Eastgate for students

ODONTOTERMES TRANSVAALENSIS

The termites that make small towers which work like chimneys because they are open at the top and when you put your hand over this you feel the hot air coming out….. are called

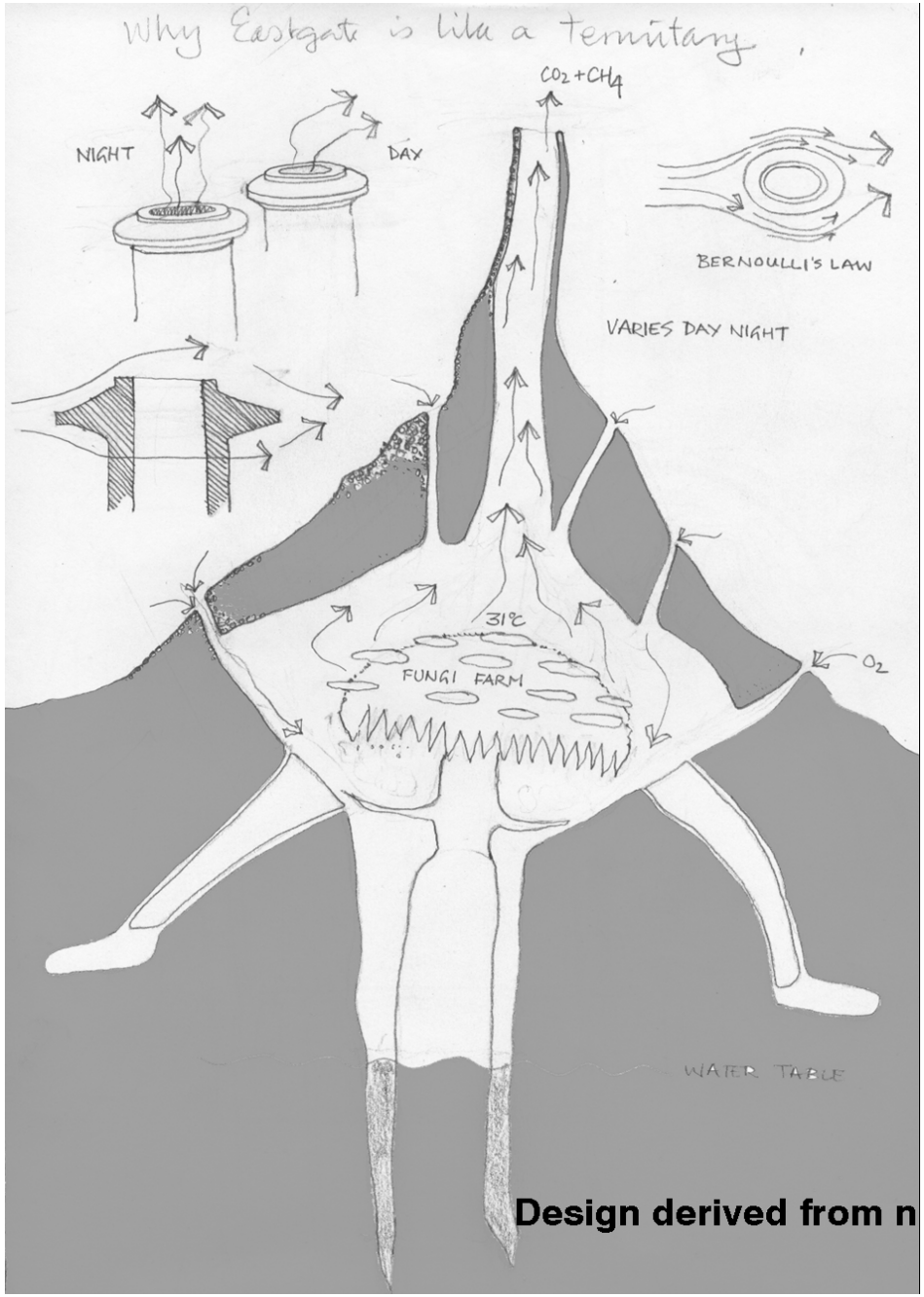
The story of Eastgate in brief

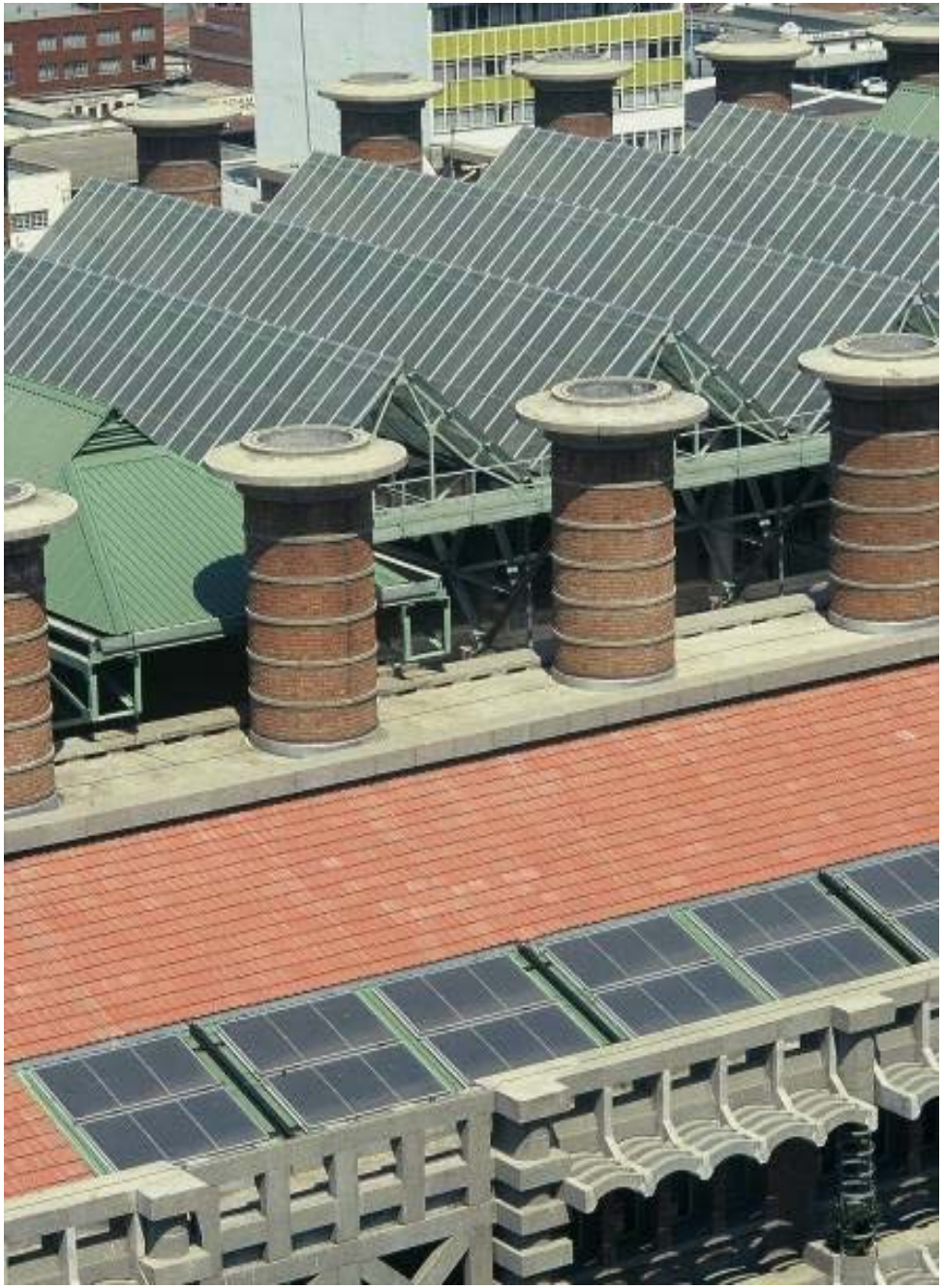
- *This is a long story but here is it in brief. The design teams challenge in 1992 was how to optimize the use of the diurnal swing of 5C on each side of comfort level (say 20C) which we get in Zimbabwe which is a mid altitude (1400Mts ASL) subtropical climate, to illuminate the need for refrigerant cooling systems and associated costs and energy consumption. One evening at this time I saw David Attenborough's BBC life series video of the inside of a termites nest in Nigeria. I was greatly moved by the thought that these animals (which are even more sensitive to environmental conditions in the spaces they occupy than humans) were able to make an architecture which performed in these and in other climates which were even more extreme, without a power connection to the mains for either water or electricity. They are so sensitive to temperature and humidity that when they move outside on the surface of the ground they have to make tunnels of mud and spit to move in. They do this by arching which follows the column of pheromone gas which runs in the path they must follow. This tunnel presumably ensures that they are protected from direct sun light and humidity is maintained at the optimum level for their survival. The mounds which rise up above ground above their nests are breathing devices. They do not live in these mounds they live below and the mounds are built from the excavated material produced from forming the voids in the ground below. Some of the mounds are open at the top and look like chimneys. Others (different species) are closed and breathing occurs through the surface membrane of the mound by gas diffusion. The mounds are lungs and what is below is the body with stomach where they cultivate fungi which by symbiotic processes digests their food of biomass material like we employ bacteria to do the same in our stomachs. So what we are looking at is a body (about the size of a goats) with one million termites transferring the energy like blood circulating in veins. It is a complex living system*
- *Scott Turner describes this in physiological terms and in his book the theme of which is that the house they live in is an extension to the organism and he applies this theme to many other examples of animal architecture. In 1992 I was trying to make human architecture but at that time without the benefit of Scott's incites. During a long conference call recently between me Scott and Rupert Soar, Scott said "It was only when I began to see the thing as a process like an earth fountain and not an object (sic frozen in time) that I began to understand how it worked. It is all physiology." This was also a turning point for me about 15 years later. We should try to see things in nature not as objects and copy their form but as processes and systems.*
- *So going back to 1992 in Harare I saw the mounds as chimneys; the- open -at -the -top ones. And I thought that (and read that) they worked rather like chimneys; stack effect driven by temperature differentials particularly at night when the nest temperature below ground remains more or less the same as ground temperature due to the thermal mass of the soil while the air and surface temperatures dropped dramatically due to back radiation to space at night. The bigger the differential the greater the buoyancy and the faster the air exchange. Exhaust hot CO2 rich air is replaced by colder O2 rich air. The hot air goes up the flue and the cold air enters through smaller ports at the bottom of the mound. This Scott and Rupert have since proved to be incorrect. It is much more complicated see Scott's books. Their studies were with the closed type and the process is very like the mammalian lung gas diffusion through membranes.*

