

Performance Criteria for Healthy Indoor Environments

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The Significance of Indoor Environment Quality (IEQ)

1. A degraded indoor environment is expensive for building owners

- Decreased building value
- Lower rent
- Potential financial risk

2. A deteriorated indoor environment is a potential financial risk to the building owner (BOMA)

- If a tenant lodges three major complaints in one year, there is a 52% chance that they will not renew their lease
- The ensuing cost can equate to 1.5 years rent
 6 months vacancy +
 6 months rent concession +
 Brokerage fees +
 Retrofit costs +

 = 1.5 years rent

3. IEQ affects human health and productivity

Indoor Environment	Human response
Thermal	Comfort
IAQ	Stress
Acoustic	Sick leave
Lighting	Work performance

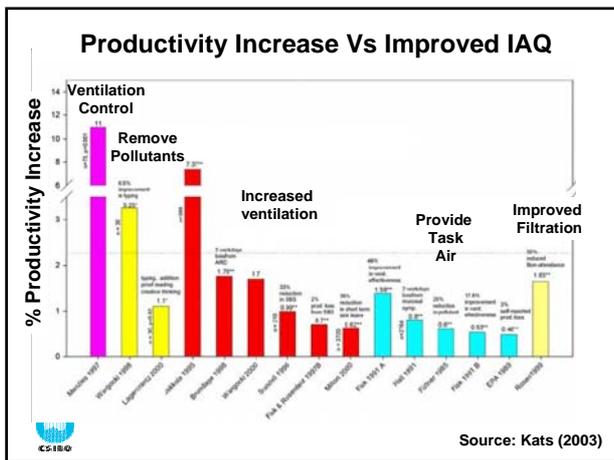
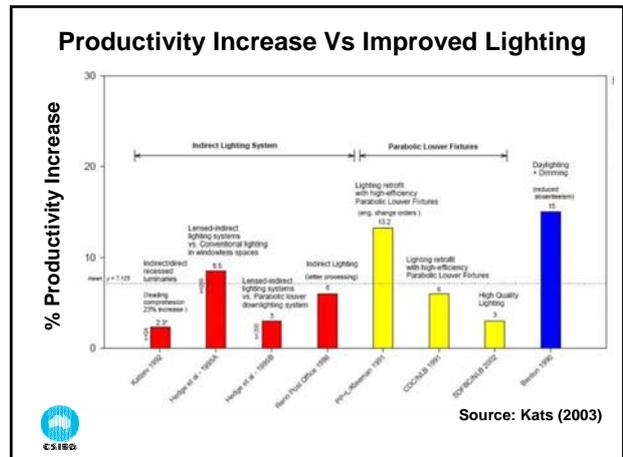
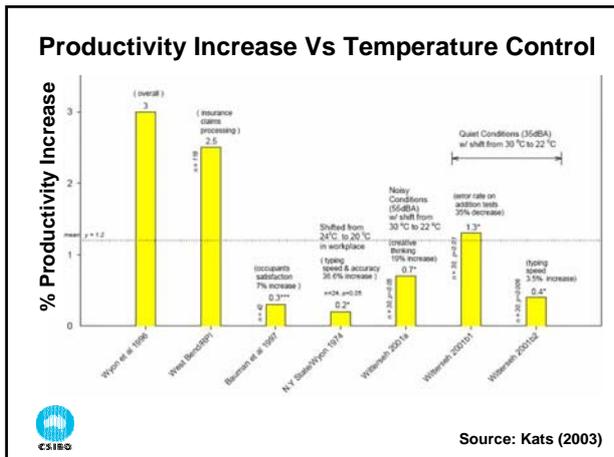
Can have positive or negative effect

3. IEQ affects human health and productivity

- Financial loss/profit to business
 - Worker salaries comprise more than 80% of business costs
- Human cost/benefit for occupants
 - People spend 90% of time 'indoors'

Source: Romm and Browning (1994)
 Source: National Activity Pattern Survey (US)

Does IEQ really affect productivity?



Potential Productivity Gains From Improvements in Indoor Environments (\$US)

Source of Productivity Gain	Potential Annual Savings or Gains
Reduced respiratory illness	\$7 - \$16 billion
Reduced allergies and asthma	\$1 - \$5 billion
Reduced SBS symptoms	\$10 - \$35 billion
Increased work performance: improved thermal, lighting, acoustics	\$25 - \$180 billion
TOTAL	\$43-236 billion

Adapted from : Fisk (2000)

