Chapter 5
Bridging Synthetic and Organic Materiality:
Gradient Transitions in Material Connections

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ABSTRACT

The recent movement from mass production to mass customization enabled by digital fabrication has opened the door for new typologies in architecture and design. The author brought the idea of mass customization to material connection, which normally appears as orthogonal seams that are predominant in man-made objects. This chapter introduces gradient material transitions that seamlessly bridge synthetic and organic matter. Using digital image processing of organic forms, the fabrication process generates 3D tooling paths, culminating in the concept of 'bio customization' rather than mass customization, a new prospect of digital fabrication.

INTRODUCTION

If mass produced parts and components are the atoms of modern design, jointing techniques are the bonds between these atoms, the nucleus of today's built world. "The art and technology to build is based on the skill to combine, to connect and to join similar, various or different parts, materials or components in order to construct a new whole" (Emmitt, Olie & Schmid, 2004). Seams between standardized parts and components are everywhere in our physical environment from products to buildings. These lines reveal how built objects are assemblies of standardized parts and components. There is a well-established tradition of assembling structures according to this method in human history. Building with adobe bricks has over 9,000 years of history and the Egyptian pyramids are made of millions of standardized stones. It is no exaggeration to say that throughout history, people have continuously flattened and standardized the diverse natural materials into regular, uniform, repeatable, measurable forms. Our living environment today consists mainly mass produced artifacts, which is typically considered to be the consequence of Industrialization

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and subsequent mass production. The nature of mass production is such that it creates uniformity, which became a dominant aesthetic trend: Functionalism. Adolf Loos (1908/1998) claimed in his essay 'Ornament and Crime' (1908) "the evolution of culture is synonymous with the removal of ornamentation from objects of everyday use," and expressed his "passion for smooth and precious surface" (Rykwert, 1973). In part, due to new materials and tectonics, Functionalism could create a dialogue that questioned standard perceptions of the built environment. Although the means of standardization have evolved, there has been continuous criticism to this process by organizations such as the Ludites in early 19th century and the Arts and Crafts Movement. This criticism of anti-machine trends is today continued in the form of organic fluid shapes enabled by recent digital tools, resulting in 'blobby' reforms. "The biomorphic structures and organic designs referred as "blobitecture" have their roots in the postmodernist rebellion against the perceived mechanistic dryness of modernism, with its well-known emphasis on function, scientific analysis, and order" (Walters, 2003). CAD/CAM technologies realize efficient construction process of such structures: mass customization rather than mass production. "Mass customization of buildings means that all produced building components have a unique identity, are individuals that can be addressed independently. Each building component is different, and fits only in one place" (Oosterhuis and Biloria, 2008).

MATERIAL CONNECTIONS

Before humans, nature discovered jointing techniques long ago. Organisms developed biological forms and jointing techniques such as suture joint on skulls and the connection of a tooth to the jawbone. Joining techniques such as mechanical fasteners are simplified techniques to hold man-made structures together. In the design process, designers and engineers subdivide a required function into parts and components ultimately built with mono-materials. They specify materials to fulfill assigned requirements taking advantage of material properties; for example a window component with a transparent sheet glass and a well insulated frame. As long as man-made structures are fabricated as complex assemblies of parts and components, whether mass-produced or digitally mass customized or one-off hand crafted, connections between components are inevitable. "From a philosophical and practical stance we can see that where materials or building components meet each other - at the points, at the lines or at the planes or surfaces – there is nothing" (Emmitt et al., 2004). Thus, assembled objects typically have pronounced seams between parts and components. Designers and architects do not have many choices to deal with these seams: to accentuate the contrast between components by using parting lines as graphical elements, disguise them from the eye using complex tooling, surface finishing or processing methods. The technological limitation of standardized parts and components is represented by their seams and appears as orthogonal seams that are predominant in man-made objects.

Konrad Wachsmann, a forerunner in architectural details, "emphasized the need in any age to understand technical possibilities – in terms of machine-made standardized elements" (Creighton, 1969). Consequently his focus on architectural details such as joints and mechanical fasteners contributed to detail qualities of modern architecture. Mies van der Rohe (1959) stated that God is in the details. The details do influence how people perceive the quality of a built structure or fabricated product. We simply appreciate the quality of details and connections such as well-fitted stone works from Inca civilization or Japanese wood joinery. The number of books and magazines focusing on details illustrates how much people pay attention to detail. "Details – connections, joints and knots – have an extraordinarily crucial place and meaning, both technologically and culturally" (Emmitt et al., 2004).