# DEFORMATION NETS FOR PLANE MIRROR ANAMORPHS

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**Abstract.** This publication is a continuation of a discussion on anamorphic images of objects.. Specifically, the principles for creation of deformation nets for planar mirror anamorphic images will be discussed here. The method proposed by the author is unique and not the only one in the choice proposed by the others.

**Keywords:** reflective anamorphic images (=anamorphs), plane anamorphs, mirror anamorphs

## 1 Introduction

To the group of the plane mirror anamorphs belong these of superficial anamorphic images, whose restitution requires not only setting a proper observation point (view-point) but also properly defined and positioned mirror that reflects the image. Deformations of orthogonal nets will be considered and discussed for the reflexive (=mirror) planar anamorphs. The complexity and the shape of the deformation net depend on the complexity of the mirroring surface. Specifically, it is important how many mirroring planes participate in reflection and what the inclination angle of the mirroring surface reference to the projection plane.

The order of the discussed cases will follow the classification order presented by the author in one of the previous publications ([8] p. 28 Table 2: Classification of the reflective anamorphic images based on the type of restituting surface and application). Only these cases will be discussed in which the mirror surface is planar, either singular or combined to make a surface of a pyramid.

This publication is a continuation of a discussion on anamorphic images of objects presented in previous papers ([6], [7], [8], [9], [10]). In particular, this research work aims at developing a method for construction of deformed images by means of application of deformation nets.

## 2 Deformation net for a singular plane mirror anamorph

The plane of the mirror ζ will be positioned orthogonally to the anamorphic projection plane $\alpha^a$. Let us assume that the orthogonal net will be positioned in the plane $\beta$, which coincides with the mirror plane ζ. Following the principles of the transformation let us now determine the image of the net observed from the view-point $O_b$. This image will construct a deformation net presented in Fig.1. The net with converging lines has been presented in the top view in Fig.1. This will be a deformation net for the planar mirror anamorphs.

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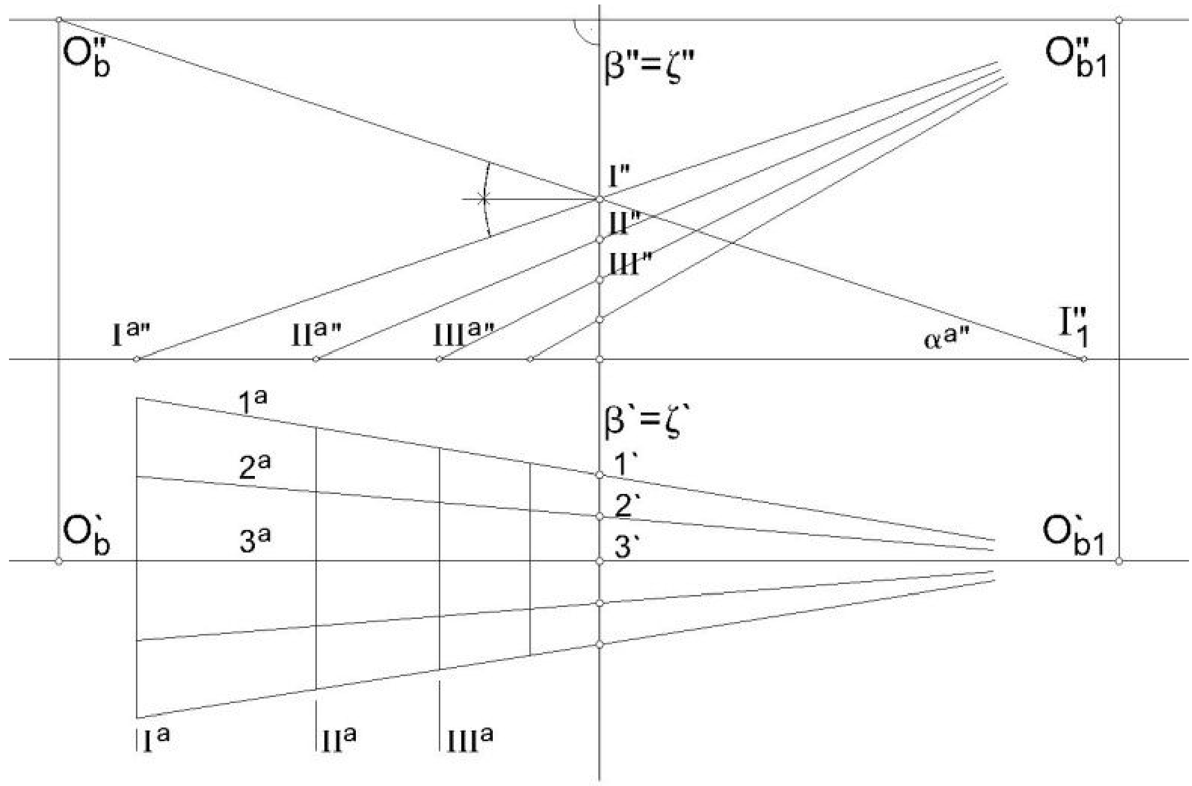


