
THE MAGGIE PROGRAM: GIVE FORCIBLY DISPLACED PEOPLE ACCESS TO HEALTH, EDUCATION AND SELF-RELIANCE.
HIGH-INSULATED AND ADAPTABLE SHELTERS FOR SCHOOLS, COMMUNITY CENTRES, PRE AND POST MEDICAL CARE AND TEMPERATURE CONTROLLED WAREHOUSING FOR REGIONS EXPOSED TO HARSH CLIMATES.
TODAY, THERE ARE 60 MILLION REFUGEES IN THE WORLD. MORE THAN HALF LIVE IN CAMPS EXPOSED TO EXTREME WEATHER. EVERYDAY, 42,500 NEW REFUGEES JOIN CAMPS.
UNHCR APRIL 2015.
maggie
DMOA Architects & Engineers
LET'S BUILD OPPORTUNITIES
Photo: © Peter Casier

PREFACE

When disaster strikes, the whole world shivers through the images that reach us. The emergency response has become more effective. But the needs of the affected and displaced people remain long after most relief organisations have left.

Nearly 60 million people have been driven from their homes by war and persecution. Every day last year on average 42,500 people became refugees, asylum seekers, or internally displaced; a four-fold increase in just four years (UNHCR June 18, 2015). On average, a refugee lives 11,8 years in a camp (UNHCR, 01/2015).

Many of the troubled areas are located in climates subject to extreme heat, cold and wind. *An estimated 17.8 million displaced people worldwide are exposed to unacceptable weather conditions (cold or heat). This causes day-to-day distress, inflicting diseases and causing mortality rates to rise among refugees.*

In extreme climates, temperatures can drop as low as -15°C in winter and rise till +45°C in summer. In those climate the use of tents is inadequate. Tents are not economical either, as the lack of insulation requires heating during the cold seasons which drives up the cost for fuel consumption and adds greatly to the risk of fire and respiratory diseases. Extreme heat also impacts the health of refugees and is an important cause of mortality for those at risk.

Countries hosting refugees do not allow them to settle permanently. Hence, the challenge is to develop temporary constructions that are as sturdy and well insulated as fixed constructions.

The maggie was developed upon a long list of criteria provided by different shelter experts and relief organisations. This is detailed in this publication. This document resumes our journey to fulfill all the criteria and to mould and optimise the elements into an ingenious, durable generic shelter that provides a low-cost, sustainable solution.

The maggie is a part of a multi-discipline approach. It is the result of collaboration between shelter experts, researchers, academics, other civil engineers, construction companies and volunteering professionals. The maggie program complements other VN & NGOs initiatives to address the health and educational needs of refugees.

I assisted and coordinated many disaster relief and development projects around the globe. The hardship of these people is beyond imagination and acceptance. Hence our quest that gave birth to our innovation and project.

This leaflet supports the inauguration of our "maggie" prototype.

Bart Peeters, head of the maggie program

INDEX

02 • PREFACE

04 • NEEDS

06 • **FOCUS** PEOPLE

08 • **FOCUS** PURPOSES & REGIONS

10 • CRITERIA USED FOR DESIGNING THE SHELTER

18 • THE maggie

20 • THE maggie: TECHNICAL DRAWINGS

25 • WHY DMOA GOT ENGAGED?

26 • PARTNERS

NEEDS

HEALTH ISSUES DUE TO EXPOSURE TO A HARSH CLIMATE

Forced displaced people have a disproportionately high rate of mortality, diseases and mental illness. From the nearly 60 million displaced people, almost half are in a state of extreme vulnerability. A number of the causes for diseases amongst refugees are preventable when providing comfort for those at risk. The maggie shelter addresses the shortcomings of tents and is a solution against the elements of a harsh climate.

HEALTH ISSUES DUE TO COLD.

A World Health Organisation Report in 1985 established that there is a link between poor health and low indoor temperatures. Further research has strengthened this finding. Cold can affect the health of people. Many refugee camps are located in regions with a harsh climate. At temperatures below 12°C, blood tends to thicken and cardiovascular, cerebrovascular, circulatory and respiratory diseases rise sharply. Temperatures drop drastically at night in high-altitude regions. Frost, snow and storms are reality, even in arid and semi-arid areas . Tents provide little protection against the brutal elements of nature. Refugees rarely have access to energy sources. They burn rubbish and any organic materials they can find in the proximity of camps. It inflicts respiratory diseases, which are prominent among refugees. The scramble for organic materials has an important ecological impact on the area and often causes conflict with the local residents. Research shows that refugees spend much of their modest income or savings on buying fuel or coal to warm their tent in winter. Tents are cheap to procure but have a short life span (need to be replaced at regular), little insulation and a high cost of ownership.

