



Handbook (Minimum)Standards for construction projects in the Global South

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Handbook (Minimum)Standards for construction projects in the Global South

Results of the project „(Mindest-)Standards für nachhaltiges Bauprojekte in der Entwicklungszusammenarbeit und Katastrophenhilfe“ 2023
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Note on the publication

humantekture is solely responsible for the content of this publication; the positions expressed here do not reflect the views of Engagement Global gGmbH and the German Federal Ministry for Economic Cooperation and Development (BMZ).

This handbook summarises the work experiences of humantekture and of the series of events supported by this project as well as previous ones. It is intended as an aid and inspiration for your own work. The information and recommendations presented do not claim to be correct or complete. Rather, they are to be scrutinised independently. The authors of the handbook accept no responsibility for any errors, mistakes or damage that may result. However, we welcome any suggestions for improvement and will be happy to take these into account in future versions.

PREFACE

Construction measures are funded and implemented worldwide as part of German development cooperation and disaster relief. The measures usually have a high level of visibility and therefore serve as a role model. The spectrum of construction measures implemented in this context ranges from classic building construction projects, such as the construction of hospitals, schools and training centres, to civil engineering measures, such as bridge and road construction, to well construction and the construction of irrigation and drainage systems and the installation of systems for generating renewable energies.

As diverse as the construction measures are, they are united by the question of which standards are applied to the construction projects: Local, German or international? And what is the situation in countries where there are no or only a few regulations on the standards to be applied? Particularly in the partnership-based cooperation in which German (Non-) Governmental Organisations work with their local partner organisations and their local planning offices, the need for information on the standards to be applied in the early planning phases is crucial for the success and quality of a construction project.

In practice, building consultants are often called in very late in the course of a project, when relevant planning decisions have already been made and changes are only possible with difficulty and at great expense. It is therefore important to provide knowledge about the relevant process steps in the monitoring of construction projects and the corresponding (technical) standards as early and as easily accessible as possible. However, the project managers of the German (N)ROs, the local project partners and their planners usually do not have the knowledge about the (minimum) standards to be applied and often are not aware of the high relevance of involving construction consultants in the project at an early stage.

This handbook is the result of a project funded by the Programme for the Promotion of Development Policy Qualification Measures and is intended to help close this knowledge gap and provide information on technical (minimum) standards as applied in our working practice for the following areas: Safety (escape routes & fire compartments), resilient design principles (storm and earthquake-resistant construction), climate-adapted design and accessibility/ inclusive construction. It also contains recommendations on the planning process with the aim of designing

sustainable construction projects. In addition, this publication includes a number of practical examples that illustrate the challenges and possible solutions for taking the (minimum) standards and the associated „lessons learnt“ into account.

The handbook is intended as a basis and starting point for defining the (minimum) standards to be applied and is therefore a supplementary component to the toolbox in the cooperation between local partners, local planners, as well as representatives of the donor organisation and international construction consultants. This is because each project must be considered in its respective context and the (minimum) standards to be applied must be adapted accordingly.

On behalf of the entire humantecture team,
we wish you a good read.

Michael Gausam & Maike Buttler

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1_INTRODUCTION

Authors: Michael Grausam, Maike Buttler

CONTEXT: WHY (MINIMUM) STANDARDS?

More than 200,000 people died in Haiti as a result of the earthquake on 12th January 2010¹. The earthquake in Turkey on 6th February 2023 killed more than 57,000 people.² Earthquakes are one of the greatest natural hazards alongside the threat posed by other people, animals or diseases. However, hurricanes, floods and fires also destroy people's livelihoods and are responsible for the deaths of many. Climate change acts as a catalyst here and leads to more frequent and often more severe natural disasters. Many lives could be saved and damage to buildings and infrastructure avoided or at least greatly reduced by taking a few (minimum) standards into account.

Building Back Better (BBB) is a strategy that is used in particular in post-disaster reconstruction: Reconstruction should take place in such a way that the people affected are resilient to disasters in the future. The term is not only limited to buildings, but also to other areas such as agriculture, the resto-

ration of ecosystems or the management of natural resources. In the construction sector, the definition of planning and building standards is a central component. This should not only be considered for reconstruction after disasters, but for every project with construction measures, especially in development cooperation. This is precisely where the negative effects of disasters can be prevented. However, in development cooperation in particular, construction projects have often been regarded as a necessary accessory rather than as relevant to development policy for some years now. (Minimum) standards are sometimes perceived as onerous requirements by some project partners. However, construction projects that are funded as part of development cooperation and disaster relief should serve as a model for good (minimum) standards. This is another reason why many donor organisations call for (minimum) standards to be taken into account when implementing the construction measures they support.

1 Source: https://www.spiegel.de/thema/erdbeben_in_haiti_2010/ (Last access: 20.12.2023)

2 Source: <https://www.auswaertiges-amt.de/de/aussenpolitik/humanitaere-hilfe/erdbeben-tuerkei-syrien/2580184> (Last access: 20.12.2023)



Presidential palace after the Earthquake
in Haiti on 12th January 2010



Coastal village destroyed by a Tsunami in
Sulawesi, Indonesia after an earthquake in 2018



Building destroyed by an earthquake and
a Tsunami in Sulawesi, Indonesia in 2018



Building destroyed by a fire
in Cameroon in 2021

CHALLENGE: LACK OF KNOWLEDGE

In the early 2000s, many international aid organisations were still often implementing construction projects themselves with their own staff on site, but as a result of the reconstruction after the earthquake in Haiti on 12 January 2010, a rethink has taken place: Partnership-based work has now become the guiding principle of many organisations, not only in development cooperation but also in post-disaster reconstruction.

Partnership-based working means that the partners in the project countries are responsible for the development, planning and implementation of projects. The donor organisations provide support in the form of advice and financial assistance. However, many organisations often have little or no experience with the implementation of construction measures. Furthermore, in many countries there are only

a few government guidelines for construction and in many cases the local planning offices and construction companies commissioned do not have sufficient knowledge of the necessary (minimum) standards - especially if these are to be determined by comparing German/international with local standards according to the „principle of application of the higher standards“, as required by some funding organisations. In some regions, such as in parts of West and Central Africa, the situation is aggravated by the fact that there are few architects and therefore planning is often carried out by engineering firms that are experts in static calculations and building construction but have no expertise in spatial planning. As a result, the planning of escape routes, accessibility and climate-adapted construction is often not given sufficient consideration.

SOLUTION: KNOWLEDGE TRANSFER!

At the start of a project, a construction project's quality can be influenced the most. This decreases over the course of a project and becomes increasingly complex. If, for example, the necessary escape routes are only determined after the design planning has been finalised, the planning has to be changed at great expense. If it is not done until the construction phase, it is even more time-consuming to implement the necessary changes. It is therefore particularly important in the early project phases, ideally even before a local planning office has been commissioned, to define the (minimum) standards for the respective project and communicate them to all those involved in the planning. However, in many project constellations, construction consultants are only brought in after the design planning has been finalised. The first point of contact is often project managers who have no construction expertise.

In response to this situation, a training module was developed as part of the project „(Minimum) standards for construction projects in

the development cooperation and emergency response“ funded by Engagement Global with funds from the BMZ, Diakonie Katastrophenhilfe and Architekten über Grenzen to sensitise project workers at German NGOs to the topic of (minimum) standards in construction projects and to provide information on the procedure and the (minimum) standards to be applied. The training module was successfully trialled in an initial face-to-face event and two further online training sessions.

This handbook summarises the results of the project and is intended to serve as a working aid for the planning and implementation of funded construction projects in addition to the training courses. It contains suggestions and recommendations on process standards and technical (minimum) standards based on the experience gained from our work over the last 15 years and the experience of the seminar participants. In addition to project managers of German (N)GOs, the manual is also aimed at partner organisations and their local planners.

2_PROCESS STANDARDS

Author: Michael Grausam

2-1 INFLUENCE ON PROJECT QUALITY

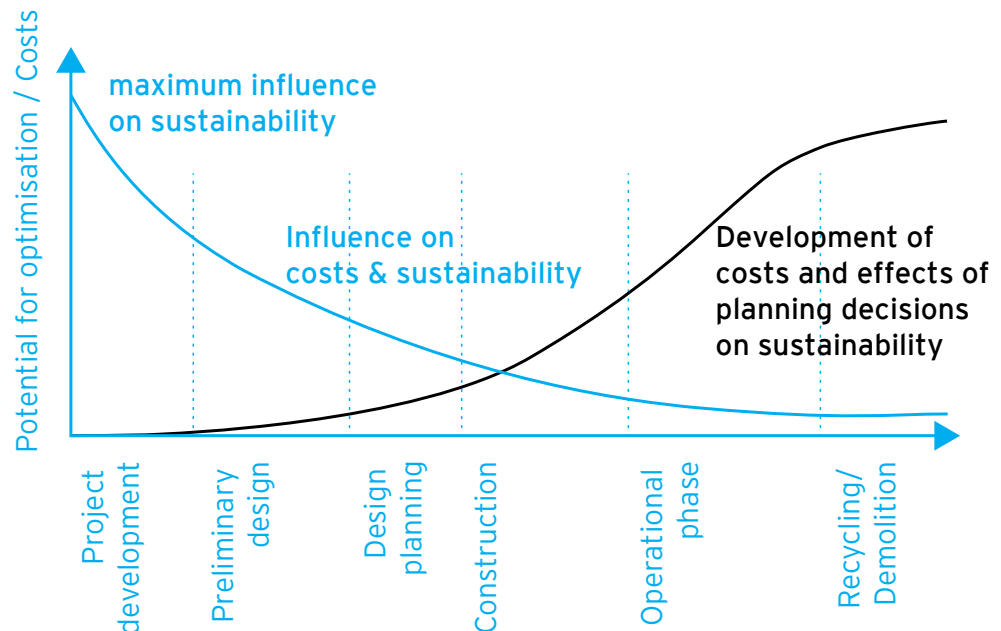
In every phase of a building's life cycle, it is possible to influence its ecological, economic and socio-cultural quality. However, the later in the course of a building project, the smaller, more complex and more expensive are the possibilities for exerting influence (see Fig. 2). Therefore, it is particularly important at the beginning of a building project to comprehensively determine information and needs in order to be able to make targeted planning and construction decisions.

Yet often too little attention is paid to these initial project phases. There are many reasons for this: time pressure after a disaster (safe accommodation must be provided quickly for

those affected), narrow time frames to apply for or to spend grants, or lack of budget for comprehensive needs planning, basic assessment and (preliminary) design planning, etc.

Despite or precisely because of this, no hasty decisions should be made at the beginning of the process. Basic conditions and parameters should first be comprehensively clarified and a solid, context-related planning should be carried out. In doing so, the course for a successful, sustainable building project can be set at an early stage. But also in the following project phases, decisions have to be made that have a high impact on the success and quality of the project - e.g. regarding the participation of

Fig. 2_ Life cycle and opportunities for influence; own illustration according to: Ebert, Thilo; Eßig, Natalie; Hauser, Gerd (2010): Zertifizierungssysteme für Gebäude: Nachhaltigkeit bewerten. Internationaler Systemvergleich. Zertifizierung und Ökonomie. DETAIL Green Books



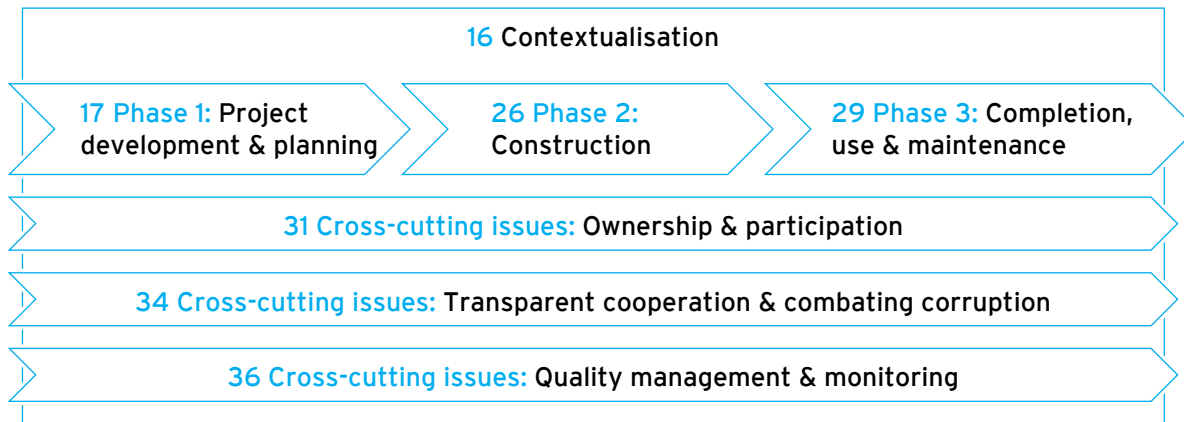


Fig. 3_ Phases and thematic complexes in construction: structure of recommendations for action

future users in the planning and construction process, the choice of construction techniques and materials as well as quality control during the construction phase.

This chapter is intended to provide recommendations for action during the different project phases that can contribute to a successful project. The recommendations are first of all intended to serve as inspiration for the sustainable design of building projects.

They are divided into three chronological project phases and three cross-cutting issues that affect all phases. All these topics must be considered in their respective contexts. (see Fig. 3)

The recommendations are aimed at persons in charge of building projects, building owners, planners from NGOs and funding agencies. They are therefore also suitable for readers with little knowledge of construction. Some sections contain basic knowledge that should not be new to building professionals.

2-2 CONTEXTUALISATION

Adaptation to the respective context is the most important factor for a successful, sustainable planning, construction and operation of buildings. Similarly, the following recommendations must be adapted to the respective context in order to make a meaningful contribution to the ecological, economic and socio-cultural sustainability of a building project. In particular, the framework conditions for humanitarian assistance after a (natural) disaster such as an earthquake are different from those in the context of long-term development cooperation: while projects after disasters usually require the fastest possible action and project lead times are therefore very short, development cooperation projects usually have sufficient time for comprehensive project development and planning. With regards to humanitarian assistance, it is therefore all the more important to be prepared before the disaster occurs. Natural disasters in particular usually occur with a certain regularity. This in

turn enables (limited) planning in disaster relief, for example by preparing logistics before a disaster strikes and stockpiling material for emergency relief and reconstruction in the respective regions.

Furthermore, local (building) culture, climatic conditions, applicable rules and laws, resilience-related minimum technical standards and financing options can differ significantly depending on the project context. This should be taken into account in the planning.

Due to these differences in project context, there can be no universal master plan for a sustainable construction project. However, by carrying out crucial process steps and considering some important principles, a framework for a sustainable construction project can be established.

Fig. 4_ School construction in India



2-3 PHASE 1: PROJECT DEVELOPMENT & PLANNING

Whether a construction project will be a success or a failure is often already determined before the official start of the project. Many projects fail because basic information was not obtained and basic conditions and parameters were not sufficiently clarified. In order to be able to take a professional approach in this early phase, some organisations use checklists (see chapter 2_8_Quality management). These

contain important criteria that need to be met in order for a project to be carried out, such as approvals that need to be obtained, the availability and quality of information and planning documents, or the implementation of certain process steps (e.g. participation procedures). The most important steps that should be taken before construction begins, regardless of the context, are as follows:

ESTABLISHING COOPERATION PARTNERSHIPS

Partnership-based cooperation between international and national organisations is fundamental to the successful implementation of projects in the context of development cooperation and disaster relief. Cooperation is usually not limited to one international and one national partner organisation in the project country, but often involves several partners on both sides (international & national). For example, there is often a financing organisation (often ministries, foundations, etc.) and an implementing organisation on the side of the international organisations. In turn, there is an implementing partner organisation in the project country, which often works together with other national organisations, e.g. smaller local NGOs, but sometimes also with state organisations. In partnership cooperation, the implementing organisation in the project country is in charge and external intervention is limited to advice on process-related or construction-related issues and financial support.

It is only recommended in only a few cases to implement projects without a local partner organisation, for example in war zones, when rapid action independent of the conflict parties is necessary to help the civilian population.

Practical experience has shown that the success of projects depends to a large extent on the quality of the cooperation partnership. A trusting relationship between the partner organisations and especially their presence on site can ensure the quality of the (construction) project. Therefore, this first phase of cooperation initiation is of great importance. If an organisation does not yet have any cooperation with suitable partners, it is all the more difficult to assess the quality of a cooperation partnership in the run-up to a project or to find a partner organisation at all. For this purpose, it is advisable to make use of networks of other national and international organisations that have been active in the project area for some

time. Once a potential partner organisation has been identified, it is important to check whether cooperation is promising. The following questions help to check the organisations' ability to cooperate:

- Are objectives, working methods and values of the organisations identical or compatible?
- Does the local partner have technical, financial and human resources to carry out the project and to continue it later?
- Does the organisation already have experience? Are there references?
- How will the roles and tasks be distributed between the partner organisations?
- How should the partner organisations communicate with each other?
- Are all necessary areas of competence covered by the organisations?
- Can competence gaps be closed through qualification measures?

In order to be able to answer these questions, it is important that the potential cooperation partners get to know each other personally and exchange views in a direct conversation. Arrangements by e-mail, telephone or video conference facilitate communication, but cannot replace face-to-face meetings, as these play a decisive role in building trust.

A central means of concretising and establishing cooperation is the drafting and conclusion of a cooperation agreement. This usually includes the purpose of the cooperation, the

areas of competence of the cooperation partners, their rights and obligations as well as regulations on central elements of the cooperation (decision-making, reporting, duration of the cooperation, etc.). Sensitive issues such as the termination of the cooperation and so-called exit clauses should also be included. Since the cooperation agreement, once drafted, should ideally not be changed, it is advisable to record concrete agreements on the construction project separately through annexes such as written minutes and supplementary agreements. The following applies: The more (sensitive) issues are clarified in advance of a construction project, the less potential for conflict there will be in the further course of the project! In terms of a good working atmosphere, however, it is important to maintain the right balance between organised cooperation and room for manoeuvre on both sides.

This first phase of establishing the cooperation partnership aims at finding a suitable partner, building trust and identifying possible conflict potential at an early stage. If in the course of the cooperation initiation it turns out that the ideas of the two parties are very different and the drafting of the cooperation agreement becomes problematic, it may make sense to refrain from cooperation. In such cases, more time should be invested in the search for a partner or, if necessary, the project should be abandoned altogether!

DEFINE STAKEHOLDERS, ROLES & TASKS

One of the most important steps in the beginning of the project is to identify all relevant stakeholders and to define their roles and responsibilities. Unclear roles and responsibilities can lead to big problems and misunderstandings

during the project. The following figure gives an example for the typical setting of stakeholders and their responsibilities in the partner-centred cooperation.

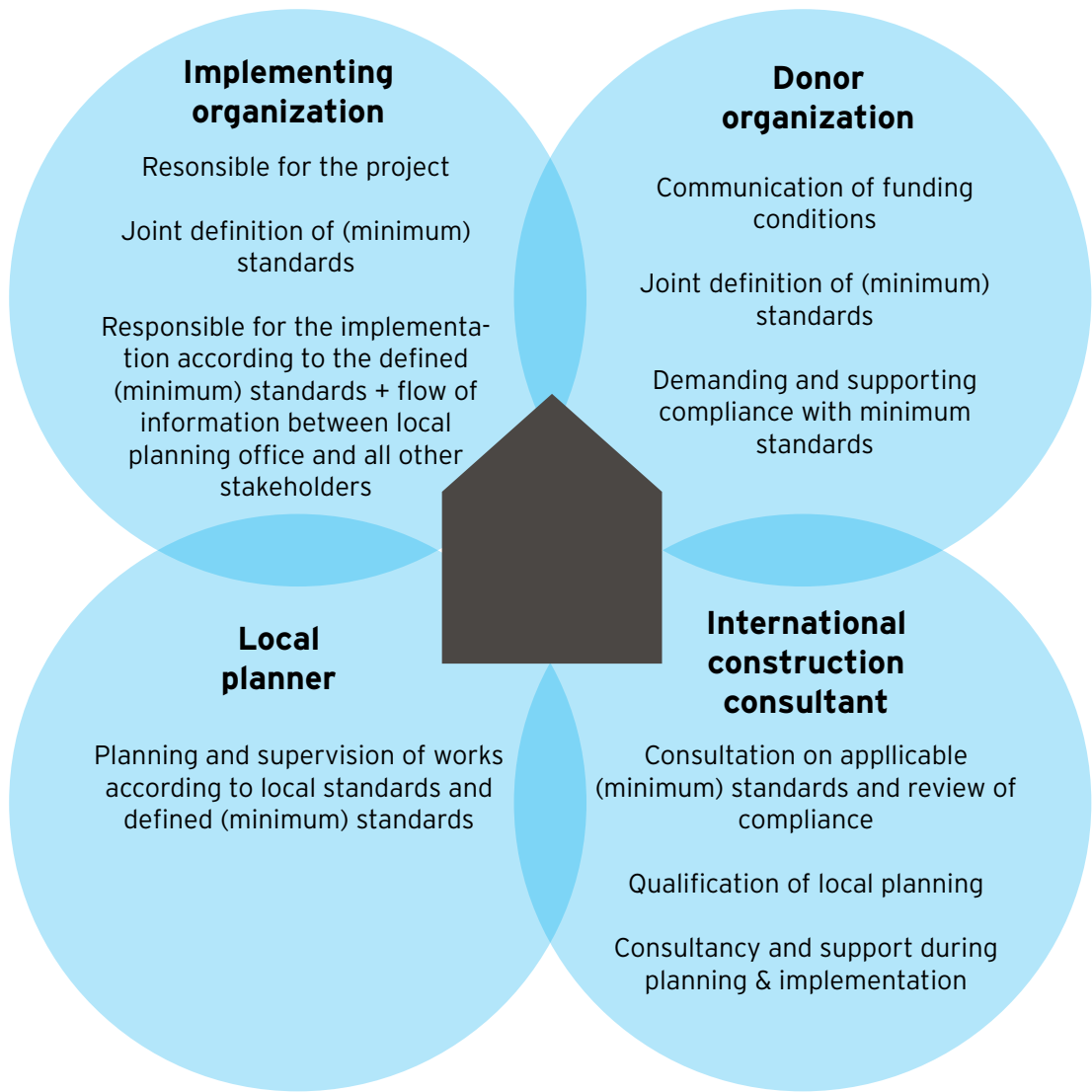


Fig. 5_ Typical constellation of stakeholders and their responsibilities

DEMAND ANALYSIS AND BASELINE ASSESSMENT

Every planning process begins with an analysis of the needs of future building users and the determination of the basic information required for the planning. These form the basis for planning in the further course of the project. It is therefore important that both the demand analysis and the assessment of the basics are carried out or checked by people with the appropriate socio-cultural and building skills.

During the needs assessment, the preliminary project objectives are put in the local context and examined for plausibility. In doing so, it should be generally scrutinised what the objective is and how it can be achieved. Can a goal be achieved in another way than by constructing a new building? Can existing buildings be used or converted?

A fictional example: A long-standing project partner expressed the wish to build new health stations in seven remote villages, as up to now there was only one central health station for the villagers and the trip to the station was very arduous - especially for people who were ill. In the course of the needs assessment, it became apparent that the construction and maintenance of seven new health centres would be very costly and the long-term financing could not have been secured. Therefore, alternatives were explored and a potential solution was to set up a mobile health station that would visit each village once a week.

Building usually involves a great deal of effort. On the one hand, a construction project offers a lot of potential for improving local living conditions, but on the other hand, it also involves a high level of risk and potential for conflict. Building is usually also about influence and resources, especially when financial resources are provided from abroad. The construction of new buildings therefore only makes sense if there is a verified need!

Once the basic need for a new building or a conversion has been established, the next step is to concretise the needs planning and to collect the planning bases: What spaces are needed and what are the quality requirements? What is the cultural context? What are the climatic conditions? What are the typical local construction methods? In addition, it is important to find out what skills the local craftsmen, construction companies and engineers have, what building techniques are used and what building materials are produced locally or are available.

It is also essential to clarify which local rules and laws are to be observed and where there may be gaps to international building rules and standards that are to be applied in the project.

The following list serves as a tool and includes the most important guiding questions for the needs analysis as well as for the basic assessment:

Needs assessment/ review:

- Definition of the task: What need has been identified or what problem needs to be solved?
- How can the need be met or the problem solved? Does a new building have to be constructed or can existing buildings be converted and/or rented, or is there no need for a construction measure because a non-constructional solution to the problem can also be found?
- Has the need for a building measure been identified?
 - »» What uses are to be accommodated in the building?
 - »» What space is needed for this?
 - »» What are the requirements for the quality of the space?
 - »» Is the use of resources justified in relation to the benefits?
- What are the objectives and how to adapt them to the local context?

Baseline assessment:

- Definition of future users and their characteristics (demographic, socio-cultural and use-specific)
- Determining capacities, qualifications and interest of future users to participate in the planning and implementation of the building project
- Definition of uses and areas (spatial programme):
 - »» What uses are planned (teaching, living, etc.)?
 - »» Which areas and rooms are needed?
 - »» Are there any special requirements for their quality (laws, standards, etc.)?
- Culture of the residents
- Site analysis, climate
- Local building culture (architecture, building techniques and materials)
- Existing building knowledge and skills (craftsmen, planners, etc.)
- Local capacities (materials, craftsmen, planners, etc.)
- Identification of potential risks (floods, earthquakes, hurricanes, etc.)
- Local building regulations and standards (laws, ordinances, standards) and comparison with international specifications (e.g. EN, DIN, ISO, SIA, ASTM, etc.) »» Contextual reference and proportionality!

CLARIFICATION OF LEGAL OWNERSHIP

Regardless of whether a new building is to be built, an existing one extended or converted or infrastructure constructed: The legal ownership of the property/properties should be clarified at an early stage; ideally already during the baseline assessment. Depending on the legal context (regional, traditional, religious, cultural, etc.), ownership rights will vary considerably and may be documented quite differently. For example, property rights are not everywhere recorded in land registers. Land may also be subject to tribal rights that allow access to land only for certain uses and user groups. Corresponding documents such as land titles or land register entries that specify ownership should definitely be documented. The focus here is on

securing long-term use for the intended purpose. Many „white elephants“ - buildings that are empty or not being used for their intended purpose - exist because of ownership disputes over the land. If the property is privately owned, it should be transferred to a (non-profit, church or state) partner organisation beforehand or the land should be leased with a long term contract (e.g. 50 years). Exceptions to this are, for example, private land in the context of (re)construction projects of private residential buildings. Furthermore, the question of what should happen to the land after the end of its designated use (e.g. for a school) should be clarified. These aspects should be part of a contract, such as the cooperation agreement.

(PRELIMINARY) DESIGN & TIME PLANNING

The (preliminary) design planning also includes a technical construction description, a cost estimate/calculation as detailed as possible and a time schedule in addition to the drawing design documents. Depending on the context, planning is done by local or international planning offices or in cooperation between a local and an international office. In the opinion of the workshop participants, it usually only makes sense to use international planning offices for most construction tasks if no (suitable) offices are available locally or if the situation requires it, e.g. after a natural disaster when as many shelters as possible need to be provided in a short time and no local planners are available. For innovative projects, on the other hand, cooperation between international and local offi-

ces can be advantageous, as „new“ ideas and knowledge can be brought in from outside. If the planning is mainly done by an international office, a comprehensive survey of the context is particularly important, as the international planners are usually not familiar with the local context.

No construction project should be carried out or supported without professional planning! Smaller organizations in particular often try to keep planning costs as low as possible and therefore sometimes refrain from professional planning. In doing so, they underestimate the importance of professional planning: the stability of structures can only be ensured through the work of competent planners!

In addition to the functional aspects (room sizes, spatial arrangement, etc.), other aspects also play an important role in the planning:

Building shape and orientation: How is the building shape designed? What are the advantages and disadvantages? Do the shape and building orientation allow an optimal use of/ protection from solar radiation, wind, rain etc.?

Aesthetics: Does the design correspond with the aesthetic perception of future users and the local communities?

Construction techniques and materials: What techniques and materials are used? Do they correspond with the cultural context? What is their influence on the indoor climate? Are the building materials resource-friendly in production, easy to maintain and recyclable?

Resilience: Which natural disasters can occur? Is the construction designed to withstand them without damage? What level of resilience to natural disasters makes economic sense while ensuring the protection of the population?

Surface sealing: What proportion of the land surface will be sealed by the construction measures? Can surface sealing be reduced, e.g. by optimising the building shape and choosing water-permeable constructions and materials for paths and squares?

Planting: What planting is present on the site? What impact will the construction measures

have on it? For example, can the existing trees be preserved? What new planting is planned in addition or at least as a compensatory measure?

Energy supply: What energy demand has been forecast for the (planned) building? Can it be connected to an existing energy supply network? Which renewable energies can be used in an economical and ecological way?

Energy-efficient/ climate-friendly construction: Is the design well adapted to the local climate in order to achieve (high) thermal comfort without the use of active systems (ventilation, cooling, heating, lighting)? Which active systems are necessary to ensure the comfort of future users? What options are there for making the active systems as energy-efficient as possible (construction and operation)?

Water supply: How will the supply of fresh water be ensured? Can the water supply be ensured by a public water supply network? Can a well be drilled for water supply? Are water storage tanks required?

Water disposal: How can the wastewater (black and grey water) be disposed of or treated for further use (irrigation, biogas production, etc.)?

Rainwater management: How is the rainwater that accumulates on the property managed? Can it seep away locally or be collected for other uses (irrigation, flushing toilets, etc.)?

Particular care should be taken in choosing construction techniques and materials to ensure that they are adapted to local conditions, such as craftsmanship and the availability of building materials, and that training is provided where necessary to improve construction techniques and for maintenance and rehabilitation.

Usually local traditional building techniques are compared to modern, international building techniques. In practice, local building techniques are often seen as inferior by partner organisations and target groups (e.g. earth or wood buildings), which is why they prefer modern building techniques and materials - usually reinforced concrete and masonry. But those are not always the better choice. In such cases, prejudices can be reduced through targeted communication and awareness-raising measures, such as presentations and visits to successful projects.

Finally, the planning documents should be checked by a competent building expert with regard to their completeness and correctness of the content. A prerequisite for this is that the check is carried out by a person with good knowledge of both the project context and the German and international building standards.

Regardless of the size and complexity of the construction project, the following planning documents should be available as a minimum:

- > **Plans:** a site plan showing the integration of the new building(s) into the surroundings, the floor plans of all storeys as well as a roof elevation, sections (at least longitudinal and cross-sectional) through the essential room situations (staircase, rooms, terraces, balconies, etc.) and all views of the building façade
- > **Technical building / construction description (architects report):** The technical description summarises all essential qualities of the plot and the building in writing: From the location and ownership of the plot to the planned building materials and technical building equipment.
- > **Cost estimate:** All relevant cost items are included in the cost estimate/calculation according to their planned dimensions as well as additional costs (planning fees etc.).
- > **Time plan / schedule:** The time schedule shows the planned duration of all work steps required for the construction project and their interdependence. In addition, public holidays and holiday periods as well as annual and rainy seasons, if applicable, should also be included in the time planning. Project stages of particular importance, which for example mark the completion of a project phase (granting of building permission, acceptances, interim acceptances and inspections, etc.), are referred to as milestones and should be marked accordingly in the schedule

FINANCIAL PLANNING & ECONOMIC EFFICIENCY CALCULATION

The preparation of a detailed financing plan is a basic requirement for a successful building project. The financing plan lists all costs associated with the acquisition (expenditure) for example for the construction/renovation of a building, including additional costs (interest on loans, fees, etc.). Furthermore, the financial resources (financing by NGOs, local partners, bank loan, etc.) are compared to the acquisition costs.

In addition, it is advisable to carry out a profitability calculation. This should include not only the acquisition costs for the construction/renovation of the buildings, but also the income (rent, donations, etc.) and expenses (supply and disposal costs, maintenance and repair costs, etc.) during the operation of the building and possibly also the costs for future renovations or demolition. Risks that are difficult to calculate, such as currency fluctuations and disasters, should also be taken into account. This serves to identify financing risks (cost explosions, financing gaps, etc.) and to secure the long-term operation of the building.

The recommended period of consideration is at least the planned useful life or even the planned lifetime of the building. According to the current BMZ guidelines (ZBauKirchen 2015), a commitment to use the building must generally be ensured for 10 years. Some Organisations even demand a minimum of 24 years for buildings and 10 years only for smaller constructions such as latrines, water tanks, wells.

In both cases, it is advisable to maintain an open and trusting relationship between the partner organisations (local NGO, donor etc.). Already at the beginning of the project, transparent communication should create the basis for mutual trust. It is also important that the local partner organisation itself covers a big part of the financing of the acquisition / construction. Whereas especially the operating costs should be covered completely with own funds from the local organisation / users / beneficiaries.

2-4 PHASE 2: CONSTRUCTION IMPLEMENTATION

BUILDING STANDARDS & CONTRACTS

In many countries of the Global South, there is a lack of suitable building standards for the planning and implementation of construction projects, e.g. on earthquake-resistant construction. In principle, the applicable building regulations must be complied with in every country. However, if these are not or only insufficiently available in the project countries, a recommendation would be to supplement the existing rules with suitable international standards. However, the standards should be adapted to the respective context. Often, international building codes and standards are used because of time pressure, such as the US International Building Code (IBC), which may not be adapted to the specific situation. On the other hand donors often have their own (minimum) requirements / standards for construction measures. This is especially the case if they are financed with funds from public donors such as ministries. This handbook is aiming to give an advice on applicable (minimum) standards and how to implement them in the following chapters. These (minimum) standards and other requirements should also

be integrated in a cooperation agreement as a basis for the cooperation and in contracts with the local planners and construction firms.

Contracts help to create clarity about the rights and obligations of the parties involved (donors, implementing organisation, planners and construction companies) and thus help to avoid and clarify conflict situations. The planned quality requirements and (fair) payment conditions can be defined and warranty obligations in the event of defects and (structural) damage can be set out. In addition, security retentions can be agreed, which are only paid out some time after completion (e.g. twelve months, better longer) if no defects have occurred. In practice, however, this is difficult to handle in many contexts. On the other hand, positive experiences was made with bonus payments, e.g. for completion on schedule and sustained good quality. The bonus payment was paid in addition to the agreed fee/contract value, which in principle corresponds to a positive variant of security retentions. Also a combination of both is possible.

BUILDING PERMISSIONS

As a general rule, building work should not be started without a building permit! Despite the undisputed general validity of this statement, in practice there are always isolated projects whose construction was started or even com-

pleted without a building permit. This can lead to considerable difficulties for the project if, for example, the responsible authorities prohibit the intended use due to the lack of a building permit and/or building inspection.

Only in cases where no building permits are issued by the local authorities or if there is no requirement for a building permit by the local government exceptions should be made and

alternative proofs for the respect of local standards can accepted, if the donor organisation and the construction consultant approve to this.

CONSTRUCTION MANAGEMENT

The application of an adapted, qualified construction management across all phases of construction projects is a prerequisite for successful project realisation. This means above all the use of experienced construction experts and sufficiently qualified personnel. Frequent changes of personnel should be avoided as far as possible, as continuity in the project team is a decisive factor for successful knowledge transfer and trusting cooperation. This also applies in particular to construction.

Preferably, local personnel should be used for planning, construction management and construction. In the case of construction projects with high requirements for which there is no local capacity, it is necessary to resort to external, specialised planners, construction companies and craftsmen from neighbouring regions, countries or even internationally.

Different strategies can be used for smaller and simple construction projects in rural areas. In the following, two options from the practice of German Organisations are presented:

- One option is the use of already locally available and sufficiently qualified skilled workers (technicians, craftsmen, semi-skilled workers). In addition, the training of skilled workers within the framework of

construction measures is also a possibility. However, this only makes sense if they do not work as day labourers but permanently on the construction site and if they are accompanied by experts (e.g. engineers), who plan and supervise the works.

- Another possibility for the realisation of smaller, simple building projects is the construction of guided self-construction by future users. Here, too, qualified specialists are needed who plan and coordinate the work and are responsible for fulfilling the defined quality standards - through instruction, control, and execution of components relevant to stability. In addition, training of the „unskilled“ users is necessary. The coordination effort for this is usually much higher than the construction by experts, but in most cases, it results in a high identification with the building and a strengthening of the future users' sense of responsibility towards it - keyword „ownership“. At the same time, they learn the necessary manual skills for the maintenance of the buildings.

Cash for work“ programmes serve as a means of implementing construction projects with the involvement of the local population. As the name implies, money is paid for work, e.g. for transporting building materials. „Cash for

Work“ projects can strengthen the acceptance of construction projects by improving the (financial) living situation of the participants. This is especially the case if they are future users. In contrast, an extension of „Cash for Work“ projects to other population groups has also led to difficulties in the practice of some organisations (strikes to enforce wage increases, etc.).

The basis for construction is detailed work planning - this is mandatory to achieve a sufficient to very good construction quality. As far as possible, all technical details, from the number and shape of the reinforcing steel to the wall colour, should be defined in the works planning. In addition to the construction drawings (usually 1:50 or 1:20 scale), this is mainly done in a detailed construction and performance description.

This high complexity of planning documents requires appropriately qualified personnel for construction management who have sufficient (construction) expertise and practical construction experience based on planning documents. The local presence of the person responsible for managing and securing the construction site (usually a site manager) throughout the entire construction period is of crucial importance for the quality of the construction work. Their accommodation in the local community during the construction period usually has a positive effect on the acceptance of the construction project by the population.

In addition, a (trustworthy) guard is usually needed on the construction site, both to ensure safety on the site and to counteract theft of construction materials.

ADDITIONAL COSTS AND DELAYS IN THE CONSTRUCTION PROCESS

Unforeseen additional costs and delays often occur in the construction process and are usually unavoidable. For example, during construction there are often cost increases due to exchange rate fluctuations, inflation, etc., which were not taken into account in the budget. Likewise, time delays can occur due to problems with material transport, material availability, personnel availability or traditionally different time management etc.. These are related to the respective situation in the country and are difficult if not impossible to reconcile with the requirements of the funding agencies.

In both cases, it is advisable to maintain an open and trusting relationship between the local partner on the one hand and the donors on the other. Already at the beginning of the project, transparent communication should create the basis for mutual trust. Only in this way is the local partner likely to inform the funding partner organisation about problems in good time and mutually agreeable solutions can be found together.

2-5 PHASE 3: COMPLETION, USE & MAINTENANCE

BUILDING/ CONSTRUCTION ACCEPTANCE AND GUARANTEE

After completion of the construction works a construction / building acceptance should be organized. Therefore the quality of construction works have to be verified by a construction expert, the construction company / craftsmen and the client and all construction defects listed in a protocol with defined delays for the correction of these defects. Only after

the implementation of the corrections the final instalment should be made. Anyway a guarantee of min. 5% should be retained for min. 1 year, up to 5 years, in order to ensure that the construction company will cover further corrections that might occur due to defects that were not visible at the time of the final acceptance.

COMPLETION/ EXTENSION BY THE FUTURE USER

The identification with and usability of the building / construction by future users is an important factor for maintaining a good construction condition. Therefore, the question is whether and in which cases it makes sense to have a completely finished building / construction built by construction staff or to allow for adaptations by future users, e.g. through partial completion with the option of finishing on one's own. Some transitional shelter concepts follow the latter approach.

In practice, many organisations already have positive experiences with expandable residential buildings, where, for example, parts of the building (bedroom and bathroom) have been completed and a terrace has been laid out for later expansion. This is usually also compliant with the requirements of the funding agencies. If, however, the state of completion at the end of the project does not allow for adequate use of the building, this can lead to conflicts with the funding agencies. Funding guidelines usually require the buildings to be completely finished at the end of the project.

CONSTRUCTION USE AND MAINTENANCE

Already at the beginning of the project, the question of suitable concepts for the long-term use and maintenance of the building must be considered: Can the building be adapted to changed usage requirements? How is the building to be maintained? Are local experts or

even the users themselves able to carry out maintenance and repair work on the building and/or the technical equipment, or can they be enabled to do so?

