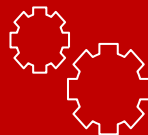


TEMA 2011—2014



Theory meets working life (TEMA)

A guide from an interdisciplinary collaboration project improving knowledge and skills of indoor air quality

YRKESHÖGSKOLAN
NOVIA



"Theory meets working life" (TEMA) 2011-2014 was an interdisciplinary collaboration between Novia University of Applied Sciences, The Association of Finnish Local and Regional Authorities in Finland, Umeå University, and the County Council of Västerbotten in Sweden. The project was funded by the EU / Botnia Atlantica, The Regional Council of Ostrobothnia, Region Västerbotten and the parties themselves.

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Theory meets working life 2011-2014

At date, when discussing age for retirement and strategies for keeping employees longer at work, indoor air quality aspects are becoming increasingly important. Building-related illness is a common problem and many investigations in Europe show long-term economic, social and environmental effects. TEMA was a cross-border cooperation project for coordinating resources, exchanging best practices and searching for new solutions to this problem. This project was interdisciplinary and involved primarily employees within social and health services, building technology and maintenance, and education. Much can be learned from how other countries and regions deal with indoor air problems. One project aim was to conduct a survey on today's knowledge and future needs, another is to search for best practices.

The results will lead to education materials and courses for target occupational groups and, by activating key occupational groups, contribute to regional growth and sustainable development.

*Annika Glader
Project Leader*



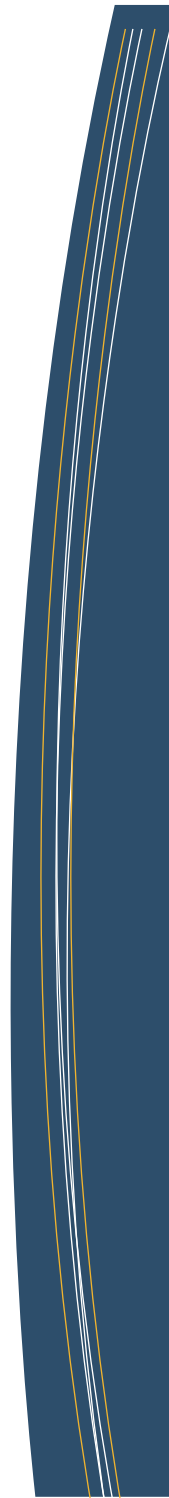
TEMA

TEMA (Theory meets working life) was an interdisciplinary project that mainly targeted at professionals within the healthcare and construction industry, but also all those who for various reasons would benefit from information about the indoor environment problems.

This guide is an overview of published reports and studies, produced by the project. The publications can be found on the project website www.tema.novia.fi/publikationer

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Increased knowledge on moisture damaged buildings in the construction field

When solving problems with the indoor environment, the diversity of names of operators in the construction industry has caused problems for clients in the selection of qualified building investigators. The overlaps in education systems and the lack of qualification boundaries have caused problems also for educators and students. To meet the need for expertise in the field, one has so far been relying on voluntary, fee-based courses. Still, this system has not been able to meet the needs.



“To meet the need for expertise in the field, one has so far been relying on voluntary, fee-based training courses .”

A working group, within the moisture and mould programme in Finland, has made a plan for the development of education and skills for those who work with investigations and renovations of moisture and mould damaged buildings. Most polytechnics with construction education have some form of training concerning the indoor environment and renovation, although the number of hours of classroom teaching varies greatly. Some schools have already sufficiently comprehensive training to meet some of the new proposals on skill requirements.

Novia University of Applied Sciences is responsible for the education of construction engineers and builders in Swedish in Finland and have, within the project TEMA, started the development of Swedish training materials and strategies .



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Leif Östman, Senior Lecturer
Thomas Olofsson, Professor

→ www.tema.novia.fi/publikationer/Byggnadsteknik/Rapporter

Damage investigation of concrete floor structures

Best practices in Finland and Sweden

Several trade associations have published best practice guidelines for the investigation of moisture damaged buildings. A building investigation begins with an inspection of the building and the customer is responsible for ensuring that it is carried out by a competent investigator. Both in Finland and Sweden there are documented methods that can be followed.