HEALTH ISSUES DUE TO HEAT.

Heat causes cardiovascular, cerebrovascular and respiratory diseases. Heat-related illness occurs when our bodies can no longer transfer enough heat to keep us cool. Excess heat causes rashes, swelling, dehydration, exhaustion and heart-stroke. Pregnant mothers, newborn babies and elders are particularly at risk. Women in refugee camps experience worse pregnancy outcomes, including increased foetal mortality, low birth weight, premature labour, post natal complications and infections.

Photo: © Peter Cascer

SAFETY ISSUES AMONGST REFUGEES

The refugee population is a mosaic of individuals, each with a personal history. They reconstitute their complex societies in the refugee camps and take with them the ethnic, cultural and religious rituals and convictions of their home country. The scarce resources and challenges for survival further exacerbate the divisional tension amongst refugees. Creating safe refuges within a camp for those at risk is a demanding task given the fact that countries hosting the refugees only allow for temporary settlements. Still today, tents make up the vast majority of the shelters. Tents provide little protection against intruders.

THE NEED FOR EDUCATION AND SKILLS FOR REFUGEES

In the midst of conflict or sustained poverty, education for migrants and refugees is often seen secondary to the struggle for food, aid and shelter. Providing education (children) and skills (adults) helps refugees to get back on their feet and develop competences that allow them to return and build a better future. Yet experience has shown that small refugee populations receiving little support, often prove capable of developing some sort of sustainability within a reasonably short time. Equally, the UN reports that refugees with an education often provide the leadership during the rebuilding of communities. Self-reliance is key. Educated refugees also contribute greatly to the sustainable peaceful coexistence between factions and the economical development of a region after conflict.

> “The maggie shelter addresses the shortcomings of tents and is a solution against the elements of a harsh climate.”


Photo: © Peter Casaer

FOCUS

PEOPLE

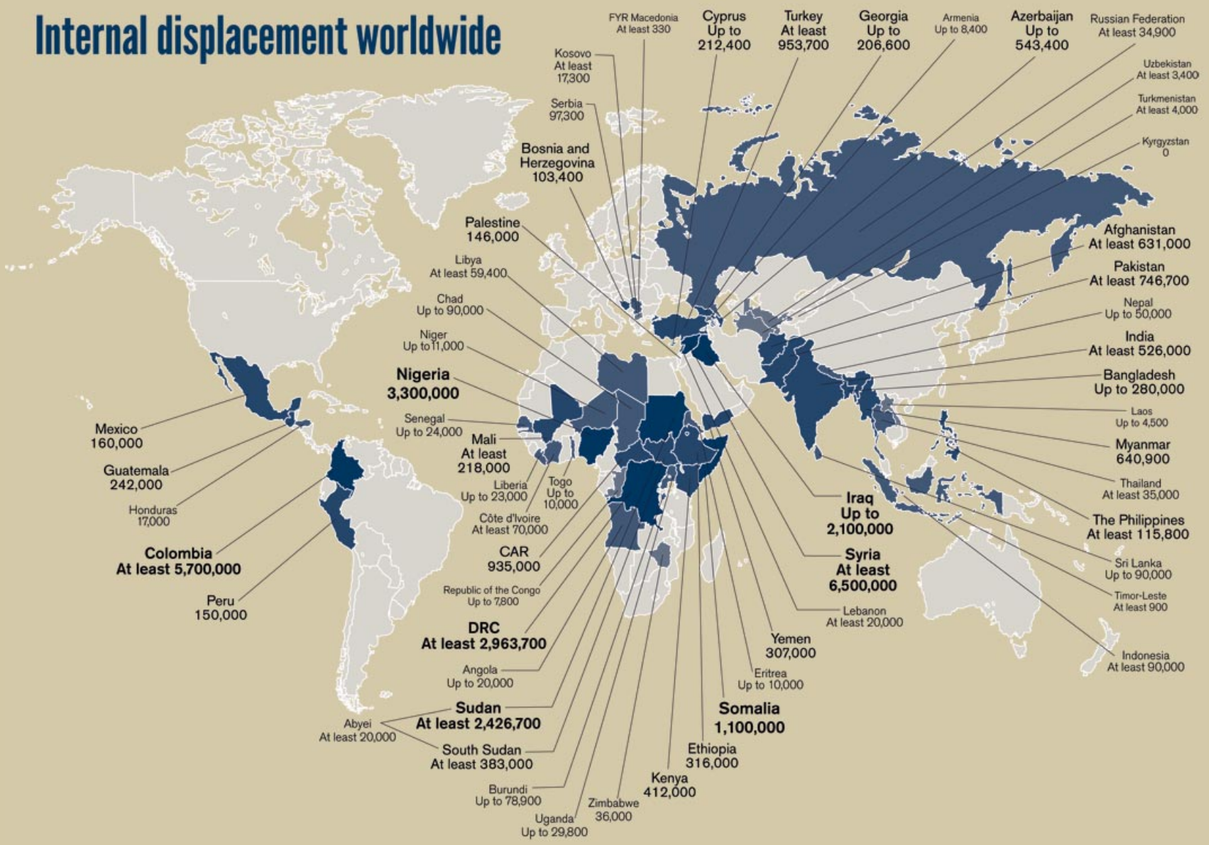
There are nearly 60 million displaced people in the world. About 2/3 are internal displaced people and 1/3 are refugees. Half of the forcibly displaced people are kids.

