GENESIS OF ARCHITECTURAL FORMS –

INVENTIVE DESIGN IN THE VIRTUAL AGE

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Abstract

The digital architectural visions show that architecture is more and more influenced by virtual reality and concept of cyberspace. The primary forms in architecture differentiate according to the ways of the ideas' expressions (intuitive hand-drawn sketches or digital images). Paper points out the similarities and differences between the initial architectural ideas of the creative process revealing in the intuitive architectural forms - hand-drawn sketches and digital forms – computer images. Primary intuitive and digital architectural forms are analyzed in the following aspects: primary ideas (concept of a man and avatar, extreme qualities and gradations, sensual and expressive ideas, notions and visions, codes of communication and info-connotations), structure (multi-layered and soft-diffused, morphological and topological, massive and light, additive and multi-programming, organic and liquid, order and higher order, motion and animation), shape (floral-like and organic, additive and multi-components, ideals and deformed shells, motion and flow-liquidness, closeness and infiniteness, disintegration and replayed cycles of growth) and context (landscape and virtual, real and abstract, cultural connotations and multi-programming, historic and soft-library decalcomania) of intuitive and digital forms.

Genesis

At the beginning of every act of architectural creation is a primary idea or vision, that comes into existence in the architect's brain. The next step of creation is the expression of certain vision - giving the primary form to idea. The architect can use the traditional tools of expressions or digital technologies. The result of the creative process based on the architect's intuition reveals in intuitive primitive form - freehand-drawn sketch driven by the architect's drawing skills or digital primitive form – computer image driven by the software potentialities. Both processes hide the unrecognisable and non-interpretative deep secret of axioms, generators, processes and decisions making by architect. It is not possible to take the real view on the genesis of process of creation. But it is possible to compare the results – the initial ideas revealed in the intuitive and digital primitives. Paper points out the similarities and differences between them on the basis of interpretative analysis of the architectural sketches and images in the following aspects: primary ideas, structure, shape and context of primitives.

Primary intuitive and digital ideas

Architectural ideas are based on the spatial-contextual theory, which defines relations between object and context and it works out the patterns of composition, architectural styles and architectural representation. Architectural design explores matter and space-time dimensions. The principles of spatial-contextual design, defined by Vitruvius in his work *De architectura libri decem* [16, p.252], describe the genesis and determinants of architectural ideas, which are subordinated to the aims of architecture (durability, utility and beauty) and to the mutual relations between man, object and context. The fundamental axiom of spatial-contextual theory defines the human body as the measure of architecture. The anthropocentric point of view seems to be unquestionable till now, however patterns of spatial composition, context-dependent architectural forms and principles of aesthetic valuation were changing in course of time.

Architecture of the 21st Century is rich in architectural manifestos and programs, ideas and patterns, discussions and controversies, styles and conventions, which influence design theory and they change the perception of architecture. The patterns and languages of spatial composition seem to be in a state of eruption of ideas. They are mostly inspired by the informative theory, fine arts and driven by the technological development. The digital architectural visions show that architecture is influenced more and more by virtual reality and concept of cyberspace. The aims of architecture of digital age can be defined as simulation of the life processes (instead of durability), creation of fiction (instead of utility) and expression of the intelligent structure (instead of beauty) [6, p.405]. Simulation of life processes in the architectural space means that time expressed by

motion is an active factor of so-called *liquid architecture* [9, p.43]. Creation of fiction implies that form follows fiction and not function [9, p.43]. The most important change in relation between a man and object of digital age is an absence of traditional features of human body [4, p.20; 14, p.95). Visually oriented mind [1, p.38] takes part in process of communication with intelligent environment [10, p.7].

Computers are not only tools of architectural work but their inner languages, codes, programs, icons or graphic conventions are becoming the matter of architectural reality. Real life is supplemented by actions in virtual reality [2, p.35], and in architectural design – the architectural objects are supplemented by the virtual representatives, intuitive primary ideas – by the digital primary visions and hand-drawn sketches – by the digital images.

