

Releasing The Strength of Fibres and Density of Paper by The Application of Heat and Controlling Grain Direction to Achieve Paper's High Relief Pattern.

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Abstract

Relief pattern and depressed or raised form on paper has attracted contemporary architects and artists from many disciplines, linking in particular industrial design, architect, urban design, painting, sculpture and printmaking, but there have always been problems through the achievement of high relief. In spite of wide presence of relief works in all area of Art, no deserving study has been undertaken into the potential of papers as how to make very high relief. To date the highest printed relief on paper is no more than five millimetres and this paper intensely investigating to enhance the pronouncement of the relief forms.

The investigation of materials is often believed an important part of the process of making a piece of art. Close involvement with paper and production of high relief form through embossment and print making techniques was to lead this investigation to the eventual manipulation of the paper's fibre itself. As paper must be pulled or pressed in a mould to form a high relief pattern, printmaking press and techniques was chosen for this investigation. Through the utilization of pressing and also stretching the papers fibre under strain in order to achieve a raised or depressed form in high relief, two basic factors that were parameters of success identified. Firstly, the temperature of fibres and secondly; the grain within the sheet and the condition of papers' filaments on the mould. The effect of heat on fibres and its inherent qualities has proved to be quit a new and revolutionary phenomenon in printmaking. Since embossed patterns have created, the actual use of heat on paper was almost to a certain extent unknown. The application of heated tools to create depressed brand signs and symbols on the pelt and skin has been in use for thousands of years. In Iran this involved the application of heat to design leather, and to prepare book covers. In Persia embossment through heat also was used on the parchment that applied as paper.

This study managed to accomplish the goal of achieving high relief pattern on popular and normal papers through the application of heat and grain direction. The result of the achievement was the enhancement of the concavity and convexity of patterns by at least twenty times and was also able to resolve the problem of embossing.

Keywords: High relief pattern, paper's fibre, grain direction, filaments, paper mould.

Introduction

Relief pattern and concave or raised elements on paper has interested contemporary artists. In spite of the wide presence of relief works in all areas of Art, no comprehensive study has been undertaken into the potential of papers and their ability to support very high relief. To date the highest printed relief on paper seems to be no more than five millimetres. This research therefore, set out to explore how relief pattern involving paper could be developed. The investigation of materials is often believed an important part of the process of making a piece of art. Close involvement with paper and production of high relief form through the development of appropriate techniques lead the researcher to the manipulation of the paper's fibre. This was achieved through pressing the paper into moulds or formers, through while major issue arose.

In these experiments heat was the main factor in releasing the strength of the paper's fibre. Fibres commonly remain in balance where the average condition is 65% relative humidity and 24°C temperature. Through the application of heat in excess of 55°C, paper fibres release and become softer and the structure of the paper allows a greater depth of relief under pressure, whilst still allowing the paper to remain smooth and crinkle free.

Grain direction among paper is another factor for determining forming and stretching. The grain of a paper refers to the alignment of the fibres within the sheet. The vast majority of fibres in paper follow the same direction during the process of paper production. When a sheet of paper is dampened for the purpose of embossing, the fibres absorb water and swell and, as a result, the paper is at the weakest when pulled at 90° to the direction of the fibre. When a printing mould is subject to a stripy, ribbed, or wavy design, paper has to be pulled in the opposite direction of the stripe, in this case the paper's grain ought to be located in the opposite direction to the mould. In other words, fibre stretches more easily along the grain direction than across it. Paper made from highly beaten (or hydrated) fibre is usually weaker and less dimensionally stable and also less able to stretch. Paper made from less hydrated fibre tends to be stronger because fewer bonds are formed between fibres, but as they are less dense each fibre has freedom to move under pressure, giving the paper a greater capacity to stretch.

