

Intro to Small Unmanned Aircraft Systems & Recreational Drones





Photography

“A picture is worth a thousand words”



Brownie Camera (1900)



Introduced the “snapshot” to the masses!

Snapshot vs. Photograph

A snapshot captures a moment; a photograph captures a memory.

A photograph tells a story and makes the viewer think and ask questions.

A photograph is a view of something many others have seen before but seen from a new perspective.

Commercial photography is as an artistic expression of a vision, but with the goal of advancing a business or cause.

Photography Niches

Food

Stock

Event

Sports

Street

Aerial

Macro

Portrait

Wildlife

Fashion

Still Life

Weather

Newborn

Landscape

Architectural

Documentary

Long
Exposure

Photo-
journalism



Aerial Photography

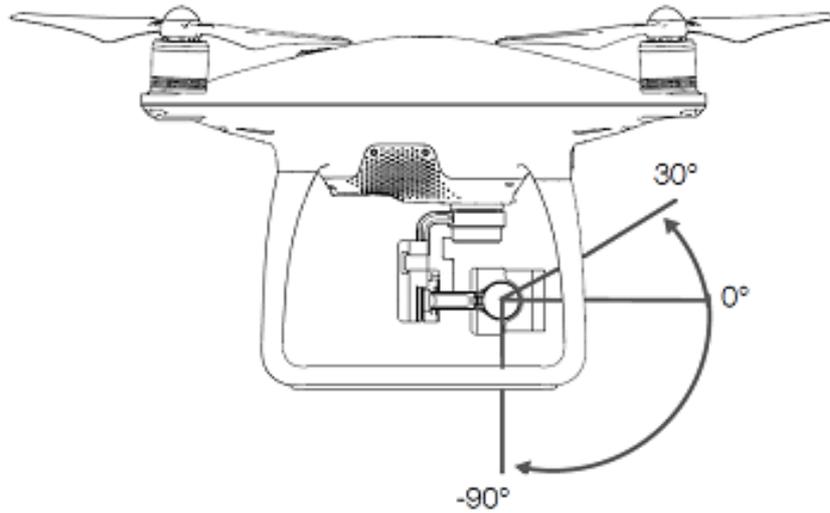
Aerial Photography gives a new perspective of things viewed from above. It is literally a “bird’s eye view” of the world.



Early Aerial Photography



New York City – 1930 by Fairchild Aerial Photo



- Provides a stable platform for a camera
- Designed for specific camera & drone model
- 2-Axis & 3-Axis Stabilized
- Integrated or separate control

Gimbals



- Joystick Control
- Head Tracking

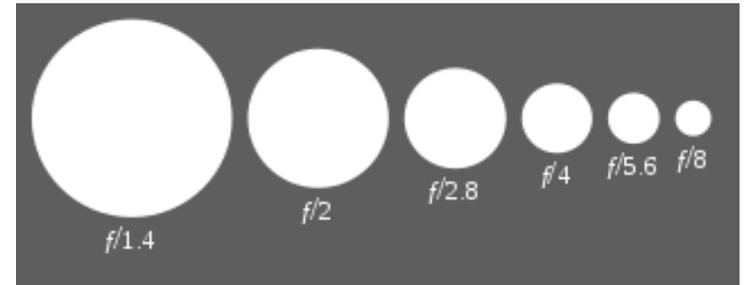
Gimbals

Camera Basics

Three Primary Adjustments

- **Aperture** – “f-stop” or shutter opening

f/1.2 – f/2.0 – **f/2.8** – f/4.0 –
f/5.6 – f/8.0 – f/11 – f/16 – f/32



Most drones have a fixed f/2.8 aperture.

- **Shutter Speed** – in seconds or fractions of a second – length of exposure – 1 sec – ½ sec – ¼ sec
- **ISO** – sensor sensitivity – low ISO for bright scenes & high ISO for low light

Controls the sensitivity of your camera's sensor to light

Controls the area over which light can enter your camera

ISO

Aperture

Shutter Speed

Less light
100 ISO
More detail

More light
f/1.4
Shallow DOF

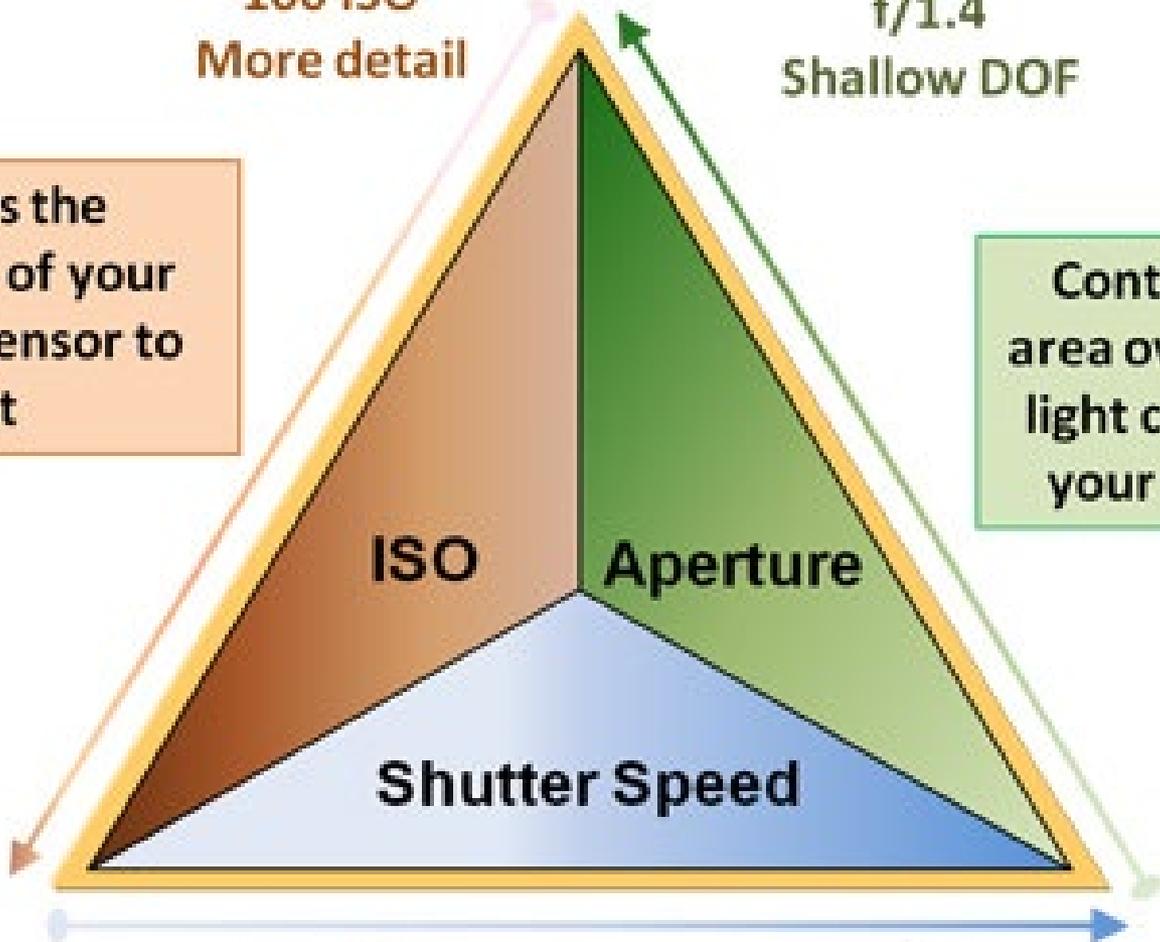
More light
12 800 ISO
Less detail

Less light
f/22
Greater DOF

Less light
1/1000 sec
Freeze action

Controls the duration of the exposure (how much light is allowed to reach the sensor)

More light
1 sec
Artistic blurs



Exposure Choices

Small aperture increases the depth of field so more of the photo is “in focus”.

Fast shutter speed “stops the action” and gives a sharp photo.

