

DOI: 10.24904/footbridge2017.09675

PARAMETRIC DESIGN FOR FOOTBRIDGE: A CASE STUDY

Lisha RENProfessor
Tongji University
Shanghai, Chinarenlisha@tongji.edu.cn**Hanbin HOU**Civil Engineer & Architect
RISD, USAhhou@risd.edu**Xin RUAN**Professor
Tongji University
Shanghai, Chinaruanxin@tongji.edu.cn

Summary

In recent years, more and more algorithm and parametric methods are applied in the field of architecture and industrial design. Meanwhile, current bridge design, in most cases, is still based on practical demanding, like the span. Although footbridge shares the similar structure with large-scale bridge, it also has some distinctive characters, for example, they are always small span bridges so that we have multiple ways to solve structural problems. In addition, there are a large number of footbridges everywhere, which is an important facility for our daily life. With the increasing of our spiritual demand, user experience and visual effect will be the primary elements to achieve the final design. Parametric design could develop thousand kinds of new forms even with certain parameters, which is fit for our design principle that is user experience first.

In this case, we tried to use parametric design method to create several types of bridges, which contain the factors controlling bridge features. These factors have close relationship with user experience. Then we change factors to make thousands of iterations to evaluate different form by whether they fit for the surroundings. After define the best user experience principle, we use genetic algorithm to choose the bridge location and optimize the form. Moreover, algorithm could also be used to optimize multiple bridges simultaneously, which means if there are one more bridges build at one place simultaneously, the algorithm can optimize these bridges simultaneously. Bridges' formations will not only be influenced by the surroundings but also bridge each other. Because of the flexibility of parametric design, it gives a new design thinking for footbridge, which is pedestrian is the first influencing factor instead of structure and construction.

Keywords: algorithm generation; parametric design; user experience; footbridge

1. User experience vs. structure

Current bridge design, in most cases, is based on practical demanding, like the span. Although footbridge shares the similar structure with large-scale bridge, it also has some distinctive characters. For example, they are always small span bridges so that we have multiple ways to solve structure problems. In addition, there are a large number of landscape footbridges, which has higher requirement for aesthetic than function. With the increasing of our spiritual demand, user experience and visual effect will be the primary elements to deliver the final design. User experience is a term from industry design. With user good experience design, visitors may have more pleasant experience, so that the bridge is not just a fundamental facility but a kind of facility for people taking a leisurely life.

In this case, we design visitor's view. Bridge shapes, structures, locations are all serving for visitor's experience. For example, bridge's upper structure are designed like a pavilion, so that the shape can guide or block visitors' view. In addition, bridge site also well optimized by matching better view experience. Such

as, bridges are arranged diagonally for a better view of landscape. User experience design can forecast the user feeling before construction, which is better than pure structure design, which we know how people feel only after build it. Also, conventional design process much depends on designer's experience to think about what is the visitors favorite. On the contrary, user experience design rely on clear logic and optimization algorithm, which is more reliable.

2. Parametric design vs. normal design method

Because of the changeable of parameters, parametric design is a good way to link bridge shape and specific context. For example, we can set a bridge into different site by changing the bridge length parameter, and change the beam height by changing height parameters without modifying the model itself. So that we can use the same serial bridge prototype to fit different situations. On the contrary, conventional design method will be very hard to modify the features. We have to rebuild the whole model totally, as long as modifying the features. So, it's not convenient to do multiple test and find the best result. Also, it cannot easily suit for multiple situations. Moreover, parametric is the foundation of algorithm optimization. Because machine learning which is the basement of algorithm optimization is based on operation of parameters. For example, when we were choosing bridge site, we used bridge axis and either end of the bridge as parameters. Optimization process is by changing these parameters to optimize the best view angle. So that we decide the bridge site.

In this case, we use parametric design in several steps. First, we use parametric method building up bridge prototype models. Then, we deliberate the shapes by changing parameters. Finally, we combine site information and user experience demand then set bridge on the site by using algorithm optimization.

3. Conclusion

In general, user experience and parametric design are all new trials on footbridge design. Both of them are more suitable for nowadays people's demands. After whole process of design, it can be easily notice that the advantage of parametric design in the field of user experience, as well as, reduce workload. Moreover, user experience was the prior factor in design concept. And the bridge is not only a structural construction, but has a tight connection with local context and visitors. What is more important is when they work together, they stimulate each other. There are infinite potential by using that. These two viewpoints should be paid more attention on.