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Module 3

# Environmentally Friendly School Infrastructure



**Rise Up Against Climate Change!**

A school-centered educational initiative  
of the Inter-American Development Bank

# Rise Up

Against Climate Change

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educational initiative  
of the Inter-American  
Development Bank

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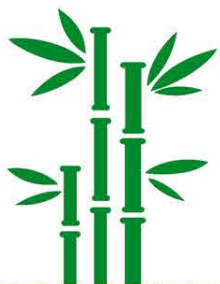
# Rise Up

Against Climate Change





Educational spaces, apart from their functionality and efficient use of natural resources, should be conducive to learning and offer comfort and security to the people entering them. This requires construction and maintenance processes that keep in mind both the occupants and the environmental conditions that surround them.



# Identifying the problem

Do you know when, how, and from what materials the school where you work or study was made? Is it cool in the summer and warm in the winter? Does it require some system of artificial air conditioning? Is it pleasant to work or study in the school? What are the challenges that your school might face due to climate change? Have you thought about these issues before?

Curiously, the global tendency has been to standardize construction techniques and materials without consideration for the enormous diversity of environments, geographies, climates, and cultures in which we reside, and natural phenomena to which we are exposed. As a result, much construction is done using materials foreign to a region, or following designs that are inappropriate for the ecosystem, which ultimately has a negative effect on the resulting buildings' comfort, maintenance costs, and sometimes even durability. Occupants of such buildings are likely to encounter excessively high or low temperatures, little sound insulation, and poor lighting. Importantly, such buildings leave a huge ecological footprint.

Sustainable or ecological construction (also called “green” construction) is a growing movement around the world. In light of the impending threat of climate change, such forms of construction benefit the world by:

- Saving financial resources by reducing expenses on energy consumption, water, and other materials
- Saving energy
- Making efficient use of water
- Reducing carbon dioxide (CO<sub>2</sub>) emissions
- Recycling waste

- Planting trees in yards, along fences, and in gardens to improve the quality of air in the school
- Offering comfortable and cozy conditions for learning
- Setting an example for other community buildings

For the above reasons, architects and other construction and design professionals have begun to adapt traditional techniques and materials, as well as newer alternatives, to local conditions for more sustainable or ecological results. In many cases, these alternative forms of construction allow important economic savings by significantly reducing operating costs and promoting construction activity itself.

Despite growing support for bioclimatic architecture and traditional construction techniques, few new spaces are being built according to these principles. This is often due to limitations posed by building regulations, as well as estimates of higher initial investments that do not take into account future savings in operations and maintenance that justify and quickly recover any early additional costs. Nevertheless, for the construction of schools, many of these new techniques, materials, and technologies are within reach, simply awaiting the decision to innovate and realize an important goal: caring for and improving the environment in which we live.





### Box 1. Estimating an ecological footprint

The term ecological footprint refers to the amount of environmental resources and services that people, communities, or countries require to keep up their current lifestyle. It also includes the amount of land that is necessary to produce what is consumed and to process and degrade waste. In recent years, the concept of the ecological footprint has been developed as an indicator of environmental sustainability (or the lack thereof). Several websites offer tools to calculate its size. These show that the more-developed countries require more land and resources than they have to keep up their populations' current lifestyles.

Some schools or educational buildings have been established for a long time. Their construction likely reflects the social, economic, and educational needs of their time. Nevertheless, many of those needs have changed over the decades. Today's needs include, among others, promoting sustainability and contributing to the reduction of environmental degradation. Schools can achieve these objectives by adopting methods that reduce the demand for natural resources and promote their efficient use, as well as by utilizing techniques, technologies, and/or materials that do less harm to the environment.

Sustainable architecture is both efficient and appropriate to specific natural and social contexts and provides an impressive opportunity to transform your school's lighting, ventilation, and thermal and acoustic comfort to uphold environmental criteria while fostering the academic process. It takes into consideration many factors: the type of land, climate, environmental and risk factors, nearby natural ecosystems, and characteristics of the community in which the school operates.

If your school is already constructed, do not feel overwhelmed; the objective is not to create a completely new and different educational center, but rather to modify certain aspects of your school, bit by bit and in the simplest ways possible. So though this module is particularly useful for those beginning entirely new construction, it is also useful for those carrying out a minor renovation or the addition of a new classroom.

Remember that the proposals expressed here offer general guidance. Any final decisions should be supported by the consultation of a specialist who will analyze the particular conditions of the ecosystem where the school is or will be located, the available materials, as well as any social, economic, or cultural particularities of the region. A central point to consider is that Latin America and the Caribbean enjoy considerable diversity in sociocultural conditions and ecosystems, which means that building solutions, too, may be quite diverse. In other words, there is no one way of making a green school.

