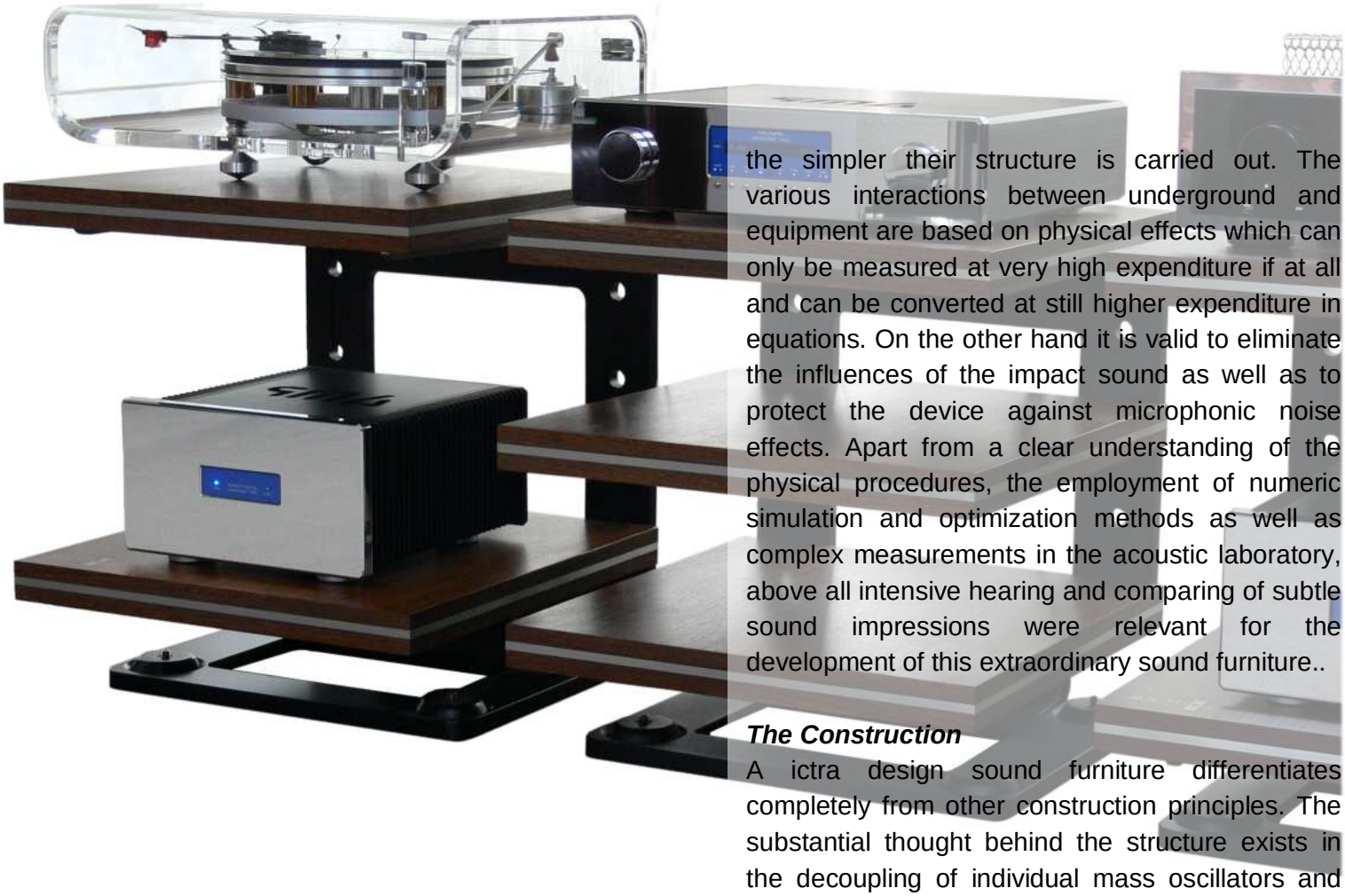
ictra design Sound Furniture – Research on the Base



Perfection is the idea. Perfection into the smallest detail. Perfection in construction, form and function.

