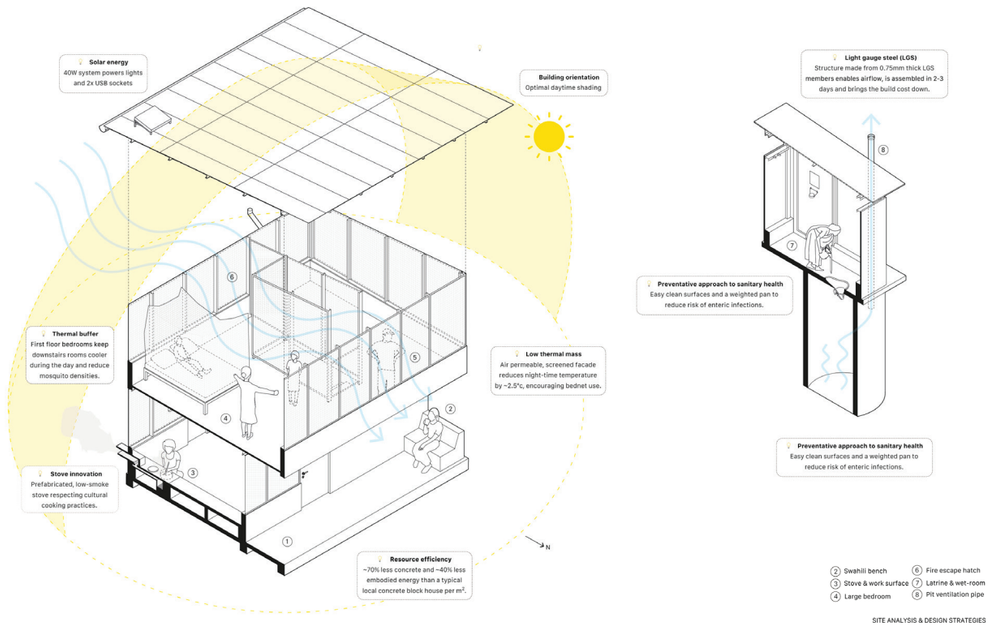
The Star Homes Project
Mtwara Region, Tanzania

110 houses to improve family health built across 60 villages in Mtwara, Tanzania



② Swahili bench
③ Stove & work surface
④ Large bedroom
⑥ Fire escape hatch
⑦ Latrine & wet-room
⑧ Pit ventilation pipe

SITE ANALYSIS & DESIGN STRATEGIES

The Star Homes Project explores ways of developing low-cost, comfortable and durable insect-proof housing to enhance the health of people in rural areas of Sub-Saharan Africa. Led by an interdisciplinary team of architects, public health specialists, and entomologists, the house design combines a series of novel interventions on a single home that improves the family's living conditions. The project consists of 110 identical, single family 'Star Homes' constructed across 60 different villages in rural Mtwara, one of the more underdeveloped regions of Tanzania, with a high incidence of malaria, respiratory tract infections, and diarrhoea. These houses form the basis of a trial, which aims to provide robust data to show whether improved housing can improve family health.

A detailed process was undertaken to select the recipients and location of the Star Homes. In 2019, prior to the start of the construction, a survey of the rural villages in Mtwara was conducted. Households that wanted to participate and met the study inclusion criteria (such as having children under 13 years of age in the household) could enter a lottery to win a Star Home built on their land. The lottery was conducted in an open and transparent manner to select the recipients.

Scientific Study

Following the construction of all 110 Star Homes in June 2021, families moved in and began participating in the trial, in which children under 13 years sleeping in the Star Homes and neighbouring traditional homes will be followed over a three-year period, to detect episodes of malaria, acute respiratory infections, and diarrhoea. Alongside the trial, a team of architects, entomologists and social scientists are assessing the performance and acceptability of the house design, using mixed methods involving in-depth interviews, focus group discussions, house walk throughs and a questionnaire-based surveys. Light traps are used to collect mosquitoes and flies in the Star Homes and the control homes, to assess the amount of malaria carrying mosquitos entering the houses. The study is due to be completed by the end of 2024.

