GRAPHICS IN URBAN DESIGN – POSSIBILITIES OF HAND-DRAWN IMAGES AND COMPUTER TECHNIQUES

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Abstract

The paper deals with the issue of graphic representation in urban design as an artistic and technical field that is symbiotic to the field of architecture. The basic expression instrument of urban design (spatial planning) is the projection of 2D. The ability of an urban designer or urban planner to adequately present a design is, therefore, an element of the creative process that should be acquired during higher education. The aim of the research was to reveal the key parameters influencing the resulting effect of graphic processing of a masterplan drawing and a perspective drawing from a human perspective, as a typical urban expression element. The paper focuses more closely on examining the differences between hand based and computer graphic processing. A set of categories for a masterplan drawing and perspective views has been summarized for the purposes of research, which has been used to evaluate a sample of student works. The key research methods of data evaluation are comparison and correlation analysis. The results of the research summarize the advantages and the disadvantages of the hand based and computer graphic processing and the key graphic mistakes made in urban design students proposals.

Keywords: **Computer Techniques; Graphics; Hand-drawn Images; Masterplan; Perspective View; Urban Design.**

1. INTRODUCTION

The subject of this paper is the quality of the graphic processing of the urban design as a key part of the architectural and spatial planning work. Virtually all architectural and land-use planning is currently based on the 2D projection of the design. "Building manuals tend to present building structures in the form of one-dimensional reference drawings, either as projections or cross-section drawings, which is after all, the form they should be, and are usually shown, in design drawings" [1]. The art of knowing how to represent your design appropriately should be learned by each archi-

tect (urban designer) during his college degree. Graphic processing as the final product of the work of an architect and urban designer has a major impact on the interpretation, acceptance and success of the urban design. For these reasons, it is necessary to continuously deepen the theoretical knowledge in the field of graphic processing and their subsequent application to the pedagogical process in the preparation of new graduates for the needs of the practice. The aim of the research was to reveal the key parameters influencing the resulting effect of graphic processing of a masterplan drawing and a perspective drawing from a human perspective, as typical urban expression instruments.

The work is structured into four basic parts – theoretical analysis of the problems, methodology, results and their interpretation and recommendations for practice.

The theoretical analysis of current knowledge focuses in general on graphics in urban design, in the second part the focus is on defining the current framework of key advantages and the shortcomings of computer and hand based processing techniques with emphasis on the educational process.

"Urban-architectural drawing is largely about the art of suggestion" [2]. The notion of graphic design in urban planning represents an extremely wide range of varied graphical representations in the context of land-use planning documentation of a different purpose and scale. For research purposes, the field of interest has been narrowed to one of the most frequently used urban drawings – a masterplan at a scale of 1:1000 and a perspective view from the human perspective.

"The plan drawing allows an understanding of entrances, access, and movement across or through a site, as well as important adjacent locations and buildings or structures" [3]. "Perspective drawings are necessary to verify the idea with regard to both the ground plan and the section in the spatial layout. While the floor plan helps to create space, only a perspective view can create an impression from this space" [4].

A specific controversy among experts raises the question of confronting computer and hand based techniques of processing graphic documentation. On the one hand, there is a general need to adapt to the conditions of current technologies [5], on the other hand, the importance of hand drawing technique cannot be forgotten. Every technique has its advantages and disadvantages. "Man and computer have different complementary abilities. The human mind excels in recognition schemes in the assessment of complex situations and has the intuition to create new solutions. The computer excels in analysis and numerical calculations" [6].

The methodology of the research is based on the evaluation of student work through a theoretical analysis of derived categories. The methods of comparison and correlation analysis are used to help to answer key research questions: What are the most common issues of graphic processing students have to deal with and what could be improved? Does it have a major impact on the graphical presentation of the project, whether the student is using hand based technique or computer technology?

The results of the work bring new knowledge, which is also summarized in several recommendations for practice, but especially for the needs of the educational process at faculties of architectural focus.

Figure 1.
Masterplan 1:1000, Eye-level perspective (without scale). Authors: Lešková, Ladacsi, Štefancová

2. THEORETICAL BACKGROUND

2.1. Graphics in Urban Design

Urban design covers a wide range of visual presentations ranging from the scale of the region, city to zone scale and public spaces. All these measures require a special graphical approach. The elementary part of the documentation at each level is an overall masterplan with all the attachments. Graphic design at scale 1:1000 – 1:2000 is probably the most favoured among the urban studies design. The graphical form at this level balances between the diagramatical detail level of the whole city region, regional scale and the detailed solutions of the public spaces, which creates the ideal conditions for the application of special graphic expressions. One of the most distinctive zoning level scale attachments is the perspective view from the human level (Fig. 1). Both representations are able to express the urban design at varying scales, details, and impressions, and complement each other (Table 1).

