Responsive building elements in an integrated design process

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Comfort in buildings should be considered as the absence of long-term values of environmental comfort parameters, rather than the maintenance of precise and close limits. The overall satisfaction of the occupant will be influenced by the building’s own climate-modifying performance, the occupant’s ability to adapt the building by means of controls, and the freedom of the occupant to take adaptive behavioural actions.

Baker, Steemers
Integrated Building Concept

- Actively used for transfer and storage of energy and daylight
- Integrated in the building construction
- Integration with building services functions
- Responsive to dynamic climate conditions and occupant intervention
Energy saving strategy

Efficiency improvements

Responsive and adaptive behaviour = climate-adjusted

Individual building and HVAC components

Integrated building concepts = climate responsive building elements

Direct use of natural energy flows for comfort and healthy indoor environment
Thermal responsive building elements

- Usable space
- Room height
- Atria

Spatial

- Connecting
- Door
- Staircase

Connecting

- Separating
- Façade partition

Separating

- Structural
- Building services
- Sun protection
- Blinds
- Daylight control
- Double skin façade

Structural

Building as utility

- Foundation (piles)
- Floor mass

Conditioning
## Thermal mass

<table>
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<th>Principle</th>
<th>Goal</th>
<th>Condition</th>
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| Passive   | Heat storage in concrete floor (and wall)  
• Passive gains in heating season  
• Night cooling in summer | • Big diurnal temperature variations. Direct contact between indoor air and mass surface. Convective heat exchange “open” ceiling (> 20%) |
| Active    | Heat storage and exchange trough embedded water pipe work floor (and wall) | • Low temperature heating system/high temperature cooling  
• Heat transmission by convection and radiation  
• Open ceiling (> 60%)  
• Special/additional sound absorption material  
• High air tightness of façade  
• High thermal quality of façade  
• Limited cooling load |
Activated floor (TABS) design
Room acoustic design

Plagyo edge section PU27/27
GypSound Andante 11
lead 1.5 mm
Gyproc panel 9.5 mm
ABA joint finishing
elastische seal
PE 30 tape
PE 30 tape strip Gyproc panel
Gyproc MS 100/2.50.2A

14 May 2008
Kantoorgebouw Kraanspoor
Window shutters

- sun energy absorption instead of rejection
- influence local outdoor climate
- thermal transmission
Daylighting Element with PCM

Winter

Summer

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Commissioning Model

Process phases

INITIATIVE  PROGRAM  DESIGN  ENGINEERING  CONSTRUCTION

Feedback integration aspects

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Summary

• Thermal responsive building elements become a prerequisite for low energy buildings

• An integrated design approach is necessary

• Besides thermal mass activation more design information about responsive building elements is desirable