Jobsite Photography

Should Be a Scheduler's Job

By Ron Winter, PSP, FAACE

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Introduction

Communicating and 'proving' the current construction jobsite status is difficult to do in prose. Pictures are often far more effective in this regard. Photos have the potential to present more information that any other medium but they often fail to fully realize their potential in documenting the construction process.

'Old' film-based photography used to be somewhat expensive, inconvenient, and time-consuming. The photographer was required to fill up a roll of film, take it to be processed, and later organize the physical pictures in boxes or books. Digital photographs and videos are relatively inexpensive, quick, and easy to create. Built-in computerized adjustments make it easy to take decent pictures in simple situations. Digital picture files can be stored on cheap and plentiful storage devices. So, what is the problem?

The problem arises when the photographer does not understand how to identify and compose a good picture, doing it so poorly as to be unusable, or even just losing the important information due to lack of organization or proper documentation of where and when the photo was taken.

Jobsite photos have many uses including capturing current status, documenting project or milestone completions, and for marketing purposes to demonstrate a company's talent. [1] This paper primarily concerns itself with taking in-progress photos of construction in order to document the condition and quality of the work at a particular point in time.

Why A Scheduler?

Some companies hire a professional photographer to capture pictures of the construction process. While photographers have knowledge of how to take a good picture, they often fail to understand what needs to be photographed or how to properly document the photos captured. In addition, they often are not able to understand and highlight changing events as they occur.

Construction managers and foremen understand the construction processes well but are primarily focused on managing events instead of documenting them. They often also lack the understanding of taking good photographs or documenting them well enough to be useable once the project is over.

Construction schedulers who are trained in photography are the perfect fit to photograph and document the events on the construction field. Schedulers are charged with monitoring and documenting activity status. They are less distracted by management issues and better able to maintain a constant observation of the project.

Schedulers are keenly aware of the construction schedule. For example, they are one of the few personnel who know when the internal rough-in facilities are about to be covered by concealing drywall. It is important to wait until all of the internal rough-in is completed but not covered-up before photographing in order to capture the entirety of the as-built condition.

Schedulers also understand the importance that each task provides to project completion. They should be amongst the first people to understand the relative importance of any delay and to immediately capture the job status should a near-critical or critical delay occur.

A scheduler can make numerous uses of the pictures during construction to enhance their job performance. [2] Photos can communicate the issue being referenced in Requests for Information (RFI) from the contractor to the project architect, speeding the resolution of open issues. .

Photos can be used to orient and assure the owner that the necessary progress is being made. Attaching focused pictures of in-progress work to status reports improves communications and possibly avoids confusion or mis-identification during review meetings.

Time Impact Analyses (TIA) would be enhanced by including a picture depicting the problem. This would allow the counsel or an upper-management reviewer to quickly comprehend the issue being discussed.

Finally, jobsite photos can be used to later support or defend unresolved claim issues. Expert witnesses can testify to the objects in the picture instead of just using conjecture and inspection reports.

Construction Photography Best Practices

If a scheduler is to be good at jobsite photography, he or she must be trained on choosing the right camera, properly planning and executing the photographic session, capturing good pictures under unusual conditions, and properly storing the pictures for later quick retrieval

The Camera Itself

Digital cameras make the job of obtaining professional quality pictures much easier than when using film cameras. One can shoot as many shots as desired and later select the best one without additional cost. Built-in electronic controls greatly assist the photographer in obtaining the best shot even using the camera's General setting. [1]

The easiest to use camera is built into smartphones that many schedulers carry. Figure 1 shows a close-up of a corner of the smartphone containing the built-in camera and flash.
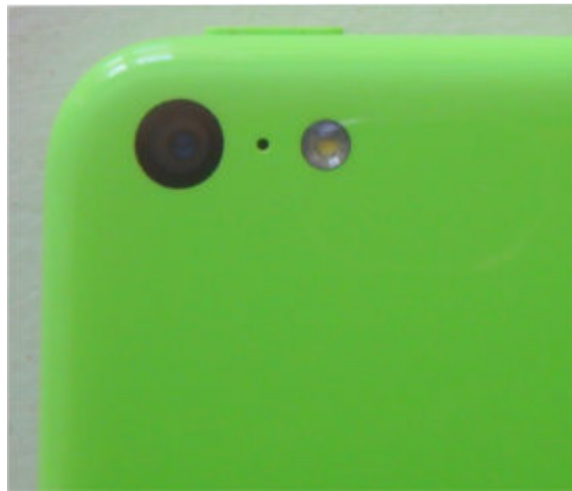

