UNIVERSITÀ
DEGLI STUDI
FIRENZE
DIDA
DIPARTIMENTO DI
ARCHITETTURA

MAILAB
Multimedia
Architecture
Interaction

BRIEF | Climate Based Design Strategies

G. RIDOLFI

Overview

Environmental Design Class

- 01. **BRIEF** Program & Environmental Report
- 02. **CONCEPT** Architectural Mass & Lay-out Optioneering
- 03. **SCHEME** Architectural Proposal
- 04. **DETAIL** Envelope Design & Conceptual Prototype
- 05. **FINAL** Project Communication

01 **BRIEF** | Program & Environmental Report

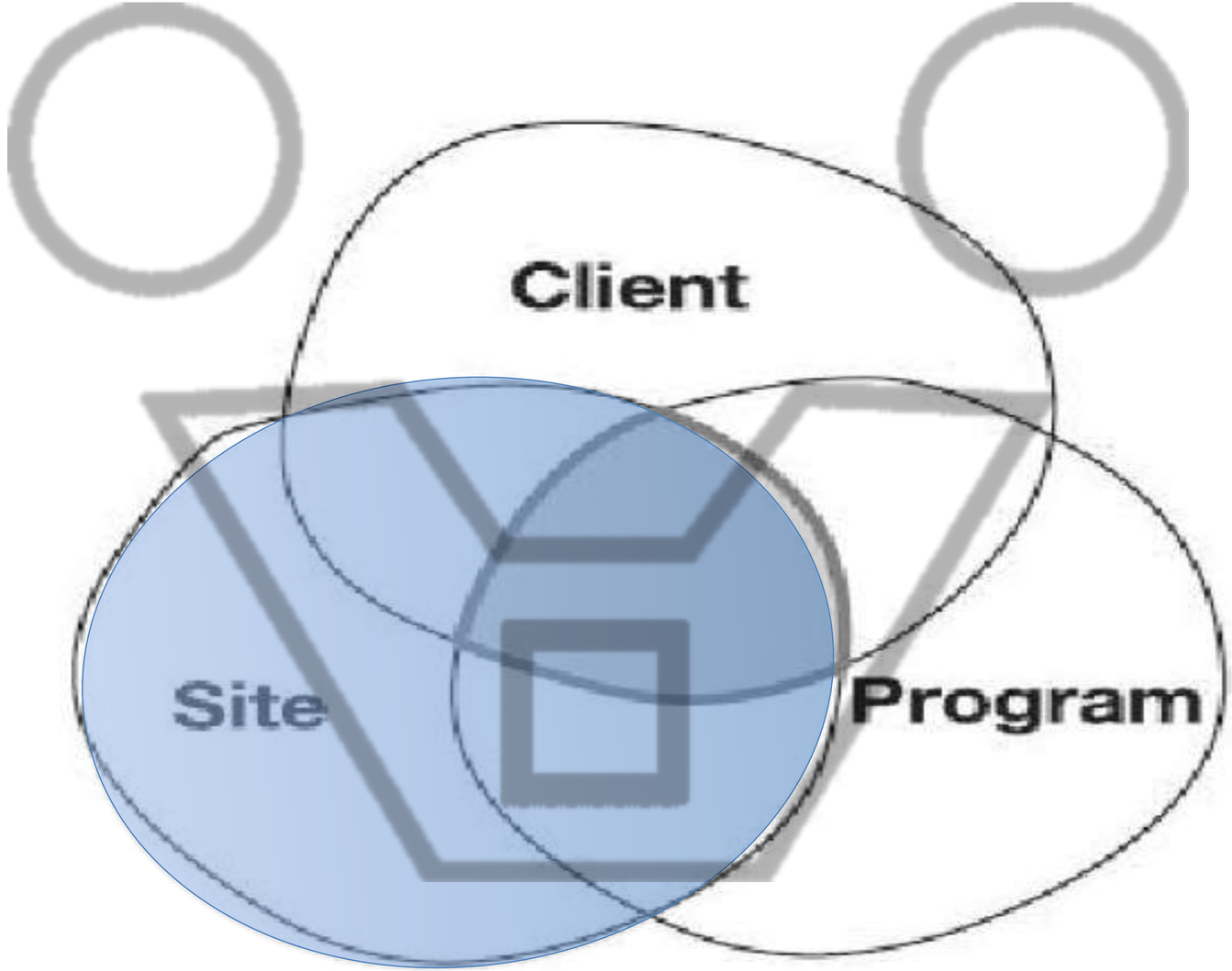
- 1.1. Project Mission & Space Program
- 1.2. Comfort Modeling & Environmental Users' Requirements
- 1.3. Climate based Design Strategies
- 1.4. Site Assessment

Overview

part 1.3

BRIEF | Climate Based Design Stretegies

ENVIRONMENTAL REPORT | Climate Based Design Strategies



Site & Surroundings

- Climate & biological
- Site levels & orography

- Cultural elements
- Regulations

- Surfaces + Materials
- Noise, Odour, Pollution

Site & Surroundings

NATURA

- Climate & biological
- Site levels & orography

UOMO

- Cultural elements
- Regulations

INDIVIDUO

- Surfaces + Materials
- Noise, Odour, Pollution

Site & Surroundings

NATURA

- Climate & biological
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UOMO

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- Regulations

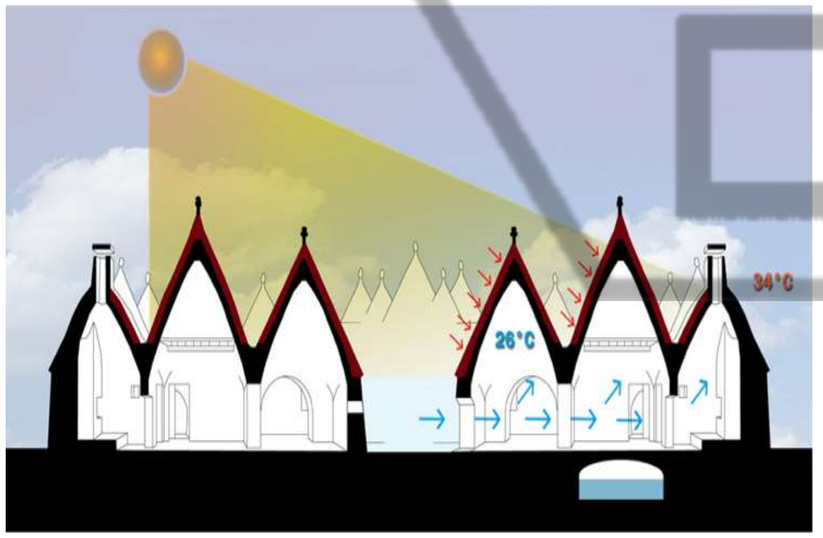
INDIVIDUO

- Surfaces + Materials
- Noise, Odour, Pollution

The Climate Report

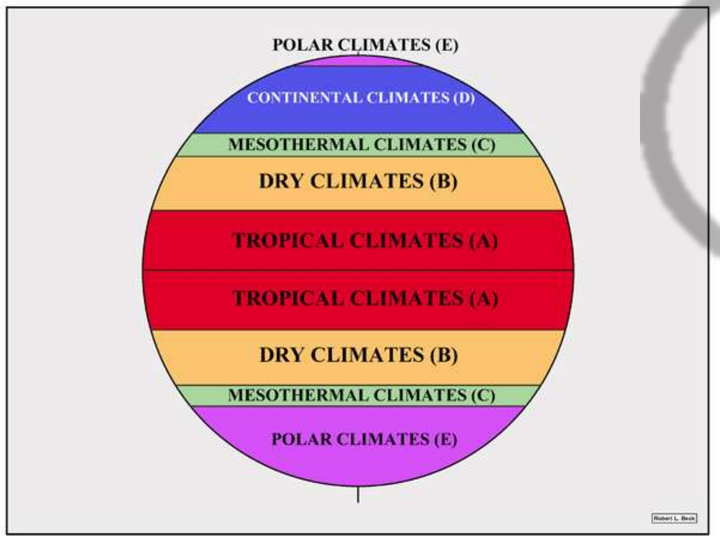
Climate Aspects

2	CLIMATE
	Climate Profile
	Map of the soil solar exposure
	Ventilation Map (breeze and cold wind)
	Best Solar orientation
	Shade Maps (more appropriate at mid morning -10 am, noon, midafternnon -2 pm, late afternoon -4 pm; in midsummer, midwinter, equinox)
	Rain fall



Climate Classification

Köppen's climate classification



Latitudinal Model of the Köppen Climate Groups

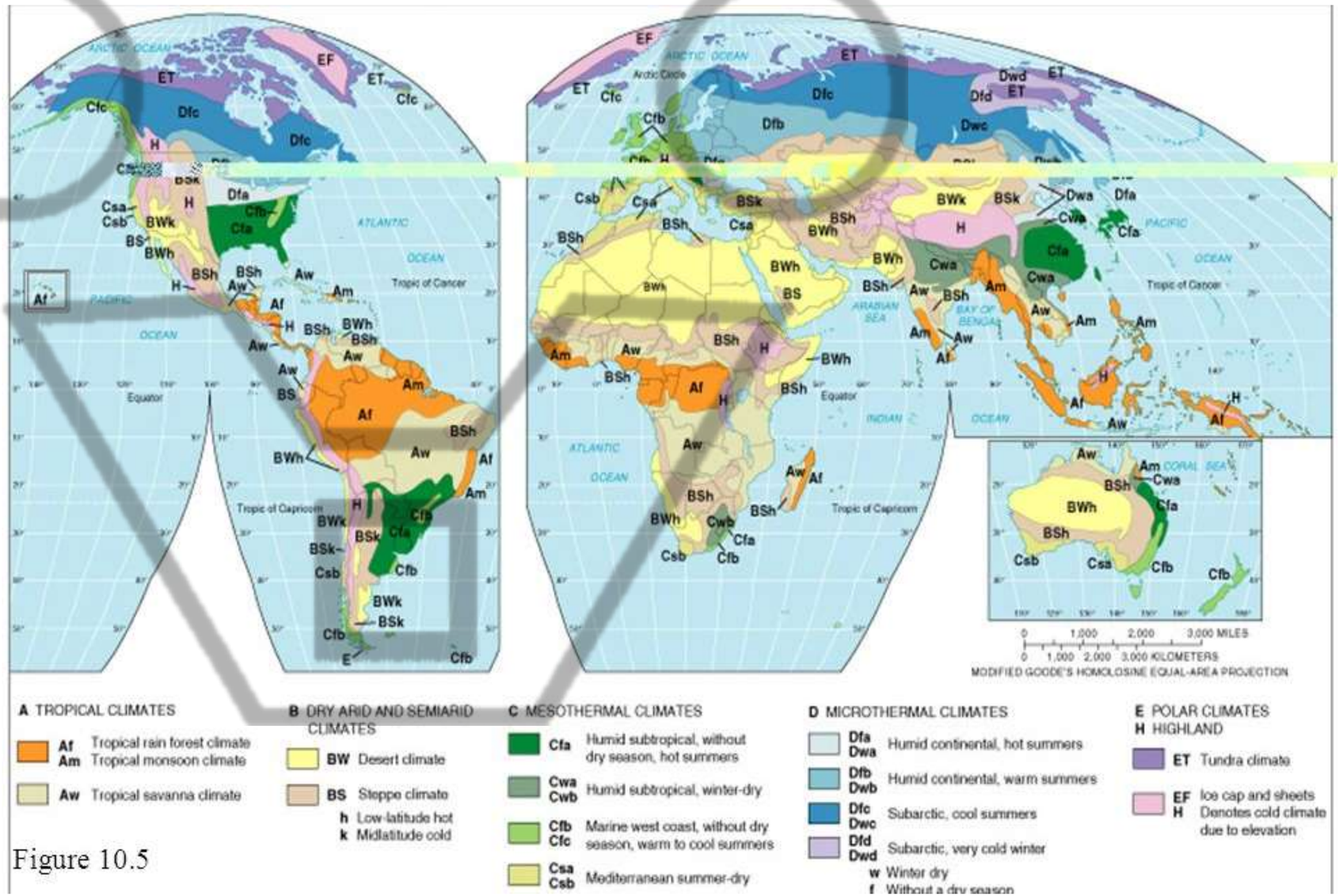
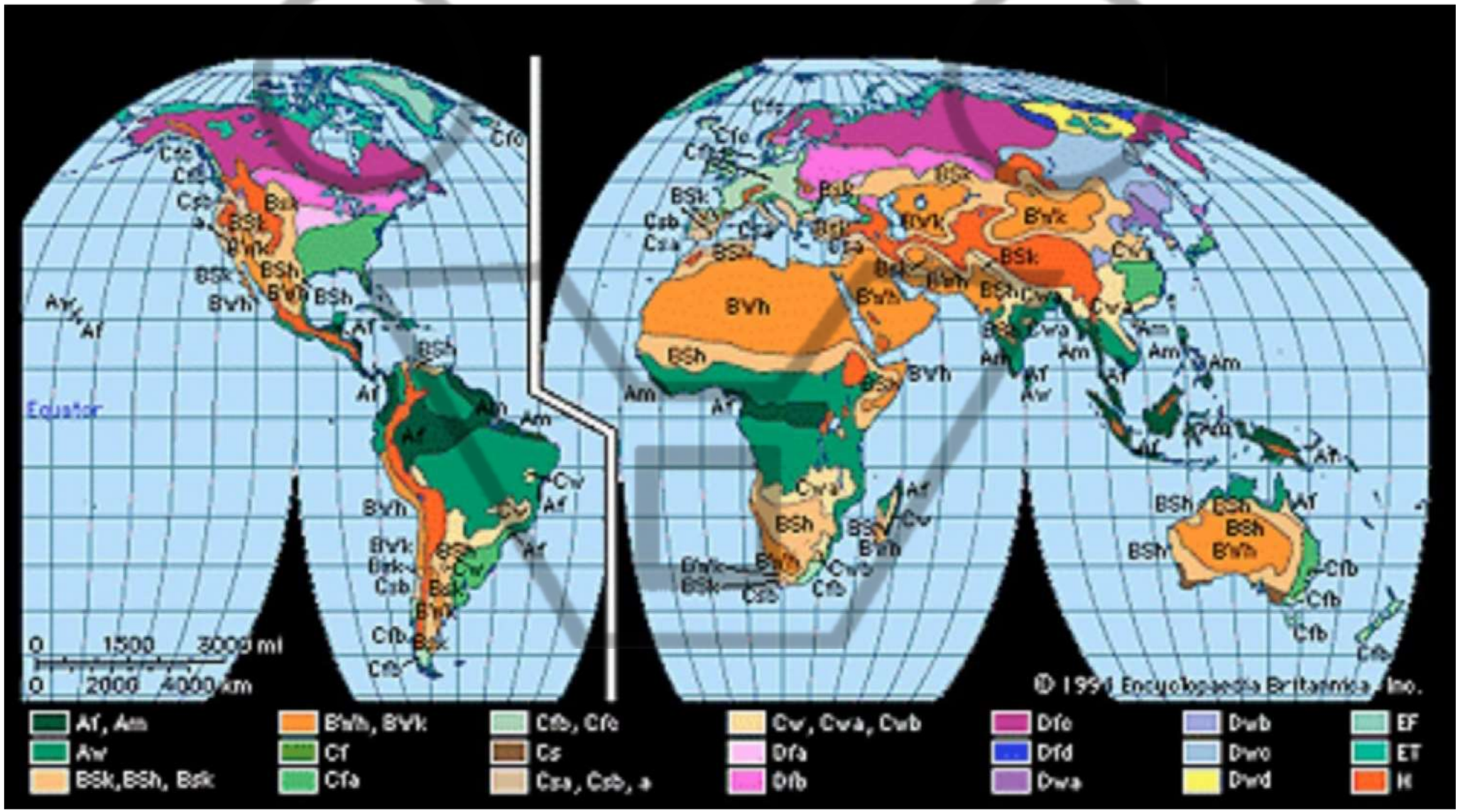


