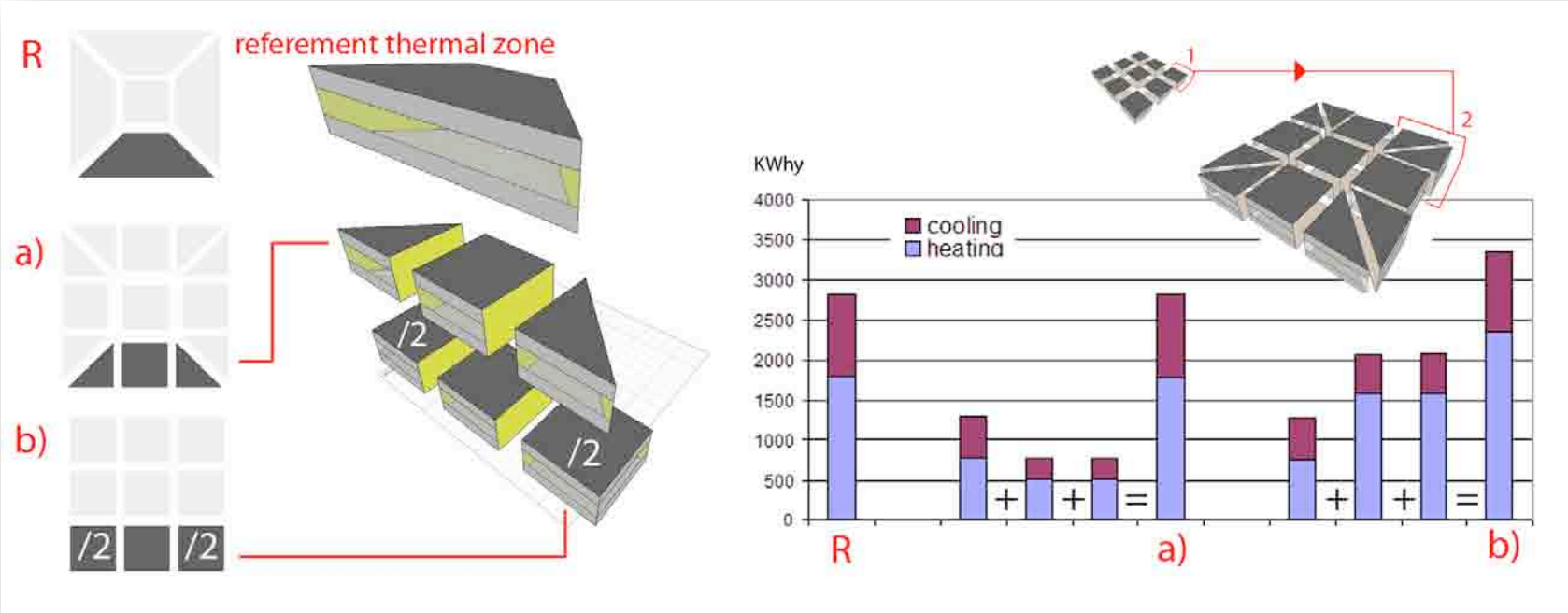
# Architectural implications of need for cooling in cold climates office buildings

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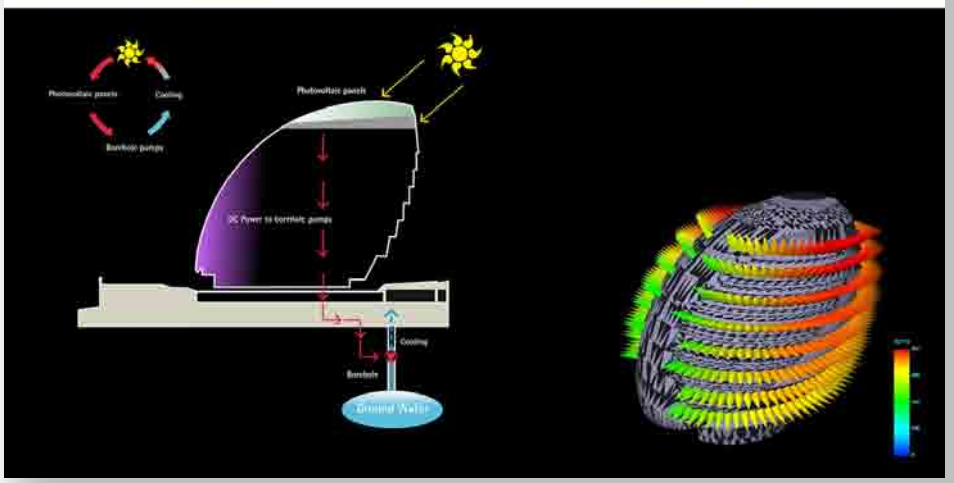
In order to better evaluate architectural implications of increased need for cooling is necessary to explore the process through which low energy office buildings are conceived.



