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VENTILATION, AIR FLOWS IN BUILDINGS AND INDOOR AIR QUALITY
- RD&D AND DEVELOPMENTS IN GERMANY

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INTRODUCTION

Ventilation, infiltration, indoor air flows and air exchanges determine two aspects of fast growing interest: the energy balance of buildings and the indoor environment. Whilst in the wages of the energy crisis RD (research and development) & D (demonstration) in the different areas had been focused on rational energy use now with view on the public awareness of the environmental situation (outdoors and indoors) also the aspect of indoor air quality stimulates widespread RD&D activities. The developments in the near future will be influenced by the demand to bring energy conservation into line with acceptable indoor air quality. This is expressed in several main RD&D programmes supported by Federal Ministries as well as in other institutional or industrial activities.

The areas of ventilation, infiltration, indoor air flows and air exchanges cover a wide range of technical subjects, first of all heating and air conditioning. An overview over the complex structure and organization of RD and D in the Federal Republic of Germany is given in a report by L. Trepte and A. Le Marié¹. This paper presented at the 10. AIVC Conference as poster will summarize some new developments and thus complement the report.

1. FEDERAL RD&D PROGRAMMES

Most important for areas of energy conservation and indoor air quality are programmes and projects supported by the Federal Ministry for Research and Technology (Bundesministerium für Forschung und Technologie, BMFT) and the Federal Ministry for Youth, Family, Women and Health (Bundesministerium für Jugend, Familie, Frauen und Gesundheit, BMJFFG). As a matter of fact RD&D have priority in programmes of BMFT. The BMFT understands its role as an initiator and a catalyst to accelerate the introduction of RD&D results into practical application.

On behalf of the BMFT the Project Management for Biology, Ecology and Energy (PBE) in KFA Jülich GmbH coordinates the programme "Energy Research and Energy Technologies". This programme is structured by different focal points, from which in this connection "Rational Use of Energy and Solar Energy for Buildings" is of main concern, with the following activities:

- passive and active solar systems
- heat pumps and heat pump application
- improvement of insulation technics
- air exchange, ventilation, hot- air heating, heat recovery
- improvement of conventional heating systems
- energy conservation in buildings: consulting, information, systems.

An overview over the supported projects, as well as the principal researchers, duration, fundings etc., is given in a report edited annually by PBE².

Whereas the above mentioned programme is focused on energy aspects another one, also supported by the BMFT, is started 1987 and aimed at indoor air quality. With the working title "Indoor Air Pollutants" it is structured in the following way:

- pollution sources and indoor air quality measurement techniques
- connection between energy conservation and indoor air quality
- model simulation and development of models
- risk assessment.

In addition to these programmes and supporting activities also other Federal Ministries, e.g. the Ministry for Regional Planning, Buildings and Urban Development (Bundesministerium für Raumordnung, Bauwesen und Städtebau, BMBau), or Ministries of the states initiate and support projects in these areas.

2. UNIVERSITIES, FEDERAL AND OTHER RD&D INSTITUTIONS

In the system of German RD&D activities, especially for basic research but to some extent also for contract research and development several types of other institutes and institutions are incorporated. Independent of ongoing programmes they contribute essentially to progress in the areas of energy conservation and indoor air quality. These are e.g.

- universities, technical universities and incorporated institutes, examples:
 - University of Essen, Institute for Thermodynamics and Air Conditioning
 - Technical University of Berlin, Hermann-Rietschel-Institute
 - RWTH Aachen, Institute for Heat Transfer and Air Conditioning Techniques
- Max-Planck-Gesellschaft (MPG) with about 60 institutes, research above all in natural science and medicine, cooperating with universities, examples:

Max-Planck-Institut für Physiologische und Klinische Forschung, Bad Nauheim, Max-Planck-Institut für Strömungsforschung, Göttingen

- National Research Centres (NRC) with twelve major research centres with some 16 000 employees, including 8 000 scientists and engineers. They conduct scientific, technological, biological as well as medical research. They cooperate closely with universities and many of the scientists working at the National Research Centres are also on the staff of universities located in the same state. Examples: Jülich Nuclear Research Centre (KFA Kernforschungsanlage Jülich GmbH), Jülich, Karlsruhe Nuclear Research Centre (KfK), Karlsruhe
- Fraunhofer-Gesellschaft (FhG) for the promotion of applied research with some 30 institutes
- Federal Institutions, subordinate institutions of the federal ministries. Carrying out research and tests they play an important role e.g. for formulating regulations, standards etc..
Examples: Federal Health Office with Institute for Water, Soil and Air Hygiene, Berlin, Physical-Technical Federal Office, Braunschweig
- Other research institutions beyond universities, but carrying out research and development on a non-profit base. They usually have connections to universities and to some extent the staff of these institutions is also on the staff of an university.
Example: Institute for Window Engineering (Institut für Fenstertechnik), Rosenheim.

3. STANDARDIZATION, INDUSTRIAL RD&D ACTIVITIES

In the last years in standards and guidelines and in industrial RD&D activities mainly energy aspects were placed into the foreground, among others as a result of the Regulation for Heating Insulation (Wärmeschutzverordnung) based on the Energy Conservation Law (Energieeinsparungsgesetz). In connection with new developments and a better understanding of indoor air quality requirements some of the major standards and guidelines will be revised. Examples are:

- DIN 1946 T2 "Room Ventilation, Technical Health Regulations", in preparation
- DIN 1946 T6 "Ventilation of Dwellings", draft
- VDI 3816 "Ventilation in the Case of Outdoor Air Pollution", draft.

The approaches include aspects of definition of indoor air quality, new definition of ventilation requirements, optimization of air flows and ventilation efficiency.

For joint research and technical associations because of the multiplicity is only referred to the following two examples:

- FLT Forschungsvereinigung für Luft- und Trocknungstechnik in cooperation with AIF Arbeitsgemeinschaft Industrieller Forschungseinrichtungen, RD&D interest at present: assessment of air flows, ventilation efficiency, legionella and allergenes in HVAC systems, aspects of comfort
- FGK Fachinstitut Gebäude-Klima (PR-Association), main activities: information services concerning air conditioning, health, comfort and rational use of energy in buildings, support of cooperations, initiation of RD&D.

The industrial RD&D activities in the Federal Republik of Germany are very widespread and can be summarized in the following way: Further and advanced development of compact and maintenance free HVAC systems and components, development of demand controlled ventilating systems, heating-ventilating-systems, indoor air quality: measuring as well as controlling by filtering etc..

4. DEVELOPMENTS

Also if window ventilation still dominates in residential buildings in Germany, the growing awareness for health aspects and energy conservation will stimulate RD&D. In office and industrial buildings already more advanced HVAC systems are in practical use and it can be assumed that some output of this know-how and increasing benefit-cost-relations will also influence the residential buildings market positively. Looking in the near future the following RD&D efforts have to be undertaken (examples):

- Research and development fields:
 - air flows: modelling, measurements, quantification of ventilation efficiency, energetic optimization of air flows
 - sensors for indoor air quality
 - assessment of indoor air quality, health effects
- Practical application:
 - development of appropriate sensors and control units for indoor air quality (moisture, carbon dioxide etc.)
 - technics for air treatment (pollutant removal)
 - buoyancy assisted ventilation
 - demand controlled ventilating systems, basic ventilation, demand ventilation, efficient ventilation
 - air heating systems, heat recovery
 - intelligent buildings, integrated building techniques, which link indoor environmental control, energy supply including lighting, security, communication and automation.

These are the subjects in present and starting German RD&D projects. Tomorrows technic for ventilating and heating will depend on the acceptance of the results by the market.

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