From unplanned to planned urban settlements.
Housing solutions for environmentally-friendly cities in developing countries.

Author:
Viola Angela Polesello
Università Iuav di Venezia
vpolesello@iuav.it

1 | Introduction

Our world has been seriously damaged by unsustainable development and extensive consumption, with important consequences like declining biodiversity, degraded land and soil, depleting natural resources, polluted air and water, and severe climate risks.
Rapidly growing urban population and the effects of climate change place added pressure on the economic, environmental, and social health of cities.
Indeed, society has to rethink urban areas through evolving resource efficiency in cities with increased focus on planning and making social and economically attractive places, well-functioning spatial structures and energy efficient systems.
Buildings can play a fundamental role in order to contribute to energy efficiency and lower energy use in urban areas, improving the local economy and the living conditions, particularly for low-income communities of developing countries, where the majority of people lives in informal settlements in extreme poverty conditions.
After a first analysis of the current link between buildings, urban areas and pollution levels due to the current energy consumption, focusing on the bad quality of life and the multiple risks in the cities of developing countries, the research shows how can be possible building sustainable housing, and thus cities, also in developing countries (through a case-study based in Nairobi, Kenya). This can be possible with simple project interventions according to natural climate and local resources, i.e. local materials, local know-how, thermal comfort inside homes, orientation, avoiding oversizing, natural lighting, good air quality (passive and bioclimatic design). In this way, people living in poor conditions can develop simple low-cost ecological settlements with basic living conditions provided, achieving not only better local living conditions, but also playing a role in the creation of liveable, affordable and prospering cities in a world context.
Access to adequate and affordable housing for poor people can be achieved: it will require governments to shift away from the current unplanned urban context to integrated policies able to increase housing supply and reduce housing cost, thanks to simple changes in the construction methods, to create environmentally-friendly cities with sustainable housing for all.

2 | Urban growth: current situation and perspectives

There has been a phenomenal shift towards urbanization in recent years, with over half the world's population currently living in cities. Many cities are facing serious challenges in managing rapid urbanization. Almost one billion people currently live in slums.
By 2030, UN-Habitat estimates that 3 billion people will need access to adequate and affordable housing. The negative effects of rapid, unplanned urbanization include lack of proper housing and growth of slums, inadequate and outdated infrastructure, escalating poverty and unemployment, safety and crime problems, pollution and health issues, as well as poorly managed natural or man-made disasters and other catastrophes.

At the same time, sustainable urbanization can be a key contributor to poverty reduction. It has contributed to lifting more than 700 million people out of poverty in the last 15 years, more than 70% of them from rural areas moved to urban ones.
Today cities generate around 70% of global GDP and their growth of cities can be turned into opportunities that will promote equality and leave nobody behind.
Millions of people have been moved out of substandard living conditions and given adequate housing. Between 2000 and 2014, the proportion of the world's urban population living in slums declined by 20% to 22.8%.
However, population growth and migration meant those living in slums increased from 807 million to 883 million during that time (UN-Habitat 2018).
Thus, housing affordability has become a global crisis, affecting people in low and high-income countries: critical challenges around housing such as affordability, slums and inequality have negatively affected people's lives and the sustainability of cities.
As countries rapidly urbanize, the issue of sustainable urbanization becomes crucial since unplanned urbanization will constrain the future sustainable development of cities, as well as their vulnerability and their less carbon intensive and more resilient future.

3 | Urban poverty: the proliferation of slums

Urban areas in both developed and developing countries will increasingly feel the effects of phenomena such as climate change, resource depletion, food insecurity and economic instability. These are all factors that will significantly reshape cities in the century ahead and all of them need to be effectively addressed if cities have to be sustainable, that is, environmentally safe, economically productive and socially inclusive (UN-Habitat 2003).
However, cities in all parts of the world are very different places.
Cities and towns in developing countries face numerous challenges, including large proportions of people living in slums; expansion and dominance of the informal sector; inadequate basic services, especially water, sanitation and energy; unplanned peri-urban expansion; social and political conflict over land resources; poor mobility systems; and high levels of vulnerability to natural hazards.
It is know that a house is considered as "durable" if it is built on a non-hazardous location and has a structure permanent and adequate to protect its inhabitants from the risks of climatic effects such as rain, heat, cold, and humidity. Instead, the urban poor build their houses of weak, inadequate materials, often against hillsides that are subject to landslides during heavy rains. This also means that when an extreme natural event happens, slum dwellers lost completely a place to live.
By 2030, around 3 billion people will need proper housing and access to basic infrastructure and services like water and sanitation systems. This translates into the need to complete about 96,150 housing units per day from now until 2030 (UN-Habitat 2003).
The proliferation of slums and a chronic lack of adequate housing represent the major challenges of urbanization today. Slums, informal settlements and inadequate housing remain the visible manifestations of poverty and inequality in cities.

4 | Housing affordability in developing countries: how to?