After completion, it is necessary to take further

measures for the long-term preservation of the construction. The following measures are particularly suitable for large residential buildings with several residential units as well as for non-residential buildings (schools, hospitals, etc.) an infrastructure measures:

- Appointment of a person responsible for maintenance and servicing
- Training of local technicians/ craftsmen and, if necessary, users on maintenance and servicing
- Preparation of a maintenance and servicing plan
- Preparation of a user manual with (illustrated) instructions on maintenance and

servicing of the structure and the system technology

- Dedicate a budget and build up reserves (by the user organization) for maintenance and repair >> Included in the profitability calculation (for new constructions min. 0,5 - 1% of the construction costs are recommended for the first years after commissioning)
- Conduct training for users to prevent damage of the construction caused by use, e.g. through wrong ventilation methods in buildings
- Maintenance and care of communal facilities such as shared sanitary facilities by all users or by an external service

EVALUATION/ MONITORING

In order to use experience and knowledge from completed projects for current or future building projects, evaluations - of the structural and technical condition of the buildings / constructions, the consumption and the user satisfaction - are of crucial importance. Many professional organisations use this tool. However, most evaluations are rarely carried out long after the completion of a project, but rather

at a time when there is little or no knowledge about the use of the building and/or possible hidden deficiencies. Therefore, it is recommended to evaluate buildings / constructions also after a longer period of use (e.g. after 5 years).

2-6 CROSS-CUTTING ISSUES: OWNERSHIP & PARTICIPATION

OWNERSHIP

The aim of the planning and construction process should be to achieve the acceptance and identification with a project of the actors involved, especially future users, so that they also take responsibility for the building in the future.

Ownership is now regarded as a guiding principle for successful cooperation in partner-

ships (cf. Nuscheler 2008: 14 ff.). The term „ownership“ means to take responsibility. In the context of development cooperation, it is used to describe the identification of people with a project that affects them. Ownership especially refers to the responsibility of target groups and partner organisations (cf. BMZ, n.d.).

PARTICIPATION

Participation of the target group and partner organisations in the building process is seen as a central means of strengthening ownership: Both should be significantly involved in the planning process from the beginning or even take responsibility for the building project themselves. This applies to the planning and decision-making process as well as to the construction and especially the operation of the building.

Usually, a distinction is made between four different levels of participation in the sense of taking part in decisions (cf. SenStadtUm. 2012: 29). Here are some examples of these different levels of participation in the reconstruction of buildings:

- **Information:** Conducting information events on the already completed planned residential building.

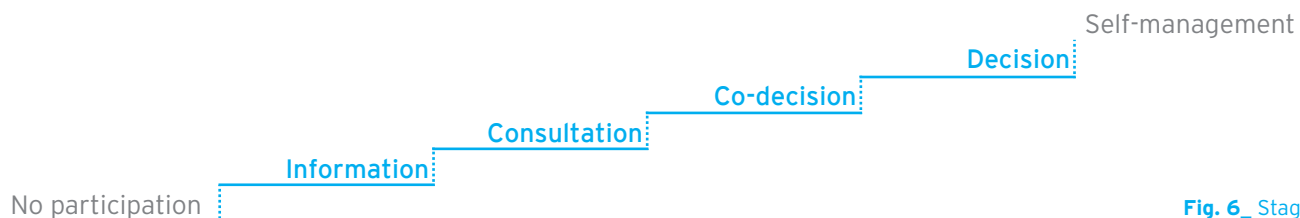


Fig. 6_ Stages of participation

- **Participation (consultation):** Asking future users about their needs and requirements for the residential building as a basis for planning.
- **Co-decision (cooperation):** Future users can decide on the design of the residential building in consultation with the planners, e.g. on the layout of the rooms.
- **Decision-making (self-management):** After a natural disaster, those affected receive help in the form of money and can decide for themselves how to rebuild their residential building.

In short-term disaster relief, participation often cannot have the same priority as in medium- and long-term development cooperation. Participation usually requires additional time and money at the beginning of the development and planning phase and must be taken into account in the time planning. However, if the entire construction process is considered, time and funds can also be saved through participation - even in emergency relief.

An example: After the devastating earthquake in Haiti on 12 January 2010, countless NGOs came there to help rebuild homes. In one remote region, two NGOs worked on reconstruction at different times. The first NGO worked without the participation of the village community and made its own decisions on whose house to rebuild - this led to high social tensions and eventually the reconstruction had to be stopped. The second NGO invested a lot of time in the formation and participation of a local committee consisting of representatives of

the village community. Together with the committee, selection criteria for the reconstruction of houses were first defined. Their evaluation was then carried out in consultation with the committee, with technical aspects being assessed by external construction experts. Based on the evaluation, the decision was finally made jointly as to whose house should be repaired or rebuilt. The participation process thus required more time and resources at the beginning than in the first organisation, but led to a much better result overall.

The question about meaningful levels, methods and actors of participation therefore always belongs at the beginning of the process: goals, actors, form and framework for participation must be defined and communicated at the beginning of the project. It is important to provide transparent information about the objectives and the scope for decision-making so as not to raise false expectations among the actors involved. The distribution of roles should also be clearly communicated.

The consideration of cultural backgrounds and local power structures can promote inclusion, but also hinder it.. Where citizen and user participation is already practised by partner organisations in other areas, it is usually easier to carry out participation processes with a high degree of decision-making competence than in strictly hierarchical structures where this lies with a small elite. Moreover, not everyone is willing and/or able to participate in the process. Depending on the context, very different levels and forms of participation can therefore be meaningful and effective.

Regardless of the level and form of participation, trust and respect between partner organisations, target groups and the project team form the basis of a successful participation process. Therefore, a certain eye level between the actors should be ensured. In practice, it has proven beneficial, for example, if the working and living conditions for the international project team are the same as for the local partners (e.g. accommodation, transport, etc.).

In addition to many advantages, participation also involves risks. A participation process can even have a negative impact on the acceptance of or identification with a construction project. This is particularly the case if hopes and expectations that were attached to the participation process are not or only insufficiently fulfilled - e.g. if participation is promised, but decisions have already been made in advance and the process is thus not conducted in an open-ended manner. It is therefore important to stick to the opportunities for participation that were communicated at the beginning of the process!

2-7 CROSS-CUTTING ISSUES: TRANSPARENT COOPERATION & COMBATING CORRUPTION

There are cases of corruption in many construction projects. This is not only the case in countries of the Global South, but also in “the North”. The national organisation of Transparency International in Germany defines corruption as: „The abuse of entrusted power for one’s own benefit or advantage.” (Transparency Deutschland 2016: 3). In this context, corruption is even seen as harmful to self-interest by most corrupt actors; they would like to do without it, but are prepared to accept it in an emergency and assume that corrupt behaviour is the norm. Transparency in cooperation and communication with other actors should therefore lead to avoiding corruption (cf. Gauer-Lietz 2016).

Particularly in emergency and disaster relief, there are often cases of externally caused corruption that are difficult to influence by those responsible for the project: One example is the demand for so-called acceleration money, without which urgently needed goods are not delivered or released. Due to time and moral pressure, sometimes there seems to be no way around payment. Lack of resistance often leads to higher and higher demands. There-

fore, payment should also be refused here if possible (cf. Transparency Deutschland 2007: 11 ff.).

In contrast, corruption caused within a project can be actively avoided. Corruption manifests itself, for example, through the misappropriation of project funds, the retention of financial gains (currency exchange), the preferential treatment of related persons or groups of persons in the awarding of jobs and contracts, as well as bribery and/or threats to confidants (cf. Transparency Deutschland 2007: 8 ff.).

Transparency serves as an effective means of combating corruption. Transparency Deutschland recommends transparent information on the flow of funds, on planned projects, on payment conditions and actual payments and, above all, that this information is kept up to date. Access to this information should be as low-threshold as possible, in the sense that it should be easy to find and use. Publication on the internet is a particularly effective means of achieving this (cf. Transparency Deutschland 2013).

In construction projects, the following additional measures are suitable for ensuring a corruption-free working method:

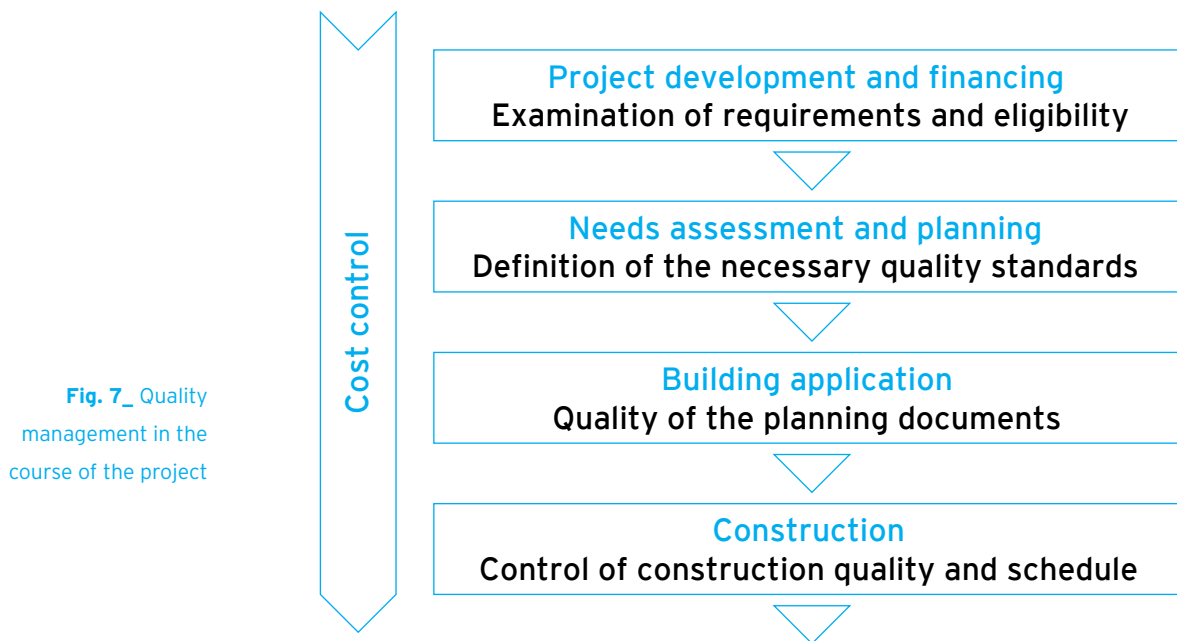
- Setting an example of continuous, transparent communication and working methods
- Local presence of one's own organisation and partner organisations
- Definition of behavioural guidelines to combat corruption
- Clear definition on the use and disposal of financial resources
- Establishing simple and clear principles: e.g. no expenditure without receipts.
- Coordination with partners on the issue of corruption: What is corruption? When do I behave corruptly? How do I deal with corruption?
- Educating all project partners and involved actors on what corruption is and demanding a corruption-free way of working (also by means of a contract) as well as the obligation to pass this on to third parties (e.g. subcontractors).
- Establishment of anonymous complaints mechanisms (e.g. „complaint box“ or „transparency officer“)
- Involvement of third parties to check transparency (e.g. a „monitor“ from the regional Transparency International chapter)
- Claiming and control of invoices and accounting
- Implementation of sanctions in case of identified corrupt behaviour

Possible sanctions in case of identified corruption include the dismissal of employees or companies involved, imposing financial and legal penalties, but also the termination of the cooperation. There is always a risk that sanctions will affect those for whom the project is intended for, and not those who act in a corrupt manner. Therefore, it should be considered in the respective context which sanctions are suitable to effectively fight corruption and at the same time achieve the actual project goal (e.g. ensuring built space for people in need).

2-8 CROSS-CUTTING ISSUES: QUALITY MANAGEMENT & MONITORING

Building comes with great responsibility. Buildings form the third skin of human beings and should provide protection against harmful external influences from people and nature. The planning and construction process itself also have an impact on the people affected and their environment. Therefore, and especially because of the increased public attention when international organizations and/ or

planners are involved in the process, it is all the more important that no negative impact emanates from the construction project and that constructions completely fulfill their protective function. For this purpose, quality control measures should be taken throughout the entire planning and construction process (see Fig. 7):



CHECKING THE NEED AND THE ELIGIBILITY FOR FUNDING

The preparation of a project outline (concept note) has proven to be a very good means of reviewing needs before funding is identified. It summarizes the main results of the needs assessment and the baseline survey. It should also include a spatial programme with information on the number and areas of rooms / equipment needed, a cost estimate based on comparable construction projects in the region, and a time schedule. The concept note should be reviewed by a construction professional who will prepare a technical opinion report.

Here is an example of a concept note outline:

- Project background (e.g. natural disaster)
- Key results of the needs analysis
- Project description
- Location and property (land register entry, purchase contract, possibly geological survey etc.)
- Programme (room/ spatial programme)
- Cost framework/estimate (cost per m2)
- Available resources on site (building material, craftsmen etc.)
- Quality management (definition of planner & site engineer)
- Tendering and awarding process
- Time schedule
- Risk analysis (natural disasters, conflicts, political situation etc.)

DETERMINING THE NECESSARY QUALITY STANDARDS

Most projects struggle with the gap between local and international quality requirements. The goal should be to define context-specific (minimum) standards that incorporate local standards and supplement them with meaningful international standards. Minimum standards such as the stability of buildings and escape routes must not be negotiable. Other standards have to be regarded in the context. A negative example of implementing quality standards is for example the construction of an elevator for barrier-free access to classrooms on the grounds of a rural school, although the school does not have an sufficient electricity supply and also the maintenance is very difficult and costly! In order to avoid such less useful construction measures,

the minimum standards should be defined at the beginning with all relevant stakeholders (especially with donors, local partners and the planning team). Planning then takes place on the basis of the defined standards and should be checked with regard to their consideration. Many German NGOs follow the principle of the "application of the higher standard", which means that for some aspects such as security and accessibility the German standards will be compared with the local standards and the higher / stricter standard has to be applied. This publication aims to give orientation on exactly this topic and therefore the following chapters give an overview on the most important (minimum) standards.

QUALITY OF THE PLANNING DOCUMENTS

Before a project is approved or a building application is submitted, the planning documents (plans, technical description, cost estimates etc.) must be examined. Suitable construction experts should also be commissioned for this, which is common practice in many orga-

nisations: the documents are examined for completeness and quality and a construction expert opinion should be prepared. The list on the following pages provides an overview of the minimum information that should be included in the respective planning documents.

MONITORING CONSTRUCTION PROGRESS AND QUALITY

On-site presence has proven to be a central means of monitoring the progress and quality of construction. Continuous project monitoring during the construction phase should be carried out by the contractor's construction management and the client's construction supervision. If the contractor's own organisation is not directly present on site or does not have the necessary competences, construction monitoring can be carried out by a partner organisation or by third parties, such as a commissioned architectural or engineering firm.

A combination of regular monitoring by local partners/ construction experts with selective monitoring by their own organisation from a distance has proven successful. An important instrument for this is the continuous documentation of the construction progress through digital photos, keeping a construction diary as well as regular reporting to one's own organisation and partner organisations.

Tasks of construction supervision include:

- Checking the conformity of the construction work with the planning and the legal requirements and other requirements (e.g. minimum standards from donor organisation)
- Monitoring the time schedule
- Checking the quality of materials
- Keeping a construction diary
- Measuring the completed construction work together with the construction companies
- Acceptance of construction work, identification of defects and control of their elimination
- Invoice checking
- Cost control during construction
- Cost assessment
- Documentation
- Reporting

COST CONTROL

As with any construction project, costs should be analysed continuously during the course of the project and compared with the quotation, the original cost framework and the cost estimate and calculation, especially during construction. This makes it possible to keep an eye on expenses and, if necessary, to take measures to avoid cost increases or to acquire additional funds. According to DIN 276, there are the following stages of cost determination:

Cost framework: The cost framework serves as a basis for decision-making in requirements planning. It is normally calculated without knowledge of the building design on the basis of the room programme per m² of planned floor space. For this purpose, the costs of comparable building projects are used (if available). In addition to the presentation of the total costs, at least the construction costs should be shown separately.

Cost estimate & cost calculation: Cost estimation takes place in the preliminary planning, cost calculation in the more detailed design planning. The two differ in the accuracy of the calculation: while the cost estimate is usually based on the costs per component element (e.g. an exterior wall), the cost calculation also takes into account the individual component layers (e.g. masonry, plaster and paint). In development cooperation and disaster relief construction projects, the cost estimate is often not carried out separately and the calculation is usually only carried out on the basis of the design planning.

Quotation: Here, the costs are normally calculated on the basis of the offers from construction companies. The quotation is also used to compare the offers of several bidders and thus to make a decision for awarding the contract.

Cost determination: All costs actually invoiced and paid after completion are recorded here. Evidence of own work can also be taken into account in the cost statement.

Operating costs: Particularly in the case of non-residential buildings, the expected operating costs should also be calculated before construction begins and a corresponding financing concept should be prepared.

Similar to the cost estimation/calculation according to DIN 276, the cost categories listed on the following pages should be taken into account in the cost calculation.

As an alternative to the planning-oriented sorting according to cost groups, they can also be sorted according to execution in line with the award structure, e.g. according to trades (carpentry work, masonry work, etc.). However, listing according to cost groups is easier to understand for most laypersons. At the latest from the cost estimate onwards, it is advisable to list the costs in accordance with the award structure. This facilitates comparison with the real costs and thus cost control during construction. The level of detail of the cost determination increases from the preparation of the cost framework to the cost statement. When determining the cost framework, at least the



Continued on page 42

Design plans

- Site plan (scale 1:500/ 1:1000)
 - Access roads and paths with qualities (material etc.)
 - Property boundaries
 - Main facilities (existing and planned buildings and their components)
 - Secondary facilities (existing and planned parking spaces, waste disposal areas, facilities for water supply and disposal, installations for energy supply etc.)
 - Elevations (heights of the top edge of the finished floor EC in relation to sea level and the terrain, terrain contours: Elevation points or contour lines)
 - Scale & north arrow
- Construction / Building plans (scale 1:100/ 1:200)
 - Floor plans
 - Floor plans of all floors
 - Illustration of the ground floor plan with outdoor facilities
 - Roof view
 - Exterior and interior dimensions
 - Inclination (roof, ramps etc.)
 - Room designations and area details (floor area)
 - Door and window openings with marked door or window opening direction
 - Parapet heights of window openings and railings
 - Height details (Finished Floor level, ground surface etc.)
 - Staircase dimensions (width, stair rise)
 - Information on fire protection qualities of building components
 - For renovation/extension projects only: use of different colours for existing structures (black), planned demolitions (yellow) and new constructions (red)
 - Scale & north arrow
 - Elevations
 - (Façade)Views from all directions
 - Window opening direction and type
 - Railings, balconies, terraces
 - Height details (Finished Floor levels, height of railings, ground surface etc.)
 - Scale
 - Sections
 - At least one longitudinal and one cross-section through the building
 - Heights (dimensions of all major components Finished Floor levels of all storeys, ground surface etc.)
 - Dimensions of cut window and door openings (parapet & opening height)
 - Slopes (roof, ramps etc.)
 - Scale
 - Determination of the area
 - Presentation of the main areas (gross floor area, net floor area, etc.)

Fig. 8_ Overview of required planning documents and their content

Technical description

- Property
 - Climate
 - Connection to transport system
 - Ownership of the land
 - Land area
 - Description of the plot and its surroundings (location, height above sea level, existing development, etc.)
- General description
 - Execution of the construction measures: Tendering & type of tendering, own work etc.
 - Construction management/supervision
 - Acceptance procedure
 - Risks (earthquakes, hurricanes etc.)
 - Standards used as a basis for planning
- Construction
 - Bautechniken und Materialien nach Bauelement: Mauern, Decken, Dach etc.
 - Innenausbau: Bodenbeläge, Farben, Türen und Fenster etc.
- Technical Equipment
 - Systems engineering: heating, ventilation, air-conditioning etc.
 - Sanitary installations
 - Electrical installation
- Outdoor facilities
 - Green areas, terraces, car parks, etc.
 - Technical installations in outdoor areas (outdoor lighting, fountains, etc.)
- Equipment
 - Electrical appliances (TV, HiFi etc.)
 - Furniture
 - etc.

Cost estimation/ calculation

- General
 - Inflation rate in the project country
 - Exchange rate (national currency project country : donor country currency)
- Land (cost/m² land are) Grundstückswert (Wertgutachten)
- Preparation and development (cos/m² plot area)
 - Demolition
 - Felling of trees
 - Public and non-public development (roads, electricity, water etc.)
- Construction (costs/m² floor area)
 - Excavation pit
 - Foundations
 - Walls
 - Ceilings
 - Roof construction
 - Openings (windows and doors)
 - etc.
- Technical equipment (costs/m² floor area)
 - Heating, ventilation, cooling
 - Electrical and IT installations
 - Sanitary installations
- Outdoor facilities (cost/m² plot area)
 - Green areas, terraces etc.
 - Technical installations in the outdoor area (outdoor lighting etc.)
- Equipment
 - Electrical appliances (TV, HiFi etc.)
 - Furniture
- Additional building costs
 - Planning fees (architecture, statics, consulting, etc.)
 - Financing costs
 - Fees, taxes etc.
- Contingencies



Continued from page 39

construction costs should be shown separately from the total costs. The quotation and cost statement should be made in the same level of detail according to award units (e.g. masonry wall, plaster, wall paint) so that the costs can be compared directly with each other (cf. BKI 2016: 32ff.). In addition, it is advisable to include a risk allowance, e.g. for currency fluctuations and/ or price increases.

In particular, cost frameworks and cost estimates/ calculations usually also serve as a basis for finding financing and for funding commit-

ments. Financing additional costs that arise later in the course of the project is usually a major challenge. As a general rule, the real costs are not reflected until the costs have been determined. In the preceding phases, significant deviations are quite common: In Germany, these may deviate from the established costs by +/- 10% in the quotation and by +/- 20% in the cost calculation. In the partner country, the deviation can be significantly higher, depending on the availability and quality of cost information for comparable construction projects and a realistic consideration of risks.

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3_PLANNING GUIDE TECHNICAL (MINIMUM) STANDARDS

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3-1 INTRODUCTION TECHNICAL (MINIMUM) STANDARDS

Risks & opportunities

The purpose of construction measures is to protect people from negative environmental influences and other potentially dangerous creatures and to ensure the supply of utilities. Buildings in particular must be able to withstand a variety of dangers and be accessible to all users. In addition to humans and wild animals, the greatest threats include heat and extreme cold, fire, earthquakes, strong winds/storms and dangers from precipitation, floods and storm surges, e.g. as a result of earthquakes or in connection with hurricanes. Due to climate change, the frequency and intensity of extreme weather events, such as torrential rain and storms, is increasing. It is even assumed that these can have an influence on the occurrence of earthquakes. In particular, fires, storms, floods and earthquakes are natural events that existed before humans walked the earth. And they themselves usually do not kill people. Buildings and other structures that are not designed to withstand these natural events are responsible. Most natural disasters can be planned for - they recur at more or less regular intervals. This includes the seasonal occurrence of hurricanes and heavy rainfall as well as the somewhat more irregular occurrence of earthquakes, which might occur on average every 50 years, for example, but sometimes also occur more frequently (e.g. Haiti in 2010 and 2021). While hurricanes in particular still allow time for preparation and evacuation, the situation is dif-

ferent for natural events that are more difficult to plan for, such as earthquakes.

Technical (minimum) standards should serve to protect users from the above-mentioned hazards and create a safe and liveable environment through anticipatory planning. Since the specific requirements can vary greatly depending on the context, it is important to define the requirements for the construction measures at the start of any planning process and to assess the local context and, in particular, the local risks and design the planning accordingly.

Appropriate solutions can be developed on this basis with the involvement of the relevant specialists. These can range from the choice of location to urban planning and design solutions to the use of suitable plant technology.

(Minimum) standards and the principle of „application of the higher standard“

While there are very specific requirements for accessible planning and protection against fire and its spread between and within buildings, there are various principles for climate-adapted construction and protection against the effects of earthquakes, storms and flooding, among which the appropriate ones should be selected. For all construction measures and every risk, it is essential that planning is carried out by suitably qualified experts, usually

engineers and architects, and that it is adapted to the respective context. The planners should take into account the (minimum) standards defined at the start of the project in the planning and also ensure that all other locally applicable standards are taken into account.

Generally the principle of „application of the higher standard“ applies to the definition of (minimum) standards. To give an example: for construction projects with funding from Germany the standards valid in Germany are compared with the standards valid in the respective project country and the higher standard is applied. For example, when planning escape routes, the requirements applicable in Germany (length of escape route, width of escape route, direction of door opening, etc.) are compared with the requirements in the respective project country and the stricter requirements are applied. If, for example, a maximum escape route length of 35 m and a width of min. 1,20 m is required in Germany, but a maximum escape route length of 40 m and a width of min. 1,5 m is required in the project country, a maximum escape route length of 35 m and a width of min. 1,5 m applies for the respective project.

Escape routes	German standard	Local standard	Applied standard
Max. Length	35 m	40 m	35 m
Min. Width	1,2 m	1,5 m	1,5 m

The responsibility for comparing the standards lies with the planning office responsible for

the planning - usually the local planning office. However, as this office generally has no knowledge of the standards applicable in Germany, it relies on the transfer of knowledge about these standards and on the support of appropriately qualified building consultants.

The following chapters present (minimum) standards based on German regulations and standards for the following areas:

- Safe building (escape routes & fire compartments)
- Resilient construction (earthquake, storm and flood-proof construction)
- Climate-adapted construction
- Accessible construction

These (minimum) standards are not to be understood as complete and all-encompassing, but merely represent the (minimum) standards from the practice of humanitektur that are relevant in most projects (usually with a funding amount < EUR 1 million). Depending on the complexity of the project and the requirements of the donor organisation or financing institutions, such as the German Federal Ministry for Economic Cooperation and Development (BMZ), further (minimum) standards may be required. For example, projects with more than EUR 1 million in BMZ funding have significantly higher requirements for the scope of the (minimum) standards to be applied than projects with less than EUR 1 million in BMZ funding.

3-2 SAFE BUILDING DESIGN - ESCAPE ROUTES AND FIRE SECTIONS

OBJECTIVES OF SAFE DESIGN

A safe building design includes measures to protect against fires and that enable the users to escape in the event of fires, but also in the event of earthquakes, storms and floods or even attacks by armed men. Fire protective measures shall prevent the development of a fire and the spread of fire and smoke. The rescue of living beings and effective fire-fighting are also part of fire protection. Therefore architectural guidelines on escape routes and fire sections are essential planning tools for the design of safe buildings. This chapter explains the principal planning rules of escape routes and fire sections so that they can be taken into account at the earliest planning phase.

Particularly in factories in the global south, fires with many victims occur again and again as a result of insufficient safety standards. For example, in 2012, when a textile factory in Ban-

gladesh burned down. As there was no independent escape route from the building planned and the fire quickly spread to the entire first floor and upper floors, people were trapped on the upper floors and tried to escape through the windows, from which they jumped and were seriously injured. More than 100 people died.

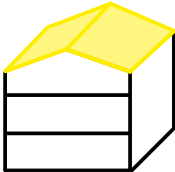
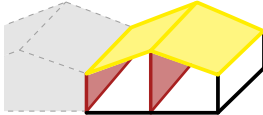
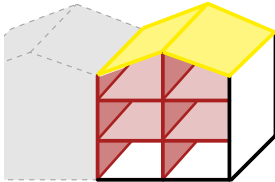
In the event of a fire, the number of victims depends on the quality of fire protection in a building. Well-planned escape routes and the setting up of fire sections that prevent a fire from spreading rapidly and uncontrollably are key to survival.

The information in this chapter refers to European and German laws, directives and standards, but were adapted in order to simplify them. References are BauOBl, MBauO, MSchulbauR, ASR A, MVStättVO, Muster-KhBauVO.

BUILDING CATEGORIES AND TYPES

The recommendation for escape routes and fire sections are determined by the position and height of the building. In addition, fire protection requirements increase based on the number of use units and the size of the floor area. Use units means a separate series of occupied rooms intended for the use by one person or a group of persons with the same purpose of

use such as apartments, commercial space, conference rooms, treatment room, classrooms or offices. Furthermore the use of buildings such as residential, educational, health care facilities and the number of occupants are decisive for the design of escape routes. However, very small buildings that are not intended for longer occupancy such as latrines

Free-standing building		(Non) free-standing building	
Single storey	Multi storey	Single storey	Multi storey
			
• Only one use unit and • Total floor area < 400 m² • Min. 5 m distance to neighbour buildings	• Only one use unit and • Total floor area < 400 m² • Min. 5 m distance to neighbour buildings  Non-combustible roof covering	• Use units ≥ 2 and/ or • Total floor area ≥ 400 m² • min. 5 m distance or fire wall to neighbour buildings  Non-combustible material  Non-combustible roof covering	• Use units ≥ 2 and/ or • Total floor area ≥ 400 m² • min. 5 m distance or fire wall to neighbour buildings  Non-combustible material  Non-combustible roof covering

are excluded from this requirements. In the case of increased fire loads and explosion risk, stricter regulations apply and need to be discussed with a construction expert and the funding agency.

Fig. 9, Fig. 10 and Fig. 11 give an overview of the (minimum)standards for safe building design. Fig. 9 shows the requirments for non-combustible walls and ceilings between units of utilisation. Fig. 10 and Fig. 11 show the requirements of escape routes and the technical details for different building types. Dimensions may differ from other requirements such as accessible design, but both must be taken into account.

Specific building uses

For specific building uses, higher requirements are imposed because it is to be expected that the users will not be able to save themselves so

easily. Nevertheless the above mentioned standards also apply to specific buildings.

Hospital/ health care buildings

For hospitals/ health care buildings must be assumed that patients can save themselves only slowly or only with assistance, therefore the requirements for escape routes and fire sections are more strict. In addition, it must be taken into account that some patients may not be able to get up and must be rescued in the hospital bed.

Educational buildings

Fire safety in educational buildings must be adapted to the needs of children. Due to their body dimensions, limited experience and reduced awareness of risks, it can be assumed that children need help and guidance during their escape and that the escape will not always run smoothly.

Fig. 9_ Illustration of building categories

Building categories			Fire sections	Escape routes
Freestanding building	Single-storey building	Max. 1 use unit Total floor area < 400 m ²	No requirements	• Min. two independant escape routes per unit of use are required! • Emergency exits: The first route has to lead via a door, the second can lead via windows (only for <200 persons per use unit) or another door
		Use units ≥ 2 Total floor area ≥ 400 m ²	• Fire spread between each unit of use or max. 400 m² floor area and/ or after 40 m must be inhibited by fire walls	
	Multi-storey building	Max. 1 use unit Total floor area < 400 m ²	• Non-combustible roof covering	• Min. two independant escape routes per unit of use are required! • Emergency exits: The first route has to lead via a door, the second can lead via windows (only for <200 persons per use unit) or another door • From all levels above ground floor the independant escape routes must lead via min. 2 separate stairwells. The second route can alternatively lead via a ramp. Exceptions are only for residential, office & accommodation buildings and a small number of users possible
		Use units ≥ 2 Total floor area ≥ 400 m ²	• Non-combustible roof covering • Fire spread between each unit of use or max. 400 m² floor area and/ or after 40 m must be inhibited by fire walls • Fire spread between storeys must be inhibited by fire ceilings	
Non-freestanding building	Single-storey building	Max. 1 use unit Total floor area < 400 m ²	• Non-combustible roof covering • Fire spread to neighbour buildings must be inhibited by fire walls	• Min. two independant escape routes per unit of use are required! • Emergency exits: The first route has to lead via a door, the second can lead via windows (only for <200 persons per use unit) or another door
		Use units ≥ 2 Total floor area ≥ 400 m ²	• Non-combustible roof covering • Fire spread between each unit of use or max. 400 m² floor area and/ or after 40 m and to neighbour buildings must be inhibited by fire walls	
	Multi-storey building	Max. 1 use unit Total floor area < 400 m ²	• Non-combustible roof covering • Fire spread to neighbour buildings must be inhibited by fire walls	• Min. two independant escape routes per unit of use are required! • Emergency exits: The first route has to lead via a door, the second can lead via windows (only for <200 persons per use unit) or another door • From all levels above ground floor the independant escape routes must lead via min. 2 separate stairwells. The second route can alternatively lead via a ramp. Exceptions are only for residential, office & accommodation buildings and a small number of users possible
		Use units ≥ 2 Total floor area ≥ 400 m ²	• Non-combustible roof covering • Fire spread between each unit of use or max. 400 m² floor area and/ or after 40 m and to neighbour houses must be inhibited by fire walls • Fire spread between every storey must be inhibited by fire ceilings	

Fig. 10_ Requirements
for building categories

Building elements		(Minimum) Standards for Residential buildings, office buildings, administration buildings, Hospital / health care buildings & educational buildings	Remarks
Escape routes	Length & height	35 m max. length of evacuation route (1st emergency route) from the most remote point of a room to the next emergency exit or a necessary stairwell for all rooms intended for the use by people (no technical rooms / store rooms etc.) Min. clear height 2 m of the entire escape route (corridors, stairs, exits)	For all other building types a consultation with experts and construction consultant concerning the (Minimum)Standards is necessary! For the detailed planning the consultation with an expert/ construction consultant is recommended!
	Corridors	10 m max. length of corridors with only one escape direction (stub corridors) Min. 0,875 m clear width depending on number of persons and use. In educational and hospital/ health care buildings min. 1,5 m clear width and 2,25 m if beds have to be moved (hospitals/ health care buildings)	
	Stairs	Inclination max. 30° • Steps with tread 29 cm and rise 17 cm optimal Clear width of stair flight min. 1 m depending on number of persons, but max. 2,4 m Railing height min. 1 m • No horizontal filling bars • Distance between filling bars min. 12 cm	Deviations from the here mentioned (Minimum) Standards, should only be done with agreement of the donor organisations and the responsible construction consultant!
	Exits	Clear width of emergency doors min. 1 m depending on number of persons and use • Clear width of emergency doors in escape corridors and escape staircases as wide as the required min. width of escape corridor/ stair flight, but not wider! Dimensions of emergency windows min. 0,9 m (clear width) x 1,2 m (clear height) and parapet height between 0,9 m and 1,2 m	Please consider also the detailed information in the chapters!
Fire sections	Walls	Fire protection walls have to be placed between buildings if the distance is < 5 m and inside of buildings between all units of use and after max. 400 m² and/ or after max. 40 m of length • In hospital buildings max. 150 persons are allowed within one fire compartment and each upper floor in the care area must have min. two fire compartments The walls have to be made of non combustibile material and be impermeable to fire and smoke	For all other building types a consultation with experts and construction consultant concerning the (Minimum)Standards is necessary! For the detailed planning the consultation with an expert/ construction consultant is recommended!
	Ceilings	Fire protection ceilings have to be placed between all storeys The ceilings have to be made of non combustibile material and be impermeable to fire and smoke	
	Doors / windows	In fire walls between buildings no windows and doors should be placed • In fire walls inside of buildings openings for doors(windows) The doors have to be self-closing, made of non-combustibile material and be impermeable to fire and smoke	Deviations from the here mentioned (Minimum) Standards, should only be done with agreement of the donor organisations and the responsible construction consultant!
	Installations	Installations (electric cables, sanitary pipwork etc.) should be arranged side by side and encased/ covered with non-combustibile material and all wall and ceiling openings for the installations in fire walls and ceilings have to be closed/ filled with non-combustibile material	Please consider also the detailed information in the chapters!

Fig. 11_ (Minimum)Standards of building elements

REQUIREMENT OF A SECOND STRUCTURAL ESCAPE ROUTE

Generally for all buildings a second structural escape route is required. Normally it has to lead directly to the outside or in multi-storey buildings via min. two separate staircases or ramps (only 2nd escape route). Only in residential, office and accommodation buildings and a small number of occupants, can the second escape route be led via a window, terrace or roof, if the occupants can safely escape from there or the fire brigade can arrive within 10 minutes and the necessary equipment such as ladders are available. It is important to consider that only a small number of people can be rescued

via a ladder. The rescue rate by the fire ambulance is about 3 minutes per person. Rescue routes using rescue equipment from the fire ambulance are only suitable for rescuing a limited number of people. It must be agreed with the local fire ambulance if suitable rescue equipment is available and whether they can arrive promptly. In addition, access routes, set-up areas and manoeuvring areas must be coordinated and designed in accordance with local law. However, this exception needs to be discussed with a construction expert or the funding agency.

DESIGN OF ESCAPE ROUTES

Escape routes are routes that people should use to exit the building by the shortest route to safety. The focus is on self-rescue. In the event of fire panic and bad vision due to smoke can make orientation difficult and lead to accidents during the escape process. Specific standards are therefore required for the design of escape routes:

- Two independent escape routes are required, but they may lead via the same necessary corridor

- The escape route length must not exceed 35 m to the exit, to the open air or to the necessary stairwell
- In principle, the escape route must be kept as short as possible
- Escape routes must be kept clear of obstructions and fire loads (wiring and piping are dangerous fire loads and can release

Fig. 12_ Escape route markings



toxic smoke)

- Clear Height at min. 2 m (corridors, stairs, doors)
- The minimum width of the escape route must not be narrowed by installations
- Installation of emergency lighting
- Marking of escape routes
- Installation of alarm system Providing emergency power supply for alarm system and lighting
- In Non-Residential buildings: Installation of fire extinguishers

Components of escape routes

To ensure a quick and trouble-free use of the escape routes door, corridor and stair widths must be coordinated. Minimum width of the escape route must not be narrowed by fixtures or equipment or by doors and the doors should also open in the direction of the escape routes.

Escape Corridors

Escape/ necessary corridors must be separated from other rooms and need to be protected against the entry of fire and smoke.

They need to fulfill the following requirements:

- Corridors with only one direction of escape leading to safety should not exceed the length of 15 m
- Clear width depends on number of persons and use:

Number of persons	up to 5	up to 20	up to 200	up to 300	up to 400
Clear width in m	min. 0,875	min. 1,00	min. 1,20	min. 1,80	min. 2,40

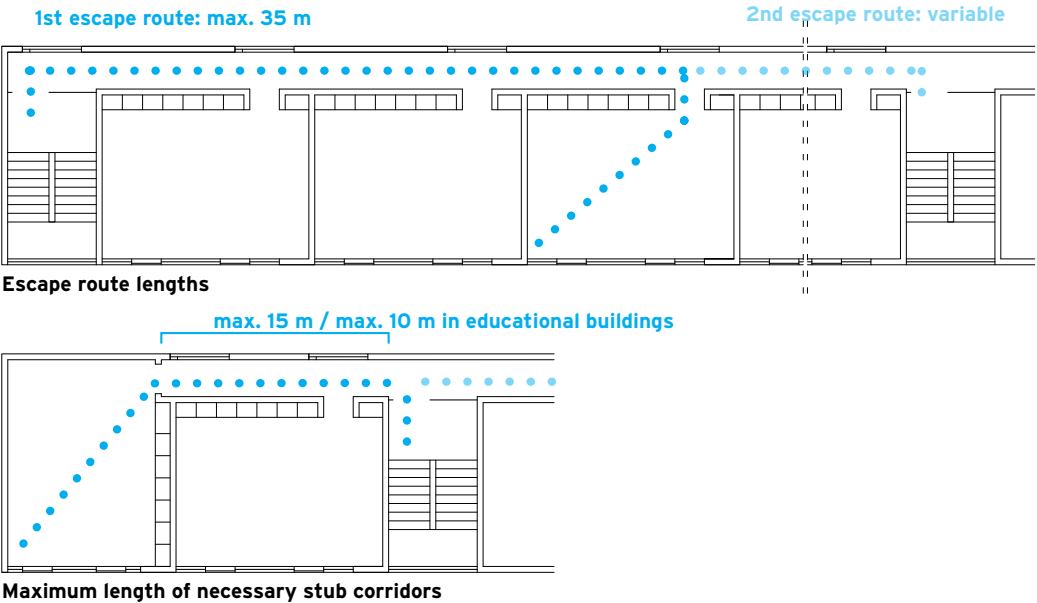


Fig. 13_ Escape route length

Escape staircase

To protect emergency stairs from fire and smoke in case of emergencies, they should be located in a separate stairwell, on the exterior walls and should be isolated from other rooms by walls and doors. Stairs pose a potential fall risk for fleeing people. It is therefore important to design them as safe as possible:

- The necessary stairwell must not be a helical or spiral staircase
- Slopes and treads of a staircase connecting two floors should be regular and should not differ from each other
- Stairs with an inclination of 30°, a tread of 0,29 m and a rise of 0,17 m are particularly safe to climb
- Continuous staircase that lead directly outside
- One openable window per floor for lighting and smoke removal and fire fighting with min. 0,60 m (width) x 0,90 m (height) and max. 1,20 m parapet height
- A maximum of 6 use units can be connected to the stairwell on each floor
- Stair flight width min. 1 m (according to the amount of persons see also corridors)
- The usable width of escape stair flights must not exceed 2,4 m
- The railing height should be at least 1,00 m and the distance between the filling bars should not exceed 12 cm
- No horizontal filling bars in the railing (danger of overclimbing by children!)