Figure 1: Smartphone Camera

While smartphone cameras are steadily improving, they are still quite small and subject to several natural limitations. They lack a zoom lens, have a short battery life, and generally produce poor results when shooting in low light conditions.[3]

Smartphone camera users should at least consider using a photo app to enhance the shot to produce the best picture possible.[4] One can also add attachment lenses over the original lens to obtain wide-angle and telephoto effects. In addition, if the smartphone has a Global Positioning System (GPS) built-in, one can often geotag the photos.[3]

The next step up from a smartphone camera is a dedicated 'Point-and-Shoot' camera like the one shown in Figure 2 below. Just like a smartphone, they are small and light enough to fit in a pocket. Their lenses have a wider aperture with more than four times the light gathering area, producing crisper and cleaner pictures. They also have much better battery life, allowing for an entire day's worth of pictures on a single charge.

Figure 2: Point-and-Shoot Camera

Dedicated Digital Single-Lens Reflex (DSLR) cameras like the one pictured in Figure 3, below produce superior pictures. These cameras employ a mechanical shutter to switch from the user viewing the scene to the camera actually capturing the picture. This normally provides for higher resolution and lower noise (imperfect capture) due to not sharing the duties of capture and driving the viewfinder.

Figure 3: DSLR Camera

The negative aspect to this mechanical shutter design is that real-time information cannot be displayed. The internal mirror can focus the incoming light on the monitoring sensor or the recording sensor but not on both at the same time. This eliminates digital features such as

recording video or giving a live image display. DSLR cameras also tend to be much larger as well as more expensive than other types of digital cameras.

Digital Zoom versus Optical Zoom. The zoom feature in a camera allows the photographer to properly frame a picture without having to move closer to the subject. There are two types of zoom, digital and optical. [5] Optical zoom uses a mechanical adjustment of the lenses to achieve the image magnification. Digital zoom cuts out part of the captured picture and then expands the remaining to fill the original size, just as a software photo-editing program might do. This expansion of the picture results in a loss of quality, reducing the ability to later expand the picture again and still maintain sufficient detail.

Neutral-Density Filter. One important trick to prevent the bright sports from being completely washed or 'blown out' is to use a neutral-density (ND) filter. [6] This type of physical filter reduces the intensity of all light wavelengths equally, allowing the camera or photographer to select a wider range of settings, exposure time, and sensitivity. This process can produce superior results in high-contrast situations.[7]

Polarizing Filter. Light typically behaves as if it were waves, oriented in all different directions. Light reflecting off of a non-metallic surface may become polarized in a direction parallel to the surface. The intensity of the polarized light may then wash out other objects in the area and hide what is behind an otherwise transparent surface. Using a polarizing filter can selectively block out this phenomenon, reducing the glare from puddles or allowing the camera to capture what is visible behind a transparent surface such as glass. [21]

As with any jobsite visit, always be wary of dangerous areas and wear the required safety protection gear.[8] Do not walk around while looking into the camera's monitor. The camera should always be protected from moisture and dust. Use a hand or neck strap to prevent dropping the camera in rugged areas and to free your hands to use handrails. Lock up the gear when not in use. Download the pictures frequently to avoid losing the photos along with a missing camera.

Planning for Good Construction Pictures

A good scheduler is also a planner. A good plan makes for great pictures. Who is better equipped to plan for great pictures than the jobsite scheduler? The plan should include a checklist of items to be documented, including areas covered by open RFI submittals, completed and active activities, and any this-period accident sites.

The jobsite scheduler should be aware of what the schedule says is being constructed. Of particular importance is to capture the detailed progress of at least the critical and near-critical activities. Before beginning, the photographer should plan the route and be consistent and methodical for all photo sessions.

Shoot the important work from at least two angles to help negate issues of shadows and hidden details. Shoot wide-angle shots first and then approach the work for more detailed pictures. This will put the details into a context that will make comprehension clearer. Moving in a predictable pattern also increases later viewer comprehension.

