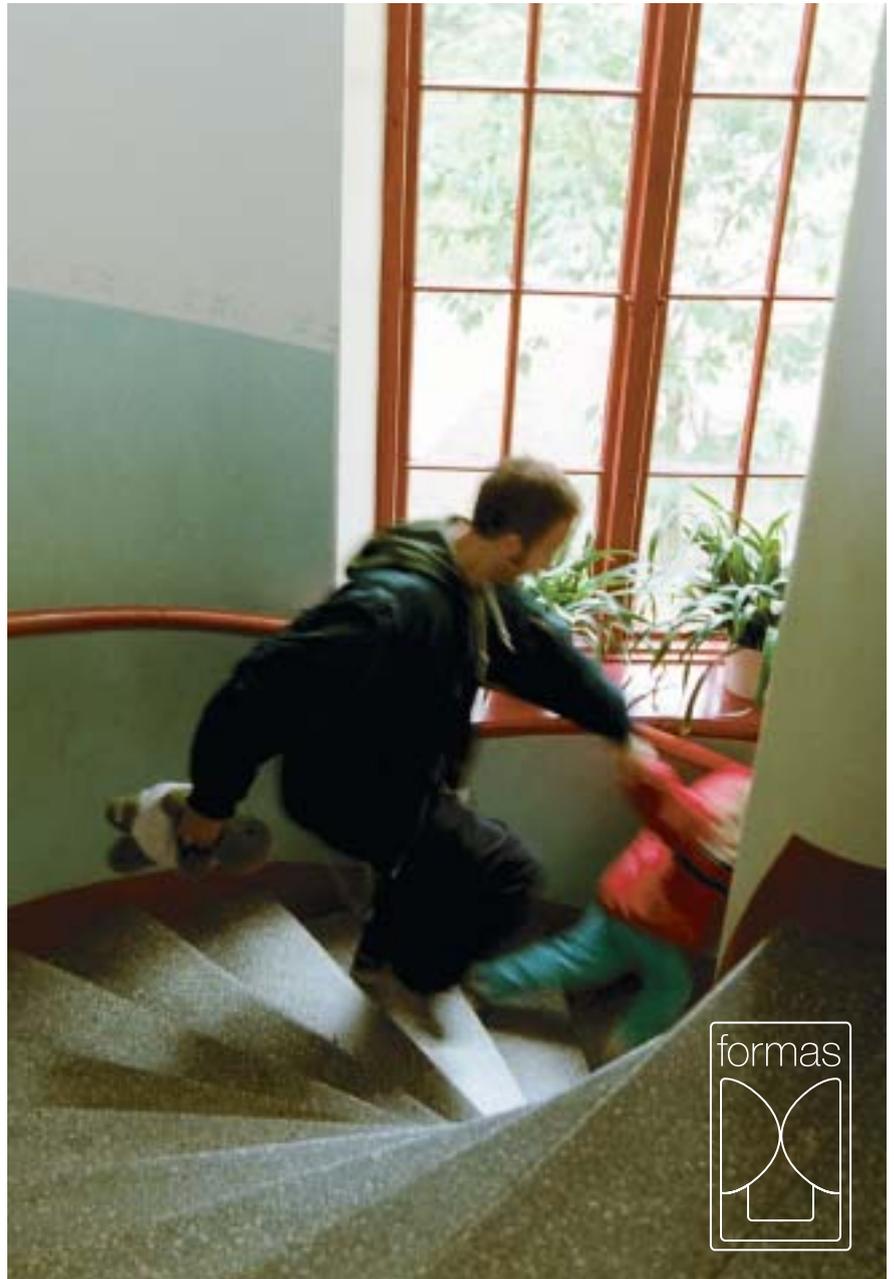


The Healthy Building

Stage 2



The key action "The healthy building" has embarked upon its second three-year period, 2001-2003. More than 30 projects share SEK 24m. With co-funding from other interested parties, this sum will be doubled. The first part of the key action was completed at the end of the year 2000.



Research on environment and health in buildings

The object of the Formas key action "The healthy building" is to bring about a sustainable society by uniting the environmental and health perspectives in buildings.

Faultily designed, built and managed buildings give rise to diseases and use too much energy. The object of the key action is to increase knowledge of problems in the indoor environment which have not yet been elucidated and to reduce the risk that errors in design, construction and management will result in indoor environment related health problems.

