

LET'S MAKE IT DIFFERENT!

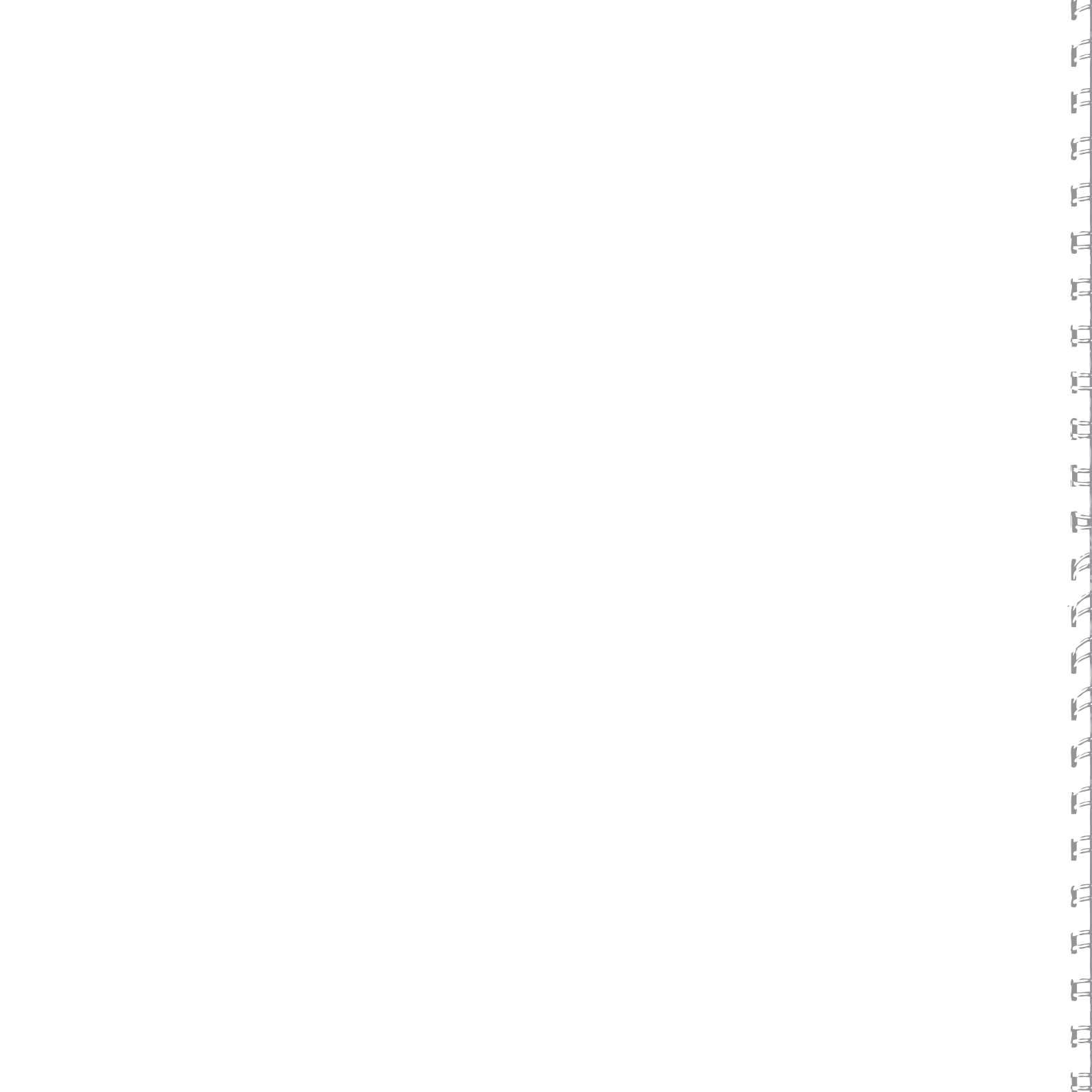
STEP BY STEP.

TOGETHER!



SCHOOL BUILDING INNOVATION BOOKLET

RESPECT, ADAPTATION, SUSTAINABILITY, TRADITION, COMMUNITY, HUMANITY, QUALITY, COMMITMENT



LET'S MAKE IT DIFFERENT!

STEP BY STEP.

TOGETHER!

SCHOOL BUILDING **INNOVATION** BOOKLET



CIGLER | MARANI UNLIMITED

2014



woven classroom in Tigray, Ethiopia

...People in Need, a Czech NGO working in Ethiopia for already more than 10 years., and Cigler Marani Unlimited, non-profit section of Cigler Marani Architects studio, have merged their capacities, skills and power to search for school construction innovations “how to make it better”...

The contact between CMU and PIN has been initiated long time ago, but it was in 2013 when the architects has been tending to bring their know how into the process.

To multiply the effect of cooperation, the Mekelle Institute of Technology, the Department of Architecture was invited to participate. CMU has provided local 4th year students with a workshop about sustainable design.

As the result of cooperation this innovation booklet was issued. The catalogue is printed out and used for the negotiations with authorities, clients and donors.

CIGLER | MARANI UNLIMITED





woven classroom in Tigray, Ethiopia



People in Need is a Czech NGO working in Ethiopia for already 10 years. It was established in 1992 in the Czech Republic. Over the past 20 years, it has grown into one of the biggest non-profit organisation in central Europe.

Today PIN focuses on four key areas: humanitarian aid and development co-operation, support for human rights, social integration and education programmes.

Their mission in Ethiopia has celebrated its 10year anniversary in 2013. The engagement in Ethiopia is said to be one of their most successful ones also because dozens of school buildings have been built.



woven classroom in Tigray, Ethiopia

CIGLER | MARANI UNLIMITED

architecture
within human
commitment

CMU is a section of Cigler Marani Architects studio founded on reflecting the sustainability of worldwide architecture and the good quality design accessibility.

The architecture is more than a design; it can solve and create problems at the same moment. The architecture of good quality is natural. If it works, it promotes the development. The inspiring environment is the background for the progress. It is not only about a physical protection and shelter. When the basic needs are fulfilled, people search for the motivation and stimulus.

It is clear that the good architecture is not about loads of money but about ideas. That is why their goals are

::: to assist to identify sustainable architectural principles :::

::: to promote new/old technologies and encourage new ideas and concepts in architectural design while respecting specificity of different communities :::

::: to interconnect the humanitarian, academic and private sector – multi-stakeholder partnership :::

::: to support architects' creative, technical and cultural talents :::



woven classroom in Tigray, Ethiopia

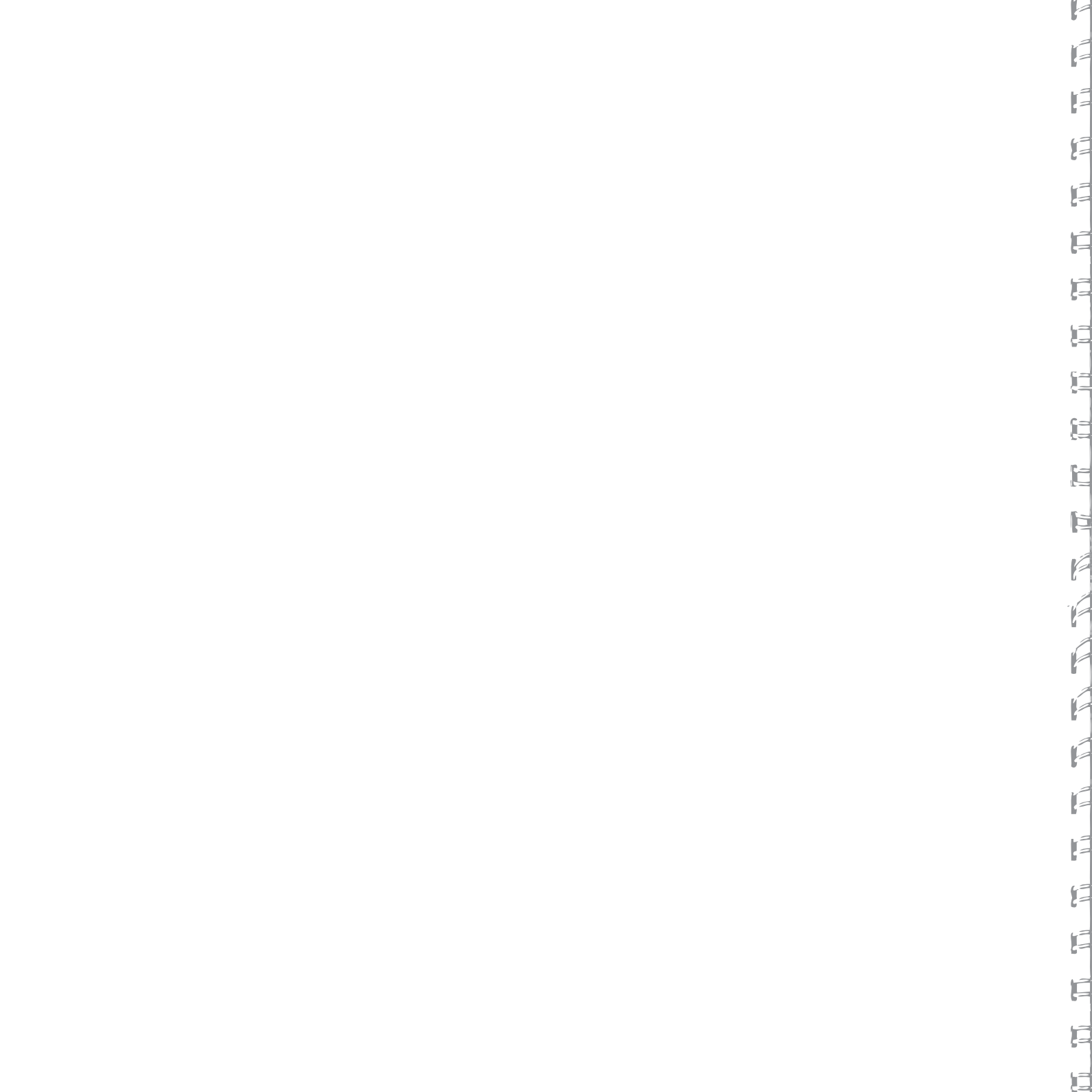
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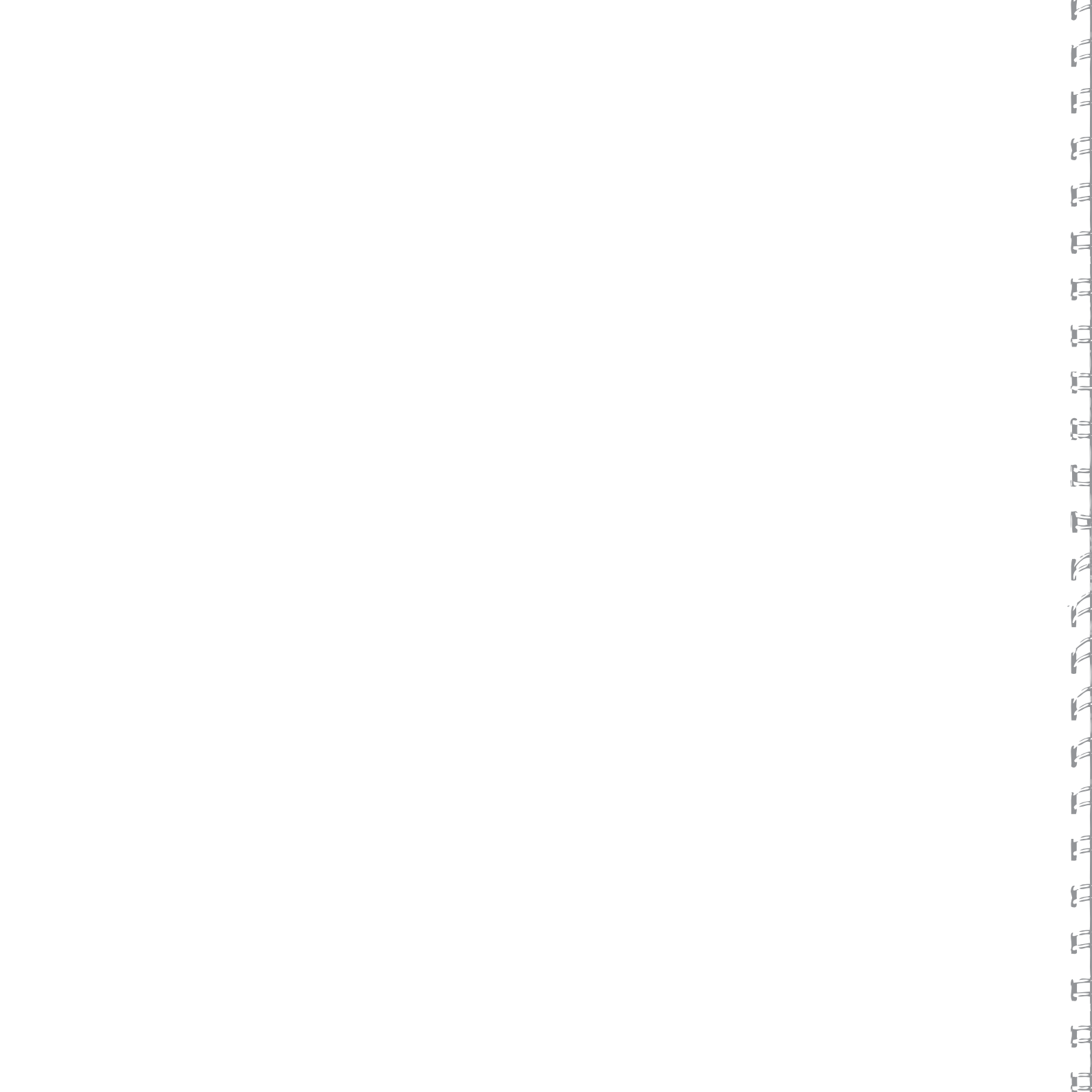
HOW TO USE THIS BOOK?

The following pages present the existing school design that respects local administrative standards, but still offers a room to alternate, adapt, improve and INNOVATE.

Subsequent chapters describe individual innovations that are applicable on existing design separately or in combination with others. The final innovation compilation depends on the school site, local community, local authority, focused goals and donor's capacity.

Our designed innovations are structured into following chapters: dispositions, construction, materials, interior, exterior and site plan... The book is completed with references from abroad.





15

INTRODUCTION

DISPO

CONSTRO

MATERIO

INTERIO

EXTERIO

SITE

FRESH IDEAS

ELSEWHERE

INTRODUCTION



LAMPALA, ZAMBIA



CHEPEMMA, KENYA



LUFUKU, MADAGASKAR



ZAMBIA



MOZAMBIQUE



SNNPR, ETHIOPIA



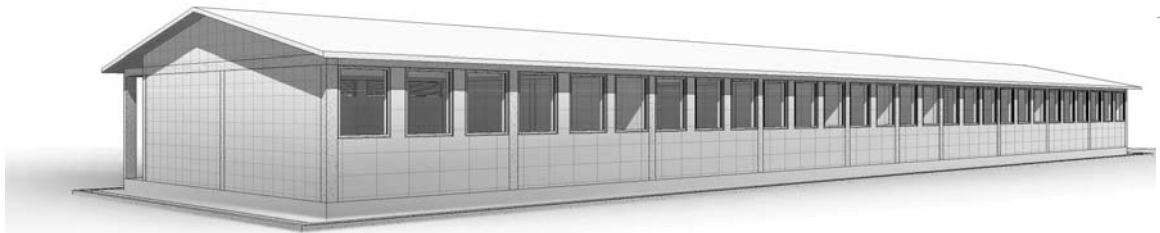
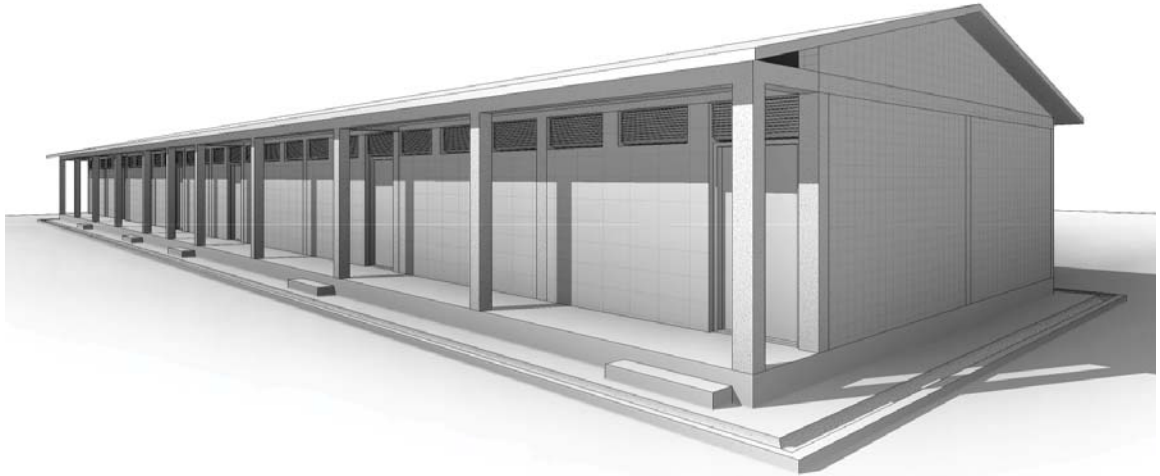
SOMALI R, ETHIOPIA



One said that to understand African architecture it is needed to understand climate. Africa is very diverse continent with many different weather conditions. The temperature and humidity vary from region to region across even one single country. So does the vegetation and potential building material. It is the altitude and geographical coordinates that say how the landscape looks like.

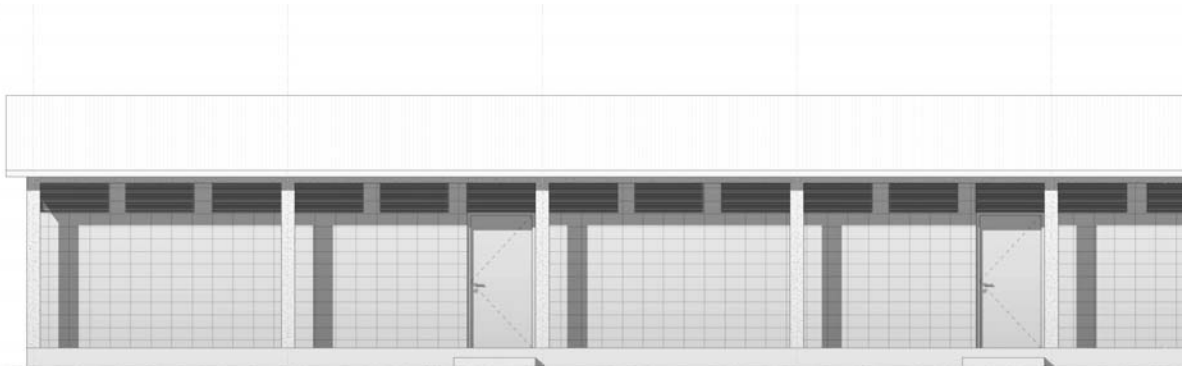
So why a man ignores it and tries to impose the same model of building in any environment? Because of the fact that it works in one place it doesn't necessarily mean that it would work in another. The design might be good, but it is the environment that is determinant.

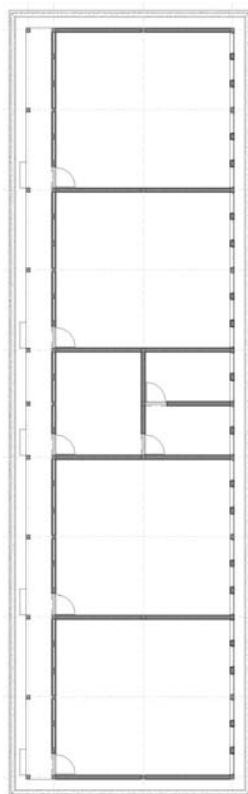
Standing in front of a school one can't guess which region, country or even part of the continent it is. The same model has been built up in humid Ghana, arid Mali, remote Zambia, isolated Madagaskar (with its characteristic features of endemic nature species!!!) and even in Ethiopia, in the country with the continent's largest concentration of UNESCO architectural sites...



The public building can be the result of a customary use along time, or of urban/rural/development planning as a given space with different functions.

It also can be the outcome of a **PARTICIPATION** process – both top down (this is launched by the public administration), or bottom up, demanded by the clients (for PIN by communities).





The existing design has its justifiable **QUALITIES**. That's why it is duplicated again and again all over the world.

The **SIMPLE** disposition permits natural using. At the same moment the **SIMPLE** disposition means **SIMPLE** structure and the **SIMPLE** structure means **SIMPLE** construction.

These qualities are underlined by the use of "**DURABLE**" material - concrete. Its durability is perceived by eyes of people who live or lived in mud houses that don't resist a single rainy season without consequences.

Appealing fact is that architecture of good quality is evident. If it works, it promotes the development. The inspiring environment is the background for the progress. It is not only about a physical protection and shelter. When the basic needs of community are fulfilled, people search for the motivation and stimulus. They find it in their surroundings.

In many cases the community has improved the "school skeleton" in its own way with its own ideas and means. It is not about loads of money but about **GOOD IDEAS**.



concrete block wall in Woinhat, Ethiopia

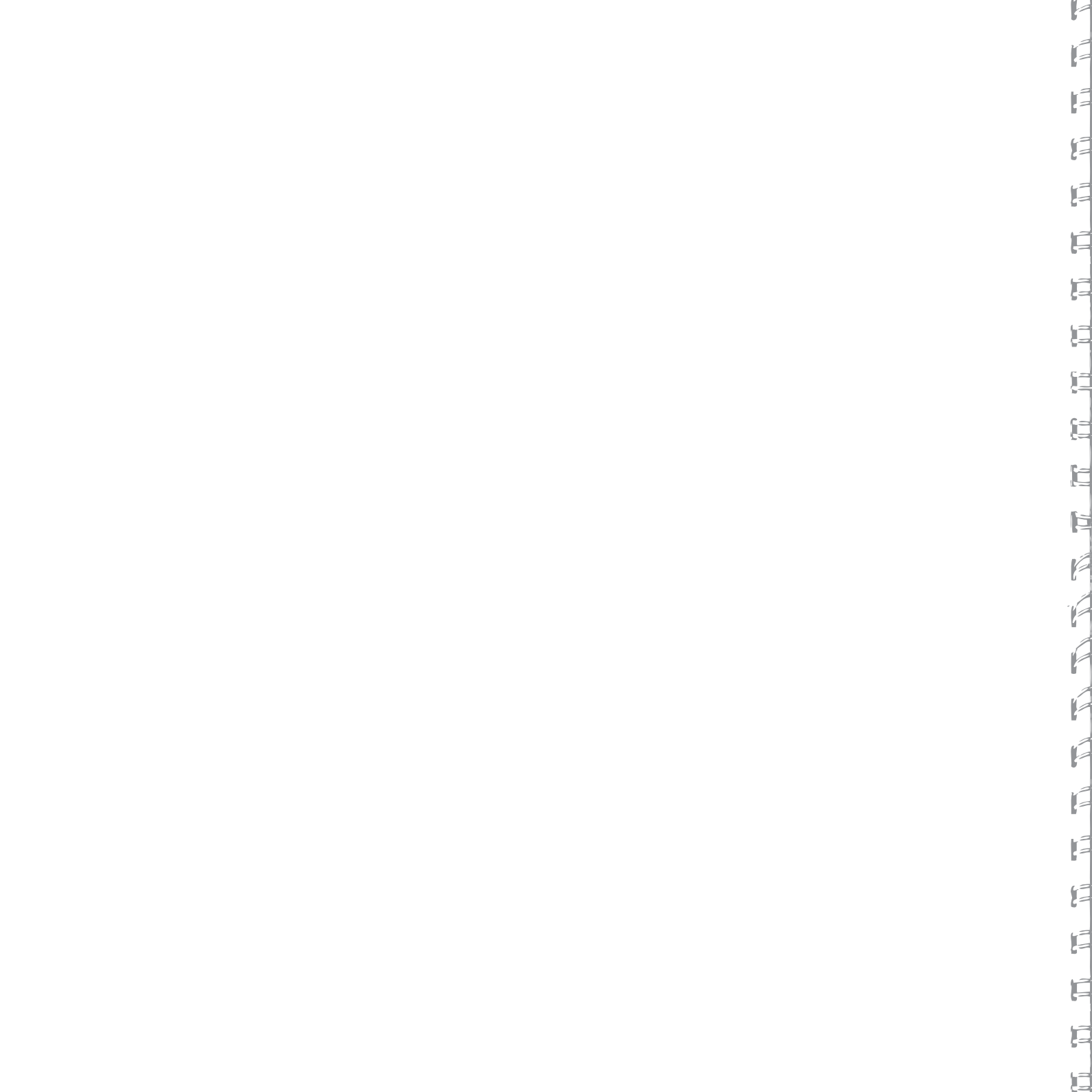
EXISTING DESIGN



the time of urgency and capacity building is **OVER**, we might take charge to think **DEEPER**, to plan **BETTER** and to create **NICER...**

to think **GLOBALLY**, feel, **UNDERSTAND** and deal with **SPECIFIC** environments, with neglected and remoted areas, to respect the local conditions, **RURAL** population, to turn the school into the places **OVERFLOWING** with inspiration and **MOTIVATION**, to **ATTRACT** people to care about it, to make it as an example worth following, to think **PROGRESSIVELY** and **SUSTAINABLY**, to use **LOCAL** materials, to use secondary materials - to **RECYCLE** and **REUSE**, to engage community and its hospitality, to make the community feel the **OWNERSHIP** of the educational buildings, not to create only a school, but the place of the contribution to the **DEVELOPMENT...**

the existing school design follows the administrative standards, but there is still a room to alternate, adapt and improve. Our designed innovations are structured into following chapters: dispositions, construction, materials, interior, exterior and site plan...



INTRO

DISPOSITION

CONSTRO

MATERIO

INTERIO

EXTERIO

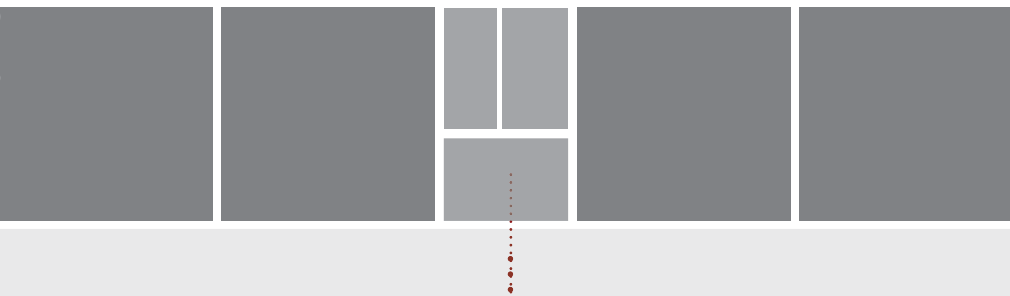
SITE

FRESH IDEAS

ELSEWHERE

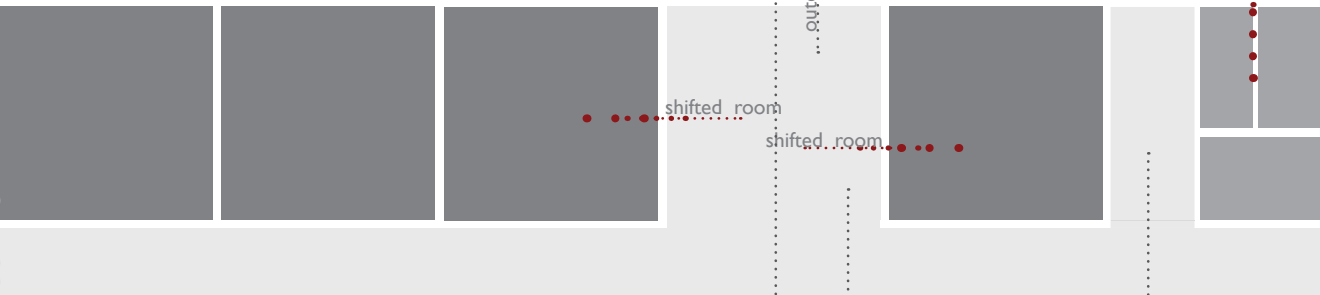
DISPOSITION

EXISTING



- classroom
- open space
- administrative

COMMUNITY FRIENDLY



CHILDREN FRIENDLY



creating semi-private alcoves

roofed open space

administrative core shifted to the side

shifted room

shifted room

shifted in depth

shifted in depth

shifted in depth

shifted in depth

creating safe corners

outdoor gathering place

outdoor gathering place

FORM FOLLOWS FUNCTION...

TO BE HANDLED EASILY

FORM FOLLOWS FUNCTION

TRANSPARENCY

INTER-CHANGE LAYOUT

SAFETY

PRIVACY

EASILY

EXTENDABLE PROTOTYPE

COMMUNITY GATHERING SPACE
school as a core of the community

School has classes during mornings and afternoons, but it might be used by community as a meeting place. It is advisable to differentiate one room in its appearance from other classrooms so that it might be used for special events. It is possible to employ canopies, shaded pavilions, niches, alcoves or courtyards for these functions.

OPEN SPACES

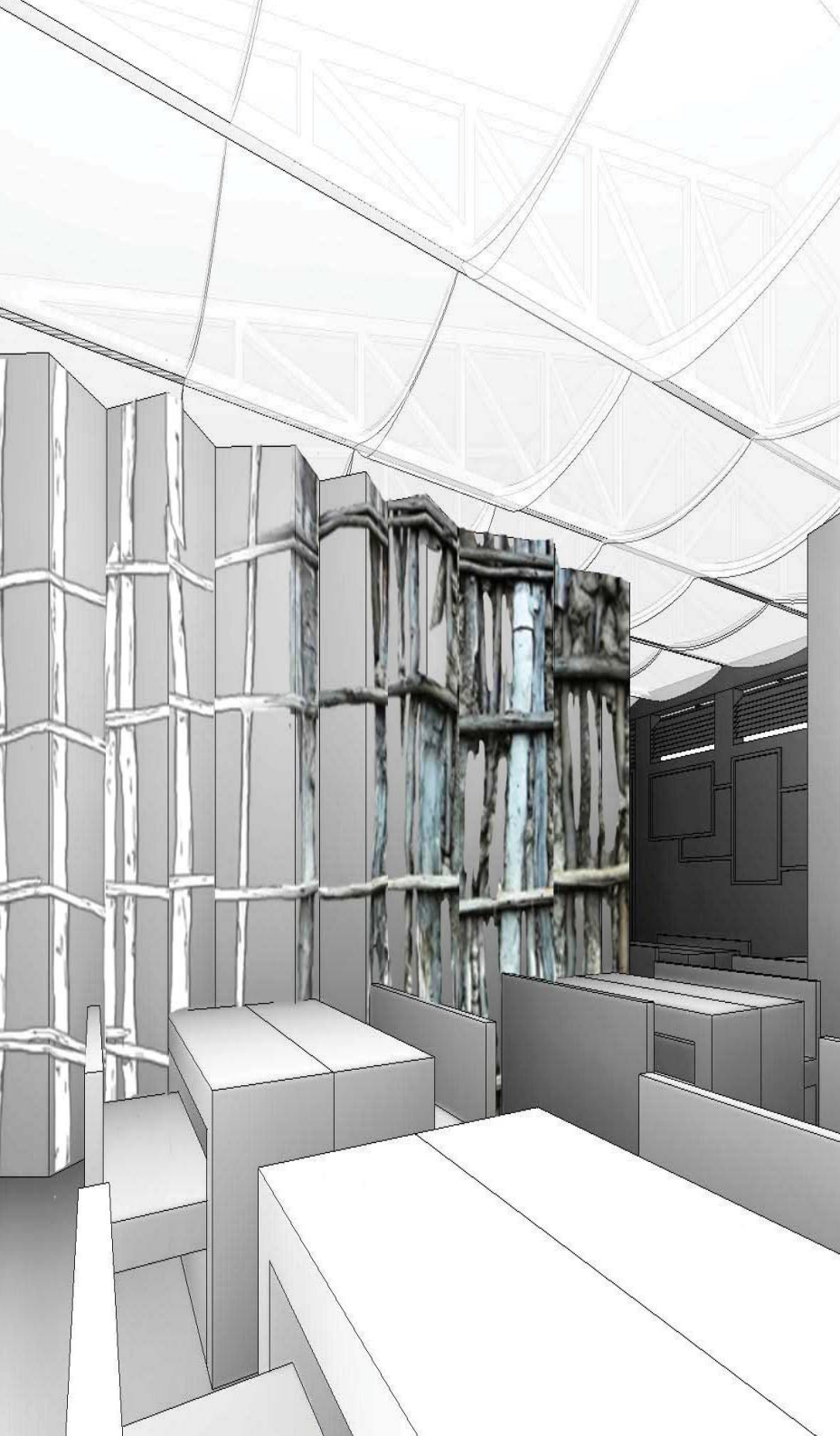
Easy access to open spaces from classrooms allows children to be in close contact with their environment and to engage in physical activities.

