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DEFORMATION NETS FOR THE CONSTRUCTION OF SUPERFICIAL ANAMORPHIC IMAGES

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Abstract. This publication is a continuation of a discussion on anamorphic images of objects and, in particular, the principles for creation of deformation nets for superficial anamorphic images will be discussed. It focuses on the plane and folded single- plane, pyramidal and prismatic anamorphs. With these deformation nets it is possible to create modern anamorphs with ease.

Key words: anamorphic images (=anamorphs), plane anamorphs, surface (=superficial) and mirror anamorphs

1. Introduction

Nets, matrices or grids are the simplest and most commonly used means for re-producing or re-scaling images, paintings and any kinds the pictures. The nets are also important in case of construction of specifically distorted images. When the original image will be covered with a regular, orthogonal net (or grid), then we receive a matrix of smaller size squares containing particular pieces of art to make the whole image when combined together. By producing an anamorphic image of such a net we receive so called geometrical matrix or a deformation net by means of which we will be able to constrain deformations of image being inscribed into specific cells of this net. In this paper geometrical constructions for making many types of anamorphic transformation nets will be provided. Construction methods used to create a specific geometrical net will depend on the type of a superficial (= a surface) anamorph or on the type and shape of mirror used for creating a mirror anamorph. In this publication the surface (or superficial) anamorphs, and specifically plane and folded superficial anamorphs will be discussed. The following cases of folded anamorphs will be described below: a single-plane, a prismatic and a pyramidal anamorph [1]. The nomenclature used for particular cases has been described by the author in previous publication [1]. Equivalently to a term of “superficial anamorph” the term of “surface anamorph” will be also used in this paper.

2. Geometrical principle for construction of geometrical matrix for surface anamorph

Before we start producing any anamorphic image, particular relations between the specific parameters must be analyzed. These parameters are such as follows: the size (or area) of anamorphic image p_b, position of the view-point O_b, and the size of real image p, which lies in the plane β perpendicular to the plane α^a. Geometrical relations between the listed parameters are explained in Fig.1.

Real image p will have a determined size and will be covered with an orthogonal net. This net will be projected in a perspective transformation onto the perspective projection plane. This plane called later an anamorphic plane, determines an anamorphic deformation net p_b. In this way we can determine the size and the shape of a deformation net for a plane anamorph (Fig.1).

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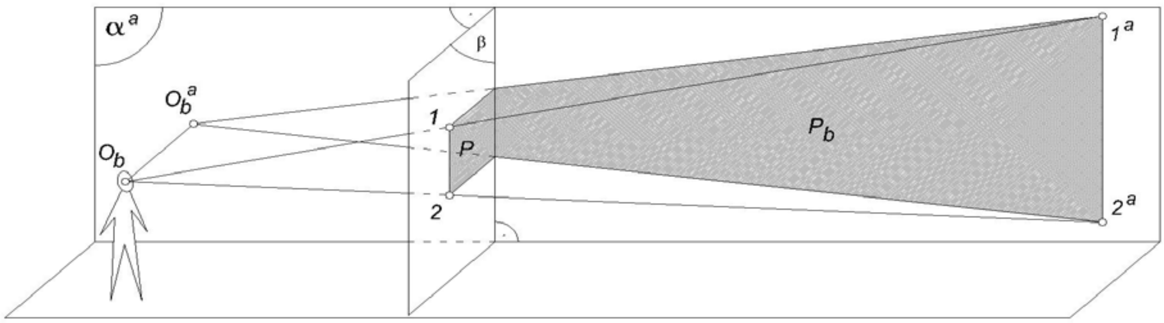

Fig.1: Determination of an area of geometrical matrix.

Deformation net will be created as a perspective projection of the orthogonal net onto the vertical wall, which will be considered as an anamorphic image plane, while point O_b will be the center of perspective projection. Simultaneously point O_b will be the center of image restitution (Fig.2).