In addition to projects in medicine and technology, projects of a social science orientation have also been allocated research funds in the second stage of the key action The healthy building. Some of these projects form part of a comprehensive international research programme "Damp buildings and health". Researchers from Sweden, Denmark, USA and Japan are taking part in this programme.

Ill health that may be building related

Research on healthy indoor environments - the medical basis

This is a unique project since it uses new medical measuring methods to evaluate the health effects of important building technological factors such as the types of filters in the supply air system and damp flooring materials. These measuring methods include visual examinations and inflammation markers in nasal lavage. *Project manager:* Dan Norbäck, Uppsala University, dan.norback@medsci.uu.se

Low frequency noise in dwellings

This project will enhance knowledge of ill health and sleep disturbances caused by low frequency noise in the dwelling. The effects of noise attenuation measures will be medically evaluated, and a collection of samples will be formed as a reference for use in remedial measures and preventive work. *Project manager:* Kerstin Persson Waye, Göteborg University, kerstin.persson-waye@envmed.gu.se



Identification of unhealthy indoor environments

This research is expected to result in a strategy of practical utility for the identification of unhealthy indoor environments. One hypothesis is that temperature and the moisture status of the floor, ceiling, partitions and indoor air affect the chemical and microbiological composition and biological activity of dust particles in the air. *Project manager:* Lennart Larsson, Lund University, lennart.larsson@mmb.lu.se

The influence of sorption effects and ozone on perceived air quality

The object of this project is to investigate the effect of adsorption and desorption of chemical compounds on normal building materials, in the laboratory and in real environments. Measurements are made using both ordinary chemical methods and the perceptions of members of an odour panel. The materials are then exposed to the effect of air and ozone and a new investigation is made. In the next phase, two identical office rooms, with different ventilation solutions, will be investigated. *Project manager:* Björn Lundgren, SP, bjorn.lundgren@sp.se

Damp buildings and health (DBH)

During the first stage of this international research programme, a questionnaire survey was made among more than 14,000 children in Värmland. The survey showed that there is a relationship between damp in dwellings and health problems among small children. There were more symptoms in buildings with ground slabs than in buildings with suspended foundations. In stage two work will continue on identifying exposure associated with damp, and the significance of exposure for health will be determined. Some researchers are making case-control studies in a selection of dwellings, 200 "damp" and 200 "dry" dwellings. They conduct inspections, interviews and health investigations and measure exposure to different substances.

■ One of the projects concerns the health effects of small and particulate contaminants which contain plasticisers. Sedimentary and floating dust will be studied using methods that permit analysis of individual dust particles with respect to plasticiser content. *Project manager:* Björn Lundgren, SP, bjorn.lundgren@sp.se

■ Another project will measure microorganisms, chemicals and particles. *Project manager:* Carl-Gustaf Bornehag, SP, carl-gustaf.bornehag@sp.se

■ Semivolatile organic compounds in indoor air are investigated in a third project. This is a group of compounds which must be phased out in products within about ten years. Is there any relationship between the quantity of such compounds in indoor air and the moisture status of the building? The results will provide another piece of the puzzle in assessing the health effects in damp buildings. They will also provide information on the significance of the indoor environment for the load this type of compounds exert on humans. *Project manager:* Bo Jansson, Stockholm University, bo.jansson@itm.su.se

■ Endotoxins, mould and glucans in dust are measured in the fourth project. Dust is collected on filters with the assistance of vacuum cleaners. Samples are taken from children's mattresses and from the floor in children's bedrooms. *Project manager:* Torben Sigsgaard, Aarhus University, sigsgaard@dadlnet.dk