Exploration of relief techniques

Emboss print

Raised and embossed image was used extensively in bookbinding prior to the advent of printing. Heat was used to make relief images on thin wooden board and also on sheepskin, deerskin and calf leather. For decoration, leather bindings were stamped in relief with heated panel stamps, and sometimes dyes were used in combination with blind images to accentuate patterns or titles. The main part of bookbinding's *finishing* was the lettering or relief images carried out by skilled craftsmen, using heated hand tools. Principally, relief patterns were made by heated wooden or brass letters [1]. Similarly, in some of the thirteenth century works on parchment and subsequently in early books, heat was used to create images. In holy books such as the Koran and the Bible, this is particularly evident in the relief detail that is applied to the leather covers. Moslem experts believe that a Koran written in 1286 in Marrakesh may be the earliest known example of tooling with heated iron to produce relief images[2]. In Egypt these boards were made of papyrus pulp. In Islamic bookbinding, in the 10th century cut out patterns integrated with embossed text were used on the cover of a book to make a high relief. In this technique cut out patterns of papers were pasted as filigree on to the second pieces of different paper. Occasionally a Kufic inscription would be cut out and applied in this way. The use

of this type of tooling in Persia may date from the first half of the 14th century. In early examples it is not possible to determine whether or not the decorative points and lines were first tooled in embossed image without colour (blind) and then painted with liquid gold as had been done in *Copti* in Egypt [7].

Sculptural image

As far as high relief work in this study was concerned, Alberto Butters was almost certainly the only known artist who used heat to produce and form his paper or plastic relief and sculptural images. He also tried to transcend the confines of the two-dimensional surface through heat. It would seem that his work formed a bridge between the artists who used heat to discolour or change the appearance of their work and artists who worked with relief patterns. By the early 20's some artists such as Butters and Shimamoto started to use different materials, which had previously been considered non-traditional, for example polystyrene, fibreglass, polyester and plastic. By using artificial materials and with the development of modern plastics, such as celluloid, Plexiglas and Perspex, new mediums were at hand for the artist to exploit. Although Butters started to exploit plastic bags in his works, other artists such as Lucio Fontana (1899), Enrico Castellani (1930), Pieter Engels (1938) had used variety of them in their works. It was only Butters who extended the relief possibilities of plastic through heat.

Around 1949/50, Butters experimented with various unorthodox materials, in his tactile collages, these materials included pumice, tar and burlap that is a type of thick, rough and strong cloth. At this time he also commenced his "*Hunchback*" series, which were humped canvas that broke with the traditional two-dimensional plan. A few decades later his innovations were followed by other artists, such as

Jos Manders (*Communicati*, series, 1968) and Anish Kapoor (*When I am pregnant* series, 1992).

Pregnant,

Fig.1. *When I am Pregnant*,
Anish Kapoor, 1992,
Fibreglass and pigment,
Dimension variable.



am

Butters' dialogue between the age old traditions of painting and the search for a new means of expression and representation led him to create various textures and surfaces with the topography of materials and the topology of abstraction.

Fig.2. *Muffa*
Alberto Butters
1959-61
58 x 46. 2 cm



For the creation of relief and topographic images,

he

first constructed some compositions and placed a central swathe of fabric that added both depth and dynamism to the compositions. One example of this series titled *muffa (mould)* fig.4. alludes to the rapid outgrowth that mould as an organism displays, evoked in the lively, effervescent surface of the composition. Discussing Butters use of fabric in the composition to create topographic image, Bruno Mantura says, “[Laying] aside almost completely all paintbrushes, the artist builds his work with an *outré* material, the old and consumed sackcloth, creating painting therefore with what is one of the oldest bases of painting [4].

Butters’ compositions (fig.2), form, themes, metamorphosis, accidental processes, natural processes, reactions. and scientific relations have induced him to burn, to fuse and to carbonate, materials of common and poor use.

In the mid 1950s Butters began burning his materials, a technique he termed *Combustion*. With the torch flame, he burnt wood or plastic for the realization of his pictures. In this case flame makes marks, crackers, black spots or holes in the medium. There is a relationship between Butters and Klein’s work. Both used flame from torch to create their work. Butters used flame to make crackers, spots and holes while Klein used heat to create imagery on the flat surface or discolour his flat work. Butters’ experimentations were in Italy, in the same period and parallel with Klein in France. In the mid Sixties Butters continued to work with plastic, elaborate form with fire and applied it on a support of *cellotex*. In these works, the vision was simplified; the colour was given to the background and the plastic, burnt or left transparent, had the function of creating shades of the same colour. For the creation of relief and topographic images, he first constructed some compositions and placed a central swathe of fabric that added both depth and dynamism to the compositions. One example of this series titled *muffa (mould)* fig.2. alludes to the rapid outgrowth that mould as an organism displays, evoked in the lively, effervescent surface of the composition. Discussing Butters use of fabric in the composition to create topographic image, Bruno Mantura says, “[Laying] aside almost completely all paintbrushes, the artist builds his work with an *outré* material, the old and consumed sackcloth, creating painting therefore with what is one of the oldest bases of painting.