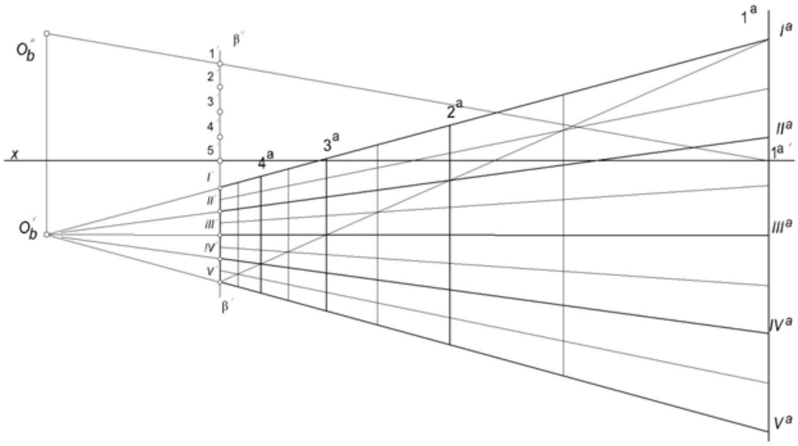

Fig.2: Geometrical matrix for the construction of a plane anamorph.

3. Deformation nets for folded superficial anamorphs

In this paragraph specific properties of deformation nets constucted for both concave and convex pyramidal or prismatic superficial anamorphs will be discussed.

3.1 Deformation net for a convex prismatic surface anamorph

This case is similar to the solution described above. Let us transform in perspective projection an orthogonal net (=grid) of the real image p belonging to the plane β from the view-point O_b onto the visible faces of a convex prism (Fig.3). In consequence we obtain a distorted geometrical net (=deformation net) on the faces of the prism. To measure real sizes in the considered deformation net we need to develop the faces of the prism together with their deformation nets onto one plane. The development must be performed in relation to measures taken from Fig.3.

There are several parameters, which influence complexity and the final form or shape of the deformation net created for a convex prism. Among the others, the factors, which influence the form of a deformation net are as follows:

- Freedom of the measures of bi-facial, internal angles in a prism, which is relative to the constraints set up on a convex prism construction.
- The number of visible faces of a convex prism, which depends on the location of a view-point O_b.

- The inclination angle of a projected face of a prism in reference to the edge of the prism.

In order to simplify a constructional drawing of a deformation net and to make the geometrical principle for a deformation net construction clear, we will provide an example of a deformation net constructed for straight prisms, both convex and concave. The prisms will have two visible faces. Let us assume that the vertical lines of orthogonal grid belonging to the faces of a prism are parallel to the vertical edges of the prism faces. The principle for a grid construction has been presented in Mongean projection in Fig.3.

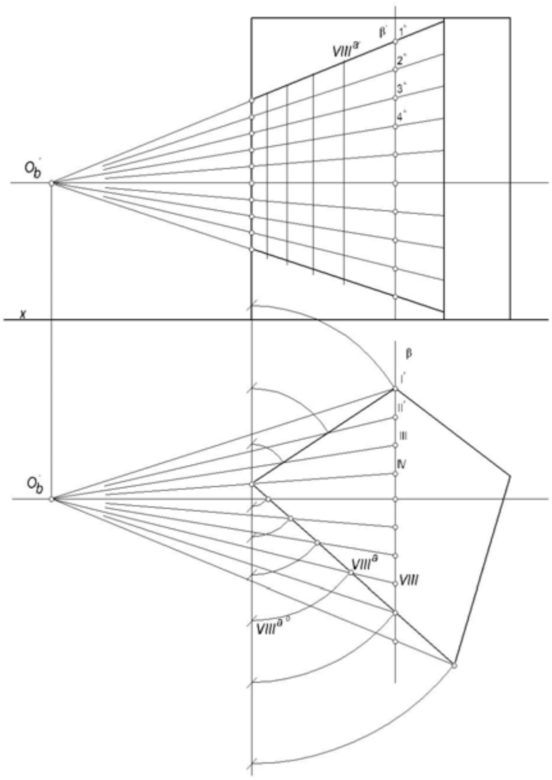

Fig.3: Geometrical principle for the construction of a convex prismatic surface anamorph.

