The Son-O-House is one of our typical art projects which allow us to proceed more carefully and slowly (over a period of three to four years) while generating a lot of knowledge that we apply to larger and speedier projects. Son-O-House is what we call 'a house where sounds live,' not being a 'real' house, but a structure that refers to living and the bodily movements that accompany habit and habitation. In the Son-O-House a sound work is continuously generating new sound patterns activated by sensors picking up actual movements of visitors.

Along the highway between Son en Breugel and Eindhoven situates a large industrial park with a special quarter reserved for companies from the IT and new-media industry. The artwork's role is for strengthening the identity of the area, not only as a technological statement but also as a social space where people can organize informal meetings, relax during lunch hours or just enjoy its beauty. The structure is both an architectural and a sound installation that allows people to not just hear sound in a musical structure, but also to participate in the composition of the sound. It is an instrument, score and studio at the same time.

The structure is derived from typical action-landscapes that develop in a house: a fabric of larger scale bodily movements in a corridor or room, together with smaller scale movements around a sink or a drawer. This carefully choreographed set of movements of bodies, limbs and hands are inscribed on paper bands as cuts (an uncut area corresponds with the bodily movement, a first cut through the middle corresponds with limbs, and finer cuts correspond with movements of the hands and feet). We staple the pre-informed paper bands together at the point where they have the most connective potential and as a result curvature emerges. The outcome is an arabesque of complex intertwining lines (white paper model) that is both a reading of movements on various bodily scales and a material structure since the paper curves stand upright in cooperation with each other. We only have to sweep these lines sideways to

First we set up a camera to record bodily movements in home-situations. Then the computer analyzes the images for movement by comparing movie frames. The software is drawing contours around each package of changing pixels. If we place cameras at different key positions in a house one can see that movements are actually complex structures of three cooperating scales: body, limbs and extremities. When we put the frame-contours one after another these different scales of movement become very apparent.
Normally the kinetograms would be mapped onto a plan and then extruded vertically into a structure. Here we choose to map the movements onto paper elements that are more abstract because they still have the potential of becoming either a floor-element or a wall-element or both. The paper was either uncut (body), cut in half (limbs) or cut in half again (hand or feet) to indicate the body's coordination of movements.

In the house-that-is-not-a-house we position 23 sensors at strategic spots to indirectly influence the music. This system of sounds, composed and programmed by sound artist Edwin van der Heide, is based on moiré effects of interference of closely related frequencies. As a visitor one does not influence the sound directly, which is so often the case with interactive art. One influences the real-time composition itself that generates the sounds. The score is an evolutionary memoryscape that develops with the traced behavior of the actual bodies in the space.
Something really fundamental seems to take place here. If we would follow Gottfried Semper’s architectural order, which goes from A. plan-foundation to B. corner-columns to C. wall-textile and finally to D. hearth, that is going from action to construction to perception, and finally to sensation, we see a reversal here: starting with the soft (textile or paper) that hardens out by teaming up with other soft elements into a rigid whole. Tectonics emerges out of weaving and interlacing.

The paper strips all have cuts of different lengths, and are stapled together at the point where they are cut. This directly results in a curvature effect, making the points systematically gather the whole curves up by itself. The system consisting of multiple curves on different scales should actually be read as a complex of ribs or arches, where the arches have the progressive sizes of a drawer, a bed, a room and a house.
The final analog-computing model. The white paper arabesque is extended sideways by purple paper bands according to a tiny algorithm: the lines sweep out sideways following the initial direction of the white paper but trying to connect as quick as possible to another surface. This means that sometimes the lines that start out quite vertical need some length to come to the ground, while sometimes it finds another surface immediately and stops. This results in a structure that both closes and tears open, similar to the combing of hair with curls. The final digital version differs from the analog one especially at the ends, where re-combing of the curls produces four ducktails.
Structurally the Son-O-House should not just be seen as a complex set of vaults intersecting. Actually the surfaces of the shells on top of the structure have a different curvature than the more linear elements towards the tips close to the ground. The taping does not only allow for access, but also for structural integrity. The curvature increases towards the ends transforming the shell into a beam, transforming a surface into a line.

Opting for an epoxy surface would probably have allowed for a full surface structure like D-tower. But here we chose perforated stainless steel for its reversal of reflection and transparency. The stainless-steel mesh is applied on a diagrid structure made from plasma-cut stainless-steel ribs that are welded at each slotted joint.
All parts that make up Son-O-House are flat: the outer surface is made of flat strips of expanded stainless steel, and the substructure is made of intersecting ribs of flat stainless steel. Moreover, all curves of the ribs actually fit in 21 rectangular plates of six by two meters of stainless-steel plates with a one-centimeter thickness.
joint

Though the double curved structure of Son-O-House is of a non standard geometry the surface is covered with standardized, pre-cut strips. The strips are laid in an algorithmic manner that ‘reads’ the geometry. When the double curvature in a certain area consists of similar curves in both directions (quasi spherical) nine strips close into a hexagon. When the curves are too dissimilar the seventh strip ‘breaks’ away from the hexagon. This technique allows us to cover more than half of the surface with pre-cut elements.

For the steel contractor we made a model and a brochure with rules and tips, but no drawing. The surface has an ‘emergent pattern’ and no predetermined lay-out, since everything depends on the position of the first strip, where the other strips follow according to the closed-hexagon-open-hexagon rule. There are 1,000 strips cut to two meters length and 17 centimeters width. The first 50% of the surface is covered with an untreated strip, the next 45% of the surface is covered with strips that are hand-cut on the short end to fit (yellow dots), the last 5% is covered with strips that are cut on two or more sides (red dots). There is no waste.

For larger buildings we will of course not be able to use this labor intensive technique to cover the surface. One could only use pre-cut panels. In that case we would need to be able to cover the surface of a digital 3D model with a self-organizing pattern following the same rules as the hand laborers did with Son-O-House.

crack

The panelization of complex double curved surfaces is a hugely important issue, both esthetically and methodologically. This issue is called tessellation and is generally viewed as the subdivision into or addition of tile-modules. The least interesting method is triangulation, the subdivision of a surface into triangular facets, where three points always form a flat plane. The most interesting techniques are always based on variability, which is a ‘textile’ way of thinking, where flexible bands precede the hardened ceramic tile.
The three scales of movement that were indexed on the paper strips clearly return in the final structure. Some areas are accessible to the whole body, others only to hands. As in H2expo or wetGRID the visitor actively engages the architecture through a wide range of postures. This is highly intensified by a real-time calculated sound structure that interacts with body positions and body movement through the sensors placed at crucial areas.
There are 20 loudspeakers in Son-O-House that make up five spatial groups that all have their own range of frequencies. These ‘sound fields’ each consist of four individual speakers. The sounds produced by the speakers are programmed through a set of rules that makes them interfere with each other. This interference of frequencies creates a strong effect of movement and transformation. Either the source itself seems to be moving, or visitors start to move to experience the patterns. This bodily movement is continuously detected by sensors. The effect of a current sound is measured by using the sensor input and analyze the relation of one location to another location. The results are stored in a growing data base. Previously generated sounds are re-used in the future for new combinations.

The Son-O-House’s generative and reactive sound environment is developed by composer Edwin van der Heide. The sound environment creates a permanent interaction between sound, architecture and visitors. The sound influences and interferes with the perception and the movements of the visitors. The presence, activity and the location of the visitors is detected by sensors placed in the building at strategic positions. The reaction of the visitors in the building is being detected and quantified. The output of this analysis is used to influence the generation of the sound and therefore continuously challenges the visitors. The result is a complex feedback system in which the visitor becomes both a listener and a interpreter.