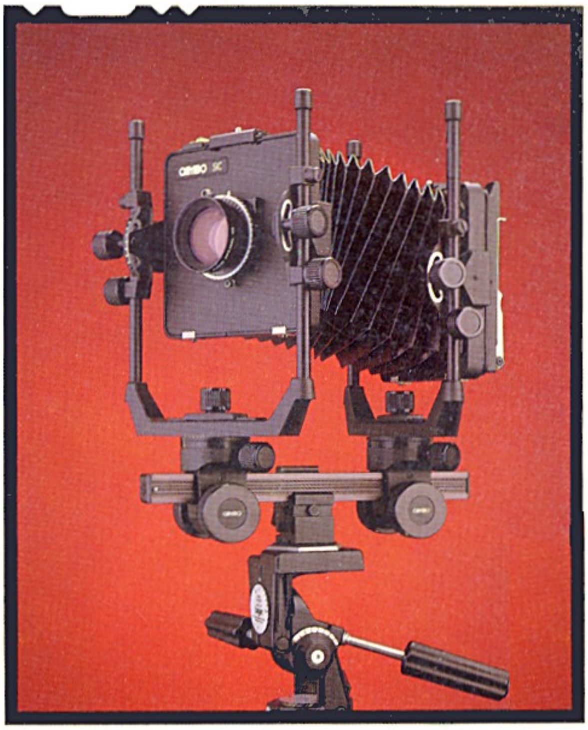
THE VIEW CAMERA



A first approach

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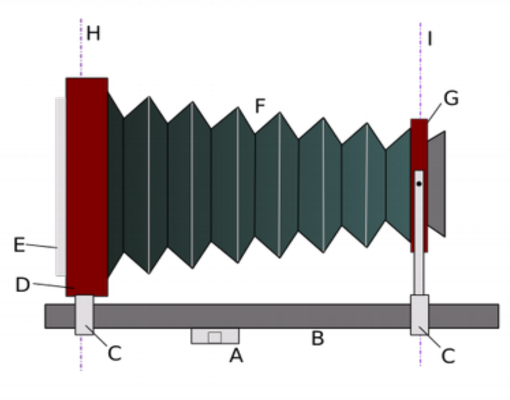
November 2014

The View Camera

Basic design:

A view camera always has the following standard features:



The optical bench & benchholder (A+B): This is the part connecting the front and back standards, and allows them to move. It has to be perfectly straight and stable. It has a rack and pinion system allowing to fine-tune the focus by moving the back and/or front standards.

The front standard (C+G): composed by the lensboard and a frame that holds it. It includes a latch system for fixing the lensboard and the bellows, and knobs for adjusting/tightening the movement axle pins.

The back standard (C+D+E): similar, but with a focusing screen or film holder and its support.

The bellows (F): light-tight, flexible, extensible and deformable walls, forming a "darkroom" inside which the light rays pass from the lens to the film. It must be long enough if you are intending to go into close-up or macro photography..

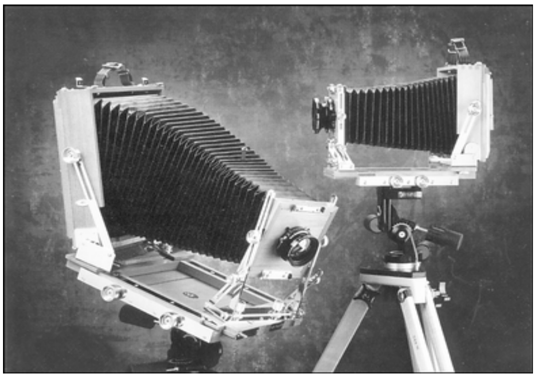
The lens: is characterised, like the lenses of any other camera, by its focal length and its aperture. The aperture is the result of dividing the focal length by the maximum diameter of the diaphragm. The longer the focal length, the smaller the angle of view. The larger the format, the larger the focal length for the same angle of view (and the less light the camera will get). The coverage of the lens is important: too small an image circle will limit the camera's movements.

The shutter: usually of the central type (near the diaphragm) and mechanical (spring-based, which implies relatively modest maximum speeds : often about 1/500th sec.). In the case of lenses without a central shutter, there are shutters that can be added in front of the lens.

Types:

The folding camera: The camera by excellence from the 1880s until the late 1930s, made of wood or metal: Graflex, Technika, etc… Often not or only slightly adjustable. Rather light, it can be used hand held. The journalists' camera of choice (Weegee, etc…) at that time. Front standard with tilt & rise-fall movements, back standard without any (or with some of very low amplitude). Fairly short extension possibilities.

The flat bed camera: Its optical bench is formed by a foldable & expandable panel. Larger and heavier than folding cameras, it requires the use of a tripod. The camera movements can be significantly larger, and the bellows extension usually a bit longer than for a folding. Often somewhat limited back standard movements, mostly only possible from the base of the standard, sometimes from the centre. Modern devices have good rigidity. Easily transportable, as they are light (wood or synthetic) and are quite compact when folded up (sometimes with the lens still in place): this is why they are often called field cameras.



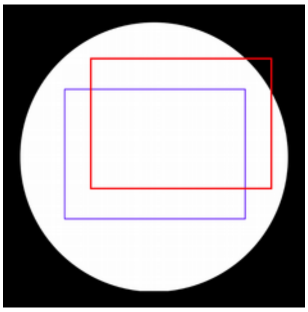
The monorail camera:

Its design is more recent. The camera is generally made of metal or synthetic materials. Some names: Sinar, Linhof, Arca, Toyo, Deardorff. The front and rear standards are symmetrical and fixed on a central rail; very good legibility of the adjustments and great amplitude of the movements. The system is very flexible, with the possibility of very long extensions, format changing, etc. A really complete system, with endless possibilities (when budget permits...). The multiplicity of components: extensions, bellows, etc. make the camera less easily transportable. It is best reserved for studio work. Some models can be fitted with a digital back..

Accessories

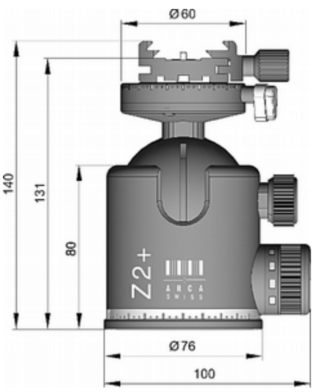
Lenses:

Since the main advantage of the view camera is the possibility of controlling perspective and sharpness by means of lens movements, it is important to look at the coverage of a lens before buying one. "Angle of view" is often confused with coverage.. The former refers to the larger or smaller portion of the subject that can be recorded on the negative from a given point of view, depending on the type of lens used (wide-angle, normal, tele). Coverage refers to the circle of image projected onto the film plane, and into which the negative must fit in order to avoid vignetting. Coverage depends on the design of the lens, not its focal length, and is mentioned by the manufacturer in its technical documentation. A larger image circle allows more lens movement without vignetting. Schneider Symmars are known for their large coverage.



Tripod:

Since exposures can easily take several seconds or even minutes, a good-quality tripod is required to ensure the stability of the camera regardless of the degree of extension of the bellows, the weight of the lens, and the resulting overhang. A distinction is made between the very heavy (and expensive) monopods designed for studio work, and the more manageable and transportable tripods. The stability of the tripod can be improved by a weighted device that can be hooked between its three legs.



Tripod head: a good quality tripod is nothing if it is not complemented by a head that is at least as good. The quality of the head is often considered even more important than that of the tripod, whose stability can always be improved by tinkering. There are two main categories: ball and 2- or 3-way. The manufacturers always indicate the maximum weight supported by their head. It is better to play it safe and take a good margin, because the overhang adds stress on the head, which may fail if it is too "light". Without accurate documentation (second hand), one can get an idea of the robustness of the head by looking at the size of the ball.

