A Marsh Arab, who lives in a traditional reed house, drinks fresh buffalo milk on a cold morning. This photo, taken in March 2017 in the marshy regions of southern Iraq, is from the series Iraq's last Eden: Mesopotamian marshes *by French photographer Emilienne Malfatto.*

Architectural lessons

for the future, via the past

Amin Al-Habaibeh

Modern cities, with their paved roads and glass towers, are hardly adapted to cope with the expected rise in temperatures. Designed to provide shade and air circulation, traditional buildings in the Middle East, Gulf and African countries could inspire more sustainable and environmentally-friendly habitats in other parts of the world.

As a result of global warming and the rise in greenhouse gas levels, cities across the world are increasingly likely to be exposed to extreme temperatures. This is particularly true in the Gulf countries, where temperatures are expected to rise to over 50 °C during the twenty-first century. But these heat surges have not spared other regions of the world – particularly Europe, where during the summer of 2019, record temperatures were reached in France, the United Kingdom and Switzerland, among other countries.

Today, lifestyles and architecture are dependent on air conditioning, and modern materials such as concrete, asphalt or glass. These materials, however, are not adapted to high temperatures. Glass reflects solar radiation to the surrounding area, creating heat islands and the risk of a greenhouse effect inside buildings.

Asphalt also absorbs a large part of the sun's rays, which it converts into a heat flux – thus contributing to warming the local environment. Concrete, on the other hand, consumes a lot of energy during its production, contributing to global warming through carbon emissions. In addition, modern urban planning does not favour public transportation. This makes private cars a necessity, creating more pollution and localized heat islands, especially when combined with the air-conditioning systems of buildings.

Historically, before the adoption of the modern way of life, most people on the planet lived in a more harmonious way with their environment. They were either farmers within oases, agricultural or fishing village communities, Bedouins or nomads living in tents in the desert, or urban dwellers living in cities.

The materials they selected to build their dwellings came from the environment. They were sustainable, adapted to their way of life, and based on what is now termed a circular economy. Due to their travelling lifestyles and animal herding, the Bedouins lived in tents that were optimized for protection against the weather, and for flexibility.

A typical Andalusian patio in Cordoba, Spain.

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> “In Jordan, the Nabatean people took this symbiosis with nature even further, by using the thermal inertia of the ground”

The tents were designed and built to function effectively with the environment – they were woven using available resources like goat hair and sheep’s wool. This is why they are called “houses of hair” in Arabic.

Environmentally-friendly materials

The tent’s material allows the air to circulate. The fibres become swollen and waterproof when wet, which is ideal during the rainy weather. In the hot and dry weather, the Bedouins would wet the tent and its surrounding area, and also humidify additional pieces of cloth and rugs to reduce temperatures by water evaporation. The tent’s high insulation capabilities allow for cool conditions in the summer, and warmth in the winter, created with a small fire. Nothing prevents us from using similar materials to create modern architecture, to make temperatures more bearable.

The buildings of the past, on the other hand, were designed with very thick walls, using natural and environmentally-friendly materials such as limestone and natural mud, mixed with local desert plants in some cases. This provided a construction material with a high thermal capacity to regulate the temperature of the buildings. The material had the advantage of being able to absorb humidity during the night-time, which would evaporate during the hot and sunny days, to provide the required cooling effect. This effect is evident at the Red Palace in Al-Jahra, Kuwait – an excellent example of the architecture and building technology that once existed in the Gulf region.

In warm climates, cities and buildings were designed to optimize shade, reduce the direct or indirect thermal gain of sun radiation, regulate building temperatures and enhance air circulation for cooling. The streets were paved with natural stones, or simply left covered with sand. That meant they reacted much better to high temperatures without storing heat, as is the case with the asphalt used today. With the narrow roads and alleyways, and buildings built adjacent to each other, the ratio of the area exposed to the sun relative to the total volume of the buildings was reduced to a minimum – as was the heat gain during the day.

Opting for shade and air

Buildings were designed with internal courtyards surrounded by rooms or walls – in most cases, from all sides. This created a large area for social activities in the late afternoons and at night, due to the maximization of shade provided by the surrounding rooms. In most cases, the central courtyard contained trees and a fountain or a well, which could also be used to collect rainwater. At midday, the courtyard functioned as a chimney for the hot air to rise and be replaced by cooler air from the surrounding rooms, improving air circulation and the cooling effect.

This type of architecture was very common in Damascus, Syria, and in Andalusia, Spain. The narrow streets could be covered with lightweight materials from date palms. This improved air circulation between the streets and courtyards of the buildings, via the rooms. The texture and the sandy colour of the walls limited the absorption and emission of the radiating heat.

Glass was not a common building material in the past. Some rooms had only two windows. The first was a small skylight, placed very high, and kept open for air circulation and natural light, while maintaining privacy. A second larger window was usually kept closed, with wooden shutters allowing a flow of air into the room, while protecting privacy.

The mashrabiyya, a projecting window with carved wooden latticework, usually located on the top storeys of buildings, ensures better air circulation and protects against direct exposure to the sun.

Built in 2011, the Sewing School Steel-Earth in Niamey, Niger, combines know-how and local materials with contemporary technological advances. The durability of the structure, which uses materials including banco, *a mixture of soil and straw with good thermal inertia, is ensured by a double metal roof.*

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This was a common feature of buildings in many regions of the Middle East, including Egypt, the Hejaz region in Saudi Arabia, and Iraq – where the windows are known as *roshan* or *shanasheel*. Some buildings in the Gulf had a wind tower to create natural ventilation, where it was possible to open and close doors in the ceiling, depending on the wind direction – performing a similar function to that of modern air-cooling systems.