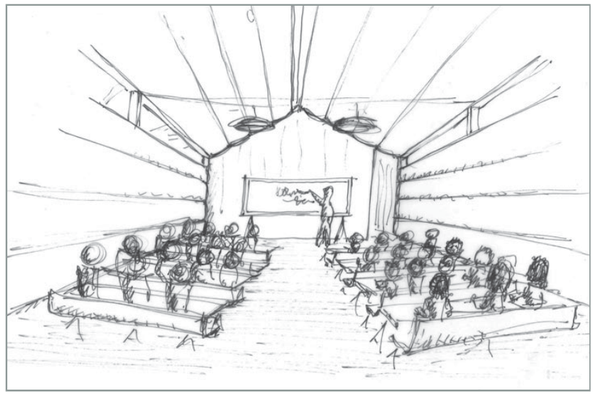
We are focussing on two groups:

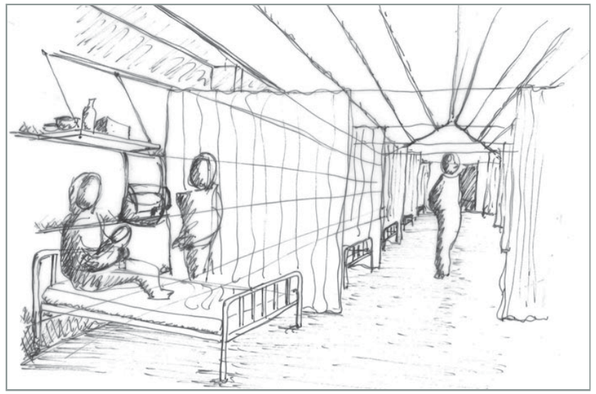
1. Internal Displaced People: an internal displaced person (sometimes abbreviated IDP) is a person who has been forced to leave his or her native place, a phenomenon known as forced migration. Millions of other civilians who have been made homeless by natural disasters are also considered as IDPs. IDPs are among the world's most vulnerable people. Unlike refugees, IDPs have not crossed an international border to find sanctuary, but have remained inside their home countries. Even if they have fled for similar reasons as refugees (armed conflict, generalised violence, human rights violations). IDPs legally remain under the protection of their own government.

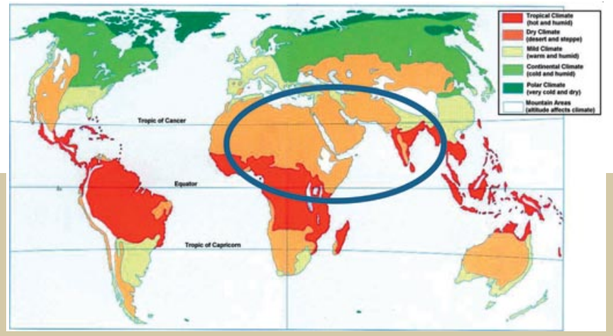
2. Refugees: if a displaced person crosses an international border than he or she will be considered a refugee. Refugees are people outside their country, who are generally unable or unwilling to return home because they fear serious harm.

We estimate that approximately 18 million displaced people can benefit from our shelters.









FOCUS

PURPOSES

We focus on providing schools, community centres, medical wards and temperature controlled warehouses.

1. SCHOOLS

Education is often the only hope and ticket for change refugee children have. Schools also play a vital role in educating children about health and hygiene.

2. COMMUNITY CENTRES

Community centres have multiple purposes. Our focus is on learning adults skills so refugees can become self-reliant, earn a living and make marketable products. Skills and knowledge also give refugees an extra asset when they return to their home country and rebuild their lives.

3. MEDICAL WARDS

Refugees have a high rate of disease and mortality. Many refugee camps are located in regions with extreme temperatures. Both heat and cold aggravate the health of patients and increase the mortality rates. The need for safe, clean and temperature controlled recovery areas are vital.