The recent diffusion of advanced simulation software able to give an estimation of the environmental behaviour of built forms has modified the creative process through which architecture is conceived, conditioning the canons on which the aesthetics of the project is based.

Simulation and computational softwares are exploited in combination with 3D modellers during the whole design process ensuring a meaningful basis to the production of sustainable forms.



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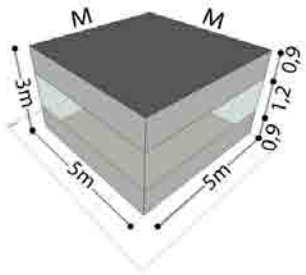
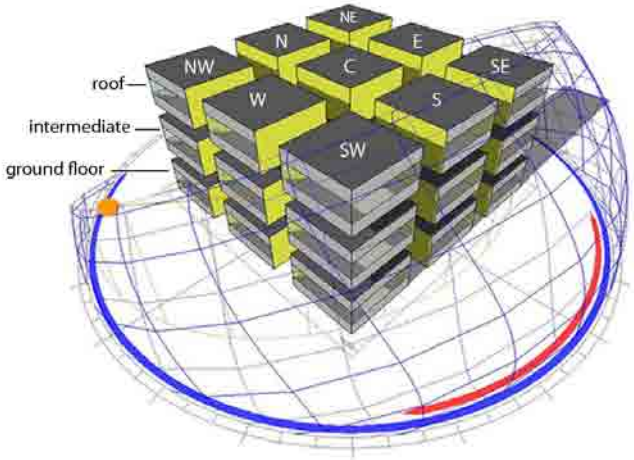
A form-envelope system was chosen because giving a visual outcome of the results. In this study form and envelope were assumed as variant in two different sets of analyses.

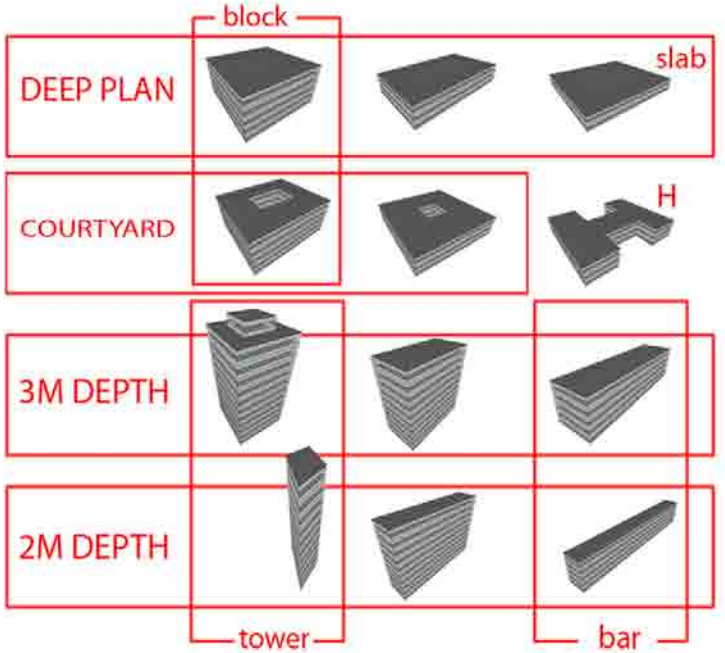
- FORM _ morphological implications of the increased need for cooling (invariant envelope).
- ENVELOPE _ Climate comfort comparison and passive strategies potential calculated through Szokolay's CPZ (invariant form).