- *The important thing for me was and still is that I was convinced that by looking at animal architecture there are important clues for an architecture which inspires the design team to make building that follow natures processes, cycles and systems. This is particularly true at a time when we must reduce energy and water consumption. Thus by copying the termite we were inspired to design a building which*
- ***Responds to the climate** and can therefore function with very little added power (and this means you have to start by understanding the climate). We began to call this designing for **solar powered passive systems (chimneys) and added power active systems electric powered fans.** The trick here is to coordinate the weather outside with the controlled internal environment taking into account lag times. It is like tuning and instrument like an organ in a church*
- *The termite's optimized the use of **thermal mass** in their constructions to stabilize the internal conditions. We opted for concrete and brick exposed as much as possible to internal spaces.*
- *The termites **control humidity** which is the key to their comfort. And so it is with humans. Fortunately in Harare humidity control was not a problem because of the climate. In Melbourne it can be a problem and particularly in South China (Dongguan) it is the main problem.*
- *The forms of their mounds clearly respond to the natural environment thermodynamically and in this case Eastgate's architectural expression is a prickly building like a desert cacti. This is perhaps the strongest characteristic of the building and a clue to this was the desert cactus. However, the cathedral termites in northern territories Australia follow this theme beautifully. A **prickly form** will shield itself more efficiently in direct sunlight and disperse heat more efficiently at night during multidirectional back radiation.*
- *The Chimneys fed by masonry ducts, the concrete teethed heat exchangers under the floors are all voids forming air passages and the spaces for human occupation were designed with as much exposed masonry (large surface area) which copied not the form as a template but the thermodynamic principles that you can see in section through termite architecture.*
-