- Intuitive concept of a man vs. digital avatar

The human being is present in the 3D representation of real and virtual world. In intuitive design, a human being is the subject of architectural idea and architectural form is addressed to the man's features. The image of a man, expressed in freehand-drawn sketches, is created from the subjective point of view of drawer, therefore the man's representation is characterized by the real individual features of human being and connected with emotional expressions (e.g. happiness, satisfaction, well-being). In digital design, a human being exists as a figure – an Avatar or Phantom. Avatar represents the ergonomic, fashion or photo-models' ideals characterized by lack of empathy. Intuitive visions, which focus on the mass experience express the consequences of overcrowding and of antagonistic relations between individuals in the space-time. The mass experience and conflicts between individuals are lacking for the digital ideas, because digital space is settled by the clones of cyberman.

- Intuitive extreme expressions of beauty vs. digital gradational beauty

Sensual, emotional and impressionistic effects of architectural ideas are important factors of creation and valuation of intuitive forms. These factors are usually on balance in intuitive designing. Digital forms are characterized by the superiority of notion of beauty to the other factors because of first priority of sight in virtual reality. Intuitive impressions consist of the extreme qualities of different notions (*black-white* thinking: beautiful – ugly, good – bad, dark – bright etc.), while there is a kind of gradations of impressions in digital designing (expressions in *grayscale* tonality). The difference between intuitive and digital images results from the dissimilarity of available color palettes of drawing tools in free-hand sketches and digital visions. Color palette is the medium of ideas' expressions among other tools and it influences indirectly the way of thinking. Virtual reality favors the complicated intellectual axioms and ideas because of the possibility of their expressions in gradational digital color palettes.

- Intuitive sensuality vs. digital virtual expressionism

The intuitive point of view of architect relates to the individual man's experience, which focuses on the perception of the space through the senses. Therefore the primary intuitive ideas express all spatial dimensions, e.g. sight (colours, forms, size), touch (textures, porosity, heaviness), hearing (sounds, music, rhythm), smell (odour, perfume) or taste (flavour) [Fig.1]. The human senses are also represented in digital designing on the level of architect's intention, but it seems that digital visions are rather the representation of the ephemeral, light, luminous, untouchable and unreal world [Fig.2] than durable, solid, absorbent, touchable and material reality. This tendency will be sustained as long as the other senses will not find their representation in the digital technology.

- Intuitive notions vs. digital visions

The architectural ideas are deep-rooted in the human being's experiences and habits, which consist of the stereotyped phrases, analogies, ideas, images and notions [3, p.37], and in the cultural heritage expressed by such codes of communication as: metaphors (archetypes, signs, symbols), metonymy (contextual determinant of the notion) and paradox (the inner contradiction of the notion) [7, p.35]. The intuitive primary ideas are expressed in notional and narrative codes of communication, therefore they can be read and interpreted as well. The digital primary ideas also relate to the codes of communication but with the superiority of the figurative and video codes [15, p.15]. Most of the virtual design patterns are the reflection of visual signs and movie conventions (e.g. stop action, instant replay, docu-dramas) [12, p.17]. Digital primitives are the expressive visions, that can be rather interpreted than read. Intuitive primitives are characterized by the condensed notions-driven ideas, while digital – by data-driven images.
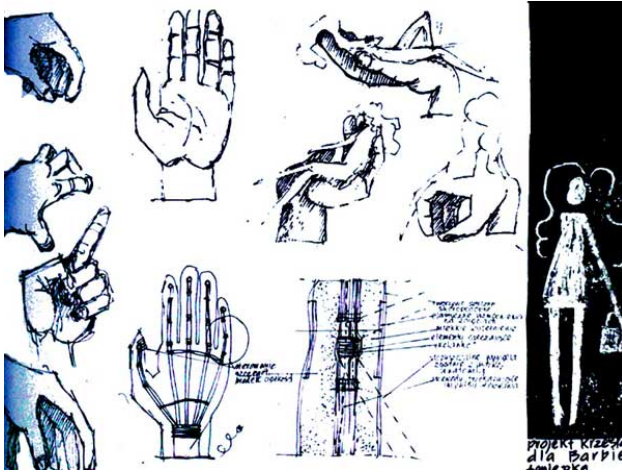
Fig.1 Intuitive concept of sensual expression