| | | Tr.s. | TEK07 | LE |
|---|---|---|---|---|
| U-value external walls | *(W/m²/K)* | 1.2 | 0.18 | 0.18 |
| U-value roof | *(W/m²/K)* | 0.60 | 0.13 | 0.13 |
| U-value floor on ground | *(W/m²/K)* | 0.50 | 0.15 | 0.15 |
| U-value windows, glasses | *(W/m²/K)* | 2.4 | 1.2 | 1.2 |
| Air-tightness | *(Ach)* | 3.0 | 1.5 | 0.6 |
| Heat rec. system efficiency | - | 0.7 | 0.7 | 0.85 |
| Occupancy | *(Pers./m²)* | 0.1 | 0.1 | 0.1 |
| Cooling set point temperature | *(°C)* | 26 | 26 | 26 |
| Heating set back temperature | *(°C)* | 18 | 18 | 18 |
| Lighting load | *(W/m²)* | 8 | 8 | 8 |
| Equipment load | *(W/m²)* | 11 | 11 | 11 |

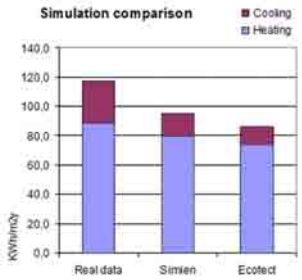
- 1st set of analyses _ **Form as a performative device**




Climate: Oslo; Lat. 59.9°, Lng. 10,6°

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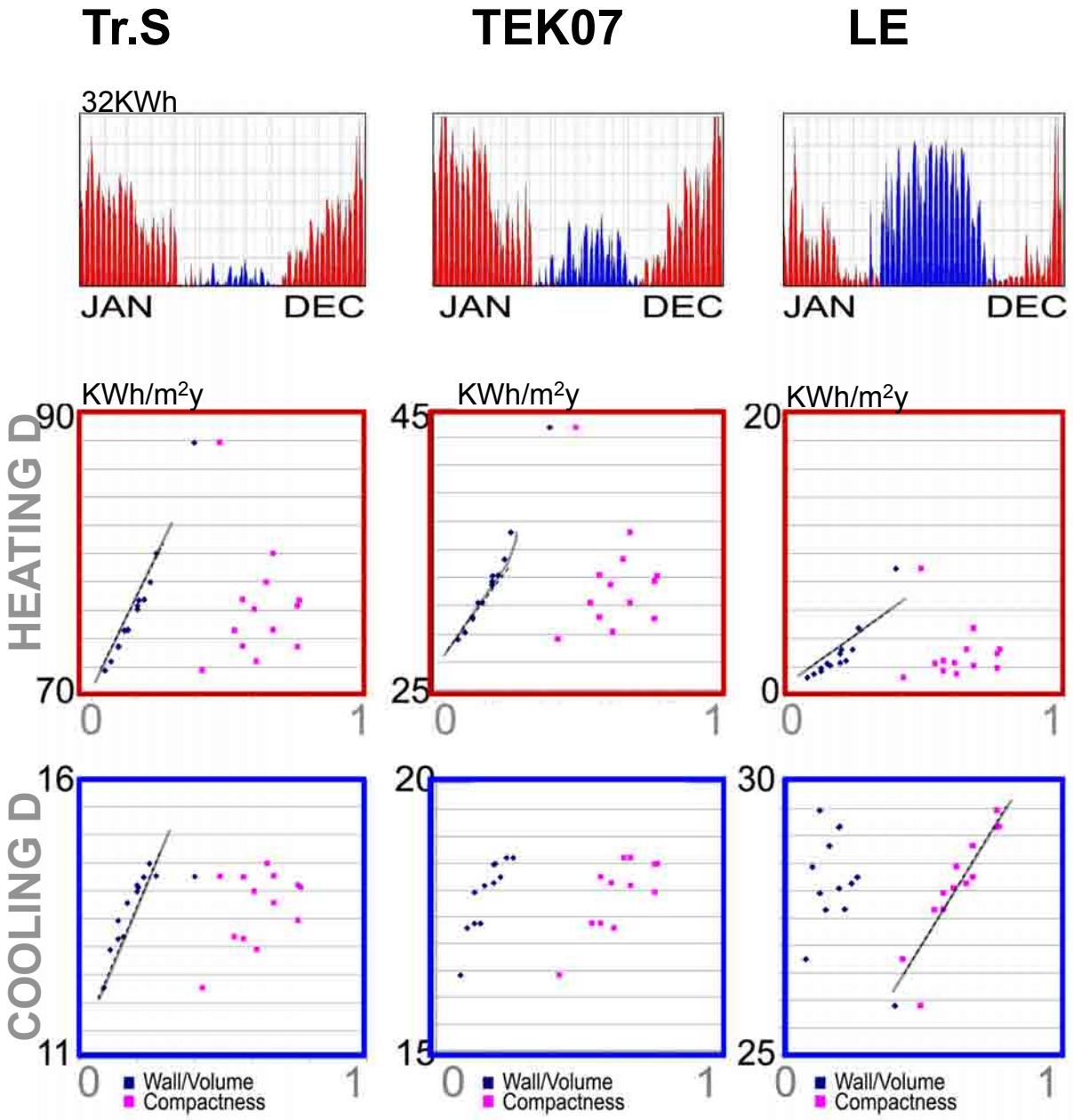
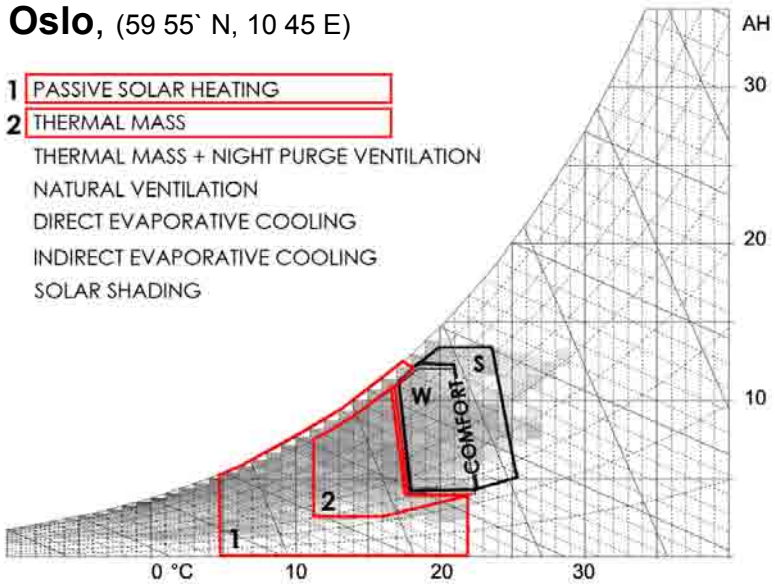