Low ISO is good in “bright light” and reduces the noise or false pixels. It also reduces the sensor heating.

Neutral Density Filters

A neutral-density filter (ND) reduces the light intensity. Doing so allows the photographer with a fixed aperture drone to select the desired shutter speed (exposure time) and sensor sensitivity.



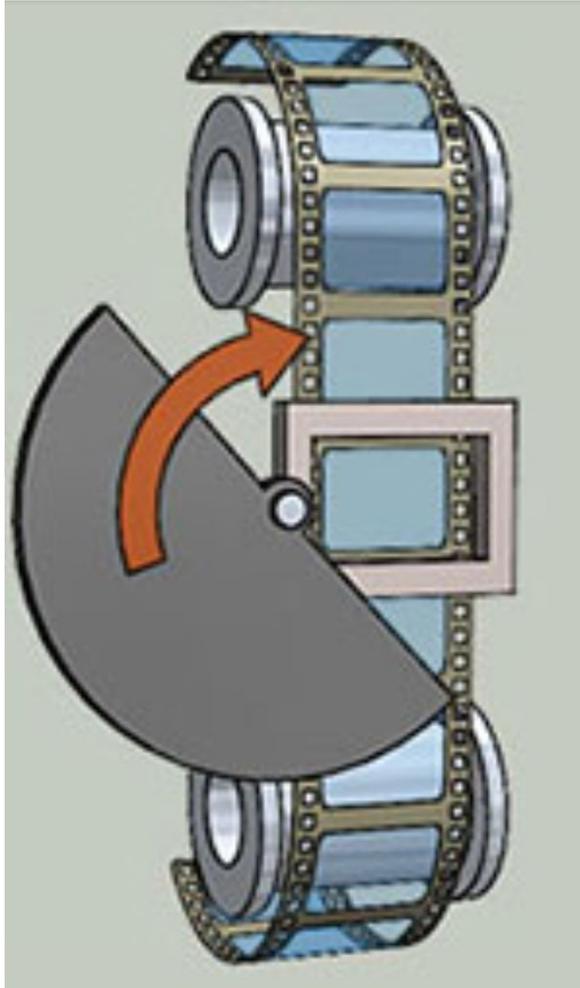
Neutral Density Filters

Use neutral-density filters (ND) to reduce incoming light which allows you to set the shutter speed.

Aperture priority f/8, ISO100



Videography



A movie camera uses a rotating shutter to control how long each frame is exposed. Typically, these cameras record at 24 frames per second, allowing the human eye to see smooth motion with minimal blur and synchronized lip movement.



Videography

“Cinematic Shutter Speed” is the setting where shutterless video closely matches that of a video camera with a rotating shutter. This allows seamlessly blending video footage from two sources.

Example:

$120 \text{ FPS} \times 2 = 240$ or $1/240^{\text{th}}$ shutter speed

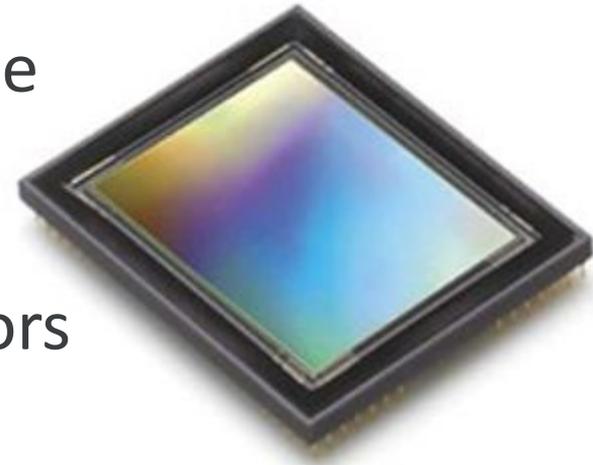
$60 \text{ FPS} \times 2 = 120$ or $1/120^{\text{th}}$ shutter speed

$30 \text{ FPS} \times 2 = 60$ or $1/60^{\text{th}}$ shutter speed

Drone Camera Specs

- **Sensors**

- **CMOS** (complementary metal oxide semiconductor) sensors are faster, which allows for higher video frame rates. CMOS sensors are less expensive to manufacture.
- **CCD** (charge-coupled device) sensors provide higher dynamic range and require less current and voltage to operate. CCD sensors have superior low light performance and deliver better image quality.

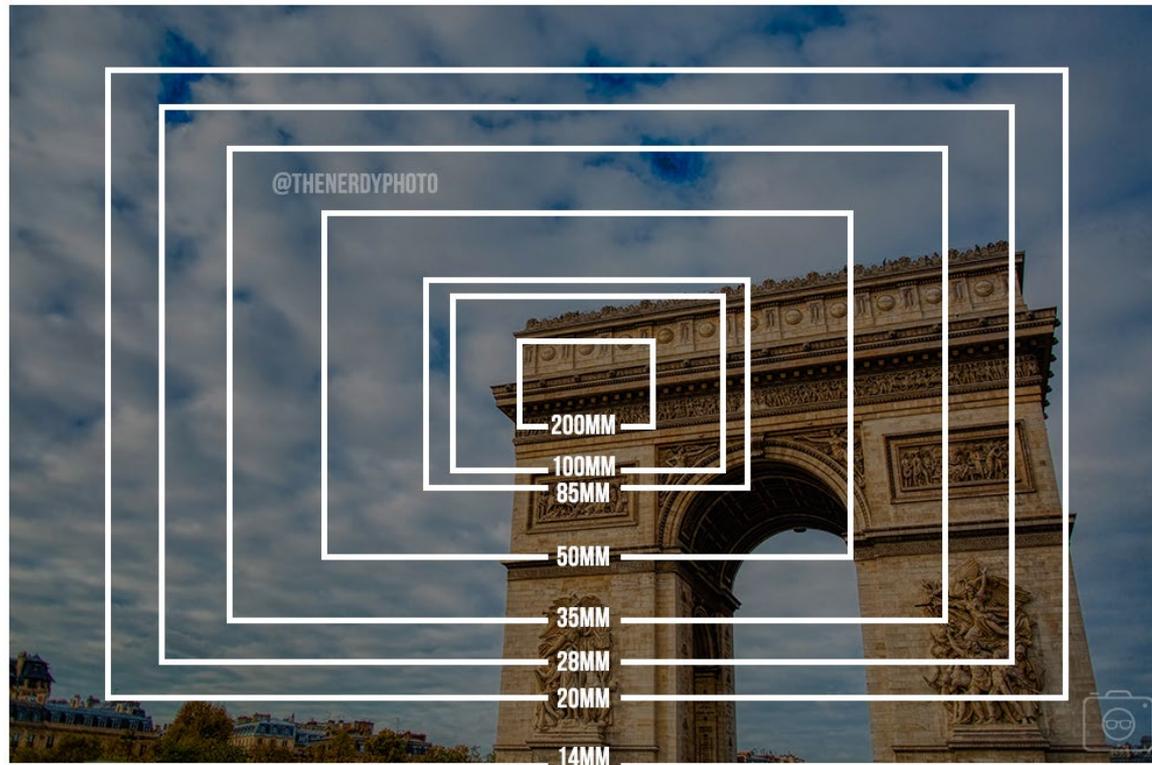


Field of View (FOV)

84° is 24mm equivalent

108° is 16mm equivalent

120° is 12mm equivalent



Drone Camera Specs

- **Video Resolution**

- **5.1K:** 5120×2700 @ 24 to 50 fps

- **Cinema 4K:** 4096×2160 @ 24 to 120* fps

- **4K:** 3840×2160 @ 24 to 120* fps

- **Full HD (FHD):** 1920×1080 @ 24 to 200* fps

- **HD:** 1280×720 @ 30 to 60 fps

*Videos recorded at high framerates will be played as slow-motion videos.