Don't be afraid to ask the foreman or supervisor of what should be captured in a picture. Their knowledge of the construction issues is critical to performing this photographic job correctly.

It is good practice to select several pictures that best represent the current progress and share these with the owner and architect of the project. They will then be able to selectively share these photos with their coworkers and upper management. Current pictures help build relationships between the stakeholders by reassuring everyone that the project is proceeding as planned.[9]

The scheduler should consider including appropriate photos in the Daily Log. They make it easier to describe the issues at hand. Photos from other parties such as the site supervisors and subcontractors may also be included. The scheduler should ensure that all pictures are properly annotated and dated, regardless of source.

Punchlists can be more easily handled if the outstanding issues are documented with a photograph. This will help prevent working on a similar item in the wrong location, saving time as well as money.

Capturing Safety Conditions. Be very aware of safety conditions being documented while photographing the work. The scheduler should not publish a picture that accidently depicts a safety violation (especially without realizing it). In the USA, the Occupational Safety and Health Administration (OSHA) regulations are very specific about occurrences of unsafe practices. Pictures depicting poor safety practices could be used against the photographer or the company in charge. Review each picture taken for safety violations and immediately address them with the appropriate management team. Once this has been done, the photographer should replace the original pictures with new ones that properly show the status they were attempting to document earlier. [1]

Carefully review all of the pictures taken in each session. The pictures can cause as many problems as they solve if the photographer is not careful as to what is recorded. Worker safety is only just one consideration. Additional infractions to consider might include union rules (such as a manager holding a tool), jobsite rules violations (such as improper parking), or immigration violations. [4]

Worker Permission: Including people in the jobsite pictures is good for viewer interest and composition but can be problematic. Pictures showing particular persons can be used to prove that they were present and cognizant of the issue being captured. Notify workers in the scene that pictures are being taken so that people who are camera shy or unwilling to have their picture taken can step away from the scene before the shoot. A sign-off from every person included in the picture may be required before a photo may be made available to the public.

Proprietary Information: Inform the management of working crews of the intent to photograph their work. In some cases, the technique or equipment being used might be considered proprietary by the contractor and they may be hesitant to share it.   The owner of the project may also need to be notified.   In some cases, site security concerns by the owner may also limit the pictures that can be taken.

Tell a Story. Photos should communicate the issue being captured to the viewer. What better way to communicate than to tell a story? Use a series of pictures to better explain to the viewer what they are seeing. One way to tell a story is to take two types of photographic shots of the same subject; wide-angle view and detail shots. The wide-angle views help orientate the viewer as to the location and configuration of the scene. The detailed shot will hopefully show the current status of the work. [8]

It is a good idea to take both shots from the same location, using the same focal length settings to give meaning to the comparisons. Mounting the camera on a tripod is handy in situations like this. Some people mark the tripod position with paint to later return and duplicate the positioning. It is also useful to bring earlier pictures to help re-frame the picture to match earlier ones.

Place Issues into Perspective. Move from wide-angle shots straight to the detailed and then try to repeat this progression elsewhere. Pair up close-up shots from different angles. Include rulers or other measuring devices in the picture at the same distance from the work to allow for later dimensional estimations. Objects with variable lengths such as pens should not be used for this purpose. People standing in the picture can serve as a reference to size but are not suitable for accurate measurement.

Another way to tell a story is to view the same area over time. Repeated use of static, strategic shooting locations can provide a time-lapse review of progress.   A wide-angle shot works best for this. Picking a location to place the camera for time-lapse shots requires planning and knowledge of the final layout of the work. It is also important to choose a location that will not be demoed long before the project is complete. The construction office is one good candidate for this.

Tips for Making Good Pictures of Construction

If it is the Scheduler's job to provide the jobsite photograph, then they had better do the job correctly. Construction jobsite pictures pose unique challenges for obtaining good pictures. Just knowing what to photograph is not enough. The picture must be in focus, using the correct lighting, and shot from the correct angle.