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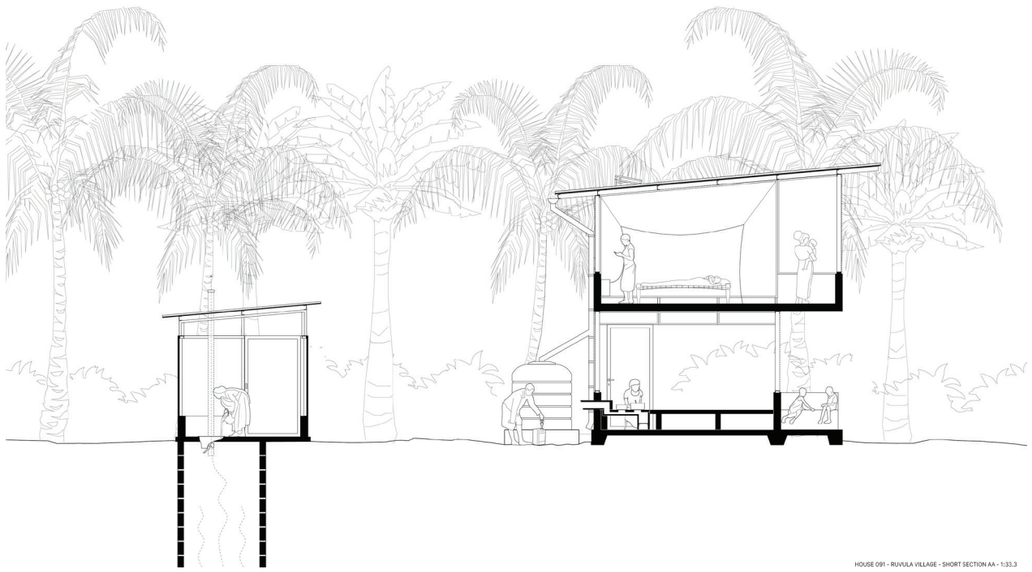
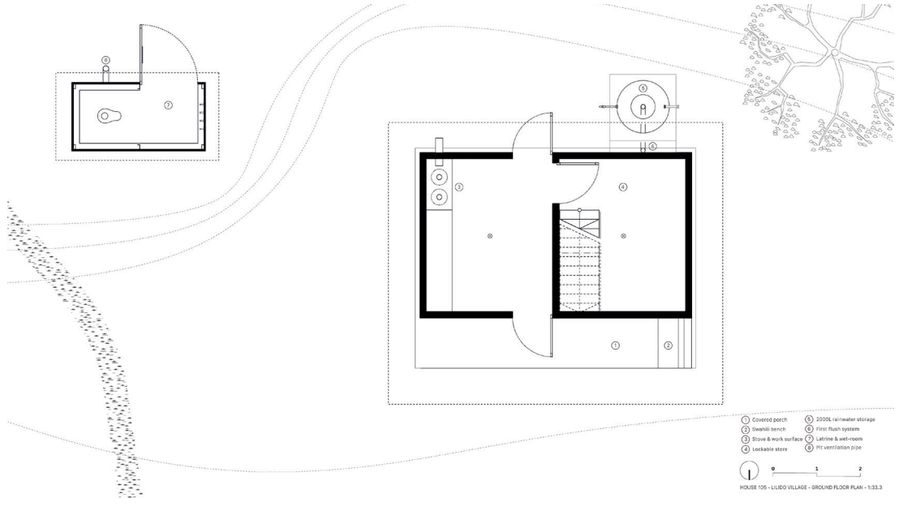
House modifications for preventing malaria

Unlike most rural Tanzanian housing, our prototype house is two stories high. This reduces the area of the foundation and roof, which are typically the most expensive and material intensive components of a house. Many houses in rural Tanzania collapse in the rainy seasons, which is often as a result of the poor quality of their foundations. Each Star Home is built on a raised concrete plinth, cast is a single pour to improve strength and backfilled with compacted earth from the latrine pit to reduce concrete use and the need for hardcore. The structural frame of each house is built using 0.75mm thick prefabricated light gauge steel (LGS) members bent in two directions for extra strength, assembled into panels which can be erected in under 2 days by a local team. Walls appear solid but are in fact hollow, consisting of two thin layers of cement render on wire mesh. The result is a home that uses 70% less concrete compared with a typical concrete block design and has 40% less embodied energy. Rainwater is collected from the roof and stored in a 2000L tank via a first flush system made from off the shelf components, which provides free clean drinking water.