# Diagnosis

First, conduct a diagnosis of the conditions or characteristics of your educational infrastructure: look closely at what you have, even as you define your aspirations and identify the path you want to follow. Your school may already be complete, or plans may still be in progress. New construction provides the distinct advantage that all the school's spaces can be designed according to environmental principles, but it is also possible to gradually achieve astonishing transformations in already existing infrastructure. Keep in mind that this task requires a group effort—it is necessary to bring together all the employees of the school: plumbers, gardeners, maintenance staff, and so on. Also even as early as the diagnosis stage, it is important to be advised by a construction professional, preferably someone who understands or has experience in sustainable design. Together, you can adapt, improve, increase, or replace some of your school's infrastructure.

For any project that aims to make a school an environmentally friendly space, it is necessary to work through the questions listed in table 1 as a first step. Those embarking on new construction may use table 2. Relevant design and planning suggestions can be found throughout this kit and in the recommendations for further reading related to each topic.





**Table 1. Diagnosing conditions in an existing school**

Topic	Questions	Answers and observations
Location	From which direction do the prevailing winds come?	
	What is the predominant climate? average high and low temperatures during the year?	
	Please describe the vegetation: trees within the school grounds (tree height, leaf loss, root density, and so on), types of trees, or nearby plant communities.	
	What is the orientation of the building? (for example, south-facing)	
	Is it located in a shady area (shaded by other buildings, trees, nearby mountains)?	
	Is it close to a body of water?	
	Is it located on an incline (is the land of the slope safe?), or inside or close to a riverbank or creek? Was the land once used for an activity that contaminated the soil? (If your school is located on a slope, we recommend you review the section on risk management to further develop this analysis.)	
	Do most students, teachers, and other workers come from nearby areas?	
The functionality and relevance of the school's spaces	Identify whether the existing spaces are in sufficient, adequate, or good condition. Are there other kinds of physical spaces that the school needs?	
	Do the existing facilities (rooms for classes, sports, rest, leisure, and food; restrooms; parking lots; and bicycle parking spots, among others) allow the school to carry out all its activities adequately and do they support people with disabilities?	
Comfort	Is the temperature in the classrooms and other areas comfortable in the winter (without heating) and summer (without air conditioning)?	
	Do the classrooms have proper air circulation (windows that open to provide fresh air, cross-ventilation)?	
	Do the classrooms have sufficient natural lighting?	
	Are the classrooms in good physical condition (well painted, undamaged floors, properly functioning windows and doors, no leaks in the ceilings)?	

**Table 1. Diagnosing conditions in an existing school, continued**

<b>Health hazards</b>	Are internal and external materials water resistant and do they stop mold from spreading inside the building?	
	Are restrooms hygienic and in good condition to prevent the spread of infections?	
	Do classrooms and other internal areas have proper ventilation?(Note: It is important for schools to be located away from polluting emissions; if this is not possible, it is recommended to place air filters in the classrooms.)	
	Do classrooms have good acoustic levels that allow for easy interaction between students and teachers? (If the school is located in a very noisy area, you could think about isolating some walls or windows.)	
	Does the yard include a garden or an area to play and relax for all workers and students of the school?	
<b>Water supply and consumption</b>	What is the source of the water that is consumed in the school? Is the water supply adequate? Are there restrictions on its use?	
	Are there gutters on the roof, or some other method of collecting rainwater? What condition are they in? Are they used? If they exist, what is done with the water that is collected?	
	Are there reservoirs or tanks for the storage of rainwater? What condition are they in? Are they used?	
	What liquid waste does the school produce? What is done with this waste? Where does it go? How much is produced?	
	Do the sanitary facilities of the school use clean water?	
	Are there systems in the sinks and toilets to conserve water?	
<b>Safety (be sure to review in detail the section on risk management)</b>	Is the school located near a hillside?	
	Is the school located in a flood zone?	
	Is there some alarm system in case of a fire or other disaster?	
	Is there a contingency plan for evaluating the vulnerability of the school's facilities?	
	Do any of the school's systems (mechanical, electric, plumbing, or structural) or materials present a risk to the school's occupants?	
	Is the school constructed and set up to resist earthquakes, hurricanes, or tsunamis, if in an area at risk from these natural phenomena?	

**Table 1. Diagnosing conditions in an existing school, continued**

<b>Energy efficiency</b>	Does the school produce any of its own electricity (through solar panels, solar water heaters, or other methods)?	
	Is it possible to control the lighting of the classrooms and other areas of the school, as well as how the different electric devices of the school are managed?	
	Are there any mechanisms for energy conservation (motion detectors, energy-saving light bulbs, and so on)?	
<b>Environmental impact</b>	Does the school generate any kind of negative environmental impact on its area (for example, sound pollution, vehicular traffic, bright lights, and so on)?	
<b>Design and materials</b>	Is the school built with appropriate materials from the school's region? Are the materials used traditionally or in a new way? What opinion do you, your colleagues, and the students have of the building?	
<b>Potential additions</b>	Is there space for the installation of dry toilets (toilets that require little or no water)?	
<b>Institutional support</b>	Do the building regulations for educational spaces take into consideration environmental factors and contingencies in the face of natural disasters?	
<b>Participation</b>	What are the educational needs of the teachers, students, and parents? What are their opinions on how those needs can best be met? Would they be willing to participate in the environmental initiatives?	
<b>Techniques used in the community</b>	Are there any buildings in the community that are recognized for having survived a diverse range of adverse circumstances or for being particularly appropriate for the climatic conditions of the region? What are these buildings like? From what materials are they made?	