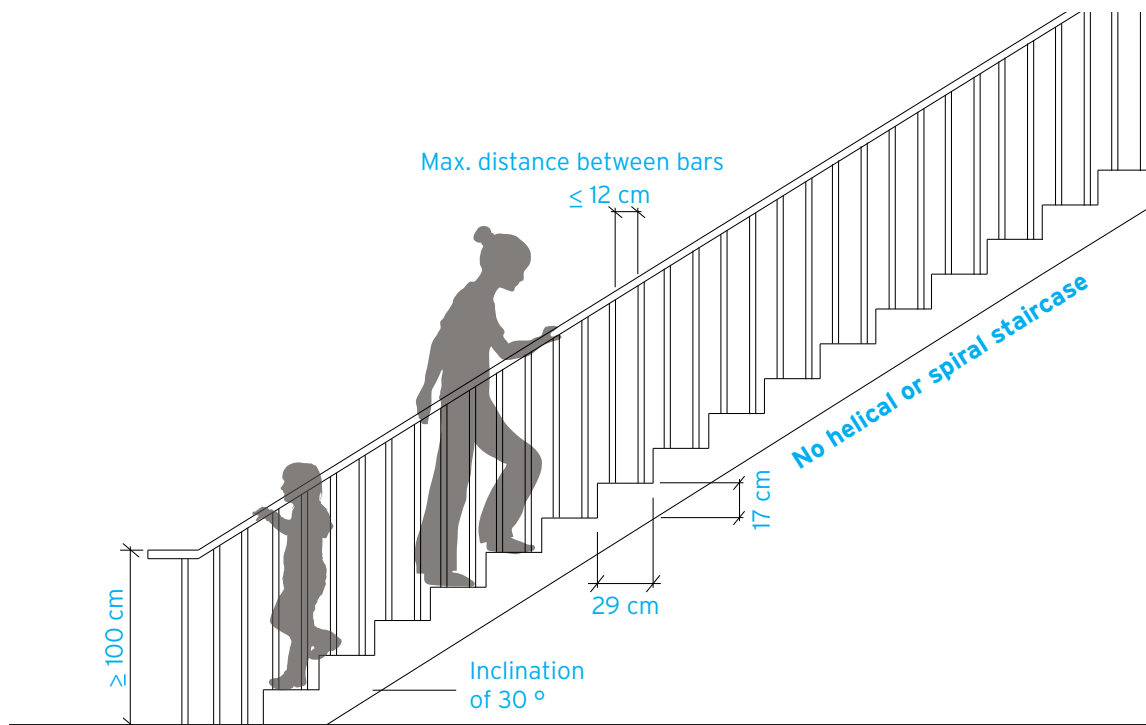


Fig. 14_ Safe design of necessary stair

Emergency exits (doors & windows)

- An emergency exit leads out of the building directly into the open. The size and number of emergency exits must be dimensioned in such a way that all persons in the building can escape to the outside as quickly as possible, even in the event of panic reactions.
- Emergency exits must be marked with a pictogram above the door/ window
- Emergency exits must always be easy to open from the inside
- Emergency exits must be kept clear
- Emergency doors & windows must not be locked or must have a panic lock
- The door swing must open in the direction of escape outdoors
- The width of the emergency door is based on the min. width of escape corridor/ stair flight. It can be reduced by max. 15 cm if the width is not less than 0,85 m.
- The emergency exit doors must have a minimum width of 1,00 m
- Emergency windows must be rectangular and at least 0,90 m (width) x 1,20 m (height)
- Parapet height can only be between 0,90 m and 1,20 m
- Emergency windows must be easy to open completely
- Emergency window sills and parapets must be able to support the weight of people

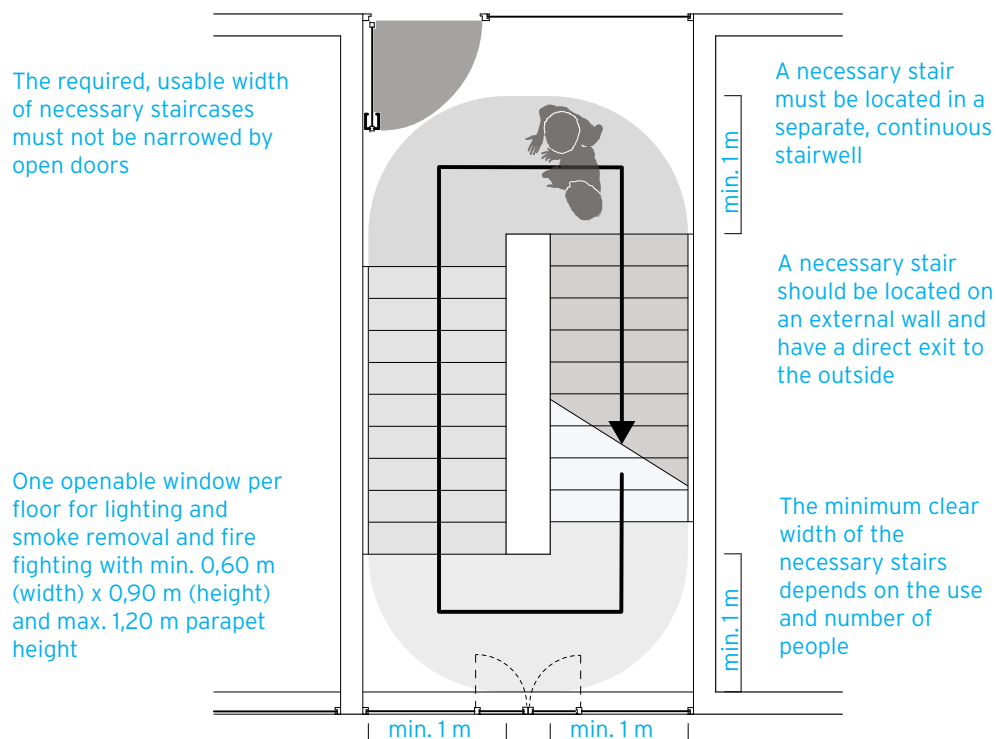


Fig. 15_ Necessary stair case floor plan

Safety barriers

All areas that are generally intended to be walked on and are directly adjacent to areas that are more than 1 metre lower (corridors, balconies etc.) need safety barriers in form of railings or balustrades.

Fall height	up to 12 m	more than 12 m
Height of window balustrade	min. 0,80	min. 0,90
Height of other railings/ balustrades in m	min. 0,90	min. 1,10

Requirements for special building types

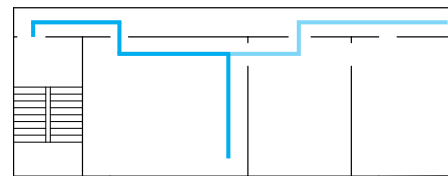
Hospital/ Health care buildings

- > The clear width of escape corridors depends on the patients' conditions:

Rescue corridors	without beds	with beds
Clear width in m for up to 200 persons	min. 1,50	min. 2,25
Clear width in m for up to 300 persons	min. 1,80	min. 2,25
Clear width in m for up to 400 persons	min. 2,40	min. 2,40

1st escape route

2nd escape route



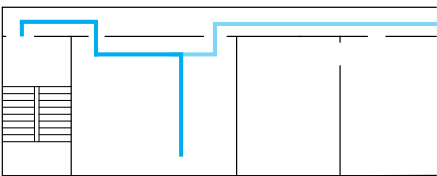
2nd escape route via an adjacent room

- > Also for inner doors in hospital/health care buildings the following clear width depending on the patients' conditions are required:

Inner doors	without beds	with beds
Clear width in m	min. 0,90	min. 1,25

Educational buildings

- > At least two independent escape routes for each classroom are necessary
- > One escape route can lead to the outside via external staircases, windows, escape balconies, terraces and accessible roofs if this escape route is not at risk in the event of fire
- > Exits/ doors to necessary corridors shall not be wider than the necessary corridor
- > Exits/ doors from necessary stairwells must be at least as wide as the necessary staircase.
- > Necessary corridors with only one escape direction (stub corridors) must not be longer than 10 m
- > The minimum width of exits, corridors and staircases are specific for educational buildings:



2nd escape route via a second exit from the class room

Fig. 16_ Examples for two independant escape routes from classrooms

Minimum requirements for exits in educational buildings:

Exits/ Doors in educational buildings	Exits/ Doors from class- rooms	Exits/ Doors from escape staircases
Clear width in m	min. 0,90	according to the min. clear width of stair flight
Opening direction	-	outwards in the direction of escape

Minimum clear width of corridors and staircases in escape routes of educational buildings:

Number of persons	up to 200	up to 300	up to 400
Corridors (clear width in m)	min. 1,50	min. 1,80	min. 2,40
Stair flights (clear width in m)	min. 1,20	min. 1,80	2,40 (not more!)

The widths may only be staggered in steps of 0,60 m/ 100 additional persons.

RECOMMENDATIONS FOR FIRE SECTIONS

In the event of a fire, it is important that it cannot spread quickly and unhindered. This applies to the building itself but also to the fire spreading to neighbouring buildings. Since most deaths in a fire are due to smoke inhalation, the spread of smoke must also be prevented.

In the case of freestanding buildings a distance of at least 5 m from neighbouring buildings should be maintained. In the case of non-free-standing buildings, the possibility of fire spreading to the neighbouring building must be inhibited. The separation wall between the two buildings has to be made of non-combustible materials and without any openings. Also windows should not be placed in the direction of the neighbouring building, if the distance is inferior to 5 m between openings for example if the two buildings are standing in a 90° angle to each other (L-shape).

- Fire and smoke sections are intended to prevent fire and smoke spread to another part of the building.
- Fire sections are separated by enclosing building elements such as walls, ceilings and roofs in combination with doors, windows and bulkheads. When implementing fire sections in the design, the following requirements should be considered (see also Fig. 9).
- Maximum size 400 m² per unit of use
 - Maximum length 40 m per unit of use
 - Fire sections between storeys
 - Building elements must prevent the passage of smoke and being sufficiently stable and resistant to fire and heat
 - Escape routes need to have adequate openings for smoke ventilation

Requirements for building elements

Building elements are assessed according to the fire behaviour of their building materials. Building elements that are intended to create fire sections must be made of non-combustible building materials. All mineral building materials (concrete, cement, bricks etc.) are considered non-combustible. Wooden structures (in fire ceilings and walls) of used rooms must be covered with non-combustible panels. Components with combustible building materials must not interrupt building elements of fire sections.

Fire walls

Walls, as load-bearing and space-enclosing components between units of use, must be stable for a sufficient duration in the event of fire and must not be permeable to fire or smoke. In addition, openings must be limited to the minimum necessary. Fire walls under the roof must extend below the roof cladding.

Fire ceilings

Ceilings, as load-bearing and space-enclosing components between floors, must be stable for a sufficient duration in the event of fire and must not be permeable to fire or smoke.

Fire doors

Doors in fire walls must have the same fire resistance requirements as the fire walls and be smoke-tight and self-closing. The function as an escape door must remain during the fire.

Installations

Installations in fire walls and ceilings should be designed in such a way that the fire resistance of the building elements is maintained. Installations (cables, piping etc.) should be arranged side by side and covered/ closed with at least 15 mm thick mineral plaster or with at least 15 mm thick panels of mineral building materials. Openings for installations in fire walls and ceilings have to be filled with concrete/ mortar or another non-combustible, smoke-tight material.

Requirements for special building types

Hospital/ health care buildings

- > Each upper floor in the care area must have at least two fire compartments
- > Further requirements apply for hospitals with a large number of patients that are not mobile and cannot bring themselves to safety:
- > If vertical evacuation would take too much time, horizontal evacuation must be made possible by setting up two separate fire sections. If there is fire and smoke in one section, patients can be evacuated by carrying them horizontally to the neighbouring section
- > Fire sections must be dimensioned in such a way that at least 30 % of the beds in the neighboring fire compartment can also be temporarily accommodated
- > If there is no possibility for horizontal evacuation, a ramp for evacuation purpose is required

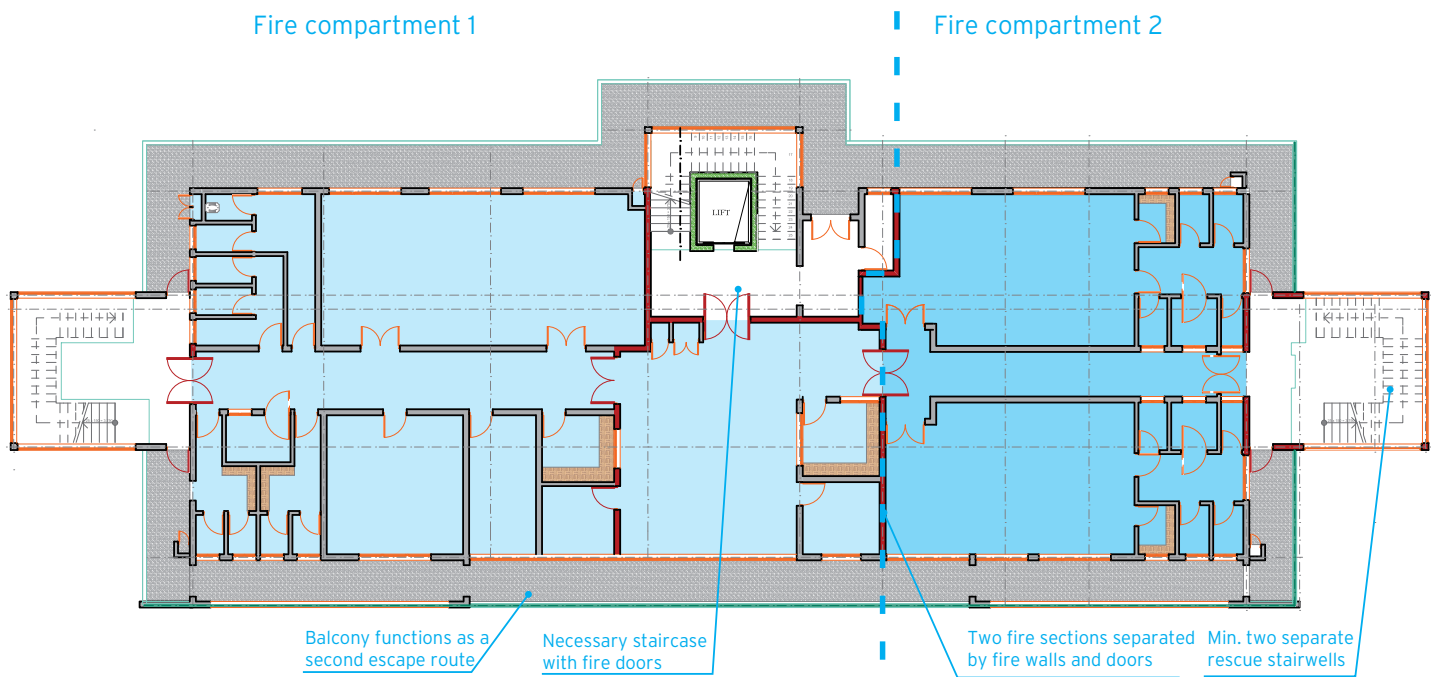


Fig. 17_ Hospital floor plan with escape routes and fire sections

3-3 RESILIENT CONSTRUCTION

OBJECTIVES OF RESILIENT DESIGN

The primary goal of resilient construction is to protect the lives of users and ensure their sustainable supply with drinking water, food electricity etc.. The guiding principle of „Building Back Better“ has been established since the reconstruction in Indonesia following the devastating earthquake and subsequent tsunami in 2004. Following this principle, reconstruction after disasters should take place in such a way that the people affected are resilient to future disasters. However, it is not only reconstruction after disasters that should be planned and built resiliently, but also new construction.

The non-destructive preservation of the building structure in the event of a disaster is not

necessarily to be considered the same as this goal, but must be seen in the context of the benefits/expenditure. For example, when (re)building single-family homes, it may make more sense not to design for the strongest expected hurricanes. Instead, it may be a more efficient strategy to build only one room per house or even only one evacuation centre per neighbourhood, in which the entire population can find refuge, in such a way that it can withstand even the strongest hurricane.

It is therefore important to first identify the existing risks and, based on this, to develop the appropriate strategy and apply suitable planning principles.

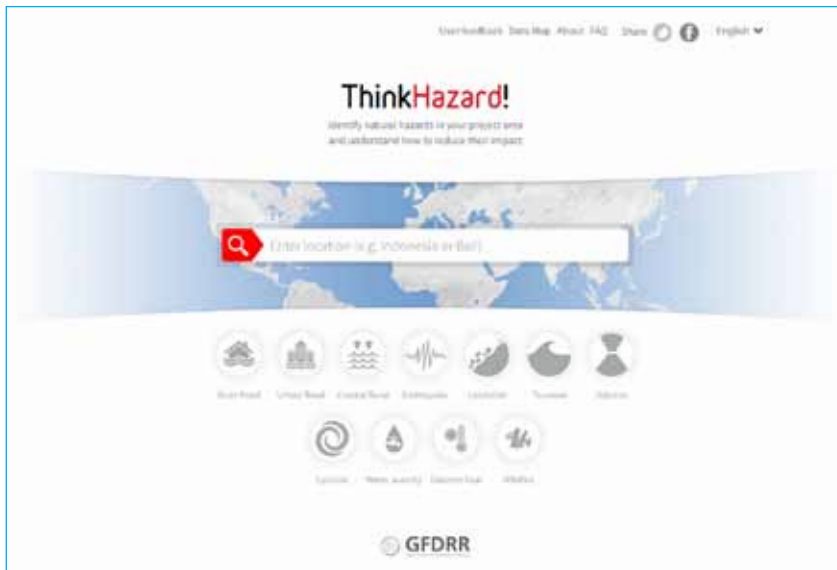
RISK ASSESSMENT

Before starting with the planification of construction measures it is always necessary to collect data on the specific project region and the sites of intervention. Apart from governmental / public planning guidelines, it is necessary to analyse the project for potential risks/hazards.

One possibility to assess the several risks and hazards at national, regional and district level is the information platform „ThinkHazards“ developed by the Global Facility for Disaster Reduction and Recovery (GFDRR), which is a multi-donor partnership that supports low and

middle-income countries to understand, manage, and reduce their risks from natural hazards and climate change (established in 2006). Think hazard gives a first indication of potential risks in a region, but it does not replace a risk assessment for the specific project region/site! Hence, it is necessary for every project to analyse the risks for the specific project and to adapt the plans for the construction measure accordingly.

The following chapters present the most important principles that should be taken into account.



THINK HAZARD! by GFDRR

“ThinkHazard! is a new web-based tool enabling non-specialists to consider the impacts of disasters on new development projects. Users of ThinkHazard! can quickly and robustly assess the level of river flood, earthquake, drought, cyclone, coastal flood, tsunami, volcano, and landslide hazard within their project area to assist with project planning and design.”

<https://thinkhazard.org/en/>

EARTHQUAKE RESILIENT DESIGN

Earthquakes pose a threat to constructions and their users that often may cause serious injuries or have deadly consequences. Other hazards such as hurricanes and floods normally leave some time for preparation and/or evacuation, whereas earthquakes can appear without forewarning. An earthquake causes horizontal and vertical soil movements. This sets buildings in strong vibrations which put a lot of strain on the building structure and thereupon may destroy it partially or completely. This leads often to a very high toll of death and injury. Therefore, it is very important to design the structure in such a way that earthquakes cannot destroy or damage the buildings in ways that someone will be harmed.

Earthquake resilient architecture means that users of the building will have enough time to escape from the building or people outside the building to get away before parts of the structure such as walls or the roof may probably come down. Not only architectural or structural aspects but also the choice of the site can already define if a construction is earthquake resilient.

There exist many guidelines for seismic constructions. The following aspects are based on Tom Schacher's Earthquake Vulnerability Checklist, April 2010 and on the checklist from the Save the Children and Development Workshop 'Principes des bâtiments résistants contre séismes et cyclones'.

Fig. 18_ Screenshot of the thinkhazard web site

Site selection

The very first step of every construction project should be to analyse the given circumstances like earthquake risk of the respective region and its soil conditions. The right choice of a site can already define if a structure is earthquake resilient or not. Therefore the following steps should be undertaken as the basis for an earthquake resilient design:

- Earthquake risk analysis
The evaluation of the local risk level with regard to earthquakes (and other hazards) has to be done before the design of a building (see 'risk assessment') because it will influence the planning significantly.

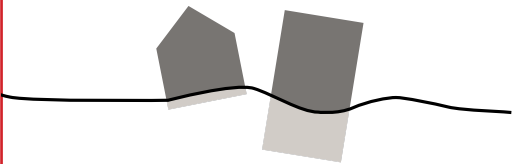
➤ Soil analysis

The local soil conditions are crucial for the load bearing capacity and the reaction in case of an earthquake. Therefore, soil assessments of the construction site have to be conducted as a basis for the structural design. The kind of ground, grown or backfilled, and its geological quality and composition have to be checked with local engineers and geologists and propositions for proper foundations have to be made.

Also the following aspects should be taken into consideration when choosing a construction site:

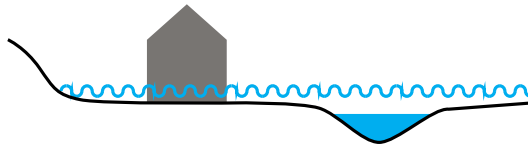
Fig. 19_ Risks of earthquakes for building structures 1-3

RISK: SOIL LIQUEFACTION



- Check with engineers and geologists
- Conduct a soil analysis
- Construct foundations down to load bearing & stable soil or do not construct in this area

RISK: FLOODING



- Check with engineers, residents & authorities
- Observe the area for signs of earlier floods
- Construct buildings elevated on stilts or so that they can be flooded or do not construct at this site!

Soil liquefaction

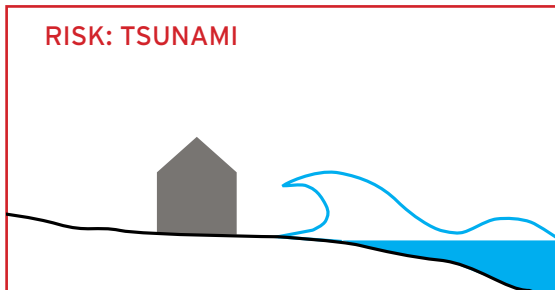
Earthquakes can lead to soil liquefaction if loose soil is containing water - the soil loses its bearing capacity because of the vibrations of the earthquake and buildings literally sink into the ground. Especially homogenous soils as you can find them in river deltas or coastal areas with alluvial soil are predestined for liquefaction.

Flat ground

In case of a flat construction site, earthquake events may strengthen risks like flooding or soil liquefaction. If an area is prone to flooding in normal times, it has a higher risk of flooding after an earthquake, for example due to a re-

sulting tsunami or a blocking of the river bed by debris or rock fall. Therefore, if the construction may not be located anywhere else, the design has to consider precautions for the building's protection like elevated floors. Residents and local authorities may have relevant information about flood risk in the respective area.

RISK: TSUNAMI



- > Check with engineers, residents & authorities
- > Observe the area for signs of floods
- > Create protection barriers between the shore and constructions (i.e. mangroove trees) and keep a secure distance to the shore!

Slope

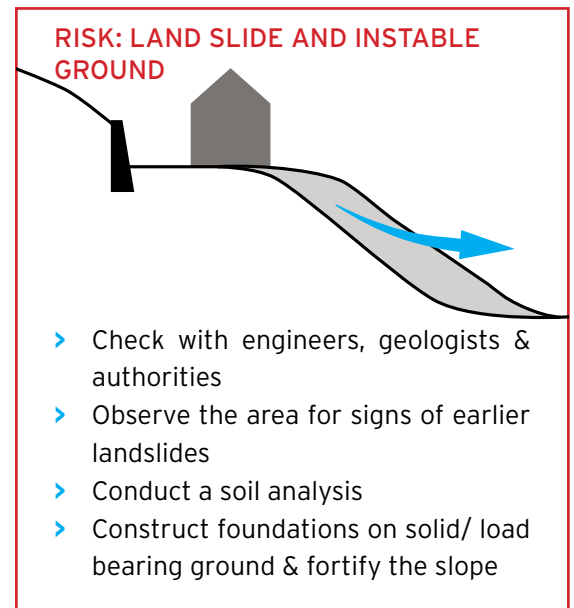
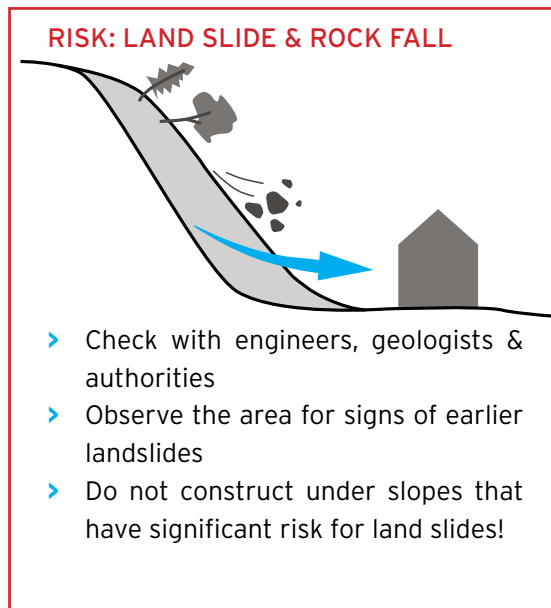
A construction site on a slope or at its bottom bears several risks like landslide, rockfall or collapse of retaining walls. If possible, slopes should be avoided in order to minimize risks and costs. If there is no other choice, the ground has to be checked very carefully and in detail by local experts.

The natural grown ground may be composed of inhomogeneous material so that an earthquake can cause landslides with falling trees or rocks from above or, in the worst case, the sliding of the building itself. If retaining walls are necessary to strengthen the construction site, their distance in the back and front of the building as well as their dimension and inclination have to be designed and calculated by a local structural engineer.

Often, a platform will be dug into the slope in order to get a flat surface big enough for the construction. It is important to conduct a detailed soil analysis with several boreholes in order to find out where the load-bearing layer runs and if it runs at a homogeneous depth. Sometimes also backfilled material was dumped underneath the platform, which has a high risk for landslides, this has also to be checked. If it is a backfill, its thickness and quality of compaction have to be checked. Generally, all constructions must be founded on load bearing & stable ground.

It is also recommended to stabilise the slope with suitable plants (i.e. vetiver grass) and if necessary with retaining walls.

Fig. 20_ Risks of earthquakes 4-5



Design principles

There are different design principles that should be considered in the planning of a building's structure in order to make it earthquake resistant.

Shape

The shape of the building has to be simple, compact and symmetric. A rectangular form with a proportion of max. 1:3 is recommendable. If a building has a more complex form that is composed of several parts, for example like an L, these parts must be separated from each other in order to allow independent movements in all directions. Also in long buildings (normally $> 1:3$), a movement joint has to be realized according to the structural engineer.

Architectural aspects

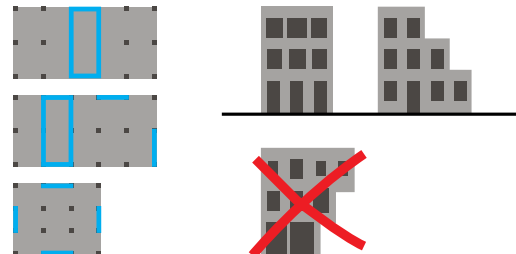
The floor plan should be regular with well distributed rigid elements like shear walls and/or rigid building cores (often stair cases and lift shafts are used as such) in every rotation direction of the building. Vertically, the ground floor should not be more flexible than upper floors and big openings in the ground floor-level and overhangs of upper floors should be avoided. In case of a multistorey building, it is an advantage if the construction becomes lighter towards the top for example by diminishing the surface of the upper floors and/or the use of lighter weight construction material. Also, the size of openings may be enlarged towards upper floors.

SHAPE



- > Simple & regular rectangular forms!
- > Building should be max. 3 times as long as it is wide
- > Longer building proportions and complex forms should be avoided. Otherwise it has to be subdivided, for example by movement joints

ARCHITECTURAL ASPECTS



- > Well distributed rigid elements
- > Regularity in plan elevation & no overhangs!
- > Ground floor should not be more flexible than upper floors
- > Reduction of weight towards the top is advantageous!

Fig. 21_ Design principles of earthquake resistant design 1-2

Construction principles

The building's earthquake safety depends on a good construction quality. Crucial aspects are a professional execution and a good quality of materials.

Structural requirements

The structural planning should be done by qualified engineers according to local seismic standards. If no local seismic standards exist, the standards from other countries with similar earthquake risks should be used as a basis for the structural planning.

The kind and dimensioning of the foundation depend on the planned building and the soil. All three types of foundation - point or stripe foundation and foundation slab, usually made of solid reinforced concrete - are possible in earthquake regions. For defining the right, proper foundation for the planned construction it has to be in accordance with the requirements and recommendations of the respective soil test and in agreement with the local engineer.

The building needs a resistant and at the same

time flexible structure which will allow building movements and give sufficient stability for walls and ceilings in order to prevent them from immediate collapse during the earthquake movements. The structure can be realised out of different materials. The most common materials are reinforced concrete or wood. But also other materials such as steel or reinforced earth structures can be used for earthquake resilient constructions. All construction components as columns, beams, ceilings and walls should be friction-locked connected with each other. Infill walls and the roof structure should be reinforced or anchored in frames in order not to collapse.

Typical constructions are:

- Reinforced concrete (RC) frames: RC frames with masonry infills demand a very high execution quality and therefore, normally can be very dangerous in low-tech environments.
- Timber frames: Timber frame constructions with masonry infill or planked with plates are traditional constructions that work well in low-tech environments. The

Fig. 22_ Example of Reinforced concrete (RC) frames (left picture)



Fig. 23_ Example of timber frame construction (right picture); image source: MISEREOR



famous ginger bread houses in Haiti suffered damage after the earthquakes, but most did not collapse, whereas many of the RC frame structures collapsed due to poor construction quality. The same experience was made in Indonesia.

- **Confined Masonry (CM):** In confined masonry the walls are built first and the reinforced concrete columns and beams/ ceilings are poured afterwards so that they interlock with the masonry. It is a good and common solution in low-tech environments.
- **Reinforced masonry:** Walls made of bricks or concrete blocks are reinforced in order to withstand the movement in the case of an earthquake. The most common construction uses concrete blocks in combination with vertical steel bars and horizontal reinforcement placed in concrete bands. Also earth walls can be used, when they are reinforced with straw and/ or bamboo. Reinforced masonry is a good system for low rise buildings in low-tech environments.
- **Ring beam:** Walls made of unreinforced masonry in combination with wooden or reinforced concrete ring beams on top of the walls can be a good low-tech solution

for single-storey houses. Depending on the height of the walls and the local earthquake risk, additional corner stitches and/ or an additional ring beam should be inserted at half height.

- **Unreinforced masonry:** Unreinforced masonry made out of bricks, stones or blocks is a very dangerous system in earthquake areas and shouldn't to be chosen there. Also, successive additions to buildings have to be avoided because of the use of different materials and structural systems. Different materials have different movement qualities, mixed structures are often missing connections and seismic gaps in-between and therefore are dangerous with regard to earthquake resistance.

The risk of every structural system is the improper execution especially with regard to the execution of load bearing elements, bracing walls and roof constructions. Therefore a good quality management system (see chapter 2-8) is essential for an earthquake resilient construction.



Fig. 24_ Example of confined masonry (left picture)



Fig. 25_ Example of reinforced masonry (right picture)

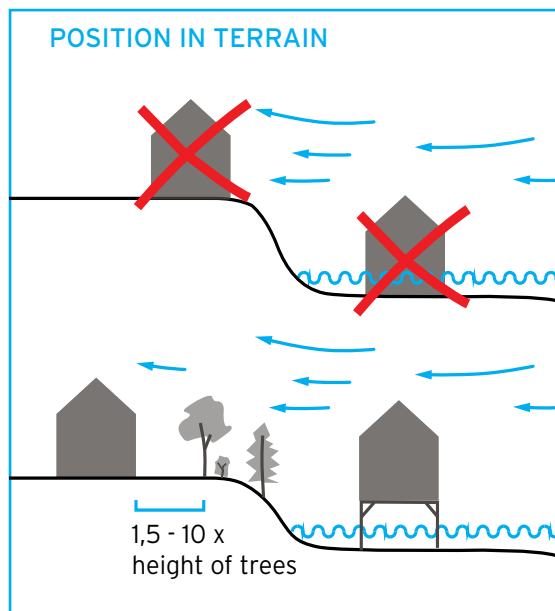
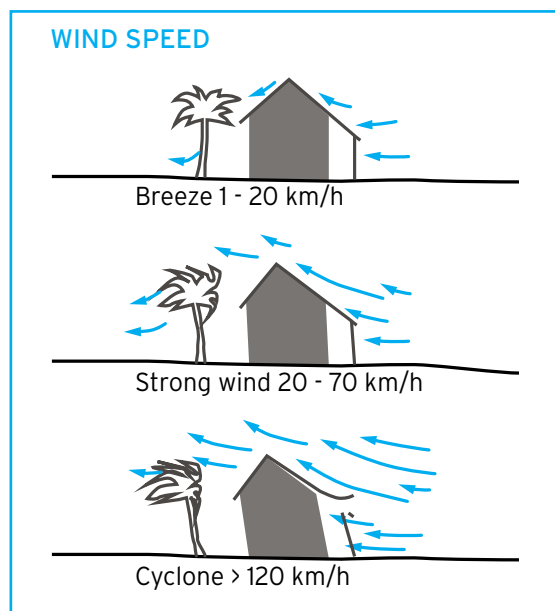
STORM RESILIENT DESIGN

Really strong winds, like hurricanes or typhoons, start at a wind speed of 118 km/h and can reach up to 300 km/h and thus can have devastating effects on constructions. In order to reduce the vulnerability of housing effectively some basic design principles should be considered in building projects that are situated in heavy storm risk zones. Buildings in these zones must be adapted to this natural phenomenon. In addition to the shape of the building, the design of the roofs, the connection of the roof with the walls, the doors and windows and the connection of the walls with the floor are of particular relevance, as strong winds are particularly aggressive here.

Position in terrain, settlement arrangement and vegetation

The degree of exposure of land and buildings affects the wind speed at ground level. For example, urban and rural communities in unprotected, low-lying coastal areas, low islands, river floodplains or rolling plains are considered vulnerable to strong winds. In hilly regions, buildings along ridges should be avoided, as wind speeds increase there. Lower speeds generally prevail in valleys (except in long, narrow valleys, where the wind may increase in speed). In regions prone to cyclones near the coast, a site should be selected above the probable flood elevation or (if not available) a building constructed elevated for example on stilts (see „Flood Resilient Design“).

Fig. 26_ Design principles of storm resilient design 1-4



Planting low vegetation and applying wind-breaks serve to deflect the wind upwards and filter it in order to protect the house itself. A row of trees planted downwind can act like a shield. To create this effect, the trees should not be too far away, max. 8-10 times the height of the trees. At the same time, the minimum distance of the trees should be 1.5 times their height, so as not to damage the house if the tree falls.

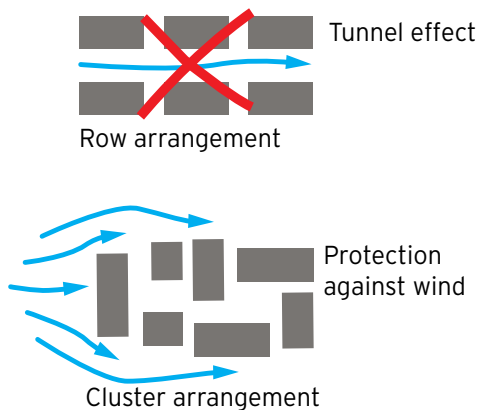
When constructing housing developments and groups of buildings, a cluster arrangement should be preferred to a rigid row arrangement: because row construction can create tunnel effects and allow the wind to pass through or even amplify it. Staggered development can reduce wind strength.

Design principles for storm prone buildings

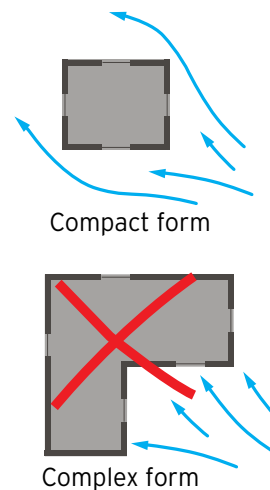
Shape and orientation

A basic principle to reduce the impact of wind on buildings is to not oppose resistance. When buildings are closed, the wind creates a suction effect on the roof that can lift the roof completely. On the other hand, when the buildings are opened up, the wind passes through them and they do not oppose resistance. One possible solution is to create ventilation openings in the upper wall area. According to the same principle of opposing resistance, compact and symmetrical building forms reduce the area exposed to wind and the wind can blow „elegantly“ around them.

ARRANGEMENT OF BUILDINGS



SHAPE



Roofs

Roof sheets being ripped off the house is probably the most common damage pattern in cyclones. This is usually due to inadequate form, slope, fasteners, sheet thickness and frequency of fastening.

The safest roofs show a slope between 30 and 45 degrees. Roofs that are too flat or too steep should be avoided.

Mono pitched roofs or gable roofs are more exposed to the wind than, for example, hipped roofs or roofs with conical shapes. Pitched and gable roofs should therefore be constructed in reinforced concrete in storm risk areas and/ or be anchored particularly well.

Overhangs and verandas are exposed to high wind pressure. That is why they should either be kept short and small or built as separate

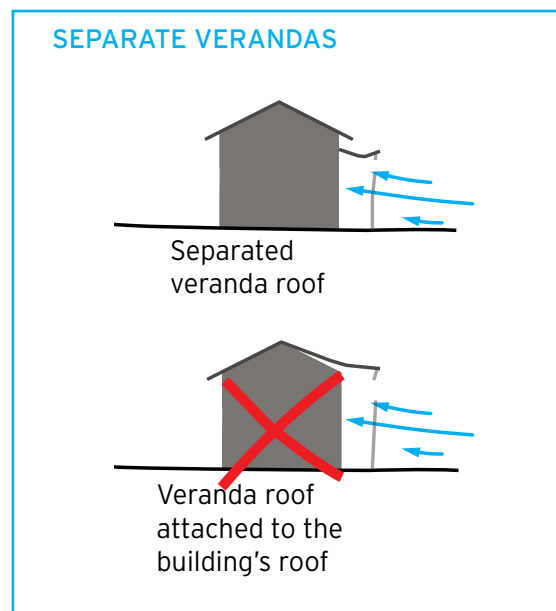
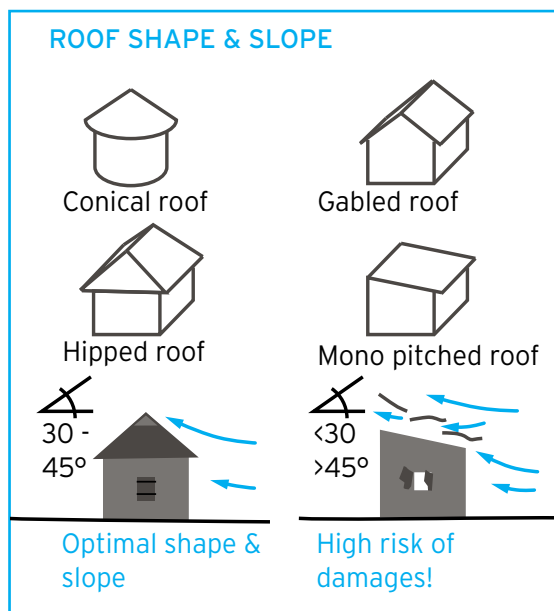
structures and not as extensions of the main building. In the second case, they can be blown away without damaging the rest of the house.

The roof structure has to be well fixed to the walls/ upper ring beam. Roof covers have to be fixed accordingly well to the structure. If corrugated sheet roofing is used, then the thickness of the sheets should be at least ~ 0,5 mm (24 gauge) and not thinner.