Figure 10.5

Climate Classification

Köppen's climate classification



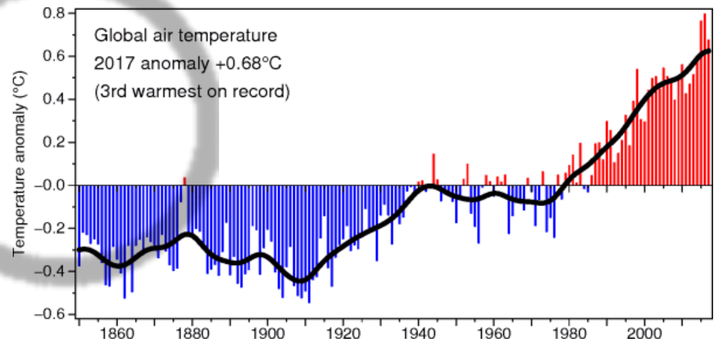
Climate Classification

Climate evolution

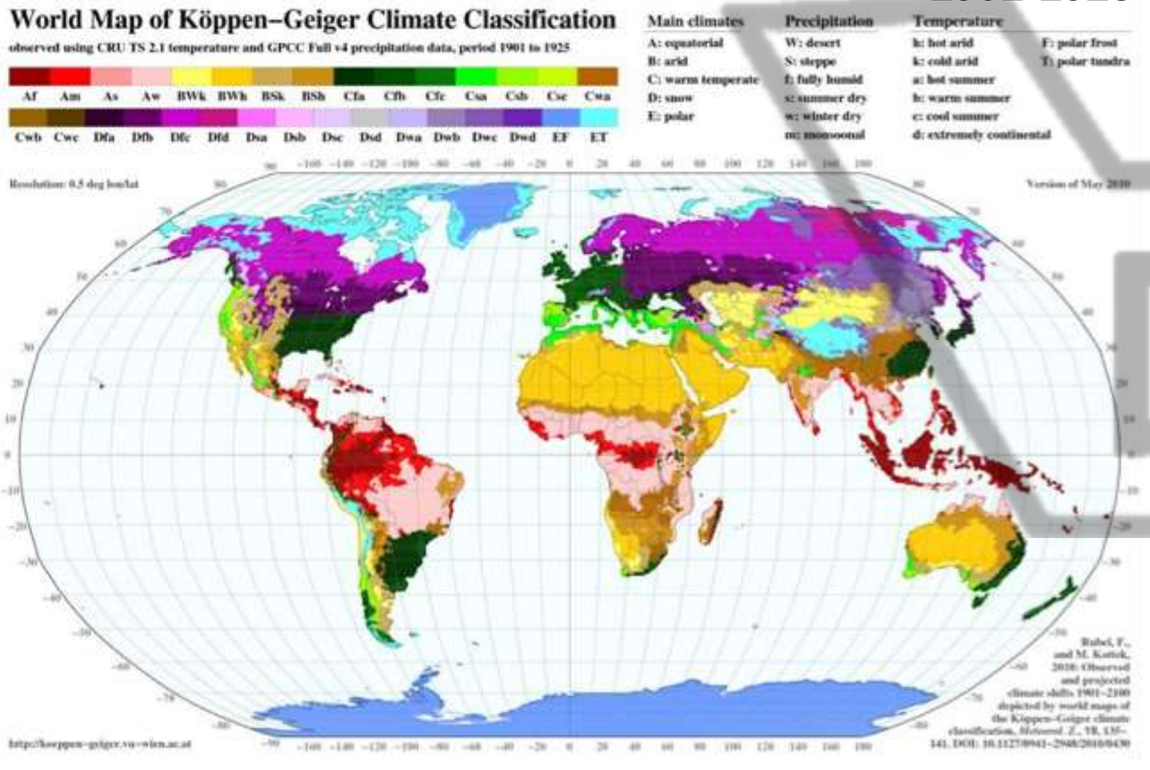
tune up your climate zone

consider climate condition of similar sites in terms of:

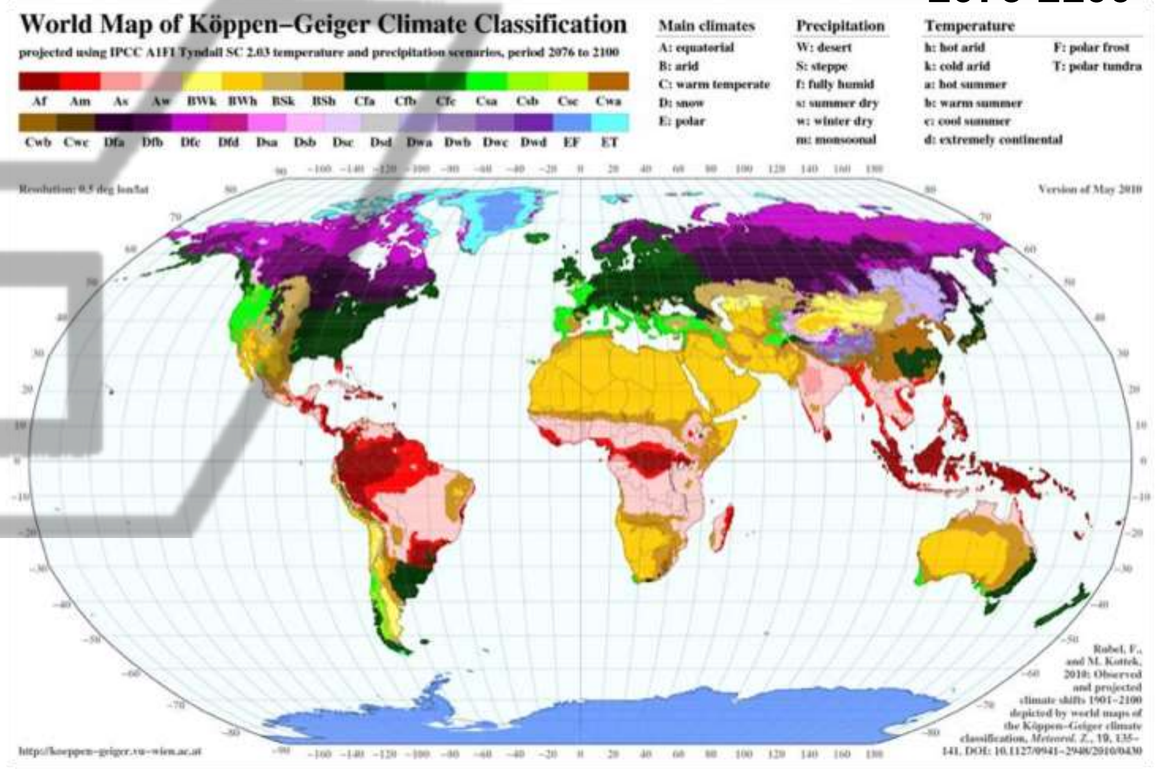
- altitude,
- locations (by the sea, hill, urban,...)
- type of soils
- terrain morphology,
- winds exposition,



