Wide Angle Photography

TWCC Composition SIG

September 11, 2022

Definitions*

Ultra Ultra Wide <16mm | Ultra Wide 16-24mm | Wide 24-35mm | Wide 35-24mm | Ultra Wide 24-16mm | Ultra Ultra Wide <16mm

Focal length:	50mm	35mm	24mm	16mm	10mm
Field of View:	40°	54°	74°	97°	122°

Horizontal Angle of View

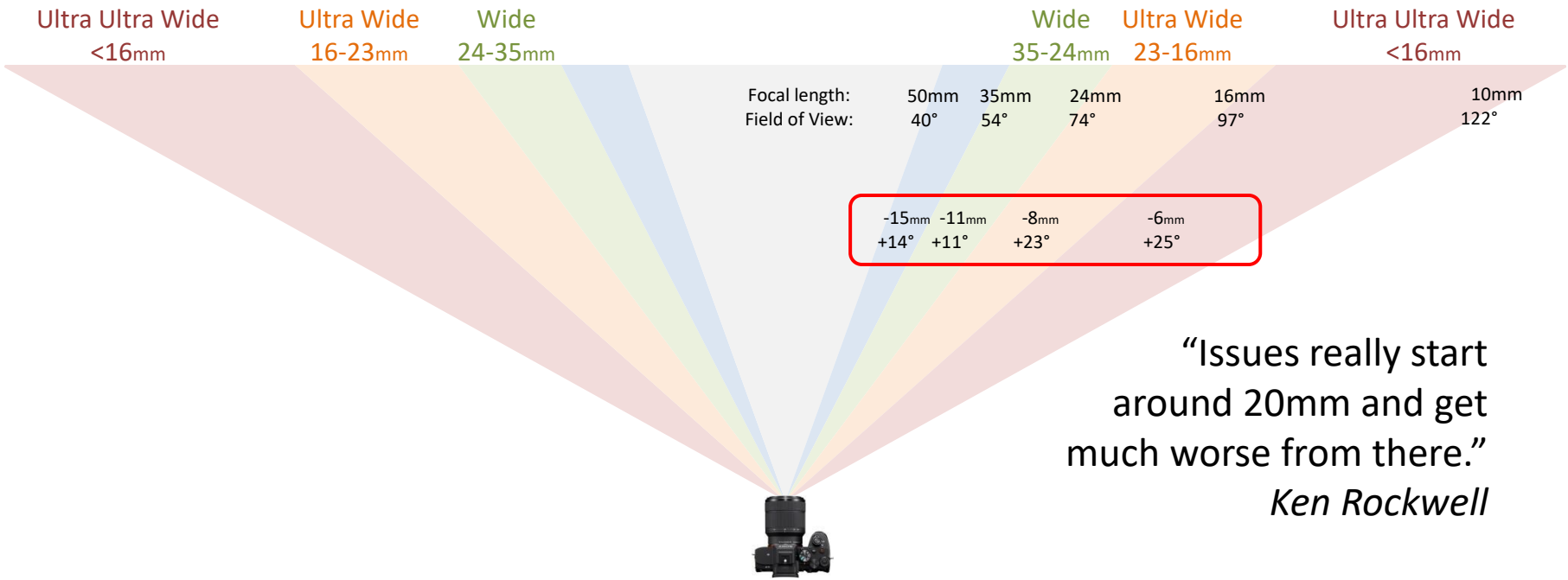
FOV and AOV mean different things
but are frequently used interchangeably

Field of view (FOV) in feet/meters

Angle of view (AOV) in degrees

* Full frame sensor. Divide by camera crop factor for APS-C format lenses:
- Canon APS-C bodies like the R7 have a 1.6 crop factor, so “Wide” is 15-22mm
- Sony and Nikon APS-C bodies like the α6500 and Z30 have a 1.5 crop factor, so “Wide” is 16-23mm

At the ultra wide end, a few millimeters of focal length make a big difference in the field of view



"Issues really start around 20mm and get much worse from there."
Ken Rockwell

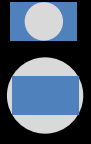

12 mm
16 mm
24 mm
35 mm
Wide
Ultra Wide
Ultra Ultra Wide

Panorama vs. Wide Angle

- Is a panorama a wide / ultra wide angle view?
- IMHO, no, generally
  - Panorama refers to a wide print format, which could be comprised of
    - stitched normal / standard angle views
    - a cropped wide angle view
    - stitched wide angle views
  - Wide angle lenses refer to a wide field of view, and by their nature they create **perspective distortion**
  - Panoramas might include perspective distortion, but generally don't

Curvilinear (Fisheye) vs. Rectilinear

Circular fisheye – typically up to 180° FOV
(can also be a rectangular crop)



No
Correction

1972 Nikkor 6mm/2.8
220° FOV, $60-160K

Rectilinear - up to 10mm / 122° FOV

Barrel distortion correction
Straight lines are straight, parallel lines are parallel
Most wide/ultra wide lenses are rectilinear

Ultra Wide Characteristics

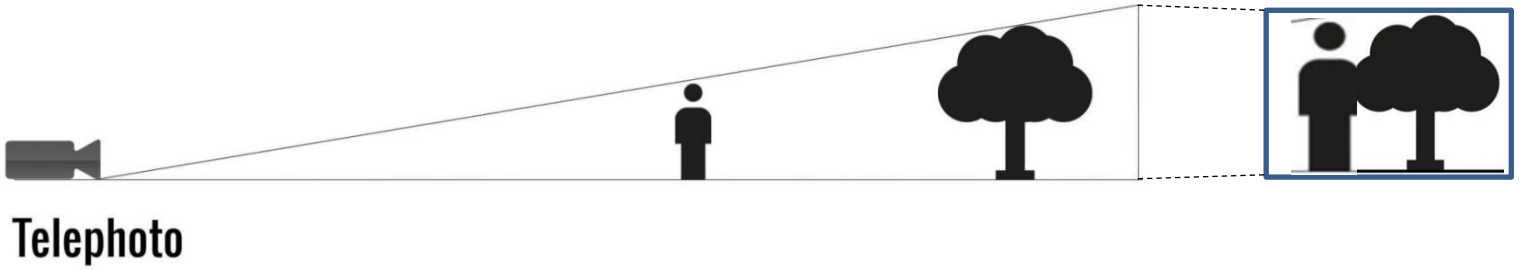
- Captures more in the frame; harder to compose
  - More objects/subjects/things/data to consider
  - More dead space to guard against
  - Beware of edge clutter
- Two types of perspective distortion to manage - or utilize
  - Exaggerates relationships between near and far, aka perspective distortion (other end of telephoto compression)
  - Barrel distortion when off-axis
- Edges are stretched; don't put people there
- Watch for lens flare
- Filter challenges: polarizer artifacts, vignetting, 3rd party filter holders

Willem Jonkers, Rotterdam, Netherlands

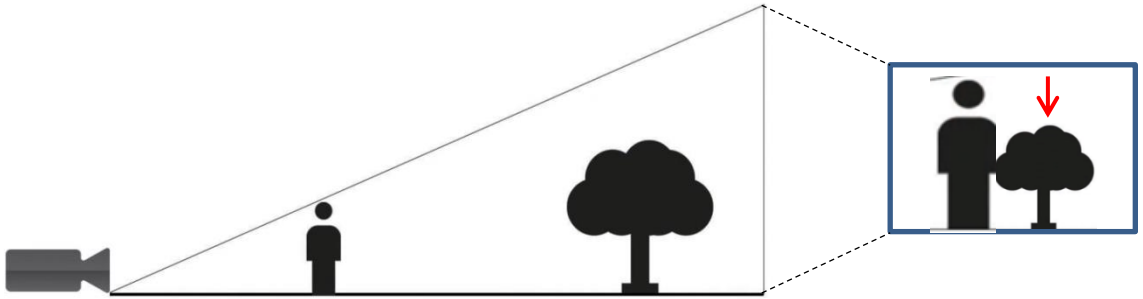
Leonardo Papèra, Iceland Photo Tours

Perspective

Perspective in art usually refers to **the representation of three-dimensional objects or spaces in two dimensional artworks**. Artists use perspective techniques to create a realistic impression of depth. ‘Play with' perspective to present dramatic or disorientating images.

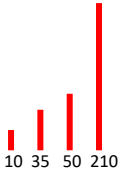


Telephoto



Wide Angle

Perspective

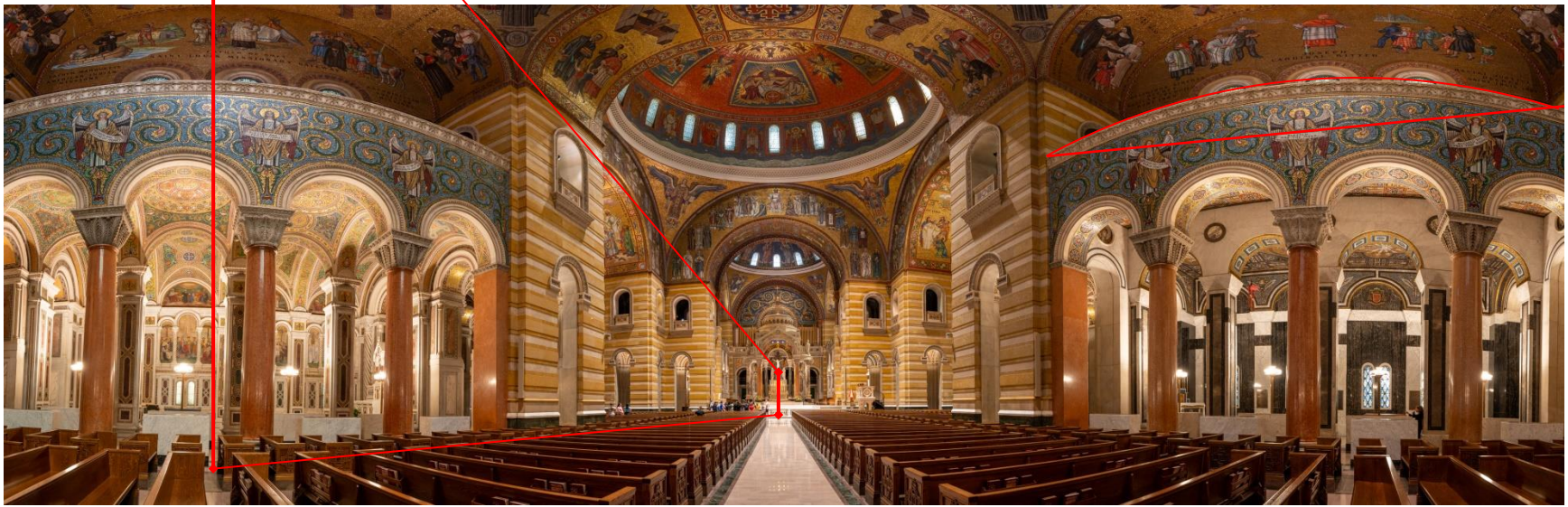


10 mm | 35 mm | 50 mm | 210 mm

Matt Brandon: https://petapixel.com/is-lens-compression-fact-or-fiction/

Ultra Wide Angle Perspective Distortion

- Perspectives are exaggerated; close objects are much larger and distant objects are much smaller
- All lines are distorted if the sensor isn't perpendicular to the verticals (subsequent slide)
- In a stitched panorama (below), objects above/below the lens plane are warped

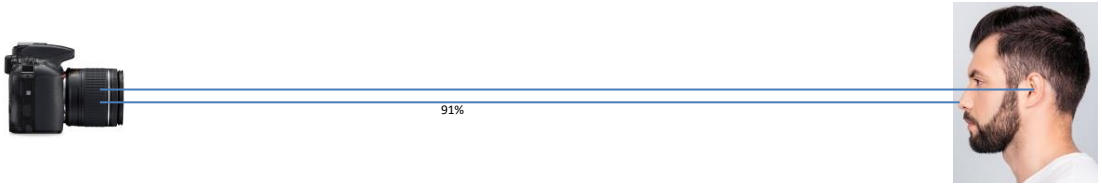


Perspective

Ultra wide Wide

Perspective Distortion

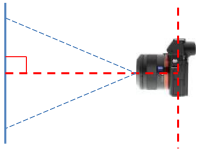
85mm @ 200cm | 35mm @ 85cm | 16mm @ 40cm | 12mm @ 30cm | 8mm @ 20cm

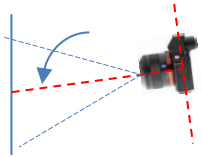


Intentional Perspective Distortion

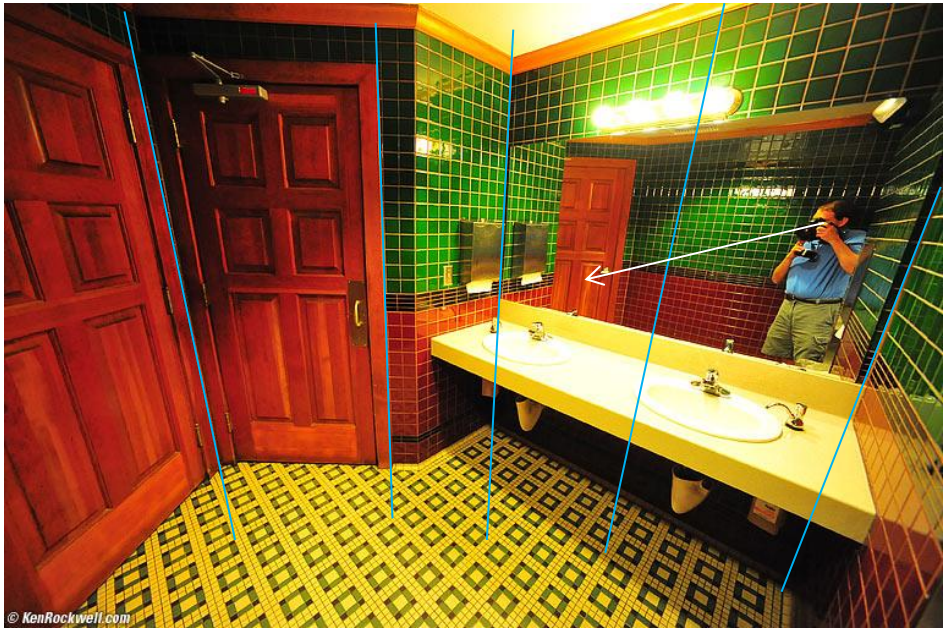
Weird Perspective Distortion

Perspective Distortion

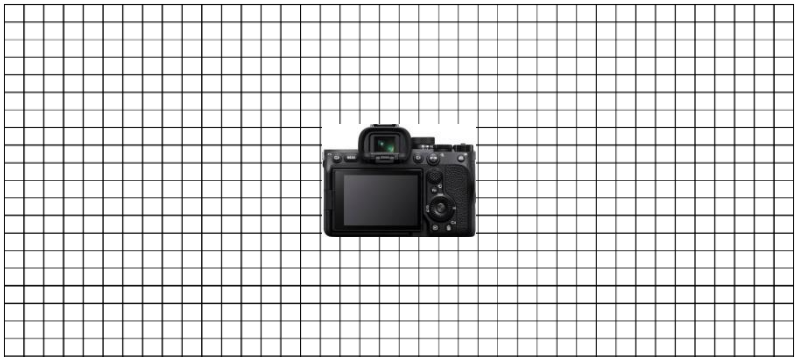




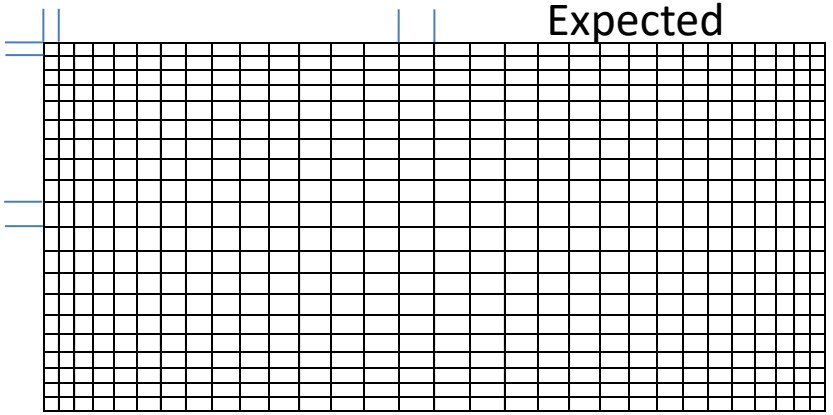
Ultrawides exaggerate any misalignment between the sensor plane and the subject plane: **keep the camera flat** to avoid barrel distortion