Focus. A good focus is essential to create useable photos. Using a small lens aperture (a large f stop) sharpens the details in a picture. Setting the aperture for f11 or f16 can help the camera create a good focus but this will also slow down the exposure rate, risking blurry pictures. A tripod can be of great help in keeping the camera steady in this case.

Lighting. A picture is just a representation of captured light. Understanding the nature of light can make for great pictures. Also, considering the direction from which the light is coming is very important.

Stark conditions where bright surfaces intermingle with dark shadows produce high-contrast situations that may fool the camera's controls into exposing the picture incorrectly.[6] Extra illumination in addition to the built-in flash can help solve this problem. An advanced technique is to 'bracket' the correct exposure levels by manually shooting the same picture using different exposure values. These pictures can then later be merged into one properly exposed picture using a High Dynamic Range (HDR) software program.

Shadows can both hurt and help a photograph. A complete lack of shadows can make the picture to appear washed-out. Consider increasing the exposure time and not using flash to produce more natural-appearing photographs. The more natural the scene looks, the easier it is to comprehend what is being documented. A tripod is useful for keeping the camera steady under long exposures. One can also just hold the camera against a corner or opening to steady a long exposure camera shot. [1]

Flash only properly illuminates objects a short distance away. It is better to not rely on the flash (or at least supplement) it with other, additional lighting. Another alternative to flash is longer exposure times. The downside of longer exposure times is that it is harder to get clear, non-fuzzy pictures using long exposures.

Optimum Angle. Before snapping the picture the jobsite photographer should look around the general area to be photographed. Try to find an angle and distance that eliminates unimportant and distracting items from entering the area to be captured. If it is not the subject of the picture, try to eliminate items such as trash, debris fields, graffiti, temporary electrical wires or braces from the frame. They will distract the viewer from observing the subject of the picture. To correct this, move and find a different angle.

Digital pictures make post-shot editing very easy. One can always later crop a picture to eliminate unwanted items on the edge of the picture that were not noticed earlier.

Perspective. Shooting a picture of a building up close can appear to show it leaning backward. Focusing on the horizon can reduce this effect. Buildings look better when shot at a three-quarter view as opposed to straight-on.

White Balance. White objects look white to us regardless of whether we see them in full daylight, a cloudy day, or under incandescent lights. This is because our brain adjusts our perception of the color seen based on the lighting level.[10] Digital cameras need our help to make this same adjustment. This is called white balance. Without it, while colors can appear in a photo as yellow or bluish in color.

White balance can be as simple as setting the camera's white balance control to one of a few obvious settings. The General Setting can be used under simple lighting conditions. Manual white balance settings become very important in unusual situations commonly found in construction sites such as unlit interior rooms with full daylight streaming in through an opening.

One can also use a diffused flash to help properly white balance a scene. Care should be taken using this technique as it can also create a non-natural look to the photograph.

Wide Pictures. Our eyes typically see larger areas then a camera does. Moving away from the area of interest can allow us to capture these areas but at the cost of detail. There are some techniques that can be used to maintain detail and still capture a larger area.

There are two ways to capture a wide area in a picture, either with a wide-angle 'fish eye' lens or a panoramic camera mode. The wide-angle mode is very helpful in enclosed spaces where the photographer cannot get very far away from the item to be pictured. The usefulness of wide-angle diminishes as the distance increases because this 'warps' the periphery of the photo, distorting the image into an unnaturally.

The panoramic camera effect creates a wide photograph, wider than normally made in a single picture. This effect can be made in several different ways. One can take several pictures while panning a scene and then later use panoramic software to stitch together the electronic picture files into a single, wide picture. Many electronic cameras also offer a built-in Scene mode that allows the stitching together of successive camera pictures.

Another built-in feature on some electronic cameras is Panoramic Mode that allows one to hold the shutter release down and slowly sweep the camera over the scene to create a continuous picture. The use of a tripod to steady the picture is suggested (but not required) in these situations. Some cameras can even automatically overcome uneven motion.

Chain of Custody

For photos or videos to be useable as evidence in a dispute, the photographer must be able to prove that they are authentic and not modified. The photos must depict the area that the photographer claims that they do, taken at the time and date claimed. To be able to later prove these facts, the photographer must establish a Chain of Custody that documents and authenticates this. Digital photographs are admissible as evidence in most courts if the proper archival steps were taken and the person submits sufficient proof that the evidence is what the person claims.