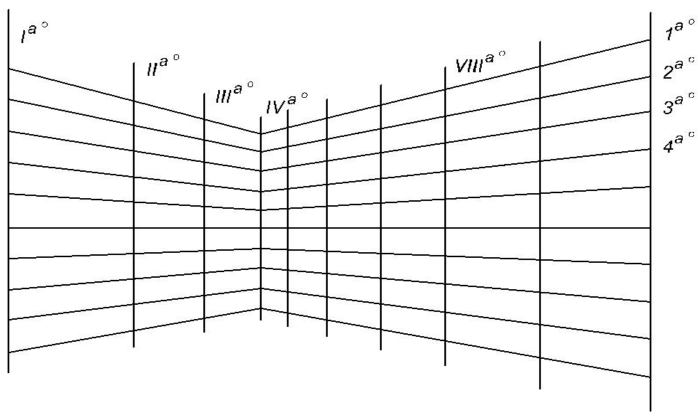

Fig.4: Deformation net for construction of a convex prismatic surface anamorph.

3.2. Deformation net for a concave prismatic surface anamorph

In order to construct a concave prismatic surface anamorph it is necessary to perform a central projection of an orthogonal grid onto the faces of a concave prism (Fig.5). Projection will be done from the assigned view-point O_b, which simultaneously plays the role of a restitution center. The orthogonal net, lying in the plane β, will comply with the constraints set up on construction of a concave prism.

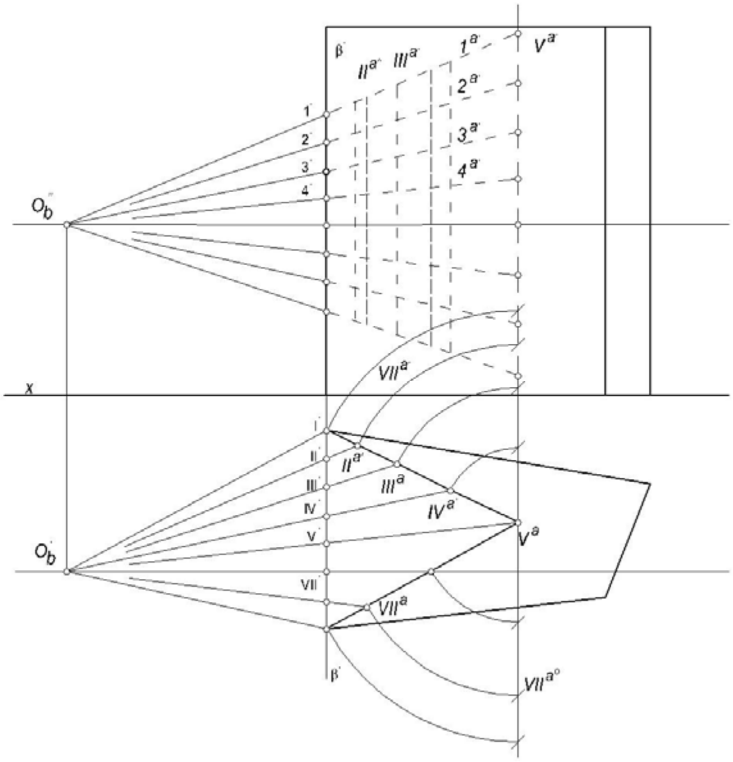

Fig.5: Geometrical principle for the construction of a concave prismatic surface anamorph.

