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Preparation Sustainable Architectre For Energy Self-Sufficiency

Doha Mohamed, Engy Atef, Ehab Hanafi Mahmoud

Abstract— Working our buildings into the cycle of nature will return architecture to its very roots. In recent projects for offices in the world, the specialists make efforts to explore the idea of energy self-sufficiency. This paper describes how the implementation of sustainability will revolutionize the form of buildings and how architects in order to humanize and beautify their buildings could exploit this approach.

Index Terms— Architecture – Sustainable - Environments – Energy – New material – Self sufficiency

1 Introduction

THE typical commercial office block, conceived during an era when the use of cheap energy was the accepted way of meeting modern standards for working conditions, was designed to create a sealed internal environment that operated despite, rather than in conjunction with, the natural environments. This high-energy approach led to the creation of buildings with deep cross-sections and highly artificial internal environments.

These buildings, densely occupied floors, together with the intensive use of computers and other machines, generate vast amounts of heat, requiring powerful equipment to extract the hot, stale air and pump in fresh, chilled filtered and humidified air. In addition, the windows are so far from most people's desks that they need artificial lighting throughout the day.

Figure 1 Autonomous house research project Aspen, Colorado

Changing our technologies and our expectations can reduce the energy consumption of a building- and halving the energy used by buildings would reduce overall global energy consumption by a quarter (Ref. 1).

At home and in old buildings, for example, we readily tolerate seasonal temperature variations. If today's office users, instead of insisting on a year-round temperature of 20 C, were also to accept mild seasonable variations, the building could be opened up to the outside environment and its reliance an air-conditioning significantly reduced.

These practices can reduce energy consumption yet still provide a controlled environment. Architects are now relying less on "active" high-energy technologies solutions and are beginning to explore "passive" technologies which use renewable energy from natural resources such as plants, wind, sun, earth and water, as shown in figure 1.

New Forms For Sustainable Architecture

2.1 Inland Revenue building – Nottingham

In this building, low-energy building was specified. Architects responded by investigating all the means available in nature for producing a temperate environment without resorting to mechanical systems and high-energy consumption (Ref.2). Two sides of the site were polluted and noisy. However, the other sides bordered a quiet canal, so the architects pushed the building to the edge of the roads and opened up a small public garden beside the canal. The basic administration was placed against the road, with social functions and communal facilities nestling around the new garden at the canal front, as shown in figure 2

The administration building was protected from the pollution and noise of the road by a meter-wide double-glazed wall, into which windows could be opened for ventilation. Between the two buildings the architects created a landscaped courtyard rather like a small ravine. The two rows of buildings were linked across this gently curving landscape by glazed bridges. This courtyard was not only the visual focus of the buildings, but also produced a micro-climate that conditioned the external air used to ventilate the buildings. An average tree, for example, absorbed carbon dioxide, gives off oxygen, transpires 380 liters of water a day and purifies the air in its vicinity (Ref.3). In summer, trees together with water, shrubs and plants compose a landscape that filters pollution, humidifies and cools the air.

Slimmer buildings allow more people to have windows close at hand, and reduce the need for artificial lighting. Inside the building, air that enters through operable windows can be circulated without using mechanical fans by shaping the ceilings and roof aerodynamically and by connecting floors to a large space or atrium: as the air in the atrium rises in temperature, the "stack effect" pulls air upwards, sucking the stale air out of the peopled spaces. Buildings that are divided by an atrium can contain large floors, with good visual contact between people and healthy ventilation.

Figure 2 Inland Revenue competition proposal.

The roof profile can be shaped to respond and in some case trap prevailing winds. Here, we can note that in certain climates and conditions this can increase the natural draw of air out of the building and produce comfortable environmental conditions without the need for high-energy mechanical cooling systems.

2.2 Law courts – Bordeaux

Law courts that are designed in the city centre of Bordeaux apply similar principals of natural ventilation in a hot European climate. The need for good circulation of fresh air in the courtrooms influenced the design of their shape. They function and look rather like Oast-hours: letting air in from below and light but little heat through a small efficient skylight. Heat from the sum at the top of the courts increases the stack effect and generates enough air movement to dispense with mechanical fans. Before the air enters the courtrooms it crosses an external pool and is cooled and humidified. The public hall in which the seven courtrooms stand is shaded but fully glazed (Ref.4).

