

## ALTERNATIVE DESIGN COMPARATIVE SYSTEM IN COLLABORATIVE DESIGN

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**Abstract.** The evaluation of alternative design sets is important phase for quick design decision and new design conception, and it is repeatedly processed. To proceed design process in standard, the repetition is reduced to minimum. And design must be optimized in limited cost and time. For smooth and fast process lots of alternative design sets are provided within the limit of possibility and it must be evaluated appropriately. It's possible to evaluate alternative design sets using various media. This paper describes the characteristics of various media which have been used for evaluation of alternative design sets, and propose alternative design comparative system based on the findings of case studies.

### 1. Introduction

Design process is a set of activity for refining design and fall into 4 phases such as recognition of problem, alternative design for solving problem, evaluation and selection, and optimization. In other words, design participants must understand the problem of project by analysis of the situation. Then alternative design sets or alternative design idea which can solve the problem is suggested by product maker and/or designer and/or client. Participants select the best out of alternative design sets using a variety of evaluation method. Finally the refining of selected design is processed.

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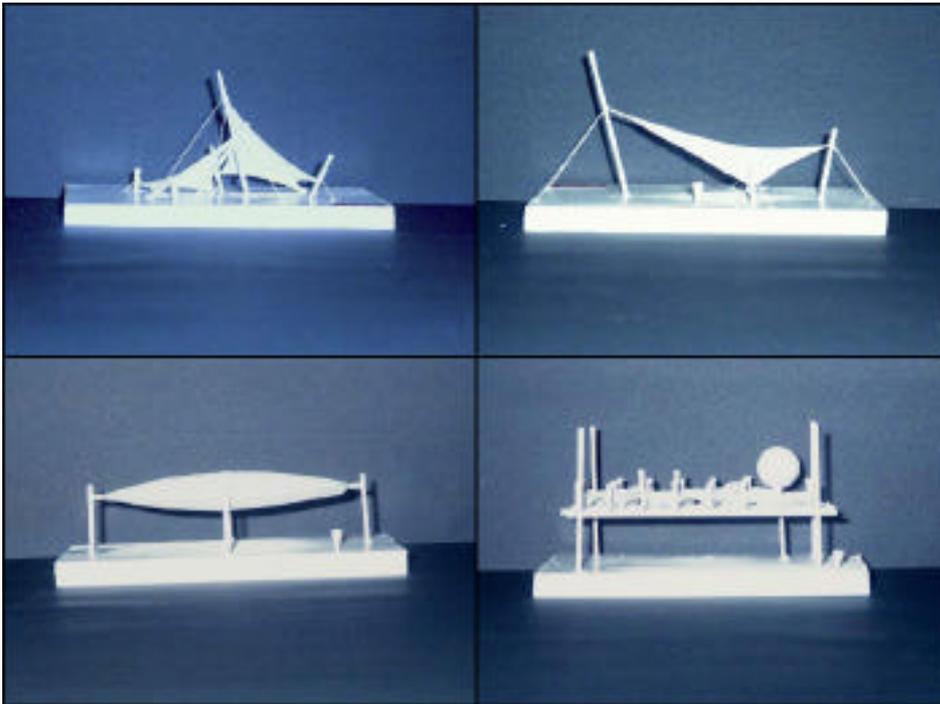
must be optimized in limited cost and time. For smooth and fast process lots of alternative design sets are provided within the limit of possibility and it must be evaluated appropriately. It's possible to evaluate alternative design sets using various media.

This paper describes the characteristics of various media which have been used for evaluation of alternative design sets, and propose alternative design comparative system based on the findings of case studies.

## 2. Evaluation Method of Alternative Design

Sasada laboratory has carried out various projects, and various media have been used for evaluation of design in each phase of design process. The following is a discussion of evaluation media such as model, CG still image, animation and VRML. We applied proper media based on the project specialty and evaluated alternative design sets effectively.

