EXERCISES IN SEATING

by Max Lamb

Sheet Steel Chair

DIMENSIONS: 500w x 600d x 750h
MATERIAL: 20 gauge, 304 grade stainless steel sheet
PROCESS: The net of a chair is nitrogen assisted laser-cut in 0.9mm stainless steel, folded by hand and secured with double sided VHB foam tape, combining a computer controlled industrial process with hand assembly. Use of pre-finished stainless steel enables the chair to be folded post-production as no finishing is required to protect the steel.

I produced over 30 paper models of my Sheet Steel Chair[1-4] before sending the file to Cirrus Laser for the first steel prototype to be cut. I discussed the laser-cutting process extensively with Dave Connoway, who runs Cirrus Laser, and it was information regarding sheet metal availability, sheet sizes, steel quality, vector-file types and the cutting process itself, that enabled me to develop the design of my chair so quickly, and error free.

Laser-cutting is an industrial process requiring specialist technology and facilities. Traditional laser-cutting machines were operated by inputting coordinates by hand into the attached computer. This was a time consuming process that made laser-cutting an expensive technique when only cutting a few of the same component. Modern laser-cutting machines are still controlled by computer, but the data can be drawn in any vector-based computer program[5] and sent to the machine remotely. The process is very quick to set up meaning it is now almost as economical to cut just one component as it is to cut thousands of the same piece. The actual time it takes for the laser to cut the template of my chair in steel is just over 3 minutes[6].

I have explored the low volume production capabilities of modern laser-cutting in the fabrication of my chair, concentrating particularly in the use of sheet metal. I liked the idea of incorporating an additional hand-process with which to reinforce the one-off or low batch potential of laser-cutting.

Bending sheet steel accurately is normally impossible without the use of a hydraulic press. Again, this is an industrial process requiring expensive set-up times, and so it was important to eliminate the need for such a process. The production of my Sheet Steel Chair is completed by bending the laser-cut template into a chair by hand. I have incorporated lozenge shape perforations along the bend lines[7], similar to the way score lines are included on origami templates to facilitate folding. These slots make bending the metal accurately in a given place by hand, very easy. The slots also remove over 70% of the metal along the bend line, significantly reducing the force required to bend the metal. I used two short pieces of MDF to help bend the faces without distorting the flat surfaces[8-10].

Industrial strength double-sided tape is used to permanently fix the folded panels together. The VHB tape[11], produced by 3M, is easily applied by hand, compared to traditional permanent fixing methods such as welding and riveting that are performed in the factory using industrial equipment. A flat, grease-free surface is the only requirement in order to achieve a permanent bond between the metal surfaces of the chair. Once a strip of the VHB tape has been applied to the appropriate surface[12,13], the backing paper is removed[14] and the corresponding face pressed against it. An instant and permanent bond is achieved. Adhesion of the last two faces completes the production of the chair[15].

Polystyrene Chair

DIMENSIONS: 1000w x 900d x 600h
MATERIALS: Expanded polystyrene and polyurethane thermoplastic
PROCESS: A process of destruction is used to construct a bombproof chair. A variety of simple tools and a reasonable amount of energy is all that is required. By making furniture by hand the unique is achieved and individual beauty inevitable. The chair takes less than 30 minutes to carve and the polyurethane rubber finish takes only 10 minutes to apply. The chair is ready to sit on just 40 minutes from start of production.

Expanded polystyrene is typically used as a packaging material. It is the impact absorbing and insulating properties, and complete weightlessness that makes expanded polystyrene so perfect for packaging fragile goods.

Polystyrene is made up of thousands of tiny balls of plastic foam, known as beads, ranging from 2mm in diameter to about 8mm. The size partly refers to the amount of expansion that occurs during production, but also the original size of the styrene granules prior to expansion. The pre-expanded polystyrene granules are less than 0.3mm Ø.

The granules are first steamed causing them to expand to almost 100 times their volume and are then fed into vast great hoppers. The expanded beads are as much as 98% air.

To turn the loose beads into moulded blocks a further process is required. The expanded beads are injected under pressure into an aluminium cavity mould of the desired size and shape, and steam is pumped through thousands of inlets covering the surface of the mould, usually in circular patterns. The combination of steam and pressure causes the beads to expand even more and naturally fuse together. The mould is opened and the one-piece expanded polystyrene block is released.