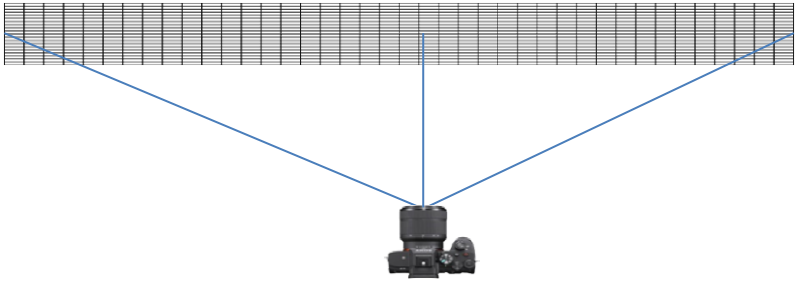


Rectilinear Stretching Theory

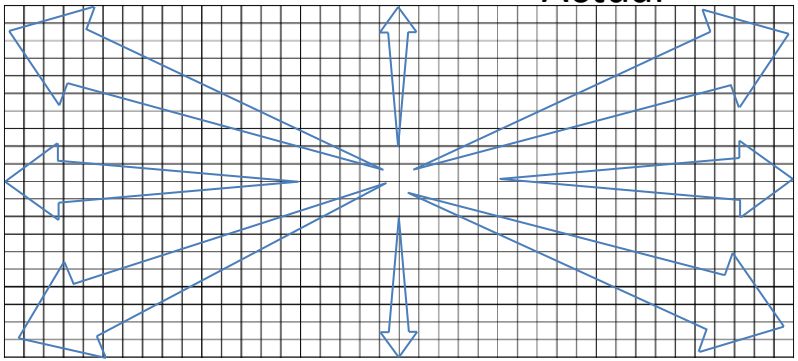


Expected



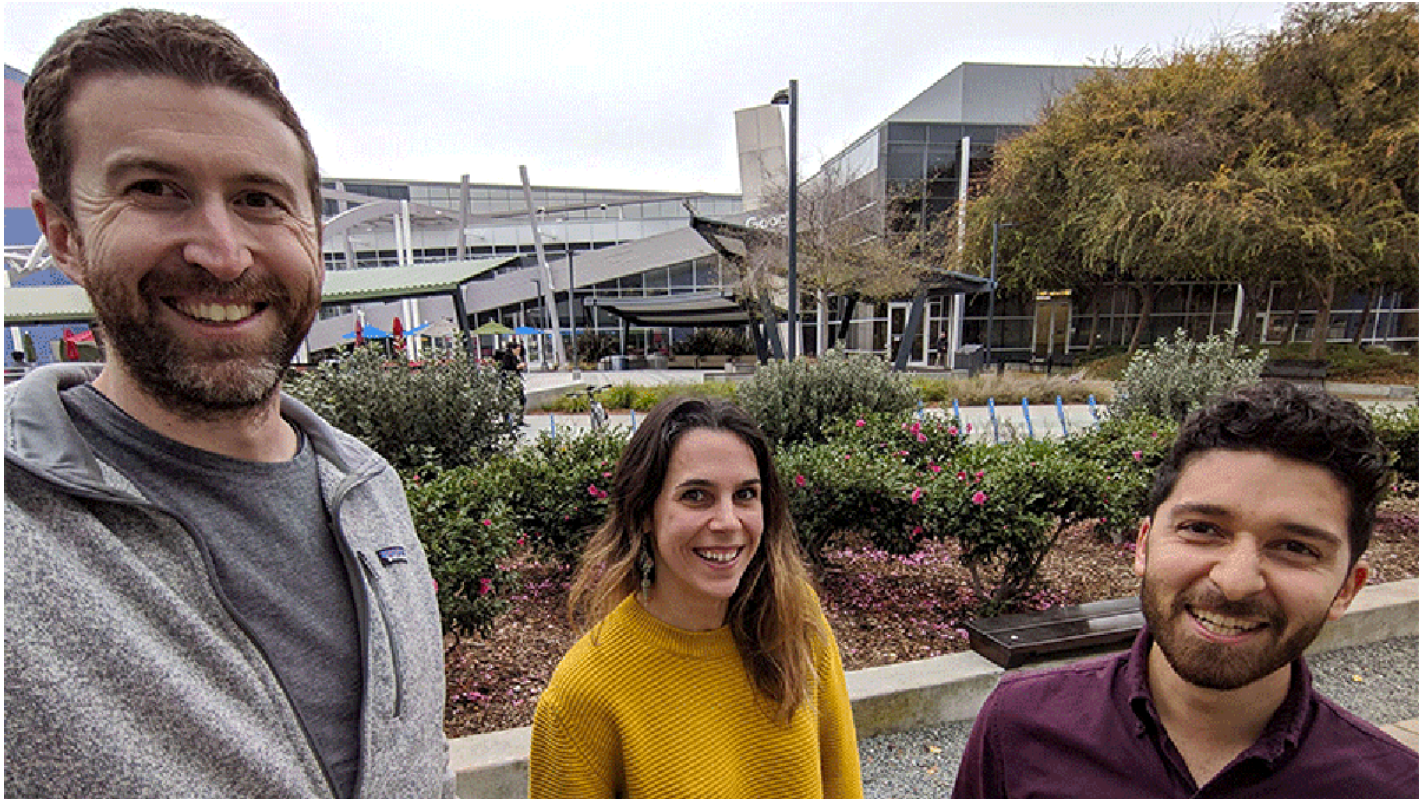


Actual



Edge Stretching: Landscapes

Edge Stretching: People



Robin Laurenson - Motherpixels Photography Calgary Landscape and Portrait Photographer

Do’s and Don’ts of Wide Angle Lens in 10 Minutes

Motherpixels Photography: https://www.youtube.com/watch?v=nNPdw-jb-Dk

Wide Angle Lens Overview

- Use a wide angle lens for its **unique ability to distort**
  - Your best friend or worse enemy
- This is your **creative** lens; it is made for distortion
- Foreground will be large, background will be small
- Or, when you must fit it all in

Motherpixels Photography: https://www.youtube.com/watch?v=nNPdw-jb-Dk

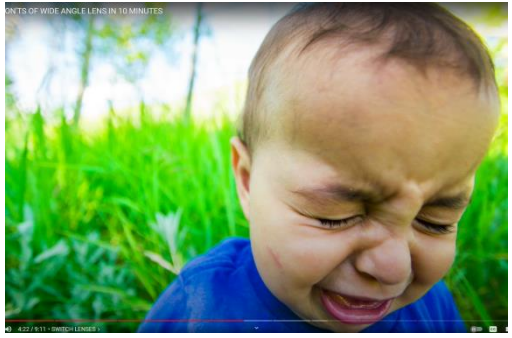
Wide Angles for Landscapes

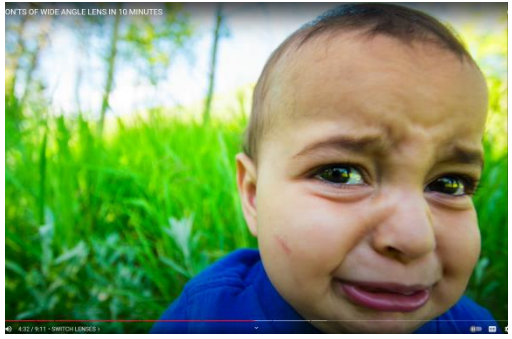
- Essential: find an accessible foreground
- Necessary: find an interesting background
- Get really close to the foreground to make it bigger in relation to the background; get down on the ground, get dirty, get wet
- Embrace the distortion to create a unique view

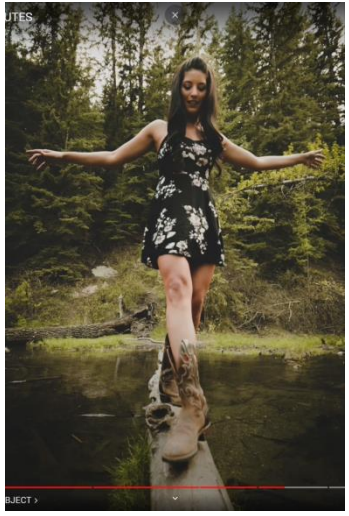
Motherpixels Photography: https://www.youtube.com/watch?v=nNPdw-jb-Dk

Wide Angles for Portraits

- **Don’t do it**: distortion is unflattering
- But if you must, center the subject in the middle of the frame - never at the distorted top, side or corner
- Or, intentionally distort the subject;
  be bold, subtle will appear like a mistake



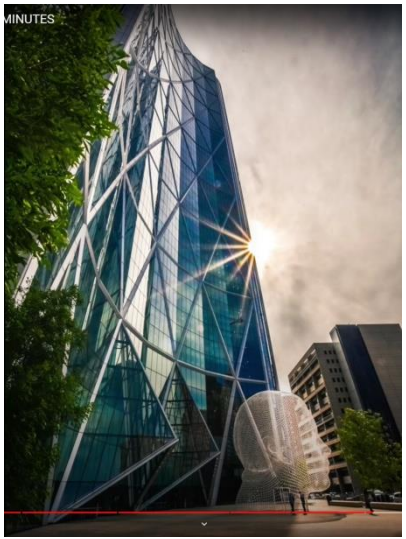


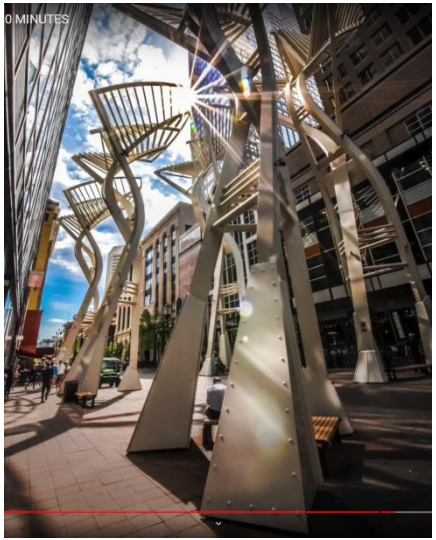


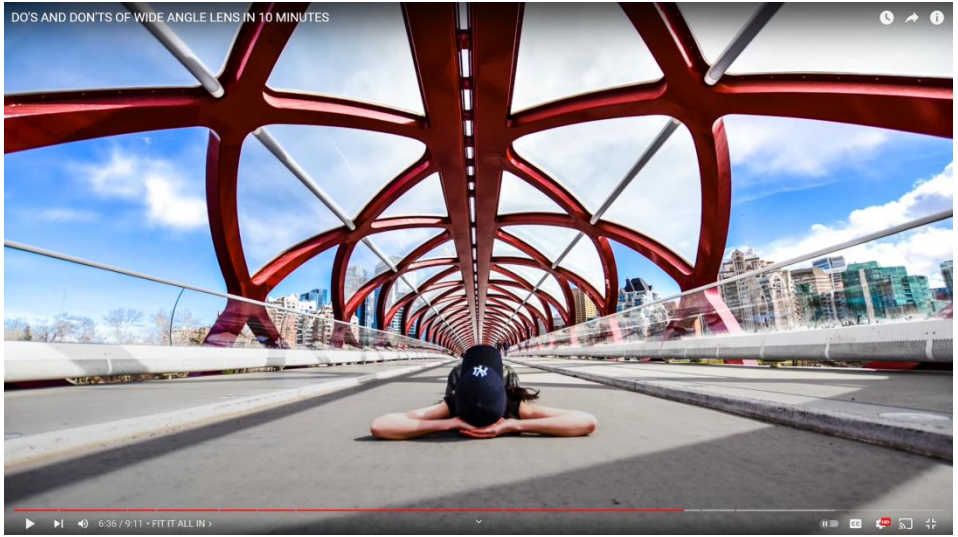
Motherpixels Photography: https://www.youtube.com/watch?v=nNPdw-jb-Dk

Wide Angles for Street Photography

- Do it; it's the only way to capture the whole building
- Excellent for unique views of architectural structures and bridges
- Capitalize on vanishing points