Exposure meter:
Except for a few top-of-the-range (and expensive) models, view cameras aren't fitted with any light measurement system, nor any automatism. It is therefore necessary to foresee a hand-held cell. Some cells can also be used as flashmeters, incident/reflected/spot measurements, etc...

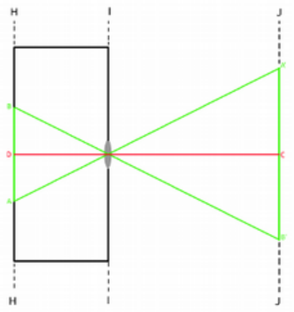
When & Why use a view camera?

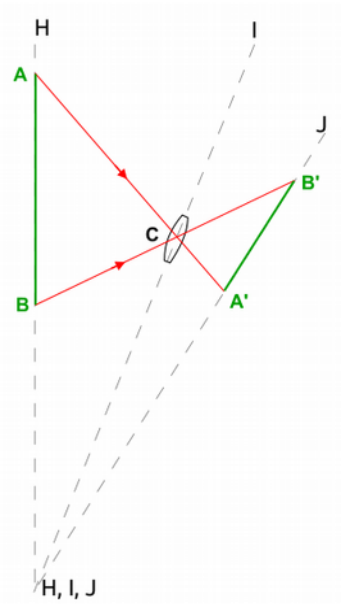
This equipment is intended for static shots: still life, industry, architecture, landscape, studio portraits. All images where the emphasis is on precision: sharpness and perspective correction.
Sharpness: thanks to the large format negative the enlargement ratio of the print will be less, and there will be less loss of quality. The best possible quality is obtained by a simple contact print. (Edward Weston)
Optimal settings: almost all corrections are possible by the tilt and shift movements of the front and back standards of the camera.
It should be noted that front tilts only affect focus, while rear tilts affect both focus and perspective control.

Movements

Unlike "fixed" cameras, the front and rear standard of a view camera can be moved in any direction. Movements to the left or right, up or down are called "shift", "rise" or "fall". Rotating the front or rear body around a horizontal or vertical axis is called "swinging" or "tilting". (see Appendix 1)

Swings & Tilts
For fixed cameras, the rear (H in our first illustration) and front (I) planes of the camera are parallel. When an object is in focus in front of the lens, the image of the object passes directly through the lens to the film or sensor. If the object is in focus, all objects in the same plane are in sharp focus. Sharpness deteriorates as you move away from this plane. Roughly speaking, the area of sharpness extends 1/3 in front of the plane of focus and 2/3 behind this plane. But, again, only the objects in the plane of sharpness will really be in sharp focus.





The Scheimpflug rule

According to this rule, the convergence of the front, rear and sharpness planes at a single point ensures sharpness of all points of the sharpness plane provided that the focus is on a point that belongs to that plane. In this case, the depth of field becomes a sort of cone that widens as it moves away from the lens.

It is easy to understand that it will be easier to take advantage of this rule if the image circle and coverage is large … and large image circle lenses are expensive. To obtain the same sharpness from a lens with a small image circle, the rear plane of the camera must be tilted; this may save sharpness but it introduces distortions in the image: the movements of the rear plane are used to control perspective.

Moving the front standard around a horizontal axis (front tilt):

Realization of a "front Scheimpflug". This increases the depth of field in a limited area close to the plane of maximum sharpness. This movement is widely used to give a sharp image from the photographer's feet to infinity.
It works very well as long as there are no high objects in the foreground. Such objects would be out of focus.

Moving the front standard around a vertical axis (front swing):

This is how a "lateral Scheimpflug" is made. This allows you to change the plane of focus, e.g. in the case of a wall, a fence or the like that moves away from the camera on one side of the image. This works very well as long as there are no elements protruding too much from the plane of the façade, fence, etc.

Moving the back standard around a horizontal axis (back tilt):

There will be an up/down distortion of the perspective. Possible problem: tilting at the base (as on photo on the right) rather than around a central axis can move parts of the image away from the plane of focus defined before the movement. It is then necessary to refocus.

Moving the back standard around a vertical axis: (back swing):

This induces a left-right perspective distortion

Shifting, Falling, Rising

In these cases, one standard is shifted in respect to the other, while keeping the two parallel to each other.
To obtain what effect?

The rear standard remains straight, so there is no effect on perspective.

The front standard remains straight, so there is no effect on the sharpness.

But it is possible to reframe the image (take more sky and less ground, include parts that are further to the left or to the right...) without changing either the perspective or the sharpness. For example, a mirror or other reflective surface can be photographed without including the image of the camera or the photographer.

The cropping is done by moving the front or back plane (or both). The final position of the front and rear planes in relation to each other is exactly the same in all cases, and requires a lens with a sufficient image circle.

Procedure

Decide on the location/position of the camera and on the lens choice

Move left, right, forward, backward. When shooting small format, this can be done by looking through the viewfinder to judge the effect of the choice of viewpoint. In large format, this would take too much time. So it is a matter of acquiring, through exercise, the feeling to convert the eye's vision to the "vision" of the camera. (Little tip: it is always possible to cobble together a "viewer-frame" in a sheet of cardboard to help estimate this "vision")

While choosing the point of view, you need to think about your choice of a focal length, which will give different fields of view and depths.

It is not uncommon that after having made these choices and after having installed the camera with its lens, one is led to modify more or less slightly the position of the latter.

If it is not possible to change the position to obtain the ideal image, a shorter lens can always be used and the image cropped by shift movements, or at the printing stage.

***Level the camera**, making sure that all movements are neutral (use the built-in spirit levels). This is especially useful in architecture, where the verticals must remain vertical most of the time. Make an initial adjustment by moving either the front or back standard forward or backward until the image appears in sharp focus on the groundglass.*

Note: it is not always easy to "find" the object on the groundglass, especially for close focuses with a long focal length. To save time, a table of correspondence can be established for each lens between a series of subject/lens distances and the bellows pulls required to obtain a sharp image (see Appendix 3). This tip was suggested to me by our member Paul Cancelier. Thanks to him.

***Camera movements** Start with the shift, rise & fall movements, as they influence the framing of your image. If you want more of a picture element, move the front standard in its direction (lift the front standard for more sky) or move the back standard in the opposite direction (lower the back standard for more sky).*

Next, deal with the rear tilts & swings, keeping in mind the same principles: to enlarge an element of the image, move the part of the film that will receive that element away from its plane.

Finally, deal with front tilts: to improve the sharpness of an element, tilt the front standard to bring it into parallel with the subject plane. To accentuate the blur, do the opposite.

***Choosing a filter**: here the same rules apply as in small format photography: effects of filter colours, exposure compensation factors…*

Calculate the exposure:

- Measure the light in the way that suits you best, ideally by taking several measurements on different parts of the image (from the lightest to the darkest) so that you can decide which parts should be favoured.

- Don't forget to apply the correction factor related to the filter you might be using.

- Check the bellows extension: the closer the subject, the greater the bellows extension when focusing. If the distance between the camera and the subject is smaller than the focal length of the lens x 10 (with a 210mm lens, when the subject is less than 2.1m away), an exposure correction will be necessary.

This is calculated by dividing the bellows extension by the focal length of the lens and squaring the result.

- If the exposure time is long, take into account the Schwarzschild effect (consult your film manufacturer's documentation).