My polystyrene chair began as an exercise in modelling armchairs and sofas using expanded polystyrene as a material with which I could realise my ideas quickly, easily, and most usefully, full-size. The surface of the material is quite fragile, breaking into little white beads easily under friction, but structurally polystyrene is in fact surprisingly strong. This is due to the closed cell structure of the foam beads.

I contacted various polystyrene companies and visited a manufacturer in Gateshead called Sundolitt, where I learnt about the expanded polystyrene production process. I discovered the standard block sizes were perfect for sculpting sofas and armchairs from[16]. 1220mm x 1220mm x 610mm is an ideal size for producing a single seat armchair, and 1220mm x 2440mm x 610 is perfect for a three seat sofa.

There are many densities of expanded polystyrene available. I received samples of each of the common densities and established that the lowest density, EPS 20, was the easiest and quickest to carve, the most comfortable to sit on, and still remarkably strong.

A claw hammer proved to be the most efficient tool for sculpting the polystyrene[17]. It also proved to be the most fun. In fact, it was my experiments with different tools that informed the overall shape and form of my armchairs and sofas. The claw hammer generates a rough, inconsistent texture, similar to that of granite[18]. The process of hitting into a square block of polystyrene and breaking huge chunks of material away from the clean faces was quick, spontaneous and satisfying.

Though my use of polystyrene began simply as a method of modelling my designs, I soon realised polystyrene had huge potential for furniture itself. Expanded polystyrene allows the production a full size, fully functioning and comfortable armchair, by hand, in just 30 minutes. The only problem with polystyrene is its fragile surface, easily broken with a slight knock. The challenge was to seek a material with which to cover/upholster the polystyrene to protect the surface, without losing the inherent texture and softness of the foam beads. I also wanted to maintain the speed aspect of the chair's production. A variety of stretchable fabrics are readily available but I wanted my chairs to differ from existing upholstered chairs. The idea of a material that could be painted or sprayed over the surface appealed, one that completely takes the texture of the polystyrene.

Rubbers, both natural and synthetic, exist in hundreds, so to choose a suitable one with which to 'upholster' my chair was simply a process of research and experimentation. Natural rubber would have been my first choice but it perishes in UV light and moisture extremely quickly. There are stabilisers that reduce the effects of weathering but these only slow down the process rather than eliminating them.

Another problem I found with latex is the length of time it takes to dry and its low viscosity. Coagulants are available to speed up the drying time and thixotropic additives that thicken the consistency of latex, but its perishability rendered it unsuitable.

I discovered a company who spray hard rubber bedliners onto pick-up trucks. The spray is extremely tough, supposedly flexible and highly UV stable. In addition, the two-part thermo-reactive spray dries in 3 seconds. It sounded perfect so I visited the Devon-based company, called Line-X, and took with me an unfinished polystyrene chair to be sprayed.

The standard colour for applying to trucks is black, although Neil, who is the main sprayer, said that nearly all colours are available. Black was chosen as it is both the cheapest and clearest colour for spraying onto a white polystyrene surface. I placed the chair in the huge walk in spray booth[19] and Neil began to spray[20]. The chair took less than 10 minutes to coat and as soon as Neil gave me the thumbs up I entered the spray booth and my rubber-upholstered chair could be sat on[21].

The finish was not quite what I had expected. Though the Line-X spray is advertised as a polyurethane rubber, I hadn't realised the difference between the various shore hardnesses. Shore A is the softest, most flexible and rubbery of the rubbers, and the coating covering my polystyrene chair was shore D. It feels like hard plastic, and unfortunately all the softness and 'give' inherent to polystyrene was lost. The chair did become bombproof, however, quite literally! The Line-X spray is now being used to line walls in buildings threatened by bomb blasts and terrorist attacks. It has even been applied to two wings of the Pentagon. My armchair lost its domestic appeal, but is now indestructible, perfect for outdoor abuse.

I have discovered plenty of rubbers suitable for upholstering my chair, but as yet I have not found one with the same speed of application as the Line-X spray. The company does in fact have a flexible rubber coating that only takes 20 seconds to dry, but unfortunately it is 'only available in the USA', as yet. The search for a soft, equally strong but flexible rubber coating continues.