BBS INTERNATIONAL

BBS INGENIEURBÜRO
BBS INSTITUT

Company for Engineering
in
Structural Design
Building Physics
Redevelopment-Techniques

Institute for Research and Materials Testing
in
Applied Building Physics
and
Building Materials

Germany
China

# About Us

The BBS is anxious to realize the current state-of-the-art in practice and consequently to give commands to the implementation.

The BBS INSTITUT supports the BBS INGENIEURBÜRO with laboratory tests while working on projects.

The characteristics of the building materials and their dependence on the accompanying situation are checked to develop an optimal concept regarding an economical point of view.

Complementary, we give advice to the development of new structures and materials. These new structures and materials will be optimised on the basis of preliminary studies which are based on scientific and practice-orientated research; also, we attend to them until launch. We work on publicly promoted themes of research as well as concrete kind of questions of the industry and economy.

# BBS
## 20 years competence and networks

BBS founded 1990
20 employees

BBS INTERNATIONAL GmbH (2009)
BBS INTERNATIONAL China Co. Ltd (2009)

mit

BBS INGENIEURBÜRO
- Engeneering
  - Niedersachsen (1990)
  - Thüringen (1993)
  - Schleswig-Holstein (1996)
  - Baden-Württemberg (1998)
  - Berlin (2005)

BBS INSTITUT
- Research and development of building materials
  - Wolfenbüttel (before 2001)
  - Hildesheim (2001)
  - Hefei – China (2007)

Cooperation with the research institute of the University of applied Sciences and Arts Hildesheim IPFB

Consulting more than 20 noted companies
Cooperation with e.g. WTA
Network with more than 50 universities,
universities and research institutes at home and abroad

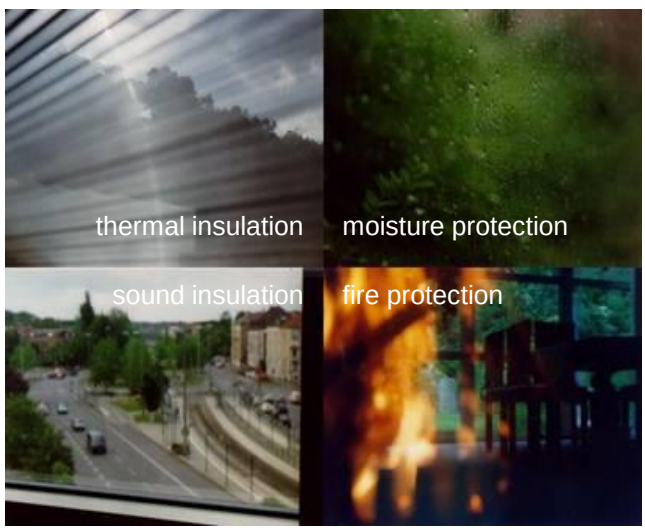
# Building Physics

Along with the development in building techniques and changes in legal standards and regulations, a building-physical review of new projects as well as existing, mostly historical buildings, becomes more and more important.

The point is to solve the problems in the sectors

## heat- and sound-insulation
## moisture- and fire-protection

without disregarding the close connection of each of these topics.



# Heat Insulation

Concerning the subject of thermal insulation, our task is to give advice with selection, design and details of heat insulation measures when planning new structures or redeveloping cultural properties.

The „Energieeinsparverordnung“ (energy-saving-law) requires a sophisticated design of the building according to building-physics.

The heat requirement has to be optimised regarding the costs (including production and maintenance requirement). Furthermore, the claim is to adapt the energetic behaviour of the building, thus the compound units, to the current requests and standards by considering constructional and preservative aspects, if necessary.

# Moisture Protection

It is a basic question in building-physics to evaluate the moisture stress of a building and its units, and how to prevent damages of the building stock.
It is necessary to reduce the dampness load towards the building‘s units by drainage and measures of waterproofing. To conceive a damp-technically perfect building, the driving rain protection of external construction components has to be evaluated and the accumulation of condensed water on the interior wall surface of badly thermal insulated external constructions, often in the area of cold bridges, has to be determined.
The basis of each calculation are capillary-, diffusion- and pyrometric characteristics of the building materials, which, if not known, can be determined with the help of additional laboratory tests

