

Internationales Joint-Venture Seminar

Mit
**Integrated Sustainable
Urban Design
Masters**
-
IUSD, Univ. Stuttgart

**Lectures
Tutorials
Workshops**

Prof. Matthias Rudolph
LBA Christian Degenhardt (IUSD)



MSc
*Integrated Urbanism
& Sustainable Design*
(IUSD)



Staatliche Akademie
der Bildenden Künste
Stuttgart

Master of Arts in Architecture

**Climate
Responsive
Design**

Seminar

23/24

Neubau 1

HS 301 + R 208

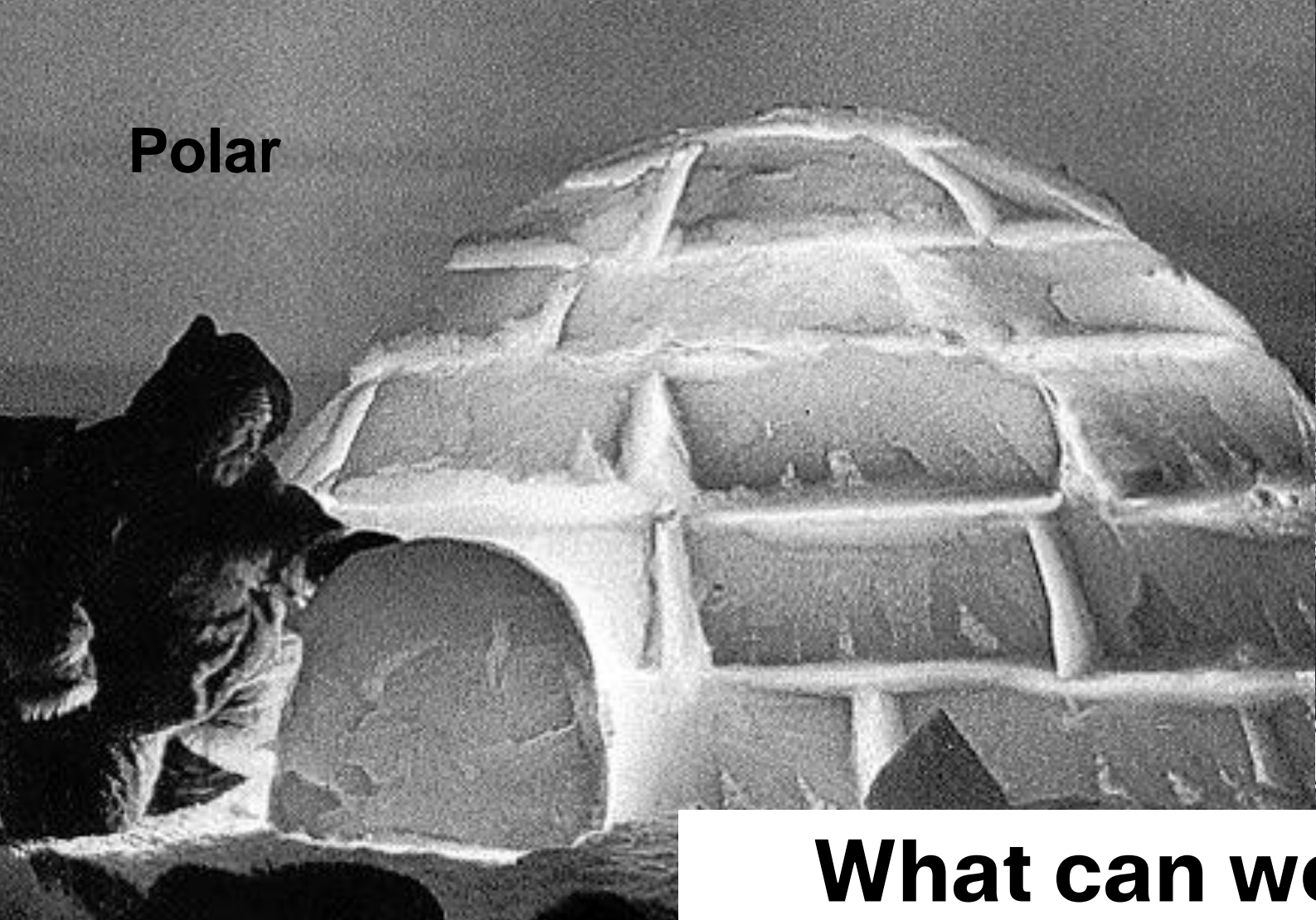
Fr 13:00 - 17:00

How can Climate influence design?