PEDOGOGICAL CENTRE
sharing learning resources

Well-defined area directly adjacent to classrooms, learning alcoves and core spaces that can be shared by children. It doesn't have to be separate library building, but general workspace with clear designation and well-defined purpose.

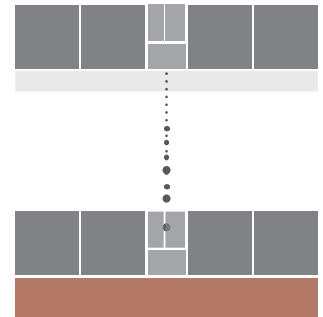
POSSIBLE AFFILIATION OR NEW FUNCTIONS

craft training centre
kitchen / restaurant
clinic



LARGER VERANDA

Roofed veranda protects from the heat and rain. The school building is important for whole community and even during the moments when classrooms are locked, it may serve to the people for gathering. Larger width of the veranda might promote it up to the terrace.



IMPLUVIUM

It is depressed part of an atrium where water flows down and where it can be diverted to the tank of the W.A.S.H. system.



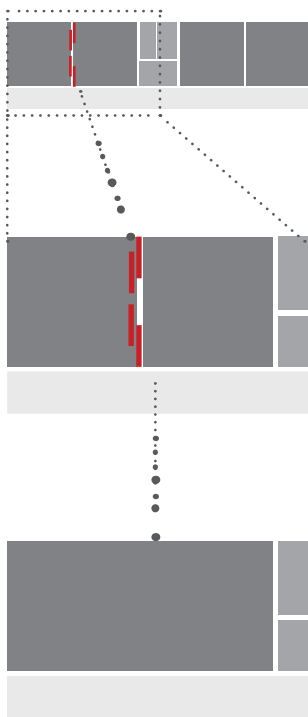
DISPOSITION DETAILS

SLIDING OR FOLDING DOOR

It allows to interconnect the classrooms into larger space suitable for extraordinary courses and events.

Door pannels can serve as writing boards or notice-boards.

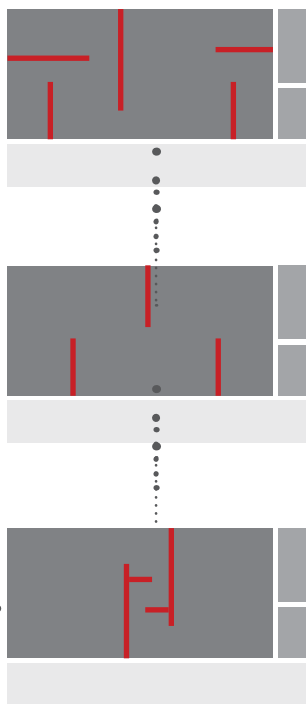
The only risk that it is confronted is reduced airborne sound insulation between the rooms...



SCREENS AND MOBILE PARTITIONS

It allows to create different kinds and qualities of spaces for different purposes.

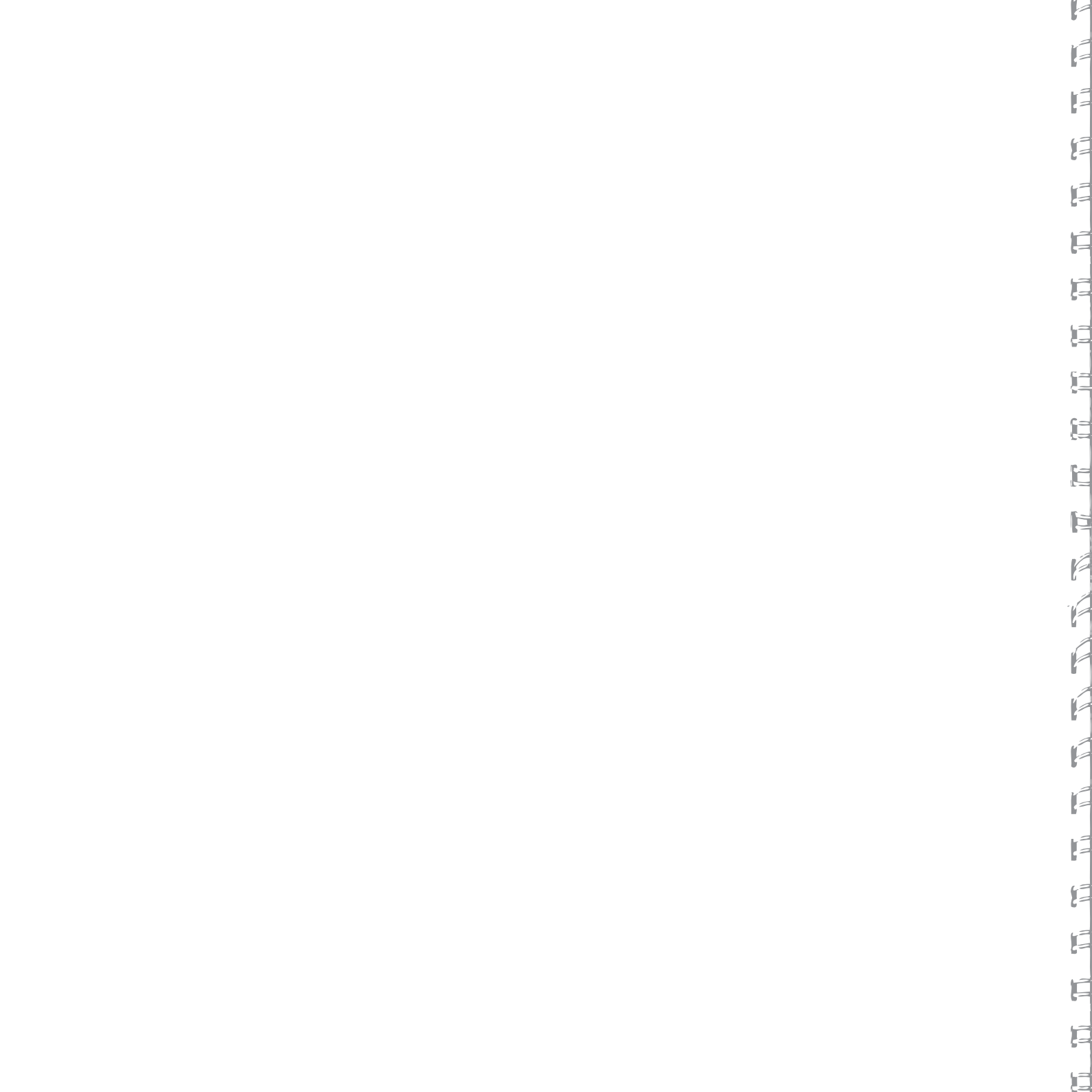
Adjustable spaces can accommodate groups of 100 people, 20 children, or 1-2 individuals. It helps to create partially open/partially closed space, with adjacent, smaller, enclosed spaces, that are separated but connected.



DISPOSITION DETAILS



Jeffery A. Lackney, PhD in his study appeals on moderate **VISUAL OPENNESS**, yet also ensure adequate **ACOUSTICAL BARRIERS**. He advises to articulate each cluster of instructional areas by gathering several small-group learning areas around a space for large-group instruction. Each of the small group areas can be further divided into individual activity areas to allow for quiet, individualized self-directed learning.





CONSTRUCTIONAL

CONSTRUCTIONAL

INTRO

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ELSEWHERE



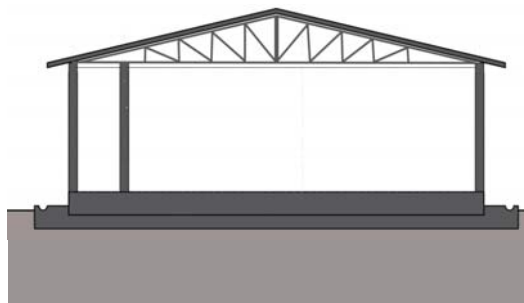
foundation formwork in V. unimata, Ethiopia

EITHER... OR...

There are two different approaches how to solve bad foundation conditions.

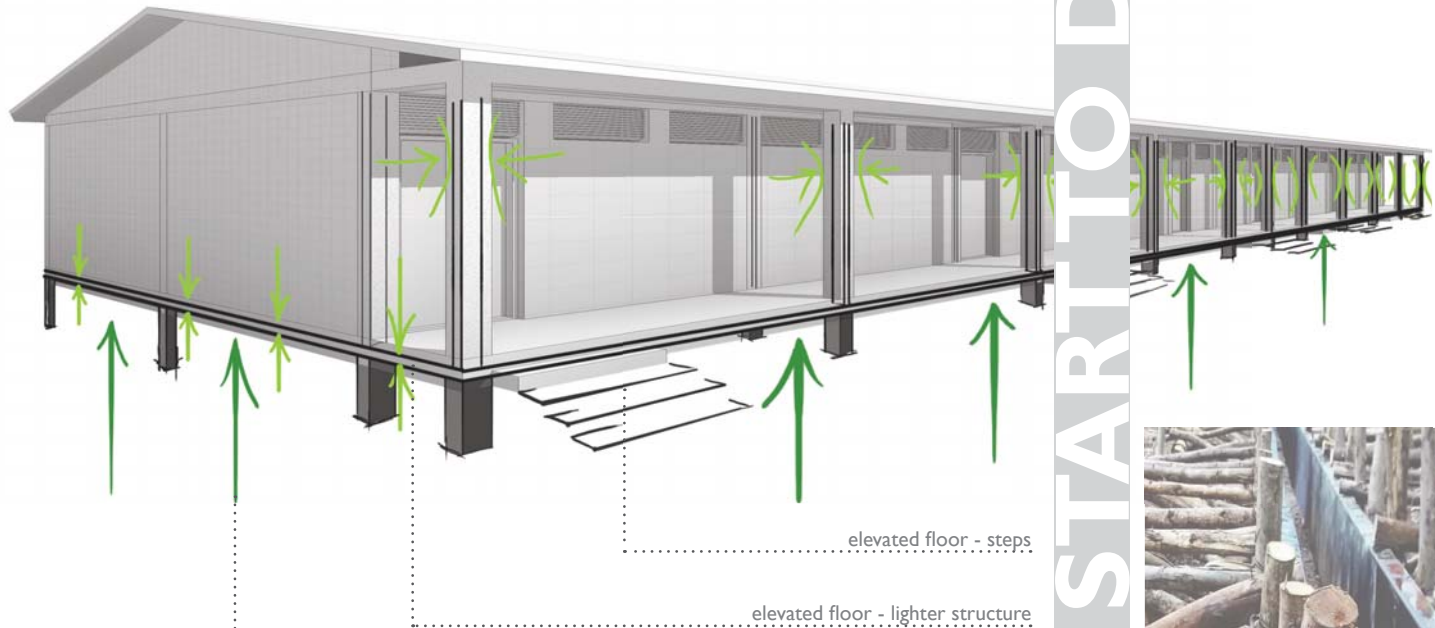
... to compact the bedrock ...

... to elevate the building ...



FOUNDATION

SUBSTANCE OF GOOD BOOTS



How a site for a new school is chosen? Is it in the best walking distance for all children from the community? In a gravity centre of the village? In a direction of futur development? In an exit of the city? Usually none of urban planning criteria is applied.

Communities build schools up on abandoned parcels that cannot be used for agriculture for any reason of following: non-fertile soil, steep slope for fields, waterlogged or less valuable in any other way.

But everybody knows that having foundations of GOOD QUALITY is the base of every project of GOOD QUALITY.

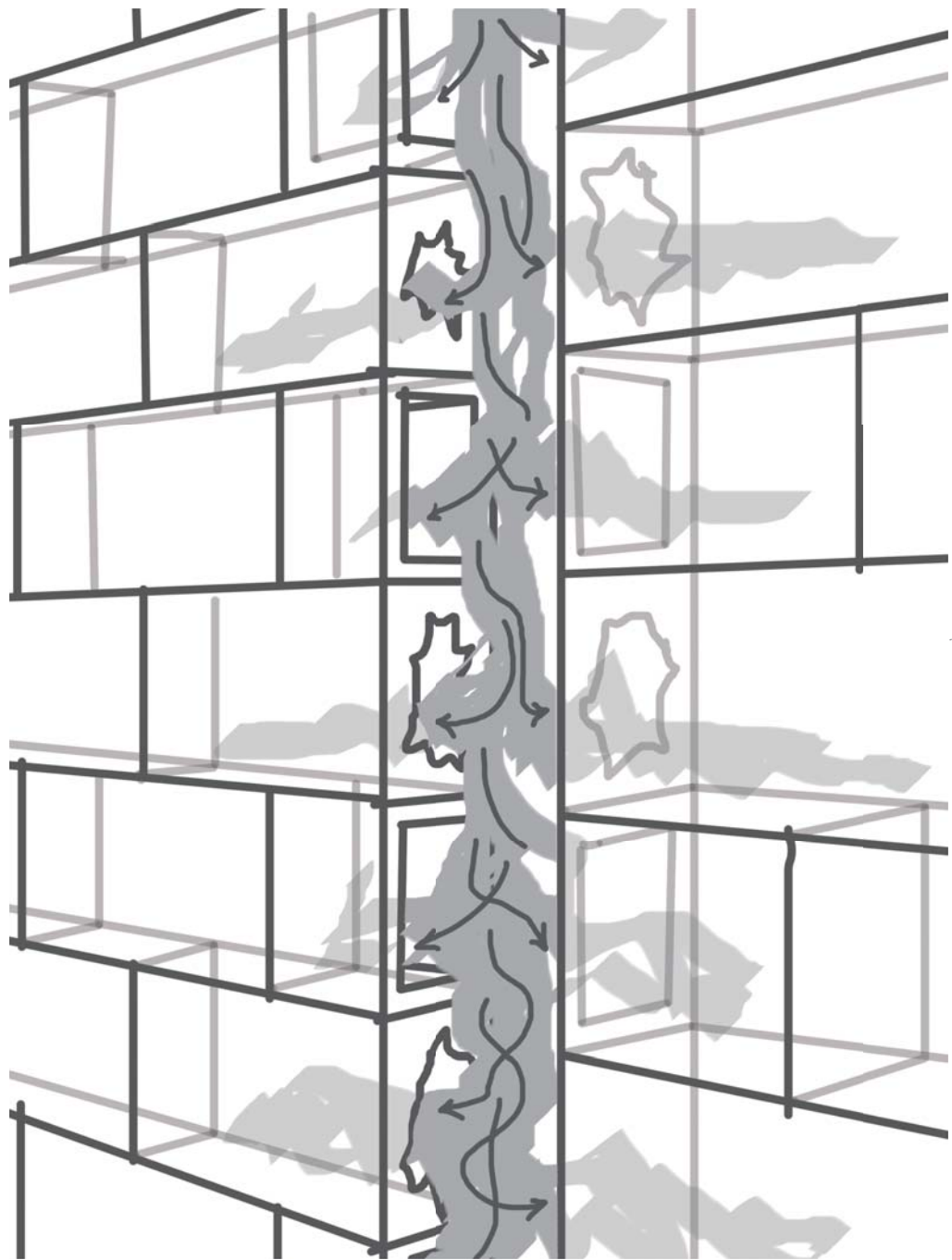
WHEN YOU START TO DIG



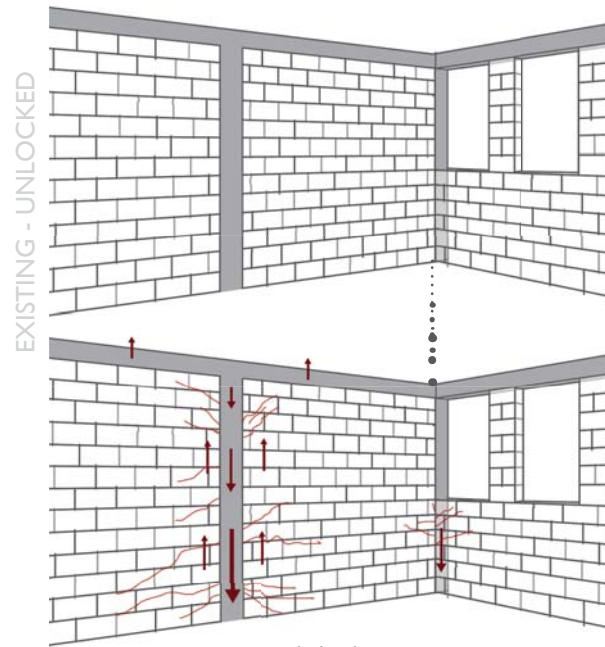
foundation formwork in Weinshata, Ethiopia



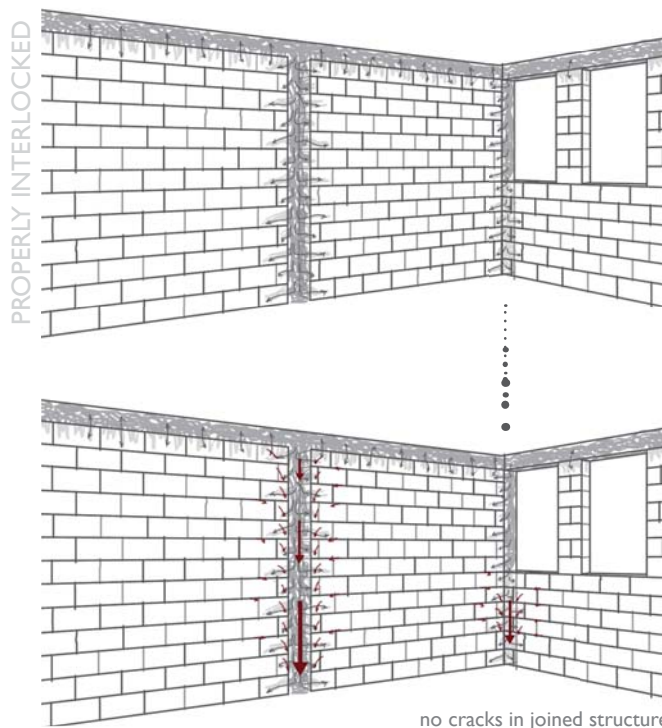
Concrete block wall in Mesindiro, Ethiopia



STRENGTHENING LOADBEARING SYSTEM



crack development in common structure
COLUMNS -> BRICKS



no cracks in joined structure



Concrete block wall in Mesticho, Ethiopia

There is a great priority given to the concrete as the material for school construction. The main arguments are its durability, resistance to harsh weather conditions and the flexibility, meaning the world-wide use.

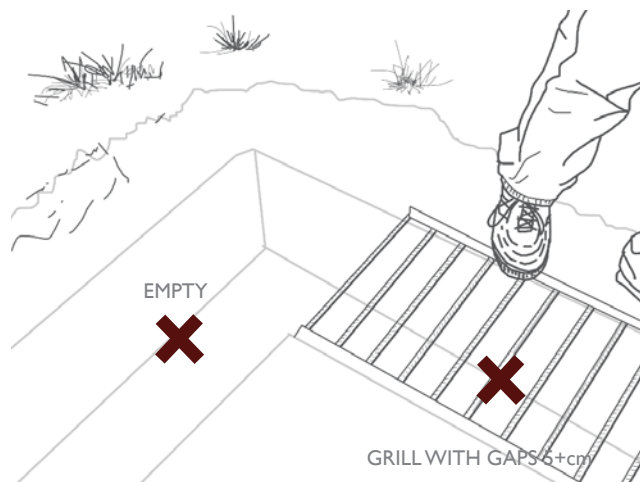
Once we decide to use it, we have to know its characteristics and advantages and how to achieve them.

The concrete column and beam structure filled with walls of concrete hollow blocks brings required stability even in areas with unfirm soils.

The essential principle to avoid cracks in between cast concrete elements and prefabricated blocks is to join them as tight as possible to resist torsing forces and to ensure that the decrease of different parts of structure on unstable bedrock is symetrical.



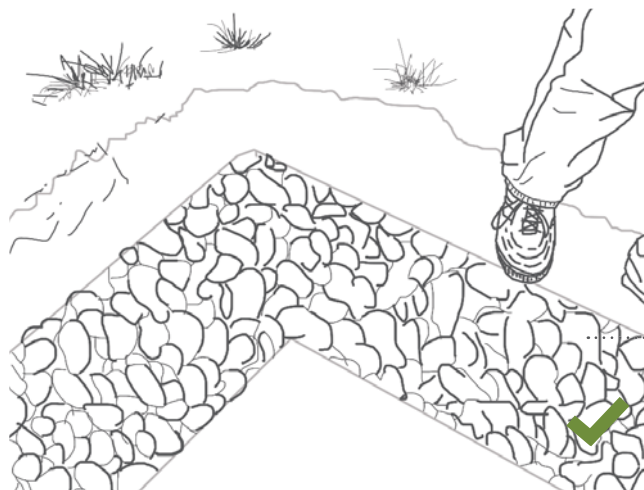
WHEN SKELETON IS UP



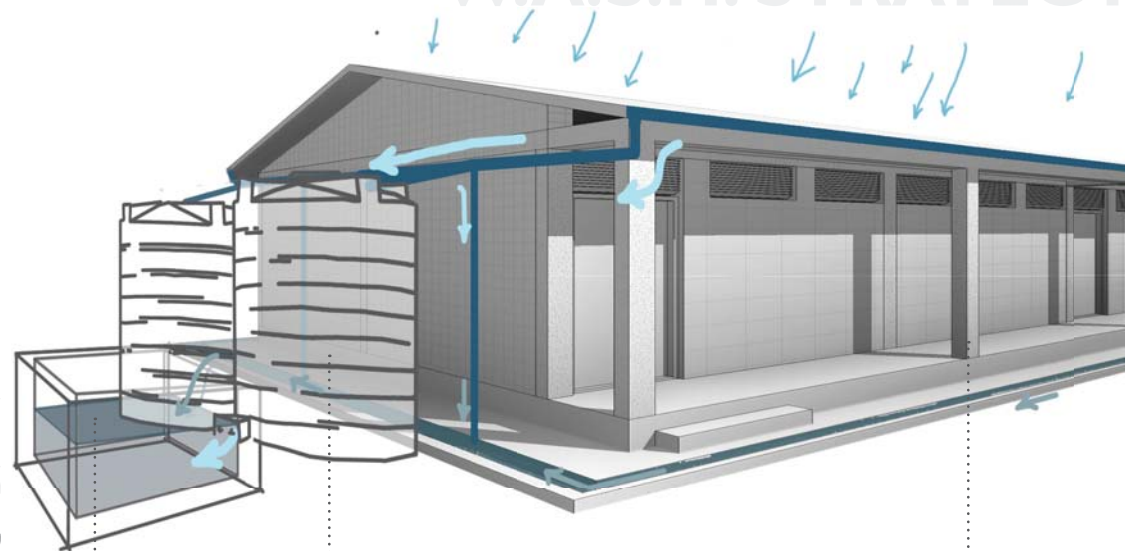
Ground gutters are necessary for complete draining system of the school building. To avoid standing water keeps the structure in good shape.

But the channels cant be covered by grills with wide gaps. There is a danger of children injury.

If there is no chance to get a finer grill, the channel can be filled with big gravels that are permeable enough for water and safe enough children to run over...



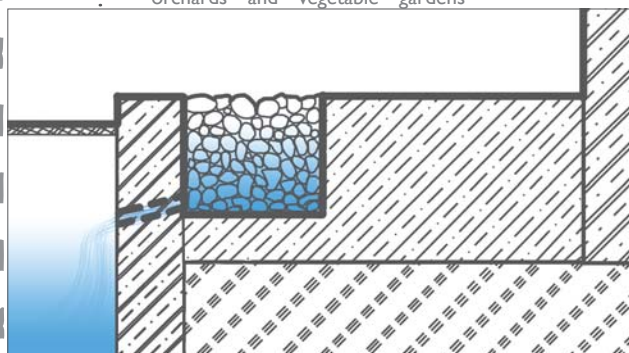
WATER AND DRAINAGE SYSTEM



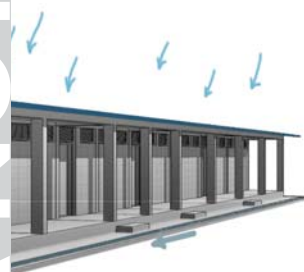
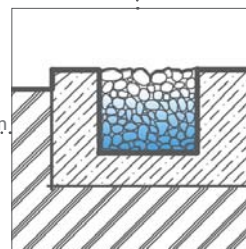
WASH programme technology

collection water tank for gardening

Water used for hand washing should be recycled and used to water the orchards and vegetable gardens



sewage canal section



The roof catchment is obvious solution for WASH projects. The gutters conduct water directly to tanks where it is stocked for later use, such as washing hands.

Some schools provide their courses with gardening lessons and they might need water of not so good purity for regular use.

There is additional tank gathering dirtier water from ground canals and overflow of principal tanks at disposal of the school.

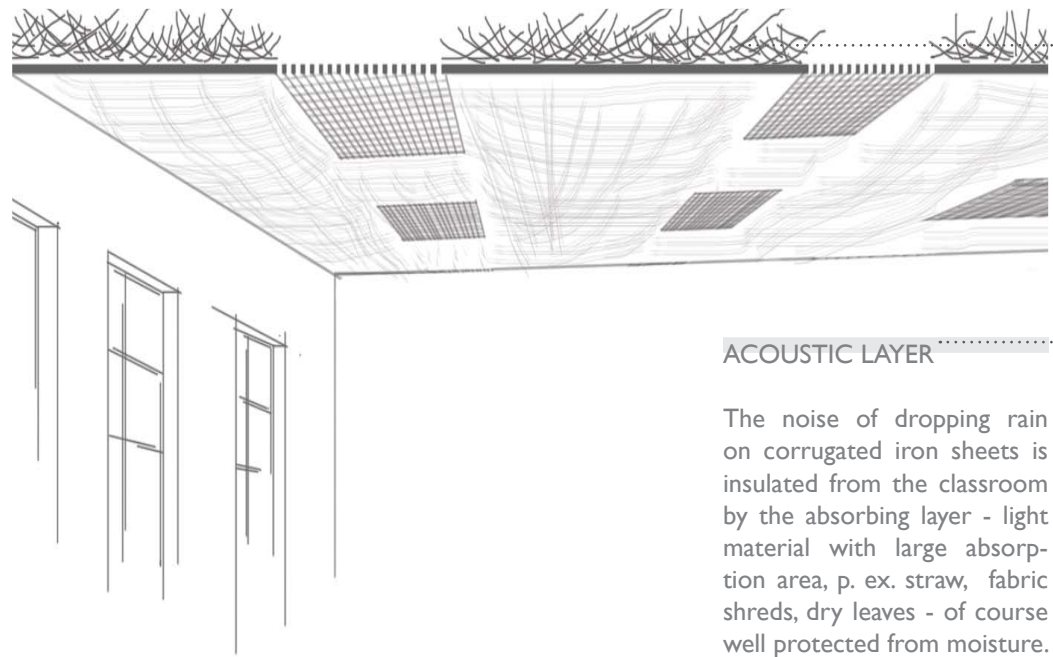


water tanks, programme WASH, Ethiopia

WHEN IT RAINS OR NOT...



roof frame, Wolminata, Ethiopia



ACOUSTIC LAYER

The noise of dropping rain on corrugated iron sheets is insulated from the classroom by the absorbing layer - light material with large absorption area, p. ex. straw, fabric shreds, dry leaves - of course well protected from moisture.

LIGHT TUNNELS

How to bring the light into the room without glaring the interior?

The Liter of Light project was launched 2,5 years ago by the My Shelter Foundation, a Philippines-based NGO which aims to provide light to homes who are without light.

The scheme uses plastic bottles filled with a solution of bleached water, installed into holes made in corrugated iron roofs, which then refracts the equivalent of 55W of sunlight into the room – during the day, at least. It takes five minutes to make, and using a hammer, rivet, metal sheets, sandpaper and epoxy, it costs \$1 to produce.