- Open Lung tower

Eastgate, Harare 1992-96

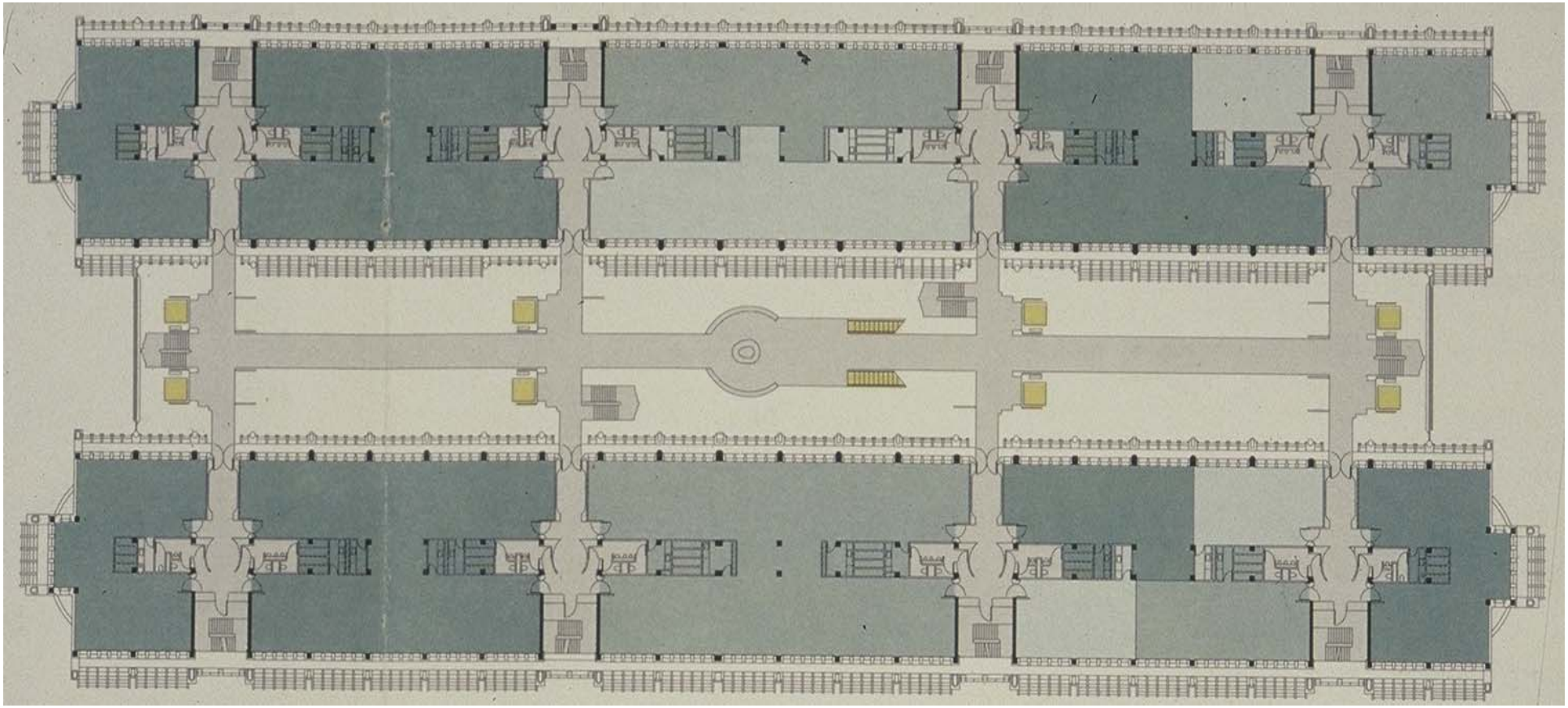




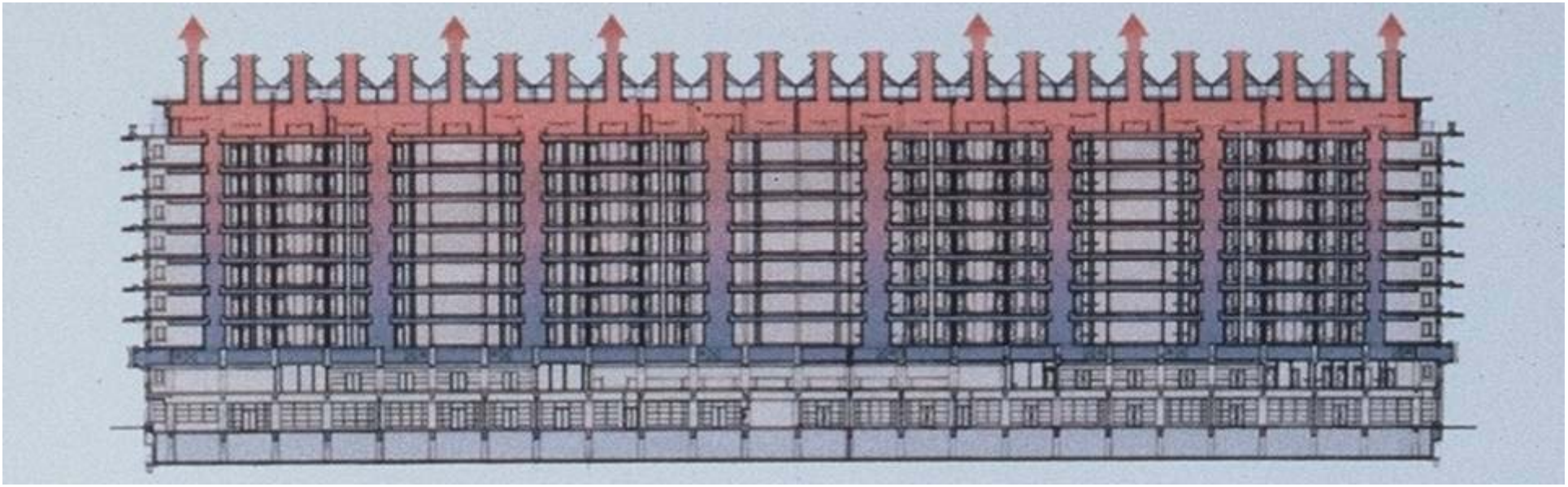
- Termites nest section

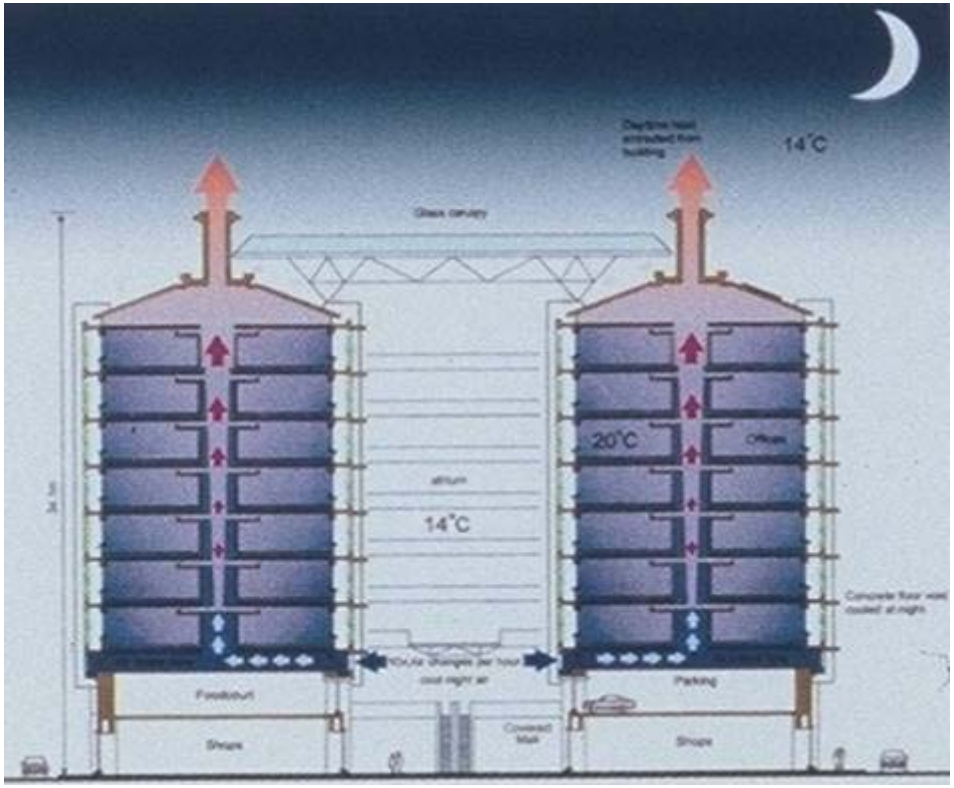
Eastgate's chimneys

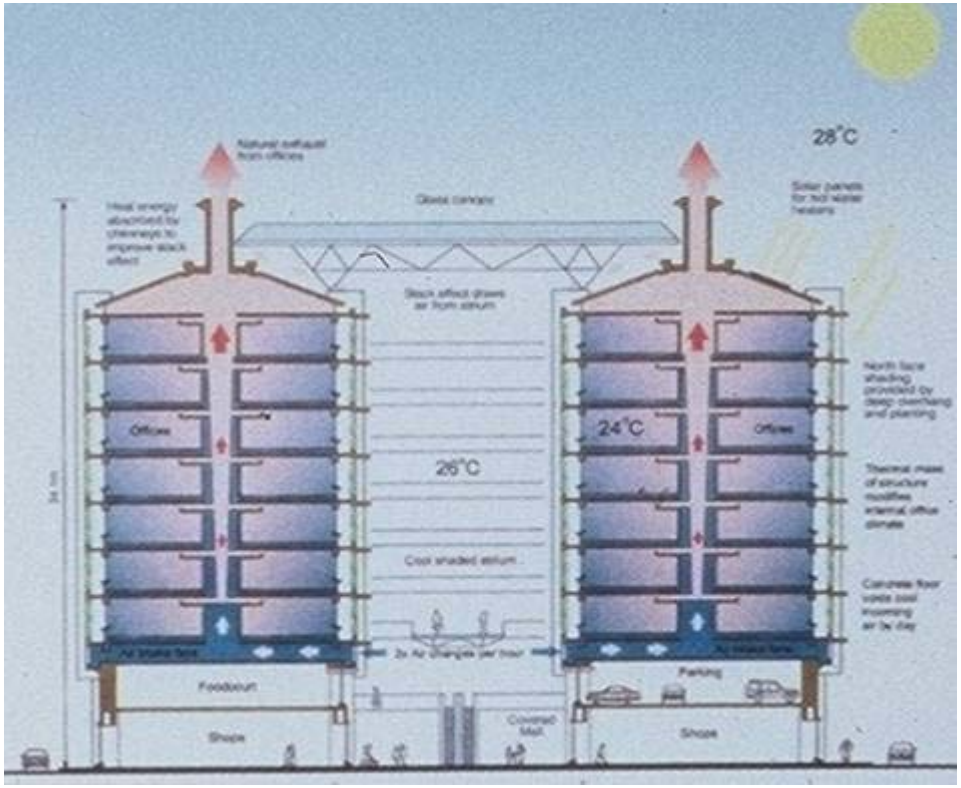
Eastgate offices



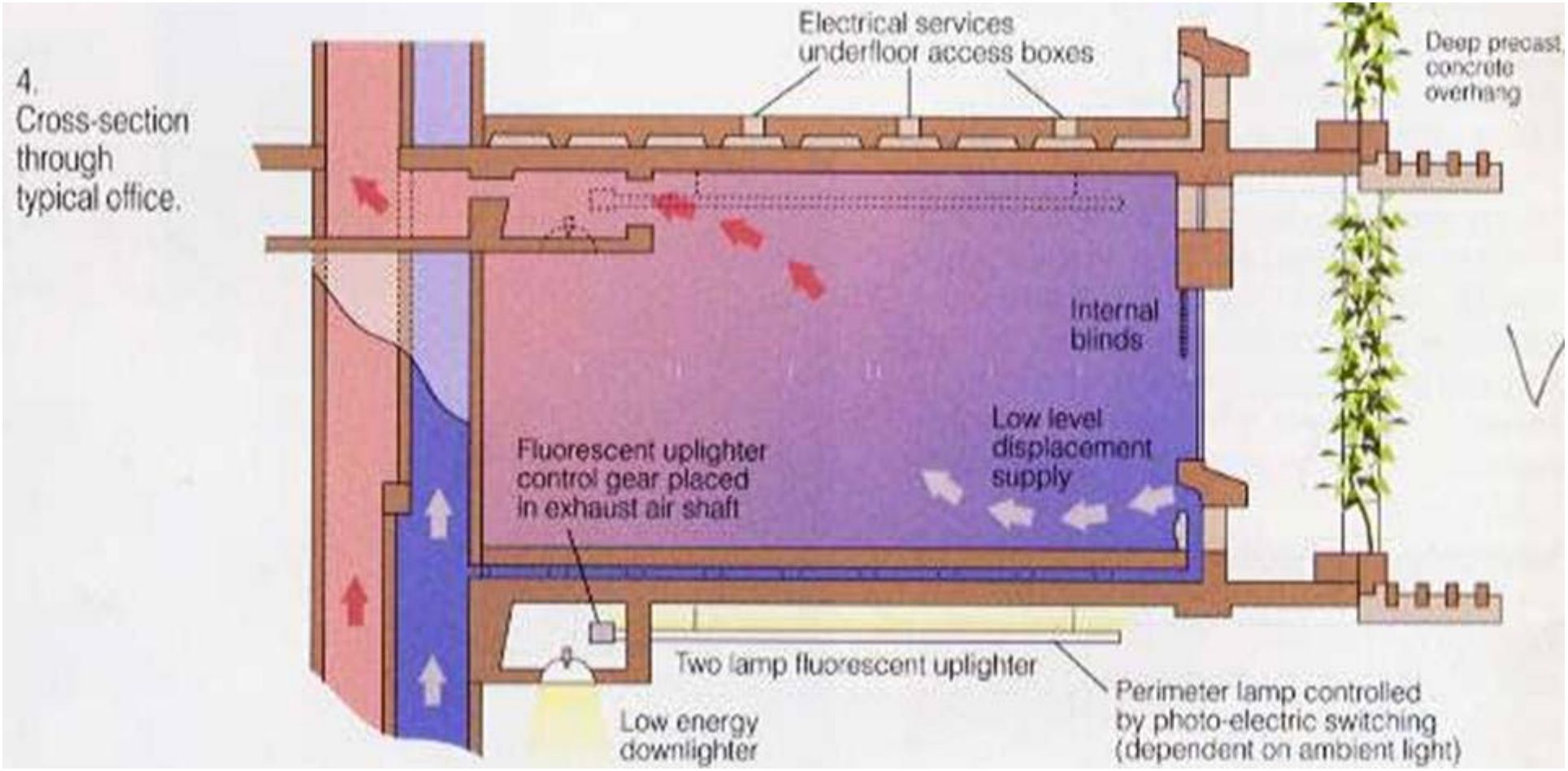
Level two



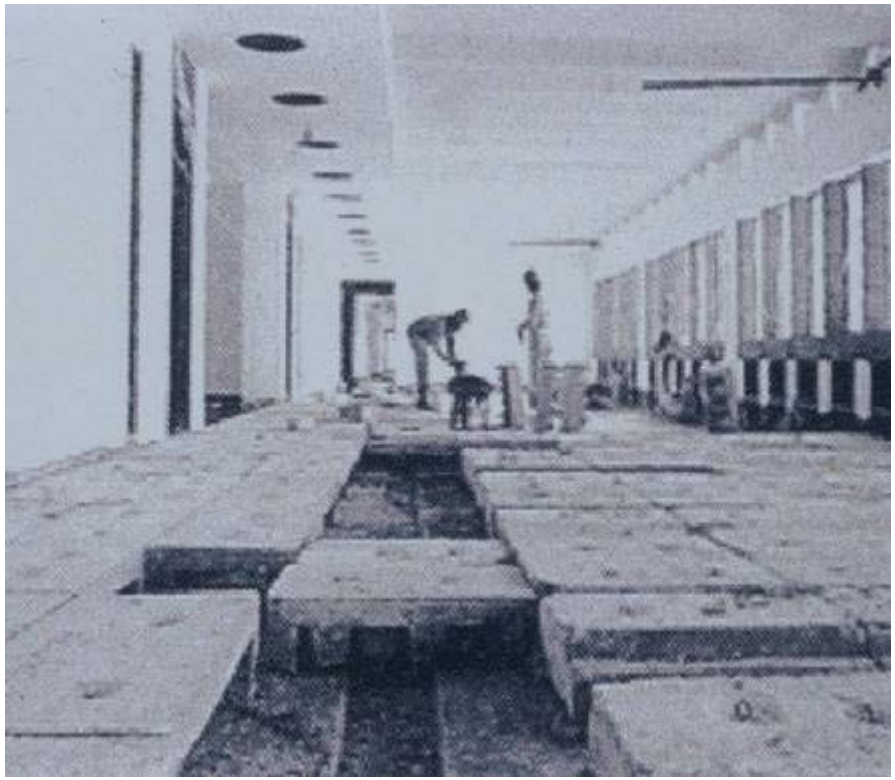

14°C
Glass canopy
20°C
Offices
atrium
14°C
Foodcourt
Shops
Covered Mall
Parking
Shops


28°C
Glass canopy
Offices
26°C
Cool shaded atrium
24°C
Offices
Foodcourt
Shops
Covered Mall
Parking
Shops