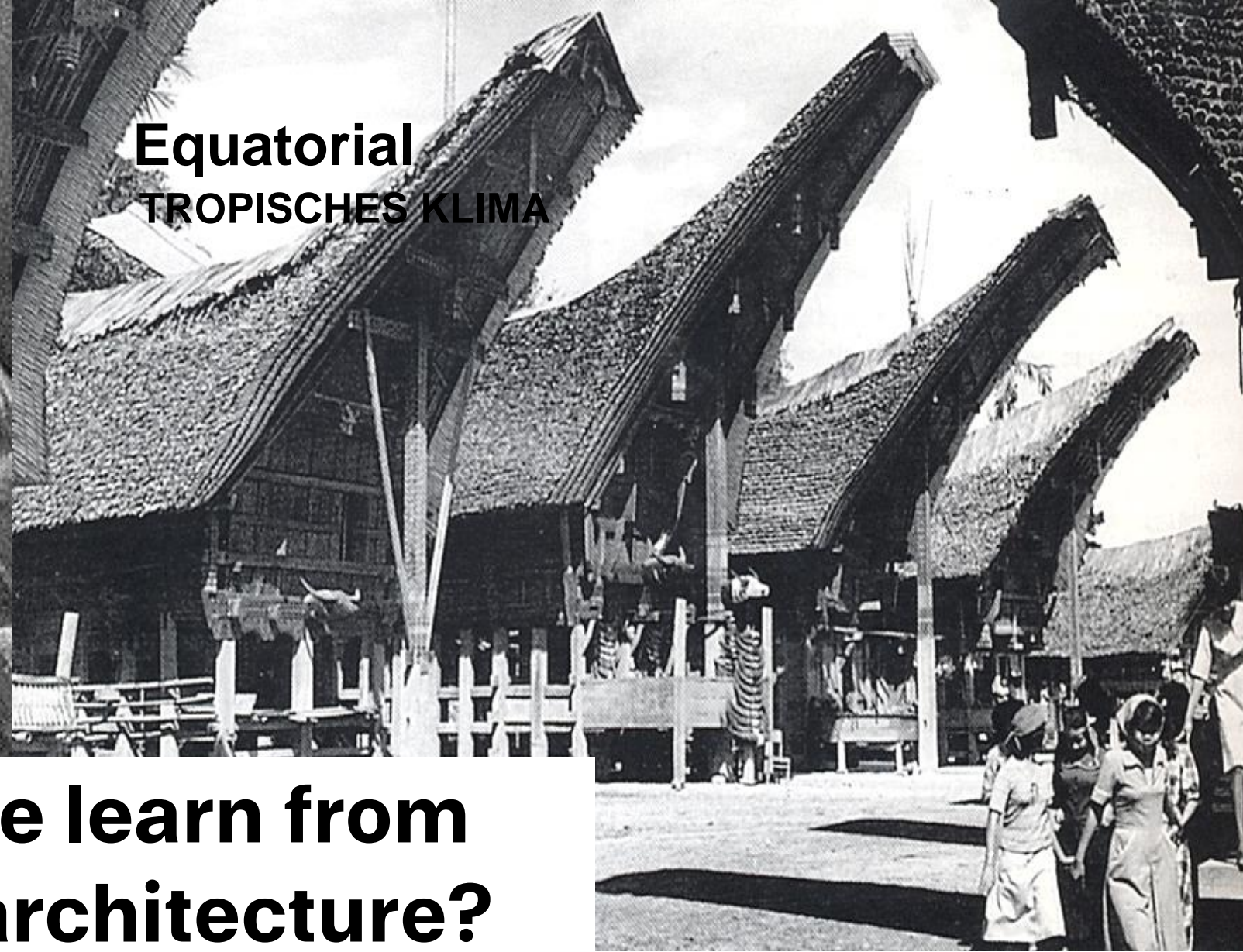


French School, Damascus Syria
Architect: Ateliers Lion - France, Paris

Polar



Equatorial
TROPISCHES KLIMA



What can we learn from vernacular architecture?