The hall draws its air across the pool, but also cool energy from constant-temperature groundwater that is circulated through heat exchangers. This natural air-conditioning system is part of an architectural competition that provides views and reflections for that inside and that can also be seen and enjoyed by those on the outside, as shown in figure 3.

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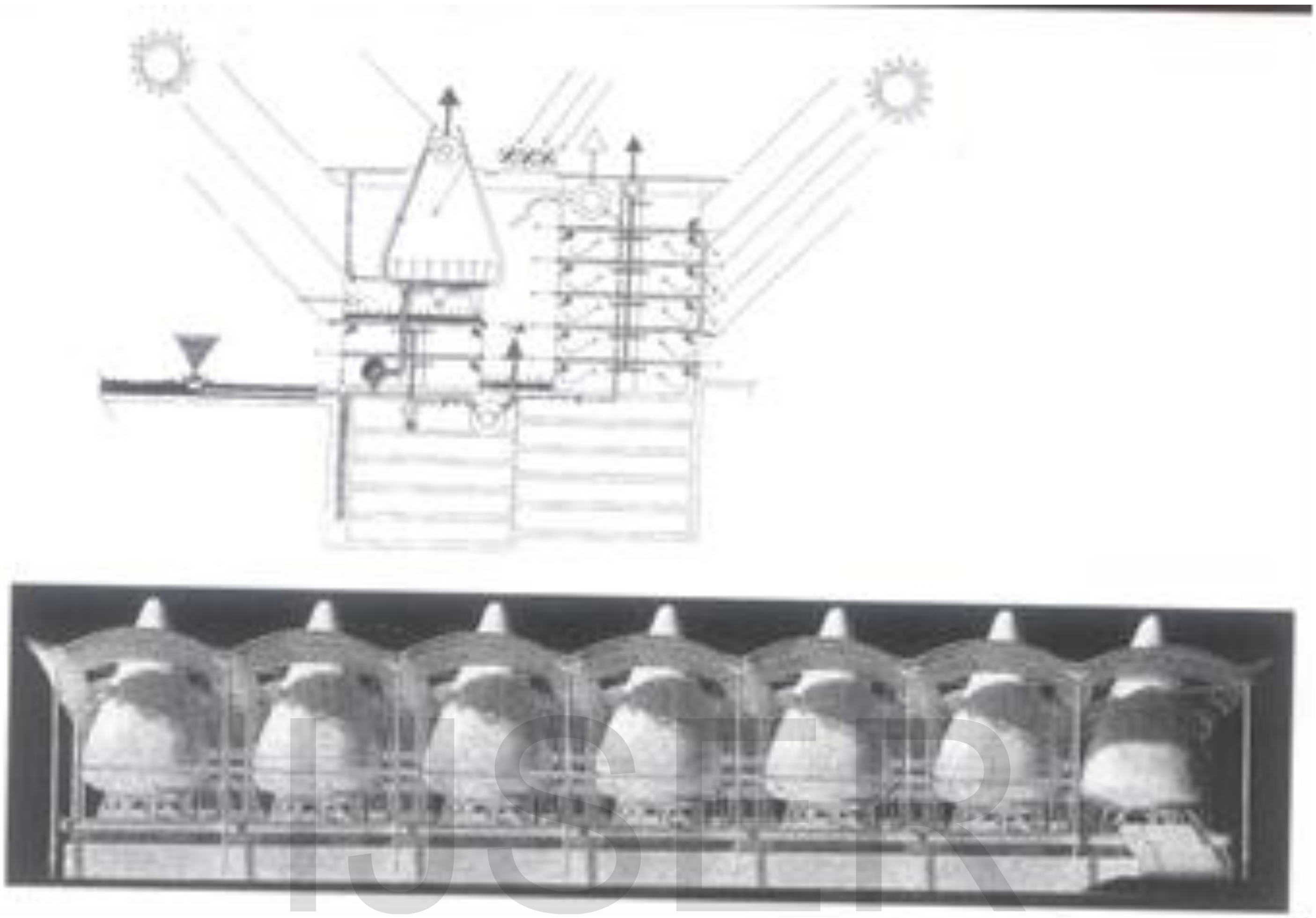

Figure 3 Law courts in the city centre of Bordeaux

2.3 Lloyd’s of London – London

The “cool energy” of night air can be stored in the internal structure of a building. The Lloyd’s of London Market building, for example, has both a glazed triple skin for insulation and an exposed internal concert ceiling that absorbs cool energy overnight and sheds it during the day.

