

Construction Management

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**Infrastructure and Engineered Structures
Lisbon, November 13th, 2008**



Construction Management.

Test Specification: DIN 1076.

- In order to assess the condition of an engineering construction, in particular its stability under load, its traffic safety and its durability, DIN 1076 specifies:
 - Regular construction inspections:
Alternately every three years, a simple inspection and a main inspection, plus
 - Inspections after:
 - major storms,
 - flood situations,
 - severe traffic accidents and
 - other events which have an influence on the condition of the construction components.



Construction Management. Engineering constructions according to DIN 1076.

- Engineering constructions are:
 - Bridges over 2.00 m clear span
 - Culverts over 2.00 m diameter
 - Tunnels
 - Supporting walls
 - Noise barriers
 - Overhead sign gantries
 - Traffic control systems
 - Exit-and-entry trough structures
 - Rain retention reservoirs, settling tanks etc.
 - Special constructions
(e.g. radio and television towers,
dams)



Construction Management.

Components to be inspected according to DIN 1076.

- Components to be inspected are:
 - Foundations
 - Massive construction components
 - Steel and other metal constructions
 - Timber constructions
 - Bearings, transition constructions and articulated joints
 - Seals, carriageways and drainage
 - Wall and ceiling claddings, protective devices
 - Corrosion protection
 - Supply pipes and cables



Construction Management. **Construction Book according to DIN 1076.**

- The Construction Book contains:
 - the position and main dimensions of the construction
 - the construction materials used
 - the statics system
 - the construction class, if applicable
 - a list of inspections and maintenance measures carried out
- The Construction Book is updated by the Inspector.



Construction Management. **Documentation of test results.**

- Writing of test reports and updating of the Construction Book using the software SIB-Bauwerke, developed by the Federal Ministry for Construction, Transport and Urban Development.
- We provide you with the documents and/or data in paper and digital form.
- You do not need an additional software license, as Acrobat Reader is sufficient for viewing the documents.



Structural Diagnosis of Bridges



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Infrastructure and Engineered Structures
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TÜV Rheinland Industrie Service GmbH



Structural diagnostics.

- Complete range of non-destructive testing and measurement services for the monitoring of structures and equipment
- Experts in the fields of
 - Monitoring/automated continuous monitoring
 - Non-destructive testing (NDT)
 - Vibrations
 - 3-D measurementconsultation, measurement and analysis of results
- Objective:
 - Greater safety during the period of use
 - Full utilisation of the service life of structures
 - Reduced upkeep and maintenance costs



Services.

Structural monitoring/
Automated continuous
monitoring

- Pre-stressed concrete monitoring
- Crack monitoring
- Rail monitoring
- Hall monitoring
- Weighing of heavy loads

Vibration engineering

- Shock protection
- Vibration analysis

Non-destructive testing

- NDT construction
- NDT geotechnology
- Pile tests

Measurement

- Monument scanning
- Isometrics



Structural monitoring.

What are the cumulative effects caused by

ageing and
damage?



change of
utilisation?



unforeseen
loading?



environmental
conditions?



Monitoring can be used for early identification of load-related or damage related changes in structural components:

- Continuous recording of dynamic influences and slow changes with high sensitivity
- Robust measurement technology for many years of operation
- Automatic routines to record special events and trigger alarms
- Clear, comprehensible data management (e.g. internet access)

Application areas:

Bridges

Historical structures

Railways
(track systems)