In order to implement appropriate and effective measures when solving problems with the indoor environment, the building should be investigated as a whole. After the initial investigation, a first assessment of the indoor climates

impact on residents' health and if there is a need for further investigations of structures and moisture is carried out. Measuring moisture in concrete requires knowledge of the person performing the measurements and interpreting the results. Both in Finland and in Sweden, the construction industry has issued instructions that describe how to measure the relative humidity in concrete structures. All damaged material is removed during renovations. One also needs to ensure that the measures taken address the cause of moisture damage.

Today, there is both knowledge and means to prevent moisture damage but these are not utilized optimally. In the building regulations issued by Boverket, it is recommended to engage a moisture expert to make a moisture control plan before every construction project. By following the laws, regulations and best practices it is possible to prevent moisture problems in buildings.

*Karolina Sunabacka, Project Assistant,
Annika Glader, Project Leader*

→ www.tema.novia.fi/publikationer/Byggnadsteknik/Rapporter



Damage investigation of public buildings

Healthy indoor air is essential for each of us, no matter what buildings we spend time in. As we spend most of our time inside, many are exposed daily to poor indoor air quality due to problems with damaged and neglected buildings. The problems can be caused by moisture and mould damage, inadequate ventilation, weakness in planning or the age of the building. Several municipalities are struggling with problems in their properties, such as lack of methods when conducting investigations, tools, skills and resources for investigating and resolving problems in a good and strategic way. During the investigation process the responsibilities among the participants should be clearly defined, as well as the information and communication.

The aim of this report is to identify procedures used when investigating dama-



ged buildings in municipalities in Finland and Sweden. Another aim is to inform about the methods and tools municipalities currently use when investigating



damages and what mistakes that can easily be avoided. The report was mainly conducted as a literature study, using sources from both countries. More literature has been available in Finland and therefore a workshop was held in Sweden as a complementary source of information of the approach of investigations in municipalities in Västerbotten. The investigation model available in Finland is created by the Finnish Institute of Occupational Health's model (Institute of Occupational Health 2009) and in Sweden SWESIAQ model (SWESIAQ 2013).

Jessica Ekström, Project Assistant

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Outdoor air-ventilated crawl space

Theory and practice

Outdoor air-ventilated crawl spaces are known to face problems caused by a high relative humidity inside the crawl space. The conditions then become favorable for different types of biological fouling. This in turn can have a negative impact on both the structural properties of building materials and the quality of the indoor air. Problems with high relative humidity are partly due to insufficient heating of the crawl space during the summer and partly due to a high moisture load from the ground below.



In this report, new theoretical relations are derived that explain how the temperature beneath the floor structure is related to the temperature indoors, outdoors, and at the ground surface.

The method can be used to estimate how the relative humidity varies inside the crawl space and how it can be affected by different measures. We have focused on measures based on combinations of controlled ventilation and heating, and developed a control algorithm which suggests that additional heating could be used periodically, during critical periods, to increase the amount of moisture that can be removed from the crawl space using ventilation.

Johan Westö, Project Assistant

→ www.tema.novia.fi/publikationer/Byggnadsteknik/Rapporter



Damp proofing of buildings

A case study

It is estimated that about 250 000 houses in Finland are in urgent need of moisture and mold remediation. The new energy saving demands leads to high requirements on building airtightness. This implies more complex moisture mechanics and makes buildings more susceptible to damage when exposed to high moisture loads. A fast working pace and tight schedules on construction sites also poses threats to a damp-proof building.