ROOF AND CEILING STRUCTURE

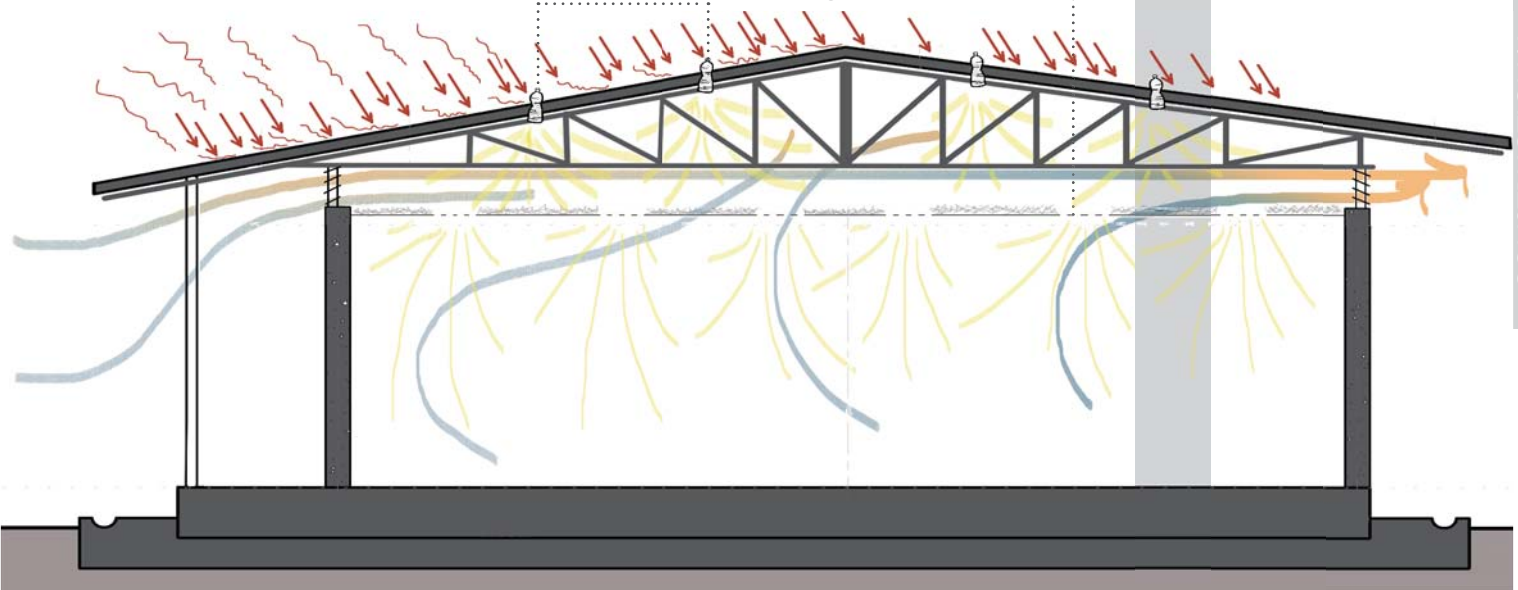
LIVABLE ENVIRONMENT

Heat? Humidity? Rain? Noise? Darkness? To create elevated roof might be a solution...

A good fresh-air circulation is needed to avoid heat and excessive humidity. At the same moment the structure is stable and weatherproof. The nature provides us with its laws about equilibrium and gradients. It is might be called natural air conditioning.

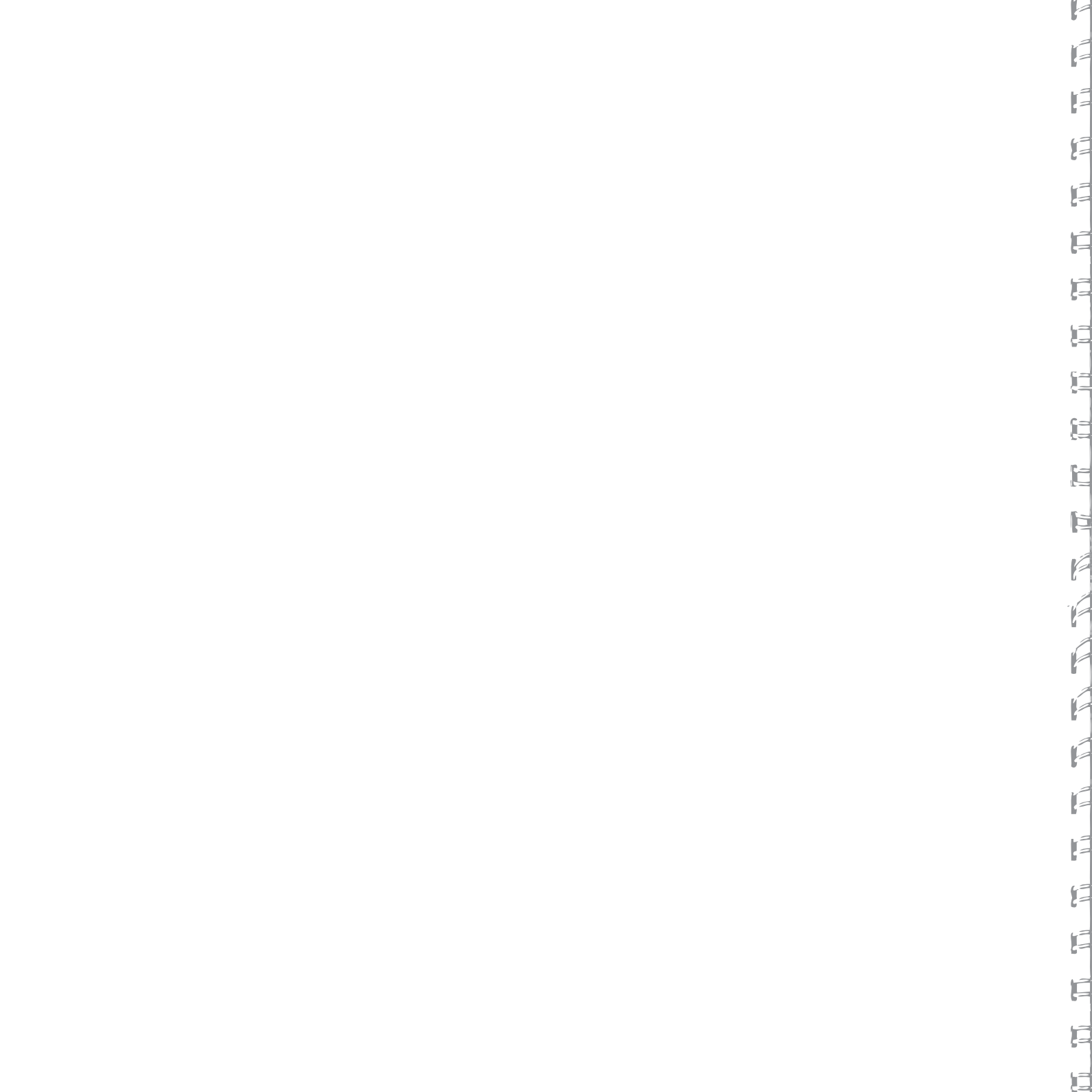
The roof of corrugated iron is separated from the classroom by the absorbing pad - mass of material that insulates the noise.

The light is conducted to the interior with "recycled" light tunnels from the project The Litter of Light.



plastic bottle bulb, The Philippines





MATERIAL

INTRO

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FRESH IDEAS

ELSEWHERE



mud plaster in Woinineta, Ethiopia



produced manually the earth mix is cast in open moulds onto the ground and then left to dry out



the wall may be plastered to be protected from particle washing (the most resistance coating is with addition of cactus juice or cement)



easy decoration with finger drawing or object imprinting - client costumising and potential engagement of children into the decoration process

57% SAND + 10% CLAY + 30% WATER + 3% STRAW

RISKS

susceptibility to earthquakes

biodegradable

foundations - the ground has to be well compressed, the foundation settling may cause cracks in the wall

deserving regular care and maintenance (depends on the degree of compaction and stabilisation)

hydroscopy - it might be avoided by applying protective films (with content of cactus juice, p.ex.)

erosion of upper parts - might be solved by vegetation windbreaks or waterproof additives to the plaster mixture

ADVANTAGES

community participation and use by unskilled labour

environmentally the most sustainable material

good thermal mass and thermal inertia - stays cool when it is hot outdoor and viceversa

non-toxic and lesser allergic reaction (studied by Habtemariam Molla)

compressive strength

fire proof

sound proof

biodegradable

durable and strong

bricks shrink before they are placed

ease of decoration

ease of cutting or adjusting dimensionally

anti-deforestation

ADOBE - SUN DRIED MUD

mud imprints, student workshop in MIT, Ethiopia

HOW MUCH?

1 m of 30cm wall = **X ETB**

X

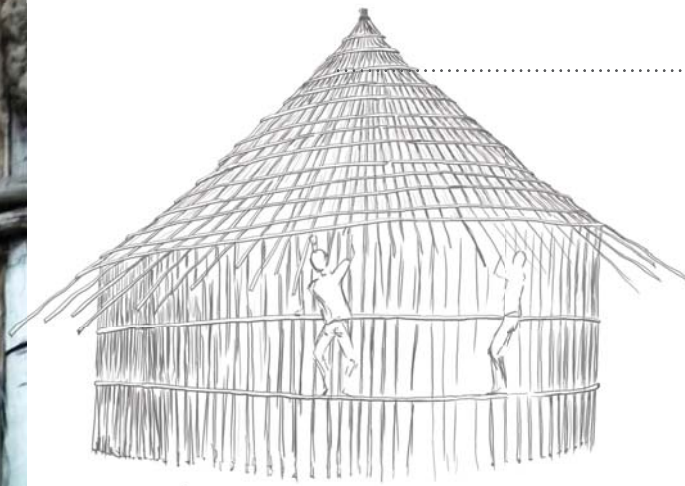
existing design with concrete hollow blocks

1 m of the wall = **550 ETB**

MATERIAL



traditional structure in Mesiricho, Ethiopia



woven work of sticks intertwined with twigs (a small thin terminal branch of a woody plant) or sometimes bamboo framework covered with mud

wooden structure - eucalyptus, bamboo



straw



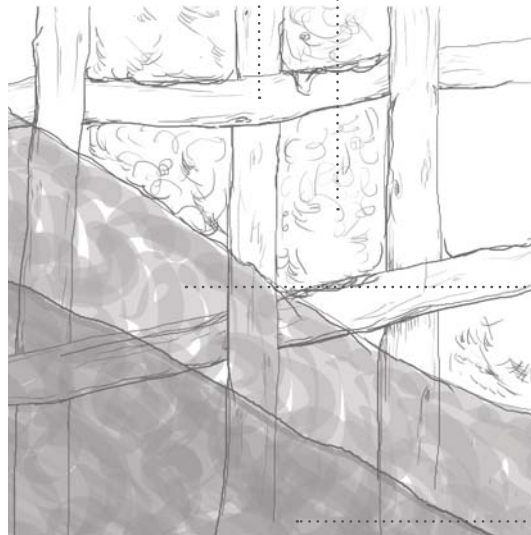
mud



mud plaster



cement plaster



WATTLE + DAUB + HARD CEMENT PLASTER

GOJOBETT / TUKUL HOUSE

RISKS

susceptibility to earthquakes

biodegradable - termites attacking wood from the foundation -> antitermite treatment (coating) in foundation

foundations - stones and concrete to protect the wood poles from termite attack

purchase and transport costs of cement

deforestation (?)

ADVANTAGES

based on traditional "gojobeit" (in Amharic) / tukul (in Tigray) houses >>>v skilled labour

wood sticks and wattle and straw prevent harsh shrinking and cracking

local material

good thermal mass and thermal inertia of mud

fire proof

sound proof - massive structure

ease of decoration

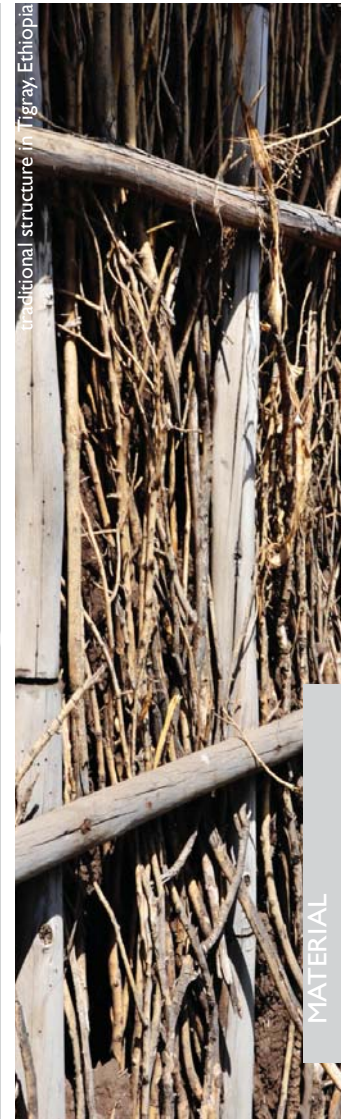
ease of cutting or adjusting dimensionally

community participation

cement plaster - water-resistant layer guaranteeing the protection of the wattle core

non-biodegradable and durable thanks to cement layer

traditional structure in Tigray, Ethiopia



MATERIAL

WATTLE'N'DAUB

HOW MUCH?

1m of the wall = 280 ETB

X

existing design with concrete hollow blocks

1m of the wall = 550 ETB

the **SIZE** of the earth block

its **TEXTURE** and its
COLOURS

BONDING pattern

stretchers and headers
ALTERNATING

highly **SKILLED** masons

REGULARITY
and **GEOMETRY**

discreet **SHADOW** play

IMPRINTS at the mould-
ing stage, reliefs or bump

CHAIN corners
CORNICE ornaments

CLAY + SILT + SAND + WATER + LIME/CEMENT

PROGRESSIVE TRADITION

RISKS

purchase and transport costs of cement

purchase and transport cost of rather heavy mechanical system machines

fragile during production of newly moulded blocks

choice of the soil type

possible presence of clay lumps during brick preparation

ADVANTAGES

local material - low costs

non-toxic, natural, chemical free

cement addition - increase of water resistance

fire resistant

sound resistant

insect resistant and non-biodegradable and durable thanks to absence of organic material

no shrinking and cracking because the blocks are dry before placing

uniformity, predictable size, but also adjustability

small masonry elements - effect for ornamentation and decoration, apart from its structural role

small masonry units - interior tricks, such as benches, shelves, openings, frames...

community participation

reduction of deforestation

COMPRESSED EARTH BLOCK

CEB in Laongo, Burkina Faso



MATERIAL

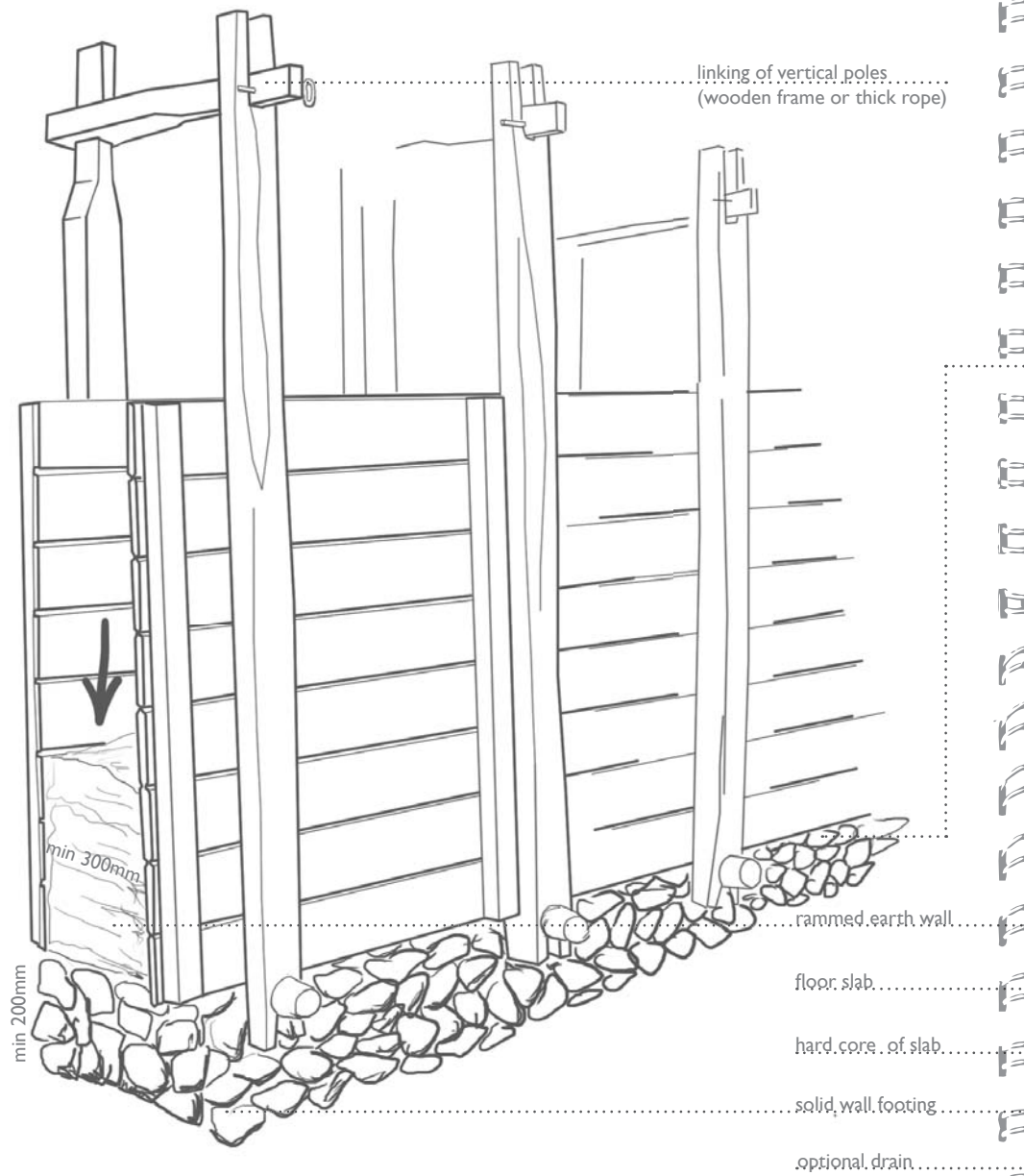
HOW MUCH?

1 m of 30cm wall = **X ETB**

X

existing design with concrete hollow blocks

1 m of the wall = **550 ETB**



SOIL + CLAY + SILT + SAND + STABILISER

NATURAL, RAW, LOCAL

RISKS

purchase and transport costs of powered tampers

susceptible to water damage if inadequately protected or maintained ("good boots and hat" - good foundation and overhanging roof)

choice of the soil type

possible presence of organic material and clay lumps

ADVANTAGES

low shipping costs

local material

non-toxic, natural, chemical free

thermally massive

adjustable plan

cement addition - increase of water resistance

fire resistant

sound resistant

insect resistant

non-biodegradable and durable thanks to absence of organic material

no shrinking and cracking because of compact water-free material

community participation

reduction of deforestation

for all climatic region - semi-arid deserts, tropics and mountains

OPTIMAL MIX

14% clay, 22% silt, 62% sand and 2% gravel. Straw or wood chips can be added as a binding agent

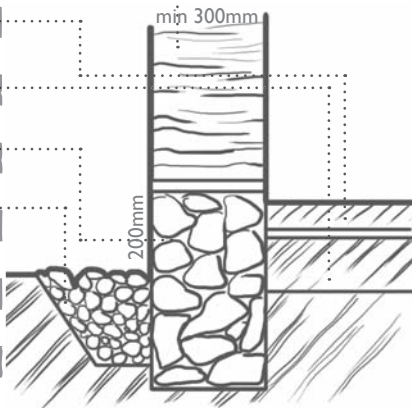
HOW MUCH?

1m of 30cm wall = **X ETB**

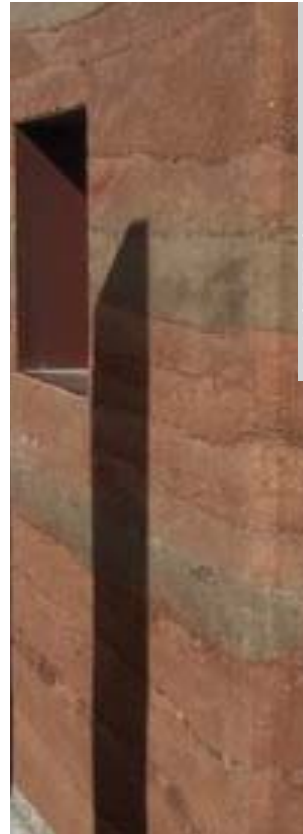
X

existing design with concrete hollow blocks

1m of the wall = **550 ETB**



RAMMED EARTH



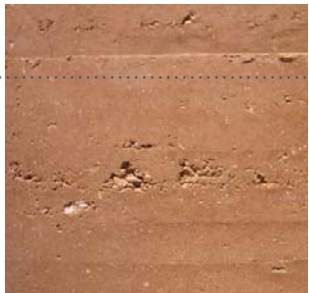
MATERIAL

TINCTURE

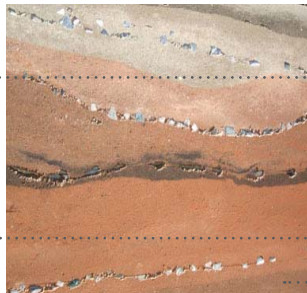
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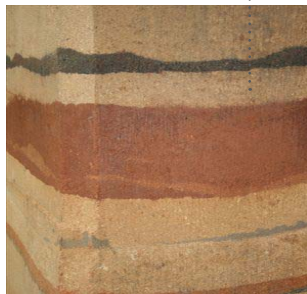
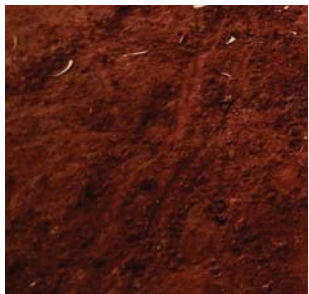
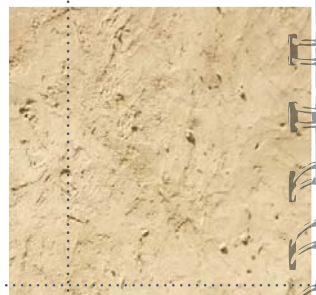
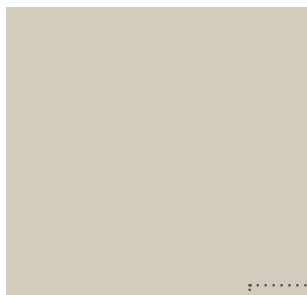
SHADE
SHADE



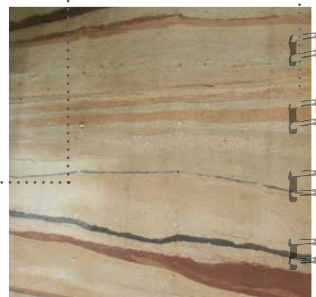
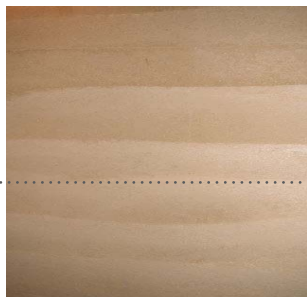
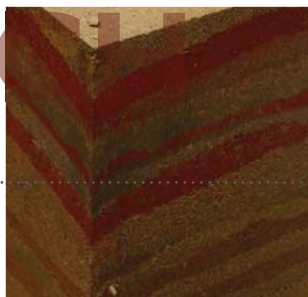
PURITY



IT IS NOT DEFFECT,
IT IS **BEAUTY**



PIGMENT



TOUCH

TRACE

SOIL + CLAY + SILT + SAND + MINERALS

APPEALING APPEARANCE

RISKS

choice of the soil type

lack of pigments in neighborhoods

ADVANTAGES

interesting appearance and very appealing structures

low shipping costs

non-toxic, natural, chemical free

local material

thermally massive

fire resistant

sound resistant

insect resistant

non-biodegradable and durable thanks to absence of organic material

no shrinking and cracking because of compact water-free material

community participation

reduction of deforestation

for all climatic region - semi-arid deserts, tropics and mountains

NUANCE



APPEALING APPEARANCE



MATERIAL

HOW MUCH?

1 m of 30cm wall = **X ETB**

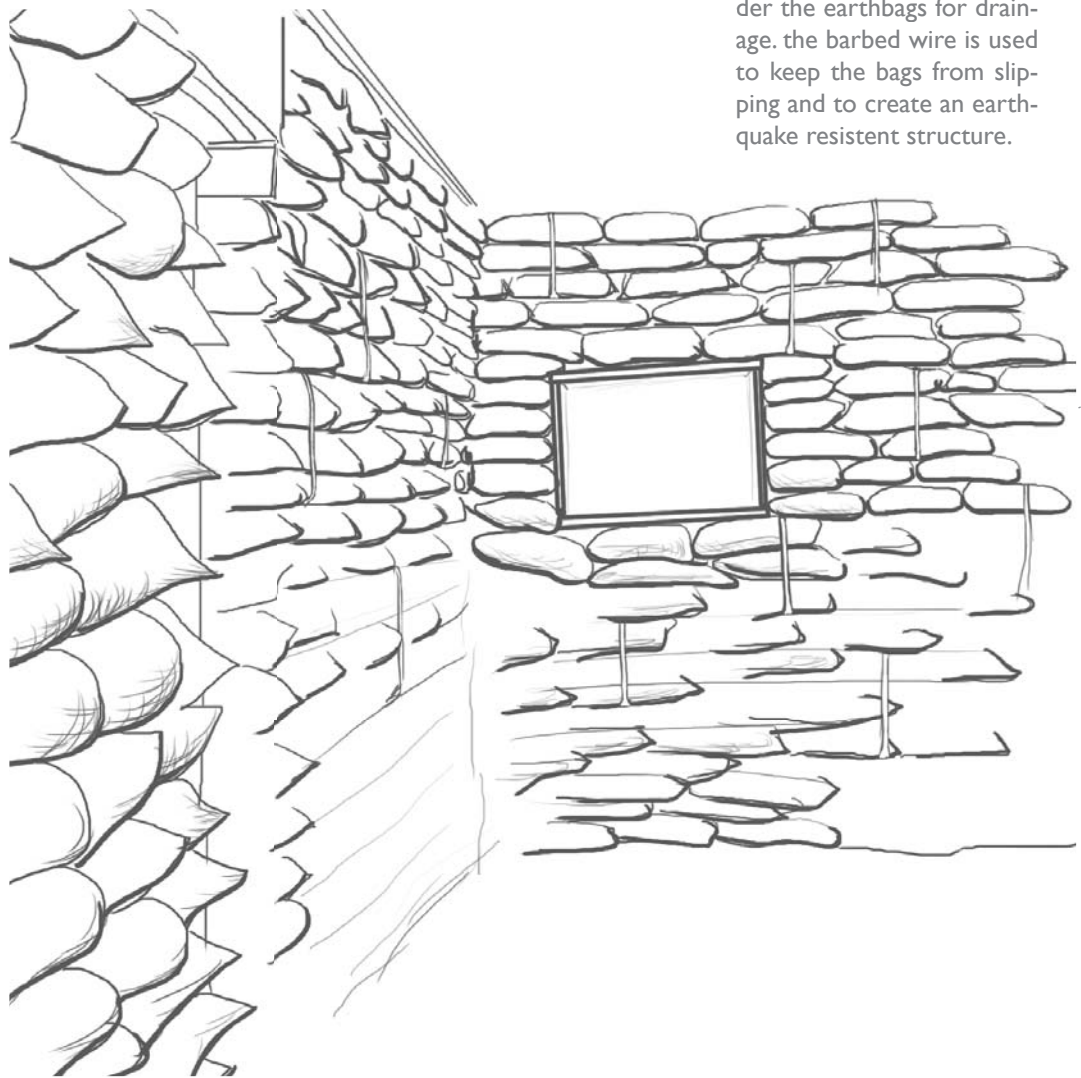
X

existing design with concrete hollow blocks

1 m of the wall = **550 ETB**



earth bag pilore house, Columbia



FOUNDATIONS AND REINFORCEMENT

it differs as per site. in a rainy locality, rocks are placed under the earthbags for drainage. the barbed wire is used to keep the bags from slipping and to create an earthquake resistant structure.

PLASTIC/RYEBAGS + EARTH + THORNY ROPE

RISKS

susceptibility to earthquakes

suitable for short span buildings if combined with vaults

BASED

using all advantages of rammed earth when evolved from historical military construction and temporary flood control building methods

ALTERNATIVES

If you do not like the idea of plastic bags - then Kelly Hart and Dr. Owen Geiger of Earthbag Building suggest natural porous bags (hemp, jute, flax or linen) filled with dirt, stone powder and sodium carbonate or lime (or numerous other cement capable wastes). After you lay a course of bags, sprinkle the layer with water, and after drying you will have a cement layer.

ADVANTAGES

bags are light and easily transportable to remote areas

filling soil - local material

good thermal mass and thermal inertia of earth

time and energy efficient

no need of much moisture - for dry regions

no need of specific ratio of clay to sand

fire proof

soundproof - massive structure

non-biodegradable and durable thanks to cement layer

ease of adjusting in plan

community participation

reduction of deforestation

decorative composition of different bags (colour and size)

EARTH BAGS



MATERIAL

HOW MUCH?

1 m of 30cm wall = **X ETB**
X

existing design with concrete hollow blocks

1 m of the wall = **550 ETB**

ROOFING
FLOORING
WALL
CEILING
FENCING
FURNITURE

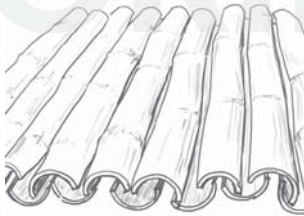


bamboo roof in Indonesia



bamboo flooring in Indonesia, ET

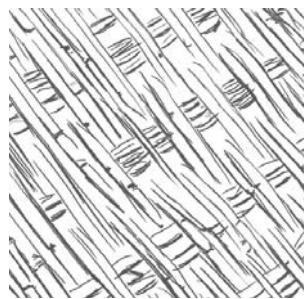
ROOFING



halved bamboo culms
bamboo shingles



bamboo shingles



FLOORING

CEILING

WALL

FENCING



FURNITURE



bamboo field in Bursa, Ethiopia



bamboo fence in Bursa, Ethiopia



ROOFING + CEILING + FLOOR + FURNITURE

MULTIPURPOSE MATERIAL

RISKS

biodegradable - subject to be attacked by fungi (rot, only when moist) and insects (beetles and termites)

cannot be used right after harvest; it must be treated with heat, smoke, or immersion

time to grow up the thick bamboo poles (3-6 years)

combustible

ADVANTAGES

based on traditional “gojo-beit” (in Amharic) / tukul (in Tigray) houses - skilled labour

local material - giant grass

bamboo planting prevents mudslides and erosion

bamboo requires few nutrients, it can grow in soil inhospitable to other plants

ease of cutting or adjusting dimensionally

community participation

multipurpose material

bamboo field in Bursa, Ethiopia



MATERIAL

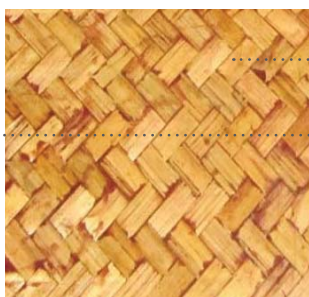
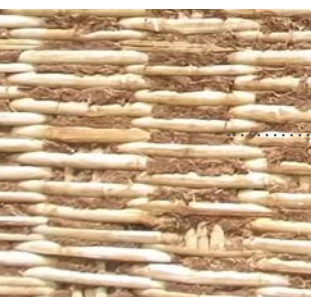
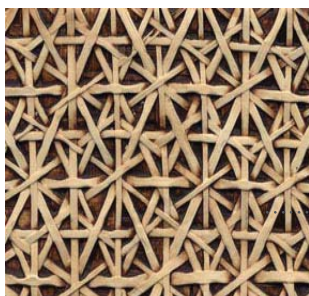
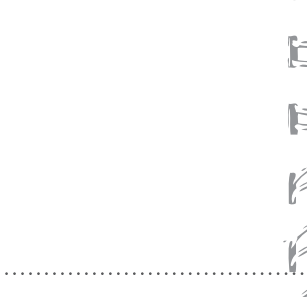
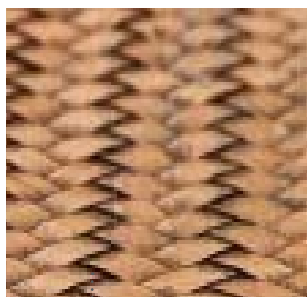
BAMBOO

USEFUL TIPS

<30 days ... good for eating
6-9 months ... good for baskets

2-3 years ... good for bamboo boards or laminations
3-6 years ... good for construction

>6 years ... bamboo gradually loses strength up to 12 years old



WORLDWIDE

WEAVING

ART

DECOR

APPEARANCE

TREND
STYLE

EMBROIDERY

SPIRIT
MODE

VA
RIE
TY

ORNAMENTAL BAMBOO

NATURAL BEAUTY

ORNAMENTAL BAMBOO



MATERIAL

ORNAMENT
ADORNMENT





bamboo field in Bursa, Ethiopia

COMEBACK REVER SION TRADITIONAL AND NONCHEMICAL METHODS OF TREATMENT

WHITE WASHING

culms are painted with slaked lime, thereby prolonging their lifespan by delaying and reducing the absorption of moisture while being a repellent against insects.