Preliminary results indicate a 30-40% reduction in malaria for children living in the Star Homes.



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Project development and study

Star Homes Project prototype

The Star Homes Project has been in development for over a decade, exploring ways to develop novel, low-cost, comfortable insect-proof housing tohelp improve the health of people in rural areas of Sub-Saharan Africa.

Project development

The Star Homes have been designed to be easily scalable and to optimise the use of resources in a way that reduces their environmental impact and build cost.

Lottery

Households that wanted to participate and met the study inclusion criteria (such as having children under 13 years of age) could enter a lottery to win a Star Home built on their land.

110 Star Homes

110 identical, single-family Star Homes are constructed across 55 different villages in rural Mtwara.

110 families move in in 2021

Following the construction of all 110 Star Homes in June 2021, families moved in and began participating in the trial, in which children under 13 sleeping in the Star Homes and neighbouring traditional homes will be followed over a three-year period, to detect episodes of malaria, acute respiratory infections, and diarrhoea.

Scientific study 2021 - 2024

The primary clinical objective of the study is to assess over a follow-up period of three years whether living in a novel design house reduces the incidence of malaria in children compared to children living in traditional Sub-Saharan African homes.

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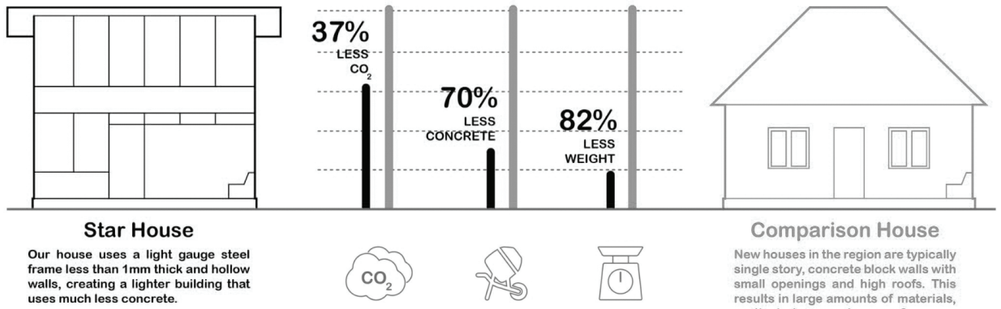
Emissions and Material Use

Per m², a Star Home* uses approximately 37% less embodied carbon and 70% less concrete. Given the significant housing demand in Sub-Saharan Africa in the coming decades, adopting similar construction methods could result in huge reductions in CO2, concrete production, and material transport emissions. The low operational energy and maintenance costs over its lifespan also unlocks time and resources otherwise spent on activities such as house rebuilding, dealing with preventable illnesses, and collecting water, which could enable families to lift themselves out of poverty long-term. In addition, all components and labour have been sourced from within Tanzania and constructed by a local team. Beyond the building's lifespan, the foundation can be reused and the LGS frame and facade panels can be reused or recycled.



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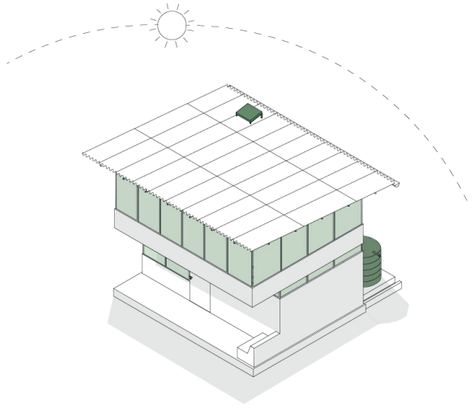
Health Interventions

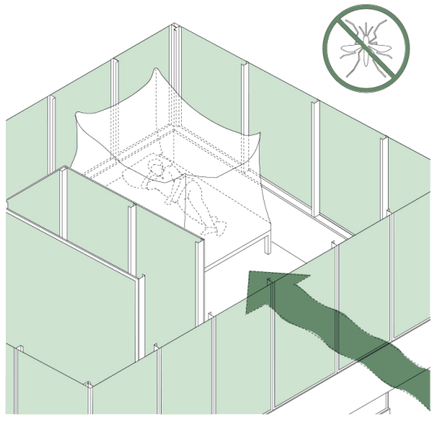


CLIMATIC DESIGN

The house is orientated to provide optimal shading throughout the day. Rainwater collection and a solar panel offer key amenities and ensure minimal operational costs over the lifespan of the house.