Doors and windows

Doors and windows are the components most frequently damaged in cyclones after roof sheetings. In order to reduce the impact of wind on buildings another basic principle is to do not let it enter the house. When the wind enters the house through a door or a window, it increases pressure on the ceiling and it increases pressure on the roof. Therefore it would be either important that the windows and door

Fig. 27_ Design principles of storm resilient design 5-8



leaves can be properly shut or that it is possible to open another window or door on the other side of the house to allow the wind to pass through.

Foundations and walls

The uplift forces of cyclones can sometimes rip buildings completely out of the ground. This is less of a factor with heavy buildings, but more of a factor with lightweight buildings. The lighter the building materials, the larger (or heavier) the foundation must be for a cyclone-resistant structure. The second important factor for the safe construction of lightweight structures, such as timber houses, is also safe connection details (-> see "connections").

However, even in massive structures such as masonry buildings, the loss of the roof can lead to complete destruction of unreinforced masonry. In these cases, it is important that

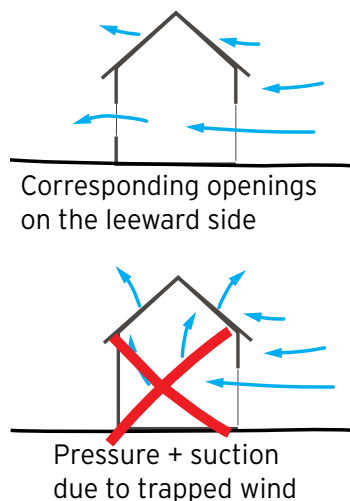
the masonry walls are reinforced (e.g. by means of columns and ring beams) and that the roof structure and roofing are firmly connected to them (-> see "connections").

Connections

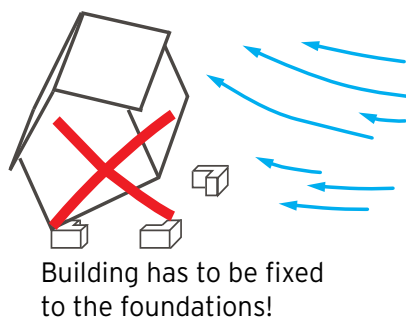
Normally, the weak point in wood or steel structures is in the connections. The saving of smaller but important parts (such as bolts) can lead to the failure of the large parts (columns, beams and rafters).

Securing the ridge of rafters: To prevent the ridge from falling apart in high winds, the rafters must be secured, for example by additional horizontal beams screwed to the sides of the rafters. Alternatives are steel or plywood gussets used directly on the ridge or metal straps over the rafters. Roof panels should be fastened with screws rather than nails.

DOORS & WINDOWS



FOUNDATIONS



FLOOD RESILIENT DESIGN

Careful choice of construction site

In order to avoid destruction and damage from flooding, a future building site should be carefully analysed: Has there been a flood event here in the last few years, decades or even the last century? If so, how severe was the event, what was the highest flood level?

Assess the flood risk on national, provincial and district level

Public flood risk maps can provide information about possible flood hazards. This is very helpful where such maps are available in an updated form. Unfortunately, this is often not the case. One further possibility to assess the flood risk at national, regional and district level is the information platform „ThinkHazards“ as shown above.

Assess the flood risk on plot level

On plot level, an analysis of the surrounding terrain can provide information about the flood risk: Are there any bodies of water nearby that regularly flood? Is the property on flat land, on a hill or in a depression? Pay special attention close to river banks, especially curve inner banks and steep sliding slopes. Existing buildings in the immediate vicinity of the property should also be analysed: Do the foundations and/ or ground floor walls show signs of flooding such as moist spots, mold, discolouration, efflorescence and/ or flaking plaster? A soil expertise provides information on the status of the groundwater and whether there is a risk, for example due to groundwater pressing into the soil layers near the surface.

Constructions should be generally avoided on land or in zones that may be affected by floodings!

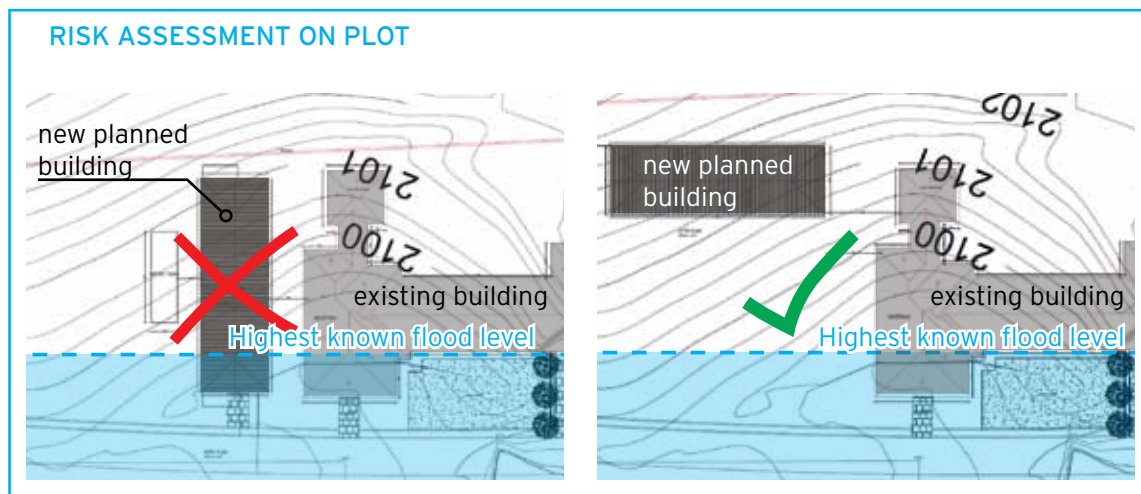


Fig. 28_ Example for placement of new building according to the flood level

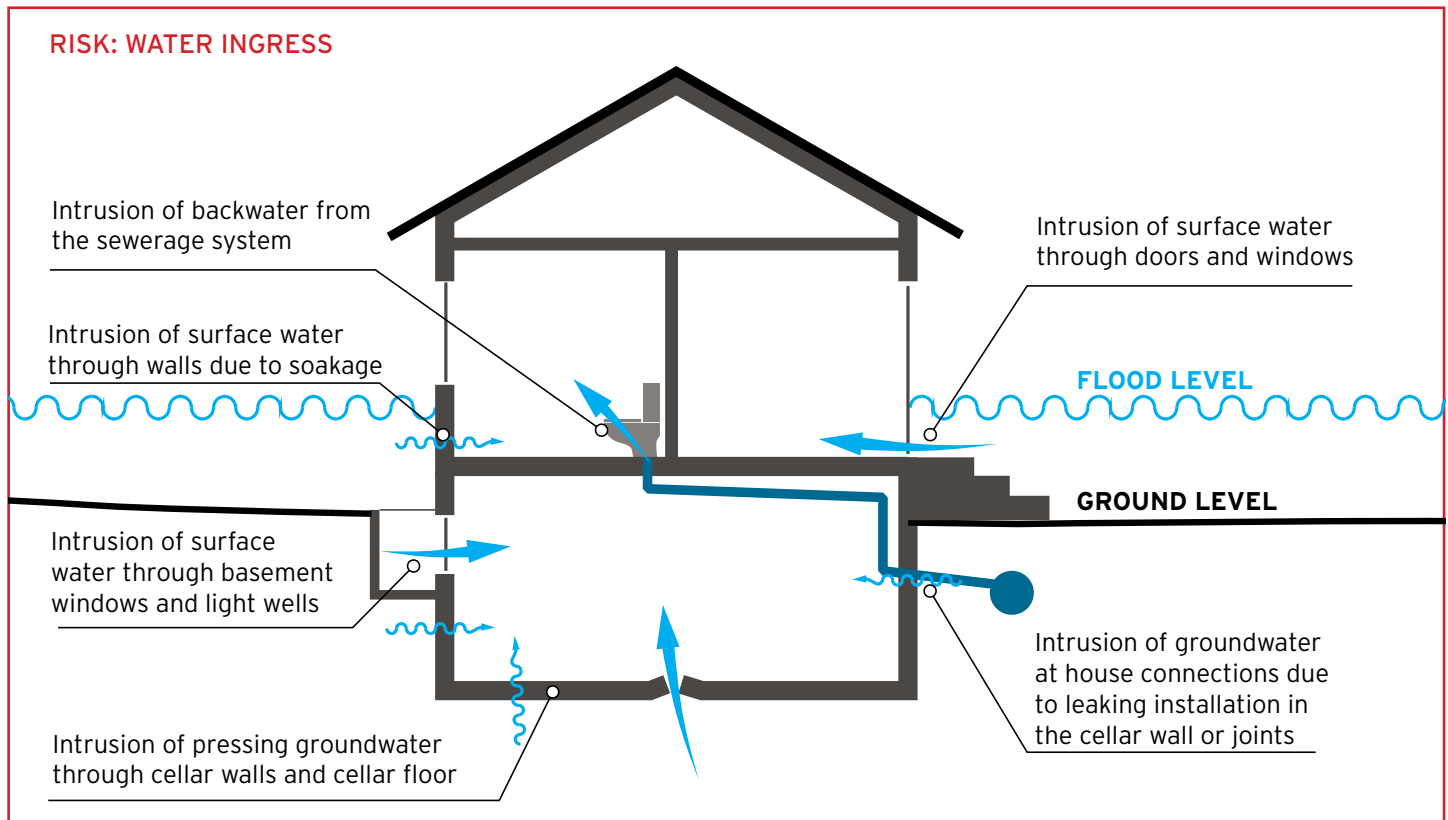
Design principles for flood prone buildings

However, sometimes buildings are already located in flood-prone areas, or, like in regions that are simply endangered on a large scale (such as some regions in Bangladesh or Pakistan, for example) it is not possible to place buildings in safe zones. In the context of climate change, population growth and urbanisation, it is likely that the area of affected regions will increase in the near future. There is a risk of water entering houses in the following ways during flood events:

- Surface water penetrates buildings up to the level of the water rise
- Groundwater can rise and penetrate the house through the floor slab and basement walls
- If a sewage system is overloaded/ a latrine flooded, contaminated backwater can also push through the house connections/ latrine hole

In these affected areas, rainwater, groundwater and floodwater must be prevented from entering or damaging a building by structural or technical measures such as protective walls, waterproofing, water resistant materials and backflow protection.

Fig. 29_ Flood entry points in buildings; own illustration based on Hochwasserschutz-fibel, BMVBW, 2015



Basically, one can distinguish between three strategies of structural flood prevention of buildings: (1) resist floods, (2) avoid floods and (3) adapt to floods.

Resist floods (1)

Permanent flood protection walls made of reinforced concrete, masonry or earth walls covered with grass keep surface water off the property. They are helpful where groundwater intrusion or backwater from the sewage system is not to be expected. Since the protection walls may leak in some places, additional pumps (with mobile generators or batteries to operate them) must be available to pump the water out of the protected area. In terms of flood protection for the general public, it must be considered that the flood water „displaced“ by enclosures can increase the water volume of the adjacent properties.

At building level, surface water can press through exterior walls of floors at risk and groundwater can press through building components in contact with the ground. Waterproofing foundations, basement walls and exterior walls in the base area protect against this and also against penetrating soil moisture. In new buildings, basements and the lower parts of ground floors should be constructed with external waterproofing or waterproof concrete. Vertical components should be subsequently sealed by vertical waterproofing, for example, barrier plaster and bitumen thick coating. Complementarily, the soil around foundations and basement walls can be replaced with impermeable clay (traditional way) to reduce groundwater pressure from the soil.

Avoid floods (2)

The ground floor, or rather the “first” floor of a building with a useful area and openings

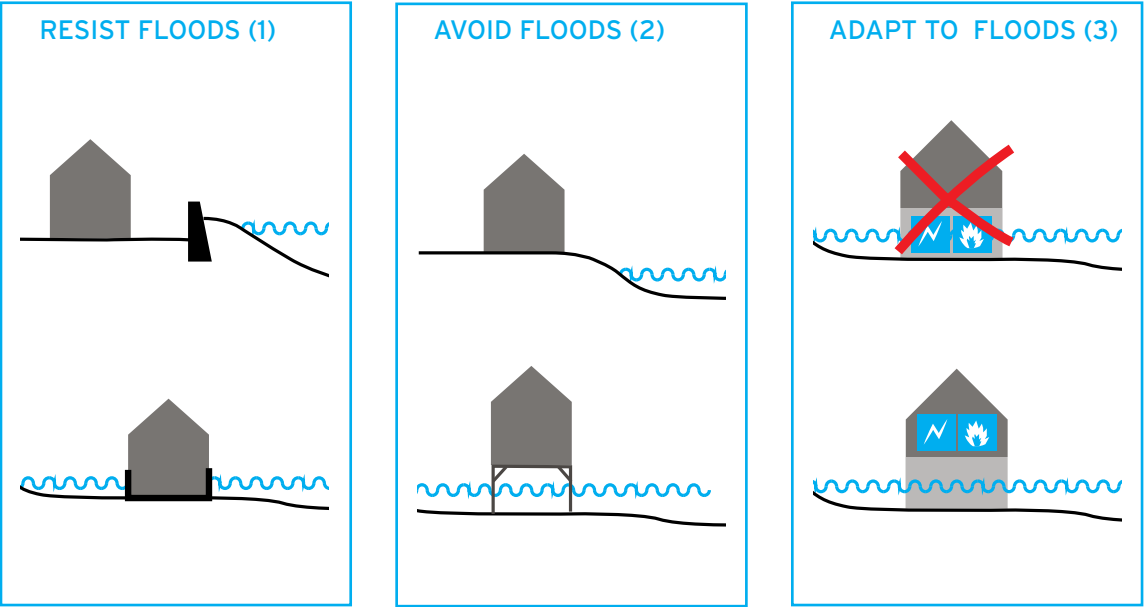


Fig. 30_ Design principles of flood resilient design

like doors and windows, must be placed above the level of the highest known flood. For this purpose, new buildings can be elevated on plinths or on pillars. Due to climate change, a buffer of at least 1 m should always be planned with. In lower floors of existing buildings, consideration should be given to accepting regular flooding and not placing sensitive uses, technology or objects there. As a general rule, high-value uses and equipment, as central compressors or heat generators, central electrical distributors, batteries of photovoltaic systems, generators and drinking water storage tanks (among other) should be relocated to higher floors. Electrical lines and electrical distributors must also be installed above the expected floodwater level.

Adapt to floods (3)

Structural elements that lie below the floodwater level and are therefore regularly hit by



Fig. 31_ Example of building elevated on stilts to avoid floods



Fig. 32_ Example of building elevated on plinth to avoid floods



Fig. 33_ Example of flood protection wall made of earth and concrete to resist floods

floodwater should be adapted to this without being fundamentally damaged. Capillary-active and diffusion-open plaster and paint coatings, especially on interior walls, can absorb and release water. Moist walls can thus dry out again in the long term and the risk of mold is reduced. Waterproofing and sealing floor coverings should be avoided so that floors and foundations can also dry out. In addition, flood water can be collected in shafts via defined gradients and then pumped away. In the affected room, there should be sufficient opportunity for cross-ventilation for drying through the arrangement of windows and ventilation openings. Also in this scenario all high-value uses and equipment, as central compressors or heat generators, central electrical distributors, batteries of photovoltaic systems, generators and drinking water storage tanks (among other) should be located in higher floors. Electrical lines and electrical distributors must also be installed above the expected floodwater level.

Flood protection in sanitary facilities

What measures can be taken to prevent water ingress through house connections? During a flood event, floodwater can also press into the sewer network and rise above the usually highest level of the sewage (backwater level). Rainwater and sewage then push through the house connection into basements or ground floors and flood them with the contaminated water. A backwater protection device (flap) prevents backwater and closes automatically when water presses from the canal side. In new buildings, it is best to do without drainage facilities below the backwater level. In addition, house inlets must be made watertight or retrofitted.

Latrines in flood-prone areas must be elevated from the ground: both the pit and the platform, to prevent surface water and also groundwater from entering. The top must be above the highest possible flood level. Because of the ele-

Fig. 34_ Example of elevated electrical installations in a flood prone floor level to adapt to floods (left)



Fig. 35_ Example of elevated water installations (tank + purifier) to avoid/ adapt to floods (right)



vation, stairs and ramps must be considered in the design. If the pit is exposed to pressurised groundwater, it must be completely sealed. Regular emptying and a connection/ opening for emptying must be provided.

Prevent flooding by considering and modelling the terrain

There are different measures to manage the rainwater on the property: infiltration, retention or utilisation. In order to provide preventive flood protection, outdoor areas and the terrain around buildings should be designed in such a way that the ground can absorb the greatest possible amount of rainwater and floodwater. In this way, surface water can be prevented from accumulating into floods or flood waves. On properties in flood-prone areas, there must be space for compensatory measures (retention areas), for example in the form of natural fields or depressions. Instead of sealing areas such as access roads, car parks or flat roofs,

they can be used to (temporarily) absorb rainwater in the form of water-bound road surfaces (use of gravel stone or green roofs instead of asphalt or concrete sealing). However, the soil characteristics must be taken into account and analysed, as not all soil types can absorb the same amount of water: Clay soils, for example, are not as permeable as soils made of sand or gravel. The property topography (e.g. flat or sloping) must also be taken into account. Where is rainwater likely to collect during heavy or continuous rainfall? For measures for the temporary storage of rainwater on roofs, the characteristics of the roofs must be taken into account. For example, the subsequent construction of a green roof requires a shallow roof slope and the supporting structure must be suitable to carry the additional load.

As little surface area as possible should be sealed!

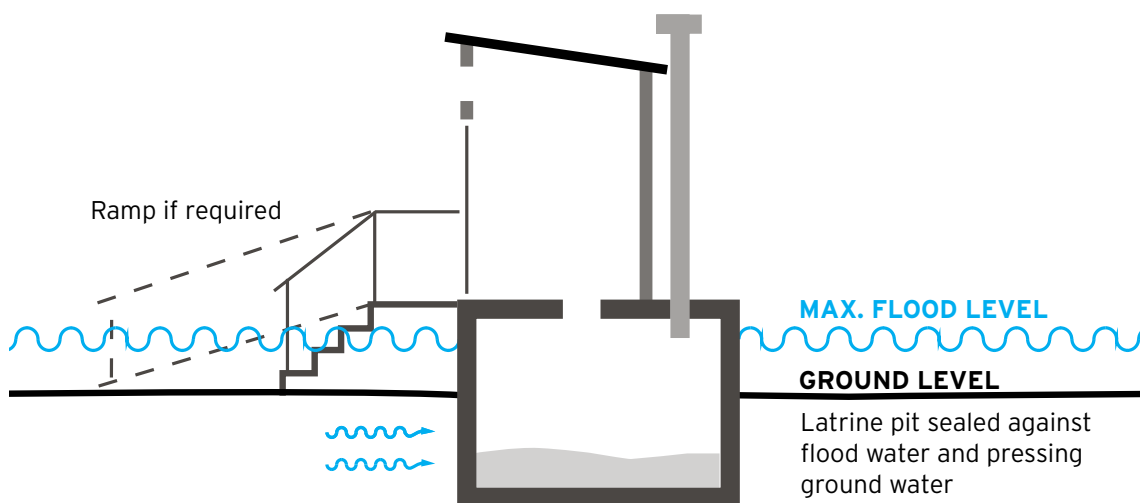


Fig. 36_ Flood resilient latrine design

3-4 BIOCLIMATIC ARCHITECTURE

OBJECTIVES OF BIOCLIMATIC ARCHITECTURE

Bioclimatic architecture is a design approach that aims on the creation of buildings that are comfortable, energy-efficient and sustainable by the optimal use of natural resources. Therefore passive design strategies are developed (starting from early planning stages) that are adapted to the specific context. In regions with moderate and predictable climates bioclimatic architecture is able to achieve its objectives only by the use of passive measures, in very hot or very cold climate zones, it normally has to be combined with an energy-efficient active system for heating, cooling and/ or ventilation.

Benefits of designing bioclimatic architecture:

- Good indoor climate & thermal, visual and acoustic comfort
- Reducing energy consumption for lighting, heating, cooling and ventilation
- Reducing environmental impact: using sustainable materials, reducing waste, and minimizing energy use, crucial for sustainability
- Supporting local economies by promoting the use of local materials and traditional building techniques
- Adapting to climate change: bioclimatic buildings are normally more resilient towards the negative impacts of weather extremes

Components of bioclimatic architecture in different climate zones

Most components of bioclimatic design are passive measures that cleverly use the natural resources such as sunlight, wind, water and earth in order to provide a healthy and comfortable indoor climate. Where necessary they are combined with energy efficient active measures. Fig. 37 gives an overview of the different design components.

Not all strategies make sense in every context. Some strategies can even be contraproductive: Insulation of the base plate is for example not recommended in hot & dry climate zones where the heat storage capacity of the soil can be used for cooling the building. Also a compact building shape does not have the same relevance in hot and humid climates that it has in cold climates, while natural ventilation is more important in hot and humid climate zones than in cold ones. Fig. 38 gives an overview of the importance of different design measures for different climate zones. But also here it is important to note that not all important measures for a specific climate zone make sense if they are combined with each other. One example: To insulate the envelope is not important in the tropics, if no air-conditioning is used. But as soon as an active cooling/ heating system is installed and used it makes sense in most climate zones.

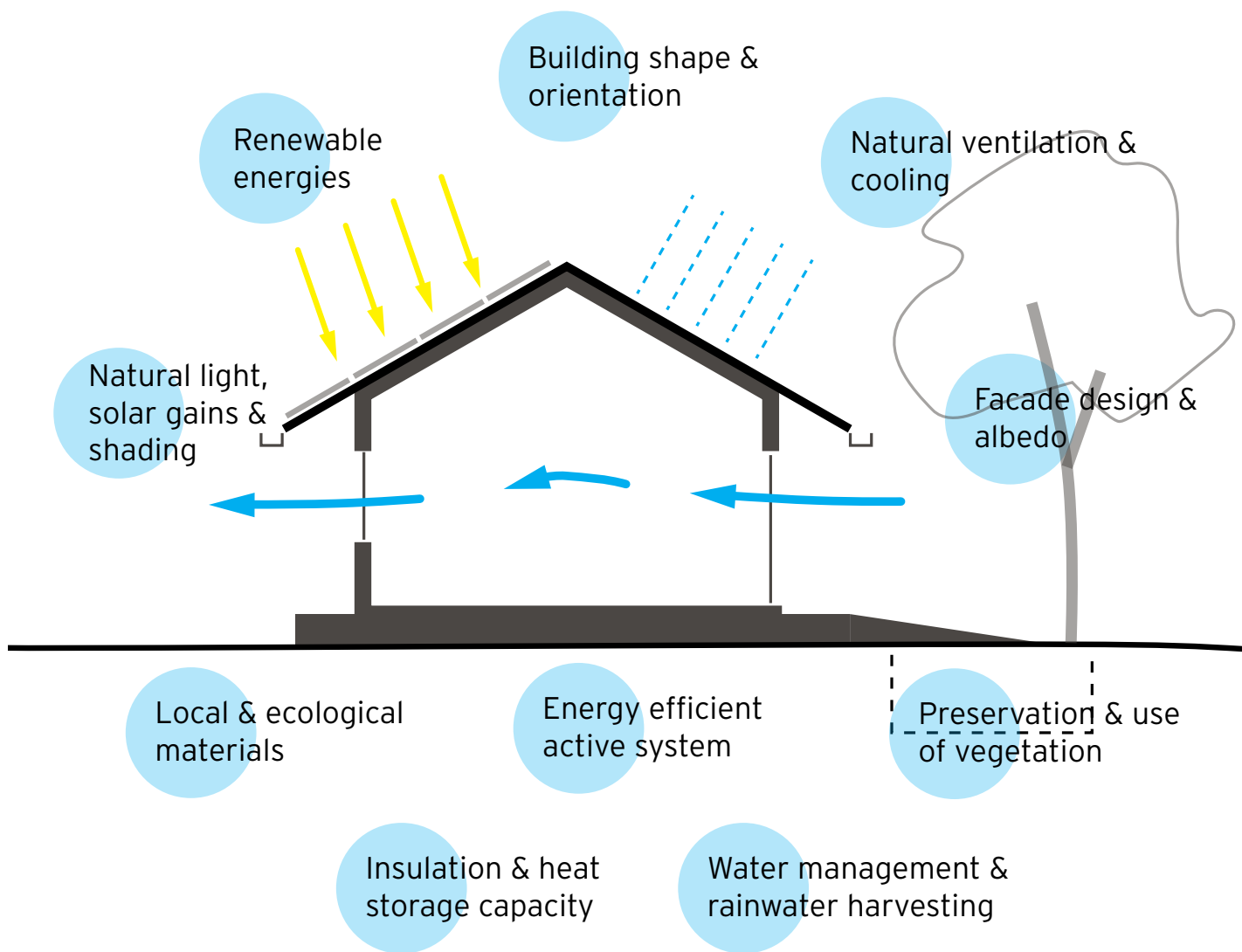


Fig. 37_ Components of
bioclimatic architecture

Design measures		Climate zones										
Passive measures	Active measures	Pole	Tundra	Highland	Continental	Moderate	Mediterranean	Sub-tropical	Tropical	Savanna	Steppe	Desert
Natural ventilation		0	0	1	4	6	6	7	7	7	7	7
	Mechanical ventilation	5	5	3	3	3	4	5	6	6	6	6
Night ventilation		0	1	2	3	5	6	7	7	7	7	7
	Artificial cooling system	0	0	0	1	1	3	5	5	5	5	6
Adiabatic cooling		0	0	0	1	2	3	2	2	5	6	7
	Natural cooling (water, soil etc.)	0	0	0	4	3	5	6	6	7	7	7
Massive construction		3	4	4	6	5	6	2	2	3	5	6
Light-weight construction		3	3	2	2	3	3	5	5	6	4	4
	Artificial heating system	7	7	7	7	6	4	0	0	2	4	1
Solar heat gains		2	3	6	6	7	6	0	0	2	3	0
	Natural heating (wood, soil etc.)	7	7	7	6	6	5	0	0	0	3	0
Heat support		6	6	6	5	5	4	0	0	1	2	0
Insulation of envelope		7	7	7	7	6	5	0	0	1	3	4
Shading		0	1	3	4	5	6	6	6	6	7	7
	Artificial lighting	6	6	4	4	4	3	3	3	2	2	2
Natural lighting		6	6	6	6	6	6	5	5	5	4	4

Scale: 0 - 7 (0 = not important; 7 = very important)

Fig. 38_ Principles of bioclimatic architecture.
own illustration based on Jones, David Lloyd (1998): Annex p. 246

CONSTRUCTION SHAPE

The building shape and its compactness have great influence on the heat gains and losses of a building. Therefore different building's compactness and shapes can improve its thermal comfort and energy efficiency. Depending on the specific climate conditions the shape and its compactness have other effects:

- Compact building shape: helps to reduce heat transfer improving comfort and energy efficiency in both hot and dry as well as cold climates
- Non-compact building shape: helps promote air circulation and reduces humidity levels in hot and humid climates

Surface/ Volume ratio (S/V)

The relation of surface area (building envelope) that is exposed to the outside environment and the volume inside of the building describes a building's compactness. It is a key factor

in limiting heat losses or gains via transmission through the building's envelope.

The smaller the S/V-ratio the more compact a building is and the less heat is gained or lost via transmission. Some shapes of the same volume are more compact than others. Spherical or semi-spherical shapes are the most compact forms but also cubic shapes are very compact whilst other shapes like elongated rectangular blocks, towers or pyramids are less compact.

Another important fact is that the bigger the volume of the same geometry the smaller the S/V ratio.

It is evident that the ideal shape and its compactness depend directly on the climate and the local environment (city/ countryside, orientation, wind direction etc.).

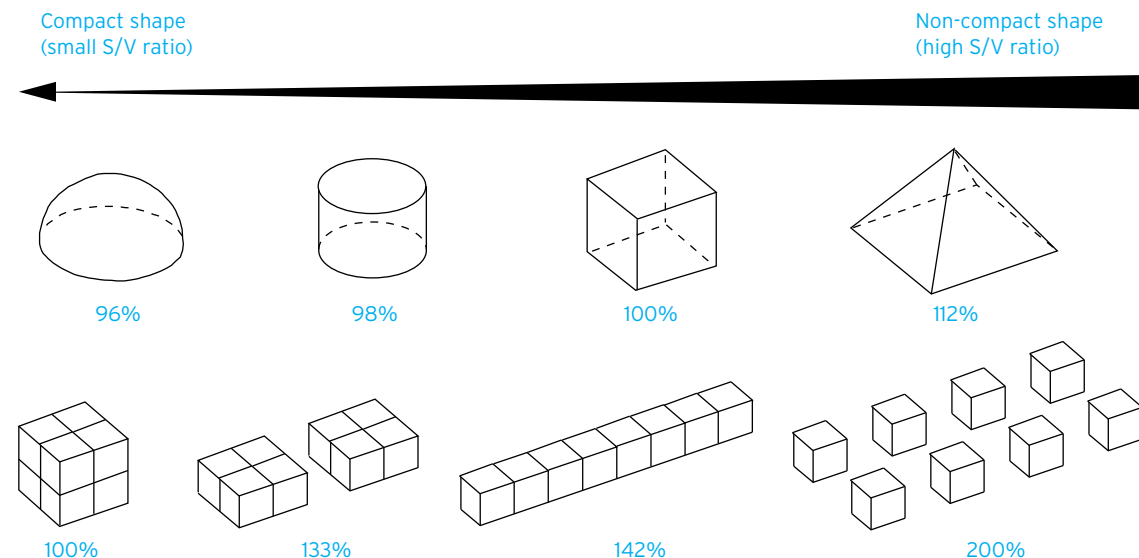


Fig. 39_ Same volume, different shape/ surface: different S/V ratio; own illustration on the basis of Detail, Energie Atlas, 2007

Fig. 40_ Example in
a hot-arid climate:
Kasbah in Morocco



Fig. 41_ Example in a cold
climate: House in Germany



Fig. 42_ Example in
a hot-humid climate:
Tropical house on
stilts in Thailand



Traditional and also modern bioclimatic architecture normally use the effect of compactness in order to achieve a comfortable climate. The table below as well as the images give an idea of an intelligent strategie by the use of an adequate shape.

Climate	S/V ratio	Strategies
Hot-arid	Small	Compact shape, thick walls (high thermal mass) & small windows
Cold	Small	Compact shape, well insulated envelope, big openings towards equator, smaller towards the other directions
Hot-humid	Medium	Less compact shape that promotes air circulation, light-weight construction that does not store heat

ORIENTATION AND SPATIAL ARRANGEMENT

The orientation of a building and the spatial arrangement within the building have a big influence on the indoor climate and the energy-efficiency of heated/ cooled rooms. It refers to the building's situation with respect to the sun's paths throughout the year and the prevailing wind directions. It depends on the latitude (North, South, equator) and on the climate. Also, where to arrange the main rooms with need of a higher comfort like living/ working spaces and where to put rooms with lower demand on a comfortable indoor climate such as store rooms, stair cases etc.

Solar architecture

Solar architecture tries to use the changing incination of the solar radiation over the day and/ or over the seasons in combination with the building's orientation and the spatial arrangement so that main rooms can profit from solar heat gain or shading to protect against overheating.

Warm climate close to the equator

Close to the equator it is normally better to arrange all habitable rooms facing North and/ or South with small openings that are shaded and to place side rooms towards West and East, where the sun radiation is the strongest

on the facade due to the lower incidence angle in the morning and evening. Open floor plans and high ceilings in combination with opposing windows and door openings help to use natural ventilation via cross ventilation.

Warm humid climates (coastal locations above the Tropic of Capricorn) are the exception, where orientation is mostly about access to cooling breezes and shade.)

Cold climate

In cold climates further away from the equator the seasonal use of sunlight for heating the rooms is advantageous for a comfortable indoor climate. Therefore it is recommended to place living areas and frequently used spaces towards the sun (North of the equator this is North, South of it it is South), while placing less frequently used areas on opposing direction. Bigger window surfaces are also placed towards the sun in order to increase the solar heat gain during the cold seasons. In the warm summer months shading of the windows shall reduce the heat gains to prevent overheating. Spatial Arrangement: concentrate living areas and frequently used spaces on the south/ north side, while placing less frequently used areas on the north/ south side.

Fig. 43_ Example of building's orientation and spatial arrangement for a building in Cameroon

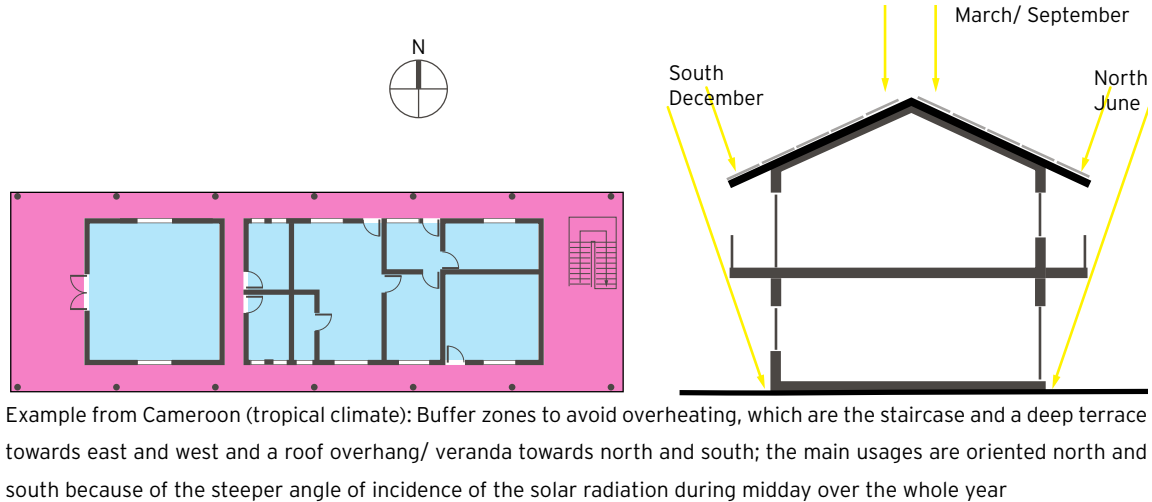


Fig. 44_ Example of building's orientation and spatia arrangement for a building in Germany

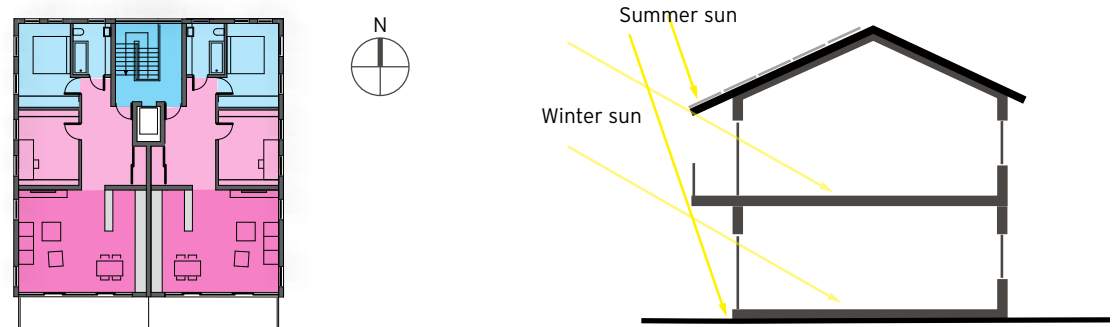
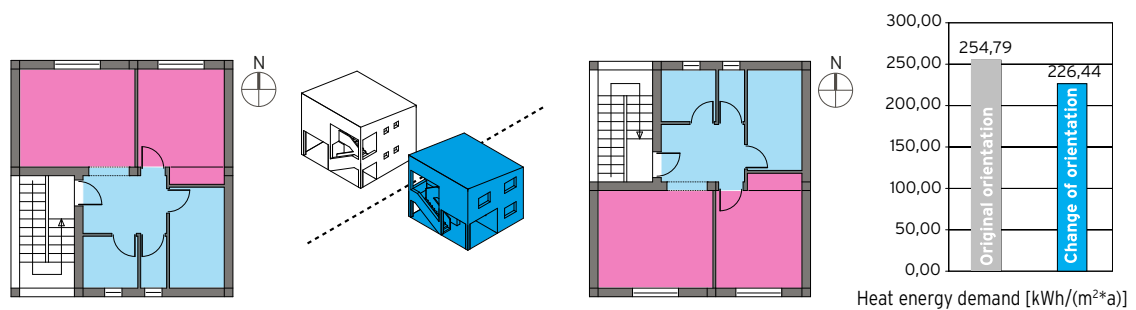


Fig. 45_ Case study of residential building in Morocco: reduction of energy demand by change of orientation



Example of residential building in Atlas mountains with cold winter in Morocco: Change from north to south orientation of building -> living room with big windows oriented towards south -> The winter sun with a low angle helps heating the building's interior oriented to the south -> 10 % decrease of heat energy demand + increase of thermal comfort

FACADE DESIGN

The facade design has the biggest influence on natural ventilation, natural lighting and solar gains. Windows can be opened to provide ventilation and windows allow the sun rays to get into a building to light it naturally and to heat the interior. At the same time, glazed windows normally have a higher heat transmission than opaque elements like walls and ceilings and therefore loose more heat energy than those. This is why the facade has to be designed adapted to the local context to optimize the solar gains and to reduce the energy losses via transmission. Generally too much glazing should be avoided in order to limit the solar gains and heat energy losses to a comfortable and energy efficient level. The Window-to-Wall ratio gives an indication on this.

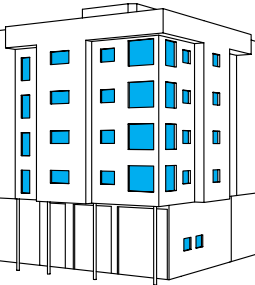
Window-to-Wall Ratio (WWR)

The window-to-wall ratio is the proportion of a building's exterior wall area that is occupied by windows expressed as a percentage. The optimal WWR is the window area that minimizes the total annual energy of cooling, heating, and lighting. It is calculated using the following

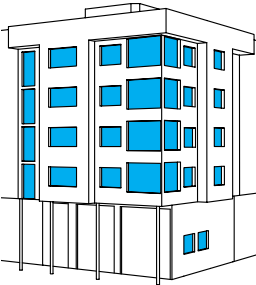
formula (entire exterior wall area has to be taken into account, also facades with no windows on them; walls adjacent to unconditioned, enclosed spaces have not to be included):

$$WWR = \frac{\sum \text{window surface of heated/ cooled rooms}}{\sum \text{total surface of the facade of heated/ cooled rooms}}$$

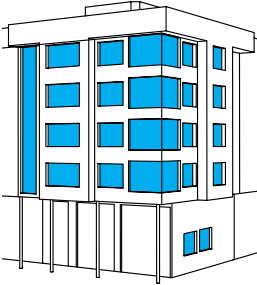
Certain factors such as climate, building type and orientation must be taken into account when determining the most suitable WWR. Low WWR reduces the direct sunlight and sun radiation, which can be more efficient to reduce the solar gains in hot climates but more harmful in cold climates due to a reduction of solar gains and by this an increased heat energy demand. Moderate WWR strikes a balance between heat gain and heat loss but does not take an advantage of the relation between the windows' size and their orientation. A too high WWR can lead to excessive solar heat in hot climates and to excessive heat transfer in cold climates. Normally a WWR of >30% in residential and >50% in non-residential buildings should be avoided.



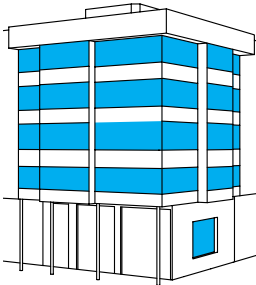
WWR 15%



WWR 25%



WWR 35%



WWR 45%

Fig. 46_ Graphic representation for different window-to-wall ratios

Climate and WWR

Cold climates: Big south-facing windows allow maximum solar gain during the winter months. The sun's rays can penetrate deep into the building, providing natural heat and reducing reliance on artificial heating. For the summer, sufficient shading should be provided. Windows towards west, east and especially north should be smaller, as the solar gains are here mostly inferior than the heat energy losses via transmission through the windows. Furthermore, properly sealing windows to prevent air leakage enhances their energy performance.

Hot Climates: Small or narrow windows are preferred to reduce solar heat gain and limit direct sunlight exposure minimizing heat transfer into the building and reducing energy consumption for air conditioning. Furthermore, properly sealing windows to prevent air leakage enhances their energy performance.

Building types and WWR

Residential buildings: A moderate WWR of around 15-30% is often suitable for housings. It means a good balance between natural light, heat loss/ gain, and energy efficiency.