Example:

For a 210mm lens and a 295mm bellows extension, we have: (295/210)2= 1.9733559 or 2 when rounded up. It is therefore necessary to multiply the exposure time by 2, or to open 1 additional stop. This formula is not very practical, as you need a tape measure and a calculator.

There are little tricks and accessories that simplify things: the Quickdisk, for example, where a disk, placed on the subject to be photographed, is measured on the groundglass. There are also automatic calculation programs. Our member Gerard Smeets is currently preparing an Excel table with these calculations; it will be put on the Picto Benelux website as soon as it is operational.

Here is a system I like to use. It is not absolutely accurate, but in practice it gives very good results:

1: For each of your lenses, prepare a cardboard strong enough to withstand multiple manipulations and write down the list of f-stops in 1/3 steps (you copy this list from your lens, or from a meter for example). Differentiate the whole f-stops in bold, in colours, by an asterisk...

*Ex: **2** - 2.2 - 2.5 - **2.8** - 3.2 - 3.6 - **4** - 4.5 - 5 - **5.6** - 6.3 - 7.1 - **8** - 9 - 10 - **11** - 13 - 14 - 16 - 18 - 20 - **22** - 25 - 28 - **32** - 36 - 40 - 45 - 51 - 57 - **64** - 72 - 80 - **90***

2: Calculate the focal length of your lens in inches, by dividing the mm of the lens by 25.4. Round up the result and write it on the top of your card.

3: Measure the extension of your bellows in inches (there are plenty of tape measures graduated in cm and inches; you can sew one to the edge of your focusing cloth, if you use one). Measure from the centre of the front standard to the centre of the back standard to avoid the effects of any tilting

4: Find where these two numbers (the focal length and the extension, in inches) fall in your f-stop scale; the interval gives the correction to be applied, in 1/3 f-stops.

Illustration: see Appendix 2

Note: This method is not valid for telephoto lenses, as their optical centre is not at the level of the lens stage.

Processing the negatives

One of the benefits of large format is that you can develop your negatives individually. This is what made the Zone System (Ansel Adams) possible. To go into the details of this method would take us too far here.

If you don't have large volumes of negatives to develop, developing in trays, as with paper, is the simplest method. It should of course be done in complete darkness.
If you have more negatives to develop, you can consider specific systems such as Combi-plan tanks, BTZS tubes, Jobo Expert tanks, etc.. The latter are particularly easy to use, but unfortunately they are very expensive...

Combiplan tank & Paterson+insert 4x5"

Jobo CPP2 + Cuve Expert

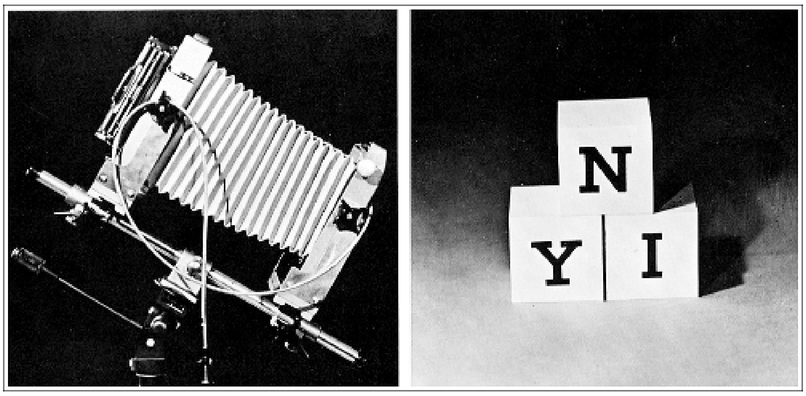
Jobo Expert

BTZS Tubes

APPENDIX 1: THE VIEW CAMERA'S MOVEMENTS

(All illustrations: New York Institute of Photography)

1a – Up, down movements (rising, falling)

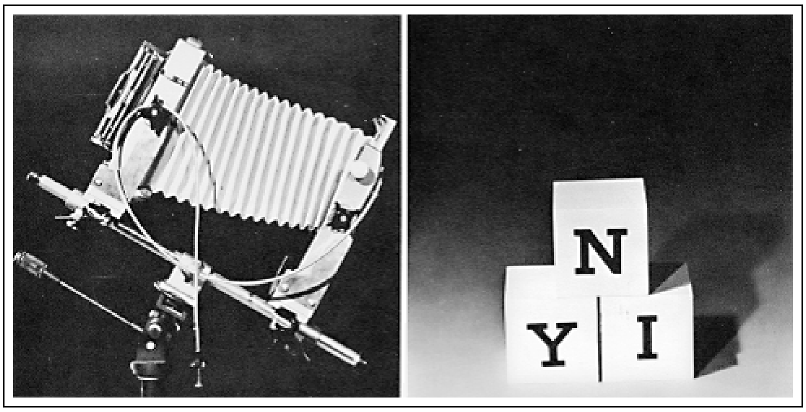


Initial setup:

All camera controls are in their neutral position

The camera is located slightly above the subject, and tilted slightly downwards.

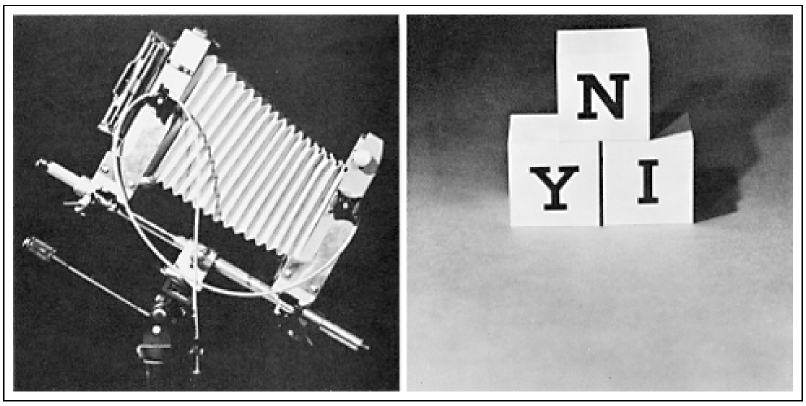
The resulting picture is in the center of the negative



The front standard was raised.

Result : the subject image moved into a lower position

The subject image moved in the opposite direction to the front standard's movement.



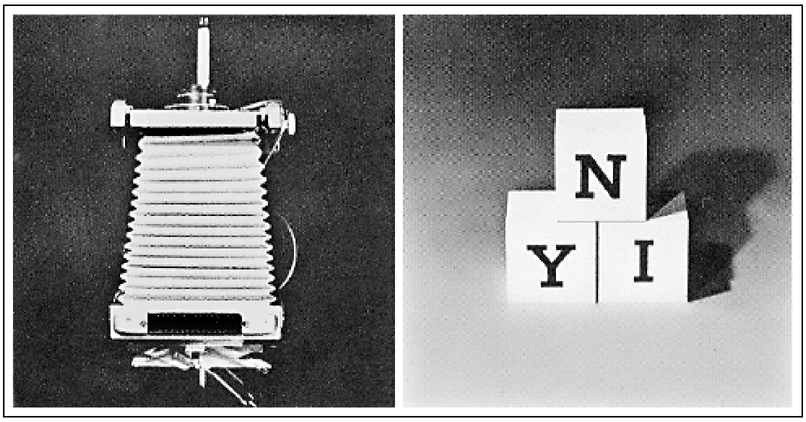
The front standard was lowered

This resulted in a displacement of the subject image to the higher end of the negative

The subject image moved in the opposite direction to the front standard's movement.