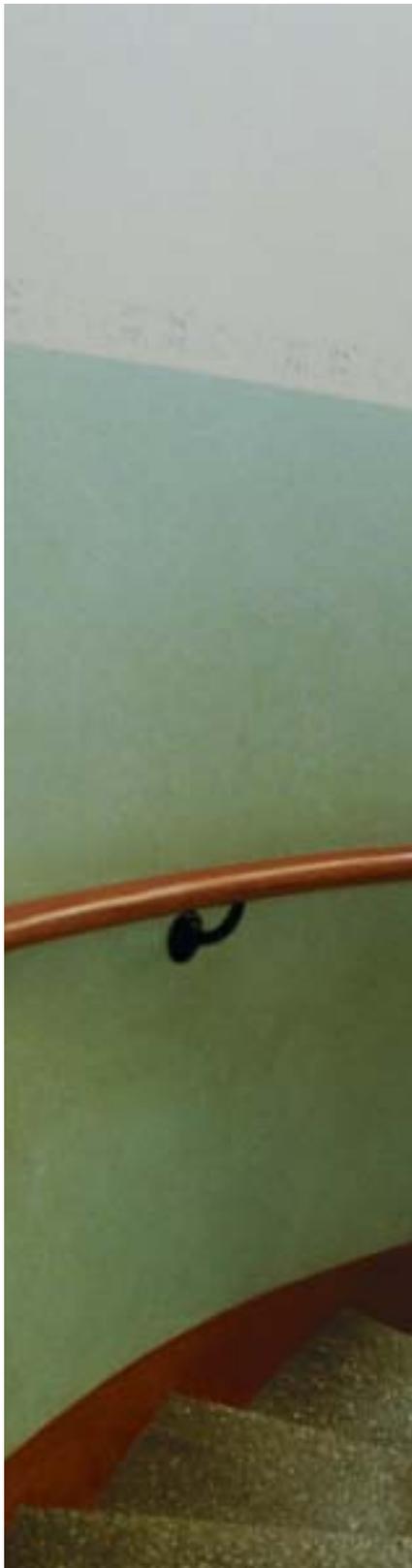
■ In yet another project, building physics investigations are made in a sample of 100 dwellings. The project measures ventilation, as well as moisture and temperature outdoors and in the bedroom and bed. The researchers also make an investigation to find if there are differences in exposure between buildings with different types of foundation. *Project manager:* Ingemar Samuelson, SP, ingemar.samuelson@sp.se

The causes of building- and work-related symptoms

The object of this project is to develop a diagnostic tool that can be used in field work to improve the total work environment. The researchers will develop a method which includes physical, psychosocial and individual factors, to find the causes of different symptoms associated with buildings and work. *Project manager:* Thorbjörn Laike, Lund Institute of Technology, thorbjorn.laike@mpe.lth.se

Flame retardants and plasticisers in the indoor environment

The task of this project is to develop methods of analysis for biologically active flame retardants and plasticisers in order to gain knowledge of their occurrence in indoor air and building materials. How do emissions from



building materials compare with those from electronics equipment? To what extent do these groups of compounds occur in different types of buildings with different activities? *Project manager:* Conny Östman, Stockholm University, conny.ostman@anchem.su.se

Short-lived chemically reactive compounds in indoor air

One object of this project is to study if short-lived and reactive compounds in the indoor environment have any health effects. These compounds are often considered to cause more irritation to the mucosa than other volatile organic compounds, and owing to their reactivity they are much more difficult to identify and analyse. It is also intended to find how these compounds are formed. It has been shown that a low air change rate provides better conditions for the transformation of certain volatile organic compounds into peroxy acetylnitrate (PAN) under the influence of ozone and oxides of nitrogen in the air. *Project manager:* Björn Lundgren, SP, bjorn.lundgren@sp.se

Does PCB in sealants contribute to elevated PCB contents in the occupants?

There has been evidence for a long time that PCB in buildings can "leak" into the surroundings, with significant consequences for the external environment. On the other hand, we do not know if PCB in sealants also contributes to elevated PCB contents in the occupants. Studies are made by means of both blood tests and questionnaires concerning dietary habits among people living in a specific area, and air samples. *Project manager:* Niklas Johansson, Karolinska Institute, niklas.johansson@imm.ki.se

Airborne mould and mycotoxins in Swedish problem buildings

A new analysis method for micromoulds is to be developed based on the PCR technique in molecular biology. *Stachybotrys chartarum* will be subjected to special examination; this is common on gypsum plasterboard. The DNA of the mould will be isolated, and in ideal conditions results can be achieved in a few hours; very small samples are needed. It is expected that the PCR technique will supersede the time consuming culture methods which are used today. *Project manager:*

Carl Johan Land, Swedish University of Agricultural Sciences, carl.land@trv.slu.se