Non-residential buildings: They can benefit from a moderate to high WWR to enhance natural lighting and create optimal learning environments. A range of 20-50% is often recommended.

Facade design in the specific context

Regardless of an optimal Window-to-Wall ratio, the design must reflect the architectural requirements taking into account the specific needs of window openings for natural ventilation, natural lighting and also cultural aspects. In many cultures for example people do not want that neighbours can look into the rooms from outside. In this case modern facades with big windows are not recommended as people often shut the blinds completely during the day so that artificial lighting has to be switched on. Another option is to add other design elements such as ornamental facade elements in front of window openings to provide more privacy and at the same time limit solar gains.

Natural Lighting and Sun Protection

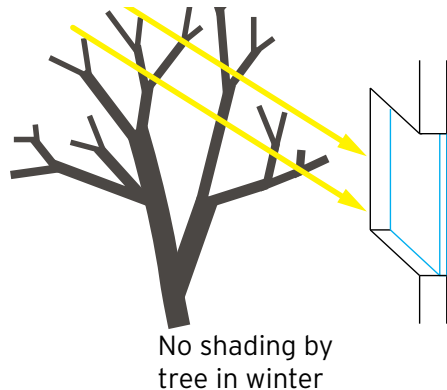
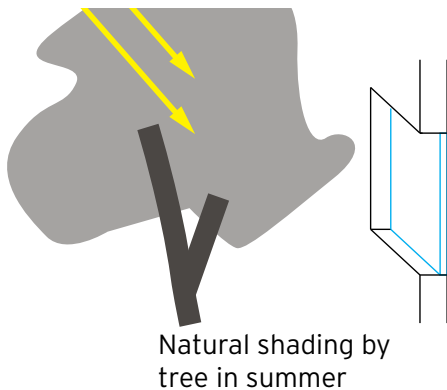
The use of natural light through windows, skylights, or similar can reduce the energy demand for lighting. Furthermore, light-colored surfaces, reflective materials, and strategically placed mirrors can help to reflect natural light deeper into the space.

But to avoid uncomfortable blinding and mainly to reduce the heat gain in the interior of the building through the solar radiation, different sun protection systems can be considered.

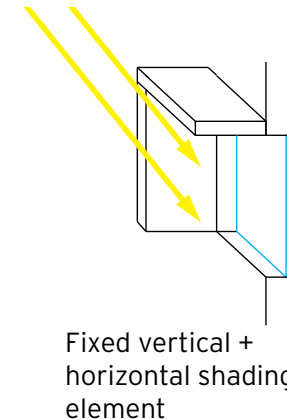
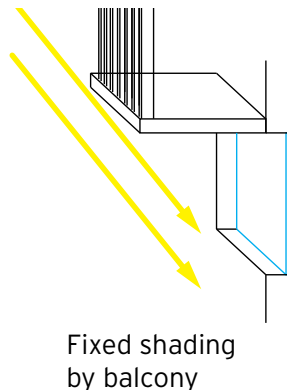
There are different ways for sun protection:

- Natural shading by vegetation. For example by deciduous trees: summer -> shading / winter -> solar gain
- Fixed shading by neighbouring buildings, roofs, balconies or other horizontal and/or vertical shading elements
- Flexible shading elements outside or inside of a building

Natural Shading



Fixed Shading



Flexible Shading

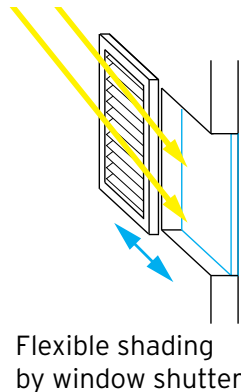
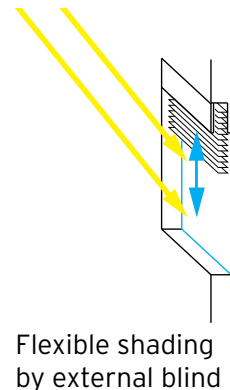


Fig. 47_ Different ways for shading: natural shading, fixed shading and flexible shading

Fixed shading

This refers to permanent shading elements outside of the building to mitigate solar heat gain while allowing natural light. Their effectiveness depends on several factors: building's latitude (sun's path through the year), orientation, local climate and the design of the shading elements themselves:

- Horizontal elements avoid direct solar radiation with steep angles of incidence (summer) while allowing direct sunlight and solar gain by lower-angle radiation (winter).
- Vertical elements avoid direct solar radiation with low angles of incidence (east, west)

Flexible shading

This refers to elements that can be adjusted according to the occupants' needs and to the changing environmental conditions, optimizing energy efficiency. There are several flexible shading systems such as adjustable blinds or windows shades/screens. They can be motorized or manually operated and can regulate the amount of sunlight, heat gain and glare.

Although they can be installed inside or outside of the building, they are more efficient outside because they block sun radiation before it enters the building, reducing solar heat gain and cooling loads improving the energy efficiency. It has to be taken into account, that

being outside, they are exposed to all weather conditions and so have to be stable and well maintained.

Fixed shading vs. flexible shading

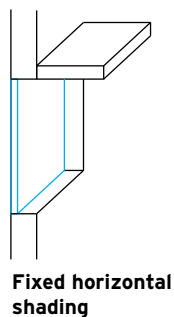
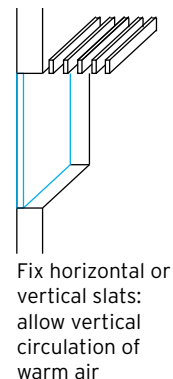
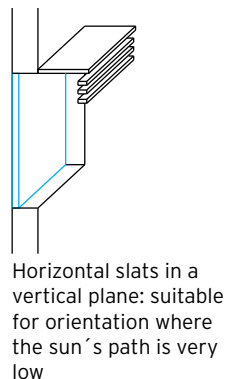
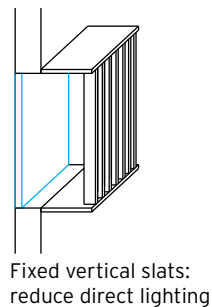
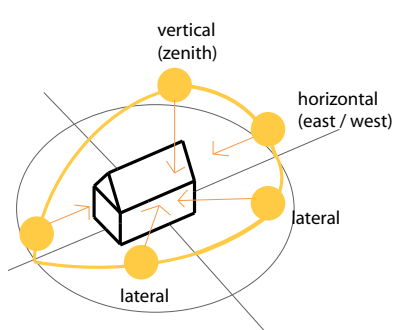
Both systems offer a protection against solar radiations but they have different performances.

Fixed shading requires relatively lower maintenance compared to flexible shading systems. But they lack adaptability to optimize natural light levels and cannot be adjusted.

Flexible shading can be adjusted based on the occupants' preferences to maximize natural light, but requires more frequent maintenance and may require professional expertise by automated systems and generally are more expensive.

Ornamental elements in front of windows

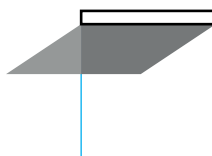
A special form of shading elements are ornamental elements made of wood, metal or even carved out of stone. They exist for hundreds of years and were already used in ancient Indian or Arabic Architecture. They are combining several advantages: Provide privacy, shade and natural cooling: wind that blows through the small openings of the ornamental element is compressed and this leads to a cooling effect.



**Vertical sun
(zenith)**



Lateral sun



Horizontal sun

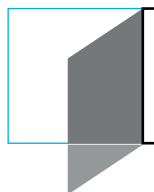
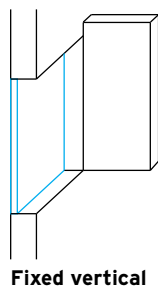
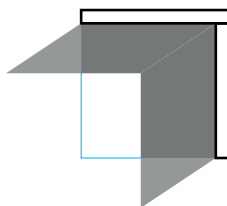
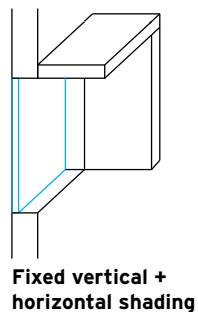
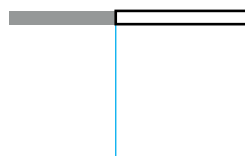


Fig. 48_ Different shading of fixed elements depending on their position and the relative sun position. Source: own illustration based on Maracaibo 1999_2

COMPONENTS' DESIGN: MATERIALITY OF THE BUILDING'S ENVELOPE

Sustainable materials

When considering sustainable materials for buildings, there are several factors to take into account: local availability, building time and costs, energy consumption by the production process, durability and maintainability, recyclability, and potential for reuse. All these factors have to be carefully considered.

For example lightweight constructions (wood, bamboo, straw, fabrics) are renewable compared to most massive construction materials (concrete, brick, stone). But massive construction materials tend to be more durable and require less maintenance over time, since lightweight construction materials may require periodic inspections, treatments against moisture and pests, or replacements to ensure their longevity.

Thermal mass

It refers to the ability of a building component to absorb, store, and release heat energy, which can regulate indoor temperatures improving energy efficiency. Materials with high thermal mass, such as concrete, brick, stone, or adobe have dense and heavyweight characteristics. They are also known as massive materials or massive constructions.

In **cold weather conditions**, during the day, the thermal mass of the building's components, such as walls, floors, or ceilings, absorbs the heat from sun radiation and/ or heating sys-

tem. In the evening when the external temperature drops, the stored heat is slowly released back into the space, maintaining a more stable and comfortable indoor environment.

In **hot weather conditions**, when the outdoor temperature is high, the thermal mass of the building can absorb heat from the interior spaces, helping to keep them cooler. This process is particularly effective when combined with proper insulation and night ventilation.

On the other hand, in **hot-humid climates** it may be better to use lightweight construction, such as wood, bamboo, straw bales or fabrics, to better promote natural ventilation.

Albedo

Albedo refers to the measure of how much solar radiation is reflected by a surface, usually expressed as a percentage.

High albedo surfaces (light colors) reflect a greater amount of solar radiation, while low albedo surfaces (dark colors) absorb more solar radiation. It helps to use high albedo materials for the building's envelope and paving around the building, reducing heat gain and cooling loads, particularly in warm climates. On the other hand, if the buildings' envelope is provided with low albedo materials, the interior of the building can benefit from increased heat gain in cold climates.

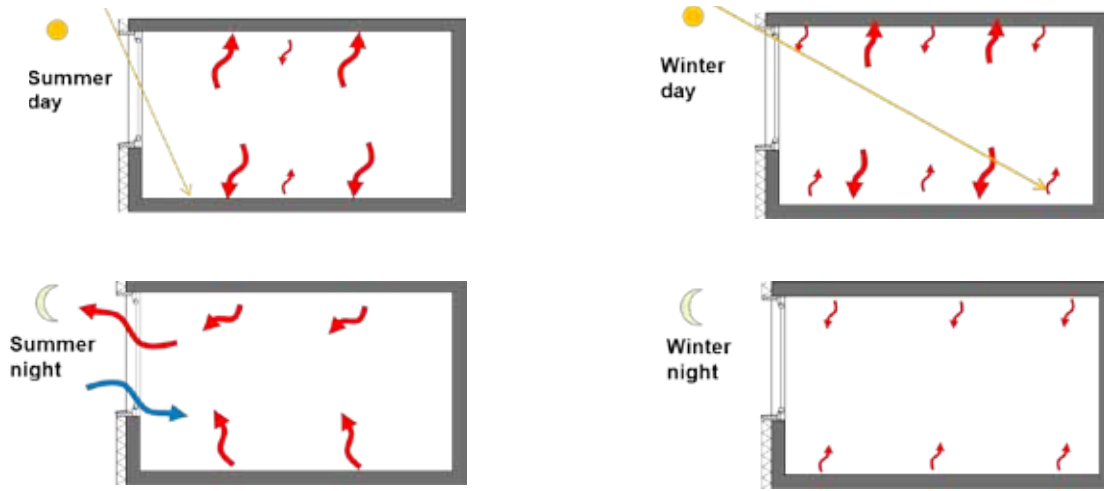


Fig. 49_ Use of thermal mass in climates with difference between night and day $>10^{\circ}\text{C}$

Typical albedo values for different surfaces (% reflected)

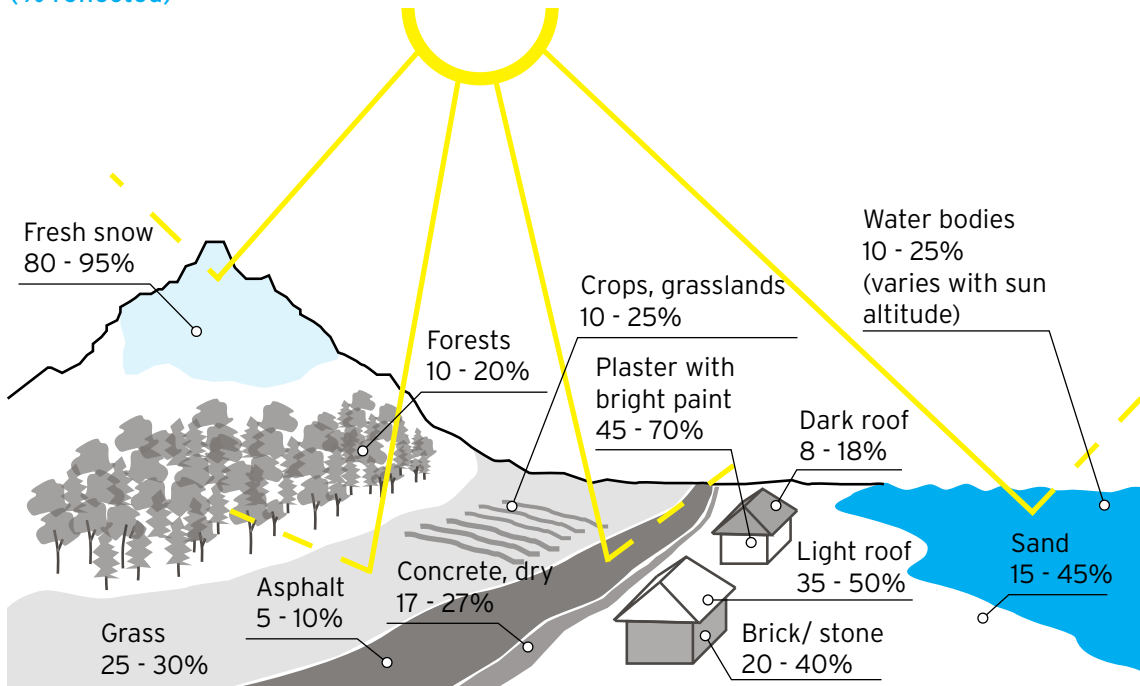


Fig. 50_ Different albedo values for different surfaces based on illustration from clima-tepedia.org/albedo

Insulation

Insulation has a very low heat conductivity and is used to reduce heat transfer through the buildings envelope consisting of walls, roof, and floors. This helps to improve the thermal comfort and to reduce the energy demand for heating and/ or cooling. The lower the heat conductivity the less heat is transmitted via 1 cm of material.

The U value indicates the heat transfer of construction elements (walls, ceilings, roof, floors etc.) for a temperature difference of 1 K between inside and outside of 1 m² construction element and the specific diameter and heat conductivity of the used materials. The lower the U value the better it is insulated. A typical U value for massive brick walls of 36 cm diameter without insulation is 1,2 - 1,4 W/(m²*K). In cold countries U values below 0,2 W/(m²*K) are typical for modern, well insulated buildings, while in warm countries a wide range is applied in modern insulated buildings, for example ranging from 0,5 to 0,75 W/(m²*K).

If insulation is properly installed, it can also prevent thermal bridges. Thermal bridging occurs at building junctions where different building components with different thermal conductivity meet, such as wall-to-roof connections, corners and window and door frames. The presence of thermal bridges can result in localized heat loss or gain, leading to temperature imbalances, condensation and other problems on their own.

In cold climates the insulation of the whole building's envelope is recommended in order to reduce the energy demand for heating. In warm climates it is not always recommended to insulate the whole envelope: While the insulation of the roof helps in all climates to improve the thermal comfort and reduce the energy demand for heating and cooling, the insulation of other elements are not always useful. The insulation of the floor slab against the earth is for example not recommended in hot climates where the soil can absorb heat.

Fig. 51_ Formula of U value

U value

$$U = \frac{1}{R_{se} + \sum d/\lambda + R_{si}}$$

R_{se}: Outer heat transfer coefficient in (K*m²)/W

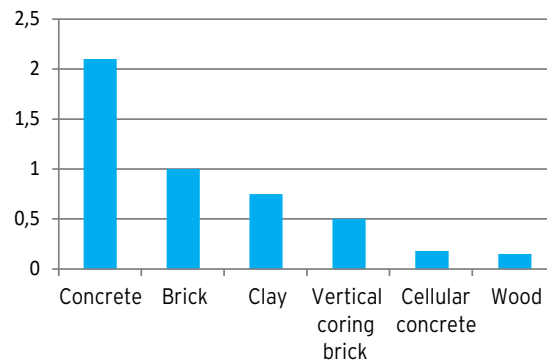
R_{si}: Inner heat transfer coefficient in (K*m²)/W

d: Layer thickness in m

λ: Specific thermal conductivity of the layer in W/(m*K)

Fig. 52_ Heat conductivity of different construction materials

Heat conductivity of construction materials [W/(m²*K)]



The insulation can be applied on the exterior, interior or inside of walls, ceilings and roofs. It depends on the climate and if heating/ air conditioning systems are installed and where the installation is best placed. The external insulation is the more common and normally also the more efficient one for both, warm and cold climates. But in tropical climates where the humidity is very high, the internal insulation can work better than the external one. Also in rooms that are only heated/ cooled for a very short time (few hours per day or even week) an internal insulation can be advantageous as it reduces the thermal mass and by this the room temperature changes faster, as soon as the heater/ air-conditioning is switched on.

There are different materials for insulation: Organic materials such as petrol based ones (polystyrene, polyurethane etc.) and most natural materials and inorganic materials such as rock wool, cellular concrete and foam glass. Natural materials are for example rice husk, cork, straw, hemp, sheep wool, perlite, wood fibre and cellulose insulation. Also mixed materials like earth mixed with straw or rice husk have reduced heat conductivity and help to reduce the heat transmission.

In cold climates insulation of 20 - 30 cm (cellulose fibre, rock wool etc.) is often applied. In warm climates insulation of 4 - 10 cm (rock wool, cork etc.) is mostly sufficient. This depends on the local climate and the local regulations.

Heat conductivity of different insulation materials [W/(m²*K)]

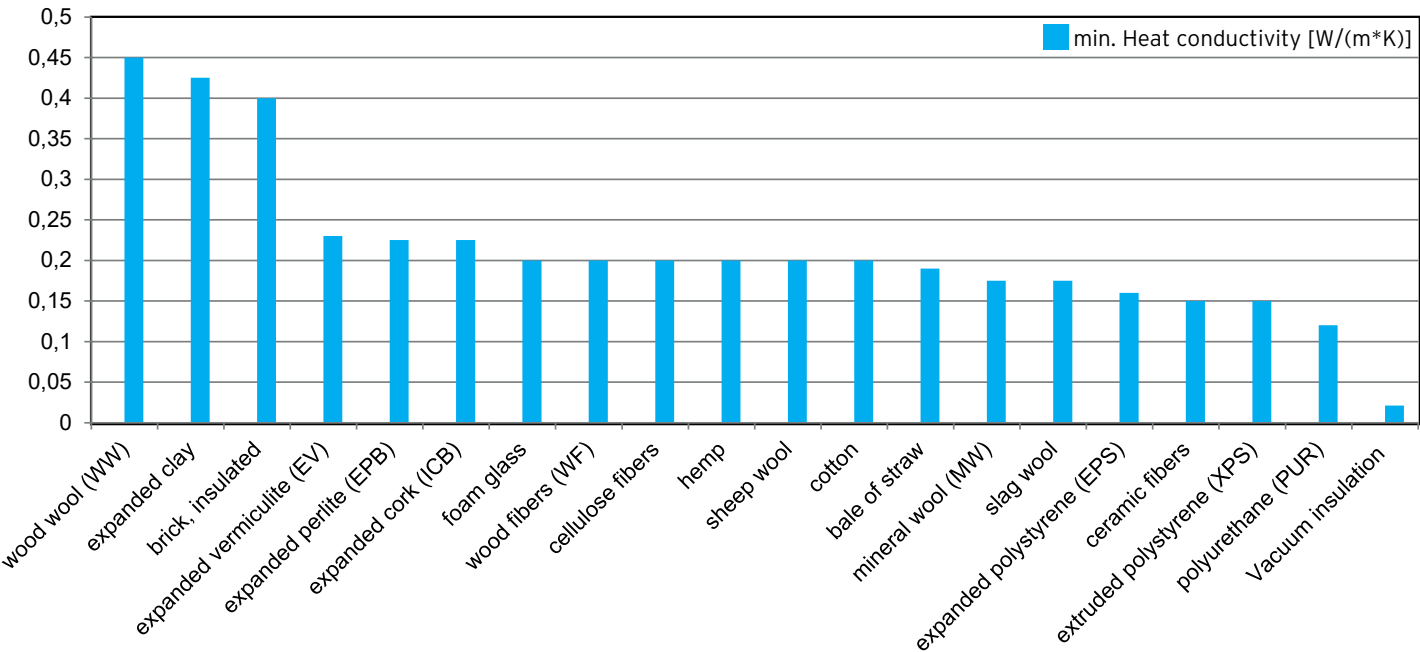


Fig. 53_ Typical heat conductivity of different insulation materials

NATURAL VENTILATION

Natural ventilation consists in using wind as a passive cooling strategy in buildings by controlling the air flow to go to the interiors. Several factors have to be considered: site analysis (wind direction, nearby buildings or trees); building's orientation; size, place and orientation of building's openings.

Cross-ventilation

The air goes across the interior of the building due to air pressure differentials. Openings, such as windows, doors, or vents, are placed on opposite sides to facilitate the flow of air. Open floor plans can also help facilitate airflow.

Tropical climate: cross ventilation improves the thermal comfort when the inside is hot and humid. Overhangs or hoods help to protect windows from direct rain and / or sunshine while maintaining the cross ventilation.

Hot climates with cooler nights: cross ventilation is used at night to replace the warm air that has been stored inside during the day.

Stack effect

This method uses the density of air to promote air movement. Since hot air is lighter than cold air, it naturally rises. If the warmer air inside a building can escape through an opening near the roof or upper level of a room, then cooler air from outside is pulled in to replace it. This movement refreshes the interior.

Ventilated roofs

The design of a ventilated roof includes a cavi-

ty in the roof construction for example by providing a ventilated air layer between the roof covering and another separation layer between the cavity and the rooms underneath. Ideally the layer between the cavity and the rooms underneath are well insulated. As solar radiation heats the roof surface, the air in the roof cavity also heats up. It becomes lighter and carries away heat from the roof through natural convection.

Elevate the building to promote natural ventilation

To raise the building off the ground on stilts allows air to flow freely underneath the structure, which can help in keeping the house cooler overall. The raised design can also take advantage of the stack effect. This is especially effective in tropical regions, where ventilation is essential for natural cooling.

Wind tower or wind catcher

A thin tower is installed on top of buildings, which harnesses natural ventilation and cooling in hot and arid climates. The vents at the top of the tower are oriented to face the dominant wind direction. The wind is drawn into the tower and descends to the inside of the building. It comes in contact with the interior surfaces of the tower, made of materials with high thermal mass, or contact water-filled containers (evaporative cooling). This helps cool the air by transferring its heat. As the cooled air enters the building, it displaces warmer air, which is expelled through other openings like windows or vents located at lower levels.

Solar chimney

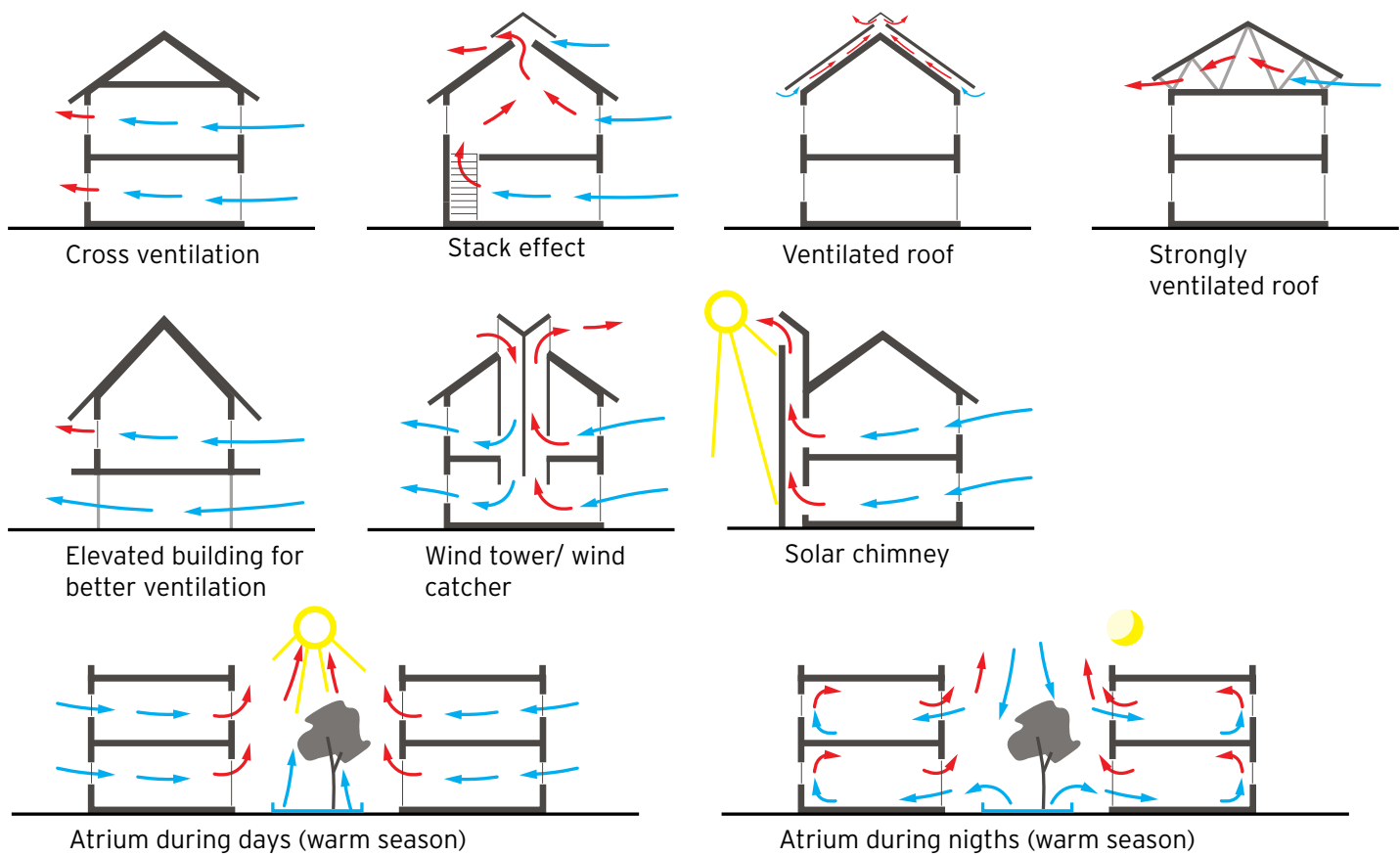
It harnesses solar energy to create natural air flow inside a building by using the temperature difference between the indoor and outdoor air. It is usually constructed with heat-absorbing materials such as dark-colored concrete or metal. The sun's radiation heats up the dark surface of the vertical chimney, causing the air inside it to warm up. Through the stack effect the hot air rise and escape through the outlet at the top absorbing cooler air from the building's interior. This continuous circulation of air helps to remove stale and warm air from the building interior, providing natural ventilation.

A solar chimney is particularly effective in hot climates where solar radiation is abundant.

Atrium as thermal buffer

Atriums often have a tall, open design that promotes the stack effect acting as a vertical chimney, facilitating the exchange of air and promoting airflow drawing cooler air from the lower levels. Furthermore, the use of vegetation and/ or water basins within the atrium can also refresh the air inside by evaporative cooling and reinforce the natural ventilation.

Fig. 54_ Overview of different natural ventilation schemes



USE OF VEGETATION

The use of trees, plants and other vegetation reducing the sealed surfaces has several advantages:

- Vegetation can provide shading to the building
- Vegetation refreshes the air absorbing solar radiation and cooling the air by evaporation through transpiration and can also control the airflow around buildings
- Greened surfaces allow rainwater to infiltrate the soil, reducing stormwater runoff, flooding and the strain on drainage systems
- Improved air quality absorbing carbon dioxide and release oxygen through photosynthesis
- Vegetation helps absorb and block sound, acting as a natural noise barrier
- Greened areas provide spaces for recreational activities, community engagement, and social interaction

Green roofs

Green roofs are a roof systems that are partially or completely covered with vegetation. They involve the installation of a layer of soil or growing medium, along with plants, on the roof surface providing the building with an extra insulation layer and storing rainwater. This leads to a natural cooling effect by evaporation in the summer and less heat transmission due to the insulation effect, which reduces the need for heating and cooling. There are two main types of green roofs:

- Extensive green roofs: These are lightweight, low-maintenance green roofs that typically have a shallow substrate layer (5-15 centimeters) and support low-growing, drought-tolerant plants such as sedums or mosses. They are well-suited for buildings with load-bearing constraints or where regular maintenance is challenging
- Intensive green roofs: These are more elaborate green roofs that can support a greater variety of plants, including shrubs, grasses, and even small trees. They have a thicker soil layer (more than 15 centimeters) and require more maintenance and irrigation. They offer more opportunities for landscaping, recreational use, and creating rooftop gardens. Intensive green roofs are very heavy and therefore the structure of the building has to be strong enough.

Green facades

Green facades consist of the installation of vegetation on the exterior walls of buildings providing additional shading and cooling by evaporation in hot seasons and also thermal insulation in cold seasons to the building. The plants grow vertically, covering the facade. The plants normally grow on a structural support system, such as a trellis or modular panel system, where plants are directly installed, or they are installed in separate containers. There are also plants like ivy or wild wine that can grow without support system directly on the facade, but this risks damages to the facade.



Fig. 55_ Green roof with intensive greening in Bangladesh



Fig. 56_ Green roof with extensive greening in Morocco



Fig. 57_ Green facade in Bangladesh

3-5 ACCESSIBLE DESIGN

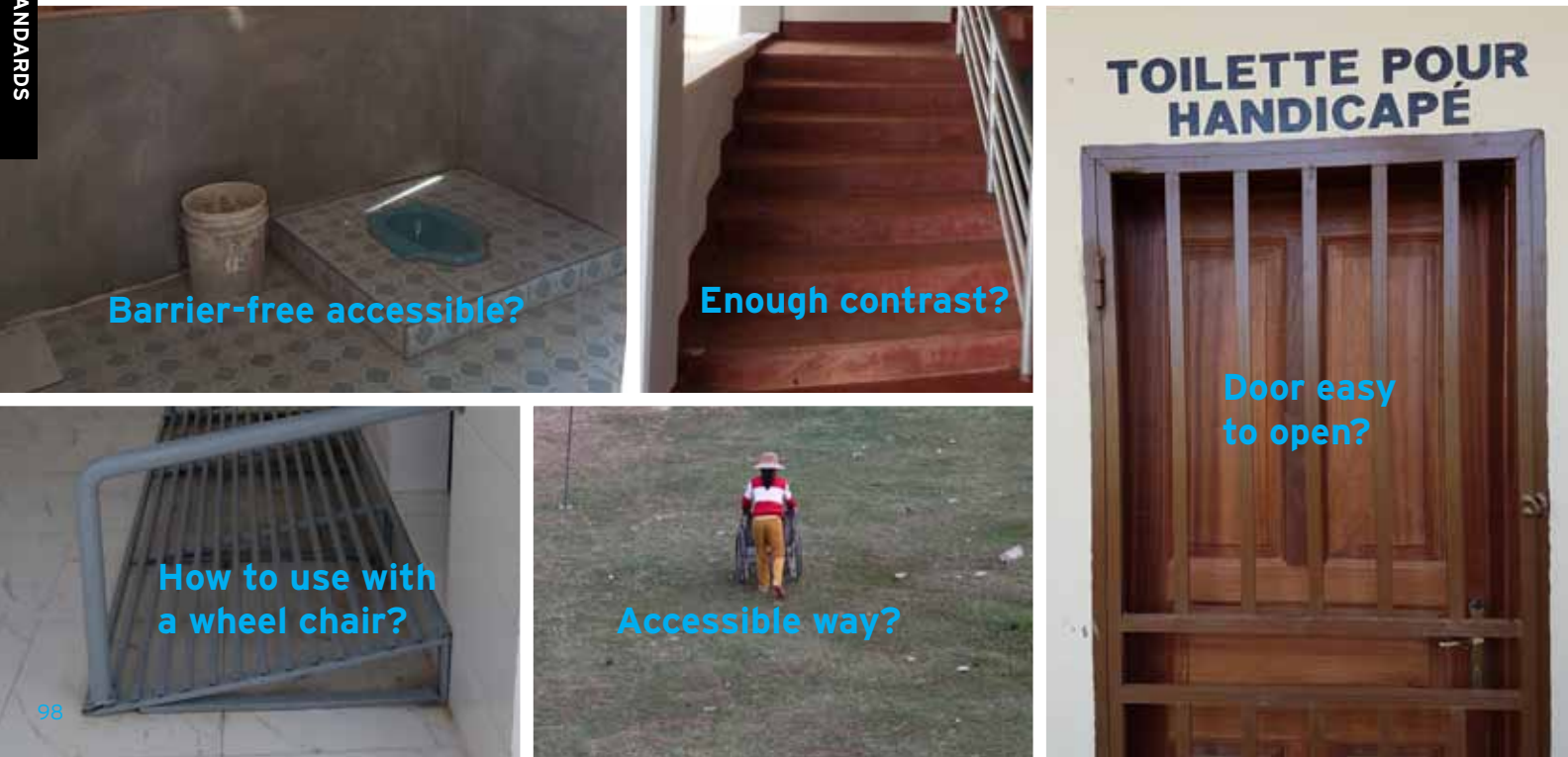
OBJECTIVES OF ACCESSIBLE DESIGN

In many countries there are still no laws or regulations to protect accessibility in cities and buildings. However, there are people with disabilities all over the world who should also have the right to be able to move and access all places safely, to which everyone else has free, safe and independent access. Even in the absence of legal requirements, it is ethically responsible to prioritize accessibility and ensure equal access for all.

It is important to always consider accessibility in the design for several reasons:

- People with disabilities (should) have the same rights as everyone else to access public spaces, buildings, and services so they have equal opportunities
- It benefits not only people with disabilities but also a wide range of individuals, including older adults, children, pregnant women, parents with strollers, and people with temporary injuries
- Taking accessibility into account in the design of buildings and public spaces from the beginning is often more cost-effective than renovating inaccessible spaces

Fig. 58_ Challenges
of accessible design



The United Nations (UN) recognizes accessibility as a fundamental human right for persons with disabilities. The UN Convention on the Rights of Persons with Disabilities (CRPD) specifically addresses accessibility and outlines the obligations of state parties to ensure equal access for individuals with disabilities, emphasizing the right of persons with disabilities to live independently and participate fully in all aspects of life (Article 9).

Accessibility includes people with different types of disabilities across different categories. It refers not only to physical disabilities, like persons with walking impairments, but also sensory, cognitive, psychological, learning, speech or multimorbidity disabilities. Furthermore, persons like older adults, children, preg-

nant women and illiterate people also have special needs and should also be considered while designing.

Each individual's experience and needs can vary within these categories, so buildings should be tailored to their specific requirements as best as possible to ensure equitable access. The physical, sensory and psychological categories focus more on constructive aspects while cognitive and learning categories involve actions inside the building such as signage, information signs or interior design. There are not yet sophisticated standards for all areas. That is why in the next chapters we focus on the design of spaces for people with physical and sensory impairments.

Category	Types of disabilities (examples)	Impact accessibility in buildings
	Physical: mobility impairments (e.g. wheel-char users), amputations or limb differences, muscular dystrophy, cerebral palsy, spinal cord injuries	need of ramps, elevators, accessible parking spaces, no thresholds, etc.
	Sensory: visual impairments, hearing impairments, deafblindness	need of braille signage, contrasting surfaces, visual alarms, hearing loops, etc.
	Cognitive and learning: intellectual disabilities, autism spectrum disorders, down syndrome, traumatic brain injury, dyslexia, discalculia, ADHD, dementia	need of clear signage, easy-to-understand instructions, alternative ways for information (written materials in accessible fonts, ausio recordings, etc.)
	Psychological: depression, anxiety disorders, bipolar disorder, schizophrenia	create an environment that is conducive to mental well-beeing, such as natural lighting, quiet spaces, reduced seonsory stimuli, etc.

Fig. 59_ Types of disabili-
ties; own illustration
based on Types of disabili-
ties: definition, types
and models of disability,
disabled world, [https://
www.disabled-world.
com/disabiliitz/tipes](https://www.disabled-world.com/disabiliitz/tipes)

REQUIREMENTS FOR DIFFERENT BUILDING TYPES/ USES

Accessibility in buildings is for some users necessary, for some helpful and for all comfortable. Buildings are considered barrier-free if they can be accessed and used by people with disabilities in the usual way, without difficulty and generally without assistance. This promotes the sense of autonomy, freedom, and inclusivity on the basis of equal opportunities.

Often, the distances are so difficult and few aids are available that people rarely leave their homes, and if they do, it is only with the assistance of relatives. Therefore, one should ask around within the target group in advance and, if necessary, also carry out home visits in order to adequately determine needs.

Building type	Areas with accessibility requirements	Building elements in areas with accessibility requirements			
		ENTRANCE	HORIZONTAL CIRCULATION		
ONLY privately accessible	Residential buildings with up to 2 dwelling units	min. 90 cm clear width	clear width of flat & toilet doors: min. 90 cm other doors inside: min. 80 cm clear width	min. 120 cm	
	Residential buildings with > 2 dwelling units	min. 90 cm clear width	clear width of flat & toilet doors: min. 90 cm other doors inside: min. 80 cm clear width	Shared spaces: min. 150 cm Inside apartment: min. 120 cm	
	Non-residential buildings without any public access (offices etc.)	min. 90 cm clear width	min. 90 cm clear width or min. 100 cm wall opening width	min. 120 cm + turning area: 150 cm x 150 cm	
Publicly accessible	Non-residential buildings with public access (health centres, hospitals, universities, schools, guest houses, administrations)	min. 90 cm clear width	min. 90 cm clear width or min. 100 cm wall opening width	min. 150 cm	
Other building types		Consultation with donor and construction consultant necessary!			

Fig. 60_ Different requirements for different buildig types

To ensure accessibility in a building, there are both mandatory measures and recommended guidelines. Mandatory measures are normally those that must be implemented to comply with accessibility codes and standards. Recommended guidelines, on the other hand, are not mandatory but highly encouraged to create a more inclusive, non discriminatory and accessible environment.

In case that the project involves a complex building, it is highly recommended to coordinate with donor and construction consultants for detailed implementation. When designing spaces for wheelchair users, it is also important to take into account the dimensions of the standard wheelchair to be used.