Cooling the office

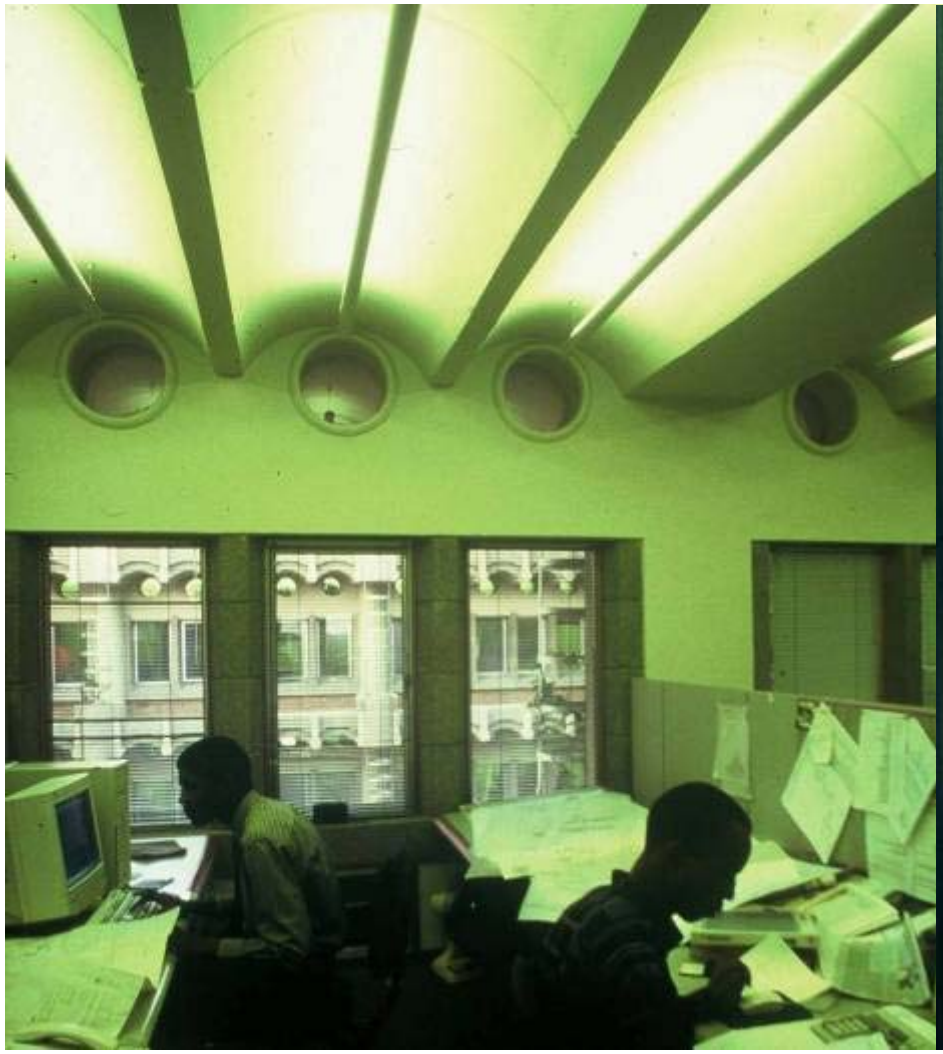


Section through typical office Eastgate, Harare

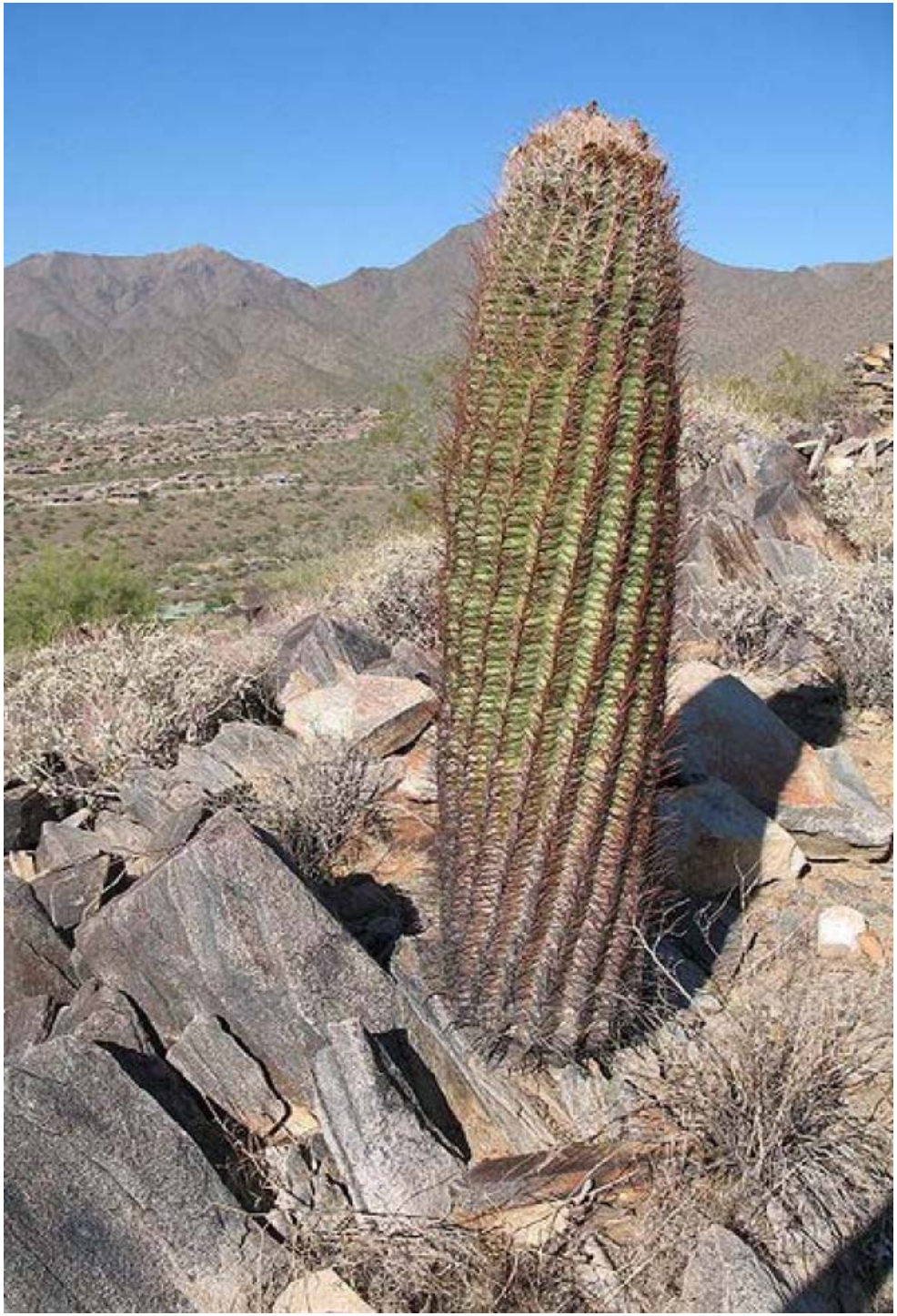


precast concrete floor units form a heat exchange which the air passes through - removing the cold collected from the previous night - before entering the office space

uplighters use the vaulted concrete ceiling as the reflector so the heat is absorbed by the slab above



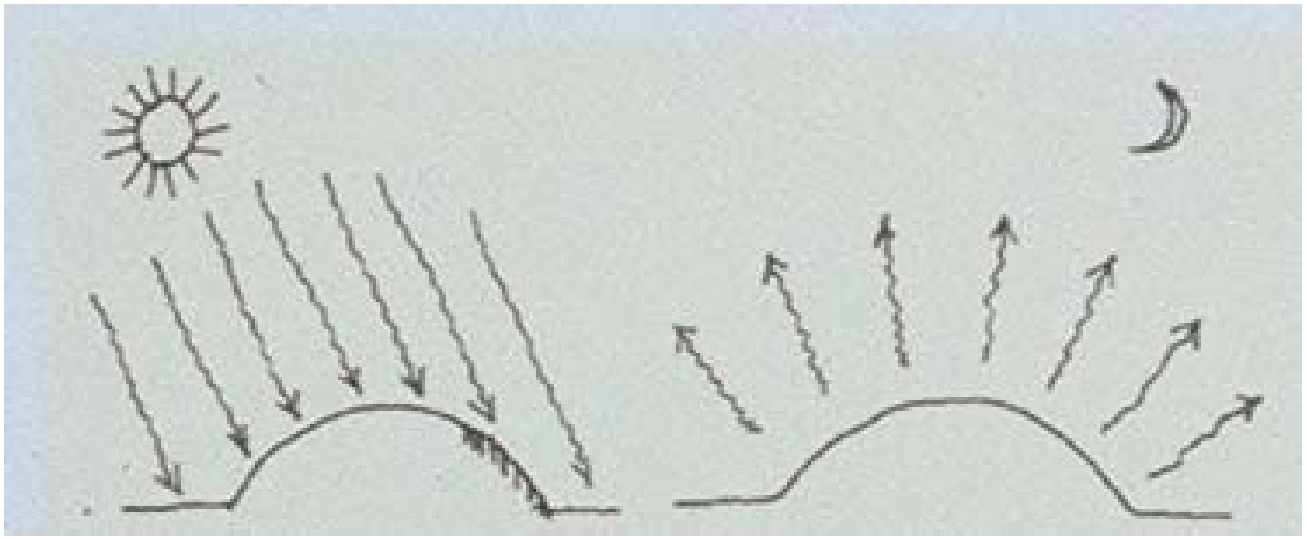
Eastgate, Harare



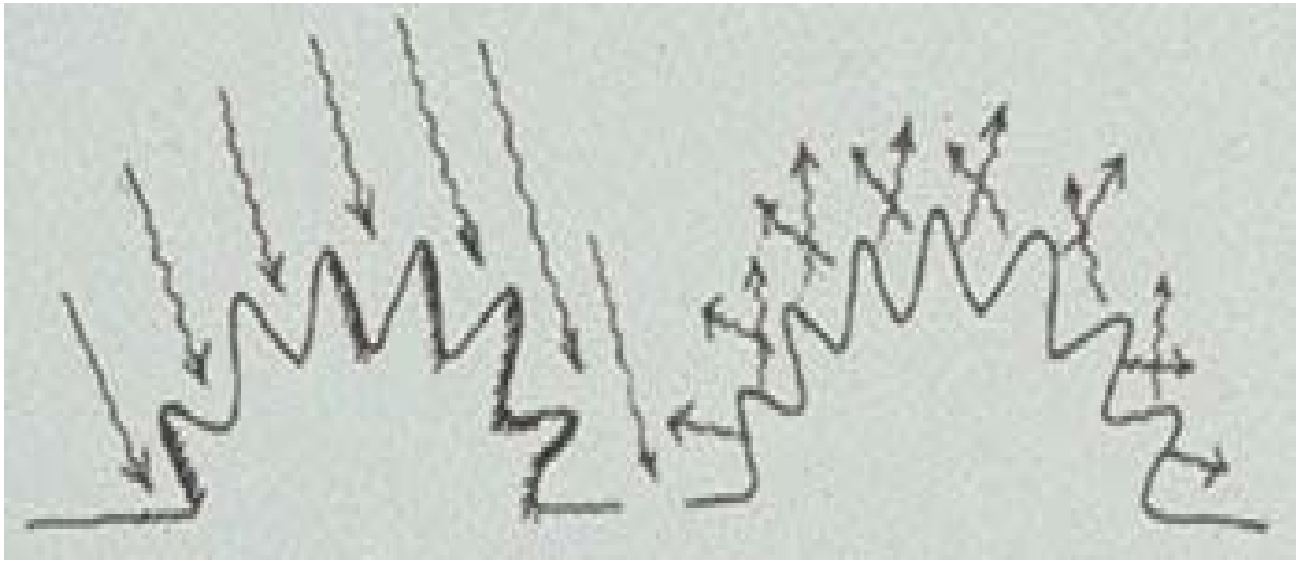
- The following sides of the architecture of Eastgate are a formal expression of passive cooling at the interface between the building and its medium altitude environment with clear often cloudless skys and where the diurnal shift of 12 degrees is exploited to disperse excessive solar heat in the same way as prickly desert plants. This is form copying a natural process