Arid
WÜSTENKLIMA



Typische, traditionelle Wohnhaus- und Dachformen verschiedener Regionen

kalt



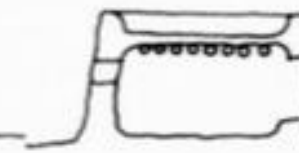
a

gemäßigt



b

trocken



c

tropisch



d

Climate as design parameter for Sustainable Architecture



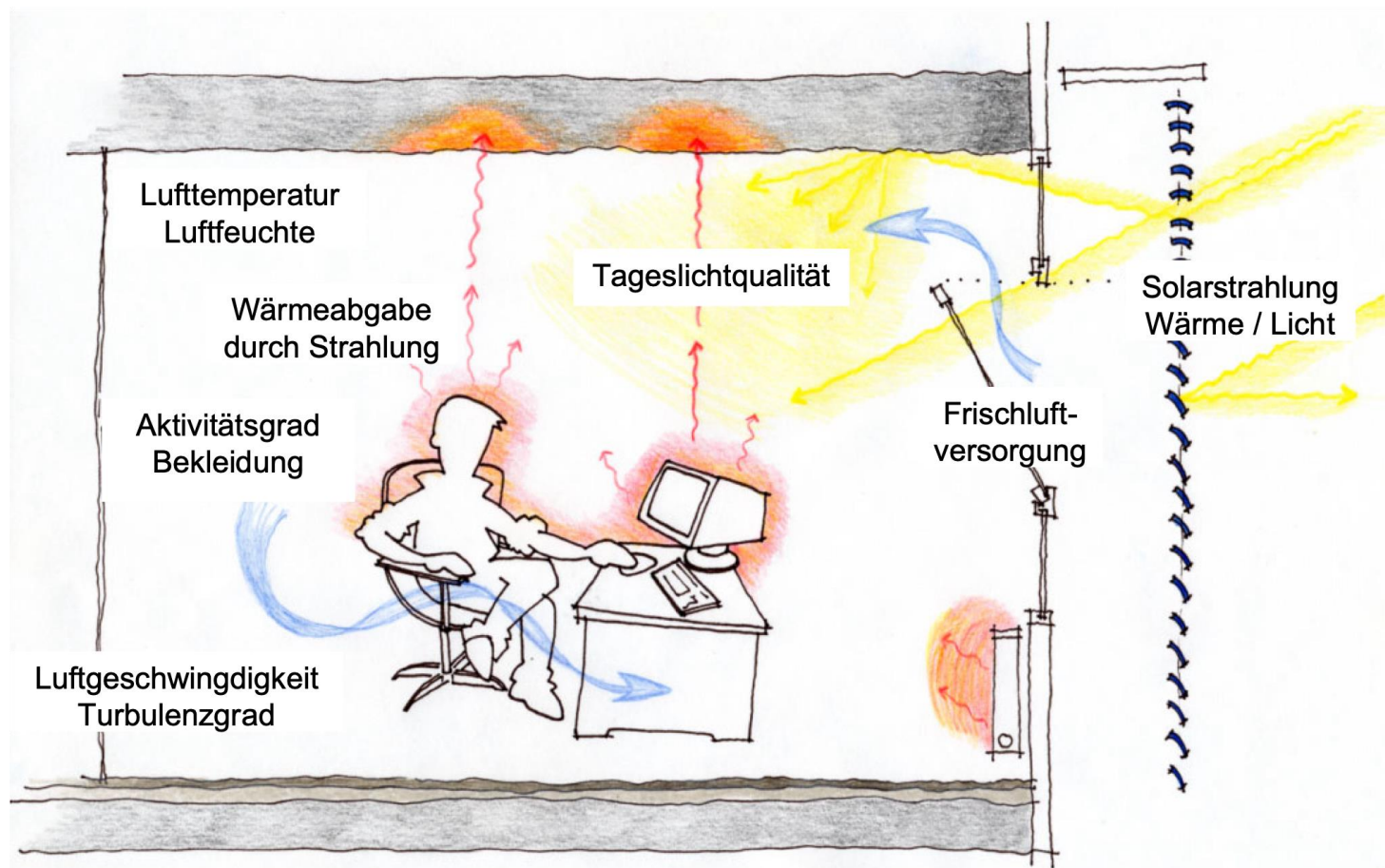
Köppen-Geiger Climate Classification

Af	Am	As	Aw	equatorial
BSh	BSk	BWh	BWk	arid
Cfa	Cfb	Cfc		warm temperate
Csa	Csb	Csc		
Cwa	Cwb	Cwc		
Dfa	Dfb	Dfc	Dfd	boreal
Dsa	Dsb	Dsc	Dsd	
Dwa	Dwb	Dwc	Dwd	
EF	ET			polar

Source: koeppen-geiger.vu-wien.ac.at
(c) Kotttek et al. (2006), Rubel et al. (2017)

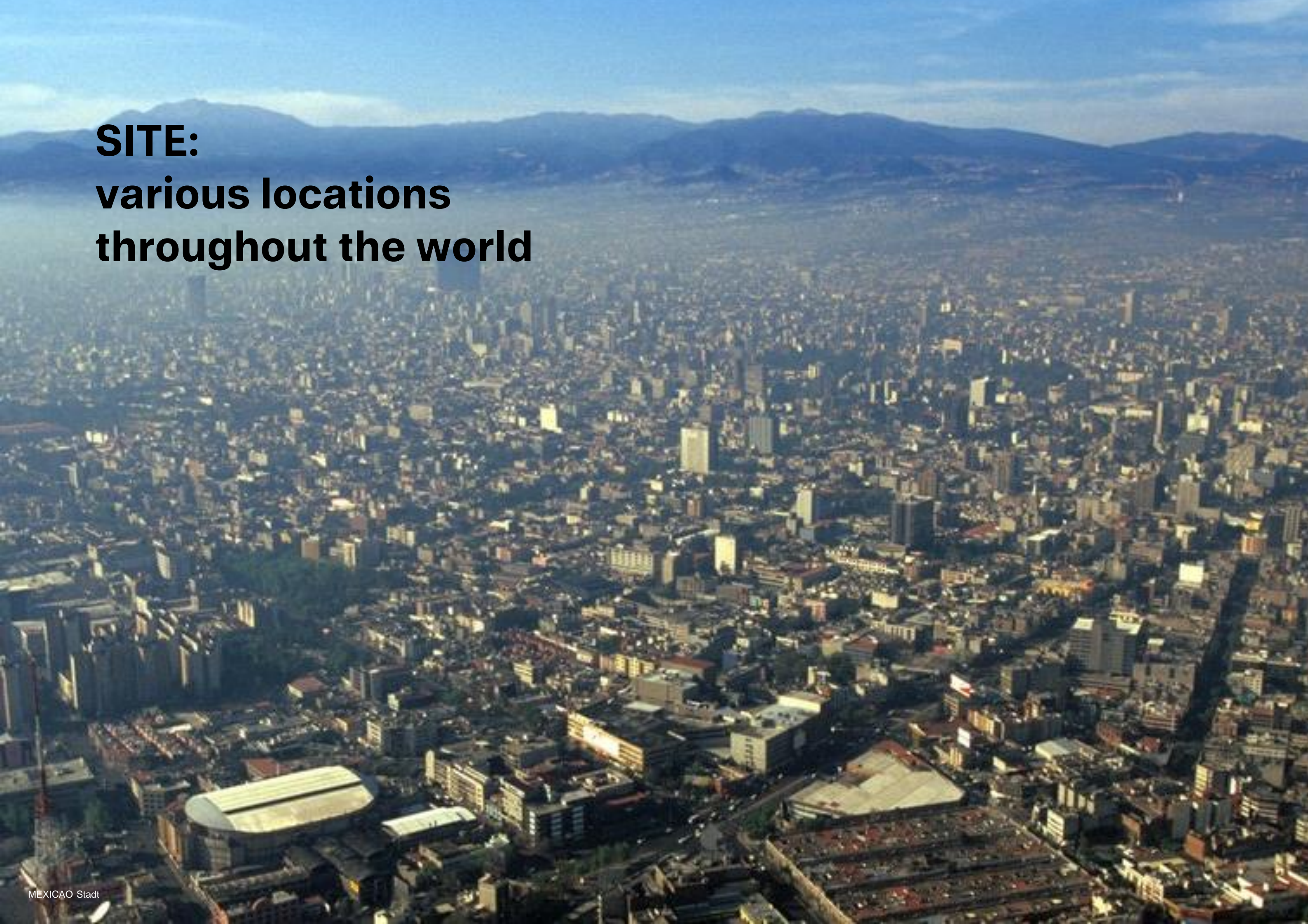
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Image IBCAO