# Acustics

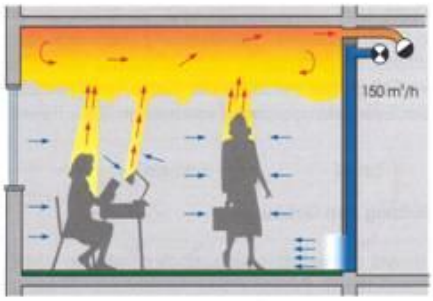
The area of acoustics is divided into four sections: sound-insulation (building-acoustics), room-acoustics, noise and vibration control.
The field of work of sound insulation includes advisory as well as supervisory activities in the area of the building-acoustics. At this, the sound-technical planning as well as measurements and check-ups of airborne and impact sound insulation of building elements take centre stage.
With help of simulations, the acoustic behaviour of larger rooms can be mapped, in order to give instructions for the optimal positioning of absorption- and/or reflection-areas.
In the area of the emission control for example emissions by traffic-noise, sport and leisure facilities are gathered and rated. On the basis of these results, necessary noise-control measures can be developed.
Another section of acoustics is about attenuation and damping of structure-borne sound. The spectrum of questions reaches from protection of shock-sensitive measuring-equipment to whole buildings.

# Fire Protection

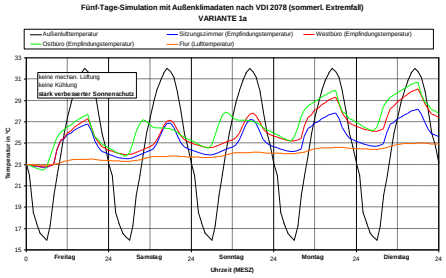
The major task of fire-protection engineering of building objects is the development of an integral ‚fire-protection-concept'. Therefore, the optimisation of the total concept has to be the centre of attention considering the various regulations, deletions, standards and guideline specifications in co-ordination with the involved persons, without neglecting the safety-relevant demands.
Besides calculation-methods of fire-protection engineering, this concept is completed by the creation of escape-, extinguish- and rescue plans as well as securing the historically valuable pieces of the expositions.

# Thermal and Hygroscopic Simulations of Buildings

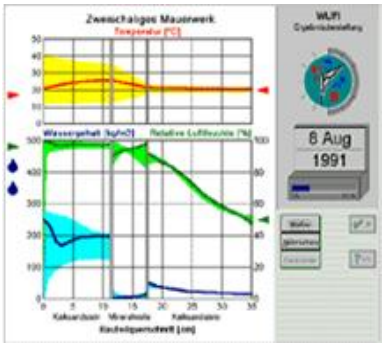
Regarding an energy-saving building-technique, we are able to accomplish transient simulations of any building-projects with the help of the programme TRNSYS, which was developed by the Solar Energy Laboratory at the University of Wisconsin-Madison. Not only the needed power of heating installations and/ or air conditioning-systems can be categorised with the help of these calculations, but also estimations about the hygroscopic behaviour of the room climate can be done. The effects of outer or inner anti-glare shields on the temperature's behaviour inside the building can be realised as well as the possible effects of the application of different shields.