Results questioned traditional assumption of convenience of recurring to compact shape in cold climates.

Different nature of the relation between heating and cooling demand and the shape when using stringent envelopes

# 2nd set of analyses _ the envelope / bioclimatic design

The composition of all the elements constituting the envelope is determined on the basis of the quantitative comparison between the external climate and the desired internal conditions.




A relatively simple approach, aiming at **maximizing solar heat gains and minimizing thermal losses** during the whole year, traditionally characterized architectural design in cold climates.

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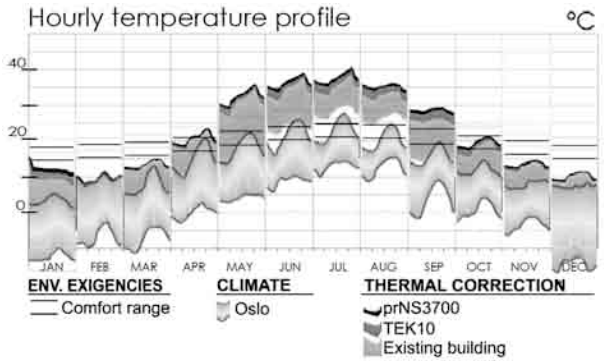
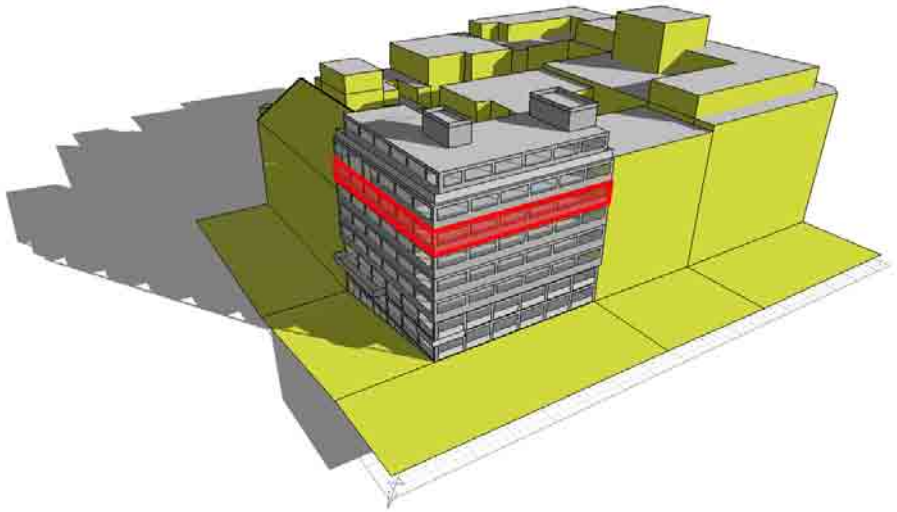
quantifying the spontaneous shift of temperatures and relative humidity values due to stringent envelopes + internal gains



