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SYMMETRY AND TRANSFORMATION IN INDUSTRIAL DESIGN

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Abstract: *Industrial Design manufacturing possibilities have been modified by digital fabrication. A shift form more regular, isometric shapes to those with lower levels of symmetry has occurred. Transformation is becoming more frequent in everyday objects through different strategies. During the last years we have been studying cutting and unfolding techniques, in particular the correspondence between cutting patterns and the different types of flexibility they provided to rigid sheets. There is an asymmetry between the development of materialization and drawing instruments for non-uniform transformations, which may be one of the reasons why isometry is still so persistent. The enhancement of these tools will enable experimentations in the continuous transformation of material properties through morphological interventions.*

Everyday objects are documents of their time. They speak of the technologies available, the aesthetic values, ideals and aspirations of a particular culture. They give shape to our surroundings and depict our social practices. Digital fabrication is changing the shapes of these objects, incorporating configurations that were unthinkable to manufacture with previous technology. At first, only precision and productivity were increased. As time went by, the limits of these technologies were defied with more complex shapes that were feasible, not only because they could be produced, but because they did not increase costs substantially. In addition, they satisfied the challenge of new inquiries, of creating paths in unexplored areas. So, we were surprised with unusual shapes in everyday objects and in unbelievable architectural interventions in big cities.

The most rigorous isometric symmetry was strongly valued by the Modern Movement. Postmodernism and the subsequent design trends questioned the merit of considering precise order as an aesthetical value in everyday objects, abandoning pure shapes and dealing with others that were more complex and less regular. Digital Fabrication techniques provided a very important tool to explore this area. Some of their processes promote a greatest development of the lower levels of symmetry. Such is the case of 3D printing, which allows the materialization of any shape, no matter how irregular or intricate it might be. However, there is always a vestige of order, be it in the abstract or in the physical level.

There are other processes, such as cutting and assembling or cutting and unfolding which frequently follow the tradition of the Modern Movement, even if this is no longer necessary. Efficiency remains associated to constructive systems with isometric parts, following the well known expression “less is more”. If we think in die cutting, punching and other traditional cutting systems we can understand and justify the idea of reducing the amount of different parts. However, new cutting technologies -such as laser or water-jet cutting or CNC routing- do not have this limitation. Price does not change if equal or different parts are cut from sheets, as there is no matrix involved. From the drawing file there is only a digital translation to the cutting machine.

1.1 Transformation criteria in industrial design products

We analyzed the occurrence of transformation, considering both: homeometry and syngenometry, in everyday objects. We recognized these different situations:

1. No transformation at all, following tradition: even if the fabrication methods available change, isometric parts are still being produced. They simplify assembling, but they do not increase the amount of possible configurations except for the number of components involved. For example, the Puzzle screen, designed by Egawa and Zbryk clearly shows this.
2. Transformation through material changes: components are isometric but, as they are built in flexible materials, they can change their shape and produce new configurations with less regularity. The Cloud system, designed by Bouroullec Brothers is a clear demonstration of the introduction of post-assembled variations.

3. Transformation by disrupting order through shape: the common procedures that control object creation, such as lattices or regulating structures, are questioned and objected through the shape of the final objects. Sheer wall, the separating screen of Jesse Pietilä, begins with a triangular lattice that is deformed and modified in its depth to hide, partially, the view on the other side of the screen.
4. Transformation in the concretion of a given shape: a previously determined shape is fragmented in units for its realization. In general, there is homeometric symmetry among the parts. Jakob + MacFarlane´s bookcases for the Loewy Library in Paris are an evident example. Frequently CAD systems promote these actions as they provide commands that easily produce sequential sections. The design challenge is to choose the most appropriate cutting directions, joints and assembling order, according to the structure of the shape to be materialized.
5. Transformation through flexibility: three dimensional objects are produced through cutting and unfolding of rigid sheets. The deformation can be either elastic or plastic. Even if there are no restrictions to non-uniform transformations, as cutting is defined by digital media, there is still a strong presence of isometric regularity. The Shadow bed, designed by t.n.a. design studio is an example of this possibility.