Fig.2 Digital luminous and ephemeral reality

• Intuitive natural-cultural connotations vs. digital info-pattern connotations
The intuitive primary ideas relate to the archetypical concept of the nature (e.g. forest, grassland, desert) and culture (e.g. forum, meeting, community) and they are connected with the natural-cultural connotations. Digital primitives refer to the archetypical informed space-matter, in the meaning of the programmed reality powered by the info-formulae. Recognition of the formulae signifies understanding the essence of the reality and being creative [5, p.58]. Digital primitives are the extension of digital spatial codes of programming (numbers, grids, units, commands) and human imagination (patterns, figures, forms, solids), therefore they are connected with the info-pattern connotations.

Structure of intuitive and digital forms

The structure of the architectural object is defined by the principles of spatial composition based on the order (proportion and ration), disposition (quantitative and qualitative composition of elements in the whole), economy of composition (utility of buildings' elements) and symmetry (harmonious arrangement) (Vitruvius, *De architectura libri decem* [16, p.252]) in the spatial-contextual theory. This definition is becoming useless for design in digital age, because the representation of the spatial structure is built not in the former 3D-coordinate system but in the latter 5D-macrosystem (matter, space, time, energy, information) [13, p.196]. Digital design theory express the fusion of all dimensions of the spatial structure in certain patterns of design (informed matter-space-time-energy).

• Intuitive multi-layered vs. digital soft-diffused structures
Intuitive structures are multi-layered and additive, in which the layers are inflicted and imposed on each other. Intuitive structures are the morphological and topological sequences of forms, elements and particles, and they refer to the static mechanics. Digital structures are also multi-layered but in the meaning of soft and liquid structures, in which the layers diffuse and infiltrate through each other. Digital structures are the morphological and topological sequences of forms and its parts too, but they refer to the relative theory. Intuitive structures are logical, stable and discontinuous, while digital structures are rather algorithmical, unstable and continuous.

• Intuitive ideals vs. digital informed-deformed ideals
Many intuitive primitives are characterized by the ideal structures, relating to the concept of perfect forms, e.g. sphere, cube, cylinder, cone etc. [Fig.3] Digital primitives are usually more complicated in consequence of inclusion of the ideal forms in toolbars of CAD programmes, therefore the ideals are treated not as something what can be designed but as something what can be used, deformed or transformed. The intuitive ideals are built of the heavy and massive materials, while the digital ideals are usually made of light, transparent or so-called informed materials, it means, that the materials' particles are connected with information. Users can interfere in the program of material to change the shape or visual attributes of forms [Fig.4].
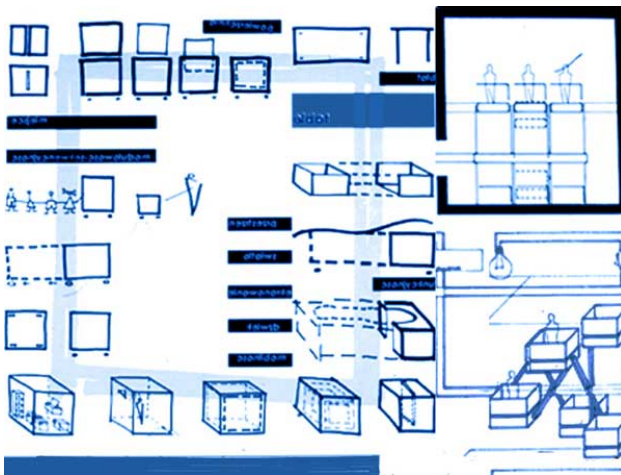
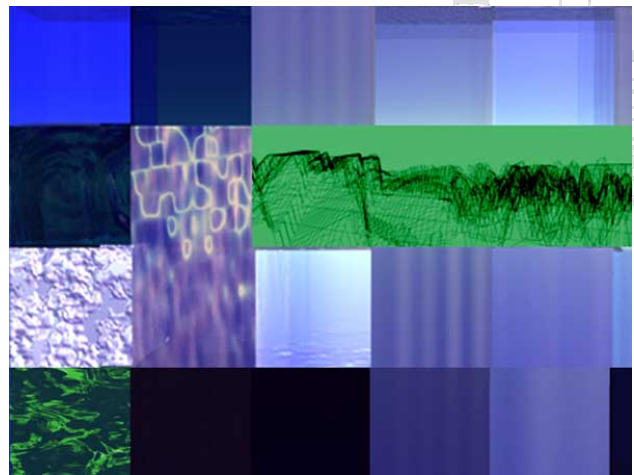Fig.3 Intuitive ideal structure