Drone Camera Specs

- **Video Formats**
- **MP4:** A highly compatible and widely used container format, making it suitable for sharing and viewing. Commonly used on PCs.
- **MOV:** A container format, often associated with Apple's QuickTime, that can hold high-bitrate video files and is good for editing.



Photography is more than Megapixels



12 MP Cameras



Videography is more than Resolution



- 4K
- 720p
- 1080i
- WVGA



Each of these shoots in 4K resolution.

Print or Video?

Print – image size is important – larger print size or cropped images are better with more MP and larger sensors

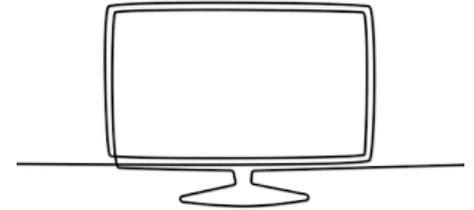
Video – view on a phone, a monitor, high-definition TV or large projections – commercial uses require higher resolution

PPI vs. DPI

Video screens use pixels to create an image

Pixel are measured in Pixels Per Inch (PPI)

Monitors have from 94 to 160 PPI

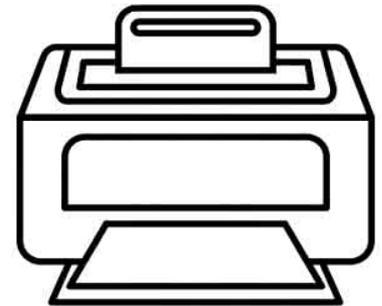


Printers use ink to create an image

Ink is measured in Dots Per Inch (DPI)

5x7 or 4x6 photos are fine with 300 DPI

8x10 photos need 600 DPI to look good





Print Image Size Ratio (W x H)

35mm camera film = 36mm x 24mm (3:2)

Drones have a 3:2 or 4:3 aspect ratio

Standard Print Paper Sizes (USA)

- 4x6 (3:2)
- 5x7 (7:5)
- 6x8 (4:3)
- 8x10 (5:4)
- 8x12 (3:2)
- 10x12 (6:5)
- 10x15 (3:2)
- 11x14 (14:11)
- 11x17 (17:11)
- 12x16 (4:3)
- 12x18 (3:2)
- 16x20 (5:4)
- 20x24 (6:5)
- 20x30 (3:2)



Video Image Size Ratio (W x H)

Drones have a 3:2 or 4:3 native image ratio but can be cropped to 16:9

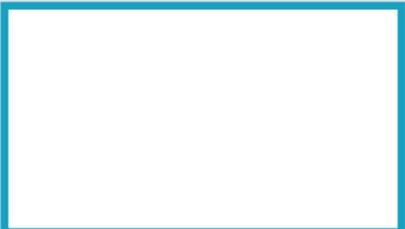
- Facebook*/Instagram* = 1:1 (1200 x 1200 pixels)
- Standard TV = 4:3 (640 x 480 pixels)
- HDTV = 16:9 (1920 x 1080 pixels)
- 4K Ultra HD = 16:9 (3840 x 2160 pixels)
- Cinema 4K = 17:9 (4096 x 2160 pixels) – Letterbox on a HDTV
- Ultra-widescreen = 21:9 (10240 × 4320 Pixels) – shown in theaters

** Social media offers different sizes for different purposes from profile photos to cover photos.*

CAMERA SENSOR SIZE COMPARISON



MEDIUM FORMAT
53.0 x 40.20mm



FULL-FRAME
35.00 x 24.00mm



APS-C
23.60 x 15.60mm



MICRO 4/3
17.00 x 13.00mm



1"
12.80 x 9.60mm



1/2.55"
6.17 x 4.55mm

JPEG or RAW (DNG)



Post processing a RAW photo in Lightroom or Photoshop can greatly improve photo quality over a compressed JPEG.



Normal Lens



Wide Angle or Fisheye vs. Normal



Normal Lens



← **Wide Angle – Telephoto** →

Avoid “selfie nose”

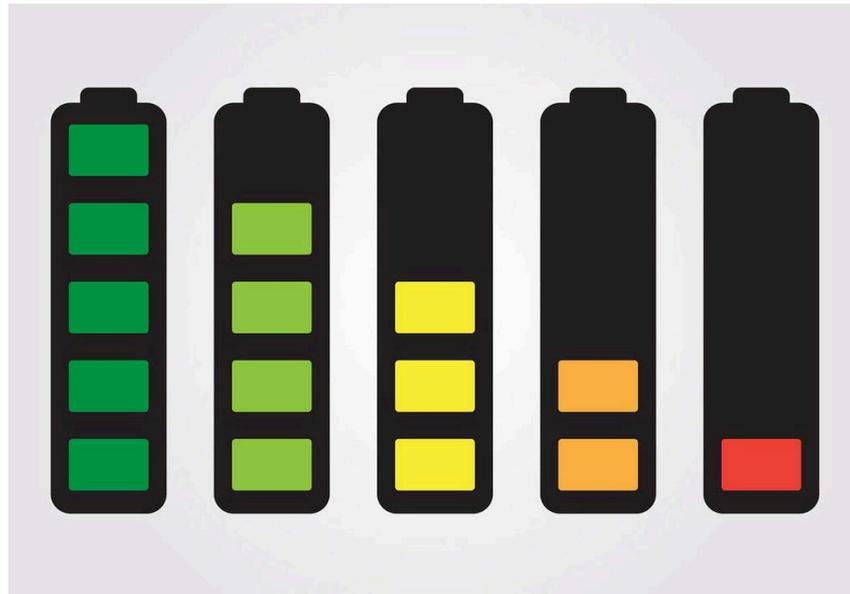
Stable Hover

Stable hovering requires an advanced flight control system and onboard sensors.



Flight Time

Most camera drones will fly for 20+ minutes, which is plenty of time to take a good photograph. So don't worry about flight time but carry 2 or 3 extra batteries.