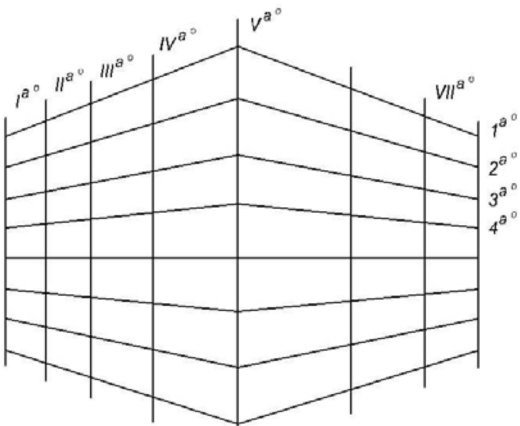

Fig.6: Deformation net for construction of a convex prismatic surface anamorph.

The case is similar to the one of a convex prism. The development of the prism faces will be performed taking into account measures derived from the top view of the prism (Fig.5). Only these faces, which contain the deformation net for a concave prismatic anamorph of the prism, will be included in the development (Fig.6). Let us compare the two types of deformation nets, one for a convex prism (Fig.4) to the other for a concave prism (Fig.6). We can easily notice that larger distortions take place in a central zone for a concave prism, while for a convex prism larger distortions take place in the boundary zones.

In case of a larger number of visible prism faces, the deformation net would be more complicated and expanded, while the anamorphic image would be more complicated and significantly more interesting.

3.3. Deformation net for a convex pyramidal anamorph

The principle for construction of a deformation net for a convex pyramidal anamorph has been presented in Fig.7. Let us consider a right, rectangular pyramid (Fig.7). View-point O_b belongs to a vertical line *l*, which passes through vertex W.

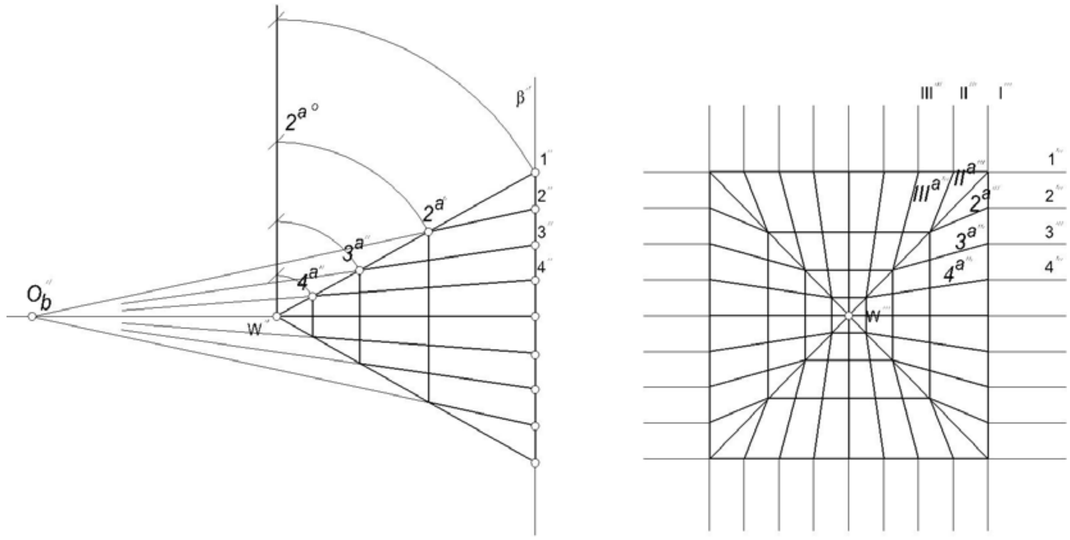

Fig.7: Geometrical principle for the construction of a convex pyramidal surface anamorph.