Sensitisation of the occupants of moisture damaged buildings

The project will investigate how the occupants of moisture damaged buildings react to house dust. It will also investigate the significance of personality and life style factors and the significance of the different chemical, physical and biological components of the dust. Biomarkers of practical utility will also be developed for exposure and sensitivity. *Project manager:* Lars Mölhave, Aarhus University, LM@mil.au.dk

Aerosols indoors - physicochemical characterisation and health effects

The project will study the fine fraction of aerosols indoors with respect to physico-chemical characterisation and health effects which depend on heating (electric ovens, lighting, etc). Collected samples will be examined by a number of methods, e.g. in-vitro and in-vivo studies. *Project manager:* Olav Björseth, Technical-Natural Science University of Norway, olav.bjorseth@iot.ntnu.no

Clinical indicators for sensitivity to sensory irritation in the indoor environment

The aim is to validate clinical tests for the assessment of SBS patients and to gain further knowledge of SBS. Tests will be made concerning the repeatability of irritation thresholds in the nose and eyes, indicators for dry eyes, histamine reactivity in the nose and the level of stress hormones. The predictive power of each of these tests will then be measured on 300 office workers with and without symptoms. *Project manager:* Sören K Kjaergaard, Aarhus University, SKK@mil.au.dk

An experimental intervention study of electrostatic air filtration in class rooms

There is good evidence that filtration of air by electrostatic techniques reduces exposure to particles indoors and that this also yields positive health effects. The study will evaluate whether electrostatic air filtration is an alternative to increased ventilation and replacement of filters in conventional ventilation systems. It is performed in four schools, two



in rural areas and two in an urban environment. Health effects evaluated are asthma and allergic complaints, SBS symptoms and self-assessed productivity. *Project manager:* Carl-Gustaf Bornehag, SP, carl.gustaf@kau.se

Housing environment - a determinant of health and wellbeing?

The aim is to study the housing environment and its effect on activity, involvement and health in people with functional impairments. The knowledge gained is expected to be useful in planning and designing dwellings of greater accessibility for mainly functionally impaired persons, but also from the perspective of creating supportive environments for activity and health for the population at large. The methods developed may have great significance for design, construction and environmental planning in general. *Project manager:* Susanne Iwarsson, Lund University, siw@arb.lu.se

Technical requirements, user requirements and the consequences of alternative solutions

Mould, indoor environment - measuring methodology and health impact

The object is to develop and evaluate methods for the determination of mould cell mass in dwellings and to investigate the relationship between the quantity of mould cell mass and the occurrence of inflammation in the occupants. *Project manager:* Ragnar Rylander, Göteborg University, ragnar.rylander@envmed.gu.se

New methods for analysis of microbial contaminants and inhalable dust

The project will develop new methods of measurement for certain airborne contaminants in the indoor environment, both the chemical content of airborne indoor dust (gas chromatography/UV spectroscopy), and the protein and allergen content of the dust (two dimensional gel electrophoresis). The effect of these contaminants on the airways will also be investigated. This will produce new and better conditions for the identification of airborne contaminants which affect health. *Project manager:* Christer Tagesson, Linköping University, christer.tagesson@ymk.liu.se

Evaluation of standard methods for emissions from composite constructions

The different parts of a floor construction must interact so that the least possible secondary emissions are produced. In the autumn of 1999 the Flooring Trades Association (GBR) presented an industry standard for the measurement and reporting of such effects. The project will evaluate measurements made in accordance with the industry standard, study the long term effects of chemical breakdown and determine the reproducibility of the method. In this way the standard will be quality assured. It is hoped that it will be accepted by CEN/TC264. *Project manager:* Dag Duberg, Golveltprenörernas Bransch AB, dag.duberg@golvbranschen.se

The risk of indoor environmental effects due to recycled wood material

Has recycled wood the same microbiological qualities as new wood? The project will study the occurrence of mould on old and new material, and the ability of the material to withstand mould attack when exposed to moisture. It is hoped the results will reduce the risk of errors in design, construction and management. *Project manager:* Pernilla Johansson, SP, pernilla.johansson@sp.se

Development of test for odour emissions from building materials

Emissions from building materials can be measured with chemical instruments or odour tests. Odour tests have not been developed to the same extent as chemical methods. In Sweden there is theoretical knowledge of odour tests. In Denmark and Finland practical measurements have been made. The aim of the project is to develop, in Nordic cooperation, practical methods for odour tests on building materials. *Project manager:* Kristina Saarela, Technical Research Centre of Finland VTT, kristina.saarela@vtt.fi