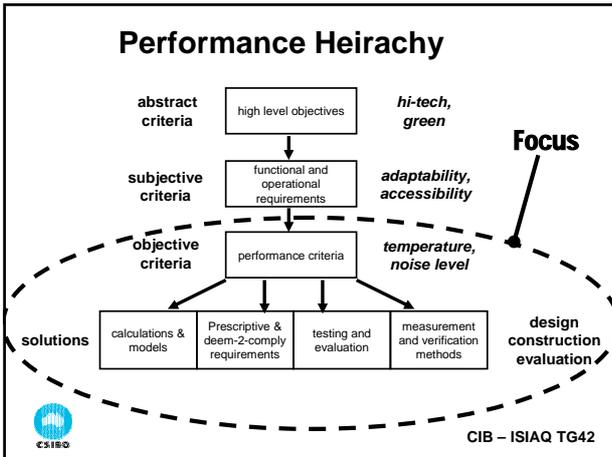
Why do we need performance criteria for indoor environment quality?

A definition of the end product such as

“The building shall be comfortable and healthy”

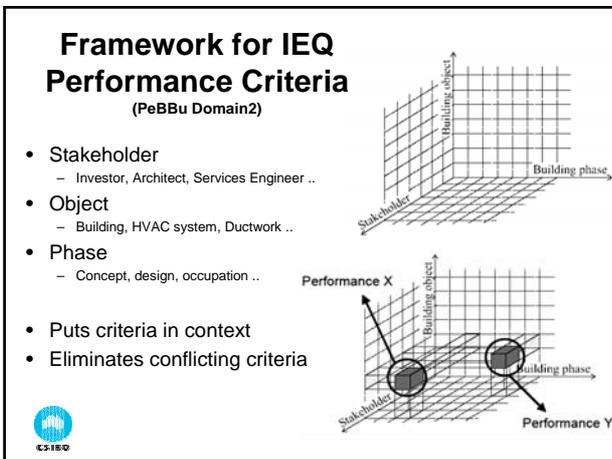
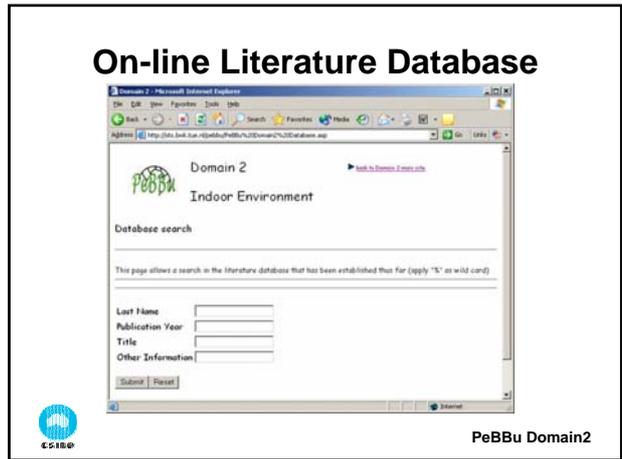
Is not enough!

- ## IEQ performance criteria: relevant initiatives in Europe
- PeBBu
 - Performance-Based Building Network, Domain 2, Indoor Environment
 - CIB ISIAQ TG42
 - Performance criteria of buildings for health and comfort
 - FiSIAQ
 - Classification of Indoor Climate 2000
 - HOPE
 - Health Optimisation Protocol for Energy-Efficient Buildings
 - TOBUS
 - decision making tool for office upgrade
 - Ecospace
 - Innovation platform for enclosed spaces technology



PeBBu Domain 2 Indoor Environment

- ## PeBBu Domain 2 – Indoor Environment
- One of six scientific domains of the ‘Performance-Based Building Thematic Network’
 - Funded by EU 5th Framework
 - Key aim is to develop performance criteria for use in European standards.



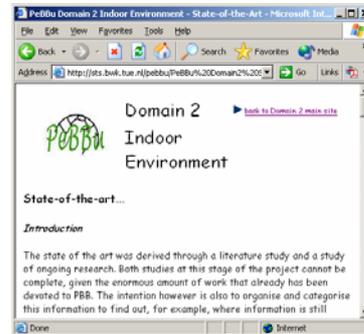
- ## Future Research Areas
- Capturing client expectations
 - Measurement and verification techniques
 - Simulation/Evaluation tools
 - Demonstration of performance approach
 - Interactions: Physical / Psychological / Social

Survey of EU Current Practices and Attitudes to PBB

- Israel
- Sweden
- UK
- Netherlands
- Germany
- Belgium
- Portugal
- Italy
- Greece
- Czech Republic
- Slovenia
- Slovakia
- Poland
- Bulgaria



State-of-the-art Report



CIB - ISIAQ TG42 Performance criteria of buildings for health and comfort



CIB - ISIAQ TG42: Performance criteria of buildings for health and comfort

- Joint Task Group
 - CIB
 - International Society for Indoor Air Quality
- Established in 2000
- Draft Report – Completed 2003
- Final Guidelines – June 2006



