Fraunhofer
IBP

FRAUNHOFER INSTITUTE FOR BUILDING PHYSICS IBP

MEASURING AND TESTING FACILITIES

BUILDING PHYSICS TESTING

Fraunhofer IBP is focused on research, development and testing in all fields of building physics. Based on the competence of more than 350 scientists, engineers and technicians numerous outstanding testing resources and measuring instruments are available. Knowledge, experience and creativity can be offered as the keys to innovative products and sustainable quality of buildings. Tailored laboratories and software tools are available in the following departments:

- » **ACOUSTICS**
- » **BUILDING CHEMISTRY, BUILDING BIOLOGY, HYGIENE**
- » **ENERGY SYSTEMS**
- » **HEAT TECHNOLOGY, LIGHTING TECHNOLOGY**
- » **HYGROTHERMICS**
- » **INDOOR CLIMATE**
- » **LIFE CYCLE ENGINEERING**

We carry out complex building physics studies at our efficient and well-equipped laboratories and test centers and at our outdoor testing site in Holzkirchen, which to the best of our knowledge is the largest facility of its kind. Modern laboratory measuring techniques and computational methods help researchers develop and optimize building products for practical applications. We also carry out experiments in environmental test chambers, simulation facilities and existing buildings to assess components and overall systems for new buildings and renovation projects based on the principles of building physics.

Fraunhofer IBP has been approved by the German building inspection authorities as a testing, monitoring and certification center for building materials and building techniques in Germany and the rest of Europe. Four of the institute's test laboratories have been granted flexible accreditation by the German accreditation body Deutsche Akkreditierungsstelle GmbH (DAkkS) in accordance with DIN EN ISO/IEC 17025. This entitles them to develop new test methods and to modify existing methods.

How to use this digest

The easiest way to find the right laboratory or facility is to use the keyword register, which is organized in three different ways:

Measurements in laboratories (type of measurement or quantity to be measured)
Measurement objects (or part of a building etc. to be measured)
DIN **Standards** (DIN, EN, ISO, VDI, etc.)

For technical reasons, the departments are listed following the given alphabetical order of the German department names.

MEASURING AND TESTING FACILITIES – AN OVERVIEW

HEAT TECHNOLOGY, LIGHTING TECHNOLOGY

MEASUREMENT AND TEST RANGE

HEAT TECHNOLOGY, LIGHTING TECHNOLOGY

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“IN-SITU” MEASUREMENT OF PHOTOMETRIC CHARACTER-ISTICS OF STREET PAVEMENT

Measurement	Reflection characteristic of street pavement: Level of mirroring S, mirroring factor κ_P and luminance coefficients q_0, q_d thereby classification of the R class and C class
Standards	DIN EN 13201, CIE 144:2001
Measurement object	Measurement of street pavement layers on site

TECHNICAL DATA

Light source	Actively controllable luminance screen to provide the necessary diffuse and direct light components
Sensor system	Luminance meter grade A
Measuring angle	Measuring the street pavement at 1° and 2.29°

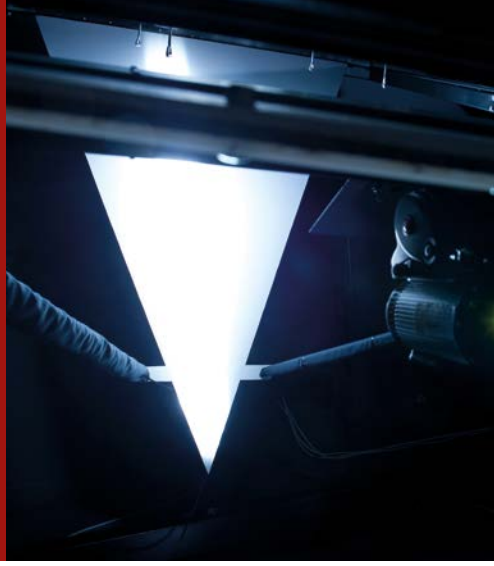
SPECIAL FEATURES

On-site measurement	On-site measurement of built in street pavement avoiding core abstractions and artificial aging of samples
Time-efficient measurement	Compact, lightweight device Automatic control of the measurement

MORE INFORMATION

IBP Research News 36 (2009), Nr. 494

LIGHT TRANSMISSION AND REFLECTION OF FAÇADES



Measurement	Directed-directional light transmission and light reflectance (luminance coefficients, BRTDF), directional-hemispherical light transmittance and reflectance
Standards	DIN EN 410, DIN EN 13363, DIN EN 14500, DIN EN 14501, DIN V 18599-4
Measurement object	Glass, Complex Fenestration Systems (CFS) like functional glass types (e.g. printed glass, glass for light control), blinds, textile sun protection, glass-sun protection composites, systems for skylights

