

# The Systemic Study on Ceramic Molding Method Construction with Rhinoceros Software Platform

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**Abstract.** The accurate 3D molding function of Rhinoceros software is used and combined with the fast and realistic render effect of Keyshot, which is the fastest and the most effective three dimensional design software in the area of current ceramic molding design. The paper is mainly explored the application of the Rhinoceros software in constructing ceramic molding with the example of some ceramic. It will describe the molding design to shorten the development cycle of product to improve the design efficiency.

## 1. Introduction

The biggest defect is of traditional ceramic molding design is confirmed with shape of ceramic painting, model, drawing board and other multiple measurements by hand and repeated modification. The design accuracy cannot be ensured also it cost the labor and time of designer. Hence, it will be a necessary tendency to assist design with construction molding of computer, a substitute of human labor. The help and effect of the industrial design software, Rhinoceros, means much to the construction molding of computer. Its curved surface molding can adjust the method of surface control vertex and make the molding with the controlling of the curved surface. Designer uses the tool based on curve to define the shape through adjusting edge; or he keeps the complete control of the Bezier curve to get the accurate shape and curve which meet the requirement through the adjustment on anywhere of the curved surface with molding tool.

## 2. Traditional Way of Ceramic Molding Design

In the current ceramic molding design, firstly, designer will make a primary design according to the plan, including the layout design, design sketch and other series of process. The planning will be confirmed in the type choosing conference and then it will be the technical design which confirms project planning, including the processing of the model and the ceramic material. There will be repeated changes between design planning and effect in primary design. The speed of improving planning is limited to the traditional methods, which is the reason of the long cycle. Designers have an easier way to show with the computer assisted technology. They can discuss planning more intuitive and convenient in the virtual environment created by CAD platform.

## 3. The Surface Molding Principle of Rhinoceros

Rhinoceros is software that equipped with Nurbs curved surface and Bezier curved surface to construct model. Nurbs curved surface is used in quick molding construction while Bezier curved surface is used in curved molding construction with high quality, which is the basis of advanced surface to get the mathematical expression of surface of B spline interpolation through point approximation. The molding principle of Rhinoceros is based on this mathematical expression to

describe the space curved surface. The algorithm of NURBS (Non-Uniform Rational B-Splines, uneven and reasonable B sample) is very complicated because it is a counting describing the complex curved surface. Uneven curve allows the existence of many nodes to describe Bezier curve. The characteristic allows that NURBS is not only used to express the free form of curved surface, but also to show the basic geometric molding, such as conic curve, conic section and cone. So it is very suitable to make the ceramic model. Spline curve method can control the shape of curve in one area and the user can look at the interactive change and join to the design with the function of Rhinoceros to record history. The pure digital development mode requires designer should have a creation of innovated sketch and effect at first. Many designers would like to draw the primary picture in paper with pencil and the simple color processing with mark pen is following. But many designers create with drawing software in computer. Having finished the draft, there is the display technology of digital model which needs the render software (such as keyshot, vray and so on) to have an exchange between digital model and physical model. The curved surface created by Rhinoceros can be cutting trimming with throwing machine to be processed; or to be made into all kinds of samples with rapid programming technique, which can made the digital into the physical. It is convenient for judges and exchange of design. The final issue of design data will be announced with the curved of the highest quality.

#### 4. The Method of Ceramic Molding Construction for Rhinoceros

Here is the design method of ceramic molding for Rhinoceros. Taking one ceramic molding as example, it introduce the basic process of ceramic molding design for Rhinoceros and it will have a back-endsrender with the aim to construct the ceramic molding planning quickly and accurately. The design will shorten the design cycle to great extent and save luxury time of enterprise to reduce the cost and risk.

**4.1** First is the application of referred photo. The ceramic designer will show the original inspiration with the form of draft and Rhinoceros is imported to draw the 3D digital model according to the concept draft of designer. First, enter Rhinoceros and create file. The Three Views of ceramic product (Top, Left, Back) can be imported into the Three Windows through clicking menu-search-background photo-putting with mouse. And then the picture is adjusted to make sizes corresponded one by one in the Three Views. Just shown as Picture 1.

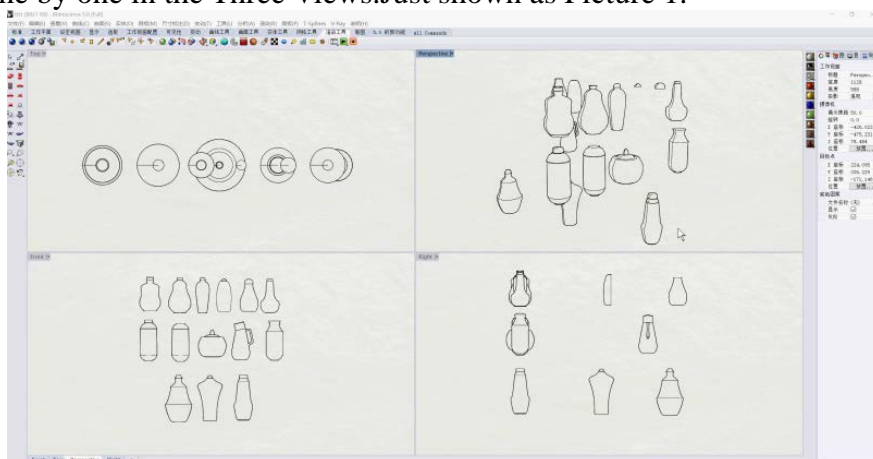


Fig.1 The Input of Three Views

**4.2** The Making of Basic Curved Surface of Ceramic. The making of ceramic base surface profile is a digital model which is based on the Three Views when it is aligned at it. Firstly, the body of ceramic is drawn from Y axis because it decides the final shape of ceramic. It is the key line in drawing, just shown as picture 2.