4. TEMPERATURE CONTROLLED WAREHOUSES

Food and drugs deteriorate due to exposure to sun and heat. The challenge is to have an unbroken logistical chain. High insulated, energy efficient warehouses are the solution. Additional challenges are safety against intruders, preventing mould and repelling dust, insects and rodents.

REGION

Most displaced people are situated in the circle on the map. In this zone, we have 3 main types of climates; dry and semi-dry (desert and steppe), mediterranean climate (northern Africa) and tropical (African equator countries.

Photos: © Peter Casaer

Photo: © Peter Casaer

CRITERIA USED FOR DESIGNING THE SHELTER

Designing a shelter is complex. It is often misunderstood and oversimplified. The reason is that there are many factors and norms to take into account related to technical, organisational, logistical but also to local cultural factors. At current, the need for shelters is so large that procurement agencies of international organisations are often taking the price per unit as a main determinant. Fortunately, this is gradually changing.

This section details the criteria that was provided by different shelter experts and that we have taken into consideration. The elaborate list of criteria (see below) that one must take into account, explains why tents are still extensively used in the humanitarian world.

More and more, shelter experts are working together to come up with a set of quality benchmarks for tents. Our shelter concept sits between the tent and a fixed construction. Hence difficult to benchmark. We used the criteria of both tents and fixed constructions to set our targets and for testing and simulations exercises.

Over the next pages, we will provide an overview of these criteria we have used for the development.

COMFORT	SAFETY	HYGIENE	DURABILITY	ADAPTABILITY
Heat	Snowload	Clean	Community involvement	Different climates
Cold	Fire retardancy	Fresh air	Energy Friendly	Different purposes
Rain	Protection	Anti insects	Eco friendly	Modular combinations
Accoustics	Strong winds	Anti rodents	Life span	Local upgradeability
Daylight	Natural forces	Anti dust	Local repairability	Compact transport

CHALLENGE I: **COMFORT**

The task of designing shelters for optimal comfort is really the task of quantifying levels of discomfort and removing any factors which adversely affect human health or cause discomfort.

Photo: © Daniel Demoustier

Heat

Heat is a major cause for discomfort and increases the number of heat-related illnesses and deaths. Children face a much greater risk of dehydration and heat-related illness in hot weather. Desert climates feature very hot periods of the year with maximum temperatures of over 45 °C (113 °F) in the hottest regions.
Target: inside temperature below 27°C / 78.8°F

Cold

Million of refugees have little protection against the cold. Tents and unfinished dwellings provide hardly any insulation. Children are particularly vulnerable. Sub-zero temperatures expose refugees to pneumonia and a host of other respiratory diseases.
Target: inside temperature plus 16°C / 60.8°F

Rain

Even in arid (desert) or semi-arid climates, heavy persistent rainfall accompanied by strong winds can occur, causing damage to dwellings and tents. The water-resistance of tents deteriorates quickly in a harsh environment causing water to enter.
Target: 100% waterproof over full life span 15 years

Accoustics

Refugee camps are often overcrowded places, with many people having endured a traumatic event. Noise, particurarly at night, affects the mental health and stress level of the refugees. Needs assessments among refugees indicated the importance of noise reduction.
Target: noise reduction -40 dB

Daylight

Daylight is an important factor for the comfort of people. Daylight is also an important factor for schools, community centres (workshops, skill centres) and medical wards. We have taken the guidelines for schools as our target norm.
Target: 150 – 300 Lux from daylight

CHALLENGE II: **SAFETY**

Snowload

Many regions that host refugees have snow during the winters. Few tents are designed to withstand the weight and consequences of snow.
Target: snowload of 100 kg/m2.

Fire retardancy

Fire-retardant fabrics are textiles that are naturally more resistant to fire than others through chemical treatment or manufactured fireproof fibres. Fire retardancy is critical in shelters because refugees burn any material they find during the cold seasons. Fires in refugee camps are common.
Target: textile fire retardancy EU class M2

Protection

Safety is high on the agenda in refugee camps. Safety against intruders of hostile individuals/groups but also safety against unusual behaviour of patients and family members in distress (e.g. Ebola). The walls of the maggie become very sturdy when sand is used as filling. Hence, access through the walls is difficult.
Target: reinforced walls and outer doors + double entry

Strong winds

The criteria for community or family tents procured by some of the relief agencies is 75 km/hr. That means that most tents are destroyed by winds over 75 km/hr.
Target: Conform Eurocode EC1, 100 km/hr => 150 kg/m2 on structure.