**Basic
Photography
Composition**

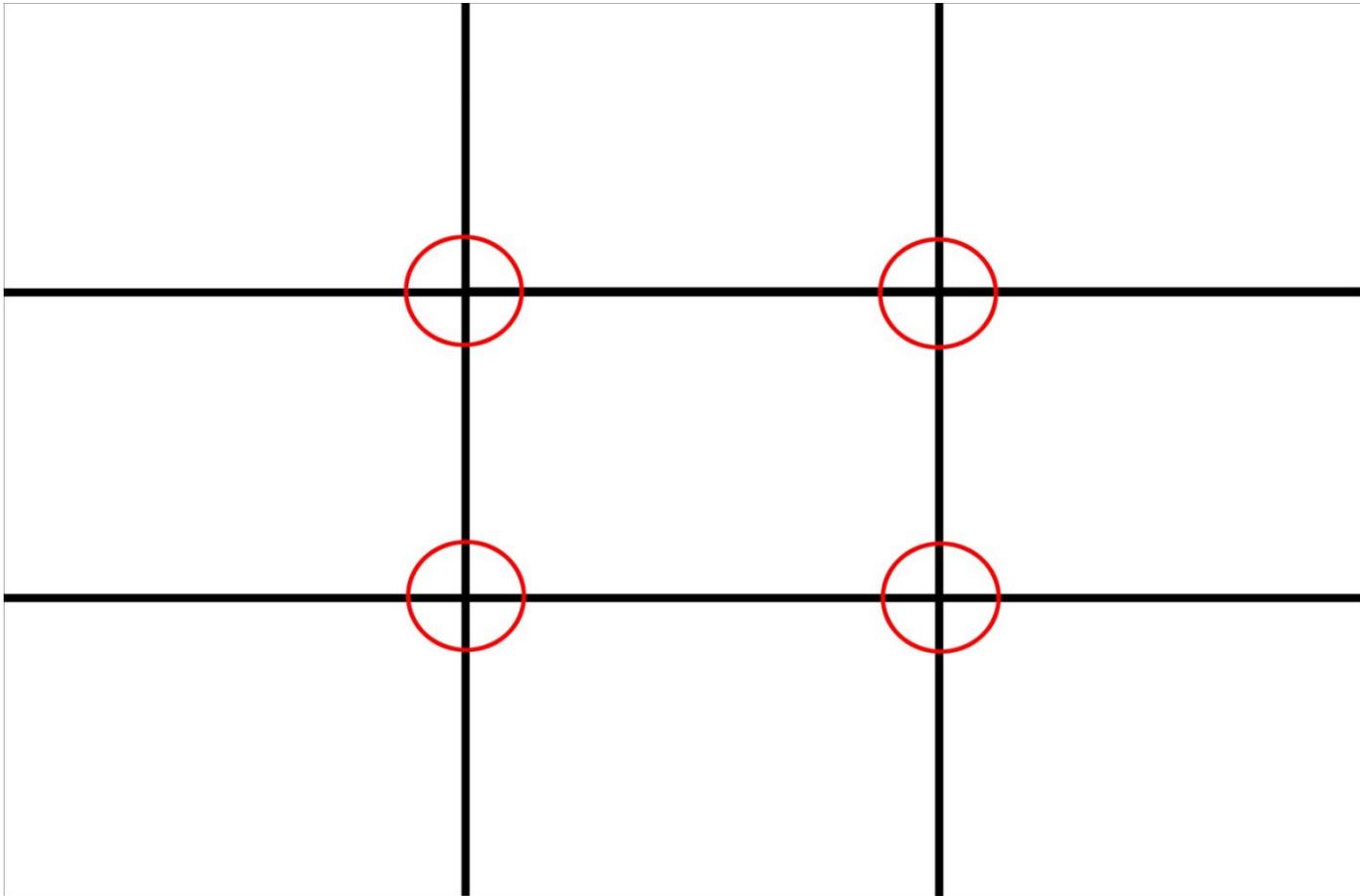
**Rule of
Thirds**

**Leading
Lines**

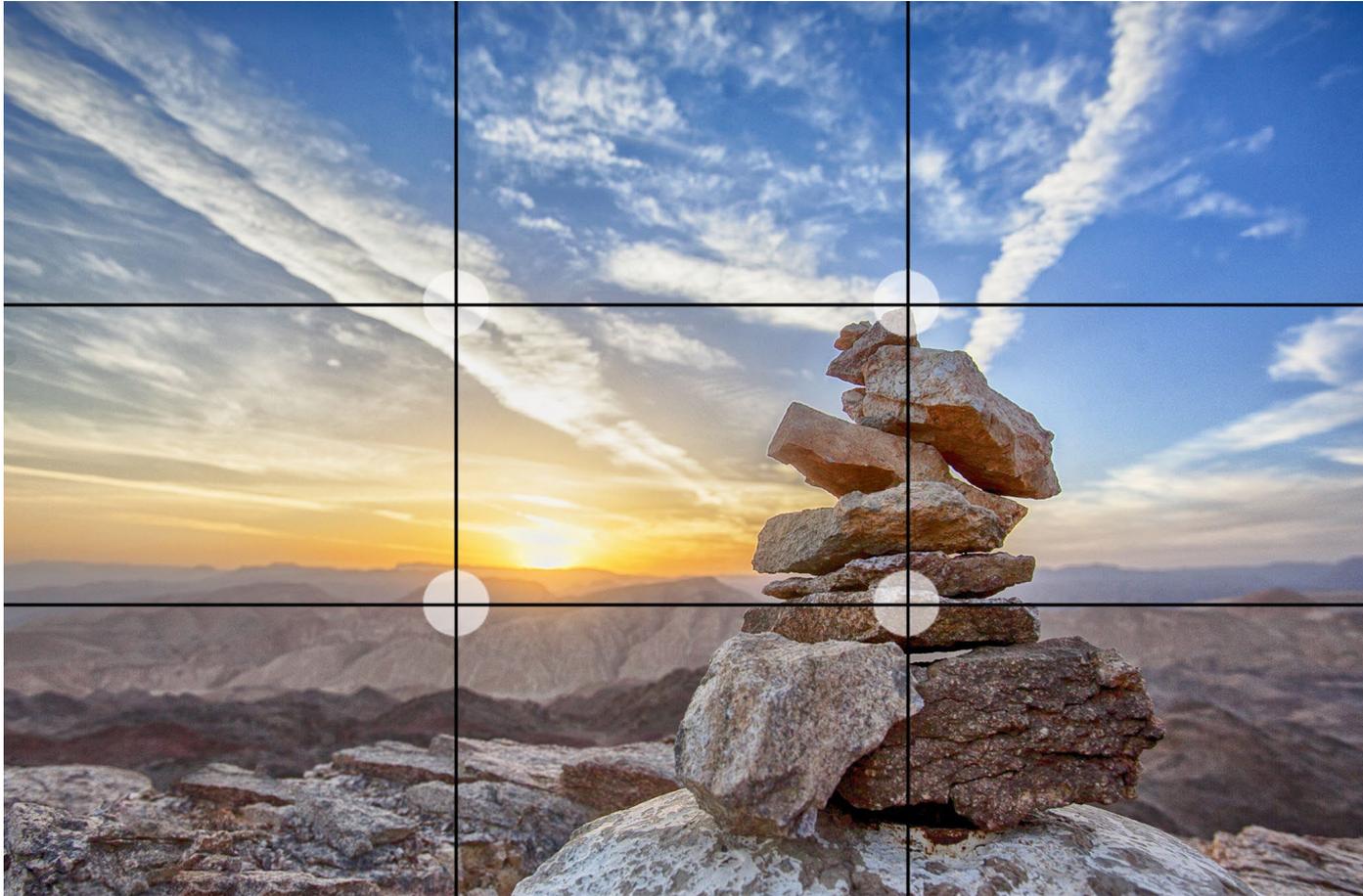
Symmetry

Patterns

Rule of Thirds



Rule of Thirds





Leading Lines give Structure



Patterns

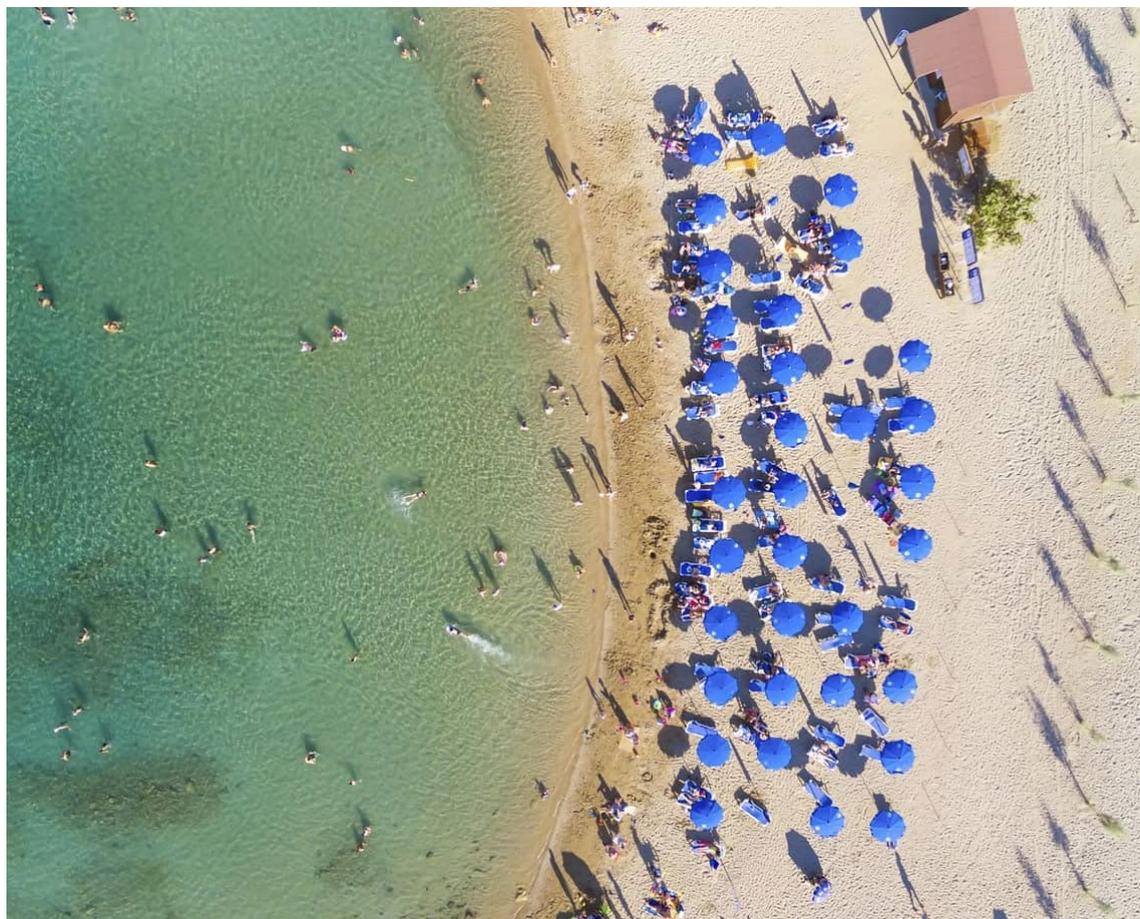


Symmetry





Include People in the Photo





Look for Color





Texture Creates a 3-Dimensional Look



Wedding Photography



Andrew Morgan – Tanzania



Baldwin Foley – Family Photo