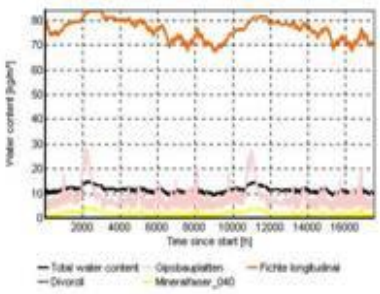


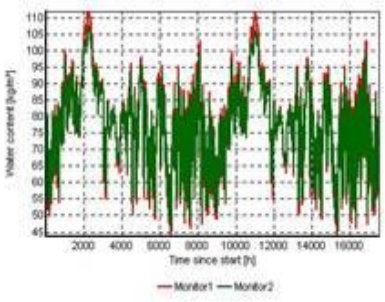




# Hygroscopic Simulations

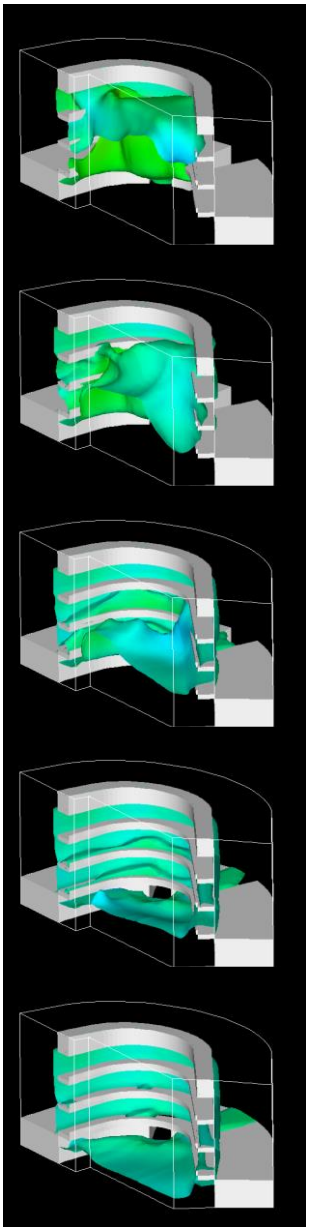


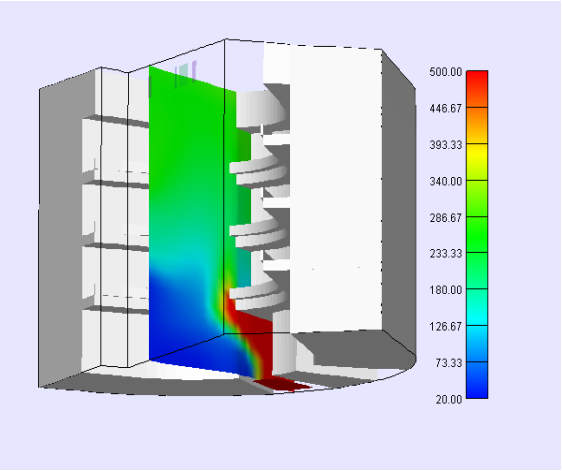




The determination of the development of the moisture content as a result of improvements, for example, inlaying heat insulation or the insertion of hydrophobic plasters, describes an almost insoluble problem because of the reason that existing standards can not give any approach towards reality. To get realistic results of the transient hygroscopic calculation of multi-layered components under natural climatic conditions, the program WUFI , which was developed by the ‘Frauenhofer Institut für Bauphysik IBP’ is used. With this program, the coupled heat- and moisture transport can be mapped in building constructions over several years. The assessment of reconstruction-arrangements becomes feasible as well as solutions of questions regarding moisture behaviour at newly developed structures.

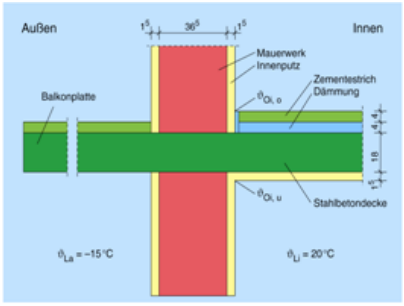
# Flow Simulations



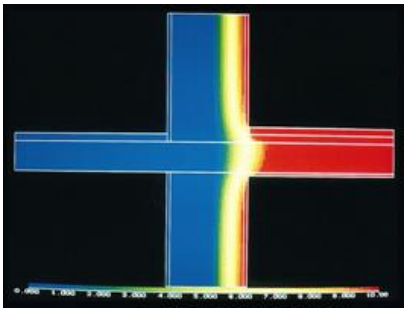
Computer simulations of different flows can be complementary accomplished by our partners. There is a tight legwork between our and their tasks.
Air pollutants are calculated with the help of the program MISKAM for the current and the design status. The expected strains of emissions are evaluated on the basis of limits and illustrated with the help of coloured graphics for the investigated area.
Air-drifts, which are caused by thermal effects and/ or wind as well as fire-gas-spreading, can be approximated by 3-D-models with numeral CFD-calculations.



# Thermal Simulations of Building Components



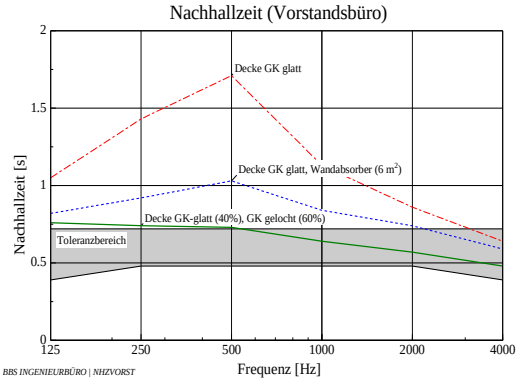

Regarding thermal simulations of building components, we possess 2- or 3-dimensional programs to calculate the temperature and heat flow in these components, for example HEAT 2 and HEAT 3.
These programs are primarily used for the calculation of heat bridges, whereas the possibility exists to determine the necessary minimum heat insulation for avoidance of condensation on the interior wall-surface on one hand, and on the other hand to show the increased heat loss of a deficiently insulated component.