Fig.4 Digital informed-deformed ideals

- Intuitive concept of motion vs. digital animation

The ideas of intuitive spatial-contextual theory relating to the concepts of growth, mobility, instability, flexibility, variations or spontaneity are also adapted to the digital design theory. In intuitive design – the motion is expressed in sequences of static drawings showing the transformation of the structure in fixed time-periods. In digital design – new category of motion in architecture reveals in form of computer animation and acting in "informed time" [13, p.218]. It is connected with simulation of changes of perception of moving observer through the spatial structure or perception of simultaneous changes and transformation of the structure in the continuous digital time.

- Intuitive organic vs. digital liquid structures

The primary freehand-drawn sketches reflect the nature-like substance of primitives in intuitive design. The intuitive organic structures refer to the simple and curvilinear forms, which come under evolutionary rules of unicellular organisms' development, it means, more complicated forms are created on the way of addition or partition. In digital design, the primary organic structures refer to the topological liquid forms based on the algorithm of transformation. Digital organic primitives are characterized by the generative structures of the complicated multi-cellular organisms, which evolve on the way of mutation, modification and transformation (e.g. skew, stretch, expand, deform, twist, wave) thanks of structural genetic code - the information saved in the smallest spatial units about possible form transformation and growth (nanotechnology) [17, p.49].

- Intuitive concept of order vs. digital higher order

Intuitive architectural patterns relating to question of order seem to be replaced by disjunction and disorder in the meaning of reaching the higher order or higher complexity of systems in digital age [9, p.46]. It is a consequence of acceptation of higher level of structural, formal and information complexity of architectural objects resulting from the principle of entropy [11, p.274], which describes not only the physical world but also the man's perception and the cultural phenomena. According to the thermodynamic principle of entropy, all material structures and systems evolve from order to disorder, from disorder to non-equilibrium and from non-equilibrium to new higher order extracted from the chaos [11, p.305]. The former design principles of economy of composition and structural order defined by the spatial-contextual theory are transformed into the principles of sustainability, describing the energetic and information potential of the structure, and by the higher structural complexity of architectural objects in the digital design.

- Intuitive additive - subtractive structures vs. digital multiprogramming

In intuitive design, the relations between particles and structural element or between elements and structure are described by the patterns of composition, which are based on the principles of addition, subtraction, multiplication and division. Primary intuitive structures are constructed in the same way as the toy houses, which are made of the building blocks by the children. The primary intuitive structures are founded on the assumption, that every structure has to be finite in the space-time and composed by the limited number of structural elements to be real. Disposition of elements in the whole loses its importance in situation of relative whole and open-endedness of digital structure, and of infinite numbers of attainable structural elements. Digital structures can be

built by the visible and invisible objects (Boolean objects and operations), what causes that structural relations between elements from one side – can be illegible, from the other – can be changeable and controlled by digital multiprogramming.

Shape of intuitive and digital forms

The spatial-contextual design theory defines the shape of architectural object by the description of its visual (view, shape, beauty, elegance, impression), mathematical (proportion, numbers, measure) and social features (approbation, acknowledgment) (Vitruvius, *De architectura libri decem* [16, p.252]). The development of architectural ideas brought new criteria of creating and valuating the architectural forms; criteria, which were especially articulated in plenty in the last 20th Century (from modernistic, postmodernistic to beyond-modernistic concepts). Modernistic impact on describing the architectural form is in introducing the esthetical values of simplicity, expression, structural trueness and purity. These criteria give priority to the structural verification of form in the meaning of searching for the patterns of the inner structural order of form. Postmodernistic impact is in articulation of such esthetical values as: pleasure, conformity to the modern codes of communication and formal differentiation. The postmodernistic criteria refer to the semantic verification of form. Beyond-modernistic impact on shaping the architectural forms is in introducing the esthetical criteria of conversion, conformity to the principles of in-formation and liquidness. Liquid architecture means polymorphism of the amorphous matter [17, p.49] as the result of interaction between creator and information contained in form (form as bits). In digital architecture, form is verified by the cybernetic criteria in the meaning of data-driven possibility of transformation, transgression, translation and transmission of architectural form.