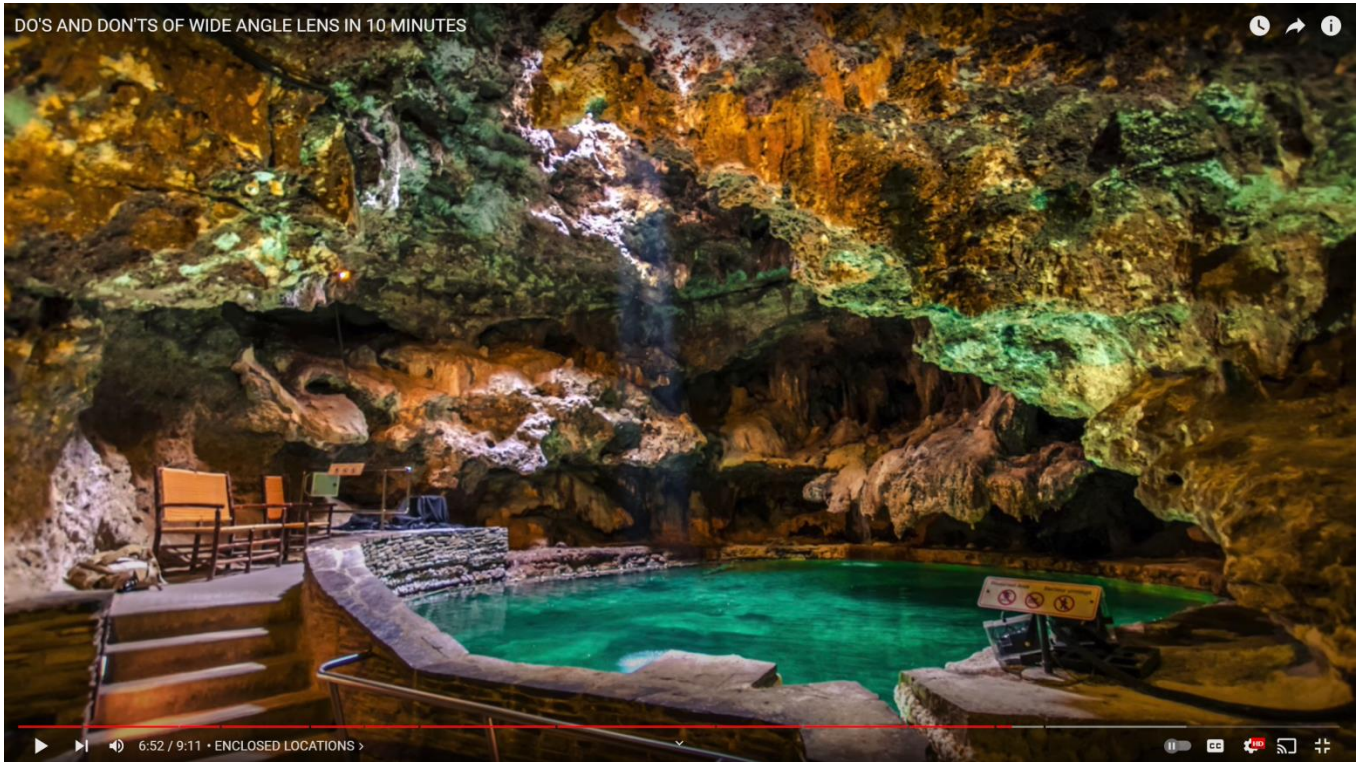






Wide Angles for Enclosed Spaces

- It’s the only option if you want to “fit it all in”



Wide Angles in Cityscapes

- Makes distant buildings look small
- Only use if you have dramatic skies, storms, sunsets or stars / Milky Way

Mads Peter Iverson
Danish Landscape Photographer

Five Steps to Make Powerful 16-35mm Photos

Stop Making These Wide Angle Lens Mistakes

Mads Peter Iverson: https://www.youtube.com/watch?v=3hk7xtBhPIc, https://www.youtube.com/watch?v=RrJJq8P9wdM

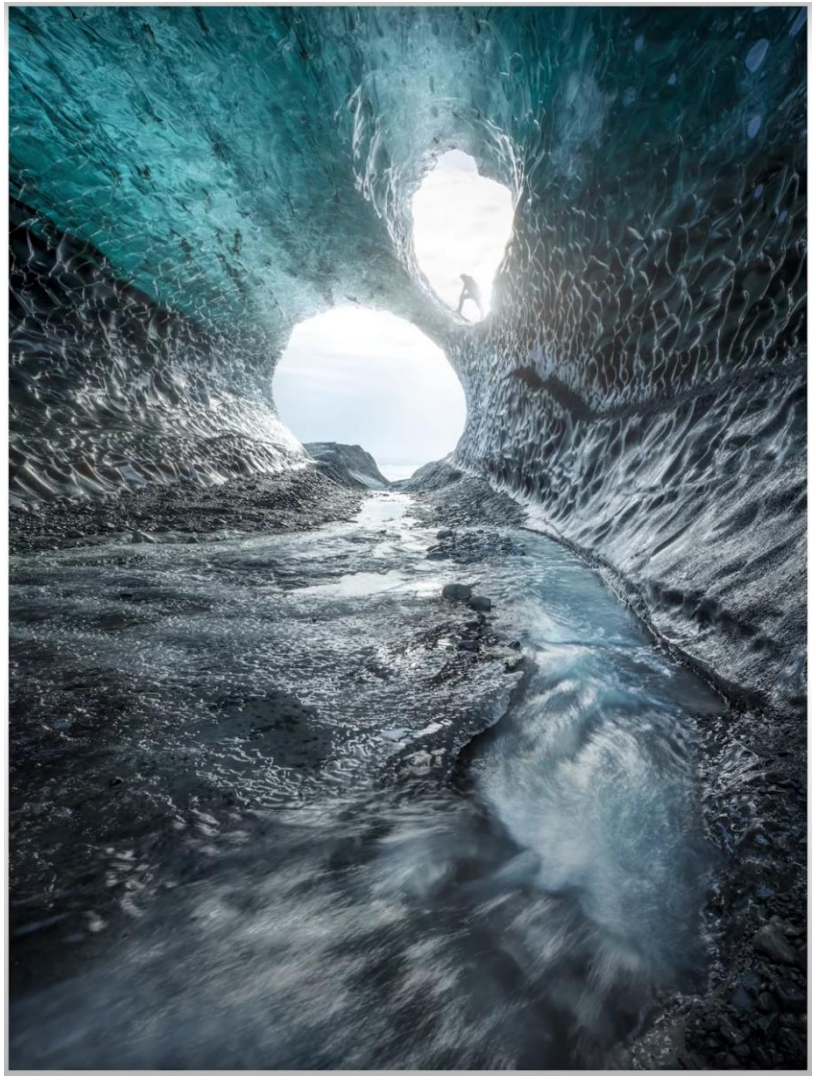
Five Do's

1) Holistic thinking
   - Part A) Zoom out and see the entire scene as a whole:
     - Individual parts don't need to be stunning but the entire photo needs to make sense
     - Added together, the parts must benefit each other
   - Part B) The whole is greater than the sum of the parts, like puzzle pieces make up a puzzle
     - Don't include elements that don't benefit the photo

Mads Peter Iverson: https://www.youtube.com/watch?v=3hk7xtBhPIc

Holistic Thinking

By itself the wave is not particularly interesting, but makes a huge contribution to this photo



Holistic Thinking

Sum of the insignificant parts: leading lines, focal point, sense of scale

Five Do's

2) Find an interesting focal point
   - Unique, relatable natural features that stand out i.e. landmarks, buildings of cultural or historical value, people, rare/unique objects, etc.

Mads Peter Iverson: https://www.youtube.com/watch?v=3hk7xtBhPIc

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Five Do's

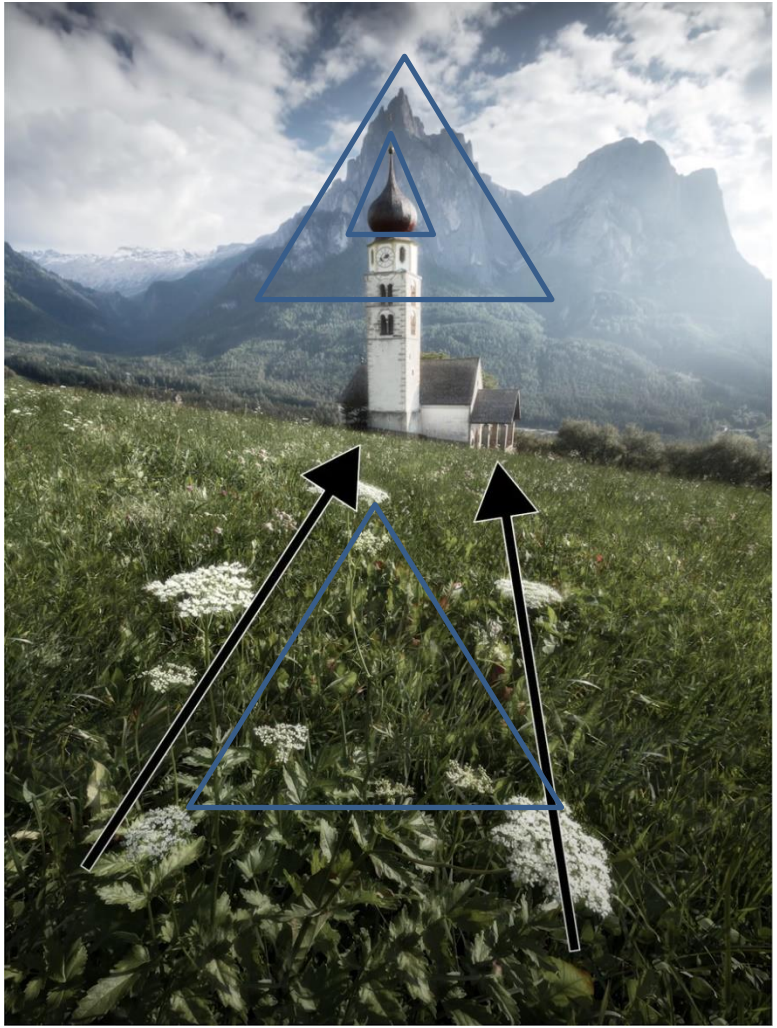
3) Create a strong meaningful composition:
   - Find a foreground that BENEFITS the focal point
   - The foreground needs to make sense
   - The foreground helps tell the story, gives impression of location, helps the viewer into the image, pushes an idea, leads focus to the focal point, …
   - Simplify the frame for powerful images; include only a few dominant elements that fill up the space and leave no room for confusion

Mads Peter Iverson: https://www.youtube.com/watch?v=3hk7xtBhPIc

Leading lines in the grass.

Not particularly interesting by itself, but consistent with and contributes to the photo as a whole.

Mads Peter Iverson:
https://www.youtube.com/watch?v=3hk7xtBhPIc



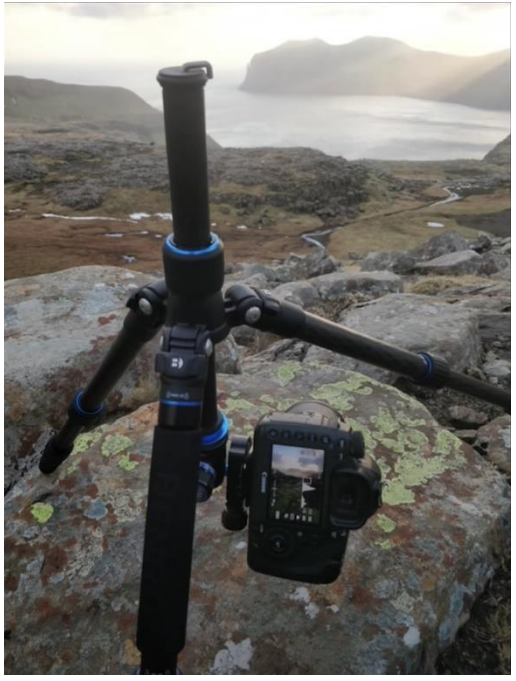
Mads Peter Iverson: https://www.youtube.com/watch?v=3hk7xtBhPIc

Five Do's

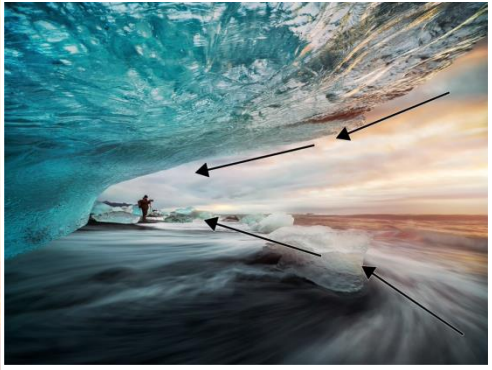
3) Create a strong meaningful composition, continued:
   - Wide angle lenses create dramatic depth
   - Accentuate this by getting really close to the foreground