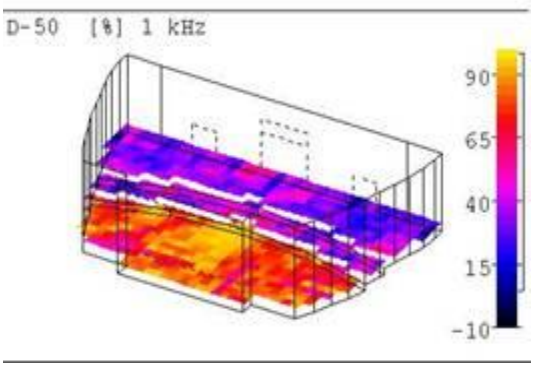


# Building- and Room Acustic Simulations

The calculation of the building's airborne and/or impact sound insulation is made by approved programs which are based on the existing DIN-standards complementary to European standards.

With the aid of the 'CATT-Acoustic'-system we are able to calculate and to map the acoustic parameters of a room and to give guidelines for absorption- and reflection areas.



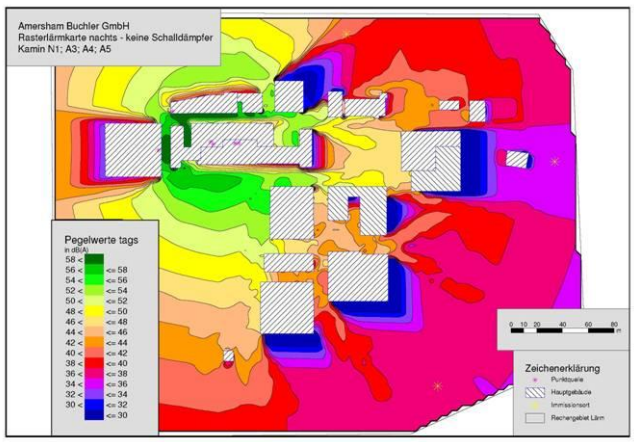



# Noise Controlling

In the area of the emission control, for example, emissions by traffic-noise, sport and leisure facilities are gathered and rated. On the basis of these results, necessary noise-control measures can be developed.

The legitimacy of construction projects can be proven as well as the compatibility of land utilization-planning.

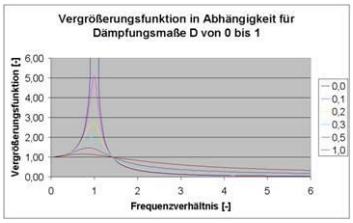
The results can be interpreted as noise-charts, as survey-maps with specified receiver-positions or in table form broken down for each storey.



# Vibration- and Shock- Control

Another section of acoustics is about attenuation and damping of structure-borne sound. The spectrum of questions reaches from protection of shock-sensitive measuring-equipment to whole buildings.
Protection against vibrations and/or shockwaves emitted by traffic routes or technical equipment becomes more important in our growing society.

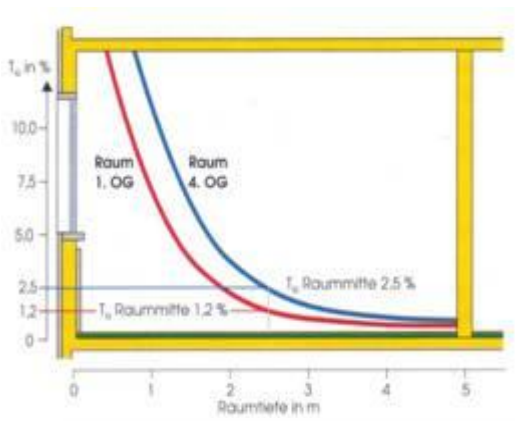
The isolation of vibration-sources of their surroundings as well as the attenuation of the existing vibration-amplitudes e. g. in buildings, are the goals of the sonic planning-performances.