Natural forces

Tents are particurarly prone to whirlwinds, twisters and tornados due to their light weight / volume ratio. Our quest was to develop a shelter that could also provide a safe heaven that would withstand most forces of nature.
Target: include tensioning straps allowing storm resistance

A refugee camp is a large mosaic of individuals, each with a personal history. Refugees reconstitute their complex societies in the refugee camps and take with them the ethnic, cultural and religious convictions of their home country. The scarce resources and challenges for survival further exacerbate the divisional tension amongst refugees. Fire and damage due to storms are other pertinent concerns.

Photo: © Peter Casaer

CHALLENGE III: **HYGIENE**

Hygiene is critically important to limit the spread of diseases. Refugees may have fled through infested areas or settled into areas that are prone to insect-vector diseases. Camp-refugees live in unhygienic and crowded camps where many diseases spread easily. Indoor air quality (IAQ) is a term which refers to the air quality within structures, especially as it relates to the health and comfort of building occupants. IAQ can be affected by gases (including carbon monoxide, radon, volatile organic compounds), particulates and microbial contaminants (mould, bacteria).

Photo: © Daniel Demoustier

Clean

Hygiene requires that shelters should be cleaned at interval. There are different needs when it comes to cleaning. In general, cleaning with conventional soap is sufficient. However, the textiles used for the inner lining for medical wards destined for patience with infectious diseases need to be cleaned with disinfectants (antimicrobial & antiseptics).
Target: easy to clean internal walls, regular cleaning with soaps containing chlorides should not deteriate the textile significantly

Fresh air

Respiratory diseases are a major health concern. Ventilation with clean fresh air reduces the levels of indoor air pollutants. Equally, high levels of CO_2 is one of the most acutely toxic indoor air contaminants depriving the brain of oxygen. High levels of carbon monoxide can lead to nausea, unconsciousness and death.
Target: relative humidity > 30% < 70%, CO_2 < 600 ppm

Anti insects

Insects such as mosquitoes and flies are by far the most common disease carrier (vector). These insects may carry a parasite, bacterium or virus that is infectious to humans. Most often the disease is transmitted by an insect bite, which causes transmission of the infectious agent through subcutaneous blood exchange.
Target: anti-mosquito fabric covering all ventilation and passage openings

Anti rodents

Rodent-borne and other communicable diseases are of particular concern to vulnerable populations in complex humanitarian emergencies and refugee camps. The point prevalence of virus-infected rodents is reported in many refugee camps. Our goal is to resist any rodents from entry.
Target: block rodents from entering

Anti dust

We focus on camps located in exposed areas. Often, these are arid or semi-arid regions where sand and dust is excessively prevalent. Sandstorms in these regions are common. Our goal is to drastically reduce dust from entering (compared to the common tents).
Target: dust repellent fabrics and double entry

CHALLENGE IV: **DURABILITY**

Community involvement

Community involvement or the participatory approach is promoted in many organisations in order to ensure that the beneficiaries (refugees) have a sense of ownership. Emergency response requires a quick erection of the structure. The maggie is designed to do that, while allowing the filling with insulation at a later stage. Both the erection and the filling up of the shelter are activities that allow community engagement. A micro income generating programme can be set up when more shelter units are deployed.
Target: allow various community engagement

Energy Friendly

The energy cost to heat a tent is far more important than the initial cost of a tent. A study in Mongolia shows that more than 30% of the disposable income goes to coal to heat the donated shelters. But heating also comes with an important cost to the health (many burn anything such as plastic to keep warm) and the environment (organic materiales are collected in the area to burn).
Target: design an energy efficient shelter (heating, cooling, lighting, ventilation)

Eco friendly

The ecological requirements are twofold; the choice of materials and the impact on the environment. All materials are conform the EU legislation and cause no harm to the refugees or the environment. We advocate natural or recycled materials for the insulation. The materials can be re-used after the end of their shelter life. The impact on the environment is explained in the previous challenge.
Target: longevity of shelter, re-useability of individual parts, avoid the use of hazardous materials.

Life span

Tents have a limited life span (between 6 and 12 months on average). Refugees remain in camps for 11,8 years on average. Many camps have a second, third or even fourth generation of refugees, meaning durable shelters are needed. Our goal is to design a shelter that can last 15 years (exposed, intensive use). We use materials, elements and techniques that are commonly used in the industry and that have proven to be durable.
Target: 15 years of intensive use in harsh environment

Local repairability

Local repairability is a strong criteria, demanded by the leading agencies. It means, can you repair the shelter easily with local tools, skills or materials, should there be damage? That also implicates that the construction materials chosen, should be standard elements found in most regions so that they should easily be replaced if needed.
Target: allow for easy repair using local materials and/or tools.