External façade is a formal expression of passive cooling

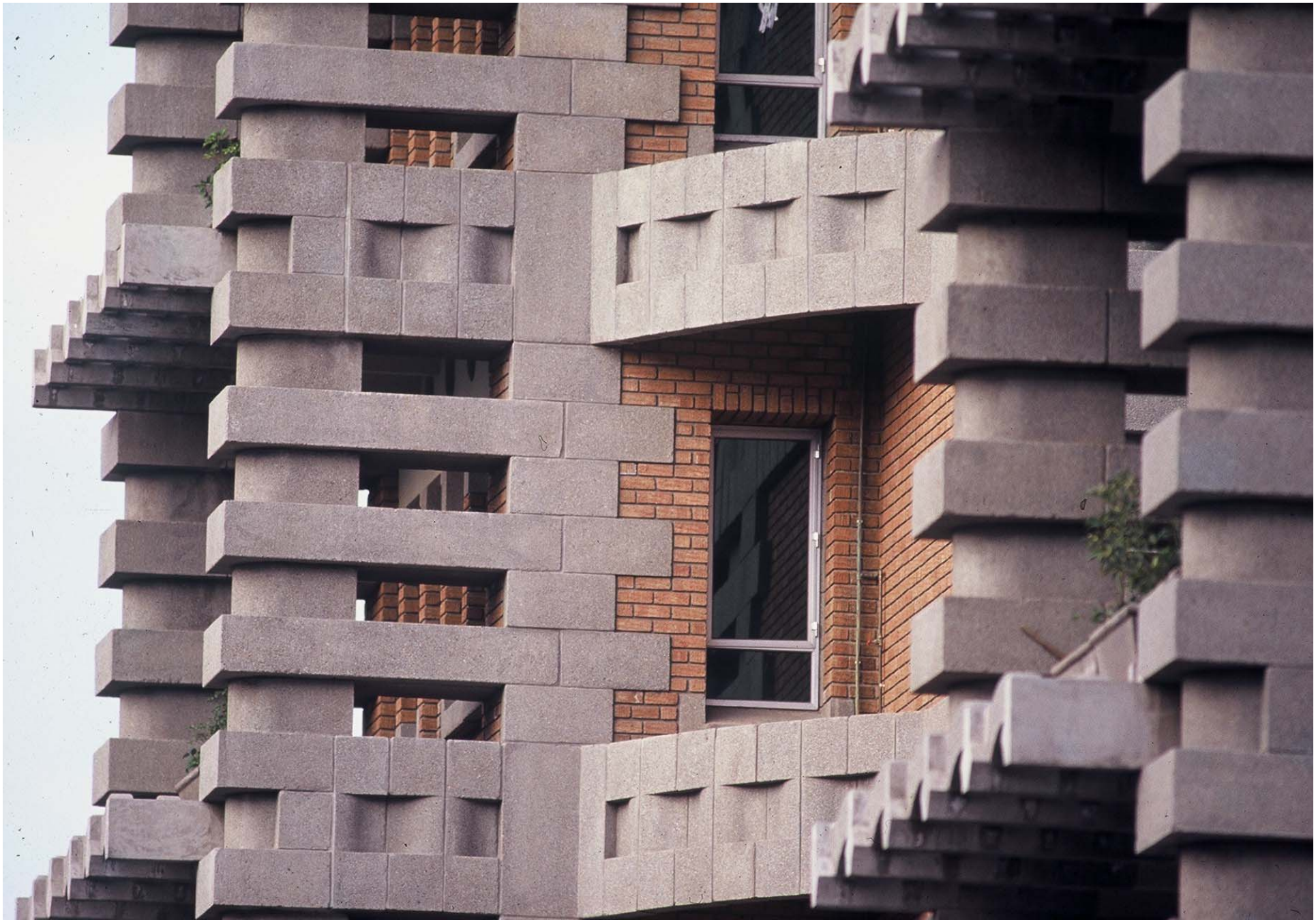
- Smooth bodies are better at absorbing heat and poor emitters of heat to space at night



Prickly bodies are poorer absorbers of heat by day and good emitters of heat at night