According to UN-Habitat (2012b), housing is one of those basic social conditions that determine the quality of life and welfare of people and places.
It is important to consider that housing is more than just houses, especially for people living in slums in unsustainable and unsafety conditions.
Where homes are located, how well designed and built, and how well they are weaved into the environmental, social, cultural and economic fabric of communities are factors that

influence the daily lives of people, their health, security and wellbeing, and which affect both the present and future generations.
Housing is therefore central to sustainable development: this means that design according to the prevailing climatic conditions is crucial, in order to achieve sustainable housing and energy use reduction. Thus, building sustainable housing means developing sustainable settlement planning strategies for sustainable urban projects.
At local level, settlement patterns and urban design solutions should be adjusted to the prevailing climatic conditions including wind and sun light conditions: in hot climates, winds are important for ventilation, while sun is important to protect houses from winds and allow sunlight exposure during winter months in cold ones.
Placing of buildings, density of the settlement patterns, landscaping and location of vegetation can be used to both direct and protect from winds and to shade or allow sun distribution.
Building orientation, form and envelope (color, thermal mass, and shading) contribute towards creating a locally appropriate *passive design* strategy, which uses natural climate, material properties and physical laws to protect settlements through bio-climatic design and climate specific settlement planning. For example, sustainable building materials have a minimal impact on the environment and on occupant health, and use less energy than conventional materials over the entire lifecycle of the product (i.e. harvesting, production, transportation, construction, maintenance, demolition, recycling).
Some basic considerations when choosing sustainable materials are local availability, durability, workability, structural capacity, embodied energy, thermal performance, affordability, prevention of disaster risk, impact on indoor air quality and health, recyclability, installation and maintenance requirements.
In addition, building services can save significantly over the life of the housing, even if, for the moment, these technologies can be achieved only thanks to international or local funds and support. Building services include provision for plumbing, sanitation, drainage; fuel for lighting, appliances, cooking; energy generation; heating and cooling systems where necessary; renewable technologies.
In developing countries, where the majority of urban population still living in informal settlements, *passive design* strategies can reduce energy consumption and ensure comfortable accommodation with simple project interventions, in which local communities should be involved to reduce housing costs.

5 | Case study. Low-cost ecological living settlements in Kenya, Nairobi

The case study, developed for the city of Nairobi (Africa), aims to show how high thermal mass – to benefit of solar gain and, at the same time, to lay the house cooler during the hottest periods –, best orientation of house – to maximize the positive effects of local climate and sun position during the whole year –, together with a simple study of windows – to increase the gain of natural lighting and ventilation during the day – can exemplify possible and simple design methods, which are flexible and adaptable to different places. Thanks to low-cost solutions, slum dwellers and their communities can be helped in the construction of sustainable and affordable housing.
The case study starts from the analysis of the local climate to understand the main possible design strategies. Then, it shows five design options, starting from the base configuration to end with the best one in terms of housing energy savings and ecological living conditions. Results are based on the application of the European Standard EN 15251:2007, assuming that people have many adaptive opportunities, depending on the outside temperatures and the locale climate through the year.
Examples include:

People

- Dress code

- Furniture type
- Consumption of hot/cold drinks
- Metabolic rate/posture

Building

- Openable windows
- Operable blinds
- Local fans
- Spatial variations (i.e. benefit from solar radiation or a cooling breeze).

Adaptive comfort temperatures are based on outside temperatures during the preceding few days and are calculated through the *external running mean temperature* [T_{rm}]: this is defined as the exponentially weighted running mean of the daily mean external air temperature [T_{ed}], calculated from the formula:

$$T_{rm}= (1 - \alpha_{rm}) [T_{e(d-1)} + \alpha_{rm} T_{e(d-2)} + \alpha_{rm2} T_{e(d-3)} + \alpha_{rm3} T_{e(d-4)} + \alpha_{rm4} T_{e(d-5)} + \alpha_{rm5} T_{e(d-6)} + \alpha_{rm6} T_{e(d-7)}],$$

Where:

T_{rm} = running mean temperature for today

T_{rm-1} = running mean temperature for previous day

T_{ed-1} is the daily mean external temperature for the previous day

T_{ed-2} is the daily mean external temperature for the day before and so on

α is a constant between 0 and 1 and it is recommended to use 0,8.

The allowable indoor operative temperatures are then plotted against the *external running mean temperature* T_{rm}.

The indoor adaptive comfort temperature is the temperature at which most people will be comfortable. It varies on a day-to-day basis according to the outdoor temperature over the previous few days, i.e. in warm weather. It will be higher than in cooler conditions.

The comfort temperature band is the range of temperature conditions within which the great majority of people will be adequately comfortable.

This is a wider range than 'ideal' conditions and would tend to encompass feelings such as *a little warm* or *a little cool*, but acceptable.

Suggested comfort bands regarding to the indoor adaptive comfort temperatures are calculated using the following equations as result of three different categories:

CATEGORY I (high level of expectation)

Upper limit: $T_{o\,max} = 0{,}33 \cdot T_{rm} + 18{,}8 + 2$

Lower limit: $T_{o\,min} = 0{,}33 \cdot T_{rm} + 18{,}8 - 2$,

CATEGORY II (normal expectation)

Upper limit: $T_{o\,max} = 0{,}33 \cdot T_{rm} + 18{,}8 + 3$

Lower limit: $T_{o\,min} = 0{,}33 \cdot T_{rm} + 18{,}8 - 3$,

CATEGORY III (a moderate expectation)

Upper limit: $T_{o\,max} = 0{,}33 \cdot T_{rm} + 18{,}8 + 4$

Lower limit: $T_{o\,min} = 0{,}33 \cdot T_{rm} + 18{,}8 - 4$,

Where

T_o = limit value of indoor operative temperature, °C

T_{rm} = running mean outdoor temperature.

These limits apply when $10 < T_{rm} < 30°$ *C for upper limit and* $15 < T_{rm} < 30$ *°C for lower limit.*

As follows, the results from calculations with the use of climate tools and building environmental assessment and modeling software, according to the European Standard EN 15251:2007 criteria and formula, applying to the poor urban context of Nairobi, Kenya.