Fig.1: Geometrical construction of the deformation net for a singular plane mirror anamorph

## 3 Deformation net for the singular mirror anamorph with the inclined mirror plane

Let us now position the plane of the orthogonal net $\beta$ perpendicular to the anamorphic projection plane $\alpha^a$ so that this plane $\beta$ and the mirroring plane ζ have a common line of intersection. The lines creating the orthogonal net will be either horizontal or vertical assigned respectively with (I", II", III") and (1', 2', 3') (Fig.1). Let us assume that the view-point $O_b$, which is the center of projection, lies at a certain distance both from the projection plane $\alpha^a$ and from the mirroring plane ζ. The mirror plane ζ and the projection plane $\alpha^a$ are inclined at angle $\varphi$.

In order to construct the deformed image of the orthogonal net let us at first centrally project it from the view-point $O_b$ into the mirror plane ζ and then according to the mirroring principle let us transform this net onto the anamorphic projection plane $\alpha^a$. Geometrical simplification of the construction leads to central projection of the orthogonal net assigned in the plane $\beta$ onto the projection plane $\alpha^a$ from point $O_{b1}$, where the point $O_{b1}$ is the mirror image of the point $O_b$. Projection rays passing through the point $O_{b1}$ coincide with the reflection rays starting at point $O_b$ for all subsequent points $1^z$, $2^z$, $3^z$.. lying in the mirror plane.