### 2.1. EVALUATION BY MODEL



*Figure 1* evaluation by model

A set of alternative models, Figure 1, was suggested by product maker to decide shape of membrane which was used for resort facility of sand beach in Okura

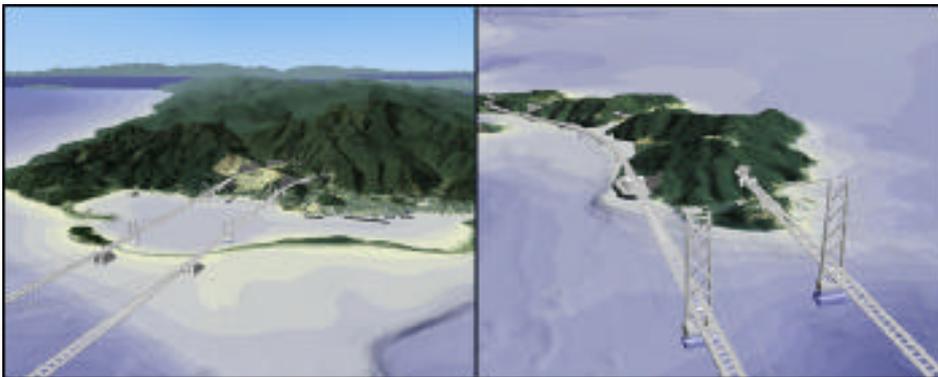
Project. Participants including product maker, designer and design team in Sasada laboratory reviewed these models and did decision making in design meeting. Participants touched models with the hand while reviewed design. After design meeting was over, designer took away selected model to office and referenced it for design.

In this case models are used appropriately for evaluation of design and decision making. Because feature of 3 dimension in model let participants recognize easily the shape of membrane. Also it's possible to examine the membrane from various point of view. Generally model is effective evaluation method when participants verify design object in early stage of design process.

But model is lacking in flexibility of scale. It's difficult to evaluate the relationship between design object and surrounding environment. Also participants can not review it from eyepoint level.

## 2.2. EVALUATION BY CG STILL IMAGE

In Kitan Project we needed to examine route of bridge which would be built across Kitan Straits from proposed sites. When the bridge is built across straits, pier is usually laid in the seabed. If designer examines the route of bridge considering the safety and difficulty of construction, he must grasp the location of pier accurately. For effective evaluation of route, we made CG still image which include topography of site, bridge and topography of seabed.



*Figure 2* evaluation by CG still image

First of all, sets of bird's eye-view of each route were made for proposed sites. The site including 4 islands was very large and had many critical points. It's difficult to compare 2 printed CG still images each other against routes. For solving this problem, we put 2 routes of bridge in same CG still image, Figure 2, and reviewed it from various critical points.

In big project which covers wide area, CG still image is effective for dealing with huge data including topography.

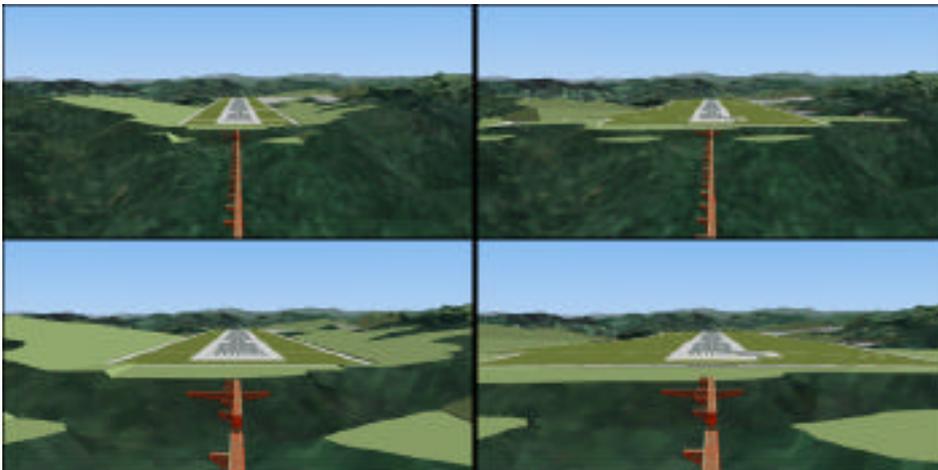
When client reviewed 2 routes at the same time, he asked whether he browse 3D model interactively and review the route from the point of his view or not.

### 2.3. EVALUATION BY ANIMATION

In Harima Project we needed to examine the width of airstrip considering the viewpoint of pilot. We made 2 animations, Figure 3, for 150 m airstrip and 300 m airstrip, and reviewed the safety of airstrip.

When we review the changing view, animation by key frame of viewpoint is more effective than CG still image by specified viewpoint. Animation have been used for effective media in many projects, but sometimes we found problem of initiative. Sasada(1995) describes it as follows. Designers write animation scenario and create animation under their initiatives, the animation strongly reflects the designers' point of view. Sometimes this makes other participants such as clients become irritated because they feel that they are looking at what designers want to show and not what they want to see. For solving the problem, Sasada(1995) proposed the design review system with computer graphics for clients. Using this system, clients can create their own animation their own way.

