Climate Responsive Architecture

Thoughts, App Idea, Reichardt, MSA Münster, 23.02.2020

1 Rudowsky, Architecture Without Architects

2 aesthetic of the box

3 regionalism versus international style

4 Modern Movement, Le Corbusier, Mies van der Rohe, F.L. Wright

5 Modern Movement, Germany, May, Wagner, Scharoun, Elsässer

6 Bauhaus for Australia, Rose Seidler House, Sydney

7 Tropical Modernism, Maxwell Fry, Jane Drew

8 Charles Correa, Geoffrey Bawa, Glenn Murcutt

9 Future of Cities, Nature, Singapur, Mailand

10 Climate Responsiveness, Principles, Krishan

11 The „German Way“ towards climate efficiency

13 rethink, reduce, reuse, recycle, motor boat versus sailing boat

14 Example building material, architects dream, concrete

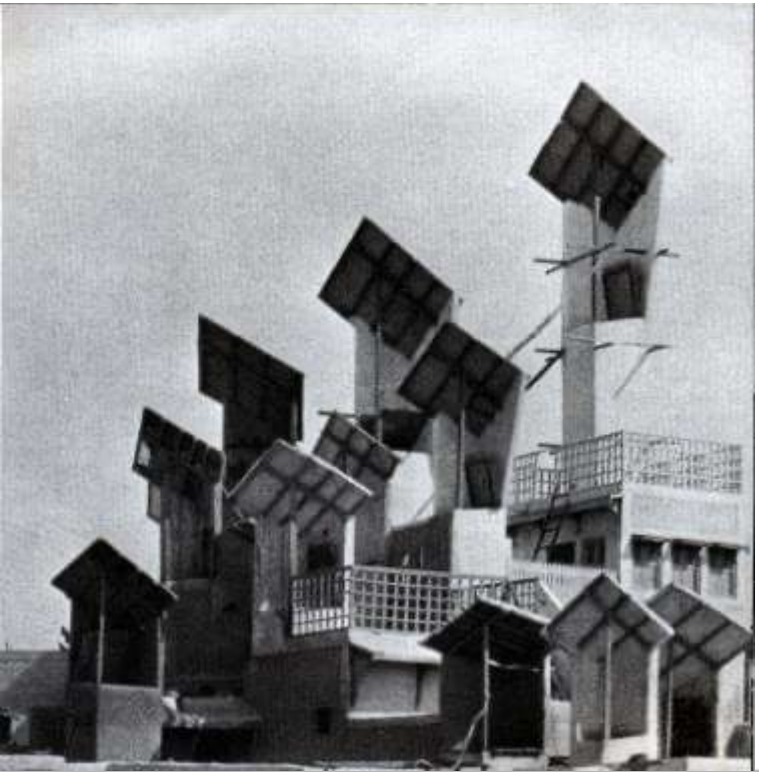
15 App Idea, motor boat versus sailing boat

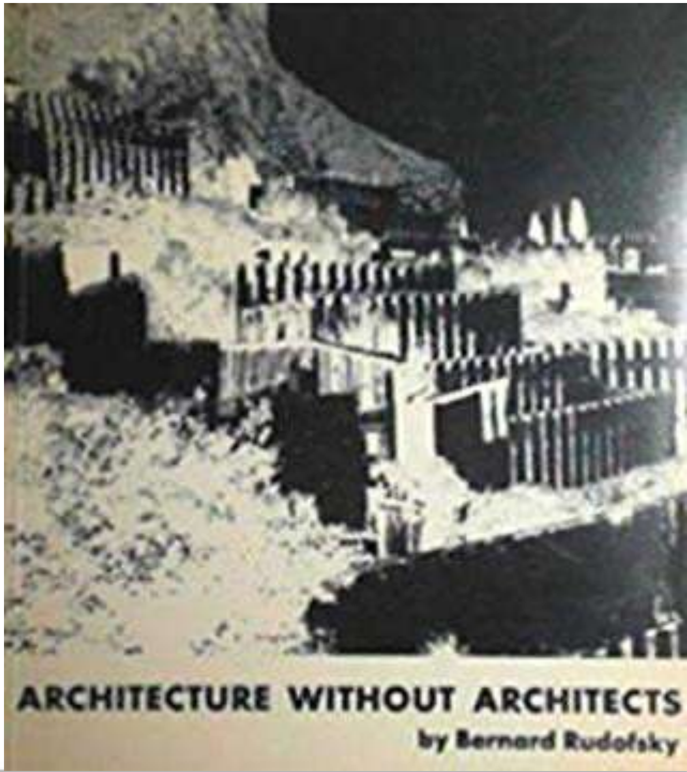
Rudowsky

Architecture Without Architects

Rudowsky
Architecture Without Architects

Rudowsky
Architecture Without Architects



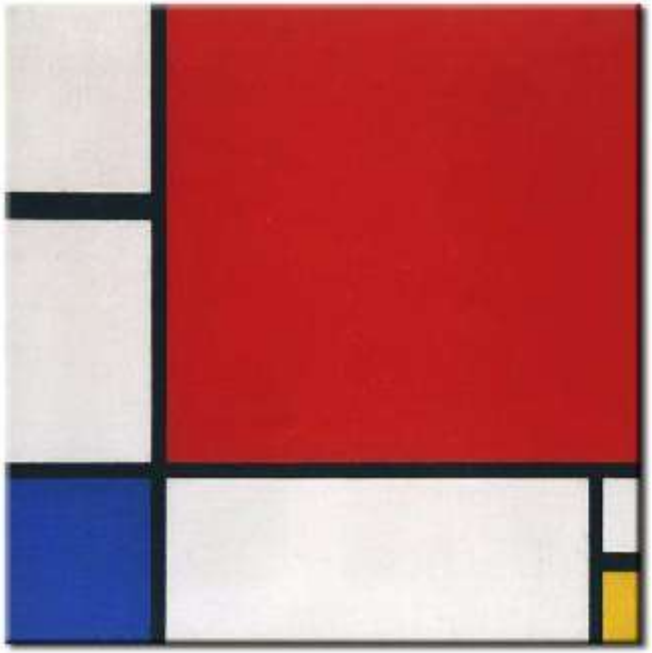


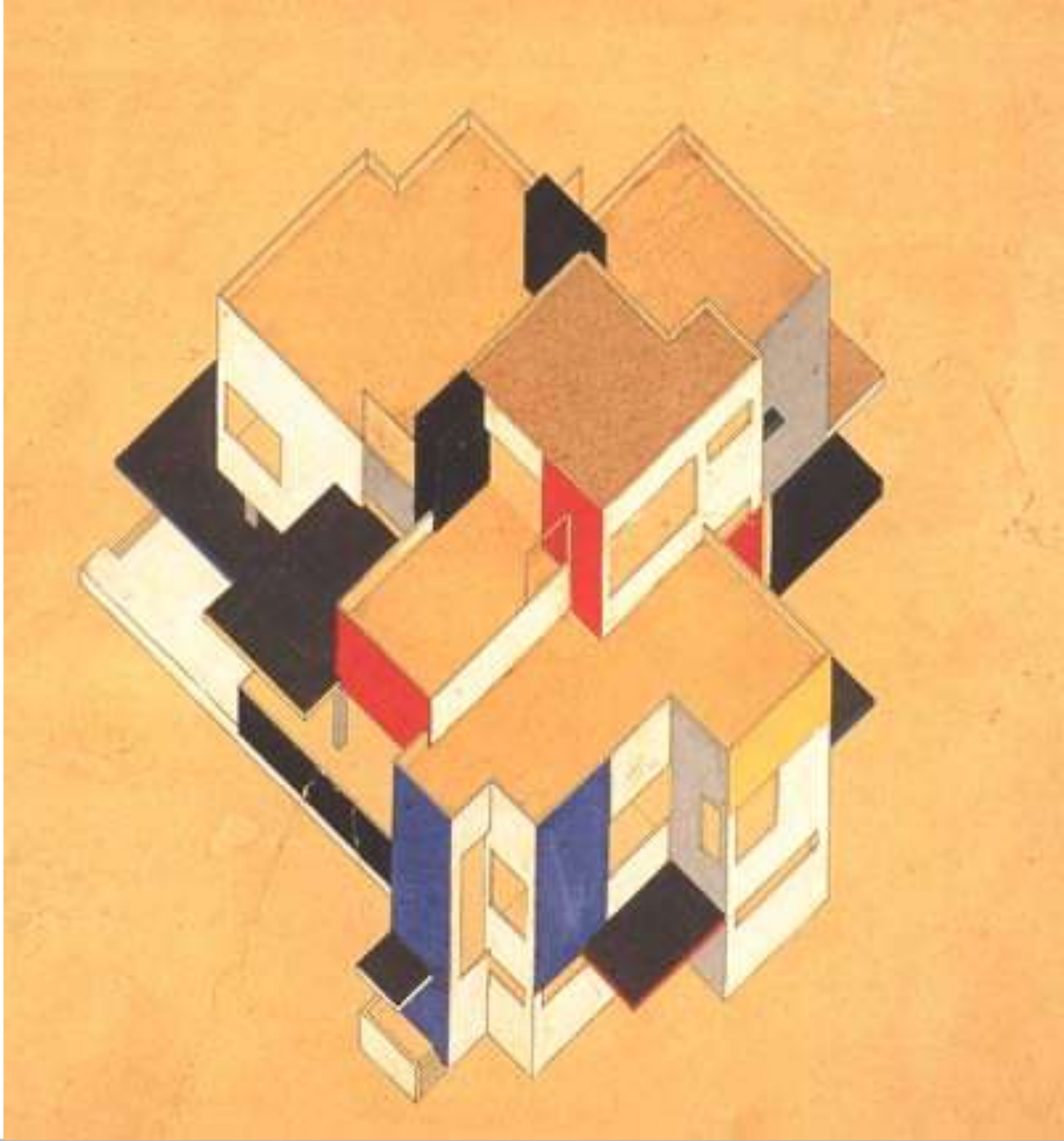
Rudowsky

Archutecture Without Architects

regionalism/ international style

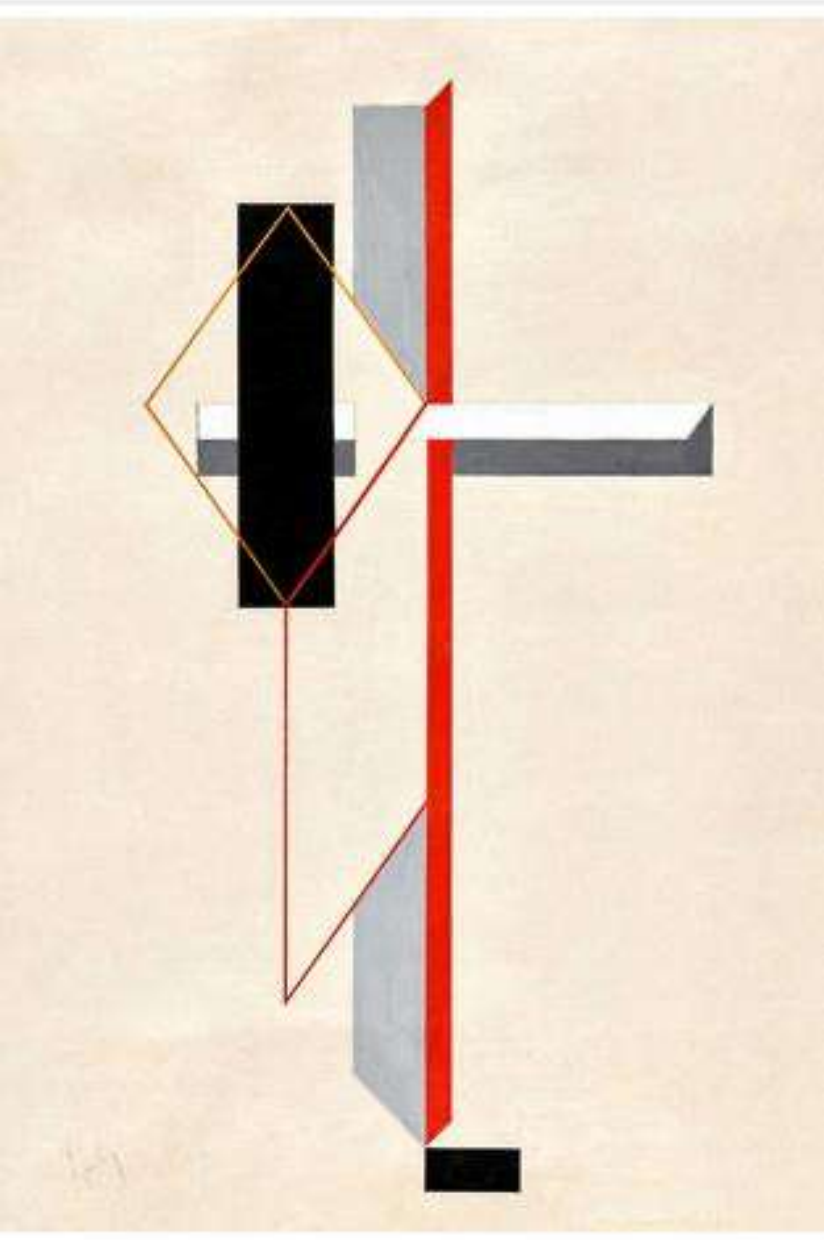
regionalism/ international style





aesthetics of the box

Mondrian, van Doesbutg, de styl



aesthetics of the box

Art, Muche, Bauhaus, Proun, El Lisitzky

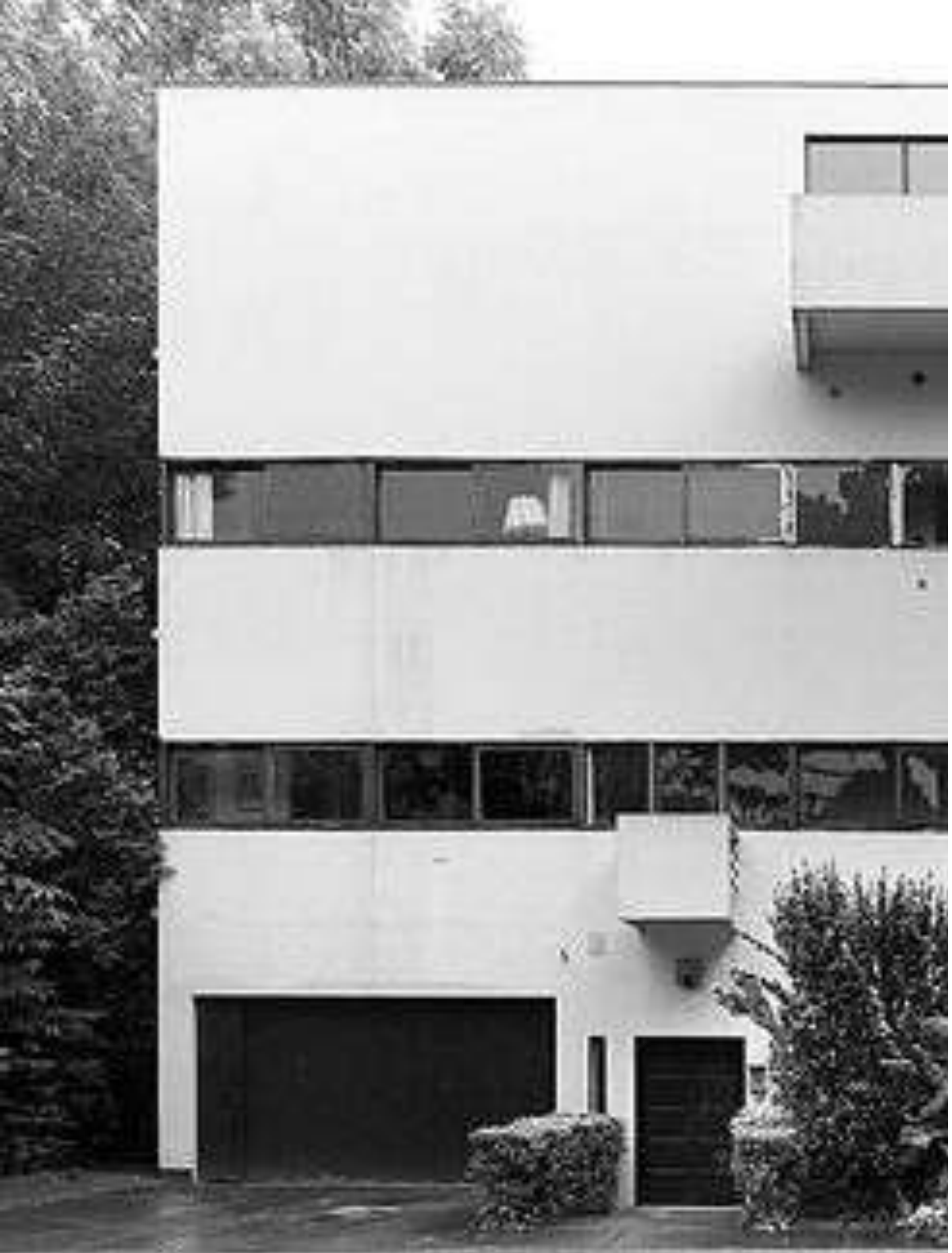
aesthetics of the box
Gropius, Dammerstock Karlsruhe

aesthetics of the box

Mies van der Rohe, Weissenhof, Tugendhat

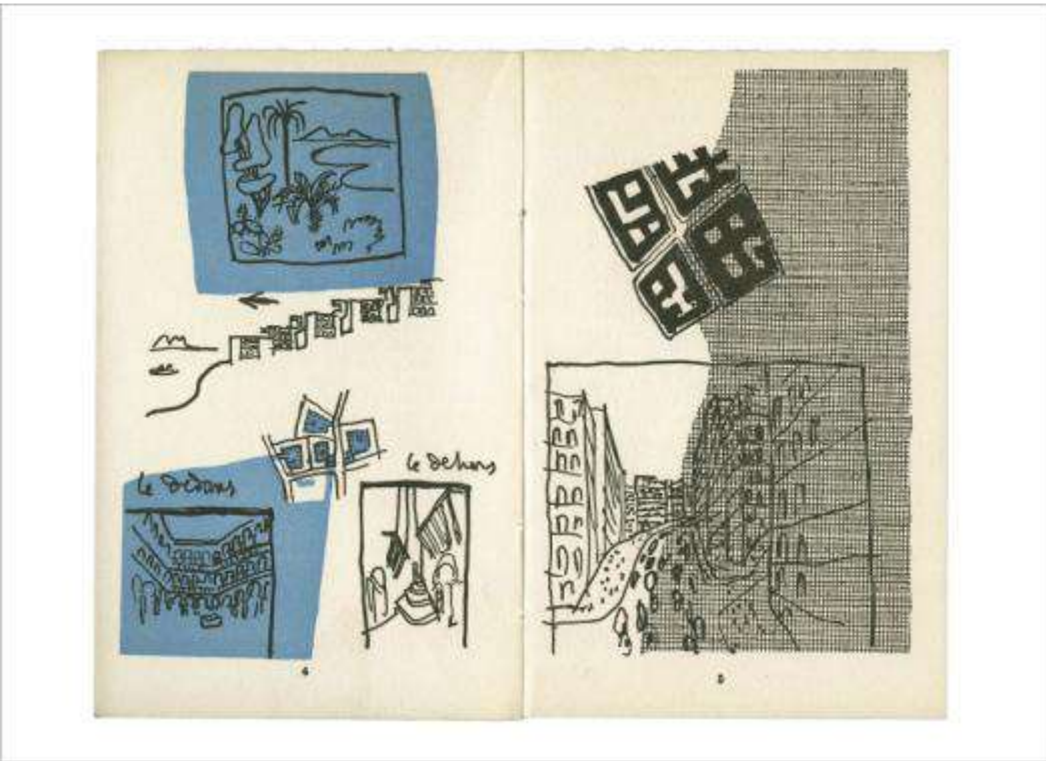
regionalism/ international style
MoMa Exhibtion, New York, 1932