SCREENING OUT VECTORS

Screening openings minimises the intrusion of insects, with an aim to reduce the vector-bourne diseases such as malaria and dengue fever. Two self-closing doors protect the sleeping area.

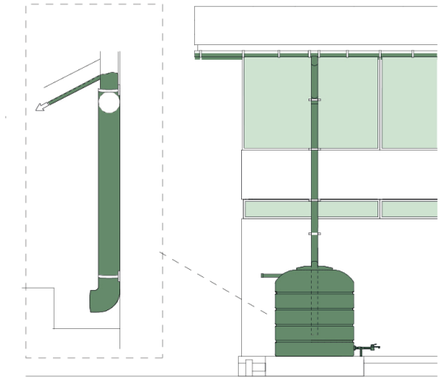


SAFER SLEEPING

Large permeable façades increase ventilation and decrease concentrated odour plumes which attract mosquitos. This reduces night-time temperature in the bedrooms by around 2.5 degrees and encourages bednet use.

HEALTHIER COOKING

Respiratory illness is an acute problem for women and children in Sub-Saharan Africa. A smokeless stove and well ventilated cooking area aims to improve indoor air quality. Surfaces are easily cleanable surfaces and raised ground floor.

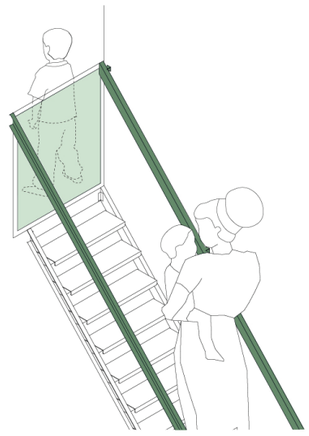


CLEANER WATER

Rainwater tanks are screened to reduce vector entry and breeding in the tank. A ‘first flush’ system to minimise dirty water from the roof entering the SIM tank.

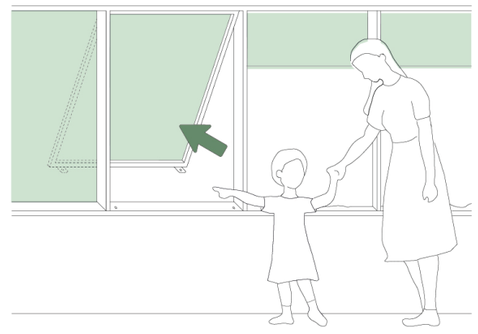
FLY - PROOF LATRINE

The latrine utilises a self-closing toilet pan and screened ventilation pipe to reduce flies breeding in the latrine pit. The latrine also provides a private area for the family to wash.



ACCESSIBLE FOR ALL

A child gate and low handrails help prevent children and the elderly falling on the stairs. The house also includes solar-powered lighting and a USB phone charger.



FIRE SAFETY

The house is designed to be safe in the event of a fire. This strategy combines fire-retardant materials and an escape panel on the first floor to ensure the family can exit the building quickly.

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Assessing the impact of a novel house design on the incidence of malaria in children

Between February and July 2021, each household was visited and the keys handed over to the new owners. During the visit, the house's features were explained and any questions answered. At the end of July, with research permits received, disease surveillance was due to start. However, a survey revealed that 11 households had not yet moved in and many more used their new houses inconsistently. Drawing on in-depth interviews with household heads and community leaders, and focus groups with community members, the research team set about trying to understand the reasons underpinning the reticence to take up residence in the Star Homes. The Star Homes project team undertook a responsive program of community engagement, including football and netball tournaments to disseminate information about the project. These experiences highlight the critical need for pilot studies to understand the expectations, fears and hopes of participants in specific contexts.

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Adequate, safe and affordable housing

The Star Homes Project was finalist at the UIA 2030 Award, a partnership with UN Habitat, in Category 3 for Adequate, safe and affordable housing, recognising projects which have contributed significantly to the provision of accessible, adequate, safe and affordable housing, urban regeneration and/or slum upgrading consistent with the principles underpinning Target 11.1 of SDG11.