**Table 2. Diagnosing the conditions of a school yet to be built**

Topic	Questions	Answers and observations
Location	Is the designated location in an area near where the majority of potential students live? (Location, among other things, affects how students will get to and from school; any traffic problems need to be foreseen and avoided.)	
	Are there any limitations in terms of public services (water, drainage, waste recollection) for the site where the school will be built? If yes, are you considering addressing these deficiencies using environmentally friendly alternative technologies?	
	From which direction do the prevailing winds come?	
	What are the average temperatures in each season of the year?	
	What are the general characteristics of the nearby vegetation (tree height, leaf loss, root density, and so on)?	
	What is the future building's ideal orientation? In other words, where would it best take advantage of the hours of light and offer the best temperature conditions for the various parts of the school?	
	Is the plot in a shaded area (due to other buildings, trees, or a nearby mountain)?	
	Is it next to a hill?	
	Is it close to the banks, bed, or slope of any body of water (river, lake, dam)?	
	Is it close to an area with a lot of noise or streets with much traffic?	
	What is the soil quality? (You can determine that it is fertile and healthy if there is vegetation growing, either naturally or cultivated; if it is eroded and bare, it might have been stripped or used for intensive urban occupation, or contaminated with toxic substances, among others.)	



**Table 2. Diagnosing the conditions of a school yet to be built, continued**

<b>Design and materials</b>	Have you identified any new construction techniques that would be ideal for the new school?	
	Why do you consider these to be the most appropriate?	
<b>School requirements</b>	Are there any buildings in the community that have survived a diverse range of adverse circumstances or are particularly appropriate for the climatic conditions of the region? What are these buildings like? From what are they made?	
	Have you identified all the spaces that the school will need to achieve good educational development (classrooms, workspaces, playground areas, rest areas, kitchen, restrooms, gardens, parking lots for cars and bicycles, among others?)	
<b>Health and comfort</b>	Have you considered whether the site is free from atmospheric or soil contaminants? Is some kind of acoustic isolation needed (trees, wall or window isolation, and so on)?	
<b>Economic resources available for construction</b>	Do the resources available permit the incorporation of alternative technologies during construction?	
<b>Environmental impact</b>	Will the construction of the school have negative environmental impacts (due to traffic, loss of green space, or disruption of a river or stream, among others)? Is it possible to reduce or eliminate these effects? How?	
<b>Institutional support</b>	Do the building regulations for educational spaces take into consideration environmental factors and the risk of natural disasters?	
	friendly construction (using alternative building technologies and techniques, among others)?	
<b>Participation</b>	What do the school's future teachers, students, and parents want to see in a school? How do they think these visions can be realized?	

# Planning

A planning exercise with a strategic and integrated vision requires several steps (see figure 1).

These steps may include the following:

- Identify where you stand, using the guides previously presented (tables 1 and 2).

- Reflect on and define where you want to be in the future.
- Plan what needs to be done to achieve the vision you have conceived by outlining several stages of the process:

How do we get there?

Where do we stand?



Strategic stage



What is the ultimate goal?

Programming stage



What task must be accomplished to reach that goal?

Operative stage



Who will be responsible for each task, with what resources, and in what time frame?

Where do we want to be?



- » Define your vision. First, you must consider and define the greater purpose of the educational center. If alternative materials and technologies are used, consider that the school could serve as an example of environmental performance for the entire community. It could also improve overall environmental conditions, both through the educational methods used inside the classroom, and in the way the administration manages the areas and activities around the school.
- » Plan the details. Identify all the things that must be done in the most detailed and exhaustive manner possible by diagnosing the school's environmental performance. To this end, you can use one of the example surveys provided in this kit and/or seek out specialized consultation. It would also be a good idea to inquire into sources of financing for projects of this nature and to survey the school community and compile a list of perceived problems and aspirations.
- » Delegate responsibility. Once you have set your goals, it is advisable to define the person (or people) responsible for each, and the time frame in which it should be met.

This exercise is undoubtedly the heart of the project, and is preferably done by a large and diverse group of people interested in and committed to the project's goals.

