

# VISUALISING BY MEANS OF ENDOSCOPE, COMPUTER AND HAND-DRAWN TECHNIQUES

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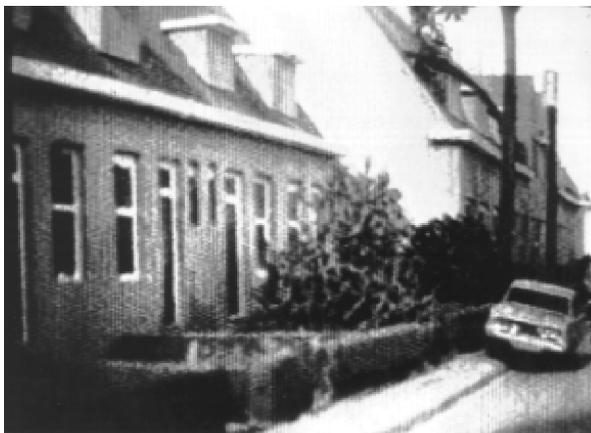
Traditionally, communication during the various stages of the building process takes place via drawings of floor plans, elevations, perspectives and scale models. Computerized drawing techniques have recently come into use. Ways of presenting designs have increasingly become of far-reaching importance in current architecture.

Nowadays architectural firms employ specialists who are familiar with the latest developments in the field of presentation techniques, or they farm this highly significant part of their job out to gifted designers. Some of the new techniques being developed endeavor to provide a more realistic presentation of designs of housing estates. Apart from new drawing techniques, mention should also be made of the endoscope, an instrument which can simulate an eye-level tour around a scale model while recording it on videotape. Realistic representations differ quite a lot from the conventional architectural presentation techniques applied, which require a larger amount of imagination on the part of the onlookers.

The afore mentioned architectural notation systems, on the one hand, can only be understood by experts, in spite of added explanatory signs and symbols. The often used models and artist's impressions, on the other hand, frequently create a somewhat distorted view, due to lack of concern for spatial proportions. As a consequence, the design presented and the actual architectural realisation may turn out to differ widely.

To bridge the widening gap between the experts and the users, clients and government officials, research concerning architectural representation is needed.

*Figures 1 - 3  
A comparison of different  
techniques to produce a  
realistic picture of a  
building project: video-  
endoscope recordings,  
perspective drawings and  
elevations, among others.*



In 1990 a Dutch scientific journal, issued by The Delft University, published an illustrated report of research findings under the title *Overdracht en Simulatie* (Information and Simulation). The article gives a description of a pilot study carried out by a research team (Van Der Does, Van Haaften, Kegel and Vrins) to assess and evaluate various presentation techniques used in architecture. This study was just a first step towards a more detailed follow-up study, to which I shall come back after having given a summarized view of the pilot study.

### **OBJECTIVE OF THE PILOT STUDY AND RESEARCH QUESTIONS TO BE ANSWERED**

The objective was formulated as follows: A research study into the requirements and merits of realistic eye-level simulation in architecture by means of video-endoscope recordings of a scale model, as compared with: a) video pictures of building projects and b) simulation through other techniques.

Furthermore, we supposed that within certain limits moving video pictures would be the most suitable technique to produce a realistic picture of existing or of planned building projects. We were able to record a "walking tour" of an endoscope through a scale model on videotape.

The first question to be answered in our study was: Which elements of scale model and video recording are essential to obtain pictures which come sufficiently close to the real situation?

To evaluate and compare the various techniques, factors of motion, photorealism and colour had to be varied. The perspective drawings and photographs of the same situation, which were made to serve as material for comparison, gave rise to a second question: Which set of photo's, slides and drawings are fit to be used as reference material for a comparative study of the value of the video-endoscope technique and what is the best way of presenting them?

To answer these two questions it was necessary to carry out first a separate predominantly technical and experimental study. Only after that would it be possible to examine what use the various techniques have for the users. Two further questions could be derived from the foregoing ones, completing our research problem.

Question 3: What merits and demerits does the video-endoscope technique have for those involved compared with other realistic eye level simulation techniques?

Question 4: How detailed should this simulation technique be to give those involved a picture which is about as accurate as video recordings of the real situation?