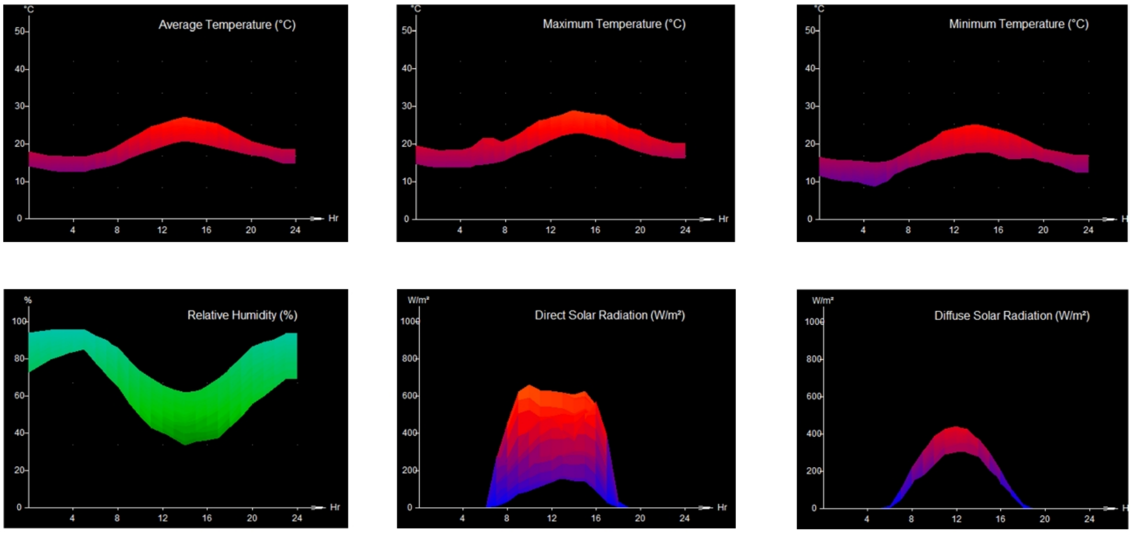


Figure 1 | *Design with climate in Nairobi: weather data (Calculations with Weather Tool – Ecotect).*

TEMPERATURE (C°)

C°/MONTHLY DATA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AVERAGE TEMPERATURE	19.2	20.5	20.8	19.5	18.6	17.8	16.6	17.2	18.1	19.4	18.7	18.8
MAXIMUM TEMPERATURE	29.0	29.9	29.2	27.3	25.6	26.3	25.5	24.4	27.3	29.2	26.8	24.8
MINIMUM TEMPERATURE	10.4	8.2	12.6	15.0	12.2	11.4	8.0	9.3	8.0	8.6	13.2	14.2

RELATIVE HUMIDITY (%)

%/MONTHLY DATA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
9:00 AM	65	56	65	78	77	77	78	73	67	65	68	74
3:00 PM	40	37	39	59	62	60	58	52	46	39	52	53

DAILY SOLAR RADIATION (Wh/m^2)

Wh/m^2/MONTHLY DATA	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SOLAR RADIATION	7701	8075	7048	5211	5093	4960	4403	3960	5880	6211	5694	7013

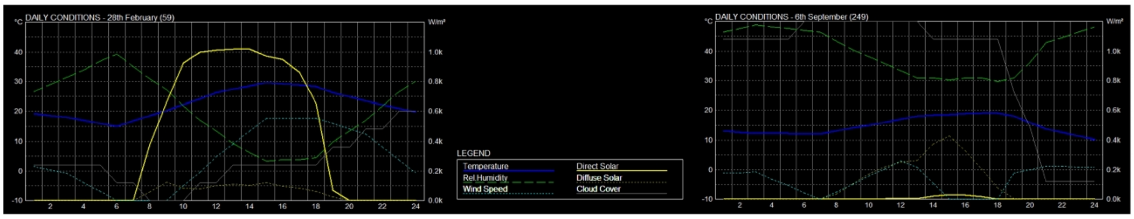


Figure 2 | *The graphs above underline the direct solar radiation (Wh/m2) during the hottest day of the year (28 Feb) and the coolest one (06 Sep) in Nairobi, the average of temperature (C°), as well as changes in relative humidity (Calculations with Weather Tool –Ecotect).*

