Reliable moisture and temperature data measurement within a building envelope

Background description

According to (Building Regulations, 2010) and the corresponding guidelines (Stang, 2008), buildings have to be secured against moisture accumulation due to moisture transport from internal air and moisture absorbed from the external ground.

The recommended approach to verify risk-free exterior building envelopes with respect to moisture transport from internal air is to use a steady-state diffusion model (DS/EN ISO 13788, 2001) and (Andersen, 2009).

In the steady-state diffusion model, temperature and humidity curves and hereby indication of any dew points are calculated using a few input data like material data for each layer and monthly averaged data for interior and exterior temperature and humidity. An application for the steady-state diffusion model is presented by (Andersen, 2011).

Because of the well know limitations of the steady-state diffusion model it cannot be uses as a replacements for deeper analyses like dynamic simulation algorithms. Instead, it can be used as a quick way to eliminate noncritical parts of the building and to document these parts as risk free with respect to moisture transport from internal air.

Further studies and measurements is required to document that the steady-state diffusion model gives acceptable results for building envelopes in buildings exposes to real-life usage. And hopefully to document that the steady-state diffusion model always gives results on the safe side. In this case the steady-state diffusion model could be introduced as a standard for applying for a building permit. Of course supplemented with further result e.g. from a dynamic analysis for building envelopes indicating moisture problems as a result from the calculation.

In order to document the validity of the steady-state diffusion model measurements in the form of temperature and moisture data sets has been collected using a data logger connected to temperature and humidity transducers in different depths through an exterior wall, each measuring a new data set in a given time interval every 5 minute (Demohouse Nexø - Fugt, 2011).

Temperature and humidity transducers as used in (Demohouse Nexø - Fugt, 2011) are state-of-the-art transducers with a high accuracy in data measurements. Unfortunately, when encapsulated into insulation layers the heat produced by the transducers cannot be ventilated away and corrupts the data. Studies have shown that the temperature measurements is approximately 8 °C to high which in the given conditions gives an error of up to 30% to and thus, is useless for research purposes.

Purpose

The purpose is to present a plan for transducers, data loggers and data collections in order to minimize sources of error and inaccuracy in measuring moisture and temperature data within a building envelope.

Problem formulation

The project focus is to present a plan for moisture and temperature data measurements within a building envelope. The plan includes description of suitable transducers, data loggers and data storage to be used to measure the moisture and temperature profile through a building envelope.

Questions to be answered are the following:

- How to get reliable measured data using transducers and data loggers?
- What kind of transducers and measurement equipment is most suitable for measuring moisture and temperature data within a building envelope?
- What kind of IT management and control should be applied?
- How to get a complete reusable plan for moisture and temperature data measurements for a building envelope?

Delimitation

- Laboratory measurements will be applied as data quality and not data quantity.

Choice of model and method

What Partial problem	**Why** Why study this problem?	**Which** Which models/theories are expected to be used to solve the problem?
How to get reliable measured data using transducers and data loggers?	Moisture data analysis for research purposes requires accurate data	Laboratory measurements.
What kind of transducers and measurement equipment is most suitable for measuring moisture and temperature data within a building envelope?	Heat produced by transducers within a building envelope corrupts the result. Thus, transducers independent of their own environment is desirable	Research specifications for available equipment. Create new components. Cooperation with suppliers for equipment e.g. Buhl & Bønsøe A/S. Laboratory measurements. Measurements on an exterior wall in laboratory
What kind of IT management and control should be applied?	Minimize inaccuracy in data measurements	Experiments in laboratory and in Nexø, Kirkestræde 47
How to get a complete reusable plan for moisture and temperature data measurements for a building envelope?	Reduce time and cost for measuring moisture and temperature data for new building envelopes	Laboratory measurements for different kinds of equipment.

Time schedule

Start date is 15/4/2013 and expected end date is 15/4/2014. The time scope is estimated at 400 hours. Roughly, this represents the workload for two persons working in average 5 hours each per week in 30 weeks with additional workloads in some periods.

The phase plan is estimated as follows:

Date interval	**Phase**	**Subject**
15/4/2013 – 15/5/2013	#1: Initiation	Project definition
15/5/2013 – 3/6/2013	#2: Planning	Laboratory plan, Initial experiments, External contacts
1/8/2013 – 15/1/2014	#3: Implementing	Laboratory measurements, Part conclusions for best suitable equipment, best IT structure and control and similar
15/1/2013 – 15/5/2013	#4: Documenting	Conclusions, Report writing, Plan for / Recommendations for moisture and temperature measurements in building envelopes

Project organisation and economy

The project team consists of Steffen Vissing Andersen and Erland Ketil Larsen, both from VIA University College, ICT Engineering.

- Work hours for project team are set to 400 hours.
- Work hours for a laboratory assistant is set to 80 hours
- Laboratory equipment is 30.000 DKK

References and expected sources

Andersen, S. V., 2009. *Moisture in Buildings.* s.l.:VIA University College, Campus Horsens.

Andersen, S. V., 2011. *Moisture Analysis - An application for steady-state diffusion analysis.* [Online]
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Brandt, E., 2009. *SBi Guidelines 216 - Fugt i bygninger.* s.l.:Statens Byggeforskningsinstitut.

Building Regulations, 2010. *BR10.* s.l.:The Danish Ministry of Economic and Business Affairs and Danish Enterprise and Construction Authority.

Demohouse Nexø - Fugt, 2011. *Demohouse Nexø Bornholm - Fugt.* [Online]
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DS/EN ISO 13788, 2001. *Hygrothermal performance of building components and building elements – Internal surface temperature to avoid critical surface humidity and interstitial condensation – Calculation methods.* s.l.:s.n.

Stang, B. D., 2008. *SBi Guidelines 224 – Guidelines on Building Regulations 2008.* s.l.:Statens Byggeforskningsinstitut.