The Japanese artist *Shozo Shimamoto* was another artist, who with Alberto Butters, Lucio Fontana and John Cage used heat and fire as well as tearing and piercing in their work. He has executed a number of experiments during his burlap and pierce investigations. To do this, *Shimamoto*, painted paper and then pierced it with holes to reveal the different layers underneath and also to extend the limitation of two-dimensional surface[5].

Another artist who investigated the surface in relief was Piero Manzoni. His idea for planning a composition was similar to Butters, Shimamoto and Fontana, he believed that painting should represent nothing but itself. He began his series of *Achrom* in 1957. His techniques and activities were interestingly parallel and nearly in the same period as Alberto Butters, Shozo Shimamoto, Yves Klein, Lucio Fontana and Johannes Schreier. He exhibited some of his works in a group show with Klein, Fontana and Butters in 1957. Like many of renowned mid twenty minimalists who applied relieved elements and raised the surface of their works with white materials; Manzoni utilized chalk, cotton, bread or polystyrene in his works. He applied only white materials in order to create an aria of liberty; a surface, which is, and nothing else.

Enrico Casellani was another artist who had artistic experimentation to the overcoming of the traditional limits of the painted picture [6]. He works with relieved image built up from nails. His works, together with the works of preceding artists, Alberto Butters’ combustions, Fontana’s slashes and Manzoni’s *Achromes*, the surfaces in relief constitute one of the most outstanding stylistic developments – and one of those most charged with meaning of the end 20s. In 1959 Casellani executed his first *Superficie near in rilievo* (Black Surface in Relief). This was a decisive work for the development of his art, opening up new opportunities for expression using canvases with two-dimensional surfaces. Although he was working within the influence of the two-dimensional surface, as other mentioned artists, he tried to shift the focus of attention to the surface structure. Therefore he

created a concave and convex space, positive and negative to draw attention to light and shade. The technique that he applied then became a characteristic of all his works and consisted of fastening the canvas or paper onto reliefs built up from nails; in this way, some part of the canvas projected outward, in contrast to other areas which form introflexions.

Fig.3. euro 1200,
Enrico Castellani, 1995,
Relief on paper,
41.5 x 69 cm.

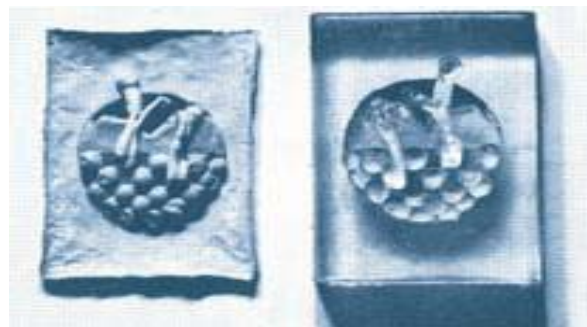


Castellani uses monochrome surfaces in his process and shapes it to form double curves with repeated elements. He utilises a series of points in relief and points forming depressions, negative and positive poles, and a series of minimal operative interventions. They are constituted by a flat membrane, the physical characteristic of which – elasticity and spatial continuity – are not altered by process of formation. The structures resulting from this operation are matched by others that are both equal and opposite and thus cancel each other out in the organization of spatial totality"[V]. In 1963 Castellani also began to take an interest in the expressive possibilities of the diverse articulation of the monochrome surface in space: thus he made shaped corner canvases, projecting three - dimensionality.

Relief print

Several printmakers were also interested in expanding the boundaries of the two-dimensional surfaces in order to meet new artistic and technological demands. Among most attempts to create three-dimensional images through printmaking techniques, the sculptural print was remarkable. It was a challenge to explore the interaction between printmaking and sculpture in order to establish a bridge between the relatively two-dimensional world of printmakers and the three-dimensional world of sculptors. Sculptural etching can also range from deep embossment (5 mm) to etchings approximately (0.5 mm).