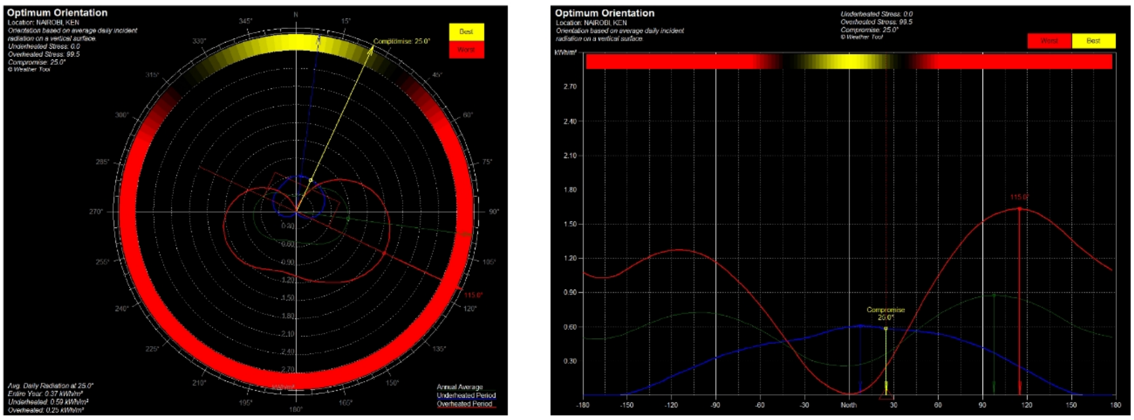
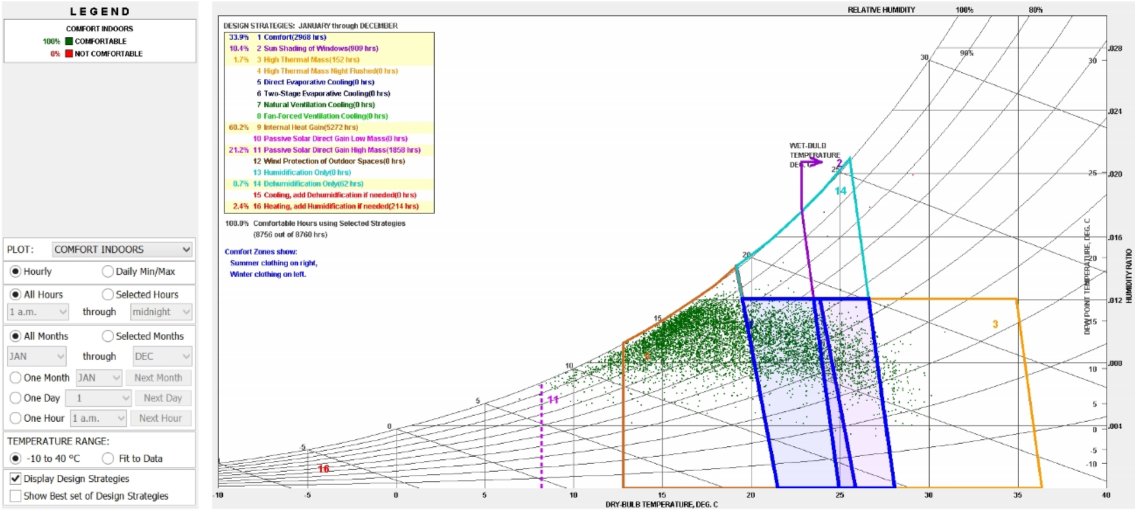


Figure 3 | *The diagrams show how a rectangular house should run East-West to maximize the length of the Northern side, where should also incorporate openings or windows. A roof overhang or the use* *of vertical and modular sunscreen can shade the openings to minimize the heat gain during the hottest period. The diagrams also exemplify the ideal orientation of housing in Nairobi, which is up to 25° East of solar North (Calculations with Weather Tool – Ecotect).*



BEST DESIGN STARTEGIES FOR NAIROBI	INTERNAL HEAT GAIN	COMFORT	PASSIVE SOLAR DIRECT GAIN HIGH MASS	SUN SHADING OF WINDOWS	HEATING	DEHUMIDIFICATION
%	60.2	33.9	21.2	10.4	2.4	0.7

Figure 4 | *Best passive design strategies for housing upgrading in Nairobi (Calculations with Climate Consultant 6.0).*

Starting from the climate analysis and the results in terms of best passive design strategies for housing in Nairobi, the following options show how, through simple building solutions and methods, poor people of informal settlements can have affordable and safe housing, well planned and able to deal with the effects of climate change.
The right orientation and the use of eco-friendly materials, available on site, can provide lower cost and basic services, less energy, and can maximize the benefits of agglomeration.

OPTION 1

ROOF
MATERIAL: CORRUGATED METAL SHEET
CONDUCTIVITY: 0,290 W/mK
DENSITY: 1250,00 Kg/m³
WALLS
MATERIAL: CORRUGATED METAL SHEET
CONDUCTIVITY: 0,290 W/mK
DENSITY: 1250,00 Kg/m³
WINDOWS
LAYOUT: NO GLAZING (generally with plastic sheet, scrap plywood, metal grid)

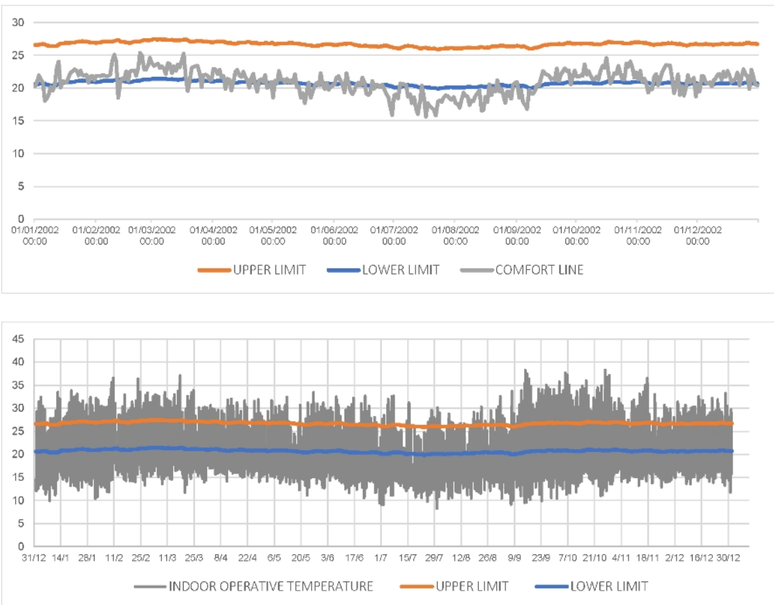


Figure 5 | *Current situation (Calculations with Design Builder and UNI EN 15251).*

OPTION 2

ROOF	
MATERIAL: CORRUGATED METAL SHEET	
CONDUCTIVITY: 0,290 W/mK	
DENSITY: 1250,00 Kg/m³	
WALLS	
MATERIAL: EARTH WALL (ADOBE)	
CONDUCTIVITY: 0,460 W/mK	
DENSITY: 1500,00 Kg/m³	
WINDOWS	
LAYOUT: NO GLAZING (generally with plastic sheet, scrap plywood, metal grid)	

