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## **"TANGLE JUNGLE": AN EXPERIMENTAL PROJECT TO COMBINE COLLABORATION AND CRAFTSMANSHIP IN DIGITAL DESIGN PEDAGOGY**

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**Abstract.** Tangle Jungle was an experiment in an alternative method of design and making for the digital age. The aim of the project was to interpret and reenact traditional craftsmanship through today's digital tools. For a particular study on the subject, we looked at the theory and works of William Morris. Morris had an exceptional taste for medieval art and produced, among other things, hand-woven carpets that are still studied today. Morris reinvented the art of his time by reviving pre-industrial modes of production and designs. Today, the digital age is experiencing a similar paradigm shift. Digital tools already work, in many instances, as a direct extension of the hands of a new breed of digital artisan makers. It is possible to assess that the digital is getting closer to Morris's notion of craftsmanship. Tangle Jungle became a testing ground for this historical connection, bringing forth the question, can we redefine our own digital craftsmanship as a form of digitally reenacted Gothic revival?

**Keywords.** William Morris; Craft, Fabrication; Digital Design; Gothic.

### **1. Introduction**

We live in a world where design and fabrication is monopolized by digital machines. Most of the digital production today is a continuation from that of industrial revolution, which relied heavily on machine based fabrication. In the late 20th century, mass customization emerged as an idea to break the seriality of mere repetitive production (Carpo, 2011). However, design and fabrication still follows a top-down process where parts are derived from an overall model and manufactured as-is. This process excludes the art of collaboration within design domain that has played a central role in the history of architecture. Gothic architecture, for instance, was not only a configura-

tion of ribs, but also a cooperative effort of masons that expressed its unique beauty (Spuybroek, 2011). Later, this art of craftsmanship flourished in the arts and crafts movement in which William Morris became an influential figure. Without having a possible technological counterpart, Morris was successful in achieving perfection through his craftsmanship and affection for medieval precedents.

Although technology has become an indispensable element of the current digital paradigm, its collaborative nature has not yet been cultivated. In this paper, we will present an experimental project – *Tangle Jungle* – as an investigation to explain the dynamics of collaboration using digital tools. Many of Morris's ideas on design and craftsmanship were intrinsic to the process of production through digital modelling tools and teamwork. The research was carried out through multiple stages: analysis of hand-woven carpets, designing digital carpets, material studies and fabrication. The final product is a result of bridging research, digital design and collaboration using digital tools.



Figure 1. *Bullerswood Carpet*, designed by William Morris with John Henry Dearle, woven 1889.

## 2. Why Morris?

William Morris is regarded as one of the greatest textile designers of all time and his designs have a classic, timeless quality which are highly valued to this day (Perry, 1996). Morris became a central figure in our research, not because we merely had an interest in bridging history and digital technologies, but because his work offered a valuable alternative to reconsider the

digital methods of production and design in our age. As a craftsman himself, Morris didn't confine to the technology and craft of his own age. On the contrary, he examined medieval examples from 13th century to develop an informed palate and craft for the art of his time. This enabled him to use existing tools and technologies for the creation of novel designs that he wanted to revitalize. This pursuit was facilitated by John Ruskin, who influenced Morris to develop a taste for the Gothic. He not only embraced Ruskin's ideas on design and craft, but also became an active political figure working to elevate the art of craftsmanship within the society. While his earlier works involved the design of embroideries, painting, furniture, tableware, stained glass and tiles, his later works flourished with designs of hand-woven carpets (Figure 1). His natural ability to understand the potentials of material and craft to combine design and technical parameters made him a successful pioneer of his time.

## 2.1 TEXTILES OF MORRIS

Although Morris was not nurtured to have a high-class taste for textile art, his ability to recognize and analyze great historical designs describes how his aesthetic judgment preceded his intellectual curiosity (Perry, 1996). His designs had the intention to combine historic motifs using figures taken from nature that brought higher complexity and richer articulation to his patterns. One of his signature motifs was the acanthus which has been widely used in art and architecture since the ancient Greece. He sought to revive such old motifs and practices through his post-medieval, modern interpretations that produced new and unique designs. He saw machine production at that time as goal oriented which was specifically evident in print making, where canvases were covered with the same patterns, which he thought made the overall design look cheap (Fairclough, 1981). As a result, he chose not to use machines for the production of embroidery, such as tapestries and knotted carpets, which made their highly customized, laborious and joyful production in the hands of Morris.