On the basis of the above discussion, we needed to develop animation tool for clients to use easily and to make simply.



*Figure 3* evaluation by animation

### 2.4. EVALUATION BY VRML

In Okura Project, resort facility was composed of central resting place, east resting place and west resting place. Each resting place was built using 2 membrane roof. Design participants decided to use same membrane except symbol of central resting place. Alternative design sets, Figure 4, was made into VRML according to variation of height and angle. Participants operated alternative design sets interactively and evaluate it one by one in design meeting. Using VRML it's possible to review from various viewpoint including eyepoint if they want to see.

But it was impossible to compare alternative design sets from same viewpoint.

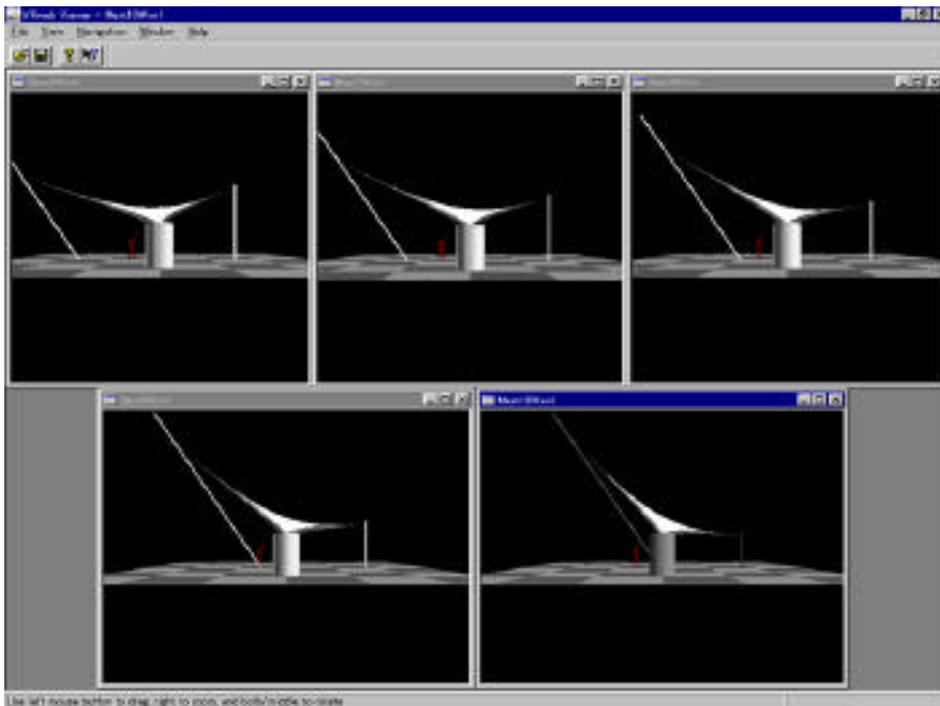


Figure 4 evaluation by VRML

## 2.5. FINDINGS

We found the characteristic of each media through case study and summarized it as follows.

- model: If the shape of object is different, it's easy to compare each other. But if the shape is same but has variations, it's difficult to compare the detail.
- CG still image: It's possible to deal with huge data and to review the relationship between object and surrounding. But it lacks of interaction.

- animation: It's convenient to review the changing view, but time-consuming work. More, participants can see only what designers want to show.
- VRML: Participants can operate alternative design sets interactively and review from various viewpoint. It is need to review alternative design sets simultaneously.

Each media was used effectively in each phase of project, but it have some problems described above. It's required to make alternative design comparative system for solving those problems. The requirements of the system is as follows.

- detail review
- interaction
- effectiveness in time
- synchronous system

Alternative design comparative system is setup using VRML and Java technologies for satisfying those requirements.

### **3. Alternative Design Comparative System**

In Okura Project, when design participants reviewed alternative design sets, they had problem to compare it one another. They wanted to see alternative design sets from same point of view, but it was impossible using VRML only.

In the design of membrane, the height and the angle of membrane are important variables for entire design. The entire atmosphere is influenced to a major degree, though the height and the angel is little changed. Therefore we needed to evaluate many alternative design sets at the same time.

This system let many VRML data be operated simultaneously. Also participants can operate it interactively and review it at the same time. Therefore it will be effective evaluation media in decision making process.