1901-1925

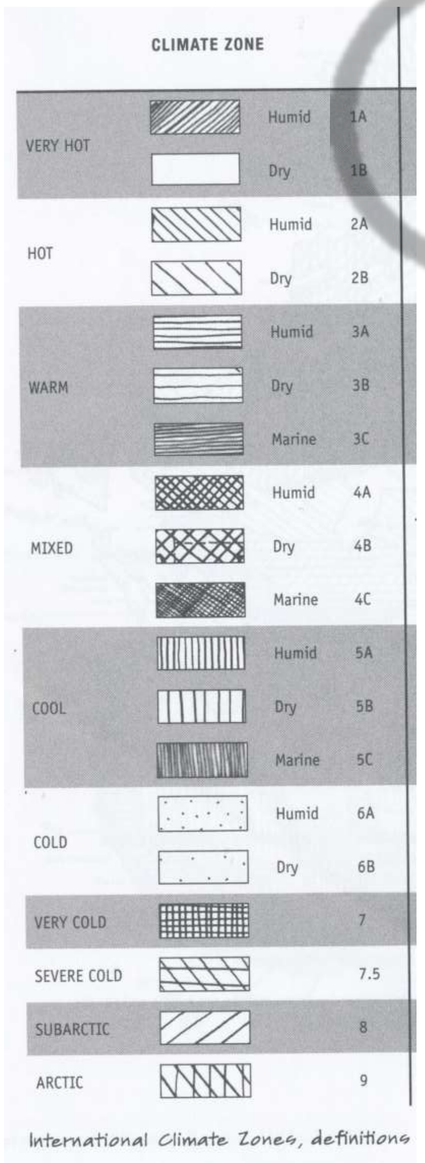


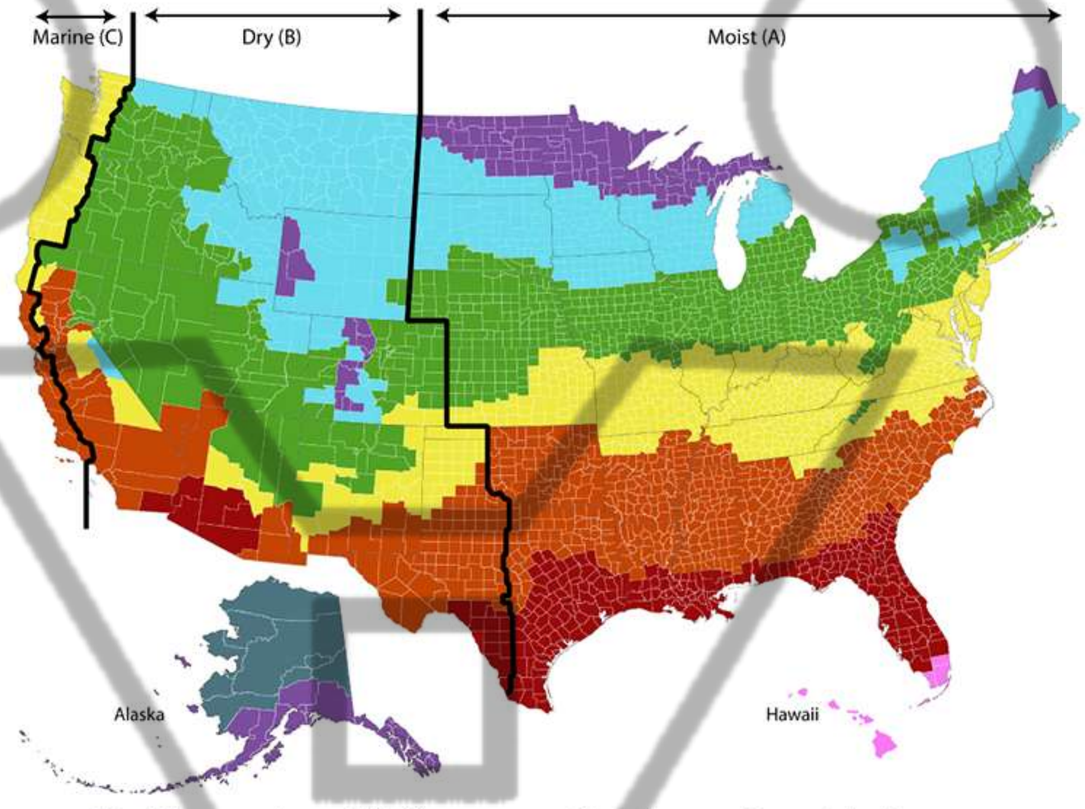
2076-2100



Climate Classification

ASHRAE Standard

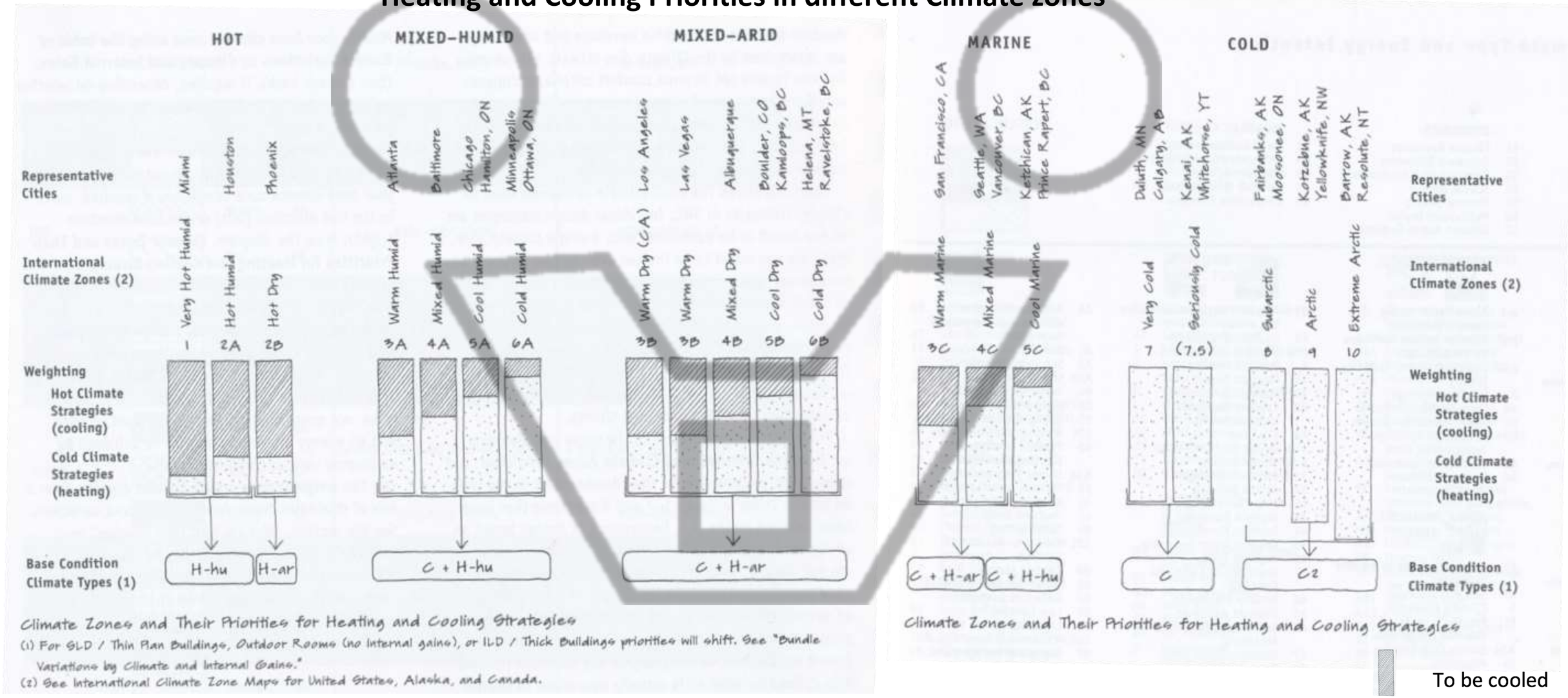




Climate Zone	Representative City
1A	Miami, Florida
2A	Houston, Texas
2B	Phoenix, Arizona
3A	Atlanta, Georgia
3B: CA	Los Angeles, California
3B: Other	Las Vegas, Nevada
3C	San Francisco, California
4A	Baltimore, Maryland
4B	Albuquerque, New Mexico
4C	Seattle, Washington
5A	Chicago, Illinois
5B	Boulder, Colorado
6A	Minneapolis, Minnesota
6B	Helena, Montana
7	Duluth, Minnesota
8	Fairbanks, Alaska

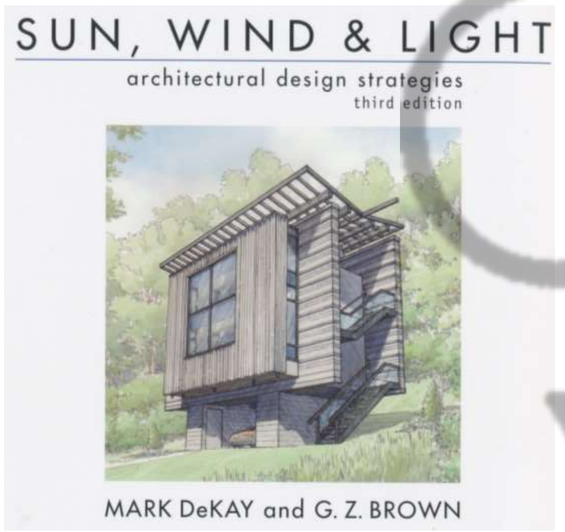
Design Strategies from Rules of Thumb

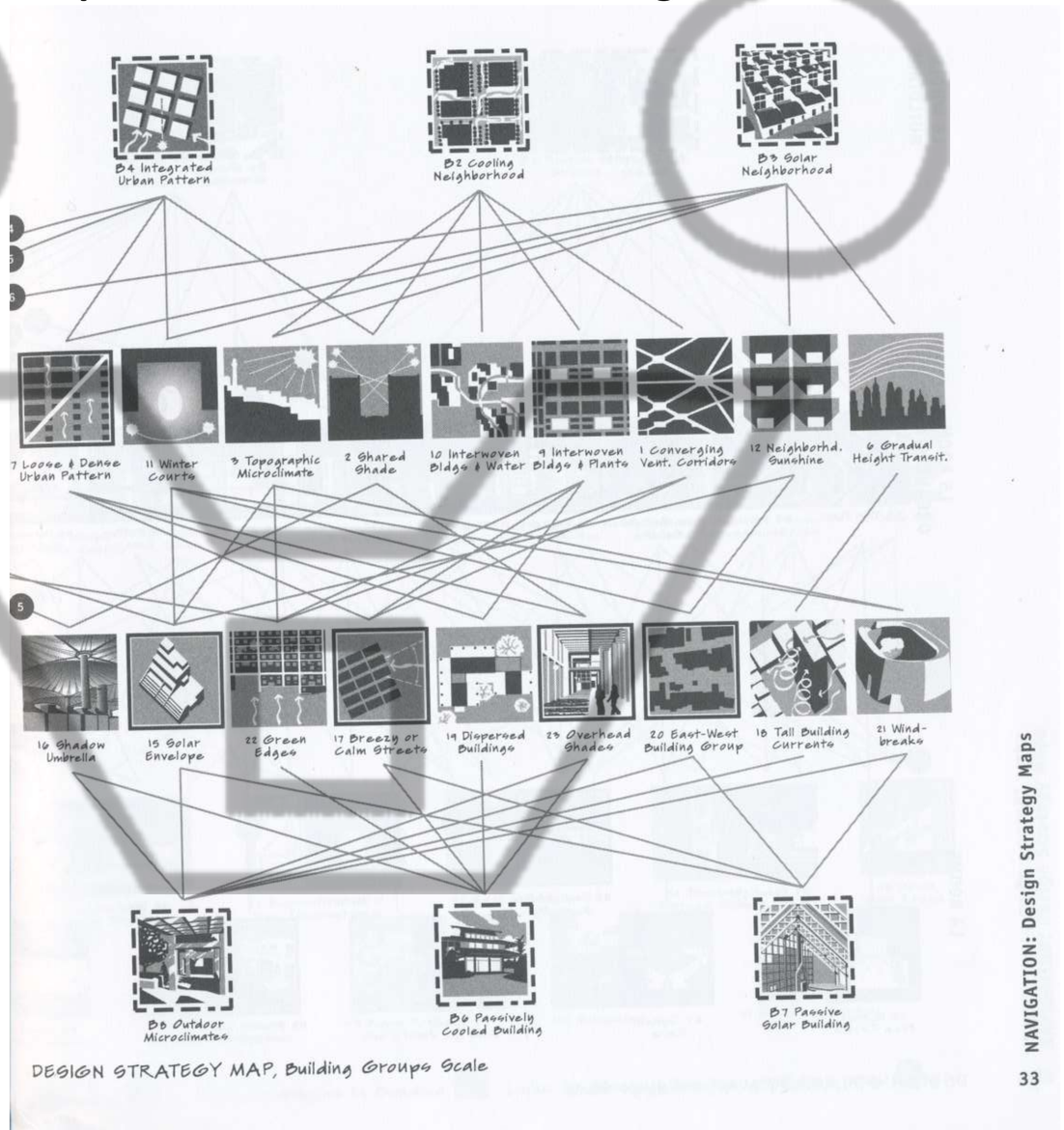
Heating and Cooling Priorities in different Climate zones



Design Strategies from Rules of Thumb

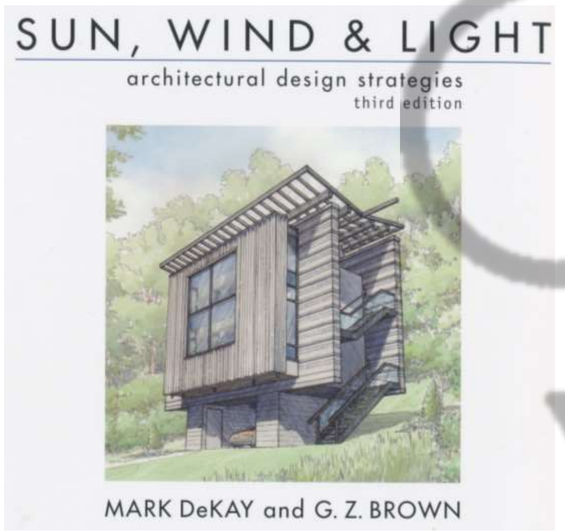
Example of Patterns for Urban Design

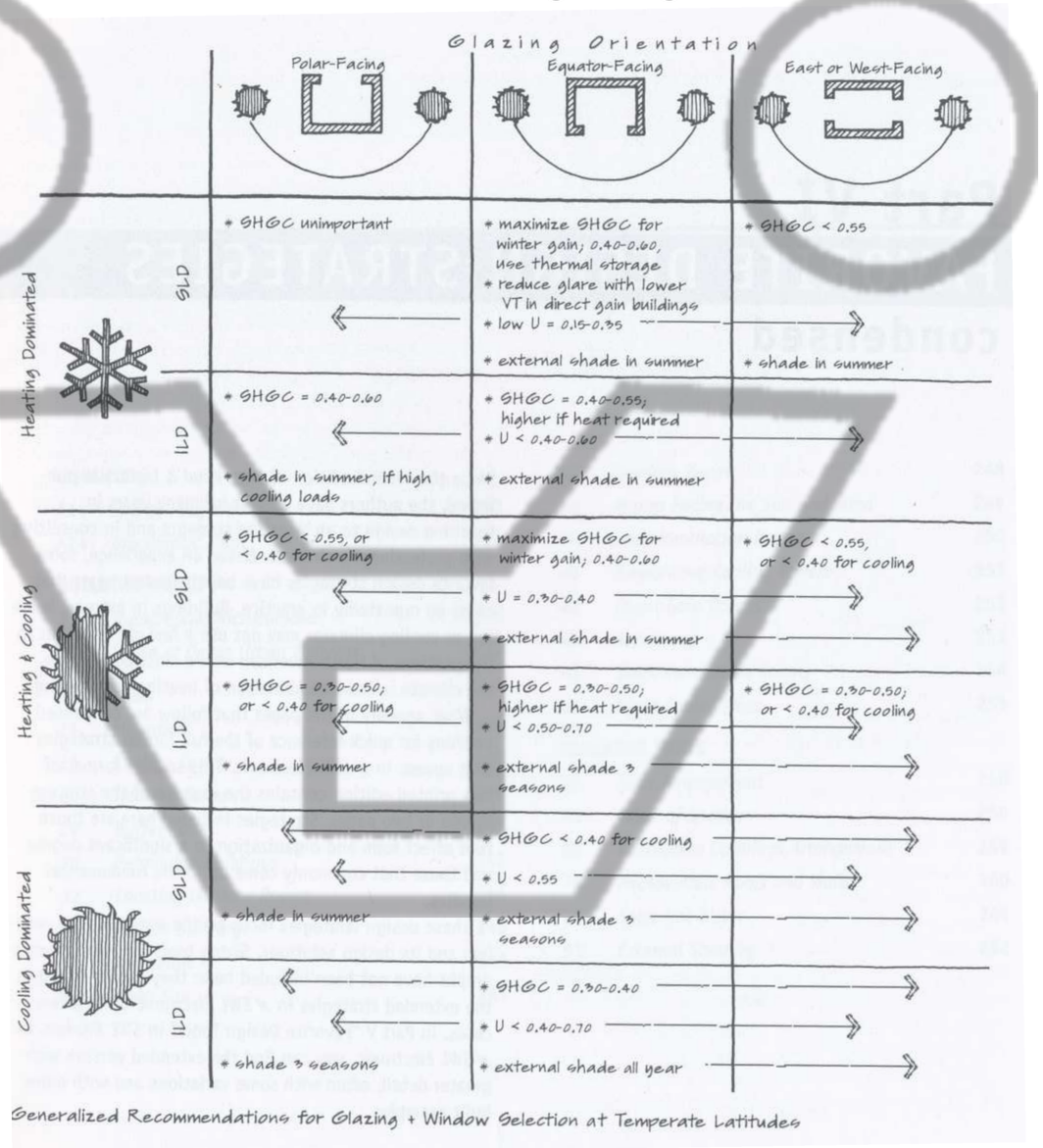




Design Strategies from Rules of Thumb

Example of recommendations for glazing orientation





Generalized Recommendations for Glazing + Window Selection at Temperate Latitudes

COMPUTATIONAL APPROACH

Design Strategies from Computational Approach

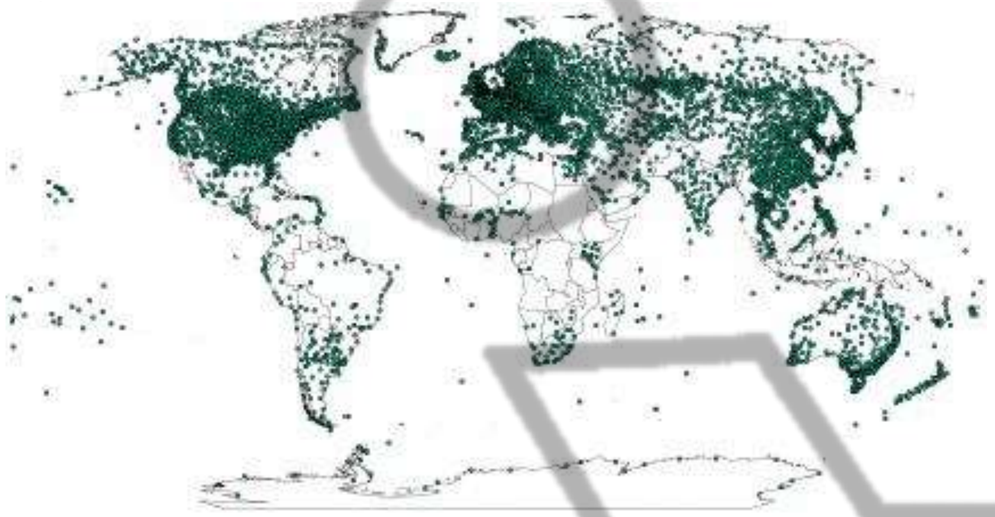
Weather Datization

Mauna Loa Observatory in Hawaii Since 1958 Charles Keeling, followed by his son Ralph and later Elmer Robinson, has been monitoring and collecting data relating to atmospheric change and the continuous monitoring of atmospheric carbon dioxide (CO2) providing the the Keeling Curve