Halls

Industrial facilities

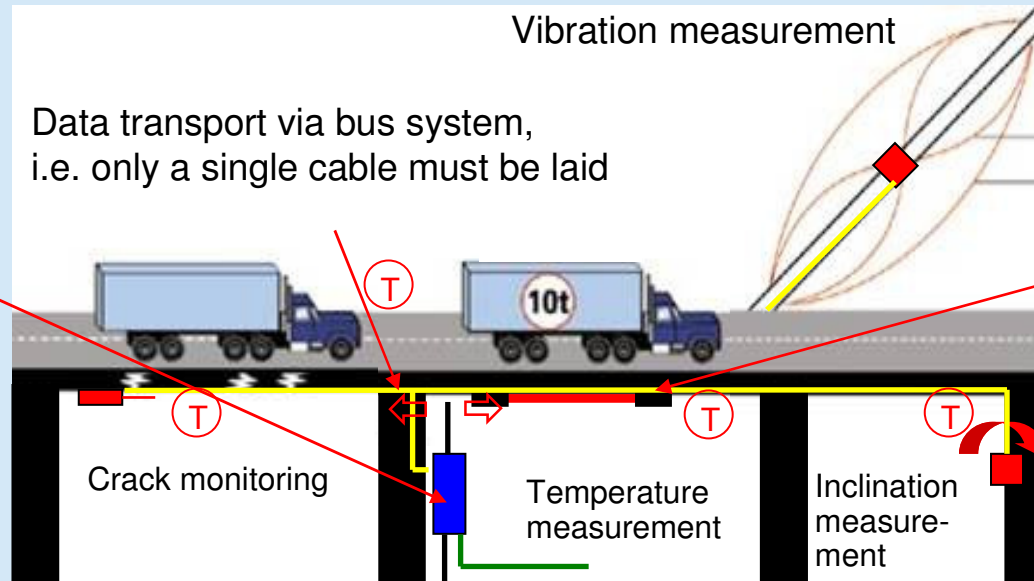


Structural monitoring.

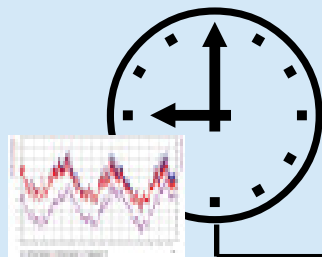
Basic approach.



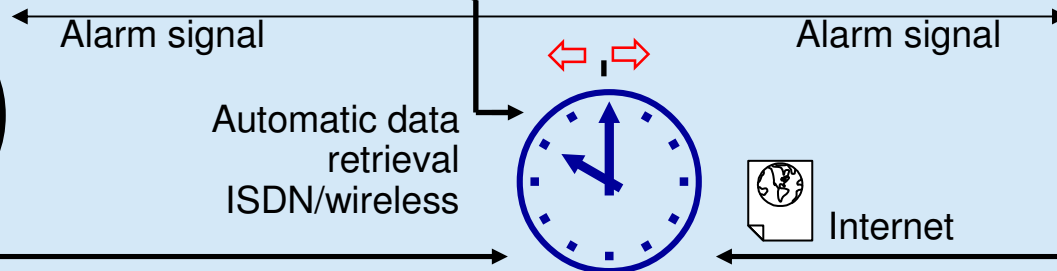
Data recording (~1Hz.5kHz), data processing, communication



Integral strain measurement



Data analysis TÜV/LGA



Central database server



Data visualisation client

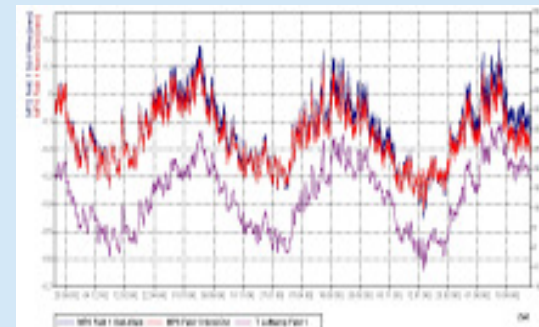
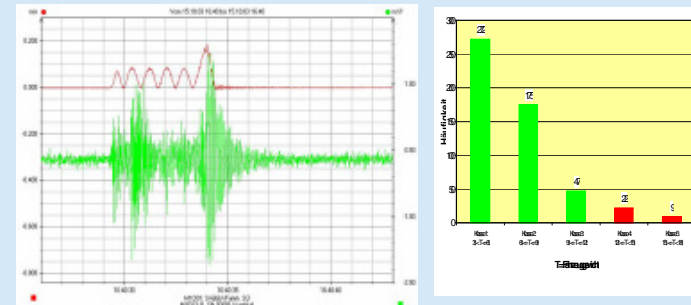
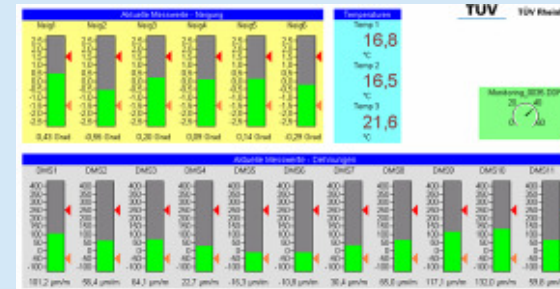


Structural monitoring. Data analysis.

- Momentary status assessment
 - Status evaluation for each measurement point
 - Limit value exceeded?