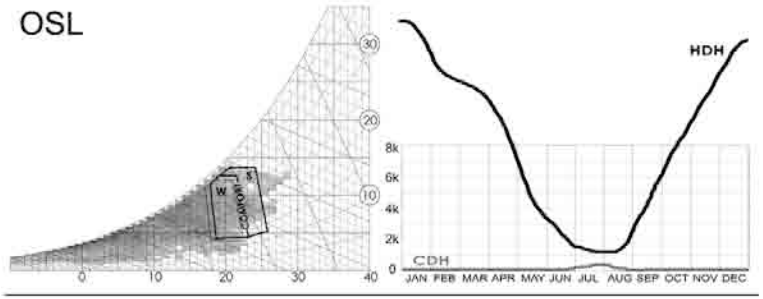

Thermal correction (internal gains: 25 W/m²)



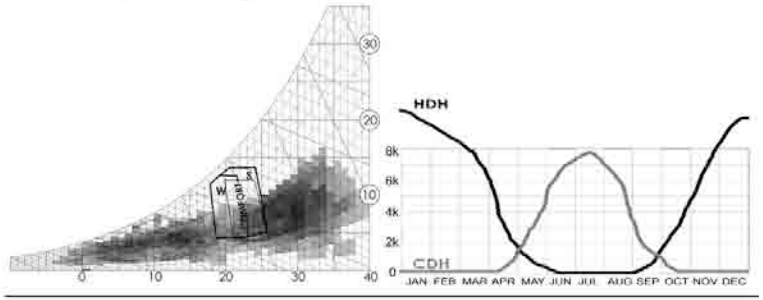
Venstres Hus, Oslo. **TRNSYS** (8760 hours) > **Excel** > **Weather-Tool**

- No HVAC system
- Working every day from 8 a.m. to 8 p.m.
- Internal gains: 25-14 W/m²
- air changes rate 6 m3/(m2*h) = 2,14ach and 1,0 ach in the night.