Although traditionally treated bamboo shows increased resistance to insects and fungi attack compared to the freshly cut culms, these methods do not however provide complete satisfaction in the long term.

CHARM

SOAKING IN WATER

freshly cut bamboo is stored either in water ponds or in running water for 3-4 weeks to leach out starch. When stored in water basins, water must be changed frequently to avoid fouling.

BAKING OVER OPEN FIRE

after applying oil on the surface of green round bamboos. This causes rapid drying of the outer shell and induces partial charring and decomposition of starch and other sugars.

APPEAL GRACE PURITY

OBSOLESCENCE YEARS AGE

CON SER VA TION

INNO CENCE

NA TURE

SMOKING

the procedure is carried out in chambers. Heat and toxic agents produced by smoke destroy the starch in bamboo making it immune to insect attack and also blackens the culms.

BAMBOO TREATMENT

TO MAKE IT LIVE LONG

RISKS

biodegradable - subject to be attacked by fungi (rot, only when moist) and insects (beetles and termites)

cannot be used right after harvest; it must be treated with heat, smoke, or immersion

deforestation (?)

time to grow up the thick bamboo poles (3-6 years)

combustible

ADVANTAGES

local material - giant grass

bamboo planting prevents mudslides and erosion

bamboo requires few nutrients, it can grow in soil inhospitable to other plants

ease of cutting or adjusting dimensionally

community participation

multipurpose material

attractive

USEFUL TIPS

<30 days ... good for eating

6-9 months ... for weaving

2-3 years ... for bamboo boards or laminations

3-6 years ... for construction

>6 years ... bamboo gradually loses strength up to 12 years old

MATERIAL



bamboo field in Bursa, Ethiopia



BAMBOO TREATMENT



BAMBOO SELECTION

use min. 3 years old bamboo

avoid bamboo with increased fiber moisture content

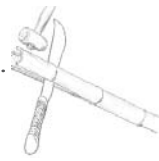
select the longest large diameter stick

PREPARATION

sizing

splitting and bending

waterproof coating



DESIGN PRINCIPLES

the longitudinal reinforcement should be about 5% of the concrete cross section

PLACEMENT

at least 4cm from the face of the concrete surface

the clear spacing between bamboo rods or splints should not be less than max size of gravels

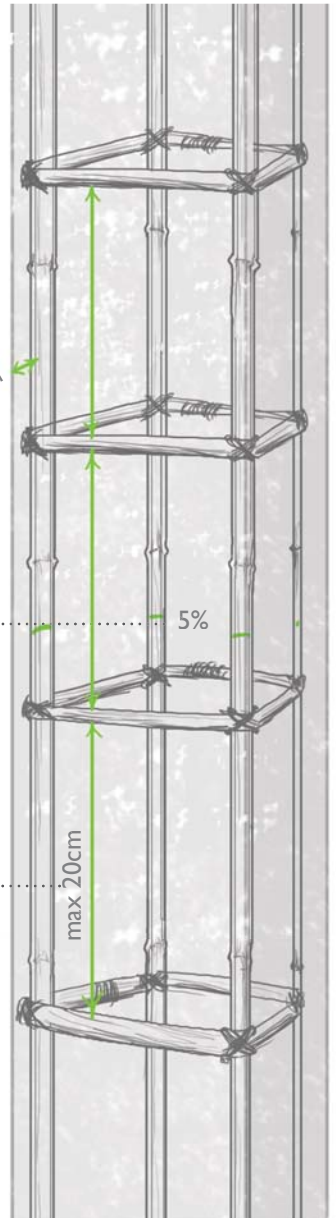
the ties can be made with vegetation strips

spacing of stirrups should not exceed 20 cm

min 4cm

5%

max 20cm



BAMBOO AS CONCRETE REINFORCEMENT

RISKS

bamboo soaks up the water in the concrete, causing the bamboo to swell then shrink, the process of which can break the concrete

adhesion between the bamboo and the concrete is poor >>> brushing

deforestation (?)

time to grow up the thick bamboo poles (3-6 years)

combustible

ADVANTAGES

local and accessible material

proved by experiments in US Naval Civil Engineering Laboratories in California already in 1965

cheaper than steel bars

bamboo can crack and deflect more than steel reinforcement - good elasticity

concrete - waterproof layer guaranteeing the protection of the bamboo

recommended for floorslabs as woven bamboo mesh

ease of cutting or adjusting dimensionally

community participation

COMPARISON

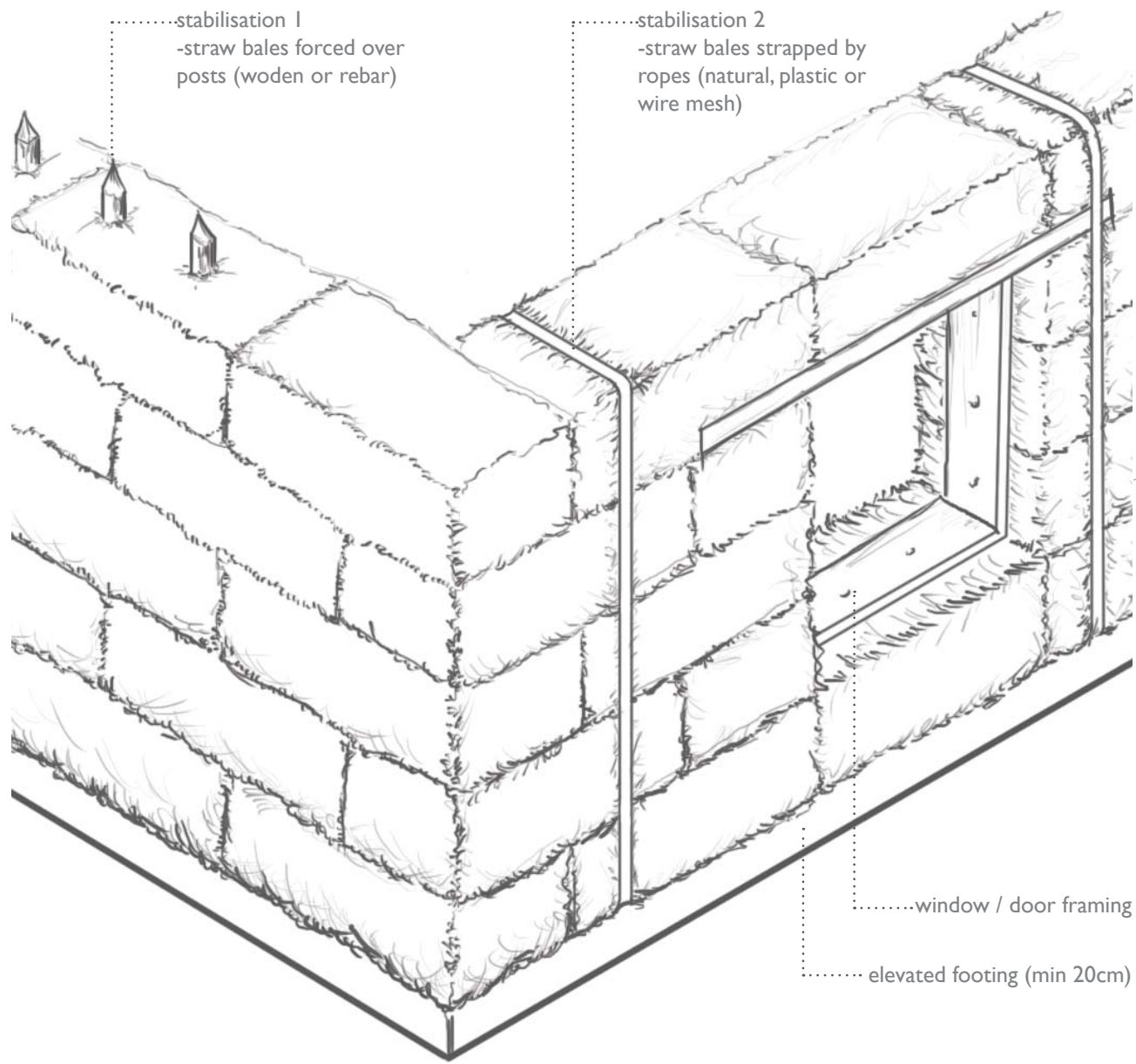
kN/cm ²	bamboo	steelSt37
elastic modulus	2000	21000
compressive strength	6,2-9,3	14
tension strength	15-38	16
bending strength	7,6-27,6	14
shearing strength	2,0	9,2

source: Deutsche Bauzeitung 9/97





sample of straw house



.....stabilisation 1

-straw bales forced over
posts (woden or rebar)

.....stabilisation 2

-straw bales strapped by
ropes (natural, plastic or
wire mesh)

.....window / door framing

.....elevated footing (min 20cm)

WHEAT//RICE//OAT//TEFF//RYE STRAW + ROPES

100% LOCAL

RISKS

biodegradable -> plaster to avoid moisture and weathering

susceptible to water damage if inadequately protected or maintained ("good boots and hat" - good foundation and overhanging roof)

thickness - suitable for external walls

impossible to be constructed during rain season

combustible >>> compress tightly and render with earthen or lime stucco

ADVANTAGES

easy and fast - less labour intensive and requires less skills and less expensive tool

local and completely recyclable material

good thermal and sound insulation

load bearing

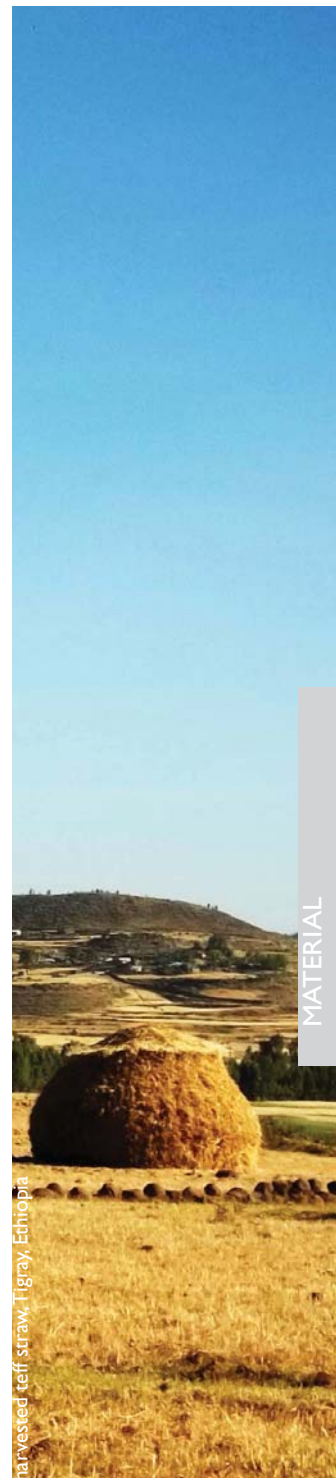
post-and-beam frame

reduction of deforestation

soundproof - massive structure

community participation

STRAW BUNDLES



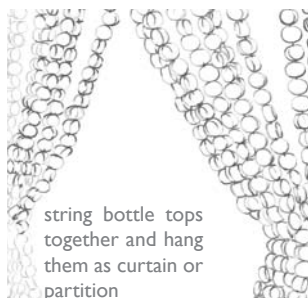
harvested teff straw, Tigray, Ethiopia

MATERIAL

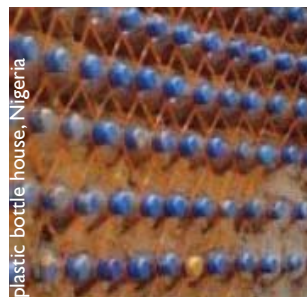
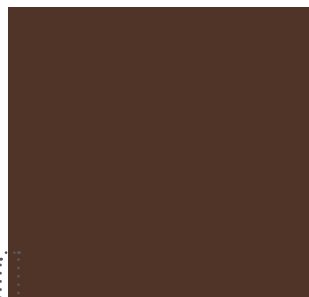


door curtain, Ghana

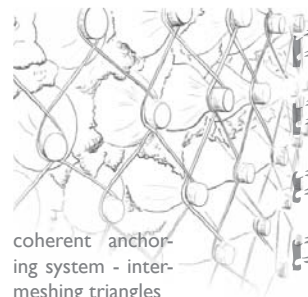
DECORATIONS curtains and railings



string bottle tops
together and hang
them as curtain or
partition



plastic bottle house, Nigeria

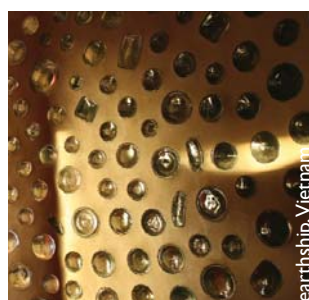
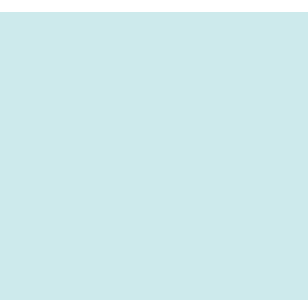


coherent anchoring
system - inter-
meshing triangles

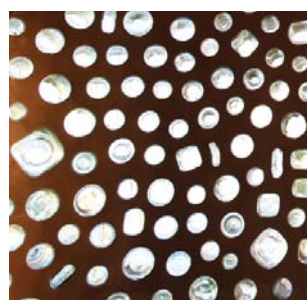
BRICKS

for walls and columns when
plastic bottles are filled with
soil, sand or rubble and sta-
bilised with ropes, wires,
chicken wires or cement

WALL DECORATIONS light tunnels and openings



earthship, Vietnam

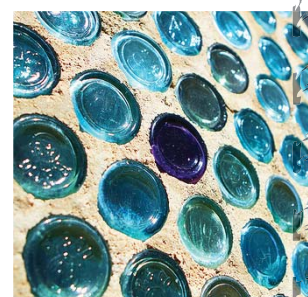


garbage decoration, USA

BOTTLES light conductors



garbage decoration, USA



PLASTIC//GLASS//BOTTLES//CAPS//STRAPS

GARBAGE THAT CAN BE USED

RISKS

bacteria contamination >>>
bottles have to be always
clean of food and dry before
the use

undecomposable and inde-
structible

when melted it releases a
compound gas - harmful to
health and environment

ADVANTAGES

low cost

non-brittle

easy to build and adjust

bearing heavy loads

solid, waterproof, windproof
and bulletproof...

awareness raising - makes
use of plastic bottles which
mostly end up in land fills

unconventional decoration

multi-purpose

WATER WELLS

GARDEN BEDS

FLOORS

for ground level - hard core

SEPARATIONS

transparent partitions



PACKAGING STRAPS

transparent partitions



plastic bottle experiments in MIT

REUSAGE

HOW MUCH?

plastic bottles are for FREE

X

existing design with con-
crete hollow blocks

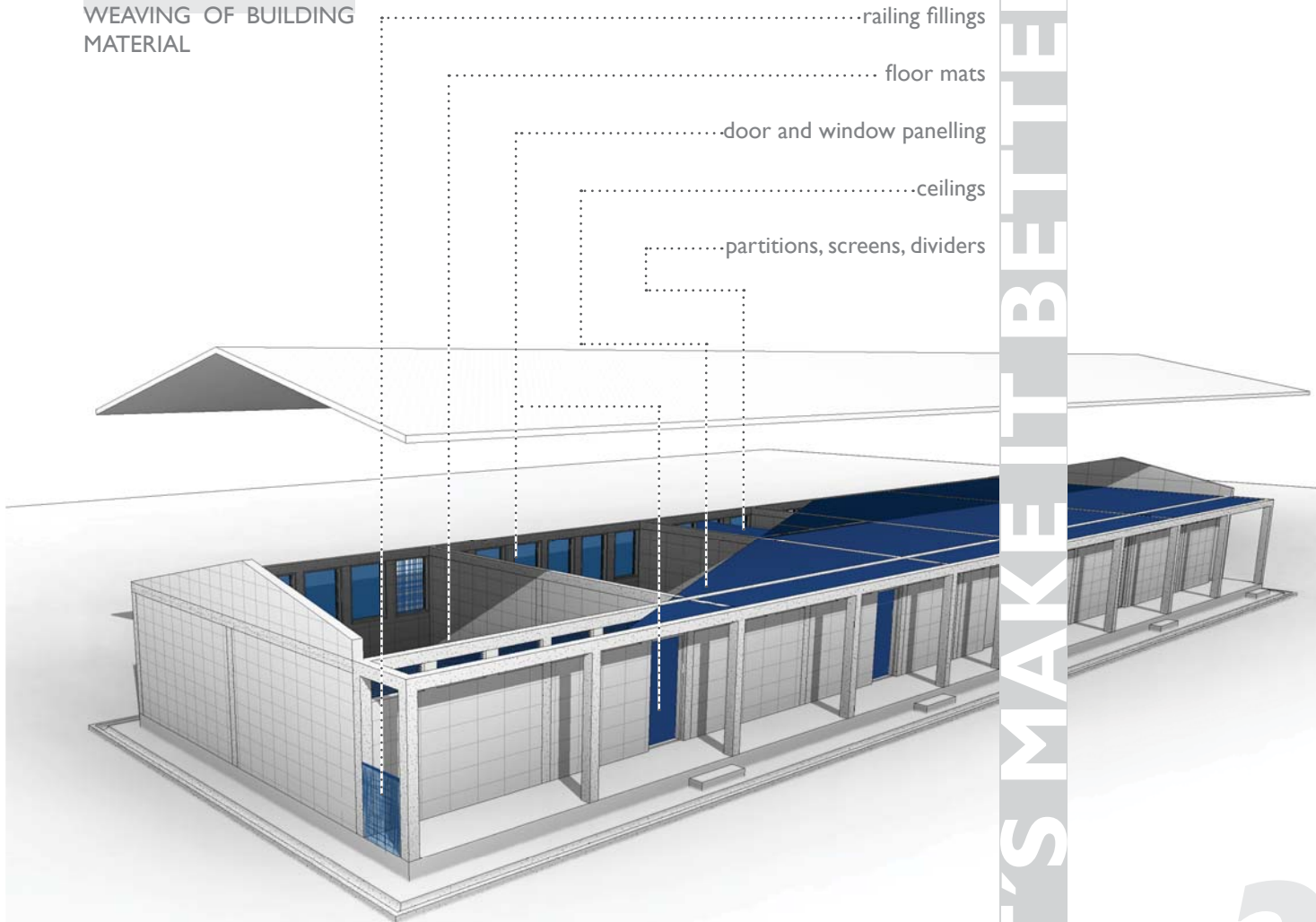
1m of the wall = 550 ETB



photo © masoro village project

ENCOURAGEMENT OF WOMEN TO PARTICIPATE IN SCHOOL CONSTRUCTION

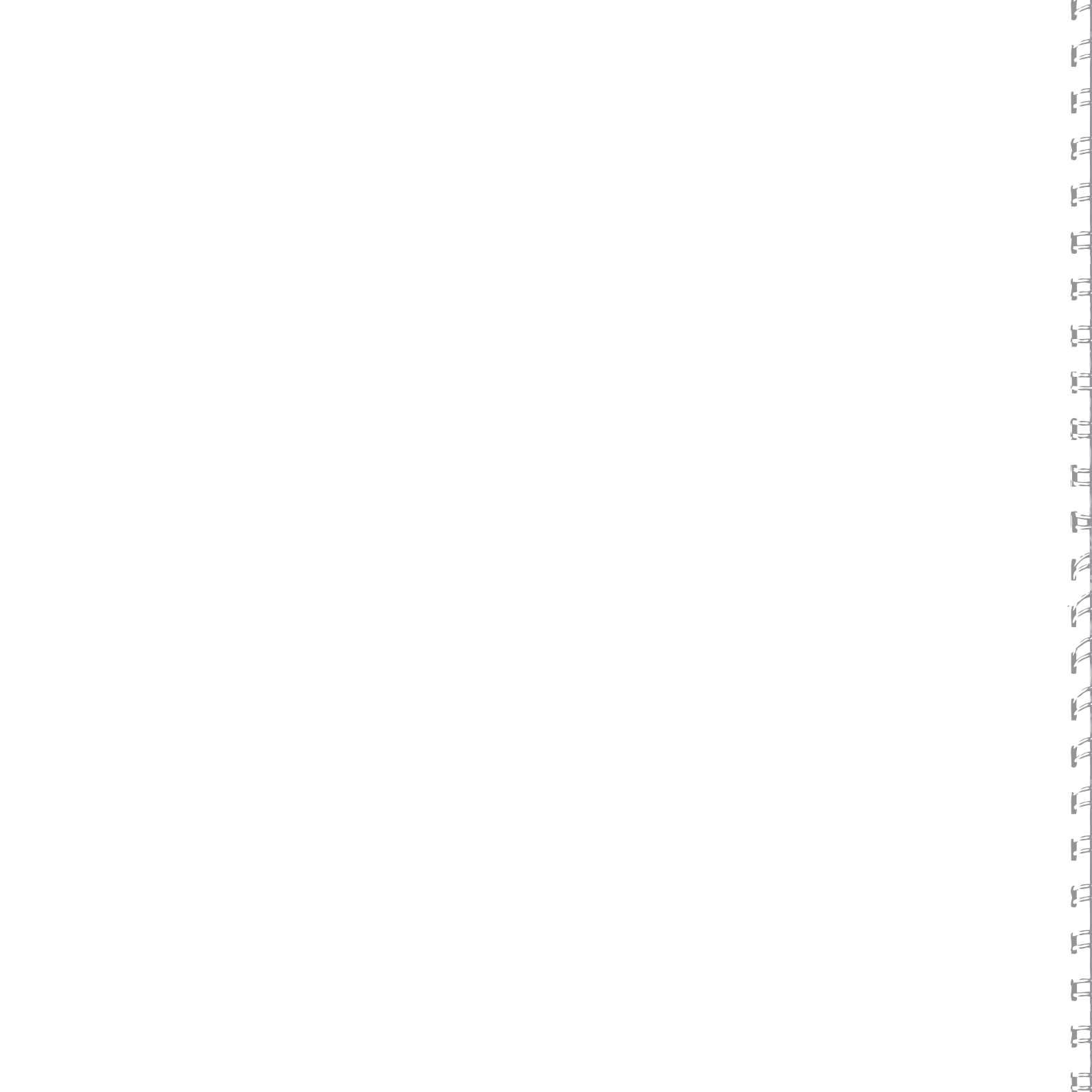
WEAVING OF BUILDING
MATERIAL

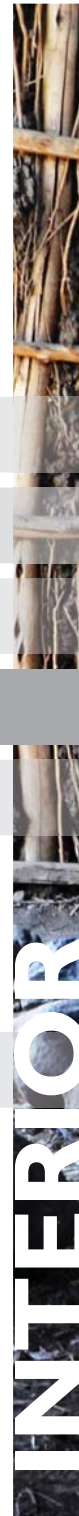


LET'S MAKE IT BETTER

MATERIAL

HOW MUCH?
social impact for FREE





INTRO

DISPO

CONSTRO

MATERIO

INTERIOR

EXTERIO

SITE

FRESH IDEAS

ELSEWHERE

INTERIOR

WELL BEING

SYSTEM
AUTHORITY
RESPECT
QUIET

CON
TRIBU
TION

Tigrayan girls

HEALTH

SAFETY

CONCENTRATION

ANXIETY?
COMFORT
GAME

CALMNESS

RELAX
ATION

KNOW
LEDGE

WELL BEING

DIGNITY

COGNITIVE AND AFFECTIVE WELL-BEING

TEMPERATURE

ACOUSTICS OF CLASSROOM >>>

ATTENTION OF CHILDREN

PHYSICAL COMFORT >>>

HEALTHY COGNITIVE DEVELOPMENT

LIGHTING QUALITY >>>

STUDENTS' CONCENTRATION

INTERIOR

EFFECTIVE BOREDOM?

ENTHUSIASM

DEPRESSION?

PLEASURE

COMFORT

TIREDNESS?

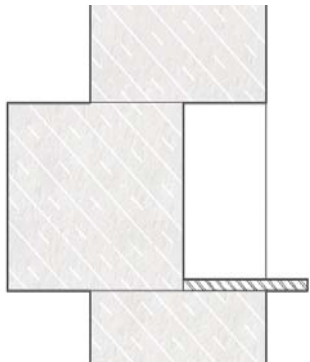
VIGOR

ACTIVITY
RESPONSIBILITY

ASPIRATION

NEEDS
CONTENTMENT

WHERE WE LEARN MATTERS



creation way of shelf-niché - pushing

INTEGRATED SHELVES

Simple classrooms do not offer any safe space for teaching aids and decoration (handmade by children themselves). Providing it with furniture might be expensive and space-consuming. The solution is to create gaps and niches in walls (block or wattle'n'daub system).

BLACKBOARD

plastered with mortar on the wall, smoothed till perfection, painted in black. Not limited in size and shape, it may be combined with niches to create pockets for chalks and sponges. Bottom edge has to be provided with a drip to protect a wall from leaking watter.



drip to protect a wall from leaking watter

FRAMES FOR POSTERS

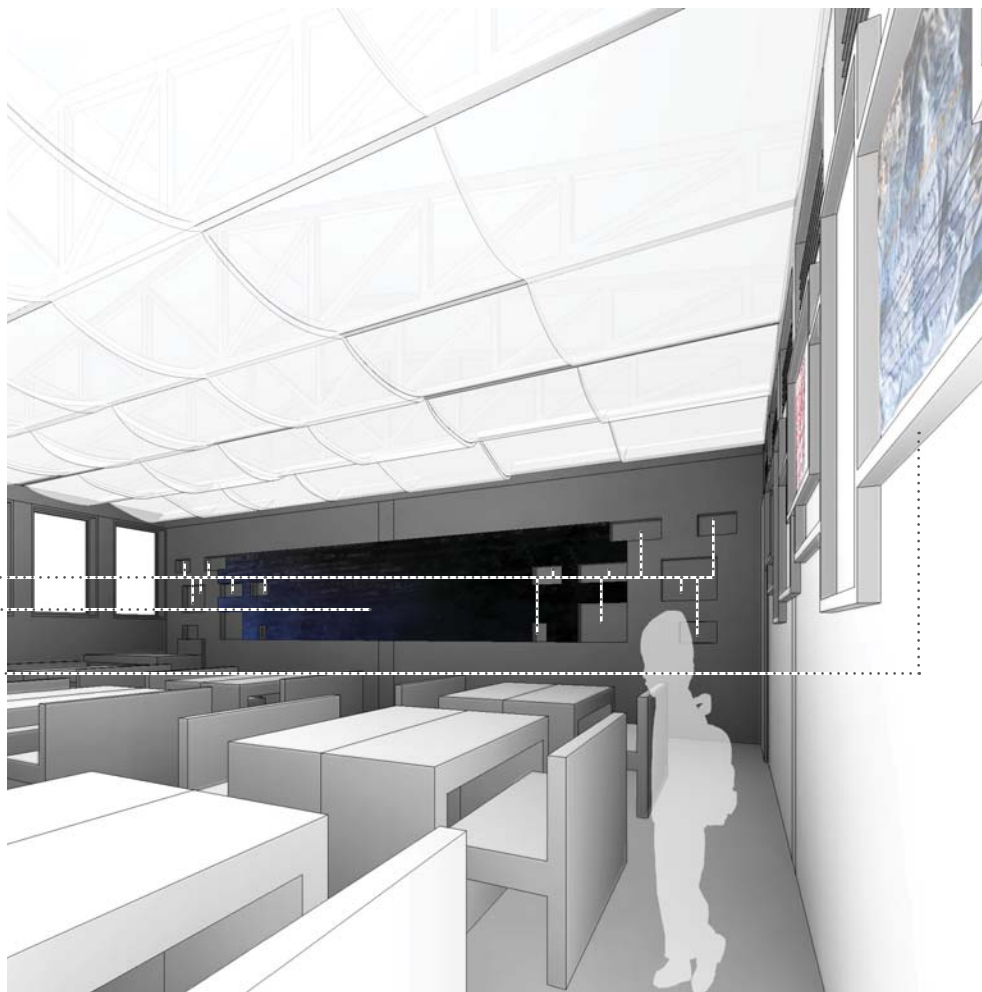
Many teaching aids, charts and posters are needed, but they might be worn by use and behavior of distracted children during breaks. In-built frames/boards (mortar or wood) protect posters from careless handling.