"Masterplan typically includes a series of themed drawings which together define the principal elements of a proposed development. These may include land use, built form, roads, communications, surface drainage, open space or landscape structure and construction phasing" [7]. The level of detail will depend on the purpose of the plan. Some are intended to stimulate development by presenting a vision, others are working documents that will guide successive stages of a commitment to development already made. Some masterplans are diagrams explaining key development principles, others are illustrative plans, as below, portraying the indicative layout of built forms and open space. How detailed the masterplan depends on its scale. In typical urban design student's work, the scale is 1:1000, or 1:2000. "Although only general structural aspects about traffic, uses, building forms and open spaces can be recognized in an illustrative site plan 1:1000. It already allows aspects such as roofs forms, lot boundaries and basic statements about the design of outdoor spaces and public thoroughfares to be depicted" [8].

"The plans are normally oriented with north at the top, and shadows can enhance the sculptural effect of trees, topographical elements and buildings. Elements like vegetation and bodies of water are usually depicted in green or blue tones approximating their natural colours. Streets and squares should not be too dark because otherwise, they tend to visually shift to the foreground. Using different line thicknesses helps to establish a hierarchy of the elements of the design. The more important the item, the thicker its outline should be. If the light-dark contrast of all elements is insufficient and they merge together when viewed, the depiction must be revised" [9].

"The graphic representation of the plasticity of the urban structure, especially in typical urban scale 1:2000 and 1:1000, has a wide range of expressions in integrated systems or styles or in partial combinations with the expression of each component alternatively. A well-thought-out match of all elements can feel harmoniously and in accordance with the concept of your own solution. The most important graphic means of expression are contour lines, water areas, greenery, architectural objects, pedestrian areas and trails, roads and parking, or tramway route. However, not all of these can be applied equally in a diverse urbanization environment with varying proportions of artificial and natural elements" [10].

In addition to considering the representation of individual components, it is equally important to consider the optimal way of graphic expression – processing technique. We currently have a wide range of hand and computer techniques to choose from. Each of them gives us the possibility to choose different colour interpretations. „Black-and-white drawings are sometimes more evocative than coloured plans, as more is left to the imagination. These images can inspire contemporary interpretations" [11].

Eye-level perspective is a typical vision of a space from the visitor's view.

This type of perspective expression is being used most often "because it documents the actual space and massing effect of the displayed architecture" [12].

It shows mainly ambience, character of places and sense of scale between buildings. "Perspective drawings generally refer to the graphically demanding attachments of the documentation, and their utilitarian function in drawing documentation is often not appreciated" [13].

"Perspectives and visualizations provide help in reading and understanding the design, especially for laypeople. The pedestrian's view illustrates the qualities of the open space, while the buildings remain relatively generic" [14]. "The format of the picture plane is important. Horizontal drawings with a ratio of 3:8 are generally best used to convey a landscape design. This shape, as well as being a dynamic proportion, tends to concentrate the mind on design by reducing the amount of paper dedicated to foreground and sky" [15].

"By choosing viewpoint and scene, the author can deepen his or her architectural and urban design by drawing attention to the structural detail he/she considers to be the most characteristic and is not sufficiently defined in the 2D drawing of the masterplan. The urban design perspective principle is to remain its level of awareness of the issue that is documenting in order to depict the basic mass-space design solution in a simple cubic way. The range of detail and staffage is chosen to specify the scale and functional use of the environment. Sometimes it is appropriate to use the staffage more significantly in an effort to characterize particularly lively environment full of traffic, life and people" [16].

„When sketching perspectives, the standpoint must be chosen in a way to avoid the similar distortion of the surfaces, the same convergence of lines, to achieve enough contrast and space in the drawing to avoid accumulation and overlapping elements – clarity of the artwork. In the drawing, we move from overall to detail, and we select the level of detailing according to the scale of the displayed space. Usually, we are also interested in the environment, and therefore we enhance the perspective view with greenery, trees, grassy and water surfaces, human figures, transport means, and so on. The drawing must be simple to support the composition" [17].

"The hand-drawn perspective remains a very effective way of conveying the intended character and feel of places, yet to be designed in detail, as they might be experienced at street level. It is familiar to most audiences giving an understandable impression of what is intended without having to resolve the architectural and landscape detail. Computer generated wire-frames or photographs are often used as bases for the drawings" [18]. A Higher level of the hand-drawn sketch is an urban sketching. "Urban sketching is a raw and pure form of art that requires drawing from life, rather than from photographs or the imagination. Behind each drawing is a story of what is happening before our eyes" [19].

2.2. Advantages and Disadvantages of Computer Graphics and Sketching in Educational Process

Nowadays, when computers have become an integral part of architectural and urban practice, the question of the use of hand based technique design remains alive. These two different ways of processing the documentation go into direct confrontation, each having its supporters and opponents, their pros and cons (Table 2).