This exploitation of the thermal mass of a building reduces the need for artificial cooling during day-time occupation. These techniques are merely reinterpretations of devices that have been used for thousands of years.

The way a building faces in relation to the sun is vital to the design of a low-energy building. Low- energy techniques commonly reduce the total commercial energy consumption of a building by between a half and three-quarters, as shown in figure 4.

The concept of a glazed double skin can be expanded to enclose an entire building in the layer of air, providing an all-enveloping glass ”chimney”.

Two glass skins reduce the impact of pollution and noise on a building (Ref.5), and allow windows built into the inner skin to be opened onto the transparent vent.

From these, stale air is drawn out by stack effect and by prevailing winds flowing over the outer surfaces of the building.

In summer the vent can be opened to increase the airflow and shad as much heat as possible. In winter the system is closed down to increase insulation and trap heat.

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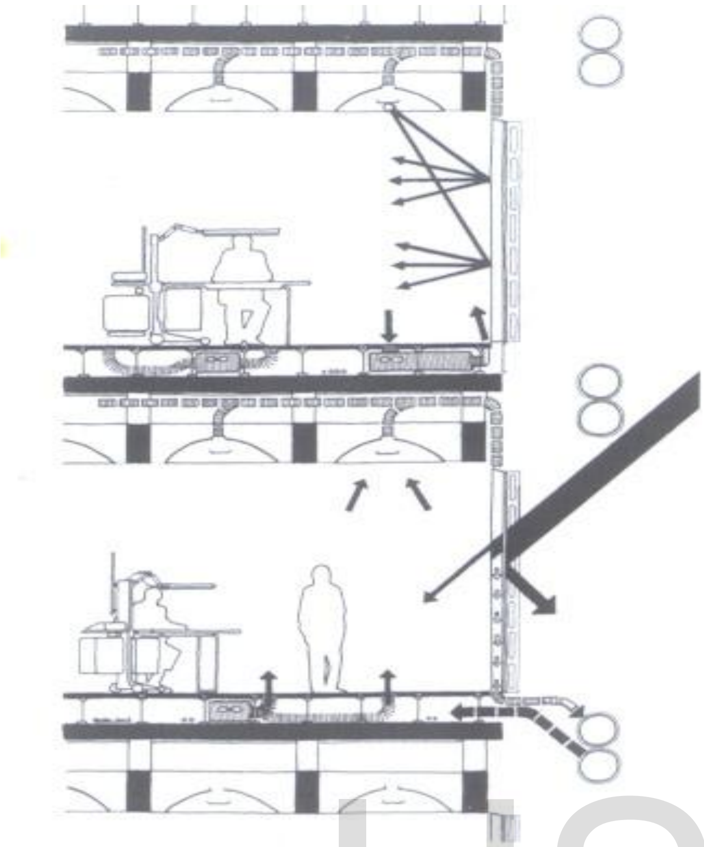