How can we take advantage of local climate and site conditions

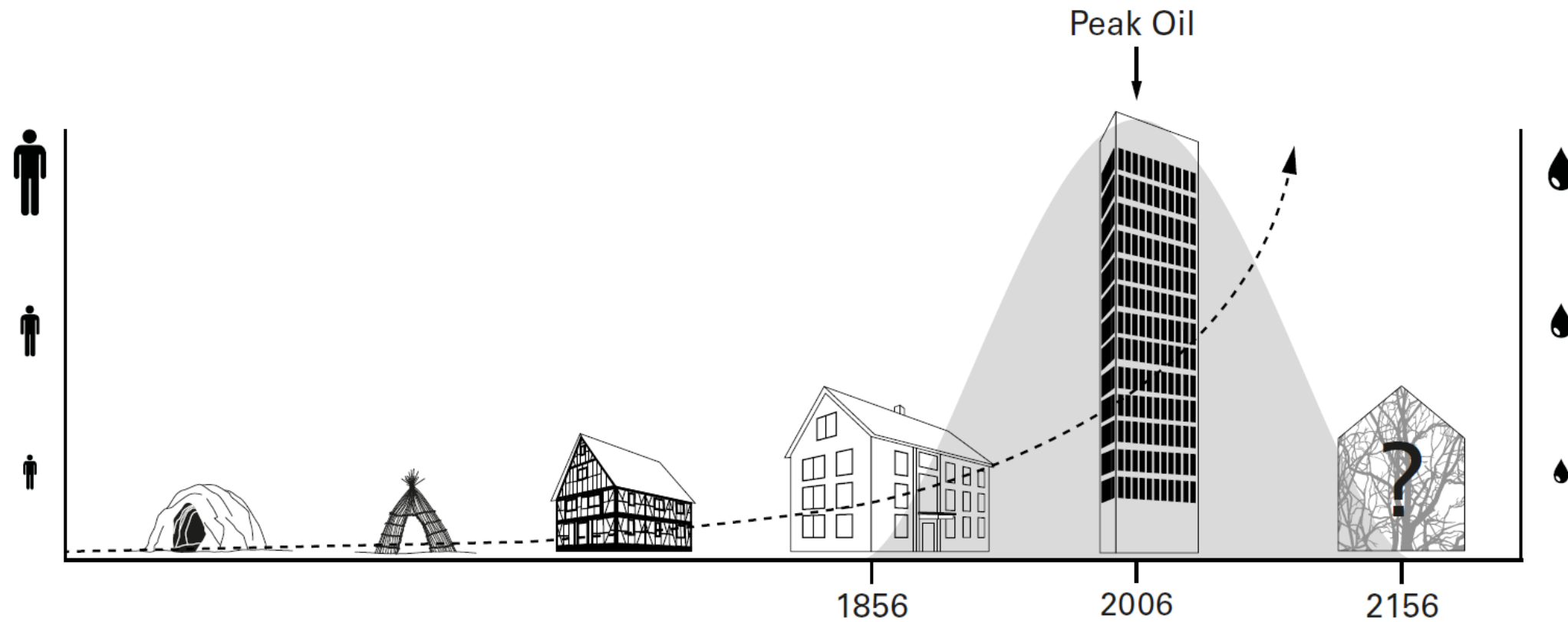


maximize user comfort
but **minimize** the environmental impact ?

**SITE:
various locations
throughout the world**



New Vernacular?