At present, computer design is preferred by most practicing architects and planners in the final design process. "The media usually portray architectural design as consisting of fancy visualizations, and the sketch is marginalized" [20]. Even strong advocates of sketching recognize the benefits of computer technology. "The computer undoubtedly greatly accelerates most aspects of architectural work and, together with being a tool of accurate and fast drawing, it is being used for analysis, testing and 3D prototyping before construction of the project itself" [21]. The need to respond to modern trends also resonates on

Table 1.
Content advantages and disadvantages of the master plan and the eye level perspective (inspired by Meeda, 2006: 41 and added by the authors of this paper)

	Masterplan 1:1000	Eye-level perspective
What it shows	• indicative built form and blocking • landscape structure • urban grain and orientation • overall character • morphology • hierarchy of city axes, streets, public spaces • active places – playgrounds, sport spaces • functional and operational structure	• intended character of places • accents and dominants of space • indicative building form without detail • ambience instead of architecture • sense of scale between buildings • life between buildings by using people, animals, cars, buses etc. • illustrates specific urban-architectural details
Why it is graphically right	• proposed buildings are shown with shadows • all extraneous detail removed • trees and vegetation have a hierarchy • drawn to a level of accuracy that is measurable – all extraneous detail removed? • showing the whole urban proposal	• bright colors and contrast enhance the energy and positive ambience of the image • a mix of people and uses emphasise the importance of activity to the success of the new place • user-friendly and accessible view • explains specific solutions

the academic ground. Uhrík and Špaček [22] are of the opinion that the aim of contemporary architectural education should adapt to today's state of the technology, focusing on digital technology as a basic element, but they add that technology can not be separated from the creative process – human must be a creative element, computer should be an analytical element.

Although computers have become an integral part of architectural creation, "all practicing architects are forced to sketch, at a very least when on site or when dealing with a client, because it is faster to draw a detail using pen or marker than a computer" [23]. Therefore, care must be taken to prepare students for both forms of graphic processing. "For an architecture student, it is important to know how to sketch by hand and use digital programs and to know when to use them. These are not mutually exclusive, sketches are sketched in the beginning, and computer models are formed later. The benefits of digital artwork are the facts that when design changes, one does not have to rework the entire artwork and the software can work with the model and evaluate data such as shadows, lighting, structure, and so on. The drawbacks of digital artwork are its time consuming and treacherous difference in the scale between paper and computer screen" [24].

But it's not just the speed of creation, or the perhaps better understandable drawing format that makes the sketch unique. The ability to be creative with the use of computer technology without prior experience with manual technique is questionable. "Denying the benefits of a computer would be a poorly educated and damaging opinion. ... At the same time, despite the recognition of the computer and digital technologies, we need to identify ways in which they differ from previous design tools. We need to consider the limitations and problems that they may pose, for example, to the mental and sensual aspect of the work of the architect. ... A hand with a charcoal pencil, pencil or pen creates a direct connection between the object, its expression and the designer's mind. A hand-drawn sketch, a drawing, or a physical model are created by the same mass of physical weight as the proposed object they embody, while computer operations and imagination take place in a mathematical and abstract world" [25].

Hand based technique as a natural act of embodiment of the human imagination has been there for thousands of years, and we can assume that the development of this ability still has a major impact today on our imagination and creativity. As Pallasmaa states: "... each act of sketching and drawing creates three different sets of images: a drawing that appears on paper, a visual image recorded in the memory of the brain, and the memory of the drawing itself" [26]. The unsolved question remains whether equivalent interconnections between the brain, the mouse, and the computer itself are taking place when creating computer processed images.

Hand based creativity also appears to be a necessary prerequisite for mastering and understanding the scale and the abstraction in computer based graphical processing. "The drawing is a code that can be understood, read and used by those concerned. Simulation, coding, scale and abstraction demand the selection of information to be included in the sketch drawing. Only the essence can be shown. The drawing constitutes a composition of a designed and reduced reality" [27]. Ability to draw, similarly to other skills, requires long training. Although the hand is not perfect, it fulfils an important role of uncertainty, which is completely neglected in today's pedagogical philosophies and methods. The relation between the whole and the parts – in hand drawing or modelling, there is a two-way relationship and a dialectical continuum, on the other hand, the PC in its perfection tend to create the impression of fragmentation and discontinuity [28].

Hand based creativity and design are undoubtedly of a fundamental educational nature and its full acquisition should precede the acquisition of computer-based design experience. Perhaps the ignorance of this requirement may cause a gradual degradation of the graphical expression, which now takes the form of over-detailed photorealistic processing on one hand and often primitive diagrammatical views on the other. "In our modern society we become less and less critical of architectural drawings, taking computer-generated perspectives for granted as the default method of architectural illustrations. Too often these images do not stand up to scrutiny, and are constructed with insufficient attention paid to vanishing points and sightlines. Continuing development of computer software has changed method of sketching skill, and it is now relatively easy to create perspectives, or plans, of a scheme" [29]. But an important communication role remains for perspectives drawn by the architect, where the benefits of being able to produce a freehand perspective should not be underestimated. It is intellectually dynamic to watch an idea drawn up quickly in 3 dimensions, and semi-realistic views often help steer the concept at a fast pace in the early stages of a project when ideas under for-

Table 2.
Comparison between hand-drawn images and computer graphics – strengths and weaknesses (inspired by Meeda, 2006: 14 and added by the authors of this paper)

	Hand-drawn images	Computer graphics
Strengths	• quickly communicating simple ideas • emphasizing the provisional status of proposals • create a unique personality • Explaining concepts without being over-precise • conveying the ambience and vibrancy of a place • encouraging participation – tools and materials are inexpensive, and usable by all	• accurately mapping information • presenting definitive solutions • simulating complex views • making changes easier • storing and retrieving many complex images • linking to external databases and information • replicating and transmitting information to others • photorealistic renders
Weaknesses	• may not be accurate • not easy to update drawing in series • changing views or designs generally means redrawing • can lack clarity • limits the collaboration within the team	• can be expensive to set up • difficult to share access • have a finished/revolved visual feel • extensive training may be required • systems failures can be difficult to handle • limited by available software tools

mation are fragile and can be subject to misunderstanding.