Removal of PCB contents from indoor air - method, technique and effectiveness

The project will evaluate methods for decontamination of internal PCB-containing joints and will monitor the effect of this work with regard to the hygienic aspects of the indoor environment. Decontamination of internal PCB joints is an even more deli-



cate operation than decontamination of external joints. It is essential to isolate the workplace, refine the decontamination technique and find methods which will reduce dispersion of dust from the joint into the ambient air. *Project manager:* Björn Lundgren, SP, bjorn.lundgren@sp.se

Will PCB contents in indoor air be lower after replacement of PCB-containing joints?

Replacement of PCB-containing joint sealants is carried out on a large scale in buildings in Sweden. The project will assess whether the decontamination measures really reduce PCB contents in indoor air. Analysis of the new joint sealants in the building is also important to find how much of the PCB from adjoining materials migrates back into the new sealants. The extent of this migration can indicate how much PCB remains in the building. *Project manager:* Björn Lundgren, SP, bjorn.lundgren@sp.se

Ultrafine airborne particles - The extent of indoor exposure in different building types and in different activities

The project will measure the concentration of ultrafine particles (<0.1 μm) both outdoors and indoors in different types of buildings, in different activities and in different environments: large town, medium town, suburb and rural area. It will make it possible to develop a relationship between concentrations indoors and outdoors, to trace the sources of the particles found in the indoor air and to show how the concentration can be reduced. The project is performed in close cooperation between technical and medical researchers. *Project manager:* Per Fahlén, Chalmers University of Technology, hvac@vsect.chalmers.se

Effects of airborne allergens and particles on the cognitive performance of school children

The project will perform intervention studies to evaluate a method for reducing the concentration of airborne allergens and particles in class rooms and to see what effect the reduction has on the cognitive performance, emotional state and perceived comfort of pupils. The intensity of the effect will be compared with that due to noise in the form of irrelevant

talk. Allergens and noise are relatively easy to measure and manipulate in the school environment. *Project manager:* Staffan Hygge, Gävle University, staffan.hygge@hig.se

Planning and design of schools - a development programme

The programme comprises four part projects. The first will develop a planning aid for the cooperation between educationalists, clients and architects in conjunction with alteration schemes. The second will investigate what goals in the curriculum the planning of the school building for the older pupils of the 9-year comprehensive school should focus on. The third concerns preparations for a competition project for school buildings. The fourth works on a model for impartial assessment of school buildings and will develop capability to disseminate net-borne information regarding school buildings. *Project manager:* Olle Stahle, ARKUS Foundation, olle.stahle@white.se

The user, the building and the indoor climate

Ventilation to reduce exposure to allergens in the classroom

The object of the project is to find ventilation solutions which will considerably reduce exposure to allergens in the school environment. The main focus is on airborne furry animal and pollen allergens in classrooms, but the results should also be useful for other particle-bound contaminants and in other places of assembly. Different ventilation principles and filter classes will be tested in existing schools. *Project manager:* Magnus Mattsson, Gävle University, mms@hig.se

Housing environment, comfort and SBS symptoms - user reactions

The reactions of adult users in dwellings with respect to comfort and health is a scientifically undeveloped area, and the technique of devising questionnaires for housing environments needs evaluation. Since 1986, Stockholm City has been working on methodology to study user reactions from a social science and municipal economy perspective. The object of the project is to identify buildings at risk regarding indoor climate and health by using the knowledge which produced the model used by the city. Both the



questionnaire and the model are to be validated. *Project manager:* Dan Norbäck, Uppsala University, dan.norback@medsci.uu.se

School environment in theory and practice

How do humans function as measuring instruments? Why do some complain while others do not? How is "normal" air quality in different premises described? How are judgments influenced by personal conditions, allergy and stress? The aim is to develop and test a model for the prediction of environmental judgments on the basis of certain assumptions concerning the propensity to complain. *Project manager:* Lena Lundin, Kristianstad University, lundin.lena@telia.com

Measures to remedy the indoor climate in schools for asthmatic and allergic children