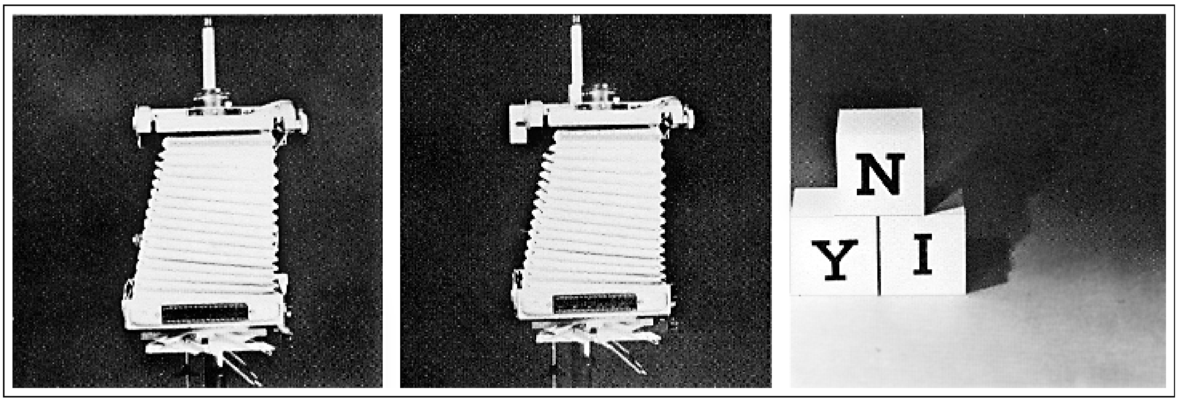
Some cameras allow rising & falling on both the back and front standards. The effect will be exactly the same if the back standard is used, except that in this case, the movement of the subject on the screen will be in the same direction as the movement of the rear body, and not in the opposite direction.

<u>*1b – Left, right movements (shift right & left)*</u>

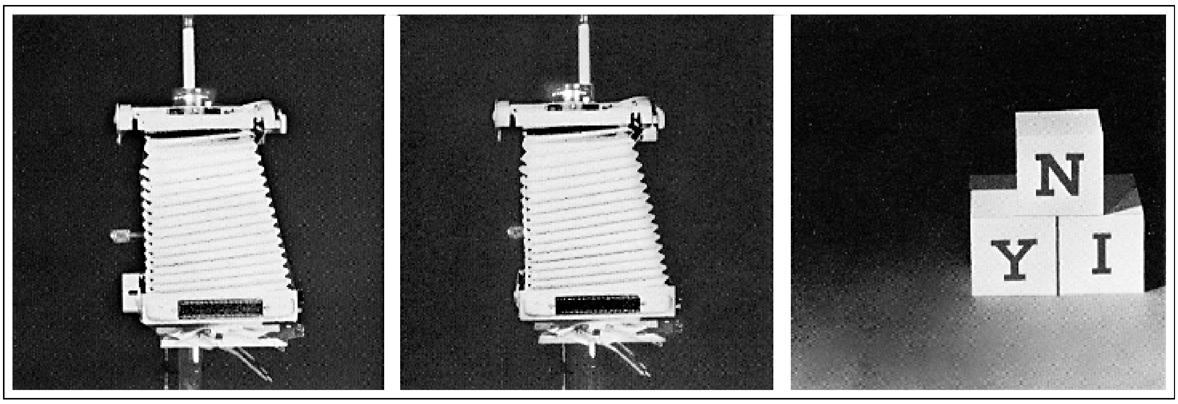


Initial setup: identical to the one in 1a (above)

All camera controls are in their neutral position



Shifting the back standard to the left, or the front standard to the right, will have exactly the same result : the subject image will move to the left side of the negative.

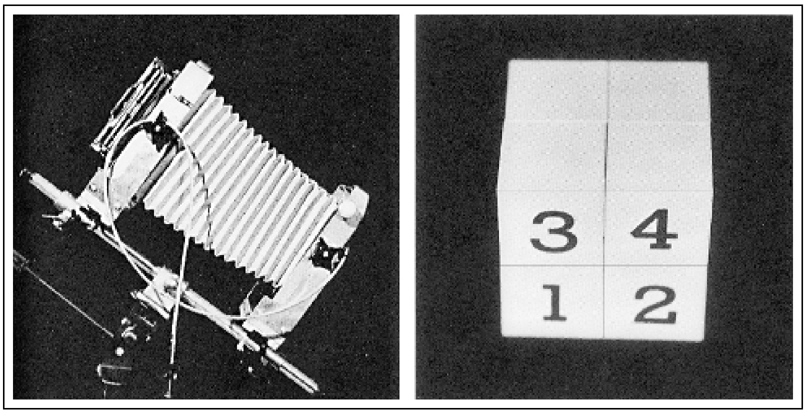


Shifting the back standard to the right, or the front standard to the left, will have exactly the same result : the subject image will move to the right side of the negative.

As none of these movements changes the parallelism between the front and back standards, there is no effect on the perspective : you could get the same effects with a 35mm camera by moving left or right.

2a – Front standard movement around a horizontal axis (front tilt)

Initial setup:



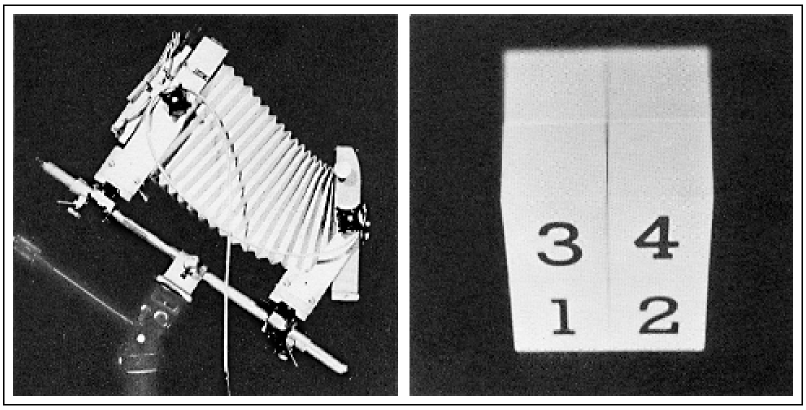
The camera is placed at a 45° angle, looking down at the subject

No camera movement at this point : all controls are neutral

Focus is on top front edge of the subject

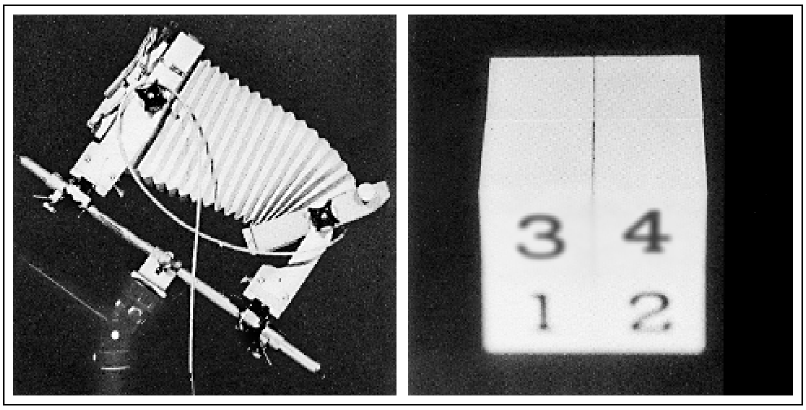
Exposure with lens fully opened (f6.3, 210mm lens)

There is a perspective distortion: top front edge appears to be the longest, other edges converge slightly as they recede



Front standard, backward tilt

Change of focal plane is obvious : the entire front face of the cube is sharp, but top face of the cube becomes very soft.