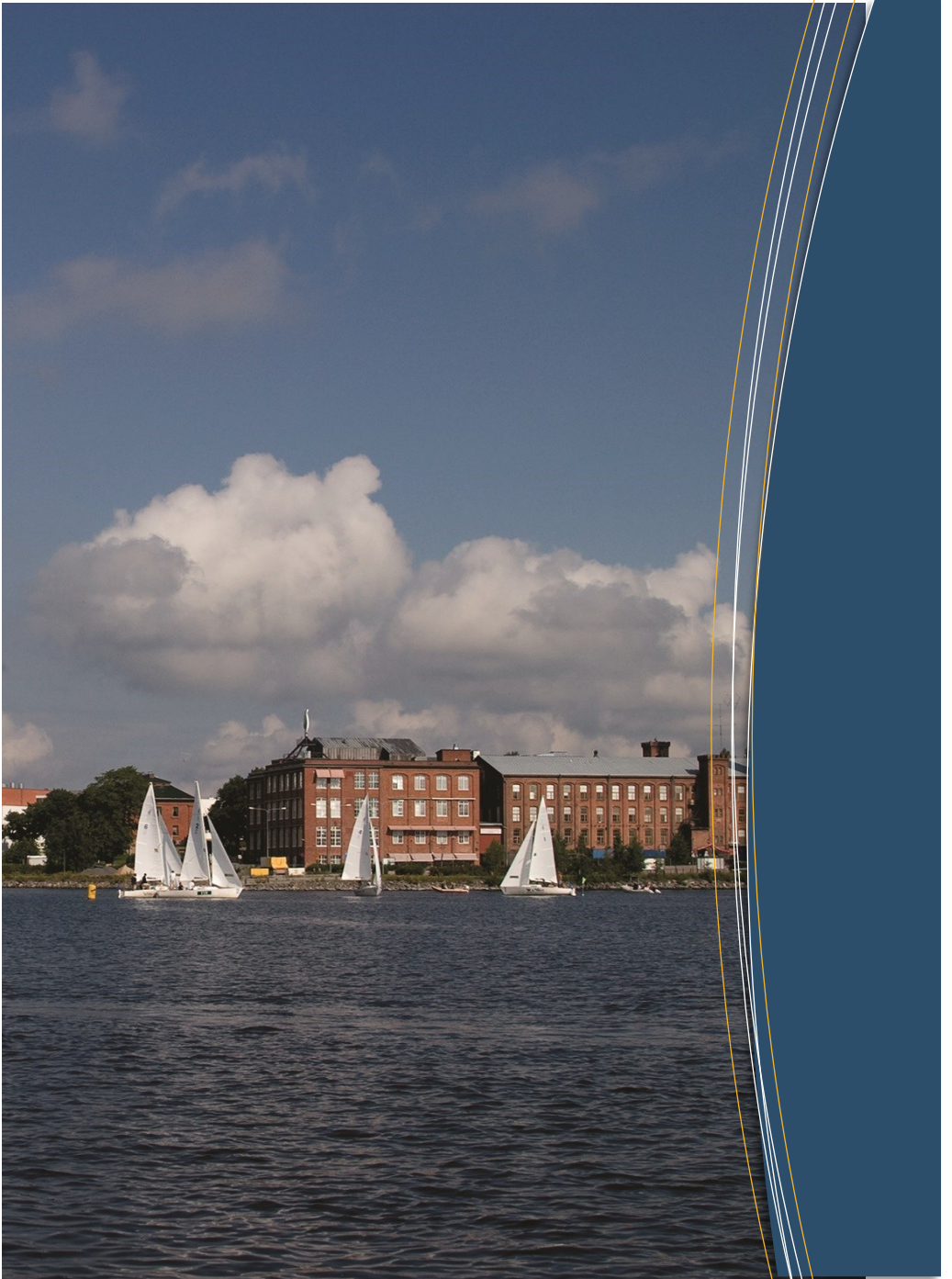


Future problems can be eliminated if engaging an expert in moisture control during the construction process. In this case study, an expert in moisture control has been followed at work in order to document important stages on how to prevent moisture damage. The results have been collected as digital educational materials, primarily intended for future construction engineers but can also be used by others who can benefit from our collected knowledge.

Yvonne Dahlbäck, Project Assistant
Johan Ångerman, Architect
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Increased knowledge on building-related illness in health care

There is a growing demand for education on indoor environment and building-related illness, both in the context of basic vocational education and training courses for professionals. Health problems, caused by poor indoor air quality in the workplace, are investigated by the occupational health service. However, those working with occupational health today, does not always have sufficient knowledge about the indoor environment and building-related illness and often lack the capacity to participate as experts in workplace investigations. To improve health care, staff should be trained on e.g. risk factors for poor indoor air quality, common health problems and impact on working capacity and productivity, the impact of psychosocial factors as well as liability issues and health economic implications.

Open Educational Resources (OER) and Massive Open Online Courses (MOOCs) can advantageously be used in the training of health professionals. Online education makes it easier for them to choose both timing and objectives. Furthermore, OER and MOOCs also constitutes a means to develop knowledge transfer between Sweden and Finland.