While it is probable that only part of the school community will be able to participate in this planning exercise, it is important to involve the entire community at different stages and in different ways. Without

## Box 2. Bioclimatic architecture in educational centers

In 2008 the Ministry of Education of Peru published *A Guide to the Application of Bioclimatic Architecture in Educational Centers*. In this publication, one may find specific recommendations on how to adjust school infrastructure to each of the distinct climates found throughout the country, considering factors such as prevailing winds, type of vegetation, and proximity to hillsides or bodies of water.

a doubt, the community should be, at the very least, continuously informed, so as to foster a spirit of collaboration and general enthusiasm for the project.

Below, we suggest several ideas to help you in the planning stages, building on the points developed in the diagnosis guides (tables 1 and 2).

## For existing schools

Once you have answered the questions in table 1 and evaluated the conditions under which the school was built, you can add additional columns to identify how to resolve each problem, in how much time, and through what steps. The information in these columns will help guide you through the programming and operative stages.

Your preliminary diagnosis will most likely lead you to attempt adjustments in the school's infrastructure, such as in the organization or integration of alternative technologies. To help you plan these

changes, we recommend you review this manual's table of contents to find the topic you want to focus attention on as you begin transforming the school.

Table 3 provides examples of the kind of analysis that will assist you in finding solutions to each of the problems that you have identified. Later, you will find a series of general recommendations on building environmentally friendly spaces, considering the conditions of each region, and some interesting examples of constructive techniques that have been employed in various parts of the world.





**Table 3. Addressing infrastructural problems: an example**

Topic	Questions	Answers and observations	Type of solution desired	Method of solution	Time frame	Steps required	People in charge and participants
Environmental impact	The school generates some kind of negative environmental impact in its area (noise, vehicular traffic, pollution, light, among others).	Generates excessive traffic during the students' arrival and departure.	Change in behavior.	We could promote the use of public transportation.	We could begin to change immediately. The response would be gradual.	Develop a program encouraging students to walk to school, ride a bicycle, or take public transportation.	Identification of people in charge and of motivation program coordinators.
			Adjustments in infrastructure.	The school has space to construct small zones for loading and unloading passengers to reduce the severity of the traffic congestion	A few months to negotiate the resources.	Generate support from parents, educational authorities, and neighboring communities.	Appointment of a committee including students, teachers, and parents to coordinate activities and act as a mediator with the neighbors.

## For schools yet to be built

Planning a new environmentally friendly school is a fantastic opportunity to experiment with a wide variety of techniques and materials that have been used elsewhere in the world, many of which are even more economical than those used in most building construction.

Table 4 provides an example of the type of analysis that will assist you in finding a solution to each problem identified during your diagnosis. Later, you will find a series of general recommendations for creating environmentally friendly spaces, as well as examples of schools built using alternative techniques. In the bibliography at the end of this module, you will find suggestions for relevant sites and documents that will help you decide which course to take. Remember, consulting with an expert is often of great help. Also, do not hesitate to contact schools that have carried out similar projects.



**Table 4. Addressing difficulties and leveraging opportunities: an example**

Topic	Questions	Answers and observations	Method for addressing a difficulty or	Necessary tasks or actions	Coordinator(s) in charge
Institutional support	Do the building regulations for educational spaces take into consideration environmental factors and contingencies relevant to natural disasters?	Only certain aspects.	Many building regulations do not adequately address environmental issues, such as natural disasters; projects designed along environmental principles can help raise regulators' awareness.	Consult a construction specialist. Contact other schools that have carried out similar projects. Seek out foundations and other organizations that provide support to these types of initiatives.	A committee of teachers and parents.
	Do the educational authorities seem open to building schools under an alternative scheme (collectively, with alternative building technologies and techniques, among others)?	We have never tried to manage a project of this nature.	Form a school resources management committee of administrators and parents to liaison with different stakeholders.	Create a presentation that will motivate the authorities to work toward the project's goals.	A committee of teachers,
Participation	What are the opinions of teachers, students, and parents on the ideal characteristics of an educational center, and ways to achieve them?	An organized list of community recommendations can be presented before the educational authorities.	Organize some way of hearing the schooling community's opinions.	Delegate tasks across the project's management team.	A committee of teachers and parents.
	Will community members be willing to participate in the construction of the school?	It might take some work to motivate and convince them, but we do believe it is possible to bring together members of the outside community to support school plans.	Invite community members to a presentation of school plans and to voice their opinions.		A committee of teachers, students, and parents.

# Selecting an environmentally friendly architecture

While each region has distinct characteristics and, thus, different requirements, it is still possible to provide some general suggestions, as listed below. First, however, is important to note that the most important aspect of any building project is ensuring the safety of those that will be using it. A specialist can best advise how to meet construction safety requirements while creating an environmentally friendly space.

A school is one of the most visible public buildings in any community. Inviting the neighbors to participate in its planning and construction can not only foster community spirit but also inspire the creation of other environmentally friendly structures.