Building elements in areas with accessibility requirements							
VERTICAL CIRCULATION			SANITARY INSTALLATIONS/ LATRINES			VISUAL ACCESSIBILITY	
Stairs	Ramps	Elevators	Movement area	Door width	Door opening direction		
IF REQUIRED: regular, landing every 18 steps, continuous handrail on both sides	ONLY IF REQUIRED: max. slope 6% min. width 120 cm	---	1,2 m x 1,2 m or for wheel chairs 1,5m x 1,5 m	min. 90 cm clear width or min. 100 cm wall opening width	opening outwards	ONLY IF REQUIRED: contrast of walls, floors and doors, >2 m clear headroom	
IF REQUIRED: regular, landing every 18 steps, continuous handrail on both sides	ONLY IF REQUIRED: max. slope 6% min. width 120 cm	ONLY IF REQUIRED: handrail, min. 1,1 m x 1,4 m, 1,5 m x 1,5 m area in front	1,2 m x 1,2 m or for wheel chairs 1,5m x 1,5 m	min. 90 cm clear width or min. 100 cm wall opening width	opening outwards	Shared spaces (e.g. corridors): contrast of walls, floors, doors & stairs, >2 m clear headroom	
regular, landing every 18 steps, continuous handrail on both sides, clear headroom	max. slope 6% min. width 120 cm	ONLY IF REQUIRED: handrail, min. 1,1 m x 1,4 m, 1,5 m x 1,5 m area in front	1,5m x 1,5 m	min. 90 cm clear width or min. 100 cm wall opening width	opening outwards	contrast of walls, floors doors & stairs, >2 m clear headroom, IF REQUIRED: tactile elements on floor, stairs & elevators	
straight stair runs, landing every 18 steps, continuous handrail on both sides, min. 2 m clear headroom, non-slippery	max. slope 6% min. width 120 cm	handrail, min. 1,1 m x 1,4 m, 1,5 m x 1,5 m area in front	1,5m x 1,5 m	min. 90 cm clear width or min. 100 cm wall opening width	opening outwards	contrast of walls, floors, doors & stairs, >2 m clear headroom, IF REQUIRED: tactile elements on floors, at beginning and end of staircase & elevators	

EXTERNAL ENVIRONMENT/ OUTSIDE THE BUILDING

The outside areas around the building also require an accessible design. It would be ideal if the surrounding public area is also accessible for every one. When the public space is not accessible, the community should look for other ways to get access to the building for everyone.

Ramps and slopes

Generally ways and paths with steps should be avoided. Providing ramps or gently sloping paths at entrances ensures easy access for individuals with mobility aids and those with difficulty navigating steps. For ramp design please see chapter „Ramps“.

Accessible parking

Designate wheelchair accessible parkings should be provided near the entrance. These parking spaces should be wide enough for wheelchair users (see Fig. 61), with proper signage and an accessible route leading to the site. There should be a minimum space of 1,2m beside the wheelchair accessible parking space.

Kerbs and sidewalks

Kerbs and sidewalks facilitate access for wheelchair users, individuals with walkers, visual impairments and people with strollers. Sidewalks should be wide, even, and free from obstructions to accommodate different disabilities. At the edges of kerbs and street path crossings, lowered kerbs or ramps should be installed and if blind people are also using the premises, additional tactile ground surface indicators (TGSIs) are recommended.

Obstacle-free paths

No debris, uneven surfaces, or protruding objects on paths or at entrances. Sufficient width allow for people with mobility impairments.

Lighting

Adequate lighting levels should be provided throughout the site, including paths, entrances, and parking areas.

ACCESSIBLE ENTRANCES

Key features of accessible entrances:

Accessible door entrance (width and swing): wide enough to allow wheelchairs and mobility aids to pass through easily, including an adequate swing area both inside and outside the entrance, allowing individuals to open the door without obstruction and move freely. Minimum recommended width is 90 cm to accommodate most standard-sized wheelchairs.

Level ground or accessible ramp: the entrance should be levelled with the ground or have a ramp with a max. 6% slope that complies with

accessibility guidelines. Ramps should have handrails on both sides for support and be wide enough (120 cm) to accommodate wheelchair users comfortably. For ramp design please see chapter „Ramps“.

No thresholds: accessible entrances should be free of any raised thresholds (> 2 cm).

Clear signage: clearly visible, placed at an appropriate height, with easy-to-read fonts and high contrast colours. They should also indicate accessible entrances and provide directional information to guide individuals towards them.

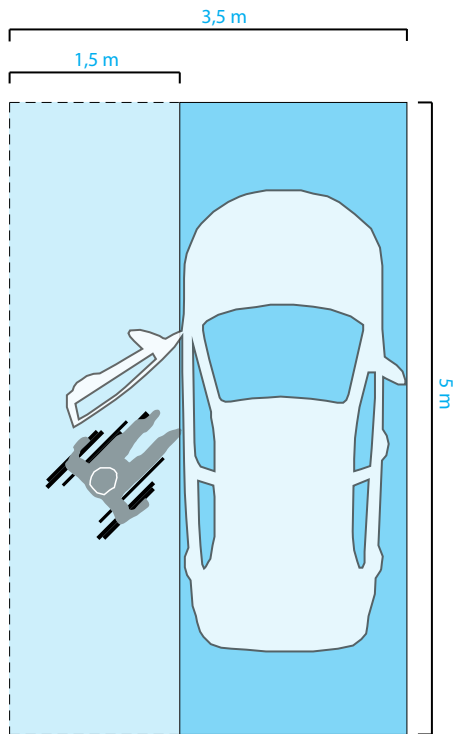


Fig. 61_ Dimensions for a wheelchair accessible parking spot (left illustration)

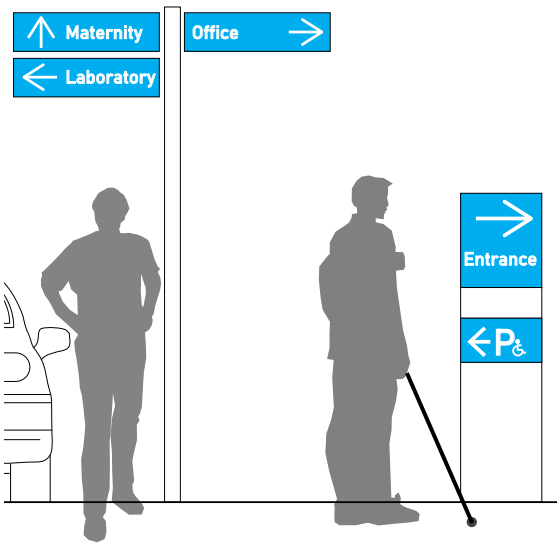


Fig. 62_ Wayfinding outside the building (right illustration)

HORIZONTAL CIRCULATION

The following aspects are mandatory for areas inside of buildings that have requirements for accessibility:

Corridor widths

- > 150 cm for general use and turning area
- > 120 cm when the length < 6 m
- 180 x 180 cm area after 15 m of corridor for wheel chair users to pass by
- free from obstacles (no furniture or equipment)

Doorways

- > 90 cm clear width
- easily noticeable, effortless to open and close.
- thresholds < 2 cm; no door stops
- > 205 clear height
- appropriate door handle height

Flooring

- > smooth anti-slip and even surface
- > no thresholds!

Visual contrast

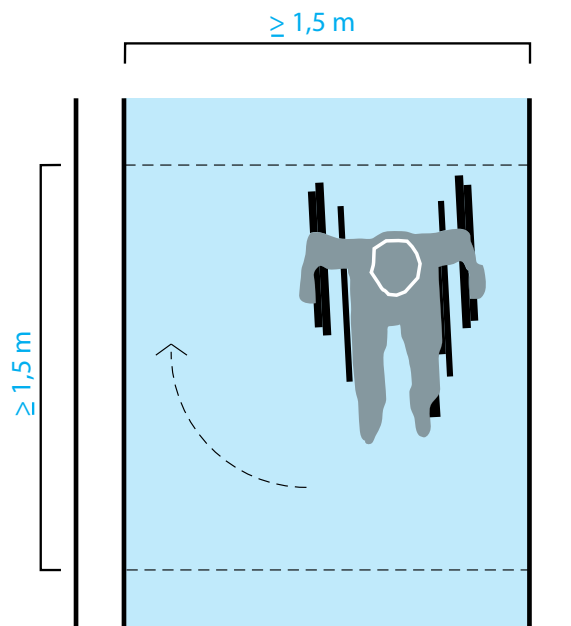
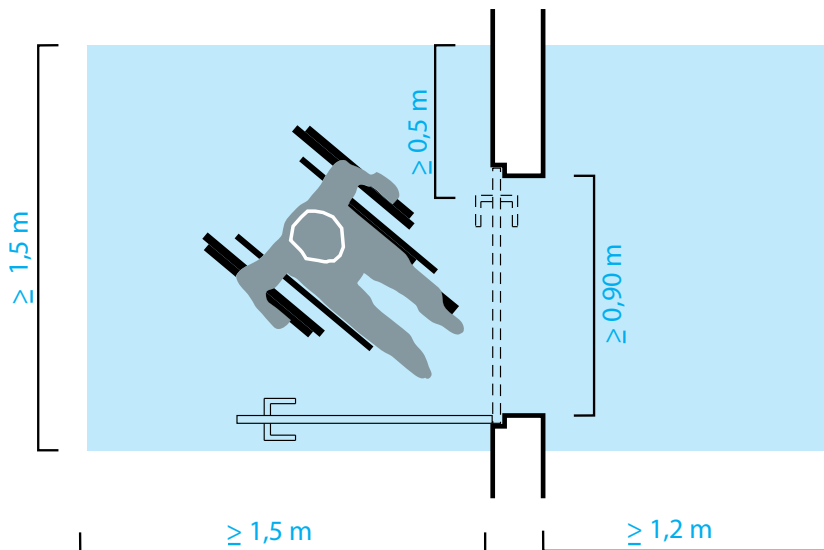
- > between flooring and walls, doors and/or pillars to improve orientation
- > no reflective or glazed surfaces

Others

Additional measures can be taken into account depending on the building's use and expected user, such as handrails, position of switches position, highly contrasting or visual markings for glazed walls etc.

Fig. 63_ Door and corridor dimensions accessibility for wheelchair users (left illustration)

Fig. 64_ Corridor dimensions accessibility for wheelchair users (right illustration)



VERTICAL CIRCULATION

In regard to vertical circulation within a building, these are the aspects that must be taken into account to ensure accessibility:

Stairs

Stair flights

- > only straight flights (only in exceptions curved stairs are allowed if the inner diameter of the curved section is at least 200 cm)
- > wide enough to accommodate individuals using mobility aids
- > non-slippery flooring

Steps

- > regular size for treads and risers
- > stairs without risers are not allowed
- > treads should not extend beyond the risers
- > steps marking at the edges for visual contrast

Landing

- > every 18 steps
- > same width as the stair flight

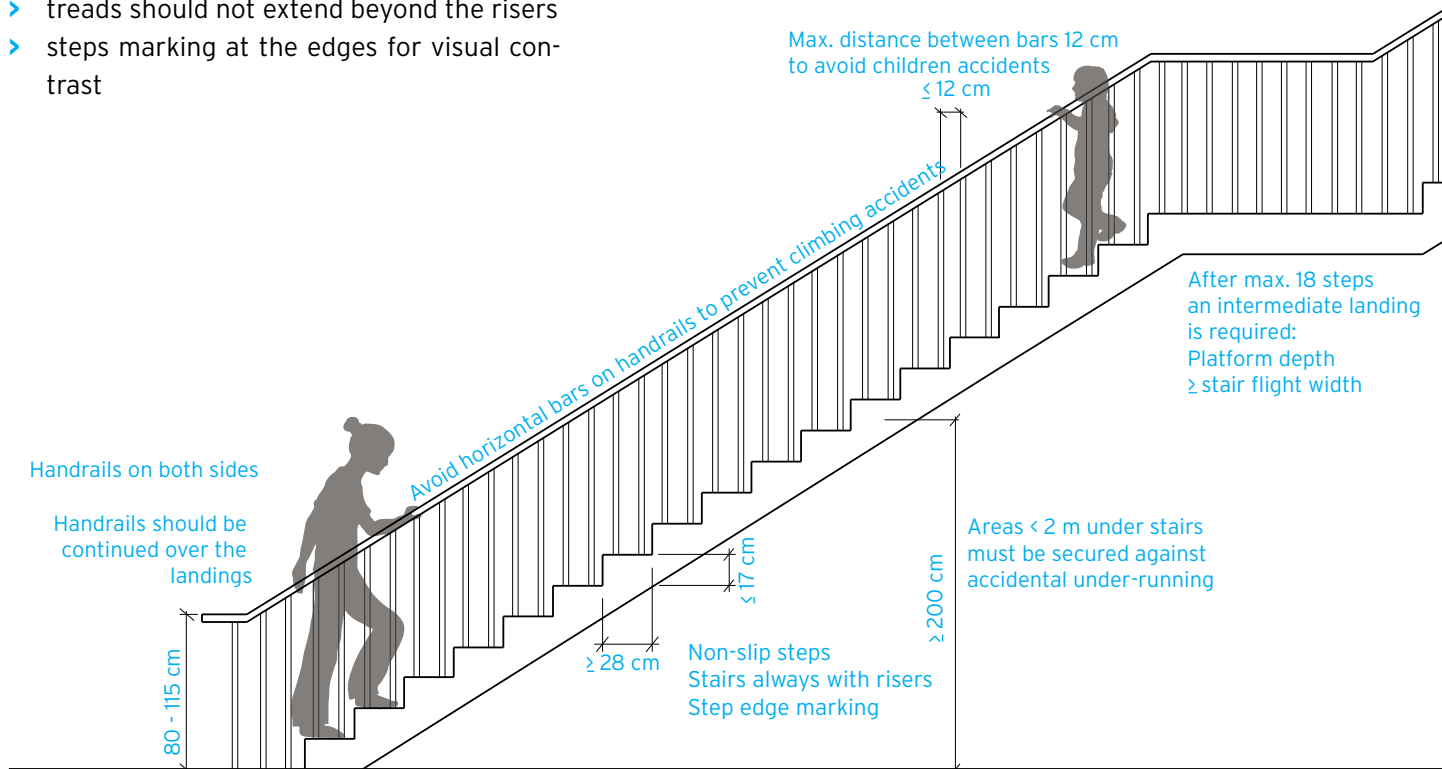
Handrails

- > on both sides
- > must be continuous, graspable, and extend for the full length and at least 30 cm over the end of the stairs
- > height 85 - 90 cm

Visibility and lighting

- > uniform lighting without glares or shadows
- > visual contrast between building elements (wall, landings, steps)

Fig. 65_ Design of accessible stairs



Ramps

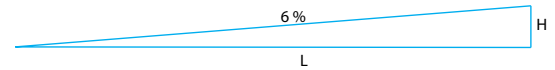
Ramps are the only barrier-free option to reach floors that are elevated from the ground apart from costly elevators that require electricity. Ramps also have the advantage that they can be used by other vehicles like carts, (motor) cycles and they are maintenance friendly. The only disadvantage is that they consume a lot of surface area. That is why it is recommended either to locate all areas with requirements for accessibility on the ground floor or to connect not only one but several buildings to the ramp, if possible.

Slope and width

- > max. 6% (for self operator wheelchair users) only in exceptions 10%, if it can be ensured that someone can help pushing the wheel chair
- > How to calculate the ramp length with 6 % slope:

6 %

$$L = \frac{H \times 100}{6}$$



- > minimum clear width: 1,2 m
- > Non-slippery surface and free from any obstacles

Handrails

- > on both sides
- > continuous, extend over the full length
- > 85 - 90 cm height

Landings

- > flat landing
- > at the top, bottom and each 6 m
- > clear width of ramp and min. 1,5 m length

Fig. 66_ Example of ramp in Indonesia (left picture)



Fig. 67_ Example of ramp outside the building in Haiti (right picture)



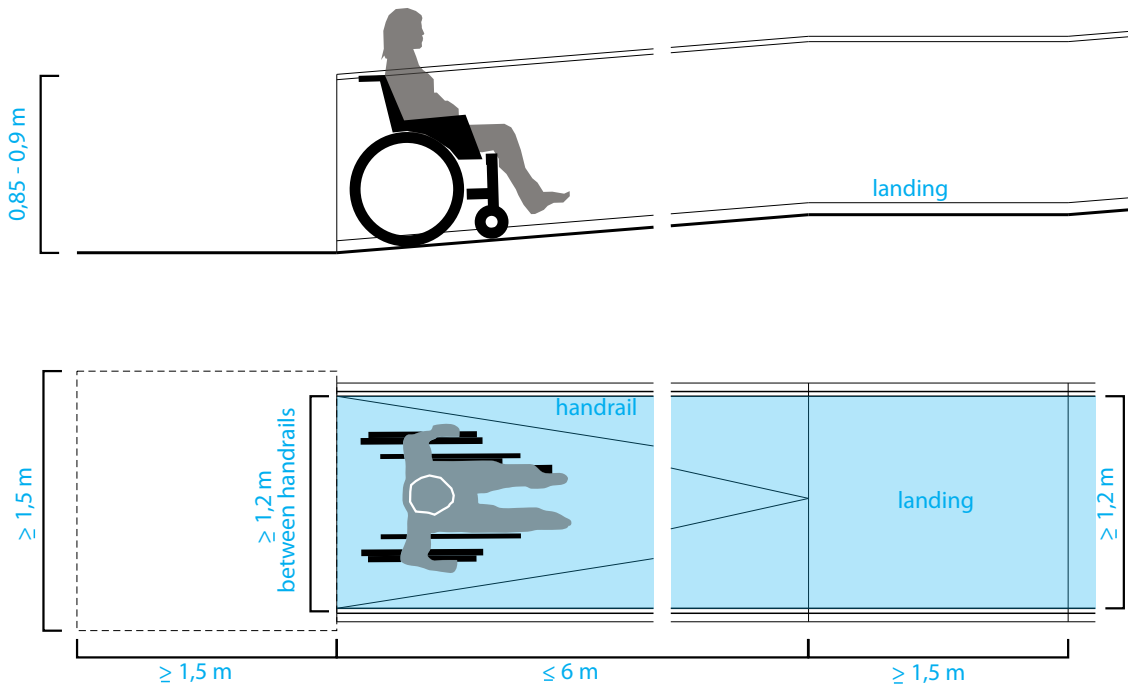


Fig. 68_ Design of accessible ramp



Fig. 69_ Different ramp slopes

Elevators

Elevators are the choice for vertical accessibility, if only little space is available and if the electricity supply is available 24/7 and the regular maintenance can be ensured.

Waiting area in front of elevator

- 1,5 x 1,5 m
- no stairs going down in front in at least 3 m

Cabin

- > 1,1 m x 1,4 m
- > 90 cm door width
- interior control panel: high 85 cm; high-contrast and tactile push-buttons

Depending on the availability on the local market it is also good to have the following features:

Cabin

- handrail
- mirror on the rear wall
- auditory and visual signals (floor announcements and door operations)
- emergency communication

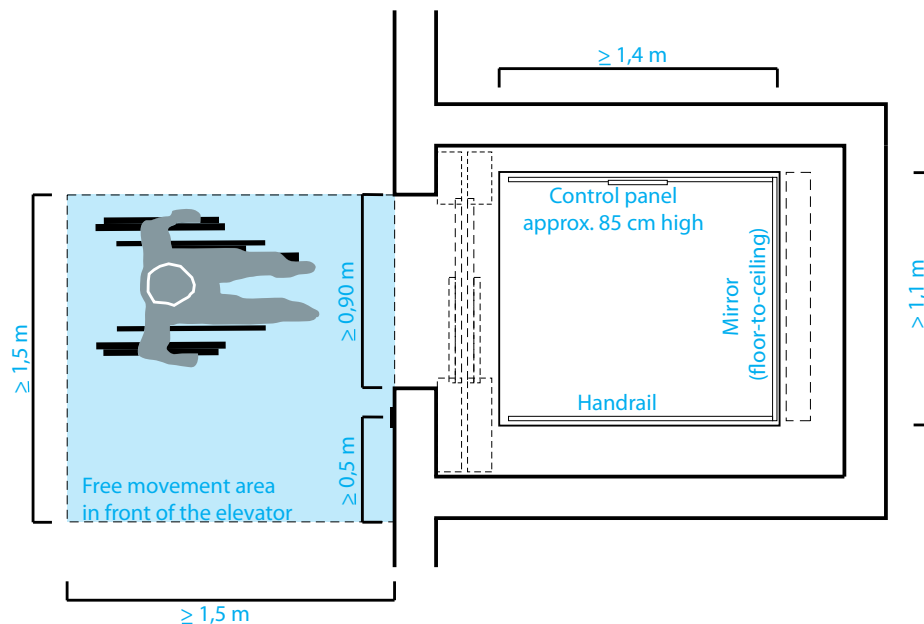


Fig. 70_ Design of accessible elevator

ACCESSIBLE SANITARY FACILITIES

Each restroom must include a minimum of one accessible toilet for individuals with disabilities in a gender-neutral manner or one for each gender. Every extra fixtures should be installed at an accessible height and they should be easy to operate.

Ensure visual contrast between the toilet fixtures, walls, floors, and doors to assist individuals with visual impairments.

Movement area and door

- minimum movement area 1,5 x 1,5 m in front of toilet seat and wash basin
- min. 90 cm door width
- door opening outwards

Toilet seat

- appropriate height (46 cm - 48 cm)
- accessible from both sides or two cabins (one from left side and one from right side) with a movement area of 0,9 m width x 0,7 m depth
- enough long grab bars on both sides

Wash basins

- max. 40 cm between tap and front edge
- max. 55 cm high, min. 90 cm width legroom long-lever or touchless tap

Good to have:

Shower

- max. 2cm floor level difference
- slip-resistant flooring
- horizontal grab rails 85 cm height
- long-lever shower fitting accessible from a seat
- folding or mobile seat with support handles

Fig. 71_ Accessible toilet designs with movement area on both sides of toilet seat and only on one side

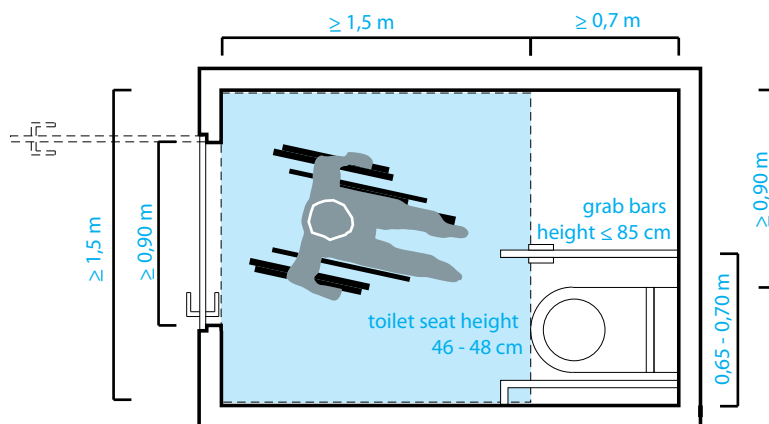
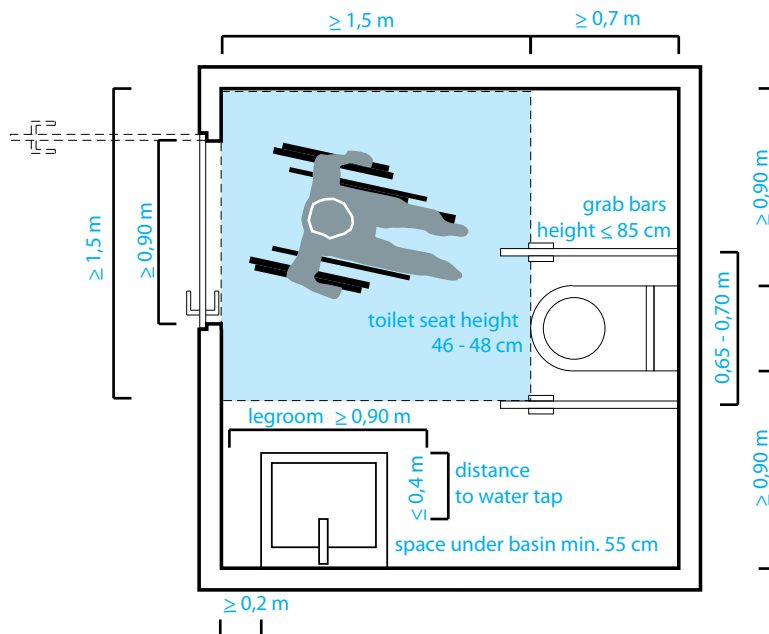


Fig. 72_ Example of accessible toilet with movement area on both sides and movable handlebars



Fig. 73_ Example of accessible toilet with movement area only on one side and fixed handlebars



BUILDING GUIDANCE SYSTEM

Guidance systems are intended to help not only people with visual and/ or cognitive impairments to find their way around, but everyone. In schools, educational facilities, hospitals and medical facilities, a guidance system should be implemented. Wayfinding signage should be installed indicating where to find the different rooms and/ or usages like examination rooms, class rooms, administration rooms or toilets.

For the wayfinding system it is recommended to use signposts with easy-to-read fonts and symbols. The latter one should also help children and illiterate adults to find their way around without help. This is not only the case for big buildings, but also for small ones such as health centres and helps for example to reduce the contact between healthy patients such as pregnant women and patients with di-

seases. The signage should have contrasting colours and should be installed at an appropriate height for the user groups.

In special buildings for blind people and/ or people with eye diseases like eye hospitals or schools for the blind, it is recommended to provide also tactile signage and/ or acoustic information:

- Tactile signage can be installed on the floor or on walls. It can be Tactile Ground Surface Indicators (TGSi), but also textiles, colour contrast or an embossed material at the wall.
- Acoustic information (like sound signals at the elevator) is always a very good guidance system. But any other alternatives for acoustic information, like loudspeaker announcements are also helpful.

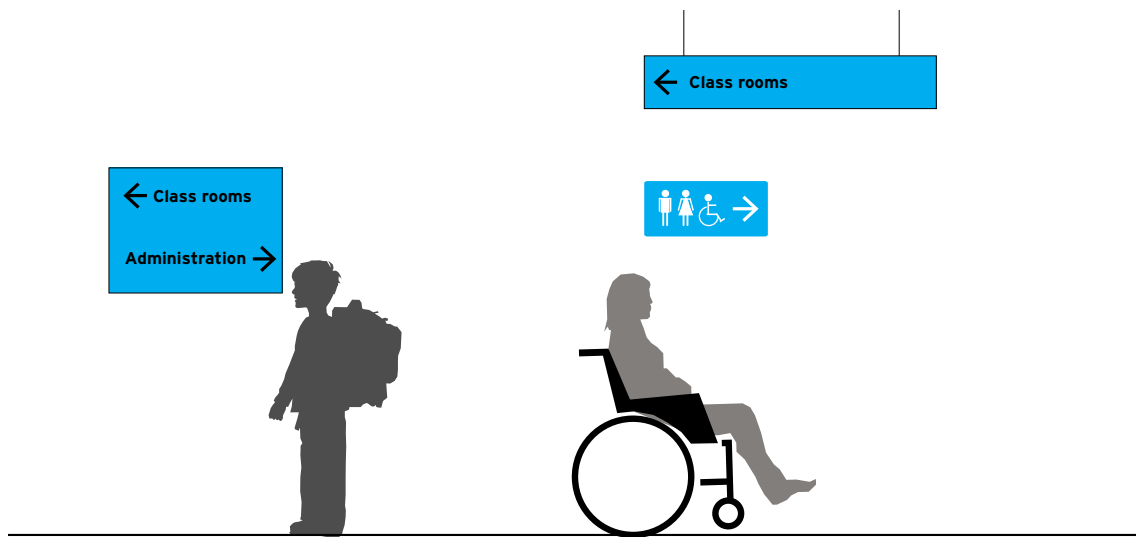


Fig. 74_ Different heights for the signage in buildings

For the different zones in and around buildings, the following measures should be taken into account:

External environment

Clear signage to navigate in the outside facilities and for example where to find the building's accessible entrance.

Entrance

clear signage indicating accessible entrances and providing directional information

Horizontal circulation

Clear singage of rooms, indicating the function, signage at junction points indicating the different rooms/ usages in the building TGSi or similar, to navigate in the building, guiding to accessible facilities.

Vertical circulation

TGSi or similar marking danger points, such as edges or stair treads but also elevators.

Fig. 75_ Examples for symbols to indicate different usages

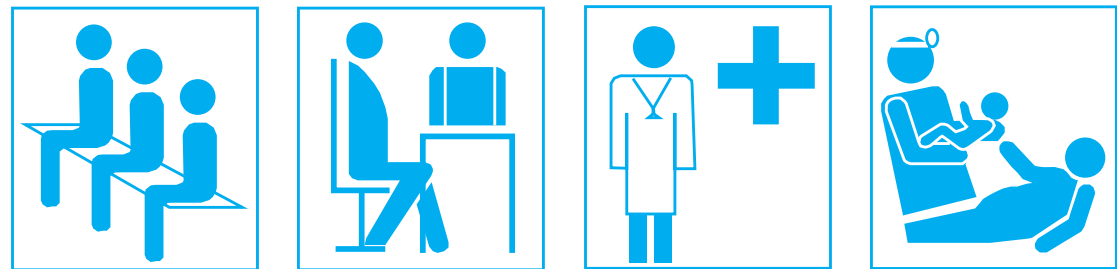
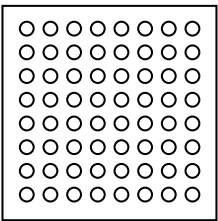
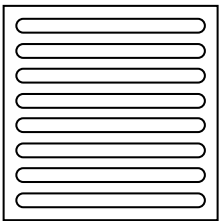


Fig. 76_ Tactile elements for the floor (left illustration)



Warning tile



Directional tile

Fig. 77_ Example of tactile ground indicator scheme (right illustration)



Image source: ILIS
Leitsysteme gGmbH

4_BEST PRACTICE

4-1 LOCAL BUILDING TECHNIQUES IN RECONSTRUCTION

PROJECT DESCRIPTION	45 Projects for rural housing space supply after the earthquake of 2010
LOCATION	Departement Ouest, Haiti
PROJECT DEVELOPER	Bischöfliches Hilfswerk MISEREOR e.V.
PARTNER ORGANIZATIONS	FEPPMPH, GADRU
FUNDING	Donations
PROJECT COSTS	16.000.000 €
BUILDING COSTS	5.463 € per shelter (22 m²) incl. construction of model houses, craftsmen training and consultancy pur construction costs: 1.600 - 1.900 € per house (22 m²)
PROJECT DURATION	2010 - 2015
CONSTRUCTION TIME	2010 - 2015
ARCHITECTURE & EXPERT PLANNING	Alexander Douline, Berater von MISEREOR and members of CRAterre
CONTACT PERSON	Barbara Küpper
FURTHER INFORMATION	www.misereor.de , www.blog.misereor.de



Authors:
Andreas Bernögger
Heinrich Oelers

Image source:
MISEREOR

Since its founding in 1958, Misereor has supported over 103,000 projects in more than 100 countries with around €6 billion. Its central concern is the fight against poverty, hunger and injustice according to the motto „help people help themselves“. Sustainability is viewed as essential, which is why, in addition to basic supplies for groups in need, environmentally friendly agriculture, renewable energies and the protection of species and natural resources such as water are the focus of the work.

MISEREOR has traditionally always given great importance to the living/Habitat and the construction of health and educational facilities. It is difficult to take stock, but several thousand social buildings and countless residential buildings have been built. One advantage is the network that has been built up at the operation sites: In the past it was mainly church institutions, but today there are more other partner organizations that act as builders or advise and support local organizations. In many cases MISEREOR itself provides advice, supports the creation of concepts, promotes the networking of local initiatives and exchanges and finances Projects. Another principle is building in mutual self-help, integrated into community and organi-

zational development projects. High standards and architectural quality are emphasized (especially when „building for the poor“), as this improves acceptance, care and long-term use. Direct support for housing projects usually only takes place in the context of reconstruction measures after disasters. An attempt is made not to lose sight of the personal responsibility of the people affected. MISEREOR wants to support people in rebuilding their houses but does not want to give them finished houses as a gift. The demand for help has to come from the locals. The beneficiaries must make a material contribution and construction according to organized self-help is a key element. As a rule, Misereor does not purchase land. MISEREOR's reconstruction measures almost always focus on rural areas, which is why construction with local materials is given priority. Ultimately, however, an analysis of the local context determines the technical options that MISEREOR can offer. There are situations in which the use of local materials is not a promising option (e.g. too high costs, complete loss of relevant traditions, high migration). The involvement of local people is essential when planning houses or living spaces - but their wishes and ideas are limited by technical and financial requirements (e.g. earthquake safety).

Fig. 78_ Infill of
timber framework
with stones and clay

PROJECT DESCRIPTION

MISEREOR has been working in Haiti for 50 years. One focus is the area of rural development. After the earthquake on January 12, 2010, in the first months of emergency relief, a concept for the earthquake-friendly reconst-

ruction of living space was developed together with the Haitian partners using traditional typologies and construction techniques. A consultant who is also a member of CRATERre was significantly involved. The hurricanes of 2012,

which again damaged or destroyed many homes, drew attention to the additional requirement of hurricane safety. Local materials should be used wherever possible. The process was intended to achieve a greater appreciation of traditional construction methods in rural communities and institutions and thus make a long-term contribution to improving precarious rural housing beyond resilient reconstruction. The ability to act, self-esteem and independence from international resources as well as the sustainability of the buildings in ecological and social terms were intended to be improved. Traditional crafts and local economic cycles should be strengthened. A secondary goal of the construction projects was reforestation with timber trees, which are supposed to enable the replacement of imported timber with local timber in the future.

Through its partners, MISEREOR financed seven residential construction projects in two phases as well as further 38 side projects, e.g. the construction of model houses for training purposes and consultancy from architects. All local organizations were encouraged to initially provide support for a 22 m² basic building. Contrary to the uniform one-size-fits-all solutions, these should be individually adaptable to the context in terms of the division of rooms, windows, verandas and extensions and later expandable by families themselves. Because of the lower cost, this was supposed to allow a much larger number of victims to be helped.

However, with the amount of donations to deal with the humanitarian catastrophe, the population also put a lot of pressure of expectation

on local partners. Some would rather have the money paid out to rebuild their houses themselves. Many wanted larger and more “modern” buildings, such as those made of cement blocks. Concrete enjoys a high reputation as an “advanced” building material – in contrast to natural building materials, which are associated with poverty. Some beneficiaries were not satisfied with the solutions offered and would have preferred houses with cement roofs. An interested Haitian organization rejected the concept and opted for a larger house type of 40 m² in concrete construction, financed by other donors. This competitive situation between different NGOs and the sometimes high expectations regarding the quality and size of the houses were posing a problem. Encouraging people to take initiative is difficult when other NGOs simultaneously hand over turnkey and more expensive objects in order to be able to spend their funding and donations quickly.

This was more possible in the remote rural areas of the Departement Ouest, as most NGO’s concentrated on more central and better-infrastructure locations (especially in Port-au-Prince). The partners’ local logistical network was therefore important – however they had little experience or expertise in residential construction. The inventory analysis in coordination with one of the local partners showed that the houses of around 1,800 affected families were no longer habitable. Overall however, the number of damaged or destroyed houses in the site catchment areas of all four partners was many times higher. Initial aid was ultimately provided for 1000 houses.



Fig. 79_ Rivière Froide:
Material transport

Through integration into longer-term agro-ecological projects and successful reforestation, some construction wood was available, even if a lot of it still had to be imported. However, the awareness of being able to use one's own wood had to be restored; as well as the courage to rely on local construction techniques, whether with stone, sand, clay or wood.

In addition to a strong courage to face life (faith and religion are very present) and craftsmanship, the potential on site was a strong community and solidarity, nourished, among other things, by the high value of the extended family. There were already traditionally established and tried-and-tested forms of collabora-

tive work, such as so-called kombite. These are based on group days on which a working group from several families meets to till a field. You just have to negotiate what the return will be, e.g. food or help with other work.

The residential buildings were built on concrete foundations, floor slabs and a stone base. A timber frame takes on the load-bearing function and is filled with stones and clay mortar, clay stones (Adobe) or wattle and daub with clay covering (Clissage). Corrugated iron was used as roofing and also protects a little veranda. In the end the buildings were painted by the residents.

Fig. 80_ Model house
(used as training centre)



BUILDING PROCESS

Two partner organizations, both networks of local organizations, expressed interest very quickly - from April 2010 two model houses were built in their regions. The other two haitian partner NGO's started to implement their concept and they soon built a model house as well in mid 2010. The other partner decided for the setting up of an office which was inaugurated in September of 2010 and which served the local population as a training site and model house for the construction and maintenance of a building with local materials. This building was used as a reference building in a prominent location to promote local ways of building and to showcase a positive example. In december 2010 the first houses were built in the outskirts of the capital of Port-au-Prince. In 2011 and 2012 began the building process of

houses in more remote areas.

According to the work concept mentioned earlier it was counted on mutual self-help and initiative of one's own, technical know-how was made available, self-help groups were supported and 300 craftsmen were trained. The families participated by providing the necessary local materials (here a small subsidy was supposed to be given), by picking up the imported materials from temporary storage spaces and by providing for the meals of both the craftsmen and the self-help groups. The ability to help themselves significantly contributed to the success of the reconstruction of Haiti. Families were motivated and accompanied in the organising and coordination of their activities by 31 local Animators.



Fig. 81_ Construction
site of model house

Fig. 82_ Timber
framework on stone base



The projects' organizational structure is represented in four levels:

1. **External Team of advisors:** (assigned by MISEREOR): regularly but not permanently on site to train experts, supervising and quality control: trainings for level 2 and 3 using practical examples
2. **Local aid organizations** with a team that is responsible for the implementation: Promotion, Training, Logistics
3. **Local craftsmen** who either are masters of their trade and train apprentices themselves and work on several construction sites or who fulfill specific technical work
4. **Local groups** that build their houses in self-help style: these kombites averaging 8 to 10 families are being trained by master craftsmen and accompanied throughout the building process. The implementation time was prolonged due to the difficult baseline situation and the lack of building experience of the partner organizations. But it was in part also due to institutional problems e.g. in choosing personnel or lack of belief in the concept. However, one can be satisfied with the quantitative and technical outcomes. The funded projects contributed to roughly 1000 families in mostly isolated areas to move from their damaged emergency accommodation into an earthquake- and hurricane-proof house after the earthquake. The beneficiary families would not have been able to make these investments in secure housing on their own due to their precarious economic situation.



LESSONS LEARNED

Compared to projects from other organizations, the subsidized housing projects with a total investment of 5.463 € per house are efficient - especially since partners, craftsmen and participating families gained a wide range of skills. In addition to the sole construction costs of around 1.600 € to 1.900 € per house, the amount also includes the costs of the model houses for training purposes, the training of the craftsmen and the cost of consultants. The projects shouldn't be put under pressure in terms of time, neither by funding guidelines nor by winter. Stable and well built buildings are important, especially if recurring earthquakes and hurricanes are to be expected.

Subsequently, many lovingly designed homes were created. The skepticism and reservations of some families about building with clay seemed to be confirmed by damage that was discovered after a short time on some houses (crumbling or holes). The acceptance of infilling the wooden construction of the external walls with stone was preferred by the majority, while the use of adobe was less accepted. The constructive suggestion that represented the best solution in terms of earthquake safety, infilling with wattle and daub, was rarely preferred. The families emphasized, especially near the city, that these flexible, thin walls offer little protection against theft and attacks - small windows and solid material are therefore preferred. The lower prestige of this technology may also have played a role.

There are good arguments for using clay as a building material, but these could have been

Fig. 83_ One of the first houses used for trainings and demonstration (Clissage-technic)

Fig. 84_ Training construction site



better communicated to some craftsmen and, above all, to the future residents. The unconvinced craftsmen implemented what they were paid to do - because they lacked experience, sometimes skills and often interest, this was not always done with sufficient quality. Among the problems were time consuming testing of the right clay mixtures for the mortar and a lack of quality awareness. The quality control and the associated presence of architects and responsible construction specialists in the local teams once again proved to be indispensable.

The specialists trained by the architects contributed to the technical improvement of the traditional construction method. This represents one of the necessary prerequisites for the sustainability of the project: technical improvements can continue to be implemented when new houses or extensions are built. The

local availability of timber is a prerequisite for the construction method to be reproduced independently on a larger scale and for expensive imports to be avoided. Even though the construction measures were linked to the introduction of agroforestry systems, the local stocks are currently not sufficient.

Acceptance among partners and target groups grows with visible results. Nevertheless, the needs, hopes and perceptions of families and local institutions must be better understood in order to prevent foreseeable blockages. Families had to make great physical and sometimes financial efforts to supply the construction sites with materials and the workers with food. Because of this extensive participation and personal contributions in the construction process, the families allowed themselves to be critical.



Fig. 85_ Rivière Froide:
Base modul with extension
by beneficiaries, clissage
combined with stone infill



Fig. 86_ Double modul
as model house, 2010

Fig. 87_ House in
Rivière Froide



During the course of the project, the extreme importance of the repair aspect became clear, as buildings made with natural materials require regular maintenance. This must be communicated and understood, because this is the only way the buildings can be used long term at an affordable cost. experience has also shown that repairs lead to appropriation and identification with the buildings. At the end of 2015, many people had started repairing or expanding their houses at their own expense and paid specialists trained in the project (a company had also been founded) to do so. Six years after the earthquake, the donation pots of many international aid organizations have been exhausted, which is why personal initiative is increasingly replacing the at times rigid expectations that had in some cases reached extreme levels due to numerous international interventions.