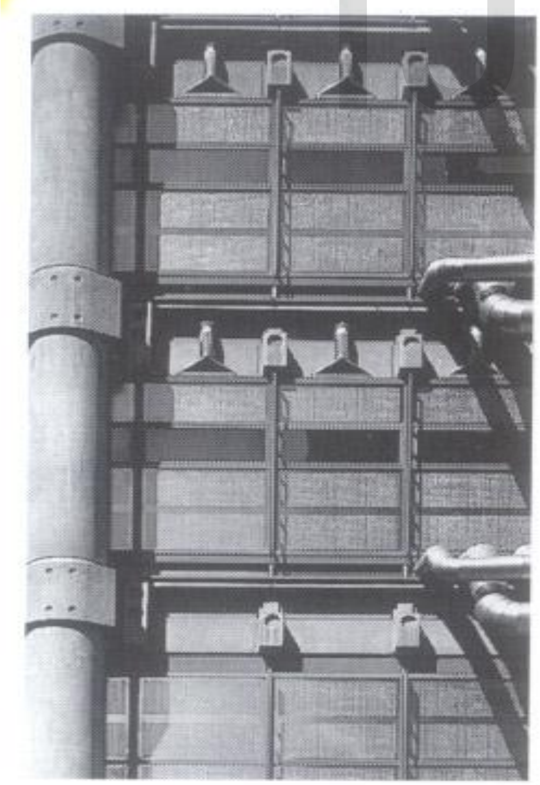

Figure 4 Lloyd's of London.

Figure 5 Lloyd's of London, interior.

2.4 Conference Centre – Tokyo – Japan

On a much large scale, a competition project for a vast conference centre in the heart of Tokyo illustrates how looking beyond the confines of the brief to the broader context can generate new forms of public space and new forms of architecture. The brief specified three enormous conference halls. The designers assessed the impact that such a mega-centre would have on the already congested site. Their conclusion was that, far from needing more building at ground level, the area-which was totally deprived of public space – would be better served by a series of open spaces offering room for public activities, for people simply to slow down and meet (Ref.6)

The buildings six stories up, freeing the entire level and creation great covered outdoor spaces for public use. The work was on a structural solution that could suspend these great halls and meet the tremendously stringent anti- earthquake regulations governing all construction in Tokyo.

Three giant silver capsules containing the conference halls, with room for 10,000 people, were suspended like ships in dry-dock over sheltered public space. Access to the halls and their roof gardens were by glazed travelator tubes that criss-crossed above the public spaces. The open plazas were stepped down from the street level and ringed with cafes, exhibition spaces, restaurants, cinemas and shops.