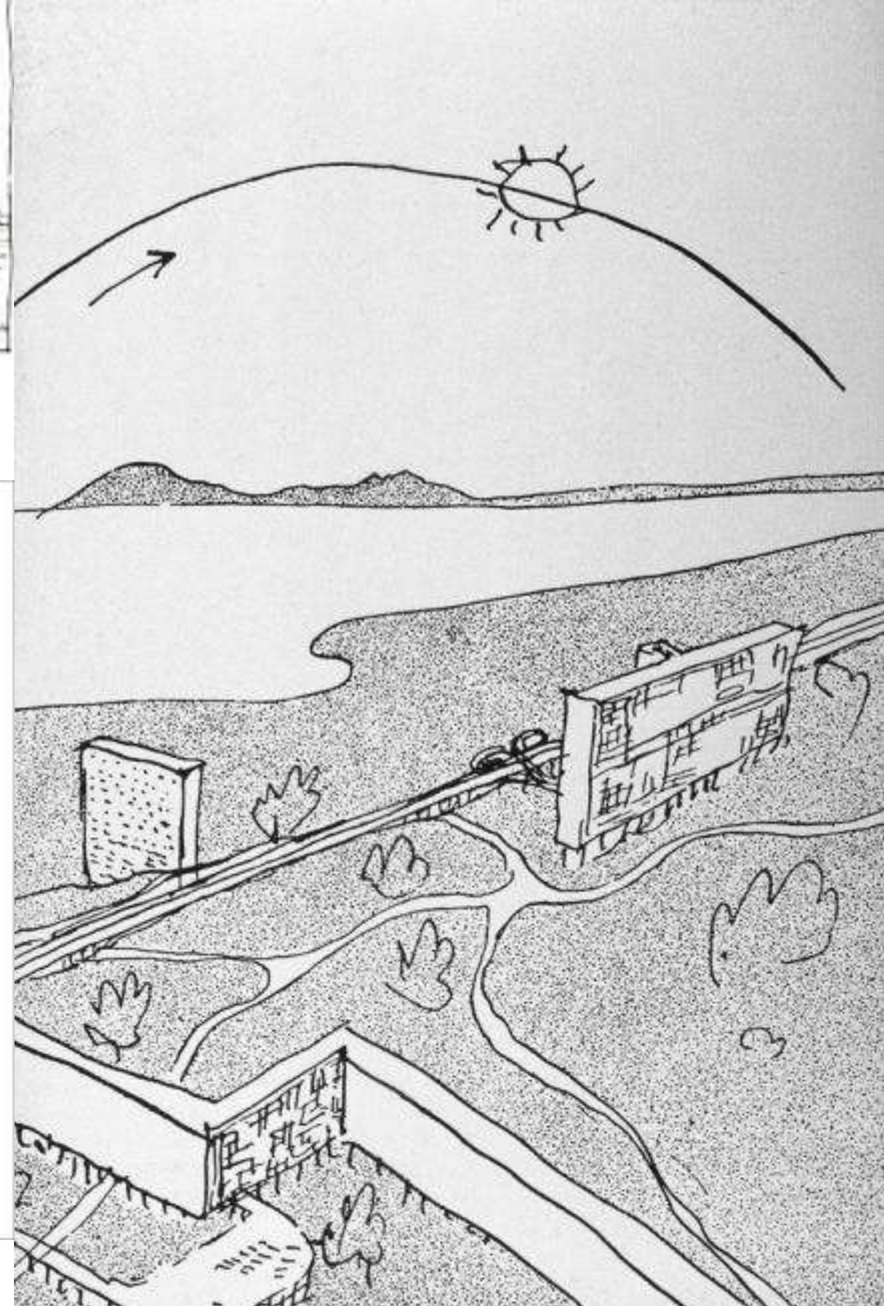
aesthetics of the box
Mies van der Rohe, Farnsworth House




Le Corbusier

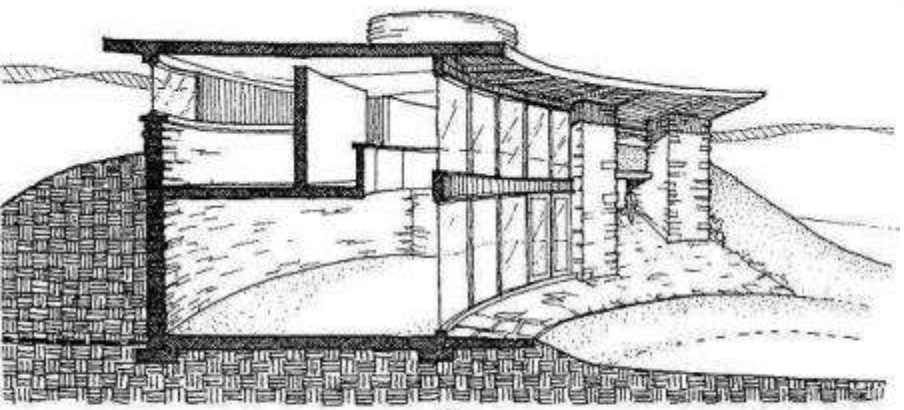
Villa Stein, Garches/ House in India, Mill Weaver Ass.



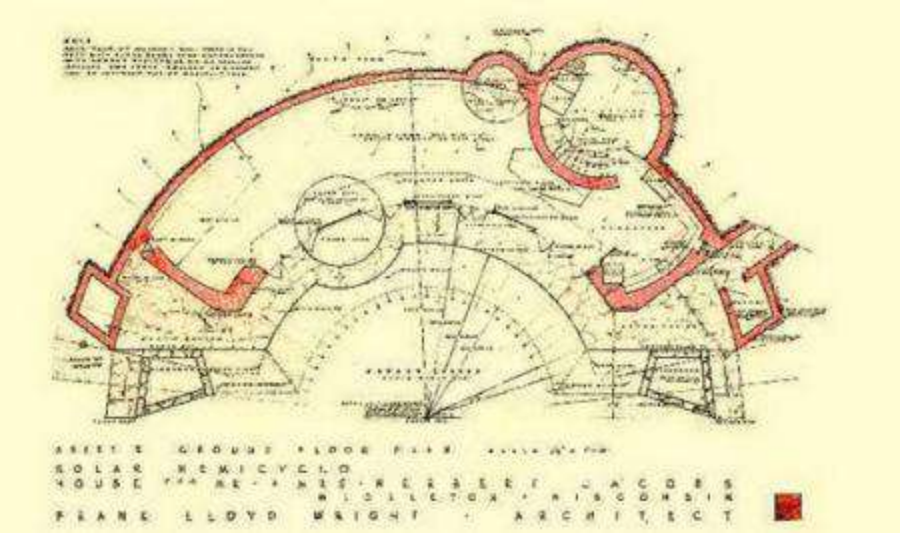


Le Corbusier

Projects for Algir, 1950…



(b)

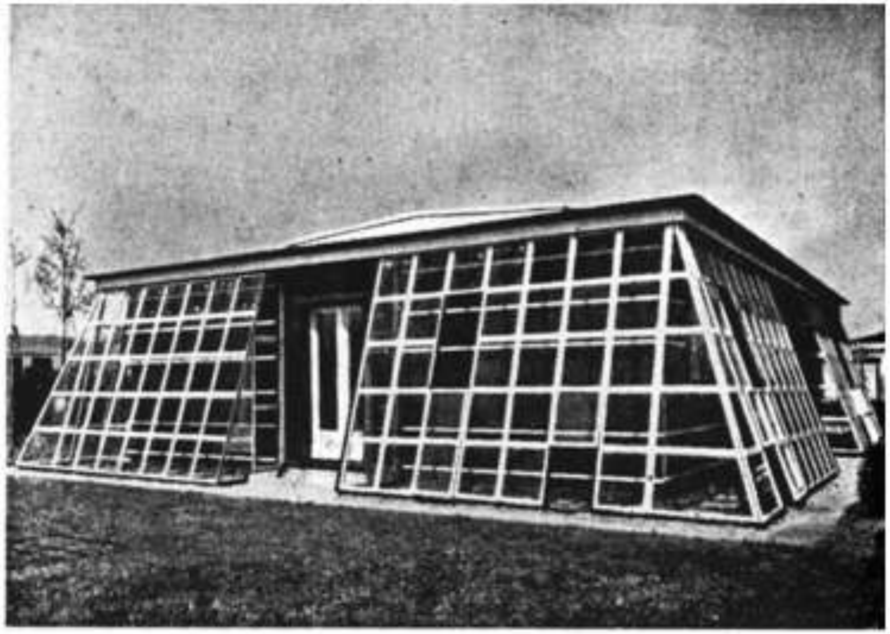


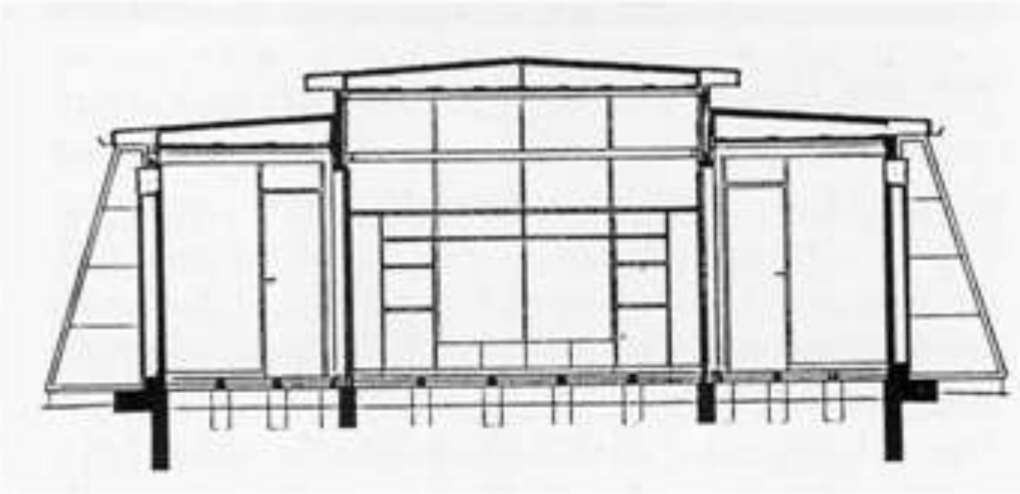
F.L.Wright

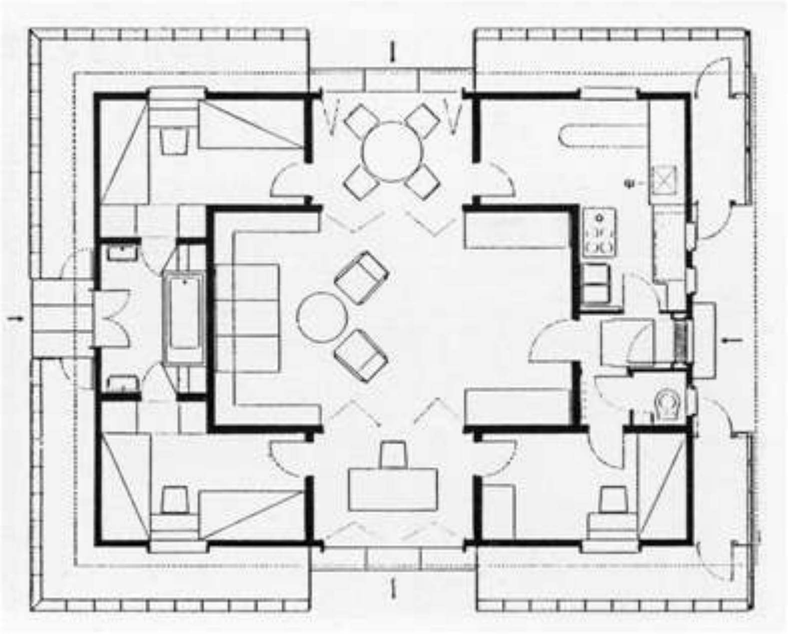
Solar Hemicycle House, Wisconsin, USA, 1944

G., F. Keck

House of Tomorrow, Solar Houses, USA, 1930/ 40

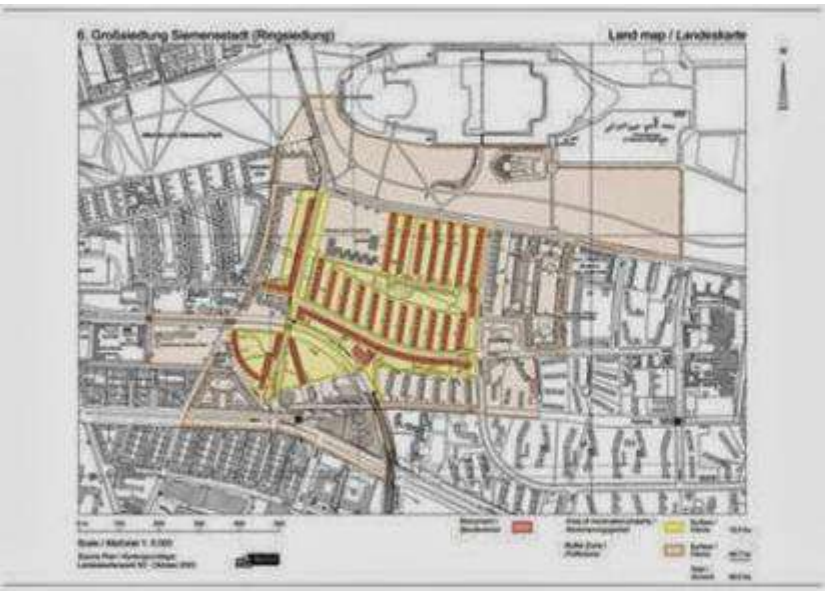






Martin Wagner

The Growing House, 1931



Light, Air, Sun,

Römerstadt Frankfurt, May, Elsässer, 1927-1929, Ringsiedlung Berlin, Scharoun, Wagner, 1929-1931

Location : 71 Clissold road, Wahroonga, Sydney

Construction (1949-1950)

Strong contrast between the nature and his building which gives people a feeling of harmony and peace

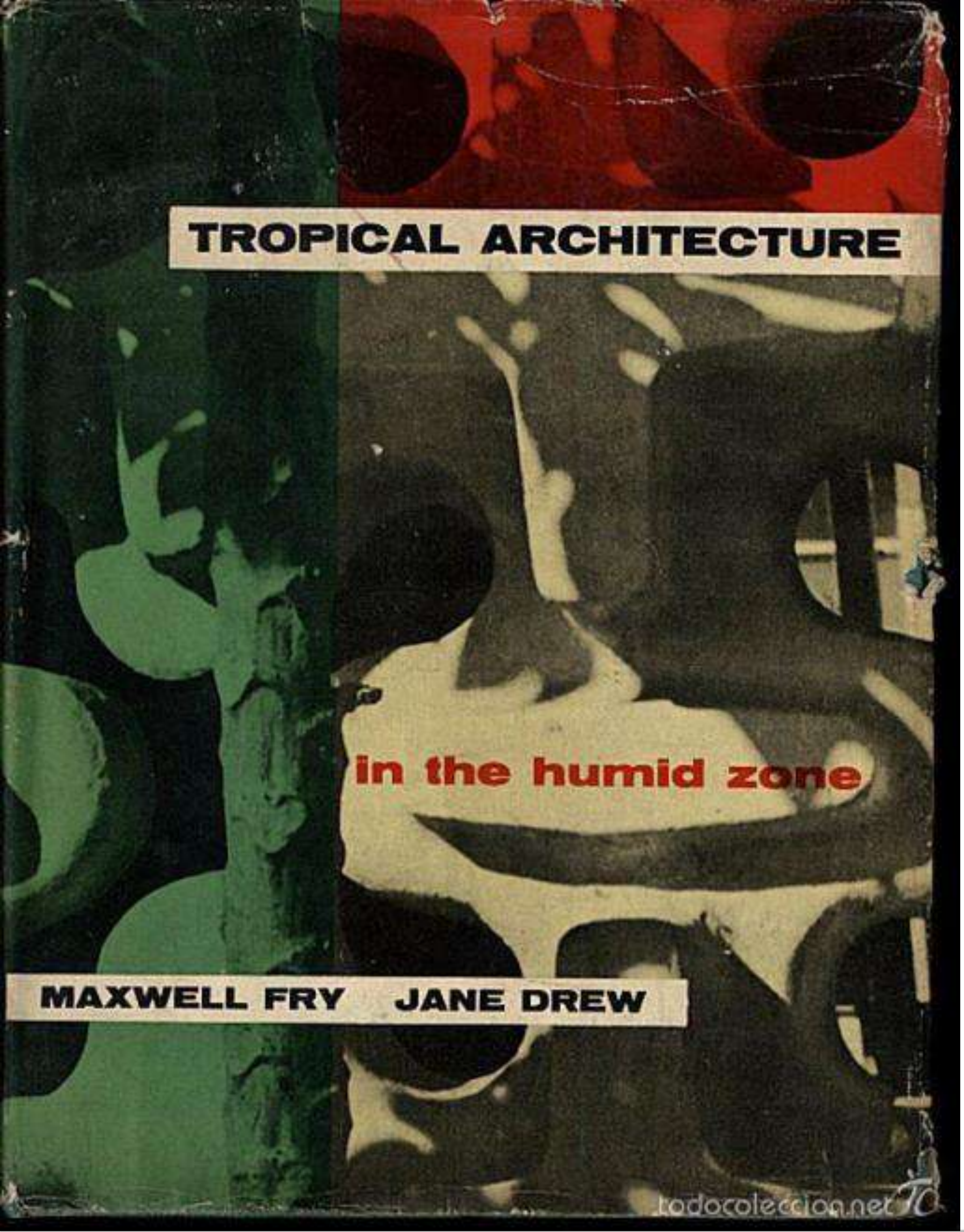
panoramic views of the surrounding bushland, producing giant green murals during the day and at night

a large wall of windows overlooking bushland of Ku-ring-gai Chase National Park in the northern suburbs of Sydney