Before taking the digital photograph, the photographer should make sure that the camera's internal date and time is properly set and there is sufficient battery power available. They should turn off any function that overlays the date or time over the actual photograph and rely in the camera's operating system to properly add the date and time to the picture file produced. [11]

Once a set of pictures are taken, the photographer should transfer the picture files directly from the camera to a write-once CD-R disk.[11] That disk should be hand-annotated with the subject, date, time, and photographer's initials so that the photographer can visually verify that

this is the same disk. This disk should then be stored in a secured location. These disks, along with the files still on the camera, are usually considered the "originals."

Other copies of the photographs can be made and stored on a computer for use and to add more thorough documentation. The pictures can even be cropped and enhanced as long as the untouched originals are available for inspection.

Another tool for enhanced security of photographs is to use software that creates a digital hashtag identification of each original picture file.[12] The software evaluates the entire digital picture to create a unique set of numbers or letters that represents the contents of the picture. Any digital modification of the picture after this will produce a different hashtag identification label. As long as the hashtag record has a proper chain of custody record, then the digital pictures files can be proven to be authentic.

Photos are considered supporting evidence in a lawsuit. The photo itself is not really evidence. It is there to support the testimony of the person who is referring to the photo. Anyone familiar with the scene can authenticate a photograph; this not necessarily have to be the photographer.[13]   In order to be considered as evidence, this person will testify that the photos are an accurate representation of the items depicted at the time the photo was taken and that the photos were taken at a specific date and time. Sometimes this testimony is not necessary when both sides of a dispute agree to stipulate that the photographic evidence is authentic.

Document the Pictures

It is not enough to take a good picture; one must be able to quickly retrieve the desired picture of a particular issue or location to be effective. The location and objects of interest should be indexed, as well as the date the picture was taken.

Add Information to the Picture. There may be important issues about a scene that a picture cannot capture. Pictures cannot always identify pertinent facts such as wind speed and temperature. Other environment facts such as noise and visibility may be important to note. Written commentary can be invaluable in conveying information that a plain picture cannot.[4] While GPS coordinates may be useful in identifying the location of an object in the picture, it is better to identify the location in relation to the project documents to include such information as room, floor, elevation, etc.

Organize and identify the photos. Most of the value of photo documentation will be wasted if the photographic identification of particular events cannot be located when desired. Photos that do not indicate the date and time that they were taken also have reduced value. Inconsistency in the filing or even the order of presentation can cause confusion and reduce the usefulness of the photos.