Mads Peter Iverson: https://www.youtube.com/watch?v=3hk7xtBhPIc

Get really close
to the foreground



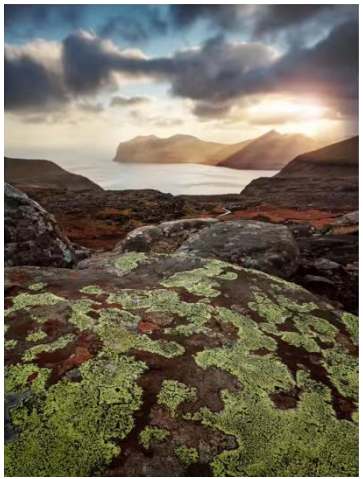
Get really close
to the foreground



Five Do’s

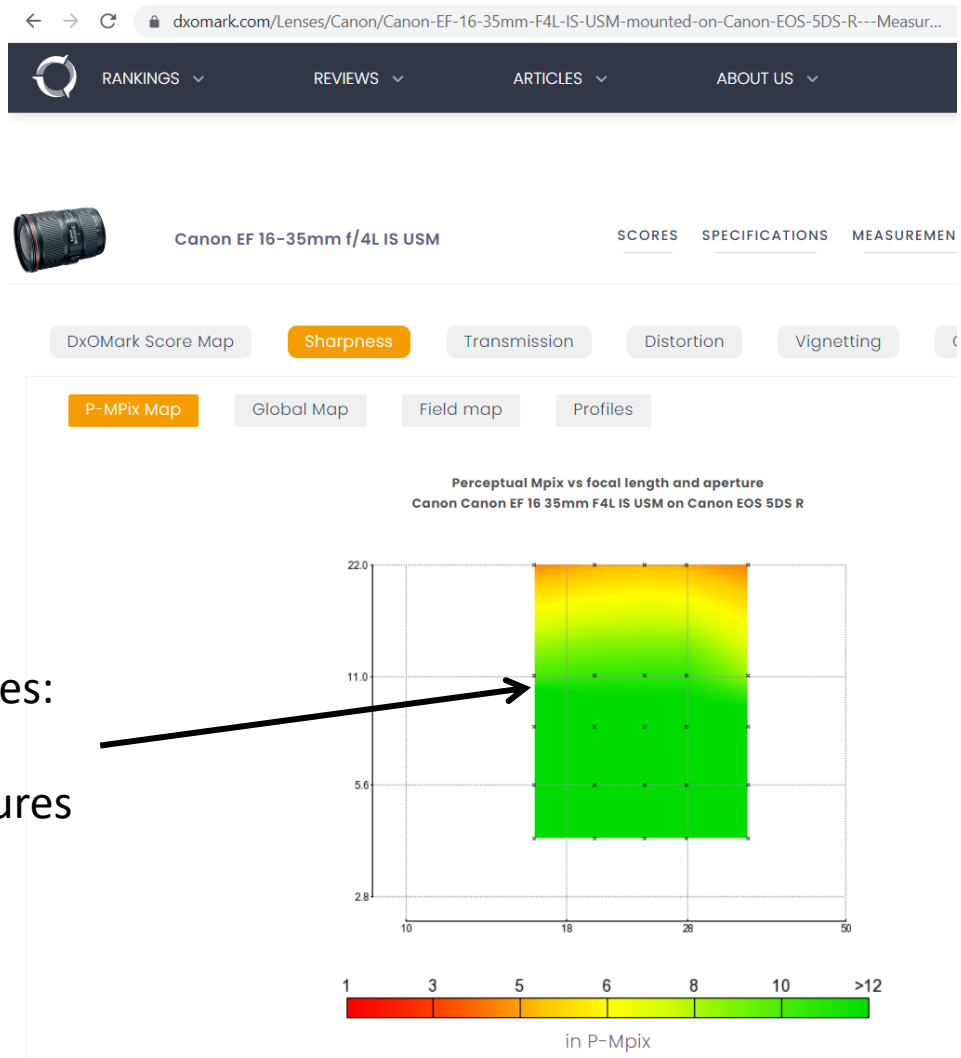
4) Everything should be in focus

- Lowest native ISO, aperture fitting the scene and lens, shutter speed dictated by the others
- Focus stacking if needed
  - Not needed for everything, F/5.6 is sufficient if foreground is > 2M away



Stacked

Mads Peter Iverson: https://www.youtube.com/watch?v=3hk7xtBhPIc



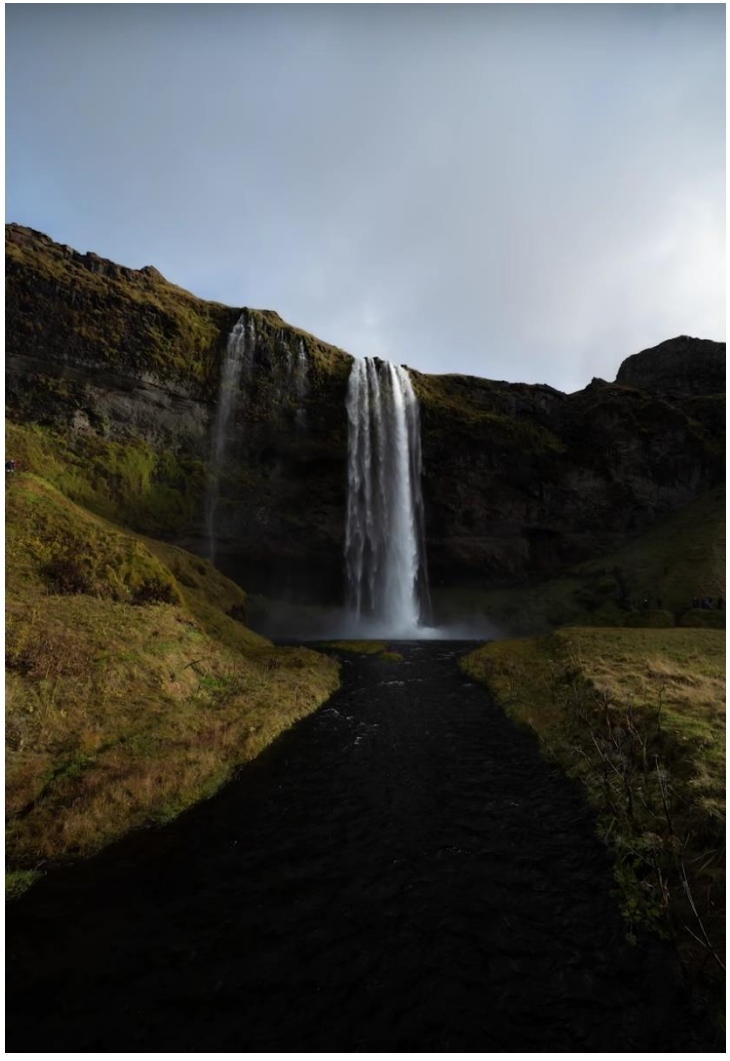
Lens capabilities: know your sharpest apertures

Five Do’s

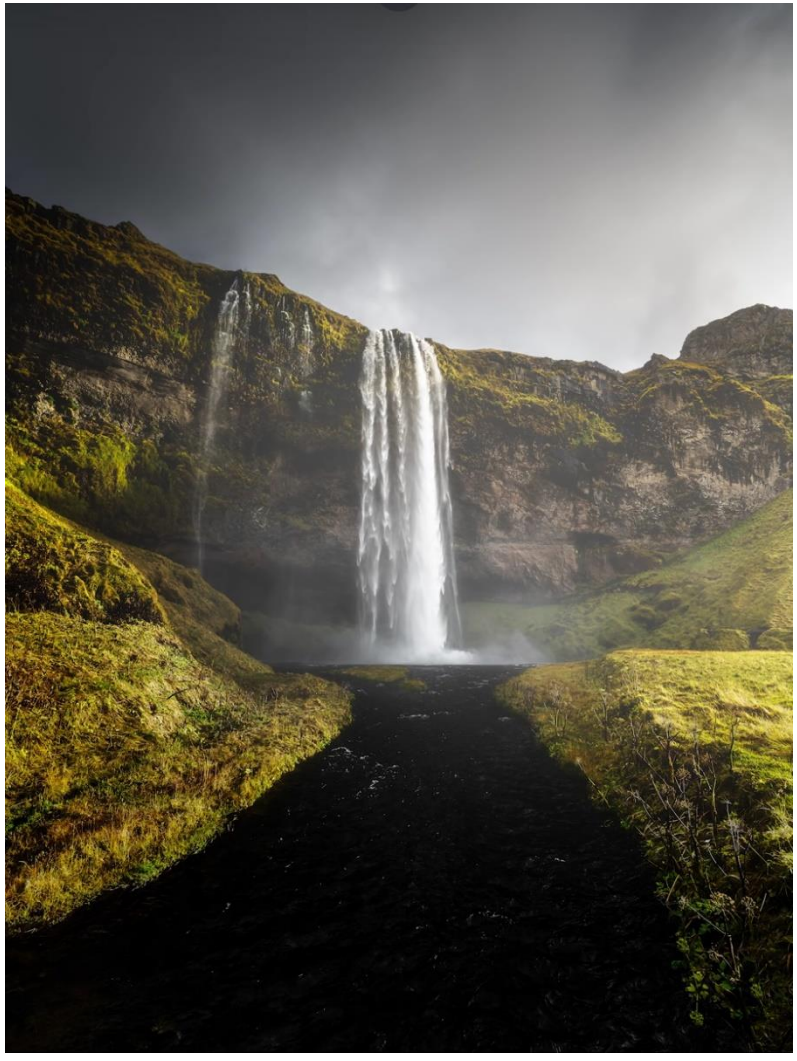
5) Editing – enhance the elements of interest; hide or remove what’s not interesting: colors, contrast, tones

Mads Peter Iverson: https://www.youtube.com/watch?v=3hk7xtBhPIc

Contrast, mist, clouds, water streaks



Brightened overall, darkened clouds, added sun flare, other local adjustments



Brightened road, local adjustments

Mads Peter Iverson

Favorites

Stop Making These Wide Angle Mistakes

- Foreground clutter
  - Get close to the ground to minimize undesirable fore- and mid-ground content
  - Leading lines should go into the scene, not out of it
- Parts of the scene are not in focus
  - Use a small aperture for greater depth of field (but not above F/16)
  - Or focus stack
- Background subject becomes too small
  - Gives too much emphasis to the foreground
  - Bracket the frame: zoom in to make the subject larger just in case

Mads Peter Iverson: https://www.youtube.com/watch?v=RrJJq8P9wdM

Stop Making These Wide Angle Mistakes

- Misuse of a polarizing filter
  - Greatest polarizer effect is at 90 degrees from sun, but an ultra wide may also include non-polarized part of the sky – very difficult to even out the polarized banding in post processing
  - Zoom in, shoot vertical, or don't use a CPL at all when shooting the sky
- Getting too close to a tall subject / building – creates distorted view of the subject from below
- Awful edge distortion – buildings tilt in, people get fat and misshapen; keep the subject at the center

Mads Peter Iverson: https://www.youtube.com/watch?v=RrJJq8P9wdM

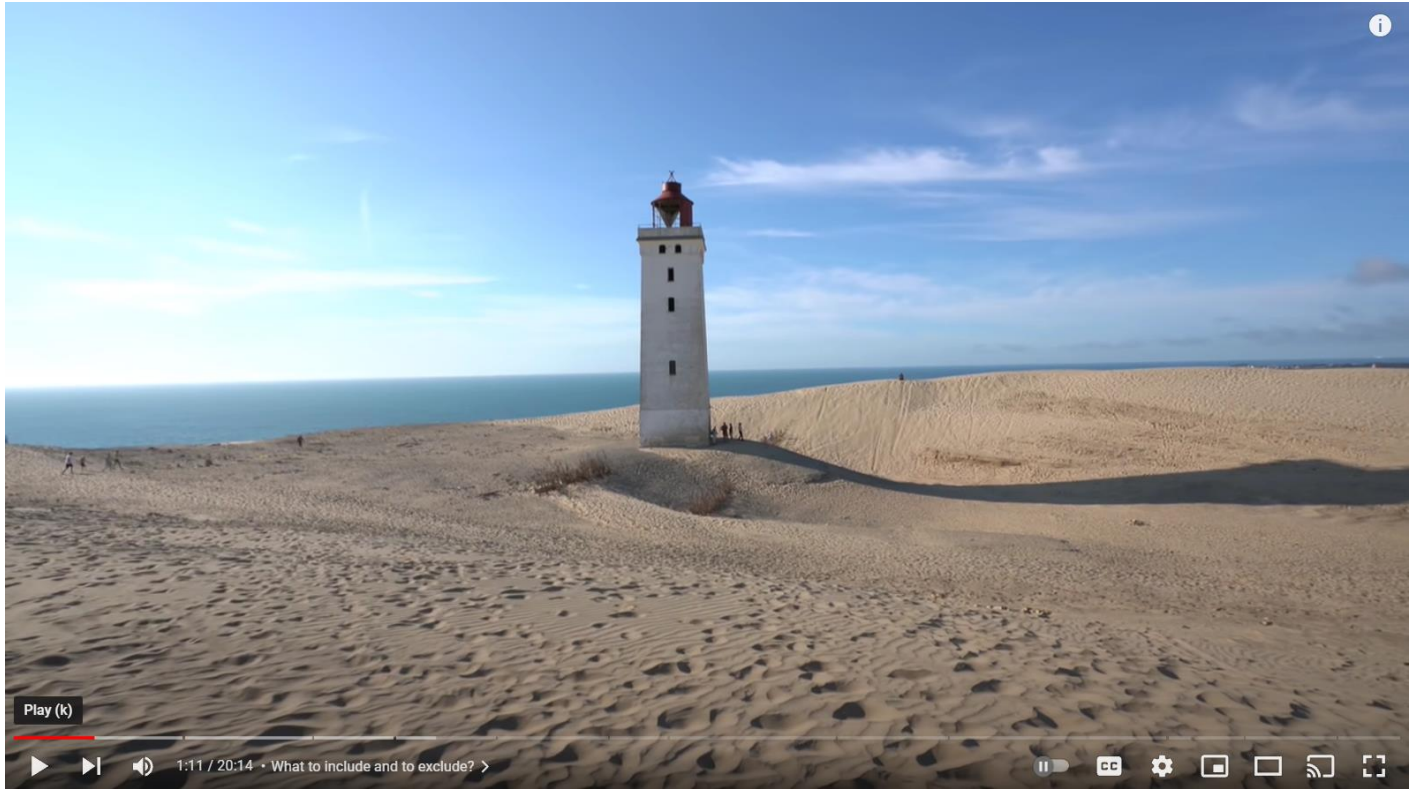
UW + CPL + Blue Sky: Just Say No

Jonathan Lee Martin: https://fstoppers.com/education/lessons-shooting-landscapes-my-first-ultra-wide-lens-257408

UW + CPL + Blue Sky: Just Say No

Phil Norton, UK Landscape Photographer https://www.philnortonphotography.co.uk/714-polariser-details.html

Original Scene



Objectives:

- Exclude foreground sand clutter
- Get low
- Get everything in focus: focus stack
- Wait for the sun/sky

←
Tells a different story about decay

Is the foreground element too strong?

→
Too close to subject

Distorted verticals


Stop Making These Wide-Angle Lens Mistakes
Edge distortion
17:08 / 20:14 • Distorted subjects are awful! ›

Break some rules!