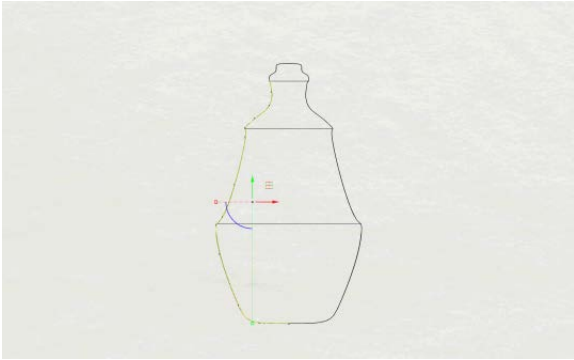


Fig.2 Drawing Ceramic Outline

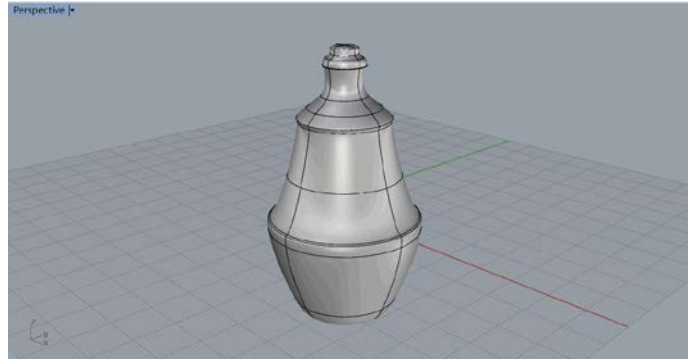


Fig.3 The Final Constructive Model

**4.3 The Observation of Ceramic.**The curve set before to construct the bottle body, a bottle mouth, a bottle cap and other basic curved surface. Please pay attention to adjust the whole outline and other detailed curved with controlling point. The final construction sketch is shown as picture 3.

**4.4 The Test of Surface Continuity.**There is a high requirement to the surface in the molding design of ceramic. The quality of single curved surface must be simple, reasonable and gentle. The curved surface tries to be described with order number with no surplus Span. CV should be added properly in the places where the great change or transition of curvature has. The CV and Span of curved surface should be even and reasonable with no obvious jumping. The high light trend and curvature variation of the surface should try to be peace. The surface continuity of NURBS includes G0 continuity, G1 continuity, and G2 continuity and so on in the aspect of curve. The highest requirement of ordinary processing is G3 continuity. There are 3 basic environmental monitoring methods in Rhinoceros software. The first one is the direct simulation of natural light reflection effect; the second one is the effects of zebra crossing on the projection effect of multiple horizontal incandescent lamps and the last one is curvature detection method which is to enlarge the surface discontinuity boundary defect with a mathematical calculation model with the end of the expression with a color map. The picture 4 is the continuity of curve tested with zebra reflex tool.

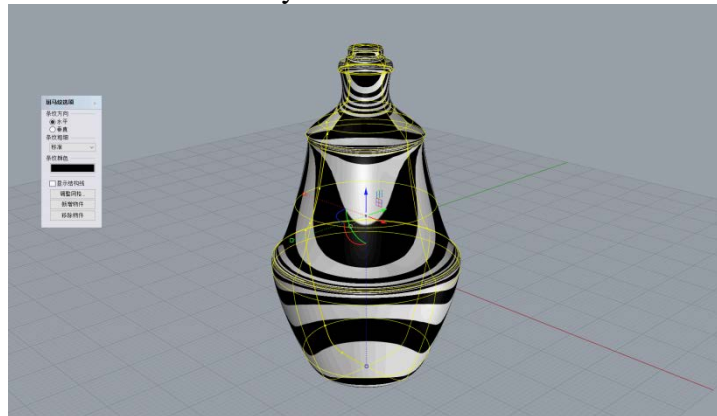


Fig.4 Zebra shown with model

## 5. The Exhibition of Ceramic Digital Model

Having constructed the model with Rhino, it is the period of rendering. In Rhino, the file is saved with the form of 3dm、3ds origes and then it is imputed into KeyShot. The 3D model is imputed. Firstly, open the material stock to choose the ceramic material and put them into the counterpart of the mold; secondly, open the environmental setting options and choose proper HDRI map; thirdly, set the background. Pure grey scene which is widely used in the current product rendering is adopted to show the detail more clearly; fourthly, set the output parameter of rendering and output the picture format. KeyShot provides many picture formats, including EXR、TIFF and JPEG. The picture 5 shows the sketch of ceramic with Keyshot's rendering. It can be seen that Virtual Reality Technology is the emerging advanced digital model display technology in the world and the top technology which major products companies are lining up to use in the

world. The core of it is that it transfer the digital molding into lively physical with the strong hardware and software capability so user can be indulged in the real world although it is the digital content, which will bridge the gap between digital one and real one and decrease the rely on physical one.It will be a great value in reducing the making of clay modeling and the cost of developing, speeding up the whole development process and increasing plan to have a try.



Fig.5 The Sketch of Ceramic

## Conclusion

To the modern design of ceramic, pen and paper are replaced by computer gradually and it has been the common new design tool.It can be seen from the above case that the thinking of design can be achieved with the strong and precise modeling capability of Rhino and the realistic render effect of Keyshot.Also the product design efficiency is improved quickly.The modeling of Rhinoceros software is flexible and accurate.It combines the design and engineering and connects the art with science to release people from heavy labor.It will shorten the cycle of design and ensure the design accuracy of design to decrease the cost of design developing,which is huge meaningful to the innovation and development of ceramic based on digitization.

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