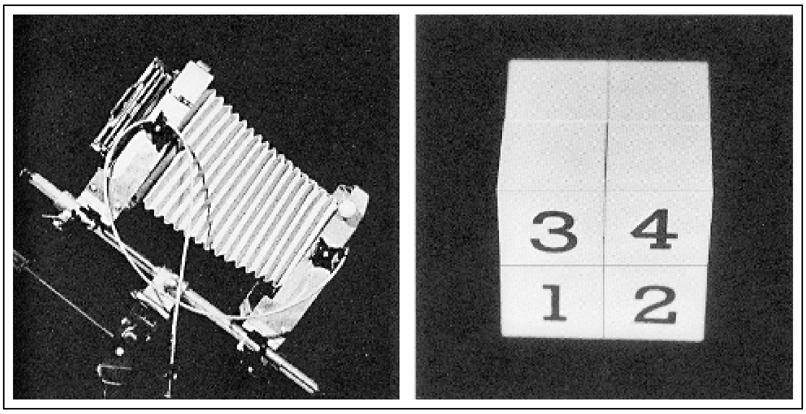
Front standard, forward tilt:

The opposite effect is obtained: the top face of the cube is now sharp, while the front face is now completely out of focus.

Conclusion: tilting the front standard corrects the sharpness of only one side of the cube (depending on the orientation of the movement, either the front or the top face), while it increases the blur of the other side...

2b – Back standard movement around a horizontal axis (back tilt)

Initial setup: as for 2a



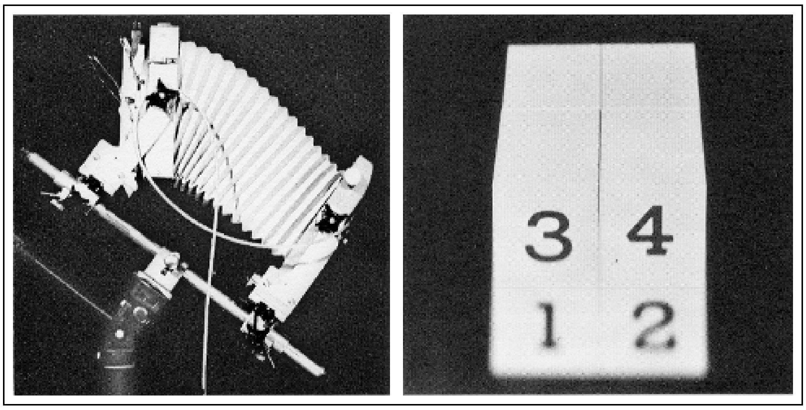
No camera movement at this point : all controls are neutral

Focus is on top front edge of the subject

Exposure with lens fully opened (f6.3, 210mm lens)

There is a perspective distortion: top front edge appears to be the longest, other edges converge slightly as they recede

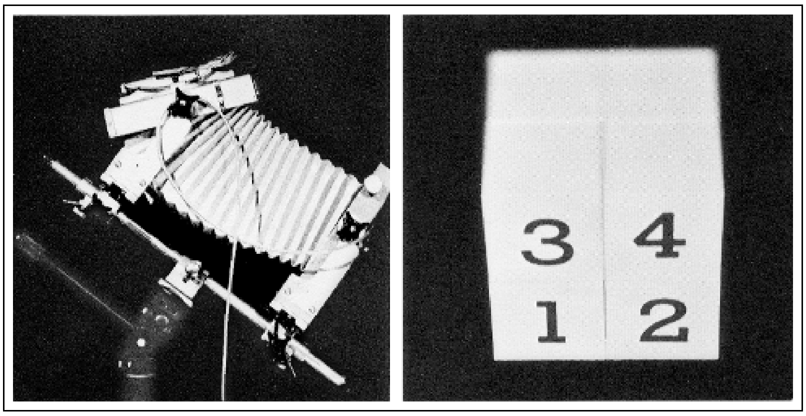
Back standard, backwards tilt



The film plane is now parallel with the front face of the subject, the front edges no longer appear to converge.

The top of the film is now farther away from the subject, while the bottom of the film gets closer. The undharp focus on some parts of the subject needs a correction, either by tilting the front panel slightly backwards to get it parallel to the back standard, or simply by stopping down the lens to increase sufficiently the depth of field.

Back standard, forward tilt

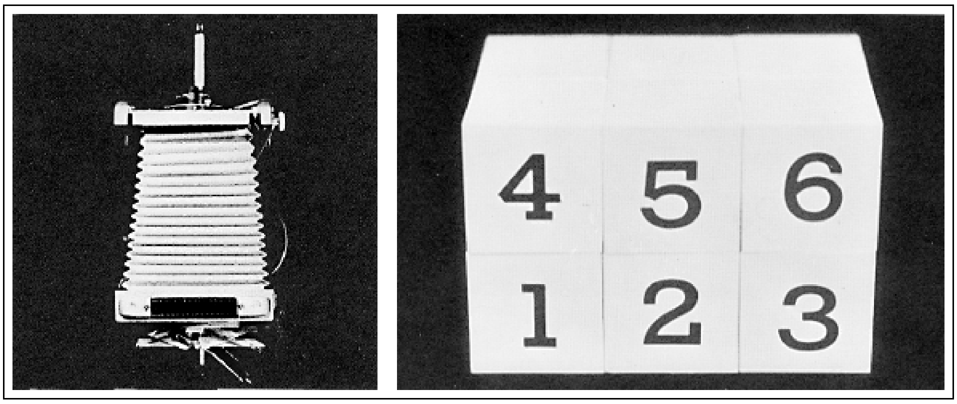


This movement changes the shape of the top face : the top edges of the cube now appear to be parallel.

Conclusion: tilting the back standard corrects the distortion of only one side of the cube (depending on the orientation of the movement, either the front or the top side), while it increases the distortion of the other side...

2c - Front standard movement around a vertical axis (front swing)

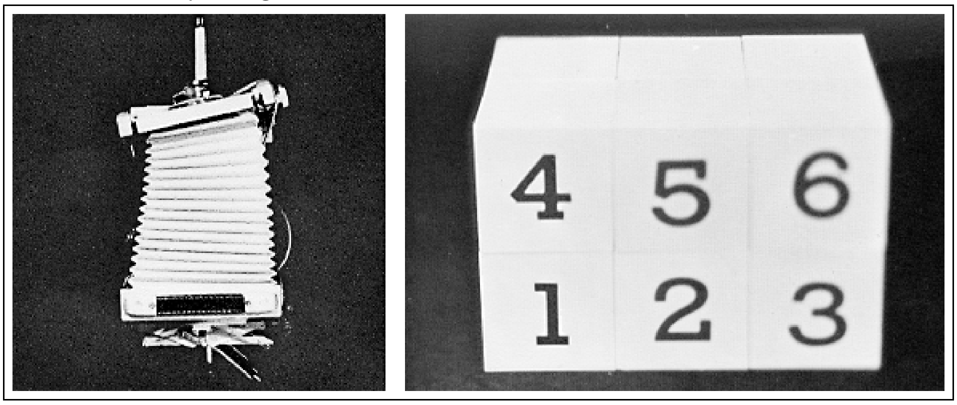
Initial setup



The camera position is just a little higher than the subject. Focus is on the front plane of the subject (f/6.3 to minimize depth of field)

All the numbers are reasonnably sharp, and the edges of the front face appear close to parallel. But the top edges are clearly converging.