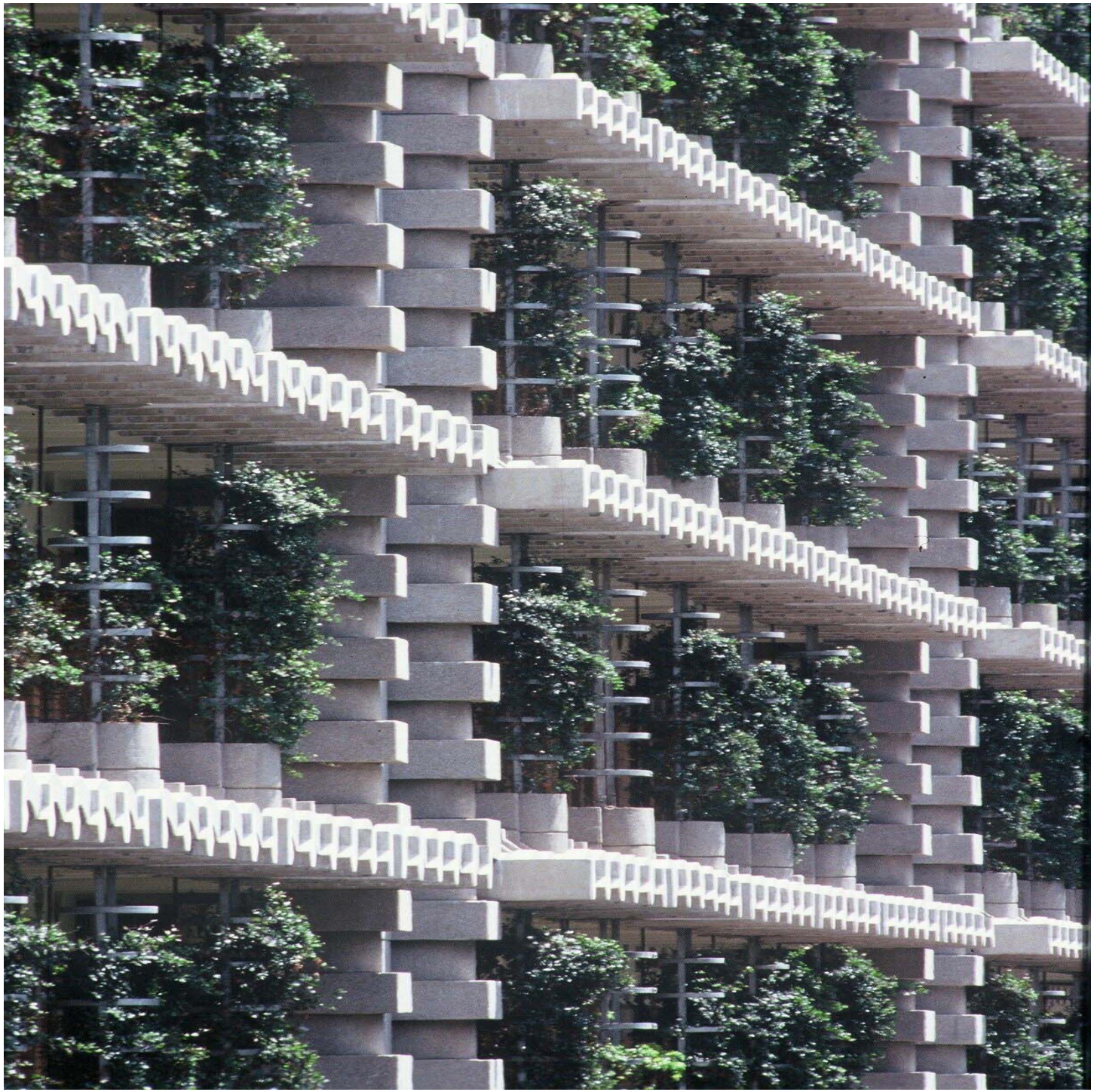
east end of building - Eastgate, Harare

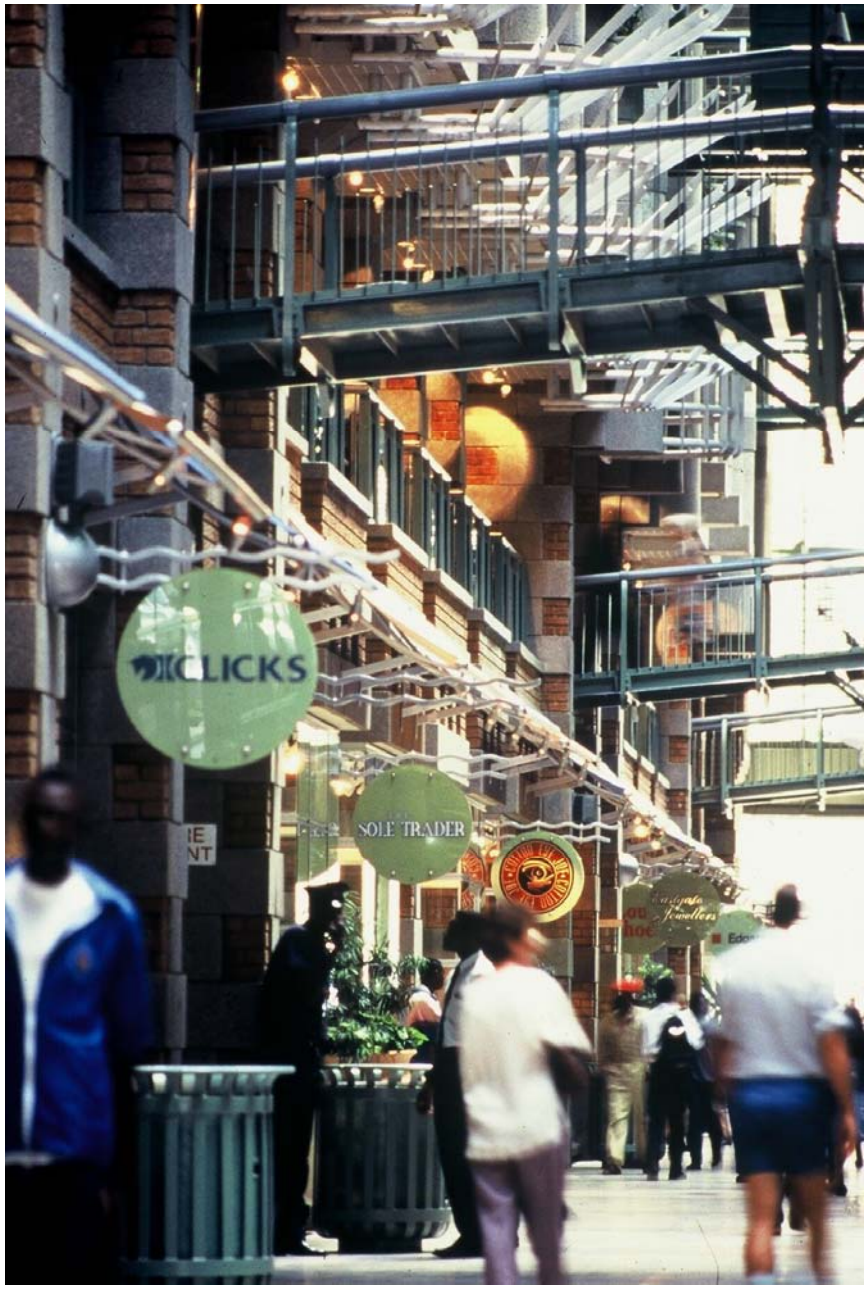


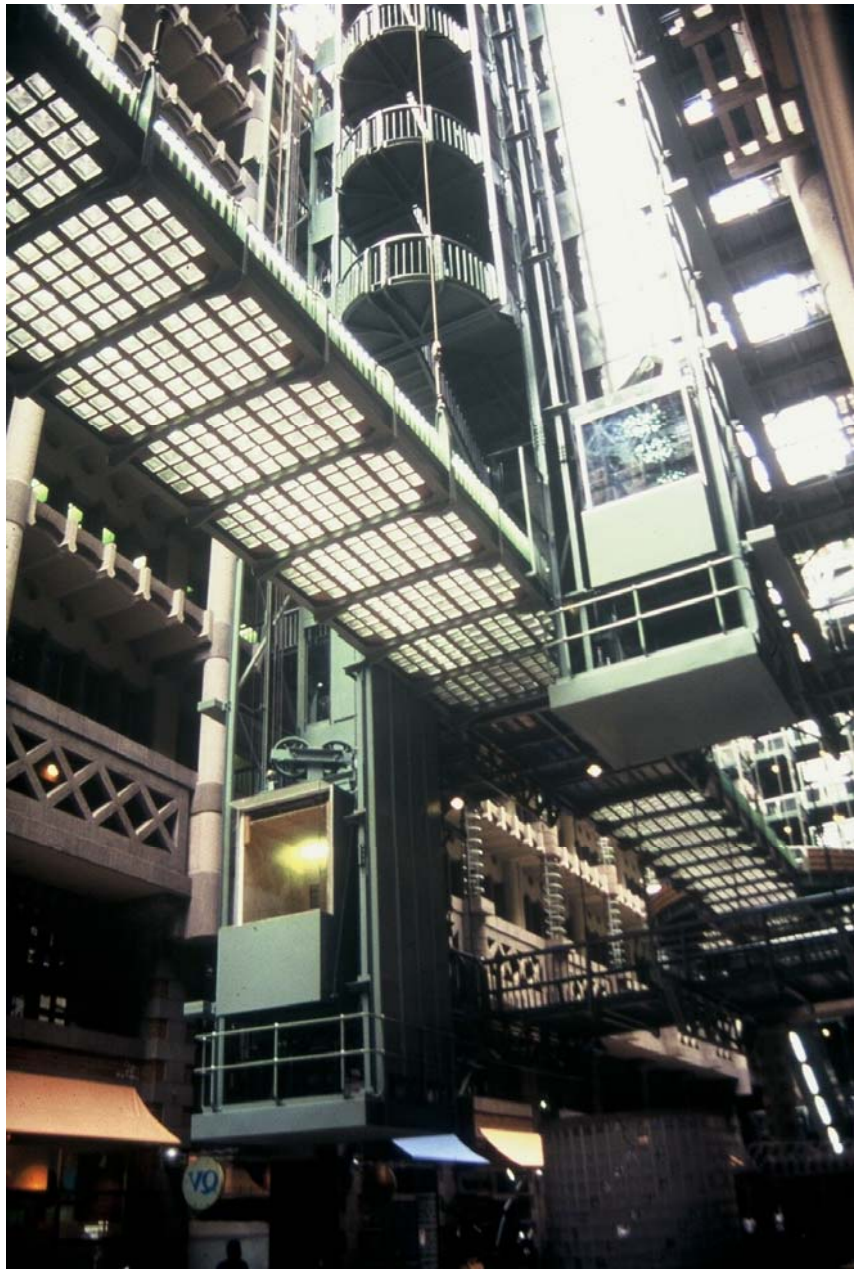
- Jagged gable end detail

- The green north and south facades

- Green facade

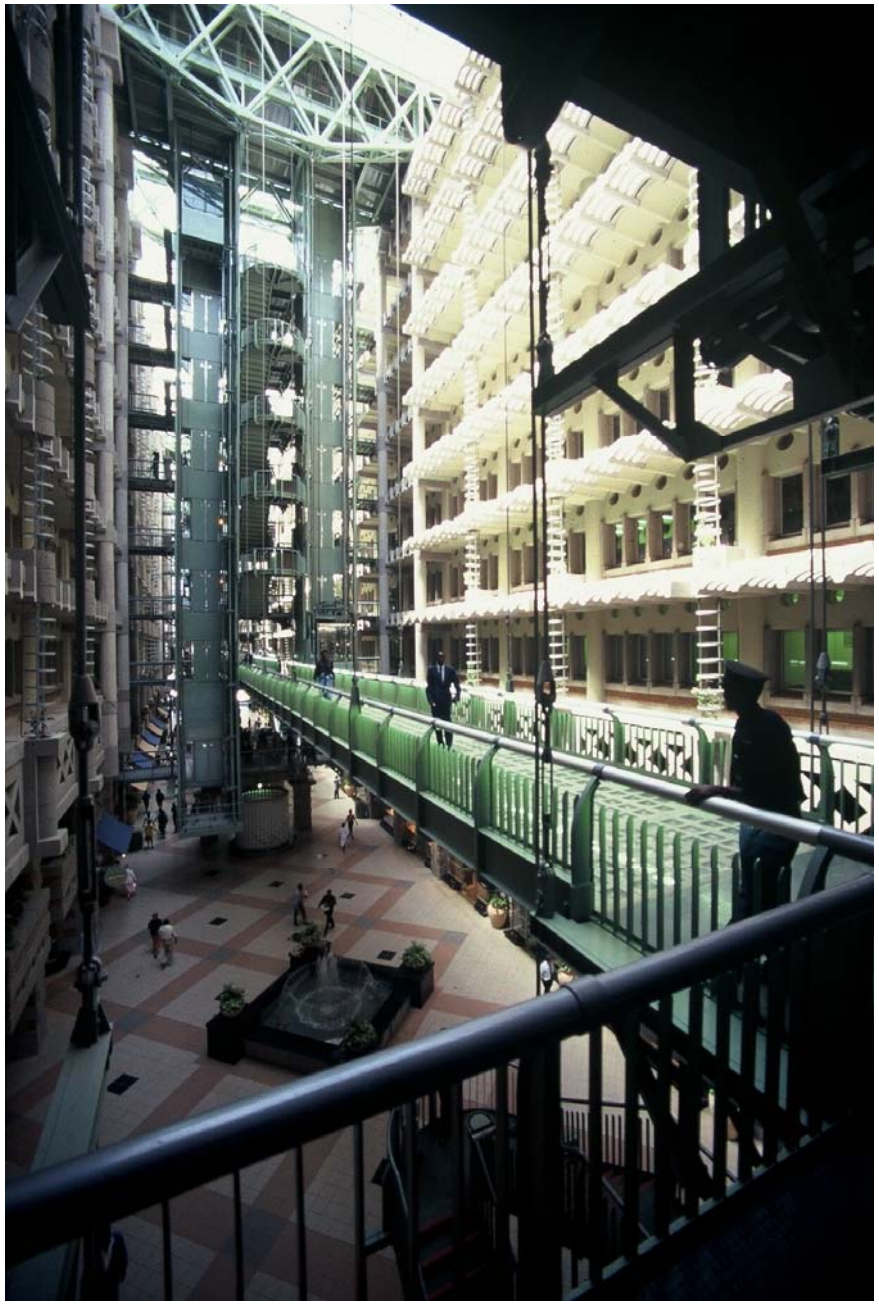






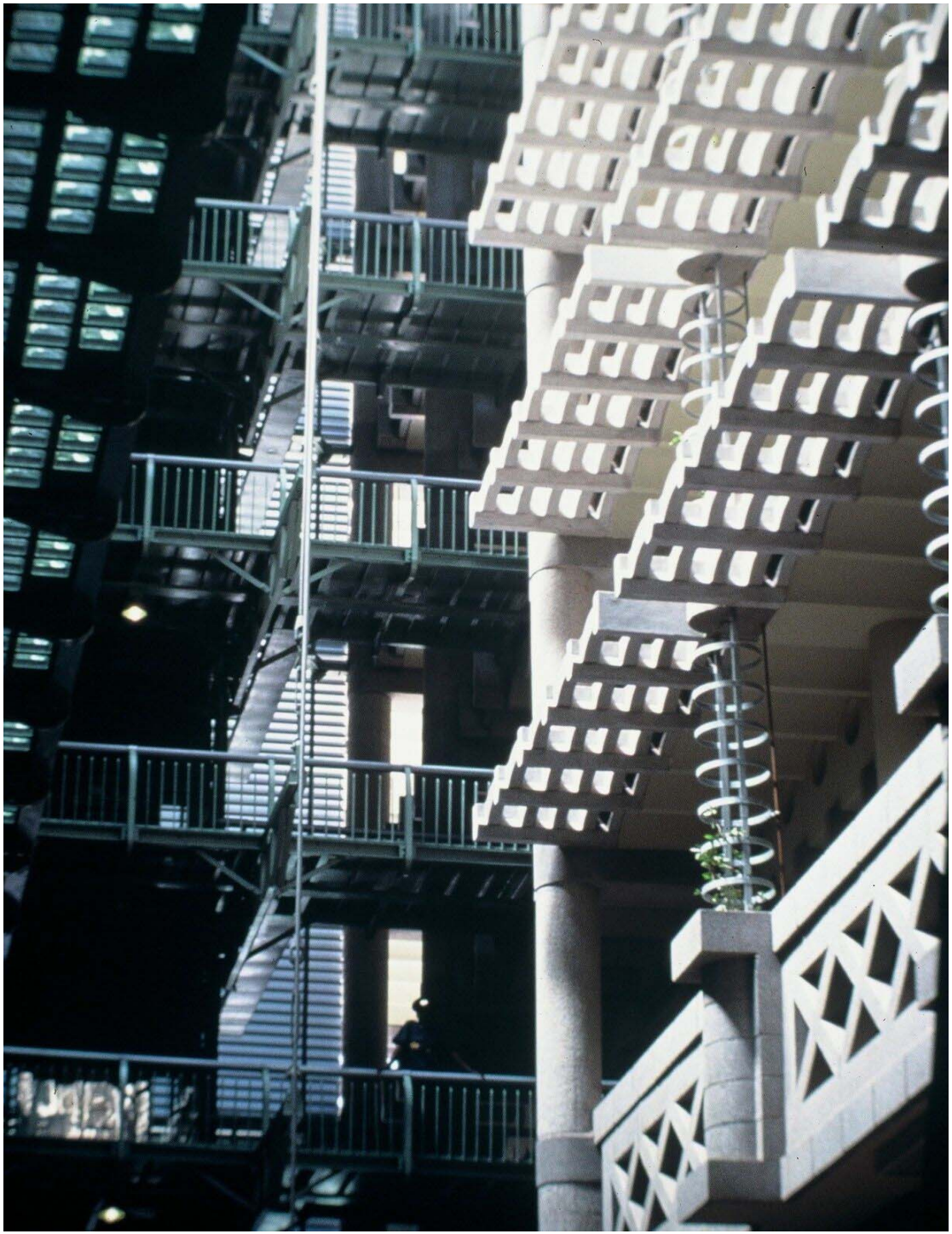
- Mall street shopping with lifts suspended above