• Organic forms: intuitive floral-like vs. digital organic liquid shapes
Organic intuitive and digital shapes are supported by the organic floral-like structures; the only difference between them is, that organic shapes are more liquid and sprawling out in digital than intuitive designing. The origin of organic architectural forms can be found in the primitive human shelters, for instance cave, earth-dug-out, huts, tents etc. Architecture brought away from its environmental roots during the civilization development. But the fundamental question, whether architectural form should refer to the cultural patterns being in opposition to the nature or being the continuity of the natural evolution, is still of vital importance. And because the answer is not self-evident, the motif of organic forms reappears in architecture, e.g. structural organic Gothic, formal organic Baroque or Art Nouveau, liquid organic Soft-architecture.

• Ideal forms: intuitive ideal shapes vs. deformed ideal shells
There are seemingly the same repertoires of intuitive and digital ideal shapes. In intuitive design – primary ideal shapes are taken from the collection of the simple geometric or natural forms (cube, sphere, cone etc.) or they are sculptured as the unique ideal shapes, using the subjective visual criteria of beautifying and ideal modelling. In digital design – the ideals are mostly transformed by the algorithmical or software commands [Fig.5]. Digital primitives are rather deformed or modelled ideals or shells (meshes, polygonal surfaces) than ideal geometric forms or figures [Fig.6].
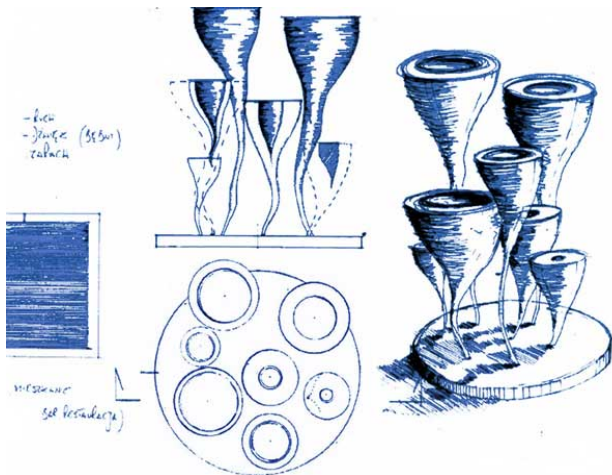

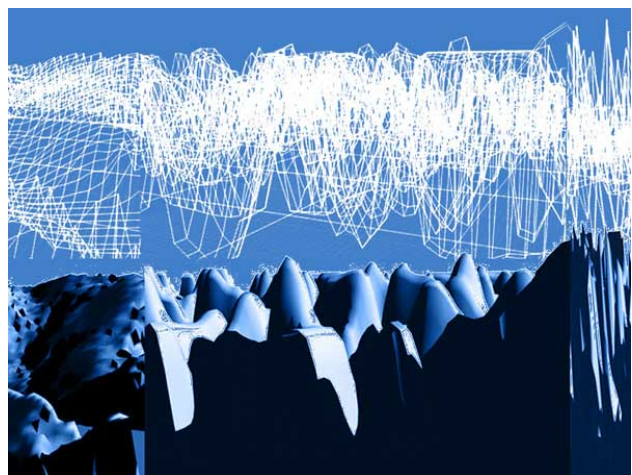Fig.5 Intuitive ideal sculptured shapes

Fig.6 Digital deformed ideal shells

• Additive forms: intuitive additive vs. digital multi-components shapes
Intuitive or digital additive primitives are very similar; they differ in complication or multiplication of structural elements. Intuitive additive primitives are characterized by the simple composition of structural elements based on the rules of statics and gravity, expressing such relations between structural particles as: founded on, supported by, hanging on, lying on (up, down, back side, side by side) etc. Digital primitive shapes are characterized by the multi-components, multidirectional and multidimensional structures and they consist of the algorithmical or random sequences of particles and elements. It causes, that geometry of digital primitives, the static work functions and active forces are sometimes out of control of the creator. Digital primitives levitate in the virtual space, therefore, in contradiction to intuitive forms founded on the ground, they seem to be statically indeterminate.