- CPL (shot vertically to minimize artifacts)
- Too close (vertical distortion)
- Strong foreground

Lines lead out
of the image

Christian Hoiberg
Norwegian Landscape Photographer

6 Pro Tips for Better Wide-Angle Landscape Photography

Christian Hoiberg: https://www.capturelandscapes.com/pro-tips-for-better-wide-angle-landscape-photography/

1) Fill the Space

22mm Large empty space in lower left

14mm Foreground acting as a frame
Rainbow fills the corner
Bird is in brightest area

Christian Hoiberg: https://www.capturelandscapes.com/pro-tips-for-better-wide-angle-landscape-photography/

2) Use a low perspective; get close to foreground

Waist high
Messy, uninteresting foreground

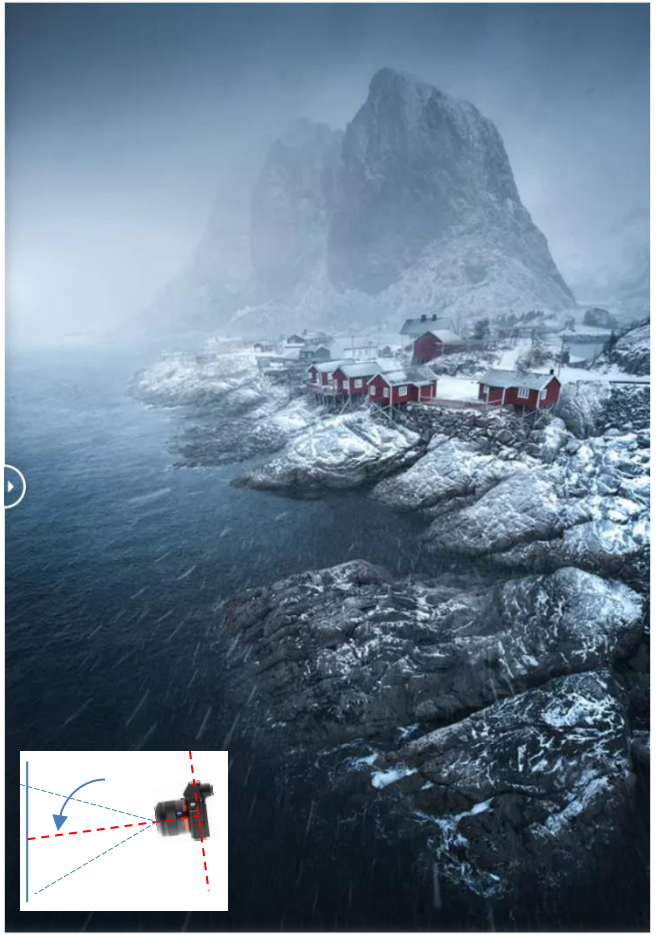
Lower perspective
Crisp, interesting foreground

Christian Hoiberg: https://www.capturelandscapes.com/pro-tips-for-better-wide-angle-landscape-photography/

3) Take advantage of distortion

Wide angle lens makes distant mountains appear small and unimpressive.

Tilt the lens down to stretch the edges, making the distant subject more impressive.



Christian Hoiberg: https://www.capturelandscapes.com/pro-tips-for-better-wide-angle-landscape-photography/

4) Pay attention to the edges & corners
   - Branches
   - Tripod legs, camera bags

5) Watch out for filter vignetting
   - Budget filters
   - Stacked filters

6) Focus stacking is your friend

Christian Hoiberg: https://www.capturelandscapes.com/pro-tips-for-better-wide-angle-landscape-photography/

Nigel Danson
UK Landscape Photographer

Going Wide…

7 Tips To Get Better Wide Angle Shots

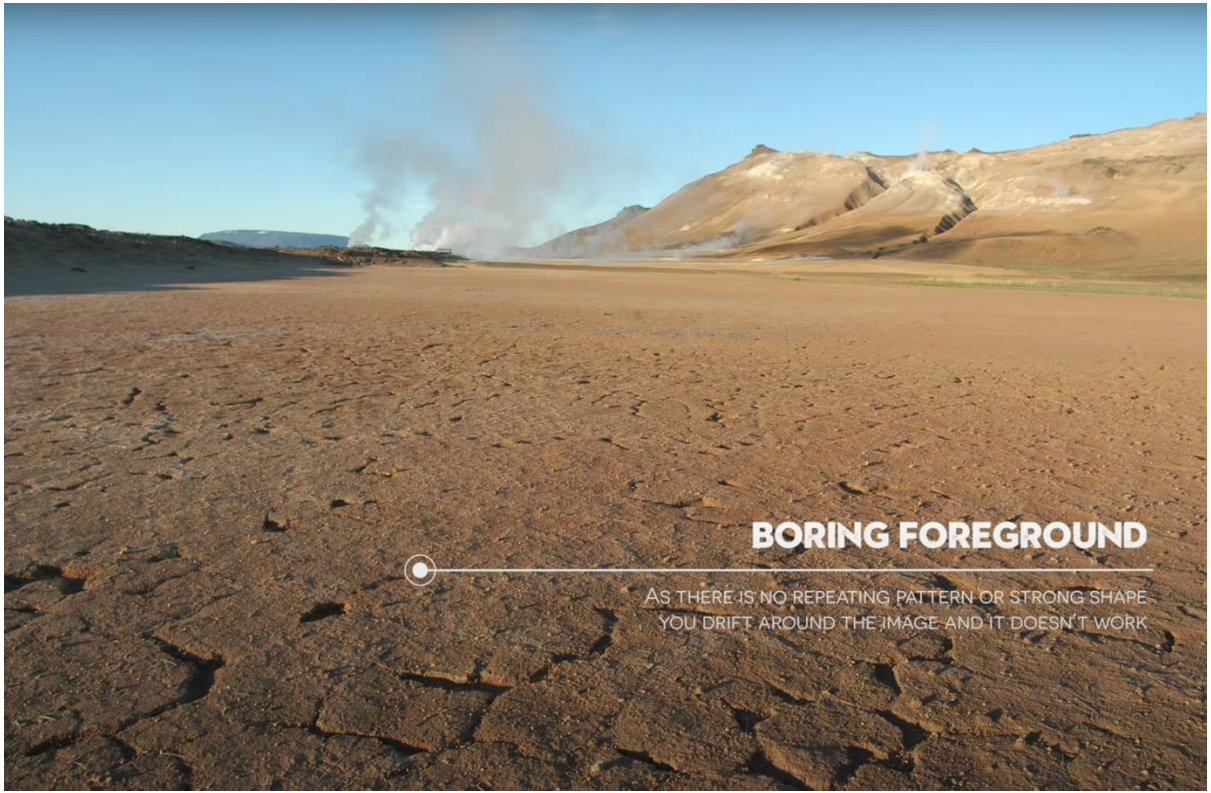
Nigel Danson: https://www.youtube.com/watch?v=r-TW4uC28ZM

1. Powerful Foreground

We tend to look at a landscape from the foreground up; looking into a scene from the front of the scene to the back.

If the foreground is boring the eye will tend to drift out of the image.

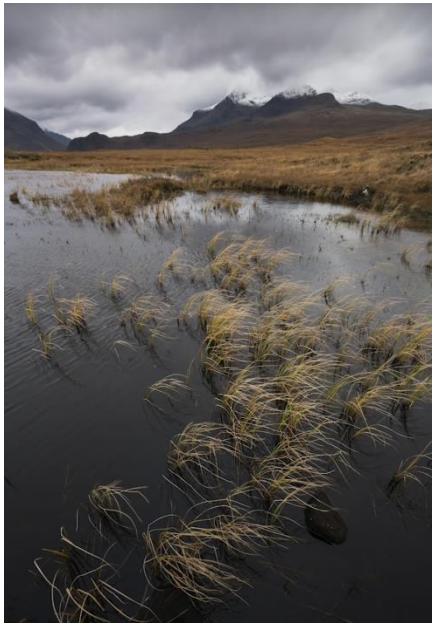
Point slightly down (40/60) to capture more foreground … unless you point slightly up (60/40) to capture more sky.



Nigel Danson: https://www.youtube.com/watch?v=r-TW4uC28ZM

1. Powerful Foreground

Foreground is seen first, must be interesting



Nigel Danson: https://www.youtube.com/watch?v=r-TW4uC28ZM

Nigel Danson: https://www.youtube.com/watch?v=r-TW4uC28ZM

2. Connecting Mid-Ground

Mid-ground connects foreground to the background/subject.

Adjusting the camera higher/lower makes significant change in
mid-ground.

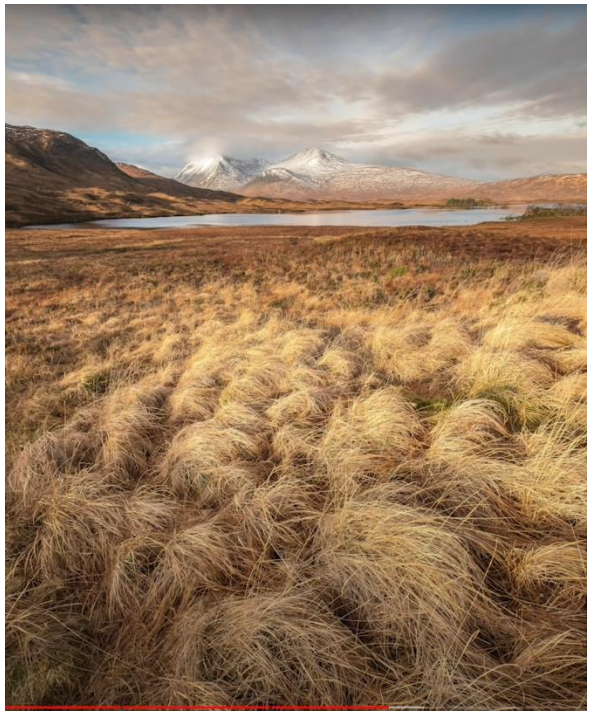
Weak mid-ground:

Nigel Danson: https://www.youtube.com/watch?v=r-TW4uC28ZM

3. Distance

Fantastic mountains are made small by a wide angle perspective; without fore- and mid-ground then the image is boring; maybe wide angle isn't best.

A good sky really helps keep viewer in the image:



Weak sky, subject too small:

Nigel Danson: https://www.youtube.com/watch?v=r-TW4uC28ZM

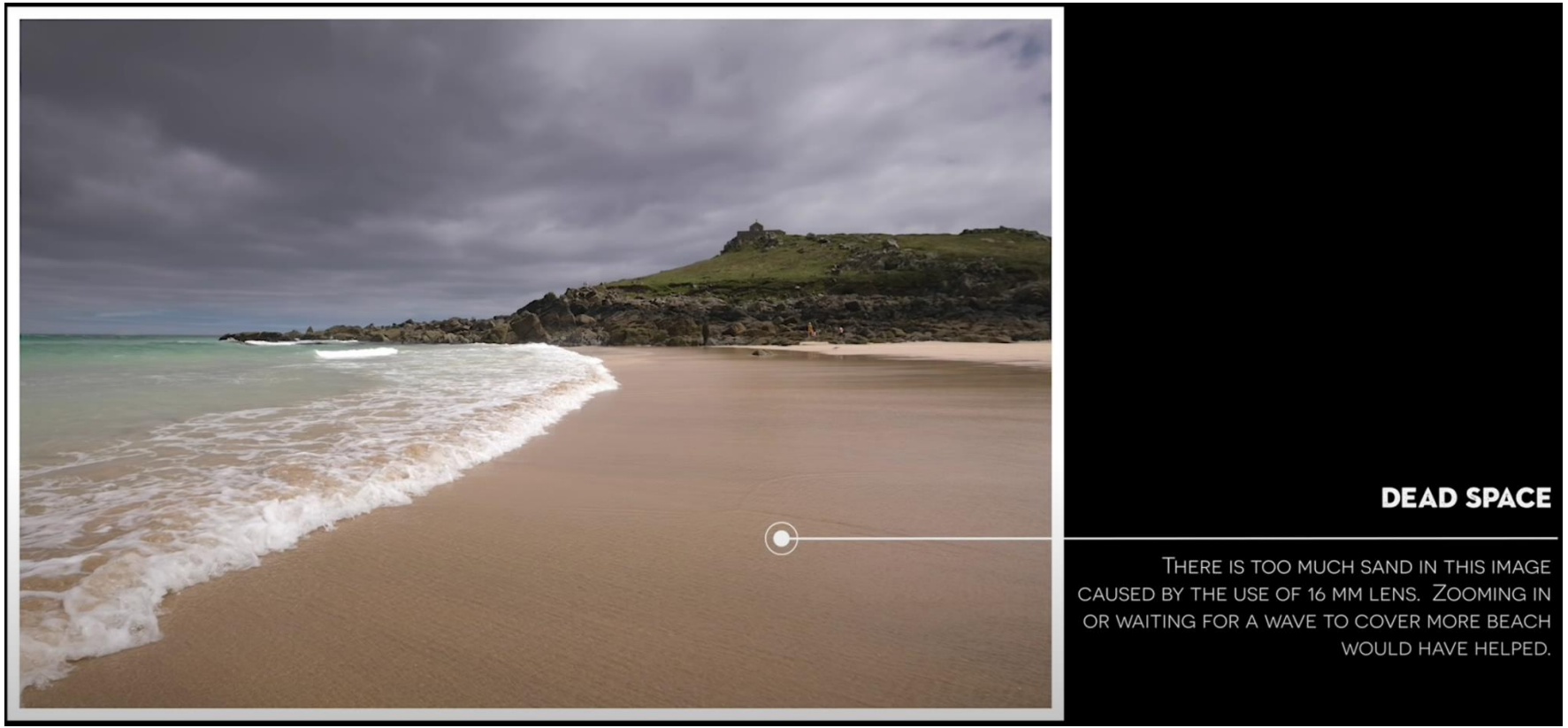
4. Camera Movement

Movement [finding the right camera position] is very important to the shot; start with your wide angle phone, then make lots of movements with your camera (not tripod) until you find the shot.

Moving small distances makes a big difference in the foreground and mid-ground.