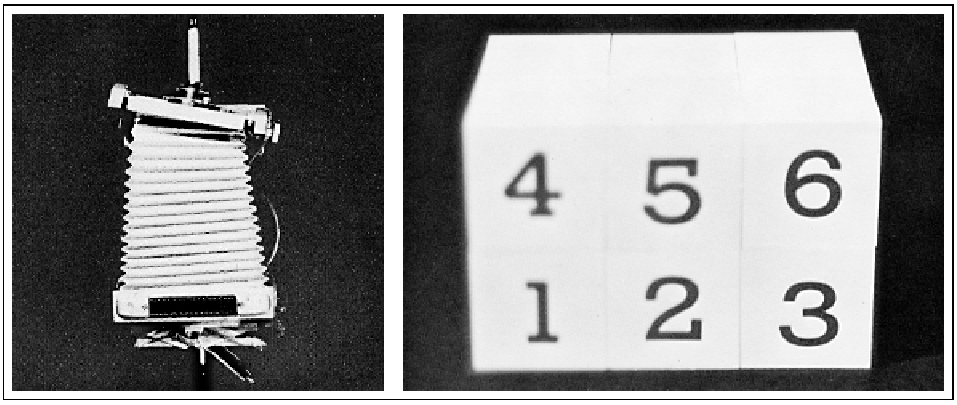
Front standard, left swing



The apparent size of the image is not affected, but the focus clearly shows a change.

The focus on the right side of the cube is now very soft, while the left side focus remains acceptable.

Front standard, right swing

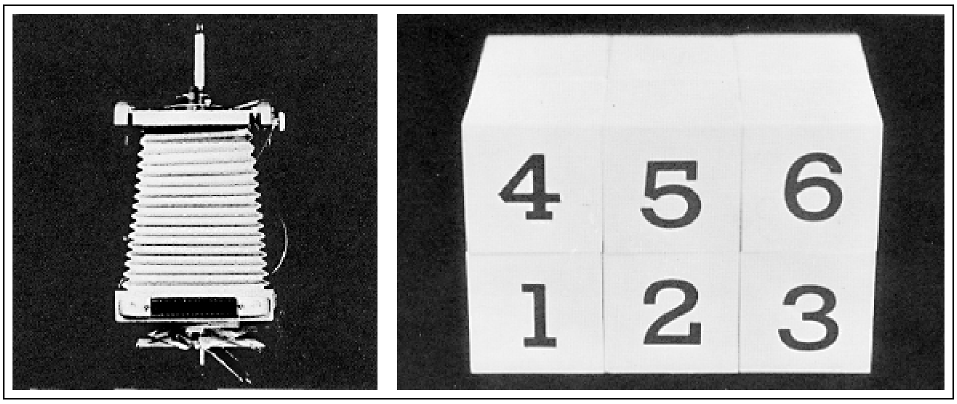


The apparent size of the image is not affected, but the focus clearly shows a change.

This movement creates exactly the opposite effect than the one showed above: blur on the left, reasonnable sharpness on the right.

2d - Back standard movement around a vertical axis (back swing)

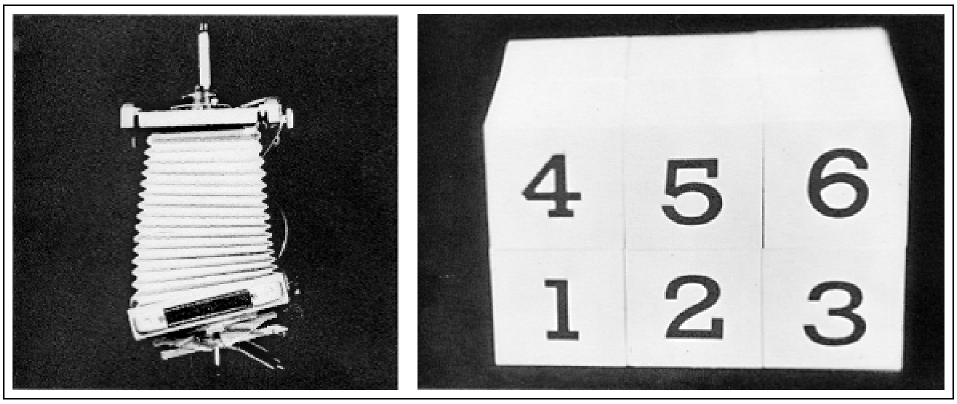
Initial setup:



The camera position is just a little higher than the subject. Controls are neutral. Focus is on the front plane of the subject (f/6.3 to minimize depth of field)

All the numbers are reasonnably sharp, and the edges of the front face appear close to parallel. But the top edges are clearly converging.

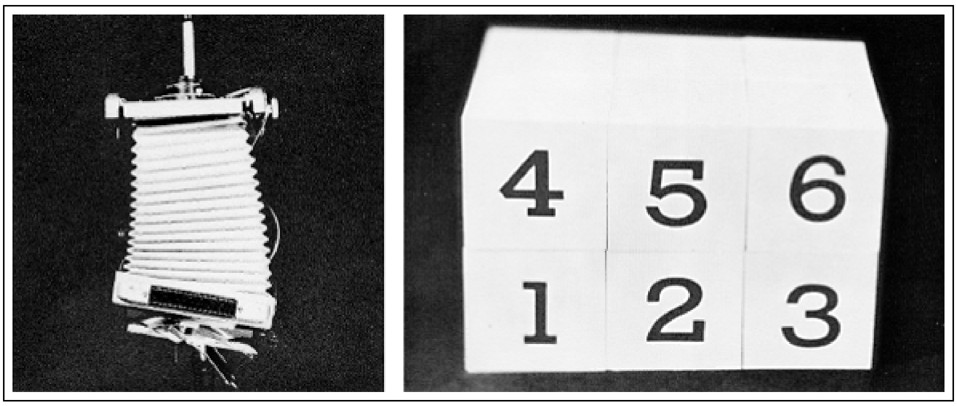
Back standard, left swing



Film and subject planes are not parallel any more.

The focus change remains slight, but swinging the back has a drastic effect on the resulting size of the image (the right side of the subject being nearer to the film plane appears as being larger, while the left side, now farther away, seems smaller)

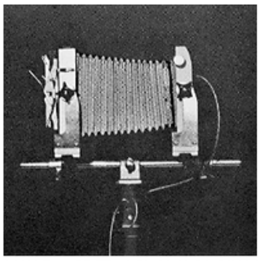
Back standard, right swing.



Film and subject planes are not parallel any more.

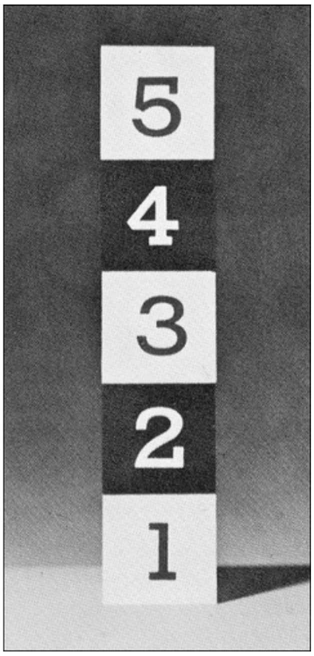
The focus change remains slight, but swinging the back has a drastic effect on the resulting size of the image (the left side of the subject being nearer to the film plane appears as being larger, while the right side, now farther away, seems smaller)

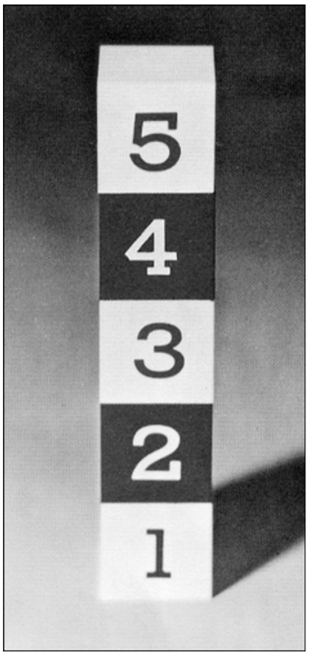
<u>3 – Some combined movements..</u>

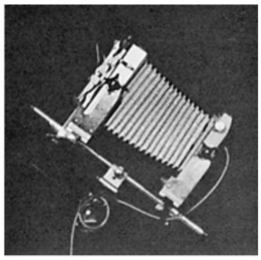


Initial setup:
Camera is at same height as the subject.
The front of the cube is in sharp focus, and the sides are parallel.