Almost thirty years of experience of an Engineering team in handling with construction materials and the most modern development methods paired with enthusiasm for music and Hi-Fi lovers, have led, after years of intensive work to a product which as a sound furniture offers the best possible requirements for working as well as offering the highest aesthetic standards. Long before the onset of the ictra design furniture, the ictra developers made a decisive observation but the connection wasn't really clear till much later. On the one hand the location of a Hi-Fi component determines the quality of the music reproduction considerably. This factor is widely known today and accepted by all music enthusiasts. It is all more clearly ascertainable, the higher the quality and often also the simpler their structure is carried out. The various interactions between underground and equipment are based on physical effects which can only be measured at very high expenditure if at all and can be converted at still higher expenditure in equations. On the other hand it is valid to eliminate the influences of the impact sound as well as to protect the device against microphonic noise effects. Apart from a clear understanding of the physical procedures, the employment of numeric simulation and optimization methods as well as complex measurements in the acoustic laboratory, above all intensive hearing and comparing of subtle sound impressions were relevant for the development of this extraordinary sound furniture..

The Construction

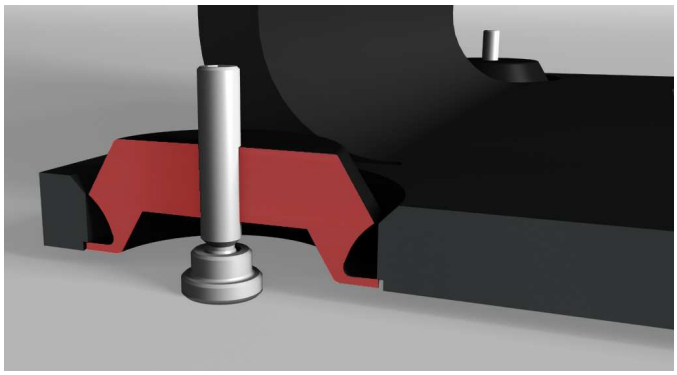
A ictra design sound furniture differentiates completely from other construction principles. The substantial thought behind the structure exists in the decoupling of individual mass oscillators and the avoidance of mutual influences. Each piece of equipment in the chain of a hi-fi equipment, as well as each component of the underbody (i.e. a hi-fi rack) provides, with appropriate stimulation, for a vibrating mass. Usually all devices are placed next to each other into a piece of furniture, whereby mechanical interactions are inevitable. The ictra design concept begins with separate sound furnishings, which permit separate placements of different types of devices. Thus a record player can be set up and operated perfectly in an isolated manner from components which react sensitively to microphonic noise effects. The concept is based on a sub-chassis construction and plans a complete decoupling in relation to impact sound, without however having to forego the advantages of a tonally balanced underground. The different elements of the structure, whose interactions as well as the mechanical production process were simulated and iterative optimized by means of the finite element method (FEM).

The Base Element

The base element of the sound furniture consists of a 20 mm thick, cold transformed steel plate of high mass, which, after its mechanical treatment is submitted to a heat treatment process, through which the tensions caused by the forming are almost completely eliminated.

The arrangement of the geometry on the base element ensues an optimized shaping in regard to a natural frequency and answer frequency. At the bottom of the base element there are four guide rails with vibration dampers. These dampers were specially heat treated in order to adjust load deflection and damping ratio. The height adjustment results from the integrated thread bolt which is secured by additional vibration dampers against partial oscillation and rotation. Each of this thread bolts stands with its half spherical head in a pan of hardened steel which minimizes defined coupling to the underground and recognizes possible indentation to sensitive flooring To adjust the level of the base element exactly there is a special water level in the lower front crossbar.

The vertical back side of the base element is equipped with two parallel drilling rows that can take up to a maximum of three floor supports per base element and locks due to a longitudinal groove against twisting. The distance between the vertical drillings are 100 mm through which an individual height adjustment is made possible.