Fig .4. Print from resin
mould.



In etching, the plate is simply pressed on the soft surface of the paper causing a slight emboss. The paper can be embossed through this technique either by being pushed out as intaglio printing or in as relief printing. Most embossed prints are designed not to be inked. Usually an inked plate is printed on plain white paper, resulting in an embossed form similar to Butters and Fontana's works that uses the play of light and shadow to reveal the image. Low relief embossing, whether on paper, canvas or plastic, is similar to low relief sculpture. Higher relief or additional areas of embossment can be made

on a print with a second plate specially constructed out of layers of boards, woods, metals, resin or any suitable materials (fig.4).

Pulp image and Deep etch*

Pulp and paper sculpture can also be counted as a relief. The creation of a form of paper sculpture or relief utilized in this technique can be achieved by pouring liquid paper over a low relief shape or shapes. When the paper is dry the mould is gently removed revealing a negative or positive impression in the paper. Although achieving a high relief form through pulp and paper sculpture is easier, the most popular technique is *deep etch*. A deeply etched plate is printed in relief, intaglio or both together. It is the intaglio process that makes the most of the actual depth and even greater illusion of depth and the range of tone and colour. Similar technique to *deep etch* is *relief etching*. When an image is drawn directly onto the plate by protecting material and leaving the surrounding area unprotected, the drawn image is left in raised relief. Technically, the etching process may be exactly the same as a deep etch, but visually the emphasis is on the more positive relief; the corroded metal has become the negative area.

A number of other techniques such as inkless intaglio and blind image have the same style of plate and all are emboss prints, distinguished by the height of the relief. It is always possible to find a print in which the effect obtained and the actual materials and techniques used are virtually impossible to detect. Indeed, a more anonymous surface effect may be deliberately sought in preference to others that are recognizable. Most of these techniques and all relief prints can be taken from many kinds of surface other than etched metal, the most obvious being wood and lino.

Many artists and printmakers were also interested in making their own paper to expand their style. Paper is generally made by the layering of short vegetable fibres to form sheets. Materials such as cotton, artichoke, straw and bamboo are capable of being reduced to a state suitable for paper forming. The fibre must be shortened and separated into fine fibrous strands similar to bamboo after it has been crushed and beaten with a mallet. After two to five hours of simmering the liquid is drained off and the pulpy mass then poured into a tube or tray and ready for casting or forming the sheet [^].

Using of geometrical design for the basis in relief

Most Persian covers in the 14th century are in relief and have geometrical ornamentation. A piece of perforated leather cut into an intricate pattern and superimposed on a board or geometrical design were used often in blind. To make a raised pattern, whole patterns were often stamped from a large heated metal block, while another technique was the embossing of designs with a heated matrix of toughened camel hide[⁹]. Unlike Christianity, Islam rarely used pictorial representations of religious imagery[¹⁰]. The Muslim artist forbade the imitation of human and animal forms and was instructed to confine itself to plant and abstract motifs. It was for this reason that Islamic artists used the imagery of mathematics to discover the principal structures that are reflected in matter. Islamic art is essentially a way of ennobling matter by means of geometric patterns, there were contextualised through calligraphy[¹¹]. The key to the construction of the complex geometric design (*fig.5.*) is through a grammar of mathematical principles and the constraints of symmetry and laws of proportion. The basic component for Islamic design is a simple square or a triangle derived from the square. Most design known as the "*repeat*", rational system of growth generation[¹²]. As the square plays central role in Islamic design, the square was selected for the practical work in the studio investigation of this research. In the final stage of the studio investigation a series of relief curved elements were also designed based on the proportion of Islamic ratio. The ratio of the elements within these works were based on the relationship between one element to the others and the surrounding space. For instance, a relationship between a positive element to negative space based on a specific ratio or comparing one element which is half of another double the former. In Islamic design the ratio is

expressed as (a: b) or represented as a fraction (a / b), where a and b could be any number. Proportion is the equality of two or more ratios which can be either:

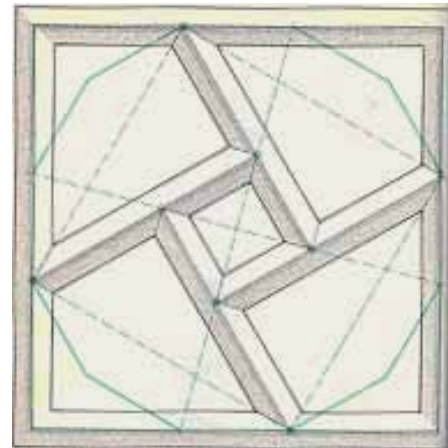


Fig.5. The basis of the square in square.