The craftsmen were paid for their work throughout the project, which probably strengthened the local economy. One consequence of the intervention was also the frustration of the non-beneficiary families and the resulting tensions. An improved selection process should therefore be created for participation reasons and more intensive problem and solution analysis should be carried out with those families who receive houses.

An important learning point is the difficulty of introducing innovation after a disaster. Because it takes time and practice, which is usually lacking under the conditions of expectations and time pressure after disasters. Analysis carried out by MISEREOR immediately after the earth-



Fig. 88_ Owner-occupied home

quake clearly demonstrated the advantages of timber frame construction and half-timbering. Although the risks of concrete and cement construction methods have become clear, this has not particularly influenced general ways of thinking. But the hope is to be able to introduce innovations in small steps and build trust in alternative construction methods, instead of sacrificing sustainable goals due to resistance from partners.

MISEREOR therefore continues to work with all four partner organizations to improve the natural living environment of the population, primarily within the framework of agroecological projects. Improved house construction and agroforestry are important cross-sectional topics with regard to the production of wood for house construction. In order to maintain interest in adapted construction methods in the country and the specialist knowledge of

trained craftsmen, a pool of skills relating to construction with local materials has been created in collaboration with one of the four partner organizations. There is hope that in the next few years this will become a contact point for universities, donors of construction projects, local families and international parties involved.

4-2 CO-OPERATIVE PLANNING OF A GIRLS' SCHOOL

PROJECT DESCRIPTION	Boarding school for Dalit-Girls
COUNTRY & LOCATION	Uttar Pradesh, Sabukpur, India
FUNDING ORGANIZATION	Mädchenschule Khadigram e.V.
PARTNER ORGANIZATION	Gramin Bharat Foundation
FUNDING	Donations, Landesstiftung Baden-Württemberg
GROSS SURFACE AREA	878 m ² (Phase 1), 1394 m ² (total)
PROJECT COSTS PLANNED/ REAL	ca. 125.000 € / 151.500 €
CONSTRUCTION COSTS	ca. 127.000 €, ca. 145 €/m ² Gross Surface Area
PROJECT TIME	October 2008 bis January 2015
DURATION OF CONSTRUCTION	2 years
ARCHITECT	Dipl.-Ing. Architekt Michael Grausam
EXPERT PLANNING	Structural engineering by Henrik Stern, Ingenieure ohne Grenzen e.V.
CONTACT PERSON	Michael Grausam (humantektur)
FURTHER INFORMATION	www.humantektur.de www.maedchenschule-khadigram.de



Author:
Michael Grausam

Image sources:
Michael Grausam

„Mädchenschule Khadigram e.V.“ is a charitable organization located in Althütte in Baden-Württemberg. Since its founding year in 2003 its main focus is the education of girls from underprivileged social classes in India. The founder and cChairperson of the organization Marianne Frank-Mast, has many years of experience in development cooperation in India. Mrs. Frank-Mast lived in northern India for several years in the 1970's Jahren where she ran a health center in the remote village of Khadigram on behalf of the

German Development Service (DED). In addition to its work in the 1970's the organization opened its first school for girls there in 2003. Members of the organization work on a voluntary basis only and so the majority of donations and grant funds can be directly invested in local projects on site. To run the schools in India the organization is partnering with local organizations. Furthermore members of „Mädchenschule Khadigram e.V.“ conduct medical camps in rural regions of India.

CONTEXT

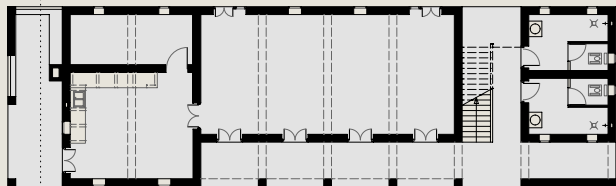
There is still a large number of girls from underprivileged social classes who have no or only limited access to education. Especially in rural India school infrastructure is by no means extensively available or access is only possible when paying fees that are only affordable by families with higher income. The education of Girls from low-income families is therefore quite uncommon: Many families regard their sons education as very important, as they will one day provide for their families. The girls on the other hand are very often married into another family when they are still very young and so they leave their parental home. Aggravatingly the girls are much more involved in domestic chores than boys and their work force would be missing in the household if they would go to school.

(casteless) in Khadigram, a village in the state of Bihar in 2005. The operation as boarding school should ensure that the girls receive a sound basic education over a period of four years without the parents having to pay high school fees and without the girls neglecting their school obligations due to having to be available to help in the parental household. Additionally, the organization is participating in other educational projects in the region as funding partner and also conducts medical campaigns in rural India. Upon request of an Indian family connected to the German organization a plan was developed in 2008 to build another school in the neighbouring state of Uttar Pradesh. The school for girls in Sabukpur was intended to operate according the model of the school in Khadigram.

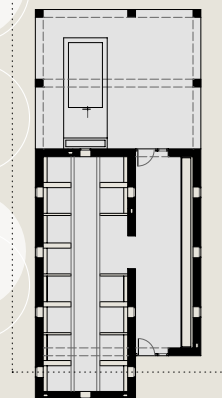
To counter these circumstances the organization „Mädchenschule Khadigram e.V.“ in cooperation with the local partner organization „Shram Bharti“, opened a boarding school for girls from families of the Adivasi (indigenous tribes) und Dalit

Fig. 89_ View on campus

Kitchen garden



Community house



Bath house



Watch house



Class house



Class house



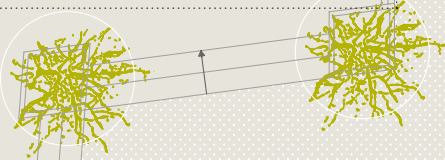
Class house

Class garden

Class garden

Class garden

School yard



Street

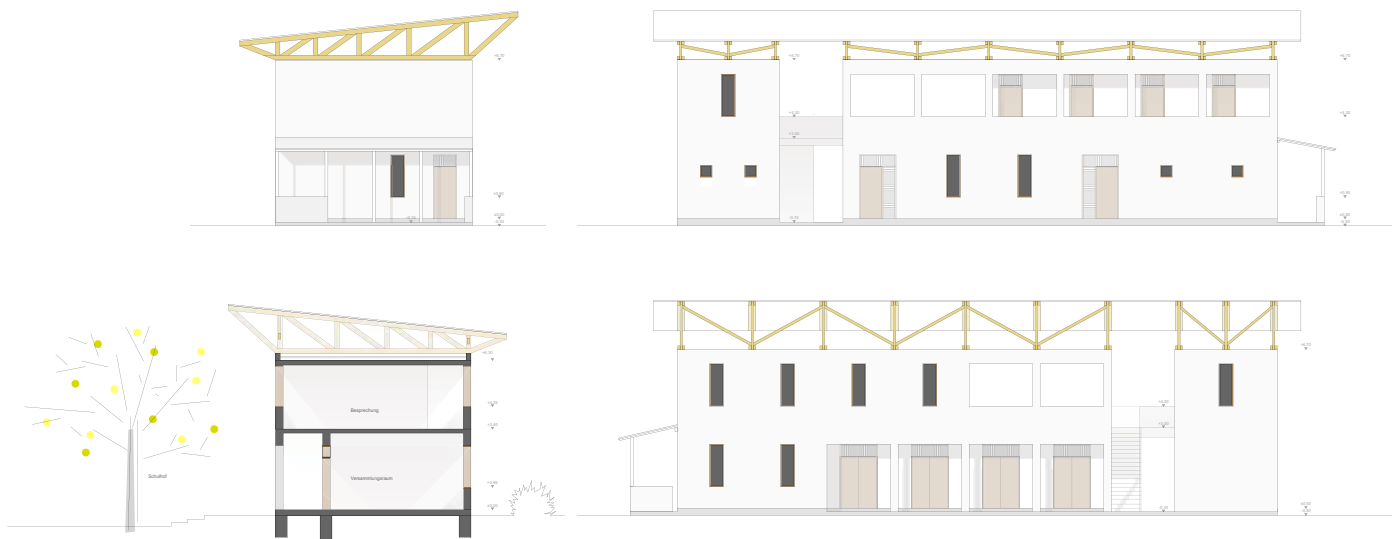


Fig. 91_ Elevations
and sections of the
community building

PROJECT DESCRIPTION

The new boarding school was constructed on a former field in the village of Sabukpur counting around 500 inhabitants. The first construction phase from 2009 until 2011 included a school building with classrooms, a community house, a bathhouse as well as a guardhouse. The school buildings not only contain space for classrooms but also for the girls' dormitories. The school was intended to be extended by one or two more school buildings. The realization of the second construction phase is still pending.

The buildings are grouped together around a central courtyard from which they can be accessed. On the side of the school buildings that is facing away from the courtyard, kitchen gardens have been created for educational reasons. While the guard house and the bathhouse are single storey buildings, the other buildings were constructed with two-storied to ensure optimal use of the property and to keep soil sealing as low as possible. All „public“ spaces have been planned on

the ground floor, whereas the second floors are a more private place of retreat.

Above the flat roofs insulated with a „floating“ metal roofs have been installed providing additional shade. This is how solar radiation in the summer months is largely kept away from the mass construction building. This effect is supported by returns from the ground floors and from the south and west facades. This is how the building design was adapted to the local climate with hot summers and cool winters with temperatures just above freezing point by night.

The construction design was solely based on locally accessible common construction materials and techniques. The brick walls were plastered and the ceilings consist of reinforced concrete. To reduce the use of concrete to a minimum, the flooring was built with a first layer of recycled bricks followed by another layer of 5 cm reinforced concrete interconnecting the two layers

Fig. 90_ Site and floor
plan of the school

and therefore avoiding a version with the sole use of massive reinforced concrete.

The fresh water supply is provided via two wells, one located in the middle of the school courtyard and the other one in the bathhouse. When positioning the wells, ground water flow direction and sufficient distance to latrines were taken into account. Every building has a water tank on its

roof that is connected to the central pump in the bathhouse. The greywater from the bathhouse and the kitchen are filtered and collected in an underground reservoir and it is being used to water green areas. All other waste water is directed to a three-chamber septic tank.

PLANNING AND BUILDING PROCESS

The German architect Michael Gausam, was entrusted with the planning of the building as he spent part of his studies in India and therefore, he was familiar with the local context. For structural engineering the civil engineer Henrik Stern from the association „engineers without borders“ was hired. The entire planning of the project was a pro bono voluntary commitment.

Building in the rural region of Sabukpur was a particular challenge: There was no reliable planning documents nor prepared information about the local building techniques and materials. Neither the property measurements matched the official site plan, nor was the information contained in it complete. During the first on-site inspection the property turned out to be bigger than anticipated and the power line supplying the neighbouring village was located on parts of the property. To avoid these challenges an approach oriented towards local circumstances was chosen to plan and construct the school:

The baseline survey on-site was conducted by the German association in coordination with the architect. On the basis of this information a first preliminary draft was created in Germany, which was then coordinated with the German and Indian partners residing in Germany. The detailed planning phase was conducted directly on-site in Sabukpur in the beginning of 2009. Here the exchange with local partners was in the foreground. As there was no professional construction company in the region around Sabukpur and as no Indian engineer was prepared to work in this re-

Fig. 92_ Formwork of the concrete work





mote area, the representative of the partner organization located in the region took on the role of site coordinator. He already had some prior experience in the construction of multi storey buildings. He coordinated tradesmen, acquisition of building materials and tools, the quality control on the construction site as well as administrative matters. One of the biggest challenges in the beginning of the building process was to overcome communication barriers. The Indian workers and even the site coordinator only spoke very little English and the German architect only a few words of Hindi. Furthermore, neither the Indian site coordinator nor the tradesmen were experienced reading plans. Therefore, the most important expressions and words were clarified by means of drawings, photos, plans and models to create a common ground of communication. The proposal by the German architect to use clay and bamboo for the construction were dismissed as these building materials were rejected by the Indian partners and also the local workers did not have sufficient experience. This is why locally available construction techniques were used: bricks and reinforced concrete.

Execution planning and construction implementation were conducted in close cooperation between local professionals and German planners: all details were talked through cooperatively and locally common construction methods were predominantly used and quality controlled and optimized as required by the German planners. The buildings were constructed one after another, starting with the smallest one storey building and then step by step the bigger buildings. This is how details of implementation details could be tested and if necessary improved in the next construction phase. The guard house was built first and the workers were supposed to build it in a way they were used to. Only the measurements of the foundation, the walls and the reinforced concrete ceiling were predetermined values as well as the use of PE-sheet as humidity barrier. Specifically, the latter was a source of incomprehension for local workers. But improvements of details that are important for structural stability such as the use of reinforcement steel and of concrete covering were implemented right away. Other details like the flooring were built according to the Indian workers' judgement. After completing the built

Fig. 93_ Concrete works: prefabrication of lintels; self-made spacers to ensure the concrete cover ; concrete work with lift of the ceiling

ding, both sides conducted quality controls and the lessons learnt regarding cooperatively set standards were implemented in the next construction phase. One example was the appearance of cracks in the floor of the guardhouse resulting from settlement of the unreinforced floor between the foundations. This is why the floors in the other buildings have then been reinforced. The Indian workers mistrusted the PE-sheet between walls and the foundation. They feared that the walls could slide off the sheet and therefore they tried one night to relocate the guard house

- without success. After a first intensive 2-month long building phase completing the guard house quickly and the bathhouse halfway, the remaining construction was conducted in absence of the German planner. Quality control took place remotely via photo documentation and written reports. Only before concreting processes the casing and reinforcement on almost all ceilings and supports were inspected on site by engineers and the concreting work was supervised.

LESSONS LEARNED

Communicating necessary quality standards

The biggest challenges were the scepticism about the, from the Indian perspective, exaggerated quality requirements and the clarification of some implementation details. From the perspective of the Indian tradesmen a ceiling thickness of 12 cm with only one reinforcement layer was perfectly sufficient. There was also a lack of understanding about the 24 to 37 cm thick walls of the two storey buildings built with cross braced bricks - self-supporting walls of two storey buildings in the region were usually built with only one layer of bricks. Differing perceptions of quality needs led to an incident where a load test had to be conducted on an intermediate ceiling that was built contrary to previous agreements and without approval and in absence of an engineer. The tests resulted in sufficient load capacity of the ceiling, but it was discovered that the reinforcement steel was worked in incorrectly and the concrete in the areas between the reinforced concrete was insuf-

ficiently compacted, as in this area plate vibrators were used only on the upper side.

In further planning it was taken as reduced carrying capacity. Consequently, the load of the over-

Fig. 94_ Kitchen gardens on the rear



lying storey was decreased: The diameter of the separating walls was reduced to a minimum and the load of the roof was diverted straight onto the outer walls. To avoid such defects in the future the source of the problem was identified in collaboration with local site managers and tradesmen and measures to improve and future avoidance were agreed upon. With the help of hammer and chisel concrete could be loosened from the ceiling and problems could be illustrated and convinced of the inferior quality. The other ceilings were concreted only after an engineer inspected the casing and the reinforcement. On top of that the compacting of concrete was consistently done by a submersible vibrator. This example shows the importance of the presence of sufficiently trained construction professionals at the construction site. It is questionable if this can be achieved only by voluntary work.

One success of the cooperative component development was that some implementation details were used in later construction projects of the site manager: He did not exactly use the same strength of 18 cm in the ceilings as it was done in the school project, but only 14 cm and he covered the reinforcement steel with sufficient concrete. These details served a significant improvement of the structural stability of buildings - specifically in the case of earthquakes which cannot be ruled out in this region.

Another success of the cooperative planning process was a strong identification of the people involved with the school: Some construction workers immediately wanted to register their daughters in the newly opened school despite their initial scepticism. An Indian partner initiated a meeting with local media representatives and proudly presented their school.

Fig. 95_ View from the first floor

Fig. 96_ Class room





Fig. 97_ View
from the street

Ensure the presence of craftsmen and labourers

Problematic for the construction was irregular presence of tradesmen and workers on-site - after receiving their payments they sometimes stayed away from work for days. In order to meet the schedule for the completion of the construction work, the salaries of the craftsmen were not paid daily (as is usually the case), but only every two weeks. Consequently, some worker families complained: the workers didn't bring back the money directly to their families but spent part of it in other ways. The problem was solved by paying out the money directly to the workers wives.

Success factor: partner choice and cooperation contract

After completing the first building in 2010 the school operation was initiated quite soon after. Simultaneously the construction work of the other buildings was continued and a first phase completed in 2011. After the German association found out, that another Indian association claimed the girls school as their own, there was a long dispute - even before a court of arbitration - which led to

a break with the Indian partner. Although they were sentenced to pay a fine by a court proceeding, the actual demand - to hand over the school to the Indian government - was not granted. The cooperation contract between the German and the Indian association proved to be insufficient: it was signed only after the construction had begun and a clause to secure further use of the buildings after dissolving the contract or after school operations ended, was missing. This could be for example a handing over of the buildings to a state organization or another NGO. One important reason to sign the cooperation contract after construction had already started was high pressure for an outflow of funds.

This example shows the significance of the first project phase (phase 0): through intensive exchange about expectations and responsibilities of all parties involved in the beginning of a construction project - specifically in form of a cooperation contract - mutual trust can be built and potential hindrances of a cooperation can be determined early on in the process.

Sustainability in a local context

There cannot be a final judgement on the ecological and social sustainability of the project as it is dependent on the duration of life and use of the building. The cooperative planning and construction process can already be evaluated as successful: the strong cooperation enabled the bridge building between Indian and German ideas, ways of working and quality standards which led to an outcome that is satisfying for both sides. The decision to use classical, locally used building techniques and materials (brick walls and reinforced concrete ceilings) proved to be right in this context: there was no local knowledge about less energy intensive building techniques such as clay walls with wood or bamboo roofs and these construction techniques were rejected by local craftsmen. It is up for question if a construction foreign to local craftsmen, that is not accepted by them would be adequately maintained and used long term. The content related discussion with the partners to enhance quality standards did not only have positive effects on the school building but also on the local building culture, as some quality standards were subsequently used in local Construction. On top of that the passive- solar Design principles used create a comparatively high thermal comfort entirely without the use of systems engineering.



Fig. 98_ Class picture
with Marianne Frank-Mast
and Michael Gausam

4-3 SUSTAINABLE ADMINISTRATIVE CENTRE - MODERN ARCHITECTURE WITH TRADITIONAL ELEMENTS

PROJECT DESCRIPTION	New construction of an Administrative Center with 3 buildings in total
COUNTRY & LOCATION	Bafoussam, Cameroon
PROJECT DEVELOPER	Cercle International pour la Promotion de la Création (CIPCRE)
FUNDING	Brrread for the World, own funds
GROSS SURFACE AREA	-
PROJECT COSTS PLANNED/REAL	860.000 € (Phase 1) / 850.000 € (Phase 2)
CONSTRUCTION COSTS	855.000 € / 874.500 € (Phase 1 + 2)
PROJECT TIME	2013 - 2021
DURATION OF CONSTRUCTION	2013 - 2021, 1 year interruption in 2016
ARCHITECT	Ideas competition with architecture students from the university in Maroua (Cameroon) and RWTH Aachen; planning and realisation: Honoré Kanga, Architecte, Agence d'architecture et d'aménagement
CONSTRUCTION CONSULTANCY	Robert Müller, Michael Grausam (humantektur)
CONTACT PERSON	Cyr-Nestor Itoua-Ayessa (Bread for the World)
FURTHER INFORMATION	cipcre.org



Authors:

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Michael Grausam

Cyr-Nestor Itoua-Ayessa

Image sources:

humantekur, Brot für die

Welt, CIPCRE

The project was realized by the Cameroonian non-governmental organization Cercle International pour la Promotion de la Création, CIPCRE, with support of the non-governmental organization Bread for the World.

CIPCRE was founded in 1990 in Cameroon and has ever since been pursuing its goal to support ecological and holistic development in Cameroon and to offer a space for social, ecumenical and interreligious dialogue. The main

focus of their work lies in environmental protection, peace work and conflict prevention, democracy and human rights as well as self-sustainability of the population.

Bread for the World and CIPCRE have been co-operating partners for almost 30 years. The Cameroonian NGO is a respected partner in international development cooperation because of its reliability and good work results.

CONTEXT

CIPCRE has worked in a rented administration building in Bafoussam with around 40 employees. A continuously growing busy bus station was established right on front of its main entrance which was strongly affecting the work at CIPRE due to dust and noise pollution.

The office building was narrow with insufficient space for the increasingly important and sensitive work of the organization and for the im-

plementation of its work and activities CIPRE was in need of appropriate space. The number of participants in their programs continuously grew from 1.740 in 2014 to 1.980 in 2015 posing a need for hotel rooms, conference rooms and catering. As these facilities could not easily be accessed in close proximity, the organization started to plan a new construction of administrative headquarters.

PROJECT DESCRIPTION AND IMPLEMENTATION PROCESS

The approx. 12.000 sqm property of CIPCRE is located at the village exit of Bafoussam next to the main road leading north. The city of Bafoussam is the third largest city in Cameroon and is located approx. 665 km north of Douala in a mountainous area approx. 1500m above sea level. It is an important economic centre of the country.

nimum) 19 ° C in July. The rainy season spans from June until September and October until December. The average annual precipitation is 1.800 mm.

As a first step in 2011 a small project funded by Bread for the World titled „locally adapted planning with traditional building materials for CIPCRE“ was realized. As part of a university cooperation between RWTH Aachen and the Institut de Sahel at the University of Ma-

Fig. 99_ Site plan CIPCRE

The average temperature in the month of march is around (maximum) 22 ° C and (mi-



Fig. 100_ New administration building (2-storey)

roua, two study groups with three professors developed drafts that were incorporated into further planning for the project as a preparatory collection of ideas. These Ideas served as inspiration for the then following architecture competition and the construction design to combine traditional local architecture and modern practicality.

A competition with local architects was held in 2012 based on the best ideas in cooperation with the University RWTH Aachen, for the conception of the construction measure in the first building phase of the project “new construction of an administration centre”. The construction project was supposed to be a model and serve target groups as an example of ecological and sustainable construction, for

example local clay construction.

The original plan was to construct four buildings, two three-storey administration buildings, one two-storey info centre with a library as a round building and a one- to two-storey canteen as a round building. However, both administration buildings were not adapted to the steeply rising terrain and they would have needed complex retaining walls. In addition to that the planned east west orientation of the buildings was not ideal in light of the tropical solar radiation onto the facades and the cost for the facilities, the outdoor facilities and infrastructure were set too low. The local developer, in collaboration with the responsible regional office of BfdW, decided to replan the project taking into account a reduction and

realignment of the buildings. A new local architect was hired as well. The altered plan only contained three buildings: a three-storey and a two-storey administration building as well as one info-centre with library. The two-winged administration buildings were adapted to the terrain course and planned in north-south alignment, to adapt to tropical solar radiation.

From 2013 to 2015 the first building phase of administration and office buildings and a multimedia building as well as outdoor areas including development and infrastructure measures have been realized. In detail, it was the new construction of a three-storey administration building for the ‚Direction générale‘ with a two-wing building cubature and gable roof (in the initial plan, two buildings were planned), new construction of a two-storey administration building for the ‚Direction Nationale‘ with a two-wing building cubature and gable roof, new construction of a two-storey Information center building including a library as an octagonal building with a conical roof. Smaller changes such as improved facade protection or a solid courtyard pavement, which were decided upon during the construction process, further enhance the buildings. The building of rainwater catchment basin, biogas and solar systems was moved into phase 2 of the project development.

The move from CIPCRE to the new administration buildings happened end of 2015.

Accompanying the construction measures two seminars about building maintenance with the use of a special software developed by Bread



Fig. 101_ New administration building (3-storey)

Fig. 102_ New Multimedia building



for the World were implemented during the project:

A business plan with a management- and training concept for maintenance (structure maintenance schedule) and the operation of the administration centre (profitability calculations) was developed. The CIPCRE Project serves as pilot and model project regarding maintenance and operation.

A second project phase from the beginning of 2017 to mid-2021 included the construction of a seminar and conference building with around 150 seats, an educational environmental centre with a marketing area, a drying and storage room for the environmental centre and a guest house with 17 rooms (usable as single or double rooms) and a restaurant area for catering for conference participants and overnight guests.

Specifics of the construction project

The buildings serve the organization as protected space for interreligious dialogue, conflict transformation as well as activities to promote women's- and children's rights.

They serve as ecological model buildings due to their adapted construction with energy efficient infrastructure measures as well as sustainable, modern architecture with design elements from the Bamiléké (principalities/ chefferie in west Cameroon) tradition. In addition they serve as a market for products from project activities for rural development.

There are plans to complement the facility with seminar rooms, guestrooms, a restaurant and a sports ground. This is how costs can be saved sustainably and income can be generated. Even if a lot has already been accomplished.



Fig. 103_ New conference building

hed it would make sense to continue to offer more consulting services to CIPCRE.

The installation of a photovoltaic system on the roofs of the administration building is in planning to provide additional power to the buildings alongside the power provided by the public network.

Construction design

The load bearing elements are made of reinforced concrete (columns, ceilings, and staircases). The ferro concrete skeleton was made with exposed brickwork made from cement-reinforced clay bricks. For the production of the clay bricks, burning was consciously avoided for sustainability reasons. Only for walls in wet areas concrete bricks were used that were then plastered and tiled.

Decorative concrete facade parts in the Bami-

léké design language were placed in front of the arcades.

The roof trusses of the buildings were made of wood, the conical roofs of the restaurant and multimedia centre were covered with corrugated aluminium panels and straw, and the roofs of the other buildings were only covered with corrugated aluminium panels.

The suspended ceilings of all buildings are made of wooden panels and split bamboo sticks and were painted.

Openable windows ensure good use of daylight as well as manual ventilation of room. This is how a lot of energy can be saved when the building is in use.

One important aspect of the construction project was hiring young people. They worked in



Fig. 104_ Office of the management

the production of clay bricks as well as bamboo panels for covering ceilings as well as constructing furniture. This is how around 50 young unemployed people could train in a job

and find work as a waged worker. As clay bricks had to be produced manually with little equipment the skills learned can be used independently from the project itself.

LESSONS LEARNED

The architecture competition that was run at the beginning of the project was a good but complex process regarding expenditure of time and budget planning.

Construction costs increased due to rising inflation which led to an increase in costs based on a discrepancy between the originally determined prices and the available budget.

As budget changes in retrospect are a very elaborate process and either consume reserves or require additional supplementary funding, construction costs should not be measured too tightly. To ensure continuous building support and supervision by experts the budget for professional fees should be set generously (usually a flat fee of 5% of total construction costs, in this case even more).

A project duration of only 3 years (per project phase) as well as the 5-year limit for the final utilization evidence documents set by the BMZ and Bread for the World don't offer much flexibility and buffer to respond to crises such as heavy rains and the Covid-19 pandemic. The latter first led to a complete lockdown in the country followed by a reduction of employees in the construction industry. This is why it

should be possible to extend the project duration in times of a crisis that entails a prolonged halt of the construction - at best until warranty obligations expire to avoid premature payout of security retainers.

Regarding sustainability the Project developer showed the capability as well as the will to maintain the buildings.

It became clear that more on site visits of architects consulting Bread for the World would be important during the construction phase.

The thatched roof coverage in accordance with traditional construction that was partially used is an appealing construction element but was proven to be only of limited suitability. Due to flying sparks the thatched roof of the multimedia building was set on fire despite 60 m distance to the fire source. The roof including the roof structure was completely destroyed. Fortunately, no humans were harmed as the fire happened on a Sunday and nobody was in the building at the time. The roof has been replaced funded by capital resources of the project developer who decided against thatched roofing for security reasons.



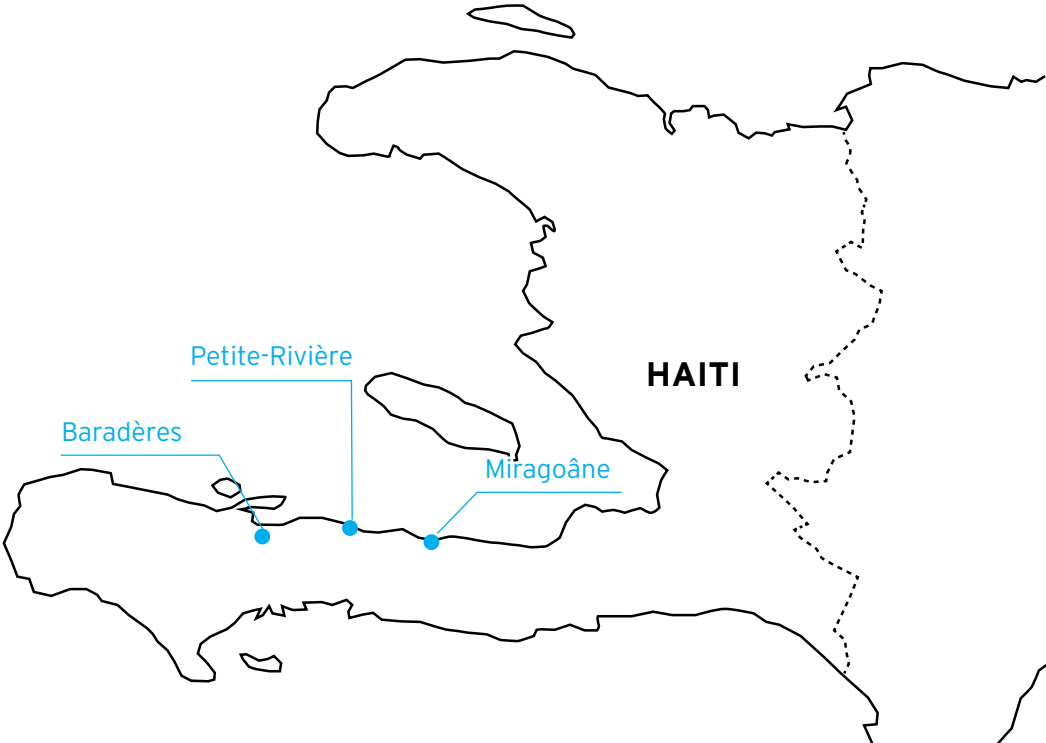
Fig. 105_ Earth
block press



Fig. 106_ Multimedia
building and canteen with
new roofing after the fire

4-4 EVACUATION CENTRES FOR THE LOCAL POPULATION

PROJECT DESCRIPTION	New construction of three evacuation centres in Haiti
COUNTRY & LOCATION	Petit Rivière/ Miragoâne/ Baradères, Haiti
PROJECT DEVELOPER	Caritas de l'Anse-à-Veau et Miragoane
FUNDING	Caritas international, BMZ
GROSS SURFACE AREA	-
CONSTRUCTION COSTS	-
PROJECT TIME	2015 - 2021
DURATION OF CONSTRUCTION	2015 bis 2021
ARCHITECT	Djery Charles, Port-au-Prince
EXPERT PLANNING	Geological survey: Geometrex, Delmas, Haiti, Laboratoire National du Bâtiment et des Travaux Publics (LNBTP), Port-au-Prince, Haiti Review: ZRS Ingenieure GmbH, Berlin (Statik) & HIC Holzhäuser Ingenieur Consult GmbH, Ettlingen (Geotechnik)
CONSTRUCTION CONSULTANCY	Barbara Schnegg, Doris Wasmeier, Michael Grausam, Claus Hemker
CONTACT PERSON	Manuel Brettschneider (Caritas international)
FURTHER INFORMATION	-



Authors:

Barbara Schnegg

Michael Gausam

Manuel Brettschneider

Image sources:

Caritas de l'Anse-à-Veau et

Miragoâne

Illustration: humantektur

The project was realized by the Haitian Non-governmental organization Caritas de l'Anse-à-Veau et Miragoâne, supported by Caritas international.

Caritas international was founded in 1921 by the German aid agency Caritas Deutschland which is based in Freiburg. The main focus of Caritas International is emergency aid following natural disasters or conflicts of war as well as reconstruction and disaster prevention predominantly in the global south.

CONTEXT

Haiti is the poorest country in the western hemisphere. The reality of the country is shaped by recurring political instability, economic crises and social problems. Rainforests have been almost completely cut down, soil erosion and flooding are the consequence. The Caribbean Island state is hit by hurricanes on a regular basis and there is an extremely high risk of earthquakes. Especially the poor and marginalized population is affected by these natural disasters as they are least prepared and cannot recover from the consequences of disasters by themselves. This is due to a lack of education and the already precarious living conditions.

This is why Caritas international aims to contribute to the strengthening of the resiliency of the poor rural population in Departement Nippes by ensuring food security and preparation measures for disasters.

Besides strengthening local civil society security committees, the elaboration of emergency

Caritas de l'Anse-à-Veau et Miragoâne was founded in 2010 by Caritas International following the earthquake in Haiti to strengthen and support disadvantaged groups of the population of the Département Nippes and to protect them from natural disasters. The main focus of Caritas de l'Anse-à-Veau et Miragoâne is humanitarian aid, strengthening civil society structures and community-based disaster prevention measures. Since its founding Caritas international and Caritas de l'Anse-à-Veau et Miragoâne are cooperating partners.

plans and the sensitization of the population in areas of disaster prevention, the construction of the protective shelters were a central element for Caritas de l'Anse-à-Veau et Miragoâne. These have been constructed in two consecutive projects between 2015 and 2021 in the Département Nippes in south-west Haiti in specifically flood prone areas close to village structures.

Caritas international in collaboration with its partner organization Caritas de l'Anse-à-Veau et Miragoâne implemented the construction measures as well as affiliated social measures such as sensitization of the population. The partner organization commissioned local Haitian professionals and companies with the creation of soil assessment as well as planning, implementation and construction management of the construction project. Specific tasks such as the planting of embankments has been carried out by the local population in a "cash for work" program supervised by the

Fig. 107_ Location of the three sites



Fig. 108_ New construction of evacuation centre in Miragoâne

local Caritas staff. International consultants of Caritas international supervised the project measures remotely and when possible, on site.

After completion the protective shelters were given over to the state civil defense authority. Therefore, the civil defense authority is now responsible for the maintenance and operation of the buildings. Operating tasks are imple-

mented on site by the respective disaster management committee. In times of disaster the buildings serve as accommodation, or otherwise it serves as offices for the civil defense authority and the disaster management committee and as meeting place. The municipality is also authorized to use the site for civil or political events.

PROJECT DESCRIPTION

From October 2015 until October 2016 the first two protective shelters have been constructed at the same time in two villages close to the coast, Petite Rivière and Miragoâne. To be better protected from flooding, properties at a higher level have been chosen that are still ea-

sily accessible by foot by the local population.

The single storey, square buildings have been constructed in reinforced concrete frame construction with masonry infill and corrugated iron roof on steel trusses and therefore fulfil

the requirements of earthquake and hurricane security.

With a floor space of approx. 450 sqm they are designed to accommodate 120 people in case of a disaster. The rooms are constructed to be approx. 80 cm above ground and are accessible by generous staircases, ramps and several doors.

They feature an accommodation area of 160 sqm, a big reception area, one office with storage room, two storage rooms for the civil and disaster relief authorities and the protection seeking population as well as a sanitary area and a kitchen with storage room. The building is surrounded by a fenced courtyard. This is a very important element of the Shelter as Haitian life predominantly takes place outside. After the hurricane and before returning to their own homes the courtyard of the shelter will be in intensive use by the protection seeking population.

Shortly after completing the first two buildings the local population could already seek shelter there during hurricane Matthew. In both buildings, that have been originally designed for 120 people, up to 270 people were seeking refuge for about 6 weeks. Also, during violent political unrest, the buildings served as protection for local residents.

Based on the positive experience regarding the first two protective shelters and because of acute need of the rural population it was decided that a third shelter will be built for the village Baradères in a mountainous area 65

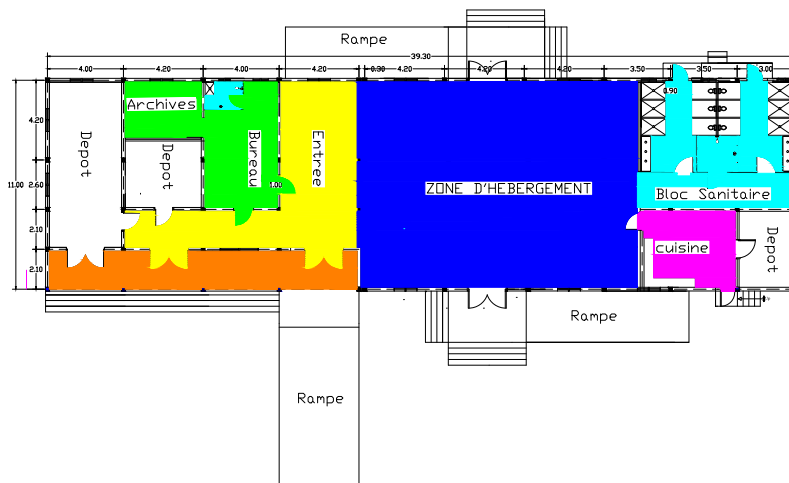


Fig. 109_ Floor plan
of the evacuation
centres in Petite-Rivière
and Miragoâne

Fig. 110_ Site prepara-
tion before const-
ruction in Baradères



km (approx. 3h by car) from the location of the project partner. As the village itself is located in a flood prone area the government provided a flat area on an elevated location on a mountainside. Due to a lack of appropriate alternatives this location was chosen for the construction. Because the property was smaller the buildings had to be designed significantly smaller than the first two shelters at approx. 260 sqm. The construction is identical to the first two shelters with a similar room concept but a smaller accommodation area (approx. 135 sqm), a much smaller reception area and only one storage room, one office and one sanitary area. Also, the fenced courtyard had to be planned much smaller because of the above-mentioned geographical circumstances. A second storage room and the kitchen were entirely taken off the plan.

Planning and construction process

While conceptualizing the protective shelters experience from the project partners as well as information from the civil defense committee and the target groups were taken into account. A Haitian engineer converted the requirements into plans with support of international construction consultants and social consultants. The first two protective shelters were visited by international construction consultants of Caritas International on a regular basis. The construction of the third building and its stabilizations could only be supervised remotely due to security and covid related reasons.

At the beginning of each project a soil analysis was conducted for the property, to ensure the stability of the building. The construction plan was adjusted and implemented according to the soil conditions. Nevertheless, in the case



Fig. 111_ View from the valley to the evacuation centre and the lower retaining wall in Baradères

of the building in Baradères, settlement cracks appeared on a ramp and on the fencing wall shortly after the construction was completed.

Therefore, it was necessary to implement measures to secure the building and the slope. On the basis of further in-depth soil reports the Haitian geotechnical engineering office Geometrex planned various stabilizing safety measures:

On the foot of the slope an approx. 3-meter-high gravity wall was built as a retaining wall. The slope was fortified with fast growing, deeply rooting vetiver grass. To protect the property and the building from wildly flowing surface water and to avoid further erosion of the slope, open rainwater channels were laid out throughout the property to ensure a controlled off flow of water.

On the upper end of the slope, a channel with an approximately 1.70 m high wall (mur anti-ruissement) was planned. This element should secure the property between the building and the downhill slope and drain rainwater accumulating on the property. During the construction of the planned wall, it became clear that at the planned location stable building ground could not be found or only at very different depths. That's why an alternative to this security measure had to be found. A private and a state owned Haitian geotechnical engineering office (Geometrex und LNBTP) did further soil assessment reports on which basis local experts created a newly adapted plan. Eventually instead of the originally planned wall a gravity dam of 5 m height (measured from foundation level to the top edge of the wall) was built a few meters in front of the building. This second supporting wall simultaneously serves now as demarcation wall of the courtyard. To ensure a



Fig. 112_ Evacuation centre with upper retaining wall in Baradères

barrier-free access to the building a ramp was installed alongside this supporting wall.

In support of the construction manager a second, independent, local engineer was called in for quality control reasons. Additionally, the geotechnical engineers of LNBTP were responsible for quality control of the excavation works during the latest implementation of security measures. The construction was supervised remotely by international experts, construction consultants of Caritas International as well as structural engineers and geotechnical engineers.

Various crises brought both the preparatory investigations and the planning and construction process of each construction project to a partial or complete standstill and thereby delaying the completion of the protective shelter.

