DECONSTRUCTING THE CONSTRUCTIVIST DRAWINGS OF IAKOV CHERNIKHOV

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ABSTRACT
The three-dimensional nature of Chernikhov’s Constructivist architecture can be analyzed by a method of reverse perspective deconstruction. After a review and classification of the drawings in Chernikhov’s book, 101 Architectural Fantasies, to determine which classes are suitable for deconstruction, the method of perspective deconstruction together with the underlying assumptions is presented and applied to three drawings. Conclusions concerning the forms comprising the architecture depicted in Chernikhov’s images and the possibility of representing this Constructivist architecture by shape grammars are discussed.

INTRODUCTION
Much of Russian Constructivist architecture was never built and consequently can only be studied from drawings such as Chernikhov’s marvellous collection of one hundred and one drawings recorded in his book of 1933 entitled 101 Architectural Fantasies (CHERMIKHOV, 1955). What is the real architecture behind these drawings?

From the outset it should be stated that Chernikhov was in fact on the periphery of the constructivist movement as represented by the Union of Contemporary Architects (OSA) and that Chernikhov’s concerns were more limited than theirs (eg. those of Lissitzky, Tatlin, Ginzburg, Leonidev, Miturnin, Melnikov and Rodchenko). Chernikhov was primarily concerned with only one aspect of konstruktivizm (Constructivism), namely, the methods by which, according to Ginzburg “the working constructive elements of a building may be assembled, formally within the range of possible combinations of those elements” (COOKE, 1984a). Proceeding from Aleksei Gan’s definition of konstruktstia, as “the assembling and ordering function within Constructivism”, Catherine Cooke clarifies the relationship between konstruktstia and konstruktivizm by noting that konstruktivizm (Constructivism) has to be understood as a total, socially responsive design method, along the lines of today’s system approach (COOKE, 1984b).

Social concerns, political objectives and technological possibilities were all concerns of the Constructivist movement. Chernikhov’s interests were thus limited to konstruktstia. Given that Chernikhov spent most of his time before 1933 in studying art and architecture and in teaching drawing and the graphic arts, ultimately becoming in, 1936 - 38, professor in the Faculty of Industrial Architecture at the Moscow Architectural Institute and head of the Department of Descriptive Geometry and Graphics at the Economics and Engineering Institute, his emphasis on formal issues is understandable. All of Chernikhov’s books are oriented toward the teaching of formal issues ranging from ornament and letter forms to the Architectural Fantasies. Although Catherine Cooke indicates in her curriculum vitae of Chernikhov that between 1928 and the mid 1930’s he was “Chief Architect to the Design Bureau of the Chemical Industry” (COOKE, 1984b), it is not clear to what extent Chernikhov was involved in the “nitty gritty” of architectural
Figure 1  The twelve groups of Chernikov's architectural fantasies showing one characteristic example of each group.
production. This association does, however, account for the heavy emphasis on industrial forms.

Whatever Chernikhov's practical involvement with architectural production may have been is not of concern to us, for it is precisely the formal strengths of Chernikhov's 101 Fantasies which are attractive. These images imply the use of a consistent vocabulary of shapes and a means of relating these shapes to each other, that is, of spatial relationships. Chernikhov's fantasies may lend themselves to representation by shape grammars (STÍNY, 1980) to allow three-dimensional composition and editing much as word processors can be used to compose and edit text. We are encouraged in this quest because this is where Chernikhov's strength and interest lay as may be attested to by his establishment of a Research Laboratory of Architectural Forms beginning in 1928. To study Chernikhov's architecture from the view point of a vocabulary of shapes and their spatial relationships, it is here proposed to determine the actual three-dimensional shapes and the three-dimensional models underlying his images by a method of perspective deconstruction.