ON THE WALLS

ON THE WALLS

PRINCIPLES

acoustics of room >>>
 attention of children
 physical comfort >>>
 healthy development
 lighting quality >>>
 students' concentration



ON THE WALLS

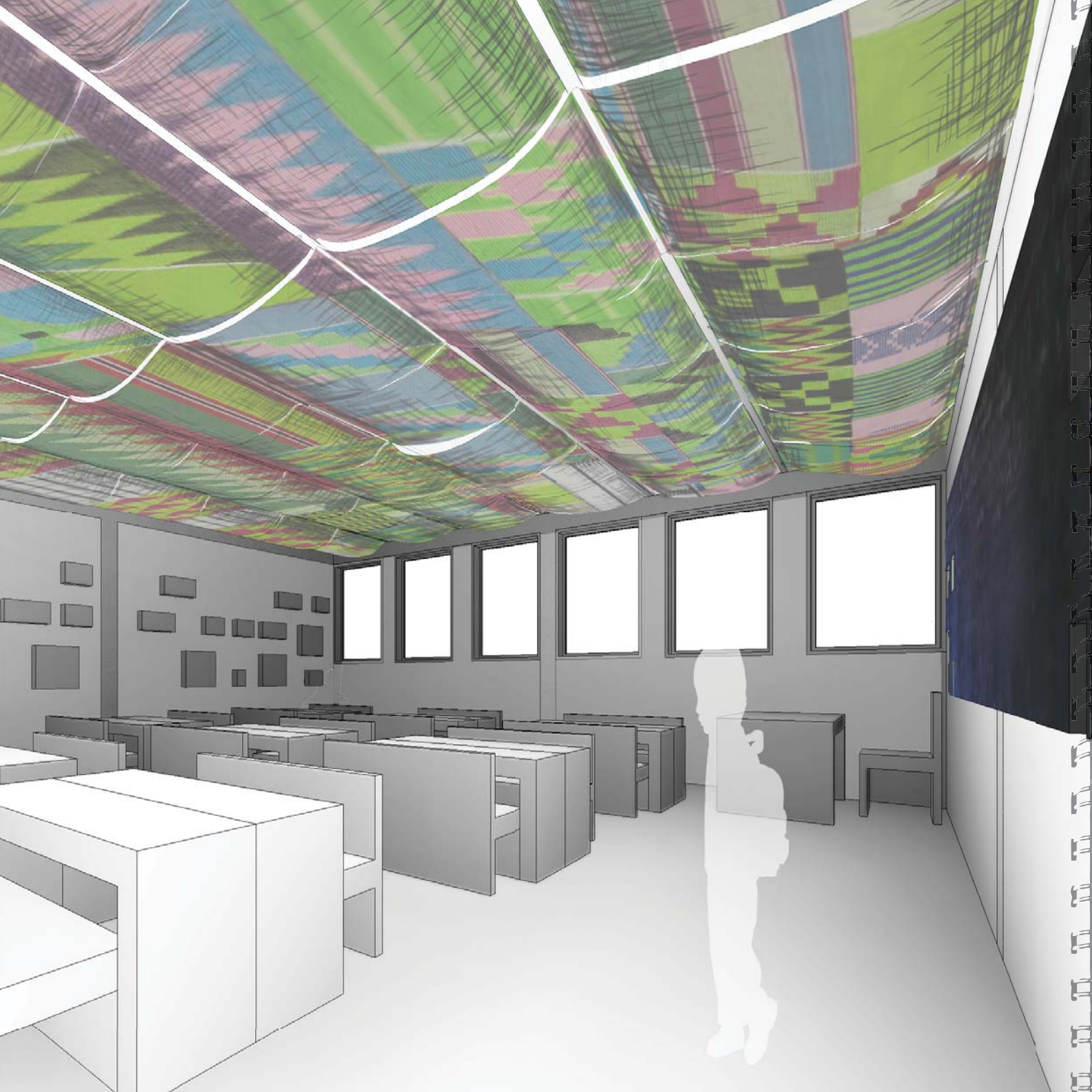
INTERIOR

HOW MUCH?

plastered black board
 = XXX ETB/m²

X

existing design with chip-
 board installation suscep-
 tible to deformation
 = XXX ETB/m²



CEILING CANOPY

HEAD IN CLOUDS

RISKS

susceptible to the moisture
- > impermeable roof structure needed

maintenance -> regular
cleaning and flapping especially in dusty environment

ADVANTAGES

better acoustics - it absorbs
undesirable reflections

joyful environment - colours
should be light, relaxed, not
dark, gloomy or dull, but
based on local preference

local material and labour -
“patchwork” attitude - assembling of collected pieces



cloth canopy - ceiling in Moroccan market



INTERIOR

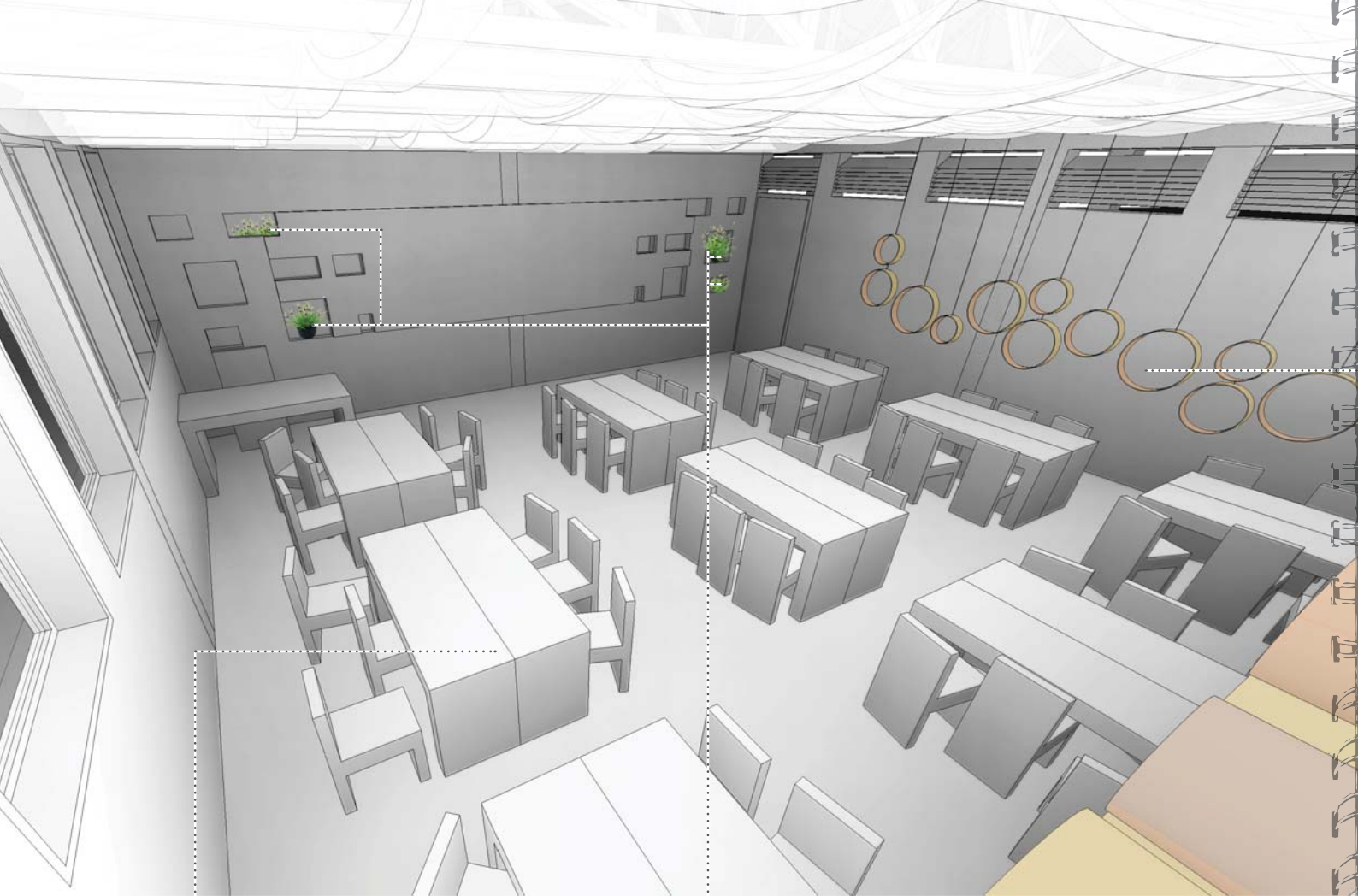
HOW MUCH?

cloth canopy ceiling
= XXX ETB/m²

X

existing design with painted
chipboard ceiling
= XXX ETB/m²

CEILING CANOPY



ROOM LAYOUT

children can work alone or in groups. Chairs or stools are easier to move around than benches. But benches can accommodate more children at once when children number is higher than expected.

TOO LITTLE STRUCTURE
CHAOS
 TOO MUCH STRUCTURE
BOREDOM

GREENARY

Addition of plants to the classroom. It might be used for decoration, or for a science project. Students can take care of the plants as a classroom job. To avoid damage, plants have to have its own place, p. ex. niché,...

ERGONOMETRIE

The development of gross motor skills is as important as the one of fine motor skills. The physical growth is affected by furniture that should be designed in accordance with their age - different size for different grade.

FURNITURE

AGE N' NEED APPROPRIATE

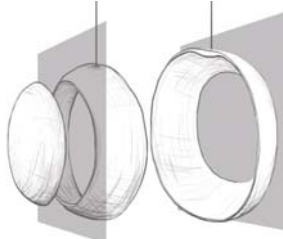
STORAGE

Shelves and facilities in the classroom for children's class projects, artwork and bags are necessary – even if just a tiny space.

It supports the feeling of ownership and care!

CALABASH

Traditional material used for dishes and musical instruments in southern regions. Often it serves as a food container, why not to employ it as suspended container for children's stuff...

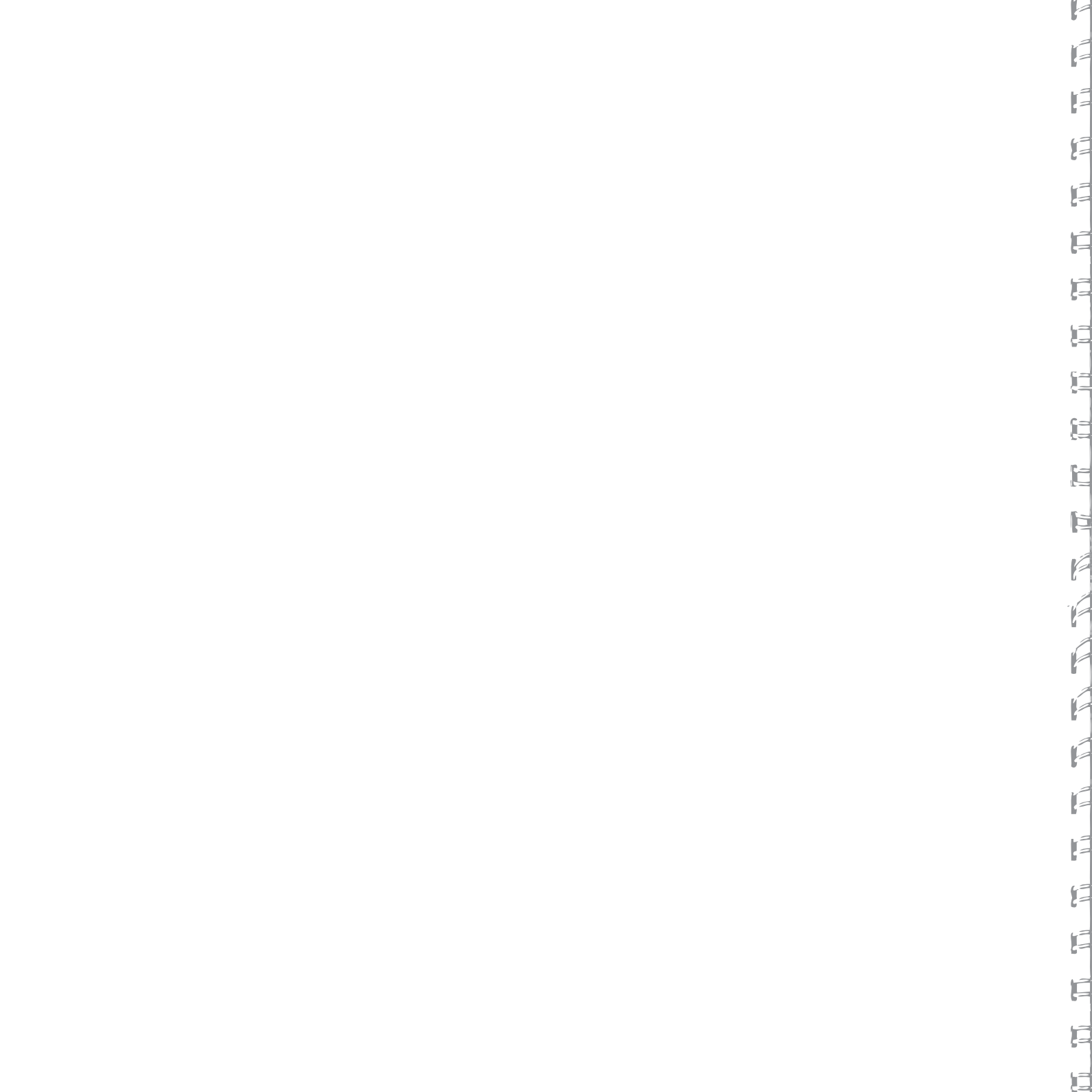


calabash on market, Ethiopia

FURNITURE



INTERIOR



INTRO

DISPO

CONSTRO

MATERIO

INTERIO

EXTERIOR

SITE

FRESH IDEAS

ELSEWHERE

EXTERIOR

IMPRESSION

LEAVES

OPUNTIA

BRANCHES

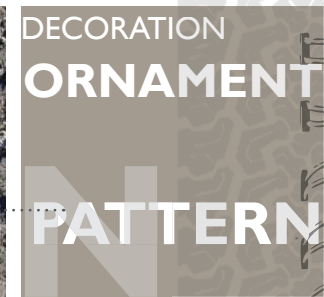
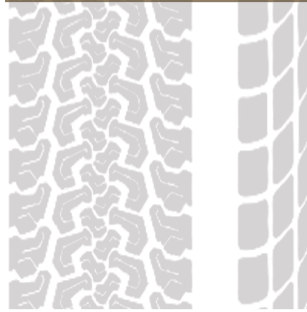
WRINKLES

HANDS

PEBBLES TYRES

BOTTLES CEREALS

FABRICS



LEAVES

VEGETATION

NATURE

SIGNAGE

DECORATION

ORNAMENT

PATTERN

INSPIRATION

APPEARANCE

GAME

CREATION

RE
PE
TI
TION

PATTERNED SURFACE

IMPRESSION

ADVANTAGES

it is possible to imprint anything to be found in surroundings...

EITHER

object is attached to the formwork during concrete pouring

OR

object is impressed on fresh layer of final plaster coating

PATTERNED SURFACE



EXTERIOR

concrete reliefs, arch. LeCorbusier, Firminy, France

HOW MUCH?

for FREE

CANVAS
SCREEN
VISUAL
TOOL

INTERACTION

**DIRECT
IMPACT**

IMMEDIATE

ORDER

PARTICIPATION
**EXPE
RIENCE**

ORIENTATION

The wall decoration contributes to the space organisation - children and visitors understand what the building, classroom or open space shelter serves for, who the space is meant for and what the mode of use is.



PAINTINGS AND COLOUR DECORATION

RISKS

it might seem too simplifying and conceptual >>> the motive has to be carefully chosen in cooperation with teachers and local educational board

preparation phase shouldn't be neglected to avoid subsequent imperfections - it is necessary to clean the wall, fill the holes and paint the undercoat

it is advised to provide teachers with brief training about experimental teaching with visual teaching aids

ADVANTAGES

syllabus-related decorations
- technique already in use - skilled labour

job opportunity for local artists

didactic use - permanent teaching aid solving lack of visual tools

usable for existing schools - maintenance of old walls

opportunity to involve children to participate and learn from experience

long-lasting - the paintings can stand for 10 years with simple maintenance and tiny corrections

economic aspect - savings on posters and paper teaching tools

maintenance aspect - teachers do not stick their DIY teaching charts on walls and walls remain decent

positive impact on enrolment and attendance



wall paintings in Bursa, SNINPR, Ethiopia



wall paintings in Bursa, SNINPR, Ethiopia

EXTERIOR

PAINTING AND COLOURS

HOW MUCH?

one external painting
XXX ETB/1,5m x 1,5m

more inspiration - interior project
Happy Classrooms by boNGO

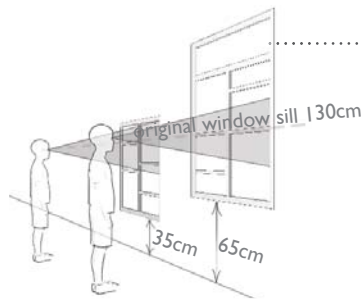


COMPOSITION OF FACADE ELEMENTS

RISKS

cost increasing for concrete skeleton 'n' blocks system because of need of supplementary lintels

intensive supervision of quality and precision so that prefabricated opening (window and door) panels with glass fillings can be installed



ADVANTAGES

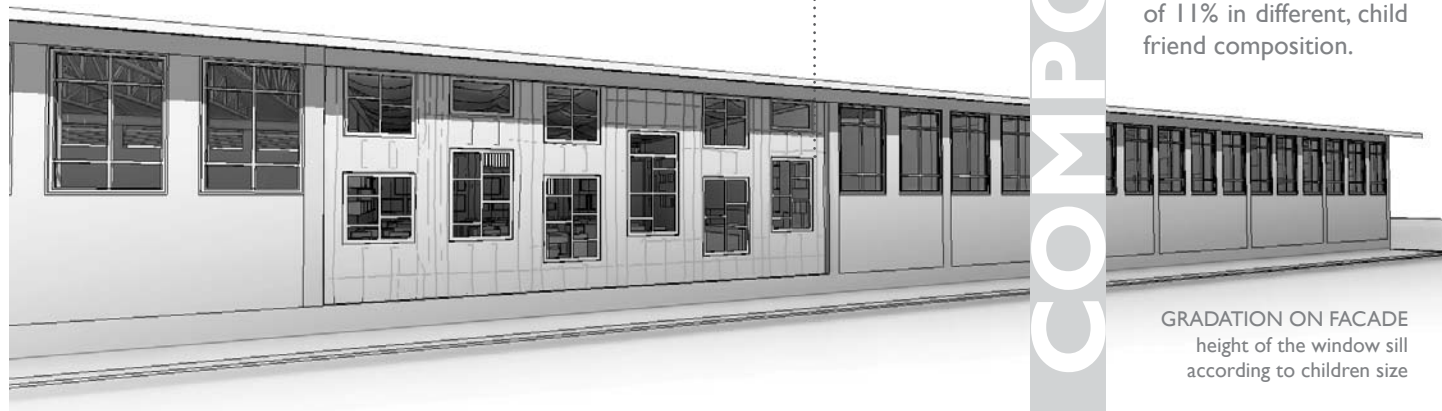
removing monotony and boredom, offering a room for playfulness

suitable for wattle and daub system that is variable because of very small distance between posts and cross-bars

child-friendly and made-to-measure - respecting the size of children, offering nice view to them

entertaining, attractive and worth exploring - positive impact on enrolment and attendance

transparence and safety



EXTERIOR

COMPOSITION vs. ORDER

To ensure adequate daylight the window area should be a minimum of 20% of the classroom floor area.

For the case of PIN schools it is 11%. The design of scattered windows uses the same area of 11% in different, child friend composition.

GRADATION ON FACADE
height of the window sill
according to children size



REVELATION OF STRUCTURE ELEMENTS

BEAUTIFUL UNVEILING

POSSIBLE USE

partitions and diving walls

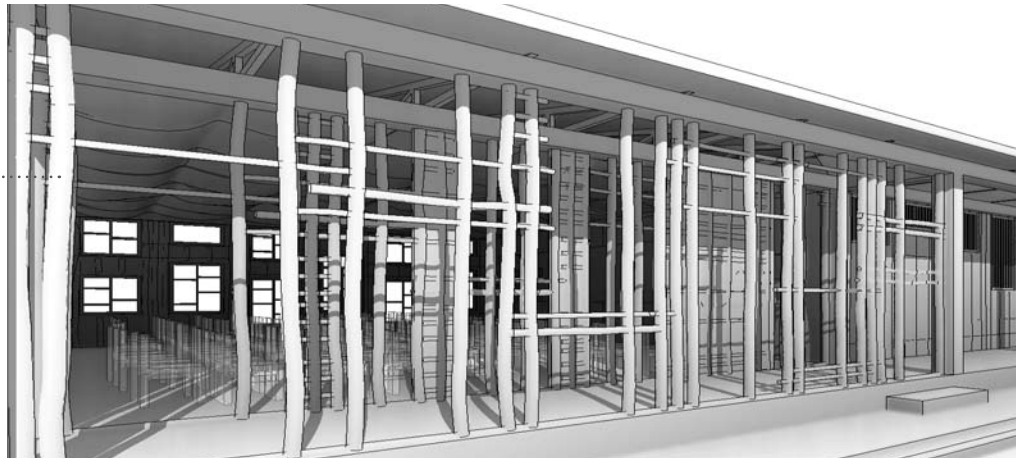
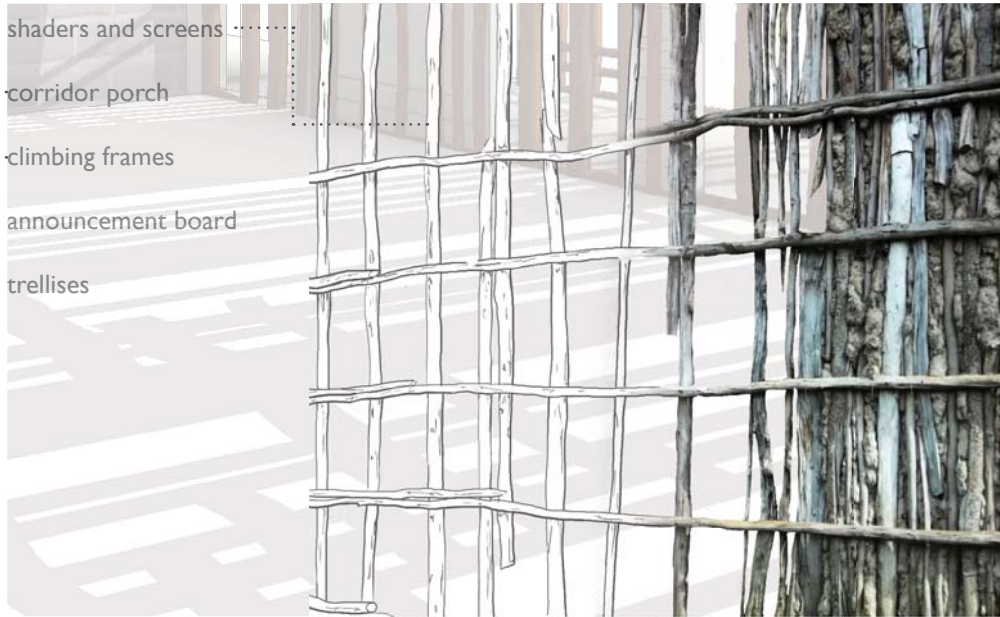
shaders and screens

corridor porch

climbing frames

announcement board

trellises



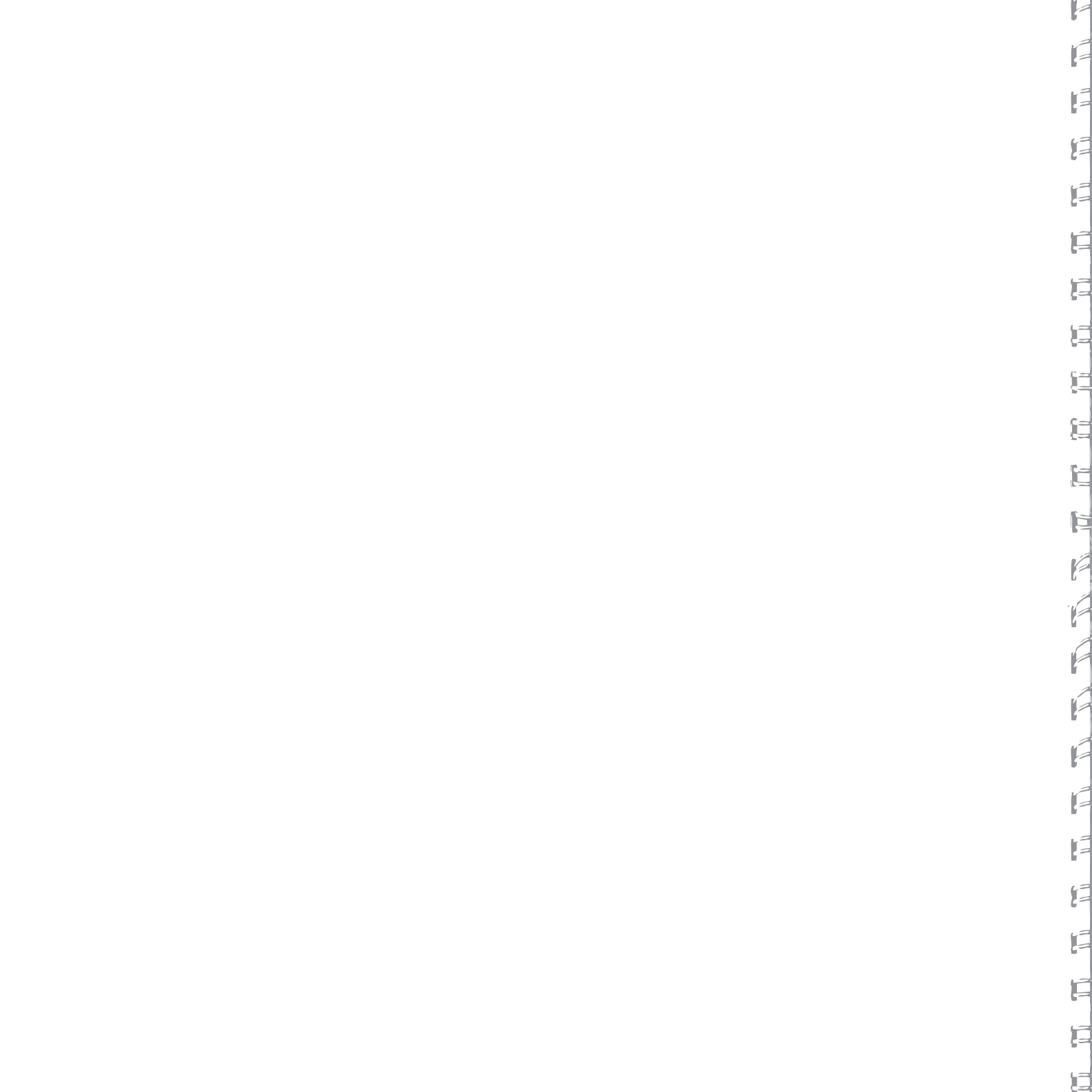
HOW MUCH?

wattle 'n' daub structure
without mudding
XXX ETB/1m

REVELATION



EXTERIOR



INTRO

DISPO

CONSTRO

MATERIO

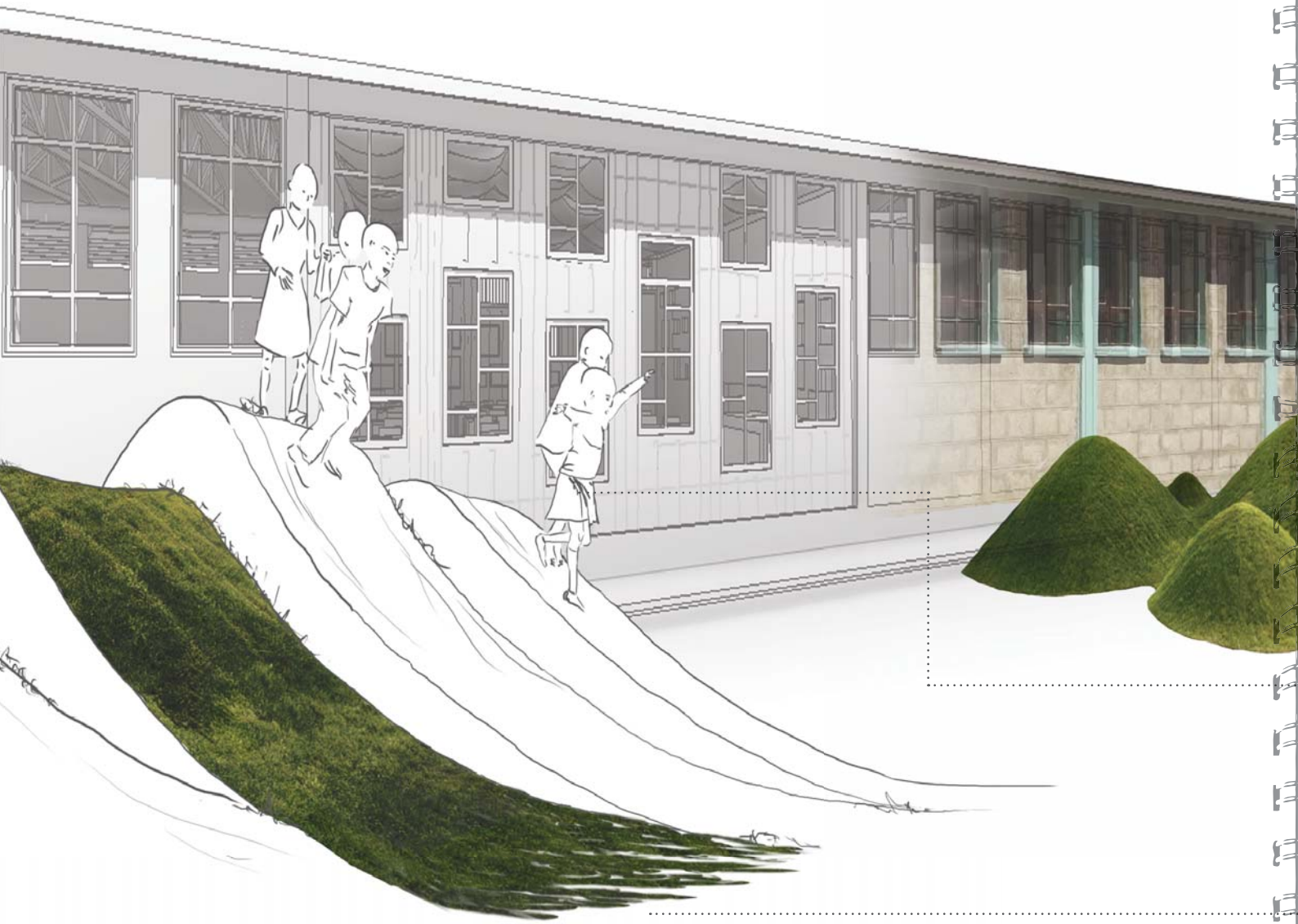
INTERIO

EXTERIO

SITE

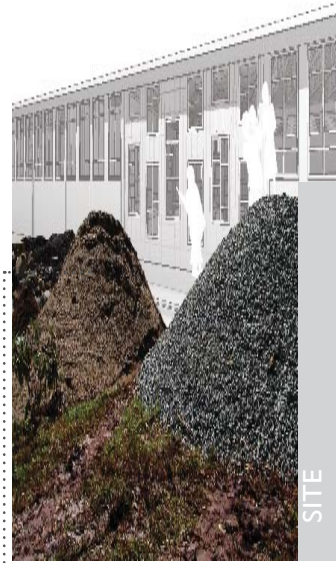
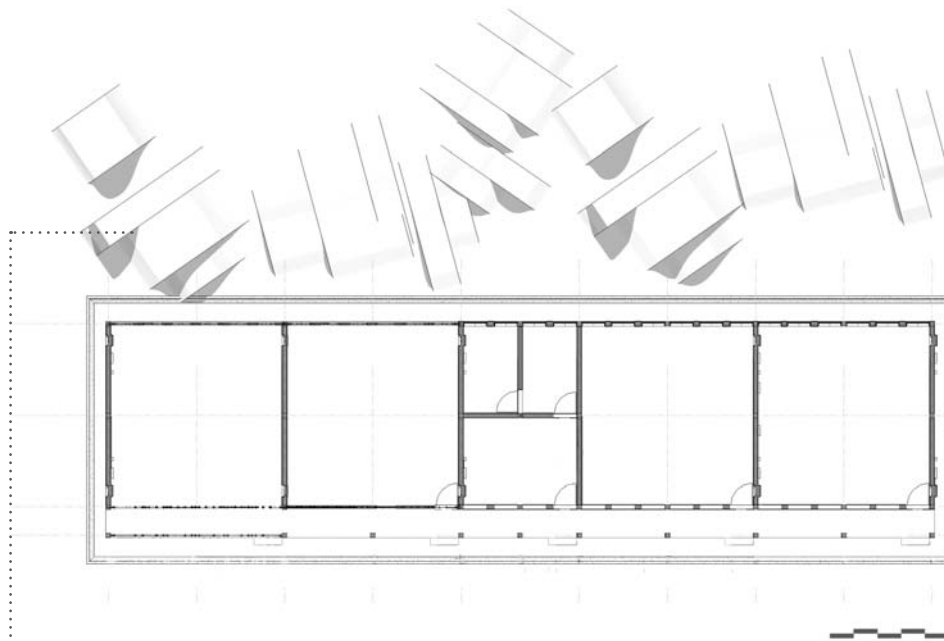
FRESH IDEAS

ELSEWHERE



LANDSCAPING

TERRAIN WITHIN REACH



ADVANTAGES

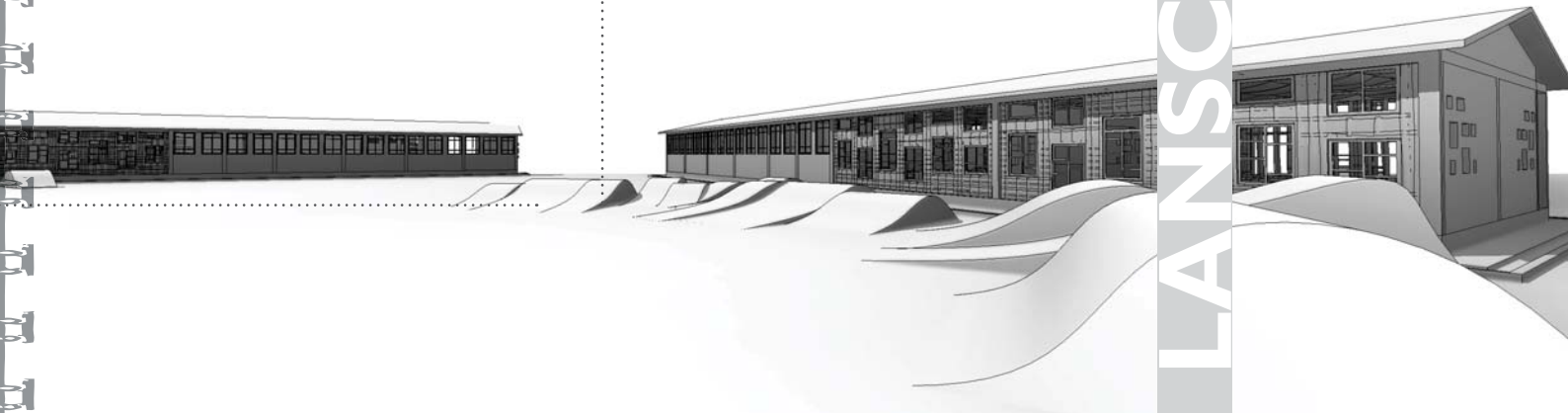
harmonises the building, school ground and whole environment

use of extracted soil and construction rubble

material stockage for future construction - cost-saving

supports the physical development of children

LANDSCAPING



GARDEN

FRIENDS

RELAX

ACTIVITY



S P A C E
GREEN



urban gardening in NYC



urban gardening in NYC



urban gardening in NYC

recycle huge volumes of tree trimmings, leaves, grass clippings, and other organic wastes back into the soil.

