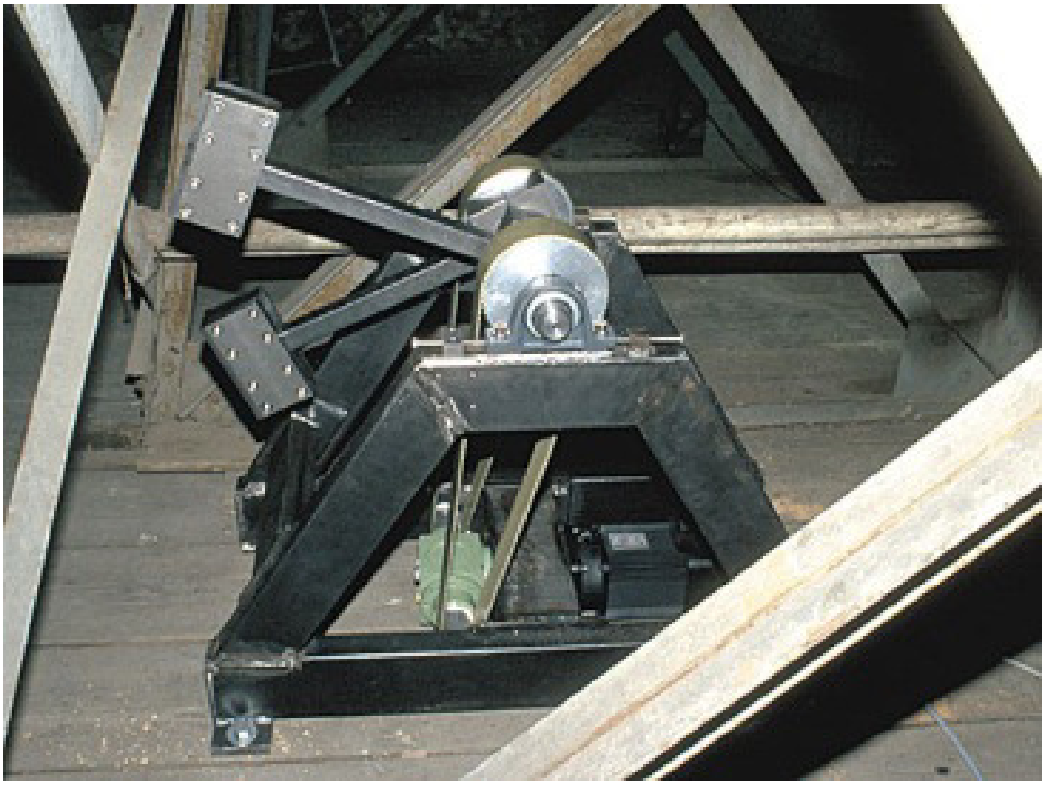
How can one know how buildings & structural cracks will react to vibrations?

Application Note ►Civil Engineering ►Maintenance



For the firm *Ingenieurgruppe Bauen*, headquartered in Mannheim, Germany, we have integrated two **standard elements** (measurement devices and evaluation software) into an overall solution to achieve the goal of automated vibration analysis in buildings and structures.

We were able to provide the solution quickly and inexpensively using our in-house software framework.

How did we proceed to fulfill the request?

The implementation included the following steps:

1. Qualification of the assignment
2. Design of the overall solution
3. Selection of software and measurement system
4. Development of customer-specific software
5. Integration of the overall solution

This application note provides some of the details about how we accomplished some of these steps. For further information, our experts will gladly answer any questions you may have. Please see the contact information on the last page.

Background

Ingenieurgruppe Bauen, headquartered in Mannheim, Germany specializes in construction planning tasks involving above ground, underground and hydraulic structural engineering, as well as conducting dynamic examinations of these structures. They have been using measurement systems from imc since 1998.

Why are dynamic tests carried out? They are carried out because structures can vibrate due to various influences. On bridges and ceiling structures, these vibrations can be triggered by people, cars or machinery. Belfries, however, are exposed to strong dynamic loads coming from ringing bells and high or maintained winds.