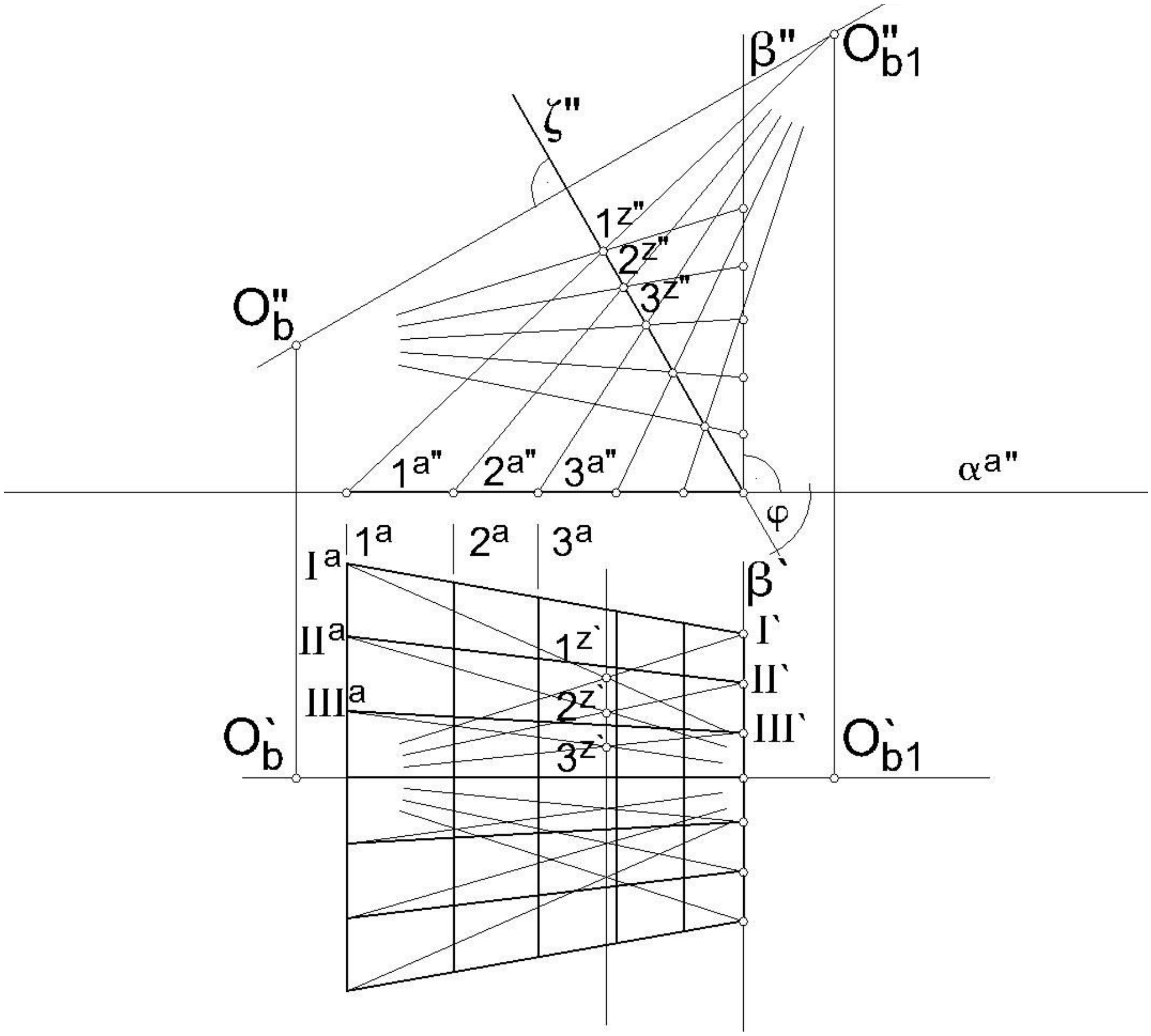


Fig.2: Geometrical construction of the deformation net for a singular mirror anamorph on the inclined plane.

## 4 Deformation net for the compound planar mirror anamorph

Let us now position the orthogonal net between the bounding lines of the area $s_o$, within which the restituted image will be created (Fig.3). One of the two grid's family of lines will include the lines parallel to the line of intersection between the two given mirrors. Let us assume that the principle projection ray passing through the point $O_b$ be perpendicular to the plane of the orthogonal grid $\beta$. By introducing compound transformation, which consists of two components as described in previous paragraph, we receive a deformation net presented in Fig.3. This net will be decomposed and it will consist of two nets creating an anamorphic image composed of two parts. Its restitution from point $O_b$ will give a non-generated, uniform image. In the provided example only 2-piece compound mirror has been taken into considerations. This leads to simplification of geometrical construction. It also allowed better understanding of the principle of the net construction.

