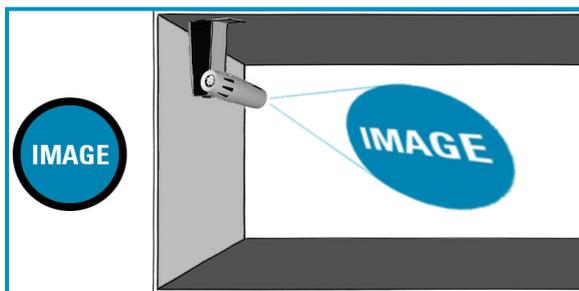


Notes on keystone correction or trapezoidal predistortion

Distorted, oblique projections and their problems

Since projections can't always be projected directly from the front onto a desired surface because the local conditions do not allow it, a physical problem arises in these cases, which, however, can largely be solved by means of a keystone correction or a trapezoidal predistortion.

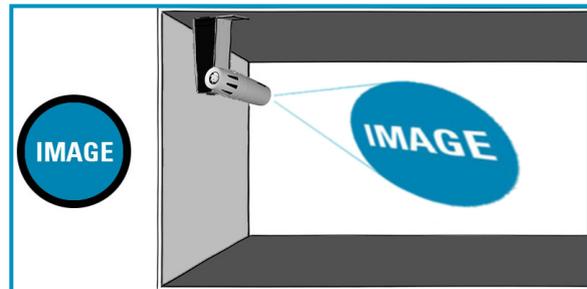
If you don't project frontally, but horizontally and / or vertically offset, so that the central projection axis is no longer aligned perpendicular to the projection surface, a trapezoidal distortion of the projected image arises. This enlarges the part of an image which is further away from the projector, while the image part which is closer to the projector is reduced. The lowest degree of distortion is always achieved by a direct projecting from the front - when the projection surface is oriented at right angles to the central projection axis. However, the flatter the angle to the projection surface is, the greater the trapezoidal degree of distortion will occur (e.g. stretching the image along the perpendicular to the central projection axis). This is due to the spherical spread of the light and its projection rays.



Avoiding distorted images by a keystone correction or trapezoidal predistortion

Projectors, moving heads or scanners - unlike e.g. in the case of arithmetic compensation by some data projectors - are not able to compensate this effect opto-mechanically, as lenses within the devices cannot be aligned parallel to the projection surface!

The only way to compensate an unwanted trapezoidal distortion in the projection is to counteract with an predistorted image by the gobo production. The image is therefore mathematically distorted based on the local conditions so that the image appears undistorted in the projection on the projection surface - we're calling this a keystone correction or trapezoidal predistortion.



The deviation was originally measured by angles. However, since this procedure has proven to be extremely difficult for the layperson, we're using a much simpler procedure which allows the customer - with little effort and without technical expertise - to determine the trapezoidal distortion of the projection.

To get to a predistorted gobo, all you've got to do is using a measuring gobo to make a projection exactly like you want it to be done later with the predistorted gobo. By frontal photos from the point of the later viewer, we can graphically predistort an image so that you're provided with a suitable gobo for a later, almost undistorted projection.

Step by step to your predistorted gobo

Step 1: If you're ordering a projector or gobo, please tell us that a keystone correction or trapezoidal predistortion is required. You will then receive a special measuring gobo from us by a small surcharge in front of the production of the desired gobo. If the projection is done by a projector with a deflecting mirror (e.g. with a scanner), you should also state this when placing your order.

Step 2: Please mount the projector exactly at the final position from which you want to arrange the later on projection.

Step 3: Place the measuring gobo into the gobo holder of your device and turn it for that it's perpendicular (orthogonal) positioned to the device before making the projection!

Step 4: Then align the device onto the surface and the desired position of the later projection (if you're using a deflecting mirror or a device with a deflecting mirror, like a scanner, align the projection by adjusting the mirror). The center of the crosshairs of the projected measuring gobo should mark the center of the final image. The gobo may then no longer be rotated in the gobo holder during the projection!

Step 5: Now take a digital photo of the projection of the measuring gobo. Please observe the following rules to enable an exact calculation of the required keystone correction or trapezoidal predistortion:

- Use a digital camera or the camera of your smartphone with a resolution of at least 5 megapixels! Select the best image quality in the camera menu (e.g. Large + JPEG superfine). Please don't use an additional flash when taking the picture.
- For horizontal projections, for example on walls, doors or facades etc., don't photograph from the device perspective, but from the point of view of the later viewer. For vertical / perpendicular projections, it is best to take pictures from the perspective of your device.
- If possible take pictures with a camera tripod to prevent blurring or „wobbling“ and to achieve a correct alignment of the camera.
- Choose helpful, symmetrical details for your photos, such as door or window frames or make markings with adhesive tape. Even if you need a certain image size for your projection, appropriate markings with adhesive tape are recommended.
- Please keep in mind that you may need a ladder or work platform, as this might be very helpful to photograph a measuring gobo which is projected high on the wall.
- Photograph outdoor projections from a distance which is as large as possible, if these are projected high on building surfaces.