Harry Seidler

House Rose Seidler

Harry Seidler
House Rose Seidler, Sydney



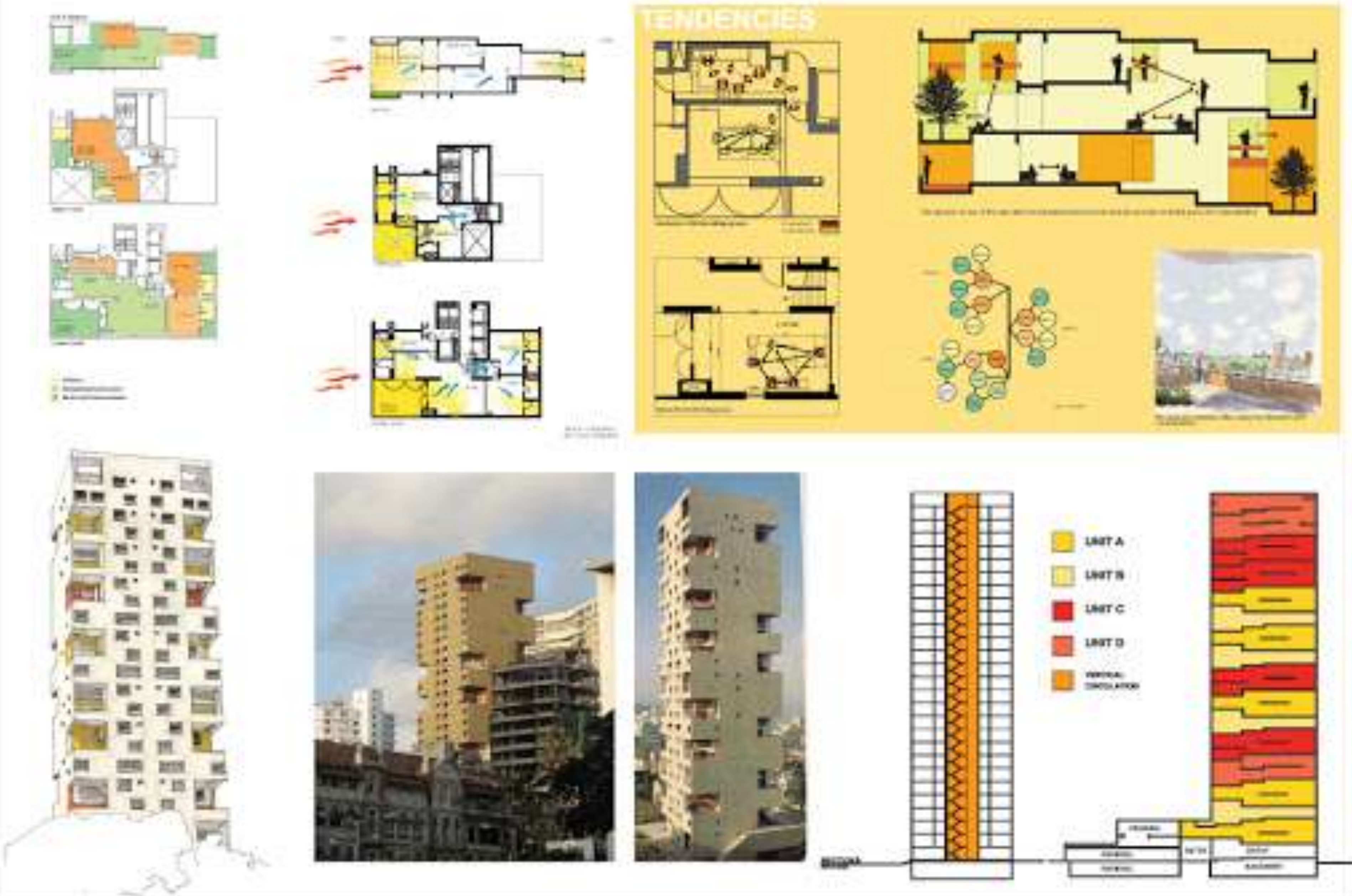
Maxwell Fry, Jane Drew
Tropical Architecture 1964



Maxwell Fry, Jane Drew

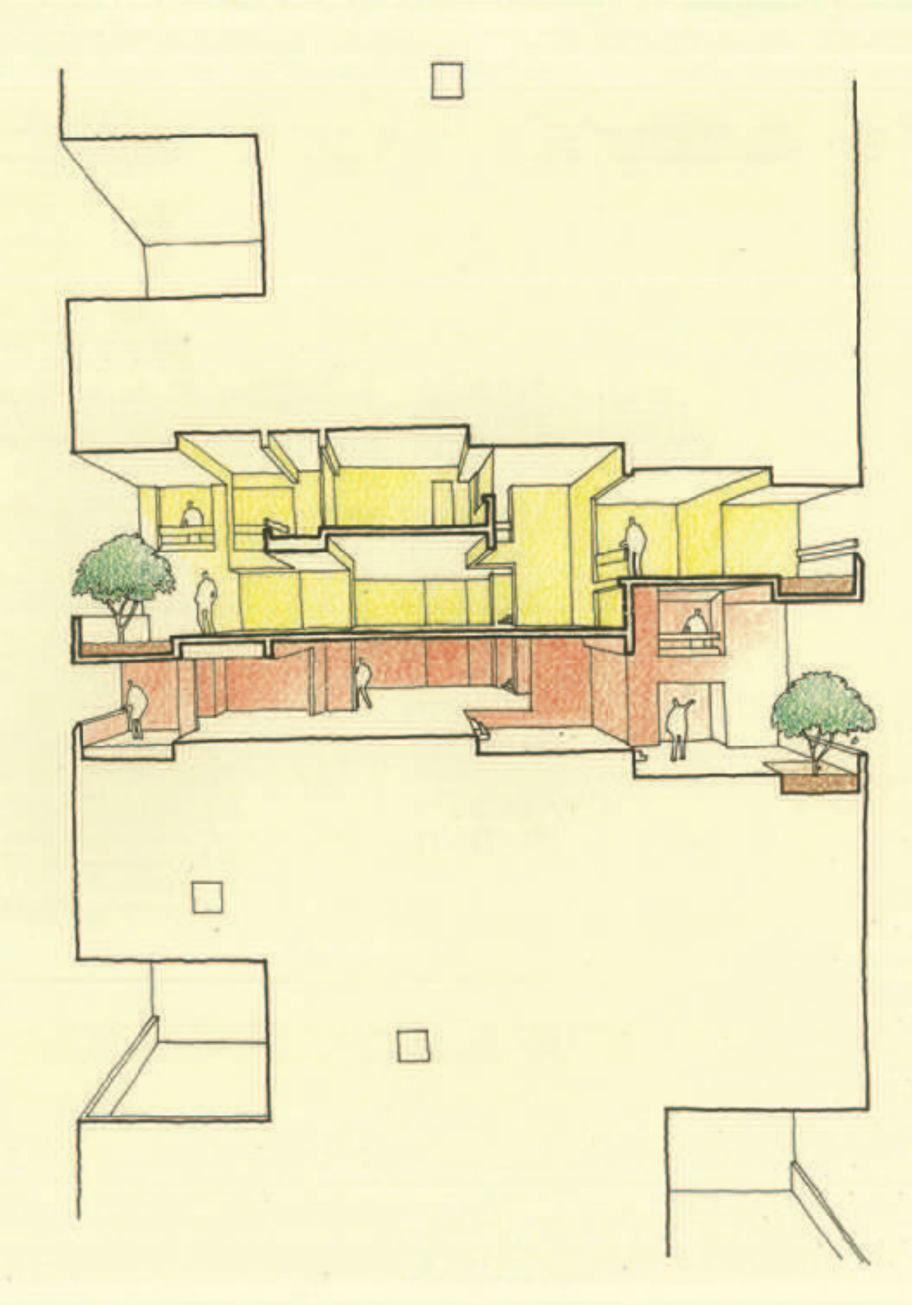
Tropical Architecture, 1964

Maxwell Fry, Jane Drew
Tropical Architecture, 1964



Charles Correa

Kancenjunga Appts., Bombay



Charles Correa

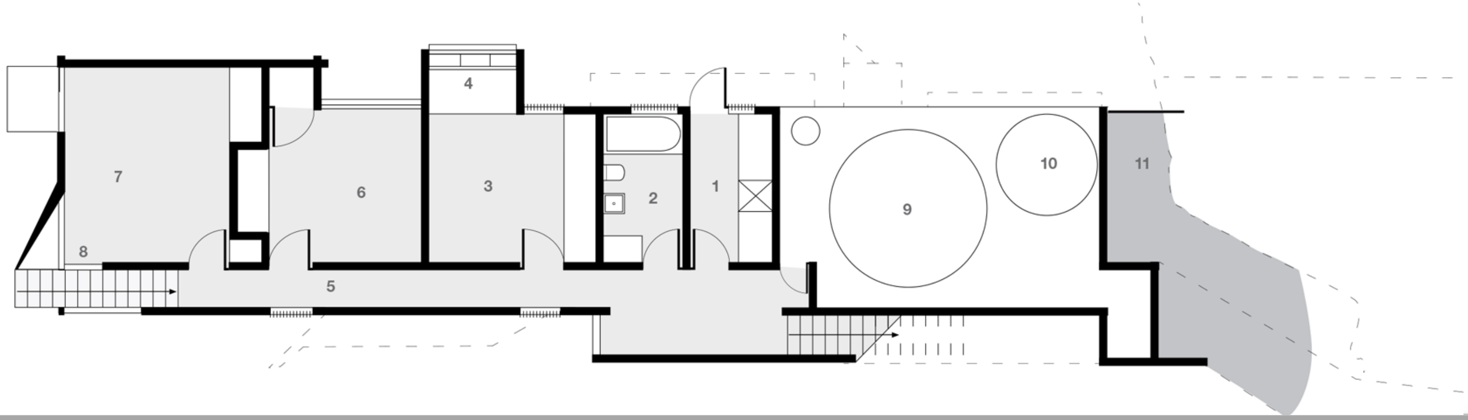
Kanchenjunga Appts.., Bombay

Charles Correa

Kanchenjungs Appts., Bombay

Geoffrey Bawa

Kandalama Hotel, Dambulla, Sri Lanka



Glenn Murcutt

House Donaldson




Glenn Murcutt

House Donaldson

Singapur, Mailand

Singapur

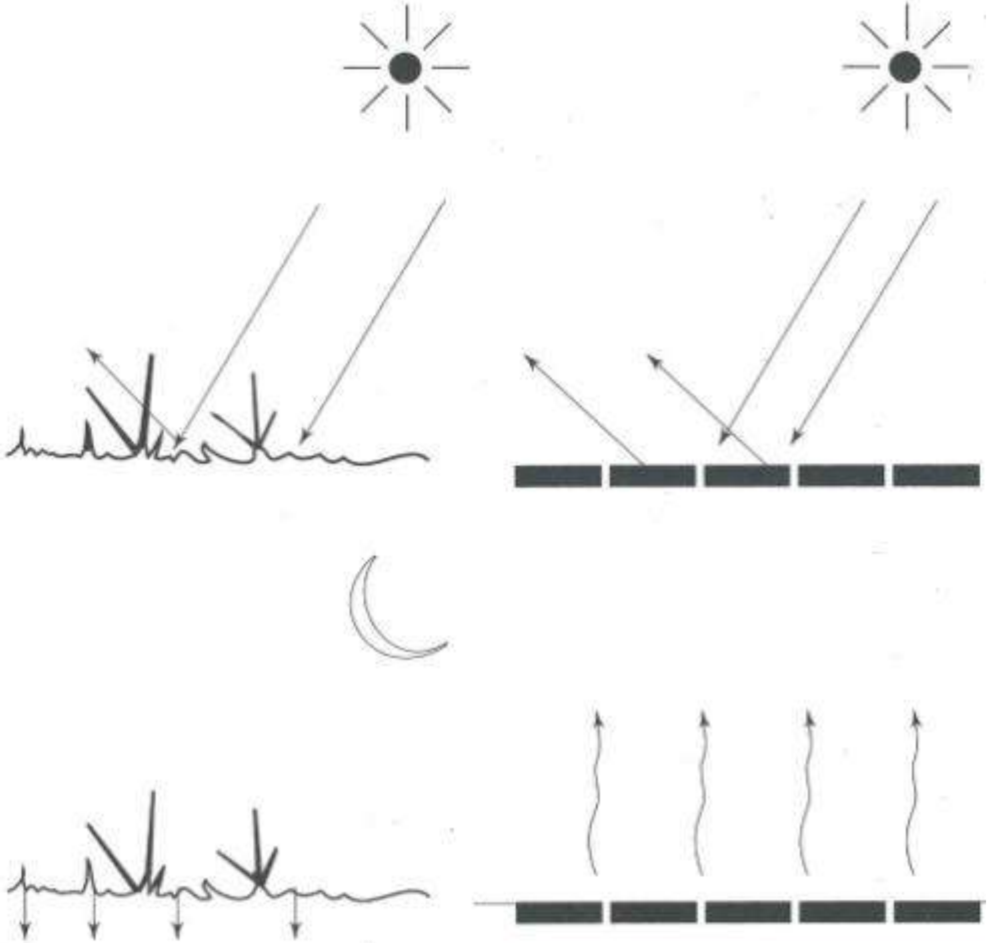


Fig. 2.25 *Different ground materials reflect, store and absorb heat to different degrees*

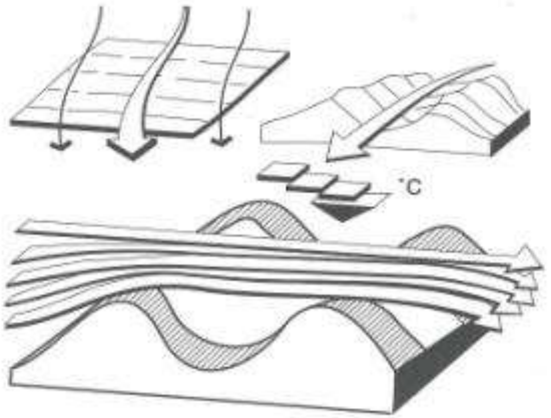


Fig. 2.9 *Landform variations and the microclimate. Flat sites experience little variation. Air speed increases up the slope and decreases down it. Depression valleys experience lower air temperatures. They have little air movement unless they lie in the direction of airflow.*

Fig. 2.10 *Pressure difference caused by obstacles*

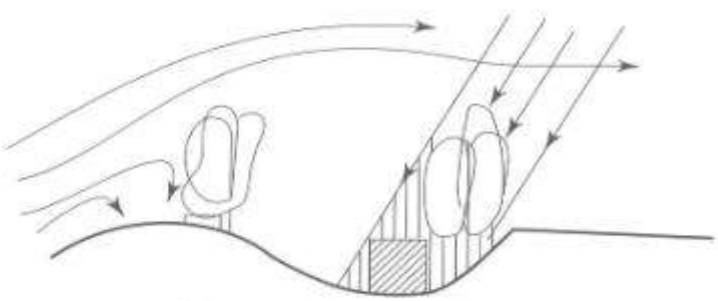


Fig. 2.11 *Landform optimization in hot climates: building in a depression and shading from heat and wind minimizes heat gain and discomfort*

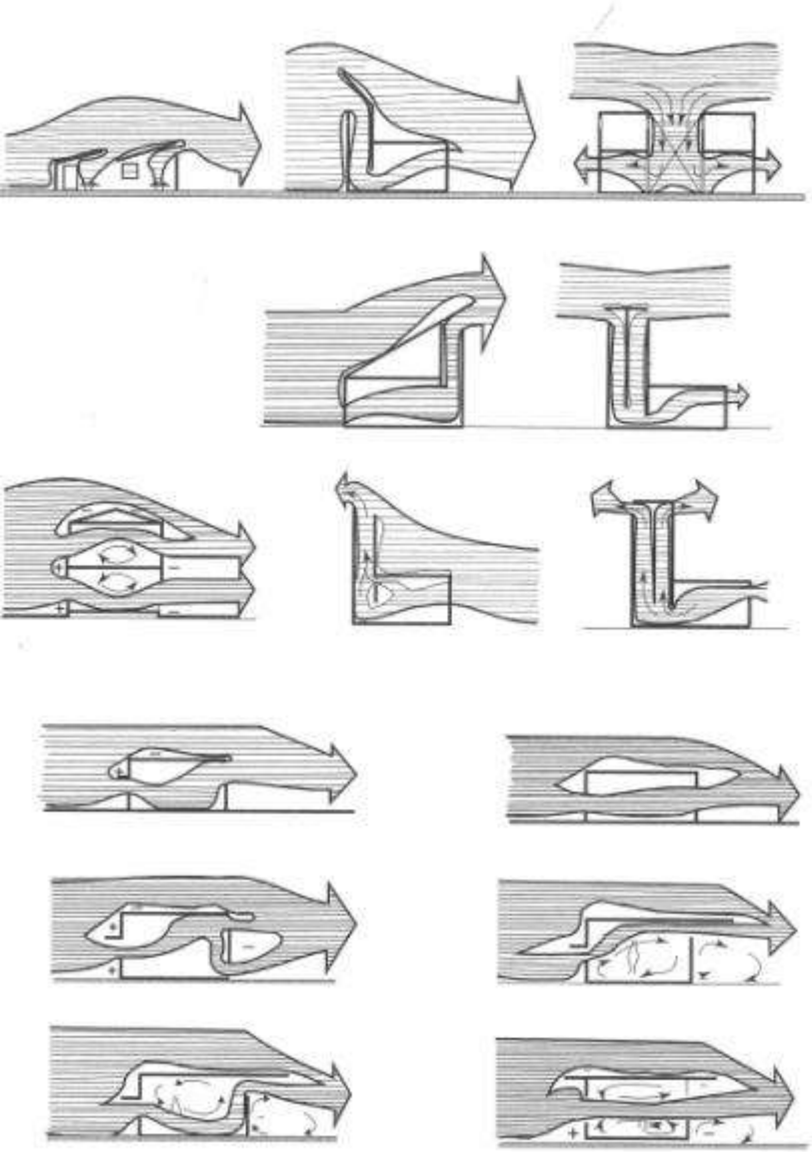


Fig. 4.20 *Vocabulary of airflow patterns (Ref. 2)*

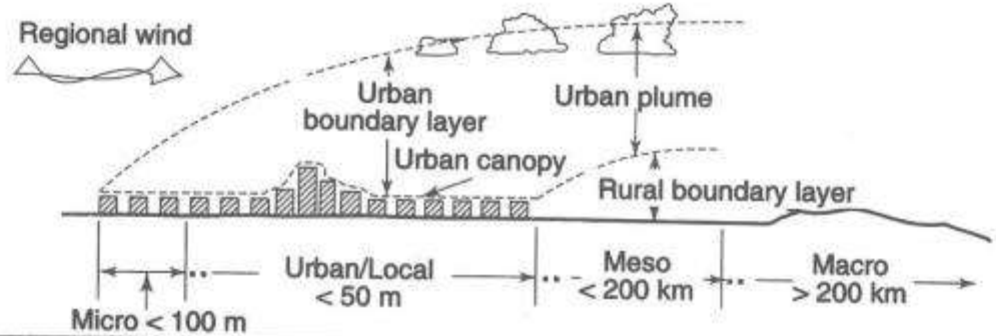


Fig. 5.1 *Schematic section showing scales of climatic study and layers of urban atmosphere modification (after Ref. 9)*

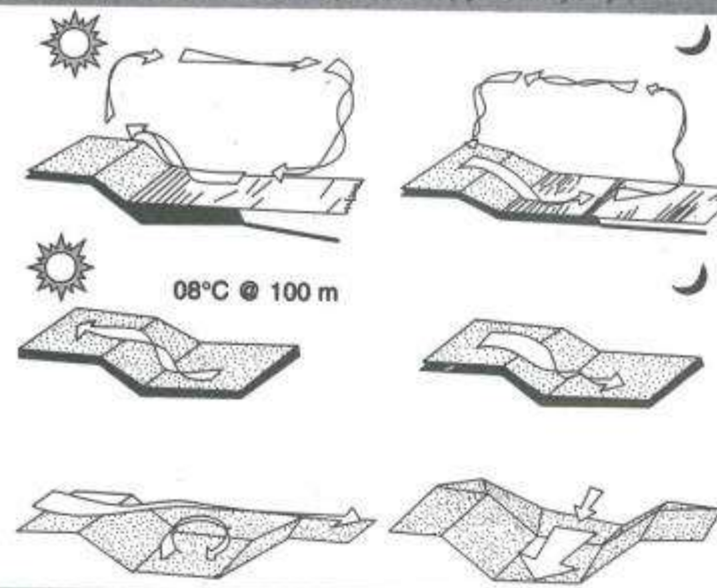


Fig. 5.2 *Geomorphology affects air movement, temperature and relative humidity (after Ref. 3)*