While there are many software programs on the market to assist the photographer in organizing and documenting photos, Windows Explorer™ is an inexpensive alternative. It is included with every installation of the Windows operating system in the Accessories folder. Using Windows Explorer, right-clicking on the digital picture file will display the picture and bring-up an on-screen menu. Selecting menu item, 'Properties' and then the 'Details' tab will open the picture's documentation screen, as shown in a typical example in Figure 4 below. [14]
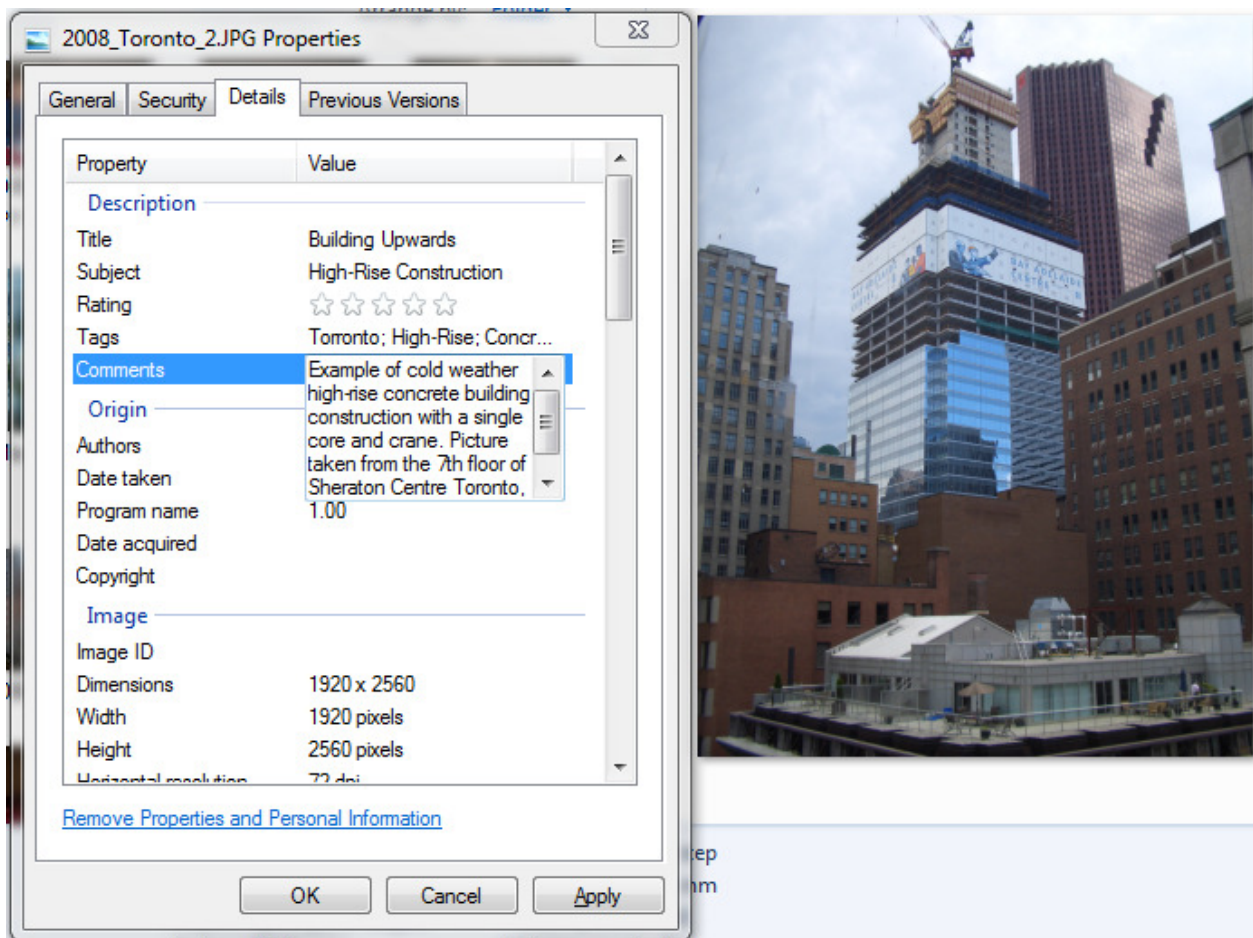

Figure 4, Documenting a Picture

In the picture's documentation screen, the user can add textual index words in the Tags field that can be used in Windows Explorer to search and organize the pictures by their content. The

knowledgeable user can add Tags to include the location, event, or subject matter being pictured. The picture documentation screen also has a 'Comments' feature that allows for the input of a nearly un-limited amount of description.

The added Tags and Comments are incorporated into the picture file such that they cannot be 'lost' even if the picture is later copied or transferred to another computer. Contemporaneous information entered here is extremely valuable at the end of the project to schedule forensic experts.

Distribute the Pictures. A typical digital picture has a file size between 1 to 2 MB. Videos require even greater file sizes dependent on quality and length of run. Due to the large file sizes of high definition pictures and videos, in many cases it is not possible to send out a group of pictures or a video as an attachment to an email.

Instead of using email, it is recommended to use one of the internet file transfer services, many of which offer a free option. One can upload an entire set of pictures or video files to the service and have them contact the recipient (or multiple recipients) and inform them that they may download the package onto their computers.

The Future of Jobsite Photography

Jobsite Safety. Software will also become more important to help manage and process jobsite photographs and video. Neural network software can already identify people in pictures and flag safety violations faster and more accurate than humans. [15] This functionality may be applied to real-time video to alert supervisors or managers of current jobsite safety violations so that they might be corrected before an accident occurs. Studies have shown that immediate correction is more effective than after-the-fact warnings.