Investigation on the **interplay** between location, ecology, material, space and form.

Applying climate responsive design principles leads to buildings that **inherently** contribute to the local architecture and cultural identity.

International & Interdisciplinary Teams

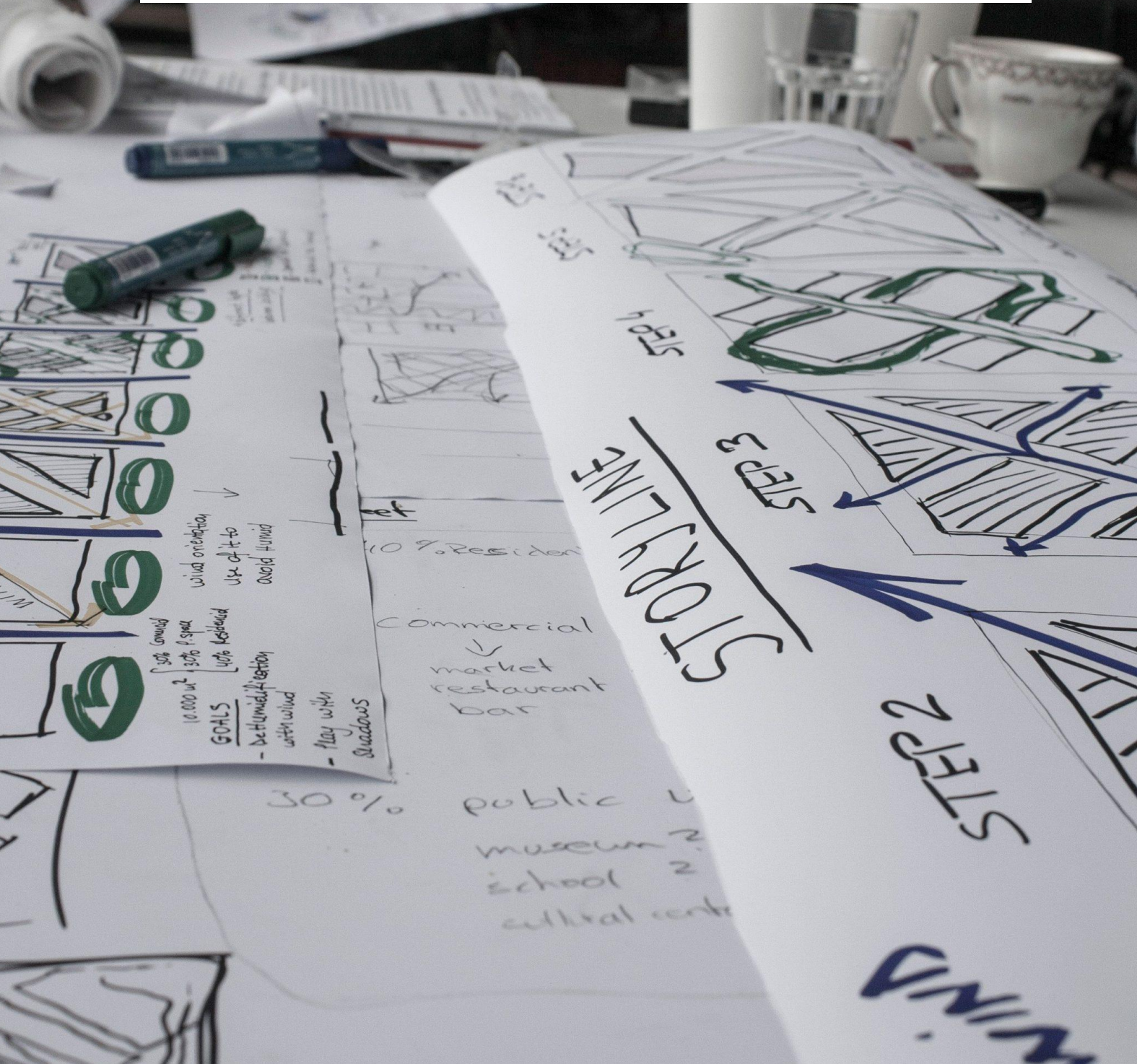


Teams 2021



Teamwork & Workshops

- Analyse
- Strategien
- Entwurfskonzept



- Standort und Klimaanalysen
- Climate Responsive Design
- Sustainable Architecture



Hyderabad's Sunshade Cooling Blocks

Sustainable urban development to reduce the heat gain and improve the livability and comfort of spaces

HYDERABAD, PAKISTAN

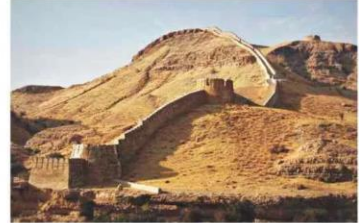
Province: Sindh
 Location: 25.392° N latitude / 68.374° E longitude
 Topography: elevation of 10 meters / east bank of Indus River
 Area: 293 km²
 Population: Total 3,429,500 (2014)
 Density: 11,000/km²
 Climate: hot desert climate
 Language: Urdu, Sindhi, English
 Religion: Muslims, Hindus, Christians

OVERVIEW 8th largest city in Pakistan and the 2nd largest in the province of Sindh, rich with culture and tradition. In economy, it is an important commercial center where industries include textiles, sugar, cement, manufacturing of mirrors, soap, ice, paper, pottery, plastics, tanneries, hosiery mills. The major commercial center for the agricultural production of the surrounding area, including millet, rice, wheat, cotton, and fruits. The city is the largest bangle producer in the world and serves as a transit hub between rural and urban Sindh. It is also the home of the oldest universities in the region, the University of Sindh, the Shaheed Bazar Hyderabad, the largest Bazar in the entire world and the Ram Kot, one of the largest walls of the world and the largest wall of Asia. It is located in the province of Sindh and goes through Hyderabad.