Insufficient learning of hand-made work is also felt by students: "Being the head of fine arts institution gives me the chance to see student's drawings all the way from their entrance exams up to graduation, and when I asked architects, teachers and students what students of architecture lacked most of all, the unanimous answer was: the ability to create a quick sketch, to formulate basic ideas through a drawing, to formulate space, floor plans, details, etc. in a clear and simple manner" [30]. "Working sketches and sketches of building details are often incomprehensible to a person other than the author himself, and therefore they do not appear in publications and the authors themselves have no reason to hide and publish them. It is also obvious that the sketches answer the habits of the work of each architect. The sketch is a very personal tool and the handling of it corresponds to that. Some architects like to present their sketches, others keep it hidden for themselves from the world" [31].

Some authors feel the computer era crisis so intense that they even tend to think that sketch should not be replaced by a computer at all. The perspective sketch is an established way of depicting one's vision of spatial dimensions, which should not be deformed or replaced by mechanical axonometry.

3. METHODOLOGY

Research of the graphical processing of students works focuses on urban design within the subject Urban Design Studio I. Teaching of urban design at the Faculty of Architecture of the Slovak University of Technology is an integral part of the field of study Architecture and Urban Design. As part of the study programme Architecture and Urban design at the First level (bachelor) of the study, all students undertake multiple urban design related subjects by which effort is escalated in Urban Design Studio I. In this class "students are introduced to the issues of conceptual creative skills in urban and architectural design via a small scale residential zone design." [32] The studio as such is generally the place where students develop aesthetic sentience that is closely related to graphic expression. Cho [33] talks about design studios as a place where students embrace aesthetics acquired in other subjects, open their eyes and are exposed to new aesthetics, learning to confront their aesthetic perceptions with consultants. In Urban Design Studio I. students work in pairs under the guidance of their teachers. The design develops gradually from the analysis of the solved area, through initial proposals to the final concept and its presentation.

Urban Design Studio I. subject was chosen because it is a studio at the first (bachelor) level of study where we can usually find both computer-processed and hand-sketched works. This makes it possible to compare hand processed projects with projects already processed on the computer (this would be hardly pos-

Table 3.
Table diagram of the procedure

no.	part of the procedure	explanatory notes
01.	selection of urban design students proposals based on the evaluation	"A" grade only
02.	selection of the 10 proposals	5 sketched and 5 done by computer
03.	selection of the researched outputs	masterplan (M = 1:1000) and perspective views
04.	creation of set of criteria – evaluation factors	based on the theoretical background
05.	evaluation of all outputs from the perspective of the chosen criteria	average of 3 independent experts
06.	correlation analysis	between the results of the different categories
07.	interpretation of the results	focused on the most remarkable findings
08.	recommendations for practice	possibilities for improving the graphics

sible due to the largely predominant computer based workflow in final presentations of the projects in later years of the studies). Among student works we can find also mixed graphics – combination of computer-processed and hand-sketched works. This paper deals only with computer-processed and hand-sketched works and the mixed techniques are beyond the scope of this research.

The research methodology is based on the evaluation and comparison of the selected student works from the perspective of key graphic categories (Table 3).

Altogether, 10 selected works were examined in the research. Half of the works, that were evaluated, were sketched and half of them were done by computer technologies. For best mutual comparability, only the best-rated works (A rated) were selected. The research is primarily devoted to the graphics, and its interpretation through hand sketched and computer based outputs, although the evaluation also reflects other work attributes such as – the concept, the physical model and the formalities.

Each of the selected elaborates contains several graphical and text parts + physical model: analyses, broader relationships, concept, masterplan (M = 1:1000), functional-operational proposal, urban detail, spatial studies and a text report. Within the research, only selected parts of the study were considered. Research has focused on the evaluation of 2 outputs – a masterplan (M = 1:1000), as a key output from urban design and planning and perspective views as an output capturing the proposed public space from the human perspective.

A set of criteria – evaluation factors (Table 4, 5) were created for assessment of the masterplans and perspective views.

Each work was considered independently by three experts in view of these categories to ensure the high-

er objectivity of research. Interpretation of the results of the work took place on two levels:

1. Assessment of individual category ratings

At this level, the averaged values of 3 evaluators for the masterplan as well as for the urban perspective from the human horizon were compared. The range of rating was chosen from 1 to 5 (5 is the best). Based on the comparison of averaged ratings, the categories with the best and worst ratings were selected as well as the highest differences between hand and computer based processing techniques. When assessing the fundamental differences in the results, we took into account those results where the point of difference was at least 0.5 (highlighted in the table by pictogram).