Not all of the images in the 101 Architectural Fantasies are of interest for the purpose of the proposed analysis. Perusal of Chernikhov's book (CHERNIKHOV, 1933) and Sasaki's translation of the accompanying text (SASAKI, 1981) shows that there are actually several types of rendering and subject matter, ranging from abstract sketches, with a debt to Kandinsky, to detailed perspective renderings, not only of individual buildings but of very articulated spatial arrangements of buildings and structures. In each rendering the subject matter and the method of architectural representation are chosen to enhance one another. Despite the diversity of technique and subject matter, however, all of the work has a unified Constructivist character specific to Chernikhov. The reason for singling out only some of Chernikhov's images for study, therefore, is not because of inconsistencies of character in the vocabulary and shape relations, but because only some of the renderings show structures and buildings with specific enough detail for the purpose of this study. Also, some of the architectural compositions are too complex to model easily and have no visible bounds in space. Thus of the twelve categories of design and representation into which Chernikhov classifies his 101 Fantasies, only four groups satisfy our requirements. To give the reader a visual justification for the selection of only four groups (groups A,D,E,J), Figure 1 shows an example of one rendering from each of the twelve groups which may be summarized in briefest form as follows:

A. Compact groupings of building elements integrated into single buildings rendered in perspective as seen from the ground. Example: #34
B. Articulated buildings with very complex structures rendered in perspective as seen from the ground. Example: #28
C. Sketches, in bird's eye axonometric, of plan arrangements of building forms. Example: Fantasy #47
D. Trussed girders structures reminiscent of present day braced, hollow, welded steel construction rendered in perspective as seen from the ground. Example: #22
E. Simple massive industrial forms with light girder trusses rendered in perspective as seen from the ground. Example #35
F. Multiple building groups rendered in perspective with minimum detail as seen from the ground. Example: #13
G. Curvilinear line sketches in perspective as seen from the ground. Example #16
H. Spatial impressions, where space is articulated by a complex web of trusses and girders which may or may not include buildings. Example: #82
I. Abstract building groups representing parts of cities rendered in bird's eye axonometric. These images are more abstract than C and involve many more buildings. Example #54
J. Multiple building masses interwoven with gigantic trussed girders rendered in perspective as seen from the ground. Example: #69
K. Axonometric compositions of line grids disposed in three-dimensional space. Example: #67
L. Somewhat sketchy but complex panoramas often involving very complex truss and girder compositions in axonometric and perspective as seen from various view points. Example: #85
After a study of the images representative of each group it may be appreciated that Groups B,F,H,L are too complex to model within the available time, software and equipment. Groups G,J and K are too sketchy. This leaves the four groups A,D,E and J with group C a possibility, although there is a paucity of clear detail in this group. This paper analyzes fantasy #34 from Group A, fantasy #22 from Group D and fantasy #69 from Group J. They are shown in Figures 5, 7 and 9, respectively.

DECONSTRUCTING PERSPECTIVES

Fantasies #22, #34 and #69 are all drawn in two point perspective from a view point (station point) at or near to ground level. Each perspective depicts a structure or building from a view point chosen to emphasise a vertical feature of the building or structure. The question to be answered, in order to reconstruct the three-dimensional shapes comprising the buildings and structures in each of the above fantasies, is whether a perspective drawing can be deconstructed.

Consider, therefore, the simple two-point perspective of a building in the shape of rectangular prism as shown in the top part of Figure 2. One can extrapolate the roof lines in this perspective view to determine the left and right vanishing points as shown. Now we know from drawing two-point perspectives of rectilinear buildings, that the station point must be so positioned that, in plan, straight lines drawn from it to each of the vanishing point positions in the picture plane must form a right angle at the station point. Thus the locus of possible station points (for example, points A,B,C) corresponding to the perspective view in the upper part of Figure 2 must be a circular arc with center on the picture plane and passing through the vanishing point positions. Corresponding to each of these station point positions there is a different building with a different rectangular plan and a different orientation. The only point of commonality between these buildings is the height. It is thus clear that a given perspective does not correspond to a unique three-dimensional shape in the absence of other information. Two perspective views of the same building as seen from two station points would, of course, dictate a unique plan corresponding to the two perspective views. This is the basis of aerial stereo photography which allows one to see aerial photographs in three-dimensional relief. Indeed, as is commonly known, our eyes, by being placed a fixed distance apart, function in the same way.