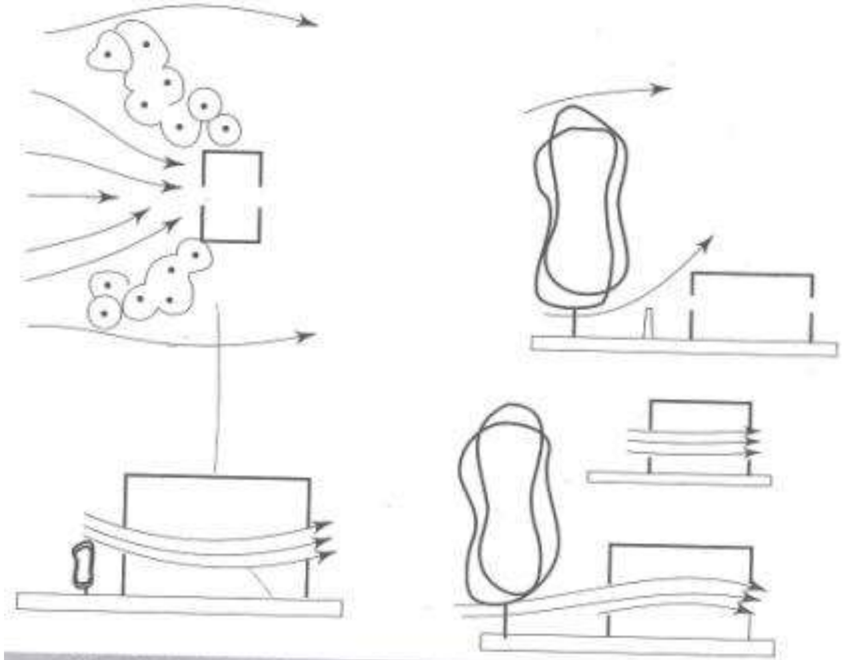


Fig. 2.15 *Vegetation increasing, decreasing and directing airflow*

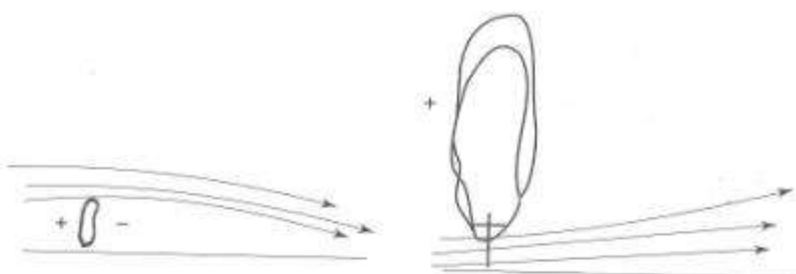


Fig. 2.16 *Vegetation causes pressure differences which shifts the air path*

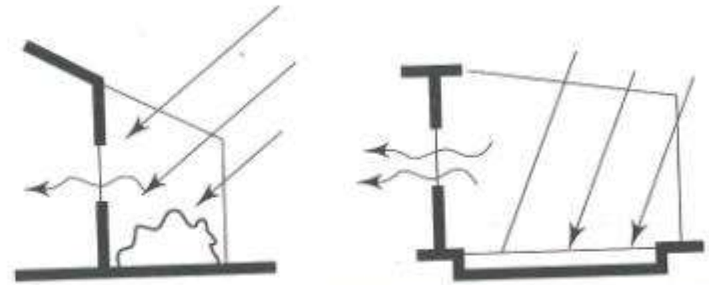


Fig. 2.29 *Heat trapping systems: Glazing traps heat and the space created could serve as a greenhouse or contain a water body. A water body would act as a thermal mass—storing heat in the day and reradiating in the night*

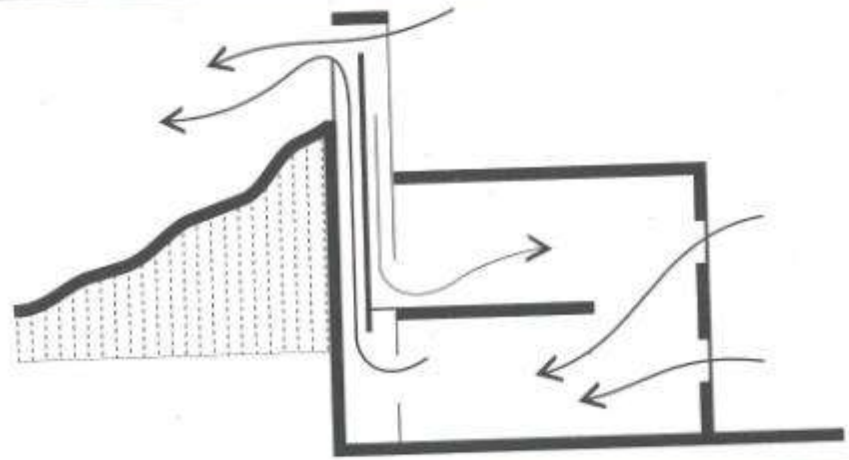


Fig. 2.30 *Windcatchers*

Principles

Climate Responsive Architecture, Krishan

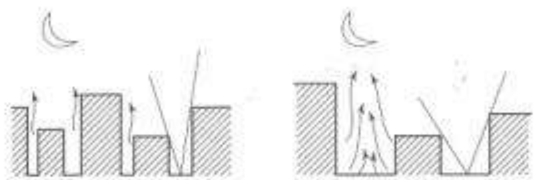


Fig. 2.22 *Greater the exposure of the walls and ground to the sky, the more the heat loss*

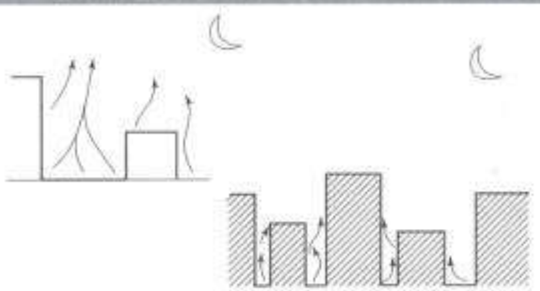


Fig. 2.23 *Compact planning in the modern context: Large heat production of modern buildings makes compact planning inappropriate in hot regions due to the decrease in heat loss capacity*

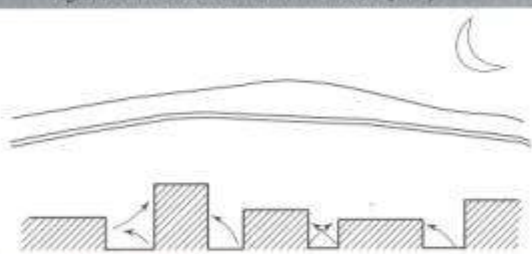


Fig. 2.24 *Compact planning in cold climates: while heat gain is reduced by compact planning, the decrease in heat loss is significant*

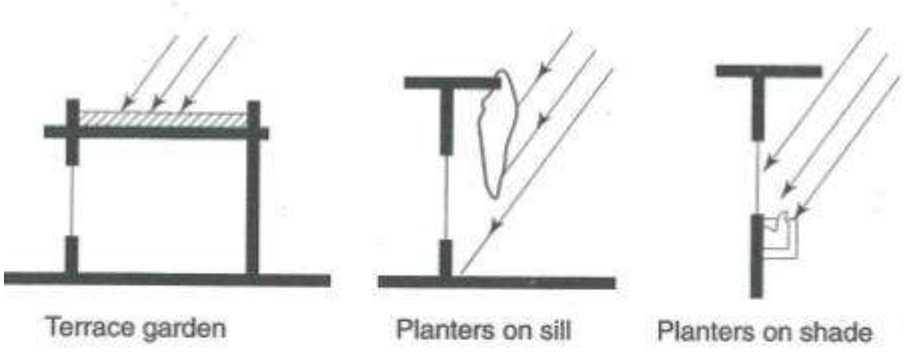


Fig. 2.27 *Integration of vegetation in the building to minimize heat gain*

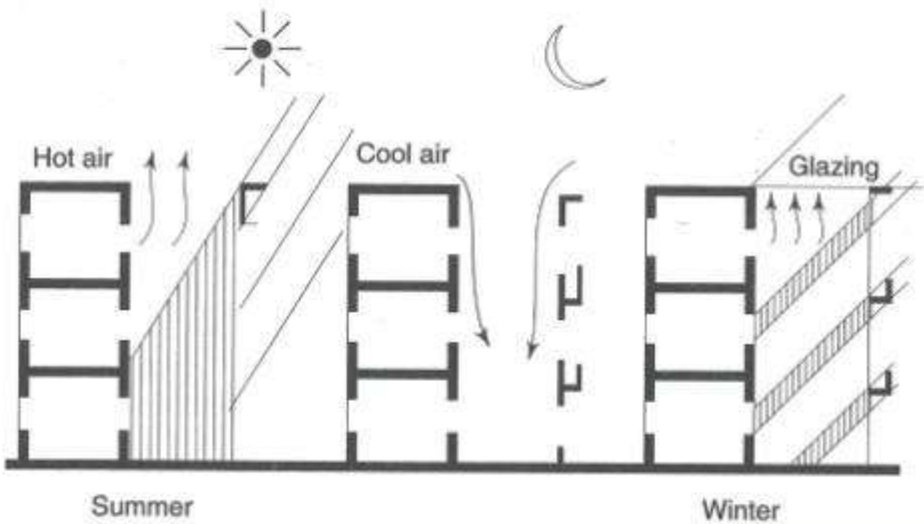


Fig. 2.28 *Courtyard atrium: Integration of operable glazing at the roof level allows the courtyard to be converted into a heat trap in winter*

Principles

Climate Responsive Architecture, Krishan

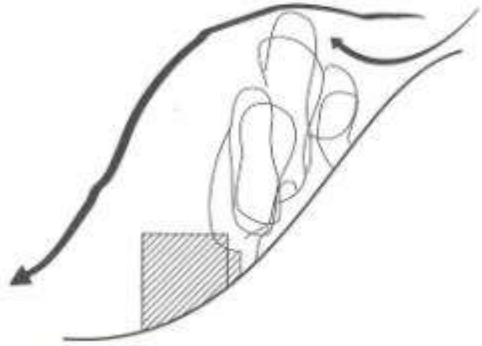


Fig. 2.12 *Protection from katabatic winds on slope: A cool mass of air descending down a slope (katabatic wind) can be deflected or minimized by thick vegetation*

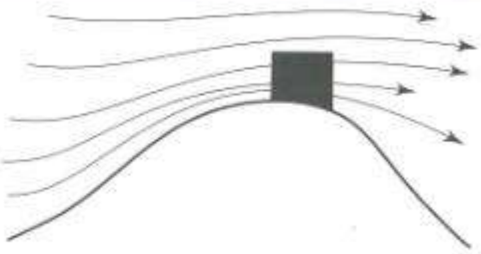


Fig. 2.13 *Air speeds are greatest on the crest*

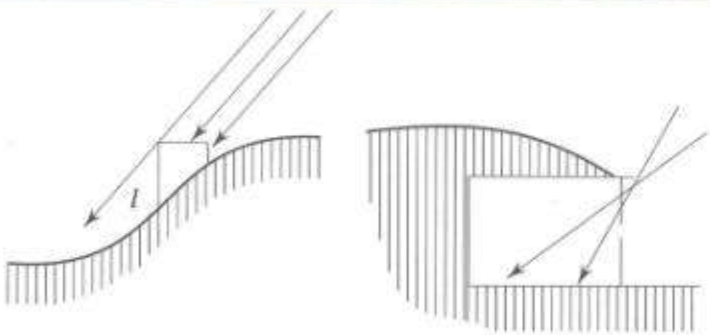


Fig. 2.14 *Landform orientation and building placement in hot climates. If the slope is steep or the sun is low, a northern slope may minimize heat gain but this would also cut off winter sun. In some cases earth sheltered construction on the south slope would be the answer*

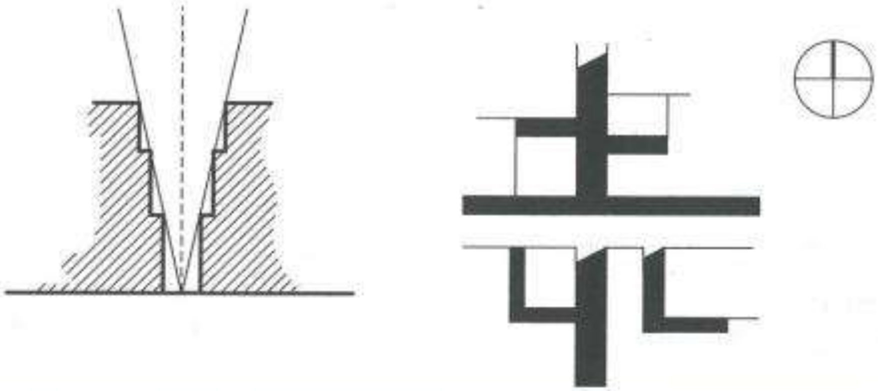


Fig. 2.18 *Street widths in hot climates: narrow north-south streets minimize eastern and western radiation*

In cold climates, wide streets, especially the east-west streets allow buildings to receive the south sun (Fig. 2.19). However, the need here is not just to gain heat but also conserve that which is received. So settlements should be compactly planned. North-south streets should be narrow. Low building heights are preferred. This would enable heat gain

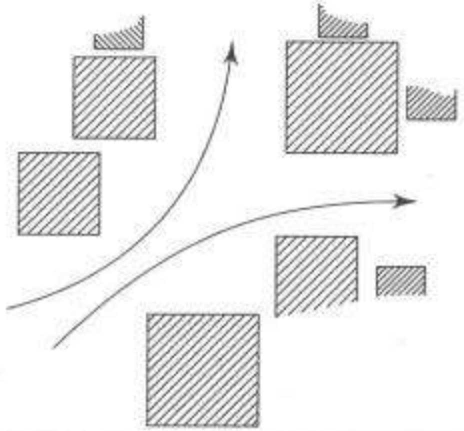


Fig. 2.19 *Arrangement of building blocks to maximize airflow*

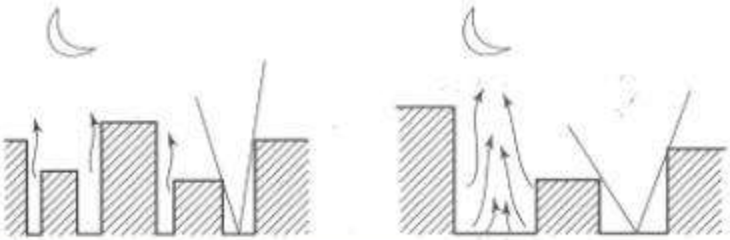


Fig. 2.22 *Greater the exposure of the walls and ground to the sky, the more the heat loss*

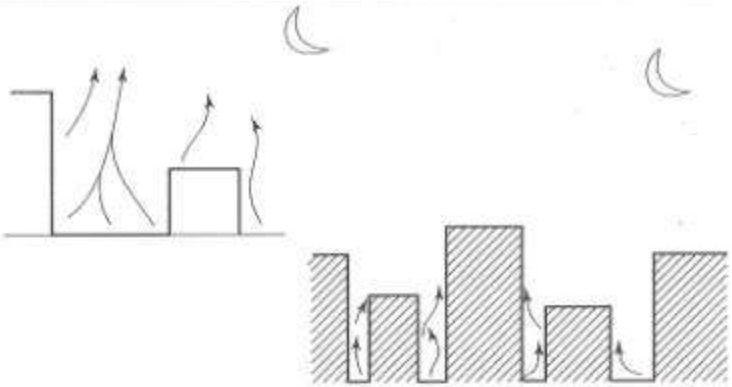
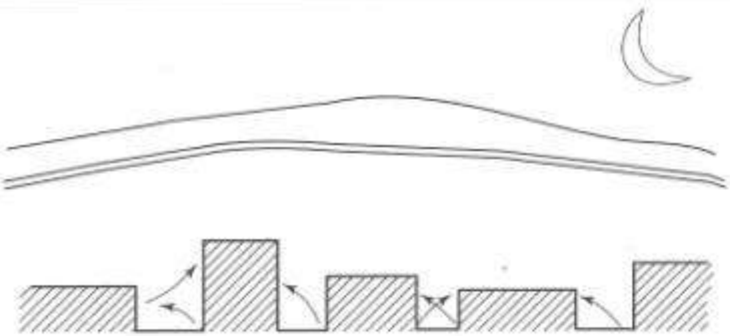


Fig. 2.23 *Compact planning in the modern context: Large heat production of modern buildings makes compact planning inappropriate in hot regions due to the decrease in heat loss capacity*



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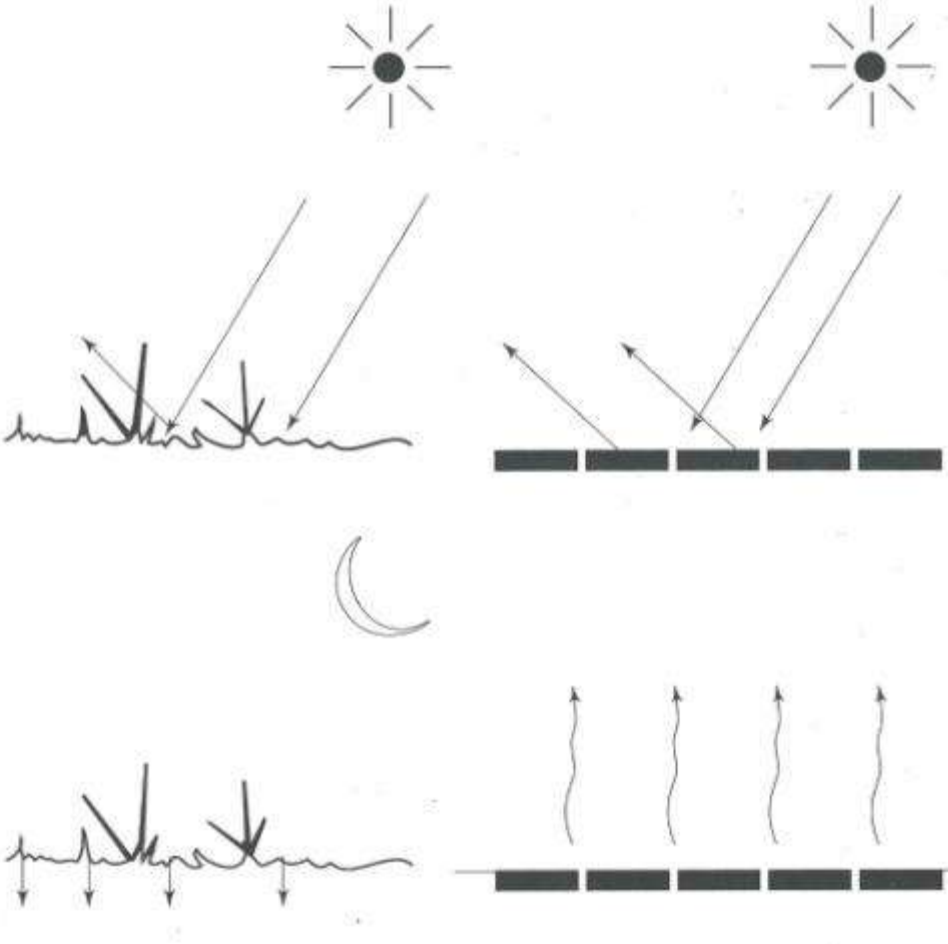