2. Correlation analysis

In order to better understand the relationships between the different categories, the relationships between them were evaluated in the second step using the statistical method of the correlation analysis. For this purpose, Pearson's correlation coefficient, which was calculated using Microsoft Excel 2010 using the (fx CORREL) function, was evaluated. Interpretation of correlation coefficients (R) was evaluated on the basis of Cohen [34]. Only statistically significant results with a correlation coefficient ranging from R = 0.5 to R = 1, and from R = -0.5 to R = -1 were taken into account. In the work, the most relevant results are described in more detail from the point of view of the authors, ie those in which logical interpretation was possible, mainly because the further verification of results by means of other methods was not carried out.

Table 4.
Comparison between hand-drawn images and computer graphics from Masterplan 1:1000

Masterplan 1:1000 10 chosen project – average value of 3 evaluators			sketching technique	computer based technique
Evaluation category		Description	Average value of 5 projects	Average value of 5 projects
01. FIRST IMPRESSION /subjective/		First impression from the drawing	3.27	3.47
02. ACHIEVEMENT OF GRAPHIC DISPLAY PRINCIPLE / objective	SPACES	3D Effect	contours, terrain, shadows	3.20	3.40
		Differentiation of Lines of Terrain and Surfaces	pedestrian and car communications, cycle paths	3.33	3.40
		Hierarchy of the Spaces	distinction of the main spaces, public, semi-public, and private spaces	3.47	3.40
		Static Traffic	rendering of parking lots	3.60	4.13 !
		Active Areas	playgrounds, sport/leisure dedicated areas	2.00	3.60 !
	OBJECTS	Differentiation of Greenery	park, garden, alley, aesthetical greenery, wild greenery	2.87	2.60
		Typology of the Objects	differentiation of the character of the buildings	3.93	3.73
		Small Architecture	characteristic elements – pavilion, podium, kiosk, art elements	2.87	3.20
	COMPLE-MENTS	Additional Markings of the Use of Objects and Areas	cycling lanes, public transport elements, entrances/passageways to the objects	3.00	2.87
03. CLARITY / subjective		understanding the main idea and content	3.47	3.13
O V E R A L L R A T I N G			35.00	36.93

Table 5.
Comparison between hand-drawn images and computer graphics for Eye-level perspective

PERSPECTIVE VIEWS (scale not specified) 10 chosen project – average value of 3 evaluators			sketching technique	computer based technique
Evaluation category		Description	Average value of 5 projects	Average value of 5 projects
01. FIRST IMPRESSION /subjective		First impression of the drawing	2.67	2.60
02. ACHIEVE-MENT OF GRAPHIC DISPLAY PRINCIPLE / objective	SPACE AND MASSING	suitability of chosen view – main public space, accents, dominants	3.87 !	2.53
	CHARACTER OF THE SPACES AND MASSING	characterization and presentation of the surfaces (pedestrians, cars, main public space); of the objects depending on the program, choice of the scale	2.93	2.27
	AMBIENCE	usage of shadows, greenery, staffage – correct measure according to the nature of the space	2.60	2.27
03. CLARITY / subjective		understanding the main idea and content, clear localization of the perspective on a masterplan drawing	2.93	2.27
O V E R A L L R A T I N G			14.20 !	11.93

4. RESULTS AND THEIR INTERPRETATION

Based on the comparison results of the evaluation of graphical processing of urban design studio, several claims and conclusions can be made. In general, student work received the best average rating for Static Traffic (3.87) and Typology of the Objects (3.83) for the masterplan and First Impression (2.63) and Clarity (2.6) for Perspective Views. On the other hand, the worst evaluation was achieved in the categories Greenery (2.7) and Active areas (2.8) for masterplan and Character of the Spaces and Massing (2.2) for Perspective Views. Overall we can say that the final assessment of the masterplan (65%) was higher than in Perspective Views (52.28%), which can

be partly explained by the greater weight of the masterplan and therefore by the greater attention of the students to its high-quality processing. Also interesting are findings of observed differences between hand based and computer based techniques. While the overall assessment of hand and computer technology is quite similar both in hand based technique (35-point average) and computer based technique (average 36.93 points), the Perspective Views have seen more significant difference in favour of hand based technique (average 14.2 points) against computer based technique (average 11.93 points).

The most important difference in the individual categories was in the Space and Massing categories (3.87 vs 2.53) and Clarity (2.93 vs 2.27) when evaluating Perspective Views (hand based VS computer based technique). From this, it is possible to conclude that a student working with a hand based technique that does not allow easy return in the process (Ctrl+Z on the computer) or an additional adjustment of the perspective angle of view (computer visualizations often use the basic overall 3D model of a project that is only modified – rotated and detailed as needed), is forced to think in a more complex way to chose the best view. Hand based techniques therefore usually present an essential part of the proposal, which also has a major impact on Clarity. Interestingly, despite the dominance of hand based processing in Perspective Views, the first impression was balanced for both techniques. A possible explanation is that hand technique, usually monochromatic with a pencil, cannot capture as much attention as contrasting and colourful computer visualizations in spite of the higher image quality for the first impression.