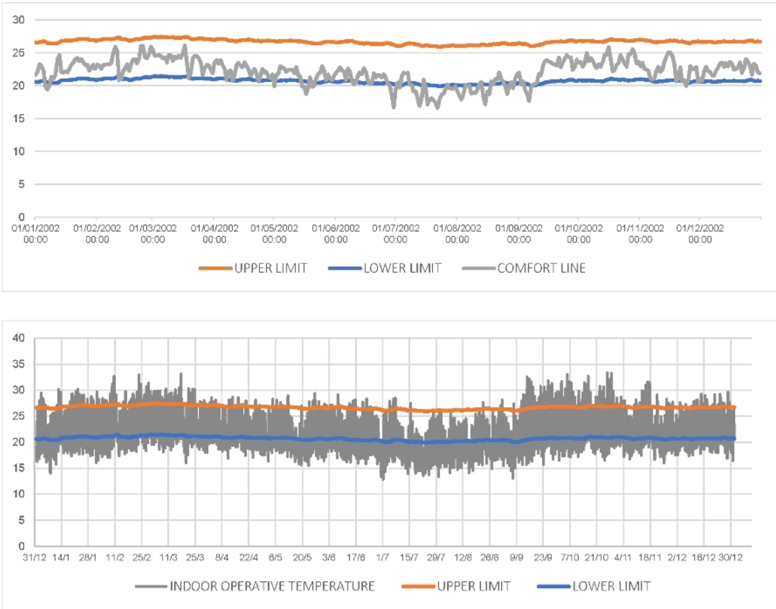


Figure 6 | *Earth wall (20 cm) and corrugated metal roof (Calculations with Design Builder and UNI EN 15251).*

OPTION 3

ROOF: MATERIAL + INSULATION	
CORRUGATED METAL SHEET	RECYCLED MATERIAL
CONDUCTIVITY: 0,290 W/mK	CONDUCTIVITY: 0,034 W/mK
DENSITY: 1250,00 Kg/m3	DENSITY: 40,00 Kg/m³
WALLS	
MATERIAL: EARTH WALL (ADOBE)	
CONDUCTIVITY: 0,460 W/mK	
DENSITY: 1500,00 Kg/m³	
WINDOWS	
LAYOUT: NO GLAZING + VERTICAL WOOD SUNSCREEN (angle: 15°)	

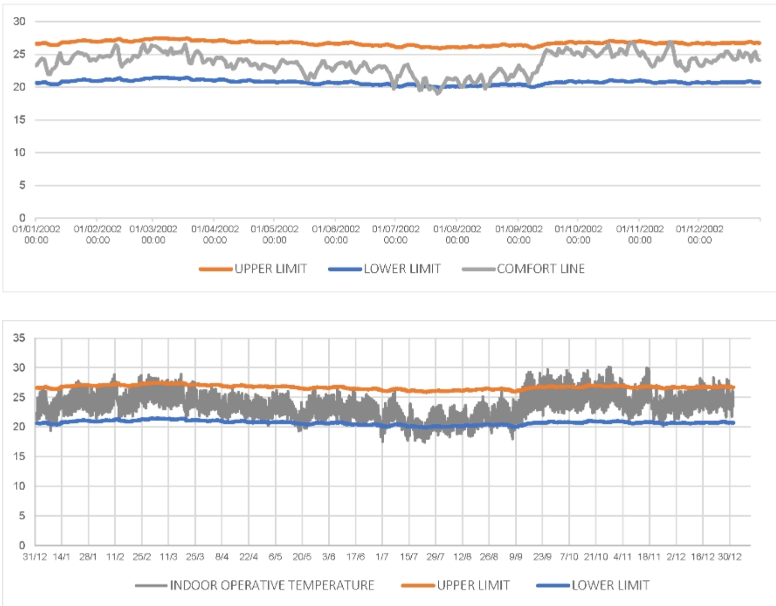


Figure 7 | *Earth wall (30 cm), roof with insulation (8 cm) and vertical sunscreen (Calculations with Design Builder and UNI EN 15251).*

The results above show how the third option can yet improve the existing condition of poor housing in Nairobi, using adobe walls of 30 cm, insulating the roof made of corrugated metal sheet with recycled materials available on site, and using vertical wood sunscreen for windows.

The poorest area of the city is rarely reached with water supply and electricity, with many houses manually build, where people live in poor and overcrowded slums, built with bad materials and approximate techniques, without basic living conditions provided. Starting from this situation, OPTION 3 shows that a better situation in terms of energy savings and sustainable living conditions can be achieved thanks to simple adjustments, design strategies and project interventions at the lowest cost, in order to contribute to the creation of efficient, inclusive and clean cities worldwide.