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Bo Glas, Researcher,
Ingrid Liljelind, Researcher,
Kåre Eriksson, Associate Professor
Maj-Helen Nyback, Senior Lecturer,
Steven Nordin, Professor*

→ [www.tema.novia.fi/publikationer/Hälsa och Socialvård/Rapporter](http://www.tema.novia.fi/publikationer/Hälsa_och_Socialvård/Rapporter)

OER = Open Educational Resources

MOOC = Massive Open Online Courses



Existing knowledge on BRI within healthcare and health protection

A web questionnaire with questions about existing knowledge and quest for information on building-related illness (BRI) was sent out to professionals who meet persons with symptoms they relate to buildings. The professionals were physicians with speciality in occupational health care, family medicine, pulmonary and allergy diseases and technicians such as occupational hygiene, safety engineering, and environmental and health protection. The questionnaire covered four main themes:

1. What is the existing knowledge about the causes of building-related illness?
2. What type of good practice is used for preventive measurements in the environment, and what kind of advice is commonly given to the afflicted individuals?
3. What are the sources of today's knowledge, and how do the professionals want to obtain knowledge in the future?
4. What are the knowledge gaps?

The answerers showed that the physicians consider the cause to be a combination of both air quality and individual factors, while the technicians considered the cause mainly to

be different factors related to air quality. The common pieces of advice given from the professionals were aiming to improve the indoor air quality. Important sources of knowledge were lectures, conferences, the internet and colleagues. Generally, they need to know more about the causes, how to diagnose,



treatments, investigations, arrangements, and the latest research.

*Ingrid Liljelind, Researcher,
Anna Söderholm, Researcher*

→ [www.tema.novia.fi/publikationer/Hälsa och Socialvård/Populärvetenskapliga artiklar](http://www.tema.novia.fi/publikationer/Hälsa_och_Socialvård/Populärvetenskapliga_artiklar)

Existing knowledge within Occupational Health Services

Buildings that are exposed to mold and dampness constitute a serious problem for society in general, and with regards to public health. It has been estimated that 600 000-800 000 Finns are exposed to poor indoor air quality daily, and that the related health problems generate costs of 450 million euros per year.



The costs stem from e.g. the examination and treatment of symptoms and illnesses, episodes of sick leave, loss of work ability, as well as reduced work capacity and productivity. In addition, the problem causes considerable hardship for those who are affected.

Six affected individuals and fifteen health care providers in the Occupational Health Services participated in a qualitative interview study. The affected were all active professionals and wished to continue their professional life. However, they experienced limited or non-existent opportunities to influence their own situation.

The health care providers addressed the need for education and training in the field. Workplace visits carried out by the Occupational Health Services were perceived as important for investigating and preventing health problems. Multi-professional co-operation was also presented as a key factor in assessing the situation of the affected.

The study concluded that affected individuals are entitled to more extensive information, and should be offered the opportunity to affect their own situation. The Occupational Health Services need more training in the field to attain a more profound understanding, and to develop the ability to provide appropriate care.

Maj-Helen Nyback, Lecturer

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Population-based studies in Västerbotten and Österbotten

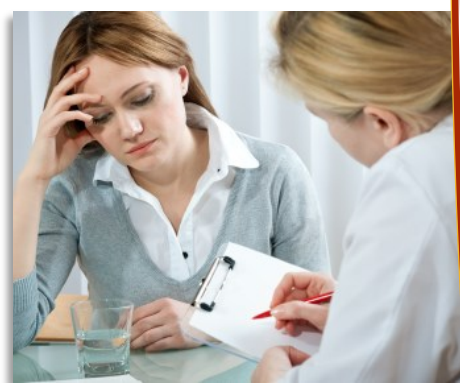
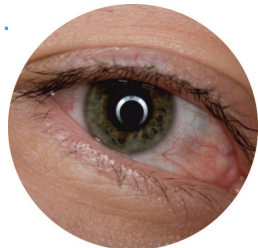
A longitudinal study was conducted in Västerbotten, and a cross-sectional study in Österbotten of different environmental hypersense.