Commercial Aerial Photography - Waterloo



Flowerama – Iowa City, IA



Real Estate – Cedar Rapids

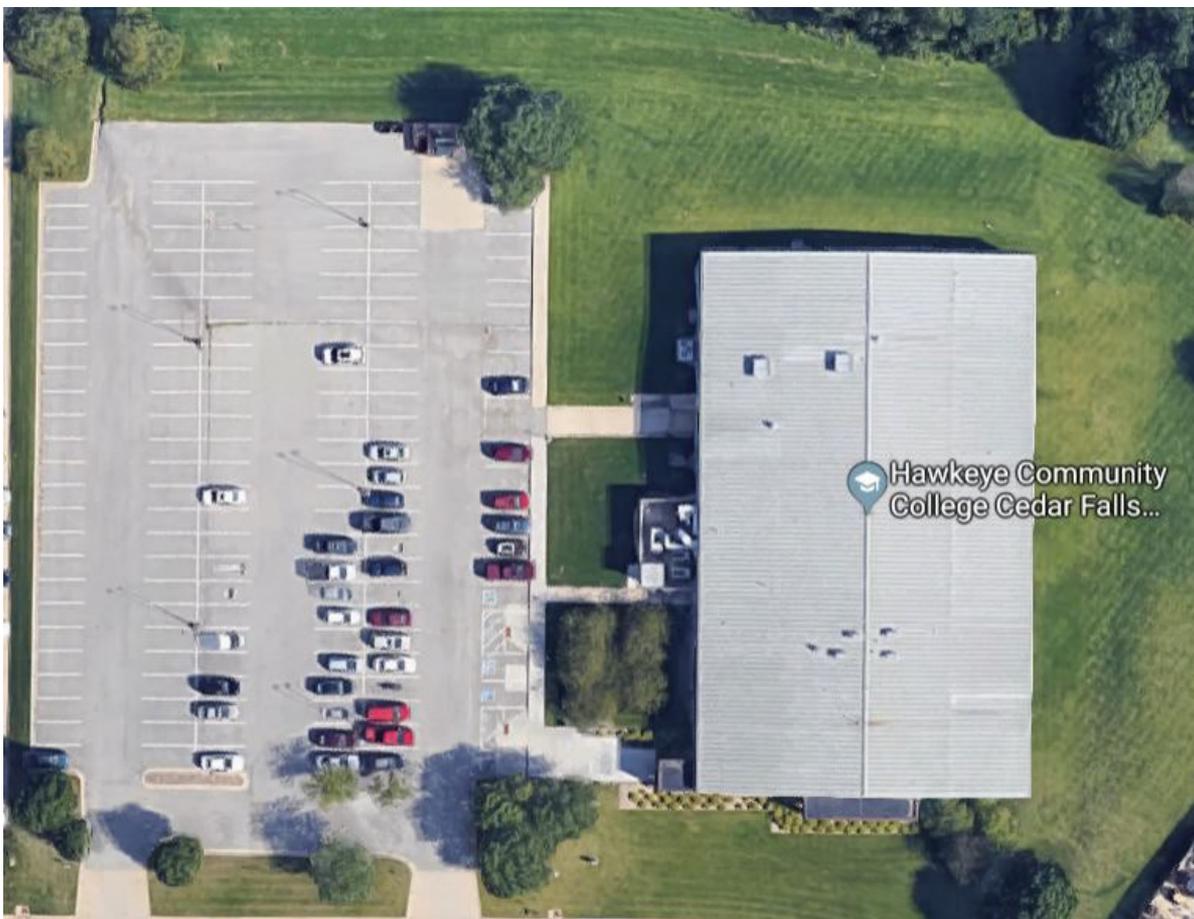


Types of Aerial Photographs

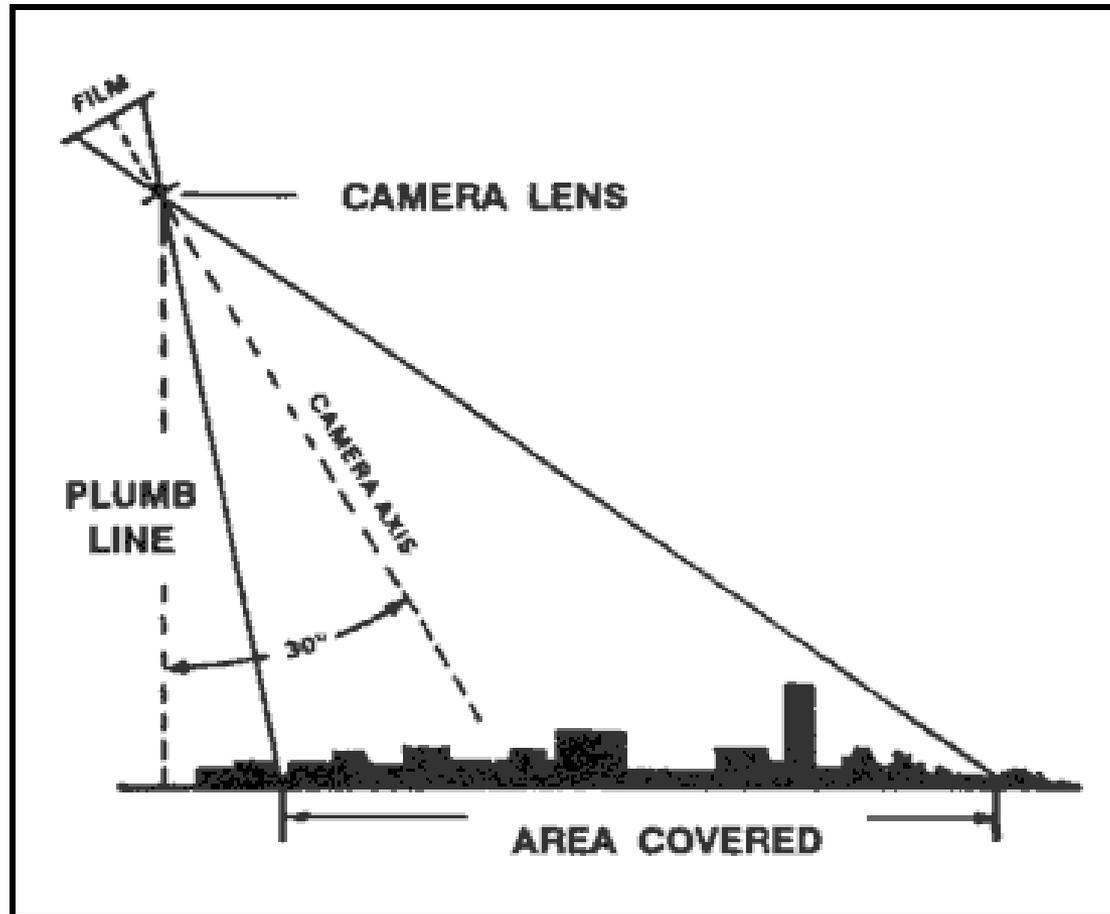
- ***Orthophotos*** – vertical photographs which have been geometrically "corrected" to be usable as a map
- ***Low Oblique*** – photographs taken from a low angle – No Horizon
- ***High or Steep Oblique*** – photographs taken from a high angle – Visible Horizon
- ***Vertical*** – photographs taken straight down