Nigel Danson: https://www.youtube.com/watch?v=r-TW4uC28ZM

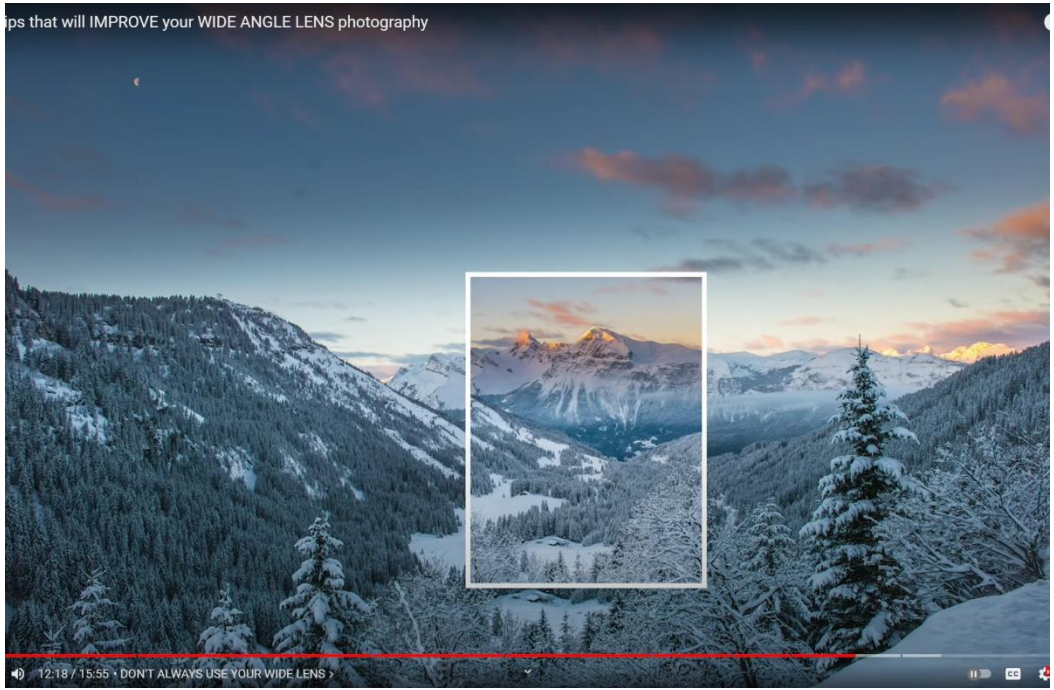
5. Avoid Dead Space



Nigel Danson: https://www.youtube.com/watch?v=r-TW4uC28ZM

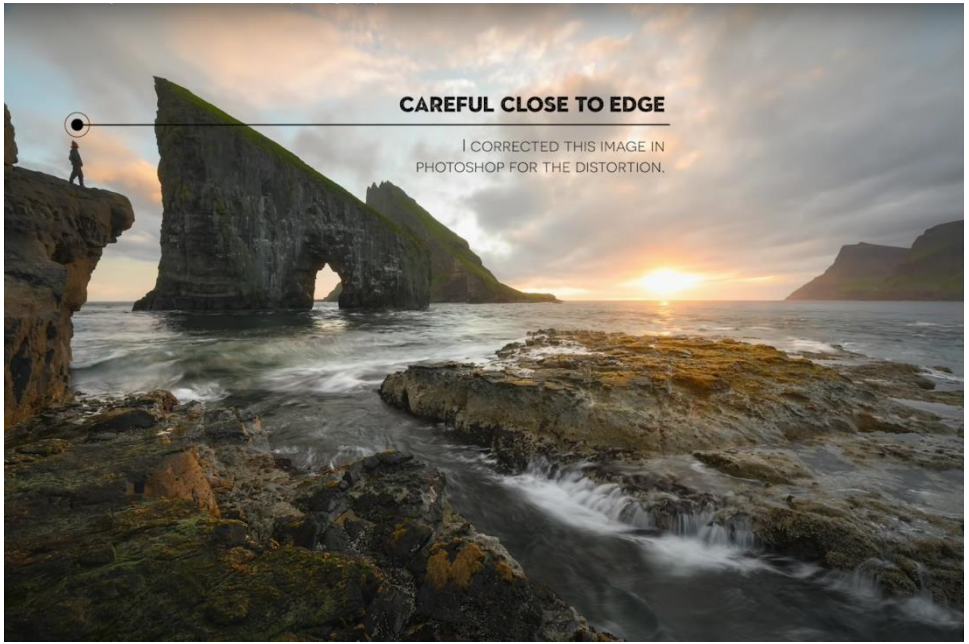
6. Don’t Always Use the Wide Angle

Knowing WHEN NOT to use a wide angle is as important as knowing HOW to use a wide angle. Left: 16mm too cluttered; right: 75mm is a stronger image.



7. Consider using People for Perspective

Be careful about distortion at the edges



Ken Rockwell Photographer and “Influencer”

How to Use Ultra-Wide Lenses

Ken Rockwell: https://www.kenrockwell.com/tech/how-to-use-ultra-wide-lenses.htm

Ken Rockwell

- Ultrawide lenses are the **most difficult lenses to use well**.
- Long lenses compress perspective, making everything on the same plane. Ultrawides do the opposite; they expand the apparent depth of an image.
- Contrary to common opinion, ultrawides are not for "getting it all in." **Ultrawides are for getting** yourself, and therefore **the viewer, right smack into the middle of something**.
- Ultrawides **require you to get very close** and personal to anything you are shooting. Even a fraction of an inch will make a huge difference in your composition, so you need to be very deliberate with your movement. If you can't or won't get close, leave the ultrawide at home.
- **Most people use ultrawides too sheepishly**, and get crummy results with tiny subjects dwarfed in the middle of an open frame. When I use my 14mm I constantly have to **force myself to get closer** and **pay rapt attention to the sides** of my viewfinder, which are too often blank or loaded with junk.
- The hardest part with ultrawides is getting close enough. **You can never get too close!**
- Painting is an art of inclusion; nothing gets into the painting unless the painter puts it there. Photography is an art of exclusion; everything gets into the photo unless you work to exclude it. **Wide angle lenses get everything in, making composition even more difficult.**

Ken Rockwell: https://www.kenrockwell.com/tech/how-to-use-ultra-wide-lenses.htm

Getting it all in

Most beginners, myself included for 15 years, think wide-angle lenses are for "getting it all in."

They think that the wider the lens (or stitched panorama), the more encompassing, impressive, huge and all-enveloping will be the result.

All that most people get with ultrawide lenses are parking lots in the bottom half of their image, and nothing anywhere except for the center. Worse, ultrawides see all the distracting junk on the side of your subject and weaken the shot.

This shot was made in the middle of the Mojave Desert, so there isn't anything on the sides. I got lucky.

Ken Rockwell: https://www.kenrockwell.com/tech/how-to-use-ultra-wide-lenses.htm

Get Close!

The hardest part with ultrawides is getting close enough. You can never get too close! You have to push yourself to get and stay close enough.

For this shot, I was leaning over the edge of the fountain to get close enough to the astronomical device to use it as a compositional element.

Watch your edges and make sure your subject fills the frame.

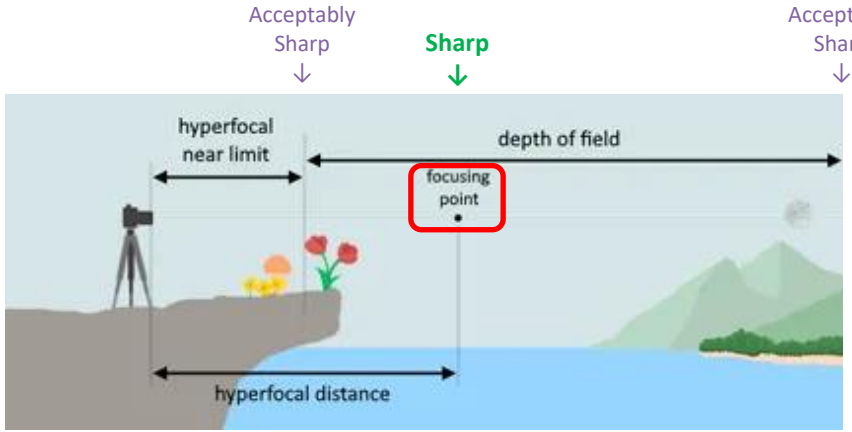
If I get lazy, all I get is a smaller subject in the middle with loads of space between it and the frame edges. I wind up cropping, which just eliminated the whole point of using an ultrawide lens.

Ken Rockwell: https://www.kenrockwell.com/tech/how-to-use-ultra-wide-lenses.htm

Other Points

Hyperfocal Distance

- Hyperfocal distance:
  - The closest distance at which the lens can be focused while keeping objects at infinity acceptably sharp
  - All objects from ½ the hyperfocal distance to infinity will be acceptably sharp
- Wider lenses have a closer hyperfocal distances
- At F/11 a 16mm lens should be acceptably focused from 1.25 feet (2.5’ x 1/2) to infinity



https://www.omnicalculator.com/other/hyperfocal-distance

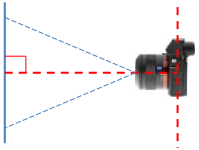
Hyperfocal Distance Chart

(Intended for full-frame cameras; values in feet.)

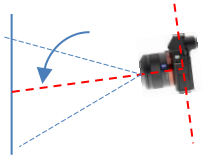
	f/2.8	*f/4*	*f/5.6*	*f/8*	*f/11*	*f/16*	*f/22*
16mm	10	7	5	3.6	2.5	1.8	1.3
20mm	15.5	11	7.8	5.5	3.9	2.8	2
24mm	22.3	15.8	11.2	8	5.7	4	2.9
28mm	30.4	21.5	15.2	10.8	7.7	5.5	3.9
35mm	47.5	33.6	23.8	17	12	8.5	6
50mm	96.8	68.5	48.5	34.3	24.3	17.3	12.2
85mm	280	198	140	99	70	49.7	35.2

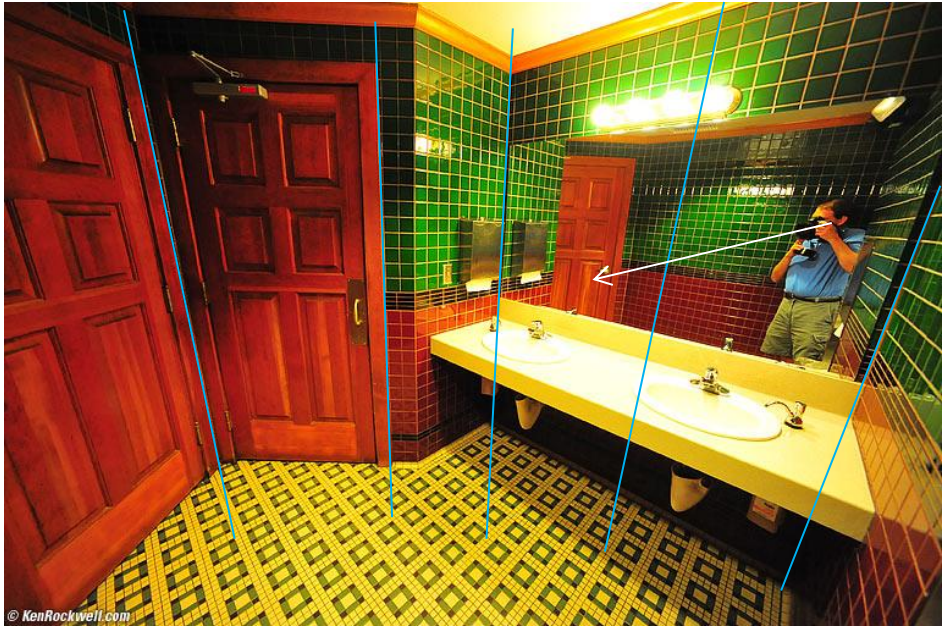
https://photographylife.com/landscapes/hyperfocal-distance-explained

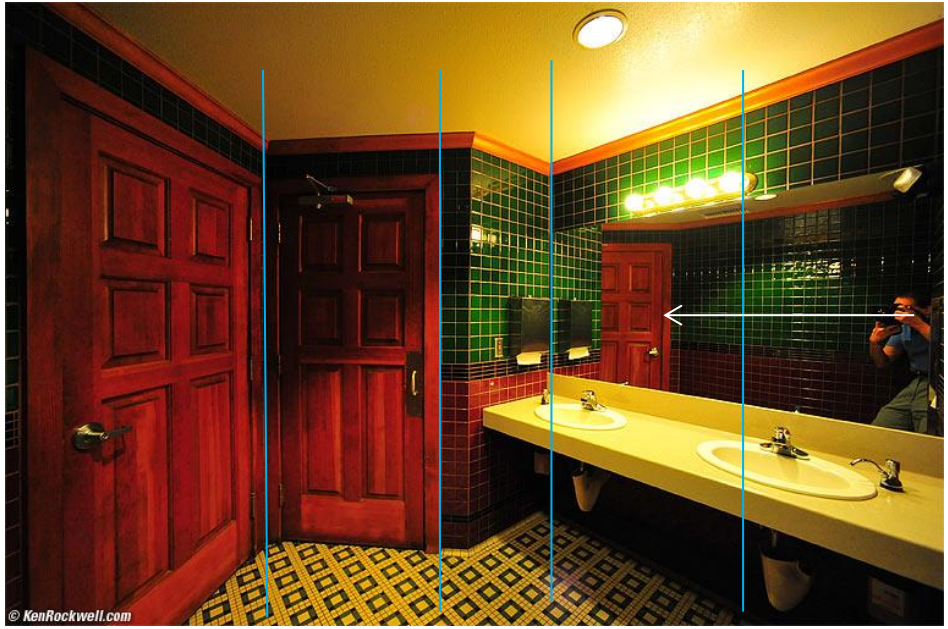
Architecture: Flat Horizon



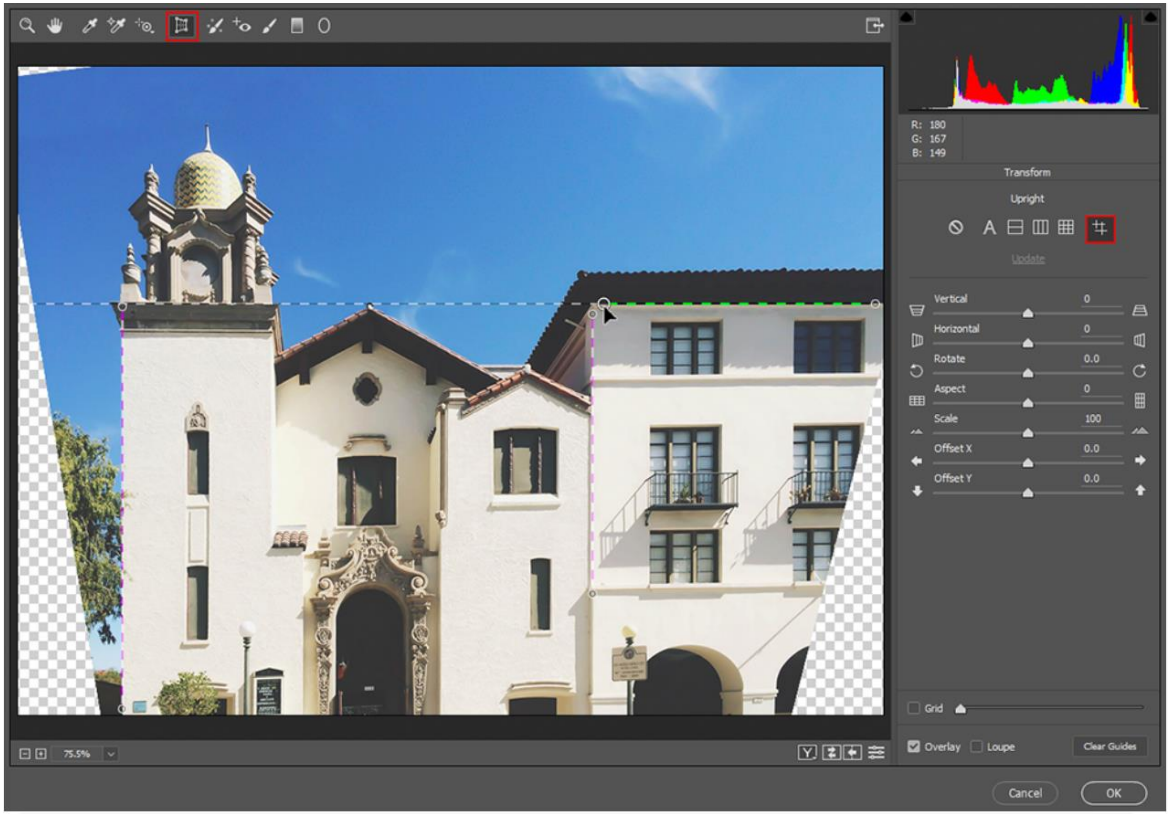
Ultrawides exaggerate misalignment between the sensor plane and the subject plane: **keep the horizon flat** to avoid distortion