Design Strategies from Computational Approach

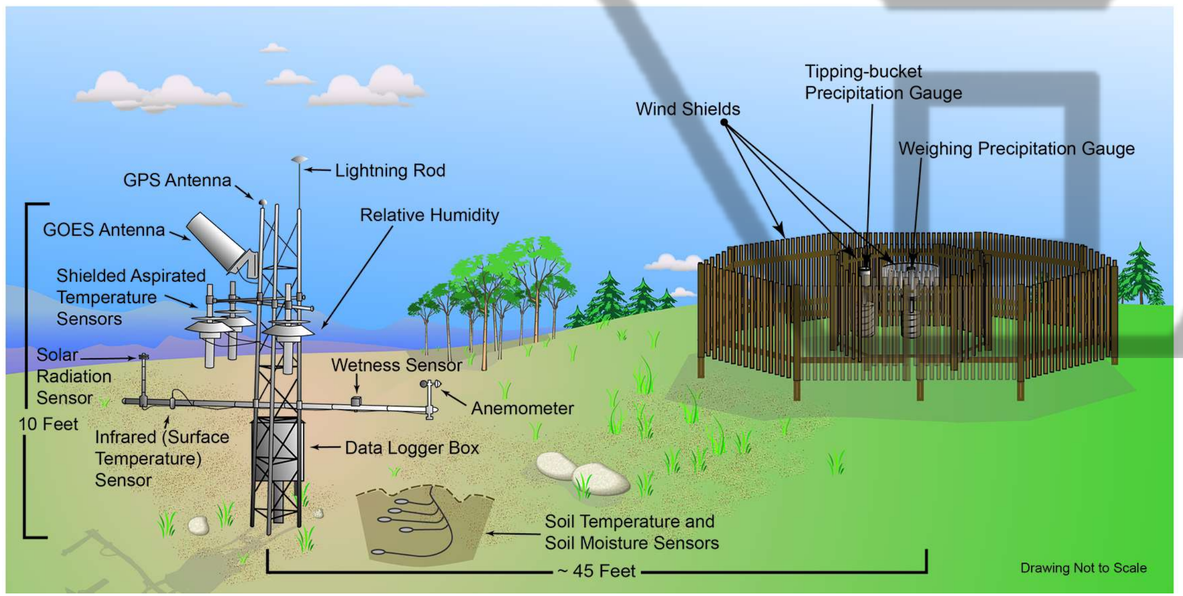
Weather Datization

Map of Weather Station locations for ASHRAE climate data



Weather data includes:

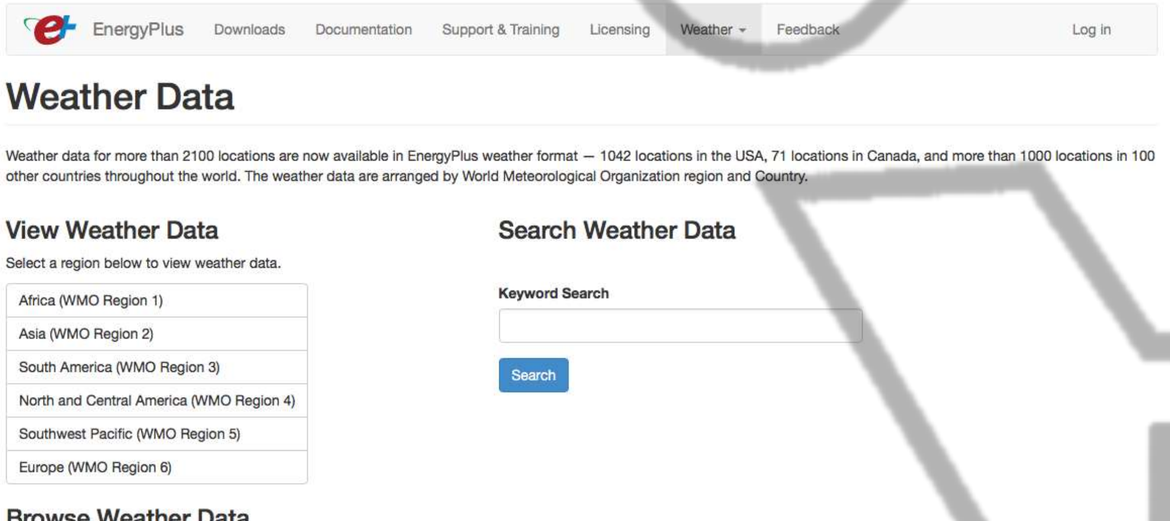
- Geographical coordinates
- Annual weather files (8760 hours of the year) used to compute Energy Use Intensity (EUI)
- TMY (Typical metereological year) that is encapsulated in the .epw files mantained by *Energy Efficiency and Renewable Energy (EERE)*
- Peak condition files used to dimension mechanical



Design Strategies from Computational Approach

Weather Datization

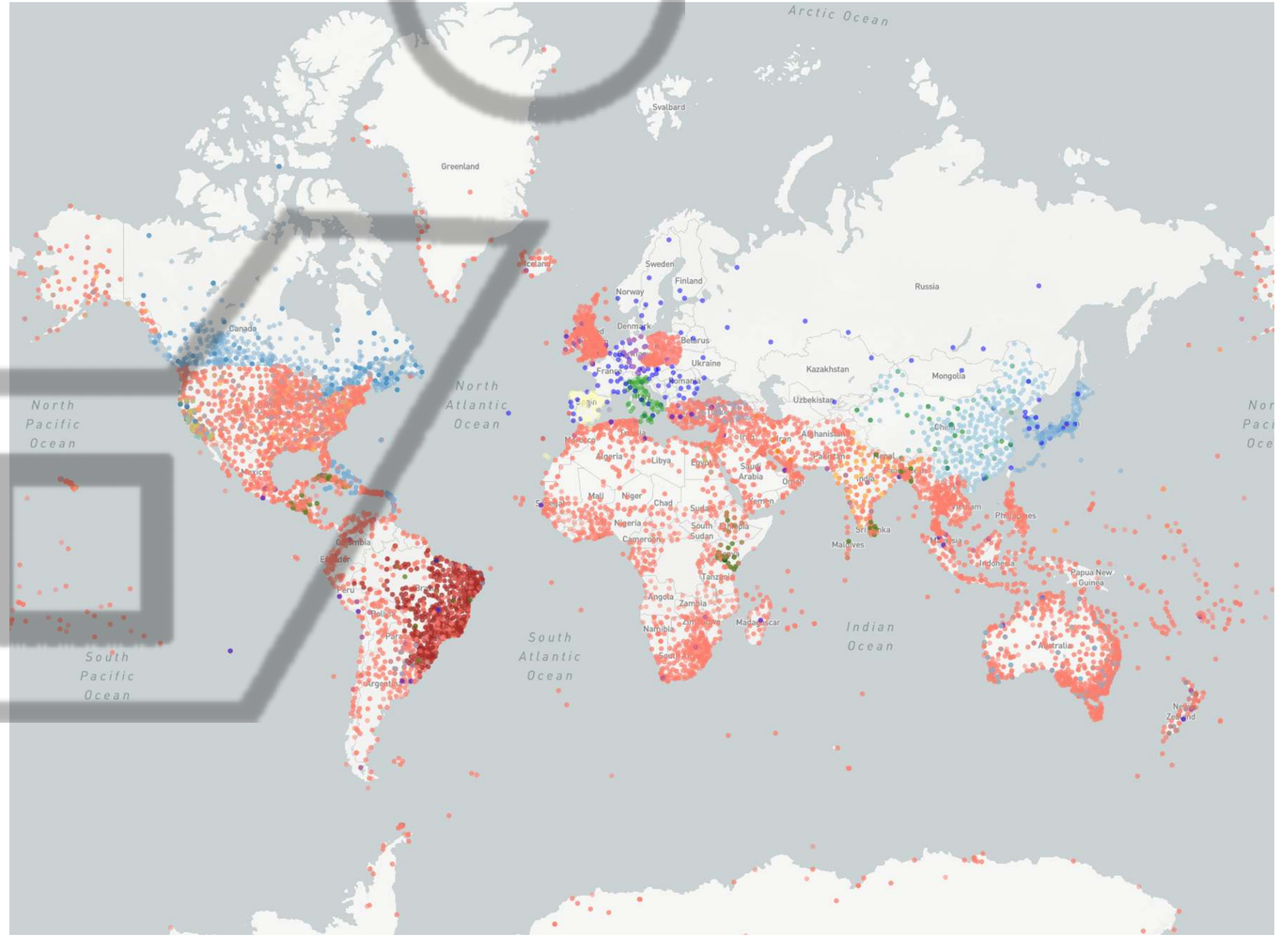
https://energyplus.net/weather



.ddy

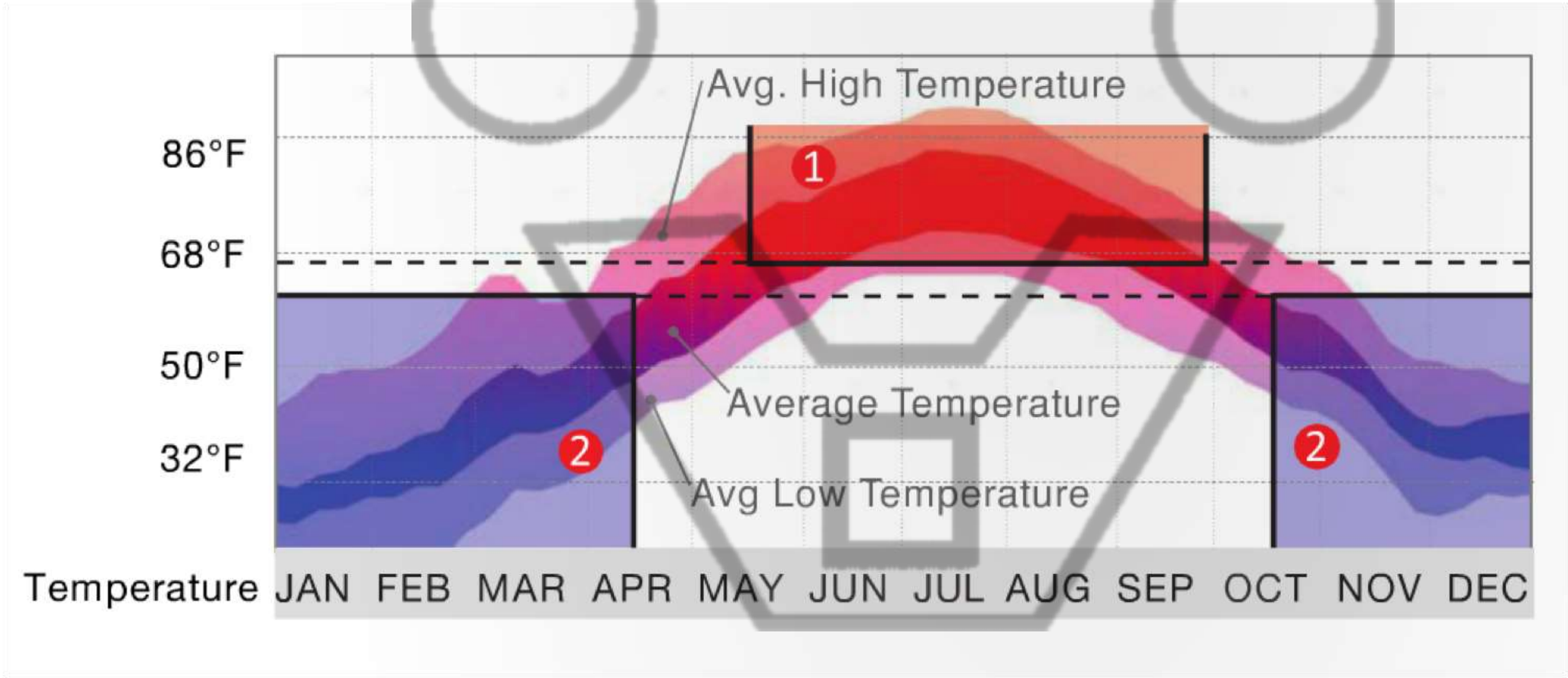
.stat

.epw



Design Strategies from Computational Approach

Design strategies based on statistical dry bulb temperature data



7.3 Temperature Method. Annual temperature profile, with estimated heating and cooling seasons highlighted.

Source: Ecotect outputs of annual weather data from Central Park in New York City.

Design Strategies from Computational Approach

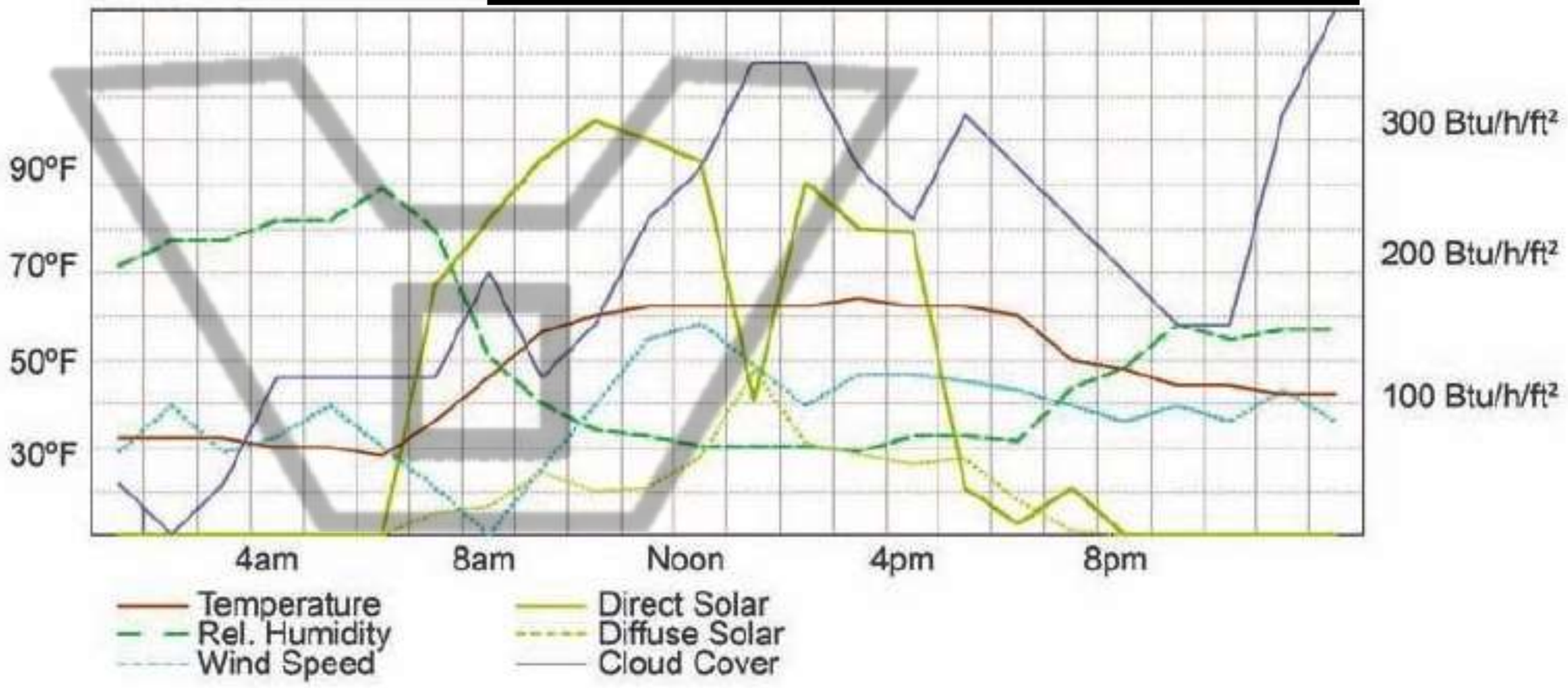
Design strategies based on statistical weather data