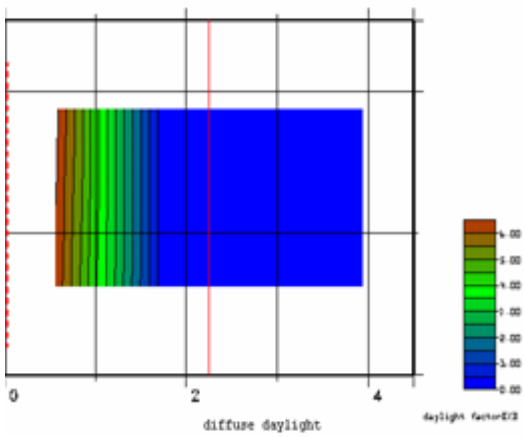



The applications are versatile:
- vibration-reducing building-bearing near rails
- vibration-isolated support of machines and aggregates
- vibration-isolated installation of sensitive laboratory equipment

# Calculations of Daylight and Illumination

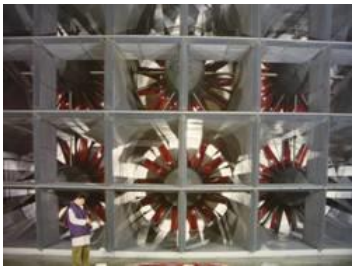
The program ADELINE, developed by IEA (International Energy Agency), delivers detailed information about day- and artificial lighting and their interactions in and on the building. In addition to the determination of the daylight's ratio regarding to DIN 5034 or ASR, ADELINE is able to produce a better association of day-and artificial light. This can be very important and comfortable at the time of planning. As a result, the lighting energy can be optimised concerning essential brightness.
In particular, this program is able to be a practical aid in the planning-phase, if searching for an assessment of innovative daylight-systems, as well as searching for solutions of lighting-situations of complex buildings' geometry. In conjunction with a thermal simulation, it is feasible to work out an energy optimisation of the building.



# Testing of Buildings, Building-parts and Materials

One of the essential tasks of the BBS INSTITUTE is the examination and testing of building materials, prefabricated parts and whole buildings in the area of the construction.



In test- and climate-chambers, which are our own or standing to our disposal, we are able to examine prefabricated parts and buildings under pre-determined conditions.
Besides measuring instruments for recording moisture- and temperature-courses inside prefabricated parts and in rooms, tools for detection of flow-velocities are available also.

Our climate-controlled laboratory has a corresponding equipment for examination of material-characteristics.

Via endoscopic analysis, it is possible to make diagnoses about the layers' construction and damages in the cross section.

# Testing of Buildings

Wind Tunnel

In developing new prefabricated parts, our institute works together with partners  all across Europe.
Through the outstanding contacts and long-time relationships, we can fall back upon newest and innovative facilities of these research establishments.

Here, we carry out utility-tests close to reality at building constructions in full scale as well as in entire buildings.

This way, test-rows at buildings can be enforced under extreme climate-conditions with our own BBS staff on the spot.

# Testing of Buildings

Climate Tunnel

The technical equipment of the test-laboratories makes it possible, to observe not only the thermal-hygroscopic reactions of prefabricated parts at extreme temperatures, -25 - +50 °C, but also to adjust all climatic loads realistically e.g.:

- Storms in hurricane-strength to check the mechanical loading capacity of a construction,
- driving rain and blizzards for utilisation rating tests
- intensive heat-radiation like in Summer.

# Testing of Buildings

Tests of Air-Tightness

Requirements of the DIN 4108 ‘Heat Insulation in Structural Engineering’ as well as plenty of damages caused by moisture convection make air-tight constructions and junctions necessary. The ‘BLOWER-DOOR-Method’ has proved itself in verifying the air-tightness, or rather, in showing leakage.
This kind of measurement is also necessary to prove the standard of EnEV-houses as well as so called ‘3-litre-houses’ and ‘Passivhäuser’. During this measurement, a ventilator is installed in an air-tight way in an aperture and differences between the pressure inside and outside can be produced.
The resulting airflow is a measurement of the shell’s air-tightness.

# Testing of Buildings

Thermography

The destruction-free Infrared-Thermography makes the measurement of relative surface-temperatures and their visual representation possible.

The thermal conditions in a prefabricated part can be visualised.
It is possible, to show the condition of the thermal insulation and weak points in the building like heat-bridges.

Furthermore, the positions of leakage in flat-roofs and decks can be fixed with thermography. Thus, it is possible to show the position of timbering in exterior walls.