Let us assume the plane β which contains the orthogonal net of real image perpendicular to line *l*. One of the families of orthogonal lines creating the net in the considered plane β contains all parallels to the sides of a base square. The layout of such deformation net produce certain simplification of geometrical construction of the net distortion. Let us perform a central projection of the orthogonal net from a view-point O_b onto the faces of a pyramid. The development of the pyramid faces together with the projected deformation net will create a real size deformation net for a convex pyramid defined as above (Fig.8).

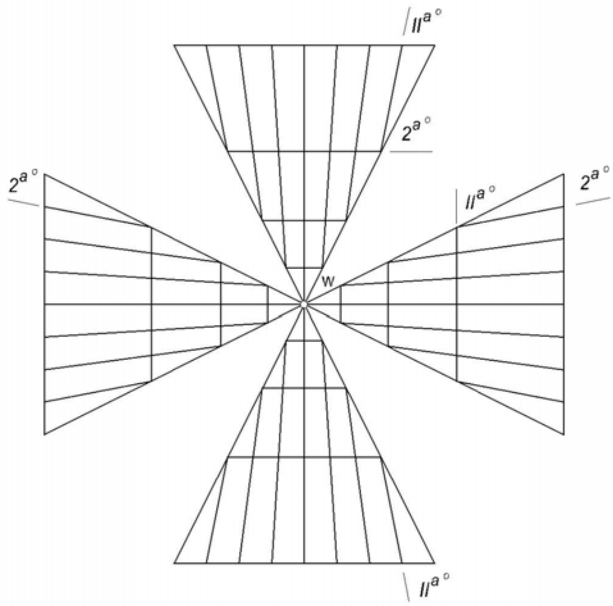

Fig.8: Deformation net for construction of a convex pyramidal surface anamorph.

3.4. Deformation net for a concave pyramidal surface anamorph

In order to provide an example of geometrical construction of a concave pyramidal anamorph the interior of a right square pyramid has been considered. The orthogonal net containing a family f lines parallel to the sides of a square has been assigned to the base of the pyramid. The principle for construction of a deformation net complies with a method described above. Let us perform a central projection of the orthogonal net from a view-point O_b onto the internal sides of the pyramid faces (Fig.9). Then we perform development of the side faces of a pyramid to get the true measurements of the net cells together with a characteristic distortion in the neighborhood of vertex W.

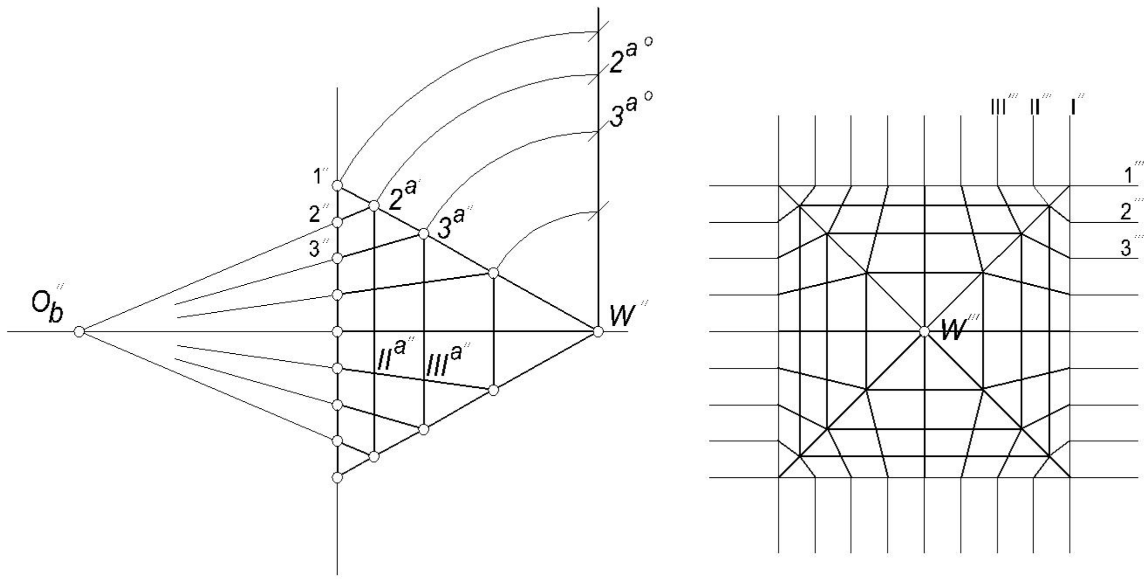

Fig.9: Deformation net for construction of a concave pyramidal surface anamorph.