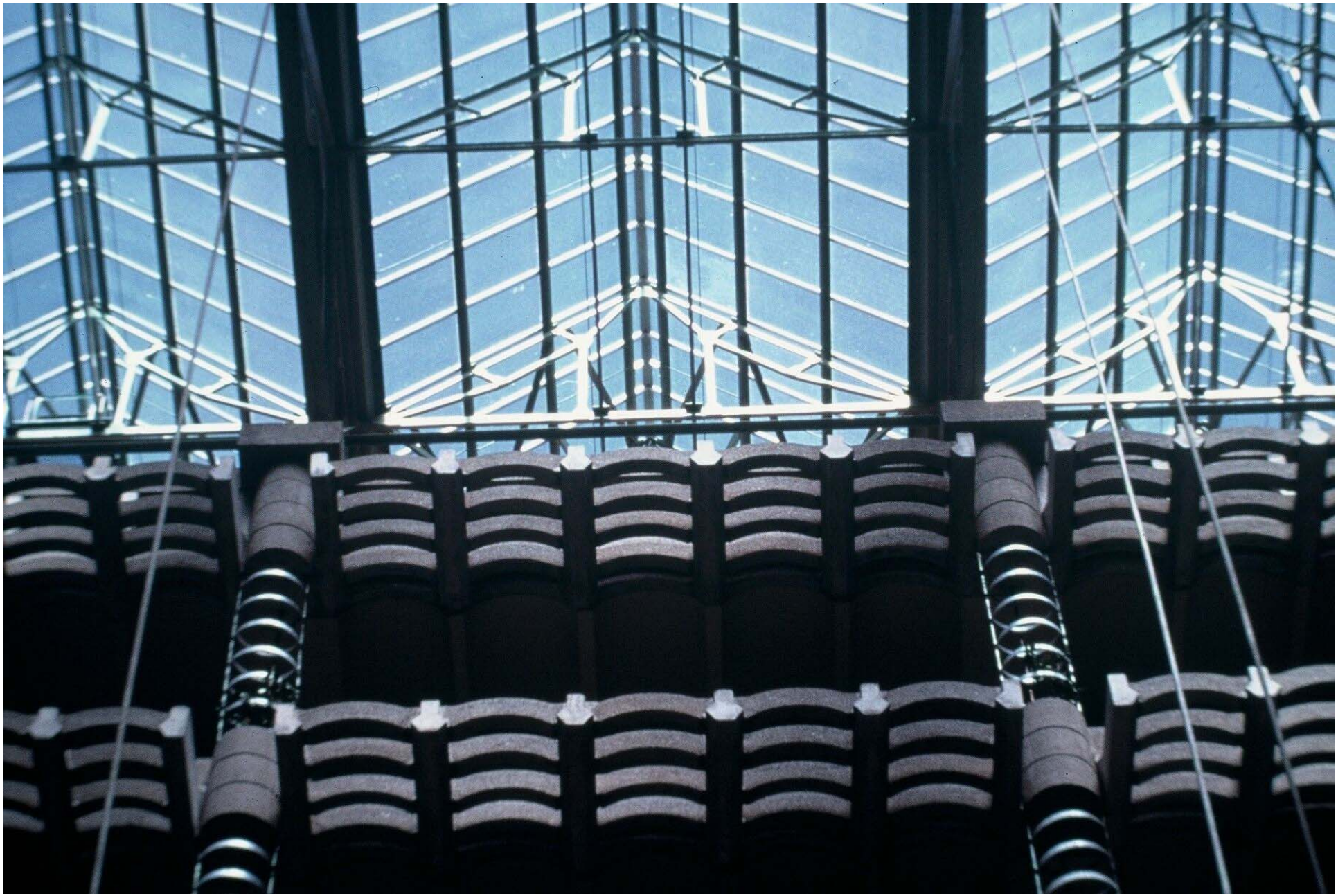
- Atrium looking west



Atrium at sky walk level

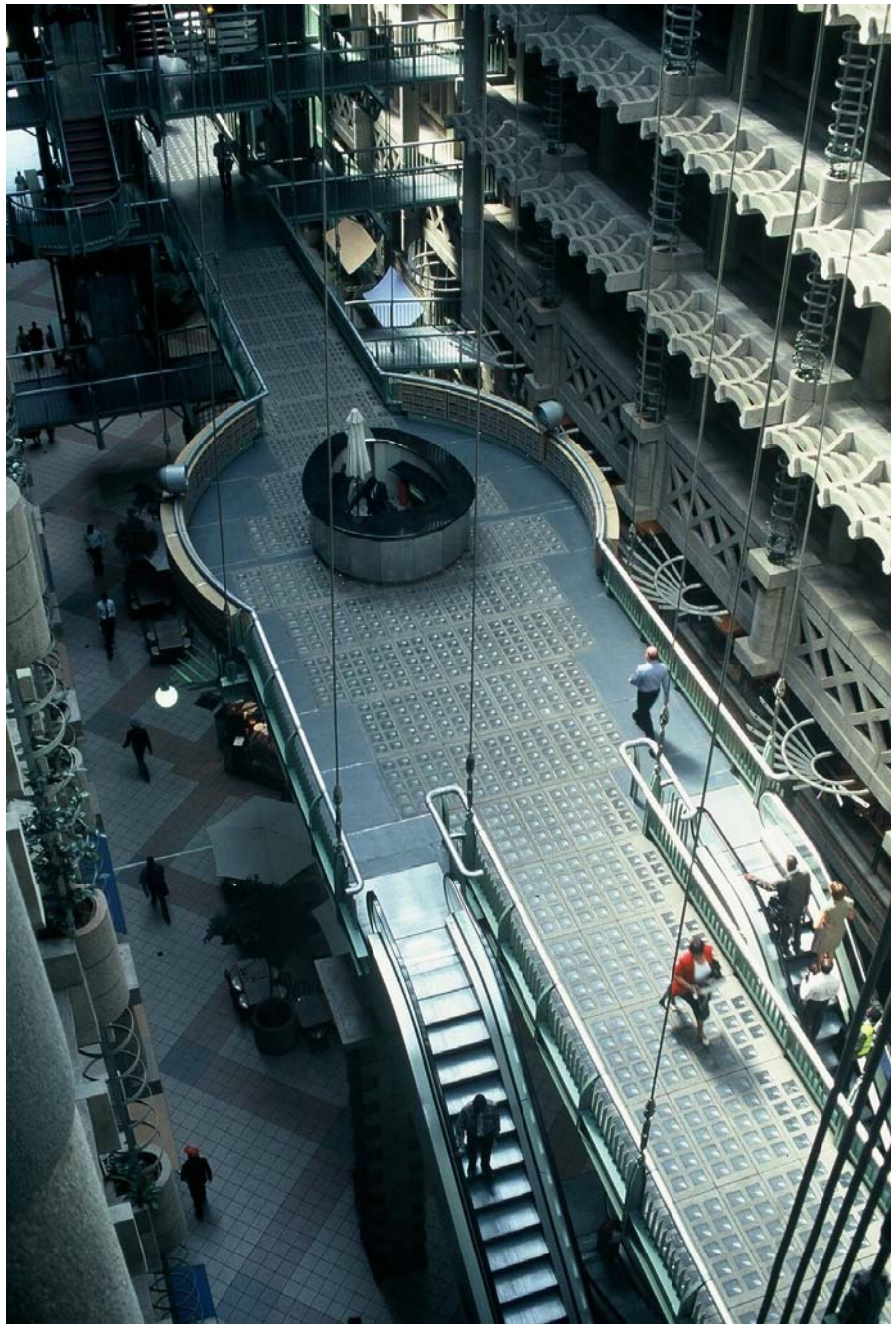
Juxtaposed to the stone architecture in the atrium is the steel and glass aesthetic, referring to the settler's mines development and since 1880