Our general recommendations include:

- Consider the location's geology, prevailing winds, and the intensity of sun and rain. Use these considerations as the basis for the design and structure of the building, its positioning, the type of materials used, the height of its ceilings, types of ventilation, use of vegetation, and so on.
  - Use materials with thermal properties that are appropriate for the particular characteristics of your region to reduce the need for air conditioning or heating.
  - Employ technologies and materials that reduce risks, minimize environmental impact, and ensure the comfort and ease of the building's occupants.
  - Consider how the school will manage the generation of waste and the disposal of wastewater.
- Consider the possibility of reusing and recycling certain materials that are considered trash (cans, bottles, tires, among other things) or produced from the recycling of other materials (plastic walls, material for coating floors from recycled paper, among others), as long as their use upholds safety and comfort requirements.
  - Keep in mind the importance of utilizing rainwater.
  - In warm climates, we recommend that you:
    - » Make the walls thick to insulate rooms and reduce changes in temperature.
    - » Build spaces with high roofs.
    - » Paint the roof and exterior walls in light colors that reflect heat.
    - » Shade the windows with awnings, parasols, or vegetation to protect from sunlight. If the budget allows, install reflective glass windows.
    - » Construct windows in the interior walls to increase the flow of light without increasing the need for air conditioning or heating.
    - » Install double or otherwise well-insulated windowpanes. Open the windows at night to freshen and cool the interior air.
    - » Ensure good cross-ventilation.
    - » Plant a large tree that will block the sunlight in the summer, while allowing sunlight and heat to penetrate in the winter.



- In cold climates, we recommend that you:
  - » Insulate roofs and walls and orient windows so as to bring in direct sunlight.
  - » Make school spaces compact so that it is easier to maintain heat inside the building. In areas with high winds, we recommend that you take advantage of the natural features of the land (a small hill, trees, rocks, and so on) as protection from the prevailing winds.
- In windy areas it is advisable to take advantage of the natural features of the land (a small hill, trees, rocks, and so on) to protect the infrastructure from prevailing winds,

In general, the native or traditional architecture of every country is largely bioclimatic. Buildings were optimized to take advantage of the natural resources available.

A new building that meets bioclimatic criteria may incur a similar or higher initial cost, but in the medium to long term reduces or eliminates energy costs of air-conditioning or heating systems.

### Box 3.

## Bioclimatic architecture

Bioclimatic architecture reduces environmental impacts by considering the environmental conditions of the building's specific location. The aim is to ensure the highest level of comfort while avoiding the use of air conditioning or heating systems that use energy. To this end, bioclimatic architecture makes use of natural sources of heat, light, and ventilation (sun, vegetation, rain, winds), and optimizes this use through strategic design, involving, for example, the orientation of the building and insulation of the walls.

Photos: SHW Group - Luis Ayala, Arquitectos AL BORDE, Kristel Gonzales, Rethinking Education Documentary



# Building materials

Building materials range from concrete, iron, and bricks, to raw mud and waste, to bamboo, palm leaves, jute, and more. Each offers distinct advantages and disadvantages depending on the characteristics of the area where the building will be located, as well as the building's use. The Internet has many examples of construction and design groups exploring new forms of construction that protect nature, mitigate the risk of natural disaster, and ensure the comfort and satisfaction of occupants. Contact foundations and construction specialists for professional help in choosing a design and managing other aspects of the project.

Before you select construction techniques and materials, carefully review the section on risk management in schools.

There is a wide variety of alternative construction techniques used across Latin America, as shown in the following case studies of schools. The stories behind these schools serve as an inspiration to their communities—and the world.

At the end of this section you will find links to sites and documents that offer further information on each case study.



## Local school built out of mud and bamboo in Pakistan

Located in Punjab, Pakistan, this school was built using local materials with low environmental impact. The main building is comprised of two floors: the lower floor was built from compact dirt, while the second floor was built from bamboo and mud. The school's positioning allows in maximum sunlight in the winter, while its windows provide natural lighting.

This project was designed by a group of German architects and was constructed by the local community.



Photos: Roswag Architekten



## Hand-built school in Bangladesh

Located in Radrapur Dinajpu, Bangladesh, this school's construction was directed by a volunteer group of German and Austrian architects. They adapted traditional methods to make use of natural lighting and ventilation and utilized locally available materials such as bamboo, straw, jute rope, and dirt. The school was built in just four months with the help of local artisans, students, and parents.

The design reflects the students' learning needs: the spaces were designed to support working in groups, as well as individual reflection and peace.



Photos: meti-school.de

## Ecological school in Indonesia

Built from bamboo and palm leaves, this school is located in Bali, Indonesia, and hosts a community of 200 children. The ventilation and height of its spaces allow it to maintain comfortable temperatures, and it uses solar energy to produce electricity.

The campus, considered one of the most environmentally friendly in the world, occupies a surface of 2,000 square meters, and produces energy through solar panels and a water-powered generator. Its

facilities include classrooms, a gymnasium, conference rooms, rooms for lodging, offices, a cafeteria, and bathrooms.