Damper Cross Section

ictra design Base Element with Dampers

The Shelf Support

Each shelf lies on a separate shelf support. This shelf support provides a three point storage that are accurately adjustable in the height by means of two solid carriers made out of austenitic high-grade steel and a resonance- optimized coupler plate out of Aluminium. Respectively on the outside ends of the two carriers as well as in the center of the coupler plate there are vibration damper screws that couple over a semispherical outer contour on the above lying shelf out of 40 mm bamboo-composite material. The shelf support is pushed onto the back side with two bolt shape milled and with two provided fine screw thread ends, into the vertical rear of the base element and bolted firmly with two palm sized nuts, made of stainless steel as well as two discs out of PTFE. Due to the positive connection and the high torque moment of the nuts, the shelf is pulled into the grooved seat of the base element.

The screwed in adjusting screw in the shelf, as well as the already mentioned thread bolts on the vibration damper of the base element are provided with integrated inlays out of dampening plastic. The adjusting screws grip on the top side in funnel shaped centering discs, which are glued defined flexibly on the bottom of the shelf. Due to the self-centering of the adjustment screws and centering disc an extremely accurate positioning of the shelf support to the shelf is possible, which relatively avoids movement and thus oscillations additionally. The shelf snaps into its end position, positions the adjustment screws in vertical direction and thereby makes high loads on the shelf possible.

Through the chosen sub– chassis structure, through coupling and uncoupling of individual ranges and by means of selective contribution of density transitions between various materials as well as high relative masses and the mutual uncoupling of the Hi-Fi devices, an almost complete isolation is reached in relation to air and sound excitation.

The Shelf

The shelf represents a special challenge in the context of the development. Due to the reaming at the bottom of the shelf, into which, the shelf support almost emerges completely, the vibration response is first affected unfavorably. As a counter measure by means of numeric calculations the physical characteristics of a solid, metallic framework are laid out as oscillation damper along the outside edge of the board. The oscillation damper on the one hand increases the initial state of very high mass on the base board, on the other hand he promotes the influencing control on the natural frequency as well as the mass distribution. A meaningful combination of board and framework can only be ensued by a selective raw material of the board. That means no other material is suitable. The application of individually selected oscillation dampers as used in grown wood is therefore dispensable. Due to the resonance behavior of the board structure external influences such as air humidity and temperature have little or no effect on