HISTORY In 711, Arab general Muhammad bin Qasim conquered Sindh, bringing South Asian societies into contact with Islam. Mian Qutub Shah Kalhor of the Kalhor Dynasty founded the city in 1768. A formal concept for the city was laid out by his son, Sarfraz Khan in 1762. In 1768 he ordered a fort to be built on one of the three hills of Hyderabad to house and defend his people. The fort was built using fire-baked bricks, an account of which was named Paccu Qiloh meaning the strong fort, which spread over 145,700 m². Tappu Mir delisted Kalhor's and called the city during that time, the metropolis became famous for culture, literary, educational, commercial and trade activities. 1843 British took control on the city and demolished the royal places of Talpurs schools, universities, historical buildings, Railway infrastructure and hospitals were built, and 100 years later, in 1947, Hyderabad obtains its independence. After that, it became a city of different cultures and rituals. The dark era of early 1900's when city was isolated in blood bath, ethnic riots and civil war between native Sindhis and Urdu speaking settlers, political and religious strikes damaged Hyderabad's economy and social environment.

CULTURE AND CLOTHING Men wear Kurta and shalwar while women wear Dupatta with kameez shalwar to show the attachment with religion. This kind of clothing also protects them from the direct radiation of the sun. Most of the youth do western clothing. The evergreen tradition of Hyderabad is that, girls and women wear bangles. The bangles of Hyderabad became famous as two migrates families from Poroband, India, settled in Hyderabad, who were skilled in making Bangles.

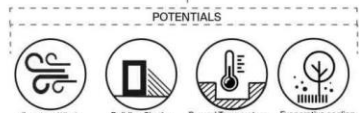
RAM KOT FORT THROUGH HYDERABAD



COMMERCIAL STREETS IN HYDERABAD



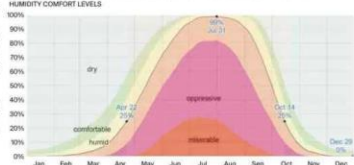
ANALYSING CHALLENGES AND POTENTIAL



CLIMATE In Hyderabad, there are only two seasons: summer and winter. The temperature in Hyderabad typically varies from 12°C to 44°C and is rarely below 9°C or above 44°C, the summers are muggy or arid, and windy, the winters are short, comfortable, and dry.



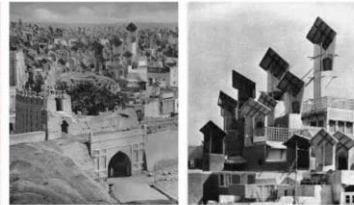
SEASONS Winter is short which only last for 2.2 months, from December to February. On the other hand, the rest of the years are summer season, the hottest period showed up from April to July which last about 3 months. The daily temperature in Hyderabad is usually extreme, it could various up to 10°C, from day to night time. During two months, Hyderabad has a rainy season that changes the weather from dry to humid.



TRADITIONAL SKYLINE OF THE CITY

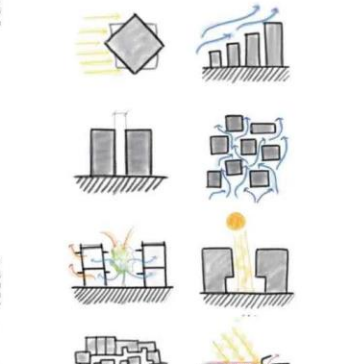


WIND CATCHERS

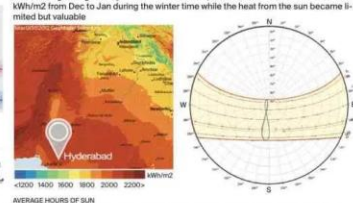


KEY QUESTIONS AND BASE STRATEGIES

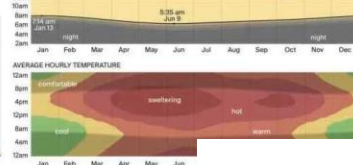
1. HOW TO MAXIMIZE THE SHADING AREA TO BRING COMFORT TO PUBLIC SPACES, BUT STILL RECEIVE ENOUGH DAYLIGHT IN BOTH, URBAN AND BUILDING SCALE?
2. HOW TO INTRODUCE NATURAL VENTILATION WITHOUT EXCESSIVE EXPOSURE TO HEAT?



SUN RADIATION AND SUNPATH Hyderabad could receive remarkably solar radiation throughout the whole year, which is about 2200 kWh/m², especially from the Apr to Jul, when the average of solar radiation is higher than 6.9 kWh/m²; the whole area could be over heating during the daytime in the other hand, the solar radiation is lower than 4.9 kWh/m² from Dec to Jan during the winter time while the heat from the sun became limited level available.