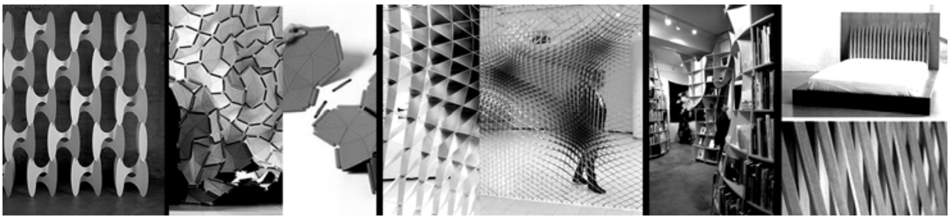

Figure 1: Transformation examples: Puzzle Screen, Cloud System, Sheer Wall, Loewy Library, Shadow bed.

1.2 Experiments in the regulation of flexibility through shape

During the last few years we have explored the possibilities of working with the last group we mentioned, in order to understand the changes Digital Fabrication can bring to our everyday objects, to exploit its potential, to make what could not be done before CNC cutting (1). We agree with Eisner (1998) when he says: "*One of the less recognized contributions of what we could call in general terms 'technology' is its capability of inviting human beings to consider possibilities for the representation of their ideas that could not have assumed shape before its existence*".
The strategy of providing flexibility to rigid sheets through machine cutting has a relevant antecedent in the work of Moholy Nagy and his disciple Bredendieck in the Bauhaus, in particular working with wood. (Guerri and Huff, 2009). If present technologies would have been accessible at that time, this exploration would have continued.
However, we noticed that the availability of these manufacturing processes was not enough; we needed to develop conceptual tools to strengthen their morphogenerative

possibilities in design. After analyzing the effects of different shapes and densities of cuttings, on the same material –MDF of 2mm - we established five different alternatives that provide diverse types of flexibilities. We named them: slits, spirals, zigzag, fringes, and their combination, as can be seen in Figure 2.

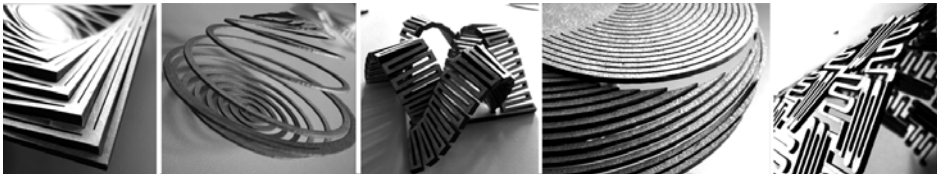

Figure 2: Different cutting categories that provide flexibility to rigid sheets.

At first, we only used uniform cutting in order to simplify experimentation. Yet, we realized that the same intensity of deformation was not needed throughout the sheet so we started working with non uniform cuttings related to the intensity of deformation desired.

1.2 Next challenges and some conclusions

As we were exploring the last group we mentioned, we were surprised to find out that the main CAD systems do not offer an easy access to progressive or non-uniform transformations as they do for unvarying repetitions. If they do, the progressions are not accurately controlled. Some programming tools solve this problem but they are not standard. Maybe that is one of the reasons why isometry is still so strong. The fabrication methods exist, but the modeling of non uniform repeated variations are behind in their generalized use among designers. This delay should not necessarily be negatively valued. It can be useful to develop the ways in which these variations can be intentionally used in products, so that a controlled use of the morphology and density of cuttings allows us to intentionally change the material qualities of a rigid sheet.

In design history, the desire to go beyond the limits of what is known, of what can be designed and produced, is persistently found. Functional optimization, economy and efficiency are relevant but they are not enough. These complex everyday objects not only reflect our technological evolution, but they are a mirror of our possibilities of transformation, of the complex ways of living we face day by day, of the unsteadiness and vulnerability of the world we live in. Today, the forms we inhabit are not pure, but are deliciously human.

Notes

(1) This research was carried out in the Project A41: Morphology and Digital Fabrication, Director: P. Muñoz, FADU, University of Buenos Aires, Argentina http://morfologiadigital.blogspot.com

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