Orthophotos



Low Oblique



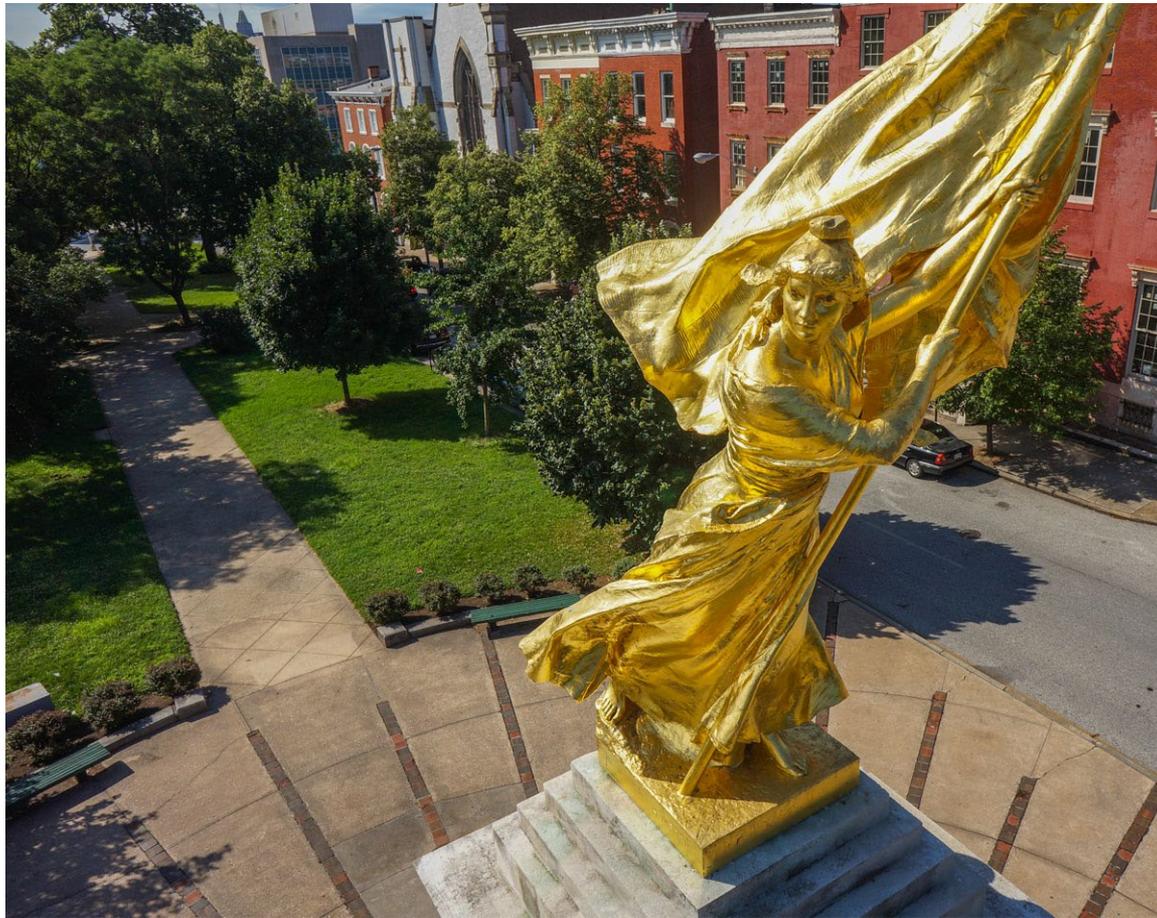
Tuilp Fields, by Anders



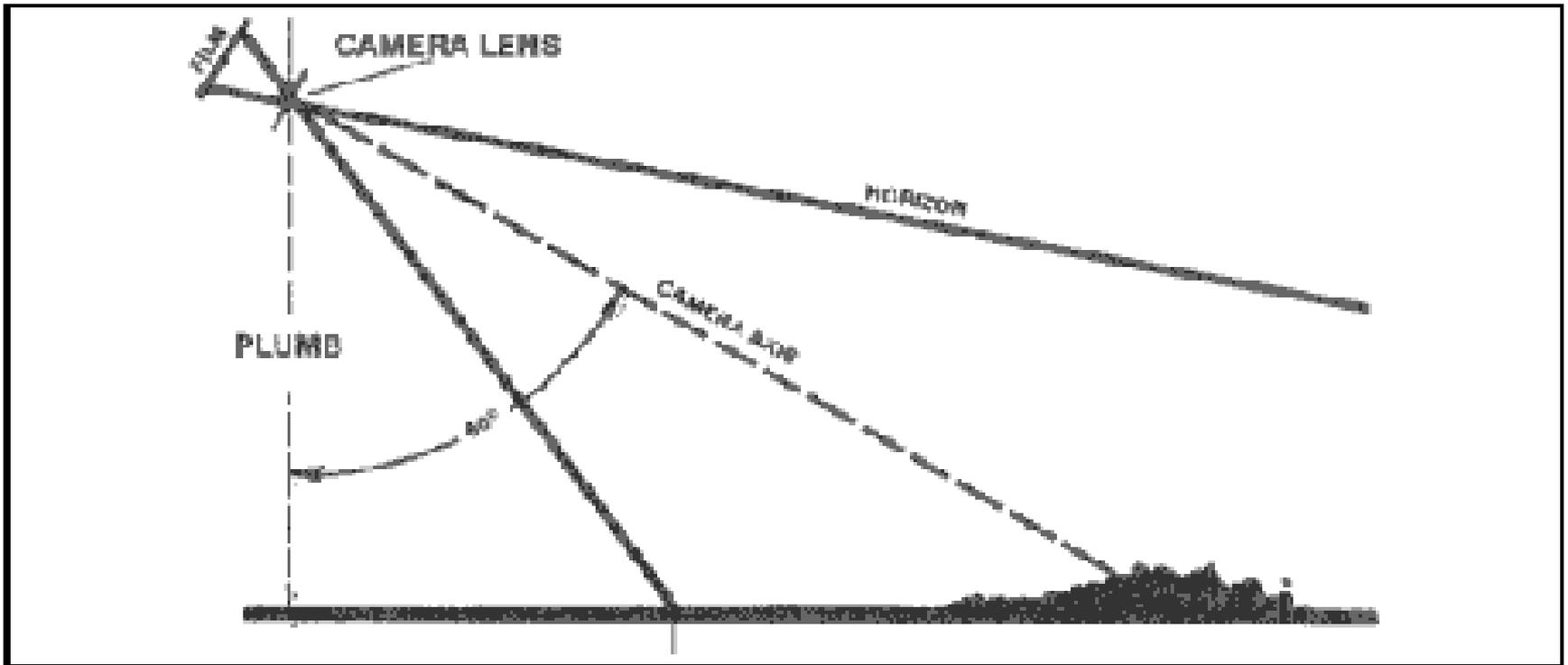
Urban Frozen Fun - Sergey Farenjuk



Francis Scott Key Monument by Terry and Belinda Kilby



High or Steep Oblique



'Above the Mist' Maringa Cathedral, Brazil by Ricardo Matiello



Baltimore's Inner Harbor by Elevated Element



Seven Foot Knoll Lighthouse by Elevated Element



Geese Meeting the Winter - Terje Kolaas



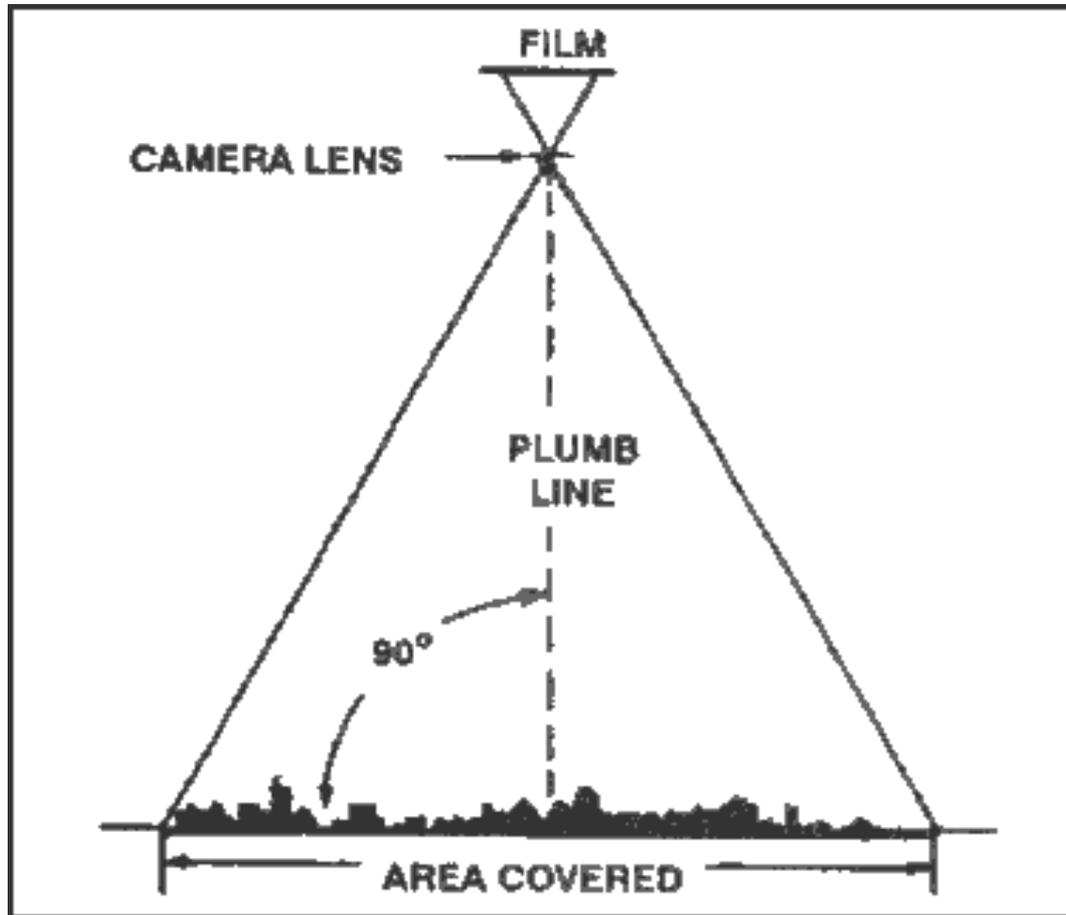
Polk City Sunset



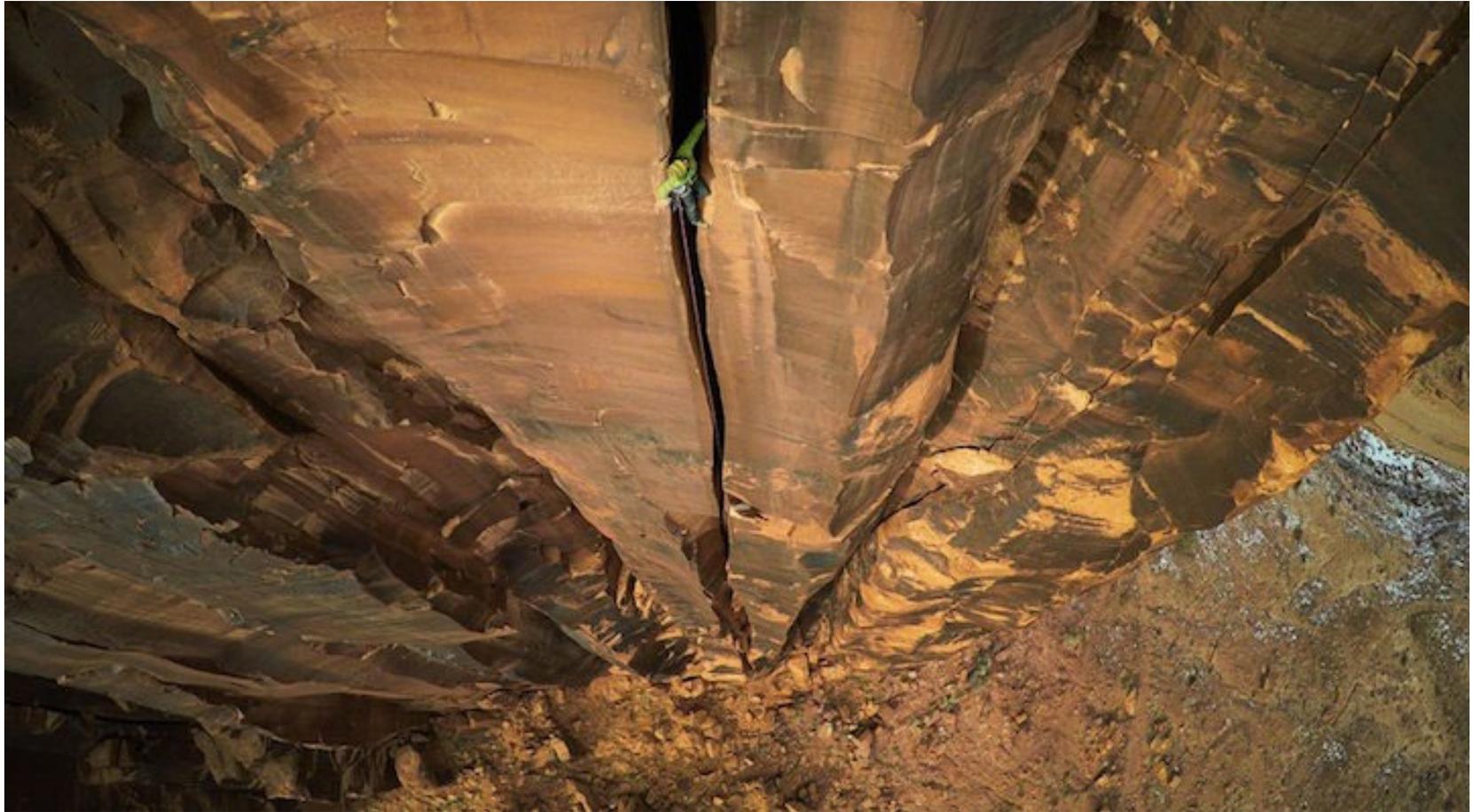
QC Drone – Des Moines



Vertical



Moab Rock Climbing by Max Seigal



Where's Wally, Limassol Carnival by Fly Over Media



JCOURTIAL – Provence, France



Luke Maximo Bell – South Africa



Wrong Way Buddy! - John Cowpland



Martin Sanchez – New Jersey



Scrap Combine Yard, Colfax, IA



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Ghost Ranch, Abiquiu NM