• Integrity of forms: intuitive organic vs. digital cosmic complexity
The consequence of evolution of architectural primary structures from the state of intuitive order to the state of digital higher-order is spatial development of primitives from the intuitive organic complexity of floral-like forms to the digital complexity of cosmic-like shapes. The concept of formal integrity of primitives, no matter whether it signifies the organic or cosmic complexity, means suitable transmission of energy through the structure and verification of the primary shapes by their energetic potential.

• Flexible forms: intuitive forms in motion vs. digital flow-liquidness
Intuitive shapes of primitives expressing the idea of motion and growth are based on the curvilinear geometric figures of a spiral, sinusoid or parabola. Digital primitives, which communicate the same idea, refer to the flow-liquid shapes of tuboid, torus or 3D-meshes. Intuitive shapes in motion are mostly supported by the one-directional structure of disintegration, flowing according to the time-direction, while digital shapes are usually expressed by the replayed cycles of appearing and disappearing or destruction and growth, according to the reversible time-cycles.

• Orthogonal forms: intuitive ordered rigidity vs. digital higher-orderliness
The orthogonal intuitive and digital shapes are characterized by the rigid structure. Intuitive primitives are imagined in the 3D-orthogonal coordinate system and they are drawn on the 2D-plane surface. Digital primitives are also designed in 3D-coordinate system, but they are expressed in virtual space, which enables to control the transformations of the shapes in all spatial dimensions at the same time. It causes that digital forms can be easily transformed from the orthogonal rigidity to n-directional higher-orderliness.

• Finite forms: intuitive concept of closeness vs. digital infiniteness
Intuitive primitives, expressed as freehand-drawn sketches, are limited by the 2D-plane surface of the sheet of paper. The images of intuitive forms are created in relation to the size of background paper, therefore they are usually closed in their spatial concept, even if they are imagined as infinite in their content. The sheet of paper expresses the potential of space but in comparison with digital space, it is only a one-layer level of an open-indeterminate space. Digital primitives come into existence in the n-layers' and 3D- virtual space. Therefore they are driven by the infinity, and they are not under the pressure of external limitations.

Context of intuitive and digital forms

The spatial-contextual design theory defines the mutual relations between a man, architectural object and context in description of: nature (orientation of building according to cardinal points), tradition (composition relating to local conventions) and habit (usual, accepted liking of social group) (Vitruvius, *De architectura libri decem* [16, p.252]). The context of architectural forms is treated as phenotypic space, a complicated organism generated by the genotype and phenotype of the place (genius loci). The contents of the spatial context consist of the people and things, memories and behaviors, paths and points, void and information, images and associations, impressions and feelings etc. The notion of place, in the meaning of belonging to or being settled, recedes into the background in digital design theory. The present life acts simultaneously in real and virtual space. Network is a new representation of the digital context (Mitchell,1995:8), in which near and distant places are connected thanks of the timing and not spatial mediation. Therefore some determinant contextual factors of architecture (e.g. place, tradition, habit) lose their meaning in digital design. It is possible that the spatial representation of the real context and urban network

will be not necessary for the future inhabitants of the metropolis. They can travel to other places in virtual dimension, causing the real effects, e.g. buying things in Internet shopping center, working in the Internet offices, participating in the Internet conferences or meeting in the chat-rooms etc. The virtual images of the visited places will be emitted in the digital network.