For Morris, design was an exercise in the fellowship of labour. He was a well-read, confident and generous scholar that always supported other artists. The social and joyful aspects of collaborative works defined his socialistic approach to arts and crafts. The influence of Ruskin was integral to the development of his thoughts on craftsmanship. He published Ruskin's book on Gothic architecture, *The Nature of Gothic*, in which Ruskin writes about the notion of craft in Gothic architecture by describing six main components (Ruskin, 1892). One of these key aspects is *savageness* which relates to the imperfect nature of builders that collaborate to achieve a common goal

(Ruskin, 1892). This fundamental aspect of labour was practiced as a form of expression the workmen was allowed to pursue. Morris believed that when craftsmen were given a certain amount of freedom with a limitation of order and necessity the design was executed truthfully and soulfully (Morris, 1899). As Morris became more drawn to the idea of reinventing his own Gothic, his medieval inspirations found an expression of labour in his own company. He not only taught himself the secrets of medieval craft but also shared his knowledge with other craftsmen to encourage the prosperity of the arts and crafts community he was starting to organize.

### **3. Digital Medievalism**

History has demonstrated that people shape their own technology to nourish artistic ability and production. Before the industrial revolution, fabrication relied solely on hand-making, which would yield a non-serial production and thus, a flourishing of unique products. Machines were merely used to embellish this procedure. However, as modes of production become more mechanized, we see a shift towards absolute seriality where things begin to appear as mere copies of a single product. This also takes out novelty and craft away from design where architecture becomes overrun by technology. Carpo states that the digital has currently been evolving to adapt to this dilemma by combining non-standard seriality, collective intelligence and mass customization (Carpo, 2011). This new form of production could return control to the skilled artisans who shape things digitally as well as manually. Thus, the digital could offer redemption in a new age where new tools and methods of production could be created that will not confine us solely to the craft and technology of our own time. This form of digital making leads us to the revolutionary ideas of Morris in the artisanal processes of arts and crafts. Here, the woven perception of art combines design, craftsmanship and politics together which should further be investigated in the digital.

### **4. Tangle Jungle**

Technology has been consistently shaping itself over the past twenty years. In a period where everything is designed digitally, the production is still carried industrially and serially. Although there is no longer a predilection for the arts and crafts, today's technological advantages would benefit from a harder look at historical methods. This is why Morris becomes important. It is necessary to study the complexity of his design culture to help evolve digital design and redefine craft and collaboration in our time.

The study of Morris became the perfect foundation for an opportunity to experiment with this new form of digital craftsmanship in a case study titled

*Tangle Jungle.* Lars Spuybroek created a course and set the research scope to the study of William Morris's carpet designs and then the construction of an ornamental chandelier. A group of students was formed to illustrate the applicability of collaboration at every stage of design and fabrication. In the first stage, students studied Morris's carpets that he designed in his late career (Figure 1). Implementing a diagramming study prior to any means of digital production intended to foster students' understanding of how these natural patterns were made. The students looked at six carpets designed by Morris Co.: Acanthus, Bullerswood, Carbrook, Holland Park, McCulloch and Redcar. Each carpet used symmetrical copies of a quadrant design that showed configurations of natural elements like twigs, petals, flowers and leaves (Figure 2). These elements were broken down as geometric lines to visualize how they bifurcate, entangle, tendrill and sprout. This investigation resulted in the discovery that each carpet had different parameters that determined how much of these design operations were used. While Carbrook carpet had the least entanglement and most sprouting, Holland Park and Bullerswood had the most tendrilling and entanglement.

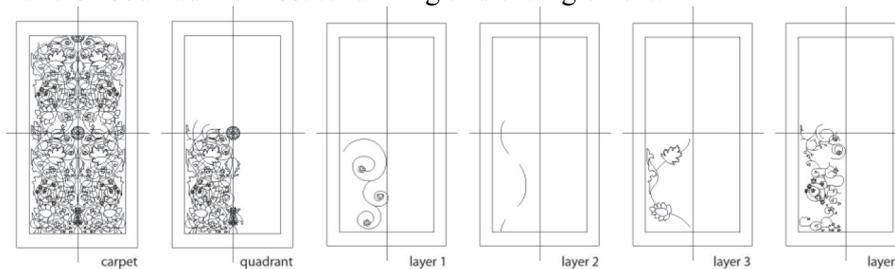


Figure 2. Breakdown of Bullerswood carpet into subsequent layers using a quadrant