A research plan was based on these four questions, consisting of two parts. Part I of the research was concerned with examining in which way video-endoscope recordings of a model (scale 1 : 200), representing an existing situation, could be optimized so as to produce recordings which were nearly as good as video recordings of the real situation. To this end, video recordings were made as well. The colour scheme of the scale model, choice of the right objective, exposure and focussing, as well as motion used for video recording were step by step brought into mutual coherence. Slides were made from the "stills" and these were put into a sequence of pictures to be compared with the videotaped tour the endoscope had made around the scale model.

At the same time, the original blue prints made by the designer of the residential area in question and its surroundings were used to make easily readable floor plans, cross sections, elevations and perspective drawings, both in colour and in black-and-white.

Using the above, we discovered which technical requirements were essential in the optical system, visual recording techniques, colour rendering and exposure time, and question 1 of our research problem was solved. By indicating the procedures used while selecting the reference material of sets of slides and drawings to be compared with the endoscope, question 2 was answered.

We felt that the results of our experiments with various presentation techniques gave satisfactory answers to the first two questions of our research problem.

In Part II of our study we made use of the results obtained in Part I. We tried to get a broader insight into the merits and demerits of the various techniques and the amount of detail required, by posing a set of questions to approximately 900 subjects (699 laymen and 207 experts).

There were two main groups of subjects: laymen/residents and architects/experts. The sample was randomly divided into small groups, consisting of 15 to 30 people. Each group was confronted with only one presentation technique. The technique was tested by comparing it with the real situation. In addition to that, the techniques were compared with each other. They were arranged schematically in such a way that two techniques, placed side by side, differed only in one element. Some of these elements had to do with technical properties: movement, immobility, drawings in colour and black-and white, and photography. Other elements had to do with diminishing degrees of realism: the real situation, detailed simulation and two-dimensional projection.

Information concerning the merits and demerits of the various simulation techniques was obtained on the one hand by comparing judgement scores with scores pertaining to the real situation, and on the other hand by a comparative analysis of the expertise, time and equipment needed for the various techniques. In this way, comparison of the costs involved was possible, to supplement the comparison of judgement scores.

## **VREEWIJK, THE RESIDENTIAL AREA STUDIED**

The locality selected for our study was a residential area, designed by the architect Granpré Molière. The selection was made on the following grounds: architecturally the site shown should present a familiar picture; no preconceived views, or at least hardly any, should be called forth by the site shown.

Therefore areas that were either very urban or very rural, and areas that were either historic or very modern had to be discarded. Eventually, a small and remarkable part of the Rotterdam garden suburb Vreewijk in The Netherlands was selected.

## CONCLUSIONS FROM THE QUESTIONNAIRE SURVEY

Our hypothesis concerning the semantic differential was that the closest resemblance to the *emotional response* elicited by the real situation would be produced by the simulation technique with the highest number of properties. Our hypothesis was confirmed by the outcome of the questionnaire. However, the technical variables of motion, photographic rendering and spatial factors were hardly of any consequence.

The conclusions from the first part of our research may be summarized as follows: When the optical principles of the camera (lens angle and distance) are meticulously applied and the colours of the scale model are faithfully rendered, with shades of colour temperature and brightness corresponding to those of the real situation, a video-endoscope recording of a detailed scale model is just as able to convey *factual information* and to elicit *emotional response* as videotape recordings of the real situation.

The technical factors of motion, photographic rendering, and perspective proved to have hardly any influence on *emotional response*, but using realistic colours and providing ample details turned out to play a very important role indeed.

Our hypotheses concerning information were more elaborate than the foregoing one, because relevant literature provided more suggestions and empirical facts. In analysing the information test we found that in some cases our results did correspond with these empirical facts and in other cases did not.

In communicating *factual information* (assessment of spatial dimensions) motion and detail were in fact found to be important factors, but colour is of minor

importance, while photographic rendering and perspective are still less important.

With respect to *communicating information* in general our conclusion was as follows: videotape recordings of a scale model in which the colours and further details are correct is a more effective method of giving information (in particular where spatial dimensions were concerned) than the other methods tested.