The project will investigate if measures such as removal of carpets and upgrading of ventilation have a greater effect among pupils who have asthma/allergy than among other pupils. *Project manager:* Hans Martin Mathisen, SINTEF, hans.m.mathisen@energy.sintef.no

Monitoring and development of schools with fan assisted natural ventilation

The project will investigate the technical and physical conditions required for natural ventilation, possibly with fan assistance, to function satisfactorily in a class room. Measurements and analyses will be made in existing schools. Both individual components and the system as a whole will be investigated. The function of window opening as complementary ventilation will also be examined. The project is to result in advice and recommendations and a tool for designers of schools with natural ventilation. *Project manager:* Lars Jensen, Lund Institute of Technology, lars.jensen@bkl.lth.se

The indoor environment in a social scientific, humanistic and legal perspective

Generations, dwelling styles and perceived indoor climate

The project will enhance knowledge of the significance which human behaviour and life style/dwelling style have on the perceived indoor climate in dwellings. The project will

also point out differences between different generations and different dwellings. The results are to form the basis for holistic analyses of the relationships between indoor environment and ill health with respect to building materials, ventilation, heating and dwelling styles. *Project manager:* Anna-Lisa Lindén, Lund University, anna-lisa.linden@ soc.lu.se

The sick/healthy building phenomenon in a Swedish and global perspective

The Swedish sick/healthy building phenomenon will be studied in a global perspective to find how it becomes a subject for research and how it is handled. A comparison will be made, mainly between Sweden and Australia, and the role of WHO will be analysed. Conditions in other countries will also be touched upon. *Project manager:* Eva Sandstedt, Uppsala University, eva.sandstedt@ibf.uu.se

Economic conditions for healthy buildings in a sustainable society

This project will be conducted in cooperation between the Swedish and Finnish House Property Owners' Associations. It will study how the market can be induced to accept building designs and system solutions which produce, with a greater degree of certainty, buildings which are and will remain healthy, even if this leads to greater first costs and higher management and maintenance costs. Is the market willing to pay higher rents? How can inducements be created? *Project manager:* Per-Olof Carlsson, Scandiaconsult Sverige AB, pcnmts@scc.se

Market conditions for implementation of new knowledge

The VASKA technique for buildings in which damage by water is prevented has not spread in Sweden as quickly as those who devised it wished. So far it is mostly in Umeå that the technique has been applied. The project will concentrate on a new location, presumably Helsingborg, and will endeavour by means of massive information campaigns addressed to property owners, contractors etc to establish a new "bridge-head" for the application of the technique. An evaluation will also be made of how the market allows itself to be influenced by new knowledge. *Project manager:* Johnny Andersson, Scandiaconsult Sverige AB, janvst@scc.se



Legal conditions for healthy buildings in a sustainable society

Alterations to conditions of contract and the structure of contracts are required in order to ensure at all stages of the process that buildings which are designed, constructed and maintained satisfy the requirement that the buildings must be and must remain healthy. The responsibility for this is divided over many parties at many stages of the process. It must be possible for the requirements and guarantees which are laid down in the contract to be verified under actual conditions by control procedures. In the project, different contract models will be tested in practical use. The project is run jointly by Finland and Sweden. *Project manager:* Johnny Andersson, Scandiaconsult Sverige AB, janvst@scc.se

Legal aspects of healthy buildings from the user perspective - charting of research needs

In this project it is people who are the centre of attention, especially those living in blocks of flats. It is estimated that up to one million people are exposed to indoor environments which may have a negative effect on their health and wellbeing. The five-six most common causes of complaints will be described in the project. A scrutiny of legislation will elucidate what measures are needed to secure the users' right to a good dwelling, and the project will produce practical advice for the users. *Project manager:* Susanna Skogsberg, susanna.skogsberg@home.se

Poor indoor environment from a legal standpoint - analysis and proposal for measures from a user perspective

The project will examine what legal means are at the disposal of the occupant of a flat in a "sick" block of flats to compel the owner of the building to take remedial action. The focus is placed on the identification and analysis of shortcomings and lack of consistency in the regulatory framework, in order that proposals may be made in due course regarding changed, clearer or new rules, better information, new insurance solutions, new procedural forms etc. *Project manager:* Mikael Möller, Uppsala University, mikael.moller@jur.uu.se



G4:2001. This brochure is also available as pdf-file on Internet (www.formas.se)

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