For continues: $a / b = b / c = c / d$ etc., $2/4 = 4/8 = 8/16$ etc.
 For discontinues: $a / b = c / d = f / g$ etc., $2/4 = 3/6 = 5/10$ etc.

Both have a constant characteristic ratio, in this case represented numerically as $\frac{1}{2}$.

The rectangle is also commonly used in Islamic design. Its characteristic ratio is expressed by the measure of its short side (a) to its long side (b); a:b could be any ratio, 2:3, 3:5, 5:6, 5:8 :

As the symmetric patterns are the most commonly used pattern in Islamic design, some practical work in the studio investigation was designed based on repetition of an element or symmetry(fig.6.). "Symmetria" in classical terminology meant the proportionality between the constituent elements of the whole. Since the concept of "Symmetria" are based on harmonic proportions, the linear numerical methods of analysis of geometrically constructed designs invariably result in approximations or inaccuracies because of the irrational numbers derived from the proportions of the geometric elements of the design[13].

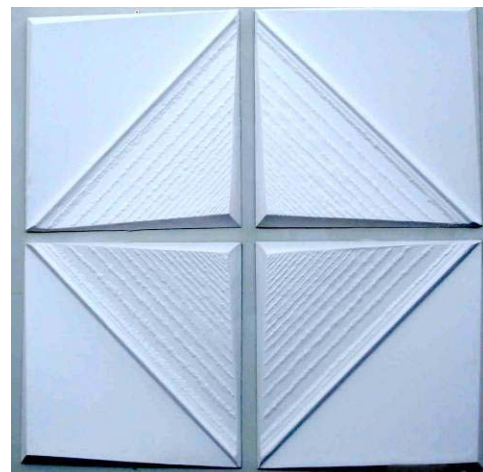


Fig.6. Author's experiment
 Symmetria Relief, four squares,
 paper relief, examination of 10cm depth
 Cartridge paper 220gr,
 Size 160cm x 160cm.

Studio and practical investigation of relief

During the studio research various processes for printing high relief pattern were examined such as emboss print, pulp image and inkless intaglio. The processes of pressing paper was of central importance, as was the amount of pressure applied. Instead of an actual printing plate the latter became more like a mould consisting of two slabs, one with the positive, the other negative (male and female respectively). The actual relief on the slabs was usually produced with layers of card, hardboard, MDF or wood. The most successful results were achieved by moistening the paper which was placed on top of slab(Fig.7.). Before pressing, heat, was applied to the paper by a heat gun,

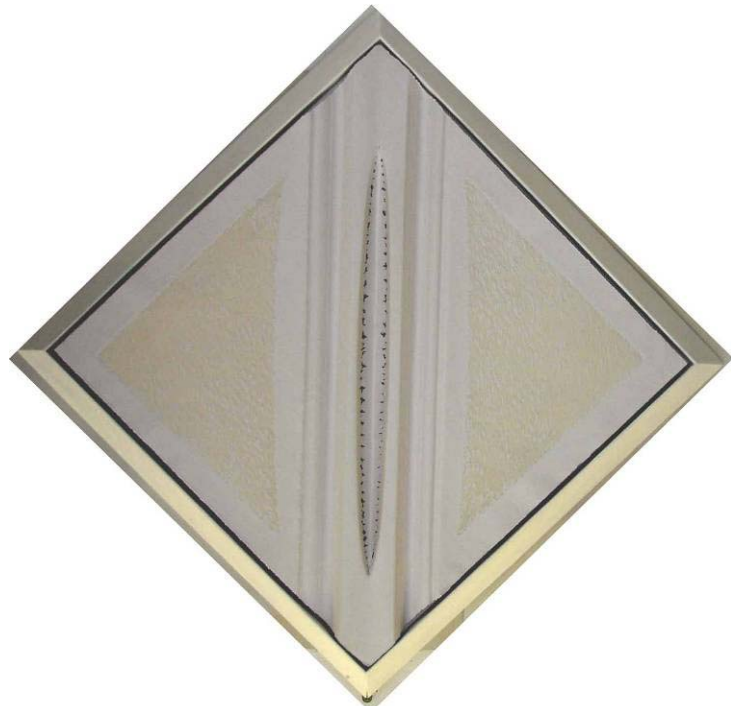
directing the gun line by line over the paper, vertically and horizontally. When the moisture began to evaporate, the paper was covered by a printing blanket to keep it warm. This enabled the fibres and filaments to release so that the paper became softer and ready for stretching.