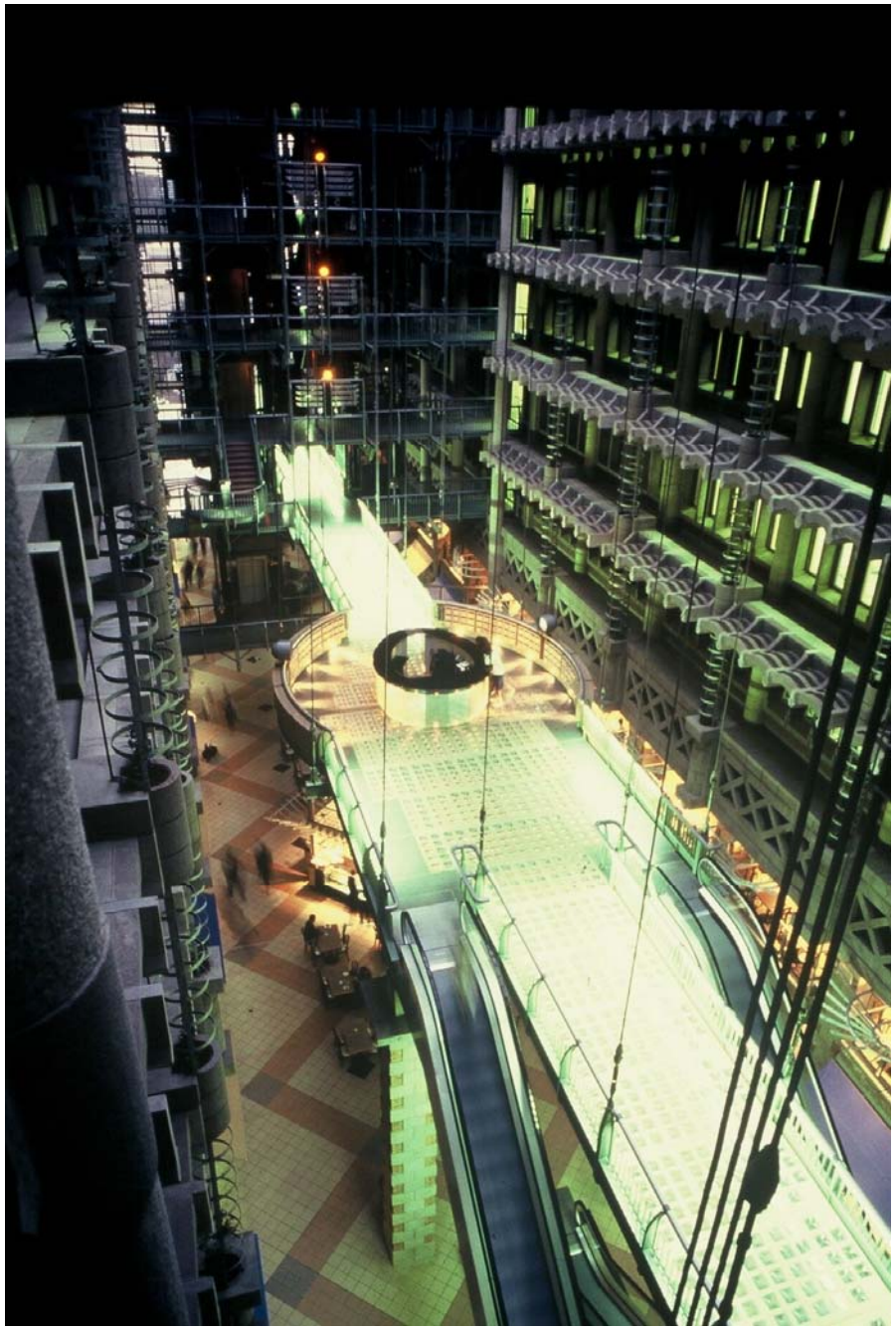


- Glass roof over the atrium

- Steel suspension bridges hanging from cables.



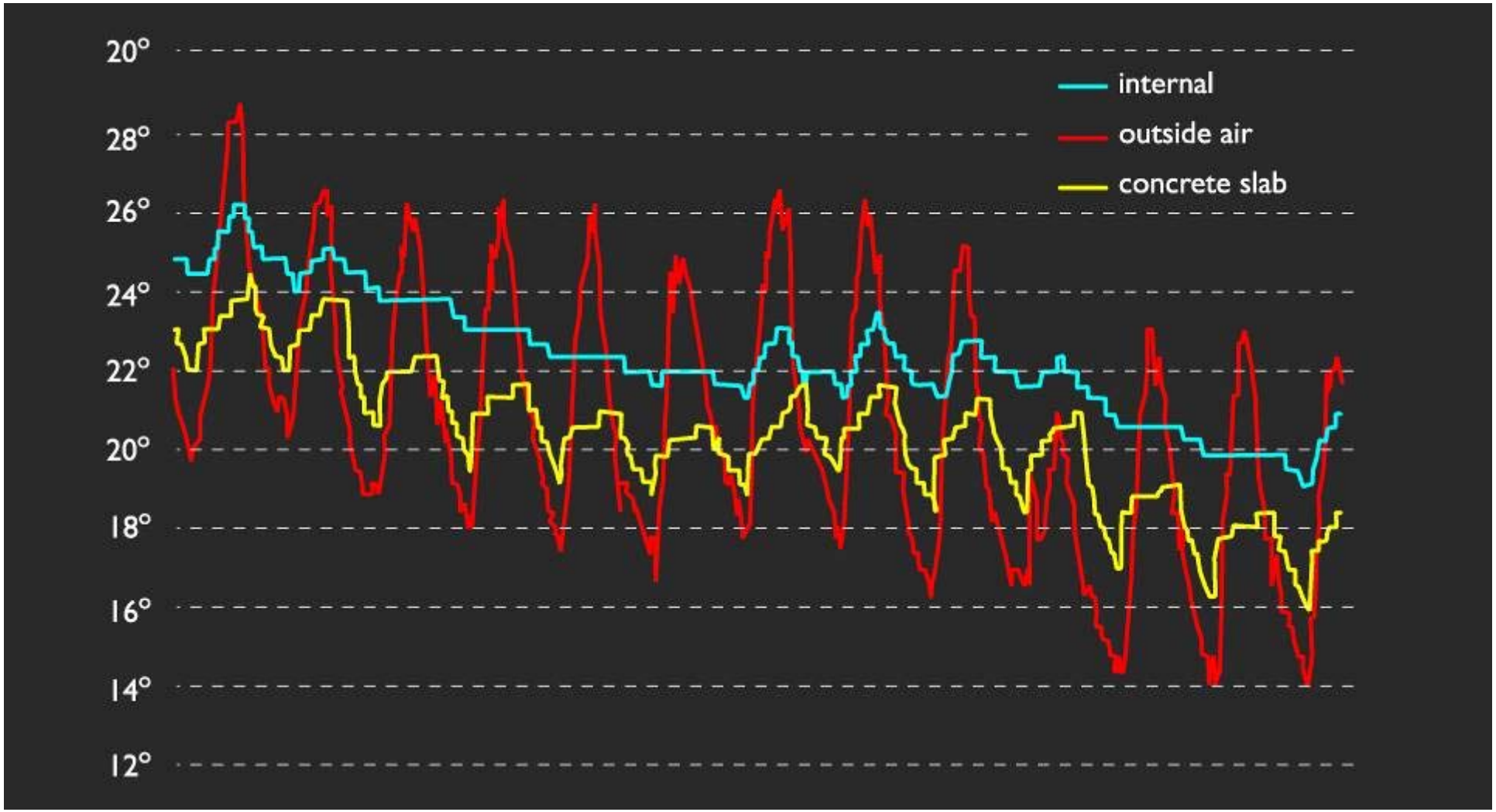
- Atrium by day



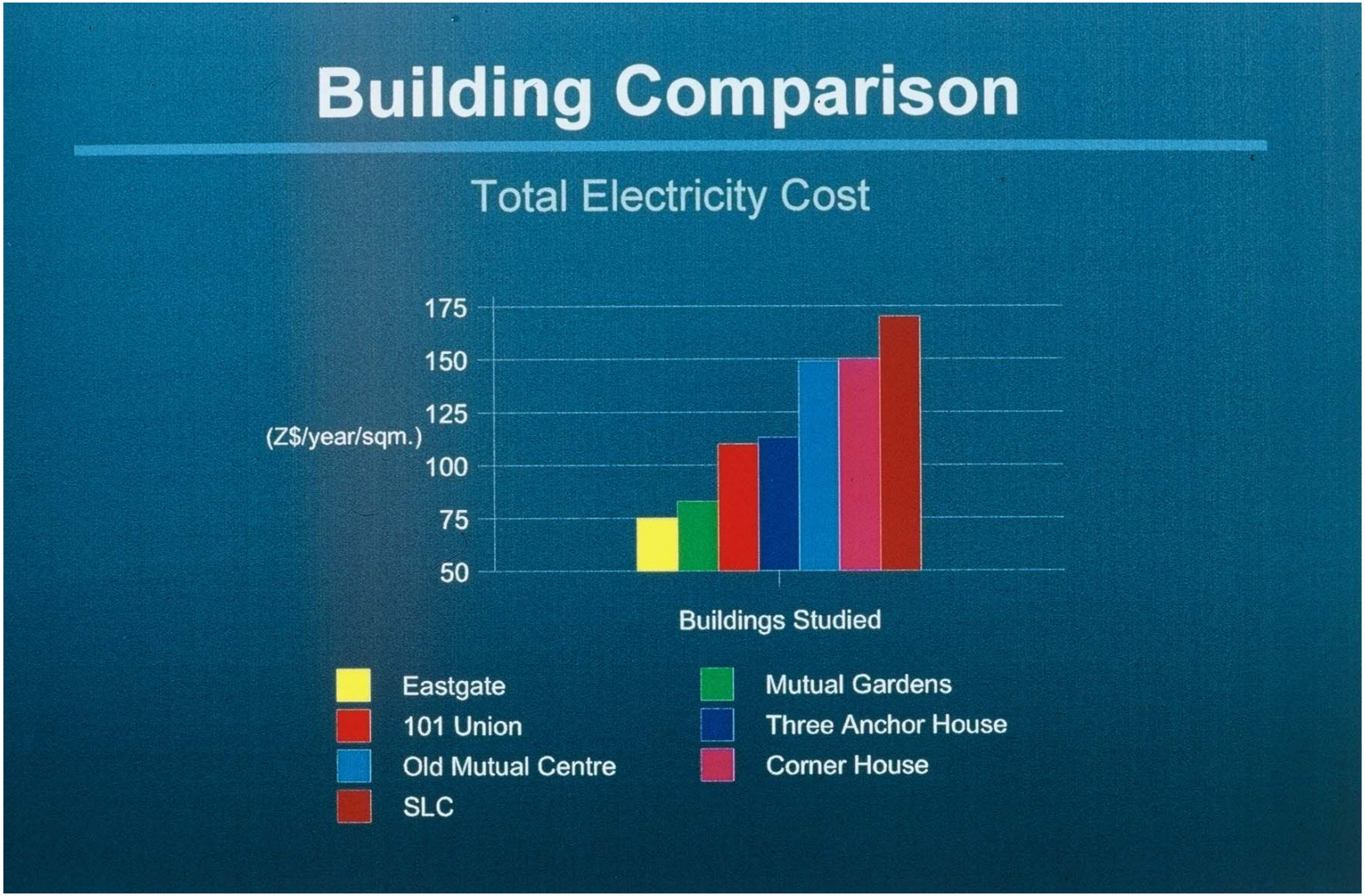
Atrium by night

- View from green bridge looking East

Degree of internal cooling achieved



Eastgate, Harare
daily readings for the month of April 1998



- Cost of electricity at Eastgate compared with six other recently-built office blocks


RAILLESS HOTEL