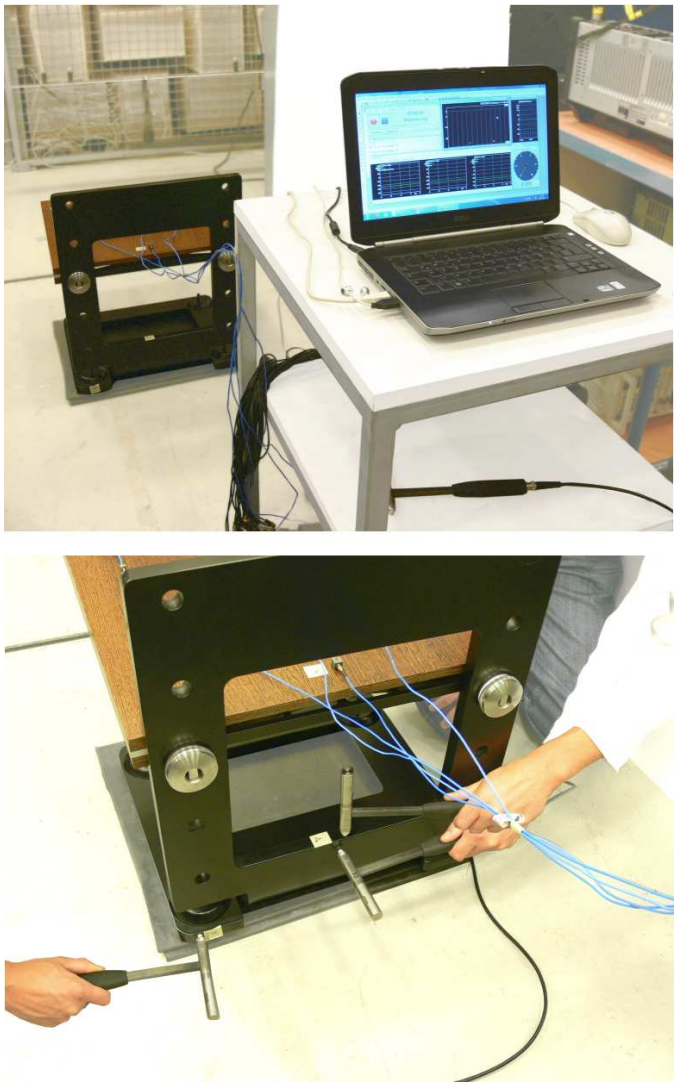
Shelf Support with Three Point Storage

Detail:
Centering Disc

the resonance behavior of the board structure.

The development of the board first began with intensive hearing tests. A variety of materials were initially examined on an isolated sub frame by testing the impression of the sound on its reciprocal effect between resonance and its effect on tonal differences. Only the knowledge gained in this way made it possible for a meaningful selection of the board materials as well as a structural design of the dimensions, support distances and further selective optimization measures.

Measurements of the natural frequencies were accomplished with the friendly support of acoustic engineers of the Institut für Kraftfahrzeuge of the Rheinisch–Westfälische Technische Hochschule Aachen. The measurements on the one hand serve the validation of FE models, on the other hand the examination of the acoustic characteristics of the entire structure. At altogether three positions (front and rear oscillation dampers as well as in the vertical frame cut out) a strong impulse is introduced into the base element through stimulation by means of an impulse hammer.



Stimulation by Means of an Impulse Hammer

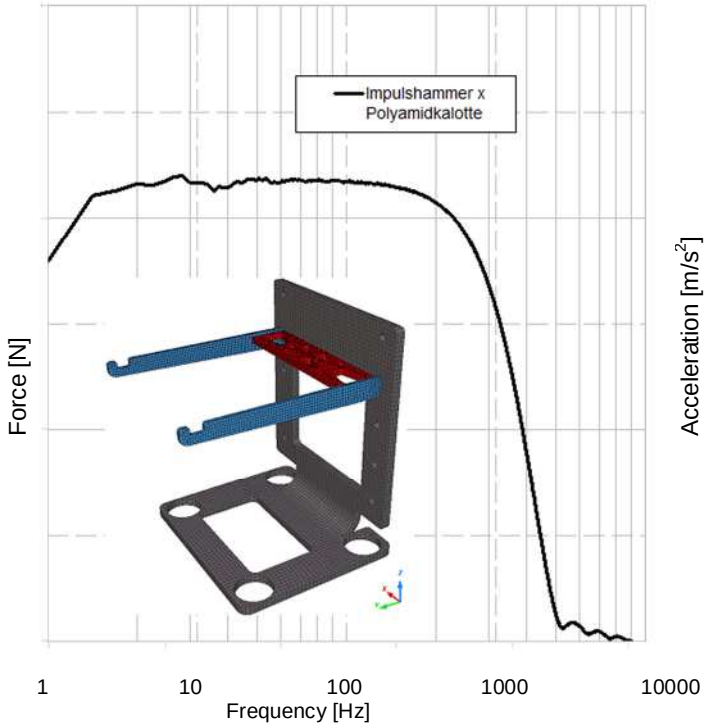
Base Element with Shelf Support and Shelf