Useful leisure time activities supporting community safety and participation.

**GARDENS
FIELDS
COMPOST**

HORTI
CULTURE

**PRACTICAL
MATH
SKILLS**

**FOOD
SECURITY**

**ALLEVIATE
HUNGER**

CONCENTRATION

**TEACHING
AID**



gardening in Berlin



gardening in Columbia

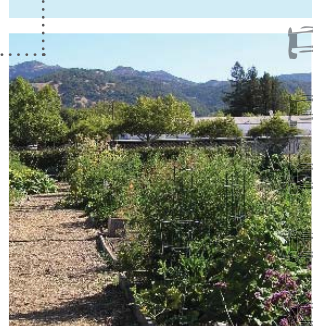
HOME
**PROPERTY
VALUES
OWNERSHIP**

**HARVEST
F O O D
PRODUCTION**

GREEN

COMMUNITY

RECYCLE



SUSTAINABLE GARDENING

SELF SUFFICIENCY

RISKS

“you cannot do it alone” - active participation of community is needed

well determined roles - to avoid problems with organisation, responsibility distribution and safety

problems of distribution - community gardens foster the development of a community identity and spirit

problems with poor harvest - distribution and drawing a lesson from it

ADVANTAGES

cultivates relation between the school and the community

harvested fruit and vegetables may be used for the midday meal

children's participation in the maintenance promotes a sense of ownership

edible plants in school compound teach children food production and conservation

environment consciousness - having garbage disposal, compost system, dustbins and brooms contributes to environmental education

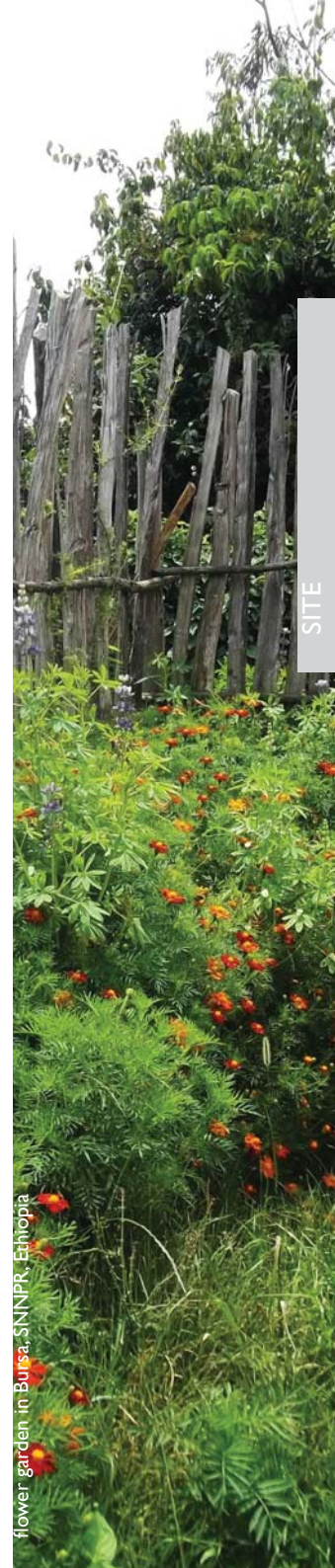
supports reuse and sustainable habits

harmonises the building, school ground and whole environment

use of natural vegetation strategically planted to improve thermal comfort and to reduce glare (direct light and reflection) in building interior

GARDENING

flower garden in Bursa, SKNIPR, Ethiopia



PLAYING

FRIENDS
RELAX
ACTIVITY



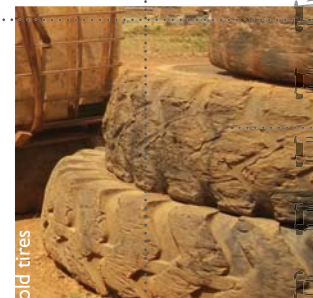
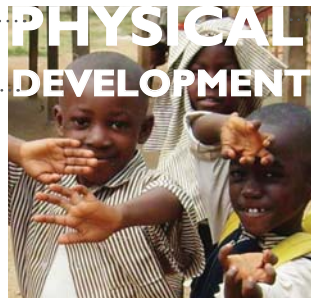
MAZE

CLIMBING
FRAMES



Open spaces can be designed as play yards for sports, school gardens, verandas for outdoor learning activities, open performance spaces, wide corridors and courtyards, trellises, canopies, shaded pavilions, niches and alcoves.

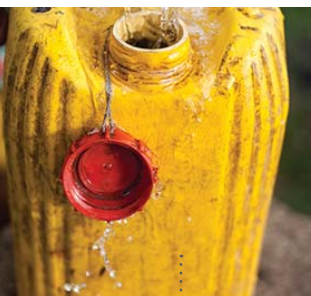
**PHYSICAL
DEVELOPMENT**



SWING

**SEESAW
SLIDE**

TOGETHER



**BENCHES
PAVILION**

Useful leisure time activities supporting community safety and participation

**E X T R A
CURRICULUM**

GAME

JERRYCANS

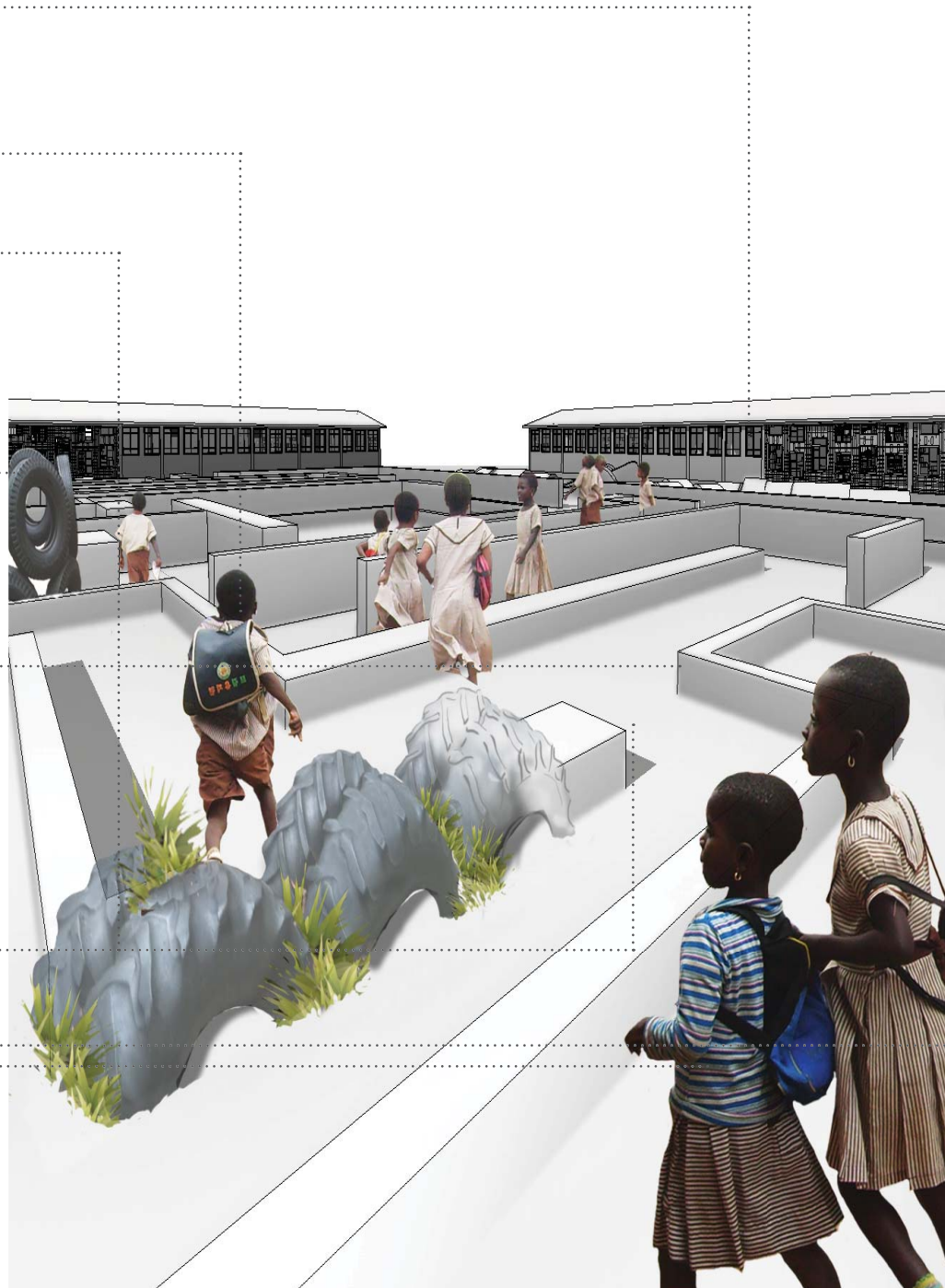
JOY

In community friendly schools the people are allowed to use some of these spaces after school hours for town meetings, local gatherings and other events.

CREATION

LABYRINTH

LITTLE PLAY MAZE



LABYRINTH

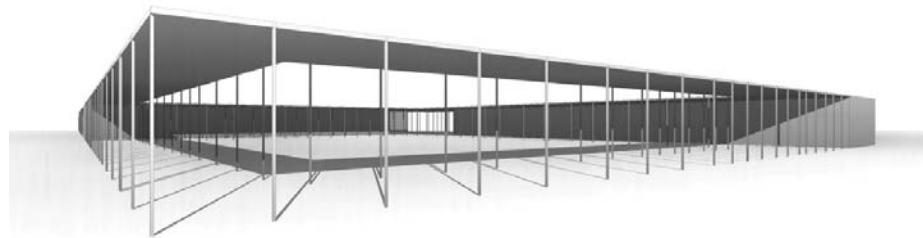
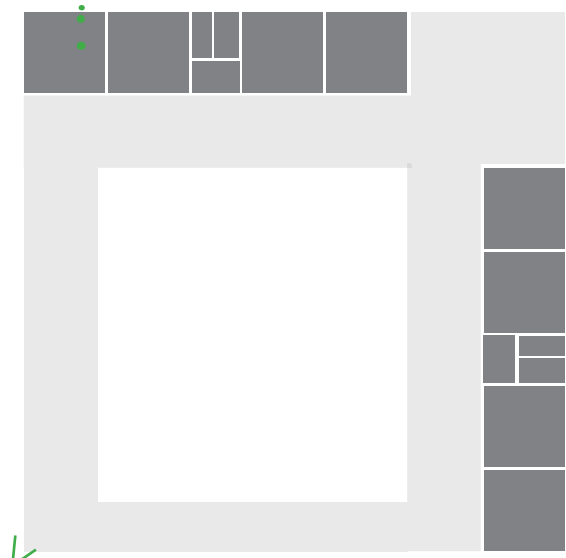
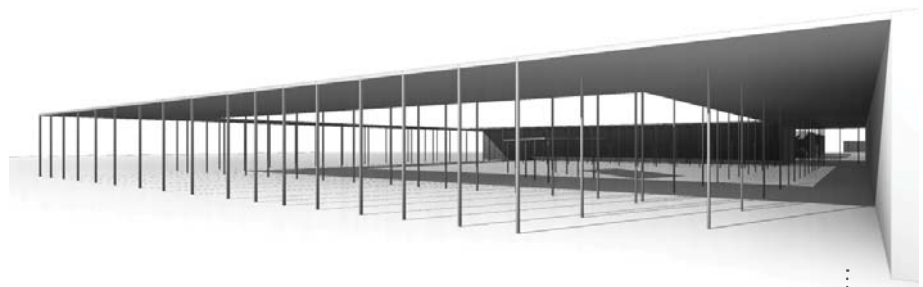
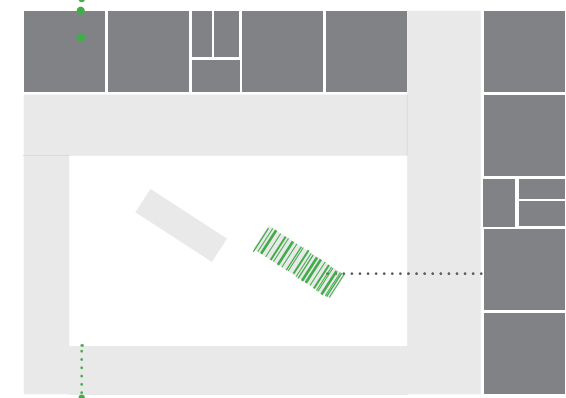
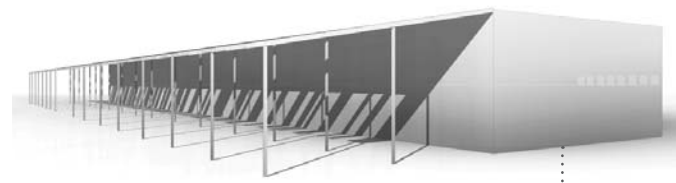


SITE



solid space 

roofed space 



INFORMAL SCHOOL EXTENSION

TRANSITION

INFORMAL TRANSITION

SITE

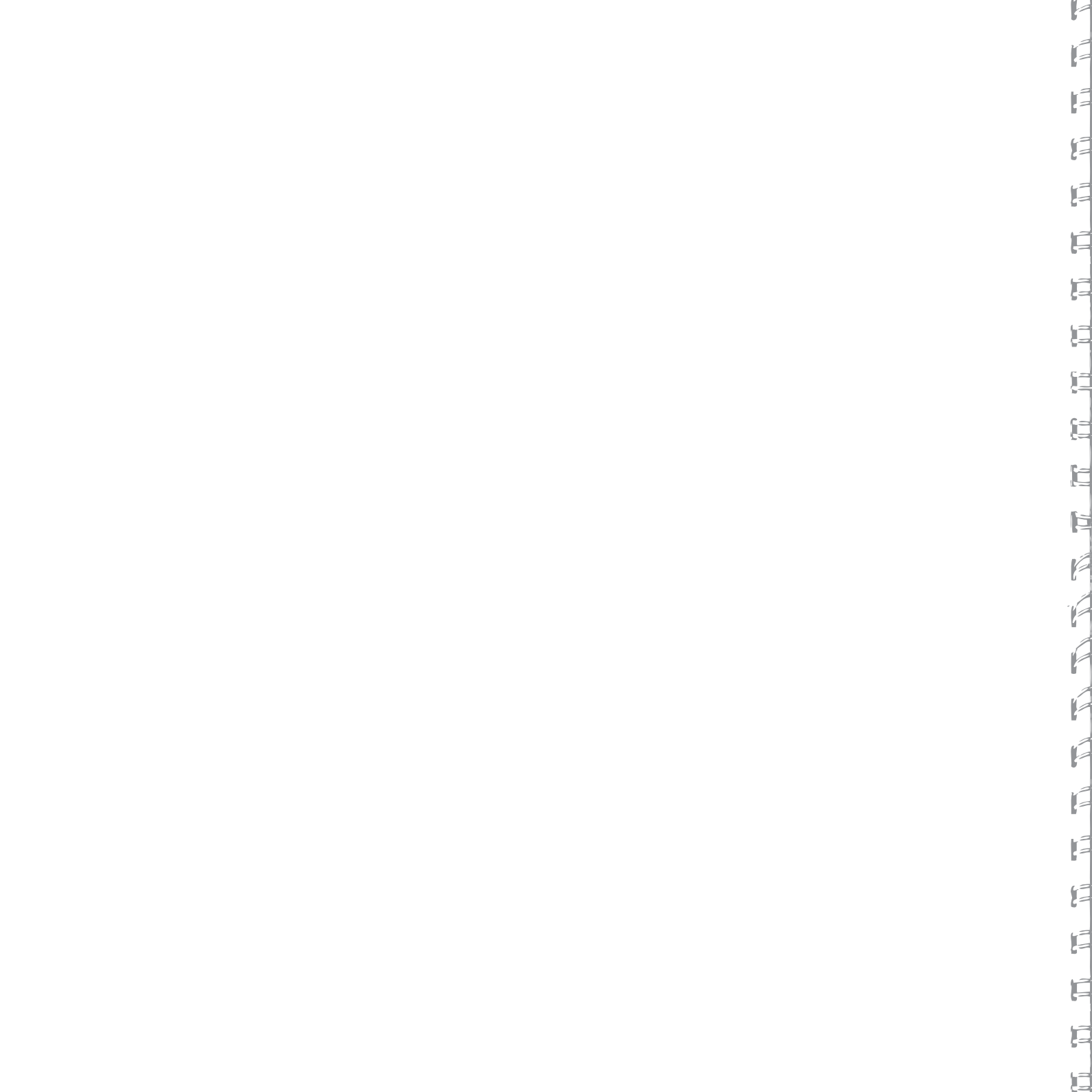


non-formal shelter.....

weather-protected transition spaces between inside and outside include porches and decks of minimum of 1.5m in depth

overhangs and porches encourage learning activities in the outdoors with visual and aural aspects





FRESH IDEAS

INTRO

DISPO

CONSTRO

MATERIO

INTERIO

EXTERIO

SITE

FRESH IDEAS

ELSEWHERE



brainstorming in MIT

EiT-M

Ethiopian Institute of Technology – Mekelle
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Mekelle University
መቼል ዩኒቨርሲቲ

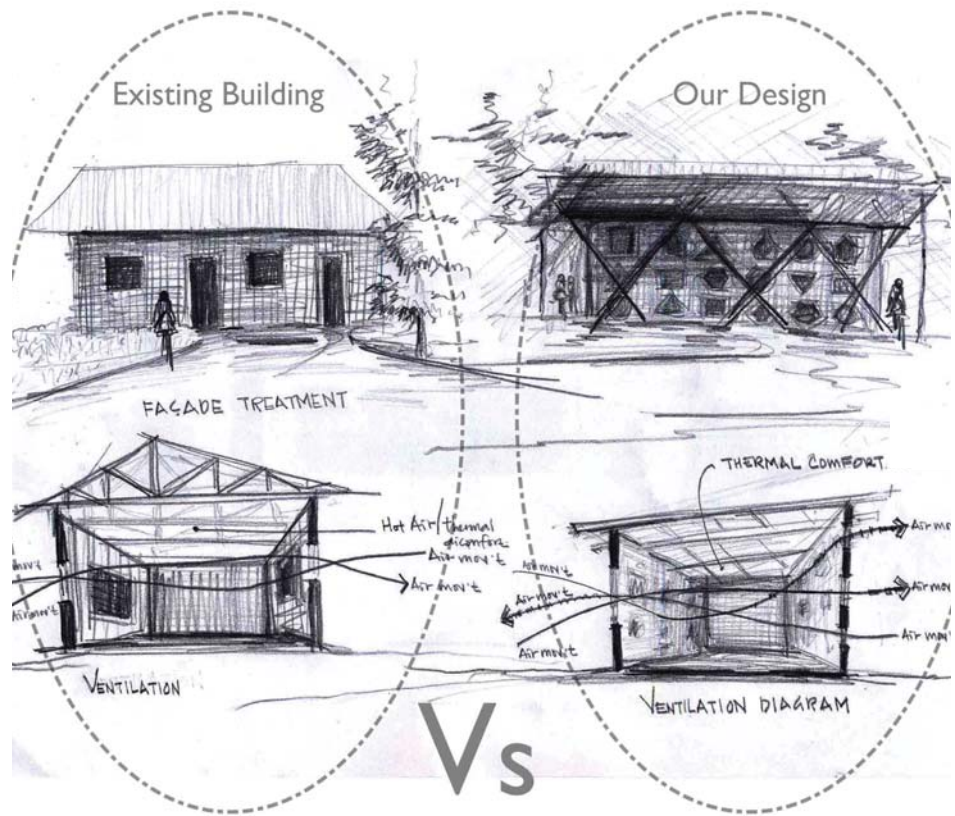
The Ethiopian Institute of Technology in Mekelle is part of Mekelle University that has short but complex history. The city of Mekelle is situated in northwestern Tigray region, in the region rich in cultural and architectural heritage. The Institute offers various programmes – architecture and urban planning among them.

The contact initiation intended to diversify inputs for the architectural research that is essential for the innovation cooperation with the PIN. When got known the situation we have decided to cooperate directly on academic level.

Together we have organised workshop called “Think globally, act locally” for a hundred of 4th year architecture students. The workshop aimed to find sustainable ways how to deal with schools and educational buildings, how to make the surroundings inspiring and motivating, how to think progressively and alternatively, how to engage community, its hospitality, how to contribute to the development...

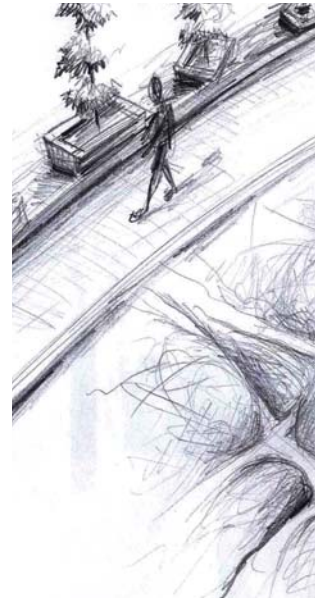
The best results and original students ideas are gathered in the following chapter.

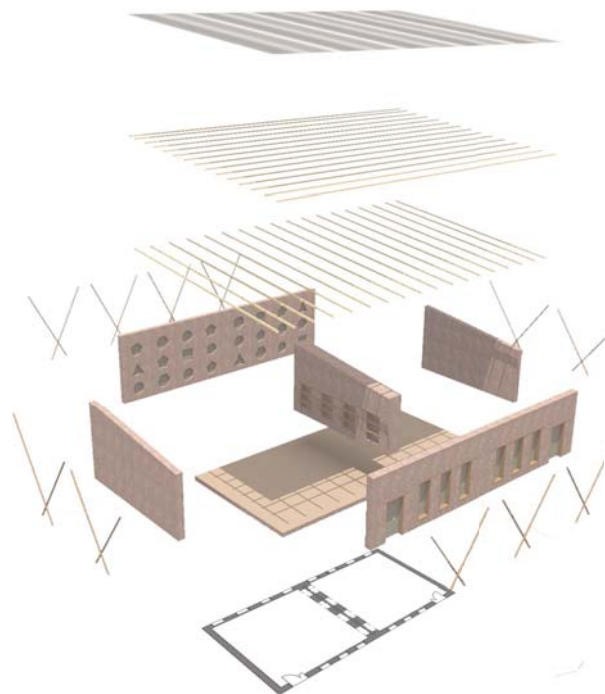
LEARNING THROUGH EXPERIENCE



Thermal Disomfort

Thermal Comfort





The design intention is learning from experience when it is needed to shape the behavior of students at their early stage of acquiring knowledge. Learning should not fix on teacher and black-board. Rather it is needed to provide them with knowledge by built environment psychologically and psychically.

The use of different geometrical shapes and colours, atypical structures and materials creates the environment inspiring for children, playful and comfortable.

The design key words are sustainability, innovation and cost effectiveness, local workmanship and comfortable environment.

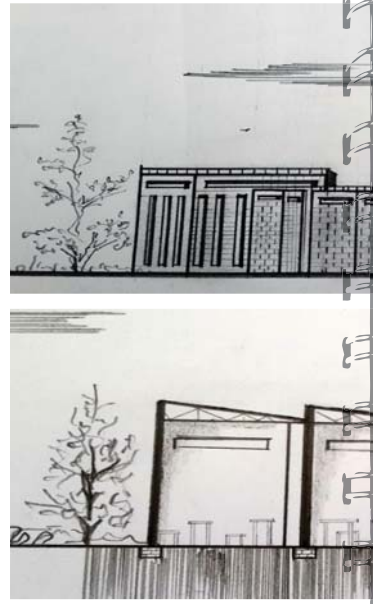
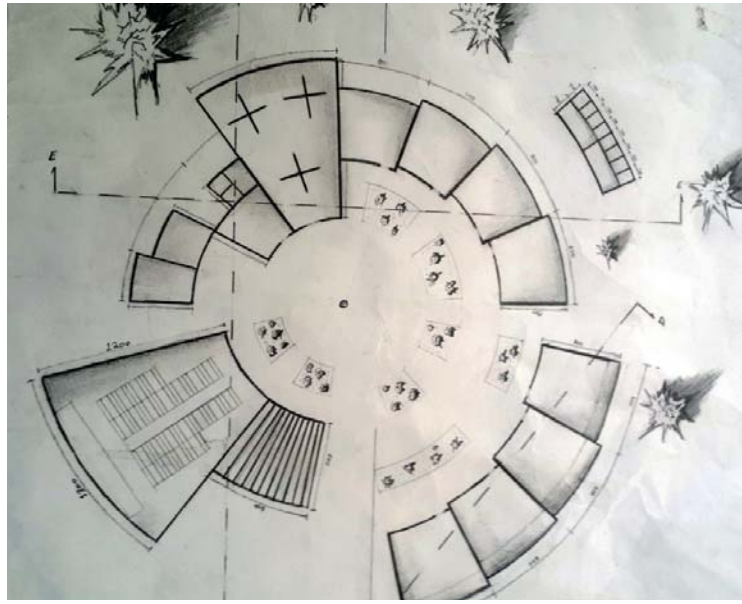
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TESFAY G

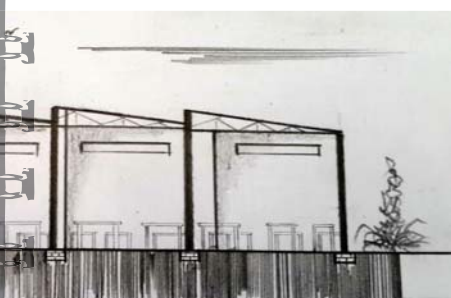
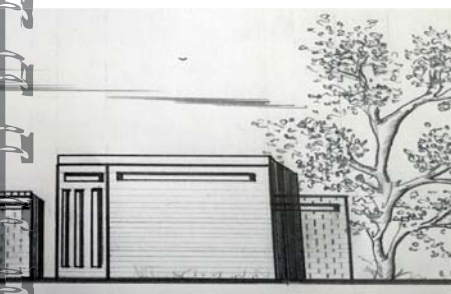
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CIRCLE OF SCHOOL





physical model



The most significant innovation of this design is based on understanding of local climate and children's needs.

The innovative disposition is based on the fact that the protection from harsh climate is needed. The circle composition creates shelter and naturally protected courtyard - obvious place of gathering. Its importance is underlined by the flag located in the middle.

The walls are built of sun-dried blocks (banco) in the rudimentary techniques. It may stimulate local population in duplicating of the building method.