With only one perspective view available for each of Chernikhov’s fantasies one is forced to speculate as to likely location of the station point which Chernikhov used. A likely station point for the sake of convenience, would be on a line perpendicular to the picture plane, which aligns with the peak of the prominent vertical features of the structure/building in Chernikhov’s perspective. The corresponding location in Figure 2 would be point A which aligns with the highest point in the perspective. It is quite likely that as a teacher of drawing and rendering that Chernikhov had a consistent way of constructing perspectives. Further research into his known writings (for example, the book “A Course of Geometrical Drawing”, of 1928 or “The Arts of Graphic Representation” of 1927 mentioned by Catherine Cooke (COOKE, 1984b)) or the study of other material now inaccessible may reveal his method of constructing perspectives. In the absence of more information on the likely position of the station point which Chernikhov used, the only option is to select a point on the locus of possible station points and obtain an understanding of the effect on the deconstruction of choosing a point some distance from the true station point. Figure 3 shows that the effect of moving the station point from A to B, for a building having a shape of a rectangular prism at a fixed orientation is to move the vanishing points. This is equivalent, as shown in Figure 4, to rotating the building and keeping the station point fixed. The renderer, therefore, has the choice, if he wishes to place a certain relative emphasis on the two visible vertical faces, of rotating the plan or of moving the station point. There is nothing which can be done with one approach which cannot be done with the other. We are no further ahead. One has to accept.
therefore, that the method of perspective deconstruction as proposed here will give a plan form which, according to Figure 2, will be rotated somewhat and of different relative proportions from what Chernikov may have intended depending on the degree to which the chosen station point is in error. Relative positions and proportions will be preserved from Chernikov's original intentions but elevations may be either more stretched or compact than intended. A study of the resulting elevations could help to justify or correct a chosen station point position. For example, if there would appear on one of the reconstructed elevations an obviously, nearly but not quite square opening or window then this would clearly suggest how the station point might be shifted to correct for this apparent distortion (In the present study the elevations were not studied with a view to correcting the chosen position of the station point).
THE DECONSTRUCTION: THE REAL CHERNIKHOV

The three deconstructions of Chernikhov's fantasies #22, #34 and #69 which are presented here are based on student work in an introductory course on architectural computer graphics. As part of the assignment to deconstruct perspectives and to construct the three-dimensional architectural models implied by the perspectives, the students were asked to create at least one view of their model which would closely replicate the Chernikhov image on which the deconstruction was based. The results may be seen by looking at the following pairs of figures: Figures 5 and 6, Figures 7 and 8, and Figures 9 and 10. This provides a check on the accuracy of the students' deconstructions (It does not, of course, identify an incorrect choice of station point). Figures 11 and 12 show additional views of fantasy #22 while Figure 14 shows another less flattering view of fantasy #34 (Note: the reconstructions of #34 and #69 both contain some inaccuracies and omissions).

Having deconstructed the images what can we learn about the real architecture behind the images? Certainly by comparing Figures 6 and 12 and 8 and 14, it is evident that Chernikhov very often chose the only advantageous view of his designs for presentation in the 101 Architectural Fantasies. This accords well with Chernikhov's own statement in the 101 Architectural Fantasies "If we add to this (colour, tone and illumination) the use of distinctive vantage points for the architectural object being represented, having chosen the most appropriate angle of vision for a certain spatial structure, in the final result we will have achieved the complete rendering of our architectural fantasy" (SASAKI, 1981a). One must ask, therefore, if the architectural conceptions were designed for the sake of the renderings or whether the renderings were designed to depict architecture. One suspects the former. One wonders with Sasaki that although "the plan generally was freely devised as the starting point of the flight of creativity, no matter how painterly the expression, the establishment of a plan was indispensable. However, nearly all of Chernikhov's plans lack anything in the nature of a plan." (SASAKI, 1981b).

Consider now in more detail the reconstruction of fantasy #22 as depicted in Figure 6 and compare with Figure 5. It would seem reasonable that the two towers depicted, being industrial structures, presumably designed for identical purposes, would be of equal size. It would seem reasonable, furthermore, that the bins on the braced frames are necessary to the function of the tower. In creating the three-dimensional model, the students' positioned two identical tower structures with bins as shown in Figure 12 to correspond with Chernikhov's perspective. It then became very clear that the more distant tower must actually be much taller than the nearer tower if the more distant tower is placed so that, in the perspective view, its horizontal position and width correspond approximately to Chernikhov's drawing. A hint of a difference between the two towers in Chernikhov's drawing may be gleaned from the fact that the nearer tower has seven rows of windows between the top of the tower and the horizontal bracing of the large vertical axis while the more distant tower has nine. To make this argument concerning the relative heights of the two towers more convincing, Figure 15 shows what would happen if the far tower is moved closer to the viewer until the top of the tower is as high as the far tower in Chernikhov's drawing in Figure 5, while roughly maintaining the same horizontal position in the perspective view. Clearly, the width of the far tower in Figure 15 is much greater than that in Figure 5. On the basis of proportion, the far tower in Figure 15 is therefore shorter than the corresponding tower in Figure 5. There is a hint in Chernikhov's drawing of yet a third braced form at the bottom left of the foreground tower to give a sense of more structures than just the two depicted. This hint of a third structure was not deemed important in the reconstruction.