OPTION 4

ROOF: MATERIAL + INSULATION	
CORRUGATED METAL SHEET	RECYCLED MATERIAL
CONDUCTIVITY: 0,290 W/mK	CONDUCTIVITY: 0,034 W/mK
DENSITY: 1250,00 Kg/m3	DENSITY: 40,00 Kg/m³
WALLS	
MATERIAL: EARTH WALL (ADOBE)	
CONDUCTIVITY: 0,460 W/mK	
DENSITY: 1500,00 Kg/m³	
WINDOWS	
LAYOUT: DOUBLE CLEAR GLASS 3/13 mm Air	

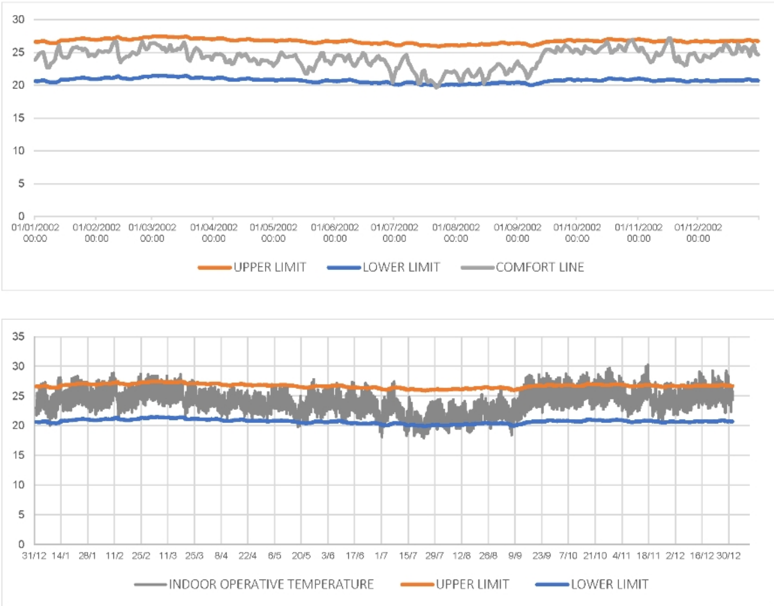


Figure 8 | *Earth wall (30 cm), roof with insulation (8 cm) and glazing (Calculations with Design Builder and UNI EN 15251).*

OPTION 5

ROOF: MATERIAL + INSULATION	
CORRUGATED METAL SHEET	RECYCLED MATERIAL
CONDUCTIVITY: 0,290 W/mK	CONDUCTIVITY: 0,034 W/mK
DENSITY: 1250,00 Kg/m3	DENSITY: 40,00 Kg/m³
WALLS	
MATERIAL: EARTH WALL (ADOBE)	
CONDUCTIVITY: 0,460 W/mK	
DENSITY: 1500,00 Kg/m³	
WINDOWS	
LAYOUT: DOUBLE CLEAR GLASS 3/13 mm Air + VERTICAL WOOD SUNSCREEN (angle: 15°)	

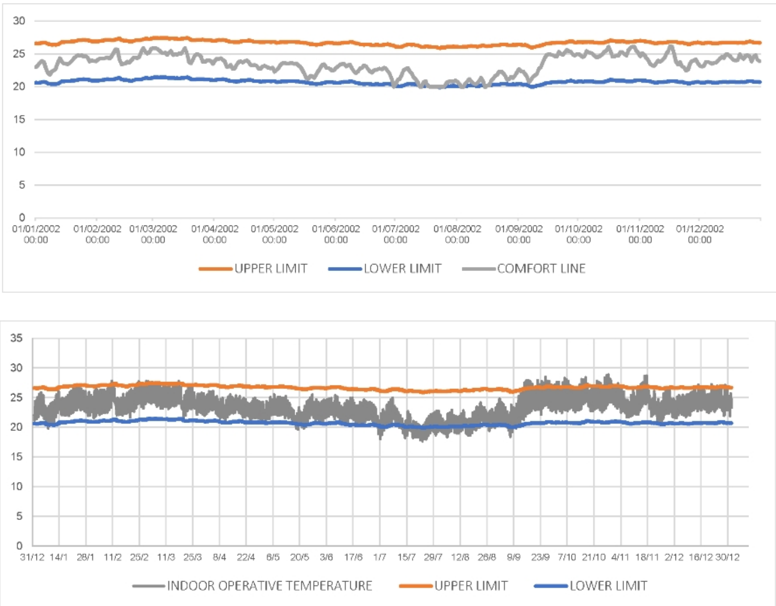


Figure 9 | *Earth wall (40 cm), roof with insulation (8 cm), glazing and vertical sunscreen (Calculations with Design Builder and UNI EN 15251).*

Green housing design requires careful consideration of often overlooked design steps such as building orientation, thermal mass, shading and type of materials used.
Material use can affect the environment before, during and after use of the material. Therefore, evaluation of the construction process and building performance in-use are essential to shape future policies and practices. Every housing project is different and needs careful analysis, not only in respect of the site capacity but also in terms of future users of buildings. It is also essential to involve tenants in all discussions at every stage, in order to ensure that they have all the information needed on how use and live in dwellings to improve their energy savings and future conditions.

For a sustainable approach to be successful, it is important to have a clear idea about habits, lifestyles and preferences of future occupants to define applicable solutions and realistic responses to actual needs.
From that perspective, as shown by the case study developed for Nairobi, the introduction of minimum standards and simple design strategies can help poor communities to achieve sustainable and comfortable housing at the lowest cost.
OPTION 5 demonstrates a general improvement in housing basic condition, using an adobe wall of 40 cm, a corrugated metal roof with insulation panels made of recycling materials, and a double-glazing for openings with vertical sunscreen for shading from summer sun.
Anyway, it is also important to underline how *OPTION 3* can improve the existing condition of poor housing in Nairobi, using adobe walls of 30 cm and insulating the roof with local available materials, like PET bottles, straw, pieces of wood or bamboo sticks.