Particularly when carrying out the security measures on the third shelter building, socio-political unrest prevented visits to the remote property, so that complementary soil surveys and the planning of the necessary stabilizing measures were delayed by several months. Meanwhile, the damage to construction components and subsoil increased significantly due to heavy persistent rainfall. The implementation of the construction work had also

been delayed several times due to the effects of the covid-19 pandemic, hurricanes, an early rainy season and political unrest. The building was completed end of July 2021.

To ensure the sustainability of the shelters, the project partner created maintenance and operating plans. The implementation of these plans is still in negotiations with the state civil defense authority.

Almost two weeks after the supporting walls were completed, an earthquake measuring 7.2 on the Richter scale with an epicentre near the town of Baradères shook southwest Haiti. In Baradères approx. 2.500 houses were destroyed, a church and a regional road was buried by a landslide. Two days after the earthquake hurricane Grace hit the region. The shelter building, the surrounding property including the slope leading to the road underneath as well as security structures withstood this stress test. Only minor visible damage could be determined which was considered to be non-structural by experts. A visual evaluation of the damages by UNOPS (United Nations Office for Project Services) is still pending.

LESSONS LEARNED

- In the case of demanding geographical conditions or complex, sensitive construction projects, such as protective buildings, crucial soil reports should only be carried out in the presence of an international expert.
- Regular telephone or video conferences with all relevant stakeholders, especially during planning and construction, are highly recommended if support from international construction consultants is only possible remotely. These conference calls will serve the avoidance of misunderstandings and ensure a seamless flow of information.
- Conclusion: The willingness of everyone involved in the project to always look for the best solution despite numerous challenges at various levels and to accompany the project responsibly, was an important aspect in the successful completion of these demanding projects.

Fig. 113_ Evacuation centre in Baradères after the earthquake in 2021.



4-5 CONSTRUCTION OF A CLIMATE CENTRE

PROJECT DESCRIPTION	Construction of a Climate Centre for the promotion of methods and technologies in the adaptation to Climate Change
COUNTRY & LOCATION	Bangladesh, Sreepur
PROJECT DEVELOPER	Christian Commission for Development in Bangladesh (CCDB)
FUNDING	Bread for the World, own funds
CONSTRUCTION COSTS	1.170.000 EUR (only for the three main buildings)
PROJECT TIME	2017 - 2022
DURATION OF CONSTRUCTION	2017 - 2022 with interruption due to COVID-19
ARCHITECT	ArriSD Associates (execution and construction supervision), Praxis Architects (Design), Nahas Khalil (development of reception kiosk und consulting)
CONSTRUCTION CONSULTANCY	Michael Grausam (humantektur)
CONTACT PERSON	Foez Talukder (CCDB), Pamela Metschar (BfdW), Michael Grausam (humantektur)
FURTHER INFORMATION	https://ccdbclimatecentre.com/



Authors:
Michael Grausam

Image source:
humantektur

CCDB, the Christian Commission for Development in Bangladesh, is a non-governmental organization located in Dhaka, Bangladesh. It was founded in 1973 by volunteers to support people in need. In the beginning the organization focused on people that were suffering the impact of the civil war in Bangladesh. Over time CCDB started to include the development of rural villages and its residents.

By now CCDB is operating in the fields of emergency relief, rehabilitation and reconstruction, as well as development programs in human resource development, focusing on independent and collective growth and distributive justice. This is to promote good governance and peace through education, health and income generation in cooperatively administered organizations.

CONTEXT

Climate Change is causing changes in living conditions worldwide. Bangladesh is one of the countries most affected by these changes. Rising sea levels together with increasing incidents of torrential rain and cyclones coinciding with a longer dry season threatens the livelihoods of the people of Bangladesh. At the same time Bangladesh is the most densely populated country in the world.

With a population of 170 million and an area of 147.570 km², its population density is five times higher than Germany's. Besides irregular rainfall and increased flooding another effect of climate change is the salinization of groundwa-

ter and soil. To survive in this hostile environment, it is necessary to develop and implement newly adapted methods and technologies. The Climate Centre serves as central learning-hub in which research on new methods and technologies can be conducted and made available to the public. Many national and international organizations have collaborated to provide an institutional framework for the Climate Centre and commit to continue to develop it further. The German organization Bread for the World is the biggest single supporter, among others like the GIZ, actalliance and several universities in Bangladesh (IDU, BSMRAU, BAU).

PROJECT DESCRIPTION

The Climate Centre is located in Sreepur, approx. 60 km north of the centre of the Capital Dhaka. It is set in a 60 ha land accommodating the Climate Learning Centre, in which research, conferences and education will take place, as well as the Climate Technology Park serving the exhibition of climate adaptation

technologies. The Climate Technology Park emulates the 5 climate zones of Bangladesh. For this purpose, an artificial rainwater-fed lake was created. In a later phase of the project a hill will be created on the north side of the plot serving as a demonstration site for adaptation solutions.

Fig. 114_ Entrance sign
of Climate Centre in
Sreepur, Bangladesh

The design was delivered by several local planning offices (Praxis Architects, ArriSD Associates, Nahas Khalil und Fuad Quaium) in collaboration with international consultation by humantektur (sustainable construction and adherence to minimum standards) and Climate & Development Advice (overall concept & Climate Adaptation). CCDB itself was responsible for the acquisition of materials and coordinated with a team of engineers, who coordinated and supervised the construction work. Local builders and labourers executed the construction of the buildings while being instructed by a team of engineers. After completion the park and the facilities were certified with LEED Gold.

Fig. 115_ Illustration of Climate Park, Image-Source: CCDB

At the heart of the Climate Centre are three main buildings: the Climate Learning Centre, the cafeteria and the reception kiosk. Additional buildings are dispersed throughout the grounds of the park. These also include the reception building with security check, as well as space for exhibitions and small shops for local products, three pavilions that can be used to host exhibitions and Seminars, and small model houses, to demonstrate ways of sustainable construction. The Climate Centre and the park were inaugurated in October 2022, after a delay due to the effects of Covid.

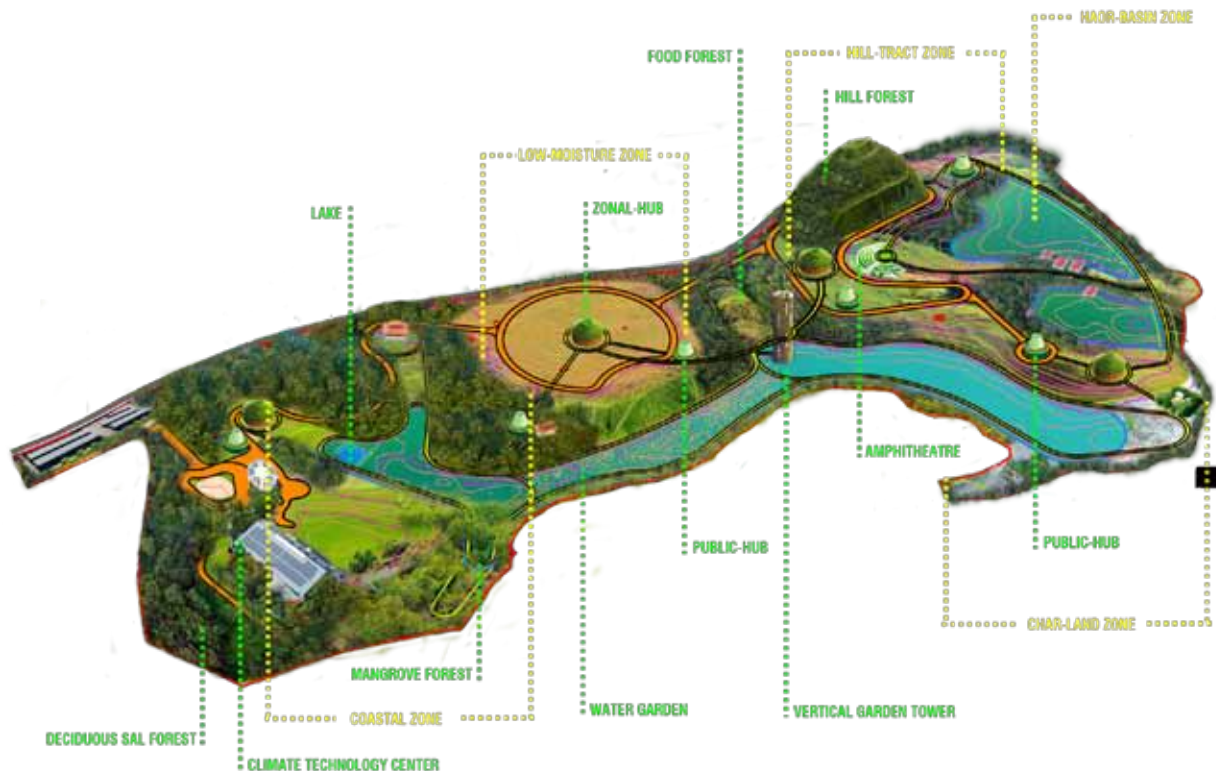




Fig. 116_ View on reception kiosk



Fig. 117_ View on Climate Learning Centre



Fig. 118_ View on Cafeteria

Bioclimatic architecture

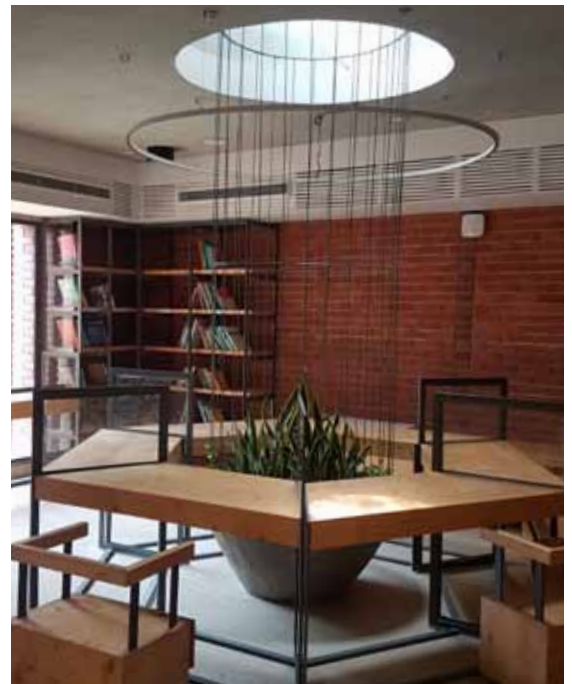
The Climate Learning Centre and the cafeteria were designed with an elevated roof to reduce heat. Sunrays will still heat up the corrugated iron roof, but the heat won't reach the rooms due to the air space between the corrugated iron and the roof underneath, eventually escaping through openings on the sides. Simultaneously the roof overhang provides shade to the rooms below, so that the brick walls of the building are not exposed to additional solar heat. The walls were built with bricks from CO₂-reduced production. The pent roofs are covered with PV modules producing solar power while providing additional shade to the roof. The Climate Learning Centre and the Cafeteria were designed in an open way with open hall-

ways, staircases, terraces and galleries ensuring natural ventilation and exposure to light. The glazed offices on the first floor of the Climate Learning Centre are protected from the sun's rays by vertical greenery. The reception kiosk was designed with a green roof on reinforced concrete with a roof overhang to cover the rammed clay walls below from rain and sun while simultaneously cooling the rooms below through vaporization. For systems engineering only energy efficient systems were applied: only conference, exhibition and office rooms as well as the library are cooled with efficient air conditioning and LED lighting. Rainwater harvesting provides for water for irrigation and toilet flush and waste water is separated and collected as grey and black water.

Fig. 119_ Shaded
terrace of the Cafeteria
(left picture)



Fig. 120_ Skylight
in library for natural
lighting (right picture)



Barrier-free design

The access and use of the Climate Centre facilities is barrier-free and therefore accessible by wheelchair. All buildings are accessible threshold-free by means of ramps and a maximum threshold height of 2 cm and sufficient turnabout space for wheelchair users. The multi-storey Climate Centre has an elevator and in the reception kiosk, the climate learning centre and the cafeteria there are wheelchair accessible toilet facilities. The park is not yet optimally designed for use by people with limited mobility. There should be electric carts leading from one station to another but some exhibition installations are not yet wheelchair accessible.

Security concept

For each room two independent emergency escape routes were planned: all rooms are equipped with either two doors or with a door and a window designed to open. As a timely rescue by the fire brigade with ladders cannot be assumed, all upper floors are provided with two structural escape routes via staircases.

Additional project phases

After a successful start of the Climate Centre there are plans to construct a Climate Campus, a conference centre with guesthouses as well as staff housing on two neighbouring lots in the years to come. In addition an artificial hill will be created in the Climate Park to present adaptation technologies for the mountainous areas of Bangladesh.



Fig. 121_ Open design for natural ventilation (left picture)

Fig. 122_ Office with vertical greenery for natural shading + cooling (right picture)

LESSONS LEARNT

The exceptional status and the extent of the project created a particular challenge: the Climate Centre is the first Centre worldwide exhibiting adaptation technologies to climate change on this scale while offering trainings. Therefore, there were not many experience reports to build on and an intensive exchange with all parties involved was necessary. On the one hand to estimate needs correctly and to plan measures accordingly and on the other hand to take the requirements of different project partners like the minimum standards requested by Bread for the World into account.

For this purpose, early and regular exchange was necessary. As the construction consultancy got involved relatively late in the process, the effort to ensure minimum and sustainability standards was comparatively high and the design had to be extensively revised. The

already commissioned architects Praxis Architects - delivered conceptually sound work but didn't have enough necessary experience in construction implementation specifically constructing clay buildings. The first designs of the reception kiosk did not meet the requirements of low maintenance clay architecture - a roof overhang was missing as well as a base protection against driving rain. The project developer CCDB had made some negative experiences with clay buildings in the past: about 20 years ago, following the advice of an international consultant they collaborated with an Indian architect from the desert state of Rajasthan and built a training centre made of claystone in Dhaka. The architecture of this building did not reflect the tropical and rainy climate of Bangladesh and the training centre soon suffered from heavy humidity damages and mold. It was decided to hire a Bangladeshi expert for

Fig. 123_ Barrier-free entrance to the climate Learning Centre (left picture)



Fig. 124_ Elevator for barrier-free access to the 1st floor (right picture)



rammed earth construction to design the reception kiosk, to not repeat mistakes from the past and to set a positive example for clay construction. In addition, implementation planning and construction supervision was assigned to an experienced office - ArriSD Associates. After the first tendering by Praxis Architects there was a massive increase in costs partly due to missing experience on the side of the architects but also because of increased requirements from the project developer. Originally it was designed primarily for local visitors. Then as the project progressed it became clear that there will be great international interest in the Climate Centre and that there will be an aspiration for a sustainability certification through the LEED rating system.

Another challenge was to realistically estimate future demand. A business plan was drafted but it contained several uncertainties. There-

fore, several already planned facilities and infrastructure were reduced in alignment with the international architects' recommendation and multiple development phases were established to ensure an efficient utilization of the buildings and to develop the project step by step according to real demand.

Furthermore, the Covid Pandemic measures significantly impacted the construction, which led to delays and increased project costs. Professional exchange between local and international stakeholders was made difficult because of travel restrictions. To ensure sufficient communication, stakeholders used videoconferencing via zoom to communicate. Even after the Pandemic it continued to be the main means of communication as this served as an important tool and significantly improved close coordination especially in combination with on-site visitations.



Fig. 125_ Escape route signage on the door of emergency staircase (left picture)

Fig. 126_ Fire extinguishers for fire fighting (right picture)

4-6 INCLUSIVE DESIGN OF A LEARNING CENTRE

PROJECT DESCRIPTION	Building purchase, modernisation & inclusive design of a Learning Centre
COUNTRY & LOCATION	Tanzania, Moshi Municipality and Majengo ward (Klimanjaro Region)
PROJECT DEVELOPER	TUSONGE Community Development Organization (Tanzanian NGO)
FUNDING	Bread for the World, own funds
CONSTRUCTION COSTS	Planned: 200.000 EUR / Realized: 215.000 EUR
MODERNIZATION COSTS	45.260 Euros (incl. outdoor facilities)
PROJECT DURATION	November 2019 to October 2021
DURATION OF CONSTRUCTION	January 2020 to July 2020 (beginning modernization to commissioning)
ARCHITECT	Winnes Massawe (Building Department ELCT ND)
CONSTRUCTION CONSULTANCY	Maike Buttler (humantektur)
CONTACT PERSON	Aginatha F. Rutazaa (Executive Director, TUSONGE)
FURTHER INFORMATION	https://www.tusongecdo.org/



Authors:
Maïke Buttler
Jana Göpel

Image source:
TUSONGE

Tusonge is a Swahili word that means “Let’s move forward together”. The Tanzanian NGO TUSONGE works in line with this guiding principle as it supports and empowers marginalized groups in grassroots communities in the Kilimanjaro Region. TUSONGE’s mission is to enable disadvantaged women, men, youth and people with disabilities (PWDs) “to create prosperity, health, freedom and contribute

to a vibrant and sustainable economy” (Mission Statement). The organization’s objectives of economic empowerment of marginalized groups and the promotion of equality are realized through a participatory and holistic rights-based empowerment process that includes among other things entrepreneurship and business innovation as well awareness raising for human rights.

CONTEXT

Large parts of Tanzania’s population are engaged in small-scale farming. Their livelihood strategies are limited to subsistence farming and small businesses. Women are often poorly educated and have insufficient knowledge about entrepreneurship, quality control, value creation or marketing. Knowledge about environmental and resource conservation is almost non-existent, despite the increasing threat of climate change. Therefore, micro-entrepreneurs - especially women and youth - are supported by TUSONGE through capacity building to acquire the necessary knowledge and thus support their efforts towards economic development.

In Tanzania, the majority of infrastructure and public facilities are not designed to meet the needs of people with disabilities. They are not inclusive. For example, access to buildings is often very limited for people using wheelchairs due to many barriers such as stairs and narrow doors. In addition, the perception of people with disabilities in the society is oftentimes shaped by traditional mindsets and stigmatisa-

tion. The assumption that disability is a curse is still widespread - especially in communities with a strong sense of tradition. TUSONGE is advocating for the rights of PWD through networking and linking partner organisations. TUSONGE also supports the establishment and activities of advocacy groups so that people with disabilities are able to fight for their rights with a strong voice.

Since TUSONGE’s foundation in 2011 the organisation has been growing steadily. Its original office was not sufficient as it did not provide enough space for exchange and collaborative work in teams. In addition, TUSONGE’s ambition to give marginalized groups like PWD equal access to knowledge, exchange, networking and learning could not be realized in its previous location. For these reasons an inclusive learning centre was planned in which the micro-entrepreneurs have the opportunity for exchange and learning - especially in practical terms. In the outdoor area of the new learning centre demonstration fields were set up to illustrate and practically test agricultural me-

Fig. 127_ Entrance with wheel chair parking space and ramp in the background

thods such as the production and use of organic fertiliser and the establishment of simple, resource-saving irrigation systems. A covered outdoor training area for 50-60 people and a seminar room for around 25 people inside the building are used for exchange meetings and

accompanying training and events. By moving into its own building in 2020, TUSONGE no longer has to pay office rent or spend time and money on renting event or seminar rooms for trainings and meetings with target groups.

PROJECT DESCRIPTION

The TUSONGE Learning Centre

The Tusonge Learning Centre is located in Moshi, a city in northern Tanzania, south of Mount Kilimanjaro and close to the Kenyan border. The city has about 180,000 inhabitants. The centre is surrounded by scattered development on the edge of the city centre, accessible by public transport (bus line) and car via the nearby national highway. The pentagonal plot measures ~ 2,800 m². In its centre, an existing U-shaped, single-storey building of about 330 m² was modernized. The open space around the building provides room for a covered seminar area, agricultural demonstration areas and a driveway with parking.

The building was fundamentally modernized. In addition to demolition work, it was planned to renew windows and doors, redivide interior walls, renew screed, flooring, suspended ceilings, plumbing fixtures and wall tiles, repair the metal roof and exterior plaster and apply new paint (interior & exterior). Rain gutters and a water reserve tank were installed. A temporary roofing for trainings outside and chicken coop for poultry keeping (demonstration farming) were newly constructed on the property.

Process of planning and modernization

The cooperation for the development and implementation of the TUSONGE construction project was based on a partnership approach.

The purchase and modernization were financed mainly by subsidies (German federal funds), but also partly by TUSONGE's own contributions (see above). Throughout the development, planning and implementation process, TUSONGE was the buyer, builder and decision-maker. TUSONGE conducted the basic evaluation for the purchase of the new property together with a local architect they had commissioned. The planning was carried out by the local architect in coordination with TUSONGE. In principle, Tanzanian building standards were applied.

However, each step was accompanied by international building consultants to ensure compliance with building criteria of the funding agencies and minimum standards according to the principle of superiority: Either the Tanzanian or the German building code was applied, depending on the strictness. This applied, for example, to the implementation of measures to create barrier-free access, but also to health

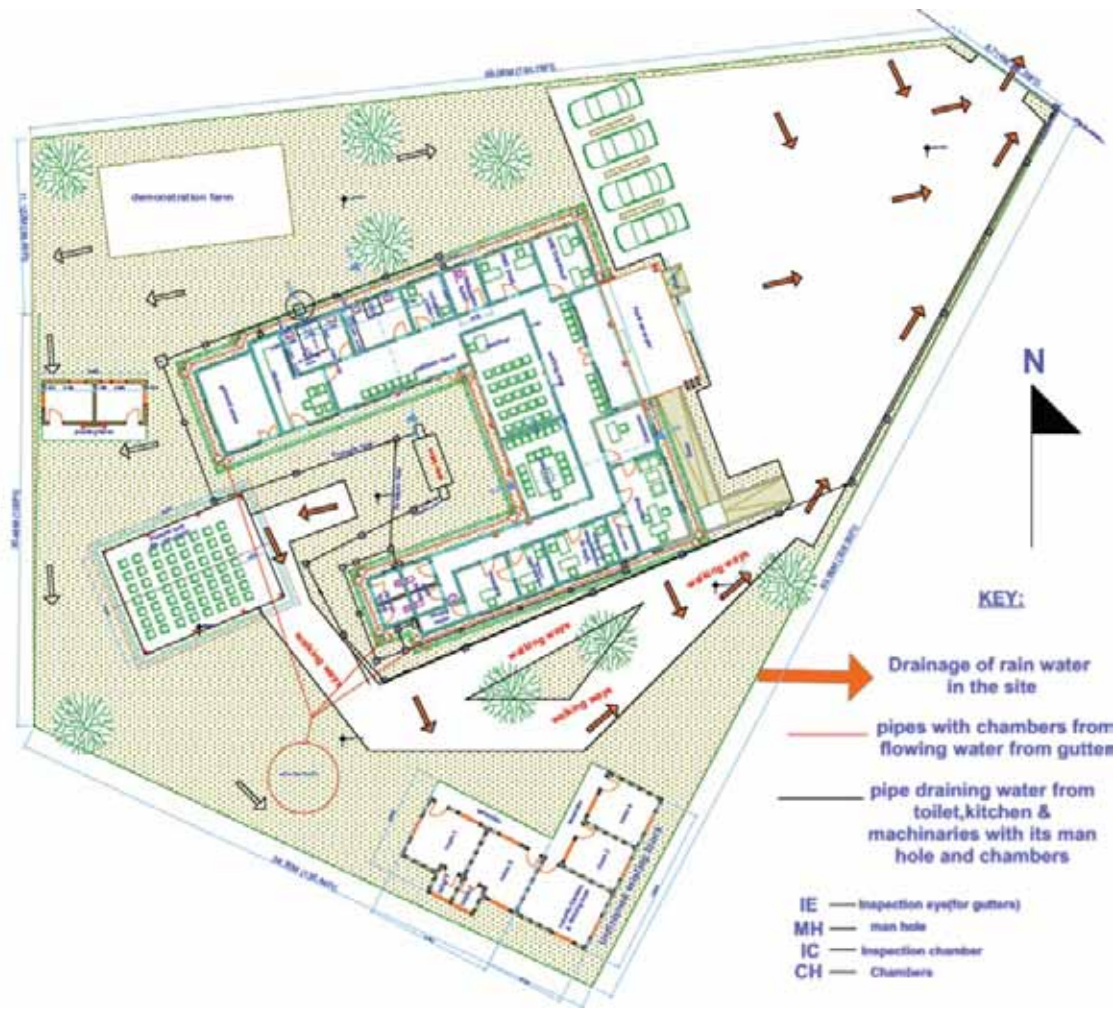


Fig. 128_ Floor plan of the modernized building

and safety. Further criteria were needs-basedness, cost-benefit ratio, fair tenders, climate adaptation, durable and maintenance friendly construction, low import of building materials and strengthening of the local economy.

Quantities and costs were determined by a locally based Quantity Surveyor. TUSONGE & the local architect assumed the responsibilities of the tendering process. Execution was done by a local construction company and construction supervision was also done by the local architect. The international construction consultancy carried out monitoring & control via videos, photos and reports.

TUSONGE is now the owner of the building with full responsibility. The running costs of the building after commissioning are in the responsibility of TUSONGE as well. Therefore, TUSONGE uses the fees of the seminar participants as income.

Accessibility

TUSONGE paid particular attention to converting the centre into an inclusive building. The building is intended for independent use by people with disabilities. The staircase at the entrance was supplemented by a ramp with a low gradient to ensure barrier-free access for people with walking impairments and wheelchairs. Covered parking spaces were created at the foot of the ramp to enable wheelchair users to get into their cars without getting wet during the rainy season. The entrance, the rooms in the building and the covered seminar area outside are accessible without thresholds. A barrier-free toilet was also realized by providing sufficient space for movement and support handles. TUSONGE also established tools and equipment that make it easier for people with disabilities to use the centre, such as wheelchairs and lifting equipment. They also recently designed play equipment that is specially adapted to the needs of children with disabilities.

Fig. 129_ Building
before moderni-
zation (left picture)

Fig. 130_ Building
after modernization
with accessible parking
space (right picture)



Outcomes

The centre has become a well frequented place for many groups and individual users. The newly formed women and girls group, a platform for women and girls with disabilities in the Kilimanjaro region for instance, meets on a monthly basis in the building free of charge to discuss its strategies. Usually, one TUSONGE staff accompanies these meetings to support the women and girls in their strategic planning and thereby increase the impact of their activities.

In general, since TUSONGE moved into the new place, the number of beneficiaries participating in trainings and workshops has increased.

Another effect associated with the move to the new building is the increased visibility of TUSONGE. Since the move, TUSONGE is actively sharing stories and pictures about its activities in the centre on several social media platforms. "Now people know where to find us", says Aginatha Rutazaa the Executive Director

of TUSONGE proudly. With the increased publicity TUSONGE also attracted more support and collaborations with other Non-profits increased. For instance, the Action on Disability Development (ADD) organisation from Dar es Salaam became aware of TUSONGE and visited the centre. Over time, the exchange became more intensive and eventually the two organisations realised a networking platform together. Even people who are not the direct target group of TUSONGE are curious to learn more about the activities and are eager to visit the centre. They are especially interested in the demonstration fields and the poultry pen and also want to learn about agricultural practices. In addition, TUSONGE receives many requests from other organisations to use the seminar rooms in the centre. Many of these requests have to be refused as the rooms are usually at maximum capacity.

Fig. 131_ Ramp from ground level to the ground floor (left picture)

Fig. 132_ Accessible toilet (right picture)



LESSONS LEARNED

In general, moving into its new premises is a huge success storey for TUSONGE. The inclusive building and surrounding enable people with disabilities to participate in workshops and other activities offered in the centre. Users of the centre - people with and without disabilities - highly appreciate the accessibility of the building.

Through its increased visibility, TUSONGE was also able to intensify its lobbying activities, especially for current human rights issues in the Kilimanjaro region. Nonetheless, there are always things to improve: One of the main target groups of TUSONGE are women with disabilities. Many women bring their children to the centre when they have a meeting or a workshop. Some but not all of the children accompanying their mothers have disabili-

ties. TUSONGE always welcomes these little visitors. The parents are sensitized about the demands towards an inclusive environment and the children can play and learn from each other. However, the centre is not fully equipped to provide a stimulating environment for the youngest visitors. At the moment, TUSONGE is establishing an outside playground and play area inside the building.

In addition, some levelling measures need to be realised in the backyard of the property. The pavement is not smooth enough in certain parts so that they are currently not easily accessible for people using a wheelchair.

As explained above, with its increased popularity TUSONGE is welcoming more and more guests and visitors. Some of them, especially



Fig. 133_ Workshop in the modernized centre

the ones who arrive from far away, stay longer. Unfortunately hostels and hotels near TUSONGE are not inclusive and are therefore difficult to use for guests with disabilities. An inclusive BnB to accommodate three to five guests with disabilities is a wish that staff still have for the TUSONGE Learning Centre.



Fig. 134_ Team in front of the building

4-7 SAFE HAVEN - CONSTRUCTION OF EVACUATION CENTRES

PROJECT DESCRIPTION	Planning and construction of school buildings as storm, flood and earthquake-resistant evacuation centres
COUNTRY & LOCATION	Philippines, Island Panay, Province Capiz
PROJECT EXECUTING ORGANIZATION	Aid agency of the Protestant churches in Switzerland (Hilfswerk der Evangelisch-reformierten Kirche Schweiz HEKS/EPER) on behalf of the local government, self-implementation of HEKS/EPER coordination office in Iloilo, Panay, Philippines
PARTNER ORGANIZATIONS	Municipality of Pilar, Province of Capiz, Ministry of Education (PHL)
FUNDING	Swiss Solidarity (Glückskette), HEKS with co-funding of COFID
CONSTRUCTION COSTS PLANNED/ REAL	1,3 Mio. CHF planned / 1,4 Mio CHF real
PROJECT DURATION/ CONSTRUCTION TIME	April 2015 - May 2017 / April 2016 - May 2017
ARCHITECT	Christoph Lettgen: conception, consulting (engineering & management), technical backstopping and supporting construction management
TECHNICAL PLANNING	HEKS/EPER Team Philippines; Yturalde Engineering & Consultancy Services, Iloilo, Philippines; ZRS Architekten Ingenieure, Berlin,
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The Save Haven project was implemented by HEKS/EPER, the aid agency of the Protestant churches in Switzerland. With projects in over 30 countries in Africa, Asia, Europe and Latin America, the foundation „works for a more humane, just world and a life in dignity“ (www.heks.ch): by supporting the development of rural communities, humanitarian aid and church

cooperation, in Switzerland by strengthening the rights and integration of refugees and socially disadvantaged people. In order to meet the needs of target groups abroad and to be able to use financial aid efficiently, the implementation of projects is mainly carried out by local partner organizations.

CONTEXT

The islands of the Philippine archipelago are located in the areas along the circum-Pacific fire belt where strong earthquakes, tsunamis and volcanic eruptions occur on a regular basis. The Philippines are also at risk of typhoons due to its location near the warm waters of the equatorial Pacific. As a result, the population of the Philippines often suffers from severe natural disasters.

In November 2013, Typhoon Haiyan caused extensive damage to several islands in the Philippines: more than 6,300 people died, around 4 million people were left homeless and there was widespread damage to infrastructure and private property. On the island of Panay alone - in the northeastern Visayas island region - around 2 million people were affected by the typhoon. Many shelters and evacuation

centres were destroyed, being of poor construction quality. Furthermore, this region had insufficient shelter capacities. Rebuilding was done under the objective ‚build back better‘.

Immediately after the typhoon, HEKS had already organised emergency aid in the province of Capiz in over 30 communities. However, HEKS overall long-term strategy was to improve the disaster resilience of the communities through new disaster preparedness capacity. Therefore, in response to the emergency and disaster vulnerability of the rural communities of Panay Island, HEKS in 2014 took up to establish new evacuation centres. The project was steered from HEKS/EPER regional sub-office in Iloilo on Panay Island, and three communities in the province of Capiz (northern Panay) were finally selected.

PROJECT DESCRIPTION

During two assessment missions in August/September 2014 the feasibility of rehabilitation measures in existing evacuation centres (reception centres) was evaluated. On Panay

Island, a risk analysis of the potential sites was carried out in April 2015. The result was that often community facilities and schools are being used and considered as evacuation

Fig. 135_ View from the sea on the new Safe Haven in Bantigue

centres. But these buildings are not appropriate for this purpose due to often single-storey buildings located in flood-prone areas, poor construction quality and limited spaces so that many people did not survive the Typhoon in 2013. Another result was that the rehabilitation of the existing buildings may cost almost as much as a new construction.

The initial project idea was to build evacuation centres out of concrete, which can usually also be used as community centres. However, due to the high investment costs for high-quality, durable concrete components, daily school use was favoured instead of occasional use as community centres.

The development of the concept and design for the evacuation centres was done in close cooperation between local and international architects, government disaster authorities and the civil society of the respective communities. The participatory design process with school stakeholders, community leaders and the disaster-risk-reduction committee was implemented by a team of a local Filipino architect and an international architect.

The buildings are designed to withstand every expected coastal disaster like super typhoon, storm surge and flash flood as well as an earthquake of max. 8.5 magnitude. The multi-hazard resistant buildings are designed for a minimum lifespan of 50 years by respecting the required structural criteria, most of all by adhering to appropriate production of reinforced in situ concrete. The used materials are durable, e.g.

waterproof concrete in all locations exposed to water or sea spray, materials being procured from certified sources and constantly quality monitored during realisation.

Design and execution of the Safe Havens schooling and evacuation centres are in line with local and international standards and building practices: in compliance with the National Structure Code of the Philippines which corresponds to the IBC (International Building Code). All structural designs were done by the local engineering consultant Yturralde Engineers, verified by the international engineering consultants of ZRS Architekten Ingenieure, and compared to the standards of the structural Eurocode. The seismic design of Reinforced Concrete Special Moment Frame was chosen as the structural concept since it is one of the best analyzed and most used structures in the Asian-Pacific area. As it is a common and well-known technique in the Philippines a good execution quality could be expected.

A challenge in the planning process was to cooperatively plan the change between the two modes of use with all responsible stakeholders involved - the „regular“ use of the buildings and its use in times of disaster. In order to ensure a good change, a concept was needed, processes had to be defined, responsibilities had to be clear and trainings were required. Furthermore, a good maintenance concept was required, so that the function of the building is guaranteed at all times.

The Safe Havens

The concept was to build Safe Havens in villages close to the coast, for example in tsunami regions, which will serve only for a part of the population who will take care of the village directly after a disaster. They are additional to other existing evacuation centres which are located further inland and less exposed to disasters in order to serve as shelter for one or several communities.

During and after a disaster, a Safe Haven serves as a shelter until help arrives. Therefore, it has to be constructed to resist these disasters and has to provide all necessary infrastructure and supplies for the time immediately after a disaster for those seeking shelter.

The structural concept for the seismic resistant construction is a 'Special Moment Frame' of reinforced concrete framework with a ma-

sonry infill from concrete hollow blocks, which are horizontally and vertically reinforced and tied to the framework. The first floor and roof deck consist of a composite floor slab of galvanized steel panel with RCC decking, the steel panels act like a lost formwork. All windows are without glass in order to avoid injuries caused by broken glass. All openings can be closed by shutters, while they are open, the shutters function as sunshades.

The choice of this kind of earthquake-resilient structure initially caused discussions with the donor. These differences had been resolved after several verifications from structural engineers and led to a continuously and carefully monitored construction process.

An evacuation centre was built in each of the communities of Binaobawan, Bantigue and Manapao, providing shelter for a total of approxi-



Fig. 136_ View on Safe Haven evacuation centres

mately 330 people during a disaster, while it can also serve as a classroom to 225 students. For disaster use, the shelter capacity was calculated with one person per square metre in the common rooms. In the communities Bantigue and Binaobawan, close to the coast, two-storey evacuation centres were built. On the island of Manapao, the construction of a single-storey shelter was sufficient because the building site is located higher than water levels and so it is protected from flooding.

As the earthquake-resistant evacuation centres are being used for school purposes in day-to-day life, they were built on the school premises of primary schools. The buildings consist of a rectangular ground plan (approx. 25 m x 10 m in Binaobawan, approx. 21 m x 10 m in Bantigue and Manapao). The long side of the buildings were arranged orthogonally to the coastline and thus parallel to the main wind direction in order to minimize wind loads.

In Bantigue and Binaobawan, the two-storey buildings have an elevated open plan on the ground floor, so that flood waves can pass, and an enclosed building volume on the upper floor. The design is reminiscent of the traditional pile construction of the coastal and riverine communities of the region. The first floor is elevated by 3.0 m to withstand the extreme case of a century tsunami wave. The staircase from the ground floor to the roof is located in the central area of the building. Each evacuation centre has sanitary rooms, a command centre (for the disaster management committee) and a kitchenette on the upper floor. The two-storey buildings have an open kitchen on the ground floor with dining resp. multi-purpose area for school use, which can be used as a covered tent area after a disaster event.

In each location, the two upper floor common rooms of 65 sqm each are safe rooms for 130 persons during times of disaster. In normal



Fig. 137_ View on ground floor area with ramp & kitchen



Fig. 138_ Plans of ground floor, 1st floor and roof during evacuation

Fig. 139_ Window shutters without glass



Fig. 140_ Water tank



Fig. 141_ School ID on the roof



times these rooms provide space as classrooms. The safe Havens in Bantigue and Manapao are slightly smaller and provide shelter for about 100 people each. All centres have a flat roof. After a disaster strike, the area of the roof terrace can be used as tent camp area or rescue platform. It is most likely that in the event of a real disaster, much more people than the just calculated capacity will find shelter in the structures.

Attached to every Safe Haven is an elevated hazard-resistant water tank to ensure access to clean water in the event of a disaster. It is designed to supply water for approx. 1 week. On the roof terrace, a power generator is installed for electric power supply during at least one and up to two weeks until power supply is re-established. An alternative power supply with renewable energy supply like PV and batteries has been discussed several times with the communities and, due to its fragility during typhoons, has finally been abandoned. Furthermore, medical equipment for the treatment of wounded persons and an emergency radio call, etc. is being stored in the Safe Haven.

An identification tag has been painted on the roof which is visible from a helicopter, so that the building is identified as a Safe Haven.

LESSONS LEARNED

The Safe Havens of Bantigue and Binaobawan have an access ramp on the ground floor to ensure easy transport of goods and as access for disabled persons. Rooms on the first floor are not accessible via a ramp and for people

with limited mobility. According to the concept, the buildings in Bantigue and Binaobawan will probably not be used by handicapped persons during disaster time. However, in regular time, all rooms should be accessible for handicapped persons for school use. In this specific case, a ramp on the upper floor with a floor height of 3,20 m would need at least a length of 21 m with 15% inclination plus several intermediate platforms. Generally, a ramp to ensure access to all relevant floors is recommended not only for wheelchair-use during school use but also for vehicles' access and transport of goods during disaster time. Therefore, a ramp should always be integrated in the building design. In the present context, a ramp to the upper floor was omitted due to the limited space available on the existing building site.

There are very few sanitary rooms for both modes of use - school and evacuation use. However, this quantity is in line with the Sphere Standards for school use and for camps for displaced persons. If the school rooms will be used by handicapped persons, the dimensions of at least one bathroom per building should be dimensioned according to the requirements for persons with limited mobility.

According to the international architect, the building concept of the evacuation centres was challenging to develop and has probably potential to serve as a typical design. A broader regional strategy to promote and spread the concept beyond these three prototypes would be a desirable approach for a project to follow.

The participatory approach, especially in the conceptual phase, was very helpful. Therefore, it is an important factor to think through the participatory components and to plan strategically from the beginning: these participatory processes should not be neglected and be considered as a relevant point of funding from the beginning.

DRR- (Disaster Risk Reduction) workshops were implemented with all relevant stakeholders, such as community, municipality administrators, Department of Education and the Provincial Social Welfare Office. The output was an Operational Manual with clear house rules, guidelines and responsibilities which support the involved communities to define the turnover from school to evacuation use and vice versa. The beneficiaries described this Operational Manual as very helpful and a novelty, which can serve as a template to other communities.

As the end-of-project-evaluation (May 2019) outlined, the Safe Havens are buildings for daily use and at the same time a place for evacuation, with a clear protocol for the switch between both uses. This novelty was highly accepted by all parties involved. The end-of-project evaluation was made when the buildings were just recently finalized, therefore it was not yet possible to evaluate the efficiency of this hybrid use. A further evaluation after, e.g. 10 years, could reveal if the concept of the double-use school - evacuation centre of the Safe Havens is as successful and appropriate to the needs as it has been intended.

DIRECTORIES

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