TECHNICAL DATA

Light source	D65 spectrum, opening angle 0.34° Exposure to sample: elevation angle of 0° up to 84° Azimuth angle: 0 to 360°
Sensor system	Spatially resolved measurements by luminance camera (2°) Monochromatic, 3 color channels, circadian action spectrum c(λ)
Sample size (L × W × H)	1.23 × 1.48 × 0.30 m

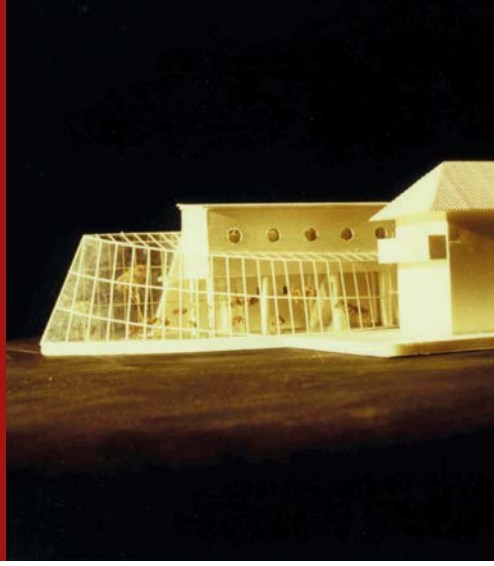
SPECIAL FEATURES

Automatic sample positioning	Highly automated measuring device. Inter alia louvre angle of blinds can be set automatically.
Further use of the data in planning	Software-based data analysis. The recorded data may inter alia directly be used in light simulation programs such as DIALux to evaluate the façades photometrically and energetically.

MORE INFORMATION

IBP Research News 36 (2009), Nr. 499

ARTIFICIAL SUN FOR DAY-LIGHTING EVALUATION OF BUILDING MODELS



Measurement	Exposition and shading studies of buildings and settlement models, daylight system evaluation and optimization
Standard	DIN 5034
Measurement object	Models of buildings or settlements

TECHNICAL DATA

Light source	85 halogen spotlights
Model table	Diameter 1.20 m; distance to specimen 6 m, gimbal mounted

SPECIAL FEATURES

Direct radiation	Narrow beam of lamps and filtering with honeycomb material lead to an almost parallel insolation on the model table (2° angle).
Automatic control	Software-based control of the relative angle of the model to the artificial sun to set any positions of the sun and diurnal cycles

MORE INFORMATION

IBP Research News 20 (1993), Nr. 237

ARTIFICIAL SKY FOR DAY-LIGHTING EVALUATION OF BUILDING MODELS

Measurement	Illuminance distributions in building models, daylight factor measurement according to DIN 5034, daylight system evaluation and optimization
Standard	DIN 5034
Measurement object	Models of buildings

TECHNICAL DATA

Light source	85 hemispherically over a model plane placed halogen lamps with 38° beam angle
Measurement	Illuminance in the interior of models and outside the model with miniature photometers. From this e.g. determination of the daylight factor

SPECIAL FEATURE

Desired luminance distributions	All spotlights are individually dimmable, so that different luminance distributions of the covered and clear sky can be set.

MORE INFORMATION

IBP Research News 20 (1993), Nr. 237

ARTIFICIAL WINDOW FOR A DETAILED ANALYSIS OF DAYLIGHT CONDITIONS

Measurement	Weather-independent investigation of daylight conditions in interior spaces, precisely controllable interaction between artificial and natural light for studies on user behavior and performance (e.g. at computer workstations), focused studies of light management systems such as daylight-responsive light control, specific tests of sun and glare protection systems under controlled conditions, studies on novel approaches such as artificial windows
Measurement object	Test group studies, computer workstations, light management systems, sun and glare protection systems, novel approaches such as artificial windows

TECHNICAL DATA

Light field	108 spotlights on 3 × 4 m, mobile in front of façade
Lamp power	30 kW in total, fully dimmable, electronically and by mechanical shutter
Direct light	Altitude angle: 0° to 60° Façade azimuth: –60° to +60°
Diffuse light	Luminance up to 10 000 cd/m²
Color temperature	2500 K to 9300 K

SPECIAL FEATURES

View out	Interchangeable scene foil
Light scenes	Computer-controlled, for example daily and annual cycles, alternating between direct and diffuse light. Variable luminance distributions on the façade
Connected laboratory	Highly flexible artificial lighting system with daylight-dependent light management. Integration into laboratory concept which makes integral indoor climate, lighting and acoustic investigations possible