The focus in the humanitarian world has been mainly on emergency response. Tents are central to the emergency response. Most tents have a short life span. But refugees remain in camps for an average of 11,8 years. There is thus an important need for temporary durable shelters.

Photo: © Daniel Demoustier

Photo: © Peter Casaer

CHALLENGE V: **ADAPTABILITY**

Different climates

Many refugee camps are located in extreme climates where temperatures can drop as low as -15°C and rise till +45°C in opposite seasons. Equally, the variance in temperatures between day and night are often high.
Target: 1 generic model that can be easily adapted to the specific climate requirements.

Different purposes

We are focussing on 4 purposes; schools, community centers, medical wards and temperature controlled warehouses. In order to remain economical, we had to design the shelter so that it was highly generic.
Target: 1 generic model for serving different purposes.

Modular combinations

Our modular approach allows shelters to interconnect and positioned in various formations. This allows for instance for men to be separated from women, separate age groups, different purposes, barriers and to provide high security.
Target: allow for shelters to connect seemingly, allow different formations.

Local upgradeability

Local upgradeability is the requirement to improve or make the shelter more adequate, using local materials. This is a requirement that shelter experts indicated as "important". An example is the need for shelves wich was on the wish list of both medical staff, school teachers and the refugees.
Target: cater for shelves, extra safety & lighting, space dividers (drapes), floor elements, ..

Compact transport

The cost of transport is an important element. Many refugees camps are located in remote places where there is little economic activity. Hence, transport costs are high and logistics complex. The weight and volumetric weight of the elements have to remain low should it travel by air and optimised should it travel by container (multi-modal). The mode of packaging (e.g. dimensions) is taken into account during the design face.
Target: fit at least 6 shelters into 1 x 40 foot container.

We researched where most refugee-camps are located. We noted that most are located in arid, semi-arid, equator (tropical) and mediterranean regions. Altitude is also an important factor. Every climate has individual challenges. Our goal is nothing less than the design of an ingenious shelter that can be adapted easily to the different climates and also to the great variance in temperatures throughout seasons or day and night. Adaptibility also requires us to design the shelter so it can cater for different purposes, allow a variety of combinations (inter-connectivity) and allow upgrades with local materials when required.

This list of criteria is not complete. Is it an overview of the main elements we considered during the development. We are confident that we comply and often exceed all of these criteria, though the need for further optimisation, testing and field-testing remains pertinent.

Photo: © Peter Casaer

maggie
DMOA Architects & Engineers

LET’S BUILD OPPORTUNITIES

THE maggie

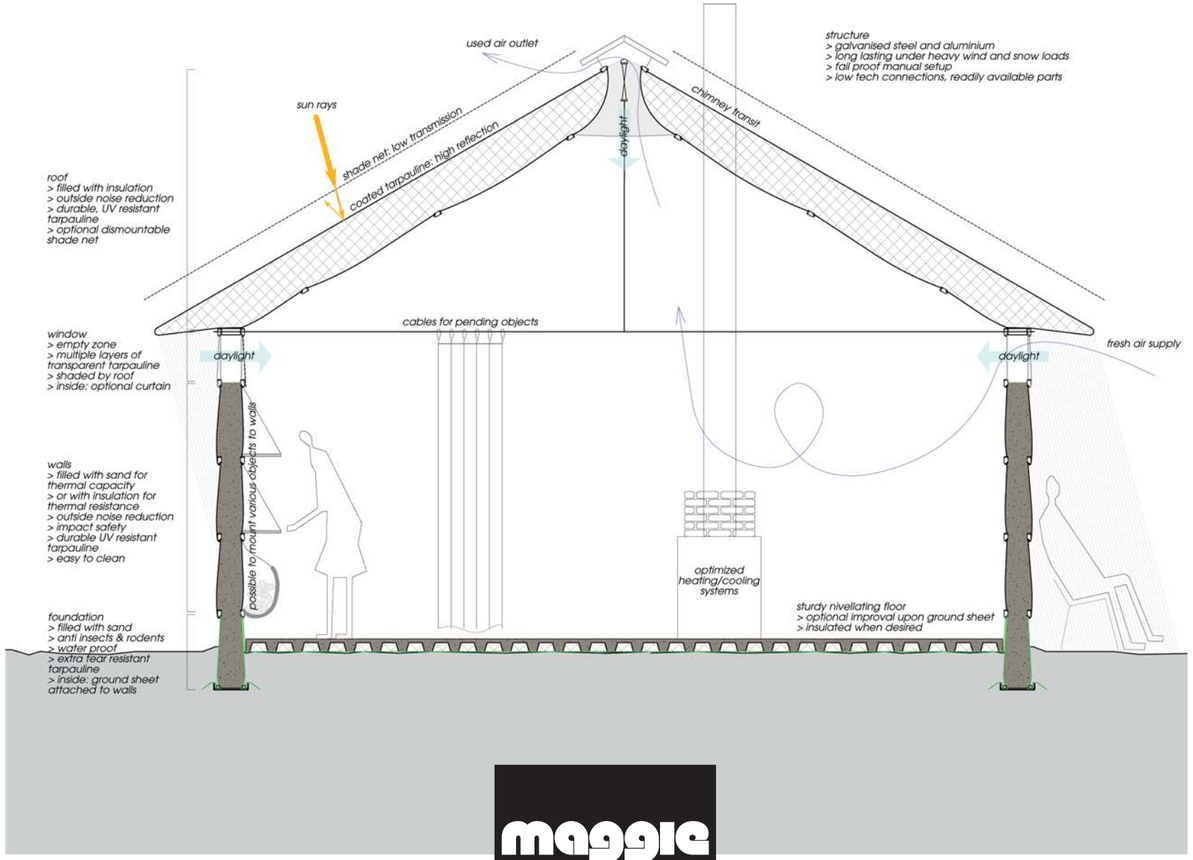
Goal: Provide a sustainable, relatively low-cost solution that alleviates discomfort and unnecessary suffering to refugees and that empowers refugees to self-reliance and choice.