Rules of proportion based on Islamic geometric design were chosen for the studio research. This was because no figurative elements were appropriate to the research, instead the purpose of the research was to concentrate on the aesthetic possibilities of relief pattern, in conjunction with fields and bands of colour that also mediated by heat. Initial studio practice began with a series of experiments into the development of the mould and slab in order to print high relief (Fig.8.). Various materials such as cardboard, wood and hardboard were used to make the moulds and different types of paper such as Fabriano 220g, Canson 300g and Cartridge 200g were used for printing.

*Fig.7. Author's experiment
Negative & positive slab,
paper relief, examination of 10cm
depth on cartridge paper 220gr,
Size 100cm x 100cm.*



*Fig.8. Author's experiment
Double rectangles,
Examination of 9cm depth
on cartridge paper 220gr,
Size 100cm x 100cm.*




Conclusion

Prior to this study I was familiar with the work of Lucio Fontana. In the summer of 2004 I saw his work for the first time in the Tate Gallery where I was not only intrigued by the simplicity of his motifs, but also inspired by his technique. For me, the creation of the sculptural form on a flat canvas was exciting. This suggested the idea of how flat paper could be formed and defined as a sculptural concept. Fontana's exploration of the method of producing holes and concave form, which he called *Buchy*, became an important part of my studio research. This involved bringing a third dimension to the works by piercing, cutting, and slashing the surface, thereby, breaking the membrane of two dimensionality of the paper. The fact that , Alberto Butters applied heat to raise his relief and detail, that he termed *Combustion*, led me to believe that it would be possible for this research to produce sculptural form with paper through printmaking techniques and heat.

The studio experimentation of producing high relief pattern on paper began with a concave form similar to what Fontana had used. This was then extended to the convex. In these experiments heat upon wet or damp paper was successfully used to increase the height of relief. This was because the combination of heat and moisture, caused the paper fibres to release so that a greater depth of relief was possible whilst the paper remained smooth and free from creases. This resulted in an extensive exploration of tearing, puncturing paper and printing burlap techniques and two successful compositions of high relief that show, a concave and a convex element. Diagonal lines and textures on the top of curved lines was a further experiment prompted by Fontana's diagonal slash and pure lines. As the studies progressed, curved lines, which were derived from previous studies, led me to use and print parallel convex lines based on relational composition and serial elements in a square structure. The final stage of the research progressed with the development of compositions based on a proportional system that is derived from Islamic architecture(Fig.6). These compositions, that rely on actual convex and concave relief, in combination with coloured stripes, were influenced by Barnett Newman's 'Stations of the Cross'. However, whereas Barnett Newman's paintings are physically flat, the work that I have produced relies on the tension between the actual concave and convex, and the coloured band. Since the latter has an almost atmospheric quality through being heated, they can appear almost as shadow, thereby implying depth. This consequently adds to the ambiguity and tension between that which is actual relief and that which is flat.

Because these compositions rely on bands of colour and concave and convex relief there is an absence of narrative, and they increasingly rely in terms of their aesthetic quality on the formal arrangement of these elements, together with subtle changes in texture. As discussed earlier in relief, the disposition of these elements was based on $\sqrt{2}$ and $\sqrt{3}$. This subsequently determined. two focal points, around which the elements were located within the composition, one for the concave and convex element and another for the bands of colour.

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*The term “deep etch” is relative to the thickness of the metal plate and even with 16-gauge zinc, only a fraction of an inch separates deep from shallow.