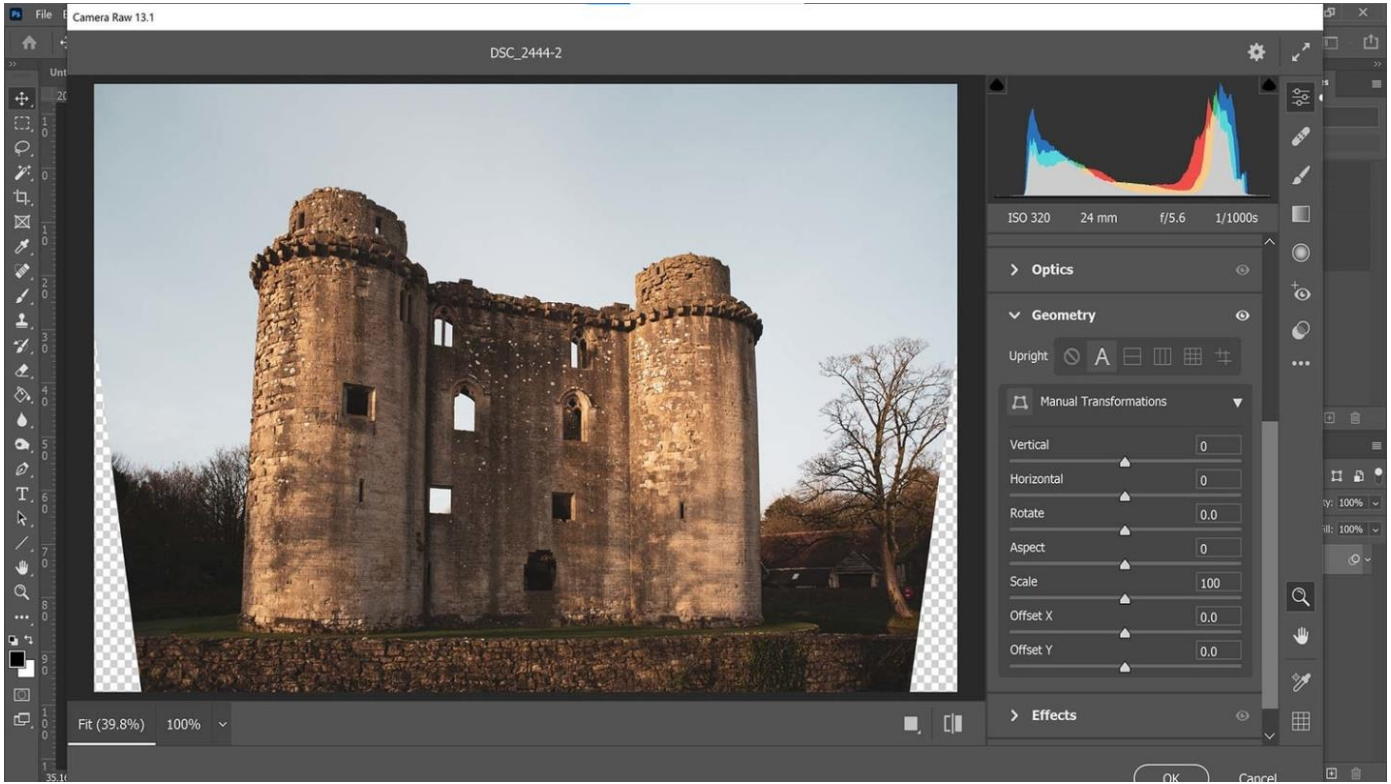


Architecture: Shoot Wider



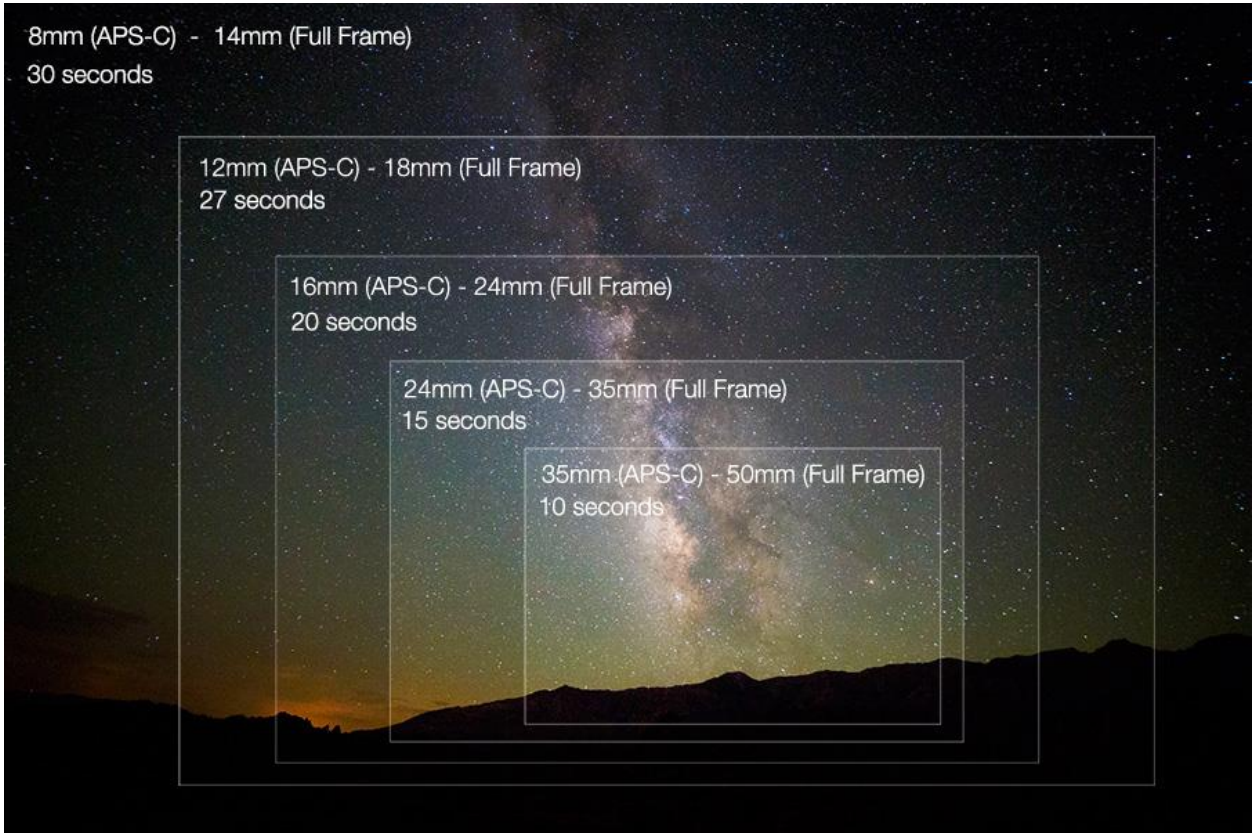
Adobe.com

Architecture: Shoot Wider



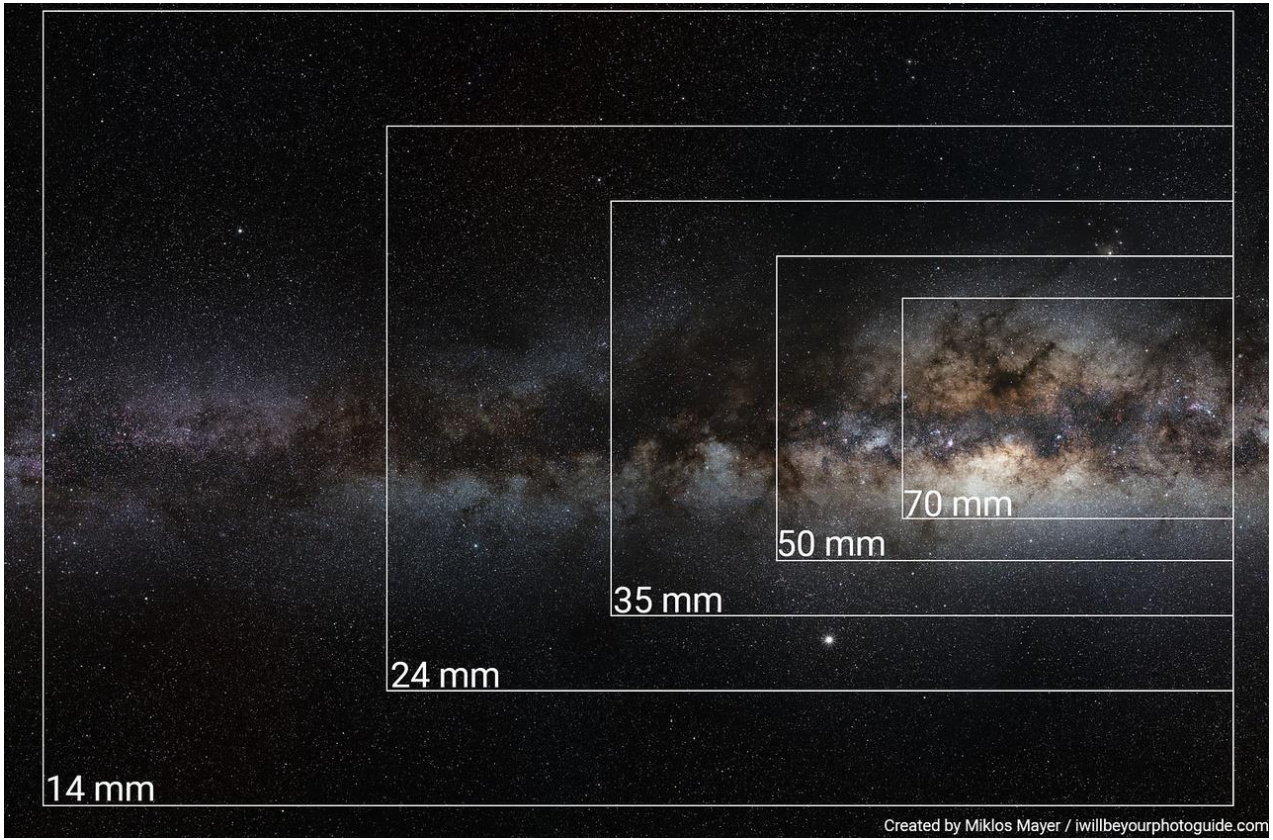
https://fstoppers.com/originals/3-ways-perfectly-straighten-verticals-lightroom-photoshop-and-tilt-shift-lens-543793

Astro: How Wide is Wide?



LonelySpeck.com

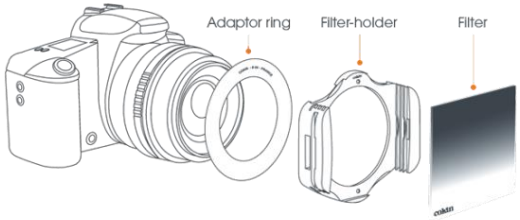
Astro: How Wide is Wide?



Three Wide Angle Filter Systems

Lens has filter threads ($$$, typical)

- Round CPL and NDs
- Holder and rectangular grads (85mm)



Rear filters (rare)

- NDs only

No Filter Threads ($,$$$)

- 3rd party holder
- Huge round CPL
- Rectangular NDs, grads (110mm)

Recommended Landscape filter kit

- CPL
- NDs: +10, +6, +3
- Grad NDs: hard, soft and reverse grads in +3 to +6 opacity

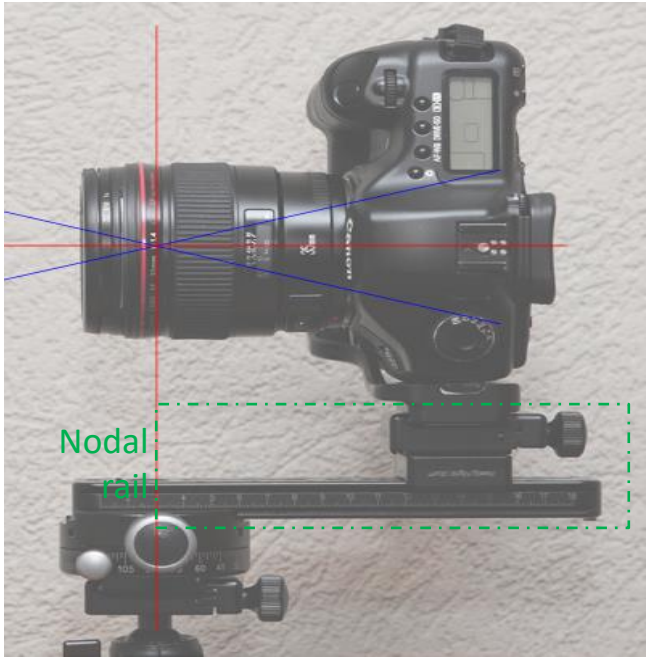
Wide Angle Panoramas

Nine 24mm portrait oriented images automatically stitched in Lightroom

Wide angle lenses exacerbate parallax problems

Nodal Rail

- Parallax problem: generally caused by a misaligned foreground and background; prevents automatic panorama stitching
- Reduce parallax problems by excluding the foreground
- Eliminate parallax problems by using a nodal rail to rotate the camera at the “entrance pupil" of the lens (aka nodal point, aka no-parallax point), instead of at the sensor. Typically near the aperture blades; frequently changes location in a zoom lenses.
  - A nodal rail is an inexpensive device that allows the camera to rotate at the nodal point of the lens rather than at the typical mount under the sensor (for single row panoramas)
  - Two-axis devices are needed for multi row panoramas
  - Amazon: $25 Desmond DNR-180 (long)
    https://www.amazon.com/Desmond-180mm-DNR-180-Dovetail-Compatible/dp/B00F1IFZCE