HOTTEST AND COLDEST DAY The hottest day of the year is windy and muggy, the daily temperature various from 26°C to 41°C, humidity is oppressive during night time. The coldest day of the year is calm and dry, the daily temperature various from 12°C to 24°C, the humidity is comfortable through out the whole day and around 15°C at night.



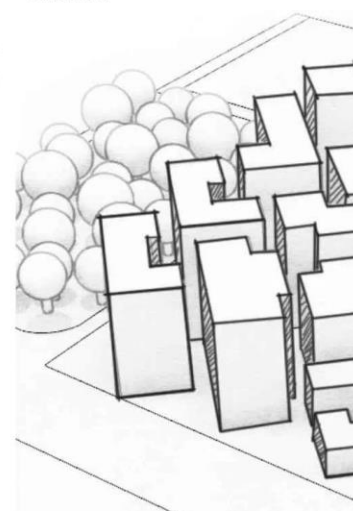
VERNACULAR ARCHITECTURE

Through history by severe climate conditions that have determined the way the city is arranged. One of the major architectural strategies is taking advantage of the breeze city every summer, despite the fact that it can be hot or arid to create cross ventilation when required.

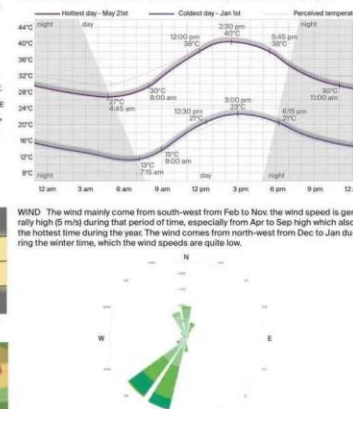
MATERIALS

The traditional building techniques in Hyderabad are simple, but effective to achieve resistance and thermal isolation. It includes fired brick, sun-dried earth bricks, and mud mortars. For additional elements such as windcatchers, windows and covers for shade, they would use wood, plaster and metal sheets.

INITIAL APPROACH



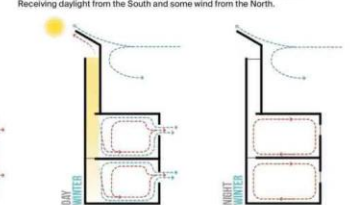
WIND The wind mainly come from south-west from Feb to Nov, the wind speed is generally high (5 m/s) during that period of time, especially from Apr to Sep high which also the hottest time during the year. The wind comes from north-west from Dec to Jan during the winter time, which the wind speeds are quite low.



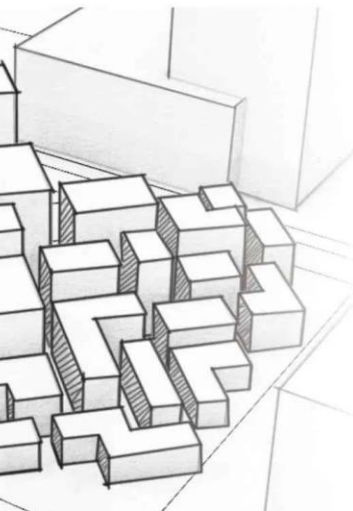
ARCHITECTURE

The weather conditions transpire fabric that arranges the houses and building exposure on all facades, resulting in designing buildings to maximize lighting and ventilation therefore built narrow and following organic pattern partially the flow of air and remove some of the bedrooms are located mostly in the East side, South location. The walls facing East and expose openings to enhance proper isolation through. This allows to keep the rooms cooler during sun nights. The rest of the facades contain small windows or air to create cross ventilation when required.

WINDCATCHER WINTER

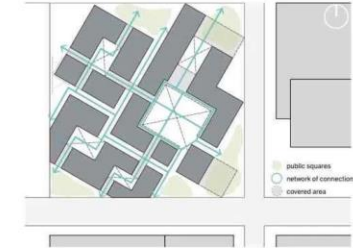


DIFFERENT BUILDINGS HEIGHTS FOR SELF-SHADING

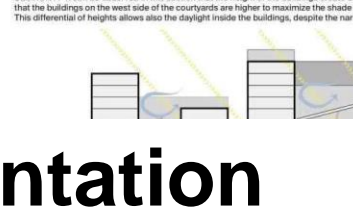


Final Presentation Examples

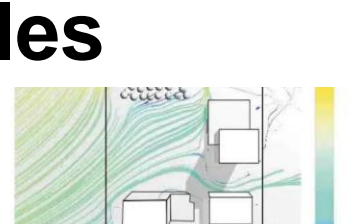
GROUND FLOOR Inspired in the traditional streets, the project randomly organized and less dense in the ground floor, which allows the wind flow through the building but reduces the speed and dust by shifting direction. This also provides diverse pedestrian pathways across the block. The east corners create welcoming half-shaded squares to connect it with the immediate context.



MIDDLE PUBLIC SPACE Provided that during certain times of the year and the days the sun can become extremely hot, the first floor of the building works as a network of shaded elevated public spaces and connect the whole block and the main courtyards. This area is protected from direct sunlight and wind by the buildings in the west and east, improving the comfort in the area while not losing its functionality.