Despite many years of research, knowledge about different environmental hypersensitivities of relevance for indoor environment and health is still very limited. The most common forms of environmental hypersensitivity are non-specific building-related symptoms (NBRS; “sick building syndrome”), multiple chemical sensitivity (MCS), symptoms attributed to electromagnetic fields, hypersensitivity to sounds, and asthma and allergy. Results from the studies show that the prevalence of NBRS and MCS is high, which is also the case for comorbidity with other environmental hypersensitivities. In addition to specific symptoms, the general health status in building-related symptomology is poor, and several risk factors have been identified (e.g., inflammatory diseases and poor psychosocial work environment). The project has resulted in a number of validated questionnaire instruments for identifying NBRS and MCS.

Steven Nordin, Professor
Maj-Helen Nyback, Lecturer

NBRS
Nonspecific building-related symptoms

MCS
Multiple Chemical Sensitivity



Metabolites in blood

An objective measure of building-related illness?

This study examined whether individuals (cases) who experienced symptoms related to exposure to indoor air showed a different metabolic answer compared with individuals who did not experience symptoms (controls). The cases and controls worked within the same office building. A blood sample was collected before and after work among five cases and five controls during five consecutive working days. After two weeks the blood sampling procedure was repeated.

A large number of low molecular organic metabolites were identified. There was no difference in metabolic pattern between cases and controls. In order to detect a possible difference in metabolic pattern between cases and controls a larger number of individuals should be examined. Inflammation is a commonly used explanation for why some individuals get sick from low level exposure to chemicals (e.g. chemical intolerance and building related health problems). An exposure study was performed to investigate the relationship between inflammation and exposure to an irritant (acrolein, formed during combustion). Inflammatory markers in the blood were identified before and after exposure. It proved to be a large difference between individuals in their reported irritation of the eyes and nose and this

was also reflected in the collected blood samples. The levels of some inflammatory markers increased due to exposure in those who reacted negatively to the exposure, both immediately after exposure and also 24 hours later. This difference was not identified after exposure to the control condition. The levels of



inflammatory markers were generally lower before exposure in the group reacting negatively to the exposure compared to those who did not react to the exposure at all.

Kåre Eriksson, Associate Professor
Anna-Sara Claeson, Research Assistant

→ [www.tema.novia.fi/publikationer/Hälsa och Socialvård/Rapporter](http://www.tema.novia.fi/publikationer/Hälsa_och_Socialvård/Rapporter)

Indoor air measurements

Are laboratories comparable?

Indoor air samples are sometimes collected when investigating buildings with suspected damages. A comparison of 14 laboratories in Sweden and Finland showed that there are differences in sampling, analysis and reports between Laboratories. Depending on laboratory, reports differ on amount and type of information given.

There are international standards for sampling, analysis and reports of indoor air and some laboratories refers to these standards but do not follow them completely.



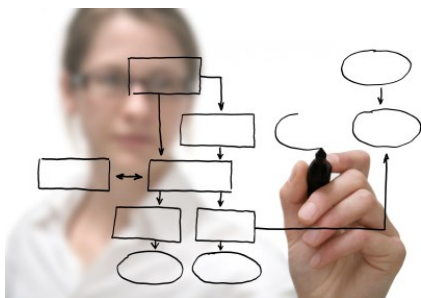
sample comprising 50 compounds. At most, one lab reported 44 compounds, of which 36 were actually in the sample.

“There are differences in sampling, analysis and reports between laboratories”

There were four labs giving comments on the results. Three labs agreed that there might be signs of moisture damage in the sample collected in a residence. Regarding the sample collected in an office, one lab regarded it as normal while the other two found indications of moisture damage. The comments given by the fourth lab were very unclear.

Bo Glas, Researcher

→ [www.tema.novia.fi/publikationer/Hälsa och Socialvård/Populärvetenskapliga artiklar](http://www.tema.novia.fi/publikationer/Hälsa_och_Socialvård/Populärvetenskapliga_artiklar)



Nine laboratories analyzed three samples and reported levels differed up to 20 times. One of the samples was a known



THEORY MEETS WORKING LIFE

Lessons can be learned from other countries and regions management with problems concerning the indoor environment. TEMA was a cross-border project between Finland and Sweden with the aim to coordinate resources, share experiences (best practices) and seek new solutions to indoor air problems. Through cross-border cooperation, we have established a dialogue and compared best practices between the countries. We have also developed education materials and courses for the construction and healthcare industry.

<http://www.tema.novia.fi>