LIGHT LABORATORIES FOR EXPERIMENTAL STUDIES ON THE PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF LIGHT

Measurement	Performance and user acceptance studies on the physiological and psychological effects of light, testing new lighting concepts, such as context-sensitive lighting, integral investigations of indoor climate, lighting and acoustics
Measurement object	Test group studies, computer workstations, light management systems, lighting systems

TECHNICAL DATA

Lighting system	Efficient LED lighting of the entire room, subdivided into several separately controllable zones Algorithm-supported choice of the color point or color of light taking the color rendering into account
Illuminance	Up to 2000 lux, directly and indirectly
Color of light	RGB saturated colors or white from 2000 K to over 15,000 K, CRI 90 at white light

SPECIAL FEATURES

Light control	Real-time consideration of numerous user-related factors (position in space, direction of view, activity, age, preferences) and environmental variables (daylight, time of day)
Interfaces	PC software for lighting control, as well as gesture and voice control. Sensors for the detection of selected user-related factors.
Conditioning of laboratory	Embedded in a laboratory concept which enables researchers to perform integral investigations of indoor climate, lighting and acoustics.

VIRTUAL WINDOW FOR WINDOWLESS INTERIORS

Measurement	Psychological studies on the effect of light in windowless environments
Measurement object	Test group studies (e.g. performance tests)

TECHNICAL DATA

Size	3 screens, each with 165 cm (65”) diagonal
Resolution	3240 pixel × 1920 pixel
Brightness	Up to 500 cd/m²
Mappable viewing angle	160°
Footage	Motifs with 15 447 pixel × 9154 pixel, any images and videos
Position tracking	IR depth image sensor, capturing the viewpoint and the view direction relative to the virtual window

SPECIAL FEATURES

Image projection	Automatic adjustment of the image, taking the viewpoint and view direction into account
Twin rooms	Next to the room with virtual window is a identical twin room, but with a real window. By directly uploading the outside world to the virtual window real and virtual situations can be directly compared with each other.

EYE TRACKING GLASSES FOR AN ANALYSIS OF VISUAL BEHAVIOR

Measurement	Binocular eye tracking data, capturing the eye movements to study cognitive and decision making factors
Measurement object	Consumer behavior, social interactions

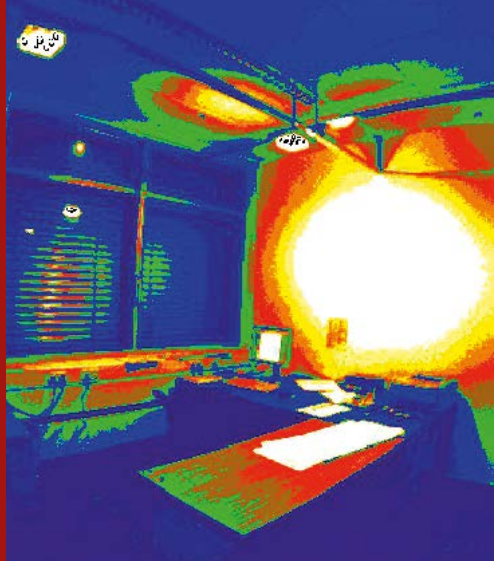
TECHNICAL DATA

Eye tracking principle	Binocular eye tracking with automatic parallax compensation
Temporal resolution	60 Hz
Gaze tracking range	80° horizontal, 60° vertical
HD scene camera	Resolution: 1280 pixel × 960 pixel at 24 frames per second (fps); 960 pixel × 720 pixel at 30 fps, video format: H.264, field of view: 60° horizontal, 46° vertical
Human interface design	Noninvasive video-based glasses-type eye tracker
Gaze position accuracy	0,5° over all distances, parallax compensation

SPECIAL FEATURES

Eyewear compatibility	Works with contact lenses
Audio	Integrated microphone
Real-time capturing	Online scene video with gaze position, pupil diameter/position, tracking status, eye image online interfacing via SDK
Calibration	Instant calibration with fully mobile use
Analysis	Quantification and visualization of eye tracking data using specific software

LUMINANCE MEASURING CAMERA FOR A SPATIALLY RESOLVED ANALYSIS OF LUMINANCE DISTRIBUTIONS



Measurement	Spatial luminance distribution of indoor and outdoor environments, photometric image analysis
Standard	DIN 5032
Measurement object	Luminous and illuminated surfaces covering a wide range of visual environments from VDT to daylight situations

TECHNICAL DATA

Camera	1.4 megapixel CCD detector, photopic spectral correction
Typical luminance range	0.015 to 50,000 cd/m² (with filter up to 5×10^9 cd/m²)
Lenses	Wide angle, fish eye

SPECIAL FEATURES

Filter	Neutral density filter with transmission of 1 and 0.01 % to raise the maximum measurable luminance
Analysis	Using the software luminance values can be measured over a series of measuring points or as complete surfaces.

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