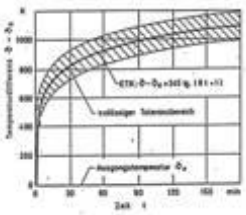
# Testing of Building Elements

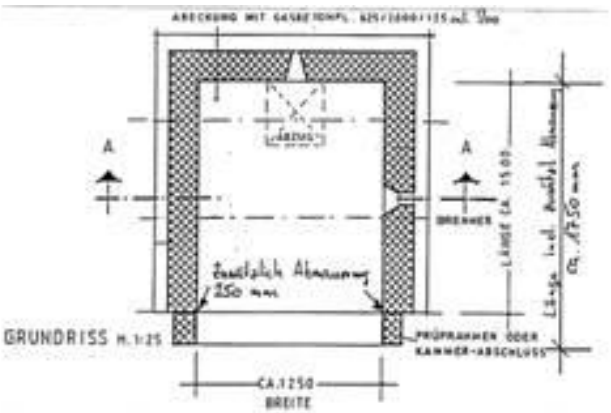
Acoustic Measurements

With the help of an acoustic measuring system, it is feasible to determine the insulation measurement against airborne- and structure-borne (impact) sound, as well as the reverberation time and the acoustical absorption.
As a result of these measurements, a statement of the building-structure's quality can be made and possible leakage can be found. The acoustic applicability of rooms concerning speech-transmission can be evaluated, also. The emissions which have an effect on the building, can also be determined as the noise-strain inside the building.

# Fire Testing

In fire-chambers of our co-operation-partners, we examine the fire protection capacity of prefabricated units as part of a pre-testing to an admission in general or to an admission in individual cases. The tests can be carried out with or without a load on the prefab parts.
On this occasion, the burning reaction of the prefabricated part as well as of the building-material can be assessed. Under the fire-examination, the fire-resistance-class according to DIN 4102 is determined by loading the prefabricated part with the unit-temperature-time-curve ETK.





# Testing of Building Materials

Climate-chamber / Test-Rooms

In our institute's climate-chamber, the thermal and hygroscopic reaction of smaller prefabricated parts can be measured precisely.

Two identical test-rooms are to our disposal, in which testing-rows can be carried out under defined conditions. This makes it possible to evaluate user-specific behaviour on the room-climate like indoor-air-quality/ -hygiene in consequence of window-ventilation or mechanical ventilation, as well as the influence of different wall-surfaces.

The available measuring equipment enables us to recognise causes for possible effects already in an early state of development-process and to offer effective solutions.

In combination with computer-simulations, an extensive and high-quality consultation of our clients can be guaranteed.

# Testing of Building Materials

Laboratory, Climate-Rooms, Measurement-Technique

In our climate-chamber we are able to observe construction under a predetermined room- and outer-climate. We provide measuring tools which can record moisture and temperature as well as determine the flow velocities. Our (climate controlled) laboratory possesses an instrumentation which is able to determine the air-speed, the ‘U’- value and climatic values like temperature and moisture. Via endoscopic analysis it is possible to make a diagnosis about the layers’ construction and damages in the cross section.

# Prüfung von Baustoffen

chemical investigations

- Schwefelwasserstoff
- Kalklösekapazität
- pH-Wert
- Gesamthärte
- Carbonathärte
- Chloridgehalt
- Sulfatgehalt
- Magnesiumgehalt
- Ammoniumgehalt
- Nitratgehalt

other investigations

- Tierische Holzschädlinge
- Pflanzliche Holzschädlinge
- Farbenanalyse
- Mörtelanalyse
- Stoffanalyse
- Deponiefähigkeit von Stoffen

physical investigations

- Oberflächenspannung
- Dicke (0.01mm...1.0m)
- Gewicht (mg)
- Rohdichte
- Wassergehalt
- dynamische und statische Wasserdichtheit
- Kapillare Saugmechanismen w- bzw. w'-Wert
- Rücktrocknungsverhalten w''-Wert
- Ausgleichsfeuchte
- Sorptionsisotherme
- Absorptionskoeffizient
- WDD-Wert -> µ-Wert + $s_d$-Wert
- Diffusion (elektronisch/gravimetrisch)

other investigations

- Brandprüfung (DIN 4102, EN 13501, etc.)
- Biegezug-, Biegedruck-, Zug- und Druckfestigkeit
- Weiterreißfestigkeit, Nagelausreißfestigkeit
- Dehnfähigkeit
- Luftdurchlässigkeit
- Scherfestigkeit

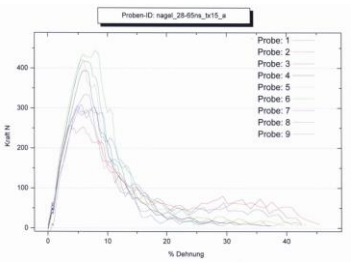
Thermal-hygroscopic Examinations

- Surface temperature
- Air temperature
- Temperature of fluids
- Relative Humidity
- Relative Humidity inside a construction
- Moisture content by gravimetric testing method
- Moisture content by sorption-isotherm
- Moisture content by electrical resistance-measurements (wood and wooden materials)
- Transient temperature and moisture measuring
- Transient climate measuring
- Diffuse radiation
- Thermal transmission coefficient ‘U’-value (in-situ)

# Testing of Building Materials

## Strength Testing

We are able to determine the mechanical characteristics of materials by tear-, pressure- and bending-tension examinations. Besides testing methods according to German and international standards, it is possible to carry out tests depending on custom-made methods.