Other building design characteristics were high structures and cloisters, to maximize shade and enhance air circulation. They were often used with domes, to increase the air volume internally, and decrease external thermal gain. The idea was to create a thermal differential that caused a cooling breeze, regardless of the actual wind speed.

A troglodyte house in Matmata, southern Tunisia.

Symbiosis with nature

In Africa, mud huts are still being built today. With a sustainable and simple design made from clay and thatch, the huts not only provide passive cooling, but are also quick to build, affordable, and recyclable. The same is true of the traditional reed houses made by the Madan people, or Marsh Arabs, in the swamps of southern Iraq – their unique design and structure provide protection with enhanced air circulation.

In Petra, Jordan, the Nabatean people took this symbiosis with nature even further, by using the thermal inertia of the ground. They created an ingeniously planned city, with innovative dwellings and an efficient rainwater harvesting system. The original inhabitants took advantage of the natural mountains in the area, carving out their dwellings in the mountainside. This ensured well-regulated temperatures in both the summer and the winter – unlike in modern buildings, where temperatures fluctuate with the season.

Similar structures and concepts using the ground's thermal inertia can also be found in Cappadocia, Turkey; the cliff dwellings of the Sinagua Indians at Montezuma Castle in Arizona, and the cavates, or man-made caves, and pathways carved from soft tuff rock at Tsankawi, New Mexico – both in the US.

One of the most fascinating historic architectural designs, the underground troglodyte dwellings, can be found in the Berber village of Matmata, in southern Tunisia. Built by digging a large pit in the ground, usually on a hilly site, caves, which serve as rooms, are carved out from the central pit, which becomes a central courtyard. This design ensures excellent thermal insulation. One of the Matmata dwellings, now converted into a hotel, featured in the 1977 film, *Star Wars: Episode IV - A New Hope*, as the home of Luke Skywalker on the fictional desert planet, Tatooine.

Adapting their lifestyles was yet another way that people dealt with extreme weather conditions in the past. The working day began just before dawn, and people sought refuge from the midday sun until the late afternoon – when they resumed their business and socializing in cooler temperatures. This culture is still practised in the Middle East and Spain, where a siesta is observed. Drinking water is stored in clay jars or water bags made of animal skin, and kept in the shade. The evaporation process creates a cooling effect for both the stored water and the surroundings.

People dressed in clothes made from natural materials – the loose-fitting styles were designed to enhance cooling and air circulation, while covering most of the body to prevent sunburn. The heads and faces of both men and women were most often protected by scarves – designed to reduce water loss through breathing, filter dust, protect from sunstroke and prevent aging of the skin. This versatile fabric is known by different names, depending on gender, region and design – in all cases, it serves as an important device for health protection.

Modern solutions from traditional concepts

In Europe, people have used wine cellars to preserve wine at a specific range of temperatures, using the thermal inertia of the ground. This concept could be enhanced to provide regulated temperature in both hot and cold weather. Incorporating traditional designs into modern architecture may be yet another solution for tackling climate change. The use of traditional architecture has worked well for some modern buildings in Seville, Spain, for example. A water fountain in the middle of a courtyard surrounded by trees and the building structure, works well to reduce the temperature.

Masdar City, a planned urban project in Abu Dhabi, United Arab Emirates, has sought to combine lessons from the past with modern technologies – with the use of mashrabiyya windows, narrow streets and traditional colours.

Other Gulf countries are also working to design sustainable eco-buildings. With ongoing research and the improvement of building and pavement materials, building design and urban planning, insulation and the use of renewable energy, cities in the Gulf and other countries with high temperatures are able to maintain their comfortable lifestyles – with considerably lower levels of carbon emissions and fossil fuel use.

In Europe, where temperatures are expected to fluctuate between extreme heat and cold in the future, a good start would be to increase the thickness of building walls by adding insulation and natural materials. This would reduce the need for heating in winter, and air conditioning in the summer.

Fortunately, the rise in temperatures also allows for an increase in renewable solar energy. In most homes, the use of photovoltaic solar energy combined with better insulation could provide the power needed to run air-conditioning systems. But this would create heat islands on the roads – particularly those made of asphalt, as is currently the case. Planting more trees would help to regulate temperatures in these conditions, and provide a cooler environment.

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Construction of a modernized wind tower, by global architectural firm Foster + Partners, at the Masdar Institute of Science and Technology, in Masdar City, Abu Dhabi, in the United Arab Emirates. This forty-five-metre-high structure made of recycled steel, is equipped with atomisers, which reduce air draughts to promote freshness.

The use of insulation would also reduce air-conditioning loads and electricity consumption. Natural or innovative new materials that absorb moisture and increase thermal capacity could regulate heat gain and aid the natural cooling process. Intelligent urban planning that simulates old cities could make the use of clean public transportation a more feasible option. Since the temperature of sea-water is more stable than that of air, replacing existing air-conditioning systems with large-scale cooling and heating systems at the district level could provide a sustainable alternative. The same technology could also be applied to river water and water from flooded coal mines.

There are many lessons to be learned from traditional buildings around the world. These lessons will help us to appreciate our global heritage – while aiding us to transfer some of this knowledge to the design of future buildings and urban developments. Over centuries, people have designed buildings to be sustainable in terms of heating and cooling requirements, using ingenious techniques and sustainable materials sourced from the local environment. If we want to reduce global warming for future generations, we must integrate these lessons with our modern technologies to create sustainable and zero-carbon cities.

Professor of Intelligent Engineering Systems at the School of Architecture, Design and the Built Environment, Nottingham Trent University in the United Kingdom, **Amin Al-Habaibeh** (United Kingdom) also heads the university’s Innovative and Sustainable Built Environment Technologies (iSBET) research group.