The initiative was supported by a foundation and by a construction and design company that utilizes bamboo in its work and assists in conserving the rainforest.



Photos: Rethinking Education Documentary



## Gloria Marshall School, Texas, USA

The school, recognized with a LEED Gold award by the U.S. Green Building Council in 2012, uses a geothermal air-conditioning system, and its longest sides are oriented in the north-south direction. All the classrooms receive natural light, and those facing the south only require artificial lighting 25 percent of the time. Sensors turn the lights on and off automatically.



Photos: SHW Group - Luis Ayala

## Chiquitana University, Bolivia

The university, like many other educational projects developed in the area, was built using adobe, wood, and native techniques to respect the unique culture and needs of the region. Its construction was directed by a Spanish architect and is a project of the Sin Fronteras University in Barcelona. The school covers 4,000 square meters and its spaces were designed to take advantage of natural light and ventilation. The collaborative method of construction (the school community did voluntary work to build it) helped the community to embrace the project as its own.



Photos: Construtierra.org



## Nueva Esperanza School, Manabí, Ecuador

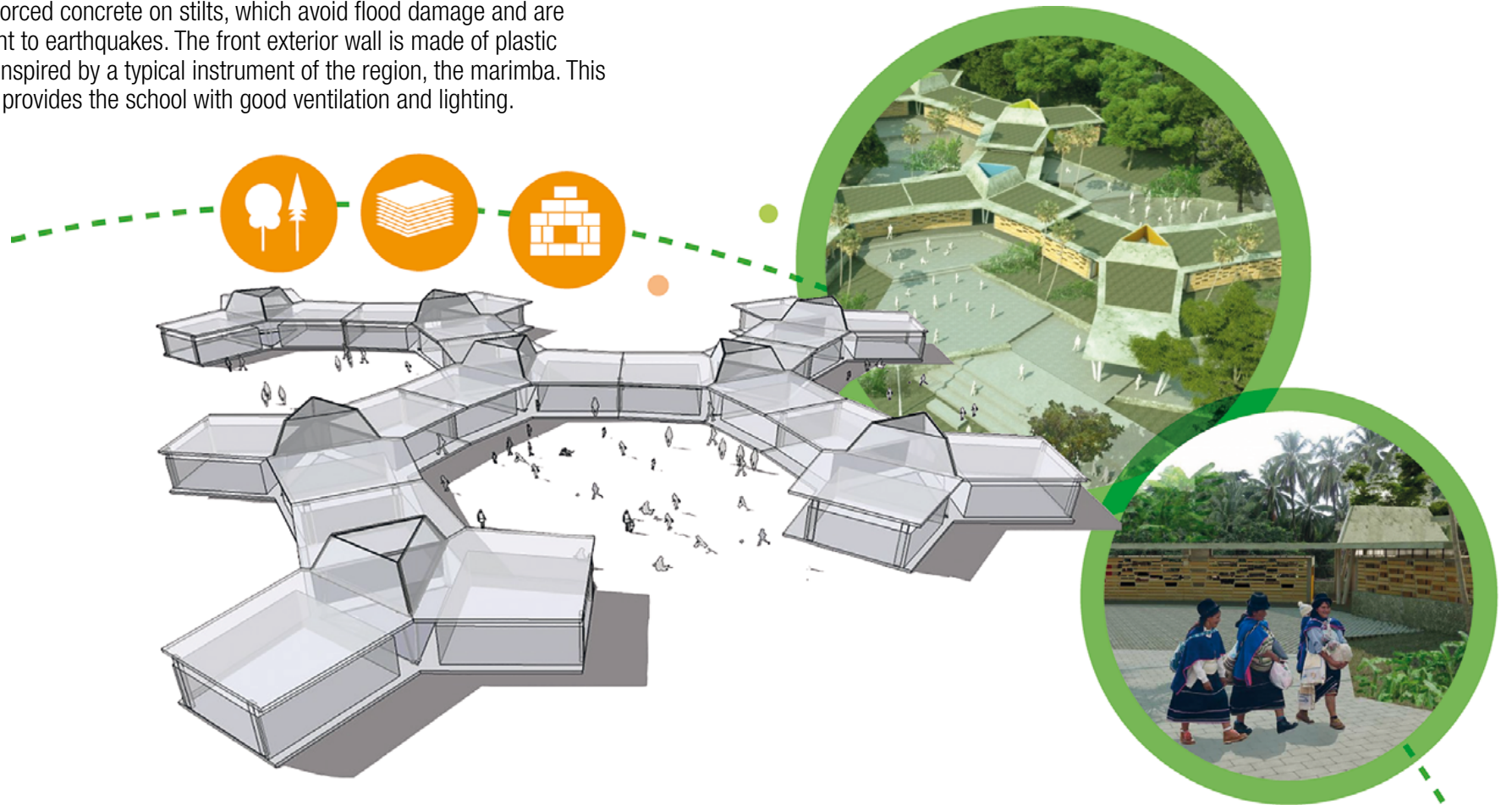
Built by the community with support from architects, the school is located on the beach, and its design is linked to the natural environment that surrounds it, integrating it with the ecosystem. The school uses the materials and construction methods of the community: wood on stilts, reed walls, wooden structures, and a roof woven from tequila leaves or cade.