But as we cannot see any other side, we have no information on the volume of the subject.





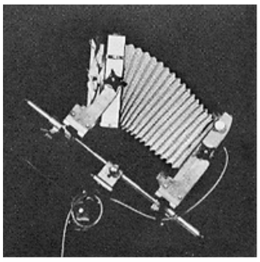


High angle shot.
All controls are neutral

Focus is on cube 4

The top face of the pile is now visible, but the lower part of the front face is out of focus.

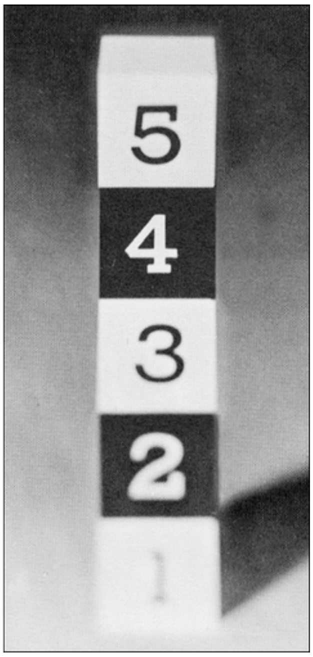
Slight convergence of the edges on both top and front faces.

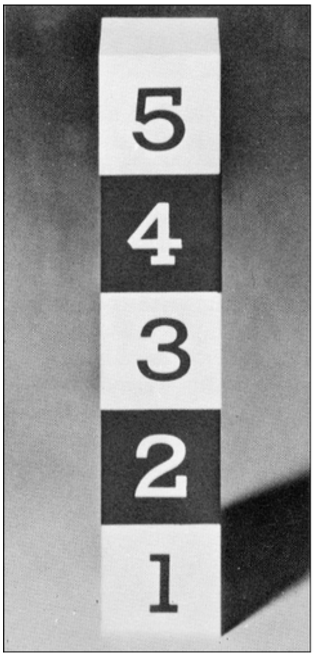


High angle shot + back standard backward tilt.

The film plane is now parallel to the subject's front plane.

The convergence of the edges is corrected.
But the focus is still wrong.





High angle shot + back & front standard backward tilt.

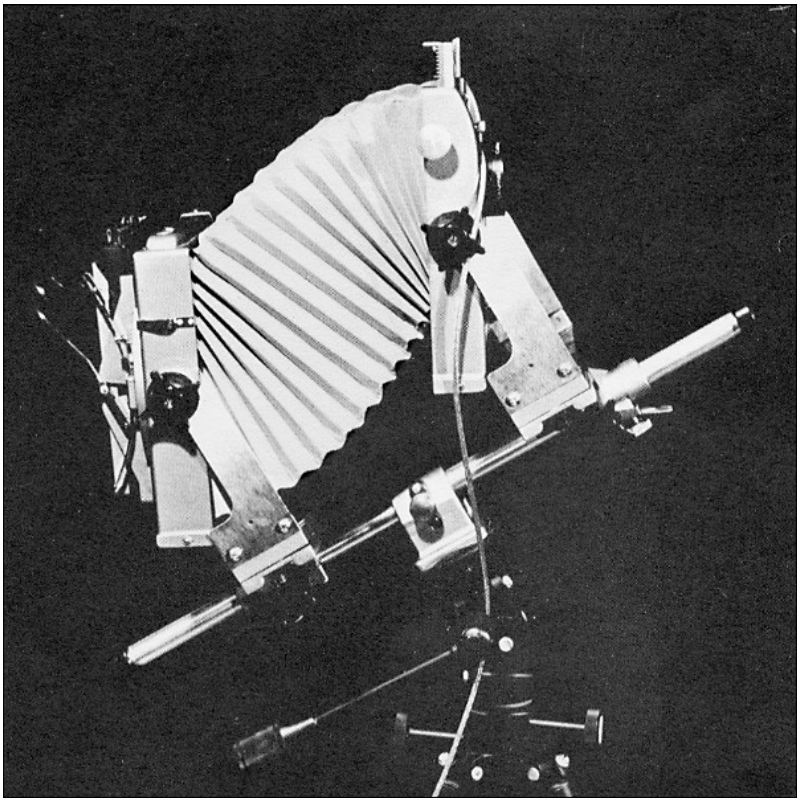
The lens plane is parallel with both the film plane and the subject's front plane.

The subject's edges appear parallel, everything is in focus, the top side is visible.

This shot would be impossible with a 35mm (fixed) camera.

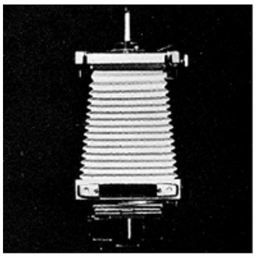
Here, the camera was set up with the same movements as in the last example on the previous page, but for a low-angle shot.

The resulting effects on the buildings are the same as in the previous image: parallelism and sharpness.



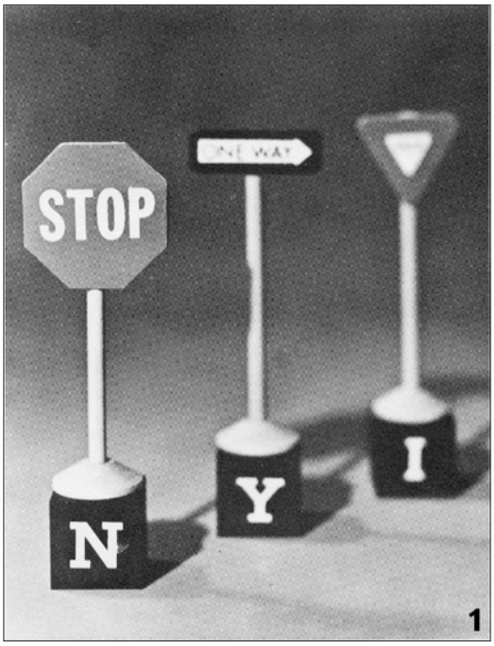
This camera setup is often used in architecture photography.

Changing the plane of focus

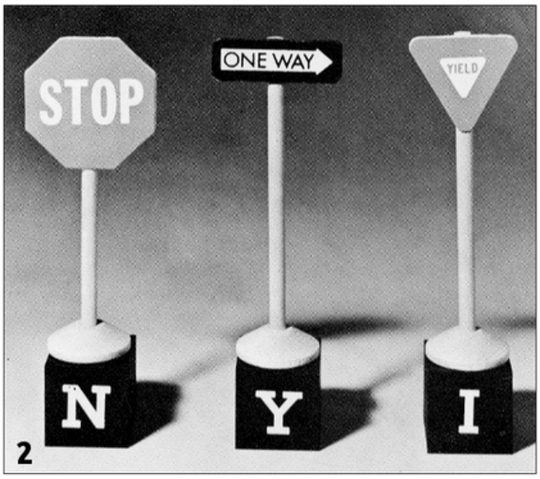


Swing movements can be used to create an altered plane of focus.