- Analysis of transient stresses
 - Amplitude of the event (e.g. weight)
 - Reversibility of the stress
 - Vibration characteristics
 - Statistics (weighting, counting, classification)

- Analysis of long-term behaviour
 - Correlation with temperature behaviour
 - Characteristic load-bearing behaviour
 - Trends in response to changes
 - Identification of reduced load-bearing capacity



Structural monitoring. Service package.

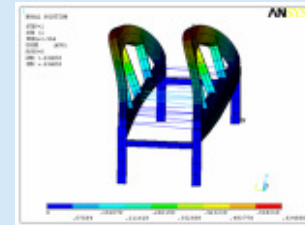
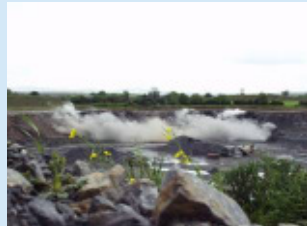
- Preparation of a monitoring concept
 - Review of documentation and on-site visit for inspection of structure
 - Modelling and damage analysis for the definition of measurement points and limit values (possible further studies, e.g. calculation, materials testing)
 - Monitoring concept (what means should be employed to achieve the goal)
- Provision of measurement technology
 - Procurement and testing of the technology
 - Installation, start-up and maintenance during the monitoring period
 - Installation report
- Monitoring
 - Continuous monitoring and evaluation of the data
 - Transmission of alarms when critical events occur
 - Documentation of events in measurement logs and annual reports
 - Data access via Internet



Vibration engineering:

Range of services and application areas.

- Prognosis of shocks in permit applications or for the estimation of construction processes
- Prognosis of vibrations for damage prevention in machinery
- Analysis and simulation of vibrations in case of damage
- Measurements for documentary proof: assessment of shocks in the neighbouring building development (immission control) according to DIN 4150
- Vibration measurements (transient or continuous) for the determination of amplitudes, natural frequencies, natural modes and resonance frequencies
- Measurements for the assessment of shocks at workplaces
- Determination of shock and vibration reduction measures



Ultrasound: Principle and application areas.

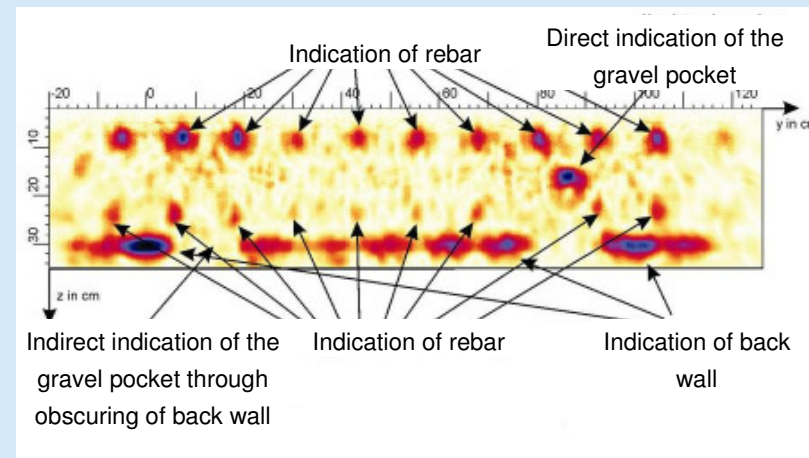
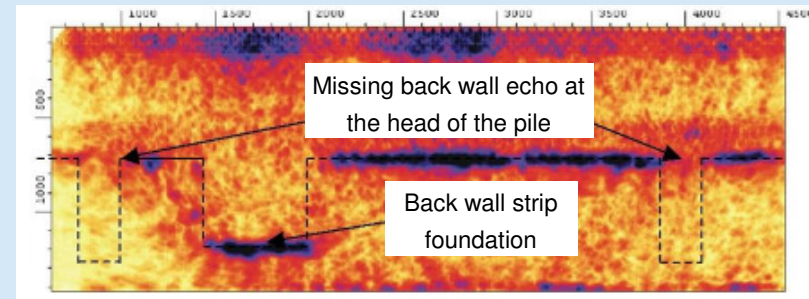
Reflection of sound waves on material homogeneities and boundary surfaces (voids, back wall of component)


Determination of component dimensions

- Even thickness and foundations
- Position of invisible recesses

Location of damage

- Voids
- Compaction defects (gravel pockets)
- Delaminating, cracks parallel to surfaces



Cooperation with  **BAM**

Impact-echo:

Principle and application areas.