Inverse relationship between Temperature and Humidity

4.5

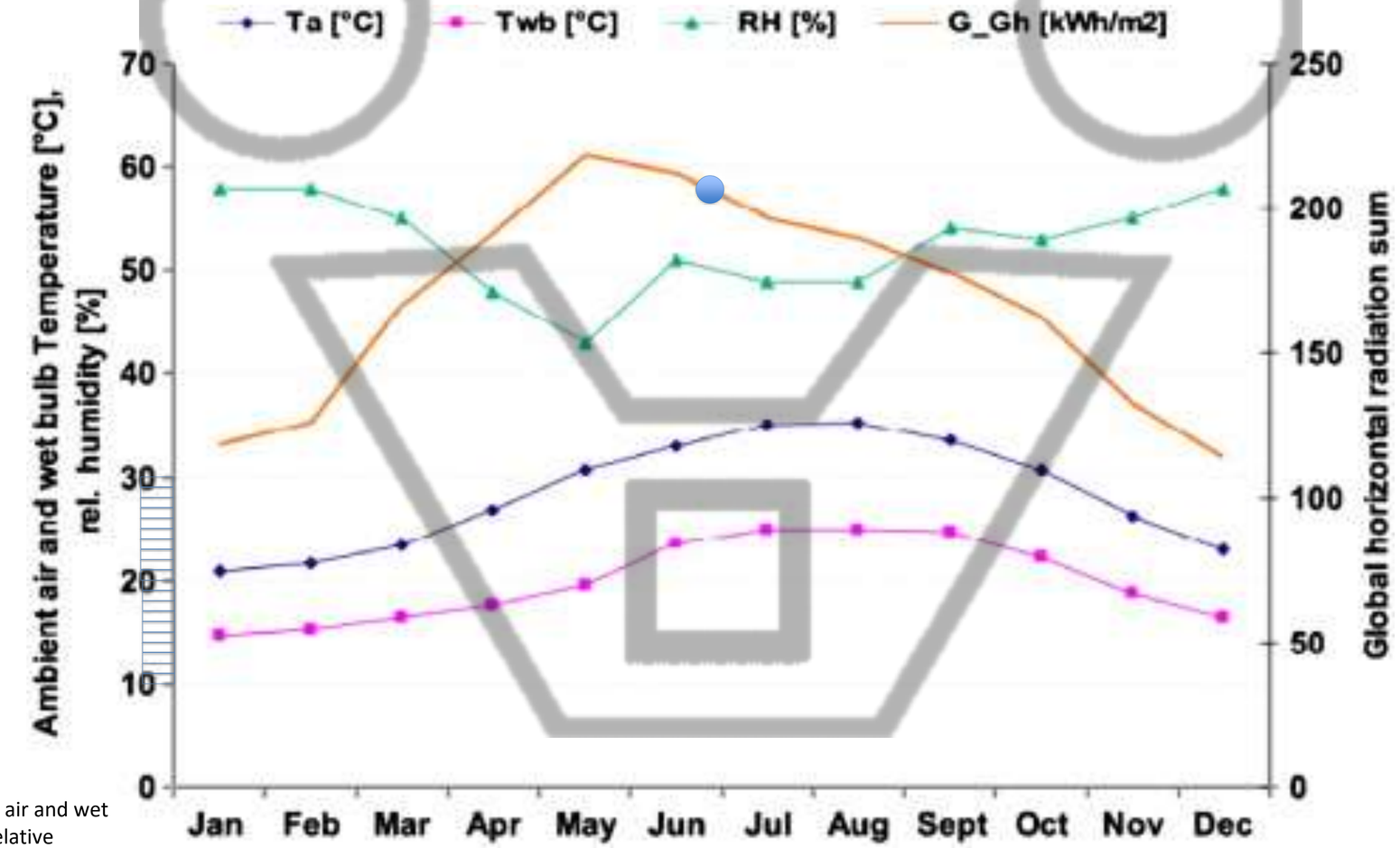
A 24-hour period set of data from a weather file shows the interaction of the dry bulb temperature, the relative humidity, the direct solar, diffuse solar, wind speed and cloud cover. Note the inverse relationship of temperature and humidity; direct and diffuse solar irradiation; and the inconsistent relationship between cloud cover and direct solar.

Source: Autodesk Ecotect Suite output of EnergyPlus weather data. Courtesy of Callison.



Design Strategies from Computational Approach

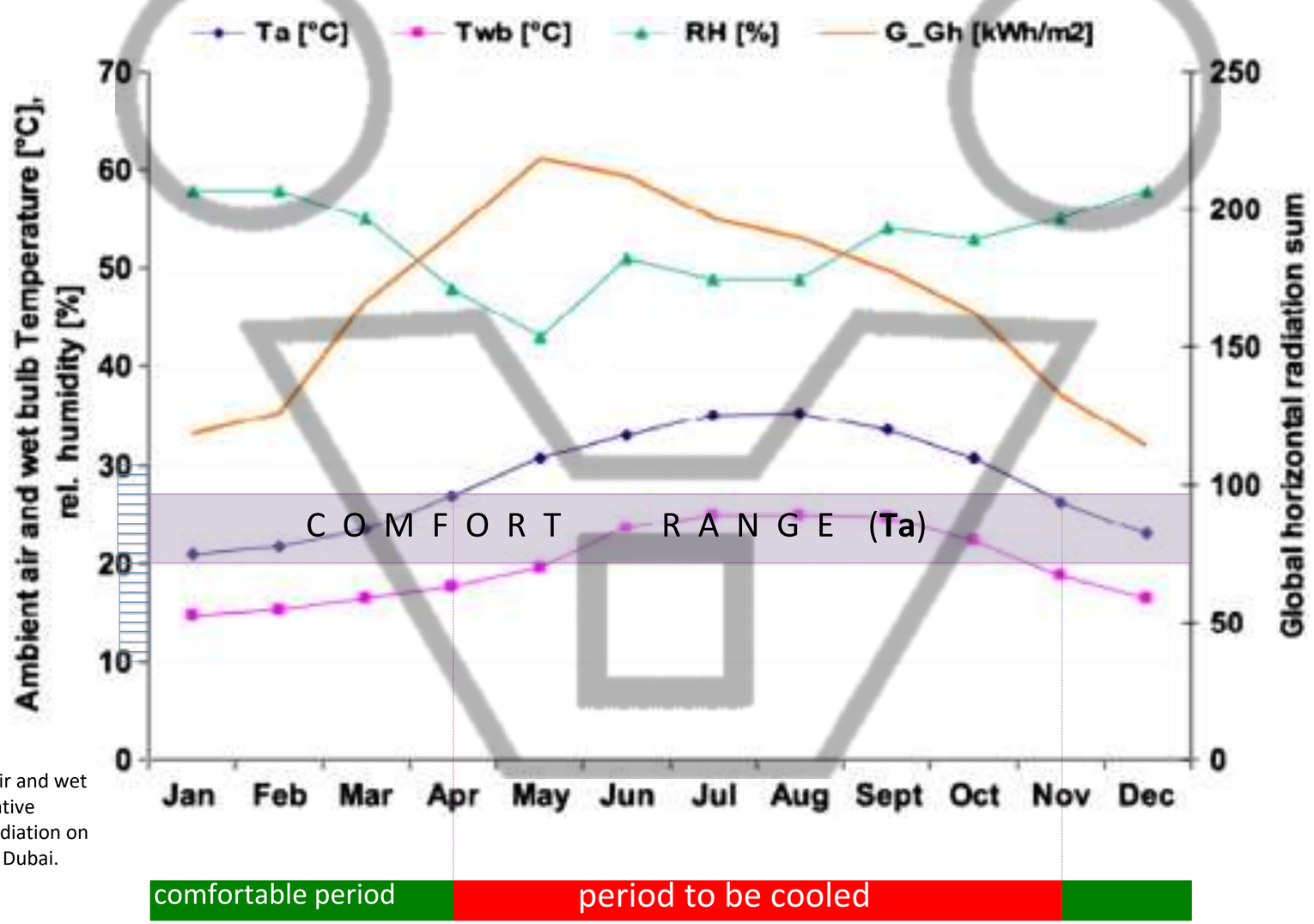
Design strategies based on statistical weather data



Monthly averages of air and wet bulb temperature, relative humidity and global radiation on a horizontal surface in Dubai.

Design Strategies from Computational Approach

Design strategies based on statistical weather data



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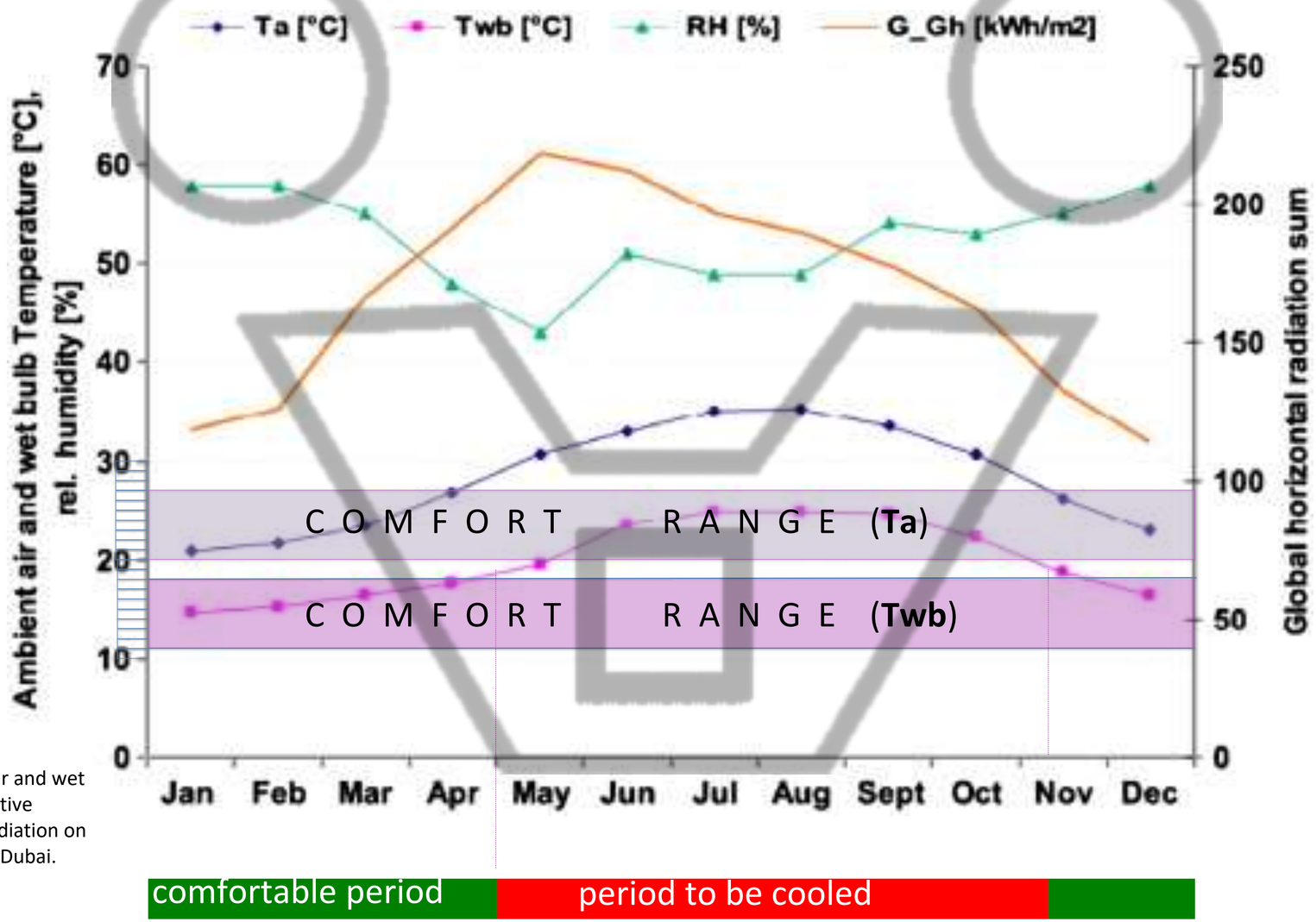
Design strategies based on statistical weather data