Role of the maggie: The maggie is the medium that provides a shelter & comfort zone, where better access to health and education is facilitated.

Method: We will deliver the maggies through a public-private-partnership programme that includes international aid organisations and private partners.

UNIQUE SELLING PROPOSITION:

- The Maggie outlives a tent many times, bringing the cost of ownership well below the cost of a tent.
- The Maggie provides good protection against intruders, insects and rodents.
- The Maggie delivers a high comfort (smart temperature control, ventilation, daylight, ..) and is energy efficient using free available materials.
- The Maggie is addressing the shortcomings of tents while remaining a temporary construction.
- The shelter is designed to be erected quickly (emergency response) while the insulation can be added later at a more convenient time.
- The maggie is upgradable over time to a high-insulated temporary & removable construction.



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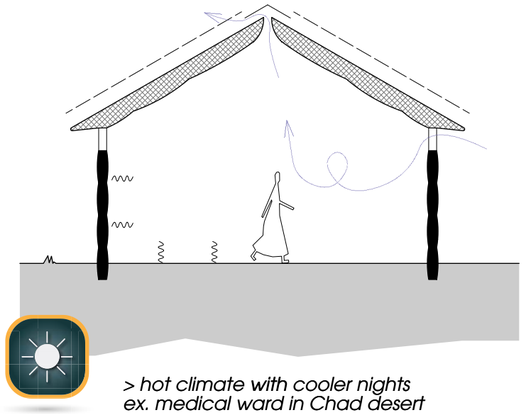
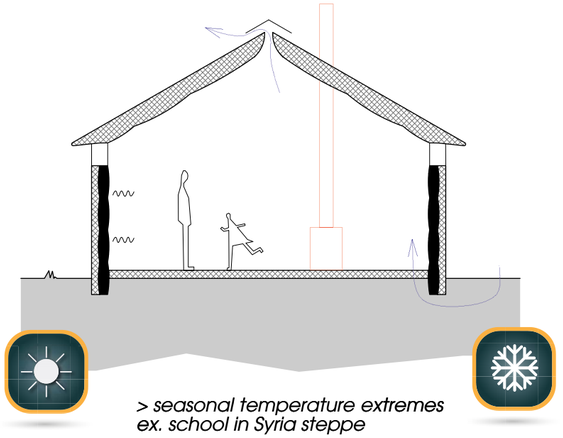
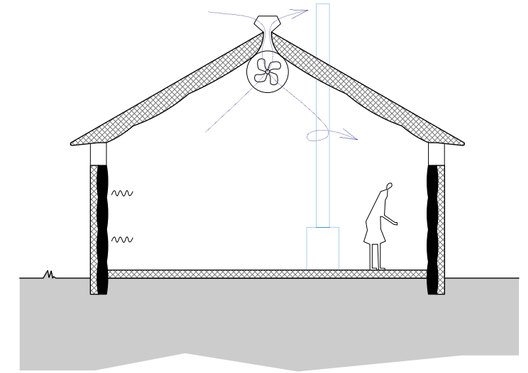
LET'S BUILD OPPORTUNITIES