Photos: Arquitectos AL BORDE

## Education and progressive development, Pacific Region of Colombia

The region where this school is located is characterized by heavy flooding and a high risk of seismic activity. Its structures are made of reinforced concrete on stilts, which avoid flood damage and are resistant to earthquakes. The front exterior wall is made of plastic wood, inspired by a typical instrument of the region, the marimba. This design provides the school with good ventilation and lighting.



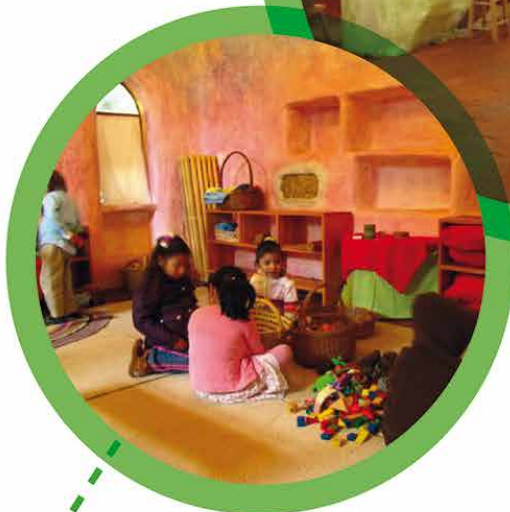
Photos: Espacio Colectivo Arquitectos



## Preschool in Morales, Mexico

The project used bales of straw, layers of mud, plaster, whitewash, and earth for construction. The space was designed to be a preschool, and built with the support of the school community.

The design included thick walls for excellent temperature and acoustic insulation. The project was completed in very little time due to the low cost of materials and voluntary labor.



Photos: Labmx.blogspot.com

## Classrooms built from soda bottles in Manila, Philippines

This construction made use of one of the most common articles of trash in any location in the world: plastic bottles. Classrooms were built using 1.5- and 2-liter bottles. Each bottle was filled with mud (liquid adobe) and left to dry for 12 hours. Once this was finished, the bottles were stacked like bricks. In addition to the low cost of the materials—some of which were considered trash—the buildings are strong and could be built by a community with little training in construction.