Despite the overall balance of computer and hand based techniques in the graphic processing of masterplan, we were able to find some differences. Hand based technique work is significantly weaker compared to computers in Static Traffic (3.60 vs 4.13) as well as Active Areas (2.00 vs 3.60). A similar, though not that significant trend, can be noted for 3D effect and Small Architecture. It can be said that computer graphics are more efficient when doing repetitive elements (parking lots, playgrounds, pavilions) and automatically generated graphical elements (shading) – thus saving time and allowing more detailed processing. An exception to this seems to be only the rendering of the Differentiation of Greenery (2.87 vs 2.60), in which the organic character of the greenery is better captured by the hand based technique, even though it is a repetitive action.

In addition to the above-mentioned observations, the research was also based on the correlation analysis which leads to more findings. Altogether, 34 statistically significant correlations were found based on the comparison of all categories (including the resulting evaluations). These were confronted with the results of the correlation analyses carried out in the same way but with the use of ratings for hand based technique and for computer technology. Based on the comparison of the results of these correlation analyses and using logical methods, the most relevant correlations were selected from the point of view of the research.

MASTERPLAN

Most of the correlation results were similar for both types of graphical presentation of the masterplan – hand and computer based techniques.

The First Impression category correlates with the Differentiation of Lines of Terrain and Surfaces ($R = 0.53$), Hierarchy of the Spaces ($R = 0.61$) and Overall Rating ($R = 0.65$). Interesting and logical in particular is the relationship between the Hierarchy of the Spaces and the First Impression. It suggests that the graphical presentation of the Hierarchy of Spaces showing the diversity and clear relationships between zones, has a major impact on the first impression of the masterplan. This relationship also favours the correlation between First Impression and Differentiation of Lines of Terrain and Surfaces, as well as the need to clearly distinguish spaces of a different program. The importance of these relationships underlines the relationship between First Impression and Overall Result.

The Differentiation of Lines of Terrain and Surfaces category, except for the above-mentioned correlation with First Impression, also related to the Overall Rating ($R = 0.61$). The Hierarchy of the spaces category ($R = 0.56$) also correlated the Overall Rating, confirming the considerable impact of these categories not only on the First Impression but also on the overall result.

In addition to the above-mentioned correlations, the Hierarchy of Spaces was also related to Clarity category ($R = 0.51$). The relationship between categories of Hierarchy of Space and Clarity, is an expected positive finding, confirming the important role of reading spaces and their program easily in order to understand the design as well.

Category Static Traffic was related to a Small Architecture category ($R = 0.55$) and to Overall Result ($R = 0.58$). It can be assumed that the
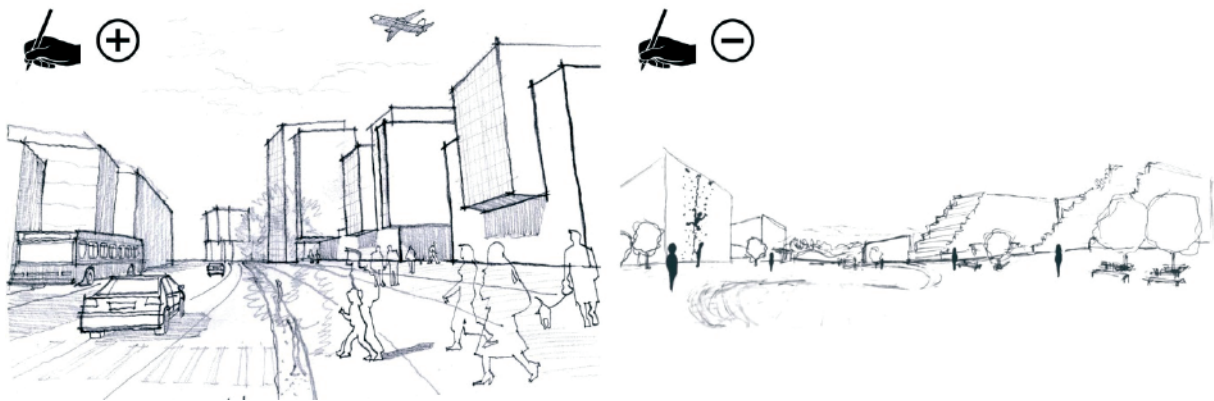
Figure 2.
Best and worst-rated hand-sketched perspective views – left Authors: Štefancová, Šutková, Kollár, right Authors: Michalka, Michalová, Štefancová