However, as far as *emotional response* is concerned, coloured and detailed floor plans of good quality, cross sections, and elevations are all hardly inferior to detailed endoscope recordings (either on videotape or on slides) and to perspective drawings.

As expected, the scores of experts are in general higher than those of laymen, but surprisingly their *emotional response* to uncoloured drawings deviated even more sharply than that of laymen.

In considering these results in relation to the costs of the various techniques, a clear notion of the purpose of the presentation should be developed first, before deciding on the presentation technique to be used.

### **COSTS CONSIDERED IN RELATION TO AN EFFECTIVE COMMUNICATION OF EMOTIONAL AND FACTUAL ASPECTS**

The costs of the various techniques tested in our study differ widely. The following ratios can be given: A set of black-and-white projection drawings is the cheapest technique. The same set in colour and a set of black-and-white perspectives each cost twice as much. A set of coloured perspective drawings costs three times as much. A set of coloured slides of the detailed scale model made from stills of the videotapes costs eight times as much. Finally, video-endoscope recordings cost nine times as much.

Obviously, in making a choice quite a few things should be taken into consideration. To mention some: the aim of the presentation; the size of the group for which the presentation is intended and the method used for the presentation; the planning stage of the building project;

available funds (in general, the financial scope of larger projects is much greater); the comparatively low costs of video copies.

## **EVALUATION AND RECOMMENDATIONS FOR FOLLOW-UP RESEARCH**

When we started our research project the picture we had of the situation was very incomplete and was based on data from predominantly outdated cases and ill-founded earlier research. We were primarily interested in optimizing the video-endoscope technique. We were indeed able to introduce quite some improvements in this as well as in other techniques, as can be read in part I of our research report. In the second part of our project we learned more about the usefulness of the various techniques compared with each other. We focussed, more than was done in earlier research, on the communication of factual information. We reviewed earlier predominantly exploratory and descriptive research, we placed it in the context of the current situation and sought for a more analytic and experimental approach. We feel that follow-up studies should continue in this same direction. We have paved the way to a closer evaluation of one or more of the various techniques. Other techniques, too, should be included in new research. A comparison of techniques tested in the present study with modern techniques, such as computer simulation, seems expedient.

I promised to come back to our follow-up study due to be published this autumn under the title *De Techniek van het Verbeelden* (The Art of Representation). An abridged version will be published in English provided that the number of interested people is sufficient.

The present lecture was announced as "Visualizing by means of endoscope, computer and hand-drawn techniques." Until now I focussed mainly on our research, with emphasis on examining the usefulness of the endoscope technique and photographic and drawing techniques. I will turn now to a comparison of the computer technique which applies CAD with two of the techniques

tested in our first study. This computer technique was now given a central place between video-endoscope recordings and coloured perspective drawings, both of which had scored favourably. The technical aspects and the position of computer technique could now be given special attention. As far as we know, no research has yet been done in *the emotional and factual* effectiveness of computer rendering, nor has any comparison been made between its effectiveness and that of other techniques.

This time our research problem was formulated as follows: How do computer renderings of projected housing complexes compare with video-endoscope recordings of a detailed scale model and with coloured perspective drawings of these same complexes?

Again, we were interested in emotional and factual effectiveness, taking into consideration the real situation, the size of the project and the cost.

This time the research plan was somewhat less complicated. Three persons were asked to make, independently from one another, each one simulation on the basis of the same information provided by blueprints (scale 1:50) of an architect's final design, respectively by means of: computer renderings; a detailed scale model (scale 1:200); and perspective drawings in colour. Information about the colours and the materials which the architects intended to use was also provided.

In this research project, the degree of detail the computer could render depended on the availability of viewpoints from which to produce perspective pictures. Moreover, objects had to be rendered in a somewhat simplified way. Our forthcoming study will go into particulars.

We tried to employ only those devices which are (or in the near future will be) available to any small or medium-sized architectural firm. Again, more information regarding this will be given in our study.

Both the expert who made the computer rendering and the specialist who took care of the coloured perspective drawing looked at the design at eye level and from the same angle.

The project in question was built in the early part of 1992, and the simulations were prepared, independently from one another, in that same period. After completion of the building project, when the real situation could be used, the questionnaire survey was conducted.