__Initial setup:__ camera position is horizontal, settings at neutral, the subject includes three objects set at different (1) or same (2) distance from the film plane.



1

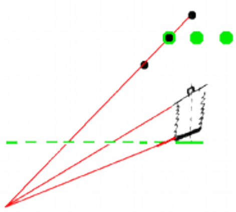


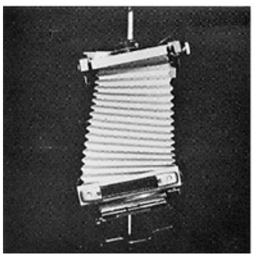
2

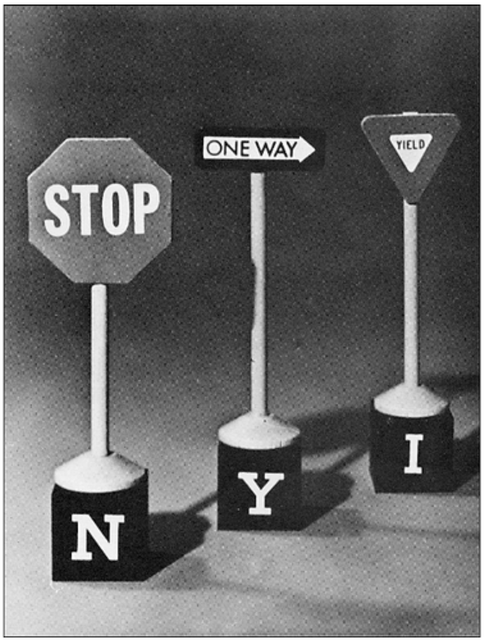
The problems:

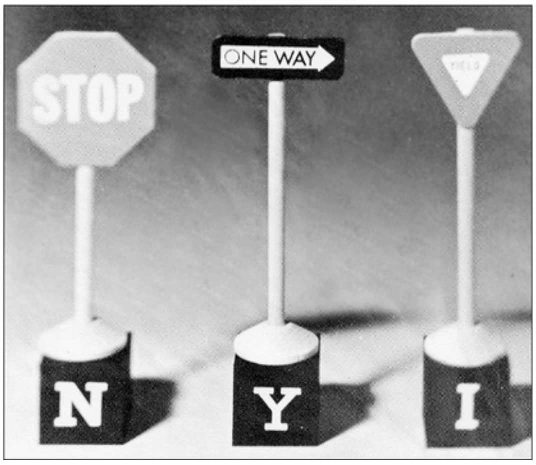
- *in the first case, only the subject "N" is perfectly sharp*
- *in the second case, all the subjects are sharp, but we would like to have a sharp "Y" while the other signs remain out of focus.*

The solutions:









In the first case, the Scheimpflug rule was applied. By swinging the front and back standards, their two planes intersect the plane of the alignment of the three subjects (red lines in the diagram) at one point. As the shot was taken at full aperture, the depth of field is still very small: the left side of the white signs' cones on the black bases are still in soft focus

In the second case, by swinging the front standard to the left, the plane of focus moves away from the one defined by the position of the subjects. Because the film plane remains parallel to the subjects (green lines), there is no change in the respective size of the objects. By slightly readjusting the focus, one can now limit the sharpness to the central subject only. By adjusting the focus a little differently, this sharpness could be transferred to one of the other two subjects.

<u>APPENDIX 2</u> : EXPOSURE CORRECTION FOR BELLOWS EXTENSION

This sheet corresponds to a f/5.6 - 8" lens (210mm/25.,4 = 8.27 -> 8")
the notes in green correspond to a measured extension of 11" (295mm/25.4 -> 11)

<u>LENS: Symmar-S 5.6/210mm - [8"]</u>

2 ____________

*2.2*__________

*2.5*__________

2.8 __________

*3.2*__________

*3.6*__________

4 ____________

*4.5*__________

*5*____________

5.6 __________

*6.3*__________

*7.1*__________

[8]...............................***X***

9.. 1 \

10.. 2   3 x 1/3 fstop = 1 stop or exposure time x 2

11...............................***X***.......... 3 /

*13*__________

*14*__________

16 __________

*18*__________

*20*__________

22 __________

*25*__________

*28*__________

32 __________

*36*__________

*40*__________

45 __________

*51*__________

*57*__________

64 __________

<u>APPENDIX 3</u>: ESTIMATE OF BELLOWS EXTENSION
AS A FUNCTION OF FOCUSING DISTANCE & LENS FOCAL LENGTH

The bellows extension can be calculated from Descartes' conjugate formula, a mathematical equation which, while only valid in principle for thin lenses, gives a sufficiently accurate result for our purposes.

For those interested, this formula is explained at length on next page.

For the other,

<u>you just have to take:</u>

1 - the focal length of the lens, expressed in metres (e.g. 210mm = 0,21)

2- the subject-lens distance (e.g. 50cm = 0,5)

<u>and to calculate:</u>

3 - 1 / distance (ex: 1/0,5 = 2)

4 - 1/focal length (ex: 1/0,21 = 4.761904762)

5 - (1/focal length)-(1/distance) (e.g. 4.761904762 - 2 = 2.761904762)

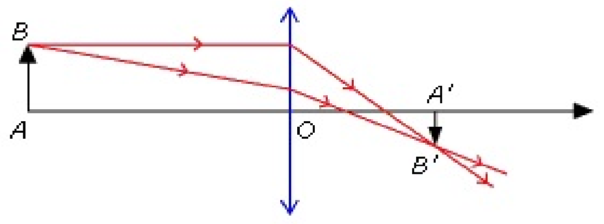
6- 1/above result, rounded off (ex: 1 / 2.761904762 = 0.36m, or <u>36cm</u>)
<u>which gives the bellows extension</u>.

It is very easy to perform these calculations for a range of focusing distances using an Excel-type spreadsheet.

<u>Once the useful data (list of subject-lens distances and corresponding extensions) are copied onto a card (one per lens), a quick look will give a reasonnable estimate of the extension to use.</u>

Descartes' conjugate formula

Detailed explanation of the formula:



*The main **optical axis** is **oriented** in the direction of **light propagation** (usually from left to right).*

The position of the object on the main optical axis is denoted by A and that of the image, by A'. These two positions are determined respectively by the algebraic values $\overline{OA}$ *and* $\overline{OA'}$.

The object being located before the optical centre O, $\overline{OA}$ *is negative. On the other hand, the image being located after O,* $\overline{OA'}$ *is positive.*

Descartes' conjugation formula** allows to **determine** the **distance $\overline{OA'}$ *between the image of the object and the optical centre O :* $\frac{1}{\overline{OA'}}=\frac{1}{\overline{OA}}+\frac{1}{\overline{OF'}}$*, these distances being noted in metres.*

$\overline{OF'}$ *, also noted f', is a characteristic of the lens, called the focal length of the lens.*
Note : for a converging lens, $f'=\overline{OF'}>0$.

Example:
An object AB is located 5.0 m in front of a converging lens with a focal length (f') of 80 cm. What will be the position of A', the image of A?
Make sure to take the right units: Descartes' conjugate formula must be expressed in metres.

We have $\overline{OA}$ *= - 5,0 m (this value is negative because A is behind the lens) and* $\overline{OF'}$ *= 0,80 m.*

Applying the relation, we obtain: $\frac{1}{\overline{OA'}}=-\frac{1}{5}+\frac{1}{0{,}8}=1{,}05\ m^{-1}$ *hence :* $\overline{OA'}=0{,}95\ m=95\ cm$.

(source: Maxicours.com)
(see also: http://hirophysics.com/Anime/thinlenseq.html)

Jacques Kevers
November 2014

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