Another example of Chernikhov's distortion for the sake of the drawing's clarity may be understood by comparing the manner in which the two forms with curved roofs at the base of the near tower are shown in Figures 5 and 6 (The forms with curved roofs are those in part A of Figure 13 shown resting above the frames used to support the bins.). In Figure 5 the forms with curved roofs appear to be symmetrically disposed on either side of the tower. When the forms with
curved roofs are symmetrically placed, as in part A of Figure 13, the resulting images in Figures 5 and 15 show, however, that the near tower obscures the form on the far side of the tower. Either, these forms are not symmetrically disposed on either side of the tower, or Chernikhoz has distorted his perspective. The latter conclusion must be true given that the tower is otherwise symmetrical when seen from the right hand side.

Let us consider now for fantasy #22 what insights one may glean from the three-dimensional reconstruction concerning the formal vocabulary of the structures and the spatial relationships between the shapes in this vocabulary. Figure 13 shows the three-dimensional model for fantasy #22 partly exploded into its component parts. Fantasy #22 belongs to Chernikhoz’s Group D as already noted. Chernikhoz describes this group as consisting of “clearly rendered design[s] of
trussed-girder structures and installations with visual demonstrations of spatiality" (SASAKI, 1981). He mentions fantasies #80, #74 and #79 as belonging to this group. Fantasies #9 and #81 would appear to belong to this group also and possibly #8 and #101. The most prominent feature in all of the drawings of this group are the heavy and expressive structural frames (the truss-girder structures). In #22, #80 and #81 the towers appear to be hollow, welded steel braced with steel tubes whereas in #74 and #79 the forms appear to be concrete. There is a common language of forms implied by these frames in the way the joints are made through local thickening and/or filleting of corners, in the manner in which the legs of the frames taper and incline for added stability, in the way the framing members split and in the way they are braced by tubes and spidery webs. The language seems to distinguish between concrete frames and hollow welded frames as already noted with the former being more angular, with sharp corners while the steel frames have
Figure 5  Fantasy #22 from the 101 Architectural Fantasies

Figure 6  Fantasy #22 as modeled with AutoCAD and rendered with GDS
Figure 7  Fantasy #34 from the 101 Architectural Fantasies

Figure 8  Fantasy #34 as modeled with AutoCAD and rendered with GDS
Figure 9  Fantasy #69 from the 101 Architectural Fantasies

Figure 10  Fantasy #69 as modeled with AutoCAD and rendered with GDS
Figure 11  Fantasy #22 detail view as modeled with AutoCAD rendered with GDS

Figure 12  Fantasy #22 overall view as modeled with AutoCAD and rendered with GDS
Figure 14  A less advantageous view of the building in fantasy #34 as modeled with AutoCAD and rendered with GDS.

Figure 15  Fantasy #22 as modeled with AutoCAD and rendered with GDS showing the result of moving the far tower in Figure 5 closer to the viewer.
rounded corners. This is not a simple language of forms in terms of describing it in formal terms such as shape grammars programmed on a computer. Suffice it to say that software for a three-dimensional rule-based editor for modelling such forms is conceivable, if complex, because of the diversity of frames and types of repetition of the structural bays which are possible. Further examination of Figure 13 shows that, in addition to the frames just noted, which support the bins and are represented in Figure 13 part A (with cross bracing shown in C), and the frame comprising the tower denoted by B, the only shape which has something in common with the shapes in the other fantasies of group D is the repetitive cross-bracing G. This shape can be considered as a cross-braced steel truss. Most of the fantasies have cross-braced steel trusses of various configurations. Again a rule-based software editor to model three-dimensional configurations of steel trusses is conceivable. All other shapes in Figure 13 appear to be unique. The Constructivist character of group D derives then from what is common to the drawings in group D, namely, the braced frames and the lighter braced steel trusses. These shapes constitute the common grammar which unifies the uncommon shapes into Constructivist architecture. The language of Constructivism in terms of the shape grammars of Stiny (STINY, 1980) appears to be broader than that definition or alternatively, it could be said to consist of more than one shape grammar for, indeed, the grammar of the braced frames is not the same as that of the light, braced, steel trusses (on account of the rounded corners and tubular cross-bracing distinguishing the steel frames from the sharp corners, concrete frames).