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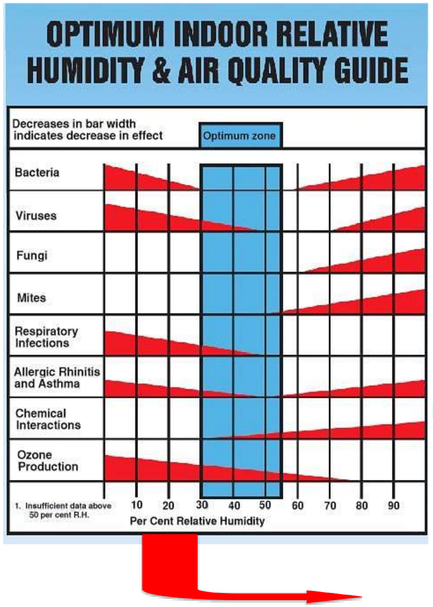
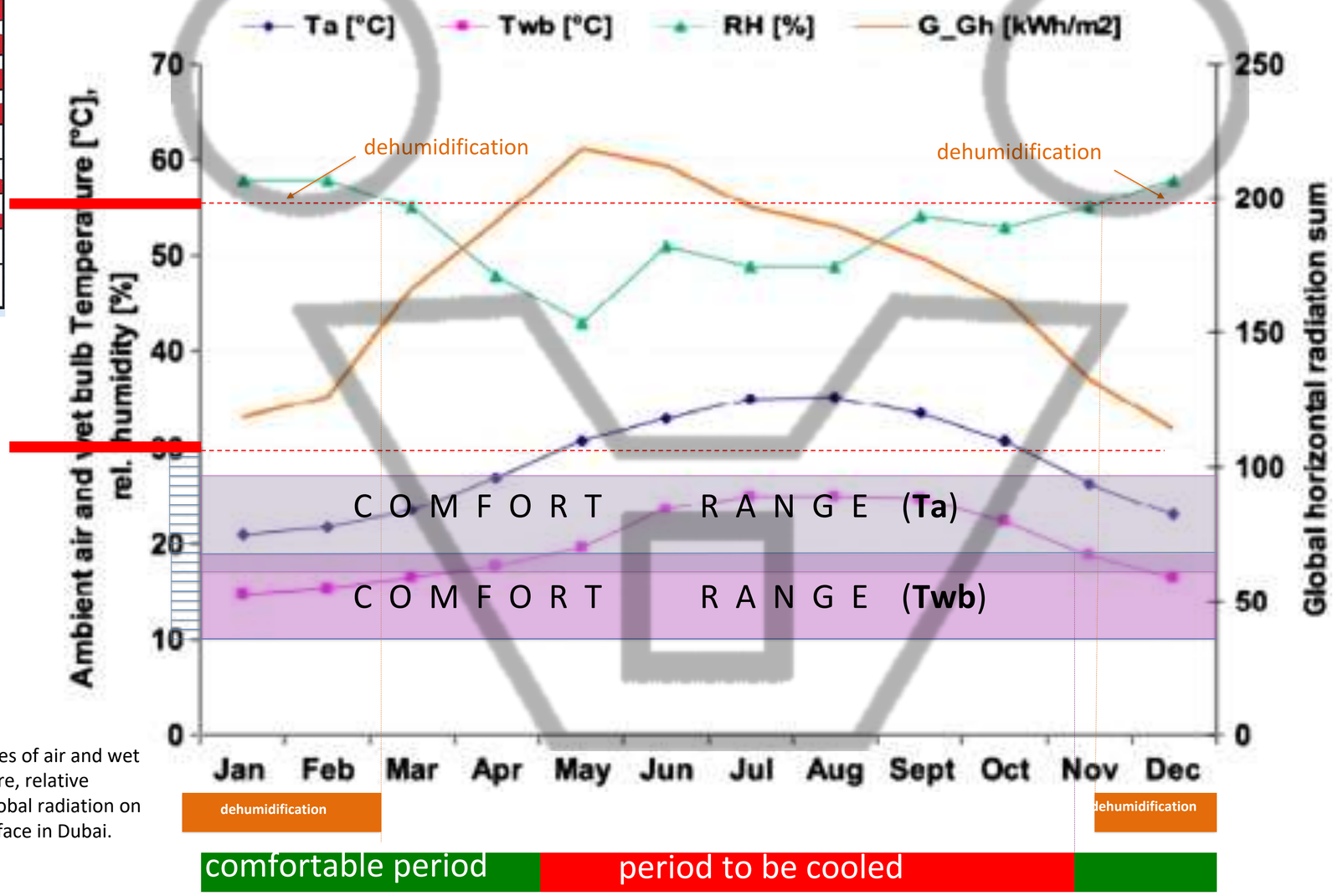
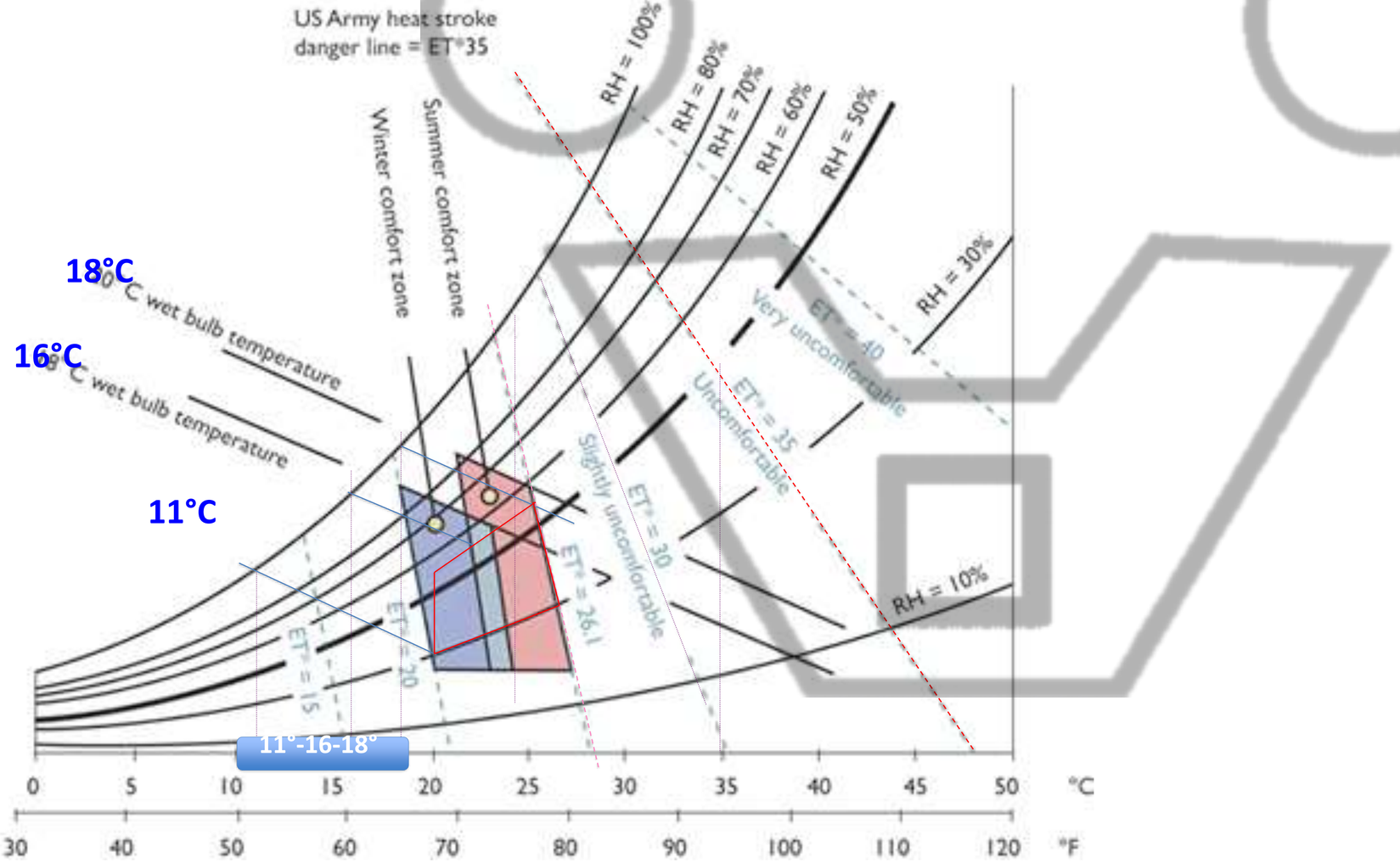




Monthly averages of air and wet bulb temperature, relative humidity and global radiation on a horizontal surface in Dubai.

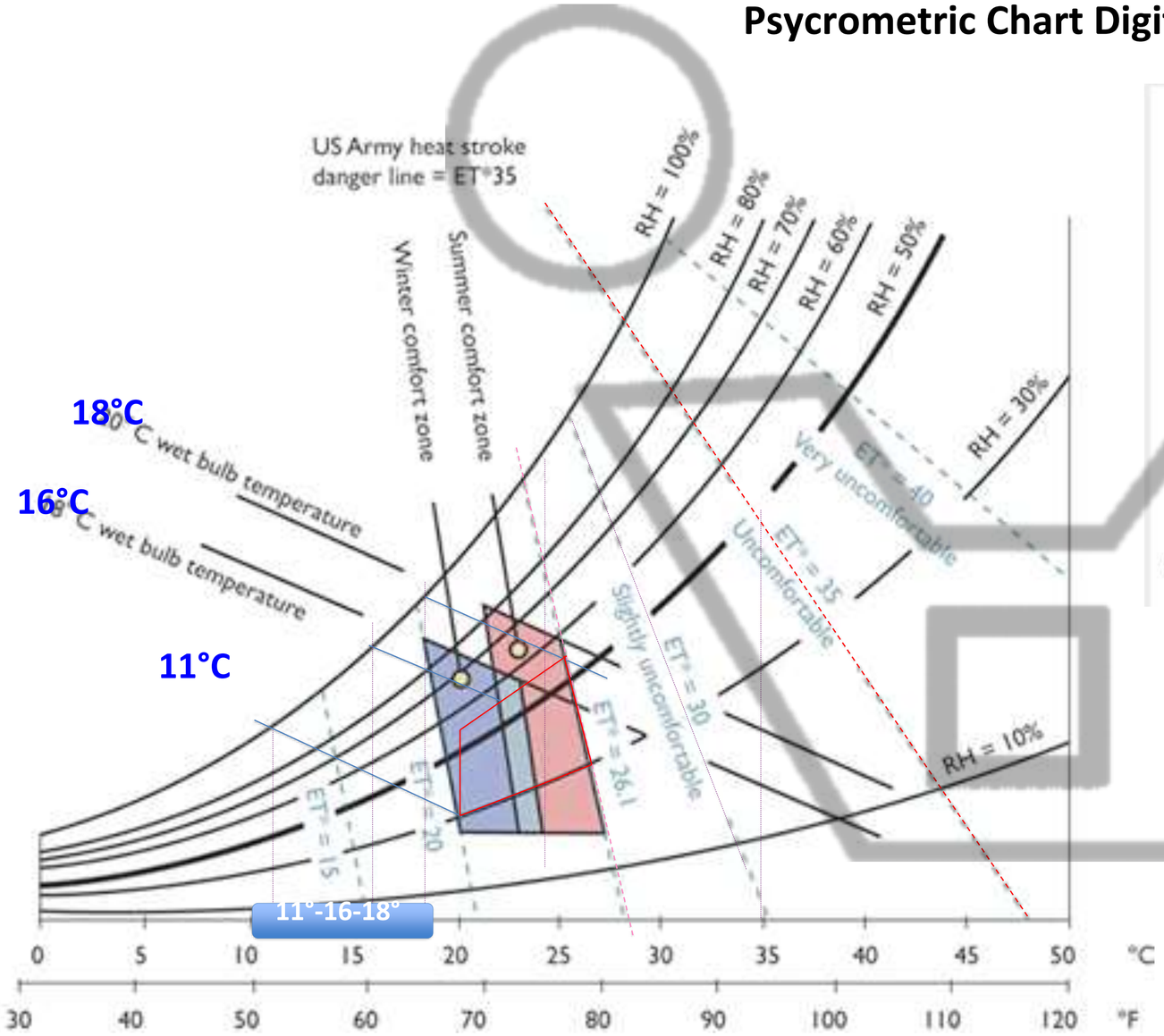
Design Strategies from Computational Approach

Psycrometric Chart Digital Tool



Design Strategies from Computational Approach

Psycrometric Chart Digital Tool



Climate Consultant 6

UCLA University of California, Los Angeles

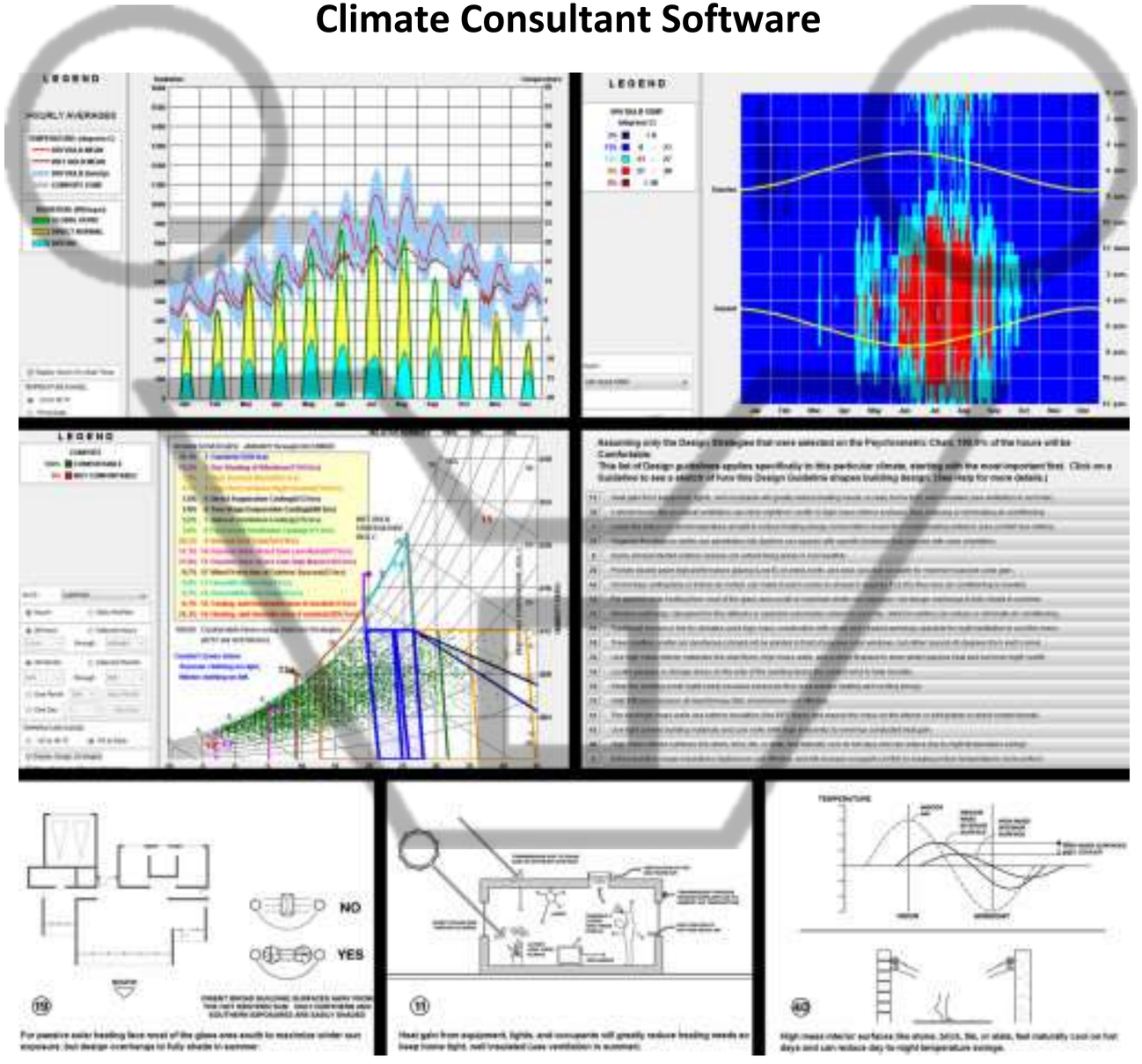
SOFTWARE DOWNLOAD
http://www.energy-design-tools.aud.ucla.edu/climate-consultant/request-climate-consultant.php