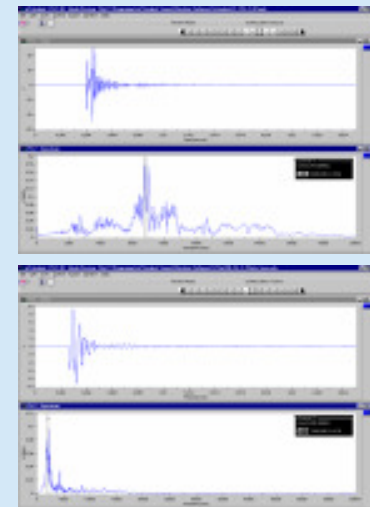
Reflection of sound waves of a wave front (mechanical impact) on boundary surfaces or voids in concrete components, natural stone and masonry

Determination of component dimensions

- Thickness of components that can only be accessed from one side

Location and analysis of damage

- Cavities or voids (cracks, material inhomogenities)
- Layer transitions
- Delaminating

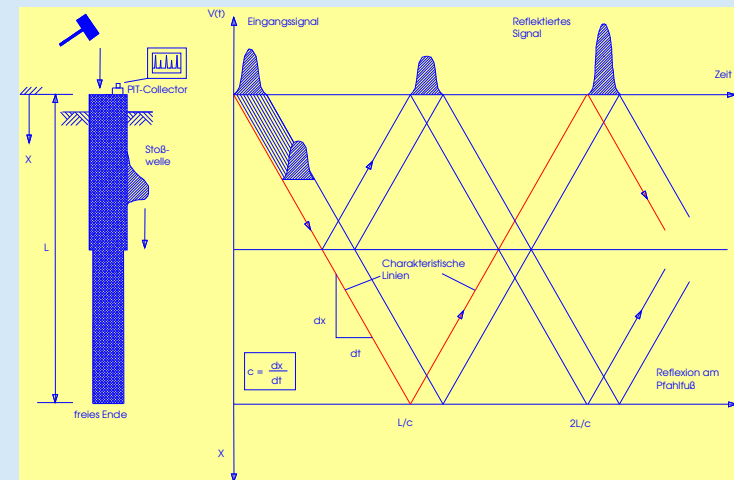


Pile testing: Principle and application areas.

Pile integrity testing, in which an impact is generated on the head of the pile, which is then reflected on the foot of the pile.
Characteristic changes in quality are recognised as changes in the measurement signal (low-strain process).



- Confirmation of the proper production of piles
- Determination of pile dimensions Identification of voids



Radar:

Principle and application areas.

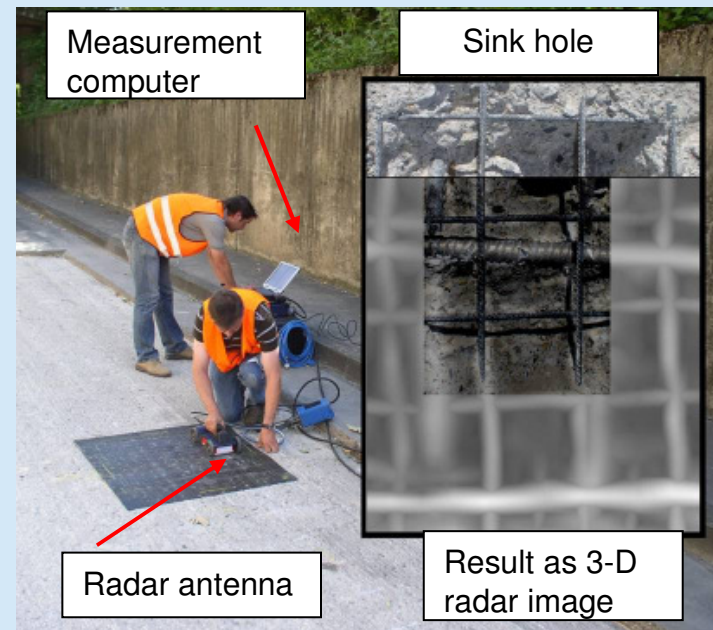
Location of discontinuities (layer boundaries, voids, components) by means of reflection of electromagnetic waves (period and amplitude) in concrete, masonry and wood.