#### 4.1. DIGITAL CARPETS

Morris's carpets simulate growth in a specific way. Veins diverge from the central axis of the carpet, towards the far corner of each quadrant. The main goal of this design is to fill the carpet with natural elements while each figure relates to the others in a specific way. In addition, the growing figures maintain a certain amount of curvature that makes the overall design coherent and balanced. This is also evident where bifurcation and tendrilling occur. When a figure bifurcates, the successive parts share the amount of curvature at the point of bifurcation. For tendrilling, the additional branch uses the vector on the preceding curve and rotates it to simulate a circular growth. In both cases the deviation proceeds logarithmically. When a branch gets further away from their origin, it makes a sharp turn to complete its twig-like figure. Since these figures could only behave in such a limited fashion, over-

lapping or entangling configurations could occur when two branches need to fill up a certain area. For the design of a carpet, growing figures are distributed prior to further infilling with flowers and leaves of various sizes.

The first stage of research involved the examination of how tangle geometry operations are applied in the design of Morris's carpets. Since the carpets were symmetrically designed, the diagramming focused on a single quadrant of each carpet for further investigation. Students used Rhino and Grasshopper tools to trace the information of figures and configurations to extract the rules of operation. This process revealed not only how actual growth took place for the design of the carpet, but also the parameters for the deviation of curves. These rules became the core focus of the design inquiry into the generation of three dimensional carpets.

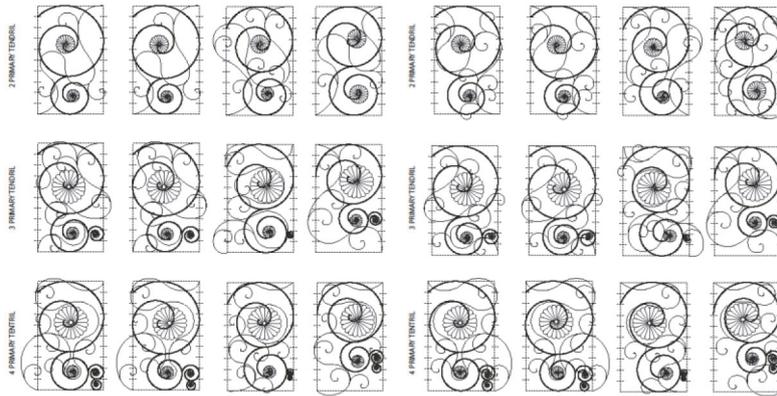


Figure 3. Quadrant matrix using 2,3 and 4 primary veins as structure.

The second stage of research was to explore how to use these rules to generate new carpet designs. Using Grasshopper students were able to build their own scripting tools to control the development and organization of figures. Each group of students investigated a different methodology for their own quadrant designs. One group used quadrant boundaries as a way to influence how the inner configuration of curves could be connected, while another group concentrated on using flowers as points of attraction for growth. All of these studies maintained the guideline to infill a quadrant with a certain amount of connections without exceeding the curvature of growth (Figure 3). Each design had a unique entanglement, bifurcation and tendriling parameter. This showed that different carpet designs could be generated by only changing parameters for quadrant designs. When four different quadrants were joined symmetrically, they became the outlines for a new carpet.

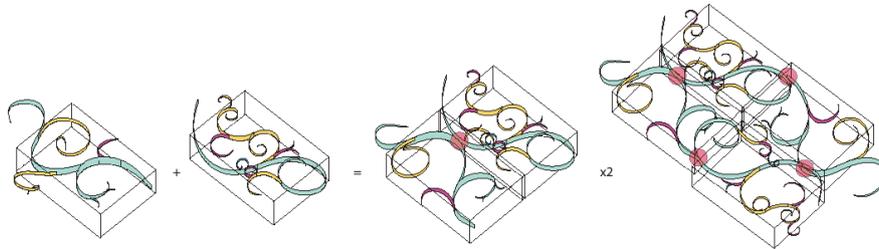


Figure 4. A study of three dimensional configuration. Two different quadrants are symmetrically copied to create structural joints that share the same thickness of elements.

Although these new designs were flat configurations, they still maintained certain rules that enabled further three-dimensional implementation. When Morris designed his carpets, the veins not only grew but also overlapped. He emphasized the overlapping by adding tint colours to the contours of veins to invoke a feeling of depth (Morris, 1899). This inspired an extension to turn the flat carpets into three-dimensional configurations. Using overlapping figures, students transformed their carpet designs into a volumetric study of curves. Later these geometries were "thickened" based on connections, deviations and structural needs. When two veins intersected, the geometries not only shared the curvature, but also the thickness (Figure 4). This way each group was able to generate a three-dimensional version of a Morris carpet based on rules of growth. The final design was planned to have a total of eight quadrants designed by three groups. At this stage, different groups exchanged their designs in order to adjust their figures to facilitate further structural connections and additions (Figure 5).