Alternative design comparative system is setup using 3 kinds of methods. The keyword for each method is as follows.

#### **3.1. USAGE OF LIVE CONNECT**

The system is composed of VRML, VRML Controller and Controller. VRML Controller is made using Java applet and Controller is made using Java Script. VRML Controller(Java applet) control VRML, and Controller(Java script) control VRML Controller.

Live Connect enables communication between javascript and java applets in a page and in different frame. In javascript, java packages and classes are properties of packages object.

But its operation is little cumbersome. If participants operate it continuously until they find desired point of view, they must push the button click and click like a game machine. It's needed to change the method of communication between VRML Controller and Controller.

### 3.2. USAGE OF JAVA TO JAVA COMMUNICATION

The system is composed of VRML, VRML Controller(Java applet) and Controller(Java applet). The communication between VRML Controller and Controller is accomplished by sending control command.

If any button of control panel on Controller is pushed, the message of information is transmitted to Manager Class. Manager Class control the movement of VRML simultaneously.

Comparing Live Connect, it was easy to operate. During the button is pushed, participants can browse alternative design sets simultaneously. Participants easily found their point of view with this method.

### 3.3. USAGE OF NETWORK COMMUNICATION

The system is composed of VRML, VRML Controller(Java applet) and Controller(Java applet). The communication between VRML Controller and Controller is accomplished by sending control command through TCP/IP protocol. This system is developed for communication between remote participants.

Proximity Sensor of VRML2.0 generates events, reporting the navigator's new position and orientation every time that information changes. By routing the eventOut fields of the Proximity Sensor to Scripts or other nodes, the scene author can track a user's movement in the scene and react accordingly. Using this method server can send the data of view point and key frame to client on network. More, it's easy to make animation by connecting key frame. Using this method, remote design participants can share the same virtual space and review alternative design sets at the same time.

### 3.4. RESULTS

Participants can review alternative design sets simultaneously and decide the best plan quickly with proposed system. They are unanimous in their approval of the plan. This system, Figure 5, let participants browse 3D space interactively and review the design from various viewpoint.

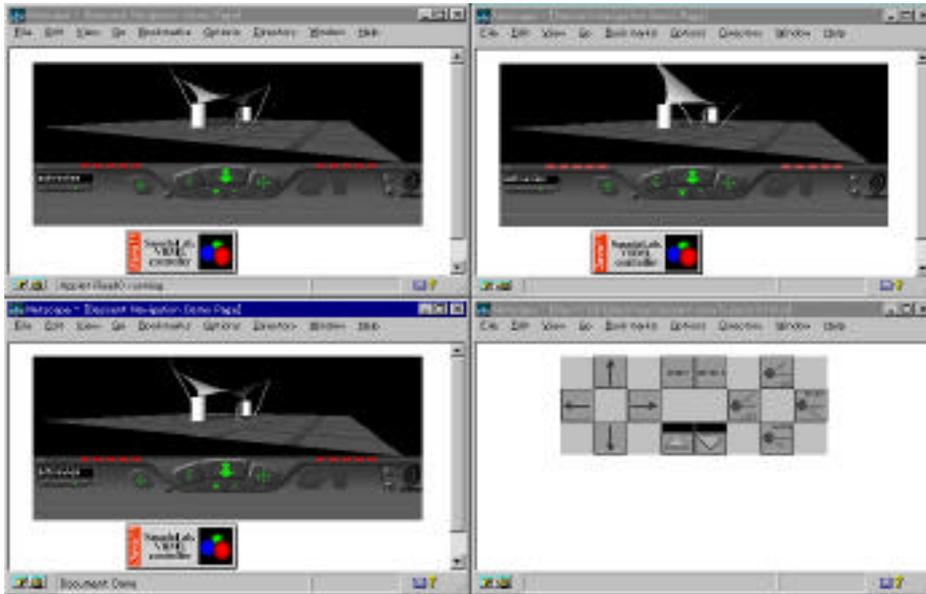


Figure 5 Alternative Design Comparative System

#### 4. Conclusion

To proceed design process smoothly it's needed to find various alternative design which can solve the problem of project within limited time. Also how to evaluate alternative design sets is important.

In various projects, various media have been used for evaluation and each decision was made timely and adequately. According these experience it's desirable for designer to have the ability and attitude of applying appropriate tools and of developing tools for requirements of project. We found that the development of tool, if they are needed, in design process increased the effectivity of design work in Okura Project.

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