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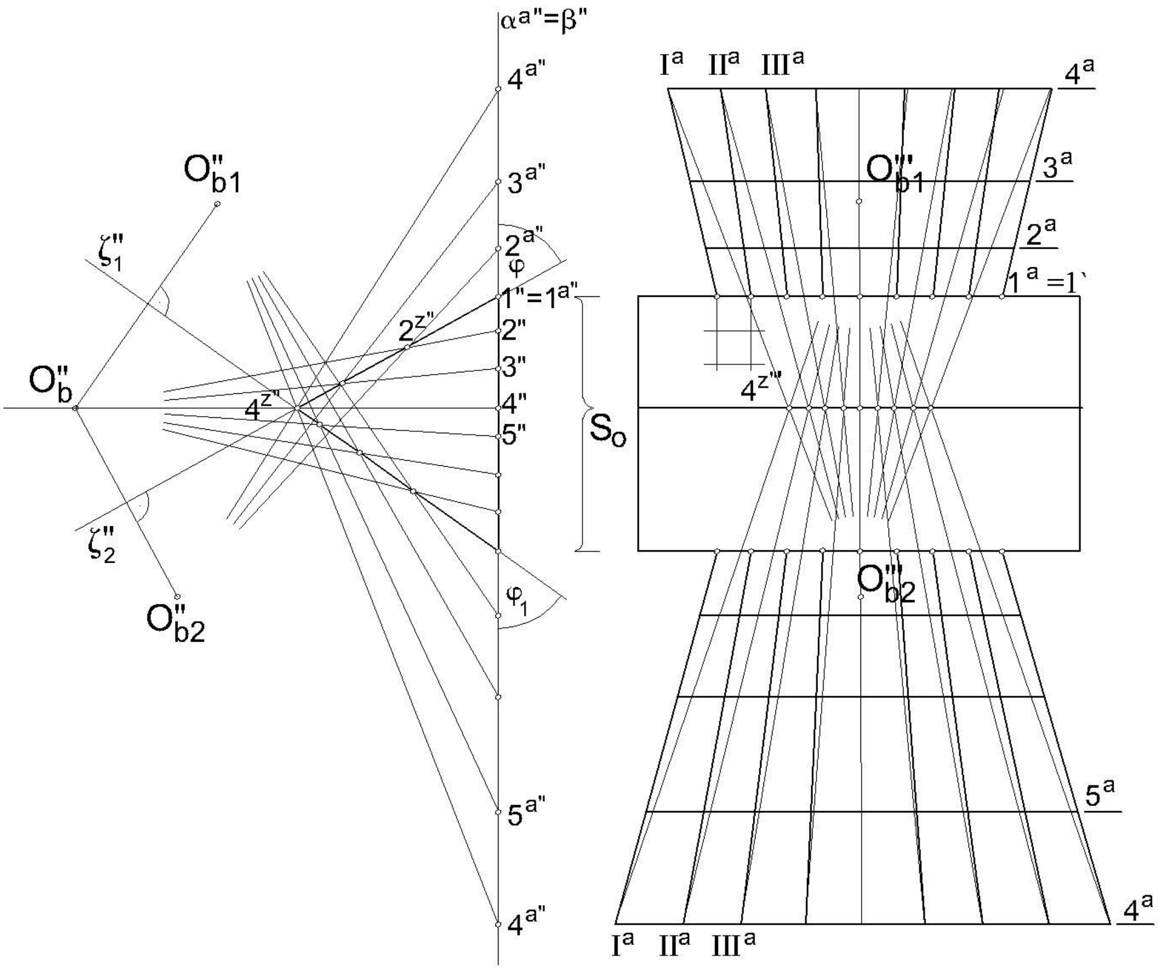


Fig.3: Deformation net for construction of a compound mirror anamorph

**5 Deformation net for the pyramidal, planar mirror anamorph**

Following the geometrical considerations regarding the planar mirror anamorphs we will now construct the deformation net for the pyramidal, planar anamorphs. The faces of a pyramid will become now the mirroring planes. Let us assume the mirroring pyramid to be a square pyramid. Let us position the orthogonal net perpendicular to the line *l*, which is the axis of the pyramid and with the grid lines parallel to the sides of the pyramid's base. Thus the orthogonal net will be positioned in the base plane of the pyramid. At first let us centrally project the orthogonal net from the view-point $O_b$ into the faces of the pyramid. Based of the reflection principle we will create the reflected image of the net in the anamorphic projection plane $\alpha^a$, which in this case coincides with the base of the pyramid (Fig.4). The reflected image will create a deformation net to be reflected in the faces of a pyramid. Let us also notice that the differentiation of the net deformation for specific faces of a pyramid will respect the inclination angle φ, which makes the pyramid face with the anamorphic projection plane $\alpha^a$. The last property may be well used to create a high quality anamorph images. In the described case the anamorph net will consist of four independent nets.