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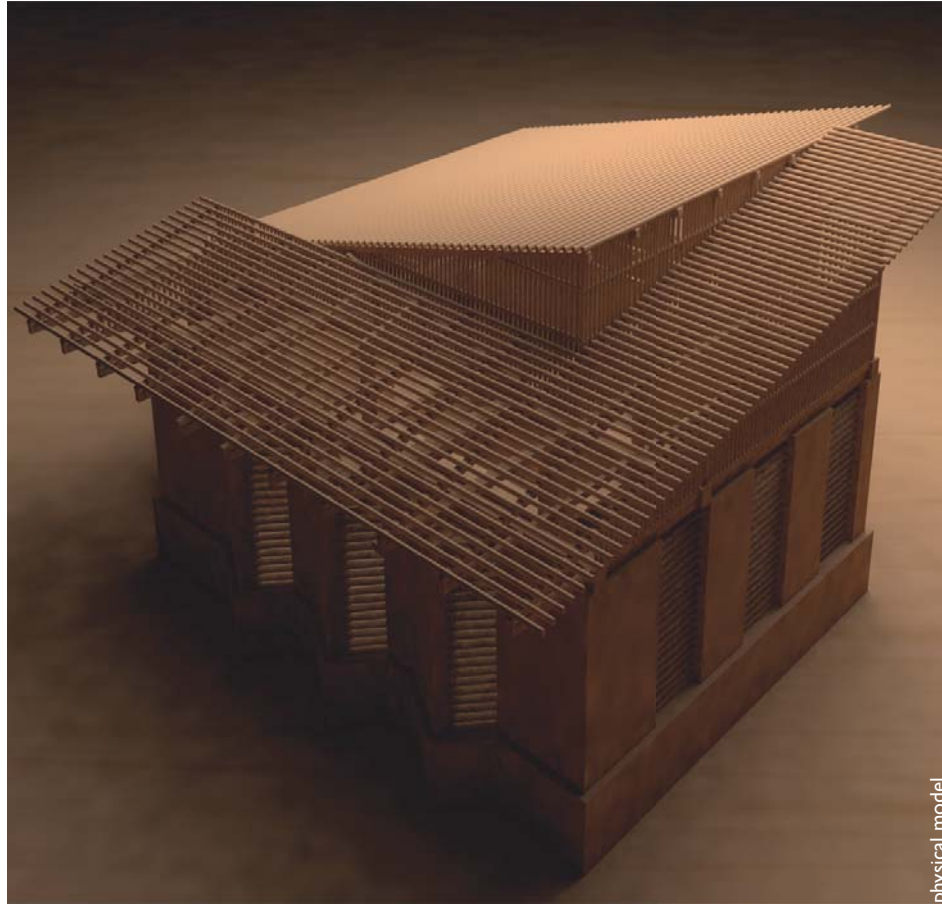
CACTUS SCHOOL



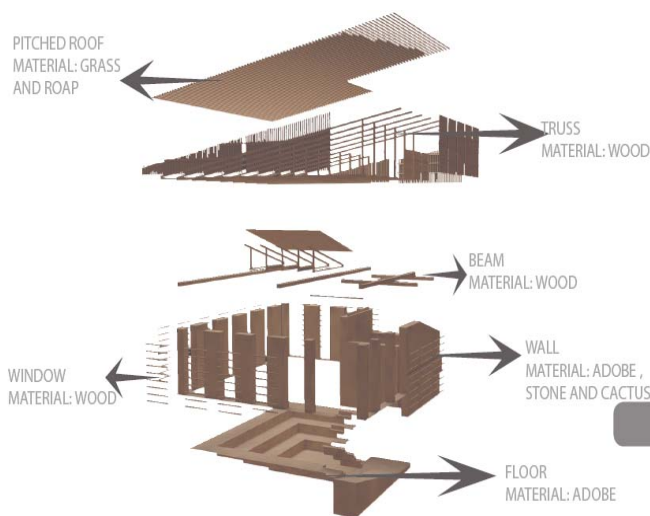
physical model



experiments with cactus juice



physical model



The know-how about cactus bricks was developed fast in Harla. The technique uses prickly pear cactus, cut in small pieces, and left to soak for 5 days with water in a barrel.

After this period, the slimy juice is then filtered and mixed with soil, loam and lime, and is then ready for use. The Harla villagers use the juice already to paint all of the exteriors of their homes, sealing them against rain.

The roof is elevated for air ventilation and the walls are placed as a wind breaker. The windows are placed according to the child psychology - in the irregular height.

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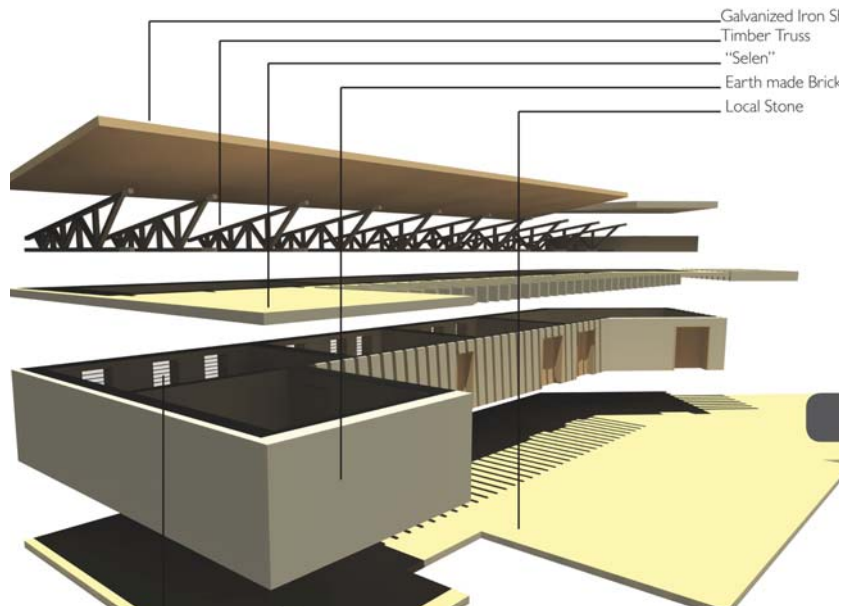
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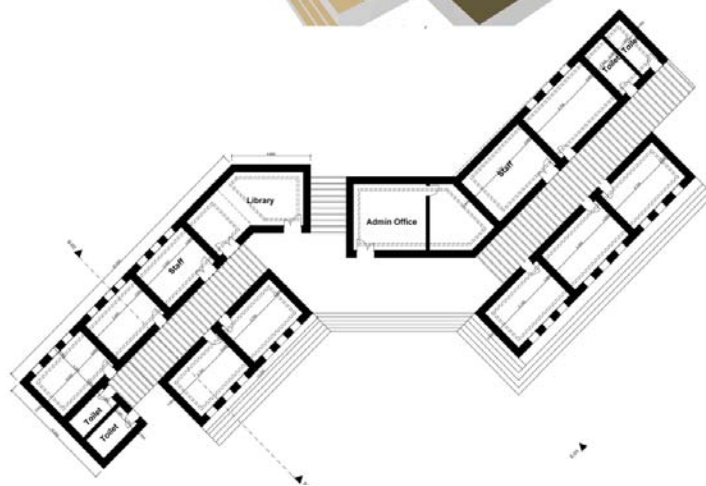
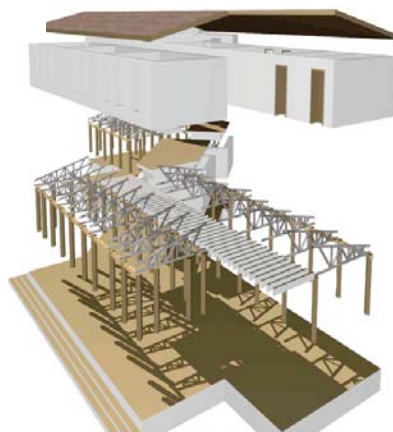
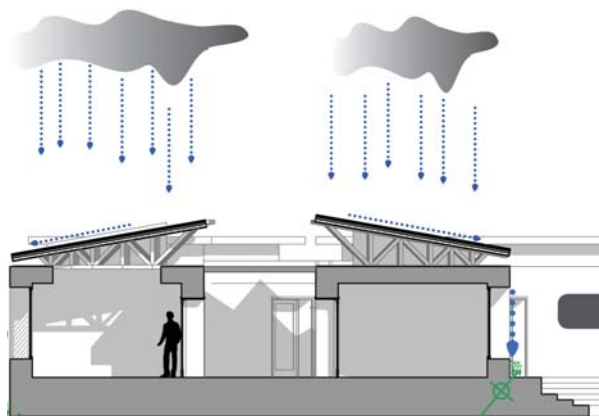
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RURAL ELEMENTARY SCHOOL





The innovative disposition is based on natural relations between children of different ages and management. Their needs and flow indicated the disposition - half closed, half opened.

The compound walls are built of sun-dried blocks (banco) in the rudimentary techniques. It may seem vulnerable to erosion by rain (hitting wall almost horizontally when carried by strong east wind...), but it is protected by sophisticated roof structure and shaders.

The climatic comfort is ensured by solar orientation, materials and the unimpeded airflow between the roof and ceiling (cross ventilation).

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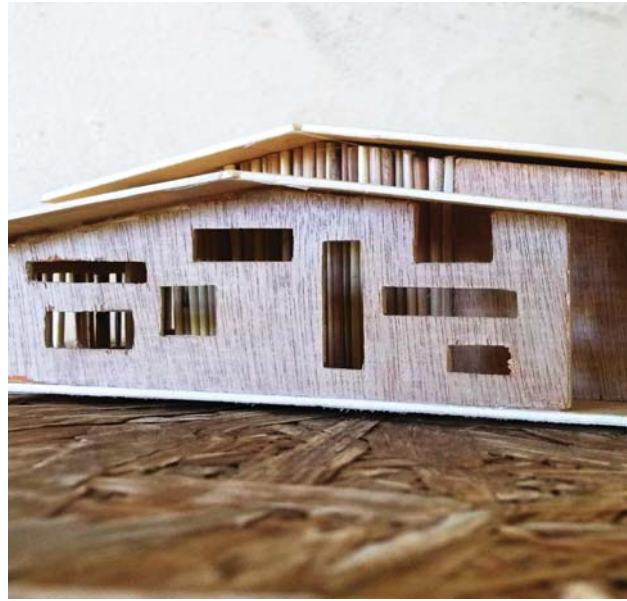
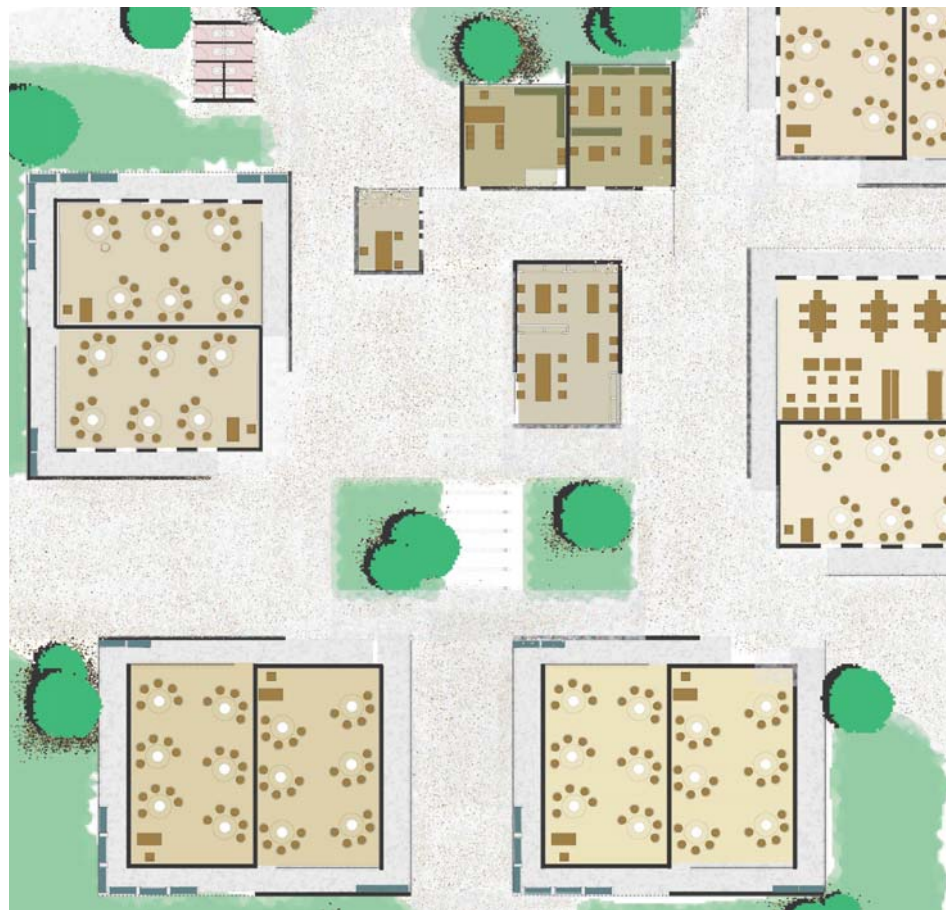
yonaelm@yahoo.com

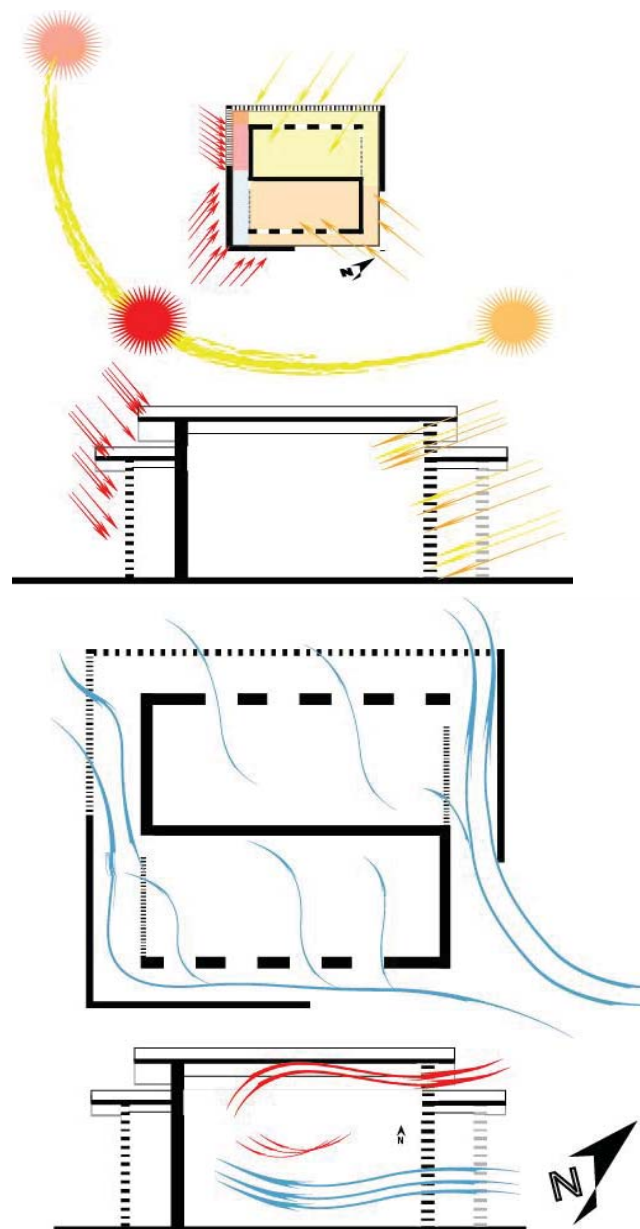
NAHOME GIRMA

EPHREM G/SILASE



THE DISPOSITION EXCELS





The most significant innovation of this design is based on understanding of local climate and people's needs.

Understanding of relationships :

- ::: lighting quality x child concentration
- ::: classroom acoustics x child attention
- ::: physical activity x healthy cognitive development

The design brings a playful disposition with using of local materials without cost increasing.

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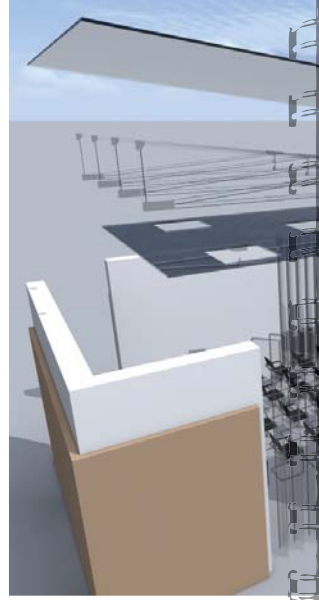
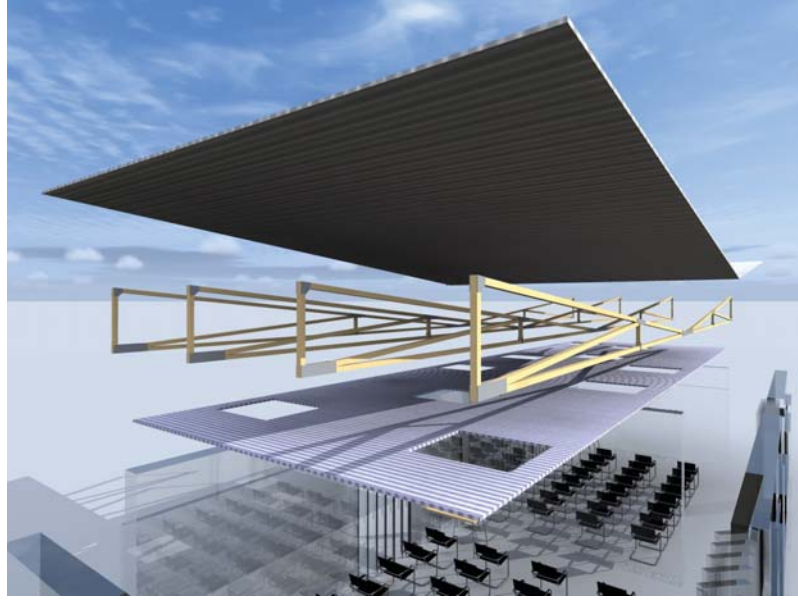
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ENLIGHTENMENT

physical model of imprints





The administrative building has been placed near to the entrance and it has good visual contact with the space where lots of kids spend their time.

Outdoor space and the kitchen have been linked to provide space for the teachers to hang out and enjoy the view to the playground.

Outdoor sitting area disposes with hexagonal shades made at the top from grass and other local bush. It is very similar to the traditional huts roofs.

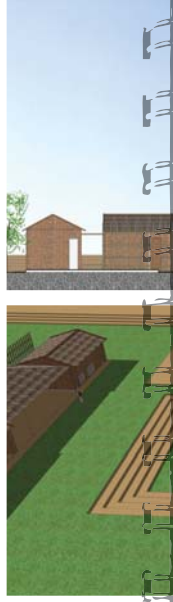
In designing library students have seen that first the step was to determine the necessity of this program in the design process. It is very simple and responsive to the surroundings (passive ventilation system), with good technology.

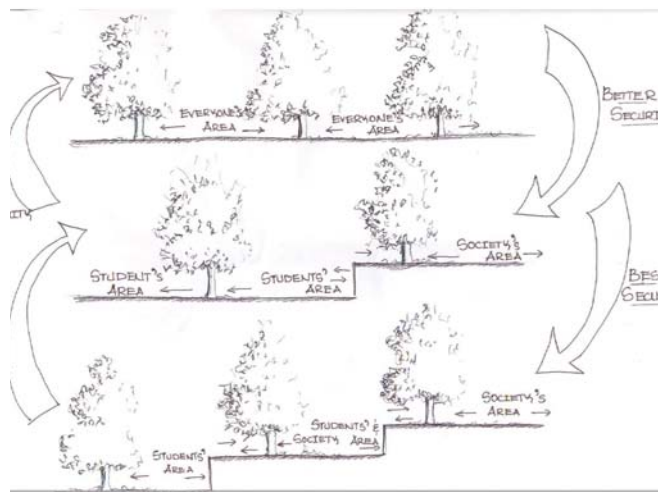
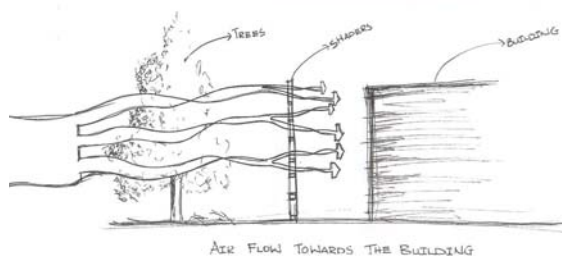
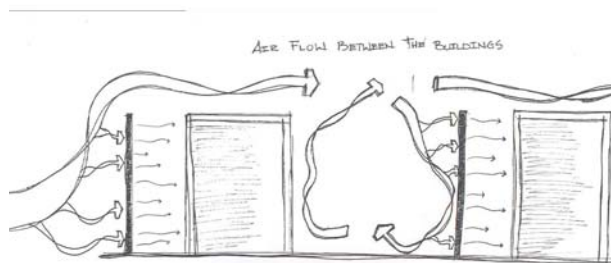
Classrooms design follows main problematics as: ventilation, specific heat regulating characters, ceiling incorporation, roofing advancement, facade treatment.

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SCHOOL AS A GAME

physical model





The concept of the school is based on semi-transparent layers - either in vertical or horizontal direction. Horizontally the site is divided into several levels according to its concentration of activities. Vertically the layers designed in function of playful shaders - the detail that might be very appreciated by children as a part of their playground and a teaching tool at the same time

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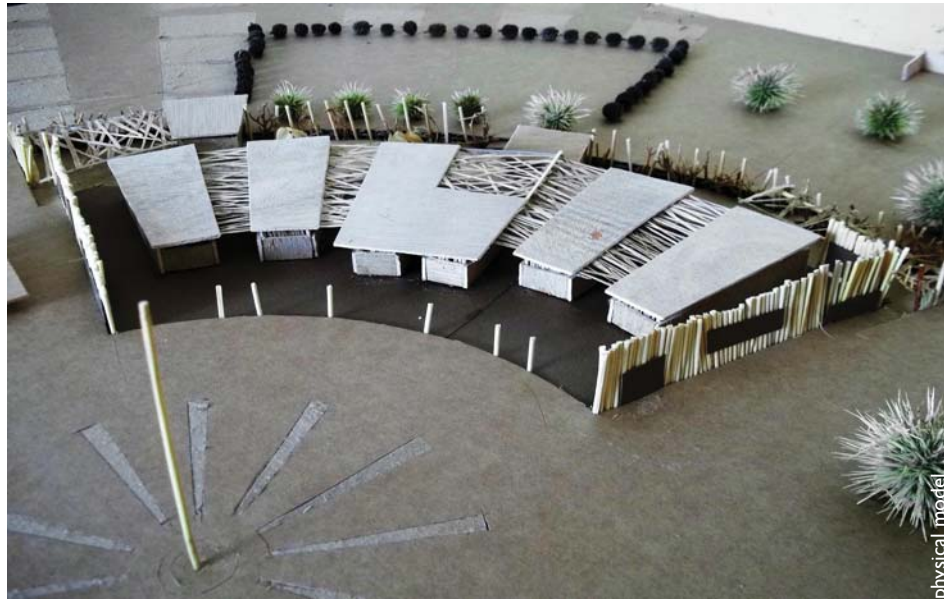
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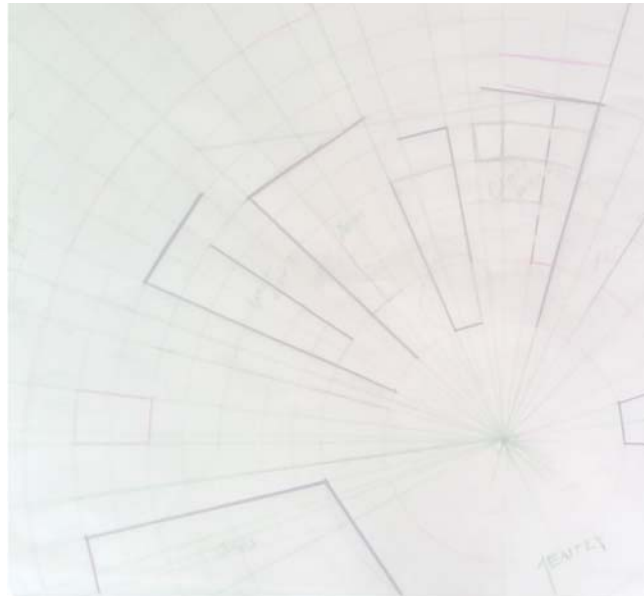
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BORROWED FROM ENVIRONMENT





physical model



As a concept students took the flag because almost in all ethiopian schools the flag has hierarchy so it became their guiding point through out the design. There are lines that radiate from center.

On the direction of the wind flow we placed two walls, an outer and inner layer, the first one is not fully closed it is half shlen and half mud wall. The second one is the classroom wall, it is made of mud bricks. The roof is elevated so that it can have enough ventilation and it is covered with shlen in order to block dust.

Mud bricks are made by mixing earth with water and animal dung, placing the mixture into moulds and drying the bricks in the open air. Straw is added to the bricks to help reduce cracking.

The hall which is buried to the ground, because of two main purposes, first it creates its own level difference usable as seating, second the excavated soil helps to make the mud bricks.

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CACTUS



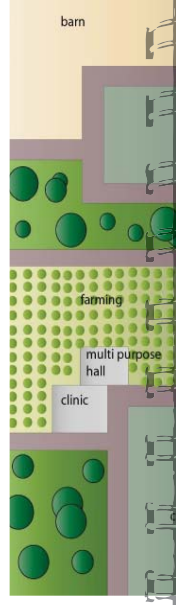
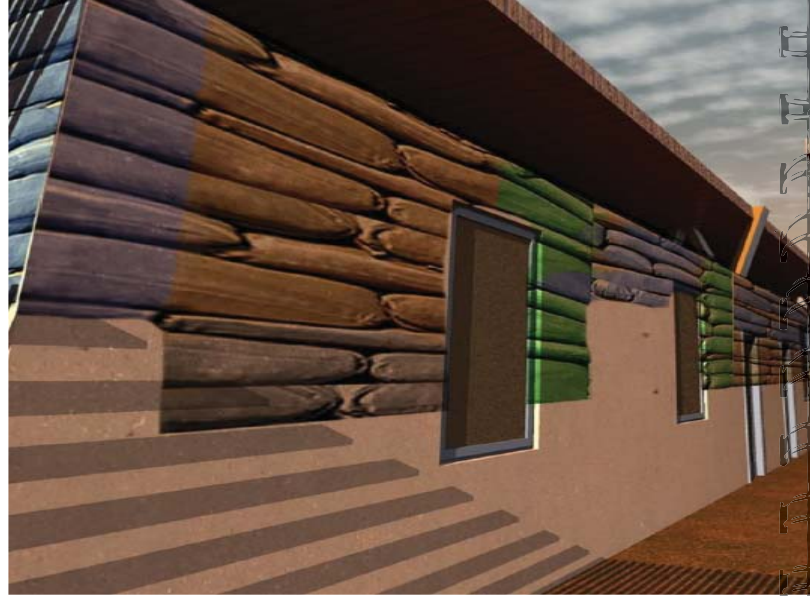
physical model

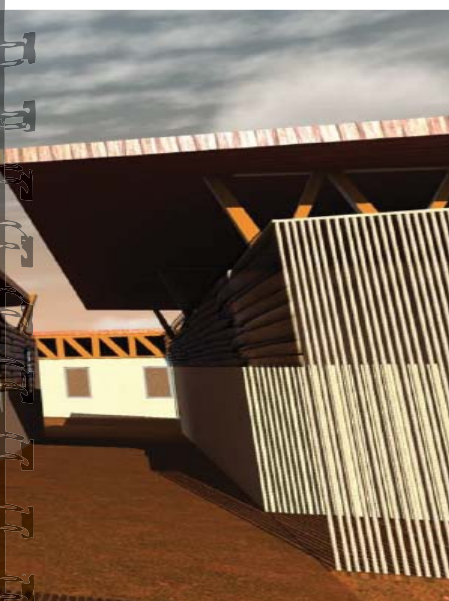


experimental



sample of rye bags





The cactus is leitmotive of entire design. During the visit of the site, the omnipresent opuncia was observed. Its structure and way of reproducing inspired the school composition in different layers.

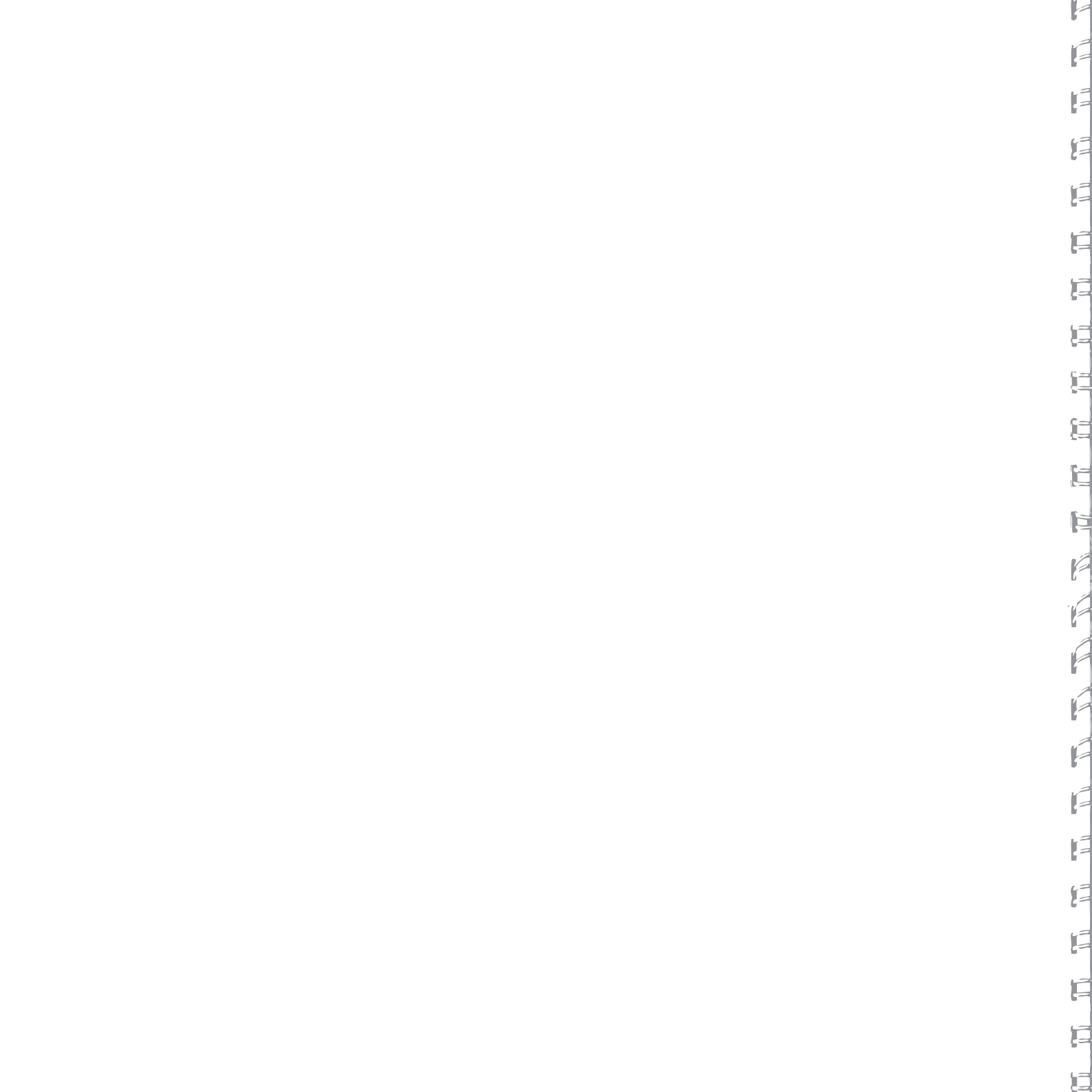
The cactus in plan - it is obvious that the rural school might grow and the growth of cactus is fitting metaphore for expansion.

The cactus on facade - with openings, and earthen bag structure it is almost obligatory to play a geometrical symphony on walls...

The cactus in materials - the cactus juice has good material characteristics, especially concerning the waterproofness.