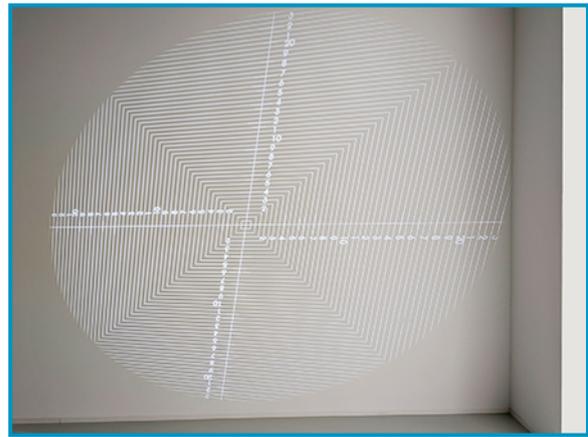
Tip 1

If possible, use the built-in bubble level of the photo tripod or a clip-on spirit level to align the camera vertically. If this is not possible, take your time and try to bring the camera into the correct position by visual judgement.

Tip 2

The edges of the viewfinder image or camera display should absolutely run parallel to the edges of the projection surface. If the vertical edges of the projection surface converge upwards in the viewfinder image, the camera must be tilted downwards. If the vertical edges of the projection surface converge downwards in the viewfinder image, the camera must be tilted upwards.

Step 6: Send us the photo(s) of your measuring gobo projection by email directly to: gobo@derksen.de. We will then use your photo to make a final keystone correction or trapezoidal predistortion of your image for that you can then carry out a largely undistorted projection.



Example of a diagonally inclined measuring gobo projection on a wall from the perspective of the later viewer as the basis of our revision.



Example after our revision / keystone correction or trapezoidal predistortion.

Example of a desired masking, for example for facade projection

If you're illuminating a facade and want to prevent light of the projection from falling through windows and doors and thus want to avoid glare of people, it's also possible to leave out or mask these parts of the facade in the projection image.

For this it is necessary that you'll take two photos from the device perspective for a better visibility of the measuring gobo, without changing the location of the camera or moving it!

For a projection to be masked, therefore, first take a photo without any inserted gobo and another photo with the inserted measuring gobo.

This is needed for that we can overlay both photos exactly on top of each other to mask the desired parts of the projection. Because, if only the projection of the measuring gobo is available, the elements to be masked are very difficult to recognize in the dark and are therefore difficult to use for our masking work.

You can also see this very well by the following projection examples.

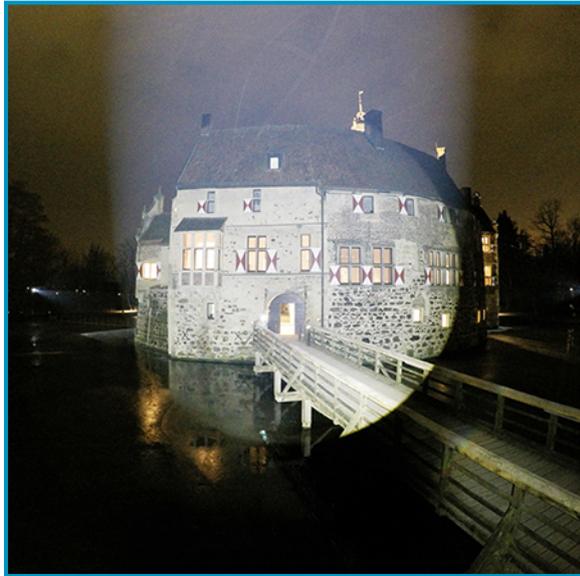


Figure 1 shows a photo of a facade projection from the device perspective without using a measuring gobo.

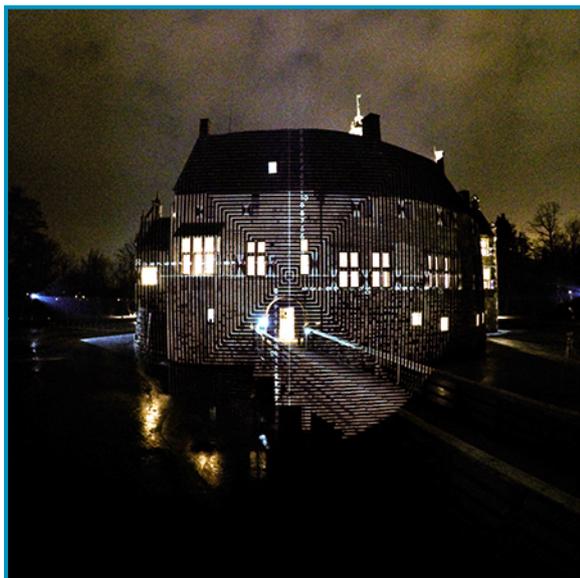


Figure 2 shows a photo in which the measuring gobo was used to project onto the facade without changing the location of the camera.



Figure 3 shows a photo after the finished, desired masking has been made (with recessed windows and doors). To generate the masking, we placed the two photos with and without a measuring gobo on top of each other for a better visibility.

Attention!

Please note that a predistortion of the gobo image is possible with an oblique projection, but this doesn't compensate an uneven illuminance of the image and also not the different depth of field levels of the projection (this means the image in an oblique projection always becomes projected with an uneven illuminance and sharpness)! How strong this effect is depends on how inclined will be projected! An adjustment of these factors is impossible due to physical reasons!

If you're not sure about how to practice with this procedure or if you've got any further questions, please don't hesitate to contact us for that we can advise you on your project.

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