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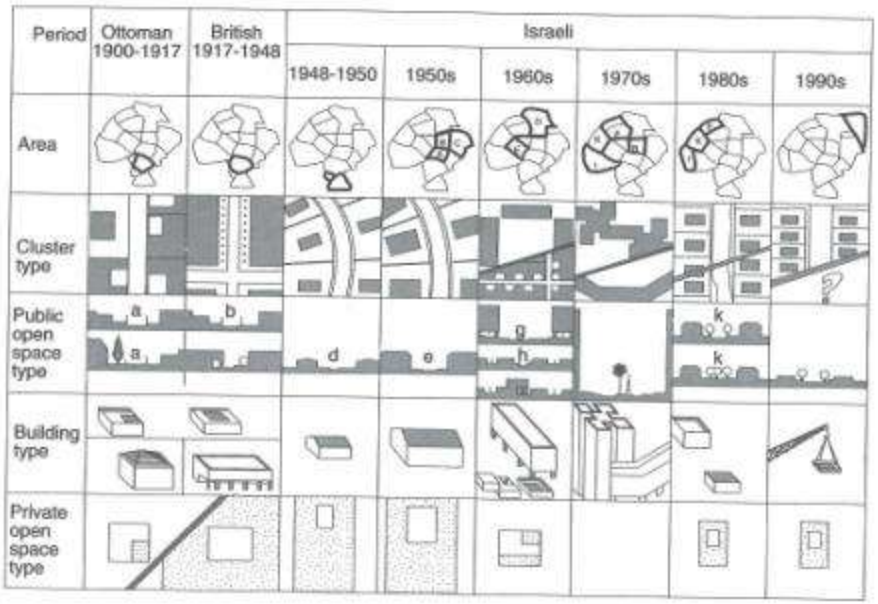


Site	T_a (°C)	V_a (m sec^{-1})
a	32.7	1.3
b	33.4	0.7
c	33.2	1.3
d	32.5	1.1
e	32.2	2.2
f	32.1	0.4
g	33.0/33.2	0.7
h	33.7	1.9
i	32.5	0.5
j	35.7	3.1
k	33.7/34.1	2.3

Fig. 5.7 *Cluster typologies (lower case letters in diagram and table) in a desert city and corresponding maximum air temperatures (T) and wind velocities (V) (After Ref. 11)*

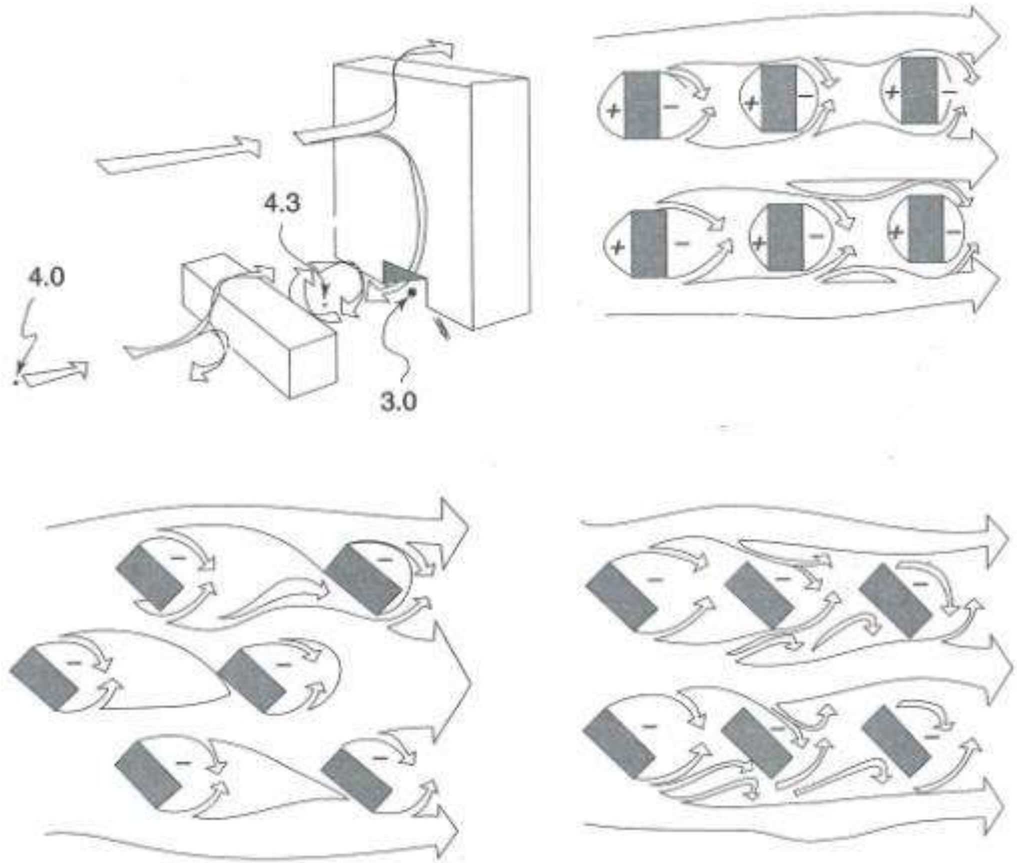


Fig. 5.5 *Wind flow around a tall building with lower building upwind, and wind patterns between buildings of similar height (after Refs. 2, 9)*

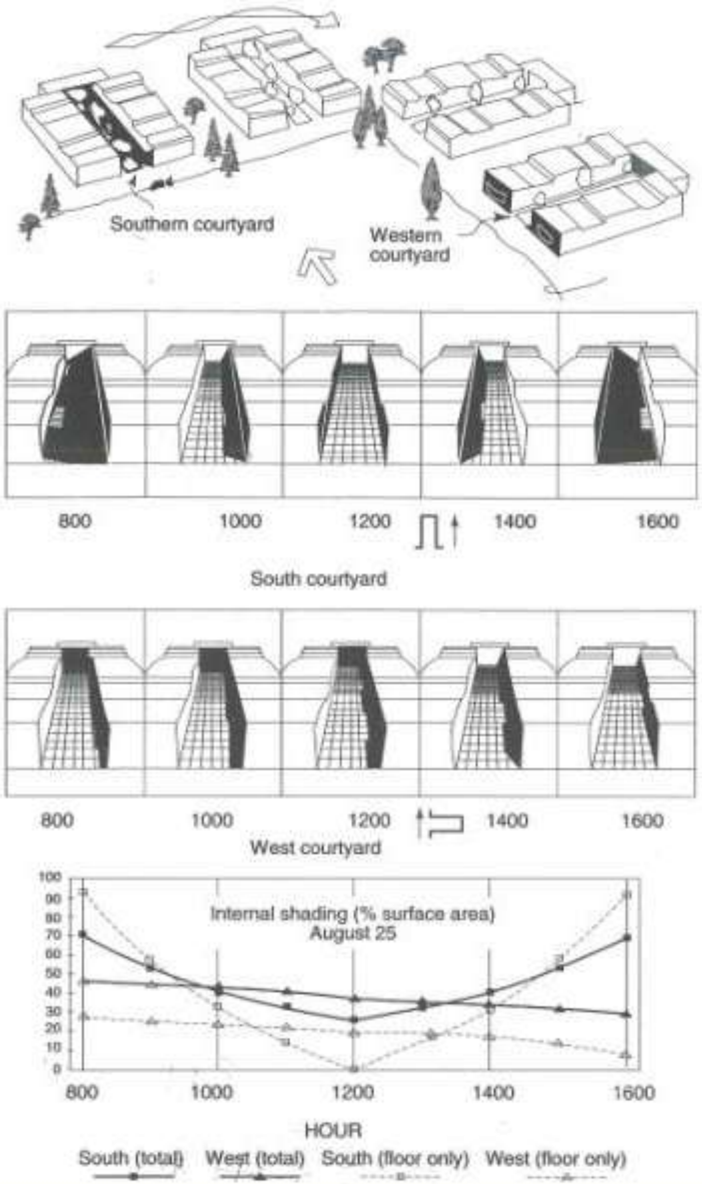


Fig. 5.9 *Two courtyards on the Negev Highlands. Internal shading of surfaces on Aug. 25 (0800-1600 hours) (after Ref. 16)*

$$R_n + F = LE + H + G - A$$

R_n = Net all wave radiation
F = Total urban heat generation
H = Latent heat transfer
LE = Convective latent heat transfer
G = Heat storage in the urban mass
A = Net advected energy

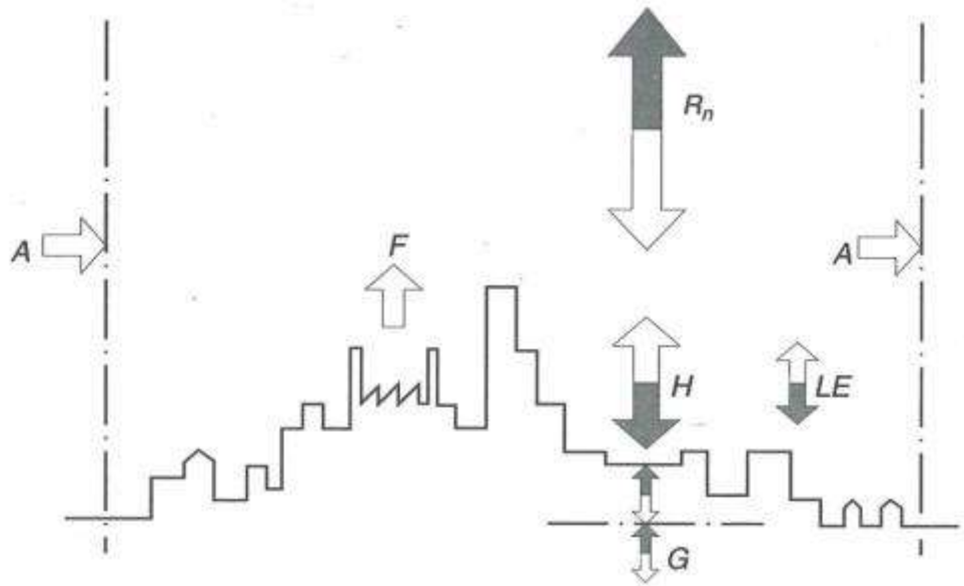


Fig. 5.4 *Urban energy balance. Shaded arrows indicate night processes (after Ref. 8)*

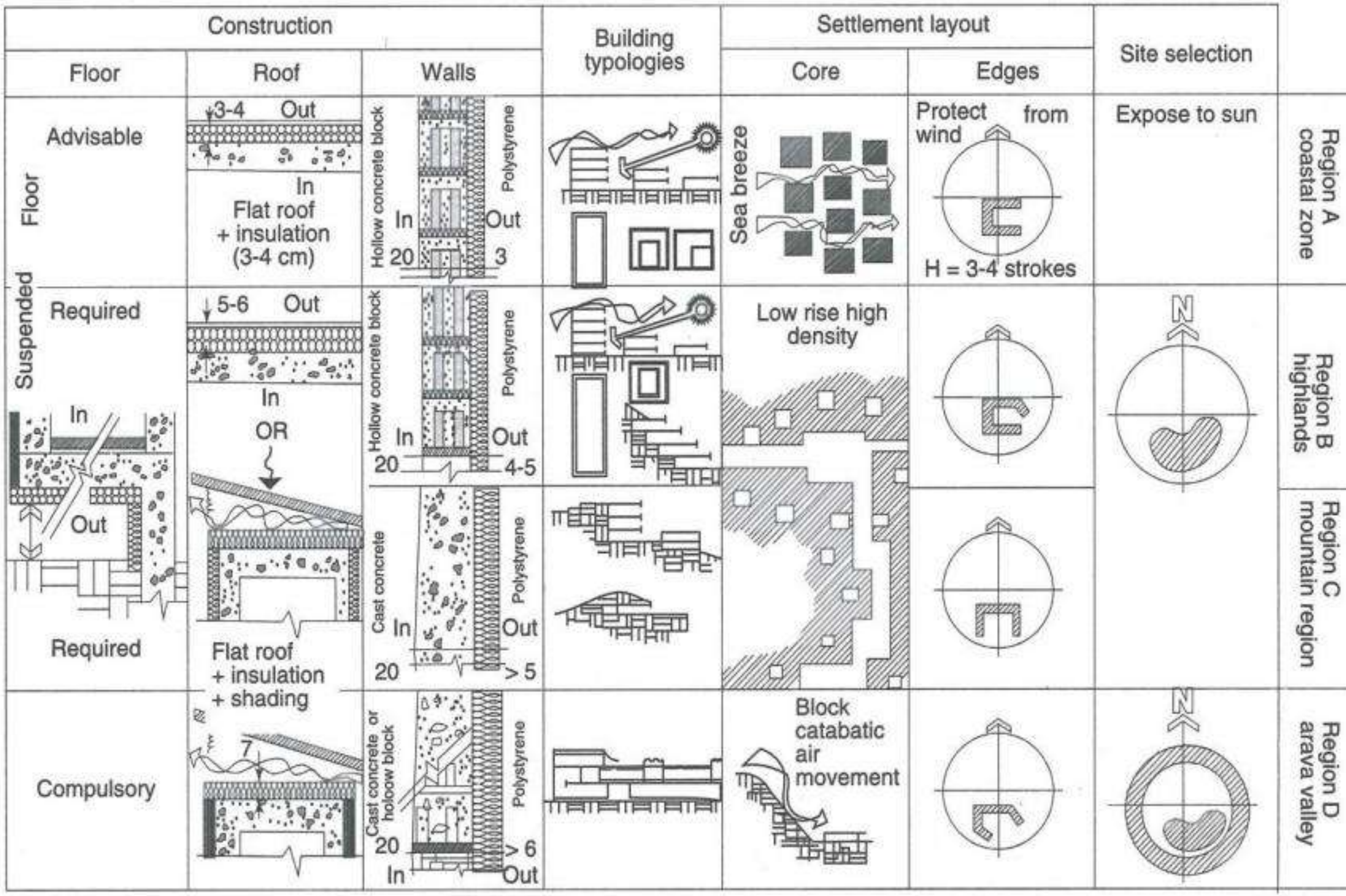
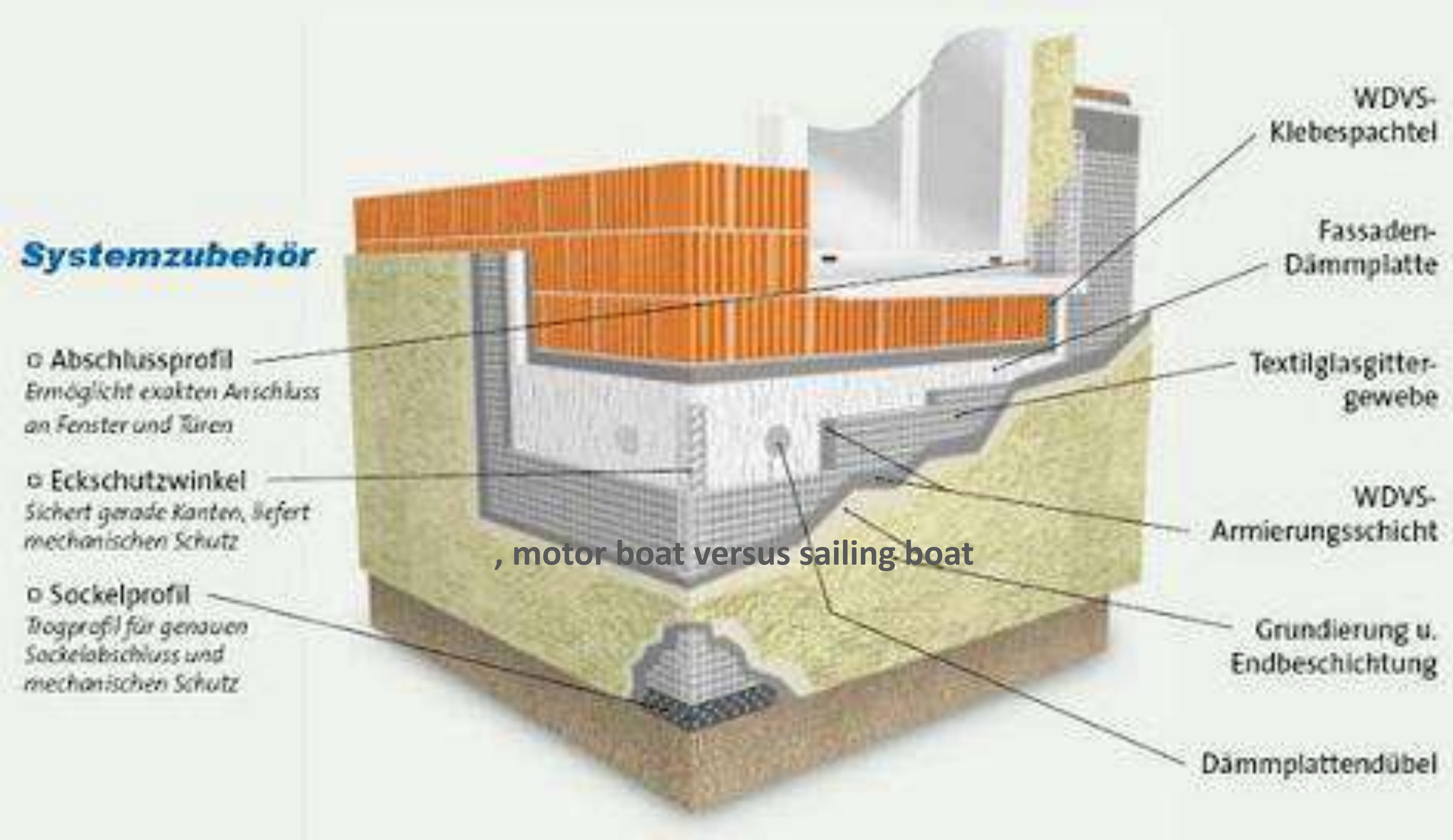


Fig. 5.3 *Design recommendations for four climatic subregions in Negev Desert, Israel (after Ref. 4)*


Passivhaus
Massiv- oder Holzbauweise

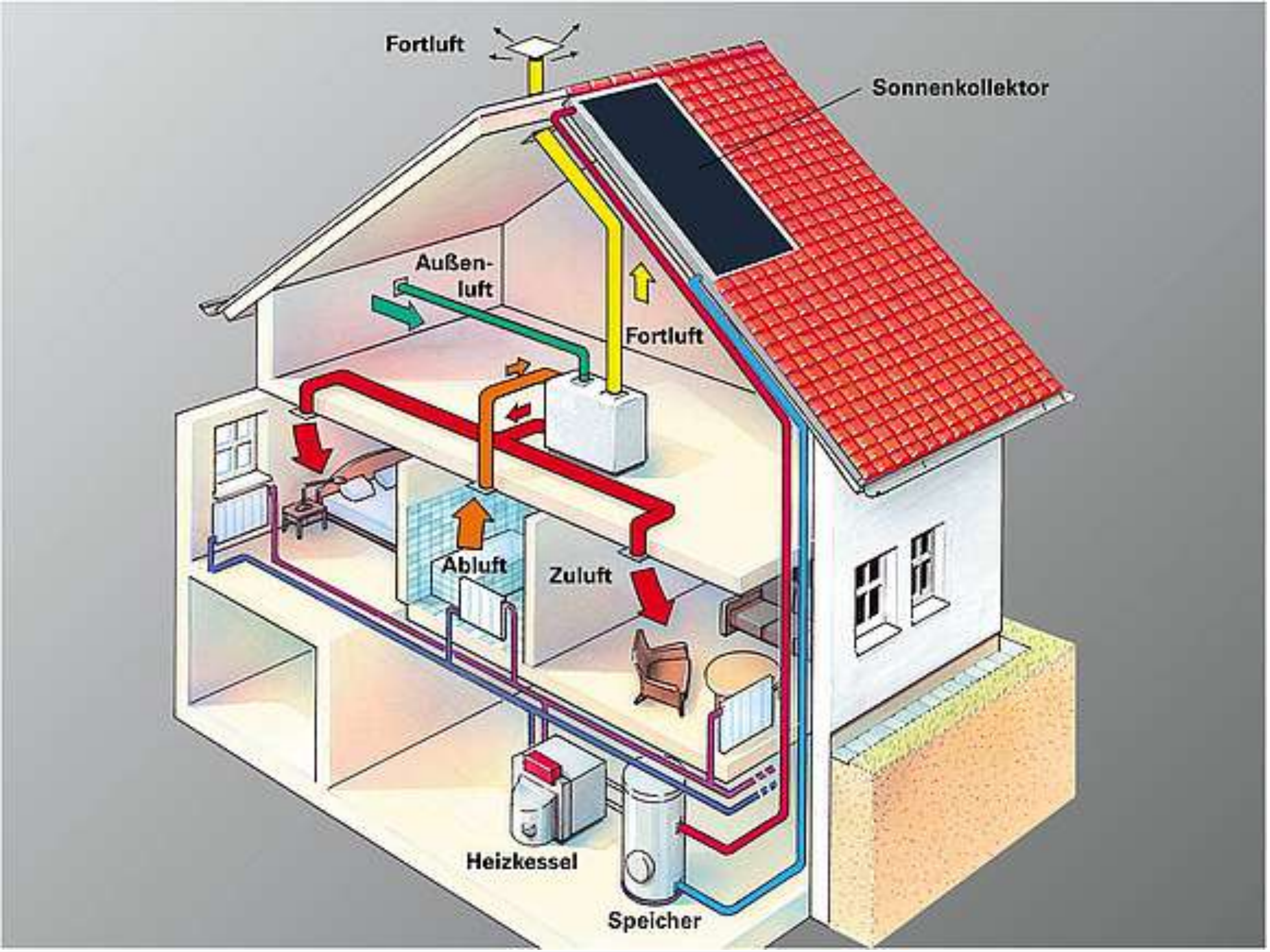
German Energy Plus House ?