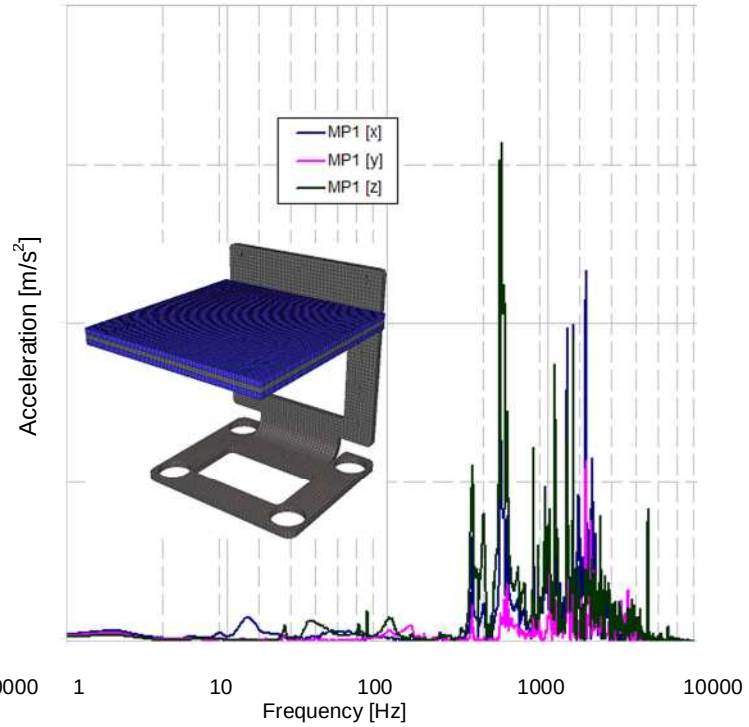
Semi- Anechoic Chamber, IKA, RWTH Aachen

The stimulation takes place in all three space axes as well as through different, exchangeable hammer universal ball joints. A metallic universal ball joint for the higher frequency (up to 8 kHz) a polyamide universal ball joint for the middle frequency (up to 2 kHz) and a rubber universal ball joint for the lower frequency (up to 500 Hz). The impulse responses are based on four positions on the utility space of the board by means of acceleration sensors and adjusted with the simulation results. The measurements permit on the one hand conclusions on different material and geometry concepts. On the other hand they are only made possible in interaction with the Software Hyperworks implemented implicit FE solver OptiStruct the development of individual components and finally the entire structure. With the numeric modal fibre and frequency analysis, as well as by the structure optimization the experience of the Altair Engineering GmbH as development partners and software house came in to good use.

Simulation Methods

The constructed Finite Element Models form the various structure components according to their material characteristics in detail and cover approx. 150000 volume elements. The objective of the research consists firstly therein, to shift the Eigen-modes, thus the structural answer to introductory kinetic energy in form of a sinusoidal stimulation





into acoustically uncritical ranges and to obtain at the same time as high a damping as possible in comparison to this. The diagram represented above shows left the measured Impulse strength of the hammer with the polyamide universal ball joint over the frequency, on the right of accelerations measured on the boards topside at a position in all three space axes. The values determined in such a way are consulted for the examination of the two represented FE models. The signal of the impulse hammer represents a realistic energy input, e.g. like an impulse caused by impact sound and thereby makes the capture of counter measures possible. The evaluation of measuring and simulation results takes place in the top shelf position, since in this usually sensitive source devices, like e.g. record players or CD players are placed.

Finally the ear decides...

The influence of many small changes and detailed solutions, which flowed during a very long period of nearly three years into tone furniture, can neither be simulated, nor clearly captured by measurement technical instrumentation. Thus influences of individual measures are partly intangible, only in combination with other details is their potential unfolded. Thus for example only through the use of special discs out of PTFE between the base element and the counter nuts is a subtle improvement of the sound impression in the acoustically sensitive middle tone range created. By avoiding the direct metallic contact between nut and base as well as by strong tightening of the nut on the one hand the necessary positive connection is granted to the sub chassis with the board resting on it, on the other hand a sufficient uncoupling is put into effect. A coordinated connection between material combination of the board and inverted central disc, heat treated damping elements or adjusting screws with elastomer insertions are only some of the various element choices.

…and the eyes also!

We would like to build a piece of furniture, which can enrich as such ambitious facility concepts. Apart from all tone indicating characteristics already specified, a piece of furniture in minimalistic design should also find its music lover. As soon as the various devices have found their individual place, the base element steps optically completely into the background. The shelves with precious wood veneer stand out optically and let each individual piece of equipment float. So that this impression also really succeeds perfectly, without exception all individual parts are hand made in Germany. Factory manufacturing also means for us to always have two open ears for the desires of our customers and friends where individual desires are concerned.

ictra design Sound Furniture / ictra design / 2013