VIDEO TUTORIAL
https://www.youtube.com/watch?v=OsWm8dfhP_U

SHORT MANUAL
https://www.researchgate.net/publication/266571240_CLIMATE_CONSULTANT_30_A_TOOL_FOR_VISUALIZING_BUILDING_ENERGY_IMPLICATIONS_OF_CLIMATES

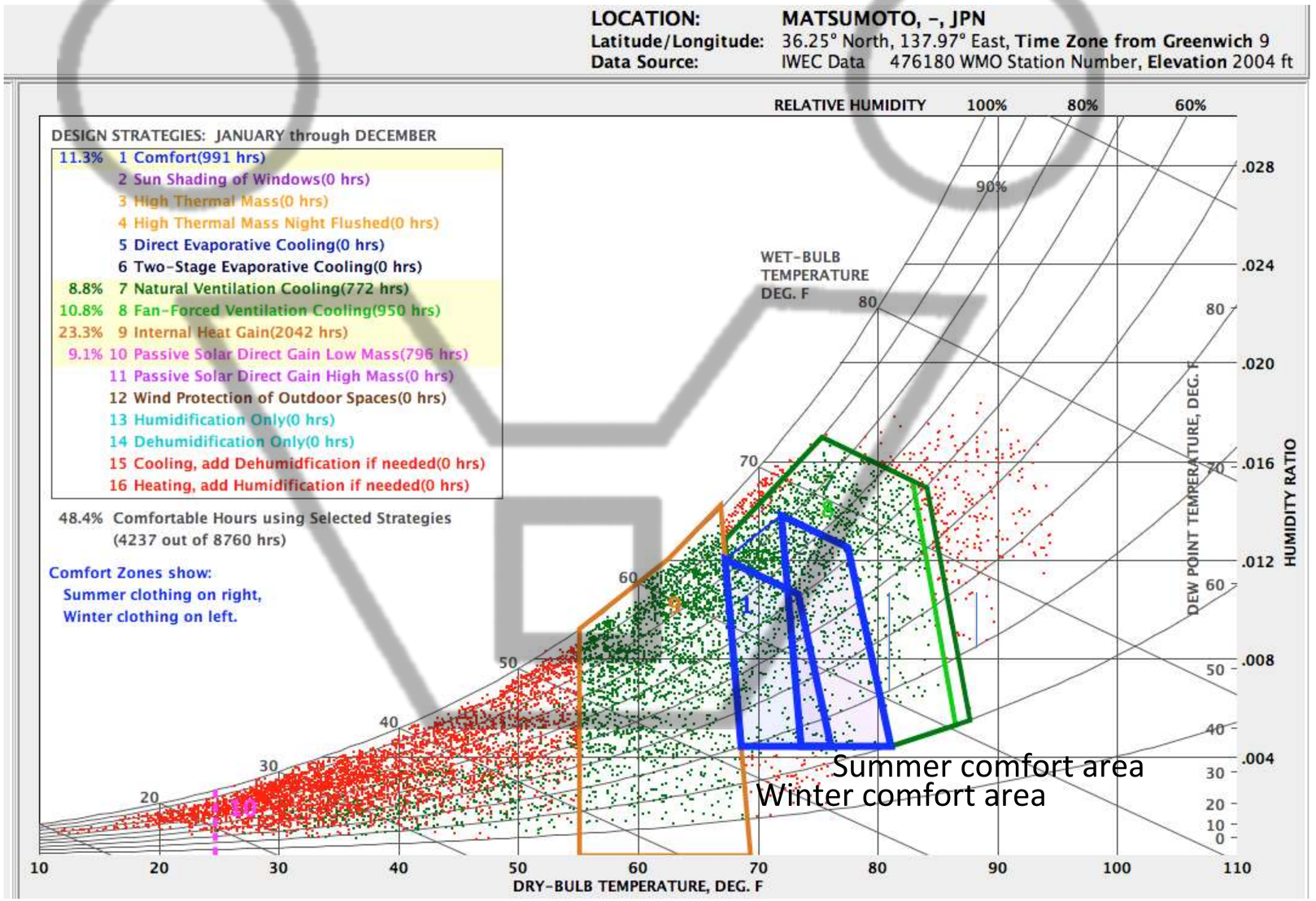
Design Strategies from Computational Approach

Climate Consultant Software



Design Strategies from Computational Approach

Climate Consultant Software



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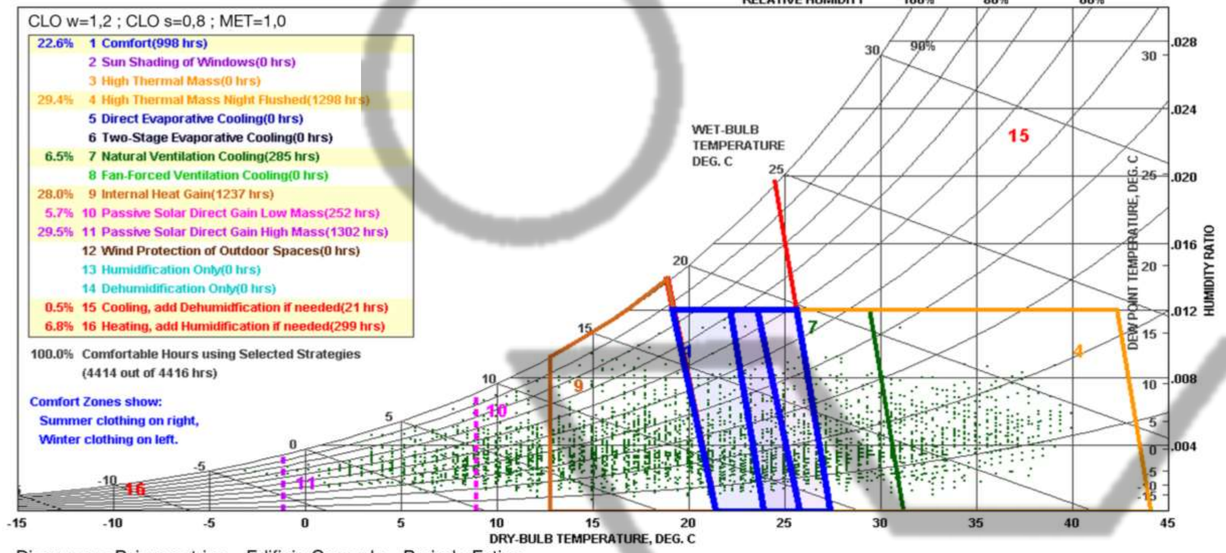


Diagramma Psicrometrico _ Edificio Generale _ Periodo Estivo

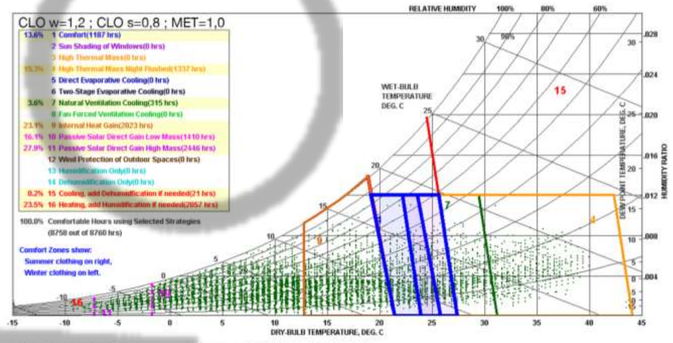


Diagramma Psicrometrico _ Edificio Generale

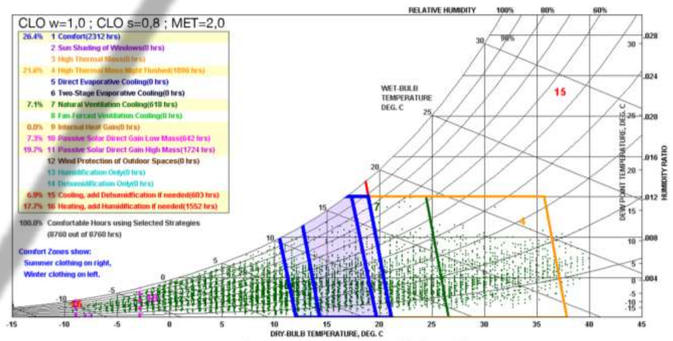
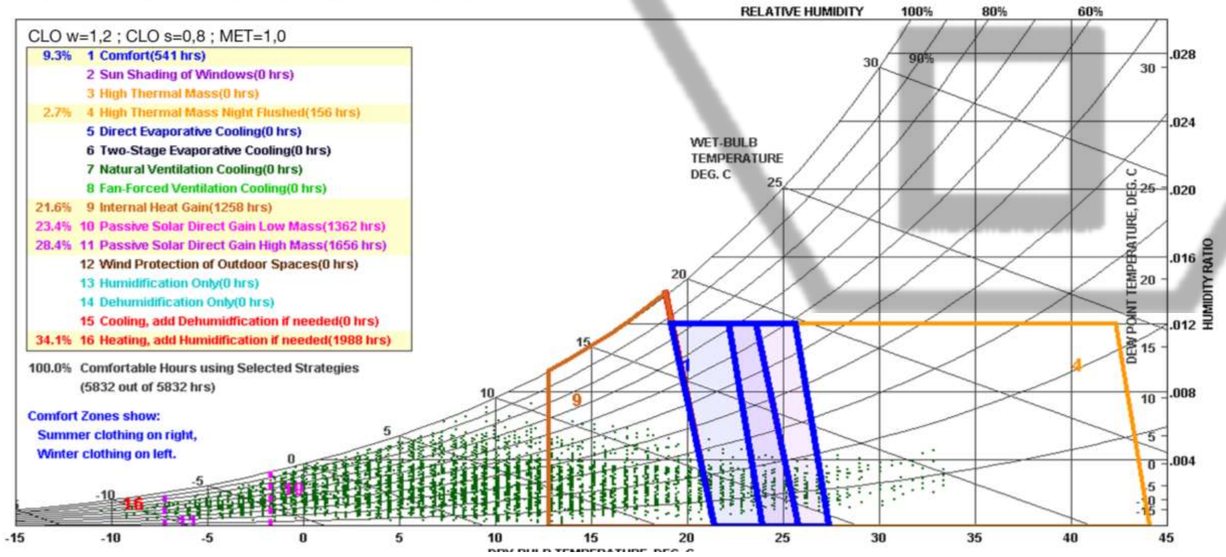
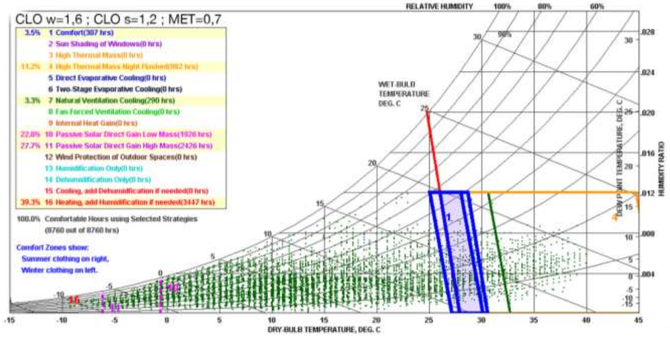


Diagramma Psicrometrico _ Sala Registrazione (SOUND)





Design Strategies from Computational Approach

Climate Consultant Software

DESIGN STRATEGIES: JANUARY through DECEMBER

11.3%	1 Comfort(991 hrs)
	2 Sun Shading of Windows(0 hrs)
	3 High Thermal Mass(0 hrs)
	4 High Thermal Mass Night Flushed(0 hrs)
	5 Direct Evaporative Cooling(0 hrs)
	6 Two-Stage Evaporative Cooling(0 hrs)
8.8%	7 Natural Ventilation Cooling(772 hrs)
10.8%	8 Fan-Forced Ventilation Cooling(950 hrs)
23.3%	9 Internal Heat Gain(2042 hrs)
9.1%	10 Passive Solar Direct Gain Low Mass(796 hrs)
	11 Passive Solar Direct Gain High Mass(0 hrs)
	12 Wind Protection of Outdoor Spaces(0 hrs)
	13 Humidification Only(0 hrs)
	14 Dehumidification Only(0 hrs)
	15 Cooling, add Dehumidfication if needed(0 hrs)
	16 Heating, add Humidification if needed(0 hrs)

48.4% Comfortable Hours using Selected Strategies
(4237 out of 8760 hrs)

STRATEGIE

- Ampie vetrate esposte a Sud per massimizzare l'esposizione al sole invernale.
- Fornire vetrate a doppio vetro a ovest, a nord e a est per proteggere maggiormente dalle base temperature, mentre a sud utilizzare vetri trasparenti per ottenere il massimo guadagno solare.
- Progettare edifici piccoli e compatti per limitare lo spreco di riscaldamento, il raffreddamento e l'illuminazione.

- Organizzare gli spazi in modo che il sole invernale penetri e garantisca un comfort maggiore nelle aree interessate.
- Tapparelle isolanti, tendaggi pesanti o tapparelle manovrabili contribuiscono a ridurre le perdite di calore notturno.
- Le serre solari sono sistemi di accumulo termico e devono essere progettate con un orientamento favorevole per poter accumulare calore naturale

- Un buon isolamento è economicamente conveniente e aumenterà il comfort degli abitanti, mantenendo la temperatura interna uniforme.
- Il tetto spiovente ventilato esternamente e con un soffitto ben isolato è una soluzione efficace poiché fa scivolare la pioggia e la neve e previene la formazione di ghiaccio.
- Utilizzare, in fase di costruzione , materiali con ottime caratteristiche isolanti termiche, ma che allo stesso tempo garantiscano la traspirabilità delle pareti per evitare i fenomeni di condensa.