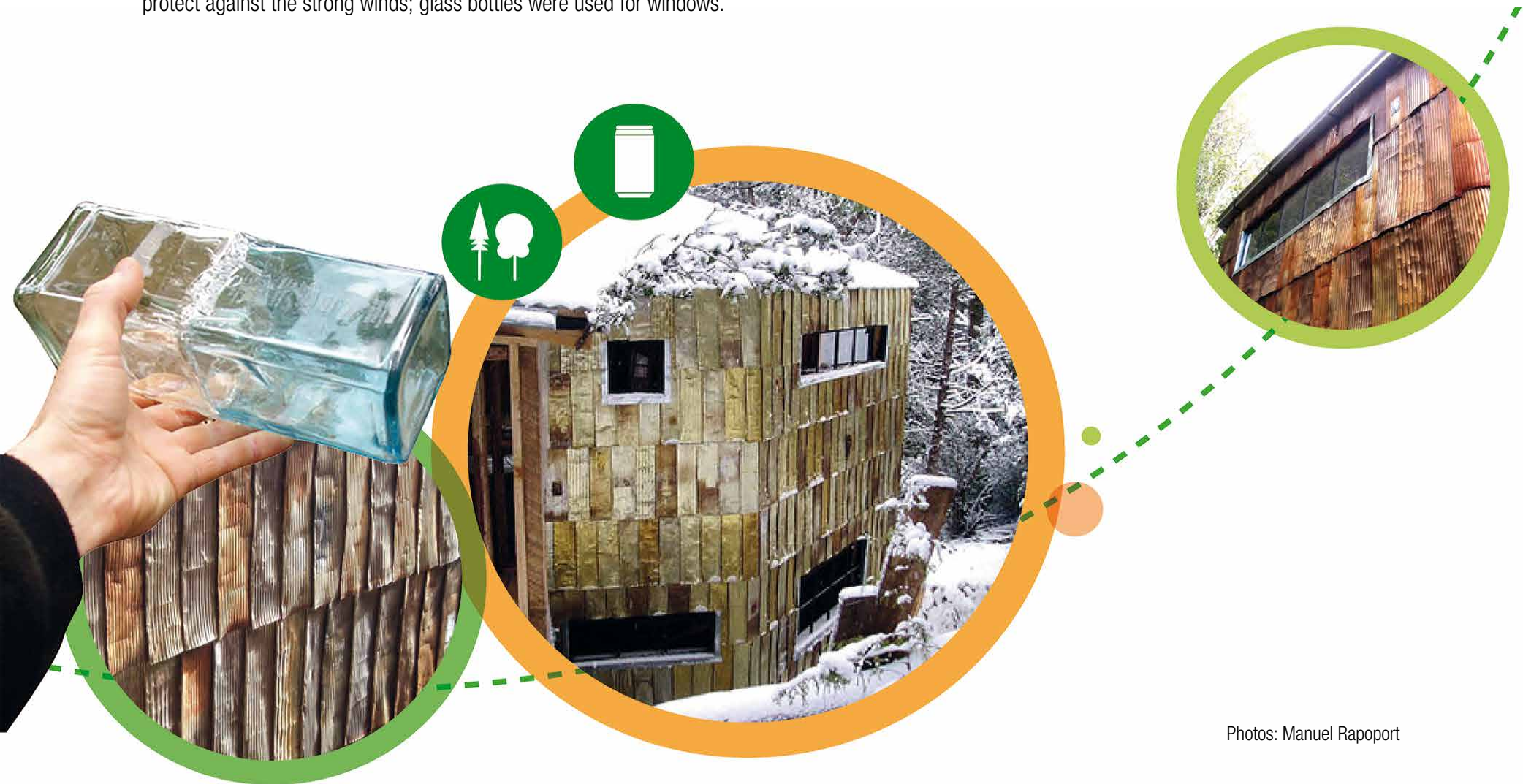


Photos: Kristel Gonzales



## A house made from cans and bottles in Bariloche, Argentina

This house, made from used cans of food and bottles, is a creation of the designer Manuel Rapoport. The construction consisted of 800 aluminum cans that were flattened and applied to the exterior to protect against the strong winds; glass bottles were used for windows.



Photos: Manuel Rapoport

## Houses made from bottles filled with sand, Nigeria

To construct these houses, bottles filled with sand were used instead of bricks. These materials were low cost, durable, bulletproof, and insulated the interior against the heat of the sun. Each house—consisting of one bedroom, living room, bathroom, and kitchen—required 7,800 bottles, and was one-third the cost of a brick house.



Photos: Sam Olukoya

## Monitoring and evaluating progress

Designing and building in an alternative way is a rare and valuable experience. Once you have made the decision to do so, the best way to monitor and evaluate your progress is by keeping a log that records every step of the process. This may be done by various actors that lead the project, so as to capture various points of view. Periodically, you could include comments from project participants to capture their experiences and viewpoints.

The log—whether written, typed, or posted online as a blog—should include detailed information on the decision-making process, the way in which any problems were resolved, as well as all innovations or adaptations of techniques tried elsewhere.

## Tips for finding financial support

When seeking financial support it is of utmost importance to make clear the concrete destinations for the resources you are requesting and the ways in which they will be used. Before beginning your search, you should already have an initial budget proposal that can be adjusted to meet the requirements of the institutions from which you are requesting financing. It is useful to put together a directory of potential financiers and an analysis of what kinds of projects each of them generally finance and under what conditions. It is possible that no single financier is interested in every part of your construction or improvement project. For that reason, it is advisable to divide the project, possibly according to topic, and to seek separate funding for each area.

**The Avina Association** has compiled a list of donors for Latin America that outlines the type of organization, country of origin, subject areas addressed, whether it finances private actors, and location and contact information (<http://www.indicedonantes.org>). The association itself addresses recycling, water, climate change, the Amazon, inclusive markets, and other issues that are important to Latin America and the world. Its initiatives constitute significant opportunities for groups in Latin America to improve the continent's future.

The nongovernmental organization Architects without Frontiers promotes equitable and sustainable human development through the improvement of living and work structures and the defense of individuals' rights to live in a decent environment. Their projects support education, health, cleaning or reparation, infrastructure, and housing in rural zones in Africa and Latin America with the use of local, low-cost materials (<http://asfes.org/>).

**The Lazos Foundation** supports the construction and improvement of schools to foster students' academic progress. The foundation works in 26 states of Mexico (<http://www.lazos.org.mx/index.php>).

**The Bill and Melinda Gates Foundation** supports efforts in various areas, including education, the environment, health, and rural development in Bolivia, Brazil, Chile, Colombia, and Mexico. The foundation also works on projects in water, hygiene, and cleaning, in particular to promote proven solutions and strategies, but only provides grants by invitation (<http://www.gatesfoundation.org/Pages/home.aspx>).

Finally, the website La Sociedad Civil provides information on agencies that support international cooperation on projects in countries in Latin America and the Caribbean (<http://lasociedadcivil.org/softis/cv/39/>).



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## Module 3

# Environmentally Friendly School Infrastructure

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# 2015

## Rise Up Against Climate Change!

A school-centered educational initiative  
of the Inter-American Development Bank