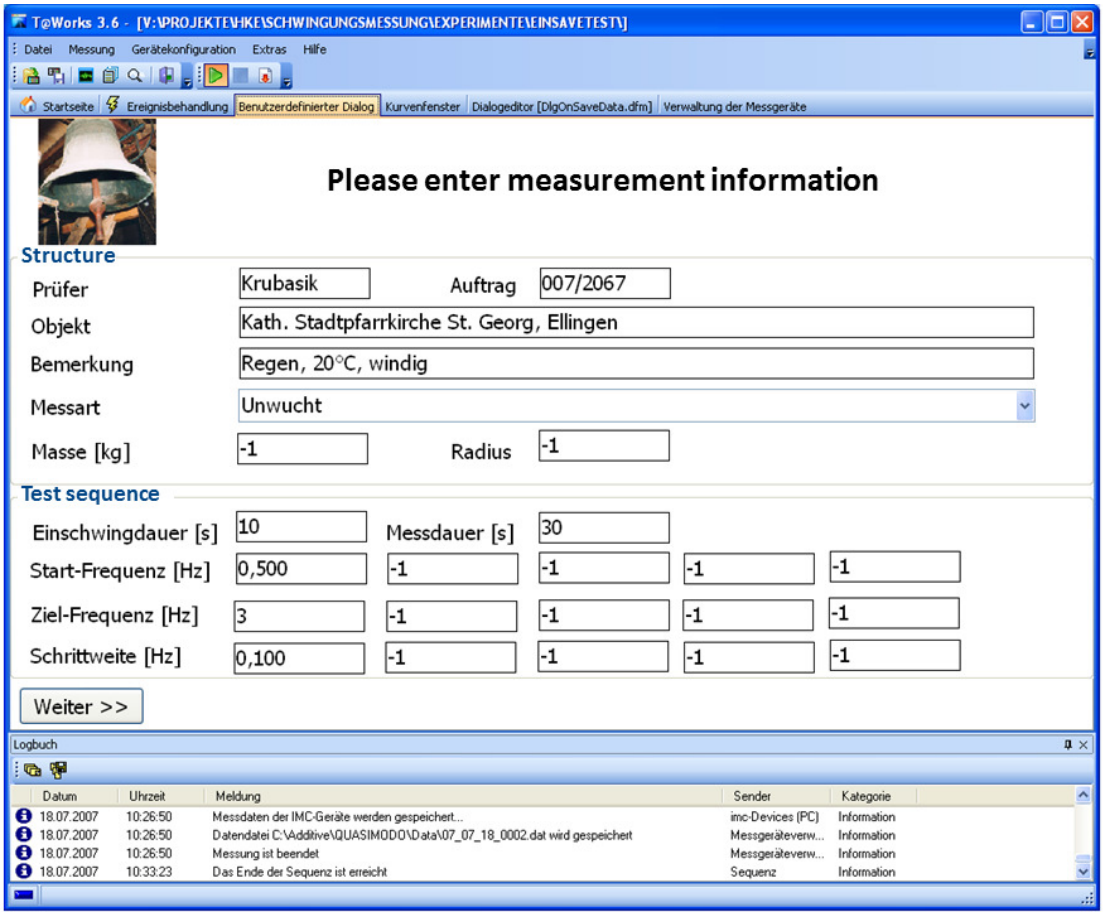
Bell positioned in belfry

Thus, for a realistic detection of vibrations and calculating structural vulnerability, vibration measurements are essential (e.g., before installing a new bell in a belfry). Important results of these measurements yield not only the natural frequencies and vibrational amplitude pertaining to the structure, but also the behavior of existing cracks. Based on the test results, it is possible to make conclusions as to the stability of the structure. Any necessary restorations or modifications can then be designed and incorporated into the structure.

Qualification and conception

Exact analysis of the task led us to the conclusion that controlling the unbalance exciter, as well as acquisition and evaluation of measurement data could all be carried out using standard devices and software from imc. However, the operation and the desired level of automation and visualization of the measurement results required custom software integration to provide the total solution.
For control and measurement, a standard imc measurement system was chosen, which has an integrated digital signal processor (DSP).

Customized software



Software graphical user interface

We developed the solution using our own software framework. This allowed us to develop the software quickly and inexpensively.
The testing software has its own user interface, allowing users to enter test information, select measurement signals and define the test sequence.
The software controls the unbalance exciter, takes over the complete testing sequence and allows for a completely automated vibration analysis via integration/connection to the standard analysis software. In addition, the data can be visualized within the software.