Nando Harmsen
https://fstoppers.com/education/beginners-guide-parallax-and-how-avoid-it-when-shooting-panoramas-485141

Critiquing Wide Angle Images

Do's

- Level the horizon: sensor plane parallel with subject (or intentionally not)
- Appropriate perspective: distance to subject, camera height
- Interesting foreground
- Connecting mid-ground
- Interesting, visible subject / focal point
- Leading lines point to subject
- Embraced distortion, get really close
- Whole image / scene "works"

Don'ts

- Shoot too wide (small subject)
- Dead space
- Out of focus areas
- Unintended distortion
- Stretch people (unintentionally)
- Filter artifacts, vignetting
- Edge clutter
- Over crowded image

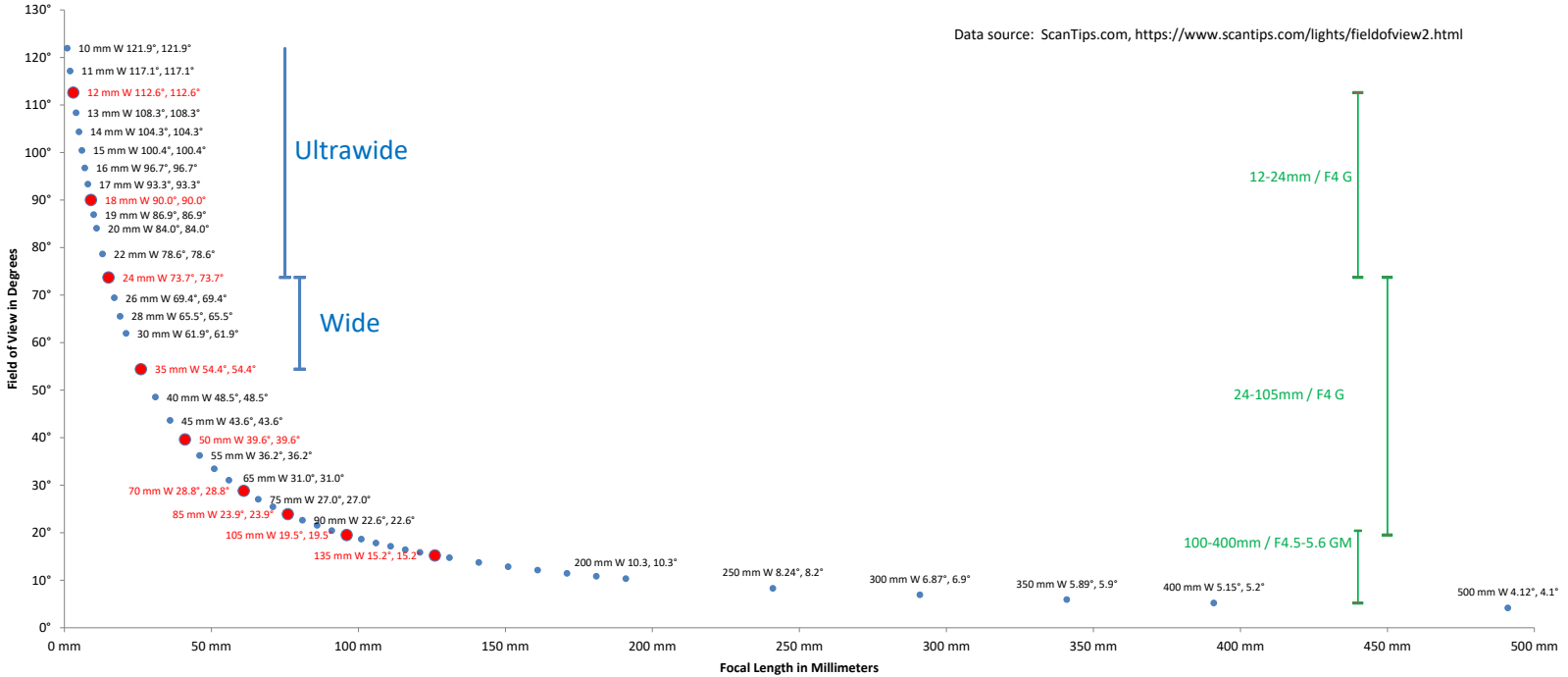
Links

- **Robin Laurenson** – Do's and Don'ts of Wide Angle Lenses in 10 minutes: https://www.youtube.com/watch?v=nNPdw-jb-Dk
- **Ken Rockwell** – How to use Wide Angle Lenses: https://www.kenrockwell.com/tech/how-to-use-ultra-wide-lenses.htm
- **Christian Hoiberg:** 6 Pro Tips for Better Wide-Angle Landscape Photography: https://www.capturelandscapes.com/pro-tips-for-better-wide-angle-landscape-photography/
- **Mads Peter Iversen:**
  Five Steps to Make Powerful 16-35mm Photos: https://www.youtube.com/watch?v=3hk7xtBhPIc,
  Stop Making these Wide-Angle Mistakes: https://www.youtube.com/watch?v=RrJJq8P9wdM
- **Nigel Danson:**
  Going Wide…7 Tips To Get Better Wide Angle Shots: https://www.youtube.com/watch?v=r-TW4uC28ZM
  Do you Need an Ultra Wide Angle lens?: https://www.youtube.com/watch?v=rC2oQ9fkrv0
- **Desmond DNR-180 Nodal Rail**: https://www.amazon.com/Desmond-180mm-DNR-180-Dovetail-Compatible/dp/B00F1IFZCE

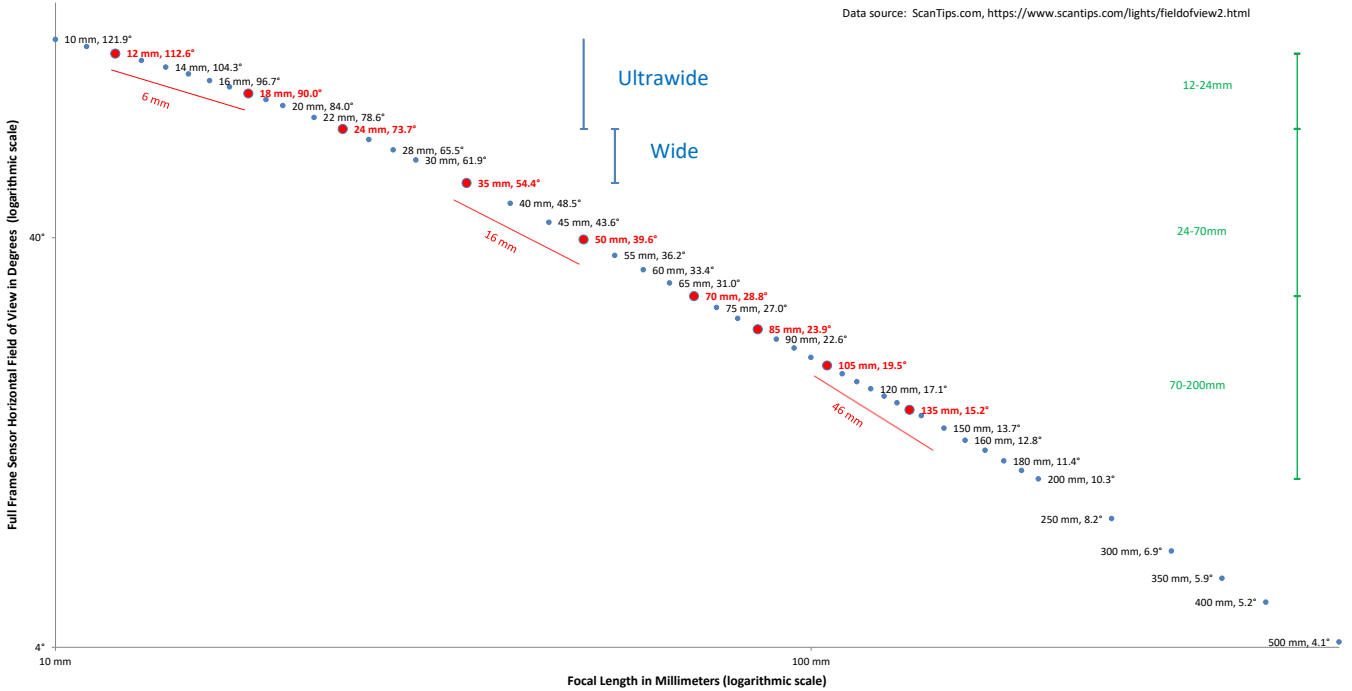
Full Frame Mirrorless Wide Angle Zoom Lenses

Canon RF 15-35/2.8	$2,300	Sony FE 12-24/2.8 GM	$2,900	Nikon Z 14-24/2.8	$2,500
Canon RF 14-35/4	$1,600	Sony FE 16-35/2.8 GM	$2,200	Nikon Z 14-30/4	$1,347
Canon RF 15-30/4.5-6.3	$550	Sony FE 12-24/4 G	$1,800		
		Sony FE 16-35/4 PZ	$1,200		
		Sony FE 16-35/4 Zeiss	$1,000		
Venus RF 12-24/5.6	$650	Sigma FE 14-24/2.8	$1,300	Venus Z 10-18/4.5-5.6	$700
		Sigma FE 16-28/2.8	$900	Venus Z 12-24/5.6	$650
		Tamron FE 17-28/2.8	$900		
		Venus FE 10-18/4.5-5.6	$700		
		Venus FE 12-24/5.6	$650		

Field of View



Field of View



Weber-Fechner Law: the relationship between stimulus and human perception is logarithmic …

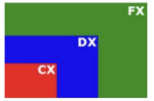
Angle of View (Nikon table)

Lens Focal Length	FOV (Angles in degrees)								
	35mm & FX format *(1)*			DX format *(2)*			CX Nikon 1 format *(3)*		
	Horizontal	Vertical	Diagonal	Horizontal	Vertical	Diagonal	Horizontal	Vertical	Diagonal
10mm	121.9	100.4	130.4	99.0	75.9	109.2	66.8	47.5	76.8
11mm	117.1	95.0	126.1	93.5	70.7	103.9	61.9	43.6	71.6
12mm	112.6	90.0	122.0	88.5	66.0	99.0	57.6	40.3	66.9
14mm	104.3	81.2	114.2	79.8	58.2	90.3	50.5	34.9	59.1
15mm	100.4	77.3	110.5	75.9	54.9	86.3	47.5	32.7	55.7
17mm	93.3	70.4	103.7	69.1	49.3	79.2	42.4	29.0	50.0
18mm	90.0	67.4	100.5	66.0	46.9	76.0	40.3	27.5	47.6
19mm	86.9	64.6	97.4	63.2	44.6	73.0	38.3	26.1	45.3
20mm	84.0	61.9	94.5	60.7	42.6	70.2	36.5	24.8	43.3
24mm	73.7	53.1	84.1	52.0	36.0	60.7	30.8	20.8	36.6
28mm	65.5	46.4	75.4	45.4	31.1	53.3	26.5	17.9	31.6
30mm	61.9	43.6	71.6	42.6	29.1	50.2	24.8	16.7	29.6
35mm	54.4	37.8	63.4	37.0	25.1	43.8	21.4	14.3	25.5
45mm	43.6	29.9	51.4	29.1	19.7	34.7	16.7	11.2	20.0
50mm	39.6	27.0	46.8	26.3	17.7	31.4	15.0	10.1	18.0
55mm	36.2	24.6	42.9	24.0	16.1	28.7	13.7	9.1	16.4
60mm	33.4	22.6	39.7	22.1	14.8	26.4	12.6	8.4	15.1
70mm	28.8	19.5	34.3	19.0	12.7	22.7	10.8	7.2	12.9
75mm	27.0	18.2	32.2	17.7	11.9	21.2	10.1	6.7	12.1
80mm	25.4	17.1	30.3	16.6	11.1	19.9	9.4	6.3	11.3
85mm	23.9	16.1	28.6	15.7	10.5	18.8	8.9	5.9	10.7
90mm	22.6	15.2	27.0	14.8	9.9	17.8	8.4	5.6	10.1
100mm	20.4	13.7	24.4	13.3	8.9	16.0	7.6	5.0	9.1
105mm	19.5	13.0	23.3	12.7	8.5	15.3	7.2	4.8	8.6
120mm	17.1	11.4	20.4	11.1	7.4	13.4	6.3	4.2	7.6
125mm	16.4	11.0	19.6	10.7	7.1	12.8	6.0	4.0	7.3
135mm	15.2	10.2	18.2	9.9	6.6	11.9	5.6	3.7	6.7
150mm	13.7	9.1	16.4	8.9	6.0	10.7	5.0	3.4	6.1
170mm	12.1	8.1	14.5	7.9	5.3	9.5	4.4	3.0	5.3
180mm	11.4	7.6	13.7	7.4	5.0	8.9	4.2	2.8	5.0
200mm	10.3	6.9	12.3	6.7	4.5	8.0	3.8	2.5	4.5
210mm	9.8	6.5	11.8	6.4	4.3	7.7	3.6	2.4	4.3
300mm	6.9	4.6	8.2	4.5	3.0	5.4	2.5	1.7	3.0
400mm	5.2	3.4	6.2	3.4	2.2	4.0	1.9	1.3	2.3
500mm	4.1	2.7	5.0	2.7	1.8	3.2	1.5	1.0	1.8
600mm	3.4	2.3	4.1	2.2	1.5	2.7	1.3	0.8	1.5
800mm	2.6	1.7	3.1	1.7	1.1	2.0	0.9	0.6	1.1
Format	35mm & FX *(1)*			APS-C / DX *(2)*			CX Nikon 1 *(3)*		

(1) 36x24mm 35mm film frame/FX sensor size – Field of View Crop Factor = 1

(2) 23.6x15.7mm APS-C/DX sensor size – Crop factor = 1.5

(3) 13.2x8.8mm Nikon1/CX sensor size – Crop factor = 2.8



Vance Schwantes

Selection of Wide Angle Photos

24mm

24mm

24mm, cropped to pano

7 x 15mm
Stacked

12mm
x 3 HDR

12mm

12mm
Focus
Stacked

27mm

17mm

24mm


12mm x 5 HDR

12mm portrait x 3 HDR x 5 panorama


12mm portrait
x 3 panorama

12mm

25mm

29mm

24mm


24mm
HIGHLANDERS
1