Research on the Application of Rapid Prototyping in Frank Gehry’s Design Process

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Abstract: Integrating computer-aided design with computer-aided fabrication and construction will fundamentally redefine the relationship between design and construction. Rapid prototyping is evaluated as one of integration methods but it has been regarded as expensive and complex design evaluation tool and is only suitable for large mechanical design shops in automobile and aerospace industry. But current status of rapid prototyping is changing since the new generation of RP equipments, less expensive and more user-friendly, now can be installed and use in design firms. Simultaneously increasing use of 3D CAAD software is also helping to use rapid prototyping widely. Frank O. Gehry is the one who use these technologies for his design add-on values and famous for his non-linear building design with exclusive use of RP and CAAD software such as CATIA. It is crucial to acknowledge rapid prototyping technologies are not only for avant-garde architect such as Frank O. Gehry but ordinary 90% architects, who can have benefit from fast and cost-effective technology. As described above, this research will focus on how he can be benefit from these technologies and extract the factors from Frank O. Gehry’s design process.

Key Word: Frank Gehry, Rapid Prototyping

1. Introduction.

1.1 Study background.

Because of the developments of modern construction, impossible design and designs are actually made in the past. These actualities are called so as a lot of architects are various, and to be able to realize to defiant actual architecture design, and to reach.

Specially, various computer programs read a design, and are easy, and do as there is to architectural design so as to be able to finish in fast time. Rapid Prototyping was used for a car or an aircraft industry only with expensive machine and the expensive cost of materials, but the cheap Rapid Prototyping machine field that can install in an office was produced in developments of RP. And recognition of Rapid Prototyping is changed in developments of the CAAD software that Surface/Solid Modeling is possible. In industrial construction Frank O Gehry preferring a Non-euclidean Geometry design is using on a process introduced Rapid Prototyping on with design development and construction process and make actual construction parts. Specially, use Rapid Prototyping for the first time, and use Non-Euclidean Geometry, and the Frank O Gehry which is creative, and announced a new work of a free form in is getting illumination throughout the world.

1.2 A study way.

First, explain Rapid Prototyping. The second. Classify in be biographical latter period. And analyze a work of the Frank O Gehry which applied Rapid Prototyping to construction.

2. Subject.

2.1 Rapid Prototyping

Definition of Rapid Prototyping is making mathematical algorithm to the real thing of a computer proposal. And be what is automated a practical three dimension object, and have made quickly through variable work processes. Reappear directly molding water from CAAD data within fast time, and mean work to compare with the original design intention. Mean that is impossible or a courtship does not get molding of the object which did impossibility for excessive labor costs to a form at excellent work businesses, and reappear. Rapid Prototyping divides a computer underwear model to Layer. Each floor is hardened in a laser or other ways. Be methods forming repeatedly an object by work to let other one fold harden after this.

Mark1) Characteristics of Rapid Prototyping.

<table>
<thead>
<tr>
<th>RP</th>
<th>characteristic</th>
<th>merits</th>
<th>demerits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLA</td>
<td>- Be representative rise, and have complicated structure.</td>
<td>Precision is high, and the face evens.</td>
<td>Durability is low, and a price is expensive.</td>
</tr>
<tr>
<td>SLS</td>
<td>1) Process is similar with SLA. 2) Materials use a functionality macromolecule or metal powder. 3) Be make hard to materials as inject a CO2, laser.</td>
<td>Very substantiality. Have strong chemicals, heat.</td>
<td>Own country comes into being on the face, be delicacies to ten.</td>
</tr>
<tr>
<td>FDM</td>
<td>- Melted thermoplastic materials. - Make with half price sieve state. - Be gush at heads and ways making stairs</td>
<td>Indoors usable. A price is low.</td>
<td>A slow speed, low accuracy.</td>
</tr>
<tr>
<td>3DP</td>
<td>- A setting calls genetically of various similar RP used in the necessary offices that there is not.</td>
<td>Be fast, and uses a color.</td>
<td>To low durability so, require re-process</td>
</tr>
<tr>
<td>MJP</td>
<td>- 3DP and MJP are BP methods making model. Own the detail routine face process that MJP was improved.</td>
<td>A speed is fast, and face process is good.</td>
<td>Durability is weak.</td>
</tr>
</tbody>
</table>
### Classification by the times of Frank Ghery

<table>
<thead>
<tr>
<th>Times</th>
<th>Plastic subject</th>
<th>Plastic characteristics</th>
<th>Year of Design</th>
<th>Art Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>End of 50th - 60th</td>
<td>Modernism inheritance and deviation</td>
<td>- Stand on its own feet since Ghery came back in Europe as establish a 1962 office.</td>
<td>1959</td>
<td>Steves House</td>
</tr>
<tr>
<td>End of 60th - Early 80th</td>
<td>Material's property of matter chase,</td>
<td>- Attempt deviation, and study materials from modernism construction.</td>
<td>1977</td>
<td>Gehry Residence</td>
</tr>
<tr>
<td>End of 70th - Early 90th</td>
<td>Establishment linguistic a form.</td>
<td>- Enemy scenary becomes formation of a work in history.</td>
<td>1978-</td>
<td>Loyal Low School</td>
</tr>
<tr>
<td>Early 90th</td>
<td>Digital Technology application.</td>
<td>- The times build digital technology, doing introduction to work.</td>
<td>1991-1997</td>
<td>Guggenheim Museum Bilbao</td>
</tr>
</tbody>
</table>

3. **Construction of Frank Ghery.**

3-1. **Before digital-technology application.**

Divides the times to 1-3, before applying digital - technology to a design.

The first quarter - Deviate with inheritance of modernism. Follow a level, vertical proportion relation, straight line, a form language of modernism such as non-decorated in a form and the sides of materials. The second quarter - Materials and a chase of a property of matter Deviate from the legitimate Western European modernism construction. Show search intention about American construction.

The third quarter - Set up of linguistic a form Get out of research about the materials which looked before, and the Ghery research holds a form language.

3-2. **The latter period - the Digital technology times.**

It is salted that Digital- technology was applied to work of Ghery, and these times are characteristics. It is not new thing that CAAD was introduced in construction work.

However, CAAD got out of tools of record, and having started for being used positively to a design recently. Be meaningful to make the forms that cannot make by hand such as sketching or modeling, and having started as tools making simulation for using a computer. At Guggenheim Museum in Bilbao, Ghery was developed for aircraft industries introduced for the first time CATIA (a three dimension computer program) to a building he pioneer played. This work had the meaning that utilized a computer before a frame design, structure calculation etc. over processes as, above all, started from form derivation works. A new form to have made by Digital- technology application is related to fold construction. Order was given face process and the works of these times a principle plastic a fractal is applied a plane. Works of the last times are analyzed to result of former works. Specially, a meaning is large at having made the form that was not able to make possible in a human eye or hand as introduce Digital - technology.

4. **Conclusion.**

Modern construction, Frank ghery uses Rapid Prototyping, only. Other construction, total design production of small scale uses Rapid Prototyping. Frank ghery let you start from work from chases of anger "American." And, recognize problems to appear in by each time. Also, did metaphorical representation as played it in this subject. These have extracted deviation from a standard, individualization phenomenon of American western part culture, digital technology, and, digital culture. Frank Ghery used materials and a form as the method which materialized too that kind of subjects. The Rapid Prototyping which he used can be written most duly to a construction office. Use of a RP model is technically mature at design development steps. But time is necessary until actualizations at Cost-Effective.

5. **Reference.**