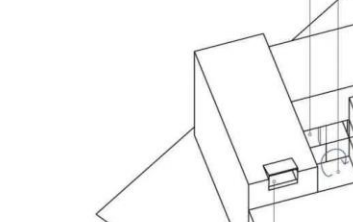
BREATHING BLOCK The project aims to provide passive strategies to solve basic comfort needs for the users and at the same time, strengthen the identity of the place. Overall, the block resembles the chaotic disposition of Hyderabad, with different heights and windcatcher towers, aspects that are decisive in the functionality of the block, taking advantage of generated shade, and being able to inject air inside the buildings.



URBAN FORM STRATEGIES [Shade] Firstly, concerning the heat gain from the solar irradiation. We propose to raise the height of the building to create more shade for the open space, for example, the streets and courtyards. With this strategy we provide a more comfortable outdoor environment for the community. [Orientation] Secondly, orientate the building to south-west to where the wind flow come from, which introduce the wind flood into the street. Then using the curve of the street to break down the wind and filter the dust. Bring the wind into the shading courtyard in the middle of the building to create microclimate. With this strategy, we introduce nature ventilation into the open space. [Sleeping and reverse] Thirdly, by using different height of the building to create sleeping and reverse effect of the wind flow. This effect proving high speed and cooling air at the upper area which will be harvest by the wind catcher and bring down to the building and ground level. With this strategy, we enhance the efficacy of the wind catcher.



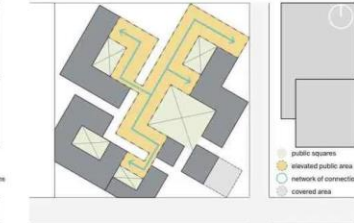
SECTION A It can be observed in this section that the height of the buildings create certain conditions for the block. That means that the buildings on the west side of the courtyards are higher to maximize the shade received by the buildings in the east side. This differential of heights allows also the daylight inside the buildings, despite the narrow streets.



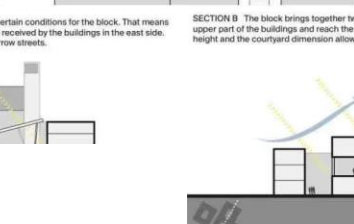
SECTION B The block brings together two strategies in terms of wind. The first is the stepped heights that guides the wind towards the upper part of the buildings and reach the windcatchers on top, while in the center, the opposite happens. The inner building reduces height and the courtyard dimension allows wind to be more static and create inner microclimate, with limited exchange of new air.



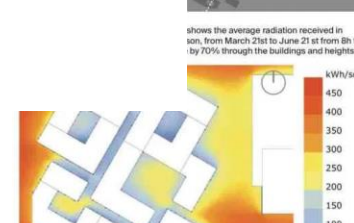
RULE OF THUMB - WIND FLOW When the distance between the building is shorter than 1/5 of the building high, the wind flow will aim over, which limited the air exchange with the lower part of the urban area.



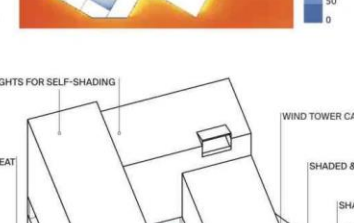
WIND FLOW URBAN SCALE In order to create shade to prevent the whole block exposure to the sun, it also increases the density of the urban form. With this high density, the wind will aim over and build but leave some recirculation in between the building that creates a microclimate. However, the slimming flow has reduced the air change in the courtyard and street canyons. In order to refresh the air and introduce the wind into the outdoor and indoor areas, we propose using vernacular architecture: wind catcher to harvest the wind and bring it down to the ground level. Furthermore, by the differential of the air pressure, the hot air will be stacked by the cold air, which creates nature ventilation also take out the hot air.



DAYLIGHT The following simulation presents the results of the average luxes that the inner spaces receive throughout the year considering a 30% glazing. It can be observed that the proportion of the buildings improves the distribution of the daylight.



SUMMER SHADING Since summer is the most challenging season, the overlaying of shadows produced during the day on June 21st, where it can be observed how the courtyards and squares are mostly shaded by the surrounding buildings.



ELEVATED OPEN SPACE OFFICES PUBLIC SPACE PUBLIC USE UNDERGROUND MUSEUM PUBLIC USE MUSEUM PUBLIC USE LIBRARY



PROJECT INFORMATION

COV:	0.41
FAR:	3.1
HEL:	76
PLOT AREA:	10,000 m ²
BUILT AREA:	30,900 m ²
PROGRAM DISTRIBUTION	
41%	RESIDENTIAL 13,000 m ²
32%	COMMERCIAL 9,700 m ²
-	23% OFFICES 7,000 m ²
-	9% SHOPS 2,700 m ²
27%	PUBLIC USE 8,200 m ²
-	6% UNDERGROUND 1,900 m ²
-	10% ELEVATED SPACE 3,000 m ²
-	11% OTHER BUILDINGS 1,900 m ²

Dates

Fridays
13.00 – 17.00

Kick-off
Friday 14.00
20.10.2023

Language
English

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