Ghost Ranch, Abiquiu NM



Ghost Ranch, Abiquiu NM

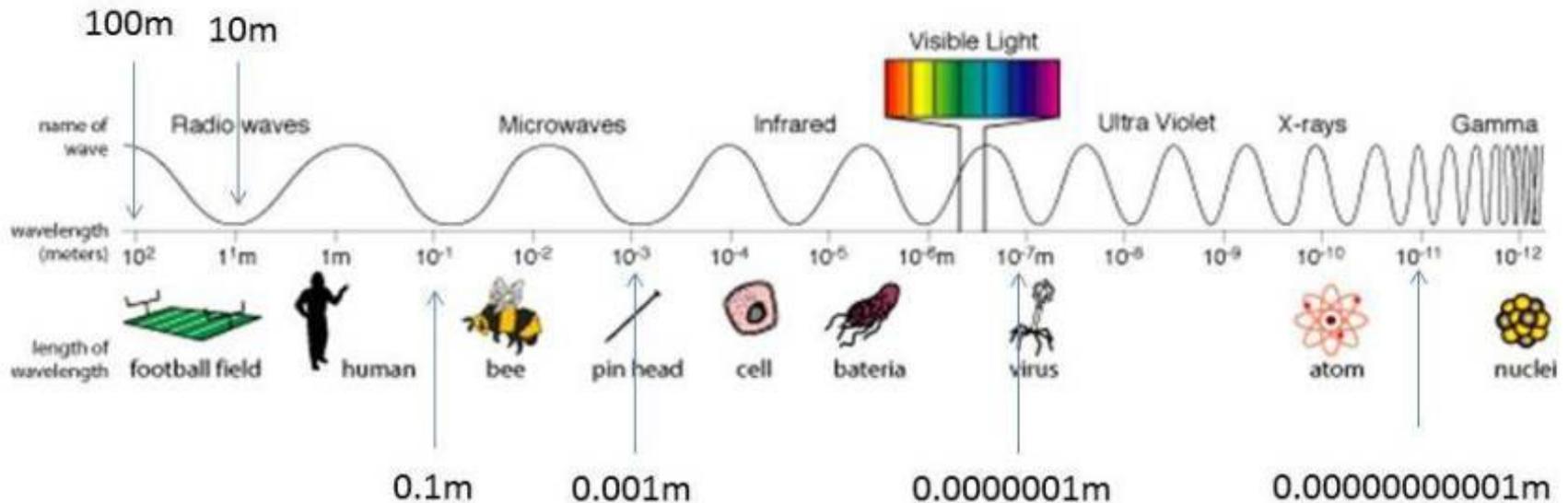


Drone Photo Tips

- Check the weather forecast
- Shoot in RAW or DNG format
- Utilize the thirds grid overlay for composition
- Stick to a lower ISO
- Take advantage of Auto Exposure Bracketing
- Be prepared to improvise
- Create higher resolution images with panoramic shots
- Experiment with both aspect ratios (16:9 or 4:3)
- Use camera lens filters
- Seek out symmetry, patterns, and lines
- Play with lights and shadows
- Take a drone “selfie”

Photography Beyond the Visible

The Electromagnetic Spectrum



Picture credit: NASA. Arrows & numbers added by Baldscientist.



Infrared, Thermal & Night Vision

All three use the same camera
with a CCD sensor

Infrared – daylight, monochrome
or false-color, plants reflect
infrared light

Thermal – day or night, false-color,
relies on temperature differences
between object and background

Night Vision – nighttime,