Mixed groups of experts and interested laymen were asked to participate. All subjects were involved with public housing in one way or another. Altogether, there were 222 subjects, divided into four groups, each group numbering about 50 members. Each of the four groups was shown only one of the presentation techniques: either the computer rendering, or the video endoscope recordings, or the drawings, or photographs of the real situation.

In preparing the production, each presentation technique had its own characteristics and variables and aspects of rendering. The set of computer renderings, shown on video, and the video-endoscope recordings were arranged in such a way that both took the same path. Semimovement was created by means of cross fading. As computing the effects of sunlight and reflection would require a great deal of extra time in the computer rendering, we decided to leave out shadows and reflections in the computer image, and, for reasons of comparison, in the scale model as well. Routing could not be arranged for the coloured perspective drawings, five in all. But we did apply in this technique the effects of sunshine and shadow. The photographs of the real situation, size 18x24 cm, were displayed on a series of placards, placed side by side. All simulations and the photographs of the real situation presented eye level views.

The first comparison was concerned with scores of *the emotional and factual* responses of the various presentation techniques and a comparison of these scores. The second comparison was concerned with *the effectiveness of the technical realization* of the three presentation techniques. Each presentation received a separate score.

In this research project each presentation technique was primarily developed in such a way that it came as close as possible to reality. In evaluation question A: *the*

*technical evaluations of the simulations* were scored separately and compared after the subjects were confronted with *the real situation*. In evaluation question B.: subjects were confronted with the three simulation techniques, comparing them with the real situation which had been shown to them previously; the techniques had to be rated in *order of preference*.

There were several types of questions: questions intended to evoke *spontaneous* reactions, questions concerning *emotional response*, questions about *factual aspects*, questions about technical aspects and questions concerning *evaluation*. Limited space does not permit me to go into the exact details.

Both with respect to questions about emotional response and to those concerning factual aspects, the experience gained in our pilot study proved very helpful. Expectations, too, were now easier to indicate. We expected that the computer renderings would come closer to the video-endoscope recordings than to the drawings, due to the simulated semimovement. We also expected that computer rendering would score better than drawings as far as an accurate perception of the elements and proportions of the buildings are concerned.

While preparing this lecture, the end results with definite scores of emotional and factual effectiveness of the various techniques were not yet available. I therefore shall have to restrict myself to the answers given to evaluation questions. Only preliminary conclusions can be given, as further interpretation still has to be done. Answers to questions intended to evoke spontaneous reactions, to questions about emotional response, and to questions about factual aspects, are still being processed. I have to leave them unconsidered at the moment. As for the preliminary conclusions, they have to do with a comparison of scores obtained from answers concerning judgement or classification of presentation techniques.

We found that computer renderings are invariably rated as of *moderate value*; drawings invariably yield *high scores*; video-endoscope recordings of the scale model yield high scores when questions about techniques

*Figures 4 - 6  
A comparison of the  
computer rendering of a  
housing complex with the  
video-endoscope  
recording of a detailed  
scale model and with a  
coloured perspective  
drawing of the same  
complex.*



focus on emotional response and *moderate scores* when these questions focus on factual aspects.

As for working hours needed in each of the three presentation techniques, the following facts can be given: the draughtsman needed 96 hours for his presentation drawings; the specialist who took care of the scale model needed 300 hours; and the computer expert needed 360 hours to produce computer renderings.

In conclusion, I would like to show you three short videotapes of the simulations which were shown to the subjects in our study. The first one is the set of *computer renderings* made of the designed complex complete with the already existing surroundings, showing a sequence of dissolving pictures arranged according to a programmed path.

These same data were subsequently simulated in a *scale model* on the basis of blueprints made by the architect and slides made from the existing buildings, recorded on videotape by means of the endoscope of the Department of Public Works. The Delft Faculty of Architecture was at that time awaiting the arrival of the newly developed colour endoscope camera with a system of interchangeable lenses and with higher photosensitivity.

The third videotape is a recording of a *walk through the same street*, made by a cameraman of the Dutch Broadcasting Company with a Steadycam camera. You are shown the real situation of the street and the completed building complex.