The loadbearing walls are constructed with earth bags. Why? Because they do not require much time to be ready, they do not need much moisture, it does not require specific ratios of clay to sand, it offers tensile strength sufficient to prevent deformation, it withstands load and last but not least it is energy efficient.

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ELSEWHERE

INTRO

DISPO

CONSTRO

MATERIO

INTERIO

EXTERIO

SITE

FRESH IDEAS

ELSEWHERE



SCIENTIFIC-EDUCATIONAL CENTER, KEDJOM Keku ||| JINDŘICH RÁFTL
||| CAMEROON ||| 2012 |||

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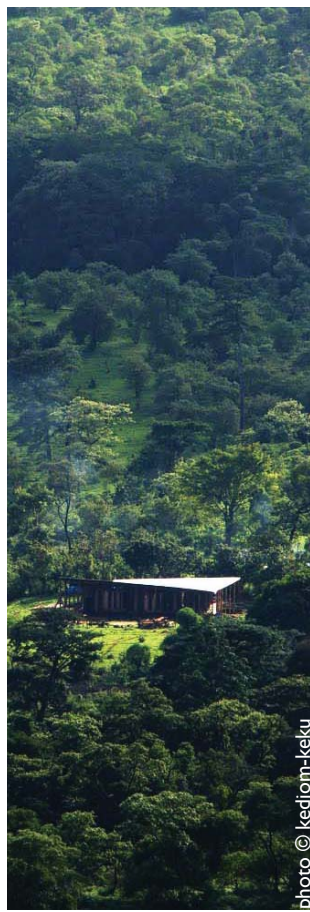


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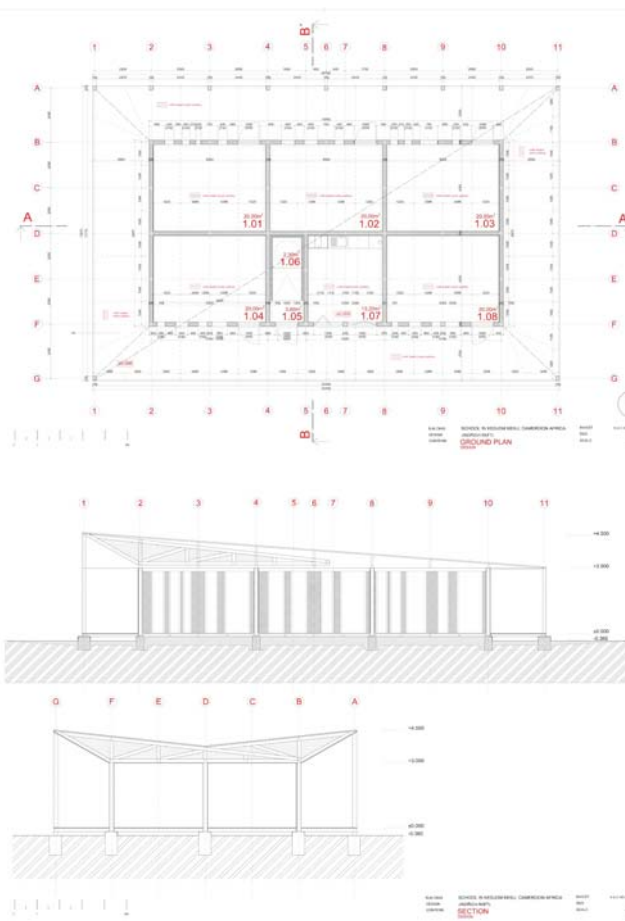
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photo © kedim-keku



photo © kedim-keku



There is a tradition of simple earthen constructions that comes from the life-style of local farmers who move their fields after few seasons. They dig a pit, stuff the clay into casts, dry the bricks and cover the roof with dry straw. The dwelling is complete in few days, inhabitable till next moving. On the contrary the school is designed as permanent construction that should represent the sustainability and the development. It should inspire the farmers to more lasting settling and to farming ways that avoid destroying of the rainforest.

The transparent disposition enables an independent running of two blocks - classrooms and research centre. The simple shape with peripheral terrace makes the construction suitable for local climate - hot days followed with heavy rains.

The climate conditions have influenced the roof structure - the truss beams separate the topcoat from living rooms - the air circulating in this gap prevents from overheating. The roof slope conducts the rainwater in one spot to be filtered and reused. The wall structure consists of wooden frames with stuffed soil and bamboo weave.

The material is local - the clay comes from the near stream as well as the stones to the foundations, the wood is eucalyptus (introduced as an alien that produces secondary metabolites that obstructs the original plants to spread), the ceiling is made with mats of chopped bamboo. Only the roof is zinc corrugated plate used because of the durability.



||| PRIMARY SCHOOL, GANDO ||| DIÉBÉDO FRANCIS KERE |||
 ||| BURKINA FASO ||| 2001 |||

photo © francis kéré arch

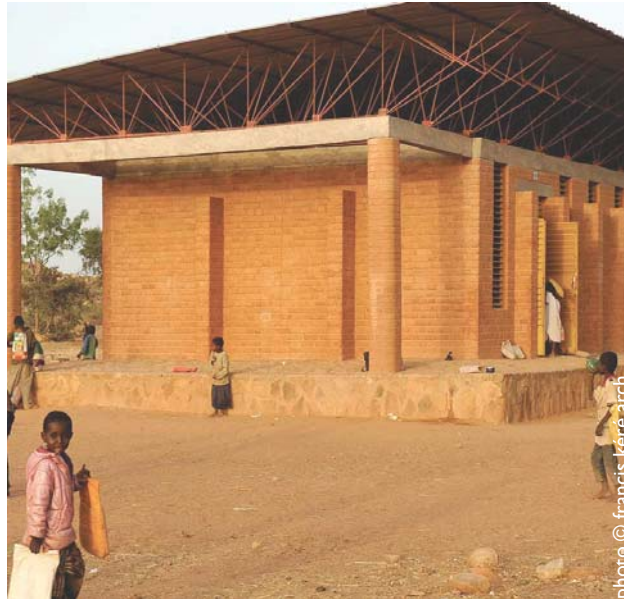


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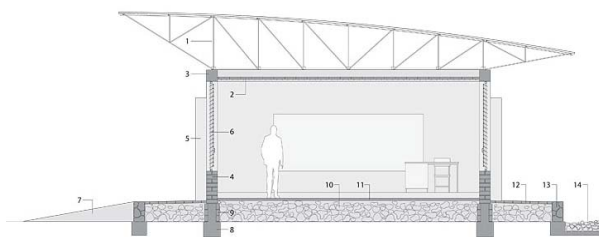
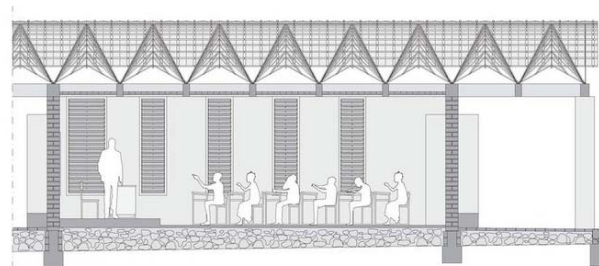
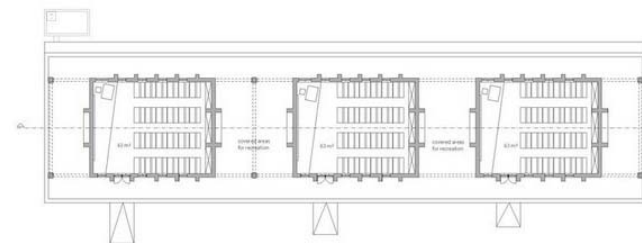
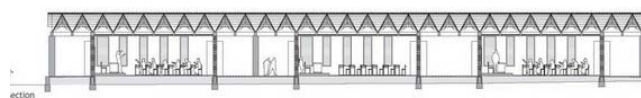




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To achieve sustainability, the project was based on the principles of designing for climatic comfort with low-cost construction, making the most of local materials and the potential of the local community, and adapting technology from the industrialized world in a simple way. It was also conceived as a standard model that could be copied within the community and would raise awareness of the merits of traditional materials.

Climatic considerations determined the building's form and materials. Three classrooms are arranged in a linear fashion and separated by covered outdoor areas that can be used for teaching and play. The structure comprises traditional load-bearing walls made from compressed earth blocks absorbing heat. Concrete beams run across the width of the ceiling, and steel bars lying across these support a ceiling also made of compressed earth blocks. The corrugated metal roof sits on a steel truss, allowing cool air to flow freely between the roof and the ceiling. The roof also has a large overhang, which shades the facades.

The roof form was dictated by practical considerations: it was not possible to transport large elements from afar, nor to use cranes. Instead, the architect devised a process whereby common construction steel bars were used to create lightweight trusses, with corrugated metal sheeting laid on top to form the roof. All that was necessary was to teach people how to use a handsaw and a small welding machine.



||| OPERA VILLAGE AND SCHOOL, LAONGO ||| FRANCIS DIEBEDO KERE |||
 ||| BURKINA FASO ||| 2009+ |||

photo © francis kéré arch

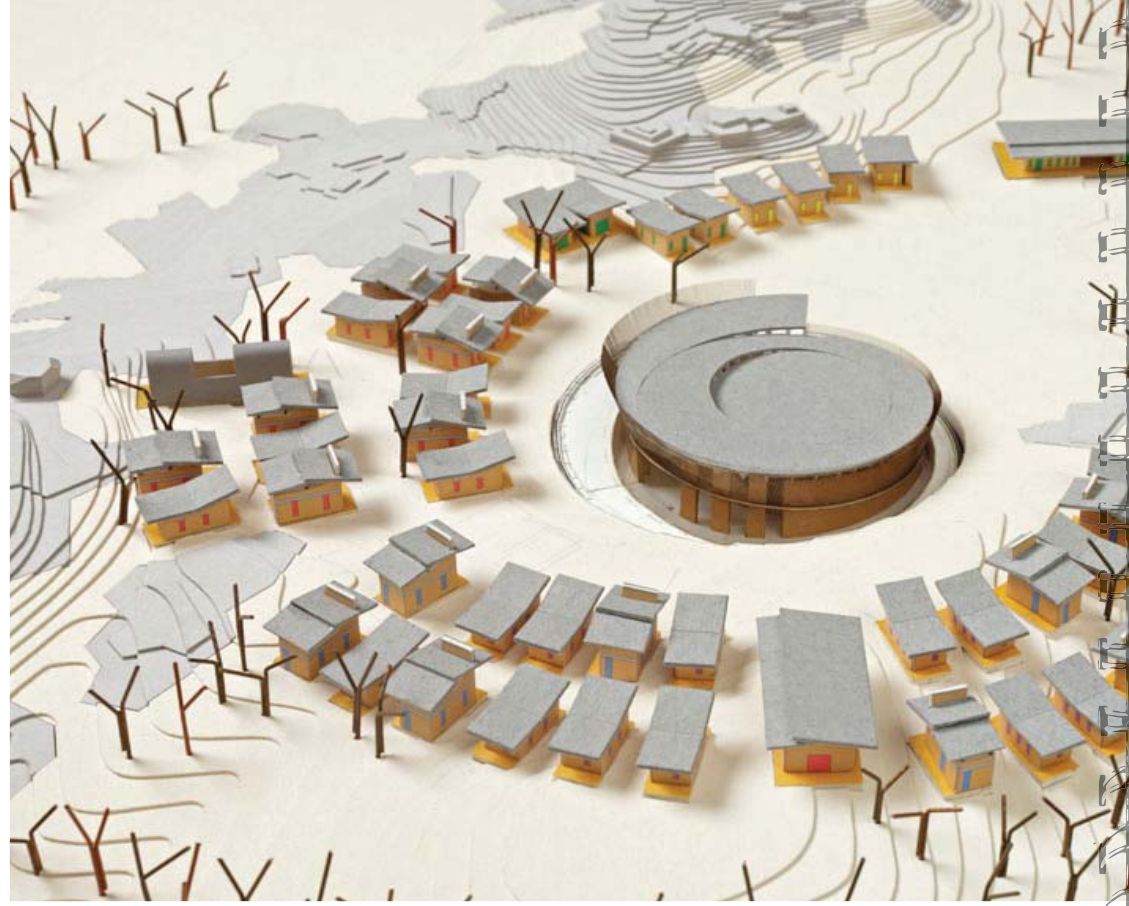
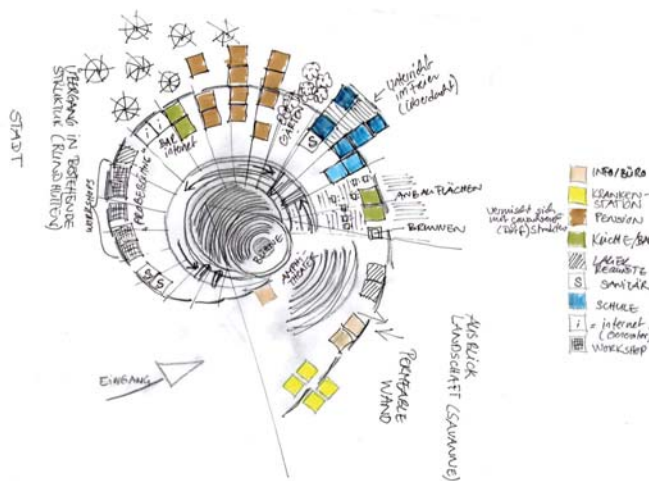
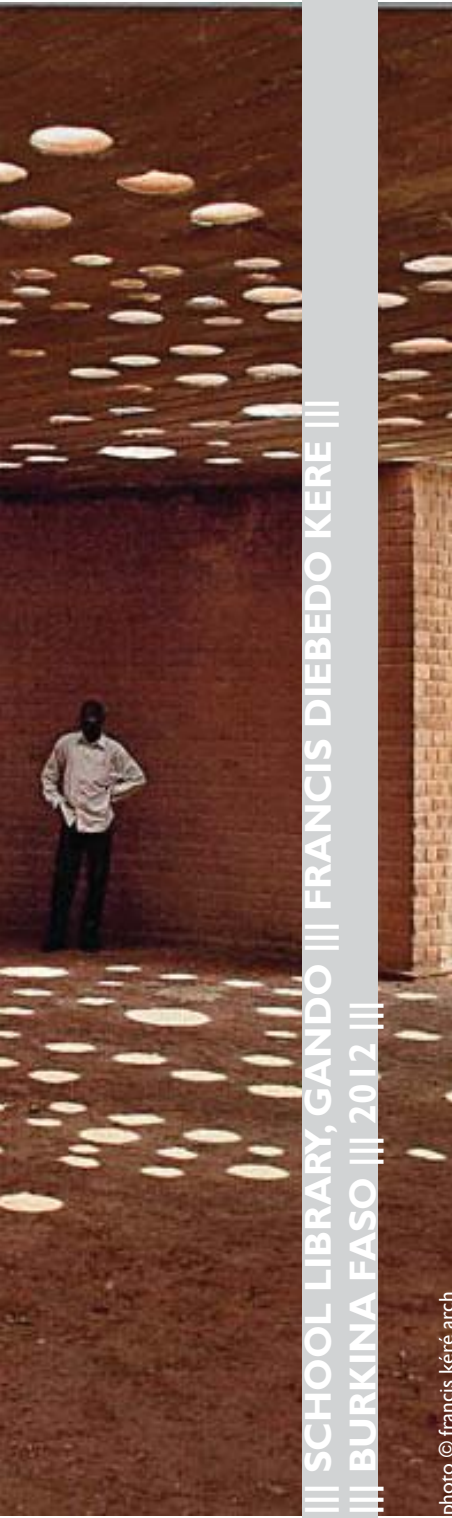


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Local materials such as clay, laterite, cement bricks, gum wood and loam rendering will be used for construction. For reinforcing elements such as beams, columns, ring-beams and foundations, concrete will be used. Due to the massive walls and large overhang of the roofs, air conditioning could be discounted in most buildings.



||| SCHOOL LIBRARY, GANDO ||| FRANCIS DIEBEDO KERE |||
||| BURKINA FASO ||| 2012 |||

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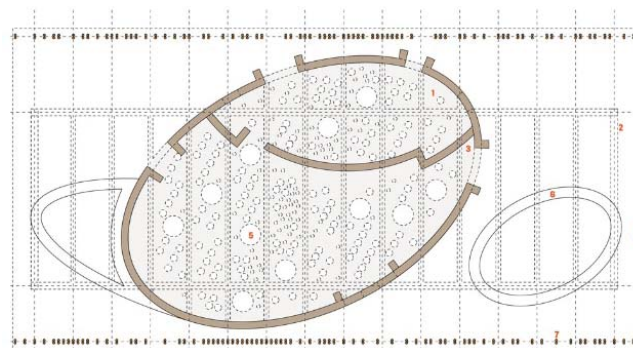
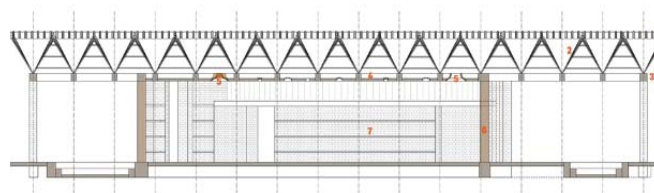
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The library will be open to everybody, not just pupils of the school. It is a place for village elders to pass on knowledge and traditions down the generations. As in the school buildings, the main construction material is compressed earth blocks. The geometry of the building is however different; in contrast to the strictly rectangular school, the library has an elliptical shape.

The library's ceiling is an innovative feature that makes good use of local technology. Clay pots, traditionally made by the women of the village, were brought to the site and cut, so as to be open at both the top and bottom. The pots were then cast into the concrete ceiling to create holes for light and ventilation. A rectangular corrugated iron roof sits above this ceiling and extends out beyond the library to create a separate shaded area for study or relaxation. As the metal roof heats up it draws the air from inside the library up and out through the holes in the roof, ensuring a comfortable rate of air circulation. The rectangular area around the library is enclosed by a facade of thin eucalyptus columns.

Eucalyptus is thought of as a weed in Burkina Faso; it dries out the soil and provides very little shade from the sun, so normally it is burned as firewood. This fast growing, hardy plant is an appropriate building material for a country such as Burkina Faso, which suffers from desertification due to deforestation. Some of the eucalyptus façade elements are arranged to form alcoves for sitting and relaxing in the shade. The interior quality of the library and surrounding space is pleasant, cool and airy – ideal conditions for learning, thinking and studying.



||| METI - HANDMADE SCHOOL, RUDRAPUR ||| ANNA HERINGER |||
||| BANGLADESH ||| 2005 |||

photo © anna heringer

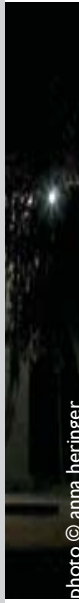


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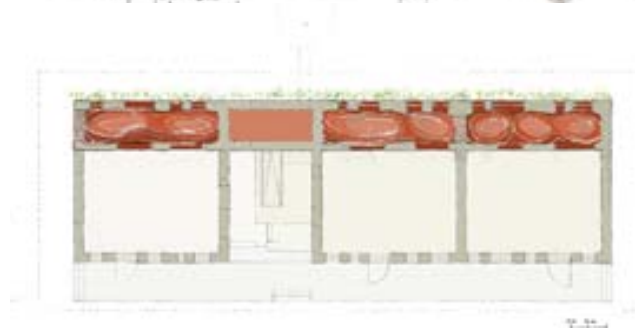
photo © anna heringer



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"This joyous and elegant two-storey primary school in rural Bangladesh has emerged from a deep understanding of local materials and a heart-felt connection to the local community. Its innovation lies in the adaptation of traditional methods and materials of construction to create light-filled celebratory spaces as well as informal spaces for children.

Earthbound materials such as loam and straw are combined with lighter elements like bamboo sticks and nylon lashing to shape a built form that addresses sustainability in construction in an exemplary manner. The design solution may not be replicable in other parts of the Islamic world, as local conditions vary, but the approach – which allows new design solutions to emerge from an in-depth knowledge of the local context and ways of building – clearly provides a fresh and hopeful model for sustainable building globally.

The final result of this heroic volunteer effort is a building that creates beautiful, meaningful and humane collective spaces for learning, so enriching the lives of the children it serves."

(Jury of The Aga Khan Award for Architecture 10th Circle)



||| CASSIA CO-OP TRAIN CENTRE, SUMATRA ||| TYIN TEGNESTUE ARCHITECTS |||
||| INDONESIA ||| 2011 |||

photo © TYIN arch

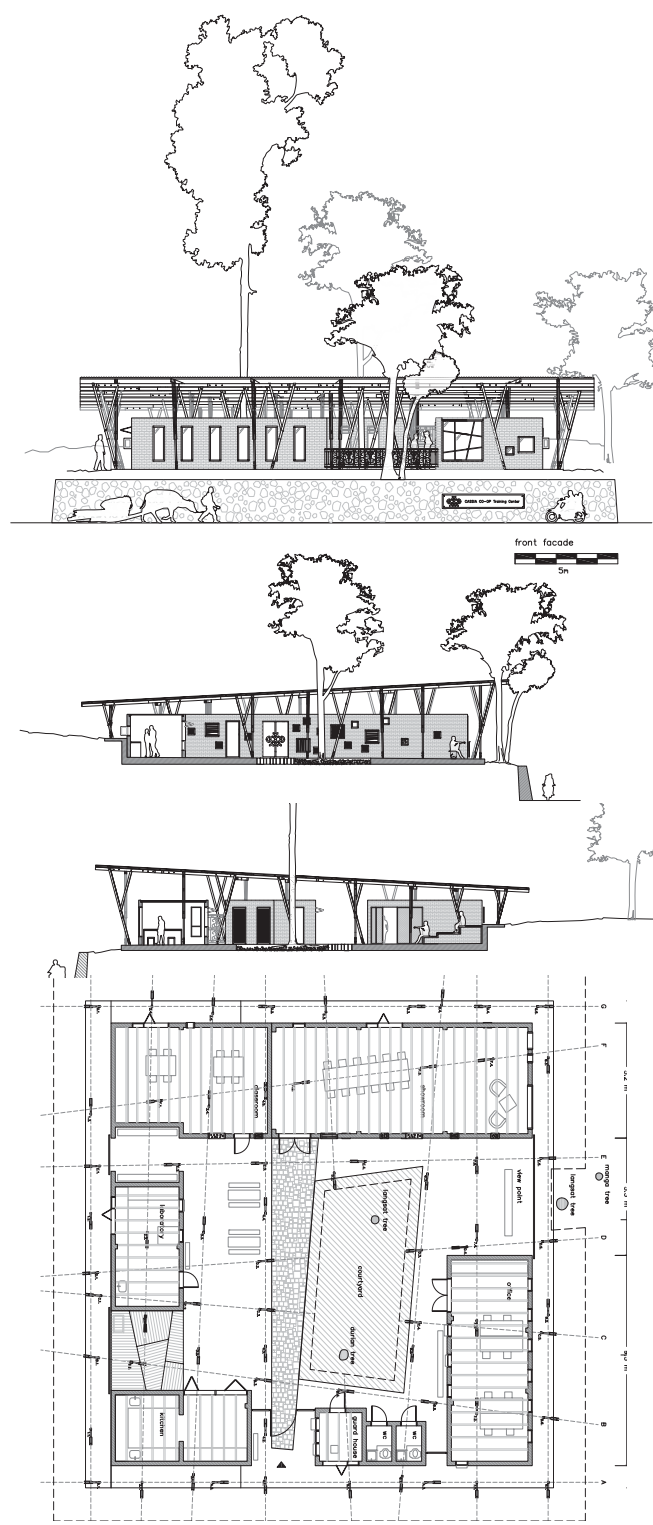


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It is a space for education for local cinnamon farmers in Sumatra. The centre is located in an area where 75% of the world's cinnamon production takes place, and large factories can be found in the vicinity.

The main goal of the 600 sqm facility is to give the local farmers and factory workers training in sustainable farming and a general education about the processing of cinnamon, from the raw bark to the finished product packed and ready for export.

The client Cassia Co-op wants the centre and the future factory to present cinnamon production in a more ecological, sustainable and socially viable way. By offering the employees safe working conditions, decent wages and health insurance Cassia Co-op will challenge the conventions.



||| SAFE HAVEN LIBRARY, BAN THA SONG YANG ||| TYIN TEGNESTUE ARCH |||
 ||| THAILAND ||| 2009 |||

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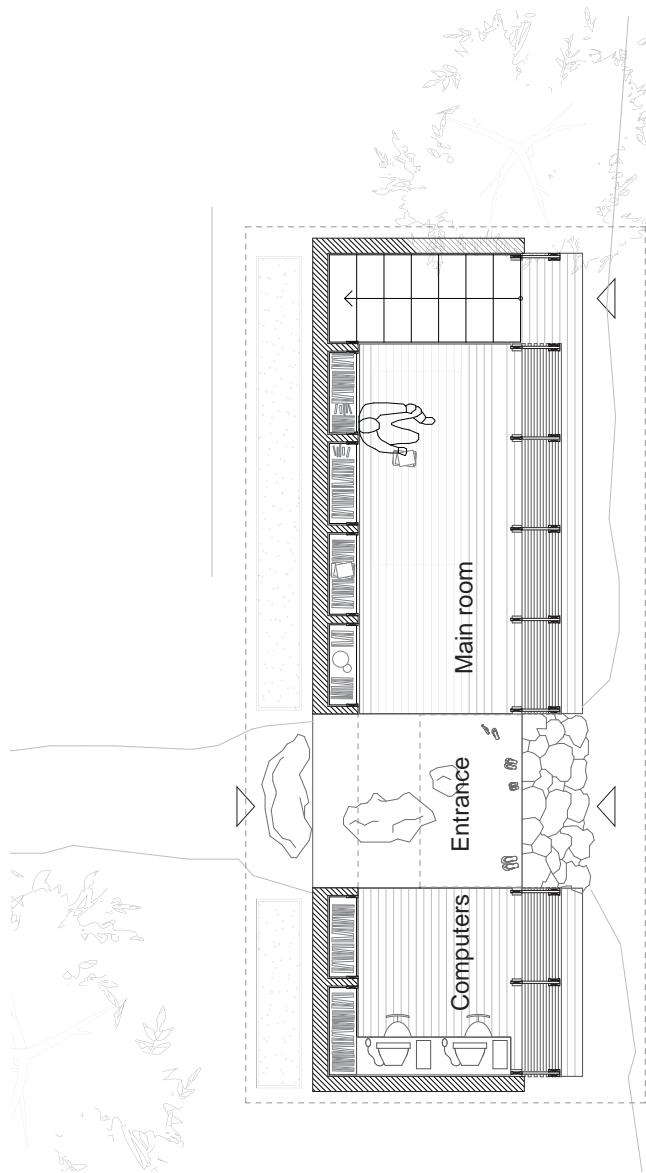
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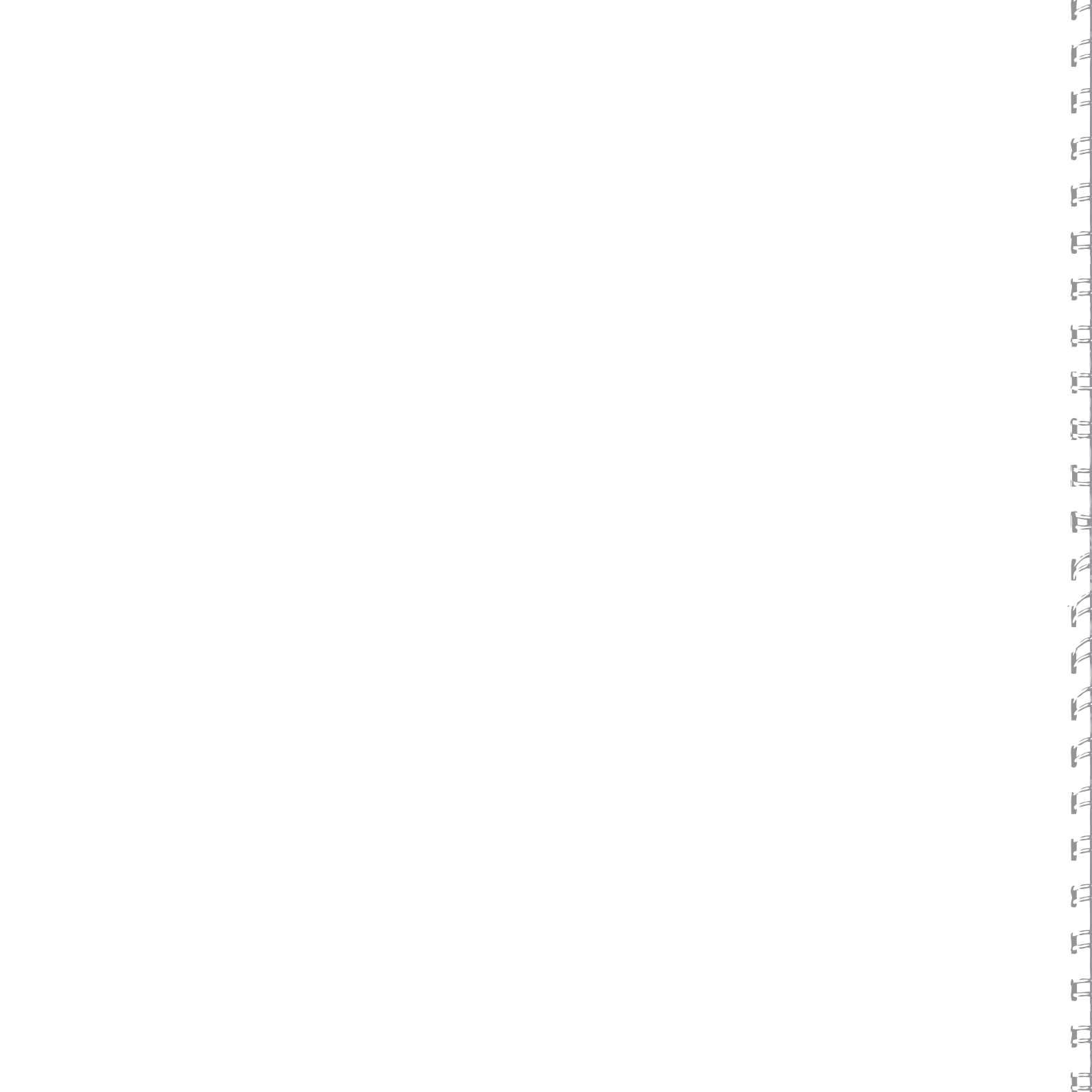


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The Library stands on a concrete base casted on a bed of large rocks gathered on-site. The walls consist of plastered concrete blocks and cool the building during the day while the open bamboo facades provided ample natural ventilation. Iron wood make up the solid frame construction and serves as a comfortable floor for the children to play on.

The most important thing to the Tasanee is that her children have food and an education. The library enables the children of the Safe Haven Orphanage to have a space to do homework, use a computer with internet and read books. The new building has also attained the important role of a gathering space and is frequently used for making crafts and playing games.



**INNOVATION SHOULD BE SIMPLE
THE MORE COMPLICATED IT IS,
THE MORE MISTAKES ARE MADE.**



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