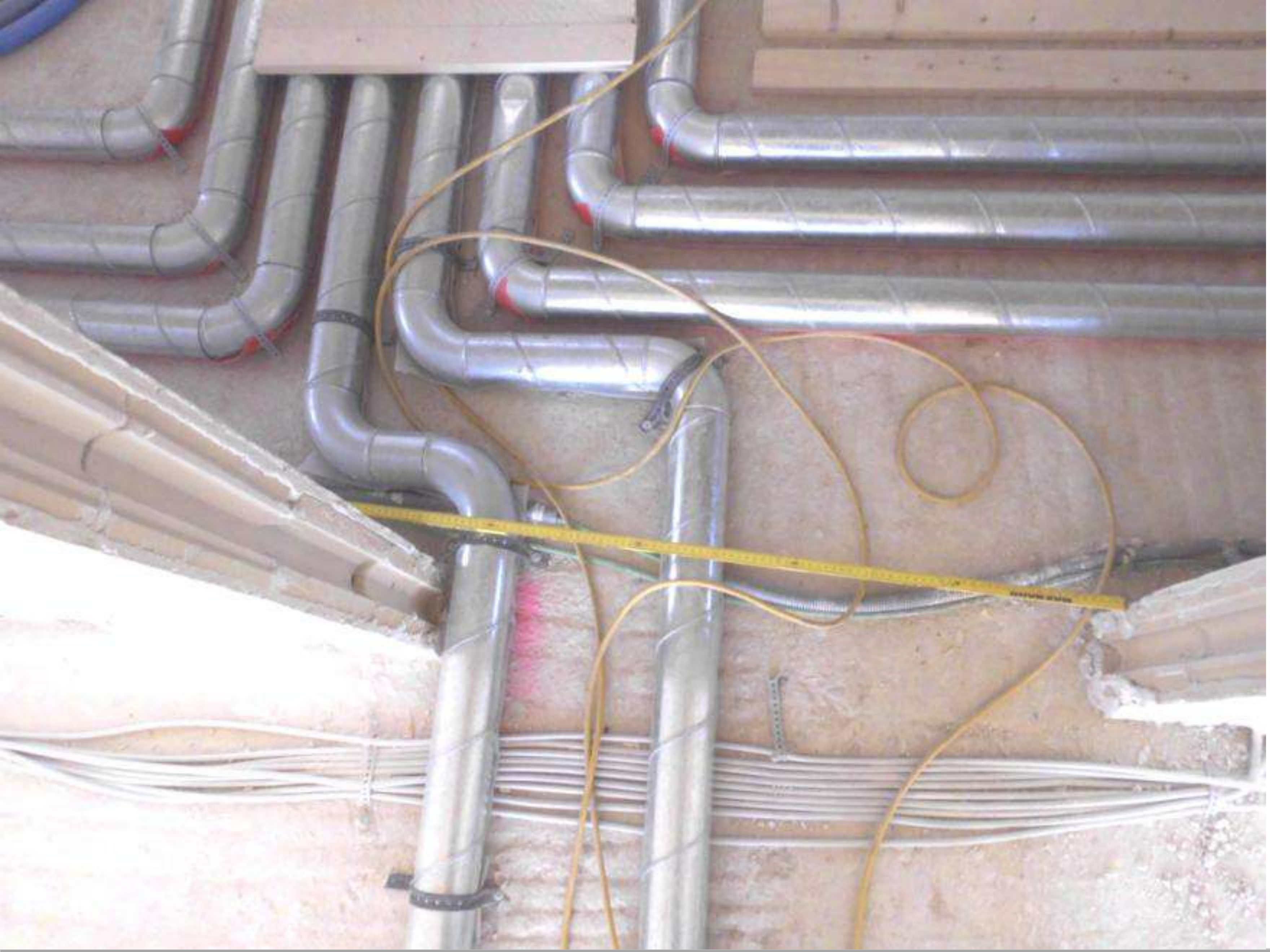
, motor boat versus sailing boat

Insulation Composite Systems ?

Insulation Composite Systems ?

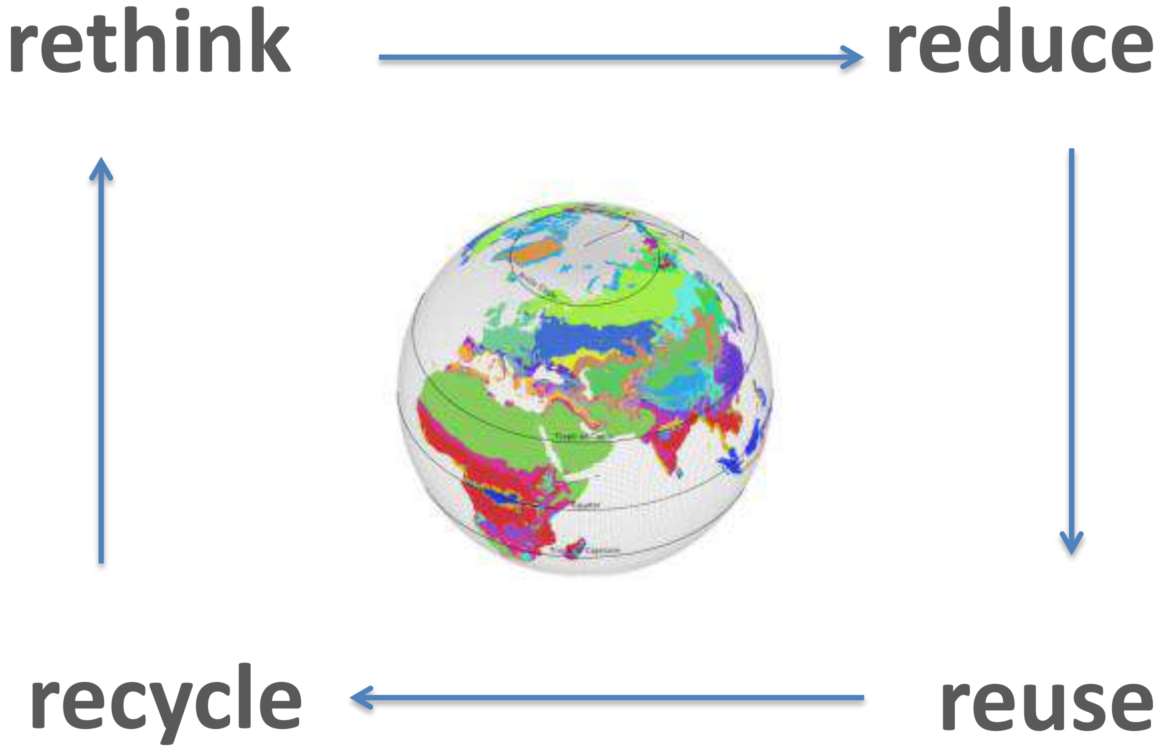


Mechanical Ventilation?



Mechanical Ventilation?

Mechanical AC Armageddon?

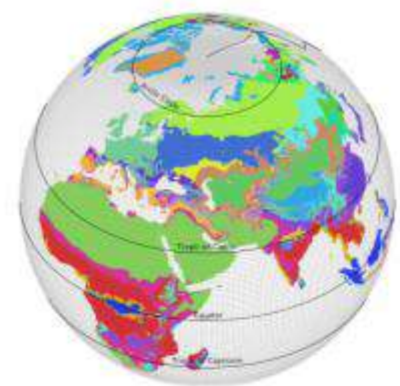

rethink
reduce
reuse
recycle

rethink

reduce

brainstorm
programming
mission

efficiency of architectural strategy, space, construction, shell, interior, utilities



ability of recycling for construction, shell, interior, utilities

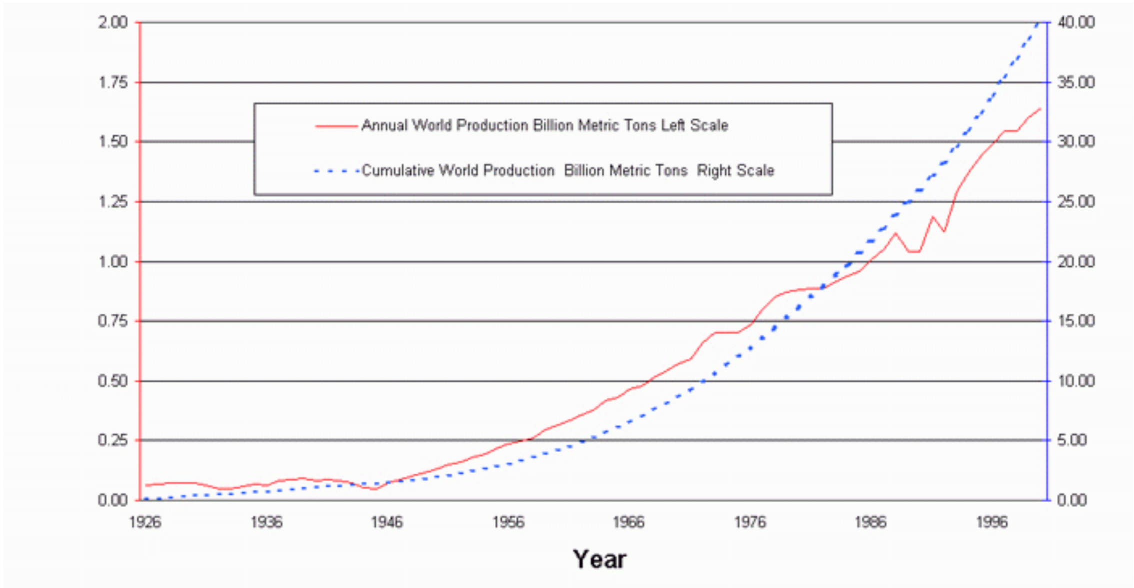
sustainability of architectural strategy. space, construction, Shell, interior, utilities

recycle

reuse

efficiency of architectural construction: reduce ?

architects dream: concrete



reduce

efficiency of architectural construction: concrete

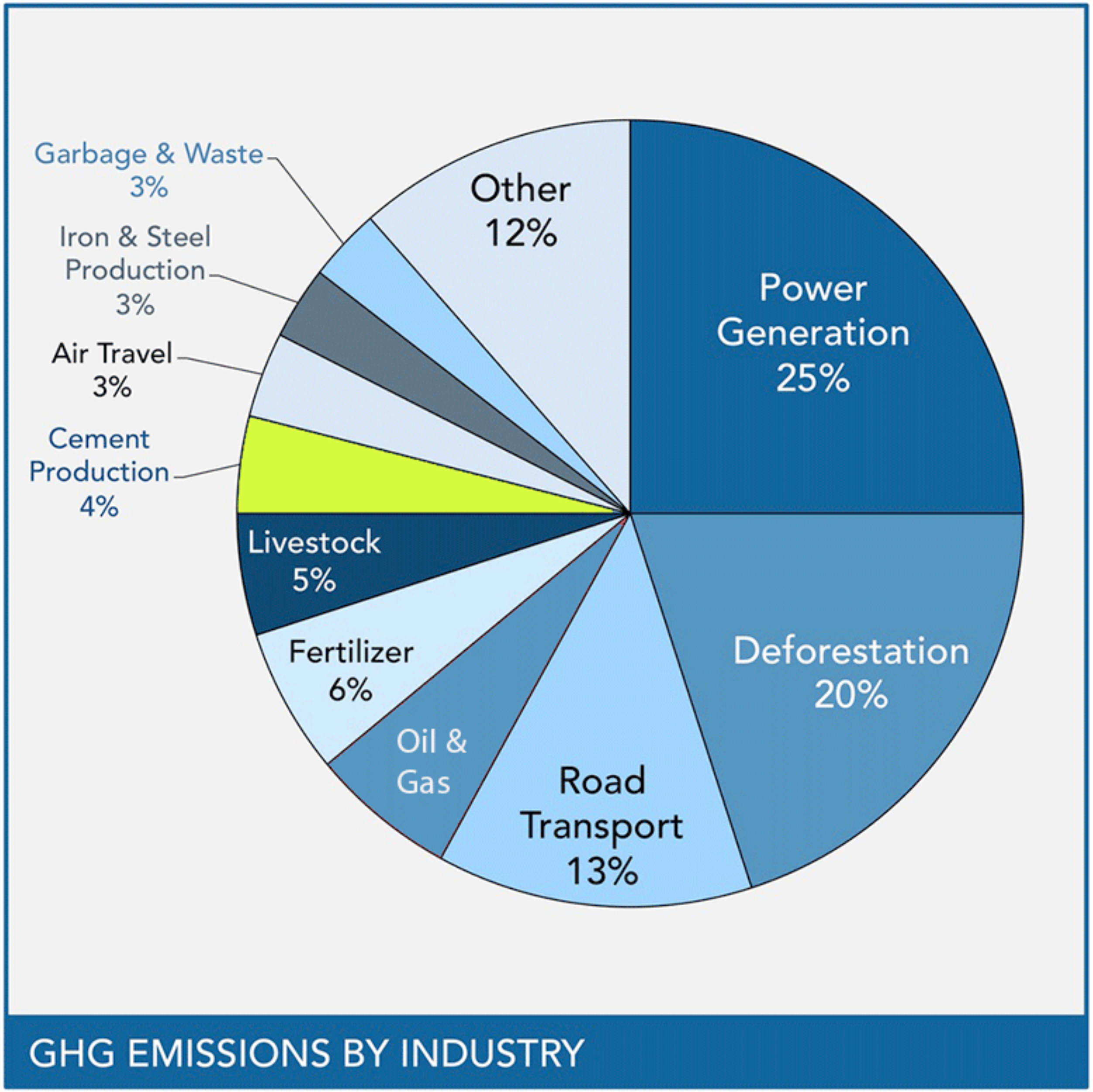
• Making cement results in high levels of CO_2 output.
• Cement production is the third ranking producer of anthropogenic (man-made) CO_2 in the world after transport and energy generation.
• 4 - 5% of the worldwide total of CO_2 emissions is caused by cement production.
• CO_2 is produced at two points during cement production :
- the first is as a byproduct of burning of fossil fuels, primarily coal, to generate the heat necessary to drive the cement-making process
- the second from the thermal decomposition of calcium carbonate in the process of producing cement clinker.

$CaCO_3$ (limestone) + heat -> CaO (lime) + CO_2

• Production of one tonne of cement results in 780 kg of CO2
• Of the total CO_2 output, 30% derives from the use of energy and 70% results from decarbonation
• Important to realise is that although 5% of the worldwide generation of CO_2 is due to cement production, that level of output also reflects the unique and universal importance of concrete throughout the construction industry.