Drone Photography. Aerial pictures provide a very good method of orienting the viewer as to the project layout. In the past, most aerial photography was taken from a hovering helicopter. With the recent advances in computer-stabilized flight, remotely piloted vehicles, or drones have become available and affordable to use as a platform to take these aerial photographs. In one industry survey, tracking job progress is the number one use of drones in construction. [16]

Besides being much less expensive, one can do more with a drone than a helicopter. Photography from drones can capture detail pictures that are difficult and expensive to obtain in other ways, such as under bridges or the outside of high-rises. The drone can take pictures

lower to the ground and closer to the subject than can legally and physically be done using a helicopter. For example, one cannot fly a helicopter immediately below the Space Needle in Seattle, Washington, USA but a drone (with the proper permissions) can. Drones can even be flown inside buildings and underground, but care should be taken to prevent instability if it loses GPS lock-on.[17]

In many countries, it requires a license or at least governmental permission to operate a flying drone. In the USA, persons using drones for work purposes must register the drone with the US Federal Aviation Authority (FAA). Before flying the drone over a construction site, the owner of the construction site and construction management should give permission to use remotely piloted vehicles.   Be sure that all rules and regulations are adhered to when employing a flying drone to take photographs.

What with people, moving equipment, and protruding objects everywhere, a typical construction zone is a dangerous place to fly a drone if flown at the wrong times. This hazard can be accommodated by flying when no one else is around.   Knowledge of the jobsite working hours is important for this. The time of day is important as shadows may hide the areas of interest. For better quality, pick a time of day where the sun illuminates the area to be viewed.

Next, the area to be photographed by drone must first be scouted so that the drone operator can plan where and how to later proceed. The drone operator will want to maximize the efficiency of the time spent flying in order to complete the job and not suffer from operator fatigue. Shoot establishment pictures from a distance and then approach the area to orient the viewer as to where the detailed pictures are located. Reducing the time difference between pictures will also prevent shadows from moving between shots and confusing the viewer.

Tower crane photography [20] is another alternative to drone photography. A wireless camera can be mounted on the hook block of a tower crane and achieve many of the same tasks as a drone. Unlike drones, tower cranes already have 'permission' for overhead flights over working jobsites; safety issues and regulations have already been addressed using a tower crane.

Virtual Reality. Walk-thoughs and investigations into specific issues can be documented by more than just video. Virtual Reality (VR) files can be created that allow the viewer to move and inspect simulated three-dimensional representations of the issue in question. With proper preparation, an expert can later visually inspect the scene just as if they were present at the time of that the VR file was created.

Augmented Reality. While VR blocks the current outside world and replaces it with another, Augmented Reality (AR) overlays the viewer's current environment with graphic images or text, as can be seen in the game Pokémon Go. The images displayed do not react to the viewer's positioning.

Mixed Reality. Knowing the location and direction a viewer is pointing, it is possible to overlay wire-frame diagrams and other such planned information from CAD drawings and other graphical constructs over the physical world, producing a combination of the two. Using Mixed Reality (MR), a computer can display the outlines of a pipe or wall in the location that they have been designed to be constructed. The images expand and contract as the distance from the viewer changes and appear to remain fixed in place. This has a tremendous potential to improve design and reduce design errors. Unfortunately, this technique is still in its infancy and in the process in the field is currently subject to erratic performance and computer crashes.

The future for jobsite photography includes showing what was built in the same picture of what was planned. Using Mixed Reality and false color or wire-frame diagrams, the photographer will be able to document the As-Planned and As-Built in the same picture in a format that nearly everyone can understand.

Conclusion

Jobsite photography is a very important part of construction management. It is key to know what to capture in a picture and when, requiring a thorough understanding of the status of the project. A scheduler is a natural for fulfilling the position of jobsite photographer.

Just as important as knowing what to photograph is the knowing how to produce quality results. This requires understanding the limitations of the various cameras available and how to overcome these issues. It is important for the photographer to understand the techniques for taking good pictures. If the pictures are to be useful later on, the photographer should properly document, organize, and index the photographs.

Knowledge of what is occurring on the field, its importance to project completion, current delaying issues, the ability to take good pictures, and to properly care and document them are the hallmarks of a great construction jobsite photographer. Add in the planning aspect and it is easy to understand why the scheduler should be the one to perform jobsite photography.

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