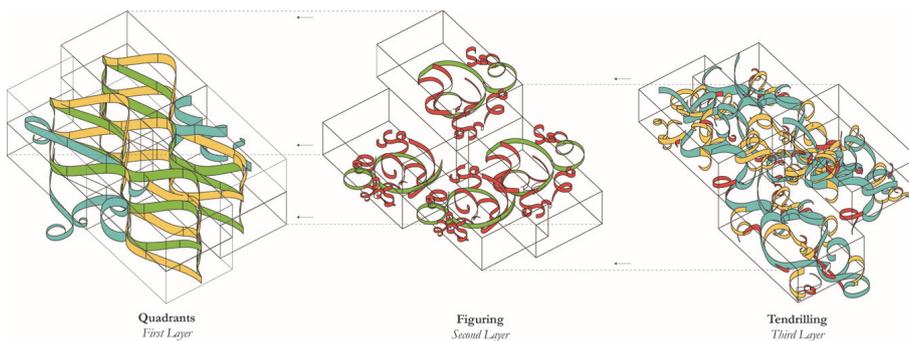


Figure 5. The final design showing overlapping quadrants and figures. Each group designed two quadrants and exchanged files to fit with adjacent figures.

#### 4.2. COLLABORATIVE FABRICATION

For the fabrication acrylic was chosen because it could be laser cut, thermoformed and ordered in multiple colours. The choice of acrylic provided many factors to be managed during the fabrication procedure. The initial mock-ups proved that acrylic was easy to cut and shape, however, bending figures required hand precision since the material became highly brittle. To attach pieces together a transparent chemical compound was used as bonding solvent. This chemical provided additional strength to the material without damaging its appearance. But, conversely, any mistake while using this adhesive could cause an irreversible connection producing an unexpected bond. These facts forced craftsmanship to the forefront, as most of the molding was done by hand following the initial design (Figure 6).



Figure 6. The fabrication sequence.

The production phase started with laying out pieces to be laser-cut. The larger pieces that did not fit into the laser cutter were divided up to be connected later with chemical solvent. For bending and molding processes, heat guns and thermoform machines were used to provide uniform or local heating. Since the pieces were formed by hand, the brittleness of the material was managed efficiently. When separate pieces were connected chemically, they began to act as a single piece structurally.



Figure 7. The final structure hung using steel cables for further assembly of quadrants.

After initial mock-up tests, students produced a final design for the installation. Different quadrants designed by student groups were joined under a superstructure that facilitated ease of multi-production. The design followed colour-coded growth, in which a certain colour was associated with each layer of elements (Figure 5). After the completion of the primary structure defining the quadrants, the piece was suspended for the final pieces to be affixed (Figure 7). This method provided a constant feedback for the structural balance, so that production could constantly adapt and change as more pieces were added. The construction of adjacent quadrants occurred simultaneously so that students had to communicate to make structural decisions. While each quadrant became differentiated with local adjustments, the whole structure acquired more structural stability. When complete, the installation produced a dramatic configuration of layered colours and thicknesses, producing dynamic colour combinations under sunlight (Figure 8).



*Figure 8. Image from the final structure*

## **5. Conclusion**

Today, digital architecture is often seen as a globalized top-down system, an approach that features parametric variations of elements through coordinative and formal design decisions (Schumacher, 2008). However, styles have evolved throughout history due to contextual factors, including climates, technology and culture. This heterogeneous nature is evident in Morris's arts and crafts. When he studied Persian carpets for inspiration, he did not wish to reproduce them exactly in a different milieu, in Victorian England. On the contrary, his intention was to study the art of weaving and design to reinvent his own style with local materials and techniques. The guilds formed during arts and crafts movement supported this tradition as they exchanged ideas and helped each other to form a better society with a greater enthusiasm for art and novelty.

In Tangle Jungle, the students followed a similar process in which the production is constantly adaptive and changing because there is digital craftsmanship on every level. In order to achieve a final product, feedback and collaboration were integral to the design process. This rendered the production as a dynamic entity rather than a static top-down assembly of parts. In this approach not only do the figures coordinated to support a structure, but multiple designers worked in tandem to bring the craftsmanship to a higher level. This approach facilitates more communication, exchange and support among students that can have direct influence on the industry. As a result the digital can promote collaboration over individual creativity to offer process oriented pedagogy and dynamic learning. Tangle Jungle is an early prototype of such a new approach, which unravels ways to reinvent the digital as a bottom up, collaborative process.

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