• Intuitive impressionistic landscape vs. digital virtual environment
The intuitive context, to which the architectural form refers, is real or symbolic, natural or sophisticated. The intuitive representation of natural or urban landscape is an impressionistic picture in pointillism–like style [Fig.7]. The memorized images of the real context is defined by the points of view and review, departure and destination, focus and reference, ugliness and beauty. Digital context is mostly hyper-real or abstract, virtual or artificial [Fig.8]. The memorized images of the virtual context are the pictures, photos, postcards and films of the never-seen places. The camera, TV or Internet are the extensions of our sight and they create digital virtual environment. But in opposition to our own direct experience of seeing the place and subjective reconstruction of it, it is difficult to verify the indirect information transfer. The virtual representations of the contextual images (photos, postcards, films) are the most important factors of virtual environment. The images of the virtual context live their own life, independent of the real world, because they can be embellished, reproduced and collected out of our memory.
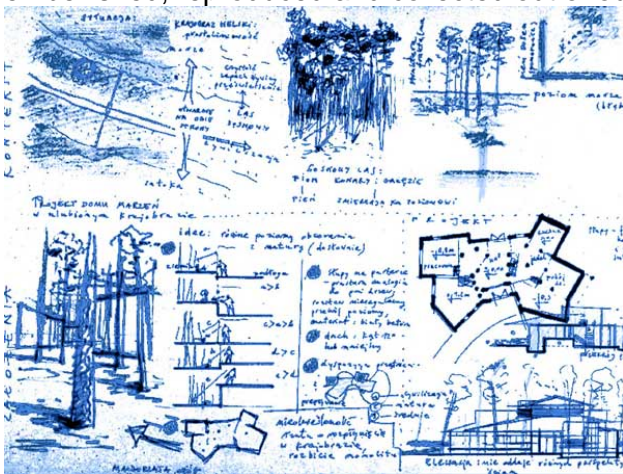
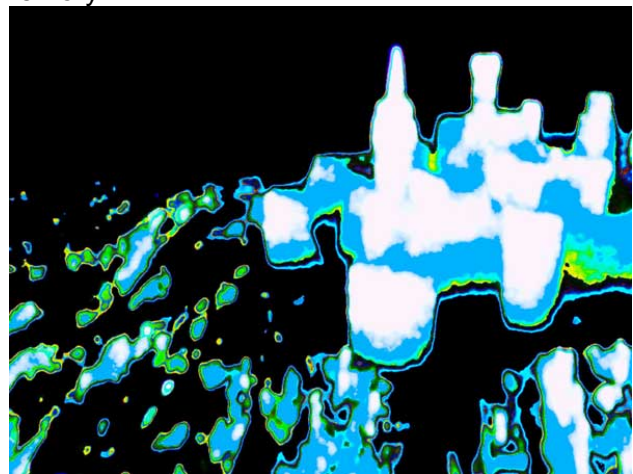

Fig.7 Intuitive impressionistic landscape

Fig.8 Digital virtual environment

• Intuitive natural - cultural context vs. digital programmed context
The intuitive primary idea of context, similarly to the idea of architectural primitives, relates to the spheres of nature and culture. The intuitive context explores the notions connected with natural (e.g. wood, park, cave) and cultural archetypes (e.g. paradise, Eden). Digital context relates to the informed space-matter and virtual reality. It expresses the unity of the wild and artificial realities and focuses on the esthetical features of digital environment. The virtual visions create the scenery of the illusion and wonders, e.g. conceptual territories of Reiser & Umemoto [18, p.96] or the haptic horizon of Stephen Perrella [18, p.50], in which all physical barriers and borders can be exceeded, and the relations between architectural forms and their context are fuzzy.

• Intuitive archetypical historic patterns vs. soft-library decalcomania
According to the man's habit of thinking, which is deep-rooted in the stereotyped and well-known ideas [3, p.37], the origin of the many primitives can be found in archetypical spatial or historic architectural patterns. The primitives, intuitive or digital, are simply inspired by the existing forms (mental decalcomania). Intuitive forms refer mostly to the well-known places or buildings from history of architecture. Digital forms show the architects' inclination to use the avant-garde architectural patterns of designs and to reproduce the objects and prototypes from the soft-library.

Conclusions

Digital primitives continue the intuitive repertoire of forms in many aspects. The differences between them reveal in the nuances of formulating the ideas, structuralizing the form, getting the shape to ideas and setting the form in the context. The most important contrasts between intuitive and digital primitives can be found on the level of structure and shape. The architects of digital era are able to control the design process of form-making on higher level of structural order and formal

complexity than in traditional designing, however the architects' choice-making during the creative process is still dependent on the primary intuitive esthetical criteria.

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