MODELLING AND RENDERING TECHNIQUES

The three-dimensional models presented in this paper were constructed with AutoCAD Release 10 using only those three-dimensional functions which are stored as 3DFACES or 3DMESHES, that is, shapes which are represented by three or four sided, polygonal faces. Any shapes which are not automatically closed by AutoCAD such as a surface of revolution (REVSURF) or an extrusion (TABSURF) were manually closed by adding faces with the 3DFACE command.

The shapes comprising the model were then converted to DXF files in such a way that a complete Constructivist model consisted of several DXF files (Each of the shape groupings in Figure 13 represents one DXF file, for example ). Subsequently, a specially written translator was used to convert the DXF files to McDonnell Douglas THINGS files for rendering with McDonnell Douglas GDS software using the Scene Viewing System (SVS). Figures 6,8,10,11,12,14, and 15 were rendered with SVS. The translator allows for the possibility that each AutoCAD block can be assigned a different color by automatically assigning color names to all the faces making up a block. It also assures that all the vertices are reordered to a consistent manner so that the normal to the polygons is consistently directed outward from the surface as required by solid modellers such as the GDS three-dimensional packages. The only restrictions on the polygonally-faced shapes created with AutoCAD, which are imposed by the translator, are that the shapes must be closed, as already noted, and that blocked shapes may currently not be nested.

CONCLUSIONS

It has been demonstrated that, with some reasonable assumptions, perspectives can be deconstructed into the three-dimensional shapes which the perspectives portray. In particular, it has been demonstrated that Chernikov's drawings from his 101 Architectural Fantasies can be deconstructed and analysed with regard to the shapes and shape relations between shapes which are the basis of Chernikov's Constructivist architecture. Not all of Chernikov's drawings are suitable subject matter for deconstruction. Using Chernikov's own classification of his drawings it has been determined which classes of his drawings are suitable for perspective deconstruction and which are not.
The deconstruction of Chernikhov’s perspectives has provided several insights into Chernikhov’s Constructivist architecture: 1) The architectural conceptions depicted in the renderings are designed more for the sake of the renderings than the renderings are drawn for the sake of an architecture. Often there is only one advantageous vantage point from which to provide a convincing view of the structures depicted and there is no semblance of a rigorous plan underlying the conception. 2) Chernikhov was willing to distort buildings for the sake of the drawings. This is especially evident in fantasy #22 where he went so far as to substantially increase the height of a tower in the background above that of a logically identical tower in the foreground. Chernikhov therefore adjusted his perspectives from the exact theoretical perspective to obtain more powerful and convincing images. 3) The Constructivist character and unity of Chernikhov’s work depends not on having all shapes being a part of a Constructivist vocabulary of shapes with specific spatial relations between them but only on some of the shapes, such as trusses, frames and grids being subject to such a grammar. The recurring shapes provide the unity and the Constructivist umbrella for the non-recurring shapes.

While it is possible that some of the above conclusions could have been reached without the use of three-dimensional computer modeling, using only a sound understanding of the theory of perspective drawing, experience indicates that three-dimensional modeling helped to bring the above conclusions into focus more directly than would otherwise have been the case. Three-dimensional modeling allowed one to see the effects of moving the relative position of architectural components, as shown in Figures 5 and 15, and hence to demonstrate clearly Chernikhov’s distortions for the sake of the drawing; it allowed one to look at Chernikhov’s architecture from viewpoint other than his and to appreciate that the architecture was designed for the sake of the drawings rather than the architecture; and, finally, in the act of modeling the individual objects comprising Chernikhov’s architecture, to appreciate more clearly the nature of the shapes and the shape relationships involved.

This paper provides an approach to study more fully any architecture which is only documented in perspective views. This approach, which can more simply be applied to axonometric views (although in both cases some speculation is required as to the design of those portions which are hidden from view), can be used to show how misleading a few isolated views of a building can be. It opens the way to a possible reevaluation of, in addition to Constructivism, other theoretical architecture known only to us in drawings, such as the axonometric drawings of Alberto Sartoris from the 1920’s and 30’s.

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