monochrome image, requires a
light source such as a red LED



FLIR – Forward Looking Infrared

Search and rescue operations for missing persons especially in wooded areas or water – Can see through smoke and haze

Monitoring wild game habitats

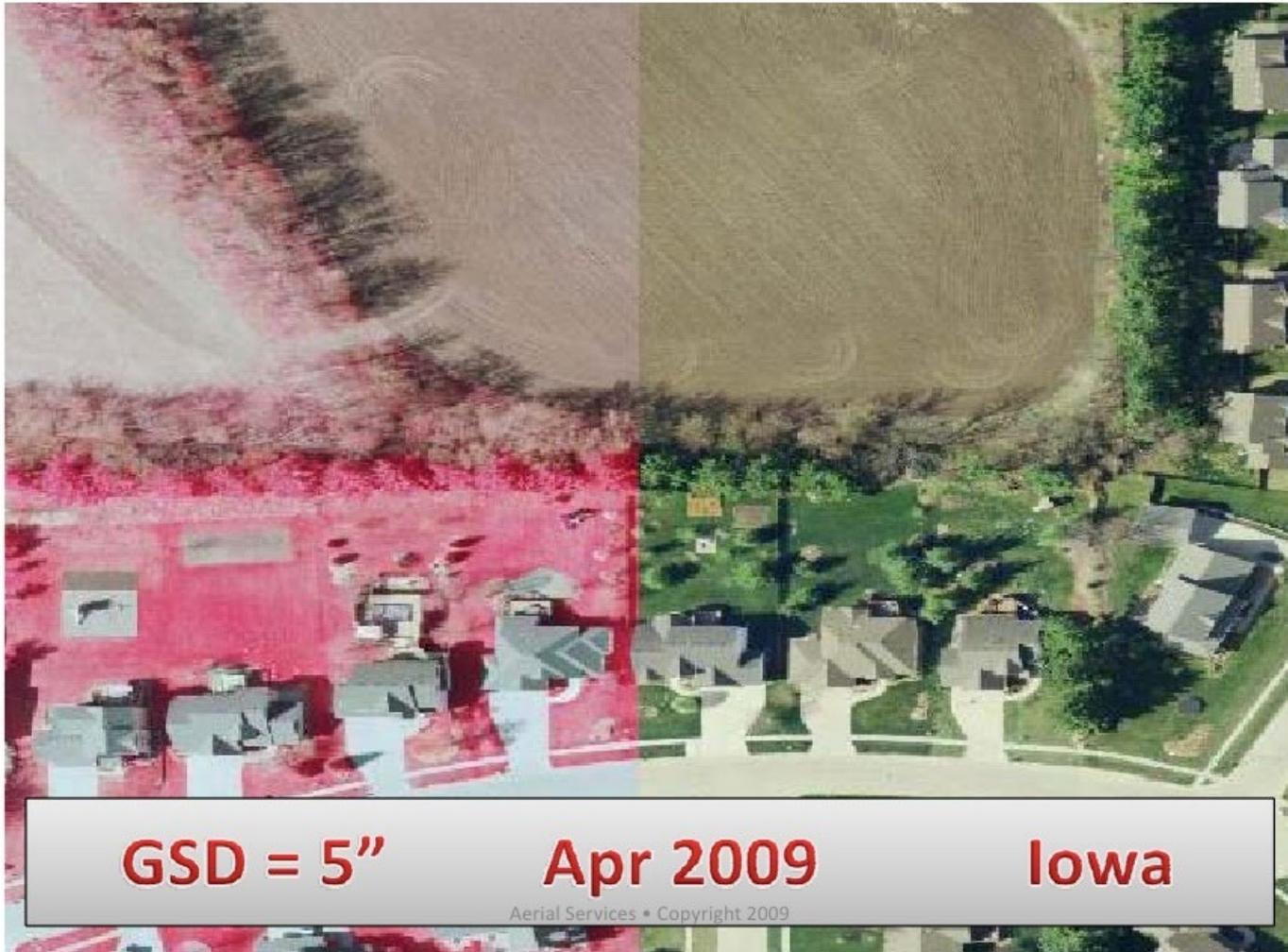
Detection of energy loss or insulation defects in buildings in order to reduce energy consumption

Pinpoint sources of ignition during firefighting operations

Detecting faulty or overheating electrical joints, connections and components

Night driving

Infrared Photograph



Thermal Image





What to consider when buying a photo drone

- Megapixels & Resolution
- Sensor Size – bigger is better
- Aperture – fixed or variable
- Field of View (FOV) – wide angle or telephoto
- Shutter type – electronic or mechanical
- Shutter speed – up to 1/8000 second
- ISO range – 100 up to 6400
- Photo Flight Modes – tripod, cinema, movie modes



Any

Questions

