the window is exposed to the sun in the summer



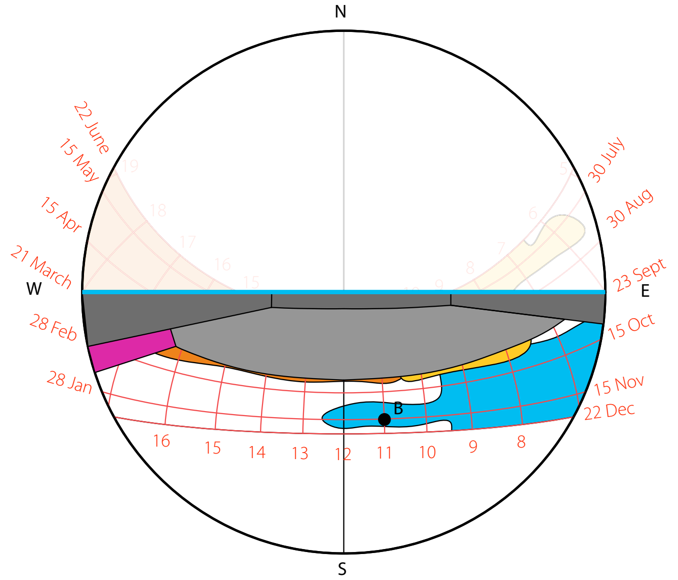


fig. 6.11 With an adequate sunshade, window is protected only durng the warm days.

The second graph is showing the situation after PU designed and calculated precisely an external concrete sunshade for the School, represented in light grey.

We can see that the window is protected from the sun during the entire hot season (the indicator A is hidden), and that at the same time, the sun is still entering the building during the cold days (in blue & indicator B), as it is lower in the sky during the cold season.

This concrete cantilever, once calculated, remains in place forever: the sun movement makes the rest. This is called "passive climate responsive design", because there are no mechanical (active) parts necessary.

4. Addressing challenges

Chapter 1 : Architectural design

	Children Size	Gender	Accessibility	Active learning	Participation	Safety	Health	Attractiveness Aesthetics	Security	Quality Durability	Daily cleaning	Urban density	Standardization Replicability
Challenge	page 16	page 16	page 16	page 16	page 16	page 16	page 16	page 16	page 17	page 17	page 17	page 17	page 17
Solution	40		22, 45	18, 19	19	21, 22, 27, 36, 38, 44, 19, 20		19, 25, 26, 27, 35, 40, 41	24	18, 20, 21, 44	25, 36	24, 26, 35	35, 37
Lesson Learned			22			38, 20		36	45	19, 20, 44	25, 44		

Chapter 2 : Water, Sanitation and Hygiene

	Children Size	Gender	Accessibility	Active learning	Participation	Safety	Health	Attractiveness Aesthetics	Security	Quality Durability	Daily cleaning	Urban density	Standardization Replicability
Challenge	page 47	page 60	page 47				page 46	page 47	page 47	page 47	page 47		page 47
Solution	53, 55, 63	65	55, 60, 62, 64			51, 56, 63	49, 60	62	51, 54, 56, 64	51, 54, 56, 64	52, 57, 59, 61, 62, 63		52, 57, 58, 66
Lesson Learned	63		53				51, 59	51	54	54, 56, 61	55, 57, 61		51, 55

Chapter 3 : Equipment

	Children Size	Gender	Accessibility	Active learning	Participation	Safety	Health	Attractiveness Aesthetics	Security	Quality Durability	Daily cleaning	Urban density	Standardization Replicability
Challenge				page 68		page 68 page 80 page 84	page 76 page 84	page 68 page 76 page 80		page 69 page 76 page 84	page 69 page 80		
Solution				74		71, 72, 85, 88	77, 85	73, 74, 80, 88		72, 73, 77, 90	74, 81, 82		
Lesson Learned						70, 80, 85	85				83		

Chapter 4 : Procurement, Execution and Handing-over

	Children Size	Gender	Accessibility	Active learning	Participation	Safety	Health	Attractiveness Aesthetics	Security	Quality Durability	Daily cleaning	Urban density	Standardization Replicability
Challenge						page 92				page 92			
Solution						93, 94				94			
Lesson Learned													

Climate responsive design	Cost	Long term Maintenance	Water saving	Ergonomics	Soap provision	Hands-free rinsing	Impacts	Sustainability	Didactics	Flexibility	Books Acessibility	Thermal comfort	Time
page 17	page 17	page 17											
28, 29, 32		21, 41											
36	18, 28, 36	20											
	page 47	page 47	page 47	page 47	page 57	page 57							
	53, 54, 57, 62, 63	49, 54, 55, 61, 62, 64	51, 54, 56, 61, 67	55	59	59							
		54	55	51	58	58							
	page 69 page 76 page 84	page 69		page 68 page 80			page 68	page 70 page 84	page 76	page 76	page 80	page 84	
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	page 92	page 92											page 92
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													94

5. Index

This document features some of the most notable innovations and lessons learned from several organizations working in the field of public school construction and rehabilitation in Syria, incorporating updated information as of early 2011.

It is the result of a process initiated and coordinated by Première Urgence, with the objective of exchanging good practices between professionals, centralizing the information and handing it over to the Syrian Ministry of Education and the Local Administrations, so that they can take maximum benefit from it.

The process started with a series of workshops held on the matter with the Ministry of Education, during which some major challenges were identified and each organization presented its own solutions and practical experience.

They are presented here to highlight the innovative practices some of these partners are undertaking to improve the quality of the school infrastructure, in order to share with the Syrian Ministry of Education the lessons learned and the good practices identified.

Four focus areas have guided our work:

1 • Architectural design;

2 • Water, sanitation and hygiene;

3 • Equipment;

4 • Procurement, Execution and Handing over.