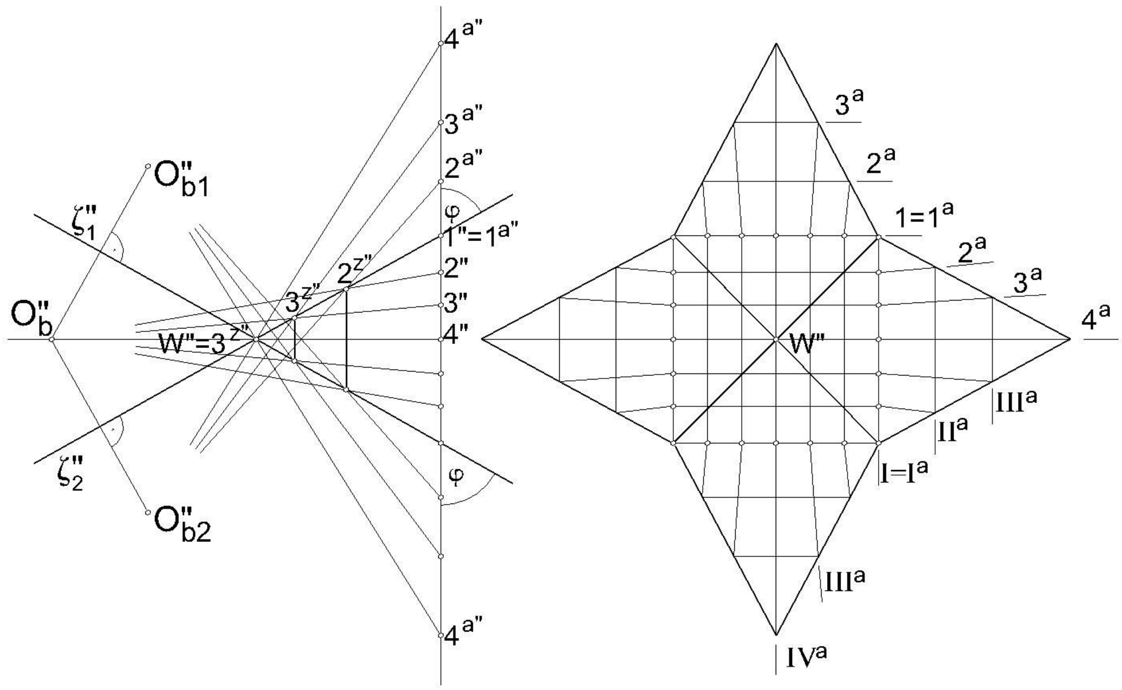


Fig.4: Geometrical principle for the construction of a concave pyramidal surface anamorph.

## 6 Conclusions

This publication is a continuation of a discussion on anamorphic images of objects presented in previous papers ([6], [7], [8], [9], [10]). In particular, the construction of deformation nets for mirror anamorphs has been discussed.

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

## References

[1] Bartel K.: *Perspektywa malarska,* Vol. II, F. Otto, PWN, Warszawa, 1958.
[2] Cole A.: *Perspektywa – świadectwa sztuki*, transl. Bończyk A., Wydawnictwo Dolnośląskie, Wrocław, 1995.
[3] Zdziarski A., Dyduch T.: *Pewne algorytmy odbić lustrzanych,* Proceedings of the Conference Geometry and Computer, Wisła 1995.
[4] Folga-Januszewska D.: *Perspective, Illusion, Illusionism,* Projekt No 143 KAW, Warszawa 1981.
[5] *Figaroscope,* supplement to Le Figaro, Dec.1995.
[6] Zdziarski A.: *Anamorphic Transformation of Space Elements Aided with the Deformation Net*, Proc.7th ICECGDG, Kraków, 1996.
[7] Zdziarski A.: *Analiza geometryczna kształtująca parametry metryczne anamorfozy zwierciadlanej, dla zwierciadła walcowego, wypukłego* – Politechnika Lwowska, Lwów 2003.
[8] Zdziarski A.: *Klasyfikacja i nazewnictwo obrazów anamorficznych* - Biuletyn PTGiGI, No15, Grudzień 2005.
[9] Zdziarski A.: S*iatki deformacyjne anamorfoz powierzchniowych cz.* I - Biuletyn PTGiGI No17, Grudzień 2007.
[10] Zdziarski A.: *Siatki deformacyjne anamorfoz powierzchniowych*: *walcowych i stożkowych* – Biuletyn PTGiGI No18, Grudzień 2008.

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