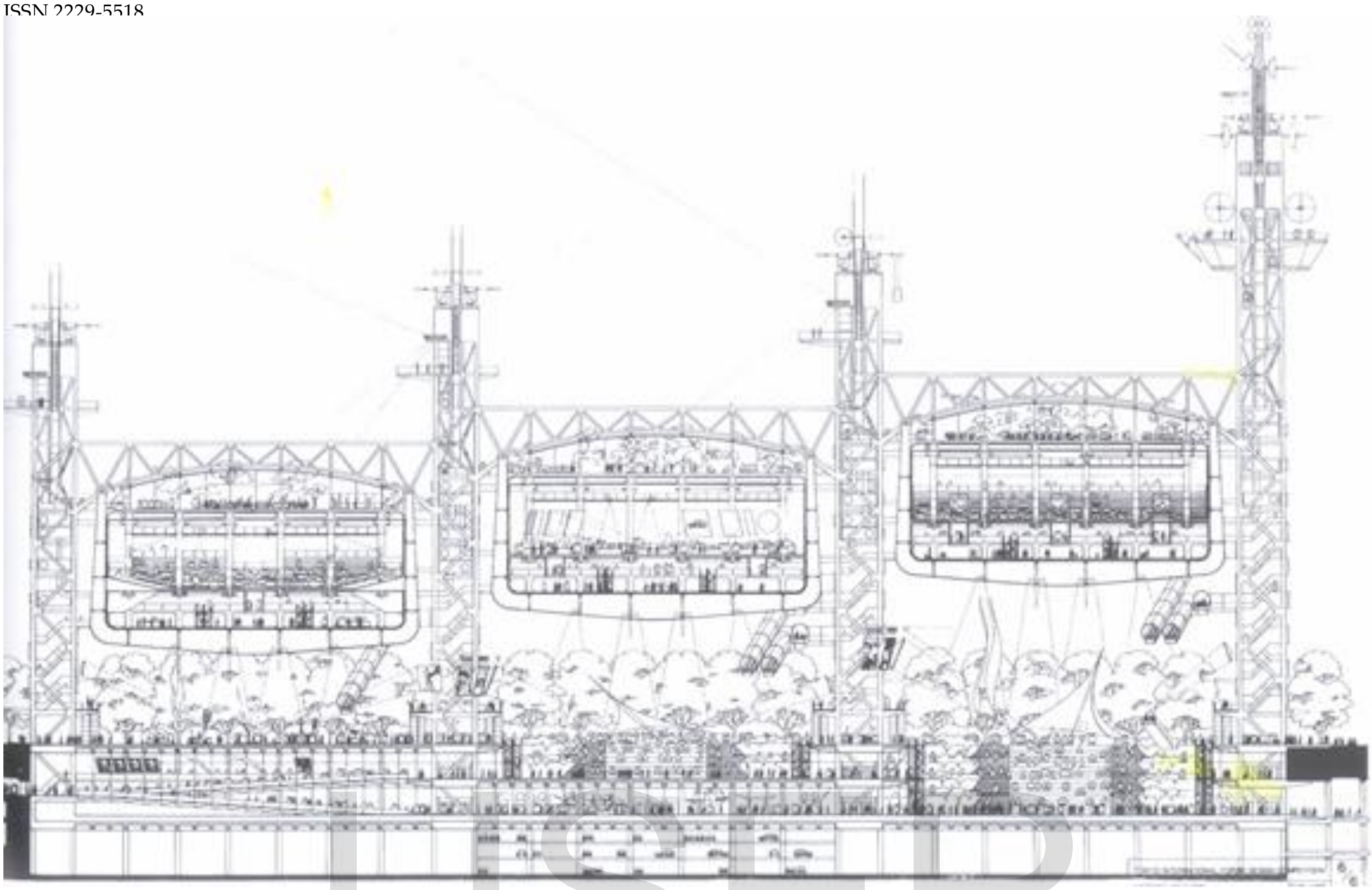

Figure 6 Tokyo Forum, Richard Rogers Partnership

3 ANALYSIS

3.1 Law courts

The courtrooms are shaped by the need encourage natural ventilation and provide good day lighting without generating unacceptable levels of solar gain.

3.2 Inland Revenue

The roof profile is streamlined to encourage prevailing winds to draw air out of the building, thus reducing the need for mechanical ventilation. Landscaped enclosures filter and humidify fresh air before it enters the building.

3.3 London

Triple glazing provides a highly insulated skin to the building. Heat from within the window depth, generated by the sun, is drawn out and stored in basement tanks, reducing the need of cooling office spaces. Translucent glass screens reduce solar gain and create a wall of light. Openable clear glass panels give the individual occupants control over their environment.

3.4 Tokyo Forum

A proposed new twenty-four hour meeting place for the people of Tokyo, a major extension of the public realm created by suspending the three giant halls in order to give the entire street level over to public use.

4 CONCLUSION

- New technology is giving buildings increasingly sensitive electronic, able to register internal and external condition and respond to specific needs. New materials exist that can generate power, that can change from high insulation to low and from opaque to transparent, that can react organically to the environment and transform themselves in response to daily needs and seasonal cycles.

- Buildings that are easy to modify will have a longer useful life and represent a more efficient use of resources. But designing flexibility of use into our buildings inevitably moves architecture away from fixed and perfect forms.

- The public projects show how buildings can interact with the public domain. When buildings contribute to the public realm, they encourage people to meet and converse. They stimulate rather that repress people’s natural human potential. They humanize the city.

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Eng. Doha Mohamed Saed Ahmed
M.Sc., B.Sc.
- *Ass. Lecture in Architecture Department, currently pursuing PH.D. degree program Cairo University, Egypt*

Eng. Engy Atef Abdul Mo'ty
B.Sc.
- *Lecture in Architecture Department, currently pursuing M.Sc. degree program Cairo University, Egypt*

Prof. Dr. Ehab Hanafi Mahmoud
PH.D., M.Phil, M.Sc., B.Sc.
- *Head of the Architecture & Civil Branch, MTC, Cairo, Egypt*
- *Head of the Architecture Department, MTC, Cairo, Egypt*
- *RMCS, Cranfield University, England, UK*
- *International Advisor CI-Premier, Singapoure*
- *Member, Research Town Plnning Institute, RTPI, England, UK*
- *Cosultant for Industrial and Residential Buildings*