Strength e.g. according to DIN EN 12311-1

- Tear propagation resistence e.g. according to DIN EN 12310-1
- Peeling tests e.g. according to EN 1464, EN 1895
- Adhesion-tension strength e.g. according to DIN EN ISO 4624
- Holding strength of connecting devices e.g. according to DIN EN 13446
- Bending-/ Pressure- tests e.g. according to DIN EN 1015-11
- Thread-/ fibre-tests
- Sheer-strength e.g. according to EN 1465, DIN EN 12090

Air- and Water-Impermeability

The air - and watertightness of textile structures and other materials can be determined according to different international standards (EN 1928, EN 20811, EN ISO 9237).
For a fast and exact determination of the watertightness, we put in electronically controlled water-pressure-appliances. By the high-precise, electronically regulated pressure-sensor, a very high measuring-precision and reproducibility is guaranteed independently of the chosen procedure. The thickness of the test-samples may vary from 0.01 mm to 45 mm.

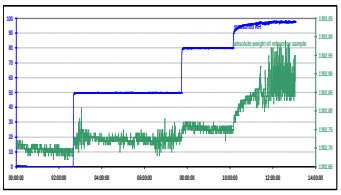
# Testing of Building Materials

Water Vapour Diffusion and Absorption

The measuring of diffusion can be carried out according to standards and/or with micro-processor controlled sensor-technology (Lyssy-Methode).

The standardised methods and climates are described e.g. in EN ISO 12572, EN 1931, EN ISO 12571.

The appliance L 80-5000 is equipped with the most modern measuring technology and enables us to calculate dependable sd-values of your clients products in the shortest time.
In the air-conditioned measuring-chamber, the samples are exposed to a defined partial pressure-gradient. The density of the resulting steam-flow is recorded and used for determination of the sd-value.



## Prüfung Luftdichtheit

nach EN ISO 9237, DIN EN 12114, DIN 53120 Teil 1 + 2
und anderen nationalen und internationalen Normen

Bestimmung des Fugendurchlasskoeffizienten nach
4108-Teil 7

Über genau definierte Querschnittsflächen können
verschiedene Differenzdrücke erzeugt werden.
Aus den sich einstellenden Strömungsmengen der Luft
lassen sich die Luftdurchlässigkeit R [m/s] sowie der
Fugendurchlasskoeffizient errechnen.

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# Testing of Building Materials

Fire Test

According to the standardised procedures of the DIN 4102-1 and the DIN EN 11925-2, as well as to the classification according to DIN EN 13501-1, the inflammability of materials through a small flame („match-flame “) is determined in the fire-box.
After a flame impingement period of 15 s, the material is classified on the basis of different prescriptive criterions as class E, F or B2.

# Consulting

Within the context of our affords we often can not One of the innovative areas of our company is the consulting of companies in the field of building industry.
In tight co-operation with various, well-known companies, e.g. in the fields of roof-, gypsum-, plaster-, nonwoven-, glass-, timber- and foam industry, it's our job to develop, evaluate and finally optimise the building materials and systems. This includes the handling of tasks regarding the practical reaction of building materials under various conditions like, for example, the influence of air-streams on heat insulation.
BBS as a Technical Service Provider carries out independently with its network or in co-ordination with the client extensive projects or supports the client with its developments.
Studies and market-analyses are the basis, which is supplemented by research and development-tasks. In own or foreign laboratories, the application-efficiency of materials or prefabricated parts is tested. In classical engineering, building-objects under realisation and application are planned or surveyed.
Through the direct access on BBS during the development, the client keeps the competence in his own house without providing cost-intensive research and development departments.