Main Topics Covered

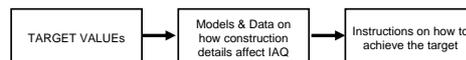
- Indoor air quality and climate
- Ventilation
- Cleanliness of supply air
- Emissions from building materials
- Moisture damage and mould growth
- Design and construction process
- Operation and maintenance
- Measurement and verification



CIB – ISIAQ TG42

CIB - ISIAQ TG42: Overview

- Guidelines for building owners, contractors, designers, consulting engineers
- Set of basic criteria and three 'levels' of target values
 - Basic (current practice)
 - Medium
 - High



- Focus is on descriptive/prescriptive guidelines, i.e how specified targets can be reached in practice.



CIB – ISIAQ TG42

FiSIAQ Classification of Indoor Climate 2000



Classification of Indoor Climate 2000

- Developed by Finish Society of Indoor Air Quality and Climate (FiSIAQ), in association with
 - Building Owners Association
 - Consulting Engineers Association
 - Association of Architects
 - Finnish Building Information Centre
- First issued 1995, Revised 2001
- Focus is on performance criteria, with some prescriptive guidance & solutions offered
- Three main sections



FiSIAQ 2000

FiSIAQ 2000: Overview

1. Target values for indoor climate (S1, S2, S3)

2. Guidance and criteria for design and construction (P1, P2)

3. Requirements for building products (M1, M2, M3)

Building & Works	Mechanical Systems	Emissions of building materials	Cleanliness of A/H components
Classification of construction cleanliness (P) Requirements for moisture control	Design criteria Cleanliness of air handling systems (P)	Emission criteria Other requirements	General requirements Requirements for each component



FiSIAQ 2000

Part 1: Target values for indoor climate

- Target and design values for IAQ, noise levels and ventilation
- Three Categories
 - S1, S2, S3
- Specific design values
- Only measurable factors included
- Verification methods for all factors



FiSIAQ 2000

Part 2: Guidance for Design and Construction

- Two categories
 - P1, P2
- Construction cleanliness and moisture control
 - Criteria for clean A/H components
 - Site planning, storage, scheduling
 - Moisture control during construction
 - Protection of building materials and HVAC components at site
- Integration of criteria into construction process



Part 3: Criteria for building material emissions

- Three Categories
 - M1, M2, M3
- Limiting values for emissions
 - TVOC, formaldehyde, ammonia etc.
- Covers all material types
 - Paints, flooring, panels etc.
- Testing Procedures Included
- Labelling Scheme
 - Specified by architectural designers
 - Now used for marketing
 - Rapidly increasing number of 'labelled' products



FiSIAQ 2000

How is it used?



FISIAQ 2000

Implementation - briefing

- Building owner specifies target values
- Indoor climate (S1, S2, S3)
 - Temperatures, ventilation, pollutants
- Indoor environmental technology
 - Construction cleanliness (P1, P2)
 - HVAC Cleanliness (P1, P2)
 - Moisture control (P1, P2)
 - Material Classes (M1, M2, M3)



FISIAQ 2000

Implementation – design

- Design is based on agreed criteria – critical steps are specified and checked
- Agreed criteria are integrated into all documentation (not just specifications)



FISIAQ 2000

Implementation - construction

- Criteria integrated in all contractor and subcontractor agreements
- Education and training of contractors on site
- Quality control method for the contractors
- Moisture control plan for site developed
- Construction cleanliness plan developed



FISIAQ 2000

Implementation – post occupancy

- Verification of target values as specified
- To ensure continued performance, IEQ performance targets are integrated into:
 - the maintenance and operation manuals for the building
 - work specifications for maintenance staff
 - Agreements with facility managers



FISIAQ 2000

Industry Acceptance

- Widely used by building owners
- Results in “good” buildings
- Accepted first by *HVAC designers*
 - then by *architects*
 - *material manufacturers*
 - *building owners*
 - *HVAC manufacturers*
 - *general contractors*



FISIAQ 2000

Acknowledgements

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- Philomena Bluysen
 - TNO, Netherlands
- Jarek Kurnitski
 - Finish Society of Indoor Air Quality and Climate



Further Information

- AusPebbu
 - www.auspebbu.org
- PeBBU Domain 2 Website
 - sts.bwk.tue.nl/pebbu
- Classification of Indoor Climate 2000. Finish Society of Indoor Air Quality and Climate (FiSIAQ), Espoo, Publication 5E
 - www.sisailmayhdistys.fi
- ISIAQ – CIB TG42. Task Force. Performance criteria of buildings for health and comfort.
 - hvac02.hut.fi