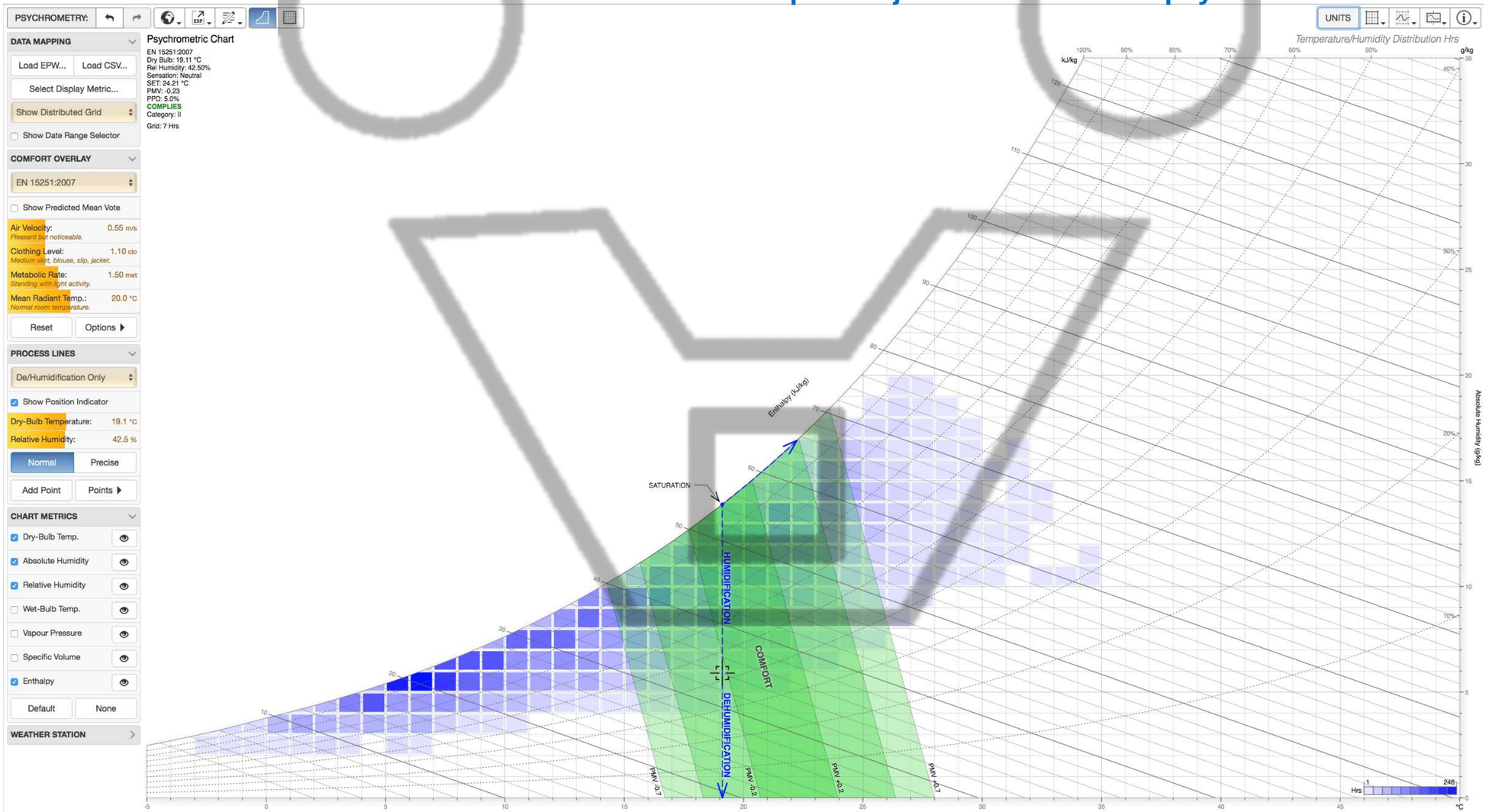
- Impostare una temperatura più bassa di comfort durante la notte è importante per ridurre il consumo di energia di riscaldamento.
- Impianti di riscaldamento o caldaie ad alta efficienza sono economicamente convenienti per i climi freddi.
- Per garantire la qualità dell'aria negli ambienti interni e risparmiare energia, l'edificio necessita di un sistema HRV o ERV con ventilatore.

Design Strategies from Computational Approach

Psychro-Chart Software

EN 15251: 2007

https://drajmarsh.bitbucket.io/psychro-chart2d.html



Design Strategies from Computational Approach

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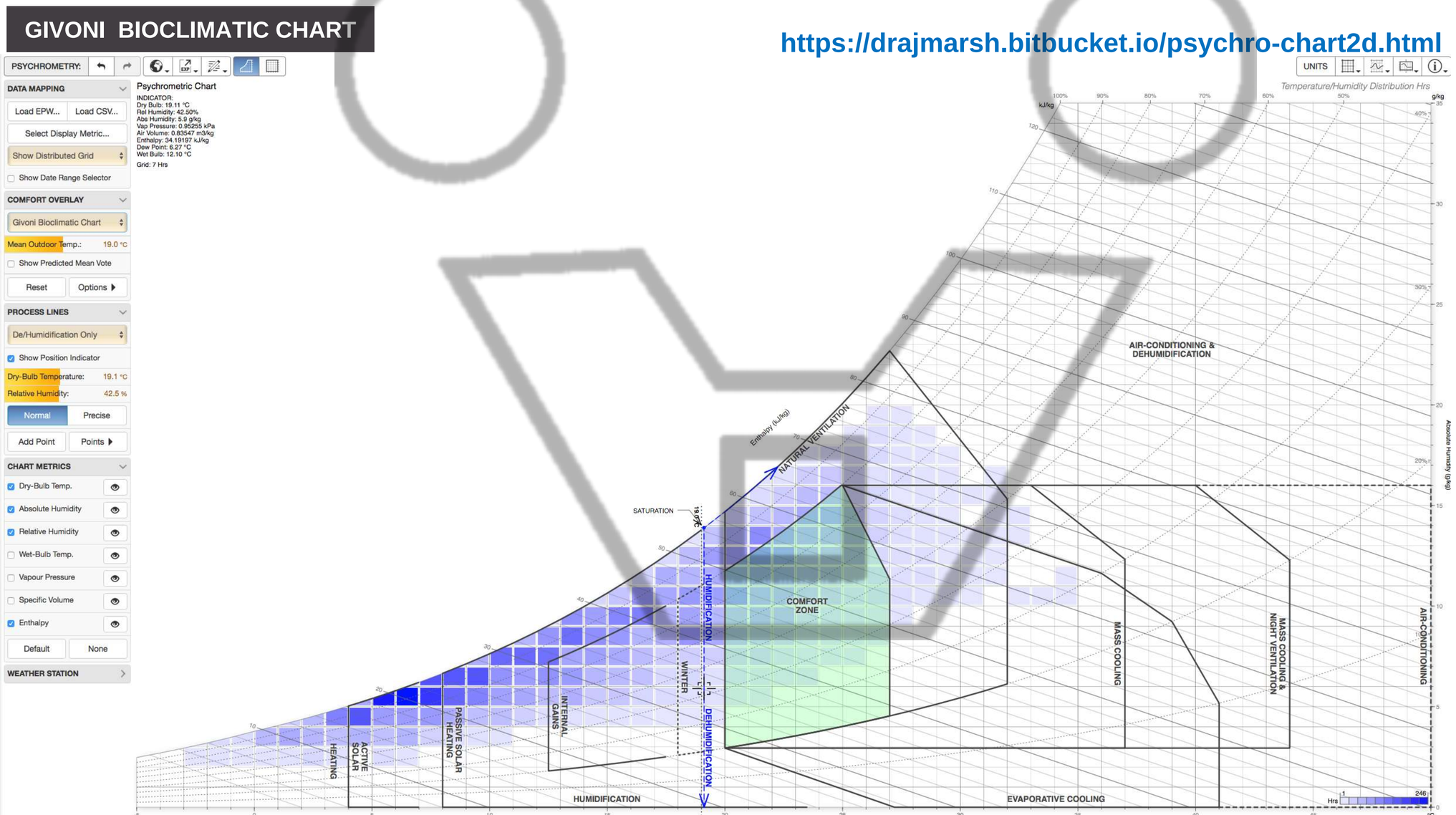
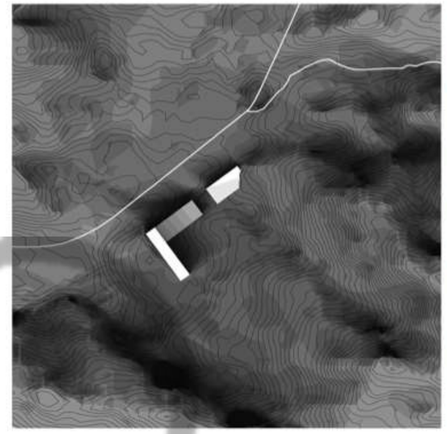
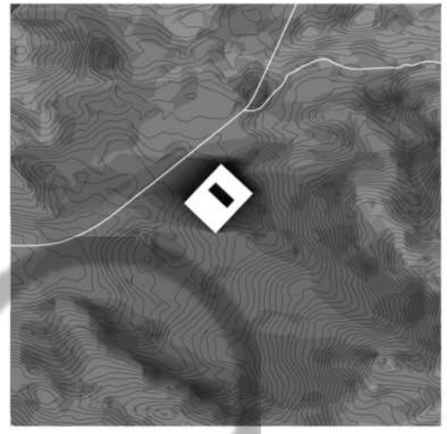
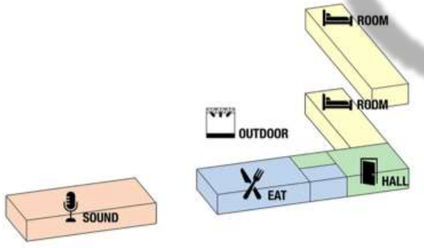
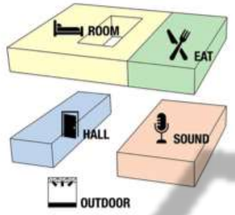




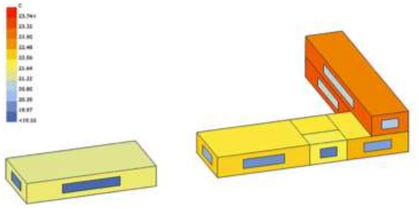




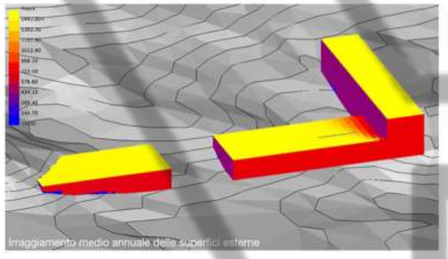
L'ipotesi progettuale si ispira alla tipologia del motel americano, con la zona d'ingresso e di servizio lungo la strada e la zona delle camere, spesso a due piani, collegata alla prima ma inserita nella parte retrostante che delimitano lo spazio esterno.
L'edificio ha forma di L ha, nel braccio più lungo con altezza di un solo piano, la zona "HALL " e "EAT" lungo la strada mentre la zona "ROOM" posta perpendicolarmente al primo blocco è alto due livelli e delimita la zona esterna sulla quale affacciano il bar e il ristorante. La zona "SOUND" posta lungo la strada ma separata dal resto è inserita nella collina per richiamare le tipiche strutture costruite dai minatori.
Il blocco delle camere funziona da schermo per i venti caldi estivi e l'irraggiamento, visto che è posto a sud, ma grazie alle pareti massive accumula calore che viene rilasciato nelle ore notturne quando è più freddo.



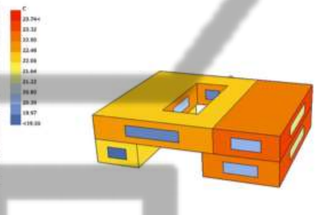
L'ipotesi progettuale è costituita da un edificio che si articola su due livelli e che richiama la tipologia dell'edificio a corte. Sebbene presenti una corte, i due lati paralleli alla strada risultano assenti, in modo da creare una zona interna, riparata dal forte sole e dove il vento si possa incanalare attraverso il principio dell'effetto Venturi, creando così ventilazione all'interno dell'edificio. Al piano terra troviamo dal lato della strada, la "HALL", e al piano superiore la zona "ROOM", tipologia che richiama il tipico motel statunitense. Questa disposizione permette, attraverso una muratura massiva nella zona camere, di accumulare calore durante il giorno, e farlo rilasciare nel periodo notturno, ovvero quando vi è la necessità di scaldare le camere. Nell'altro blocco troviamo al piano terra la zona "SOUND", lontano dalla zona camere e con la possibilità di aprirne una sezione e trasformare il chiostro in una piccola platea. La zona "SOUND", si troverebbe inserito in parte nel terreno, richiamando le numerose miniere presenti nella zona. Sopra ad essa, troviamo la zona "EAT", collegata direttamente con le stanze.



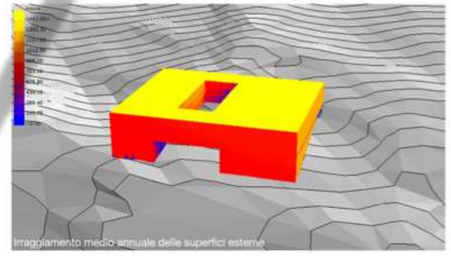
Temperatura media annuale delle superfici interne



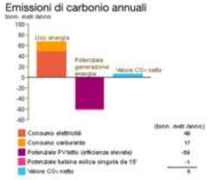
Irraggiamento medio annuale delle superfici esterne

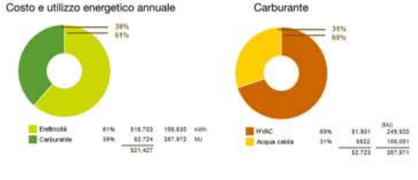


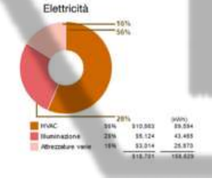
Temperatura media annuale delle superfici interne

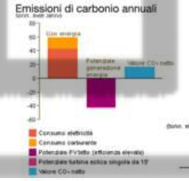


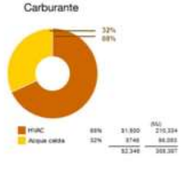
Irraggiamento medio annuale delle superfici esterne

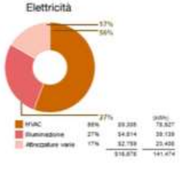


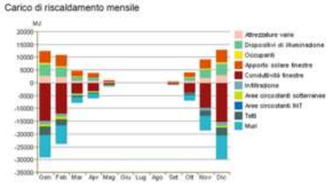


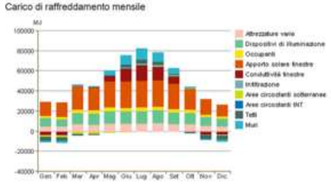


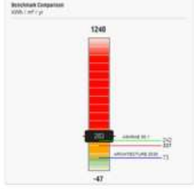


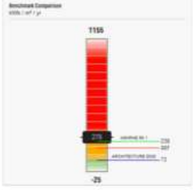












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