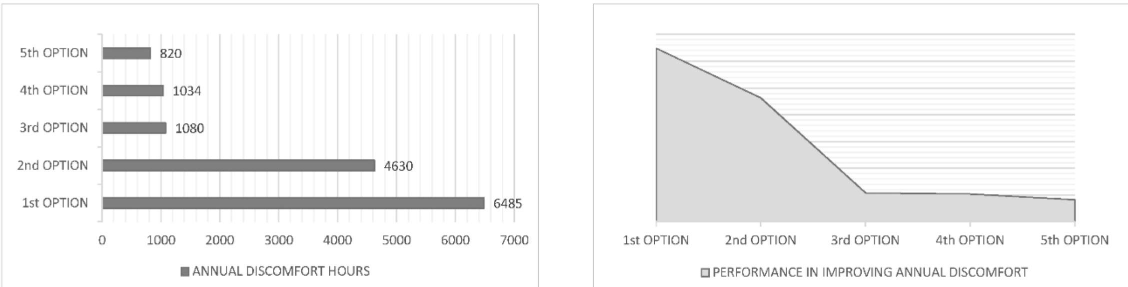


Figure 10 | *Results: an overview (Calculations with Design Builder and UNI EN 15251).*

The approach does not include active systems such as mechanical ventilation or technological installations to gain sustainability: for this reason, it exemplifies a great opportunity for poor developing urban areas, helping poor people to contribute to local sustainability. This means that, in developing countries, easy and available construction techniques and local materials can prove the ability of buildings to develop more comfortable indoor conditions, through an integration of the mentioned design principles in all ongoing new housing schemes, and a general improvement on living conditions.
This is a realistic way to develop a sustainable and simple construction process able to use and re-use local and on-site resources, starting from the positive benefits of local, natural climate conditions to give people a better quality of life and ensure access for all to adequate, safe and affordable housing.

6 | Conclusion

Today, achieving and pursuing the goal of a drastic reduction of energy consumption in buildings, which account for approximately 30% of global energy consumption, and in turn generate around 20% of all energy-related GHG emissions, is an important challenge for the contemporary cities worldwide.
In a similar scenario, the quality of the environment and, at the same time, the quality of urban life are getting worse: this happens especially in developing countries, where the majority of people live in poor and overcrowded slums, built with precarious materials and approximate techniques. The lack of access to efficient energy sources, the lack of basic urban services, the proliferation of housing in unplanned areas without safety and health, make slum dwellers the most vulnerable people to natural hazards and, in the long period, the higher polluters due their unsafety conditions.
Slums and inadequate housing remain the visible manifestations of poverty and inequality in cities and continue to be among the major challenges of urbanization today.

In a similar scenario, research results try to show how, thanks to simple design solutions, poor people of developing countries can be put in the condition of having affordable and sustainable housing, in a manner that local population can build, modify, and add-on to without technical assistance from the outside, in order to contribute to the construction of efficient, inclusive and clean cities. This can be possible through a project design able to consider the local climate and the many resources already available on site, and easy to learn by poor people and their communities.
The *Rio Declaration on Environment and Development* (1992) states: "Human beings are at the centre of concerns for sustainable development" and States have the responsibility to "ensure that activities within their jurisdiction or control do not cause damage to the environment (…). The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations".
Certainly, a mission far from being easy, but possible, changing the way we look at the poorest areas of cities, in order to ensure a sustainable urban future for all.

Bibliography

Amin A., Thrift N. (2005), *Città. Ripensare la dimensione urbana*, Il Mulino, Bologna, Italia.

Balbo M. (1992), *Povera grande città. L'urbanizzazione nel Terzo Mondo*, Studi Urbani e Regionali, Milano, Italia.

Balbo M. (1999), *L'intreccio urbano. La gestione della città nei paesi in via di sviluppo*, Studi Urbani e Regionali, Milano, Italia.

Balbo M. (*a cura di,* 2002), *La città inclusiva. Argomenti per la città dei PVS*, Studi Urbani e Regionali, Milano, Italia.

Balbo M. (2009), *La città nei PVS: sviluppo e inclusione sociale*, I percorsi dello sviluppo, n. 9, Padova, Italia.

Boko, M., I. Niang, A. Nyong, C. Vogel, A. Githeko, M. Medany, B. Osman-Elasha, R. Tabo and P. Yanda (2007), *Africa. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the 4th Assessment Report of the IPCC*, Cambridge, UK.

Dolan A.H. e Walker I.J. (2006), *Understanding Vulnerability of Coastal Communities to Climate Change Related Risks*, in Journal of Coastal Research, Special Issue n. 39, pp. 1316-1323.

Hugo S. L. Hens (2011), *Applied Building Physics: boundary conditions, building performance and material properties*, Ernst & Sohn, Berlin, Germany.

European Standard EN 15251:2007 (2007), *Indoor environmental input parameters for design and assessment of energy performance of buildings*.

International Energy Agency (IEA), UNDP, United Nations Industrial Development Organization (2010), *Energy Poverty: How to Make Modern Energy Access Universal? - Special early excerpt of the World Energy Outlook 2010 for the UN General Assembly on the Millennium Development Goals*, Paris, France.