Figure 3.
Best and worst-rated computer generated perspective views – left Authors: Miklušková, Tarhaničová, Štefancová, right Authors: Koósová, Ladacsi, Štefancová
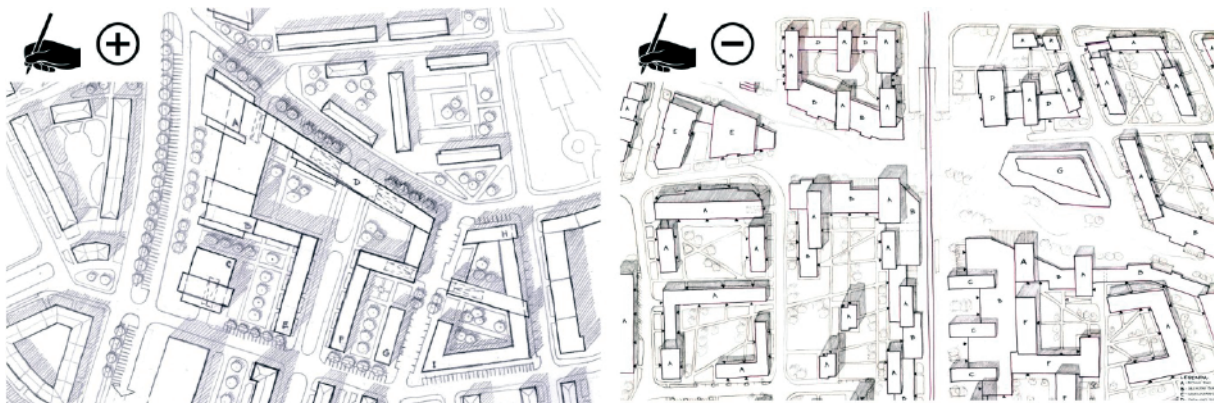

Figure 4.
Best and worst-rated hand sketched masterplans – left Authors: Štefancová, Šutková, Kollár, right Authors: Michalka, Michalová, Štefancová

observed dependence on Small Architecture was related to the understanding of the scale in the space. Thus, a detailed rendering of Static Traffic, as well as a Small Architecture, reflects a better understanding of the scale and the need to capture appropriate details.

The category of the Differentiation of Greenery was related to the Overall Rating (R = 0.65).

In addition to the already mentioned dependence on Static Traffic, the Small Architecture category also had a relationship with the Overall Rating (R = 0.71), indicating that the detailed rendering of small objects has a positive effect on the overall impression and understanding of the design.

In the computer processed masterplan, the 3D Effect category correlated with the Hierarchy of Spaces (R = 0.53) and Overall Rating (R = 0.74). It indicates that there is greater variability in masterplan processing and better possibilities of working with shadows or morphology of the terrain.

In general, for both the graphical processing of the masterplan, the Clarity Category, in addition to the Hierarchy of Spaces, was also related to the Overall Rating (R = 0.49). The most significant connection to the Overall Rating had the 3D Effect category (R = 0.74), Small Architecture (R = 0.71), Differentiation of Greenery (R = 0.65), First Impression (R = 0.65) and Differentiation of Lines of Terrain and Surfaces (R = 0.61). With the exception of the First Impression, these are the categories that affect the detailing of the masterplan, so it can be said that adequate detailing has a major impact on the Overall Rating of the masterplan.

PERSPECTIVES

Probably due to the relatively low number of categories for perspectives, the correlation analysis showed a correlation between all of them. On the other hand, some relationships have proved to be stronger than others. An example is a category of Clarity that has a high impact on the First Impression (R = 0.72) as well as the Space and Massing (R = 0.78) and the Overall Rating (R = 0.81). This finding shows the need for a clear presentation of the perspective for an independent observer that easily understands where the perspective standpoint is located in the project. At the same time, it confirms that the need to think carefully about the entire scene and appropriate choice of the view into the main composition spaces are crucial in perspective views. Further results have confirmed that the characteristics of objects and surfaces are the domain of hand based techniques. The hand can freely and quickly illustrate floors and windows of objects or hatching the surfaces and pavements. Correlation has shown that in digital visualizations the detail is focused on the staffage such as people, cars or greenery and miss the object and surface finishing and details.

MUTUAL EXCESSION OF EVALUATION

An interesting observation is a link between the Differentiation of Greenery in the masterplan and the categories of perspective views – First Impression (R = 0.53), Clarity (R = 0.52) and Overall Rating (R = 0.57). These dependencies are probably related to a sense of detail, on which the comprehensible rendering of the nature of the greenery is quite dependent. It is therefore assumed that a student able to distinguish relatively subtle differences between formal (alleys and tree lines), natural (wild and varied greenery), park, protective or special types of greenery, has a prerequisite for a better graphic presentation of the perspective view.

5. RECOMMENDATIONS FOR PRACTICE

For hand based techniques of Perspective Views it is appropriate to beware of enough visual contrast and consider the use of colours, which can greatly help to make a good first impression and increase overall evaluation of Perspective View (Fig. 2). A suitable technique for sketching is the use of soft pencils or black pens to achieve higher contrast with the background. Using the combined technique, sketched and then digitally processed perspectives, colouring or adding a contrast would be an ideal solution.

Computer based perspective views require more attention to the selection of the appropriate scene as well as the accurate processing of details (Fig. 3).

When drawing a masterplan by hand, it is necessary to deepen the details of the drawing thoroughly, paying special attention to the rendering of Static Traffic, Active Areas, Small Architecture and 3D Effect (Fig. 4).