Test sequence

With the aid of an unbalance exciter, the entire structure can be excited to a defined frequency. Highly sensitive vibration sensors then detect system responses of the examined structure in three axes. In addition to vibration signals, measurement signals from structural cracks (displacement) and from the bell (angular position) can be detected.

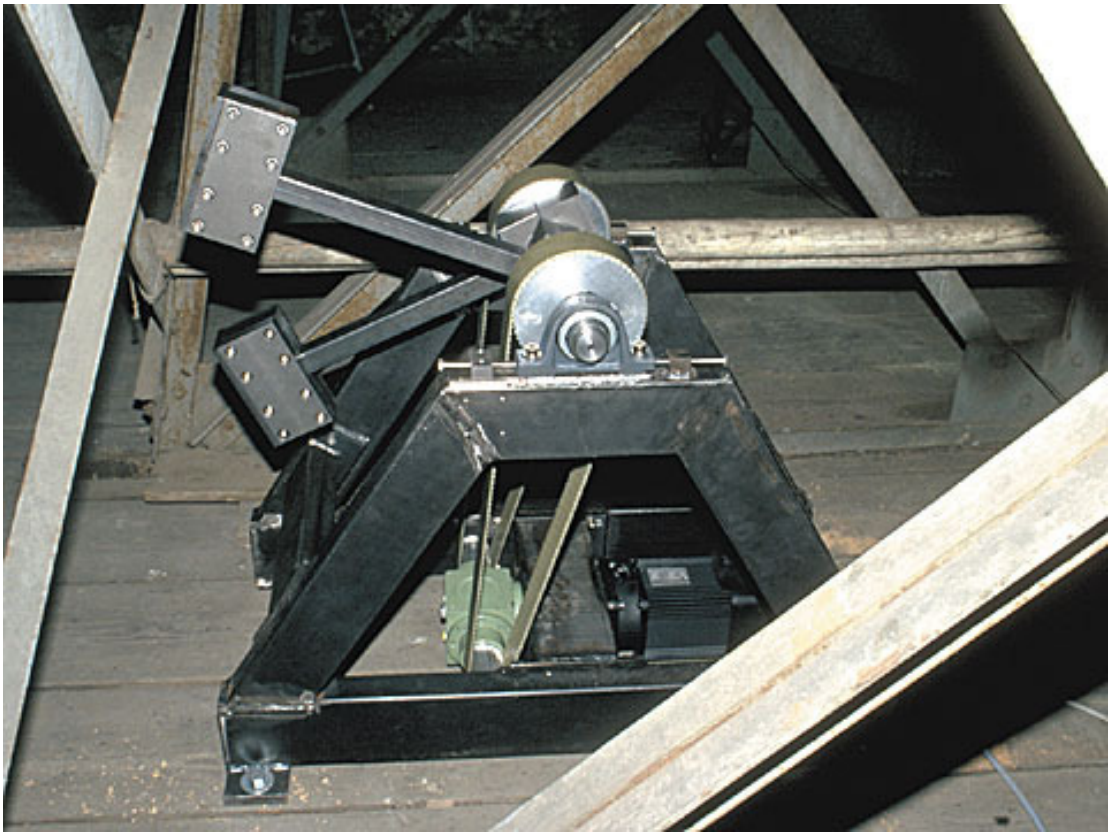


Image of the unbalance exciter

Data acquisition and control of the unbalance exciter are accomplished by the imc measurement device. The test sequence is executed by the DSP (Digital Signal Processor) within the device. Entering of structure information, selecting the measurement signals, defining the test sequence and online data visualization are taken care of using the customer-specific software and the measurement results are analyzed using the linked, imc standard-analysis software.

Conclusion

By integrating standard elements based on our own software framework, a complete solution for structural vibration analysis could be created quickly, efficiently and inexpensively.

Implementation

Acquired values

- Vibration signals
- Measurement signals from structural cracks (displacement)
- Measurement signals from the bell (angular)

Technical details

Measurement system:

- Modular imc measurement system with integrated DSP (Digital Signal Processor)
- Vibration sensors

Software:

- Software solution based on the software framework T@Works
- Integrated/connected analysis software imc FAMOS

Software properties

- GUI for entering structure and test information, selecting the measurement signals, defining the test sequence and data visualization
- Control of the unbalance exciter, execution of test sequence and automated vibration analysis

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