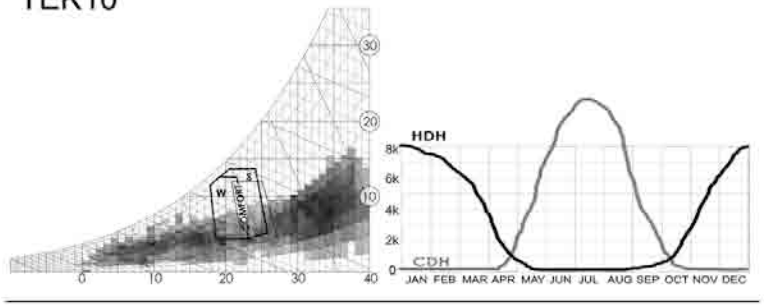
OSL



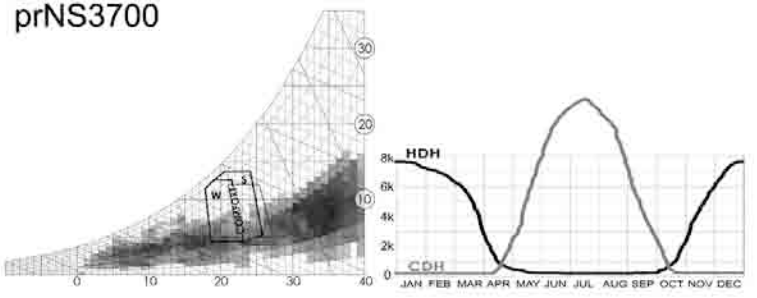

Existing building




TEK10

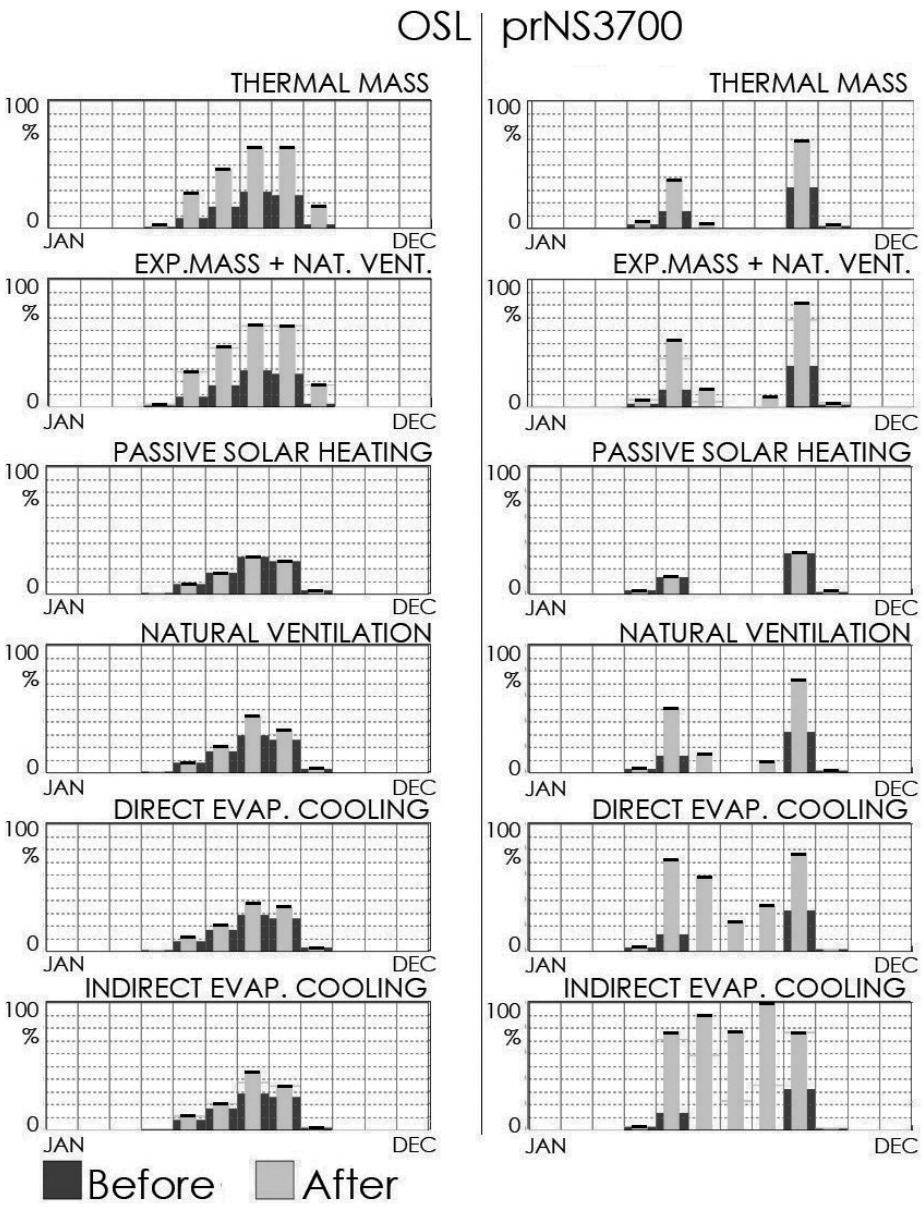



prNS3700




- The more stringent the envelope's technical requirements, the larger the thermal correction

- Significantly increased number of **cooling degree hours**




- Significantly increased **potential** of the strategies for cooling and natural ventilation.
- A force strong enough to completely upset the whole architectural concept of the building.

# Conclusions

The natural deviation of temperatures and relative humidity value due to the elevated thermal gains inside the Psychrometric would provide useful information about the increased potential of natural ventilation and passive cooling strategies, leading the architecture of cold climates office buildings into new scenarios.

This thermal correction has to be assumed as already embodied in the DNA of new office buildings

*Schneider + Schumacher*
***Westhafen tower - Frankfurt***

*Gatermann + Schossig Architekten*
***Burohochaus XX - Dusseldorf***