Hierarchy of the Spaces is one of the key categories of graphic design of a masterplan, with a significant impact not only on the understanding of the design but also on the first impression of the drawing and the overall assessment. Students should therefore not undervalue this category in their work.

A masterplan requires a fair amount of detail that the student should not underestimate by leaving the drawing too "empty" (Fig. 5).

When working on a masterplan on a computer it is advisable to focus on the entire composition and staffage. The rendering of static traffic or active areas is better handled in computer processing than hand drawing. This trend is visible in all repetitive actions such as 3D effects or small architecture, with the
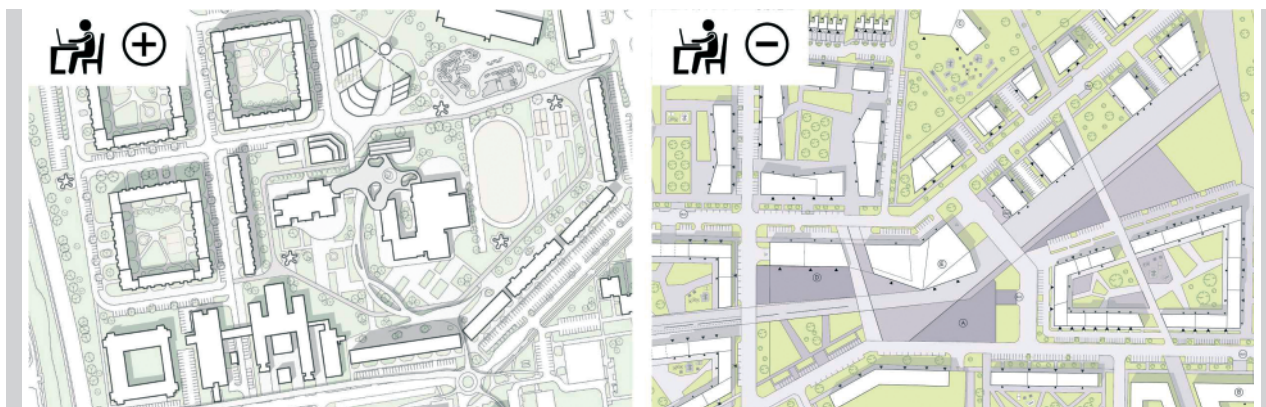
Figure 5.
Best and worst-rated computer generated masterplans – left Authors: Ďuďajová, Bubláková, Štefancová, right Authors: Koósová, Ladacsi, Štefancová

exception of vegetation. Mechanical copying of trees results in an artificial expression in which some forms of vegetation are difficult to recognize from objects. The tree has to be more organic by possible different rotation on different localities, bringing the computer graphics closer to an irregular hand-drawn drawing, which presents the greenery better.

5. CONCLUSION

The research of graphic processing in urban design aimed to reveal the key parameters influencing the final effect of graphic processing of a masterplan and a perspective view from the human perspective, as typical urban expression elements. Specific attention in fulfilling this goal was paid to comparison of computer and hand based techniques.

Due to the fact that the acquisition of graphic presentation is mainly a matter of preparation of students during university studies, the research was carried out on a sample of student works from Design Studio V (Urban Design Studio I – 1st Degree / 3rd Year, Faculty of Architecture, Slovak University of Technical in Bratislava). The selection of the year, as well as the studio, had taken into account the need for an adequate representation of hand and computer processed projects. Based on the theoretical analysis of the problems and the experience of the authors themselves, a set of characteristic categories was compiled for the masterplan and perspectives, for which the individual works were assigned points according to the authors' methodology. The key research methods of data evaluation were comparison and correlation analysis, which enabled the drawing of general conclusions, interrelationships and practical recommendations for the graphic design of studio work or

architectural and urban planning practice.

The research results highlighted the fact that hand and computer processing techniques are equivalent when processing a masterplan. In general, the level of detail of the rendering has had particular impact on the overall assessment of the masterplan, i.e. the adequately (not exaggerated) representation of the basic elements such as small architecture, different forms of greenery and the like. It is also very important to be able to distinguish the character/program of the spaces – the hierarchy, the function/program.

Hand based perspective views/sketches were of better quality, with the most important category being Clarity – an adequate selection of the standpoint and the chosen view, so that it is clear which part of the urban design is documented. It seems that computer processed work tended to underestimate the phase of choosing the most appropriate view, which is quite logically related to the way they were made, authors are not required to think about choosing the view so completely from the very beginning.

In general, computer technology has the advantage of rendering repetitive details, while hand technique brings a more organic character to the graphics, forcing the author to think more carefully about the composition of the displayed scene.

Among the main recommendations for hand based processing that emerged from the research it is focuse on the technique of using more contrast or considering the colouring of the view. The masterplan needs to be adequately deepened in detail, paying particular attention to the rendering of Static Traffic, Active Areas, Small Architecture and 3D Effect. One of the main recommendations for computer graphics is the need to pay more attention to

ARCHITECTURE

the selection of a suitable scene as well as the proper processing of detail and staffage, in particular through the pursuit of a more organic appearance of vegetation.

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