# Expert‘s Opinion

As for the assessment and removal of damages, we carry out full reports in co-operation with sworn experts. We use our own extensive instrumentation and can refer to our own laboratory as well as to the laboratories of other institutes, if needed.
Besides the constructional aspects, our reports mainly concentrate on building-physical tasks like:

- Damages on buildings
- Building construction
- Building physics
- Building climate

e.g.
- heat insulation and temperature development in buildings during summer
- mould and its reasons
- strain of historical buildings with regard to room-climate
- development of reconstruction concepts for actual building stock under an energetic point of view
- description of the usability of historical buildings

# Teaching Task and Research

With the help of teaching in the faculty of civil engineering with the subjects

Building constructions and building physics

at the University of Applied Sciences and Arts, HAWK Hildesheim, we are able to represent the fields of building construction, building physics and the techniques of reconstruction in the lectures.
With the help of the former management of the professorship “building climate” and the section “building-physics” of the MFPA in Weimar, as well as the ETH Zürich (sections “building materials”, “building chemistry” and “corrosion”) we are able to pass on not only theoretic- but also practical knowledge/experiences to young professionals.

Parts of these lectures were published and can be found on the World Wide Web.

Within the context of our affords we often can not sufficiently answer the questions and tasks that have been brought to us in a scientific way.

Supplementary projects of research in the field of applied building physics allow us to comment on these questions.

While doing this, not only the reaction of the different building materials and their combinations regarding heat and moisture are worked on, but also areas of noise- and fire protection.

# Publication

The results of our research are put together in the

BBS Reports

and are available via request or download.

In order to make the results of our research available to interested specialists and users, our reports have been published in renowned specialist journals such as:

e.g.

- Bauphysik
- Bauinstandsetzen
- Bautenschutz und Bausanierung
- bauen mit holz
- das bauzentrum
- AIT
- glas + rahmen
- wksb
- Fassade
- ARCONIS
- WTA Schriftenreihe
- WTA Journal
- WTA IZB
- RESTAURO
- ASHREA

# Lectures and Workshops

As far as we are concerned, an important task consists of the discussion of our research results in public lectures. We are involved in events like:

- Bauklimatische Symposien
- Weimarer Bauphysiktage
- Seminare für Baukonstruktion und Bauphysik
- WTA-Tagungen
- Techtextil
- Tagungen der Gesellschaft Deutscher Chemiker (GDCh)
- Feuchtetag
- Deutschen Stiftung Denkmalschutz

- Material Science and Restoration MSR
- Building Physics Conferences Europe
- International Building Simulation IBPSA
- Building Physics USA
- Shanghai International Symposium

Our aim is to amplify the acceptance of building physics and to grind their contexts. In co-operation with e.g. the WTA, VDI, “Haus der Technik” or the Architectural Association, we try to acquire and demonstrate the basics and trends of building physics involving the participants of these events and workshops.
Additionally, we organise special information- and education events like e.g. the “BBS-Day”.

# References

- Private builders
- Public builders
- State managements
- Banks
- Insurances

- Residential - and business-houses
- Department stores
- Museums
- Libraries
- School - and university-buildings
- Hospitals and Hospices
- Music-schools
- Concert-halls
- Musical-theaters
- Leisure baths
- Underground- and multi-storey parking garages
- Soccer stadiums
- Industrial plants

- Wayss & Freytag
- Bilfinger + Berger
- Müller- Altvatter
- Strabag
- Wiemer + Trachte
- Nileg

- Öffentliche Versicherung Braunschweig
- Nord/LB
- LBS

# References

- URSA International
- Transpac
- Knauf
- Knauf Marmorit
- Interpane
- Colfirmit Rajasil
- Haacke+Haacke
- Caplast
- Lafarge Braas
- BBA Nonwovens
- Icopal
- Weiß Chemie
- FSD
- I.TEC
- IDEAL Fibres & Fabrics
- Deutsche Pittsbourgh Corning
- Kleiberit

- LBS
- Öffentliche Versicherung Braunschweig

# References

LBS Hanover

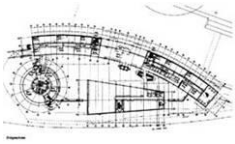


conversion the Mexico-Pavillion EXPO 2000

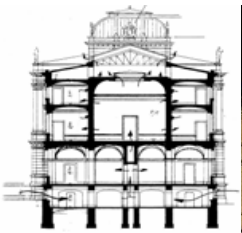
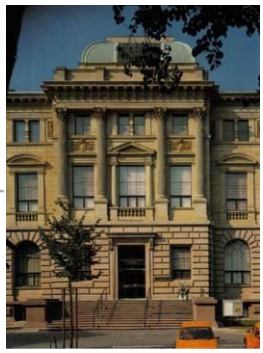


DVG Hanover


INMC-Telekom Frankfurt/Main



Herzog Anton Ulrich museum Braunschweig

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