An exhibition model, built on a 1:1 scale, showcasing the architectural elements and health interventions of a Star Home, as well as the spaces inside the house, was exhibited at the UIA World Congress of Architects in Copenhagen in 2023, as well as at the exhibition ADFÆRD / VELFÆRD - How Can Architecture and Design Improve Health and Welfare? at the Royal Danish Academy (15.09.2022 - 23.03.2023).

Constructed in wood instead of LGS, the model explores the possibility of adapting different building methods and materials with lower embodied carbon.

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Team

Jakob Brandtberg Knudsen is a principal of Ingvartsen Architects and the dean of architecture at the Royal Danish Academy – Architecture, Design, Conservation in Copenhagen, Denmark. His primary research interest is the implementation of science in bridging architecture and public health to make affordable, healthy and sustainable homes and institutions in tropical climates. Jakob has extensive experience in building practice in Europe, Asia and Africa, and is currently heading the Star Homes* Project.

Lorenz von Seidlein is a professor at the Mahidol-Oxford Tropical Medicine Research Unit (MORU), Faculty of Tropical Medicine of Mahidol University in Bangkok, Thailand. He attended medical school in Dublin, Ireland, and completed a pediatric residency in Miami, an Infectious Disease Fellowship at UCLA, and a PhD in epidemiology from the London School of Tropical Medicine and Hygiene. Between 1995 and 2000, he worked in The Gambia on the evaluation of antimalarial drugs in Sub-Saharan Africa. From 2000 through 2006, he managed wide-scale vaccine evaluation projects in Mozambique and Zanzibar on behalf of the International Vaccine Institute in Seoul, Korea. Since 2014, he has worked on malaria elimination, including the evaluation of malaria vaccine candidates at the Mahidol-Oxford Tropical Medicine Research Unit, Bangkok, Thailand, and has coordinated a trial of the malaria vaccine candidate RTS,S/AS01 in Tanzania. Since May 2020, Lorenz has been collaborating with Chinese colleagues on the evaluation of COVID-19 vaccine candidates, and is currently assessing the impact of housing improvements on health in Tanzania.

Salum Mshamu earned a Master of Medical Sciences major in Public Health (MPH) from Lund University, Sweden. He received a bachelor's degree in nursing from Muhimbili University of Health and Allied Sciences in Dar es Salaam, Tanzania, as well as a Postgraduate Diploma in Clinical Trials (PG-Dip CT) from the London School of Hygiene and Tropical Medicine and a certificate of global health effectiveness from Harvard School of Public Health. He has a special interest in housing and health, and is currently a co-principal investigator of a field trial assessing the impact of novel design houses in the prevention of diseases such as as malaria, respiratory tract infections and diarrhoea diseases. He is currently a PhD student at the Nuffield Department of Clinical Medicine at the University of Oxford, and serves as a director at CSK Research Solutions.

Otis Sloan Wood – On-site architect, Ingvartsen Architects
Otis is an architect from the UK, now based in Copenhagen, Denmark. He has worked on projects across Africa, Asia and Europe, exploring how the built environment can be designed to improve human and planetary health. Otis has a passion for using natural materials in innovative ways, and has worked on the design of a bamboo farmhouse, a hempcrete extension to a 300-year-old pub and co-founded House 4 House, an award-winning construction toy made from sustainable materials. In addition to this, he has also contributed to articles for a variety of academic journals and architectural short films under ArchiShorts.

Hannah Sloan Wood – On-site architect, Ingvartsen Architects
Hannah is an architect and educator with an interest in regenerative design and improving human and planetary health through the built environment. Her practice is driven by an interest in innovative solutions and a scientific curiosity and she recently coauthored academic papers in Cities & Health and PLoSMED journals, among others. Hannah has experience working in a range of global contexts, including three years in Tanzania, East Africa, and is currently based in Copenhagen, Denmark.

Steven Lindsay – Co-investigator, Entomology, University of Durham / Arnold Mmbando, Ifakara Health Institute

Jacqueline Deen – Co-investigator, child development, University of the Philippines

Arnold Mbando – Entomologist and Researcher, Ifakara Health Institute, Tanzania

Thomas Chevalier Bøjstrup – PhD fellow, Institute of Architecture and Technology, Royal Danish Academy

Hanako Foundation – Funder

Website: www.starhomes.wiki
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