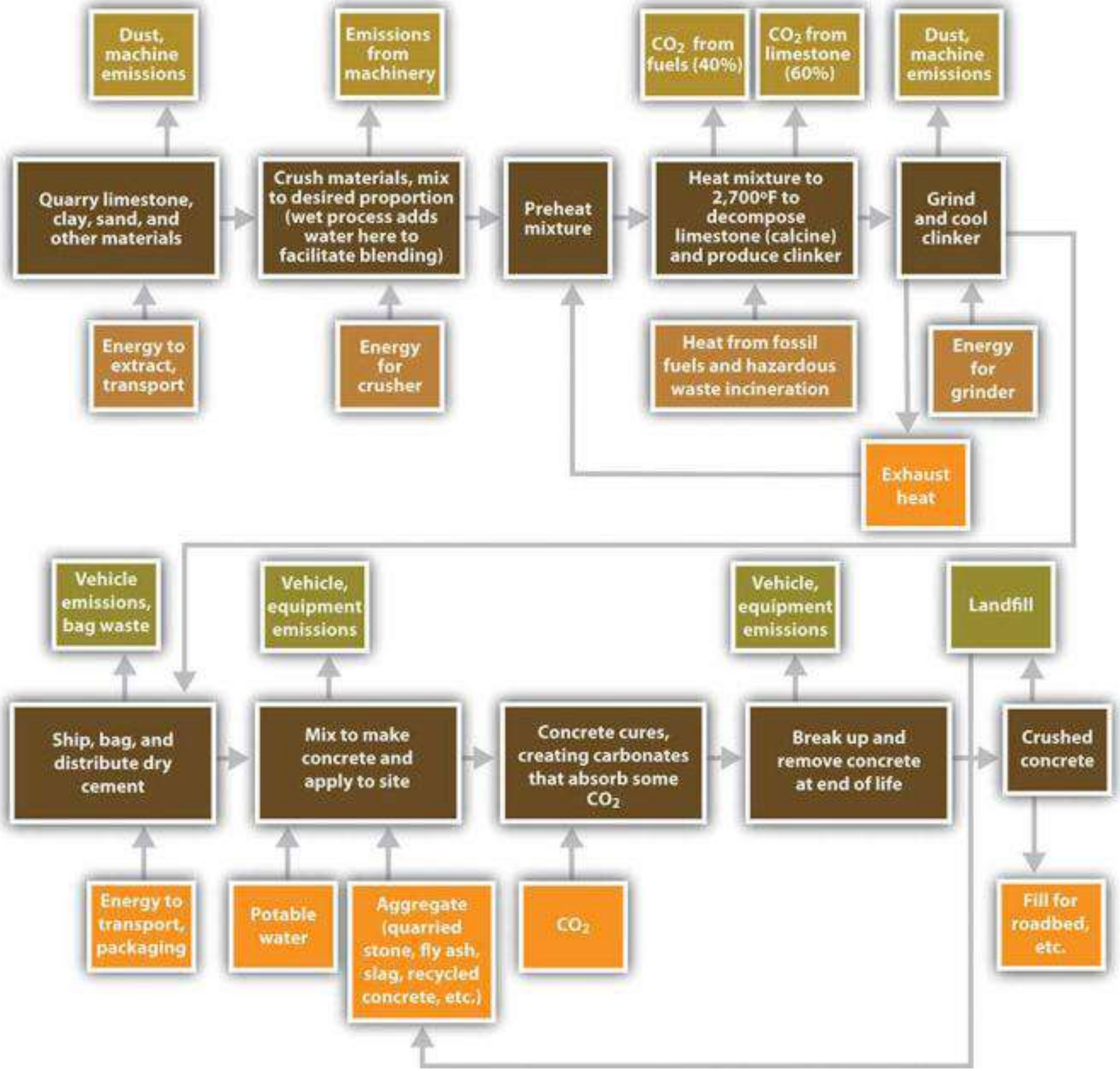
reduce

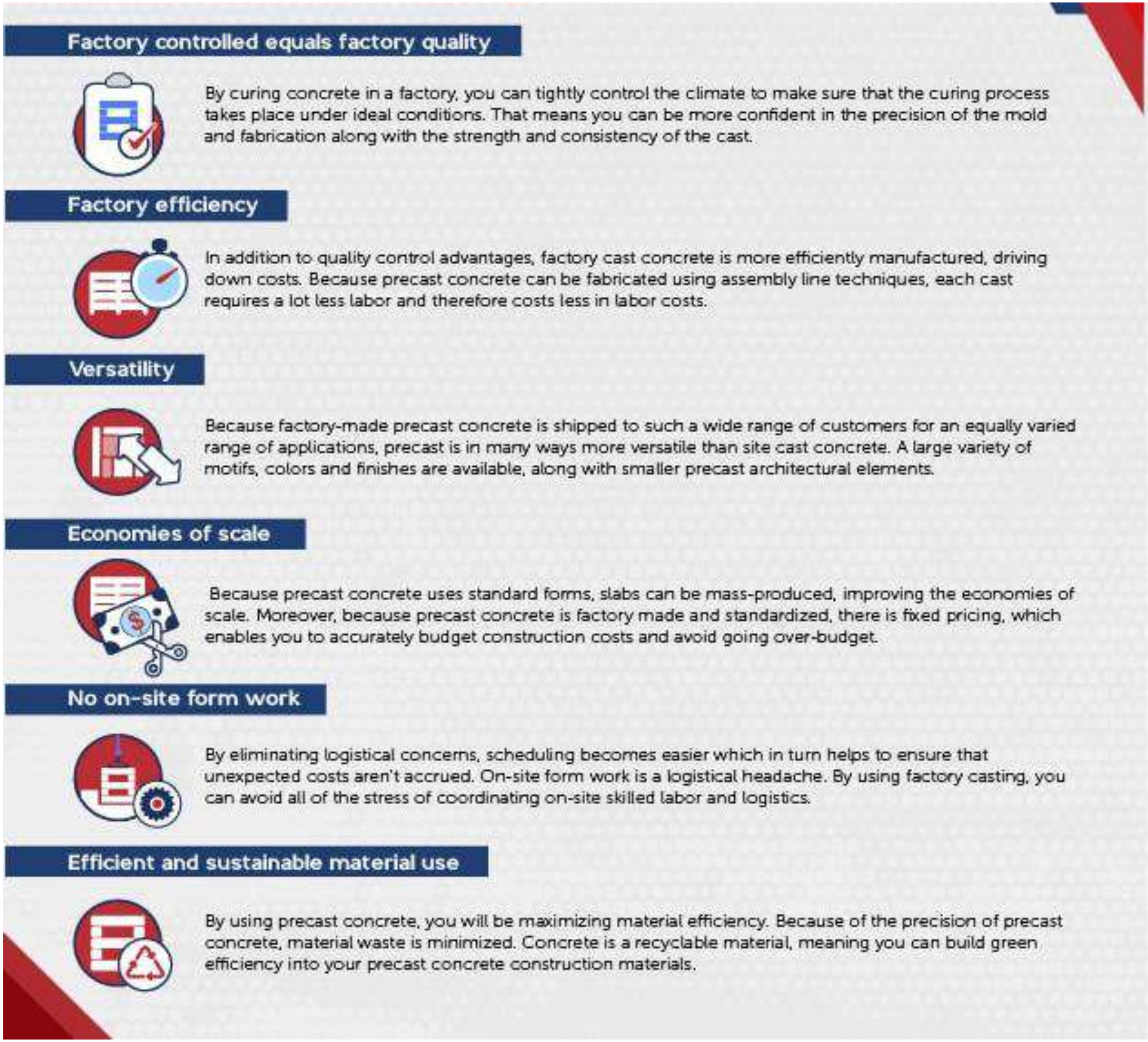
efficiency of architectural construction: concrete



reduce

efficiency of architectural construction: concrete





Factory controlled equals factory quality

By curing concrete in a factory, you can tightly control the climate to make sure that the curing process takes place under ideal conditions. That means you can be more confident in the precision of the mold and fabrication along with the strength and consistency of the cast.

Factory efficiency

In addition to quality control advantages, factory cast concrete is more efficiently manufactured, driving down costs. Because precast concrete can be fabricated using assembly line techniques, each cast requires a lot less labor and therefore costs less in labor costs.

Versatility

Because factory-made precast concrete is shipped to such a wide range of customers for an equally varied range of applications, precast is in many ways more versatile than site cast concrete. A large variety of motifs, colors and finishes are available, along with smaller precast architectural elements.

Economies of scale

Because precast concrete uses standard forms, slabs can be mass-produced, improving the economies of scale. Moreover, because precast concrete is factory made and standardized, there is fixed pricing, which enables you to accurately budget construction costs and avoid going over-budget.

No on-site form work

By eliminating logistical concerns, scheduling becomes easier which in turn helps to ensure that unexpected costs aren't accrued. On-site form work is a logistical headache. By using factory casting, you can avoid all of the stress of coordinating on-site skilled labor and logistics.

Efficient and sustainable material use

By using precast concrete, you will be maximizing material efficiency. Because of the precision of precast concrete, material waste is minimized. Concrete is a recyclable material, meaning you can build green efficiency into your precast concrete construction materials.

reduce

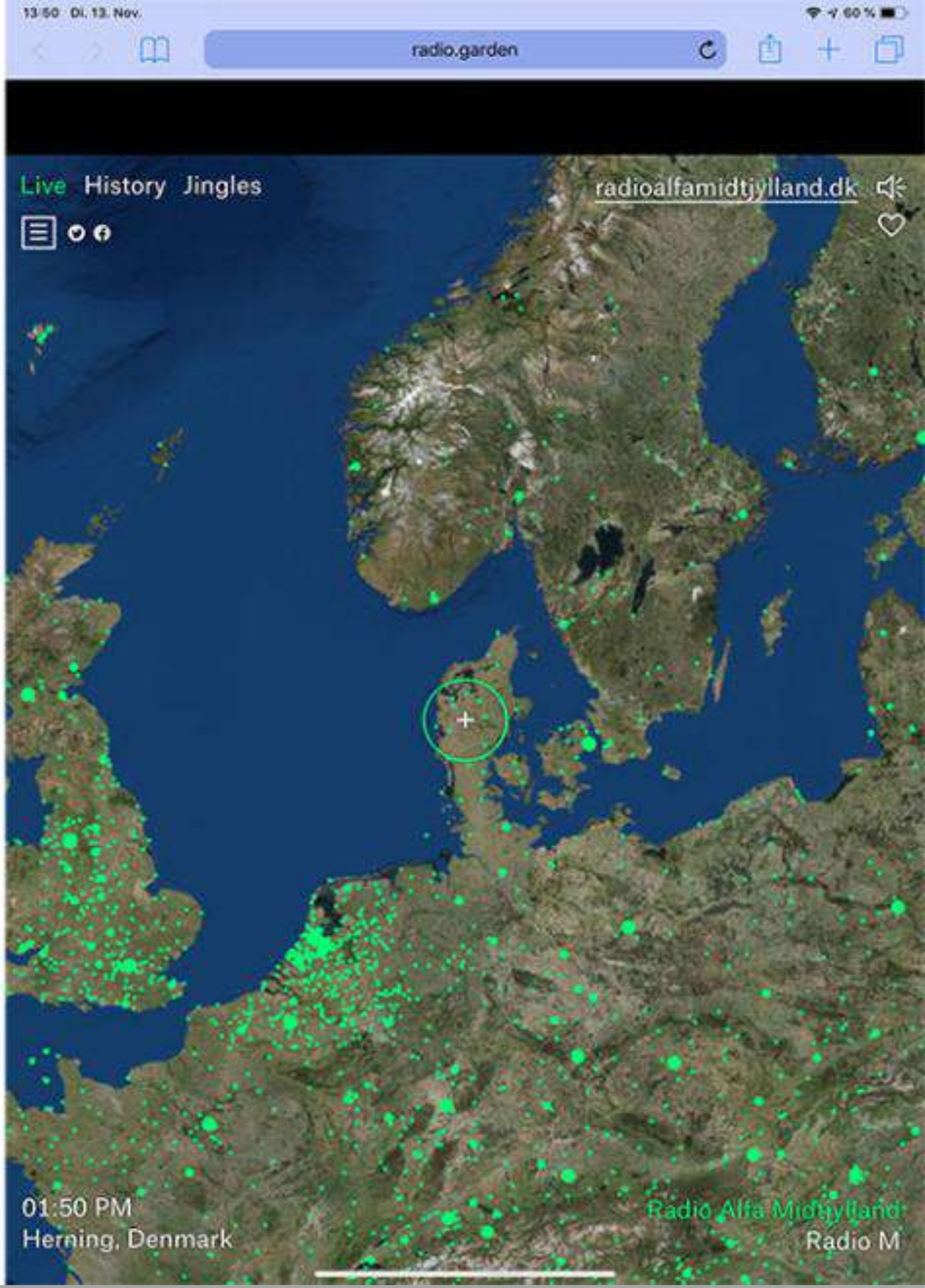
efficiency of architectural construction: concrete

Precast:

less material concrete/ steel

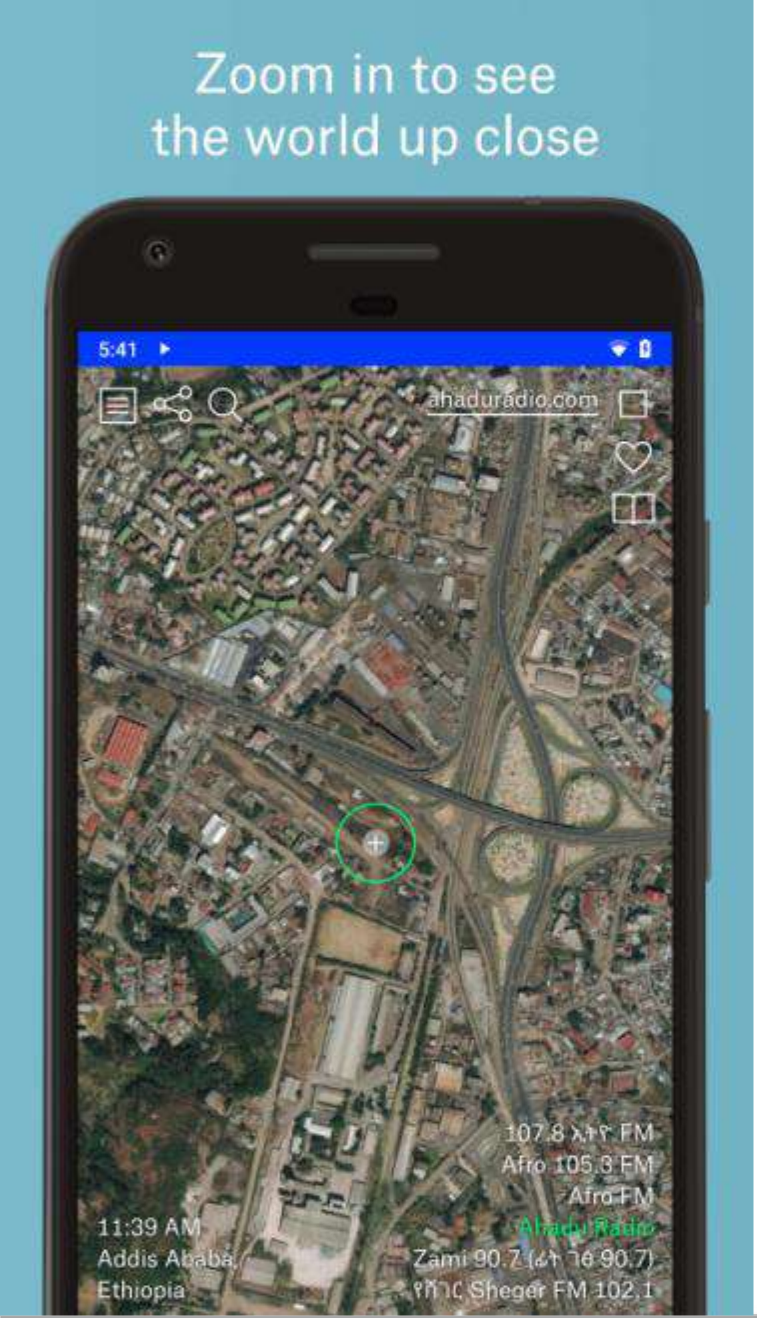
less transport/ Garbage

faster/ better quality

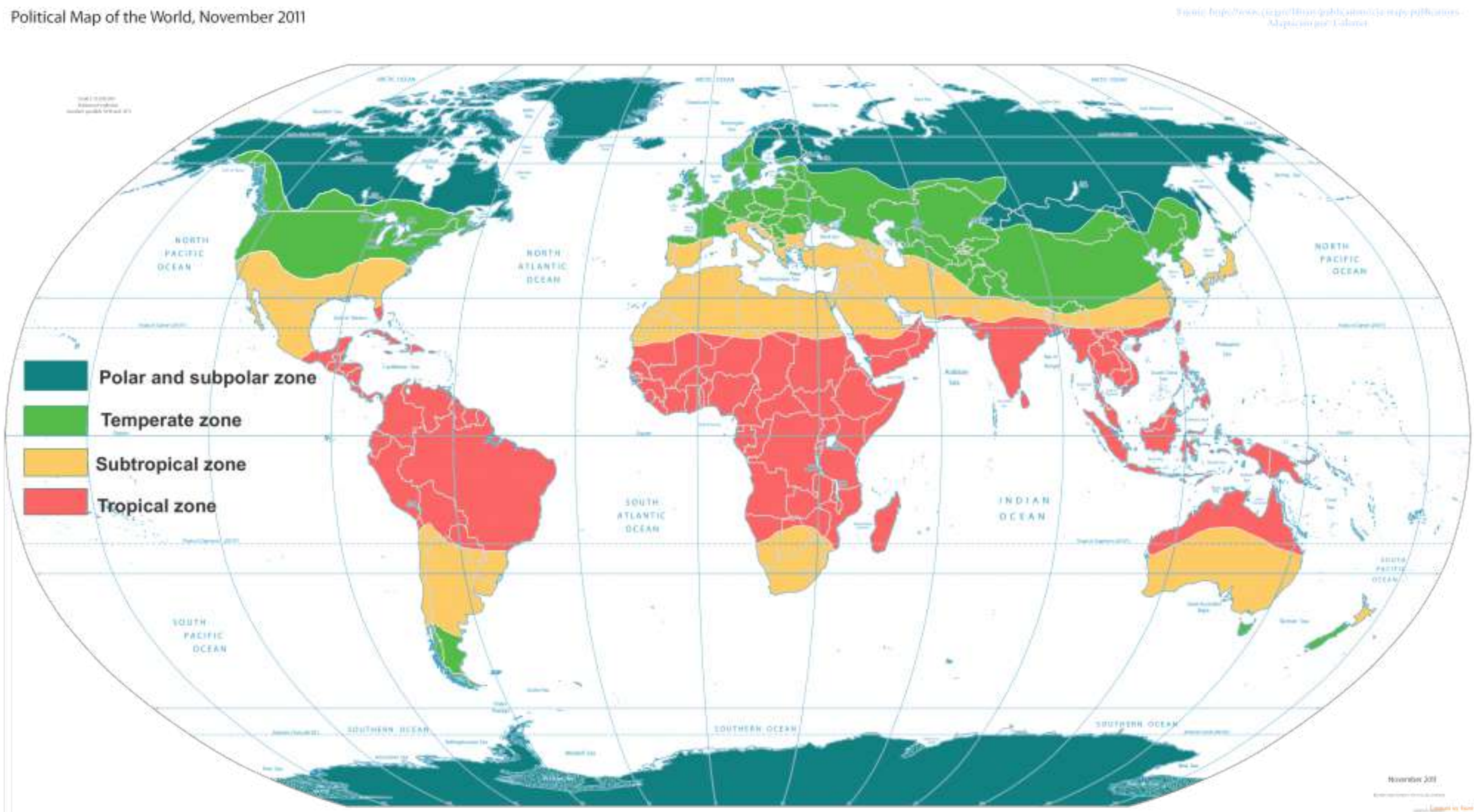


App Idea:

Radio Garden

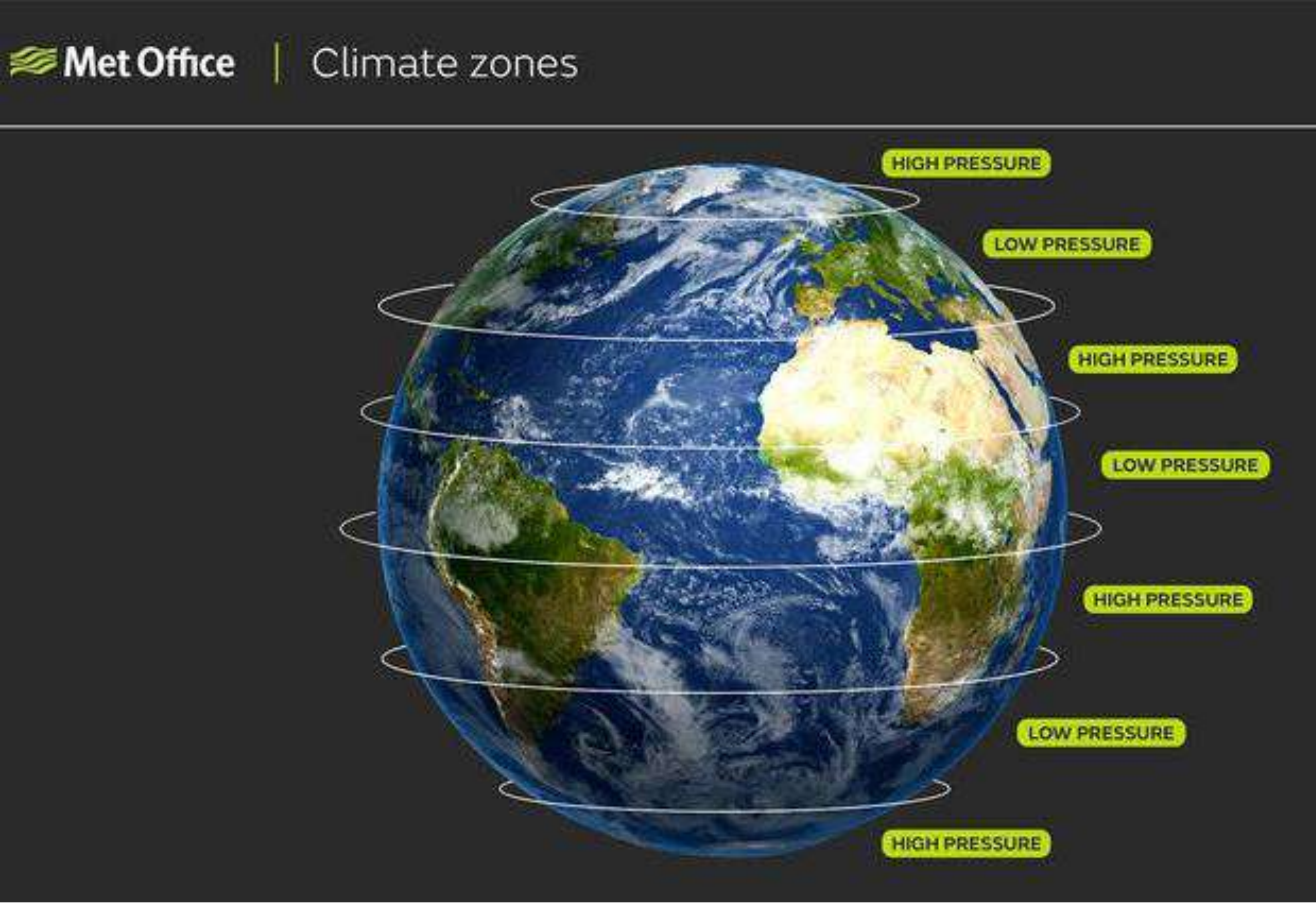


App Idea:
Radio Garden



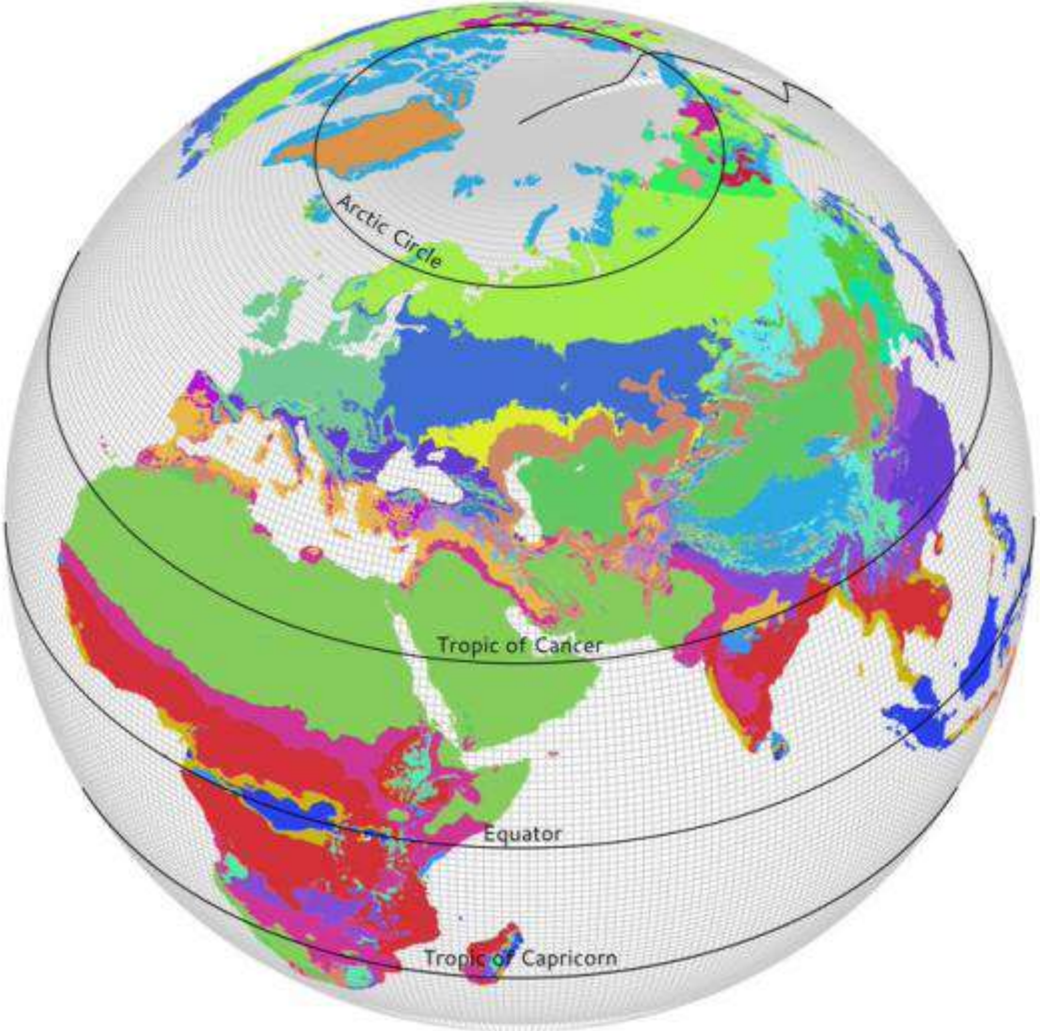
App Idea:

Global Temperature Zones



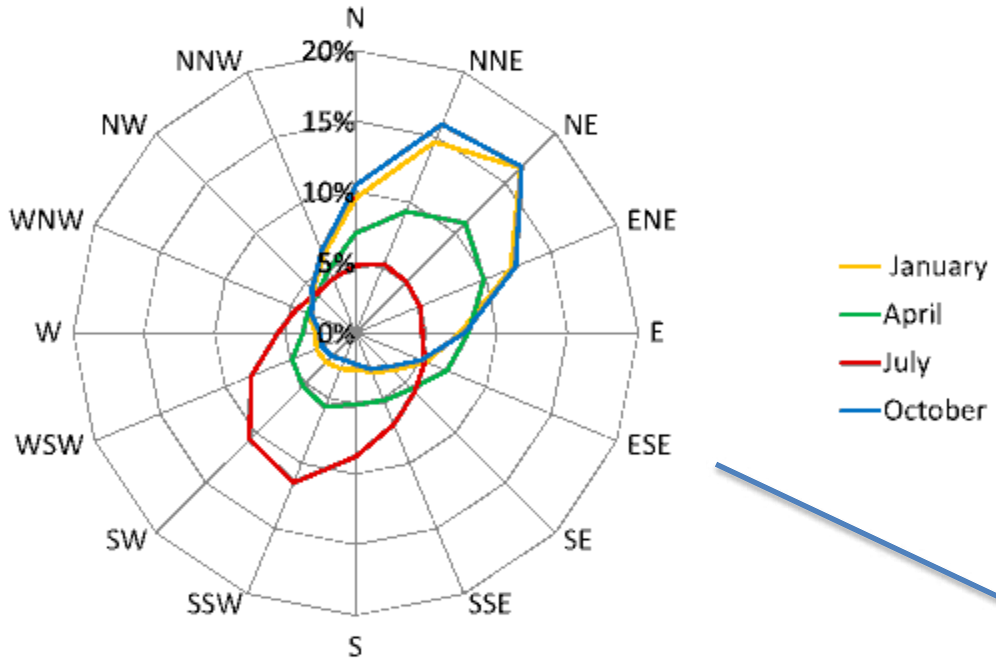
App Idea:

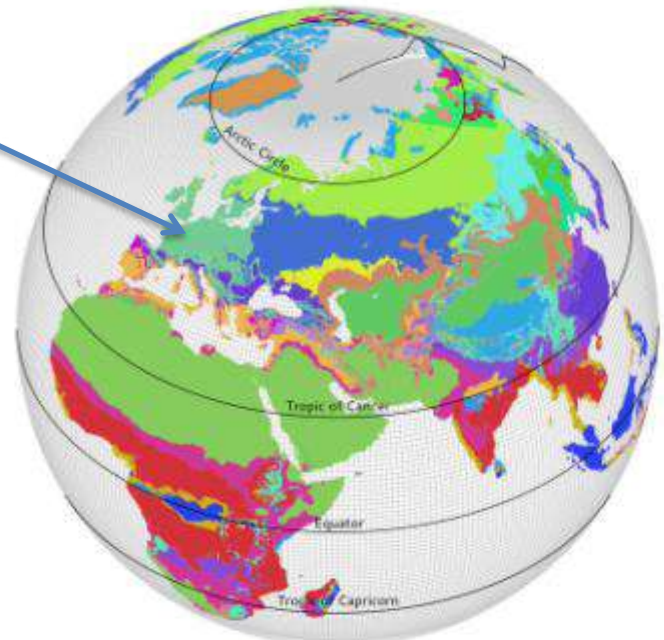
Global Tempeerature Zones loaded into „Radio Garden“ like visualisation



App Idea:

Global Tempeeratura Zones loaded into „Radio Garden“ like visualization



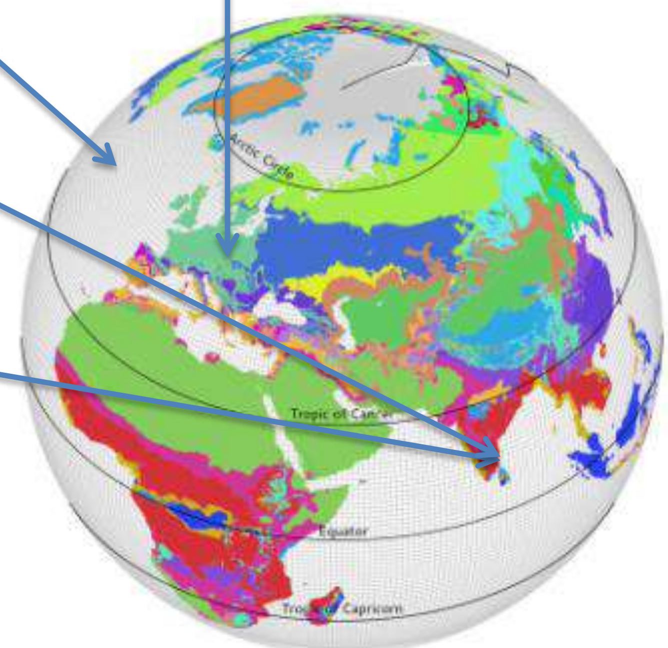


App Idea:

Global Tempeeerature Zones loaded into „Radio Garden“ visualization, connecting with climate data bases

Projects
MSA Muenster

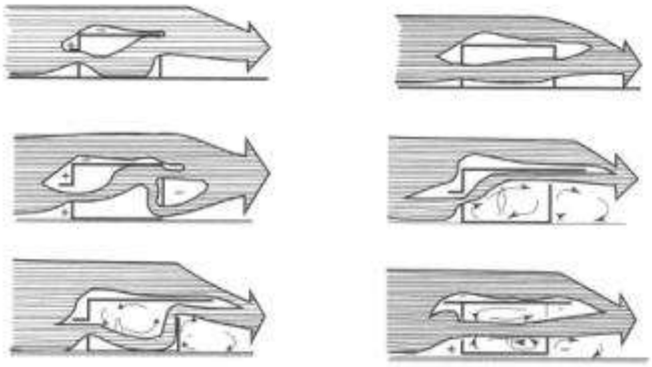
Projects
Moratuwa
University



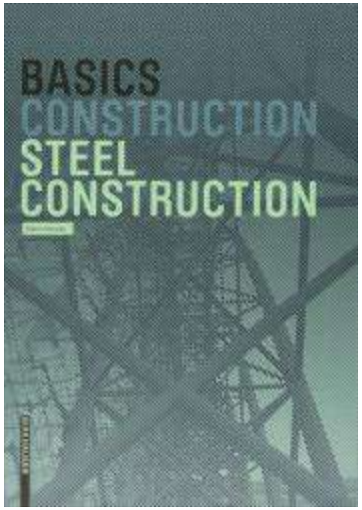
App Idea:

Global Tempeeratture Zones loaded into „Radio Garden“ visualization, connecting with projects, student projects

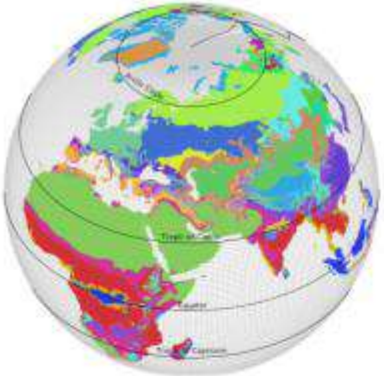
Ecology, Sustainability



Principles



Materials

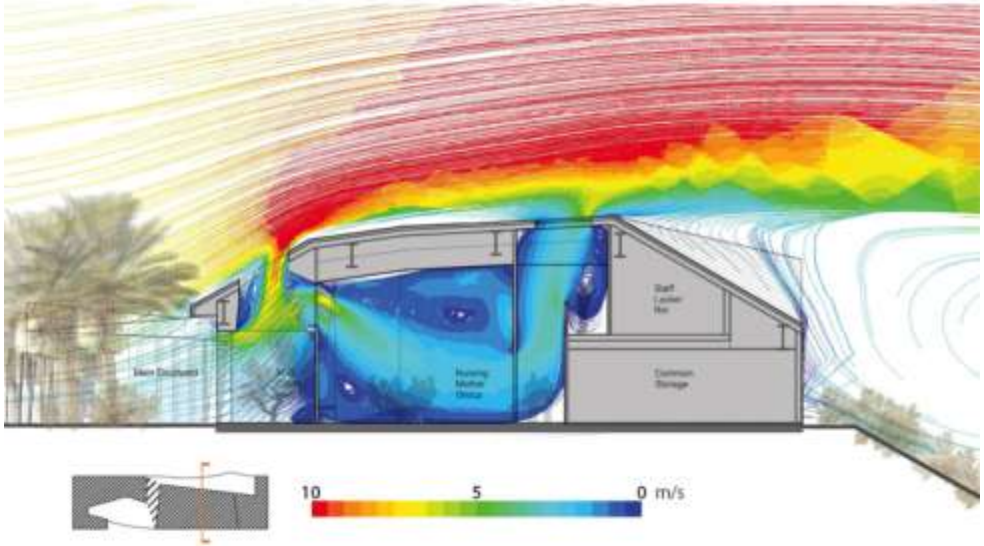


Sources, References

Utilities

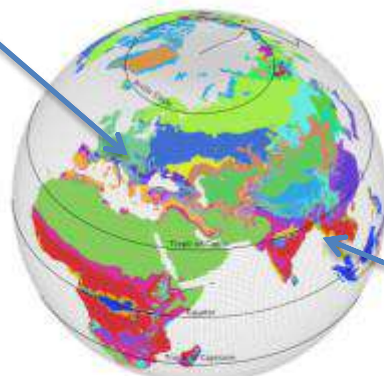
App Idea:

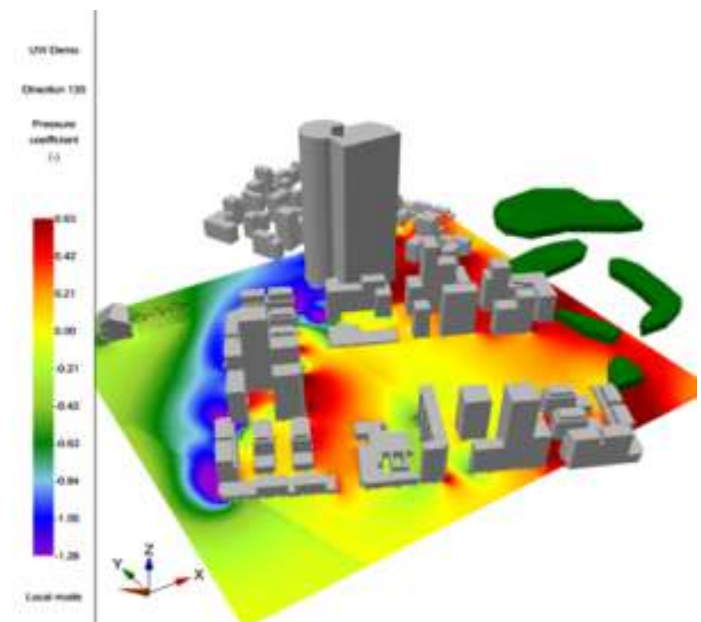
connecting with toolbox knowledge: general references, materials, ecology, sustainability, passive principles,active utilities



City Scale

Building Scale





App Idea:

connecting with toolbox knowledge: research, simulation, CFD

1 identification of worldwide landmark projects

2 student projects with mission

3 collecting of basic toolobx knowledge

4 implication of test app, controlling e.g. text and images formats on different screen sizes

5 adapting, programmig of google/ radio garden movable globe

6 suitable name for web/ app domain

7 identification of „free“ and „locked“ part of app
(locked part with deeper information, reserach, only accessible for MSA/ Moratuwa /N.Z.students)

Site web, app roadmap "Climate Responsive Architecture" **05.03.2020**

1	idea	project description
2	participants	MSA
		Faculty of Architecture University of Moratuwa
		New Zealand?
3	climate	climate zone
	responsive	nature
	architecture	topography
	main factors	culture
		technology
		material
		sustainability
		energy

lectures	JR	Keynote Colombo 2019
bibliography		

4 selection of global kandmark projects

Europe	Scandinavia	Finnland	Iglu
		Sweden	Passiv wood houses
	Italy	Pompeji	Roman atrium villa
		Calabria	Matera Cave dwellings
		Spoerri	Milano Green Highrise
	Tessin	Graubünden	mountain villages
	Spain	C. Manrique	Fundacion, Lanzarote
	Great Britain	E. Howard	Garden City
	…		
America	New England		Shaker architecture
	Illinois	Keck Bros.	Solar Houses
	Wisconsion	F.L. Wright	Solar Hemicycle House
	Florida	P. Rudolph	Florida Houses
	California	R. Neutra	VDL Research and Residence, L.A.
	Arizona	P. Soleri	Arcosanti desert city
	Colorado	Mesa Verde	Pueblo architecture
	Albucerque		Pueblo architecture
	Mexico	L. Barragan	Home and Studio
	Brasilien	O. Niemeier	Canoas house
	….		
Arabia	Persia	Bhagdir	wind towers

Asia	Japan		tradtional Japan Minka Houses
	Japan		traditional Edo Machichiya
	Japan	E. Ambasz	Acros, Building, Fukuoka
	China		tradtional Chinese Siheyuan Houses
	China		tradtional Chinese Hakka villages
	Indonesia		traditional Tongkonan, Patak houses
	India		traditional Kerala Houses
	India	C. Correa	Kenchanjunga appts. Bombay
	India	C. Correa	Climate houses
	Malaysia	K.Yeang	Eco Highrises
	Singapure		Green City
	Sri Lanka	Bawa	Kandalama Hotel
	….		
Australia/		G. Murcutt	Houses
N.Z		T. Danielm.	Solar Decathlon 2011
Africa	Egypt	H. Fathy	Houses
	Morocco	Ait Behaddou	Clay Kasbah
	Jemen	Sanaa	Clay City
	Mali		traditional Mali architecture
	Mali	F. Kere	new architecture
	….		

lectures

bibliography

5 toolbox

material

clay	
wood	bamboo
	framing
steel	framing
concrete	prefab

reuse

recycling

lectures

bibliography

natural ressources

sun

water

earth

wind

building typologies

principles

		active utilities	electricity	
			water	
			heating	
			cooling	
			ventilation	
		lectures		
		bibliography		
	planning, simulation	BIM	BIM	
		CFD	CFD	
		lectures	Jonas	BIM, Colombo
		bibliography	MSA	CFD, Colombo
6 selection of student projects	MSA			
	Moratuwa			
	New Zealand			

Motor Boat versus Sailing Boat