Determination of component dimensions

- Position of rebar, pre-stressing tendons
- Position of built-in components (anchors, dowels, etc.)
- Position of cable ducts and pipelines
- Thickness of layers along traffic routes

Location of damage

- Cracks and delaminating
- Cavities
- Distribution of moisture and salts




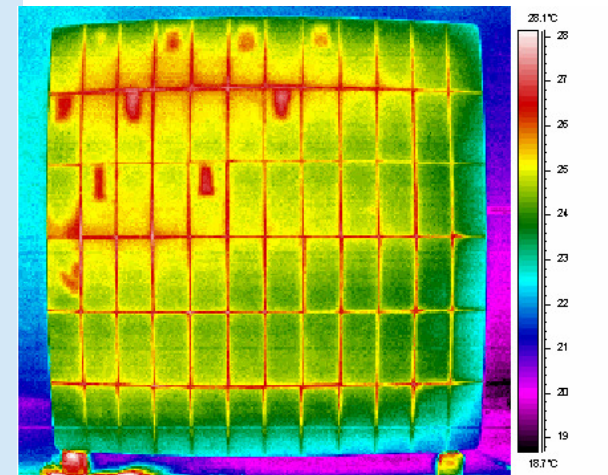
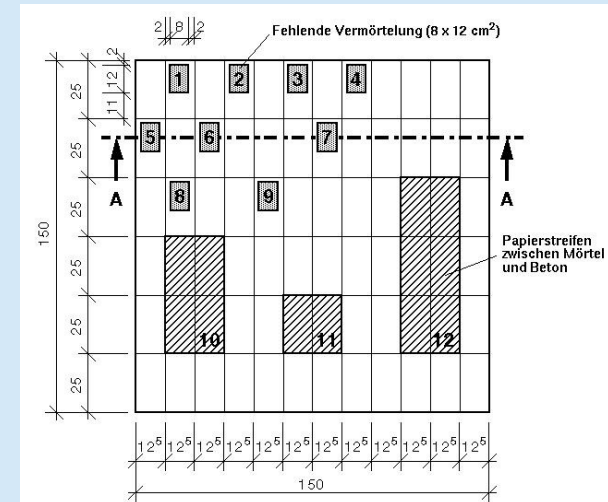
Impulse thermography: Principle and application areas.

Recording of inhomogeneities near the surface (10 cm) through observation of the cooling behaviour of a specifically heated component. Discontinuities cause a heat build-up or an accelerated heat loss.

Location of damage and components

- Location of rebar in the concrete
- Location of cavities and gravel pockets in concrete
- Location of voids and delaminating (e.g. CRP laminates on concrete)
- Localisation of masonry and joints under plaster
- Location of areas with elevated moisture levels

Cooperation with  **BAM**



3-D laser scanning: Range of services.

- Surveying of structure surfaces in the absence of layout documentation
- Mapping of damage
- Representation of structural segments
- Determination of tolerances
- Representation of piping isometrics
- Surface measurements for the recording of changes, e.g. with dams



Structural diagnostics: References.

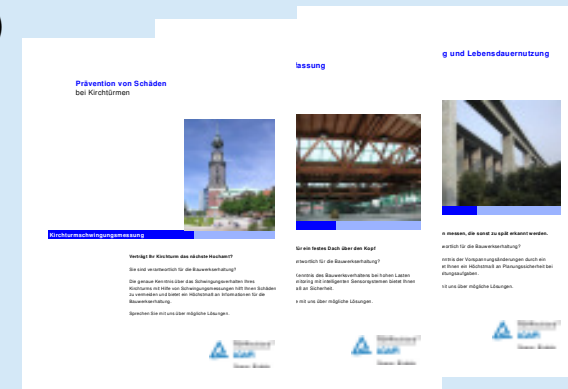
A total of over 1,000 studies and measurement series worldwide, including approx. 100 structures during monitoring (including approx. 40 bridges)

Clients

- State governments
(Thuringia, Rhineland-Palatinate, South Bavaria highway department)
- Regional government offices (Stuttgart)
- Municipalities (Munich, Hamburg, Nuremberg, Ulm, Cologne, Mülheim, ...)
- Cathedral master builders in Augsburg, Passau, Aachen, Bamberg, ...)
- Construction companies (Hochtief, Züblin, ...)
- Industrial clients (RWE, Vattenfall, VW, Bremen Ports ...)
- DB Netz AG (German train company)
- Navigation authorities

Further information

- Product brochures
- Reference lists and reference presentations
- Price list



Thank you for your attention.