Development of the deformation net has been provided based on the measurements included in Fig.7.

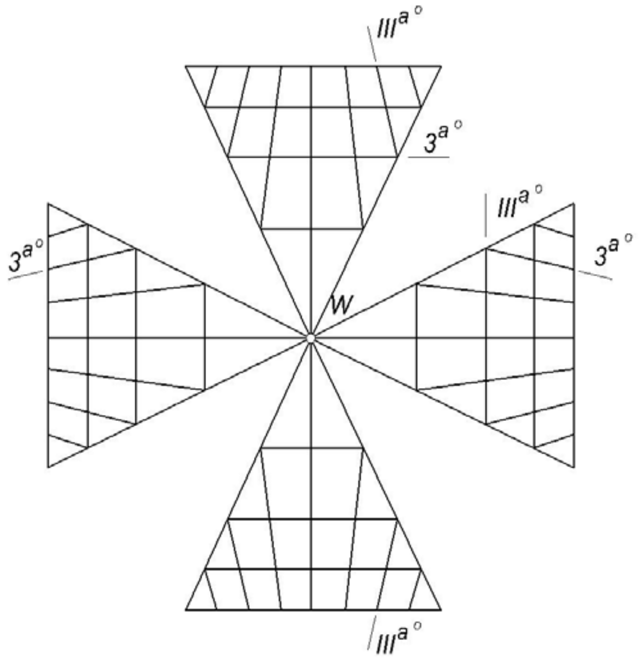

Fig.10: Deformation net for construction of a concave pyramidal surface anamorph.

4. Conclusions

The principles how to create special deformation nets will find their application into creation of specifically distorted anamorphic images. The main goal of this paper was to focus on the superficial anamorphic images, specifically on the plane and folded, single-plane, pyramidal and prismatic anamorphs. The terminology followed the one used in the previous paper [1]. In the described above examples geometrical principles for construction of deformation nets have been presented. With these deformation nets it is possible to create modern anamorphs with ease.

In subsequent publications the author will provide further discussion on construction of another deformation nets, which have been described and classified in [1].

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SIATKI DEFORMACYJNE ANAMORFOZ POWIERZCHNIOWYCH

Siatki są jednym z najprostszych i od dawna znanych sposobów przenoszenia bądź powiększania obrazów. Będą one miały również zastosowanie w konstruowaniu specyficznie odkształconych obrazów anamorficznych. Jeżeli na rzeczywisty obraz nałożymy siatkę ortogonalną to uzyskamy jego podział na kwadraty będące poszczególnymi polami siatki. Konstruując anamorficzny obraz takiej siatki otrzymamy siatkę deformacyjną która zdyscyplinuje deformacje obrazu w nią wpisywanego. Zasada budowy poszczególnych siatek anamorficznych będzie powiązana z rodzajem powierzchni dla anamorfozy powierzchniowej, bądź rodzajem lustra dla anamorfozy refleksyjnej. W niniejszym opracowaniu do rozważań przyjęto anamorfozy powierzchniowe, w szczególności płaszczyznowe i zwijalne w zakresie jednopłaszczyznowych, graniastosłupowych. i ostrosłupowych, zgodnie z przyjętą klasyfikacją i nazewnictwem [1]. W opisanych przykładach przedstawiono geometryczną konstrukcję anamorficznej deformacji siatek ortogonalnych