IPCC (2013), *Summary for Policymakers*. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (2014), *Summary for policymakers*. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea,

and L.L. White (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32.
IPCC (2018), *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, 48th Session of the IPCC, Incheon, Republic of Korea.
Lucon O., D. Ürge-Vorsatz, A. Zain Ahmed, H. Akbari, P. Bertoldi, L. F. Cabeza, N. Eyre, A. Gadgil, L. D. D. Harvey, Y. Jiang, E. Liphoto, S. Mirasgedis, S. Murakami, J. Parikh, C. Pyke, and M. V. Vilariño (2014), *Buildings*. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
Madlener R., Sunak Y. (2011), *Impacts of Urbanization on Urban Structures and Energy Demand: What Can We Learn for Urban Energy Planning and Urbanization Management?*, in Sustainable Cities and Society, 1(1): 45-53.
McGranahan G., Balk D., Anderson B. (2007), *The rising tide: assessing the risks of climate change and human settlements in low-elevation coastal zones*, in Environment and Urbanization, n. 19 (1), pp. 17-37.
Musco F. (2009), *Rigenerazione urbana e sostenibilità*, Studi Urbani e Regionali, Milano, Italia.
Myers N. (2001), *Environmental refugees: a growing phenomenon of the 21st century*, Oxford, UK.
SAMSET Project (2015), *Survey data from Namuwongo household: energy research*, Kampala, Uganda.
SEA (2012), *Informal electrification in South Africa. Experience, opportunities and challenges*, Sustainable Energy Africa, Cape Town.
Schroeder H. & Lemke M. (2015), *Sustainability of earth building materials - Environmental product declarations as an instrument of competition in building material industry*, in VITRUVIO International Journal of Architectural Technology and Sustainability, pp. 45-55.
Schroeder H. (2016), *Sustainable Building with Earth*, Springer International Publishing, Switzerland.
Stouter P. (2008), *Shaping buildings for the humid tropics: Cultures, climate and materials*, Greenhomebuilding, ASLA, Oregon, Ashland.
The World Bank - International Bank for Reconstruction and Development (2001), *World Development Report 2000/2001: Attacking Poverty*, New York, Oxford University Press.
The World Bank - International Bank for Reconstruction and Development (2010), *World Development Report 2010 - Development and Climate Change*, Washington D.C., USA.
The World Bank - International Bank for Reconstruction and Development (2018), *Poverty and Shared Prosperity 2018: Piecing Together the Poverty Puzzle*. *Overview booklet*, World Bank, Washington, DC. License: Creative Commons Attribution CC BY 3.0 IGO.
United Nations (1992), *Rio Declaration on Environment and Development*, Rio de Janeiro.
United Nations Development Programme (UNDP) (2007), *Human Development Report 2007/2008. Fighting Climate Change: Human Solidarity in a Divided World*, New York, USA.
United Nations Development Programme (UNDP) (2010), *Promoting Energy efficiency in Buildings: Lessons Learned from International Experience*, New York, NY, USA.
United Nations Development Programme (UNDP) (2011), *Human Development Report 2011. Sustainability and Equity: a Better Future for All*, New York, USA.

United Nations Environment Programme (UNEP) (2008), *Africa: Atlas of Our Changing Environment*, Nairobi, Kenya.
United Nations Environment Programme (UNEP) (2014), *Climate Finance for Cities and Buildings - A Handbook for Local Governments*, UNEP Division of Technology, Industry and Economics (DTIE), Paris, France.
United Nations Environment Programme (UNEP) (2015), *Why Buildings? Buildings Day at COP21*, 3 December 2015, Paris, France.
UNFCCC (2015), *Unprecedented Global Alliance for Buildings and Construction to Combat Climate Change*, Press Release, 3 December 2015, Paris, France.
UN-Habitat (2003), *Global Report on Human Settlements 2003. The Challenge of Slums*, Nairobi, Kenya.
UN-Habitat (2009a), *Cities and Climate Change Initiative. Launch and Conference Report*, Atti della Conferenza CCCI, 17 Marzo 2009, Oslo, Norvegia.
UN-Habitat (2009b), *Global Report Human Settlements 2009. Planning Sustainable Cities*, Nairobi, Kenya.
UN-Habitat (2010a), *Planning Sustainable Cities: UN-Habitat Practices and Perspectives*, Nairobi, Kenya.
UN-Habitat (2010b), *State of the World's Cities 2010/2011. Bridging the Urban Divide*, Nairobi, Kenya.
UN-Habitat (2011a): Affordable Land and Housing in Africa, Nairobi, Kenya.
UN-Habitat (2011b), *Global Report on Human Settlements 2011. Cities and Climate Change*, Nairobi, Kenya.
UN-Habitat (2011c), *Housing the Poor in African Cities. Urban Africa: Building with Untapped Potential*, Cities Alliance: Cities without Slums, Nairobi, Kenya.
UN-Habitat (2012a), *Going Green. A handbook of sustainable housing practices in developing countries*, Nairobi, Kenya.
UN-Habitat (2012b), *Developing Local Climate Change Plans. A guide for cities in developing countries*, Nairobi, Kenya.
UN-Habitat (2012c), *Sustainable Housing for Sustainable Cities*, Nairobi, Kenya.
UN-Habitat (2014a), *Planning for Climate Change: A strategic, values-based approach for urban planners*, Nairobi, Kenya.
UN-Habitat (2014b), *Planning for Climate Change: A strategic, values-based approach for urban planners – Toolkit*, Nairobi, Kenya.
UN-Habitat (2014c), *Sustainable Building Design for Tropical Climates*, Nairobi, Kenya.
UN-Habitat (2015a), *Green Buildings. Interventions for Social Housing*, Nairobi, Kenya.
UN-Habitat (2015b), *Integrating Climate Change into City Development Strategies (CDS). Climate Change and Strategic Planning*, Nairobi, Kenya.
UN-Habitat (2017), *Trends in Urban Resilience 2017*, Nairobi, Kenya.
UN-Habitat (2018), *SDG Indicator 11.1.1 Training Module: Adequate Housing and Slum Upgrading*, Nairobi, Kenya.
Urban F., Benders R.M.J. & Moll H.C. (2007), *Modelling energy systems for developing countries*, Energy Policy, 35(6), pp. 3473-3482.
Vidalenc E., Theys J. (2013), *Towards post carbon cities: Why? How?*, Paris, France.