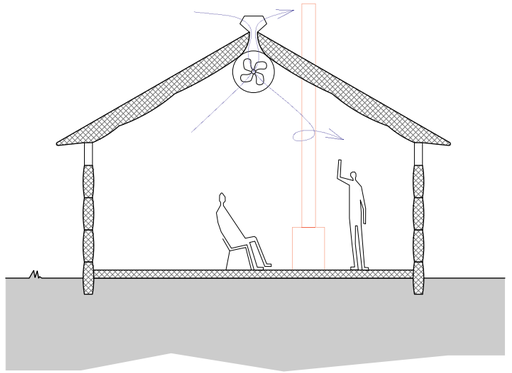
> hot climate with cooler nights
ex. medical ward in Chad desert



> seasonal temperature extremes
ex. school in Syria steppe



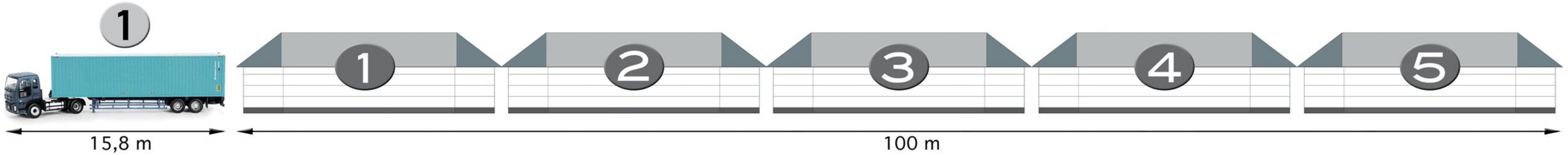
> climate controlled, permanent occupation
ex. temperature controlled warehouse in tropical Congo



> climate controlled, occasional occupation
ex. community center in Pakistan mountains

COMPACT TRANSPORT

1 x 40’ container can carry 5 maggies or about 100 meters of high-insulated schools, medical wards or warehouses



MODULAR COMBINATIONS

LOCAL INSULATION MATERIALS

The maggie can adapt to different climates and seasons. The thermal capacity or insulation is obtained through the use of free available materials that can be found everywhere; sand, organic materials, plastic waste or existing insulation products.

SAND & EARTH

ORGANIC

RECYCLED WASTE

INSULATION PRODUCTS

WHY DMOA GOT ENGAGED?

DMOA is a Belgian Architect and Engineering company specialised in distinguished housing and constructions, combining the use of innovative materials with traditional craftsmanship.

The quest for innovation is in line with DMOA strengths and day-to-day business; combining and project-coordinating various disciplines into a thoughtful and efficient durable construction.

But the Maggie program is also close to our hearts. We are fathers too and we feel strongly that we have a duty to transmit our knowledge and expertise to those organisations that are dedicated to the most unfortunate.

The development was quite a challenge. In this document you will find all criteria that we gathered through the input of various shelter experts. The technical people will certainly understand the various engineering challenges we had to endure in order to create this first prototype. Most of our choices for the materials are made upon experience, industry best practices and simulations. The prototype will allow us to evaluate and test the many requiremets so we can proceed to the proff-of-concept stage.

Benjamin Denef & Matthias Mattelaer, owners of DMOA Architects & Engineers

I was delighted when they asked me to take on the design of the maggie. I was following social profit engineering initiatives for years and was keen to engage my knowledge and skills as Civil Engineer to a cause that has a social impact.

I too became emotionally attached to the maggie through my many sketches, 2D, 3D models, research and simulations. We did many trials. Often, it was straight back to the drawing board because it wasn't quite right. The simpler the product has to be, the harder it is to get it right. Our challenge was certainly the optimisation of the shelter; using the least possible materials without neglecting the overall strength, simplicity and comfort of the shelter.

During the development, a small human being started growing in my belly. My child will have the privileges of the western world but I know that the passion I put into this project will make a difference for those kids that were less fortunate.

Inge Stuyckens, Technical Lead The Maggie

"We want to invite everybody to join our program. Together, we can make a difference."

THOSE THAT HELPED TO MAKE IT POSSIBLE

FUNDING & MARKET GUIDANCE

iwt
agentschap voor Innovatie
door Wetenschap en Technologie

innovatiecentrum

RESEARCH & KNOWLEDGE EXCHANGE

CEN TEX BEL

phyb
building physics research & consultancy

KU LEUVEN

STRUCTURE & ENGINEERING

bvba VERVAEKE spri

VERMAKO
PLASTIC GREENHOUSES

paridaens
ingenieurs

flandria
ALUMINIUM EXTRUSIONS

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Location & support: KULeuven - Dept Civil Engineering
Pictures & film: Peter Casaer, Daniel Demoustier

PRO5
COMMUNICATION

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maggie

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